REYNOLDS COUNTY HAZARD MITIGATION PLAN

2022

Prepared By:
Ozark Foothills Regional Planning Commission
3019 Fair Street
Poplar Bluff, MO 63901

Approved by FEMA: 12/1/2022

CONTRIBUTORS

Reynolds County Hazard Mitigation Planning Committee

The Ozark Foothills Regional Planning Commission (OFRPC), on behalf of Reynolds County, invited incorporated cities, school districts, area colleges, and other entities in the County to participate in the Reynolds County Multi-Jurisdictional Hazard Mitigation Plan update. DMA 200 requires that jurisdictions represented by a multi-jurisdictional plan was required to meet plan participation requirements as defined by OFRPC at the beginning of the planning process.

Jurisdictional Representatives

Name	Title	Department	Jurisdiction/Agency/Organization
Joe Loyd	Presiding Commissioner	County	Reynolds County
Paul Wood	Mayor	City	City of Ellington
Jason St. Gemme	Elementary Principal	Education	Lesterville R-IV
Eddie Williams	District 2 Commissioner	County	Reynolds County
Kendra Ritter	City Clerk	City	City of Bunker
Linda Miller	City Clerk	City	City of Centerville

Stakeholders are individuals or groups that are affected by a mitigation action or policy and include businesses, private organizations, citizens. Unlike planning team members, stakeholders may not be involved in all stages of the planning process.

Stakeholder Representatives

Name	Title	Department	Agency/Organization
Renee Horn	Emergency Management Director	Emergency Services	Reynolds County, MO
Janet Kile	Risk Manager	-	Missouri Highlands Healthcare
William Wood	Maintenance Manager	Public Works	City of Bunker
Larry Pogue, Jr.	District #1 Commissioner	County Commission	Reynolds County
Eddie Williams	District #2 Commissioner	County Commission	Reynolds County
Natasha Chitwood	Representative	-	Reynolds County Health Center
Cara Blevins	Administrative Office Support Assistant	Dam & Reservoir Safety	Missouri Department of Natural Resources
Amy Moore	City Clerk	-	City of Ellington
Ashley Hart	Planner	-	Ozark Foothills Regional Planning Commission
David Wyman	Area Engineer	Southeast District	MODOT
Joseph Minks	Superintendent	-	Centerville R-I School District
Frances Vermillion	Director	Administration	Reynolds County Health Department
Lisa Beardsley	Public Health Nurse	-	Reynolds County Health Department
Brittany Hime	Principal	Elementary School	Bunker R-III School District
Rebecca Ragon	Manager	National Inventory of Dams	US Army Corps of Engineers

Joyce Santhuff	Administrative Assistant	-	Reynolds County Health Department
Christy Roberts	President	-	Ellington Chamber of Commerce

The table above recognizes stakeholders that participated in the plan update in some way. Invited stakeholders are indicated in Step 3 of the planning process in Chapter 1.

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EXECUTIVE SUMMARY

Located within the eastern edge of the Ozark Mountains Reynolds County, Missouri, has been fortunate to avoid many of the natural disasters that impact other areas of North America. Hurricanes, tsunamis, tidal surges, and landslides are virtually unknown to Reynolds County. However, Reynolds County is susceptible to other natural hazards. Tornadoes and severe thunderstorms, severe winter storms, earthquakes, drought, forest fires, and heat waves are all hazards that impact the county on a routine basis, endangering both lives and property. The document which follows is comprised of four sections that examine the county's demographics hazard vulnerability, response capabilities and present county specific mitigation strategies.

Section One of this plan provides general background data for Reynolds County. Such data includes population statistics, identification of critical facilities, and general information regarding the county's infrastructure. Understanding "where you are" is a fundamental component of the planning process. It is hoped this section provides a snapshot of Reynolds County that will serve to assist in the implementation of this plan.

Section Two identifies and explores the types of hazards and likelihood of each hazard occurring in Reynolds County. It provides a general overview of the county's identified natural hazards in addition to explaining the impact upon Reynolds County should such a hazard occur.

Section Three provides a capability assessment of Reynolds County should one of the identified hazards occur. It outlines the county's disaster response capabilities and seeks to identify those areas in which the county may improve with regard to disaster mitigation. Specifically, it identifies key personnel, organizational leaders, and existing plans regarding emergency planning. Also, it provides a brief assessment of each municipality's readiness regarding hazard mitigation.

Section Four provides mitigation goals, objectives, and mitigation strategies relative to each identified natural hazard. Each hazard has specific challenges identified with its respective occurrence, overall goals to reduce a hazards effect, specific objectives towards achieving those goals, and implementation strategies for the county to pursue.

As stated above, the Reynolds County Mitigation Plan is a multijurisdictional plan that represents several local governments and entities within the county. The following local governments and special districts participated in both the original plan development, as well as the plan update. They are represented by the plan through its formal adoption: Reynolds County; City of Bunker; City of Centerville; City of Ellington, and the Lesterville R-IV School District. Because all jurisdictions participated in the prior plan update, there were no new participants involved with the current plan update.

The purpose of this hazard mitigation plan is to reduce or eliminate long-term risk to people and property from natural hazards. Reynolds County, its participating jurisdictions, and school districts developed this multi-jurisdictional local hazard mitigation plan update to reduce future losses from hazard events occurring within the county, its communities, school district service areas. The current document is an update of a plan that was approved during September 2017. The plan and the update were prepared pursuant to the requirements of the Disaster Mitigation Act of 2000 to result in Reynolds County eligibility for the Federal Emergency Management Agency (FEMA) Hazard Mitigation Grant Programs.

As stated above, the *2022 Reynolds County Multi-Hazard Mitigation Plan* is a multi-jurisdictional plan that covers the following participating jurisdictions:

- Reynolds County;
- City of Bunker;
- City of Centerville;
- City of Ellington; and,
- Lesterville R-IV School District.

The Centerville R-I School District, the Southern Reynolds County R-II School District, and the Bunker R-III School Districts were invited to participate in the planning process but did not meet all the established requirements for official participation. When the future five-year update is developed for this plan these special districts will again be invited to participate.

Reynolds County and the entities listed above developed a multi-jurisdictional hazard mitigation plan that was approved by FEMA on September 7, 2017 (hereafter referred to as the 2017 Reynolds County Hazard Mitigation Plan). This current planning effort serves to update that previously approved plan.

The plan update process followed a methodology in accordance with FEMA guidance, which began with the formation of a Mitigation Planning Committee (MPC) comprised of representatives from Reynolds County and its participating jurisdictions. The MPC updated the risk assessment that identified and profiled hazards that pose a risk to Reynolds County and analyzed jurisdictional vulnerability to these hazards.

The MPC also examined the capabilities in place to mitigate 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 within this plan. Flash flooding, winter storms, wildfires, and thunderstorms with high wind events are among the hazards that historically have had a significant impact upon the planning area.

Based upon the risk assessment, the MPC revisited the prior plan goals for reducing risk to the planning area from natural hazards. The goals from the 2017 plan were reviewed, contemplated, confirmed, and carried forward into the current plan update. They are listed below.

1. Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disasters.
2. Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
3. Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.
4. Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.

These goals, and the other information contained within this plan, will be reviewed every five

years under the oversight of the Reynolds County Commission. An explanation of the plan implementation and maintenance process is outlined in Chapter 5 of this plan update.

To advance the identified goals, the MPC developed recommended mitigation actions, as summarized in the table on the following pages. The MPC developed an implementation plan for each action, which identifies the action's priority level, background information, possible implementation strategies, the responsible agency, the anticipated timeline, estimated costs, potential funding sources, etc. Additional details are provided in Chapter 4.

Table I. Mitigation Action Matrix

#	Action	Jurisdiction	Priority	Goals Addressed (see page v)	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
1.1	Provide satellite phones for emergency communications	Reynolds County	High (38)	#1	All			
1.2	Extreme heat education	Reynolds County	Medium (27)	#1	Extreme Heat			
1.5	Warning siren mapping	Reynolds County	High (32)	#2	Tornado			
1.6	Upgrade water systems	Reynolds County	Low (22)	#1	Drought	X	X	
2.1	Increase training & retention efforts for EMA volunteers	Reynolds County	Medium (29)	#2	All			
3.1	Prioritize work on bridges & roadways vulnerable to earthquakes	Reynolds County	High (34)	#3	Earthquake	X		
3.2	Integrate mitigation actions into other planning documents/mechanisms	Reynolds County	High (33)	#3	All	X	X	
3.3	Install lightning protection	Reynolds County	High (31)	#3	Thunderstorm	X		
3.4	Participate in flood buyout programs to relocate residents from flood prone areas	Reynolds County	Medium (29)	#3	Flood	X	X	
3.5	Replace low water crossings with bridges	Reynolds County	Medium (27)	#3	Flood	X	X	
3.6	Map sinkholes	Reynolds County	Medium (25)	#3	Sinkholes		X	
4.1	Adopt/enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas	Reynolds County	High (39)	#4	Flood		X	X
4.2	Explore CRS institution	Reynolds County	High (32)	#4	Flood	X	X	
1.6	Upgrade water systems	City of Bunker	Low (19)	#1	Drought	X	X	n/a

3.1	Prioritize work on bridges & roadways vulnerable to earthquakes	City of Bunker	Medium (26)	#3	Earthquake	X		n/a
3.2	Integrate mitigation actions into other planning documents/mechanisms	City of Bunker	High (33)	#3	All	X	X	n/a
3.3	Install lightning protection	City of Bunker	High (31)	#3	Thunderstorm	X		n/a
1.6	Upgrade water systems	City of Centerville	Low (19)	#1	Drought	X	X	
3.2	Integrate mitigation actions into other planning documents/mechanisms	City of Centerville	High (33)	#3	All	X	X	
4.1	Adopt/enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas	City of Centerville	High (39)	#4	Flood		X	
1.6	Upgrade water systems	City of Ellington	Low (19)	#1	Drought	X	X	
3.5	Replace low water crossings with bridges	City of Ellington	Medium (27)	#3	Flood	X	X	
3.1	Prioritize work on bridges & roadways vulnerable to earthquakes	City of Ellington	High (34)	#3	Earthquake	X		
3.3	Install lightning protection	City of Ellington	High (31)	#3	Thunderstorm	X		
3.2	Integrate mitigation actions into other planning documents/mechanisms	City of Ellington	High (33)	#3	All	X	X	
4.1	Adopt/enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas	City of Ellington	High (39)	#4	Flood		X	
4.2	Explore CRS institution	City of Ellington	High (32)	#4	Flood	X	X	
1.3	Implement tornado drills	Lesterville R-IV School District	High (34)	#1	Tornado			n/a
1.4	Build a tornado safe room	Lesterville R-IV School District	High (30)	#1	Tornado		X	n/a

2.2	Install emergency generator	Lesterville R-IV School District		#2	All			
2.3	Identify Alternate Transportation Routes	Lesterville R-IV School District	Medium (29)	#3	Flood			n/a
3.2	Integrate mitigation actions into other planning documents/mechanisms	Lesterville R-IV School District	High (33)	#3	All	X	X	n/a

PREREQUISITES

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 by all participating jurisdictions and schools districts. The documentation of each adoption is included within Appendix F. A model resolution is included on the following page.

The jurisdictions listed within the Executive Summary participated in the development of this plan and have adopted the multi-jurisdictional plan.

Model Resolution

(*LOCAL GOVERNING BODY/SCHOOL DISTRICT*), Missouri RESOLUTION NO. _____

A RESOLUTION OF THE (*LOCAL GOVERNING BODY /SCHOOL DISTRICT*) ADOPTING THE (*PLAN NAME*)

WHEREAS the (*local governing body/school district*) recognizes the threat that natural hazards pose to people and property within the (local governing body/school district); and

WHEREAS the (*local governing body/school district*) has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the (*plan name*), 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 *(local governing body/school district*) from the impacts of future hazards and disasters; and

WHEREAS the (*local governing body*) recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the (*local governing body/school district*) will endeavor to integrate the *Plan* into the comprehensive planning process; and

WHEREAS adoption by the (*local governing body/school district*) demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

NOW THEREFORE, BE IT RESOLVED BY THE (*LOCAL GOVERNMENT/SCHOOL DISTRICT*), in the State of Missouri, THAT:

In accordance with (*local rule for adopting resolutions*), the (*local governing body/school district*) adopts the final *FEMA-approved Plan*.

ADOPTED by a vote of_____in favor and_____against, and_____abstaining, this_____day of _____,_____.

By (Sig): _____
Print name: _____

ATTEST:
By (Sig.): _____
Print name: _____

1 0INTRODUCTION AND PLANNING PROCESS

1.1 PURPOSE

Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of natural disasters. For hazard mitigation to be effective, mitigation actions must be taken prior to disaster, thereby reducing negative impacts to people and property. The purpose of this plan is for the jurisdictions and special districts of Reynolds County to proactively identify their extent of exposure to natural hazards as well as attainable goals and specific actions designed to minimize harm to people and property following a disaster. Furthermore, the exercise of mitigation planning results in a document—such as the current document—which outlines strategies for the implementation of prioritized mitigation actions.

The Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288), which was later amended by *The Disaster Mitigation Act of 2000* (Public Law 106-390), and implementation regulations set forth by the Interim Final Rule published in the Federal Register on February 26, 2002 (44 CFR §201.6) and finalized on October 31, 2007 establish the requirements for local hazard mitigation plans. (Hereafter, the amended law and implementing regulations will be referred to collectively as the Disaster Mitigation Act or DMA). The DMA sets forth the requirement for jurisdictions and special districts to adopt a hazard mitigation plan to be eligible to receive federal hazard mitigation grant funding. On October 1, 2002, FEMA published a change to the Interim Final Rule at 67 FR 61512, extending the effective date for state and local hazard mitigation plan adoption requirements to November 1, 2004. Since this date, participation within and adoption of a FEMA-approved hazard mitigation plan has been required for state, municipalities, and special districts to receive non-emergency Stafford Act assistance including hazard mitigation grant funding.

Following tornado and flooding disasters declared during the spring of 2002 (DR-1412), the Missouri State Emergency Management Agency (SEMA) received flood acquisition and demolition proposals from twenty-three communities throughout the state. Fortunately, SEMA assisted some of the communities with federal mitigation grant funding provided by the Federal Emergency Management Agency (FEMA). While communities like these remain eligible for federal disaster public assistance and individual assistance, they are no longer eligible for mitigation assistance unless they have participated within the development of and adopted a FEMA-approved hazard mitigation plan. For nearly 1,000 municipalities and 114 counties in Missouri, mitigation plans are required. All Missouri jurisdictions that participate in the development of the hazard mitigation plan and adopt the completed plan are eligible to receive federal mitigation grant funding. Any jurisdictions that do not participate in the development or adoption of the plan are ineligible for such mitigation funding.

To assist jurisdictions and special districts in creating or updating their hazard mitigation plan, FEMA has created guidance documents. These documents, specifically FEMA's *Local Mitigation Planning Handbook*, *March 2013* and FEMA's *Local Mitigation Plan Review Guide, October 1, 2011*, were consulted by Reynolds County and its participating jurisdictions during the update of its *2022 Reynolds County Hazard Mitigation Plan*.

The Community Rating System (CRS) is a voluntary program for which communities participating within the National Flood Insurance Program (NFIP) are eligible. The CRS provides a range of flood insurance premium reductions (0% to 45%) for certain properties located within participating communities. In this way, the program encourages communities to implement floodplain management practices beyond those required by the NFIP. Buildings located within certain flood zones of a CRS-participating community are eligible for flood insurance premium discounts depending upon the community CRS-assigned "class." The community's class may range from "10" to "0" with a class of "0" providing the most flood mitigation benefit. The table below shows the CRS classes and associated insurance premium discounts. A description of the types of properties eligible for flood insurance premium discounts can be found within Table 1 of the FEMA CRS community listing document located at https://www.fema.gov/media-library-data/1476294162726-4795edc7fe5cde0c997bc4389d1265bd/CRS_List_of_Communites_10_01_2017.pdf. Unfortunately, as of the update of this plan, neither Reynolds County, nor its three municipalities participated within the CRS.

Table 1.1 CRS Classes and Insurance Premium Discounts

CLASS	DISCOUNT	CLASS	DISCOUNT
1	45%	6	20%
2	40%	7	15%
3	35%	8	10%
4	30%	9	5%
5	25%	10	0%

Source: Community Rating System, FEMA, https://www.fema.gov/media-library-data/1476294162726-4795edc7fe5cde0c997bc4389d1265bd/CRS_List_of_Communites_10_01_2017.pdf

1.2 BACKGROUND AND SCOPE

This plan is an update to the Reynolds County Hazard Mitigation Plan that was approved in September 2017. The plans are required to be updated every five years to remain valid and ensure the plan is addressing current trends and needs of the participating jurisdictions.

The *2017 Reynolds County Hazard Mitigation* and this update were both prepared by the Ozark Foothills Regional Planning Commission (OFRPC). The OFRPC, a member of the Missouri Association of Councils of Government MACOG) was created in 1967. The commission serves the five-county region of Butler, Carter, Reynolds, Ripley, and Wayne Counties, as well as all municipalities within those five counties.

Information in this plan should be used as a guide for the coordination of mitigation activities and decisions regarding local land use planning in the future. The actions included in this plan are not final solutions, but rather short-term efforts that will ultimately have long-term strategic impacts when implemented.

In the *2017 Reynolds County Hazard Mitigation Plan* the following jurisdictions participated within and adopted the plan:

- Reynolds County
- City of Bunker
- City of Centerville
- City of Ellington
- Lesterville R-IV School District

Those entities with representatives fully participating in the current plan update included the following:

- Reynolds County
- City of Bunker
- City of Centerville
- City of Ellington
- Lesterville R-IV School District

Both the City of Centerville and the City of Ellington are fully located within Reynolds County. Portions of the City of Bunker are located in Dent County. The Bunker City Hall is located in Reynolds County. The Lesterville R-IV School District is fully located within the planning area and has no assets located in neighboring counties. The Lesterville R-IV School District participated within the current plan update because they are headquartered within Reynolds County and hold all of their assets within the county. None of the other three school districts in the county—Centerville R-I School District, Southern Reynolds County R-II School District, and Bunker R-III School District—met the requirements for participation within the current plan update.

1.3 PLAN ORGANIZATION

This plan updated is organized into five chapters and an assembly of appendices. Following is a list of the chapters and their respective title:

- 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 (A-E)

There were no document format changes made from the previously approved (2017) plan.

Table 1.2 Changes Made in Plan Update

Plan Section	Summary of Updates
Chapter 1 - Introduction and Planning Process	Updated members of the Mitigation Planning Committee (MPC) and the participating jurisdictions that formally adopted the updated plan.
Chapter 2 - Planning Area Profile and Capabilities	Completed a vulnerability analysis for each jurisdiction.
Chapter 3 - Risk Assessment	Rearranged hazard order per state preference.

Chapter 4 - Mitigation Strategy	The numbering system for the mitigation actions was reconstructed.
Chapter 5 - Plan Implementation and Maintenance	Updated MPC meetings for evaluating and updating the plan to once per year on the anniversary date of the update's FEMA approval.

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 county's regional planning commission—the Ozark Foothills Regional Planning Commission (RPC)—was contracted by Reynolds County to facilitate update of the county's 2017 hazard mitigation plan. In this role the RPC conducted the following actions:

- assisted in establishing a Mitigation Planning Committee (MPC) as defined by the Disaster Mitigation Act;
- determined if the MPC established for the previously approved (2017) plan was a standing committee that met in the interim and documented changes in the MPC membership and procedures since adoption of the previous plan;
- assessed adherence to the plan maintenance process set forth in the previously approved plan;
- ensured the updated plan meets the DMA requirements as established by federal regulations and follows the most current planning guidance of the Federal Emergency Management Agency (FEMA);
- facilitated the entire plan development process;
- identified data that MPC participants could provide and conducted research to augment that data;
- assisted in soliciting public input;
- produced the draft and final plan update in a FEMA-approvable document; and,
- coordinated the Missouri State Emergency Management Agency (SEMA) and (FEMA) plan reviews.

Adherence to the plan maintenance process established in 2017 did not occur due to a lack of funding for a process facilitator.

All of the participating jurisdictions listed within the table actively and directly participated within the plan update process. The governing bodies of all participating jurisdictions formally adopted the updated planning document[1(c)]. **Table 1.3** lists the MPC members and the entities they represent, along with their titles[1(a) and 2(a)].

Table 1.3. Jurisdictional Representatives of the Reynolds County Mitigation Planning Committee

Name	Title	Jurisdiction/Agency /Organization
Joe Loyd	Presiding Commissioner/Floodplain Administrator	Reynolds County
Kendra Ritter	City Clerk	City of Bunker
Linda Miller	City Clerk	City of Centerville
Paul Wood	Mayor	City of Ellington
Jason St. Gemme	Principal	Lesterville R-IV School District

Table 1.4 below lists all members of the MPC and notes each member's expertise in the six mitigation categories (Prevention, Property Protection, Natural Resource Protection, Emergency Services, Structural Flood Control Projects and Public Information) [1(b)].

Table 1.4. MPC Capability with Six Mitigation Categories[1(b)]

Community Department/Office	Prevention	Structure and Infrastructure Projects		Natural Systems Protection	Education and Awareness Programs	Emergency Services
		Property Protection	Structural Flood Control Projects			
County Presiding Commissioner	✓	✓		✓	✓	
County Commissioner	✓	✓		✓	✓	
County Commissioner	✓	✓		✓	✓	
County Floodplain Administrator		✓	✓			
City Clerk		✓		✓	✓	
City Clerk		✓	✓	✓	✓	
Emergency Management Director	✓			✓	✓	✓
School Principal	✓	✓			✓	
Health Information	✓				✓	✓
Health Information	✓				✓	✓
Healthcare	✓				✓	✓
Road and Bridge		✓				

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 Ozark Foothills Regional Planning Commission (OFRPC), on behalf of Reynolds County, invited all cities, school districts, special districts, transportation, healthcare, and private

nonprofit entities in the planning area to participate in this update of the Reynolds County Multi-Jurisdictional Hazard Mitigation Plan. DMA 2000 requires that jurisdictions represented by a multi-jurisdictional plan participate in the planning process and formally adopt the plan. Each participating jurisdiction was required to meet plan participation requirements as defined by the MPC at the beginning of the planning process. Minimum participation requirements were defined as follows:

- ✓ Designation of a representative from each participating jurisdiction to serve on the MPC;
- ✓ Participation in planning meetings, including virtual attendance, by either direct participation or authorized representative;
- ✓ Provision of information sufficient to support plan development by completion and return of Data Collection Questionnaires and validating/correcting critical facility inventories;
- ✓ Provision of progress reports on mitigation actions from the previously approved plan and identification of additional mitigation actions for the plan;
- ✓ Elimination from further consideration those actions from the previously approved plan that were not implemented because they were impractical, inappropriate, not cost-effective, or otherwise infeasible;
- ✓ Review and comment on plan drafts;
- ✓ Active solicitation of input from the public, local officials, and other interested parties about the planning process and provision of opportunity for public comment;
- ✓ Provision of documentation to showing time donated to the planning effort; and,
- ✓ Formal adoption of the updated mitigation plan prior to submittal to SEMA and FEMA for final approval.

Written invitations were mailed to all persons attending the Initial Coordination Meeting as well as to those agencies and stakeholders identified during the Initial Coordination Meeting. Reminders of the Initial Coordination meeting and the importance of the planning effort were emailed to invitees prior to the date of the meeting. The Initial Coordination Meeting was held April 26, 2021. All meeting documentation can be located within Appendix C.

Two Project Kick-Off Meetings were held—one on May 24, 2021, and another on June 28, 2021, at the Reynolds County Courthouse. Written invitations were mailed to all persons attending the Initial Coordination Meeting as well as to those agencies and stakeholders identified during the Initial Coordination Meeting. A copy of the meeting sign-in sheets are included within Appendix C of this document.

During the Project Kick-Off Meetings, those in attendance offered suggestions of additional stakeholders who were invited to participate within the planning process. The focus of the meetings was establishment of participation requirements, identification of hazards, as well as introduction of the Data Collection Questionnaire and the critical facilities inventory. Reminders of the Project Kick-Off Meetings and the importance of the planning effort were emailed to invitees prior to the date of the meeting.

The Risk Assessment Planning Meeting was held on June 13, 2022. Two separate written invitations were mailed to prospective attendees—one for MPC members and one for potential stakeholders identified at the Project Kick-Off Meeting. Copies of the meeting minutes and sign-in sheets can be found within Appendix C of this document. A virtual attendance meeting option was offered. Finalization of project goals, review of public comment, identification of jurisdictional capabilities and jurisdictional risk assessments were the focus of the meeting.

The Mitigation Strategy Planning Meeting was held on July 11, 2022, at the Reynolds County

Courthouse in Centerville. The topic of the meeting was update and identification of jurisdiction-specific mitigation actions. All members of the MPC and previously identified stakeholders were invited to the meeting via written letter followed by email reminders. A virtual attendance meeting option was offered. All meeting documentation—meeting minutes and sign-in sheets—can be located within Appendix C.

The Centerville R-I School District, the Southern Reynolds County R-II School District, and the Bunker R-III School Districts did not meet the plan update participation requirements as established by the MPC. While an MPC represented was named by two of the districts and representative of those same two districts participated to a limited extent in the plan update process, the two entities did not meet the participation requirements set forth by the MPC. The Centerville R-I School District returned neither a completed Data Collection Questionnaire, nor a mitigation action assessment. While the Bunker R-III did return a completed Data Collection Questionnaire, it did not assess its mitigation actions. Neither district attended the Risk Assessment or Mitigation Strategy Planning Meetings. The Southern R-II School District attended no planning meetings and provided no plan update information when requested. All jurisdictions were notified in writing and via email of all meetings. Numerous written attempts were made to collect Data Collection Questionnaires.

Members of the MPC actively participated within the planning process. These planning partners posses the expertise to develop the plan, and their organizations have the authority to implement the developed mitigation strategy. Per the See FEMA guide *Local Mitigation Planning Handbook March 2013 ("Handbook"),* active leadership from elected officials with an interest in improving safety and disaster resiliency ensures the planning process has visibility and encourages stakeholder participation.

The following jurisdictions met all of the participation requirements:

- ✓ Reynolds County;
- ✓ City of Bunker;
- ✓ City of Ceterville
- ✓ City of Ellington;
- ✓ Lesterville R-IV School District.

Public input was solicited via word-of-mouth, during seven regional public meetings, as well as through a survey distributed via social media and in-person. Due to the rural nature of the jurisdictions, their lack of resources, and the conduct of the planning effort in the midst of a global pandemic, public participation in the planning process, though solicited, was hampered. None of the participating jurisdictions have the resources needed to fund a full-time public information/marketing officer. Furthermore, cellular service, as well as broadband and internet connectivity within the planning area are either significantly limited or nonexistent. Unfortunately, this limited the reach of the public survey.

Table 1.5 below shows the participation of each jurisdiction at the planning meetings, the provision of responses to the Data Collection Questionnaire including the active critical facility validation, and the assessment of mitigation actions. As stated above, meeting sign-in sheets are located in Appendix C.

Table 1.5. Jurisdictional Participation in Planning Process

Jurisdiction	Initial Coordination Meeting	Kick-off Meeting(s)	Risk Assessment Meeting	Mitigation Strategy Meeting	Data Collection Questionnaire Response	Assess Mitigation Actions
Reynolds County	✓	✓	✓	✓	✓	✓
City of Bunker	-	✓	✓	✓	✓	✓
City of Centerville	✓	-	✓	✓	✓	✓
City of Ellington	✓	✓	✓	✓	✓	✓
Centerville R-I School District	✓	✓	-	-	-	-
Southern Reynolds R-II School District	-	-	-	-	-	-
Bunker R-III School District	-	✓	-	-	✓	-
Lesterville R-IV School District	✓	-	✓	✓	✓	✓

1.4.2 The Planning Steps

Data for this plan was created through a series of public meetings held within Reynolds County. The planning process for the *2022 Reynolds County Hazard Mitigation Plan* began during the spring of 2021, with presentations to elected officials, community members, and other interested parties. These individuals were invited to attend planning meetings, with a special effort to invite participants representing various business and service interests throughout Reynolds County communities. Participants were asked to identify critical infrastructure, ranking the likelihood of disaster occurrence, perform a risk assessment based on these factors, and determine/update appropriate mitigation strategies for each individual disaster. This data was recorded and assimilated into the current plan update by staff of the Ozark Foothills Regional Planning Commission.

Background and statistical data for this plan were collected from a variety of sources, including Data Collection Questionnaires, the United States Census Bureau, the United States Geological Survey, the United States Army Corps of Engineers, the Missouri Department of Natural Resources, the Missouri Department of Conservation, the Center for Agricultural, Resources and Environmental Systems at the University of Missouri-Columbia, and the National Climatic Data Center. The *Missouri State Hazard Mitigation Plan* was last updated in 2018 and provided information regarding tornado, earthquake, and flood hazards affecting Reynolds County.

The most recent flood insurance study for Reynolds County was completed in 1988 and resulted in a paper FIRM. At the time of the writing of this plan update a new flood mapping effort was underway for the county, but mapping data was not yet available. Flood hazard data from the 2006 HAZUS-MH loss run for Reynolds County was incorporated into the plan providing updated information on vulnerable structures, shelter requirements, and loss estimates. Other sources of information including Comprehensive Plans, Zoning Ordinances, Building Codes, and local Storm Water Regulations were reviewed for applicability to the plan.

Development of the current plan update followed the 10-step planning process adapted from FEMA's Community Rating System (CRS) and Flood Mitigation Assistance programs. This 10-step process allows the plan to meet funding eligibility requirements of the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program, as well as qualify for points under Activity 510 for Mitigation Plans, within the Community Rating System. The following table shows how the CRS process aligns with the Nine Task Process

outlined in the 2013 *Local Mitigation Planning Handbook*.

Table 1.6. Reynolds 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, and 4)

The chief officers of Reynolds County, the City of Bunker, the City of Centerville, the City of Ellington, and the four public school districts were invited via written letter and follow-up phone calls and email messages to the Initial Coordination Meeting held on April 26, 2021 at the Reynolds County Courthouse in the Commission Chambers. Those in attendance are listed upon the attendance roster found in Appendix C of this document. During the Initial Coordination Meeting, additional potential MPC members and key stakeholders were identified by the attendees. In addition, the plan's purpose was outlined, a tentative plan update schedule was set, and the general process methodology was discussed.

Two Project Kick-Off Meetings were held on May 24, 2021 and June 28, 2021, also at the Reynolds County Courthouse. Written invitations were mailed to all persons attending the Initial Coordination Meeting, as well as to those agencies and stakeholders identified during the Initial Coordination Meeting. A copy of the meeting sign-in sheets are included within Appendix C of this document. During the Project Kick-Off Meetings, those in attendance offered suggestions of additional stakeholders who were invited to participate within the planning process. The focus of the meeting was establishment of participation requirements, identification of hazards, as well as introduction/distribution of the Data Collection Questionnaires and discussion of the

critical facilities inventory. Reminders of the Project Kick-Off Meetings and the importance of the planning effort were emailed to invitees prior to the date of the meeting.

Throughout the planning process, MPC members communicated via socially-distanced face to-face meetings, virtual meetings, phone interviews, and email correspondence.

Table 1.7. Schedule of MPC Meetings

Meeting	Topic	Date
Initial Coordination Meeting	Overview of hazard mitigation provided, plan purpose/requirement/process outline explained, jurisdictions named a representative to the MPC, future meeting location was selected, public input solicitation was discussed, additional MPC members and stakeholders were identified	4/26/2021
Kick-off Meeting #1	Hazards were reviewed and identified, previous disaster declarations were discussed, data collection questionnaires were distributed, public feedback methodologies and other data sources were identified.	5/24/2021
Kick-off Meeting #2	Hazards were reviewed and identified, previous disaster declarations were discussed, data collection questionnaires were distributed, public feedback methodologies and other data sources were identified.	6/28/2021
Risk Assessment Meeting	2017 plan goals reviewed, updated 2022 plan goals confirmed, jurisdictional capabilities determined, risk assessment reviewed and refined	6/13/2022
Mitigation Strategy Meeting	2017 county plan actions reviewed, updated actions established, irrelevant/completed actions deleted, new actions added, plan for maintenance of plan established	7/11/2022

Step 2: Plan for Public Involvement *2(a), (b), (c) and (d)*
(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.

Two Kick off meetings were held during May and June 2021 as indicated above at the Reynolds County Courthouse in Centerville, Missouri. Attendees finalized the seemingly most effective way to solicit and collect public input amid a global pandemic. A survey prepared by the process facilitator was provided to the group; all agreed to share the survey with their respective

contacts. An online version of the survey was created using SurveyMonkey. The link to this online survey was shared electronically through emails, on Facebook sites, and on local websites. A copy of the survey and the results are included in Appendix D. Sixteen response were received—all online responses. Two comments were received from survey and were as follows:

- *cell phone coverage, broadband coverage, emergency sirens*
- *Internet service and cell service*

Both comments pertain to the same issue of inadequate communication infrastructure in the planning area and were noted by the MPC. Mitigation action 1.1 was established in response to the cited issue. The hazards ranked by respondents as most likely to occur are listed in Figure 1.1 below.

Figure 1.1 Public Perception of Likelihood of Natural Hazard Occurrence in Reynolds County, MO

	UNLIKELY	OCCASIONAL	LIKELY	HIGHLY LIKELY	TOTAL	WEIGHTED AVERAGE
Thunderstorm/Lightning/High Wind/Hail	0.00% 0	6.25% 1	31.25% 5	62.50% 10	16	3.56
Winter Weather/Snow/Ice/Extreme Cold	0.00% 0	6.25% 1	37.50% 6	56.25% 9	16	3.50
Flooding	0.00% 0	31.25% 5	6.25% 1	62.50% 10	16	3.31
Extreme Heat	0.00% 0	25.00% 4	31.25% 5	43.75% 7	16	3.19
Tornado	0.00% 0	18.75% 3	50.00% 8	31.25% 5	16	3.13
Drought	12.50% 2	37.50% 6	25.00% 4	25.00% 4	16	2.63
Wildfire	6.25% 1	43.75% 7	31.25% 5	18.75% 3	16	2.63
Sinkholes	18.75% 3	37.50% 6	31.25% 5	12.50% 2	16	2.38
Earthquake	25.00% 4	50.00% 8	25.00% 4	0.00% 0	16	2.00
Dam Failure	86.67% 13	6.67% 1	6.67% 1	0.00% 0	15	1.20

Source: Reynolds County Hazard Mitigation Planning Survey, surveymonkey.com, 2021-2022

The hazards ranked by respondents as most likely to result in damage (i.e. potential magnitude) are listed in Figure 1.2 below.

Figure 1.2. Public Perception of Magnitude of Any One Natural Hazard in Reynolds County, MO

	NEGLIGIBLE	LIMITED	CRITICAL	CATASTROPHIC	TOTAL	WEIGHTED AVERAGE
Tornado	0.00% 0	12.50% 2	56.25% 9	31.25% 5	16	3.19
Flooding	0.00% 0	12.50% 2	62.50% 10	25.00% 4	16	3.13
Winter Weather/Snow/Ice/Extreme Cold	0.00% 0	6.25% 1	87.50% 14	6.25% 1	16	3.00
Fires	0.00% 0	37.50% 6	43.75% 7	18.75% 3	16	2.81
Thunderstorm/Lightning/High Winds/Hail	0.00% 0	31.25% 5	56.25% 9	12.50% 2	16	2.81
Extreme Heat	0.00% 0	37.50% 6	56.25% 9	6.25% 1	16	2.69
Earthquake	18.75% 3	25.00% 4	37.50% 6	18.75% 3	16	2.56
Drought	12.50% 2	37.50% 6	37.50% 6	12.50% 2	16	2.50
Sinkholes	25.00% 4	43.75% 7	31.25% 5	0.00% 0	16	2.06
Dam Failure	50.00% 8	25.00% 4	25.00% 4	0.00% 0	16	1.75

Source: Reynolds County Hazard Mitigation Planning Survey, surveymonkey.com, 2021-2022

Levee Failure was not analyzed as no levee exists within the planning area.

Throughout the planning process, public input was solicited in a variety of ways. A public survey was designed and disseminated via the internet using survey monkey. The electronic survey was advertised via direct email contact and s regional facebook page. Analysis of the survey results indicates that the public's perception of natural hazards—with regard to both frequency and magnitude aligned strongly with the perceptions of MPC members.

The planning process and update status was discussed at seven public meetings held during March 2021, June 2021, August 2021, December 2021, March 2022, June 2022, and September 2022. The agendas of each meeting were advertised publicly. During each meeting discussion, public input was requested and a point of contact provided.

There were no reports of damages made by the public during the planning process.
All applicable public input was incorporated into the plan either directly through the creation of specific mitigation actions, or by quotation of the comment within this section.

The final public comment opportunity—prior to plan approval—was held during the month of September 2022. The completed plan draft was posted on a regional website located at www.ofrpc.org and advertised via social media and word-of-mouth. During the month of September 2022, Reynolds County and its three incorporated cities, included information regarding the public comment period upon their official commission/council meeting agendas. Comments from the pubic were encouraged and could be made either by telephone, email, or in written form to the Reynolds County Commission. A hard copy was located at the Reynolds County Clerk's office for review by those members of the public lacking access

computer/internet access. The deadline for the receipt of public comment was September 30, 2022.

All documentation of public input solicitations is included within Appendix D.

Step 3: Coordinate with Other Departments and Agencies and Incorporate Existing Information[3(b)]
(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.

During the planning process, stakeholders were provided the opportunity to be involved[3(b)]. Stakeholders identified by the MPC represented the following types of entities:

- Neighboring communities
- Local and regional agencies involved in hazard mitigation activities
- Businesses
- Transportation
- Healthcare
- Academia
- State Departments
- Other private and non-profit interests

The persons listed within the table below were stakeholders identified by the MPC as having goals and/or interests which may interface with hazard mitigation in the planning area. All were invited via written letter to participate within the plan update process and were directly asked to comment on the plan draft. A copy of the invitation and plan draft review request letters can be found within Appendix D of this document. Stakeholders that actively participated within the plan update process are included in the table in the "Contributors" Section of the Executive Summary.

Table 1.8 Planning Process Stakeholders

Name	Title	Organization
Gary Conway, Jr.	Mayor	City of Bunker
Stanley Barton	Mayor	City of Centerville
Amy Moore	City Clerk	City of Ellington
Christy Roberts	President	Ellington Chamber of Commerce
Karen White	Director	Missouri Highlands Healthcare
Joseph Minks	Professional Development	Centerville R-I School District

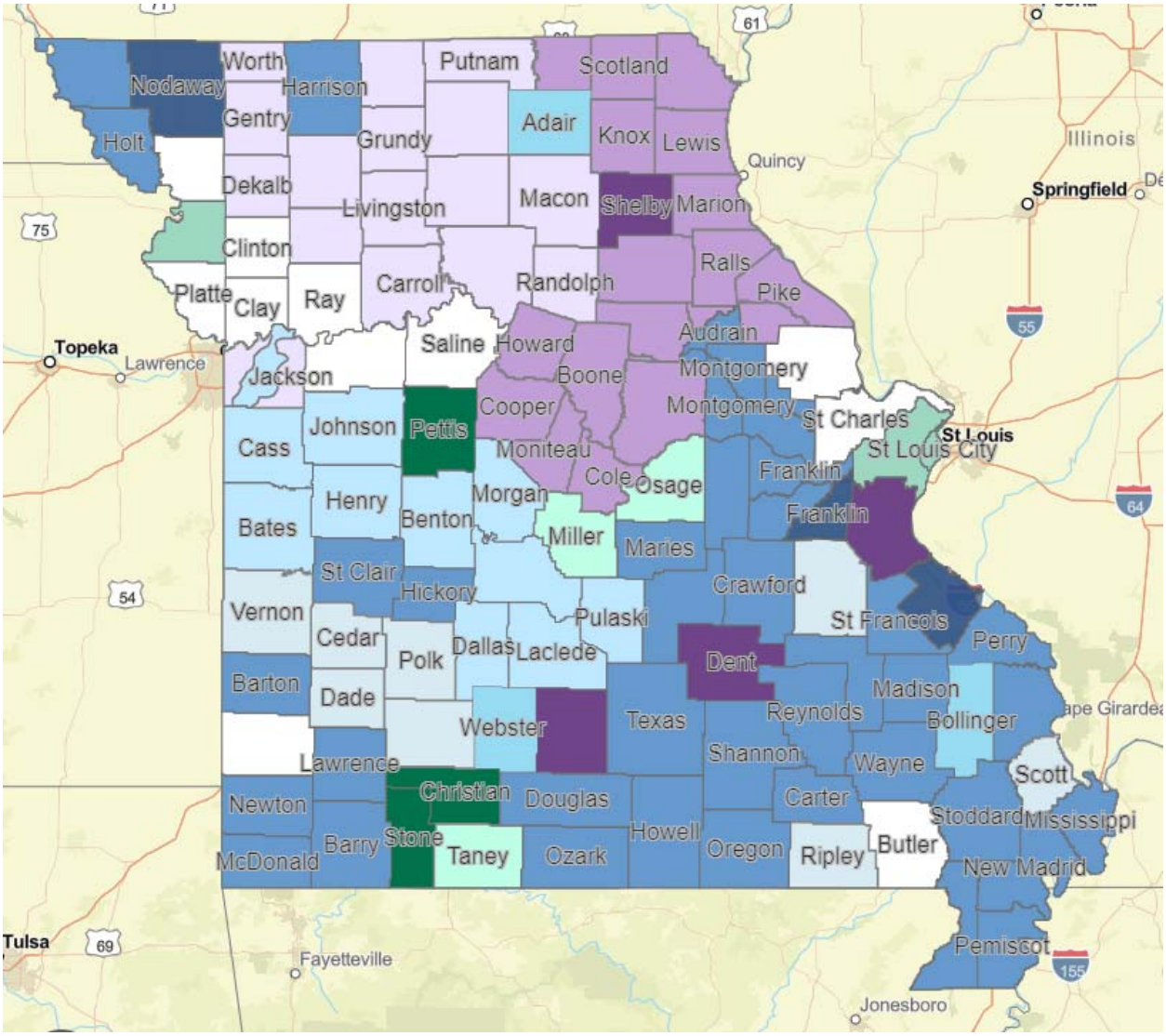
	Chairperson	
Lonnie Barton	School Board Member	Centerville R-I School District
Paula King	Superintendent	Southern Reynolds County R-II School District
Melissa Nash	Superintendent	Bunker R-III School District
Renee Horn	Emergency Management Director	Reynolds County
Jeremy Myers	Superintendent	Lesterville R-IV School District
Andrew Murphy	Regional Transportation Planner	Ozark Foothills Regional Planning Commission
Alan Lutes	Director	Ozark Foothills Regional Planning Commission
David Wyman	Area Engineer	Missouri Department of Transportation, Southeast District
Frances Vermillion	Administrator	Reynolds County Health Center
Joyce Santhuff	Administrator	Reynolds County Health Center
Lisa Beardsley	Registered Nurse	Reynolds County Health Center
Natasha Chitwood	Receptionist	Reynolds County Health Center
Brian Polk	Presiding Commissioner	Wayne County, Missouri
Ron Keeney	Presiding Commissioner	Carter County, Missouri
Jim Scaggs	Presiding Commissioner	Iron County, Missouri
Jeff Cowen	Presiding Commissioner	Shannon County, Missouri
Darrell Skiles	Presiding Commissioner	Dent County
JD Jagelovicz	Administrator	Reynolds County Ambulance District

Coordination with FEMA Risk MAP Project[3(a)]

FEMA has established the Risk Mapping, Assessment and Planning (Risk MAP) program to identify flood risk and promote informed planning and development practices that reduce the risk of property damage due to flooding. There is a RiskMAP project currently underway in Reynolds County. **Figure 1.3 below** shows locations of RiskMAP projects throughout Missouri. Reynolds County is located in the southeastern corner of the state. Those counties indicated by the dark aqua color (as Reynolds County) should be interpreted as a "Develop Hydraulics." This indicates that a RiskMAP project is underway with study currently being conducted or refined.

The FIRM released September 30, 1988, as well as HAZUS data were used as the best available data to inform the flood risk assessment (Section 3 of this document) for the planning area. HAZUS software was utilized to generate the flood hazard boundary and associated depth of flooding.

Figure 1.3 RiskMAP Study Status Map



Integration of Other Data, Reports, Studies, and Plans[3(a)]

Contact was made with the U.S. Geological Survey to obtain data needed for the flood risk assessment—specifically the surface area of water located within the county. USGS was unfamiliar with the measure and unable to provide the data. Data was collected from a variety of sources (e.g. FEMA, the U.S. Census Bureau, etc.) for which no representatives attended planning meetings.

The *2018 State of Missouri Hazard Mitigation Plan* was consulted numerous times for a variety of technical data—specifically when completing the risk assessment portion of the plan update. Specific sources of technical data included, Reynolds County's 1988 Flood Insurance Rate Map (FIRM), the Missouri Department of Natural Resources, the Missouri Department of Conservation, the National Inventory of Dams (NID), SILVIS Lab—Department of Forest Ecology and Management within the University of Wisconsin, National

Centers for Environmental Information of the National Oceanic and Atmospheric Administration, and the USDA Risk Management Agency's Crop Insurance Statistics.

Relevant information from the above-listed sources was reviewed by the planner as appropriate and included within the updated planning document. Data was either manually entered by the planner, or "copied and pasted" from the online data source to the document. Sources for each data insertion were cited where appropriate.

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

During the Kickoff meeting held on April 26, 2021, at the Reynolds County Courthouse, information was presented to the MPC that identified and profiled the natural hazards to be potentially included within the plan update. As a part of this discussion previous disaster declarations were discussed with local input provided by members of details related to those declarations. The hazards included in the 2018 state plan were also presented to the MPC, along with the hazards identified in the 2017 Reynolds County *Hazard Mitigation Plan.*

Data Collection Questionnaires were distributed to the jurisdictional representatives during the Project Kick-Off Meetings. The purpose and importance of the questionnaires were discussed, as well as the intention of inserting the collected information to conduct a jurisdiction-specific risk assessment.

During the risk assessment meeting, data provided within the Data Collection Questionnaires was reviewed and identified for incorporation within the plan update. It was further determined that each participating jurisdiction was required to incorporate the final updated hazard mitigation plan into future planning documents. In addition to the questionnaires, the MPC discussed other sources from which data could be pulled for use in the plan update. These additional data sources included internet searches, GIS analysis, local newspaper articles, local "historians", and local officials from the jurisdictions. The risk assessment found within Section 3 of this plan update provides additional detail on conclusions drawn from the data.

Step 5: Assess the Problem: Identify Assets and Estimate Losses
(Handbook Task 5)

In an effort to identify local assets a variety of sources were used. The 2018 state plan was reviewed along with US Census Data, GIS data, HAZUS data, and the completed Data Collection Questionnaires completed by all participating jurisdictions. Once assets were identified, losses were estimated utilizing information in the 2018 state plan, as well as other available data such as dam inundation maps and prior loss history for events.

Section 2 of this plan provides area profiles and information regarding each jurisdiction's capabilities. This section includes information on the participating jurisdictions' regulatory, personnel, fiscal, and technical capabilities. The information was collected through a review of local ordinances, staff members, and annual budgets. Completed Data Collection Questionnaires were also consulted to complete the jurisdiction-specific capability analysis.

Section 3 of this plan includes a discussion of jurisdiction-specific vulnerabilities relative to each hazard identified in the plan. The data used for the vulnerability estimates were taken

from the 2018 state plan as it was the best and most recent data source available.

Step 6: Set Goals
(Handbook Task 6)

No changes were made to the plan goals or priorities. The MPC reviewed the goals of the previous (2017) plan during the Project Kick-Off Meeting and finalized the goals for the current plan update during the risk assessment meeting held June 13, 2022. Minutes of the meetings are included within Appendix C of this document. The identified goals are listed within Chapter 4 and repeated below.

The goals for the updated mitigation plan were confirmed as follows:

- Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disasters;
- Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters;
- Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters; and,
- Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.

Step 7: Review Possible Mitigation Actions and Activities
(Handbook Task 6)

The final (mitigation strategy) planning meeting occurred on July 11, 2022, at the Reynolds County Courthouse in Centerville. At this meeting MPC members reviewed the mitigation strategies from the 2017 county plan and proposed new and updated strategies. Each jurisdiction was required to identify at least one mitigation action. Members were asked to consider actions that substantially addressed long-term risks identified within the risk assessment in Section 3 of the updated plan.

During the final planning meeting, each jurisdiction representative reported upon progress made by their jurisdiction upon the previously proposed mitigation actions. MPC members analyzed each action, the progress (of lack thereof) made since 2017, and either, continued, deleted or modified the action for the 2022 plan update. It was determined by representatives of the City of Ellington that residential flood risk had been significantly mitigated in the past decade; consequently, the city's mitigation action relative to flood acquisition and demolition projects was removed.

The FEMA publication *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards* (January 2013) that was used as a reference in the development of action projects. Participants were encouraged to focus on long-term mitigation solutions and consideration was given to the potential cost of each project in relation to the anticipated future cost savings. The MPC used a modified STAPLEE method to prioritize the mitigation actions included within Section 4 of this plan update. The STAPLEE worksheet used for the analysis is included within this section. The completed worksheets are available for review within Appendix E.

Step 8: Draft an Action Plan
(Handbook Task 6)

The action worksheets, including the plan for implementation, submitted by each jurisdiction for the updated Mitigation Strategy are included in Chapter 4.

Step 9: Adopt the Plan
(Handbook Task 8)

Adoption by all participating jurisdictions is anticipated during September & October of 2022—prior to FEMA's final approval of this plan. Once the adoption resolutions are executed, documentation will be submitted and included within Appendix F.

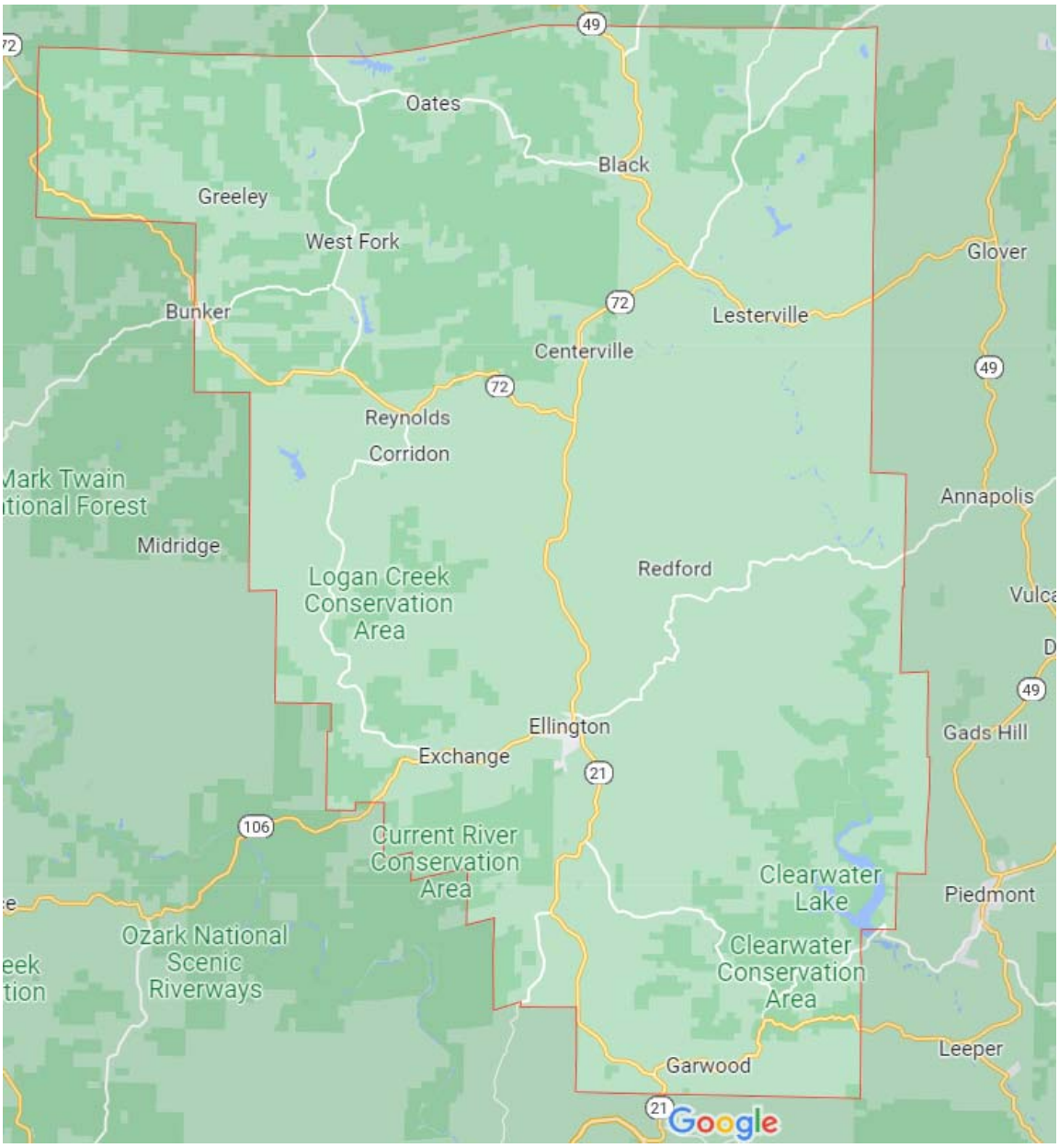
Step 10: Implement, Evaluate, and Revise the Plan
(Handbook Tasks 7 & 9)

At the mitigation strategy meeting held on July 11, 2022, the MPC developed and agreed upon an overall strategy for plan implementation and plan maintenance. Section 5 provides additional information on plan maintenance and monitoring as determined by the MPC for five years following plan approval.

2 PLANNING AREA PROFILE AND CAPABILITIES

2.1 REYNOLDS COUNTY PLANNING AREA PROFILE

Figure 2.1. Map of Reynolds County



Henry Fry, who is said to have come from Kentucky as the county's first pioneer, settled on the Middle Fork of the Black River in what is now Reynolds County during 1812. Pioneer families from the hills of Kentucky and Tennessee began to slowly and steadily move to the region. The county was officially organized in 1845.

Over the past century, Reynolds County has witnessed a fluctuating population. The county's highest population count was in 1920--10,106 residents. Over the following forty years, the population decreased by 51% to 5,161 in 1960. Since the 1960 census, Reynolds County has shown a decrease in population only once which was a 7.8% decrease reported in the 1990 Census. The 2000 Census reported a slight growth of 28 persons or 0.4% and another slight increase was seen in the recent release of the 2010 Census with an increase of 7 persons or 0.01% increase to 6,696 county residents. The county's population as reported by the American Community Survey (ACS) Five-Year Estimates was 6,096 in 2020—a decline of 600 persons or 9% from the 2010 U.S. Census full count of 6,696. In reviewing this census data, Reynolds County falls behind both the State of Missouri and the country in regards to population growth. Per the same source, from 2000 through 2020, the State of Missouri's population grew by 542,217 persons, or 9.7%, and growth for the United States was 46,817,617 persons, or 16.6%. While the number of people in the state and country grew, Reynolds County's population declined.

Reynolds County is also a county with a very-low median household income (MHI), as compared to the State of Missouri and the United States. The 2016-2020 ACS Five-Year Estimates reports that the MHI for Reynolds County is $39,552, up 52.9% from $25,867 in 2000 per the Decennial Census. The ACS also reports that the MHI in Missouri increased 51.0% from 2000 through 2020, from $37,934 to $57,290, respectively. The United States MHI grew 54.8% during the same time from $41,994 to $64,994. MHI in the planning area grew at a similar, though lower, percentage rate than either the state or national MHI. As of 2020, Reynolds County residents existed on 69.0% of the average household income amount of their fellow Missourians and 60.9% of their fellow Americans. As can be seen in examining the MHI of local residents the county is one of extreme poverty with few opportunities for financial gain.

Housing values reflect even more wealth disparities between the planning area and rest of the state and nation. Per the 2000 Decennial Census, Reynolds County's median housing value was $52,100, but increased to $96,000 per the 2016-2020 ACS. For the same time periods, the State of Missouri and the United States reported $86,900/$163,600 and $111,800/$229,800, respectively. The increases in median housing value from 2000 to 2020 amounted to 84.3% for Reynolds County, 88.3% for Missouri, and 105.6% for the United States. As with the state and nation, the greatest percentage of homes in Reynolds County were built during the 1970's.

2.1.1 Geography, Geology and Topography

Reynolds County, Missouri is located in southeastern Missouri in the Ozark Foothills region. (Figure 2.1) The planning area is bordered by Wayne and Iron Counties to the east, Carter County to the south, Shannon and Dent Counties to the west, and Dent and Iron Counties to the north. Reynolds County encompasses just over 814 square miles, or approximately 519,040 acres. According to the U.S. Census of Agriculture, Reynolds County has approximately 12,808 acres of harvested cropland of its 37,312 total acres of cropland. In 2002, there were 117,793 acres of land designated as farms.

As a rural county with no planning and zoning ordinances, single family residences and mobile homes are sprawled throughout the county, many tucked away in the dense forested areas and accessible by county-maintained gravel roads. There are only three incorporated cities within the county boundaries. The City of Centerville is the county seat with a population of 186 persons, per the 2020 ACS Five-Year Estimates. The City of Bunker with a population of 264, and the City of

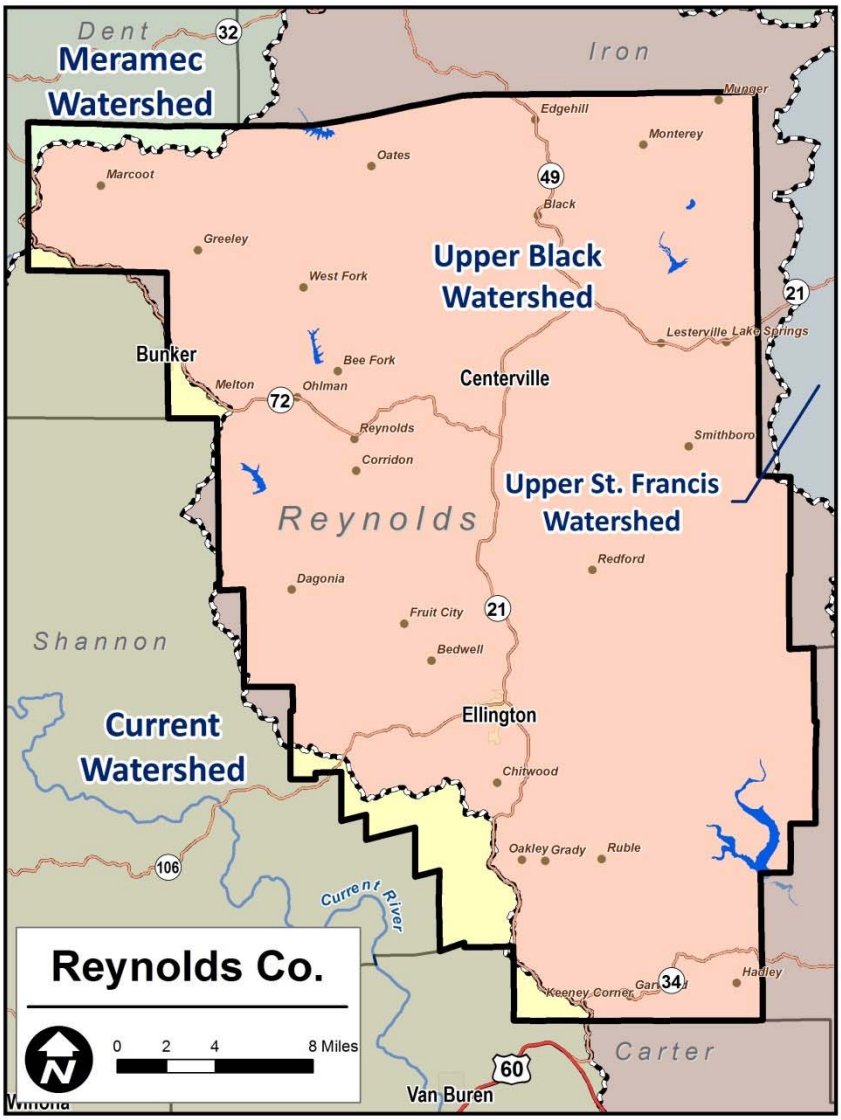
Ellington with a population of 1,380 persons complete the incorporated municipalities within the rural planning area. There are also other, smaller, unincorporated communities within the county including Black, Lesterville, Garwood, and Reynolds.

The majority of Reynolds County has a topographical classification of highly dissected plateaus. The Reynolds County's geology includes Ordovician-Age Bedrock and Cambrian-Age Bedrock.

Reynolds County has one river—the Black River—that crosses the county from the north and flows into Clearwater Lake in the county's southeastern corner. Additionally, there are numerous creeks and streams that dissect the county. There are approximately seven square miles of water surface area located within the county's jurisdictional boundaries—2.5 square miles of that total is Clearwater Lake in the southeastern corner of the county adjacent to Wayne County.

According to the United States Environmental Protection Agency, there are three watersheds that span Reynolds County, the Meramec, the Upper Black, and the Current River Watersheds. A map of the watersheds is shown below in **Figure 2.2**

Figure 2.2, Reynolds County, Missouri Watershed Map



Source: Missouri Department of Natural Resources

2.1.2 Climate

According to the National Weather Service (NWS) the average annual precipitation within the planning area is 49.65 inches, higher than the United States average of 37 inches. It is reported that of these 49.65 inches of precipitation, ten inches of that is snowfall annually. The average U.S. city gets twenty-five inches of snow per year. The number of days per year with any measurable precipitation is ninety-seven.

On average annually, there are 216 sunny days in Reynolds County. The month with the highest average temperature is July with an average high of 92 degrees. The month with the lowest average temperature is January with an average low of 34 degrees. The High Plains Regional Climate Center provides monthly climate averages based on data collected from 1981-2010. According to this data the maximum average monthly temperature in Reynolds County occurs in July at 90.51 degrees with the minimum average monthly temperature occurring in January at 22.26 degrees. The month that

averages the highest precipitation is November with 4.97 inches and the month with the lowest precipitation average is August with 3.17 inches.

2.1.3 Population/Demographics

Table 2.1. Reynolds County Population 2000-2020 by Jurisdiction

Jurisdiction	2000 Population	2010 Population	2016-2020 ACS 5-Year Population Estimate	# Change (2010-2020)	% Change (2010-2020)
Unincorporated	5,085	5,111	4,266	-845	-16.5
City of Bunker *	414	407	264	-143	-35.1
City of Centerville	176	191	186	-5	-2.6%
City of Ellington	1,014	987	1,380	+393	+39.8%
Reynolds County	6,689	6,696	6,096	-600	-8.9%

Source: U.S. Bureau of the Census, Decennial Census, 5-Year American Community Survey 2020
*population includes the portions of these cities in adjacent counties

In reviewing population data provided by the US Census Bureau, vulnerable populations can also be identified. The first vulnerable populations to consider are those persons under the age of 5 years old. Per the ACS, there were estimated to be 269 children under the age of five residing in Reynolds County as of 2020. This number represents 4.3% of the total population of the county, a rate that is lower than the percentage of children under five in the State of Missouri (6.1%), and in the United States (6.0%).

Other vulnerable populations to consider are those residents over the age of sixty-five. In Reynolds County there are an estimated 1,465 persons over 65, or 23.4% of the county's population. This number of seniors residing in the county relative to the total county population is higher than the rates reported for the State of Missouri (16.9%) and the United States (16.0%). When considering hazard mitigation planning, measures should be considered to deal with these vulnerable populations and their safety.

As of 2020, the ACS reports that there are 2,580 households in Reynolds County, with an average household size of 2.35 persons. The average household size for Missouri is similar, being reported as 2.44 persons per household, while the average household size for the United States is slightly higher being reported as 2.6 persons per household.

The median age of residents of Reynolds County is 46.3, compared to Missouri at 38.7, and the United States being reported at 38.2 years of age. The largest percentage differences in population between Reynolds County and residents elsewhere is that 28.0% of all Reynolds County residents are over the age of 62, a much higher rate for persons over 62 than either the State of Missouri (20.7%) or the United States (19.6%).

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 twenty-nine 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. Resulting from the evaluation, a low number means that the county is more resilient to hazard events, while a high number means that the county is less resilient.

The SoVI Score for Reynolds County is reported as 3.069999933, which ranks the county in the 90th percentile nationally. The score also places Reynolds County as one of the most vulnerable

counties in the state. As can be seen from this score, Reynolds County is a vulnerable county as it relates to preparing, responding and recovering from hazards.

In the table below (**Table 2.2**), further demographic data is provided to present a better picture of the local population in comparison the State of Missouri and the United States as a whole. As can be seen from this data, the residents are poorer and less educated than residents across the state and the nation.

Table 2.2. Unemployment, Poverty, Education, and Language Percentage Demographics, Reynolds 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 with spoken language other than English
Reynolds County	2,752	4.1	18.0	60.0	0.7	0.9
City of Bunker	109	2.1	23.5	16.7	0.0	1.2
City of Centerville	69	5.6	24.0	55.6	0.0	1.6
City of Ellington	645	10.7	28.0	50.0	3.3	0.0
Missouri	3,090,253	2.8	12.8	32.5	11.0	6.3
United States	165,902,838	3.4	13.0	32.1	11.8	21.5

Source: U.S. Census, 2020 American Community Survey, 5-year Estimates

2.1.4 History

Reynolds County is located in the south central part of Missouri within the foothills of the Ozark Mountains. The City of Centerville serves as the county seat and is located near the geographic center of the county. Reynolds County is bordered by Dent and Shannon Counties to the west, Iron County to the north and east, Wayne County to the southeast, and Carter County to the south.

In 1812 Henry Fry, who is said to have come from Kentucky as the first pioneer, settled on the Middle Fork of the Black River area in what is now Reynolds County. Pioneer families from the hills of Kentucky and Tennessee began to slowly and steadily move to the region.

Reynolds County was officially organized on February 25, 1845. It is still an area of rugged beauty near the geologic center of the Ozark Highland. Reynolds County was formerly part of Reynolds County which was formed in 1831 and part of Wayne County which was formed in 1818. It was also previously part of Washington County and part of Ste. Genevieve County.

The Reynolds County Courthouse has burned twice. The first time was in December 1863 when the Confederate army burned it. A new courthouse was built in the fall of 1867 on the same foundation as the previous one. This courthouse burned in late November 1871. Both times all records were destroyed. Temporary quarters again burned May 27, 1872, while a new "fireproof" courthouse was being built.

Per the 2021-2022 Official Manual of the State of Missouri issued by the Missouri Secretary of State, Reynolds County is home to three incorporated cities—all of which are categorized as fourth class cities. The City of Bunker was incorporated in 1908 and is located both in Reynolds and Dent Counties. Centerville—the county seat—was incorporated in 1976 and is located in the north central portion of the county along Missouri Highway 21. The City of Ellington, incorporated

in 1911, is now the county's population and economic center. All three of the cities, as fourth-class cities in the State of Missouri, are governed by a mayor and board of aldermen.

Four school districts are located within the planning area. The Centerville R-I School District services the north central portion of the county and provides schooling from kindergarten through eighth grade. Southern Reynolds County R-II, headquartered in Ellington, offers pre-kindergarten through twelfth grade and services the southern portion of the county. Bunker R-III services the northwestern portion of the planning area and provides kindergarten through twelfth grade. And, finally, the Lesterville R-IV School District services the northeastern portion of the county and provides pre-kindergarten to twelfth grade. Of the four districts, only the Centerville R-I School District services only those students residing in Reynolds County. The remaining three districts' service areas includes portions of neighboring counties.

2.1.5 Occupations

Table 2.3. Occupation Statistics, Reynolds County, Missouri

Place	Management, Business, Science, and Arts Occupations	Service Occupations	Sales and Office Occupations	Natural Resources, Construction, and Maintenance Occupations	Production, Transportation, and Material Moving Occupations
Reynolds County	26.2%	18.5%	13.3%	18.9%	22.7%
City of Bunker	6.7%	33.7%	8.7%	15.4%	35.6%
City of Centerville	33.3%	13.3%	26.7%	15%	11.7%
City of Ellington	16.4%	30.5%	10.3%	9.8%	33.1%

Source: U.S. Census, 2020 American Community Survey, 5-year Estimates.

2.1.6 Agriculture

Reynolds County is made up of 808 square miles of land. As of 2020, the ACS estimated that 6,096 people residing in the county. Per the Missouri Secretary of State, Reynolds County had an assessed land value of $174,709,419 as of 2021.

Per the USDA Census of Agriculture found at https://www.nass.usda.gov/Publications/AgCensus/2017, there were 341 farms in Reynolds County in 2017, down 6% from 2012 (363 farms). The average farm size within the planning area, in 2017, was 254 acres—also down from 268 acres in 2012. Iron and Shannon Counties share the largest proportion of jurisdictional boundaries with Reynolds County. The percentage of land in farms within the county was 16.7% in 2017, compared to 18.5% in Iron County, 20.2% in Shannon County, and 63.1% in Missouri. Average farm sizes in neighboring Iron and Shannon Counties in 2017, were 242 and 298 acres, respectively. The average value of a farm in Reynolds County in 2017 was $406,440—lower than neighboring counties and the state. Average farm values in these areas were as follows: Iron County: $499,202; Shannon County: $585,434; Missouri: $986,481.

The USDA categorizes farmland by type using the categories of croplands, woodlands, and pastureland. As of 2017, of all farmland within the planning area, 15.3%, or 13,224 acres, were considered cropland, 53.4%, or 46,240 acres, were considered woodlands, and 37.5%, or 32,500

acres were considered pastureland. Even though the USDA reported 9,553 of cropland were harvested in 2017, the value of crops sold within the county in 2017 was reported as $0 with total gross farm income countywide (across all farm types) reported at $242,000.

As of 2017, cattle in the county numbered 8,360, 4,366 of which were reported as sold, while chickens numbered 1,354, none of which were reported as sold. All other livestock quantities within the planning area were negligible. Livestock sales comprise the majority, if not all, of the gross profit from farmland in the county.

As of 2017, 55 farms in Reynolds County reported having workers with a total of 105 workers across all farms reporting such. Numbers were very similar in neighboring counties with 87 total workers in Iron County and 100 total workers in Shannon County. Using both 2017 ACS 5-Year Estimates and 2017 USDA data, the percentage farm-related jobs comprising the total workforce in each county was minimal with Reynolds County showing 2.0%, Iron County showing 1.0% and Shannon County showing 1.5%.

2.1.7 FEMA Hazard Mitigation Assistance (HMA) Grants in Planning Area

According to the Federal Emergency Management Agency, there have been four Hazard Mitigation Grant Awards made to jurisdictions within Reynolds County from 1993-2021. Three of those projects were residential acquisition and demolition projects within the City of Ellington and the fourth was the construction of a safe room on the campus of Southern Reynolds County R-II School District. The total dollar amount of these four projects was $4,955,957. The table below provides information for each of the projects.

Table 2.4. FEMA HMA Grants in County from 1993-2021

Disaster Declaration	Project Type	Sub-Grantee	Date Approved	Project Total
1403	Acquisition/Demo	City of Ellington	1/7/2015	$1,025,891
1412	Acquisition/Demo	City of Ellington	12/4/2008	$1,063,958
1676	Acquisition/Demo	City of Ellington	8/7/2013	$1,164,108
N/A	Safe Room	Southern Reynolds R-II	9/7/2012	$1,702,000
Total				$4,955,957

Source: Federal Emergency Management Agency, 2021

2.1.8 FEMA Public Assistance (PA) Grants in Planning Area

According to the Federal Emergency Management Agency, there have been 460 Public Assistance Project Awards made to jurisdictions within Reynolds County from 1993-2021. The majority of those projects were deemed “small” and funded repairs to roads and bridges damaged by floodwaters within the unincorporated portion of the county. The total public assistance amount of these 460 projects was $19,370,456.50. The table below provides information for each of the projects.

Table 2.5. FEMA PA Grants in County from 1993-2021

Disaster Declaration	Project Type	Project Size	Applicant	Project Total
1412	Roads and Bridges	Small	Reynolds County	$19,982.44
1412	Roads and Bridges	Small	Reynolds County	$25,088.20
1412	Roads and Bridges	Small	Reynolds County	$33,515.88

1412	Roads and Bridges	Large	Reynolds County	$81,458.10
1412	Roads and Bridges	Small	Reynolds County	$27,330.30
1412	Roads and Bridges	Small	Reynolds County	$20,074.44
1412	Roads and Bridges	Small	Reynolds County	$22,310.00
1412	Roads and Bridges	Small	Reynolds County	$22,760.00
1412	Roads and Bridges	Small	Reynolds County	$17,295.00
1412	Roads and Bridges	Small	Reynolds County	$51,737.00
1412	Roads and Bridges	Small	Reynolds County	$9,459.00
1412	Roads and Bridges	Small	Reynolds County	$16,711.00
1412	Roads and Bridges	Small	Reynolds County	$27,436.34
1412	Roads and Bridges	Small	Reynolds County	$12,169.00
1412	Roads and Bridges	Small	Reynolds County	$27,854.08
1412	Protective Measures	Small	Reynolds County	$28,751.00
1412	Roads and Bridges	Large	Reynolds County	$112,882.51
1412	Roads and Bridges	Small	Reynolds County	$41,580.00
1412	Roads and Bridges	Small	Reynolds County	$50,974.98
1412	Roads and Bridges	Small	City of Ellington	$10,885.00
1412	Protective Measures	Small	City of Ellington	$1,287.78
1412	Roads and Bridges	Small	City of Ellington	$14,486.33
1412	Protective Measures	Small	City of Ellington	$1,820.50
1412	Debris Removal	Small	City of Ellington	$9,324.72
1412	Roads and Bridges	Small	City of Ellington	$22,502.50
1412	Roads and Bridges	Large	Reynolds County	$75,660.33
1412	Roads and Bridges	Small	Reynolds County	$26,205.70
1412	Roads and Bridges	Small	Reynolds County	$26,919.40
1412	Roads and Bridges	Small	Reynolds County	$9,629.80
1412	Public Utilities	Small	City of Centerville	$1,430.50
1412	Roads and Bridges	Small	Reynolds County	$48,136.20
1412	Roads and Bridges	Small	Reynolds County	$16,002.90
1412	Roads and Bridges	Small	Reynolds County	$15,870.00
1412	Roads and Bridges	Small	Reynolds County	$23,256.78
1412	Roads and Bridges	Small	Reynolds County	$20,048.18
1412	Roads and Bridges	Small	Reynolds County	$29,352.40
1412	Roads and Bridges	Small	Reynolds County	$51,151.00
1412	Roads and Bridges	Small	Reynolds County	$29,783.40
1412	Roads and Bridges	Small	Reynolds County	$28,647.00
1412	Roads and Bridges	Small	Reynolds County	$40,054.66
1412	Roads and Bridges	Small	Reynolds County	$23,604.00
1412	Roads and Bridges	Small	Reynolds County	$20,548.42
1412	Roads and Bridges	Small	Reynolds County	$10,492.00
1412	Roads and Bridges	Small	Reynolds County	$32,00460
1412	Roads and Bridges	Small	Reynolds County	$4,036.00
1412	Roads and Bridges	Small	Reynolds County	$31,227.44
1412	Roads and Bridges	Small	Reynolds County	$51,161.34
1412	Roads and Bridges	Small	Reynolds County	$15,896.46
1412	Roads and Bridges	Small	Reynolds County	$16,252.40
1412	Roads and Bridges	Small	Reynolds County	$15,615.20
1412	Roads and Bridges	Small	Reynolds County	$18,067.30
1412	Roads and Bridges	Large	Reynolds County	$63,923.10
1412	Roads and Bridges	Small	Reynolds County	$15,452.46
1412	Roads and Bridges	Large	Reynolds County	$49,430.22
1412	Roads and Bridges	Small	Reynolds County	$18,152.80
1412	Roads and Bridges	Large	Reynolds County	$78,651.25
1412	Roads and Bridges	Large	Reynolds County	$59,872.00
1412	Roads and Bridges	Small	Reynolds County	$24,507.20
1412	Roads and Bridges	Large	Reynolds County	$132,799.12
1412	Roads and Bridges	Small	Reynolds County	$46,505.20
1412	Roads and Bridges	Small	Reynolds County	$12,688.84
1412	Roads and Bridges	Small	Reynolds County	$21,416.96

1748	Protective Measures	Small	Reynolds County	$44,168.24
1748	Debris Removal	Small	Reynolds County	$2,730.36
1749	Public Buildings	Small	City of Centerville	$4,979.39
1749	Roads and Bridges	Small	Reynolds County	$11,810.29
1749	Roads and Bridges	Large	Reynolds County	$87,801.00
1749	Roads and Bridges	Large	Reynolds County	$94,090.00
1749	Public Utilities	Small	City of Centerville	$4,136.59
1749	Public Buildings	Small	City of Ellington	$1,000.00
1749	Public Utilities	Small	City of Centerville	$2,644.40
1749	Roads and Bridges	Large	Reynolds County	$95,519.00
1749	Public Utilities	Small	City of Ellington	$1,826.66
1749	Protective Measures	Small	City of Ellington	$5,008.90
1749	Roads and Bridges	Small	Reynolds County	$18,203.22
1749	Roads and Bridges	Small	Reynolds County	$7,742.73
1749	Roads and Bridges	Small	Reynolds County	$40,859.43
1749	Roads and Bridges	Small	Reynolds County	$8,070.24
1749	Roads and Bridges	Small	City of Ellington	$1,084.42
1749	Debris Removal	Small	City of Ellington	$12,876.32
1749	Roads and Bridges	Small	City of Centerville	$9,145.49
1749	Roads and Bridges	Small	Reynolds County	$4,523.74
1749	Roads and Bridges	Small	Reynolds County	$10,944.75
1749	Roads and Bridges	Small	Reynolds County	$10,252.09
1749	Roads and Bridges	Small	Reynolds County	$15,064.06
1749	Roads and Bridges	Large	Reynolds County	$101,495.78
1749	Roads and Bridges	Small	Reynolds County	$25,989.53
1749	Roads and Bridges	Small	Reynolds County	$5,308.83
1749	Roads and Bridges	Small	Reynolds County	$6,993.31
1749	Roads and Bridges	Small	Reynolds County	$6,727.72
1749	Roads and Bridges	Small	Reynolds County	$4,690.30
1749	Roads and Bridges	Small	Reynolds County	$13,488.37
1749	Roads and Bridges	Small	Reynolds County	$1,540.46
1749	Roads and Bridges	Small	Reynolds County	$11,089.11
1749	Roads and Bridges	Small	Reynolds County	$8,468.29
1749	Roads and Bridges	Small	Reynolds County	$15,727.93
1749	Roads and Bridges	Small	Reynolds County	$5,000.17
1749	Roads and Bridges	Small	Reynolds County	$6,937.48
1749	Roads and Bridges	Small	Reynolds County	$7,028.28
1749	Roads and Bridges	Small	Reynolds County	$23,970.58
1749	Roads and Bridges	Small	Reynolds County	$1,701.00
1749	Roads and Bridges	Small	Reynolds County	$9,306.16
1749	Roads and Bridges	Small	Reynolds County	$17,531.58
1749	Roads and Bridges	Small	Reynolds County	$7,326.67
1749	Roads and Bridges	Small	Reynolds County	$17,609.95
1749	Roads and Bridges	Small	Reynolds County	$9,794.43
1749	Roads and Bridges	Small	Reynolds County	$38,214.63
1749	Roads and Bridges	Small	Reynolds County	$11,873.75
1749	Roads and Bridges	Small	Reynolds County	$8,172.58
1749	Roads and Bridges	Small	Reynolds County	$9,956.94
1749	Roads and Bridges	Small	Reynolds County	$12,650.82
1749	Roads and Bridges	Small	Reynolds County	$12,415.07
1749	Roads and Bridges	Small	Reynolds County	$49,211.33
1749	Roads and Bridges	Small	Reynolds County	$10,309.67
1749	Roads and Bridges	Small	Reynolds County	$2,226.17
1749	Roads and Bridges	Small	Reynolds County	$9,276.98
1749	Roads and Bridges	Small	Reynolds County	$15,981.95
1749	Roads and Bridges	Small	Reynolds County	$10,885.96
1749	Roads and Bridges	Small	Reynolds County	$13,503.53
1749	Debris Removal	Small	City of Centerville	$11,643.67
1749	Roads and Bridges	Small	Reynolds County	$2,228.63

1749	Public Utilities	Small	City of Ellington	$2,516.27
1749	Roads and Bridges	Small	Reynolds County	$3,920.46
1749	Debris Removal	Small	City of Ellington	$3,756.22
1749	Public Buildings	Small	City of Centerville	$2,654.71
1749	Roads and Bridges	Small	Reynolds County	$8,893.22
1749	Roads and Bridges	Small	Reynolds County	$29,415.03
1749	Public Utilities	Small	City of Ellington	$1,946.50
1749	Roads and Bridges	Small	City of Ellington	$10,822.13
1749	Roads and Bridges	Small	City of Centerville	$3,897.95
1749	Roads and Bridges	Small	City of Centerville	$6,712.00
1749	Roads and Bridges	Small	Reynolds County	$8,346.14
1749	Roads and Bridges	Small	Reynolds County	$2,298.42
1749	Roads and Bridges	Small	Reynolds County	$39,064.05
1749	Roads and Bridges	Small	Reynolds County	$23,497.78
1749	Roads and Bridges	Small	Reynolds County	$10,852.51
1749	Roads and Bridges	Small	Reynolds County	$8,345.27
1749	Roads and Bridges	Small	Reynolds County	$5,547.43
1749	Roads and Bridges	Small	City of Ellington	$28,108.00
1749	Roads and Bridges	Small	City of Ellington	$2,940.83
1749	Roads and Bridges	Small	Reynolds County	$16,657.44
1749	Roads and Bridges	Small	Reynolds County	$10,761.65
1749	Roads and Bridges	Small	Reynolds County	$50,523.94
1749	Roads and Bridges	Small	Reynolds County	$53,376.85
1749	Roads and Bridges	Small	Reynolds County	$16,633.02
1749	Roads and Bridges	Small	Reynolds County	$46,955.65
1749	Roads and Bridges	Small	Reynolds County	$56,824.19
1749	Roads and Bridges	Small	Reynolds County	$47,407.11
1749	Roads and Bridges	Small	Reynolds County	$33,056.87
1749	Roads and Bridges	Small	Reynolds County	$40,246.91
1749	Roads and Bridges	Small	City of Centerville	$9,005.49
1749	Roads and Bridges	Small	Reynolds County	$3,186.45
1749	Roads and Bridges	Small	Reynolds County	$2,912.92
1822	Protective Measures	Small	City of Ellington	$13,731.49
1822	Debris Removal	Small	City of Ellington	$1,648.00
1822	Public Buildings	Small	Reynolds County	$500.00
1822	Protective Measures	Small	Reynolds County	$23,505.99
1822	Protective Measures	Small	Reynolds County	$28,656.53
1847	Debris Removal	Small	City of Centerville	$2,038.50
1847	Public Utilities	Small	City of Centerville	$9,500.00
1847	Debris Removal	Large	City of Ellington	$47,068.64
1847	Recreational or Other	Small	City of Ellington	$1,000.00
1847	Protective Measures	Small	Reynolds County	$17,664.50
1847	Debris Removal	Small	City of Ellington	$2,964.60
1847	Protective Measures	Small	Reynolds County	$17,610.03
1847	Protective Measures	Large	Reynolds County	$77,505.77
1847	Debris Removal	Small	City of Ellington	$3,614.15
1847	Debris Removal	Large	Reynolds County	$303,792.31
1847	Protective Measures	Small	City of Ellington	$2,049.60
1980	Protective Measures	Small	Reynolds County	$1,195.72
1980	Roads and Bridges	Small	Reynolds County	$45,908.95
1980	Roads and Bridges	Small	Reynolds County	$30,988.31
1980	Roads and Bridges	Small	Reynolds County	$45,091.33
1980	Roads and Bridges	Small	Reynolds County	$16,666.74
1980	Roads and Bridges	Small	Reynolds County	$3,246.28
1980	Debris Removal	Small	Reynolds County	$4,200.39
1980	Roads and Bridges	Small	Reynolds County	$28,268.60
1980	Protective Measures	Small	Reynolds County	$5,844.72
1980	Roads and Bridges	Small	Reynolds County	$63,749.53
1980	Roads and Bridges	Small	Reynolds County	$47,156.40

1980	Roads and Bridges	Small	Reynolds County	$7,545.79
1980	Roads and Bridges	Small	Reynolds County	$19,156.28
1980	Roads and Bridges	Small	Reynolds County	$27,738.50
1980	Roads and Bridges	Small	Reynolds County	$42,925.32
1980	Roads and Bridges	Small	Reynolds County	$37,474.47
1980	Roads and Bridges	Small	Reynolds County	$3,635.56
1980	Roads and Bridges	Small	Reynolds County	$54,445.85
1980	Roads and Bridges	Small	Reynolds County	$36,552.05
1980	Roads and Bridges	Small	Reynolds County	$37,491.22
1980	Roads and Bridges	Small	Reynolds County	$4,443.51
1980	Roads and Bridges	Small	Reynolds County	$36,246.31
1980	Roads and Bridges	Small	Reynolds County	$47,922.19
1980	Roads and Bridges	Small	Reynolds County	$21,930.61
1980	Roads and Bridges	Small	Reynolds County	$20,301.43
1980	Roads and Bridges	Small	Reynolds County	$21,291.01
1980	Roads and Bridges	Large	Reynolds County	$39,843.23
1980	Roads and Bridges	Small	Reynolds County	$14,289.91
1980	Roads and Bridges	Small	Reynolds County	$61,895.97
1980	Roads and Bridges	Small	Reynolds County	$53,101.32
1980	Roads and Bridges	Small	Reynolds County	$57,802.47
1980	Roads and Bridges	Small	Reynolds County	$44,121.97
1980	Roads and Bridges	Small	Reynolds County	$25,763.33
1980	Roads and Bridges	Small	Reynolds County	$32,530.62
1980	Roads and Bridges	Small	Reynolds County	$3,373.22
1980	Roads and Bridges	Small	Reynolds County	$47,853.54
4250	Roads and Bridges	Small	Reynolds County	$55,053.49
4250	Roads and Bridges	Small	Reynolds County	$89,434.04
4250	Roads and Bridges	Small	Reynolds County	$114,213.13
4250	Roads and Bridges	Small	Reynolds County	$57,150.84
4250	Roads and Bridges	Small	Reynolds County	$33,334.28
4250	Roads and Bridges	Small	Reynolds County	$92,255.27
4250	Roads and Bridges	Small	Reynolds County	$75,905.65
4250	Roads and Bridges	Small	Reynolds County	$59,135.95
4317	Protective Measures	Small	City of Ellington	$14,562.74
4317	Public Utilities	Small	City of Ellington	$5,774.71
4317	Roads and Bridges	Large	City of Ellington	$149,790.64
4317	Roads and Bridges	Large	Reynolds County	$143,464.80
4317	Roads and Bridges	Small	Reynolds County	$9,854.77
4317	Protective Measures	Small	Reynolds County	$17,429.73
4317	Recreational or Other	Small	City of Ellington	$3,754.72
4317	Roads and Bridges	Large	Reynolds County	$653,915.99
4317	Roads and Bridges	Small	Reynolds County	$46,132.61
4317	Roads and Bridges	Large	Reynolds County	$213,136.04
4317	Debris Removal	Small	Reynolds County	$74,663.45
4317	Debris Removal	Small	City of Ellington	$5,017.46
4317	Roads and Bridges	Small	Reynolds County	$79,752.46
4317	Debris Removal	Small	City of Ellington	$4,473.46
4317	Debris Removal	Small	City of Ellington	$4,346.50
4317	Protective Measures	Small	Reynolds County	$36,704.70
4317	Roads and Bridges	Large	Reynolds County	$890,929.36
1412	Roads and Bridges	Small	Reynolds County	$19,982.44
1412	Roads and Bridges	Small	Reynolds County	$25,088.20
1412	Roads and Bridges	Small	Reynolds County	$33,515.88
1412	Roads and Bridges	Large	Reynolds County	$81,458.10
1412	Roads and Bridges	Small	Reynolds County	$27,330.30
1412	Roads and Bridges	Small	Reynolds County	$20,074.44
1412	Roads and Bridges	Small	Reynolds County	$22,310.00
1412	Roads and Bridges	Small	Reynolds County	$22,760.00
1412	Roads and Bridges	Small	Reynolds County	$17,295.00

1412	Roads and Bridges	Small	Reynolds County	$51,737.00
1412	Roads and Bridges	Small	Reynolds County	$9,459.00
1412	Roads and Bridges	Small	Reynolds County	$16,711.00
1412	Roads and Bridges	Small	Reynolds County	$27,436.34
1412	Roads and Bridges	Small	Reynolds County	$12,169.00
1412	Roads and Bridges	Small	Reynolds County	$27,854.08
1412	Protective Measures	Small	Reynolds County	$28,751.00
1412	Roads and Bridges	Large	Reynolds County	$112,882.51
1412	Roads and Bridges	Small	Reynolds County	$41,580.00
1412	Roads and Bridges	Small	Reynolds County	$50,974.98
1412	Roads and Bridges	Small	City of Ellington	$10,885.00
1412	Protective Measures	Small	City of Ellington	$1,287.78
1412	Roads and Bridges	Small	City of Ellington	$14,486.33
1412	Protective Measures	Small	City of Ellington	$1,820.50
1412	Debris Removal	Small	City of Ellington	$9,324.72
1412	Roads and Bridges	Small	City of Ellington	$22,502.50
1412	Roads and Bridges	Large	Reynolds County	$75,660.33
1412	Roads and Bridges	Small	Reynolds County	$26,205.70
1412	Roads and Bridges	Small	Reynolds County	$26,919.40
1412	Roads and Bridges	Small	Reynolds County	$9,629.80
1412	Public Utilities	Small	City of Centerville	$1,430.50
1412	Roads and Bridges	Small	Reynolds County	$48,136.20
1412	Roads and Bridges	Small	Reynolds County	$16,002.90
1412	Roads and Bridges	Small	Reynolds County	$15,870.00
1412	Roads and Bridges	Small	Reynolds County	$23,256.78
1412	Roads and Bridges	Small	Reynolds County	$20,048.18
1412	Roads and Bridges	Small	Reynolds County	$29,352.40
1412	Roads and Bridges	Small	Reynolds County	$51,151.00
1412	Roads and Bridges	Small	Reynolds County	$29,783.40
1412	Roads and Bridges	Small	Reynolds County	$28,647.00
1412	Roads and Bridges	Small	Reynolds County	$40,054.66
1412	Roads and Bridges	Small	Reynolds County	$23,604.00
1412	Roads and Bridges	Small	Reynolds County	$20,548.42
1412	Roads and Bridges	Small	Reynolds County	$10,492.00
1412	Roads and Bridges	Small	Reynolds County	$32,004.60
1412	Roads and Bridges	Small	Reynolds County	$4,036.00
1412	Roads and Bridges	Small	Reynolds County	$31,227.44
1412	Roads and Bridges	Small	Reynolds County	$51,161.34
1412	Roads and Bridges	Small	Reynolds County	$15,896.46
1412	Roads and Bridges	Small	Reynolds County	$16,252.40
1412	Roads and Bridges	Small	Reynolds County	$15,615.20
1412	Roads and Bridges	Small	Reynolds County	$18,067.30
1412	Roads and Bridges	Large	Reynolds County	$63,923.10
1412	Roads and Bridges	Small	Reynolds County	$15,452.46
1412	Roads and Bridges	Large	Reynolds County	$49,430.22
1412	Roads and Bridges	Small	Reynolds County	$18,152.80
1412	Roads and Bridges	Large	Reynolds County	$78,651.25
1412	Roads and Bridges	Large	Reynolds County	$59,872.00
1412	Roads and Bridges	Small	Reynolds County	$24,507.20
1412	Roads and Bridges	Large	Reynolds County	$132,799.12
1412	Roads and Bridges	Small	Reynolds County	$46,505.20
1412	Roads and Bridges	Small	Reynolds County	$12,688.84
1412	Roads and Bridges	Small	Reynolds County	$21,416.96
1748	Protective Measures	Small	Reynolds County	$44,168.24
1748	Debris Removal	Small	Reynolds County	$2,730.36
1749	Public Buildings	Small	City of Centerville	$4,979.39
1749	Roads and Bridges	Small	Reynolds County	$11,810.29
1749	Roads and Bridges	Large	Reynolds County	$87,801.00
1749	Roads and Bridges	Large	Reynolds County	$94,090.00

1749	Public Utilities	Small	City of Centerville	$4,136.59
1749	Public Buildings	Small	City of Ellington	$1,000.00
1749	Public Utilities	Small	City of Centerville	$2,644.40
1749	Roads and Bridges	Large	Reynolds County	$95,519.00
1749	Public Utilities	Small	City of Ellington	$1,826.66
1749	Protective Measures	Small	City of Ellington	$5,008.90
1749	Roads and Bridges	Small	Reynolds County	$18,203.22
1749	Roads and Bridges	Small	Reynolds County	$7,742.73
1749	Roads and Bridges	Small	Reynolds County	$40,859.43
1749	Roads and Bridges	Small	Reynolds County	$8,070.24
1749	Roads and Bridges	Small	City of Ellington	$1,084.42
1749	Debris Removal	Small	City of Ellington	$12,876.32
1749	Roads and Bridges	Small	City of Centerville	$9,145.49
1749	Roads and Bridges	Small	Reynolds County	$4,523.74
1749	Roads and Bridges	Small	Reynolds County	$10,944.75
1749	Roads and Bridges	Small	Reynolds County	$10,252.09
1749	Roads and Bridges	Small	Reynolds County	$15,064.06
1749	Roads and Bridges	Large	Reynolds County	$101,495.78
1749	Roads and Bridges	Small	Reynolds County	$25,989.53
1749	Roads and Bridges	Small	Reynolds County	$5,308.83
1749	Roads and Bridges	Small	Reynolds County	$6,993.31
1749	Roads and Bridges	Small	Reynolds County	$6,727.72
1749	Roads and Bridges	Small	Reynolds County	$4,690.30
1749	Roads and Bridges	Small	Reynolds County	$13,488.37
1749	Roads and Bridges	Small	Reynolds County	$1,540.46
1749	Roads and Bridges	Small	Reynolds County	$11,089.11
1749	Roads and Bridges	Small	Reynolds County	$8,468.29
1749	Roads and Bridges	Small	Reynolds County	$15,727.93
1749	Roads and Bridges	Small	Reynolds County	$5,000.17
1749	Roads and Bridges	Small	Reynolds County	$6,937.48
1749	Roads and Bridges	Small	Reynolds County	$7,028.28
1749	Roads and Bridges	Small	Reynolds County	$23,970.58
1749	Roads and Bridges	Small	Reynolds County	$1,701.00
1749	Roads and Bridges	Small	Reynolds County	$9,306.16
1749	Roads and Bridges	Small	Reynolds County	$17,531.58
1749	Roads and Bridges	Small	Reynolds County	$7,326.67
1749	Roads and Bridges	Small	Reynolds County	$17,609.95
1749	Roads and Bridges	Small	Reynolds County	$9,794.43
1749	Roads and Bridges	Small	Reynolds County	$38,214.63
1749	Roads and Bridges	Small	Reynolds County	$11,873.75
1749	Roads and Bridges	Small	Reynolds County	$8,172.58
1749	Roads and Bridges	Small	Reynolds County	$9,956.94
1749	Roads and Bridges	Small	Reynolds County	$12,650.82
1749	Roads and Bridges	Small	Reynolds County	$12,415.07
1749	Roads and Bridges	Small	Reynolds County	$49,211.33
1749	Roads and Bridges	Small	Reynolds County	$10,309.67
1749	Roads and Bridges	Small	Reynolds County	$2,226.17
1749	Roads and Bridges	Small	Reynolds County	$9,276.98
1749	Roads and Bridges	Small	Reynolds County	$15,981.95
1749	Roads and Bridges	Small	Reynolds County	$10,885.96
1749	Roads and Bridges	Small	Reynolds County	$13,503.53
1749	Debris Removal	Small	City of Centerville	$11,643.67
1749	Roads and Bridges	Small	Reynolds County	$2,228.63
1749	Public Utilities	Small	City of Ellington	$2,516.27
1749	Roads and Bridges	Small	Reynolds County	$3,920.46
1749	Debris Removal	Small	City of Ellington	$3,756.22
1749	Public Buildings	Small	City of Centerville	$2,654.71
1749	Roads and Bridges	Small	Reynolds County	$8,893.22
1749	Roads and Bridges	Small	Reynolds County	$29,415.03

1749	Public Utilities	Small	City of Ellington	$1,946.50
1749	Roads and Bridges	Small	City of Ellington	$10,822.13
1749	Roads and Bridges	Small	City of Centerville	$3,897.95
1749	Roads and Bridges	Small	City of Centerville	$6,712.00
1749	Roads and Bridges	Small	Reynolds County	$8,346.14
1749	Roads and Bridges	Small	Reynolds County	$2,298.42
1749	Roads and Bridges	Small	Reynolds County	$39,064.05
1749	Roads and Bridges	Small	Reynolds County	$23,497.78
1749	Roads and Bridges	Small	Reynolds County	$10,852.51
1749	Roads and Bridges	Small	Reynolds County	$8,345.27
1749	Roads and Bridges	Small	Reynolds County	$5,547.43
1749	Roads and Bridges	Small	City of Ellington	$28,108.00
1749	Roads and Bridges	Small	City of Ellington	$2,940.83
1749	Roads and Bridges	Small	Reynolds County	$16,657.44
1749	Roads and Bridges	Small	Reynolds County	$10,761.65
1749	Roads and Bridges	Small	Reynolds County	$50,523.94
1749	Roads and Bridges	Small	Reynolds County	$53,376.85
1749	Roads and Bridges	Small	Reynolds County	$16,633.02
1749	Roads and Bridges	Small	Reynolds County	$46,955.65
1749	Roads and Bridges	Small	Reynolds County	$56,824.19
1749	Roads and Bridges	Small	Reynolds County	$47,407.11
1749	Roads and Bridges	Small	Reynolds County	$33,056.87
1749	Roads and Bridges	Small	Reynolds County	$40,246.91
1749	Roads and Bridges	Small	City of Centerville	$9,005.49
1749	Roads and Bridges	Small	Reynolds County	$3,186.45
1749	Roads and Bridges	Small	Reynolds County	$2,912.92
1822	Protective Measures	Small	City of Ellington	$13,731.49
1822	Debris Removal	Small	City of Ellington	$1,648.00
1822	Public Buildings	Small	Reynolds County	$500.00
1822	Protective Measures	Small	Reynolds County	$23,505.99
1822	Protective Measures	Small	Reynolds County	$28,656.53
1847	Debris Removal	Small	City of Centerville	$2,038.50
1847	Public Utilities	Small	City of Centerville	$9,500.00
1847	Debris Removal	Large	City of Ellington	$47,068.64
1847	Recreational or Other	Small	City of Ellington	$1,000.00
1847	Protective Measures	Small	Reynolds County	$17,664.50
1847	Debris Removal	Small	City of Ellington	$2,964.60
1847	Protective Measures	Small	Reynolds County	$17,610.03
1847	Protective Measures	Large	Reynolds County	$77,505.77
1847	Debris Removal	Small	City of Ellington	$3,614.15
1847	Debris Removal	Large	Reynolds County	$303,792.31
1847	Protective Measures	Small	City of Ellington	$2,049.60
1980	Protective Measures	Small	Reynolds County	$1,195.72
1980	Roads and Bridges	Small	Reynolds County	$45,908.95
1980	Roads and Bridges	Small	Reynolds County	$30,988.31
1980	Roads and Bridges	Small	Reynolds County	$45,091.33
1980	Roads and Bridges	Small	Reynolds County	$16,666.74
1980	Roads and Bridges	Small	Reynolds County	$3,246.28
1980	Debris Removal	Small	Reynolds County	$4,200.39
1980	Roads and Bridges	Small	Reynolds County	$28,268.60
1980	Protective Measures	Small	Reynolds County	$5,844.72
1980	Roads and Bridges	Small	Reynolds County	$63,749.53
1980	Roads and Bridges	Small	Reynolds County	$47,156.40
1980	Roads and Bridges	Small	Reynolds County	$7,545.79
1980	Roads and Bridges	Small	Reynolds County	$19,156.28
1980	Roads and Bridges	Small	Reynolds County	$27,738.50
1980	Roads and Bridges	Small	Reynolds County	$42,925.32
1980	Roads and Bridges	Small	Reynolds County	$37,474.47
1980	Roads and Bridges	Small	Reynolds County	$3,635.56

1980	Roads and Bridges	Small	Reynolds County	$54,445.85
1980	Roads and Bridges	Small	Reynolds County	$36,552.05
1980	Roads and Bridges	Small	Reynolds County	$37,491.22
1980	Roads and Bridges	Small	Reynolds County	$4,443.51
1980	Roads and Bridges	Small	Reynolds County	$36,246.31
1980	Roads and Bridges	Small	Reynolds County	$47,922.19
1980	Roads and Bridges	Small	Reynolds County	$21,930.61
1980	Roads and Bridges	Small	Reynolds County	$20,301.43
1980	Roads and Bridges	Small	Reynolds County	$21,291.01
1980	Roads and Bridges	Large	Reynolds County	$39,843.23
1980	Roads and Bridges	Small	Reynolds County	$14,289.91
1980	Roads and Bridges	Small	Reynolds County	$61,895.97
1980	Roads and Bridges	Small	Reynolds County	$53,101.32
1980	Roads and Bridges	Small	Reynolds County	$57,802.47
1980	Roads and Bridges	Small	Reynolds County	$44,121.97
1980	Roads and Bridges	Small	Reynolds County	$25,763.33
1980	Roads and Bridges	Small	Reynolds County	$32,530.62
1980	Roads and Bridges	Small	Reynolds County	$3,373.22
1980	Roads and Bridges	Small	Reynolds County	$47,853.54
4250	Roads and Bridges	Small	Reynolds County	$55,053.49
4250	Roads and Bridges	Small	Reynolds County	$89,434.04
4250	Roads and Bridges	Small	Reynolds County	$114,213.13
4250	Roads and Bridges	Small	Reynolds County	$57,150.84
4250	Roads and Bridges	Small	Reynolds County	$33,334.28
4250	Roads and Bridges	Small	Reynolds County	$92,255.27
4250	Roads and Bridges	Small	Reynolds County	$75,905.65
4250	Roads and Bridges	Small	Reynolds County	$59,135.95
4317	Protective Measures	Small	City of Ellington	$14,562.74
4317	Public Utilities	Small	City of Ellington	$5,774.71
4317	Roads and Bridges	Large	City of Ellington	$149,790.64
4317	Roads and Bridges	Large	Reynolds County	$143,464.80
4317	Roads and Bridges	Small	Reynolds County	$9,854.77
4317	Protective Measures	Small	Reynolds County	$17,429.73
4317	Recreational or Other	Small	City of Ellington	$3,754.72
4317	Roads and Bridges	Large	Reynolds County	$653,915.99
4317	Roads and Bridges	Small	Reynolds County	$46,132.61
4317	Roads and Bridges	Large	Reynolds County	$213,136.04
4317	Debris Removal	Small	Reynolds County	$74,663.45
4317	Debris Removal	Small	City of Ellington	$5,017.46
4317	Roads and Bridges	Small	Reynolds County	$79,752.46
4317	Debris Removal	Small	City of Ellington	$4,473.46
4317	Debris Removal	Small	City of Ellington	$4,346.50
4317	Protective Measures	Small	Reynolds County	$36,704.70
4317	Roads and Bridges	Large	Reynolds County	$890,929.36
Total				$19,370,456.50

Source: Federal Emergency Management Agency, 2021

2.2 JURISDICTIONAL PROFILES AND MITIGATION CAPABILITIES[3, 7, AND 8]

The following section includes individual profiles for each jurisdiction participating within the current plan update. It also includes a discussion of previous mitigation initiatives and ongoing mitigation capabilities in the planning area. Summary tables indicating specific capabilities of each participating jurisdiction relating to their ability to implement mitigation opportunities are also included. The unincorporated portion of the county is profiled first, followed by the incorporated communities.

It should be noted that all three of the county's three cities, no special districts, and one of the four school districts headquartered within the county met the requirements as established by the Hazard Mitigation Planning Committee for participation in the project. To be labeled a participating jurisdiction, a city, county, or special/school district had to attend at least one planning meeting, complete a Data Collection Questionnaire, and assess, revise and provide a progress report upon its previously-identified mitigation actions (2017).

Only Reynolds County and the City of Bunker had representatives in attendance at every planning meeting. While representatives of the City of Centerville, the City of Ellington, the Bunker R-II School District, the Centerville R-I School District, and the Lesterville R-IV School District did attend at least one planning meeting, only the City of Centerville, the City of Ellington, the Bunker R-II School District, and the Lesterville R-IV School District completed Data Collection Questionnaires (DCQs). The Bunker R-II School District, while it did complete a DCQ, did not participate in the updating of its previously-identified mitigation actions. The Southern Reynolds County R-II School District attended no planning meetings, did not provide a completed DCQ, and did not respond to requests regarding the updating of its previously-identified mitigation actions.

2.2.1 Unincorporated Reynolds County

For the purposes of this planning document, the jurisdiction of Reynolds County consists of the unincorporated areas within the county boundaries. The county is governed by three county commissioners—a presiding commissioner, a commissioner representing District #1 and a commissioner representing District #2. Law enforcement is present in the county in the form of a sheriff's department.

- Joe Loyd-Presiding Commissioner
- Larry Pogue, Jr.-District 1 Commissioner
- Eddie Williams District 2 Commissioner
- Missouri Department of Conservation-Ellington
- County Assessor-Rick Parker
- County Attorney-Mike Randazzo
- County Recorder-Myra Turner
- County Sheriff-Donald Horn
- County Treasurer-Wanda Corder
- Emergency Management-Renee Horn
- Floodplain Administrator-Joe Loyd
- Reynolds County Health Department-Lisa Beardsley
- Family Services-Centerville
- Information Technology
- Coroner-Jeffrey N. McSpadden
- Prosecuting Attorney-Ginger Joyner

- Public Works-County Commission
- County Zoning-N/A

Mitigation Initiatives/Capabilities[3, 7, and 8]

Reynolds County is a small, poor, rural county that lacks many staffed positions typical of a Missouri county. The county's highway department has a supervisor that manages the maintenance of the county roads and reports directly to the commissioners. The county does have an emergency management director. The emergency management director works with commissioners to prevent and respond to public emergencies occurring within the county.

Due to the size of Reynolds County, its small staff and lack of resources, comprehensive planning is conducted on a regional basis as opposed to county level. The county works with the Ozark Foothills Regional Planning Commission to develop a regional Comprehensive Economic Development Strategy every five years and conducts transportation planning on an annual basis. Transportation-related planning documents produced in part by the county include the Ozark Foothills Regional Transportation Plan and the regional Public Transit – Human Services Transportation Plan.

The county conducts its own local emergency planning and is not part of a larger local emergency planning district (LEPD). As a result, the county maintains the Reynolds County Local Emergency Planning Committee (LEPC) and has its own Local Emergency Operations Plan.

Reynolds County utilizes its elected prosecuting attorney for legal direction and services. Its Highway Department supervisor is responsible for overseeing the county's transportation infrastructure, which consists primarily of gravel-surfaced roadways. The county funds a sheriff's department, which is responsible for maintaining order and enforcing law within the county. Reynolds County's fire protection is provided by six volunteer fire departments including Northern Reynolds County Fire Protection District, Ellington Volunteer Fire Department, Bunker Volunteer Fire Department, Webb Creek Volunteer Fire Department, Clearwater Volunteer Fire Department, and the Garwood Volunteer Fire Department. The county's presiding commissioner also functions as the county floodplain manager. Reynolds County has neither a planning and zoning department/committee, nor land use designations within the balance of the county.

There currently are no active watershed improvement projects within the planning area. There exist no outdoor warning sirens located within the unincorporated portion of the county. Each of the three municipalities in Reynolds County, has a warning siren(s) that is operated by municipal officials. There are no other hazard warning systems in the county.

Primary industry within the planning area consists of natural resource acquisition and processing, manufacturing, and public service. The largest employers located in the planning area include the Doe Run Mine (600 employees), Baker Products (150 employees), Paramount Apparel (100 employees), Reynolds County (50 employees), and Missouri Tie & Timber (50 employees).

The below table **(Table 2.6)** includes data collected from Reynolds County officials for the unincorporated portion of the county via the prescribed Data Collection Questionnaire.

Table 2.6. Unincorporated Reynolds County Mitigation Capabilities

Capabilities	Status Including Date of Document or Policy
Planning Capabilities	
Comprehensive Plan	No
Builder's Plan	No
Capital Improvement Plan	No
City Emergency Operations Plan	N/A
County Emergency Operations Plan	Yes, 1987
Local Recovery Plan	No
County Recovery Plan	No
City Mitigation Plan	N/A
County Mitigation Plan	Yes, 2022
Debris Management Plan	No
Economic Development Plan	No
Transportation Plan	Yes, 2021
Land-use Plan	No
Flood Mitigation Assistance (FMA) Plan	No
Watershed Plan	No
Firewise or other fire mitigation plan	Yes, *The Reynolds County Wildfire Protection Plan,*
School Mitigation Plan	No
Critical Facilities Plan (Mitigation/Response/Recovery)	No
Policies/Ordinance	
Zoning Ordinance	No
Building Code	No
Floodplain Ordinance	Yes,
Subdivision Ordinance	No
Tree Trimming Ordinance	No
Nuisance Ordinance	No
Stormwater Ordinance	No
Drainage Ordinance	No
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	No
Seismic Construction Ordinance	No
Program	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
Hazard Awareness Program	No
National Flood Insurance Program (NFIP)	Yes (CID: #290829)
NFIP Community Rating System (CRS) program	No
National Weather Service (NWS) Storm Ready	No
Firewise Community Certification	No
Building Code Effectiveness Grading (BCEGs)	No
ISO Fire Rating	Yes, Varies throughout the county by volunteer fire dept.

Capabilities	Status Including Date of Document or Policy
Economic Development Program	No
Land Use Program	No
Public Education/Awareness	Yes
Property Acquisition	No
Planning/Zoning Boards	No
Stream Maintenance Program	No
Tree Trimming Program	No
Engineering Studies for Streams (Local/County/Regional)	No
Mutual Aid Agreements	Yes
Studies/Reports/Maps	
Hazard Analysis/Risk Assessment (Local)	No
Hazard Analysis/Risk Assessment (County)	Yes, 2022
Flood Insurance Maps	Yes
FEMA Flood Insurance Study (Detailed)	No
Evacuation Route Map	No
Critical Facilities Inventory	Yes,
Vulnerable Population Inventory	No
Land Use Map	No
Staff/Department	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	No
Emergency Management Director	Yes, Part-Time
NFIP Floodplain Administrator	Yes Part-Time
Emergency Response Team	No
Hazardous Materials Expert	No
Local Emergency Planning Committee	Yes
County Emergency Management Commission	No
Sanitation Department	No
Transportation Department	Yes
Economic Development Department	No
Housing Department	No
Historic Preservation	No
Non-Governmental Organizations (NGOs)	
American Red Cross	No
Salvation Army	No
Veterans Groups	Yes
Local Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	Yes, City of Ellington
Community Organizations (Lions, Kiwanis, etc.	No, Only in cities

Capabilities	Status Including Date of Document or Policy
Local Funding Availability	
Apply for Community Development Block	Yes
Fund projects through Capital	No
Authority to levy taxes for a specific purpose	Yes
Fees for water, sewer, gas, or electric services	No
Impact fees for new development	No
Ability to incur debt through general obligation bonds	No
Ability to incur debt through special tax bonds	No
Ability to incur debt through private activities	No
Withhold spending in hazard prone areas	No

Source: Data Collection Questionnaire, 2022

2.2.2 City of Bunker

Total Population (2000): 427
Total Population (2010): 407
Total Population (2020): 264
Total Housing Units: 197
Owner-Occupied Housing Unit, Median Year Built: 1976
Largest Gross Rent Category: $200-$249
Median Housing Value, Owner-Occupied: $52,500
Median Household Income: $22,188
Median Family Income: $48,750
Per Capita Personal Income: $19,194
Persons 16 Yrs. & Over - Labor Force: 246, 44.9% Participation Rate
Comprehensive Plan: No
Zoning Regulations: No
Building Regulations: No
Subdivision Regulations: No
NFIP Participation: No
Water Service: City of Bunker
Sewer Service: City of Bunker
Electric Service: Black River Electric Cooperative
Propane Gas Service: Chilton Oil, Moss, MFA
Natural Gas Service: None
Telephone Service: CenturyLink
Law Enforcement: City of Bunker
Fire Service: Bunker Volunteer Fire Department
Ambulance Service: Reynolds County Ambulance District (RCAD)

The City of Bunker is a 4th class city located in the extreme northwestern portion of Reynolds County and zigzags across the jurisdictional boundary between Reynolds and Dent Counties. The city is overseen by a board of aldermen whose four aldermen are elected by ward. Mayor Gary Conway, Jr. leads all meetings of the council and executes legal documents on behalf of the city. A city clerk assists the board of aldermen in the management of the city budget and operations. Mr. Mike Dickerson functions as the city's emergency management director.

The City of Bunker contracts with a local attorney for legal direction and services. Its public works director is responsible for overseeing the city's municipal water and wastewater systems, as well as its parks. The city also funds a part-time public safety officer, who is responsible for maintaining order and enforcing local ordinances. The fire department serving the city is an all-volunteer department. The city's does not have a planning and zoning committee.

Little commercial development has occurred since the last plan update in 2017. No industrial development has occurred since the last plan update. Little development is expected within the community in the foreseeable future as little developable land exists within city limits. The city does not participate within the national flood insurance program as no land within the city's jurisdictional boundaries is located within the 100-year floodplain.

The two largest employers located within the City of Bunker include the Bunker R-I School System and RNS Wood Products.

The city fire department provides fire safety education for local schools. Residents of the City of Bunker do not have access to a community tornado saferoom. When needed, the city utilizes the county jail for the incarceration of persons violating city laws and ordinances.

The City of Bunker participates with in the Reynolds County Local Emergency Planning Committee (LEPC). Consequently, the city is included within the county's Local Emergency Operations Plan.

The city operates, maintains and regularly tests a warning siren system used to warn the public of fire, severe storms and tornadoes. Two outdoor warning sirens comprise the public warning siren system. The City of Bunker utilizes no other warning system such as Cable Override, Reverse 911, etc.

Residents of the City of Bunker have access to an emergency calling service via the Reynolds County 911 Public Safety Answering Point headquartered in Centerville. The city currently has no active public education campaigns, bicycle safety programs, storm sewer or erosion control projects, tree trimming campaigns, flood protection projects, safety programs, drills, or exercises. Child safety seat training as well as information regarding winter storms, heat dangers, and health and infectious disease prevention are provided by the Reynolds County Health Department.

The City of Bunker has experienced a significant loss of population within the past two decades. Specifically, from 2000 to 2020, the city saw a 32.6% decline in population from 414 residents to 264 residents. English is the predominant language in Bunker. Per the 2020 ACS 5-Year Estimates, 98.8% of residents identify English as their primary language.

In 2017, the City of Bunker identified the following mitigation initiatives:

- Replace low water crossing with culvert;
- Prioritize work on bridges and roadways that are vulnerable to earthquakes;
- Issue burn bans and provide safe burn information;
- Upgrade water system;
- Install lightning protection; and,
- Incorporate hazard mitigation plan into other planning mechanisms.

Per the ACS 2020 5-Year Estimates, there are 123 occupied housing units within the city limits of Bunker. The majority of those homes (52%) were built between 1960 and 1979, rendering an average age of the majority of housing stock in the city at 50 years old. Per the same data source, 41.5% of homes—the greatest percentage—utilize electricity as heating fuel source. Disabled persons comprise 48.1% of the population—127 of 264 persons.

Table 2.7. City of Bunker Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Capabilities	
Comprehensive Plan	No
Builder's Plan	No
Capital Improvement Plan	No
Local Emergency Plan	Yes
County Emergency Plan	No
Local Recovery Plan	No

Capability	Status Including Date of Document or Policy
County Recovery Plan	No
Local Mitigation Plan	No
County Mitigation Plan	Yes, 2022
Local Mitigation Plan (PDM)	No
County Mitigation Plan (PDM)	No
Economic Development Plan	Yes, *Ozark Foothills Comprehensive Economic Development Strategy, 2018*
Transportation Plan	Yes, *Ozark Foothills Regional Transportation Plan, 2021*
Land-use Plan	No
Flood Mitigation Assistance (FMA) Plan	No
Watershed Plan	No
Firewise or other fire mitigation plan	Yes
School Mitigation Plan	No
Critical Facilities Plan	No
Policies/Ordinance	
Zoning Ordinance	No
Building Code	No
Floodplain Ordinance	No
Subdivision Ordinance	No
Tree Trimming Ordinance	No
Nuisance Ordinance	No
Storm Water Ordinance	No
Drainage Ordinance	No
Seismic Construction Ordinance	No
Capability	
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	No
Iowa Wetlands and Riparian Areas	No
Debris Management Plan	No
Program	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
National Flood Insurance Program (NFIP) Participant	No
NFIP Community Rating System (CRS) Participating Community	No
Hazard Awareness Program	No
National Weather Service (NWS) Storm	Yes
Building Code Effectiveness Grading	No
ISO Fire Rating	Yes, 5
Economic Development Program	No
Land Use Program	No
Public Education/Awareness	No
Property Acquisition	No
Planning/Zoning Boards	No
Stream Maintenance Program	No
Tree Trimming Program	No
Engineering Studies for	No
Mutual Aid Agreements	No
Studies/Reports/Maps	
Hazard Analysis/Risk Assessment	Yes, 2022
Hazard Analysis/Risk Assessment	Yes, 2022
Flood Insurance Maps	No
FEMA Flood Insurance Study (Detailed)	No
Evacuation Route Map	No
Critical Facilities Inventory	No
Vulnerable Population Inventory	No
Land Use Map	No

Capability	Status Including Date of Document or Policy
Staff/Department	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	Yes, William Wood
Emergency Management Coordinator	Yes, Mike Dickerson
NFIP Floodplain Administrator	No
Emergency Response Team	No
Hazardous Materials Expert	No
Local Emergency Planning Committee	Yes,
County Emergency Management	No
Sanitation Department	No
Transportation Department	Yes
Economic Development Department	No
Housing Department	No
Historic Preservation	No
Non-Governmental Organizations (NGOs)	
American Red Cross	Yes
Salvation Army	No
Veterans Groups	No
Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	No
Community Organizations (Lions,	Yes
Local Funding Availability	
Ability to apply for Community Development Block Grants	Yes
Ability to fund projects through Capital Improvements funding	No
Authority to levy taxes for a specific	Yes
Fees for water, sewer, gas, or electric	Yes
Impact fees for new development	No
Ability to incur debt through general	No
Ability to incur debt through special tax	No
Ability to incur debt through private	No
Ability to withhold spending in hazard	No

Source: Data Collection Questionnaire, 2021

2.2.3 City of Centerville

Total Population (2000): 176
Total Population (2010): 191
Total Population (2020): 186
Total Housing Units: 76
Owner-Occupied Housing Unit, Median Year Built: 1959
Largest Gross Rent Category: $250-$299
Median Housing Value, Owner-Occupied: $55,800
Median Household Income: $33,472
Median Family Income: $35,625
Per Capita Personal Income: $16,581

Persons 16 Yrs. & Over - Labor Force: 161, 42.9% Participation Rate
Comprehensive Plan: No
Zoning Regulations: No
Building Regulations: No
Subdivision Regulations: No
NFIP Participation: Yes, 1/16/1981
Water Service: City of Centerville
Sewer Service: City of Centerville
Electric Service: Black River Electric Cooperative
Propane Gas Service: ???
Natural Gas Service: None
Telephone Service: CenturyLink
Law Enforcement: Reynolds County Sheriffs Department
Fire Service: Centerville Volunteer Fire Department
Ambulance Service: Reynolds County Ambulance District (RCAD)

The City of Centerville is a 4th class city located in the north central portion of Reynolds County along Missouri Highway 21. The city is overseen by a four-member city council elected by ward. Mayor Stanley Barton leads all meetings of the council and executes legal documents on behalf of the city. A city clerk assists the board of aldermen in the management of the city budget and operations. City Clerk Linda Miller functions as the city's emergency management director.

The City of Centerville contracts with a local attorney for legal direction and services. Its mayor—Stanley Barton—function as the city's part-time public works official and is responsible for overseeing the city's municipal water and wastewater systems, as well as its parks. The city—being the county seat of Reynolds County—depends upon the county sheriff's department for law enforcement. The fire department serving the city is an all-volunteer department. The city's does not have a planning and zoning committee.

Little commercial development has occurred since the last plan update in 2017. No industrial development has occurred since the last plan update. Little development is expected within the community in the foreseeable future as little developable land exists within city limits. The city does participate within the national flood insurance program.

The two largest employers located within the City of Centerville include the Centerville R-I School System and Reynolds County.

The city fire department provides fire safety education for local schools. Residents of the City of Centerville do not have access to a community tornado saferoom. Having no city-funded law enforcement agency, the city is not directly responsible for the incarceration of persons violating city ordinances.

The City of Centerville participates within the Reynolds County Local Emergency Planning Committee (LEPC). Consequently, the city is included within the county's Local Emergency Operations Plan.

The city has no functioning warning siren system with which to warn the public of fire, severe storms and tornadoes. The City of Centerville utilizes no other warning system such as Cable Override, Reverse 911, etc.

Residents of the City of Centerville have access to an emergency calling service via the Reynolds County 911 Public Safety Answering Point headquartered within the city. Centerville currently has no active public education campaigns, bicycle safety programs, storm sewer or erosion control projects, tree trimming campaigns, flood protection projects, safety programs, drills, or exercises. Child safety seat training as well as information regarding winter storms, heat dangers, and health and infectious disease prevention are provided by the Reynolds County Health Department.

The City of Centerville has experienced little population growth or decline within the past two decades. Specifically, in 2000, 2010, and 2020, the city's population was estimated at 176, 191, and 186, respectively. English is the predominant language in Centerville. Per the 2020 ACS 5-Year Estimates, 98.4% of residents identify English as their primary language.

In 2017, the City of Centerville identified the following mitigation initiatives:

- Maintain and enforce floodplain ordinances;
- Participate in flood buyout programs to relocate residents from flood prone areas;
- Maintain participation in the National Flood Insurance Program;
- Replace low water crossings with bridges;
- Prioritize work on bridges and roadways that are vulnerable to earthquakes;
- Issue burn bans and provide safe burn information;
- Upgrade water systems;
- Install lightning protection; and,
- Integrate mitigation actions into other planning documents/mechanisms.

Per the ACS 2020 5-Year Estimates, there are 67 occupied housing units within the city limits of Centerville. The majority of those homes (29.9%) were built between 1960 and 1979, with another 53.7% constructed prior to 1959, rendering an average age of the majority of housing stock in the city at more than 60 years old. Per the same data source, 58.2% of homes—the greatest percentage—utilize liquid propane as the heating fuel source. No natural gas exists within the city. Disabled persons comprise 43.9% of the population—75 of 171 persons.

Table 2.8. City of Centerville Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Capabilities	
Comprehensive Plan	No
Builder's Plan	No
Capital Improvement Plan	No
Local Emergency Plan	Yes, 4/8/2004
County Emergency Plan	No
Local Recovery Plan	No
County Recovery Plan	No
Local Mitigation Plan	No
County Mitigation Plan	Yes
Local Mitigation Plan (PDM)	No
County Mitigation Plan (PDM)	Yes
Economic Development Plan	Yes, *Ozark Foothills Comprehensive Economic Development Strategy, 2018*
Transportation Plan	Yes, *Ozark Foothills Regional Transportation Plan, 2021*
Land-Use Plan	No
Flood Mitigation Assistance (FMA) Plan	No
Watershed Plan	No

Capability	Status Including Date of Document or Policy
Firewise or other fire mitigation plan	No
School Mitigation Plan	No
Critical Facilities Plan	No
Policies/Ordinance	
Zoning Ordinance	No
Building Code	No
Floodplain Ordinance	Yes, 1974
Subdivision Ordinance	No
Tree Trimming Ordinance	No
Nuisance Ordinance	No
Storm Water Ordinance	No
Drainage Ordinance	No
Seismic Construction Ordinance	No
Capability	
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	No
Iowa Wetlands and Riparian Areas	No
Debris Management Plan	No
Program	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
National Flood Insurance Program (NFIP) Participant	Yes, CID: #290311
NFIP Community Rating System (CRS) Participating Community	No
Hazard Awareness Program	No
National Weather Service (NWS) Storm	No
Building Code Effectiveness Grading	No
ISO Fire Rating	Yes, 7/7X
Economic Development Program	No
Land Use Program	No
Public Education/Awareness	No
Property Acquisition	No
Planning/Zoning Boards	No
Stream Maintenance Program	No
Tree Trimming Program	No
Engineering Studies for Streams	No
Mutual Aid Agreements	No
Studies/Reports/Maps	
Hazard Analysis/Risk Assessment (Local)	Yes
Hazard Analysis/Risk Assessment (County)	Yes
Flood Insurance Maps	Yes
FEMA Flood Insurance Study (Detailed)	No
Evacuation Route Map	No
Critical Facilities Inventory	No
Vulnerable Population Inventory	No
Land Use Map	No
Staff/Department	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	No
Development Planner	No
Public Works Official	Yes, Stanley Barton, Mayor (Part-Time)
Emergency Management Coordinator	Yes, Linda Miller, City Clerk (Part-Time)
NFIP Floodplain Administrator	Yes, Linda Miller, City Clerk (Part-Time)
Emergency Response Team	No

Capability	Status Including Date of Document or Policy
Hazardous Materials Expert	No
Local Emergency Planning Committee	Yes, Reynolds County Local Emergency Planning Committee
County Emergency Management Commission	No
Sanitation Department	No
Transportation Department	Yes, Street Department
Economic Development Department	No
Housing Department	No
Historic Preservation	No
Non-Governmental Organizations (NGOs)	
American Red Cross	No
Salvation Army	No
Veterans Groups	No
Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	No
Community Organizations (Lions, Kiwanis,	No
Local Funding Availability	
Ability to apply for Community Development Block Grants	Yes
Ability to fund projects through Capital Improvements funding	No
Authority to levy taxes for a specific purpose	Yes
Fees for water, sewer, gas, or electric	Yes
Impact fees for new development	No
Ability to incur debt through general obligation	No
Ability to incur debt through special tax bonds	No
Ability to incur debt through private activities	No
Ability to withhold spending in hazard prone	No

Source: Data Collection Questionnaire, 2022

2.2.4 City of Ellington

Total Population (2000): 1,014
Total Population (2010): 987
Total Population (2020): 790 (2020 DEC Redistricting Data); 1,380 (ACS 5-Year Estimate, 2020)
Total Housing Units: 423
Owner-Occupied Housing Unit, Median Year Built: 1971
Largest Gross Rent Category: $550-$599
Median Housing Value, Owner-Occupied: $48,300
Median Household Income: $34,125
Median Family Income: $41,964
Per Capita Personal Income: $18,476
Persons 16 Yrs. & Over in Labor Force: 1,057, 61% Participation Rate
Comprehensive Plan: No
Zoning Regulations: No
Building Regulations: No
Subdivision Regulations: No
NFIP Participant: Yes
Water Service: City of Ellington
Sewer Service: City of Ellington
Electric Service: Black River Electric Cooperative
Natural Gas Service: Gas
Propane Gas Service: Ellington Propane

Telephone Service: Ellington Telecom
Law Enforcement: City of Ellington Police Department
Fire Service: Ellington Volunteer Fire Department
Ambulance Service: Reynolds County Ambulance District (RCAD)

The City of Ellington is a 4th class city located in the south-central portion of Reynolds County. The city is overseen by a city council whose four council members are elected at-large. Mayor Paul Wood leads all meetings of the council and executes legal documents on behalf of the city. A city clerk assists the city council in the management of the city budget and operations. Steve Williams functions as the city's emergency management director.

The City of Ellington contracts with a local attorney for legal direction and services. Its public works director is responsible for overseeing the city's municipal water and wastewater systems, as well as its parks. The city also funds full-time police department as well as a volunteer fire department via a 1% sales tax. The police department is responsible for maintaining order and enforcing local ordinances. The city's does not have a planning and zoning committee.

Little commercial development has occurred since the last plan update in 2017. No industrial development has occurred since the last plan update. Little development is expected within the community in the foreseeable future as little developable land exists within city limits. The city does participate within the national flood insurance program.

The two largest employers located within the City of Ellington include the Ellington R-I School System and Paramount Apparel International (PAI).

The city fire department provides fire safety education for local schools. Residents of the City of Ellington do have access to a community tornado saferoom, which is located on the campus of the Southern Reynolds County R-II School District within city limits. When needed, the city utilizes the county jail for the incarceration of persons violating city laws and ordinances.

The City of Ellington participates with in the Reynolds County Local Emergency Planning Committee (LEPC). Consequently, the city is included within the county's Local Emergency Operations Plan.

The city operates, maintains and regularly tests a warning siren system used to warn the public of fire, severe storms and tornadoes. Two outdoor warning sirens comprise the public warning siren system. The City of Ellington utilizes no other warning system such as Cable Override, Reverse 911, etc.

Residents of the City of Ellington have access to an emergency calling service via the Reynolds County 911 Public Safety Answering Point headquartered in Centerville. The city currently has no active public education campaigns, bicycle safety programs, storm sewer or erosion control projects, tree trimming campaigns, flood protection projects, safety programs, drills, or exercises. Child safety seat training as well as information regarding winter storms, heat dangers, and health and infectious disease prevention are provided by the Reynolds County Health Department.

The City of Ellington has experienced an increase in population within the past two decades. Specifically, per the American Community Survey, from 2000 to 2020, the city saw a 36.1%

increase in population from 1,014 residents to 1,380 residents. It should be noted that the 2020 DEC Redistricting Data indicates a continual decline in the city's population at 1,014 (2000), 987 (2010), 790 (2020). The U.S. Census Bureau should be consulted to explain the drastic difference in data estimates produced for the same timeframe (2020). English is the predominant language in Ellington. Per the 2020 ACS 5-Year Estimates, 100% of residents identify English as their primary language.

In 2017, the City of Ellington identified the following mitigation initiatives:

- Replace low water crossings with culverts;
- Prioritize work on bridges and roadways that are vulnerable to earthquakes;
- Maintain participation in the National Flood Insurance Program;
- Participate in flood buyout programs to relocate residents from flood prone areas;
- Maintain/enforce floodplain ordinance;
- Issue burn bans and provide safe burn information;
- Upgrade water systems;
- Install lightning protection; and,
- Integrate mitigation actions into other planning documents/mechanisms.

Per the ACS 2020 5-Year Estimates, there are 470 occupied housing units within the city limits of Ellington. The majority of those homes (32.6%) were built between 1960 and 1979, rendering an average age of the majority of housing stock in the city at more than 50 years old. Per the same data source, bottled gas (propane) and electricity are overwhelmingly the two primary sources of heating fuel—45.1% and 45.1% each. No natural gas service exists in the city. Disabled persons comprise 28.4% of the population—383 of 1,347 persons.

Table 2.9. City of Ellington Mitigation Capabilities

Capability	Status Including Date of Document or Policy
Planning Capabilities	
Comprehensive Plan	No
Builder's Plan	No
Capital Improvement Plan	No
Local Emergency Plan	No
County Emergency Plan	No
Local Recovery Plan	No
County Recovery Plan	No
Local Mitigation Plan	No
County Mitigation Plan	Yes
Local Mitigation Plan (PDM)	No
County Mitigation Plan (PDM)	Yes
Economic Development Plan	Yes, *Ozark Foothills Comprehensive Economic Development Strategy, 2018*
Transportation Plan	Yes, *Ozark Foothills Regional Transportation Plan, 2021*
Land-use Plan	No
Flood Mitigation Assistance (FMA) Plan	No
Watershed Plan	No
Firewise or other fire mitigation plan	No
School Mitigation Plan	No
Critical Facilities Plan (Mitigation/Response/R	No
Policies/Ordinance	
Zoning Ordinance	No
Building Code	No

Capability	Status Including Date of Document or Policy
Floodplain Ordinance	Yes, 1974
Subdivision Ordinance	No
Tree Trimming Ordinance	No
Nuisance Ordinance	No
Storm Water Ordinance	No
Drainage Ordinance	No
Seismic Construction Ordinance	No
Capability	
Site Plan Review Requirements	No
Historic Preservation Ordinance	No
Landscape Ordinance	No
Iowa Wetlands and Riparian Areas	No
Debris Management Plan	No
Program	
Zoning/Land Use Restrictions	No
Codes Building Site/Design	No
National Flood Insurance Program (NFIP) Participant	Yes, CID: #290312
NFIP Community Rating System (CRS) Participating Community	No
Hazard Awareness Program	No
National Weather Service (NWS) Storm Ready	No
Building Code Effectiveness Grading (BCEGs)	No
ISO Fire Rating	Yes, 5
Economic Development Program	No
Land Use Program	No
Public Education/Awareness	No
Property Acquisition	No
Planning/Zoning Boards	No
Stream Maintenance Program	No
Tree Trimming Program	No
Engineering Studies for Streams	No
Mutual Aid Agreements	No
Studies/Reports/Maps	
Hazard Analysis/Risk Assessment (Local)	Yes
Hazard Analysis/Risk Assessment (County)	No
Flood Insurance Maps	Yes
FEMA Flood Insurance Study (Detailed)	No
Evacuation Route Map	No
Critical Facilities Inventory	No
Vulnerable Population Inventory	No
Land Use Map	No
Staff/Department	
Building Code Official	No
Building Inspector	No
Mapping Specialist (GIS)	No
Engineer	Yes, Part-time
Development Planner	No
Public Works Official	Yes, part-time
Emergency Management Coordinator	Yes, Part-time
NFIP Floodplain Administrator	Yes, Full-Time
Emergency Response Team	No
Hazardous Materials Expert	No
Local Emergency Planning Committee	Yes,
County Emergency Management Commission	No
Sanitation Department	No
Transportation Department	Yes, Street Department
Economic Development Department	No
Housing Department	No

Capability	Status Including Date of Document or Policy
Historic Preservation	No
Non-Governmental Organizations (NGOs)	
American Red Cross	No
Salvation Army	No
Veterans Groups	No
Environmental Organization	No
Homeowner Associations	No
Neighborhood Associations	No
Chamber of Commerce	Yes, ellingtonmo.com
Community Organizations (Lions, Kiwanis, etc.	Yes
Local Funding Availability	
Ability to apply for Community Development Block Grants	Yes
Ability to fund projects through Capital Improvements funding	Yes
Authority to levy taxes for a specific purpose	No
Fees for water, sewer, gas, or electric services	Yes
Impact fees for new development	No
Ability to incur debt through general obligation	yes
Ability to incur debt through special tax bonds	Yes
Ability to incur debt through private activities	No
Ability to withhold spending in hazard prone	No

Source: Data Collection Questionnaire, 2021

2.2.5 Summary of Jurisdictional Capabilities[3, 7, and 8]

The following table summarizes the mitigation capabilities of the unincorporated portions of Reynolds County as well as the Cities of Bunker, Centerville, and Ellington.

Table 2.10. Mitigation Capabilities Summary Table

CAPABILITIES	Unincorporated Reynolds County	City of Bunker	City of Centerville	City of Ellington
Planning Capabilities				
Comprehensive Plan	No	No	No	No
Builder's Plan	No	No	No	No
Capital Improvement Plan	No	No	No	No
Local Emergency Plan	No	Yes	Yes	Yes
County Emergency Plan	Yes	No	No	No
Local Recovery Plan	No	No	No	No
County Recovery Plan	No	No	No	No
Local Mitigation Plan	No	No	No	No
County Mitigation Plan	Yes	Yes	Yes	Yes
Local Mitigation Plan (PDM)	No	No	No	No
County Mitigation Plan (PDM)	Yes	Yes	Yes	Yes
Debris Management Plan	No	No	No	No
Economic Development Plan	Yes	Yes	Yes	Yes
Transportation Plan	Yes	Yes	Yes	Yes
Land-use Plan	No	No	No	No
Flood Mitigation Assistance (FMA) Plan	No	No	No	No
Watershed Plan	No	No	No	No
Firewise or other fire mitigation plan	No	No	Yes	No
School Mitigation Plan	No	No	No	No
Critical Facilities Plan (Mitigation/Response/Recovery)	No	No	No	No
Policies/Ordinance				
Zoning Ordinance	No	No	No	No
Building Code	No	No	No	No
Floodplain Ordinance	Yes	No	Yes	Yes
Subdivision Ordinance	No	No	No	No
Tree Trimming Ordinance	No	No	No	No
Nuisance Ordinance	No	No	No	No
Storm Water Ordinance	No	No	No	No
Drainage Ordinance	No	No	No	No

CAPABILITIES	Unincorporated Reynolds County	City of Bunker	City of Centerville	City of Ellington
Site Plan Review Requirements	No	No	No	No
Historic Preservation Ordinance	No	No	No	No
Landscape Ordinance	No	No	No	No
Seismic Construction Ordinance	No	No	No	No
Program				
Zoning/Land Use Restrictions	No	No	No	No
Codes Building Site/Design	No	No	No	No
National Flood Insurance Program (NFIP) Participant	Yes	No	Yes	Yes
NFIP Community Rating System (CRS) Participating Community	No	No	No	No
Hazard Awareness Program	No	No	No	No
National Weather Service (NWS) Storm Ready	No	No	No	No
Building Code Effectiveness Grading (BCEGs)	No	No	No	No
ISO Fire Rating	Yes	Yes	Yes	Yes
Economic Development Program	No	No	No	No
Land Use Program	No	No	No	No
Public Education/Awareness	No	No	No	No
Property Acquisition	No	No	No	No
Planning/Zoning Boards	No	No	No	No
Stream Maintenance Program	No	No	No	No
Tree Trimming Program	No	No	No	No
Engineering Studies for Streams (Local/County/Regional)	No	No	No	No
Mutual Aid Agreements	No	No	No	No
Studies/Reports/Maps				
Hazard Analysis/Risk Assessment (Local)	No	Yes	Yes	Yes
Hazard Analysis/Risk Assessment (County)	Yes	No	No	No
Flood Insurance Maps	Yes	No	Yes	Yes
FEMA Flood Insurance Study (Detailed)	No	No	No	No
Evacuation Route Map	No	No	No	No
Critical Facilities Inventory	No	No	No	No
Vulnerable Population Inventory	No	No	No	No
Land Use Map	No	No	No	No
Staff/Department				
Building Code Official	No	No	No	No
Building Inspector	No	No	No	No
Mapping Specialist (GIS)	No	No	No	No
Engineer	No	No	No	Yes, Part-Time
Development Planner	No	No	No	No
Public Works Official	No	Yes	Yes	Yes, Part-Time

CAPABILITIES	Unincorporated Reynolds County	City of Bunker	City of Centerville	City of Ellington
Emergency Management Coordinator	Yes	Yes	Yes	Yes, Part-Time
NFIP Floodplain Administrator	Yes	No	Yes	Yes
Emergency Response Team	No	No	No	No
Hazardous Materials Expert	No	No	No	No
Local Emergency Planning Committee	Yes	Yes	Yes	Yes
County Emergency Management Commission	No	No	No	No
Sanitation Department	No	No	No	No
Transportation Department	No	No	No	No
Economic Development Department	No	No	No	No
Housing Department	No	No	No	No
Historic Preservation	No	No	No	No
Non-Governmental Organizations (NGOs)				
American Red Cross	No	Yes	No	No
Salvation Army	No	No	No	No
Veterans Groups	No	No	No	No
Environmental Organization	No	No	No	No
Homeowner Associations	No	No	No	No
Neighborhood Associations	No	No	No	No
Chamber of Commerce	No	No	No	Yes
Community Organizations (Lions, Kiwanis, etc.	No	Yes	No	Yes
Financial Resources				
Apply for Community Development Block Grants	**Yes**	**Yes**	**Yes**	**Yes**
Fund projects through Capital Improvements Funding	No	No	No	Yes
Authority to levy taxes for specific purposes				
Fees for water, sewer, gas, or electric services	No	Yes	Yes	Yes
Impact fees for new development	No	No	No	No
Incur debt through general obligation bonds	No	No	No	Yes
Incur debt through special tax bonds	No	No	No	Yes
Incur debt through private activities	No	No	No	No
Withhold spending in hazard prone areas	No	No	No	No

Source: Data Collection Questionnaires, 2021 & 2022

2.2.6 Special District

No special districts participated in the planning effort.

2.2.7 Public School District Profiles and Mitigation Capabilities

Of the four public school districts headquartered in Reynolds County, only the Lesterville R-IV School District participated within the current plan update effort. The Centerville R-I, the Southern Reynolds County R-II, and the Bunker, R-III School Districts did not participate in the planning process.

The Lesterville R-IV School District has one campus with one large primary building housing three schools—the Lesterville Elementary, the Lesterville High School, and the Lesterville Ranch Campus (classified by the district as an alternative high school). Per the Missouri Department of Elementary and Secondary Education's School Directory, the district's 2021-2022 enrollment was reported as 85 students within the elementary and 139 students between the two high schools. Thirty-five certified staff work at the district's campus. The district's service boundaries do not cross county lines.

Table 2.11. Lesterville R-IV School District Buildings and Enrollment Data, April 2022

District Name	Building Name	Building Enrolment
Lesterville R-IV School District	Elementary and High School	224

Source: https://apps.dese.mo.gov/MCDS/Home.aspx, 2022

Information regarding the school district's capabilities for hazard mitigation was collected from the district's completed Data Collection Questionnaire and is shown within the following table.

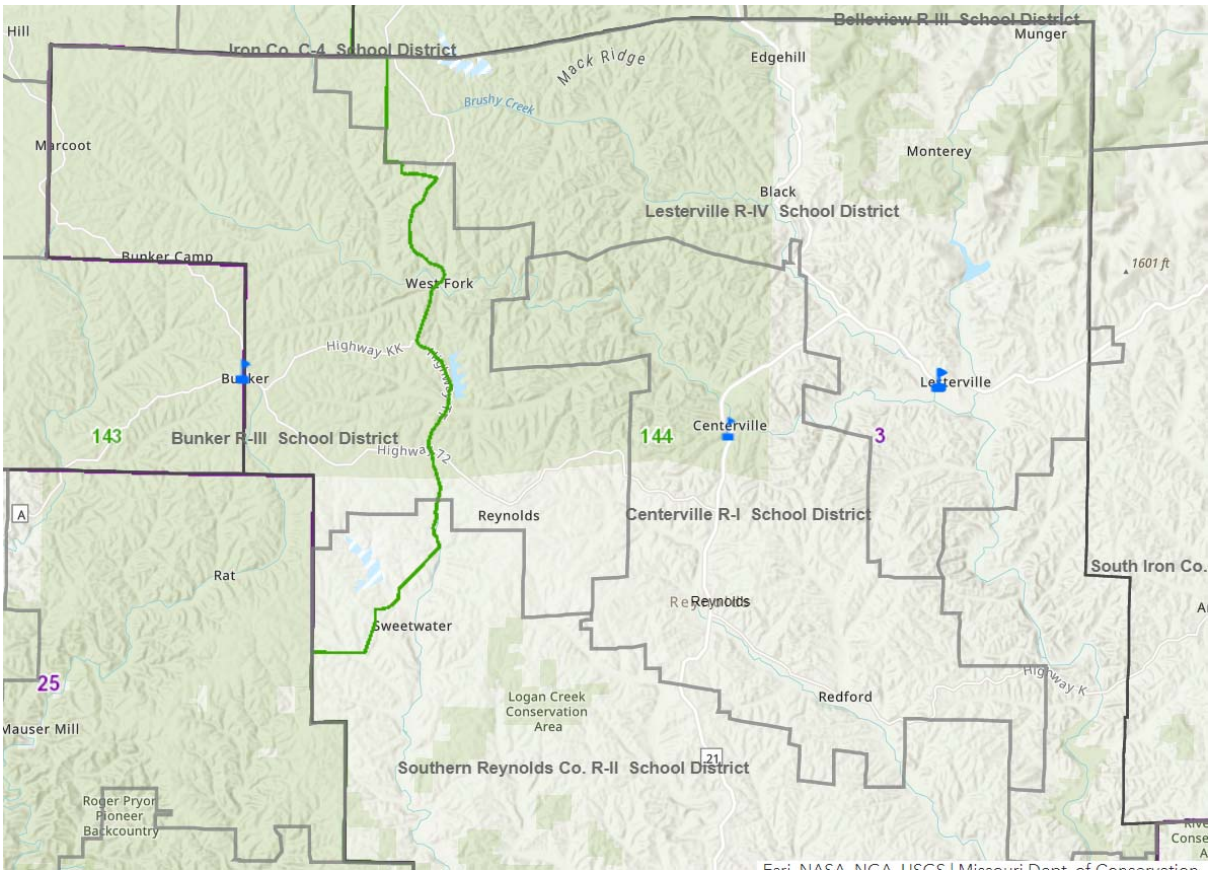
Table 2.12. Summary of Mitigation Capabilities-Lesterville R-IV School District

Capability	Lesterville R-IV School District
Planning Elements	
Master Plan/ Date	No
Capital Improvement Plan/Date	No
School Emergency Plan/Date	Yes, 5/2022
Weapons Policy/Date	Yes, 2/23/2005
Personnel Resources	
Full-Time Building Official (Principal)	Yes
Emergency Manager	No
Grant Writer	No
Public Information Officer	No
Financial Resources	
Capital Improvements Project Funding	Yes
Local Funds	Yes
General Obligation Bonds	No
Special Tax Bonds	No
Private Activities/Donations	No
State and Federal Funds/Grants	Yes
Other	
Public Education Programs	No
Privately or Self- Insured?	Private
Fire Evacuation Training	Yes
Tornado Sheltering Exercises	Yes
Public Address/Emergency Alert System	Yes
NOAA Weather Radios	Yes
Lock-Down Security Training	Yes
Mitigation Programs	No
Tornado Shelter/Saferoom	No
Campus Police	No

Source: Data Collection Questionnaire, 2022

A map of the district is shown below in Figure 2.3.

Figure 2.3. School District in Reynolds County


Hill
Iron Co. C-4 School District
Belleview R-III School District
Munger
Mack Ridge
Edgehill
Brushy Creek
Marcoot
Monterey
Black
Lesterville R-IV School District
Bunker Camp
West Fork
1601 ft
Highway KK
Bunker
Lesterville
143
Bunker R-III School District
144
Centerville
3
Highway 72
Reynolds
Centerville R-I School District
A
Rat
South Iron Co.
Reynolds
Sweetwater
25
Logan Creek Conservation Area
Redford
Highway K
Mauser Mill
21
Southern Reynolds Co. R-II School District
Roger Pryor Pioneer Backcountry

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.

Following is a community-wide risk assessment for Reynolds County, Missouri developed to identify and profile relevant hazards and assess the exposure of lives, property, and infrastructure to each relevant hazard within a particular area. The natural hazards discussed throughout this section were examined using available data relevant and necessary for determining the types of hazards, frequency and strength of those hazards, areas vulnerable to those hazards, potential impacts, and probability that each hazard will occur. The goal of the risk assessment is to estimate potential loss in the planning area including loss of life, personal injury, property damage, and economic loss resulting from a hazard event. The risk assessment process allows entities within the planning area to better understand their potential risk from the identified hazards. It will provide a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

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; and,
- **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:
    - 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, and the impact upon future development upon risk
    - Vulnerability Assessment further defines and quantifies populations, buildings, critical facilities, and other community/school or special district assets at risk to natural hazards; and
    - 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 Reynolds County Hazard Mitigation Planning Committee has determined that this updated plan, as with past county plans, will address only natural hazards. Natural Hazard has been defined by I. Burton, R. Kates, and G. White in *The Environment as Hazard*, as "those elements of the physical environment, harmful to man and caused by forces extraneous to him." Consistent with this definition, war, chemical contamination, and other manmade phenomena are excluded from classification as a natural hazard. Natural hazards can take many forms. Happenings such as those listed below, which occur in a populated area, are referred to as hazardous events. It is not until significant property damage and loss of life result from a natural hazard that the phenomena can classified as a natural disaster.

3.1.1 Review of Existing Mitigation Plans

The planning committee reviewed the hazards identified within the *2017 Reynolds County Hazard Mitigation Plan*. In the 2017 plan, there were nine natural hazards identified: Severe Winter Weather, Thunderstorm/High Wind/Lightning/Hail, Tornado, Drought, Wildfires, Extreme Heat, Earthquake, Dam Failure, and Land Subsidence/Sinkholes. The planning committee reviewed these hazards and compared them to the known historical hazards that have impacted jurisdictions in Reynolds County. After this review the committee determined the hazard identification as adequate and accurate.

The updated plan will review and analyze the following natural hazards in the order listed: Drought, Extreme Heat, Earthquake, Flooding, Dam Failure, Land Subsidence/Sinkholes, Severe Winter Weather, Thunderstorm/High Winds/Lightning/Hail, Tornado, and Wildfire. All of the above listed phenomena have either occurred within Reynolds County, or could occur within Reynolds County, Missouri due to the geography and other environmental factors. Some of the above hazards are more likely to occur within the planning area, while others are less likely. In the following pages, each hazard will be described, its history of occurrence in Reynolds County, as well as the probability of the natural hazard occurring in the future.

Due to the location and geography of Reynolds County, the occurrence of certain natural hazards, which may also occur in other parts of the world, is virtually impossible. The following list contains natural hazards, which have been determined to be insignificant threats within Reynolds County, Missouri: Hurricane and other Tropical Storms, Tsunami, Volcano, Arid and Semi-Arid-related phenomena. Hurricanes, tropical storms, and tsunamis do not occur in or near Reynolds County due to its central location within North America. Furthermore, the geologic and soil structure found within Reynolds County does not encourage volcanic activity. Because of this, there are no volcanoes within the county.

The planning committee discussed including man-made hazards within the Reynolds County Hazard Mitigation Plan. However, as only natural hazards are required by FEMA regulations the committee focused their efforts upon natural phenomena.

Levee failure was excluded from the mitigation planning process as there are no mapped levees nor associated levee protected areas within or immediately upstream of Reynolds County.

3.1.2 Review Disaster Declaration History

State and/or federal disaster declarations may be granted when the severity and magnitude of a hazard event surpasses the ability of the local government to respond and recover. Disaster assistance is supplemental and sequential. When the local government's response capacity has been surpassed, a state disaster declaration may be issued, allowing for the provision of state assistance. If the disaster results in damages beyond the local and state's capacities to respond, a federal emergency or disaster declaration may be issued allowing for the provision of federal assistance.

Federally declared emergencies differ from disaster declarations in that they are more limited in scope. "Emergencies" do not include the provision of long-term federal recovery programs, while "disasters" do include such provisions. Determinations for declaration type are based on the scale and type of damages, as well as the institutions/industrial sectors affected. The table below lists the 22 hazard events that have resulted in federal disaster declarations within Reynolds County since 1953. Of these 22 events, the majority (54.5%) were severe storms.

Table 3.1. **FEMA Disaster Declarations that included Reynolds County, Missouri, 1953-Present**

Disaster Number	Description	Incident Period Declaration Date	Individual Assistance (IA) Public Assistance (PA)
DR-372	Heavy Rain, Tornadoes & Flooding	4/19/1973 4/19/1973	PA $0 IA $0
EM-3017	Drought	9/24/76 9/24/76	PA $0 IA $0
DR-1006	Severe Storms, Tornadoes, & Flooding	11/13/93-11/19/93 12/1/93	PA $0 IA $0
DR-1023	Severe Storms, Tornadoes, & Flooding	4/9/94-5/5/94 4/21/94	PA $0 IA $0
DR-1412	Severe Storms & Tornadoes	5/6/02 4/24/02-6/10/02	PA $35,299,777.93 IA $0
EM-3232	Hurricane Katrina Evacuation	8/29/05-10/1/05 9/10/05	PA $1,816,226.90 IA $0
DR-1673	Severe Winter Weather	11/30/06-12/2/06 12/29/06	PA $6,654,375.10 IA $0
EM-3281	Severe Winter Weather	12/8/07-12/15/07 12/12/07	PA $0 IA $0
DR-1749	Severe Storms & Flooding	3/17/08-5/9/08 3/19/08	PA $26,045,574.54 IA $13,924,227.09
DR-1809	Severe Storms, Flooding, & Tornadoes	9/11/08-9/24/08 11/13/08	PA $8,529,243.13 IA $6,869,983.55
DR-1748	Severe Winter Storms & Flooding	2/10/08-2/14/08 3/12/08	PA $10,068,998.77 IA $0
DR-1847	Severe Storms, Tornadoes, & Flooding	5/8/09-5/16/09 6/19/09	PA $27,072,334.75 IA $5,417,824.37
DR-1822	Severe Winter Storms	1/26/09-1/28/09 2/17/09	PA $135,879,596.08 IA $0
EM-3303	Severe Winter Storms	1/26/09-1/28/09 2/17/09	PA $0 IA $0
DR-1980	Severe Storms, Tornados, Flooding	4/19/11-6/6/11 5/9/11	PA $161,607,587.62 IA $37,115,639.63

EM-3317	Severe Winter Storm	1/31/11-2/5/11 2/3/11	PA $0 IA $0
EM-3374	Severe Storms, Tornadoes, Straight-Line Winds, & Flooding	12/22/15-1/9/16 1/2/2016	PA $0 IA $0
DR-4250	Flood, Severe Storms, Tornados	12/23/15-1/9/16 1/21/16	PA $ $35,000,668.13 IA $13,173,843.43
DR-4317	Severe Storms, Tornadoes, Straight-Line Winds, & Flooding	4/28/17-5/11/17 6/2/17	PA $83,150,578.92 IA $12,527,583.31
EM-3482	COVID-19	3/13/20 1/20/20 - continuing	PA $0 IA $0
DR-4490	COVID-19 PANDEMIC	3/26/20 1/20/20 - continuing	PA $384,054,895.45 IA $53,147,921.66
DR-4636	Severe Storms, Straight-Line Winds & Tornadoes	1/10/22 12/10/21	PA $1,617,000.03 IA $0

Source: Federal Emergency Management Agency, https://www.fema.gov/data-visualization-summary-disaster-declarations-and-grants

3.1.3 Research Additional Sources

The following are additional sources of data regarding locations and past impacts of hazards in the planning area:

- Missouri Hazard Mitigation Plan (2018)
- Previously approved planning area Hazard Mitigation Plan (2017)
- Federal Emergency Management Agency (FEMA)
- Missouri Department of Natural Resources
- National Drought Mitigation Center Drought Reporter
- US Department of Agriculture's (USDA) Risk Management Agency Crop Insurance Statistics
- National Agricultural Statistics Service (Agriculture production/losses)
- Data Collection Questionnaires completed by each jurisdiction
- Flood Insurance Administration
- State of Missouri GIS data
- Hazards US (Hazus)
- National Fire Incident Reporting System (NFIRS)
- National Oceanic and Atmospheric Administration's (NOAA) National Centers for
- Environmental Information (NCEI)
- County Emergency Management
- County Flood Insurance Rate Map, FEMA
- Flood Insurance Study, FEMA
- SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin
- United States Geological Survey (USGS)
- Various articles and publications available on the internet (citations provided when applicable)

It should be noted that the only centralized source of data for many of the weather-related hazards occurring within the planning area is the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI). Although it is usually the best and most current source, there are limitations to the data. The NCEI documents the occurrence of

storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to 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 NCEI 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 NCEI should be cautious as the NWS does not guarantee the accuracy or validity of the information.

The NCEI 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 March 2014, 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.

1. Tornado: From 1950 through 1954, only tornado events were recorded.
2. 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.
3. All Event Types: From 1996 to present, 48 event types are recorded as defined in NWS Directive 10-1605.

Note that injuries and deaths caused by a storm event are reported on an area-wide basis. When reviewing a table resulting from an NCEI search by county, the death or injury listed in connection with the search may not have occurred in that county.

3.1.4 Hazards Identified

The hazards of dam failure, drought, earthquake, extreme heat, flooding, land subsidence/sinkholes, severe winter weather, thunderstorm/high winds/lightning/hail, tornado, and wildfire were chosen for further analysis as these were determined by the MPC to significantly impact the planning area. Not all of the hazards included in this plan impact the entire county in the same manner. For instance, dam failure will only affect the areas below the dam in the inundation area if the dam were to fail. Not all participating jurisdictions are located within the inundation area of a dam; therefore; dam failure would not impact the entire county. Some hazards do have the potential to impact the entire planning area. For example, winter weather will impact the entire county, all cities, schools, and special districts. The table below lists each participating jurisdiction and each hazard. An “x” indicates that the hazard has the potential to impact a jurisdiction whereas a ”-“ indicates the hazard is not applicable to the jurisdiction.

Table 3.2. **Hazards Identified for Each Jurisdiction**

Jurisdiction	Dam Failure	Drought	Earthquake	Extreme Temperatures	Flooding (River and Flash)	Land Subsidence/Sinkholes	Severe Winter Weather	Thunderstorm/Lightning/Hail/ High Wind	Tornado	Wildfire
Reynolds County	x	x	x	x	x	x	x	x	x	x
City of Bunker	-	x	x	x	-	x	x	x	x	x
City of Centerville	-	x	x	x	x	x	x	x	x	x
City of Ellington	-	x	x	x	x	x	x	x	x	x

3.1.5 Multi-Jurisdictional Risk Assessment

Following is a multi-jurisdictional hazard profile for Reynolds County, Missouri and all participating jurisdictions within the boundaries of Reynolds County. The data used to compile this assessment is cited throughout the body of Section 3, as well as following the tables included within this section. This plan is an update of the Reynolds County Hazard Mitigation Plan approved by FEMA in 2017. The data and information included reflect changes and updates since that time.

Reynolds County is adequately uniform in terms of climate; temperatures and precipitation are relatively consistent throughout the county. Some variations of the topography within the county exist. Reynolds County's population is spread throughout three incorporated communities; Bunker, Centerville, and Ellington, and the unincorporated areas of the county. The types of buildings and infrastructure are consistent from town to town. Residential structures are mainly wooden, brick and mortar with a significant quantity of mobile homes or modular homes. There are no urbanized areas within the planning area.

To begin the risk assessment, each identified hazard will be profiled with risks assessed on a planning area-wide basis. Some hazards, however, vary in risk across the planning area. The hazards that vary across the planning area in terms of risk include dam failure, wildfire, levee failure, flood, and sinkholes/land subsidence. Such variations are detailed in each hazard profile under a separate heading.

Furthermore, variations in development trends throughout the planning area that impact future vulnerability. For example, rural areas may have agricultural assets (crops/livestock) that are vulnerable to wind/hail damages and drought. More densely populated areas are more vulnerable to hazards such as tornado and earthquake. These differences will be discussed in greater detail in the vulnerability sections of each hazard as appropriate.

3.2 ASSETS AT RISK

This section assesses the planning area population, structures, critical facilities and infrastructure, as well as other important assets that may be at risk to damage from hazards. There have been limited changes to the planning areas since the approval of the 2017 Reynolds County plan. Although there has been an estimated population decrease within the City of Bunker and an estimated population increase within the City of Ellington, the margins of error for said changes are significant relative to the overall population. Consequently, the estimated changes in population cannot be depended upon to assess risk. Furthermore, despite these changes in estimated population, the affected communities remain small, remote, and rural.

3.2.1 Total Exposure of Population and Structures

Unincorporated Reynolds County and Incorporated Cities

In the following three tables, population data is based on ACS 2020 5-Year Estimates. Building counts and building exposure values are based on parcel data provided by the State of Missouri Geographic Information Systems (GIS) database, which can be found at the following website http://www.msdis.missouri.edu/data/datalist.html. Contents exposure values were calculated by factoring a multiplier to the building exposure values based on usage type. The multipliers were derived from the HAZUS MH 2.1 and are defined below in Table 3.11.

Land values have been purposely excluded from consideration because land remains following

disasters, and subsequent market devaluations are frequently short-term and difficult to quantify. Another reason for excluding land values is that state and federal disaster assistance programs generally do not address loss of land. This does not consider the amount allocated for farmers for which crop insurance would cover following a disaster.

Following the instructions found at, http://sema.dps.mo.gov/programs/mitigation_management.php, contents exposure values were calculated by factoring a multiplier to the building exposure values based on usage type. The multipliers were derived from the HAZUS MH 2.1 and are defined below in Table 3.3.

It should be noted that the total valuation of buildings is based on county assessors' data which may not be current. In addition, government-owned properties are usually taxed differently or not at all, and so may not be an accurate representation of true value. Public school district assets and special districts, assets are included in the total exposure table's assets by community and county.

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 portion of Reynolds County and each incorporated city. Table 3.4 that follows provides the building value exposures for the county and each participating city in the planning area broken down by usage type. Finally, Table 3.5 provides the building count total for the county and each participating city in the planning area broken out by building usage types (i.e. residential, commercial, industrial, and agricultural).

Table 3.3. **Maximum Population and Building Exposure by Jurisdiction**

Jurisdiction	2020 5-Year Population Estimate	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)
City of Bunker	264	115	13,945,000	7,926,000	21,870,000
City of Centerville	186	81	9,711	5,421	15,131
City of Ellington	1,380	484	56,876	35,538	92,415
Unincorporated Reynolds County	4,266	3,803	342,716,000	184,479,000	527,195,000
Totals	6,096	4,483	423,248,000	233,364,000	656,612,000

Source: U.S. Bureau of the Census, population estimates/ 5-Year American Community Survey 2020; Building Count and Building Exposure, Missouri GIS Database from SEMA Mitigation Management; 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%), Industrial (150%), Agricultural (100%). For purposes of these calculations, government, school, and utility were calculated at the commercial contents rate.

Table 3.4. **Building Values/Exposure* by Usage Type**

Jurisdiction	Residential	Commercial	Industrial	Governmental	Educational	Agricultural	Total
City of Bunker	$11,099	$1,416	$203	$657	$571	$0	$13,945

City of Centerville	8,010	1,416	0	0	285	0	9,711
City of Ellington	41,078	12,459	1,256	657	1,429	0	56,876
Unincorporated Reynolds County	$313,521	$10,194	$10,370	$1,970	$4,281	$2,381	$342,716
Totals	$373,708	$25,485	$11,828	$3,283	$6,564	$2,381	$423,248

Source: Missouri GIS Database, SEMA Mitigation Management Section
** All values are in thousands of dollars*

Table 3.5. **Building Counts by Usage Type**

Jurisdiction	Residential Counts	Commercial Counts	Industrial Counts	Governmental Counts	Educational Counts	Agricultural Counts	Total
City of Bunker	97	10	5	1	2	0	115
City of Centerville	0	10	0	0	1	70	81
City of Ellington	359	88	31	1	5	0	484
Unincorporated Reynolds County	2,740	72	256	3	15	717	3,803
Totals	2,837	82	261	4	17	717	3,918

Source: Missouri GIS Database, SEMA Mitigation Management Section; Public School Districts and Special Districts

Only one school district within the planning area met the minimum participation requirements as outlined by the Mitigation Planning Committee for this plan update—the Lesterville R-IV School District. 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 figures represent the total enrollment and building count for the public school district. The Lesterville R-IV School District entire service area is located within the Reynolds County.

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

Public School District	Enrollment	Building Count	Building Exposure ($)	Contents Exposure ($)	Total Exposure ($)
Lesterville R-IV School District	224	1	$13,866,11	$1,962,810	$15,828,921

Source: http://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx., Data Collection Questionnaire, 2022

3.2.2 Critical and Essential Facilities and Infrastructure

This section includes information collected via the locally completed Data Collection

Questionnaires concerning the vulnerability of the 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 Questionnaires as well as the following sources:

- *2018 Missouri State Hazard Mitigation Plan* and Hazard Mitigation Viewer, http://bit.ly/MoHazardMitigationPlanViewer2018; and,
- Hazus.

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

Jurisdiction	Airport Facility	Bus Facility	Childcare Facility	Communications Tower	Electric Power Facility	Emergency Operations	Fire Service	Government	Housing	Shelters	Highway Bridge	Hospital/Health Care	Military	Natural Gas Facility	Nursing Homes	Police Station	Potable Water Facility	Rail	Sanitary Pump Stations	School Facilities	Stormwater Pump Stations	Tier II Chemical Facility	Wastewater Facility	TOTAL
City of Bunker	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	7
City of Centerville	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	5
City of Ellington	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	1	1	0	1	3	0	0	1	14
Reynolds County	0	0	0	1	2	1	1	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	1	11
Totals	0	0	0	2	2	1	2	2	1	0	0	0	0	1	0	1	1	0	0	2	1	0	1	17

Source: Missouri 2018 State Hazard Mitigation Plan and Hazard Mitigation Viewer; Data Collection Questionnaires; Hazus, etc.

According to the National Bridge Inventory found at https://www.fhwa.dot.gov/bridge/nbi/no10/county22b.cfm#mo, there are 91 bridges located within Reynolds County. The maps below show the locations of “on-system” bridges and “off-system” bridges in the county. “On-system” bridges are located along state-maintained transportation routes, while “off-system” bridges are located along locally-maintained routes—typically county gravel roads.

Figure 3.1. State-Owned Bridges, Reynolds County, MO

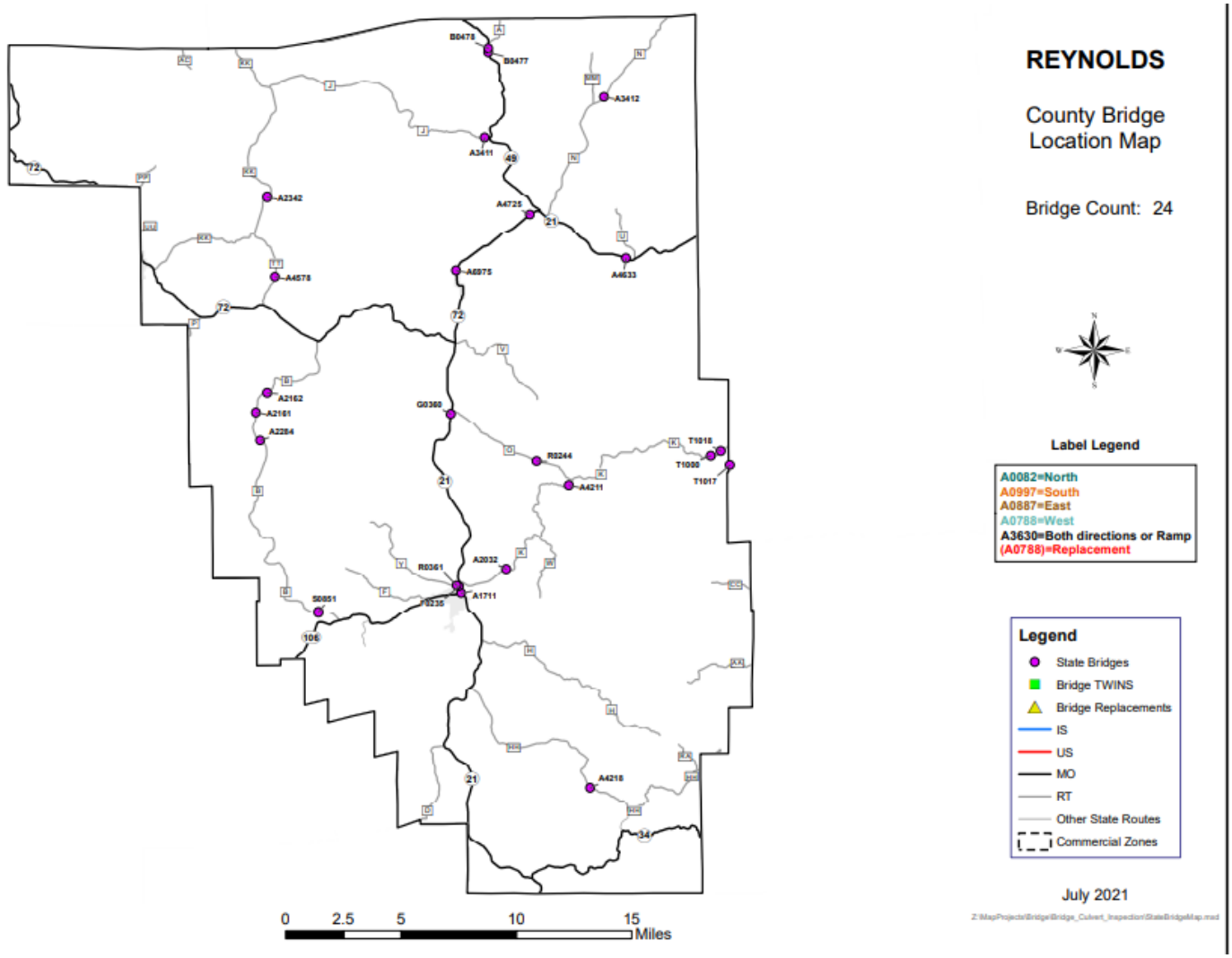
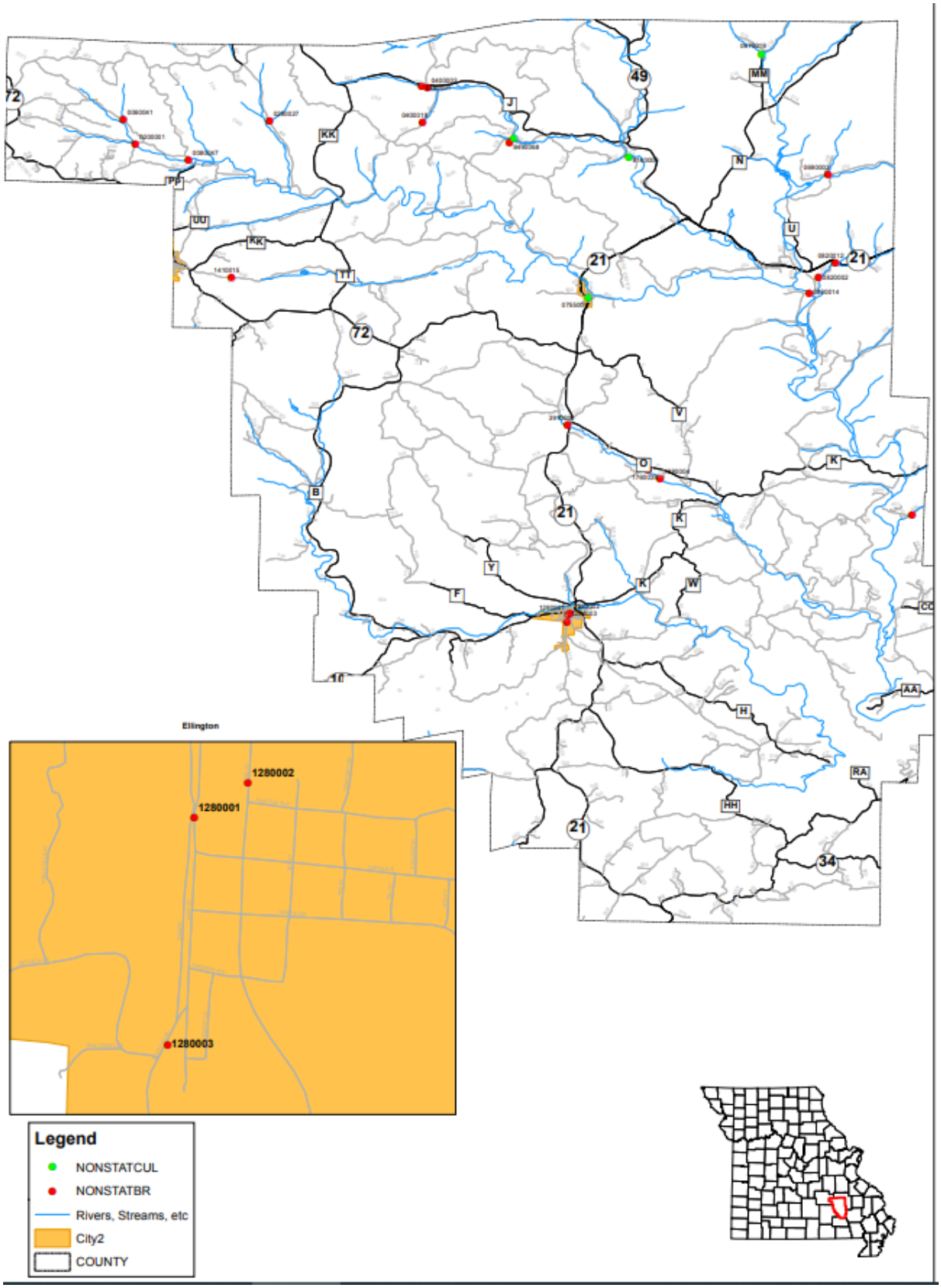


Figure 3.2. Locally-Owned Bridges, Reynolds County, MO



Per the Missouri Department of Transportation, of the county's 91 bridges, six have been categorized as being in "fair" condition while ten have been rated as being in "poor" condition. The table below lists those bridges—both state and locally-maintained—classified as structurally deficient.

Table 3.8. **Bridge Condition by Location, Reynolds County, MO**

STRUCTURALLY DEFICIENT STRUCTURES IN REYNOLDS COUNTY

As of March, 15 2022

CLASS	FED ID	BRIDGE NO	FEATURE	ROUTE	FUNCTIONAL CLASS	DEFICIENCY RATING	GOOD FAIR POOR
STBR	2017	A2342	W FK OF BLACK RVR	RT KK S	07-RURAL MAJOR COLLECTOR	STRUCTURAL	POOR
STBR	8301	R0361	DRY CR	RT Y E	08-RURAL MINOR COLLECTOR	STRUCTURAL	FAIR
STBR	8949	S0851	LOGAN CR	RT B S	07-RURAL MAJOR COLLECTOR	STRUCTURAL	POOR
STBR	9401	T1017	BEAR BR	PVT PVT BRIDGE T10	09-RURAL LOCAL	STRUCTURAL	FAIR
NSBR	12334	0060041	RATFORD BR	COUNTY RD 906	09-RURAL LOCAL	STRUCTURAL	POOR
NSBR	13414	0380001	BRUSHY CR	COUNTY RD 840	09-RURAL LOCAL	STRUCTURAL	FAIR
NSCUL	14431	0670018	IMBODEN FK	COUNTY RD 216	09-RURAL LOCAL	STRUCTURAL	FAIR
NSBR	15007	0820002	ADKINS HOLLOW	COUNTY RD 360	09-RURAL LOCAL	STRUCTURAL	FAIR
NSBR	15026	0820012	MILL CR	COUNTY RD 360	09-RURAL LOCAL	STRUCTURAL	POOR
NSBR	18200	1760038	SINKING CR	COUNTY RD 308	09-RURAL LOCAL	STRUCTURAL	POOR
NSBR	23117	3910001	SINKING CR	OLD HWY 21	09-RURAL LOCAL	STRUCTURAL	POOR
NSBR	28225	0080047	WEST FK	COUNTY RD 906	09-RURAL LOCAL	STRUCTURAL	POOR
NSBR	30506	1880004	SINKING CR	COUNTY RD 324	09-RURAL LOCAL	STRUCTURAL	FAIR
NSBR	30556	0690003	TAUM SAUK CR	COUNTY RD 206	09-RURAL LOCAL	STRUCTURAL	POOR
NSCUL	32257	8140006	BRUSHY CR	COUNTY RD 814	09-RURAL LOCAL	STRUCTURAL	POOR
NSBR	34039	2210013	TRIB OF FUNK BR	COUNTY RD 456	09-RURAL LOCAL	STRUCTURAL	POOR

Source: Missouri Department of Transportation, Southeast District, March 2022

"Scour critical" refers to one of the database elements in the National Bridge Inventory. This element is quantified using 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. There are five scour critical bridges located within the planning area and described as follows:

1. Ratford Bridge, CR 906
2. Mill Creek, CR 360
3. Sinking Creek, 308
4. Taum Sauk Creek, CR 206
5. Brushy Creek, CR 814

No scour critical bridges located within any corporate city limits in the planning area. Also, there exist no federal bridges in Reynolds County.

3.2.3 Other Assets[5(d)]

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.

There are within the county specific natural, historic, cultural, and economic assets including threatened and endangered species, natural resources, and historic resources.

Threatened and Endangered Species: Table 3.9 lists Federally Threatened, Endangered, Proposed and Candidate Species within the planning area.

Table 3.9. **Threatened and Endangered Species in Reynolds County**

Common Name	Scientific Name	Status
Gray Bat	Myotis grisescens	Endangered
Indiana Bat	Myotis sodalis	Endangered
Northern Long-Eared Bat	Myotis septentrionalis	Threatened
Eastern Hellbender	Cryptobranchus alleganiensis	Endangered
Ozark Hellbender	Cryptobranchus alleganiensis	Endangered
Pink Mucket	Lampsilis abrupta	Endangered
Western Fanshell	Cyprogenia aberti	Threatened
Big Creek Crayfish	Faxonius peruncus	Proposed Threatened
St. Francis River Crayfish	Faxonius quadruncus	Proposed Threatened
Monarch Butterfly	Danaus plexippus	Candidate
Mead's Milkweed	Asclepias meadii	Threatened
Virginia Sneezeweed	Helenium virginicum	Threatened
Hine's Emerald Dragonfly	Somatochlora hineana	Endangered

Source: U.S. Fish and Wildlife Service, http://www.fws.gov/midwest/Endangered/lists/missouri-cty.html and https://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 3.10 provides the names and locations of parks and conservation areas located within the planning area.

Table 3.10. **Parks/Conservation Areas in Reynolds County**

Park / Conservation Area	Address	City
Piedmont Park	821 County Road 418 (Wayne & Reynolds	Piedmont
Sutton Bluff Recreation Area	Mark Twain National Forest	Centerville
Centerville Access	none	near Centerville
Clearwater Conservation Area	none	unincorporated
Clearwater Lake Management Lands	none	unincorporated
Current River Conservation Area	none	unincorporated
Ketcherside Mountain Conservation Area	none	unincorporated

Lesterville Access	none	south of Lesterville
Logan Creek Conservation Area	none	unincorporated
Riverside Conservation Area	none	unincorporated
Rocky Creek Conservation Area	none	unincorporated
Johnson's Shut-Ins State Park	37.548056, -90.847500	unincorporated

Source: http://mdc7.mdc.mo.gov/applications/moatlas/AreaList.aspx?txtUserID=guest&txtAreaNm=s

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. The purpose of the program is to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. The National Register is administered by the National Park Service under the U.S Secretary of the Interior. Properties listed in the National Register include districts, sites, buildings, structures and objects that are significant in American history, architecture, archeology, engineering, and culture.

According to Andrew Rumbach—a professor of planning at the University of Colorado Denver, "Many historic resources were built before modern flood regulations and modern building codes, so they're located in areas that are prone to these kind of disasters." In some communities, historic structures may be integral to the area's local economy via the tourism industry. In others, such structures may provide a sense of identity and heritage to a community's residents. Two programs—the National Park Service's Certified Local Government Program and the National Main Street Program can assist local governments in identifying ways to mitigate damage to historic resources

No jurisdictions within the planning area participate in either program. The National Main Street Program helps member communities outline a clear deliberate path to revitalize and strengthen their downtown or commercial districts. The program is implemented by the National Mainstreet Center—a subsidiary of the National Trust for Historic Preservation. Through the program, communities develop a revitalization plan based upon market data and organized around economic vitality, design, promotion, and organization. There are no Main Street communities within the planning area.

The Certified Local Government Program is a partnership between national, state, and local governments developed to help communities save the irreplaceable historic character of places. Local communities must become certified as a CLG through a process overseen by the National Park Service, communities make a local commitment to historic preservation. Communities that have these programs typically have infrastructure designed to protect historic sites. There are no Certified Local Governments within Reynolds County.

Table 3.11 lists the properties in Reynolds County that are on the National Register of Historic Places.

Table 3.11. **Reynolds County Properties on the National Register of Historic Places**

Property	Address	City	Date Listed
Burford-Carty Farmstead S of Hwy J on	Burford-Carty Farmstead S of Hwy J on	Burford-Carty	Burford-Carty
Civil War Fortification at Barnesville	Civil War Fortification at Barnesville	Civil War	Civil War

Source: Missouri Department of Natural Resources – Missouri State Parks
https://mostateparks.com/page/85341/national-register-historic-places

Economic Resources: Table 3.12 below shows major non-government employers in the planning area.

Table 3.12. **Major Non-Government Employers in Reynolds County**

Employer Name	Main Locations	Product or	Employees
Doe Run Mining Company	Unincorporated	Mining	500
Southern Reynolds County R-II School District	Ellington	Education	50
Baker Enterprises	Ellington	Manufacturing	Not provided
Paramount Apparel	Ellington	Manufacturing	Not provided
Royal Oak, Inc.	Reynolds	Charcoal	Not provided

Source: Data Collection Questionnaires; local Economic Development Commissions

Agriculture: Agriculture does not play an important role in the Reynolds County economy. Table 3.13 below provides a summary of the agriculture-related jobs in Reynolds County.

Table 3.13. **Agriculture-Related Jobs in Reynolds County**

	Unpaid	1 Worker	2 Workers	3-4 workers	5-9 workers	10 or more workers
# of Farms	168	27	12	16	0	0
# of Workers	334	27	24	54	0	0

Source: 2017 Census of Agriculture - County Data

As of 2017, 55 farms in Reynolds County reported having workers with a total of 105 workers across all farms reporting such. Numbers were very similar in neighboring counties with 87 total workers in Iron County and 100 total workers in Shannon County. Using both 2017 ACS 5-Year Estimates and 2017 USDA data, the percentage farm-related jobs comprising the total workforce in each county was minimal with Reynolds County showing 2.0%, Iron County showing 1.0% and Shannon County showing 1.5%. Most farms located in the planning area are either hobby farms, or exist to meet family needs, such as the harvesting of cattle for beef for an individual farm-owning family. Of the county's 341 farms, 83.9% report having either no workers or only unpaid workers.

3.3 LAND USE AND DEVELOPMENT

3.3.1 Development Since Previous Plan Update[5(e)]

Few changes have occurred within the planning area since the previously approved plan was adopted. Consequently, the risk of property damage, injury, and death due to natural hazards within the planning area has been minimally impacted due to development in the past five years.

Table 3.14Table 3.14 provides population growth statistics for all cities in Reynolds County as well as Reynolds County a whole.

Table 3.14. **County Population Growth, 2010-2020**

Jurisdiction	Total Population 2010	Total Population 2020	2010-2020 # Change	2010-2020 % Change
City of Bunker	407	264	-143	-35.1
City of Centerville	191	186	-5	-2.6
City of Ellington	987	1,380	+393	+39.8
Unincorporated Reynolds County	5,111	4,266	-845	-16.5
Reynolds County	6,696	6,096	-600	-8.9

Source: U.S. Bureau of the Census, Decennial Census, Annual Population Estimates, American Community Survey 5-year Estimates; Population Statistics are for entire incorporated areas as reported by the Census Bureau

Table 3.15, below, provides the change in numbers of housing units within the planning area from 2010 to 2020.

Table 3.15. **Change in Housing Units, 2010-2020**

Jurisdiction	Housing Units 2010	Housing Units 2020	2010-2020 # Change	2000-2020 % Change
City of Bunker	196	149	-47	-24.0%
City of Centerville	99	76	-23	-23.2%
City of Ellington	488	423	-65	-13.3%
Unincorporated Reynolds County	3,250	2,847	-403	-12.4%
Total	4,033	3,461	-572	-14.2%

Source: U.S. Bureau of the Census, Decennial Census, American Community Survey 5-year Estimates; Population Statistics are for entire incorporated areas as reported by the U.S. Census Bureau

City of Bunker

Per the City of Bunker's Data Collection Questionnaire, there has been little change in development within the city sine the previous plan update. This assertion aligns with population and housing data provided by the American Community Survey, which indicates a lack of growth in the planning area.

City of Centerville

Per the City of Centerville's Data Collection Questionnaire, there has been little change in development within the city sine the previous plan update. This assertion aligns with population and housing data provided by the American Community Survey, which indicates a lack of growth in the planning area.

City Ellington

Per the City of Centerville's Data Collection Questionnaire, there has been little change in development within the city sine the previous plan update. This assertion aligns with population and housing data provided by the American Community Survey, which indicates a lack of growth in the planning area.

3.3.2 Future Land Use and Development[5(e)]

Neither Reynolds County, nor any of its three incorporated municipalities have comprehensive plans. Land use maps are also not available for any jurisdiction within the county. None of the school districts in the county have growth plans.

Growth in the county is not anticipated, and, consequently, is not anticipated to impact hazard risk in the planning area. Per the Missouri Census Data Center's ACS Profile Report for Reynolds County, the county's largest population group consists of persons between the ages of 65 and 74. This age group comprises 13.1% of the total population. It is reasonable to assume that as the members of this group age, population decline will occur within the county.

The remaining discussion in this section provides future growth and development information, where available, relative to each participating jurisdiction.

City of Bunker's Future Development

The City of Bunker has no land use or zoning regulations. Bunker is a small community with a 2016-2020 ACS population estimate of 264 persons—down from 407 in 2010. Other than the installation of a Dollar General store approximately six years ago, there has been no new development in Bunker in several years. No future growth or development is anticipated by local officials.

City of Centerville's Future Development

The City of Centerville has no land use or zoning regulations. Centerville is a small community and the county seat of Reynolds County. Centerville has a population of 186 persons per the ACS 2016-2020 estimates. Per this estimate, the population of Centerville has remained virtually stagnant with 186 persons reported by the Census in 2010. There has been no new development in Centerville in several years. Outside of hopes for a Dollar General store, no future growth or development is anticipated by local officials.

City of Ellington's Future Development

The City of Ellington has no land use or zoning regulations. Ellington is the population center of the county with 1,380 people estimated by the American Community Survey, up 39.8% from 2010 (987 people). There has been little development in Ellington in recent years. Since 2006, the city has implemented three flood buyout projects, with no replacement housing. Despite extraordinarily unusual population estimates by the American Community Survey, no future growth or development is anticipated by local officials.

School District's Future Development

The Lesterville R-IV School District was the only district to participated in the current plan update. The district has no plans for future construction of new facilities or renovation of its current facilities. Enrollment and employment numbers have remained stable over the past five years. The district has expressed interest in seeking funds with which to construct a community safe room. Such discussions, however, are in the preliminary phases.

Special District's Future Development

No special districts participated within the current planning effort.

3.4 HAZARD PROFILES, VULNERABILITY, AND PROBLEM STATEMENTS

Within the remainder of this section, each hazard will be analyzed individually in a hazard profile. The profile will consist of a general hazard description, discussions of the location, strength/ magnitude/extent of previous events, future probability, how risk varies among jurisdictions, and how anticipated development could impact that risk. At the end of each hazard profile will be a vulnerability assessment, followed by a summary problem statement including recommendations.

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.

Each hazard identified in Section 3.1.4 will be profiled individually in this section in alphabetical order. 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 areas in the planning area that are affected by the hazard. 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.
- **Strength/Magnitude/Extent:** This includes information about the strength, 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. This section should also include information on the typical or expected strength/magnitude/extent of the hazard in the planning area. Strength, magnitude, and extent can also include the speed of onset and the duration of hazard events. Describing the strength/magnitude/extent of a hazard is not the same as describing its potential impacts on a community. Strength/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. In most cases, events for the previous 20 years were provided for hazards that are random in occurrence. The data analysis period for hazard events that occur more regularly was shortened to ten years.
- **Probability of Future Occurrence:** The frequency of recorded past events is used to estimate the likelihood of future occurrences. Probability can be determined by dividing the number of recorded events by the number of years of available data 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 should be reported as 100% in any given year, with a statement of the average number of events annually. For hazards such as drought that may have gradual onset and extended duration, probability can be based on the number of months in

drought in a given time-period and expressed as the probability for any given month to be in drought.

- **Changing Future Conditions Considerations:**

  In addition to the probability of future occurrence, changing future conditions were also considered, including the effects of long-term changes in weather patterns and climate on the identified hazards.

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. In some cases, the vulnerability assessments were based on data collected for the *2018 Missouri State Hazard Mitigation Plan*.

The vulnerability assessments in this plan update will also be based on:

- Written descriptions of assets and risks provided by participating jurisdictions;
- Existing plans and reports;
- Personal interviews with planning committee members and other stakeholders; and,
- Other sources as cited.

Within the Vulnerability Assessment, the following sub-headings will be addressed:

- **Vulnerability Overview:**
  An overall summary of each jurisdiction's vulnerability to the identified hazards identifying structures, systems, populations or other community assets that are susceptible to damage and loss for hazard events.

- **Potential Losses to Existing Development:**
  (including types and numbers, of buildings, critical facilities, etc.) For each participating jurisdiction, the plan must describe the potential impacts of the hazard. Impact means the consequences of effect of the hazard on the jurisdiction and its assets. Assets are determined by the community and include, for example, people, structures, facilities, systems, capabilities, and/or activities that have value to the community. For example, impacts could be described by referencing historical disaster impacts and/or an estimate of potential future losses.

- **Previous and Future Development:**
  This section will include information on how changes in development, if any, have impacted the community's vulnerability to the referenced hazard. Furthermore, anticipated future developments within the planning area, if any, and their impact upon a community's hazard risk will be discussed.

- **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.

Problem Statements

Each hazard analysis will conclude with a brief summary of the problems created by the hazard in the planning area, and possible ways to resolve those problems. Jurisdiction-specific information will be provided in cases where the risk varies throughout the planning area. Mitigation actions may then be been developed to address the identified problems.

3.4.1 Flooding (Riverine and Flash)

Hazard Profile

Hazard Description [4(a)(2)]

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.

Flooding caused by dam failure is discussed in Section 3.4.2. It will not be addressed in this section.

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.

Ice jam flooding is a form of flash flooding that occurs when ice breaks up in moving waterways, and then stacks on itself where channels narrow. This creates a natural dam, often causing flooding within minutes of the dam formation.

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 are 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 *4(a)(1)*

Riverine flooding is most likely to occur in Special Flood Hazard Areas (SFHAs). Floodplain maps for the unincorporated portion of Reynolds County were last finalized by FEMA on September 30, 1988. Current floodplain maps for the City of Ellington are dated January 16, 1981, and those for the City of Centerville are dated August 1, 1996. The City of Bunker does not participate within the National Flood Insurance Program, has not been mapped, and is not at risk of riverine flooding. Maps showing the SFHA for all participating jurisdictions have been included within Appendix A to this document.

A floodplain mapping update project is currently underway within Reynolds County. The preliminary insurance of the revised floodplain maps is anticipated for late summer 2022. No Flood Risk Products have been developed for the planning area.

The table below provides the number of riverine flood events by location as recorded by the NCEI for the 26-year period between 1995 and 2021 within Reynolds County and its incorporated cities.

Table 3.16. **Reynolds County NCEI Riverine Flood Events by Location, 1995-2021**

Location	# of Events
Unincorporated Reynolds County	3
-Unincorporated County (unspecified) - 2 flood events	
-Unincorporated County (Martinsburg) - 1 flood event	

City of Bunker	0
City of Centerville	1
-City of Centerville (unspecified) - 1 flood event	
City of Ellington	0

Source: National Centers for Environmental Information, 2021

Flash flooding occurs in SFHA's and those locations in the planning area that are low-lying. It also occurs in areas without adequate drainage to carry away the amount of water that falls during intense rainfall events. The table below provides the number of flash flood events by location as recorded by the NCEI for the 20-year period between 2001 and 2021 within Reynolds County and its incorporated cities.

Table 3.17. **Reynolds County NCEI Flash Flood Events by Location, 1995-2021**

Location	# of Events
Unincorporated Reynolds County	13
-Unincorporated County (unspecified)- 2 flood events	
-Unincorporated County (North Portion) – 1 flood event	
-Unincorporated County (Lesterville) -3 flood events	
-Unincorporated County (Black) - 1 flood event	
-Unincorporated County (Greely) – 2 flood events	
-Unincorporated County (Munger) – 1 flood event	
-Unincorporated County (Exchange) – 1 flood event	
-Unincorporated County (Garwood) – 1 flood event	
-Unincorporated County (Fletcher Mine) – 1 flood event	
City of Bunker	0
City of Centerville	0
City of Ellington	3
-City of Ellington (unspecified) - 3 flood events	

Source: National Centers for Environmental Information, 2021

Strength/Magnitude/Extent

Missouri has a long and active history of flooding over the past century, according to the *2018 Missouri Hazard Mitigation Plan*. Flooding along Missouri's major rivers generally results in slow-moving disasters. River crest levels are forecast several days in advance, allowing communities downstream sufficient time to take protective measures, such as sandbagging and evacuations. Nevertheless, floods exact a heavy toll in terms of human suffering and losses to public and private property. By contrast, flash flood events in recent years have caused a higher number of deaths and major property damage in many areas of Missouri.

According to the U.S. Geological Survey, two critical factors affect flooding due to rainfall: rainfall duration and rainfall intensity – the rate at which it rains. These factors contribute to a flood's height, water velocity and other properties that reveal its magnitude.

National Flood Insurance Program (NFIP) Participation[5(c)]

Table 3.18, below, provides details on NFIP participation for the communities in the planning area. Table 3.19 shows the number of policies in force, the amount of insurance in force, the number of closed losses, and the total payments for each jurisdiction.

Table 3.18. **NFIP Participation in Reynolds County**

Community ID #	Community Name	NFIP Participant (Y/N) Sanctioned?	Current Effective Map Date	Regular-Emergency Program Entry Date
290829	Reynolds County	Yes, Not Sanctioned	9-30-1988	3-1-1993
-	City of Bunker	No	-	-
290311	City of Centerville	Yes, Not Sanctioned	8-1-1996	8-1-1986
290312	City of Ellington	Yes, Not Sanctioned	1-16-1981	1-16-1981

Source: NFIP Community Status Book, 6-1-2022 (https://www.fema.gov/cis/MO.html)

Table 3.19. **NFIP Policy and Claim Statistics as of August 20, 2022**

Community Name	Policies in Force	Insurance in Force	Closed Losses	Total Payments
Unincorporated Reynolds County	36	$1,715,300	57	$403,211.28
City of Centerville	4	$109,000	3	$15,000
City of Ellington	24	$3,242,500	72	$2,188,296.30

Source: PIVOT
*Closed Losses are those flood insurance claims that resulted in payment. Loss statistics are for the period from April 1976 to August 2022.

The jurisdiction with the most flood insurance payments is clearly the City of Ellington. To date, payments made to policies holders within the city amounted to $2,188,296.30, while the remainder of the entire county totaled $415,211.28. NFIP claims payments to policy holders within the City of Ellington comprised 83.9% of the total claims amounts paid within the county as a whole. No communities within the planning area are sanctioned by the NFIP. The City of Bunker does not participate within the program as all areas of its jurisdiction are Zoned X or C.

Repetitive Loss/Severe Repetitive Loss Properties[5(c)]

Repetitive Loss Properties are those properties with at least two flood insurance payments of $1,000 or more in a 10-year period. According to the Flood Insurance Administration, jurisdictions included in the planning area have a combined total of eight repetitive loss properties. As of July 15, 2022, no properties have been mitigated, leaving eight un-mitigated repetitive loss properties.

Table 3.20, below, provides providing a summary of the repetitive loss properties in the planning area.

Table 3.20. **Reynolds County Repetitive Loss Properties**

Jurisdiction	# of Properties	Type of Property	# Mitigated	Total Payments	Average Payment	# of Losses
Reynolds County	6	-	0	$246,698.466	$16,446.56	15
City of Centerville	0	-	-	-	-	-
City of Ellington	2	-	0	$21,488.06	$11,578.87	4

Source: *Missouri State Hazard Mitigation Plan, 2018*

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.

Per the *2018 Missouri Hazard Mitigation Plan*, there are no SRL properties within Reynolds County. Due to Federal restrictions on data sharing, the State of Missouri was unable to provide neither full Repetitive Loss data, nor current Severe Repetitive Loss data. “Property Type” was not available for Repetitive Loss properties. The Severe Repetitive Loss data cited here was obtained from the *2018 Missouri State Hazard Mitigation Plan*.

Previous Occurrences[4(a)(3)]

There have been nine presidential flooding disaster declarations that included the planning area. They are listed as follows:

DR-1023	Severe Storms, Tornadoes, & Flooding	4/9/94-5/5/94	No Damage Reported
DR-1749	Severe Storms & Flooding	3/17/08-5/9/08	PA $26,045,574.54 IA $13,924,227.09
DR-1809	Severe Storms, Flooding, & Tornadoes	9/11/08-9/24/08	PA $8,529,243.13 IA $6,869,983.55
DR-1748	Severe Winter Storms & Flooding	2/10/08-2/14/08	PA $10,068,998.77 IA $0
DR-1847	Severe Storms, Tornadoes, & Flooding	5/8/09-5/16/09	PA $27,072,334.75 IA $5,417,824.37
DR-1980	Severe Storms, Tornados, Flooding	4/19/11-6/6/11	PA $161,607,587.62 IA $37,115,639.63
EM-3374	Severe Storms, Tornadoes, Straight-Line Winds, & Flooding	12/22/15-1/9/16	No Damage Reported
DR-4250	Flood, Severe Storms, Tornados	12/23/15-1/9/16	PA $ $35,000,668.13 IA $13,173,843.43
DR-4317	Severe Storms, Tornadoes, Straight-Line Winds, & Flooding	4/28/17-5/11/17	PA $83,150,578.92 IA $12,527,583.31

Of the nine presidentially-declared disasters involving flooding, Reynolds County was deemed eligible for both public and individual assistance in four of the disasters: DR-1749, 1847, 1980, and 4317. DR-1980 was one of the most severe storms with 2,847 residences impacted. During DR-4317, 1,932 residences were either destroyed (396) or majorly damage (838) throughout the entire multi-county designated area. The reported per capita impact was $116.95 in Reynolds County—one of the highest per capita impacts of all declared counties. The community most heavily impacted within the planning area in both disasters was the City of Ellington.

Table 3.16 and Table 3.17, above, show the number of events of riverine and flash flooding which have occurred in Reynolds County in the past 20 years. During the 20-year period beginning July 28, 2001, 16 flash flood events occurred in Reynolds County. One of the events resulted in a death, while 4 events resulted in property damages totaling $762,000.

In the same time period, 3 riverine flood events occurred in Reynolds County. One of the events resulted in 2 deaths. Per the database, no injuries, property or crop damage resulted from the 3 events resulted. Table 3.21 summarizes the past effects of riverine flood events in the planning area.

Table 3.21. **NCEI Reynolds County Riverine Flood Events Summary, 2001 to 2022**

Year	# of Events	# of Deaths	# of Injuries	Property Damages	Crop Damages
Unincorporated Reynolds County	2	2	0	0	0
-Unincorporated Reynolds County (unspecified) – 1 flood event					
-Unincorporated Reynolds County (Martinsburg) – 1flood event					
City of Centerville – 1 flood event	1	0	0	0	0
City of Ellington	0	0	0	0	0

Source: NCEI, data accessed 6/15/2022

Data compiled by FEMA for use in their Data Visualization Tool found at https://www.fema.gov/data-visualization-floods-data-visualization reveals previous Public Assistance provided to various jurisdictions in the planning area. Review of previous Public Assistance grants can reveal repetitive damage sites which should be considered for mitigation.

Reynolds County Protective Measures - $299,037
Reynolds County Debris Removal - $432,455
Reynolds County Public Buildings - $500
Reynolds County Road & Bridge - $6,954,598
City of Ellington Debris Removal - $34,341
City of Ellington Protective Measures - $38,461
City of Ellington Public Building - $1,000
City of Ellington Recreational - $4,755
City of Ellington Roads & Bridges - $240,620
City of Ellington Public Utilities - $12,064
City of Centerville Debris Removal - $13,682
City of Centerville Roads & Bridges - $28,761
City of Centerville Public Utilities - $17,711
City of Centerville EMS - $9,335

Roads and bridges located within the unincorporated portion of the county are cited as the types of public property with the highest incidence of damage due to flash and riverine flooding. Per the data available, damage to roads and bridges resulting from flash and riverine flooding in the unincorporated portion of the county has cost the public nearly $7 million since August 1998.

The NCEI list of flash and riverine floods includes event narrative information specific to the planning area. The dates and pertinent information are provided below.

Flash Flood Events

7/28/2001 – 7/29/2001 Rainfall of 3 to 6 inches caused scattered flash flooding across parts of Iron, Madison and Reynolds counties. Numerous county roads were flooded.

5/15/2002 - 5/13/2002 Flash flooding started Sunday, Mother's Day, and continued into early Monday. Around 6 inches of rain fell on ground already saturated by previous rain. For several counties, it was the worst flooding in memory. Iron County was especially hard hit. Virtually every creek and small stream flooded closing roads throughout the county. There were numerous water rescues as people were trapped in their cars. Emergency shelters in the County were opened to help stranded motorists and people who were flooded out of homes. The story was similar in Reynolds County as Highways 49 and 21 had to be closed.

8/1/2001 Heavy rain caused flash flooding across the northern half of Reynolds County. The Middle Fork of the Black River flooded Highway 21. A campground in the area had to be evacuated due to the high water.

11/15/2005 Heavy overnight rain caused flash flooding across parts of Iron, Madison and Reynolds counties. In Reynolds County, the Bunker School District had to cancel classes for the day because of the number of roads that were impassable. Flooding was reported around Ironton in Iron County, and in Madison County, Highway M and County Roads 328 and 330 were impassable.

12/14/2005 On December 14, 2005, between approximately 5:15 - 5:30 a.m. CST, the Upper Reservoir of the AmerenUE Taum Sauk Hydroelectric Plant failed. About 1 billion gallons of water rushed down the side of Proffit Mountain to the East Fork of the Black River which flows through Johnson's Shut-Ins State Park. The rush of water destroyed virtually everything in its path leaving nothing but bare bedrock on the mountainside immediately downstream from the break.

The Superintendent of Johnson's Shut-Ins State Park, his wife and three children were injured when the flood water completely swept away their home which was located on Highway N near the entrance to the park. The three children were taken to a St. Louis hospital in critical condition, but all recovered. There was nothing left of the home except for a foundation filled with water. A dump truck filled with zinc, a tractor-trailer carrying logs, and a car were swept off Highway N by the water as well. The occupants were not injured.

Johnson's Shut-Ins State Park suffered major damage. The park store, a campground, and a playground were filled with trees, rocks and other debris. Hundreds of yards of wooden walkways were damaged. Picnic tables were swept away and a layer of mud covered much of the park. The park is a major recreation area during the spring and summer months. At peak times, there are a couple thousand people in the park. Luckily, there was no one in the park at the time of the flood.

The East Fork of the Black River flows through Johnson's Shut-Ins State Park to the Lower Taum Sauk Reservoir. The Lower Reservoir held most of the incoming water, with the excess water flowing over the dam spillway. There was minimal damage to the Lower Reservoir.

6/29/2007 Heavy rain caused flash flooding in Ellington, MO. The county sheriff reported some roads in Ellington had up to 2 feet of water covering them.

9/9/2007 Two to three inches of rain fell over a short amount of time on ground that was already saturated from previous rains (2 to 5 inches) in the previous 24 hours. The sheriff's department evacuated Twin Landings Camping Park, just north of Lesterville, due to more than one foot of water on the roads and the threat of additional rains. Several trees fell down onto Highway 21 in Lesterville because of the saturated soils.

3/18/2008 Very heavy rain fell over Reynolds County beginning late on the 17th of March and throughout the day on the 18th. The co-operative observer in Ellington reported a storm total of 9.7 inches. Four inches of rain fell in Ellington through 8 am on the 18th, then another 2 inches fell between 8 am and 11 am on the 18th, with an additional 3.7 inches in the hours after that. This caused the creeks in the area to rise rapidly including Logan Creek which flows through the middle of Ellington. The creek rose nearly 10 feet by noon. Around 8 am, an 81-year-old man was trying to clear some flood debris from a bridge that goes over the creek next to his business and was possibly knocked into the flood waters by a camper trailer that had been washed away from its location. He was pronounced dead at 8:30 am. Homes and businesses were flooded in town and several propane tanks were floating in the flood waters. Numerous roads throughout Reynolds County were flooded due to the heavy rains.

4/10/2008 Between 2 and 3 inches of rain fell in a short amount of time on already saturated soils. This caused some flash flooding, especially over the eastern sections of the county. Numerous roads were closed due to flooding including Highway N and Highway 49 about 3 miles southeast of the intersection with Highway 21. Also, in Centerville a creek overflowed out of its banks causing water to rise on several roads in town near the creek and affected several buildings in town.

6/9/2009 Up to three inches of rain fell in a short amount of time causing flash flooding. Several roads were flooded including Route F just west of Highway 106.

8/18/2009 Up to six inches of rain fell in a short amount of time causing flash flooding. Two feet of flowing water covered Highway U east of Lesterville.

4/23/2011 Between six and nine inches of rain fell over several days in Reynolds County. Numerous roads were flooded including Route B south of Reynolds, Highway F just west of Ellington, and Route 106 in Ellington. The heavy rain caused Logan Creek in Ellington to rise above record levels and prompted portions of town to be evacuated due to flooding.

12/28/2015 Between three and six inches of rain fell across the county in a 48-hour period. The heaviest rain fell in the early morning hours of December 28th causing flash flooding. Numerous roads were flooded including Route F where Logan Creek passes under it, the intersection of Highway 106 and Route B due to Logan Creek being well out of it's banks and Route CC from County Road 465 to the Wayne County line. Damage so far has been estimated around $355,000.

4/29/2017 Between seven and ten inches of rain fell causing widespread flash flooding. Numerous roads were flooded across Reynolds County including Route F west of Ellington. A number of water rescues had to be performed in Ellington due to Logan Creek rising well above its banks. Also, there were water rescues performed in Lesterville due to flash flooding. In Ellington, the only grocery store and a Dollar General store were flooded.

2/24/2018 A number of rounds of rain moved through the region over several days. Thus the soils were saturated. Between one and three inches of rain fell in a short amount of time causing flash flooding. Numerous roads were flooded including Highway F west of Ellington.

7/31/2020 Up to four inches of rain fell in a short amount of time causing flash flooding. Several roads were flooded around the Ellington area including Highway F leading up to the bridge that crosses Logan Creek, just north of intersection with Highway 106.

Riverine Flood Events

5/7/2002 – 5/19/2002 Several heavy rain events caused the Black River to flood through most of the period. Since it is a small flashy river, it rose over and fell back under flood stage several times. The river peaked about 13.5 over flood stage on May 15. Several roads in the area were closed at various times due to the flooding.

1/13/2007 General flooding occurred across parts of Southeast Missouri due to 1 to 3 inches of rain. Small creeks and streams flooded and many low-water crossings became impassable. Several inches of rain caused flooding of small creeks and streams and low-water crossings across much of Reynolds County.

11/17/2015-11/18/2015 Up to 6 inches of rain fell over two days in Reynolds County. This caused streams, creeks and low water crossings to flood. Two men drown while trying to cross low water crossings. A 49-year-old man was in his truck on County Road 814, just south of Highway J. He attempted to cross Brushy Creek and was swept downstream toward the Black River. His body was located the next day. Another man, age 40, tried to cross a low water crossing in his vehicle on County Road 510, just west of Clearwater Lake. His body and vehicle were swept downstream. Both incidents occurred between 2 am and 3 am Wednesday morning, November 18th.

Probability of Future Occurrence

Probability can be calculated by analyzing the numbers of events occurring in a set number of years and dividing the number of events by the number of years. Regarding the probability of a flash flood event occurring in Reynolds County in any given year, 16 events is divided by 20 years resulting in an average of

less than one event per year, or four events in a five-year period. Using the same formula (3 events/20 years), .15 riverine floods can be expected to occur somewhere in the planning area in any given year. This is the equivalent of one riverine flood event occurring somewhere within the planning area every six to seven years.

Changing Future Conditions Considerations[4(c)]

According to the 2018 Missouri State Hazard Mitigation Plan, "over the last half century, average annual precipitation in most of the Midwest has increased by 5 to 10 percent. Rainfall during the four wettest days of the year has increased about 35 percent, and the amount of water flowing in most streams during the worst flood of the year has increased by more than 20 percent." If this increased precipitation intensity continues, the frequency of flooding within the planning area is likely to increase. Such changes in climate patterns can lead to the development of compounding events that interact to create extreme conditions. Flooding caused by high groundwater levels typically recedes more slowly than riverine flooding, slowing the response and recovery process.

Per the state plan, "Communities already prone to flooding should be prepared for a potential increase in facility closures and/or damages, as well as an increase in public demand for flood response and assistance."

Vulnerability[5(b); 5(d)]

Vulnerability Overview

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. In some instances, steep slopes that are saturated with water may cause mud or rock slides onto roadways. These damages can cause costly repairs for state, county, and city road and bridge maintenance departments. When sewer back-up occurs, this can result in costly clean-up for home and business owners as well as present a health hazard.

Potential Losses to Existing Development

As reported within the University of Missouri GIS Department's MSDIS Structure Inventory & All Hazard Risk Dataset, there are 4,483 structures located in Reynolds County. The City of Bunker is home to 115 structures, the City of Centerville, 81 structures, and the City of Ellington, 484 structures. The remainder (3,803, or 84.8% of total structures in the planning area) are located in balance of the county. The total structure value in the planning area is estimated at $423,248,000, with contents valued at $233,364,000. The majority of structures in each jurisdiction are typed as residential and valued, in total, at $560,562,000. Residential structures comprise an estimated 85.4% of total structure value in the planning area.

Unfortunately, Reynolds County does not have a digital Flood Insurance Rate Map (DFIRM).

Consequently, MSDIS was unable to calculate the definitive number of Reynolds County structures located within the Special Flood Hazard Area (SFHA)/100-year floodplain. Such analyses would prove beneficial in planning mitigation actions pertaining to flood—particularly within the Cities of Ellington and Centerville. It should be noted that an effort is underway to produce new digital flood hazard boundaries and a DFIRM. Preliminary boundaries were not available as of the compilation of this risk assessment.

Per the *2018 Missouri State Hazard Mitigation Plan* (State Vulnerability Overview and State Estimates of Potential Losses), **"**Hazus software was utilized to generate the flood hazard boundary and associated depth of flooding. Model parameters included:

- Thirty-meter resolution Digital Elevation Models (DEM) were used as the terrain base to develop hydrologic and hydraulic models;
- Streams and rivers with a minimum drainage basin area of 10 square miles were modeled as all experiencing a base flood at the same time; and,
- U.S. Geological Survey hydrologic regional regression equations and stream gage data were included in Hazus."

HAZUS software was utilized to generate the flood hazard boundary and associated depth of flooding. Per the analysis, total building exposure to flood in the planning area is $669,647.000, with potential structural damage amounting to $25,922,000 and a loss ratio of 3.87%--the fourth highest of the state's 114 counties. The total exposure to building contents and inventory in the county is $31,244,000 and $11,000,000, respectively. MSIDS estimates 180 exposed structures county-wide, while Hazus estimates 97 exposed structures, with 28 of those receiving substantial damage.

Per the *2018 Missouri State Hazard Mitigation Plan*, there exist six repetitive loss properties within the unincorporated portion of the county and two within the City of Ellington. There are no reported severe repetitive loss properties. Per a search of the PIVOT database conducted by the State Emergency Management Agency during August 2022, 132 flood insurance claims totaling $2,606,507 had been paid from 1976 to 2002. The majority of those funds—84%--were distributed to policy holders with flood-damaged structures in the City of Ellington.

The Reynolds County Ambulance District headquarters is located within an area subject to flooding in the City of Centerville. Within the City of Ellington, the county's only grocery store and general store are vulnerable to flooding during heavy rain events. In 2017, the structures—located adjacent to each other—were inundated with multiple feet of water and closed for months leaving county residents without a local food supply.

Impact of Previous and Future Development[4(c); 5(f)]

Development of any kind can impact flash and riverine flooding within and around the development area. The installation of impervious (concrete, asphalt, etc.) increases stormwater runoff. Impervious surfaces do not allow water to be absorbed by the soil resulting in rainfall collections and flash flooding. At the time of this plan update, there was no development in low-lying areas near rivers and streams known to the MPC. While there are inadequate drainage systems within the Cities of Centerville and Ellington, no development within the affected areas of the two cities is anticipated. No additional installation of large-scale development involving impervious surfaces is planned for the two cities.

In the past decade, the City of Ellington has conducted two residential flood buyout projects. While these projects have decreased the city's vulnerability to flooding, the city has experienced population loss as replacement housing is scarce. Neither Centerville, or Reynolds County have engaged in such activities primarily due to limited funding and more pronounced demand from neighboring

counties (Carter and Reynolds). No other changes in development within flood-prone areas were determined to impact vulnerability within the planning area.

Hazard Summary by Jurisdiction

Per the floodplain maps found in Appendix A differences in risk by jurisdiction can be noted. Furthermore, Tables 3.15 and 3.16 show the type and number of events by location. Per the floodplain maps and Data Collection Questionnaires, in was determined that the participating school district did not have assets located within floodplains.

Each jurisdiction within the county has a different level of risk for flooding. Areas near the Black River, Current River, Brushy Creek, and Logan Creek or any other low water areas have a higher risk of being damaged during a flood or flash flood event. The City of Ellington—the county's population center is at a higher risk of damage during an event. The previous tables and narrative contain information regarding historical flooding events including the locations in which they occur. Until mitigation actions are implemented, the areas cited are at a higher risk of experiencing similar flooding events when compared to other portions of the planning area. Such areas have been summarized below.

Reynolds County – The unincorporated areas of Reynolds County is perhaps the most susceptible to future flooding events within the entire planning area. This is due to both the size of the county and historical data showing the high number of floods within the unincorporated portion of the county. Event narrative found within the NCEI Storm Event Database for the past 20 years cites the following areas in the county as most frequently flooded:

- Highway 21 near the Middle Fork of the Black River (3 events)
- State Highway N in the northeast portion of the county (1 event)
- State Highway 49 in the northeast portion of the county (2 events)
- State Highway CC in the northeast portion of the county (1 event)
- State Highway U near Lesterville (1 event)
- State Highway B – Logan Creek (2 events)
- State Highway F west of Ellington, Logan Creek – 6 events
- State Highway 106 west of Ellington (Logan Creek – 2 events
- County Road 814, Brushy Creek – 1 event, 1 death
- County Road 510, Doe Run Creek – 1 event, 1 death
- Lesterville Area, Black River – 2 events

Per FEMA records, Public Assistance provided in response to flood disasters is most often redeemed by the county for repairs to its roads and bridges. Specifically, since 1998, $6,954,598 in total repair cost has been incurred.

City of Bunker – The City of Bunker is not susceptible to flood events and does not participate within the National Flood Insurance Program.

City of Centerville – Areas referenced within event narrative found within the NCEI Storm Event Database cite the City of Centerville has having been affected by one flash flood event within the past 20 years. Public Assistance payouts indicate flood damage to roads and bridges, public utilities, and emergency medical facilities totaling $60,154.

City of Ellington – Areas referenced within event narrative found within the NCEI Storm Event

Database cite the City of Ellington has having been affected by four flash flood events within the past 20 years. One death and significant property damage have resulted from all flooding events affecting the city. Public Assistance payouts indicate flood damage to roads and bridges, public utilities, public buildings, and recreational facilities totaling $331,241 over the past 20 years. Flash flooding primarily from the Logan Creek is the greatest flood-related threat to the City of Ellington. 84% of NFIP claims paid between 1976 and 2002 were made to owners of property located within the jurisdictional boundaries of Ellington.

Lesterville R-IV School District – There are no school district assets located within the Special Flood Hazard Area. Given the numerous natural streams and manmade impoundments located within the districts service area, school bus transportation routes will be affected during flash flood events.

Problem Statement

As expected, certain portions of Reynolds County are more at risk of future flooding events than are others, such as areas that lie within the 100-year flood plain. The county is laced with multiple streams and creeks, during flood events, many of the streams and creeks flow out of their banks. The flooding occurs in the areas of lower elevations as the rain waters flow downhill from the upper elevations. Areas such as Bunker are immune to flooding for the most part, while the Cities of Centerville and Ellington have ongoing flooding issues. The county's only grocery store and its ambulance district headquarters are subject to sometimes severe flooding.

During this planning process the Hazard Mitigation Planning Committee established goals to prevent loss of life and damage from future flooding events. Possible solutions follow:

- Offer assistance in relocating the grocery store and general store located within the City of Ellington to higher ground—both damaged and closed by prior flood events;
- Determine and install mitigation structures to contain the source of flooding (Logan Creek) within the City of Ellington, thereby, preventing flooding of numerous residential properties, a recreational facility, city park, and the county's only grocery store;
- Analyze strategies to alleviate flooding along State Highway F west of Ellington;
- Explore CRS participation for the City of Ellington to lower flood insurance premiums and increase policy purchases;
- Relocate the Reynolds County Ambulance District headquarters building to an elevated more centralized location within the county outside of the Special Flood Hazard Area (SFHA); and,
- Request MSDIS analysis of number and types of structures within the Special Flood Hazard Area pending the release of digital flood hazard boundary data and examine analysis for potential mitigation action identification/revision.

3.4.2 Dam Failure[4(b)(1)b; 4(b)(2,3)]

Hazard Profile

Hazard Description

A dam is defined as a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Dams are typically constructed of earth, rock, concrete, or mine tailings. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, affecting both life and property. Dam failure can be caused by any of the following:

1. Overtopping: Inadequate spillway design, debris blockage of spillways or settlement of the dam crest.
2. Piping: Internal erosion caused by embankment leakage, foundation leakage and deterioration of pertinent structures appended to the dam.
3. Erosion: Inadequate spillway capacity causing overtopping of the dam, flow erosion, and inadequate slope protection.
4. Structural Failure: Caused by an earthquake, slope instability or faulty construction.

Both the Missouri Department of Natural Resources (MoDNR) and the U.S. Army Corps of Engineers maintain inventories of dams. The National Inventory of Dams (NID), is maintained by the U.S. Army Corps of Engineers (USACE). The MoDNR database contains information for dams located within the State of Missouri.

In Missouri, dams less than 25 feet are generally not inventoried and are unregulated by the Missouri Department of Natural Resources. Dams taller than 25 feet but less than 35 feet are inventoried by the department with some dam data (e.g. height, etc.) provided to the National Inventory of Dams. Dams within this size category, however, remain unregulated in the State of Missouri. And, finally, dams 35 feet or more in height are regulated by the department. Construction and operation of such dams require a permit.

Table 3.22, below, outlines the classification system—defined by inundations areas—Missouri uses to describe dams. There are no Class I dams located in Reynolds County. There are eight dams in the planning area defined as Class II. These eight dams must be inspected every three years and are the same eight dams in the county classified by the USACE as "High Hazard" dams. Table 3.23 outlines the classification system used by the U.S. Army Corps of Engineers within its National Inventory of Dams, which defines dams by size and potential loss of life assuming failure.

Table 3.22. **MoDNR 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 dwellings, or one or more campgrounds with permanent water, sewer, and electrical services or one or more industrial buildings. Inspection of these dams must occur 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

Table 3.23. **NID Dam Hazard Classification Definitions**

Hazard Class	Definition
Low Hazard	Loss of one human life is likely if the dam fails.
Significant Hazard	Possible loss of human life and likely significant property or environmental destruction.

High Hazard	Equals or exceeds 25 feet in height and which exceeds 15 acre-feet in storage, or equals or exceeds 50 acre-feet of storage and exceeds 6 feet in height.

Source: *National Inventory of Dams*, US Army Corps of Engineers

Geographic Location

Dams Located Within the Planning Area

There are twenty-three dams located within Reynolds County. Sixteen of these dams are considered high hazard dams by the U.S. Army Corps of Engineers (USACE) while three are considered significant hazard dams. Five dams in the planning area are classified as low hazard dams and are not profiled within this section. No dams physically located in Reynolds County are owned or operated by the (USACE). The Clearwater Lake Dam is owned and operated by the USACE, but is located immediately outside of the county's jurisdictional boundary in neighboring Wayne County. Of the 23 high hazard dams located within Reynolds County, seven are owned by private entities involved with the mining industry.

Table 3.24**,** below, lists the names, locations, and other pertinent information for all high hazard dams in the planning area. The term "acre-foot" is defined as the amount of water needed to inundate one acre of land at a depth of one foot. "Distance to Nearest City" was estimated as straight-line or aerial distance, rather than stream distance. An "Emergency Action Plan" is a formal document which outlines preplanned actions to be followed by the dam owner to mitigate damages and loss of life resulting from dam failure. All dams classified by the State of Missouri as Class I dams are classified by the USACE as high hazard dams, with the exception of Brushy Creek Tailings #3 Dam, which is not noted by the USACE as existing and cannot be seen on aerial imagery. Those dams located within the planning area, designated by the USACE as high hazard, and classified by the State of Missouri as Class I dams and are included within the table below.

Table 3.24. **High Hazard Dams in the Reynolds County Planning Area**

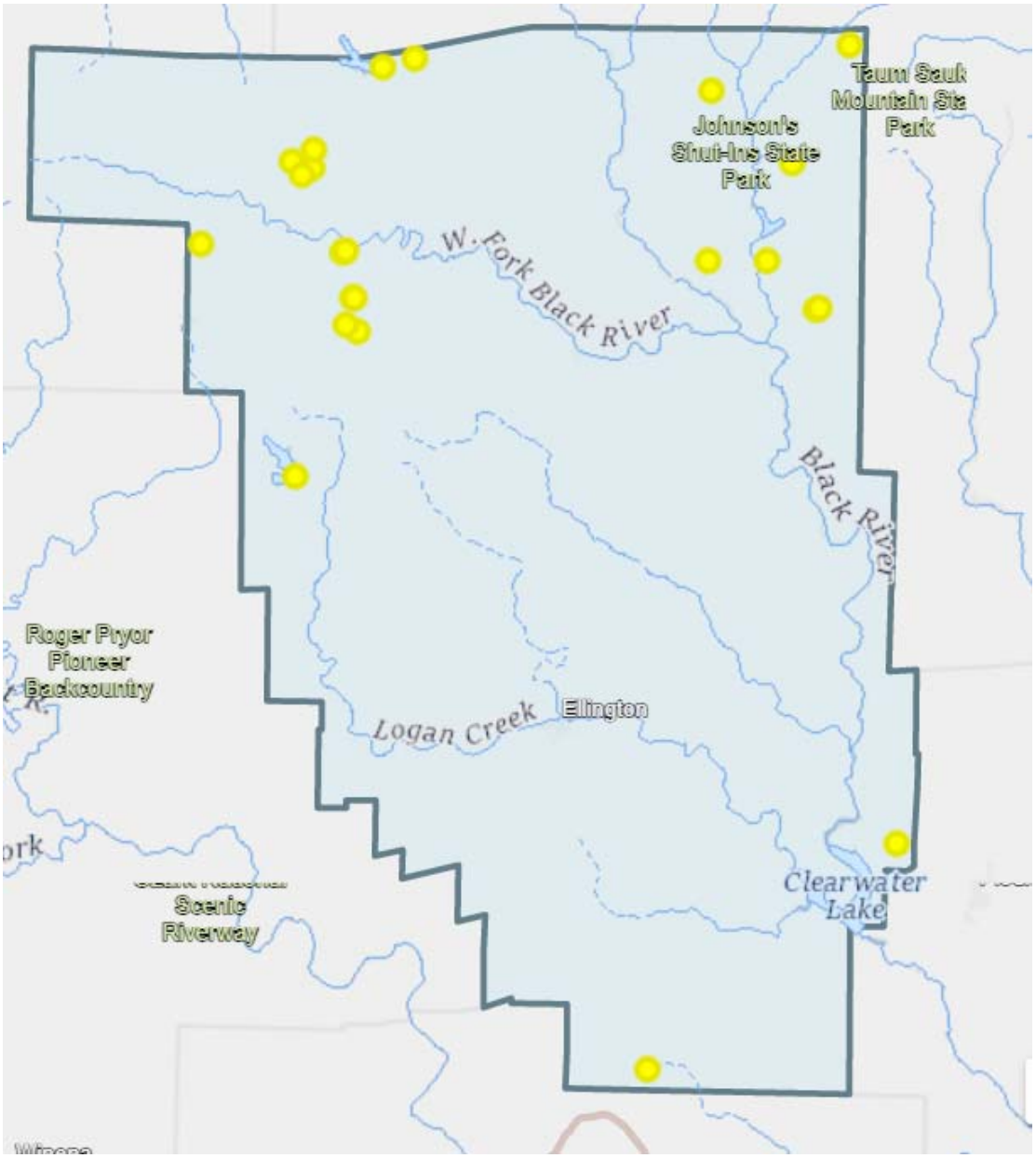
Dam Name	Emergency Action Plan (EAP)AP	Dam Height (Ft)	Normal Storage (Acre-Ft)	Last Inspection Date	River	Nearest Downstream City	Distance To Nearest City (Miles)	Dam Owner
Brushy Creek Tailings #2	No	184	25,626	Unknown	Lick Creek	Centerville	14.5	Doe Run Company
Brushy Creek Mine Water Clarification	Not Required	34	291	10-22-2018	Brushy Creek	Oates	5	St. Joe Minerals
Roy Davis Dam	Not Required	26	111	8-20-1979	Smalls Creek – West Fork	Centerville	20	Roy Davis
Wiggins Ozark Camp Dam	Not Required	28	240	11-20-1978	Tr-Mid-Fork Black River	Lesterville	3	William Wenzel
Firepit Lake Dam	Yes	58	1,523	4-13-2017	Tr-East Fork Black River	Lesterville	15	Private
Fletcher Mine Clarification Da	Yes	51	510	4-13-2017	Tr-Bee Fork	Centerville	14	Doe Run Company
Sela Land Dam	Not Required	30	32	4-30-1979	Clay Lick Hollow	Lesterville	2	Loraine Pershall
Okkapassa Dam	Not Required	28	184	4-30-1979	Clay Lick Hollow	Lesterville	2	Loraine Pershall

Taum Sauk Ps Upper	Yes	125	4,350	9-30-2020	East Fork Black River	Lesterville	6	Union Electric Company
Taum Sauk Ps Lower	Yes	60	6,350	9-30-2020	East Fork Black River	Lesterville	3	Union Electric Company
Westfork Main Dam	Yes	132	7,500	4-12-2018	Tr West Fork Black River	Reynolds	14	Private
Westfork Southeast Dam	Yes	115	1,010	4-12-2018	Tr West Fork Black River	Reynolds	14	Private
Buick Tailings Dam	Yes	144	5,404	6-17-2016	Strother Creek	Oates	3	Doe Run Company
Fletcher Tailings Dam	Yes	201	5,333	1-5-2009	Tr Bee Fork	Cenerville	12	Doe Run Company
Brushy Creek Tailings	Yes	205	4,438	1-8-2018	Tr-Bills Creek	West Fork	6	Doe Run Company
Sweetwater Tailings Dam	Yes	130	23,467	6-7-2017	Adair Creek	Corridon	4.5	Doe Run Company

Sources: Missouri Department of Natural Resources, https://dnr.mo.gov/geology/wrc/dam-safety/damsinmissouri.htm and National Inventory of Dams, http://nid.usace.army.mil/cm_apex/f?p=838:12.

Figure 3.3. High Hazard Dam Locations in Reynolds County and

Areas Impacted in the Event of Breach

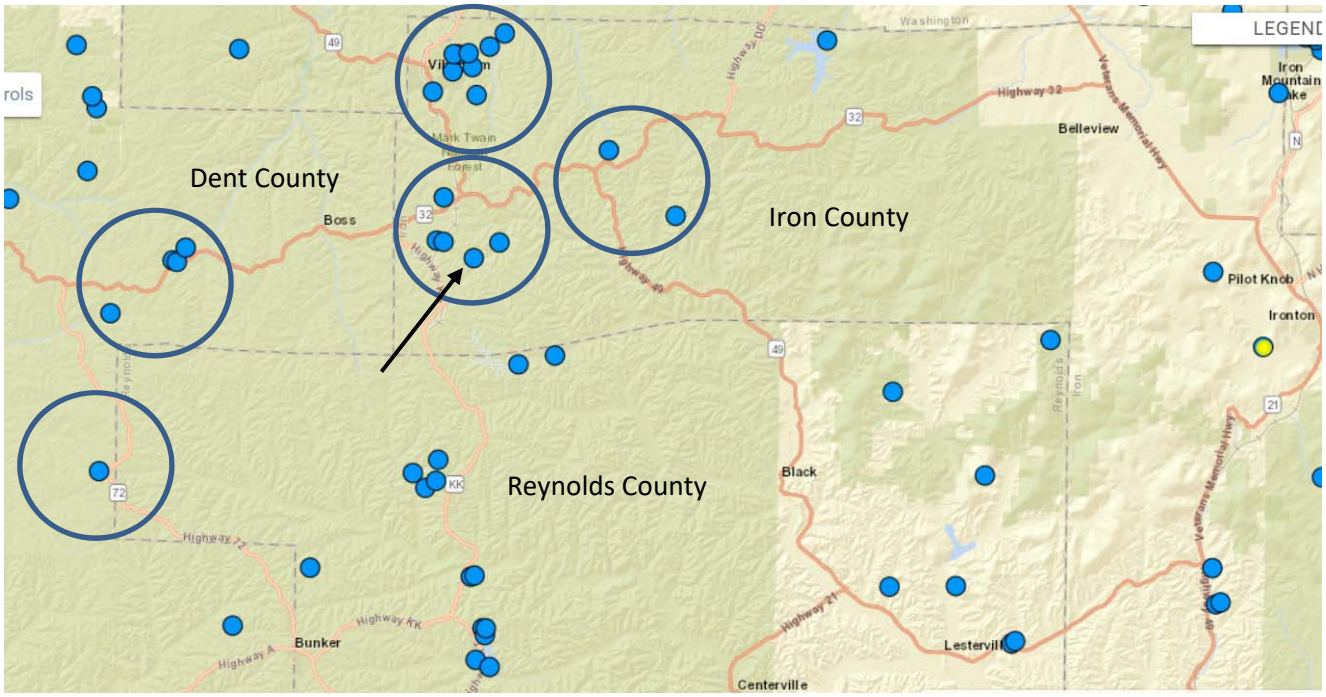


Source: U.S. Army Corps of Engineers, Missouri Department of Natural Resources

Upstream Dams Outside the Planning Area

There are 20 dams located potentially upstream of the planning area. The map below depicts the locations of those 20 dams. Per inundation maps and emergency action plans provided by the Missouri Department of Natural Resources, Dam and Reservoir Safety Program, only one of the dams—the Magmont Tailings Dam located in Iron County—will impact Reynolds County in the event a structural failure. One residence in the northern portion of the planning area is located within the inundation area of this dam 8.5 miles downstream near Black. Should a failure occur, the residence would be consumed by two feet of water within 2,100 minutes of the event. (See Appendix B.) The Magmont Tailings Dam is indicated with a black arrow in the map below.

Figure 3.4. Upstream Dams Outside Reynolds County



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

Strength/Magnitude/Extent

Typically, the severity of a dam failure would be similar in some cases to the impacts associated with flood events. (See the flood hazard vulnerability analysis and discussion.) The strength, magnitude, and extent of dam failure is related to the volume of water behind the dam, as well as the potential speed of onset, depth, and velocity. Because of this, it should be noted that, dam failures could flood areas outside of mapped flood hazards.

Based on the hazard class definitions, failure of any of the High Hazard/Class I dams could result in a 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. Note that for this reason, dam failures could flood areas outside of mapped flood hazards.

The probable severity of a future dam failure event in Reynolds County depends primarily upon two variables—the location and size of the dam in question. As stated above, there are 16 high hazard dams located in the county—all of varying sizes. Should any one of these structures fail, resulting damages could range from limited to severe depending upon both the dam's location and its size. For example, many dams are very large impoundments (5,000 acre-feet or more) are located in remote areas of the county. Should one of these structures fail, damages to transportation infrastructure and natural resources could occur but few residences would be directly impacted.

Of the dams located in Reynolds County, the Missouri Department of Natural Resources shows 11 as holding more than 500 acre-feet of water, while twelve are shown to hold between 100 and 500 acre-feet. The remaining four, for which data is available, hold less than 100 acre-feet of water.

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). Yet, catastrophic failure of a high hazard dam could result in severe destruction due to the potential speed of onset and greater depth, extent, and velocity of the flood waters. For this reason, dam failures could flood areas beyond mapped flood boundaries. Based on the USACE dam hazard class definitions, failure of a dam classified as "high hazard" could result in loss of life, serious damage to residential, industrial or commercial areas, public utilities, public buildings, or major transportation facilities.

Inundation maps showing the geographic location at risk are available only for the Firepit Lake Dam in northern Reynolds County and the Fletcher Mine Clarification Dam in the north central portion of the county. Emergency Action Plans (EAP's), however, are available for the following dams located within the planning area:

- Brushy Creek Tailings Dam (EAP)
- Buick Mine (EAP)
- Fletcher Mine Tailings Dam (EAP)
- Sweetwater Tailings Dam (EAP)
- West Fork Dams (EAP).

These maps and EAP's are included in Appendix B of this plan.

Recent inspection reports from the MDNR for all high hazard dams regulated by the State were requested of the Missouri Department of Natural Resources. Representatives of the Dam and Reservoir Safety Program within the department indicated that the reports could not be released due to privacy and safety reasons.

Previous Occurrences

There has been one significant dam failure occurring within the planning area. On December 14, 2005, the upper reservoir of the Taum Sauk Mountain Hydroelectric Plant overtopped due to operator error causing catastrophic failure of the massive structure. The dam measured 6,562 feet in length and 125 feet tall.

As reported by damfailure.org, a breach 656 feet in length developed in the early morning hours along the northwest corner of the structure. Within 25 minutes, 4,300 acres-feet of water traveled "down Proffit Mountain toward the Black River with a peak discharge of 273,000 cubic-feet per second. Before it reached the river and flowed into the Lower Reservoir where it was entirely contained, the flood destroyed 281 acres of Johnson's Shut-Ins State Park and ripped the superintendent's home from its base. By chance alone, loss of life was averted and only four people sustained injuries. However, estimates of the destruction and property damage caused by the failure and ensuing flood reached $1 billion. Damage consisted of washing out the reservoir embankment, trees, and soil, and scouring the ground to bedrock in places.

Figure 3.5. Upper Taum Sauk Reservoir Following Breach – December 2005

Figure 3.6. Aerial View of Taum Sauk Upper Reservoir Breach, Reynolds County, Missouri

There have been no other dam failures reported within the county.

Probability of Future Occurrence

Regular inspection and maintenance of high hazard dams is necessary to prevent structure failure, consequential loss of life, and property damage. Regular inspections can identify structural deficiencies before failure occurs; while, regular maintenance helps preserve the integrity and functionality of the structure, thereby lessening the probability of dam failure. Inspection records exist for all but one high hazard dams in Reynolds County—the Brushy Creek Tailings #2 Dam.

The State of Missouri Department of Natural Resources (MDNR) is charged with inspecting all dams more than 35 feet high once every three years. Twelve of the 16 USACE-designated high hazard

dams located within the planning area meet the requirements for inspection by the MDNR. Per inspection dates reported by the USACE's National Inventory of Dams (NIV), most inspections of dams located within the county appear to be conducted per the Class identification described in Table 3.2.

There are no USACE inspected dams located within the planning area. The Clearwater Lake Dam is a USACE maintained and inspected dam located along the southeastern corner of Reynolds County in neighboring Wayne County. Should this structure fail, the directly affected area will be in Wayne County.

According to all available data sources there has been one significant dam failure in the county—the Taum Sauk Upper Reservoir in December 2005. Based upon previous occurrence(s), it is reasonable to assume that a dam failure will occur at some point within the county in the next 75 years. Per the *2018 Missouri State Hazard Mitigation Plan*, during the 42-year period from 1975 to 2016 for which dam failure statistics are available, one dam failure has been recorded within the county. According to this data, annual probability calculates to a 100% percent annual probability of a dam failure in the planning area within the next 25 years, or a 2.4% chance of a dam failure within the county in any given year. This probability was calculated assuming one event per 42 years with the last event occurring during 2005.

It should be noted that historical dam failures and incidents include events from all hazard classes and all dams (whether regulated or un-regulated). Failures and incidents for regulated dams that have higher inspection frequencies should be less probable.

Changing Future Conditions Considerations

Climate change projections suggest that precipitation may increase and occur in more extreme events, which will likely increase risk of flooding, thereby placing additional stress on dams. This increased pressure directly increases the likelihood of a dam failure. Two dams in the planning area are maintained by private property owners who may lack resources to conduct regular dam maintenance. Regular dam maintenance becomes paramount to preserving the function of the structure. The lack of regular maintenance most common with privately maintained dams, further increases the risk of future structural failure.

Vulnerability

Vulnerability Overview

Per the Standard University's National Performance of Dams Program found at http://npdp.stanford.edu/, the number of fatalities and property damage resulting from a dam failure is a function of a number of factors. These include (but are not limited to):

- the size of the dam and reservoir;
- the depth and velocity of flooding that occurs downstream;
- the population-at-risk at the time of the failure;
- the location of the population-at-risk within the inundation area;
- the location of safe havens; and,
- the effectiveness of local emergency management services.

Per the same source, the majority of the dams that have failed were 50 feet or less in height and between 5 and 10 years old.

For NID-identified high hazard dams, the county's dam failure vulnerability analysis was conducted by visually identifying assets (structures and transportation routes) located in dam breach inundation areas using aerial imagery. It was determined, per the *2018 Missouri State Hazard Mitigation Plan*, there are no persons or property located downstream of any state-regulated dams within the planning area. It should be noted, however, that two of the county's high-hazard dams—the Upper and Lower Taum Sauk Dams—are regulated by the USACE and not the State of Missouri. Consequently, individual analyses were conducted for each of these structures. Interestingly, the Taum Sauk Upper Reservoir Dam is classified by the State of Missouri as a Class 3 dam, while the Taum Sauk Lower Reservoir Dam is categorized as a Class 2 dam.

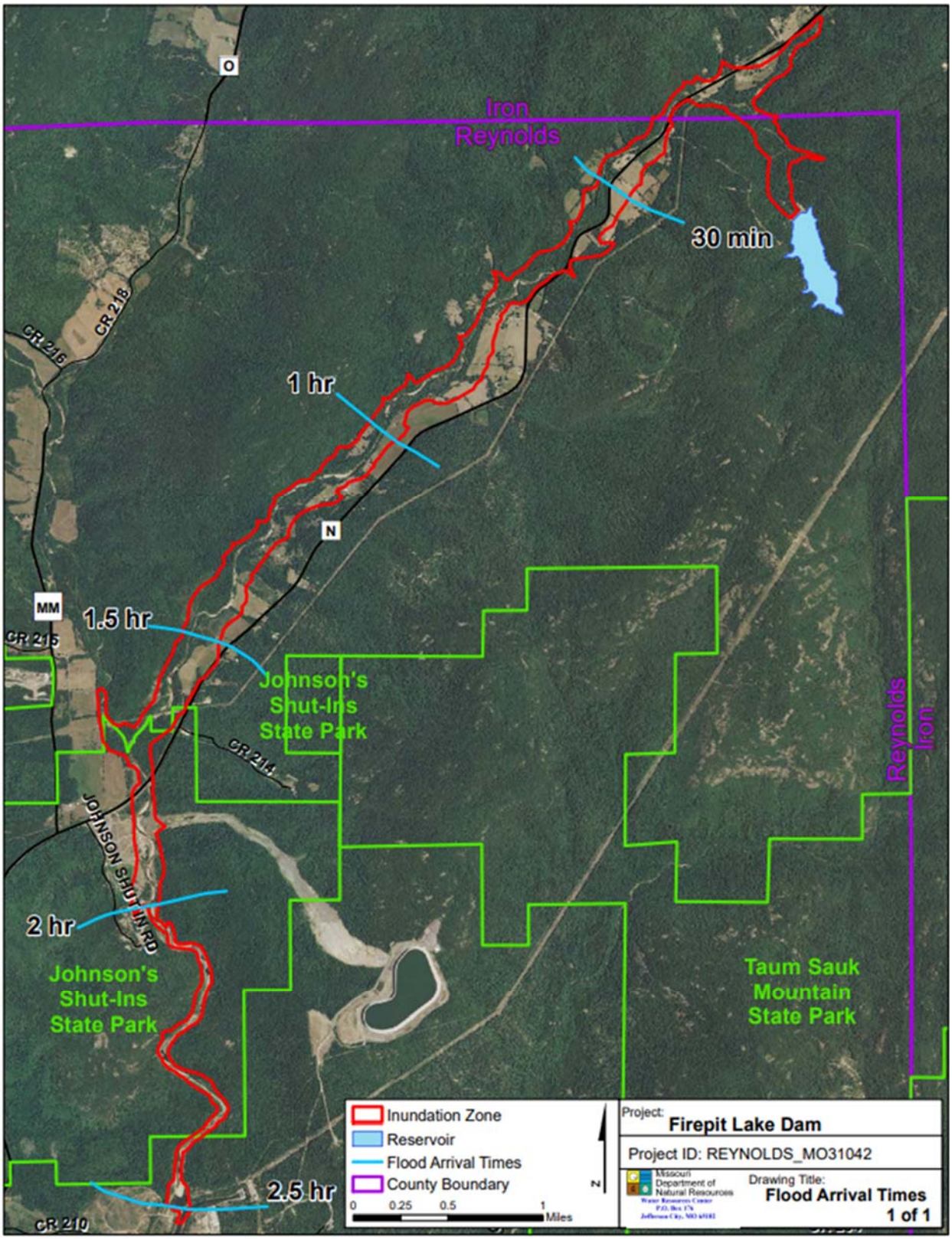
It is important to note that dams fail on an individual basis; when one dam fails not all dams fail. Vulnerability to dam failure is be limited to those persons and structures residing/working or located within the inundation zone of a failed dam. Therefore, the vulnerability of the county to dam failure based on the above information is minimal.

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

It was determined, per the *2018 Missouri State Hazard Mitigation Plan*, there are no persons or property located downstream of any state-regulated dams within the planning area. Per the USACE, the National Inventory of Dams (NID) includes inundation maps for only U.S. Army Corps of Engineers dams. The corps is, however, currently working with some state agencies to incorporate inundation maps for state-regulated dams into the NID. At the time of this plan update, the USACE did not have inundation maps for the county's two federally-regulated dams—the Upper and Lower Taum Sauk Reservoirs. Per the inundation maps available for state-regulated dams located in the planning area, no incorporated places or critical facilities were identified within the inundation zones. Furthermore, no publicly-owned or school district-owned assets were shown to be located within the inundation zones of any state-regulated dams.

Per the inundation map provided by the Missouri Department of Natural Resources (MDNR) for the Firepit Lake Dam, State Highway N would be impacted in two locations should the structure fail. Approximately 1,523 acre feet of water escaping the structure would reach Johnson's Shut-Ins State Park within 1.5 hours and eventually be collected at the Lower Taum Sauk Reservoir of the Taum Sauk Hydroelectric Power Station 2.5 hours downstream. Should a failure occur during the summer months, injury and loss of life could occur as the state park is heavily visited during warm weather months. An overview map of the inundation area is provided below in Figure 3.5.

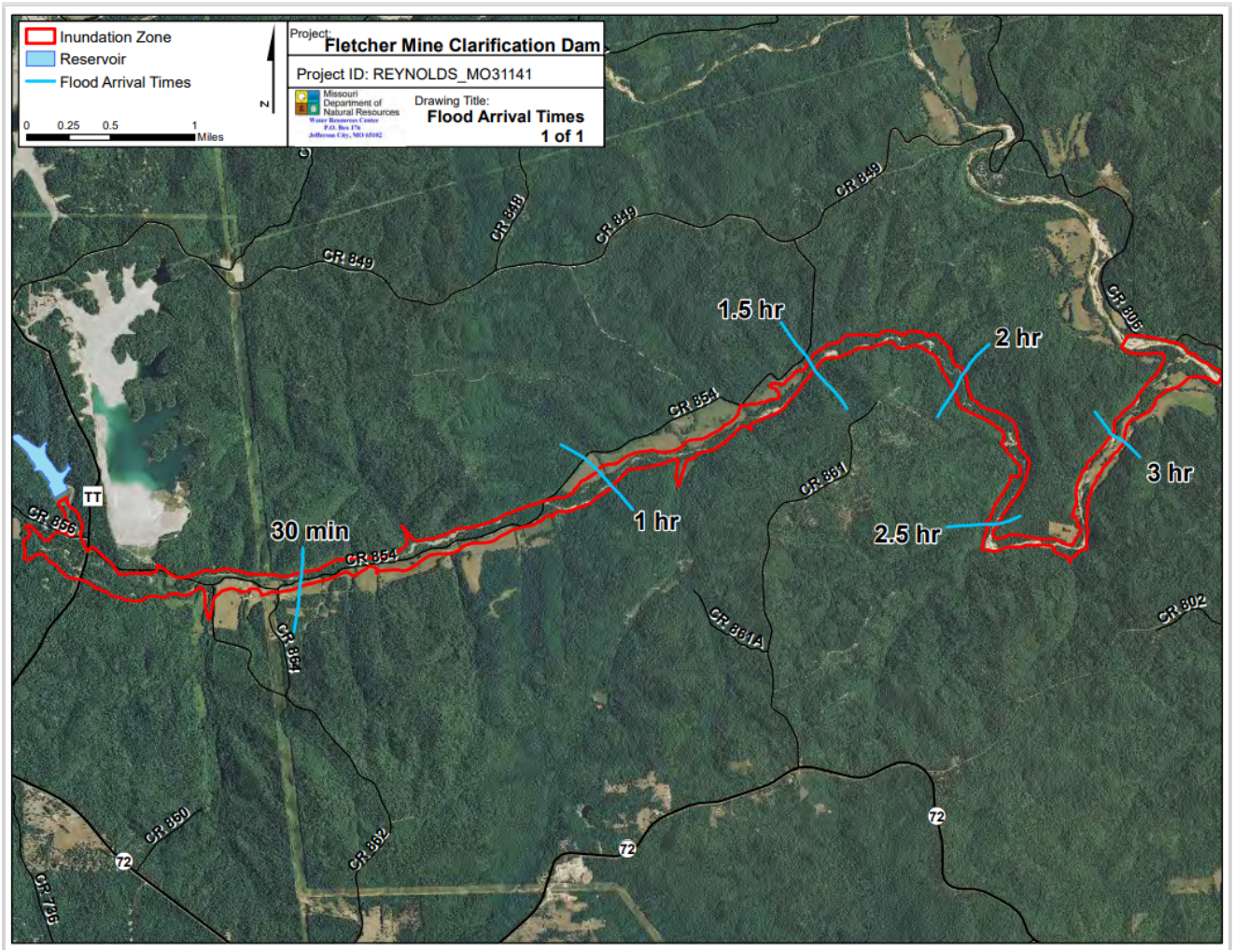
Figure 3.7. Firepit Lake Dam Inundation Map, Reynolds County, Missouri



Source: Missouri Department of Natural Resources, Dam Safety Program

Per the inundation map provided by the Missouri Department of Natural Resources (MDNR) for the Fletcher Mine Clarification Dam, five county roads (CR 856, 854, 864, 862, and 806), State Highway TT, and one structure would be impacted should the structure fail. Approximately 483 acre-feet of water escaping the structure would follow County Road 854 eastward and reach County Road 806 in little more than three hours. An overview map of the inundation area is provided below in Figure 3.6

Figure 3.8. Fletcher Mine Clarification Dams Inundation Map, Reynolds County, MO



Source: Missouri Department of Natural Resources, Dam Safety Program

While an official inundation map was not available for the three high hazard dams upstream from Reynolds County, some inundation data was provided by the MDNR. The Emergency Action Plans (EAP) for the Ed Baker #1 and #2 Lake Dams identify two structures—both located in Carter County—as within the inundation zone for these two dams. Both dams drain into the Upper Little Black A-7 Dam approximately 3.8 miles away in northeastern Reynolds County. Per the EAP, the Upper Little Black A-7 Dam has a storage capacity of 5,793 acre-feet—more than both of the Ed Baker Dams combined (957 acre-feet + 2,162 acre-feet). It should be noted that seven structures and one transportation route (County Road K-5) are located within the inundation area of the Upper Little Black A-7 Dam.

Fortunately, no critical facilities or jurisdictional assets were found to lie within the identified

inundation zones.

Impact of Previous and Future Development

No future development is planned for any other areas located within the inundation areas of dams located within Reynolds County or Iron County to the north.

Hazard Summary by Jurisdiction

Reynolds County – Inspection reports are either not available or more than 10 years old for 6 of the 16 dams classified as high hazard dams by the USACE. All 6 of these dams are located within the unincorporated portion of the county. The dams and their storage capacities are listed below:

- Brushy Creek Tailings #2, No EAP, 184 ft high, 25,626 acre-ft of storage, no inspection listed;
- Roy Davis Dam, No EAP Required, 26 ft high, 111Acre-ft of storage, last inspection-8-20-1979;
- Wiggins Ozark Camp Dam, No EAP Required, 28 ft high, 240 acre-ft of storage, last inspection-11-20-1978;
- Sela Land Dam, No EAP Required, 30 ft high, 32 acre-ft storage, last inspection-4-30-1979;
- Okkapassa Dam, No EAP Required, 28 ft high, 184 acre-ft storage, last inspection-4-30-1979; and,
- Fletcher Tailings Dam, EAP exists, 201 ft high, 5,333 acre-ft storage, last inspection-1-5-2009.

Per the Missouri Department of Natural Resources (MDNR), Dam and Reservoir Safety Program, "Missouri dams 35 feet or more in height are regulated (10 CSR 22-1.020 (13)) and dam owners are required to complete an Emergency Action Plan (EAP)." The EAP, if followed, can reduce loss of life and property damage during a dam failure. The EAP's enhance the preparedness of local emergency management officials through the provision of contact information and pre-established evacuation procedures. The Brushy Creek Tailings #2 Dam and the Fletcher Tailings Dam are both significantly sized high hazard dams with no recent inspections reported. Furthermore, the Brushy Creek Tailings #2 Dam is not reported to have an EAP on file.

Per inundation maps available from the MDNR and the USACE, Johnson's Shut-Ins State Park along the East Fork of the Black River is located downstream of two high hazard dams—the Upper Taum Sauk Reservoir and the Firepit Lake Dam. The park can accommodate up to 100 carloads of visitors and often fills to capacity by 10AM during the summer months.

City of Bunker – Not determined to be vulnerable to damage caused by a dam failure.

City of Centerville – Not determined to be vulnerable to damage caused by a dam failure.

City of Ellington – Not determined to be vulnerable to damage caused by a dam failure.

Lesterville R-IV School District – Vulnerable to service interruptions as transportation routes could be submerged and/or closed following a dam failure event.

Problem Statement

The Reynolds County Hazard Mitigation Committee noted the following regarding dam safety within the planning area:

- No EAP is shown for Brushy Creek Tailing #2 Dam.
- No inspection report is shown for the Brushy Creek Tailing #2 Dam, while the most recent inspection report for the Fletcher Tailings Dam is dated January 2009.

There are 16 dams in Reynolds County that considered "high hazard" dams by the U.S. Army Corps of Engineers (USACE). Two of the eight are regulated by the USACE and 10 are regulated by the State of Missouri via its Department of Natural Resources (MDNR). The majority of these dams hold massive volumes of water, yet, fortunately, are located within the northern unincorporated portion of the county. The areas at risk are limited to the inundation zones of these dams. The rural nature and sparse population of Reynolds County reduces potential negative impacts of a dam failure in the county, but mitigation measures are merited. The Johnson's Shut-Ins State Park is heavily visited during the summer months and is located downstream of two large artificial impoundments. Suggested mitigation actions may include the following.

- Ensure adequate communication, warning systems, and evacuation procedures are in place to warn park patrons in the event of a failure of either the Taum Sauk Upper Reservoir, or the Firepit Lake Dam;
- Ensure an EAP be established for the Brushy Creek Tailing #2 Dam; and,
- Ensure that inspection reports be issued/updated for both the Brushy Creek Tailing #2 Dam and the Fletcher Tailings Dam.

3.4.3 Earthquakes

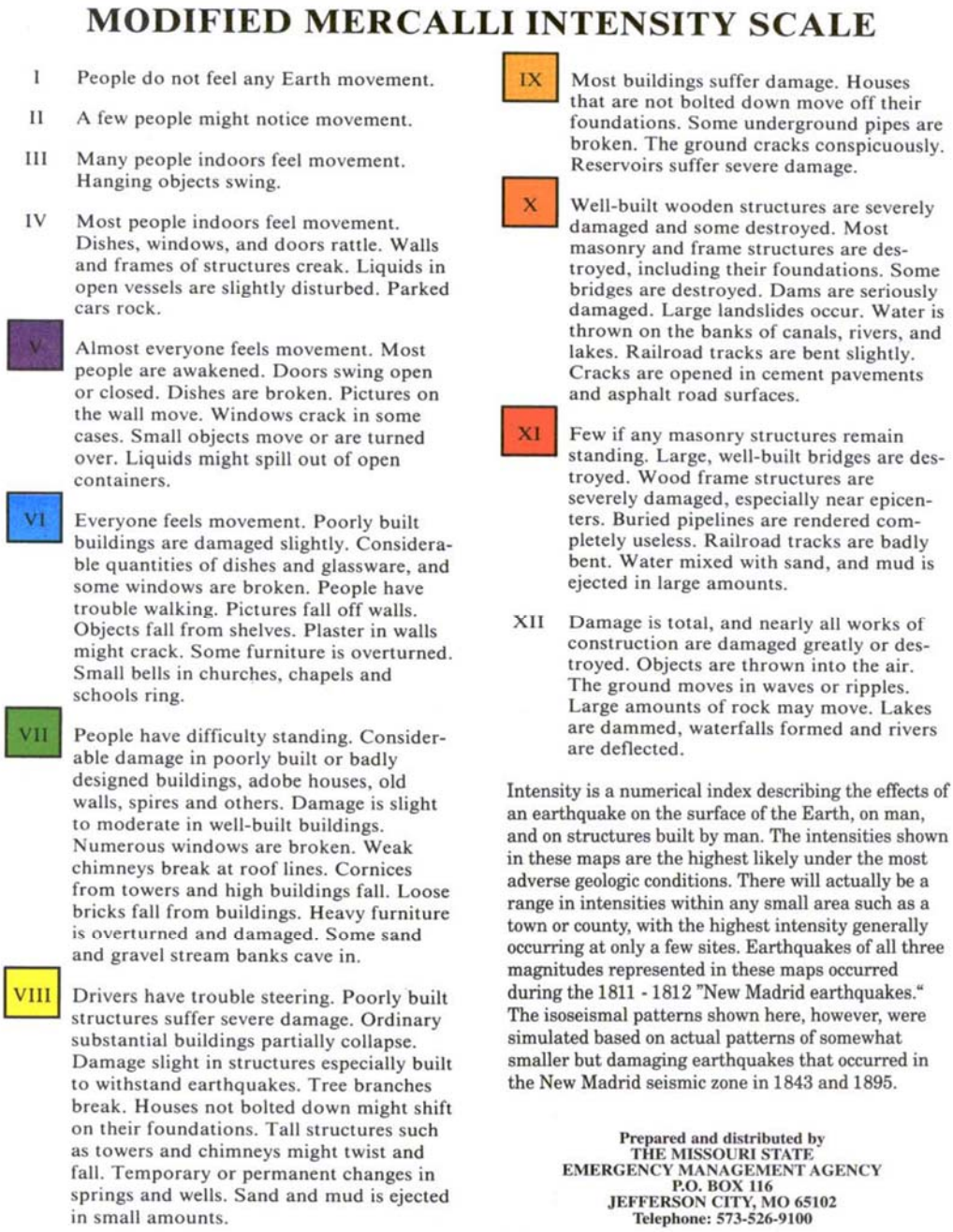
Hazard Profile

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.

As explained by the Federal Emergency Management Agency, major earthquakes and their accompanying foreshocks and aftershocks can be measured in two different ways. In 1935, the Richter Scale was developed by Charles F. Richter to measure the amount of energy released by an earthquake. The Modified Mercalli Intensity Scale was also developed as a tool to measure the severity of a quake using damage observations. The Mercalli Scale uses Roman numerals I to XII to rate an earthquake's intensity. A description of various Richter Scale and Modified Mercalli Scale intensities is offered below in Figure 3.9.

Figure 3.9. Projected Earthquake Intensities



Geographic Location

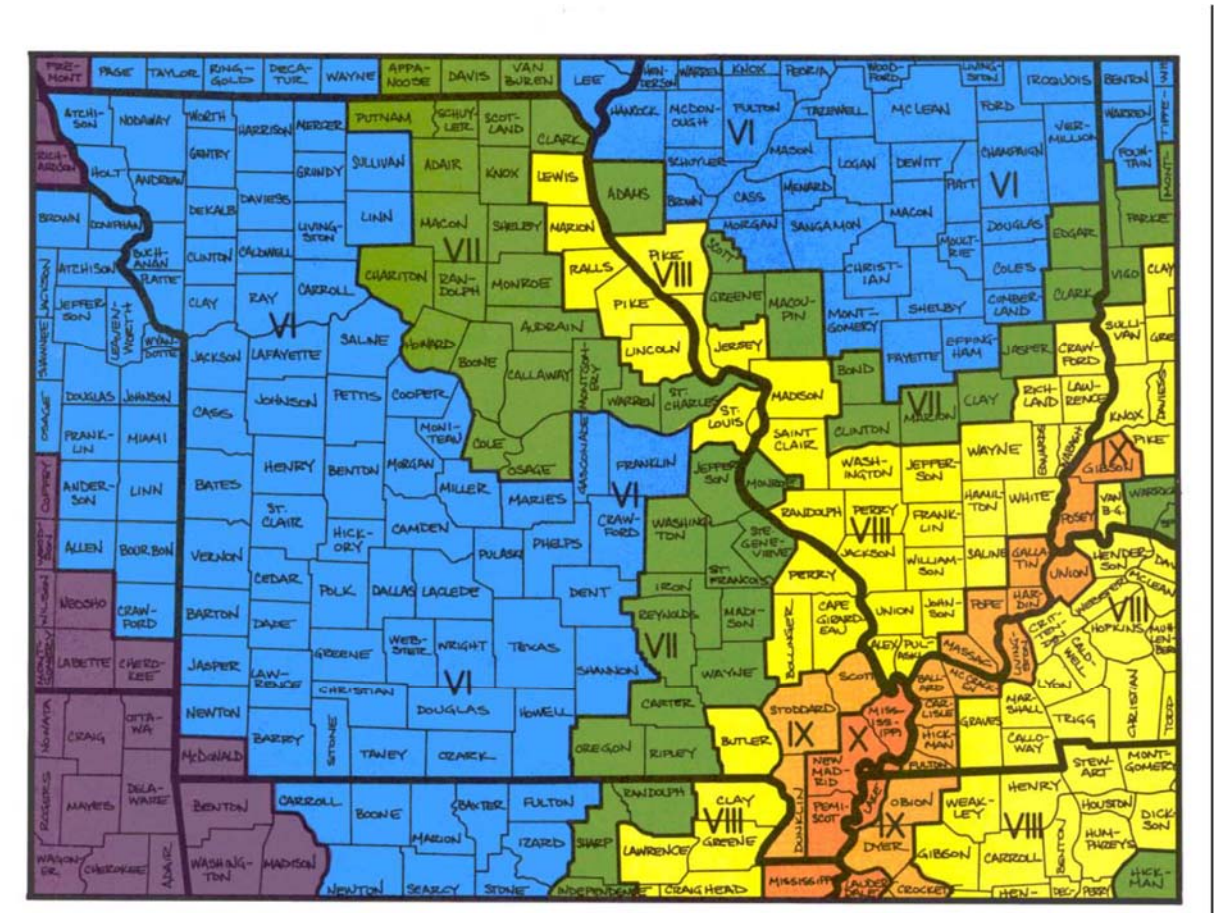
The New Madrid Seismic Zone (NMSZ) is made up of several thrust faults that stretch from Marked Tree, Arkansas to Cairo, Illinois. Although Reynolds County is on the western edge of the NMSZ, the effects of a large quake will impact the entire county indiscriminately. Data indicates that earthquake

intensity will not vary considerably across the planning area.

Of the entire state, Southeast Missouri, including Reynolds County, is most susceptible to earthquakes because it overlies the NMSZ. The county is at risk of strong ground movements. The immediate vicinity of the Ozark Foothills is also at risk from the earthquakes in the New Madrid Seismic Zone because, like in the bootheel, subsurface conditions of the Mississippi and Missouri River valleys tend to amplify earthquakes.

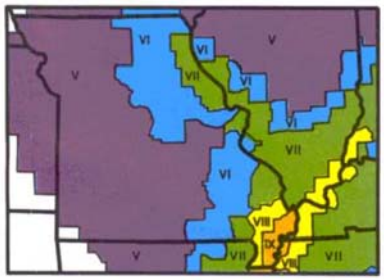
Figure 3.10 shows the highest projected Modified Mercalli intensities by county from a potential magnitude 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid Seismic Zone. The secondary maps in **Figure 3.10** show the same regional intensities for a 6.7 and an 8.6 earthquake, respectively.

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

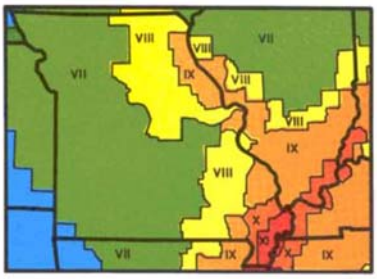


This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 6.7 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

7.6

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.

8.6



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

Strength/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 as 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.

Previous Occurrences

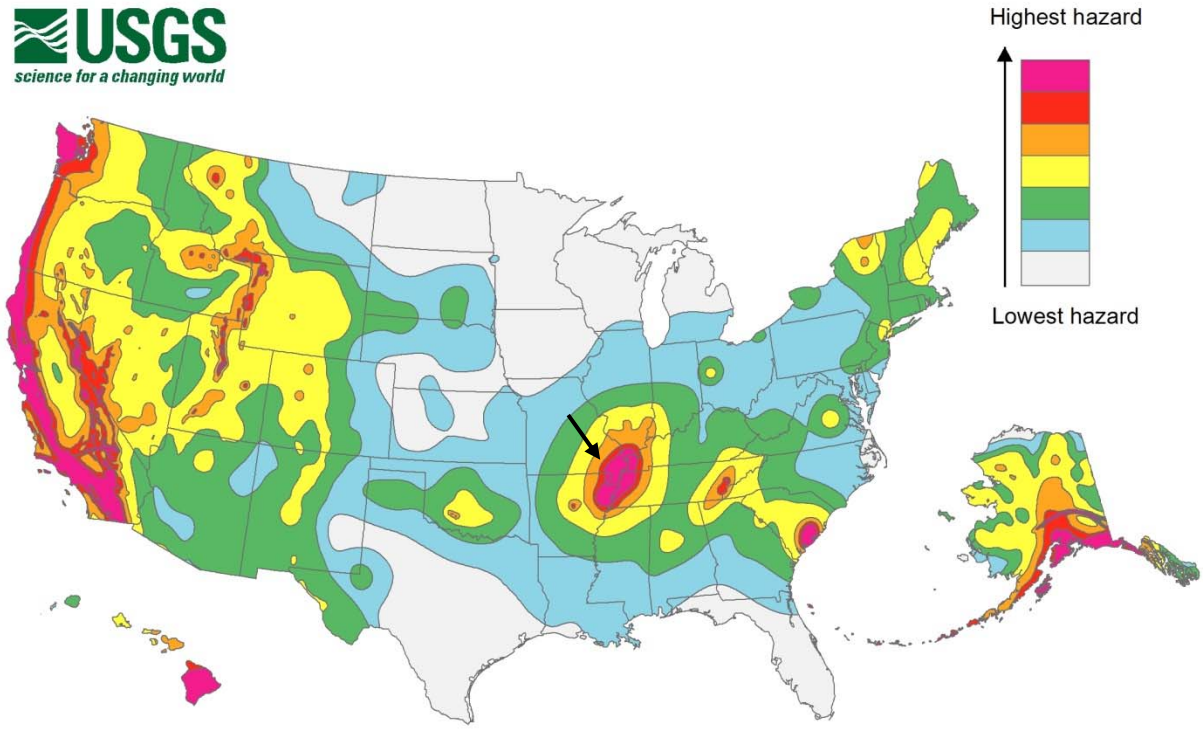
The largest earthquakes ever felt in the United States occurred along the New Madrid fault line during the winter of 1811-1812. During the course of three months, three earthquakes registering above 8.0 on the Richter Scale were felt by nearly the entire eastern half of the United States. According to the United States Geological Survey, church bells in Washington, D.C., rang as a result of the tremendous shaking. In fact, the New Madrid quakes were two to three times stronger than the 1964 Alaska earthquake and ten times more powerful than the 1906 San Francisco quake.

Per the Missouri Department of Natural Resources, 236 earthquakes measuring between magnitude 2.0 and magnitude 3.9 occurred in Southeast Missouri between 2000 and 2009. According to www.homefacts.com, there have been eight earthquakes ranging from magnitude 2.4 to 3.4 within the planning area in the past twenty years. The largest earthquake within thirty miles of the planning area, registered 3.9 and occurred in 2000. The U.S. Geological Survey estimates that there is a 4.65% chance of a major earthquake (magnitude 7.5-8.0) centered within 100 km of Reynolds County in the next fifty years. Per homefacts.com, the risk of a large earthquake in the planning area is low as typical earthquakes occurring within the region result in minimal damage and no injuries.

Probability of Future Occurrence

Earthquake hazard can be measured by describing peak ground accelerations (PGA) having a 2 percent probability of being exceeded in 50 years, for a firm rock site. The figure below, illustrates seismicity in the United States defined by recent (2018) USGS models based on seismicity and fault-slip rates. The models account for earthquake frequency and events of various magnitudes. The black arrow indicating a spot within the orange zone shows the location of Reynolds County.

Figure 3.11. United States Seismic Hazard Map



Source: United States Geological Survey

Per historical events, Southeast Missouri—including Reynolds County—will experience twenty-four earthquakes (of magnitude 2.0 to 3.9) within any one-year period. Consequently, the probability of an earthquake of any magnitude occurring within the planning area is 100%.

Changing Future Conditions Considerations

Per the *Missouri State Hazard Mitigation Plan, 2018*, "scientists are beginning to believe there may be a connection between changing climate conditions and earthquakes. Changing ice caps and sea-level redistribute weight over fault lines, which could potentially have an influence on earthquake occurrences. However, currently no studies quantify the relationship to a high level of detail, so recent earthquakes should not be linked with climate change. While not conclusive, early research suggests that more intense earthquakes and tsunamis may eventually be added to the adverse consequences that are caused by changing future conditions." This could eventually change the probability of earthquake occurrence for the planning area.

Vulnerability

Vulnerability Overview

Per the Missouri State Hazard Mitigation Plan, 2018, the most significant direct earthquake hazard

is ground shaking. Ground shaking affects structures near the earthquake epicenter but also those at further away—particularly where thick clay-rich soils can amplify ground motions. Certain types of buildings are more vulnerable to ground shaking than others. Unreinforced masonry structures, tall structures without adequate lateral resistance, and aged poorly maintained structures are specifically susceptible to large earthquakes.

Damage from a large earthquake in the New Madrid Seismic Zone (NMSZ) will vary depending on magnitude, land characteristics, and the degree of urbanization. Southeast Missouri is primarily rural with scattered small to medium-sized towns. Damage to the land could be extensive and significantly affect the area's farming industry. Shaking would be most severe to development built on thick, clay-rich soils. Roads and railroads in Southeast Missouri and Saint Louis could be severely damaged by earthquake triggered slope failures, rockfalls, and liquefaction.

The State of Missouri collects residential insurance data by zip code. As a state, Missouri has the third largest market for earthquake insurance coverage in the country. However, due to a reduced number of insurers and increasing premium costs, only 14% of residences located within the New Madrid Seismic Zone are covered by earthquake insurance according to the Missouri Department of Insurance. Deductibles of up to twenty percent of the home value are not uncommon. Since 2000, residential earthquake insurance has become less available and less affordable—leaving this segment of the state's population (including Reynolds County) more vulnerable to earthquakes.

Potential Losses to Existing Development

FEMA's loss estimation software, HAZUS 3.2 (October 2016) was used to analyze vulnerability and estimate losses due to earthquakes. All HAZUS analyses were run using an enhanced Level 2 inventory database comprised of updated demographic and aggregated data from the 2010 U.S. Census and then adjusted to 2014 numbers using the Dun & Bradstreet Population Report. Inventory values reflect 2014 valuations, based on RSMeans—a supplier of construction cost information) replacement costs. The information and data for this vulnerability overview and potential loss were gathered from the *2018 Missouri State Hazard Mitigation Plan*.

HAZUS defines annualized loss as the expected value of loss in any one year. The software develops annualized loss estimates by aggregating the losses and their exceedance probabilities from the eight return periods. Annualized loss is the maximum potential annual dollar loss resulting from various return periods averaged on a 'per year' basis. The updated annualized loss scenario presented here shows the economic losses to buildings annualized over eight earthquake return periods (100, 200, 500, 750, 1,500, 2,000 and 2,500 years).

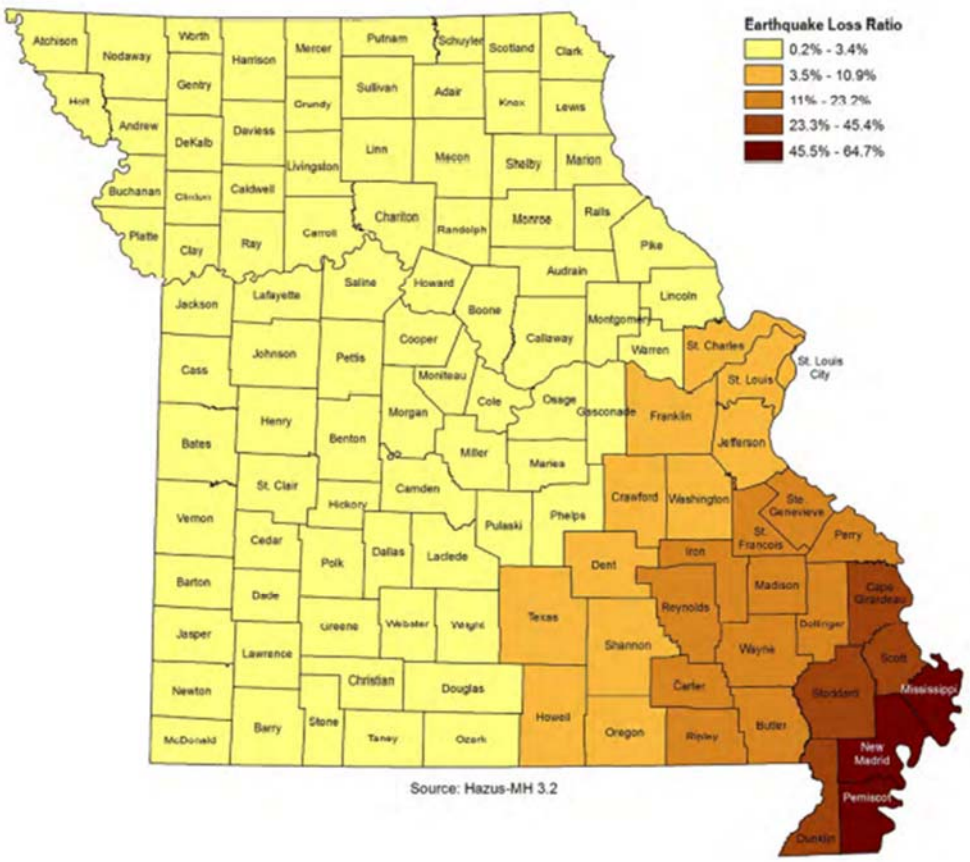
As found within Table 3.60 of the *2018 Missouri State Hazard Mitigation Plan*, annualized loss scenarios conducted using HAZUS show that Reynolds County ranked 41st when ranked by annualized loss ratio. The loss-ratio represents the ratio of the average annualized losses divided by the entire building inventory in the county as calculated by HAZUS. The loss ratio is an indication of the economic impacts an earthquake could have, and how difficult it could be for a particular community to recover from the event. With an estimated $167,000 (or $24.90 per person) in total structural value losses the county's loss ratio is $249 per $1 million in building value.

A second scenario based on an event with a 2% probability of exceedance in 50 years was also examined by the state to model a "worst case scenario". HAZUS was again used to estimate direct economic losses due to earthquake assuming a 2% probability of exceedance in fifty years scenario. Per Table 3.63 of the *Missouri State Hazard Mitigation Plan, 2018*, in such a scenario, Reynolds County will experience $19,472,000 in structural damages, $62,211,000 in non-structural damages,

and $21,814,000 lost in contents. When combined with inventory losses, rental income loss, lost wages, relocation and capital costs, the estimated loss total equals $127,687,000, thereby placing Reynolds County 42nd of 114 counties for total losses in the given scenario. With a loss ratio percentage of 12.2% (greater than 10%), the county is considered at risk for earthquake by FEMA.

The map below displays the loss ratio percentage for each county in the state. Reynolds County falls within the middle range at 12.2%.

Figure 3.12. Earthquake Loss Estimation with a 2% Probability of Exceedance in 50 Years Scenario – Loss Ratio



Source: Hazus-MH 3.2

Impact of Previous and Future Development

Future development, though not anticipated, would not increase the risk other than contributing to the overall exposure of what could become damaged as a result of an earthquake event.

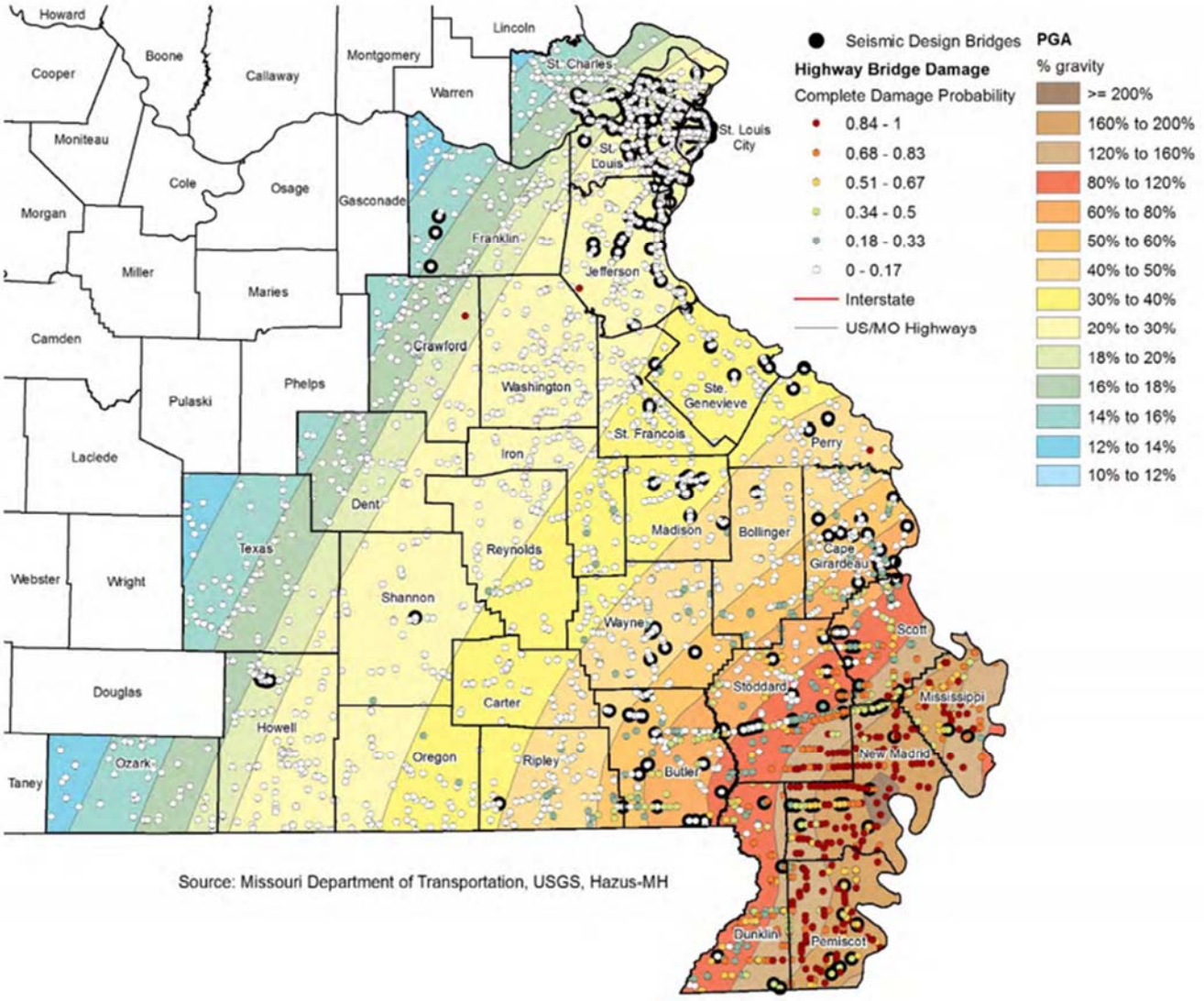
Hazard Summary by Jurisdiction

Earthquake intensity is not likely to vary greatly throughout the planning area; consequently, risk of damage and injury from an earthquake is likely to be the same throughout the county. However, damages could differ due to structural variations in the planning area built-environment. For example, damages could be more significant within the City of Ellington as it is home to more multi-story aged buildings than the remainder of the county. Aged residences—those built before 1939—are located predominantly within the eastern portion of the city. Most structures throughout the remainder of the county have been constructed since 1939.

Per the Missouri Earthquake Risk Assessment Enhancements (see Table 4.) produced by Amec Foster Wheeler Environment and Infrastructure, Inc. for the Missouri State Emergency Management Agency in September 2017, there are no fire departments, hospitals, or educational facilities in the county with a greater than 0.50 complete damage probability assuming a "worst-case scenario earthquake." The contractor assumed a level of ground shaking based on an event with a 2% probability of exceedance in 50 years for its model.

Per the same study, found within Appendix C of the *2018 Missouri State Hazard Mitigation Plan* there are sixty-four bridges in the planning area. HAZUS estimates that 75% of the bridges in the county will remain undamaged while another 12% will sustain slight damage, and the remaining 13% are anticipated to sustain moderate (6%) to extensive (4%) to complete (3%) damage. The map below, shows the location of bridges in Reynolds County as well as the levels of PGA anticipated for the county assuming a worst-case scenario earthquake. No bridges in the county have been constructed with incorporated seismic design.

Figure 3.13. Map of Bridge Damage Probability



According to MERC and the U.S. Geological Survey, there are fifteen Tier II hazardous materials facilities located within the planning area, seven of which are tracked by the Environmental Protection Agency (EPA). Six of the Tier II facilities—all located within the southeastern portion of the county—are estimated to have moderate to heavy damage, while the remaining nine facilities are expected to sustain moderate damage due to "worst-case scenario" earthquake.

Reynolds County – Risk of damage to assets and injury from an earthquake is likely to be significant particularly in the southeastern portion of the county.

City of Bunker – Risk of damage to assets and injury from an earthquake is likely to be moderate.

City of Centerville – Risk of damage to assets and injury from an earthquake is likely to be moderate.

City of Ellington – Damages could be more significant within the City of Ellington as it is home to more multi-story aged buildings and residences than the remainder of the county and is the only population center located within the portion of the county with the highest Peak Ground Acceleration (PGA) category of 30%-40% gravity versus 20%-30% gravity.

Lesterville R-IV School District – Risk of damage to assets and injury from an earthquake is likely to be moderate assuming a worst case scenario earthquake.

Problem Statement

Reynolds County is near the New Madrid Seismic Zone, physical damage would result in Reynolds County should a severe earthquake occur. Per the State of Missouri, Reynolds County has a total annualized expected earthquake loss of $167,000 When this value is divided by the county's entire building inventory value, a "loss ratio" is generated. Per its loss ratio ($249 per one million dollars), Reynolds County ranks 42nd out of 114 counties in the state.

The City of Ellington the jurisdiction with the highest potential for damage as its downtown area is home to some multi-level aged structures. Of greatest concern is potential loss of life and the disruption of essential services. To mitigate loss of life due to a severe earthquake event within the planning area and ensure the continuity of essential service provision, the following mitigation actions are suggested:

- Continue participation in earthquake awareness events; and,
- Establish and/or enforce building ordinances within city limits which address seismic reinforcement.

3.4.4 Land Subsidence/Sinkholes[4(b)(1)c; 4(b)(2,3)]

Hazard Profile

Hazard Description

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. However, the primary causes of most subsidence are human activities: underground mining of coal, groundwater or petroleum withdrawal, and drainage of organic soils. In addition, sinkholes can develop as a result of subsurface void spaces created over time due to the erosion of subsurface limestone (karst).

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 flooding.

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. Sinkholes range in size from several square yards to hundreds of acres and may be quite shallow or hundreds of feet deep.

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. Missouri sinkholes have varied from a few feet to hundreds of acres and from less than one to more than 100 feet deep. The largest known sinkhole in Missouri encompasses about 700 acres in western Boone County southeast of where Interstate 70 crosses the Missouri River. Sinkholes can also vary is shape like shallow bowls or saucers whereas other have vertical walls. Some hold water and form natural ponds.

Approximately 70% of all lead produced in the United States comes from Missouri. Per the http://historyoftheearthcalendar.blogspot.com/2014/02/february-25-viburnum-trend.html, lead production commenced in southeastern Missouri around 1721 with the daily mining of up to 1,500 pounds of lead ore for export to Europe. Lead mining in southeast Missouri has been continuous since around 1802.

Within the lead belt of Missouri, are three primary sub-districts. The sub-district which impacts Reynolds County is referred to as the Viburnum Trend—the newest of the three sub-district from which lead began being mined in 1960. The Viburnum Trend remains one of the world’s largest lead mines and a significant producer for the global market.

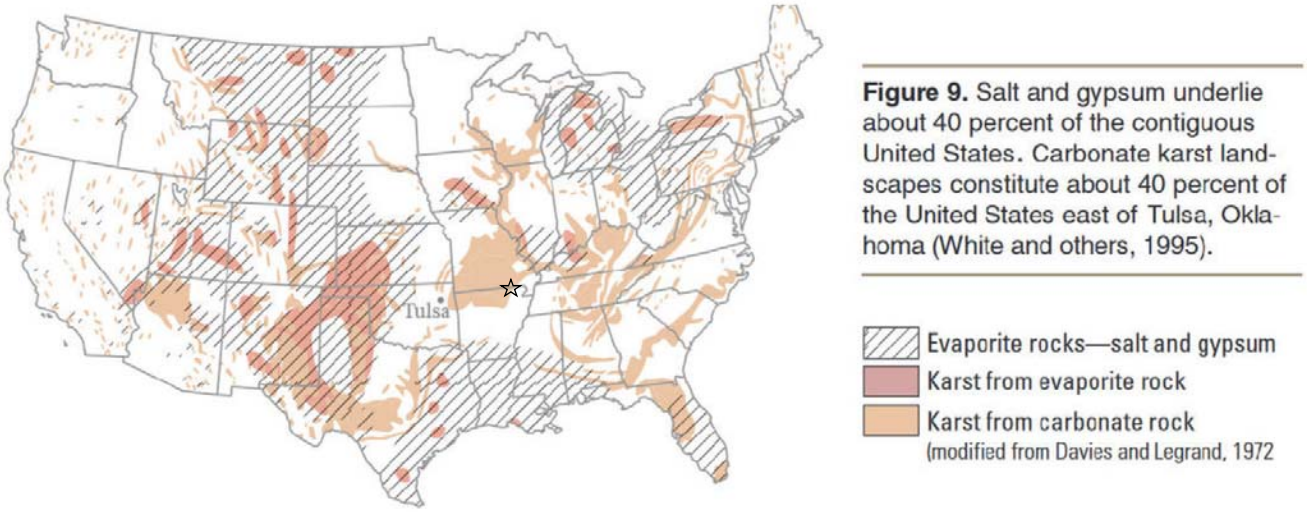
Along the Viburnum Trend are numerous mines. Three of those mines are located within Reynolds County. The Fletcher Mine (located at 37 28.027 North/91 6.600 West) and Brushy Creek (located at 37 32.370 North/91 7.544 West)—are both near the junction of Missouri Highways TT and KK in northwestern Reynolds County. The Sweetwater Mine (located at 37 21’ 35.61”North/91 8’ 48.32” West) is in the central west portion of the county. Per mindat.org, “the Viburnum Trend is a 6-mile by 40-mile North-trending deposit discovered in the late 1950s and early 1960s whose Pb-Ag-Zn deposits are exploited by the Brushy Creek, Buick, Fletcher, Magmont, Sweetwater, West Fork, and Viburnum mines.” The mines range from 1,000-1,450 feet in depth.

The Doe Run Company—the county’s largest employer—owns and operates the mines. Per the company’s website found at https://doerun.com/what-we-do/mining-milling/, twenty-five miles of underground roadways connect four Doe Run mines – Casteel, Buick, Brushy Creek and Fletcher. Doe Run’s Sweetwater Mine and Mine No. 29 are located nearby. Since 1960, The Doe Run Company has mined nearly 320 million tons of ore from the Viburnum Trend.

Geographic Location

According to the Missouri Hazard Mitigation Viewer, there are 56 sinkholes within Reynolds County and 107 mines. There are no reports of damage from the sinkholes present in Reynolds County. The USGS Water Science School offers the map in Figure 3.14 below to show areas of of the United States where sinkholes are likely to occur. Reynolds County falls within a classification of karst topography from carbonate rock. Reynolds County’s approximate location is indicated by the star on the map.

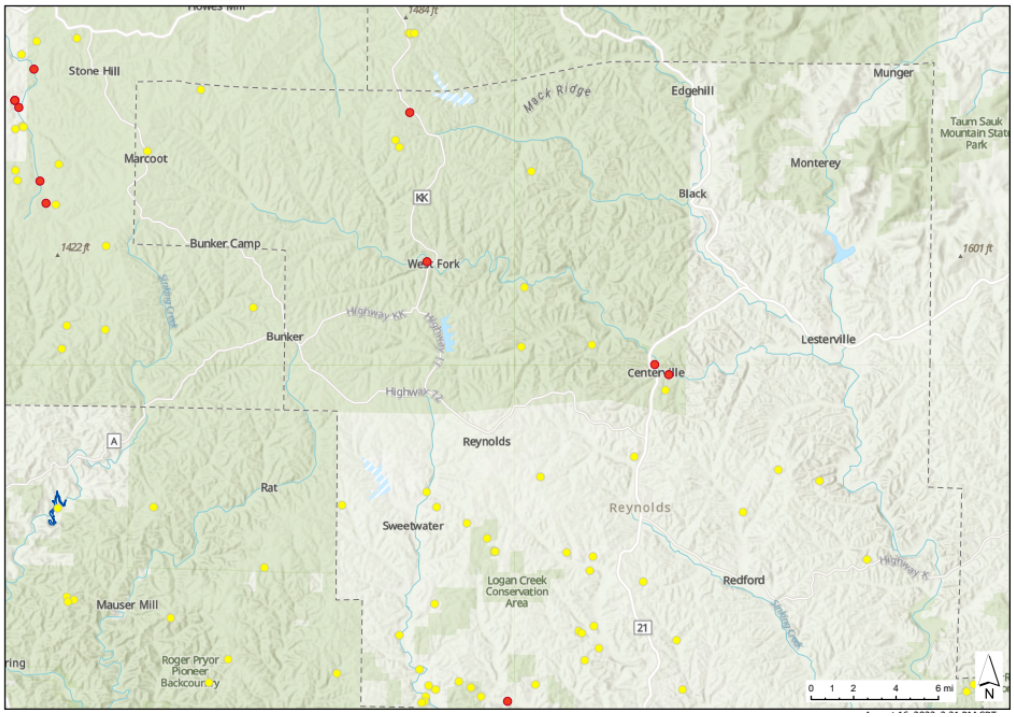
Figure 3.14. Topography Characteristics – United States



Source: U.S. Geologic Survey, Water Science School, 2022

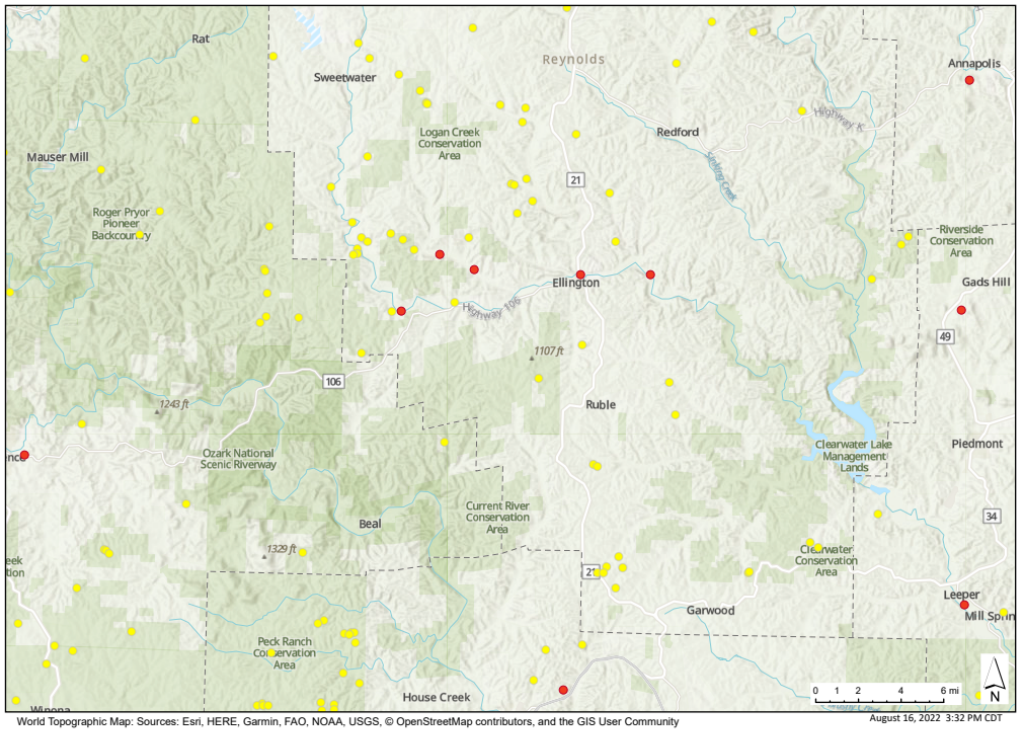
The maps below, show the location of all sinkholes and mines within the county as documented by the Missouri Department of Natural Resources GeoSTRAT mapping tool. Per the maps, sinkhole formation is most prevalent within the west central unincorporated portion of the county near the Logan Creek Conservation Area.

Figure 3.15. Sinkhole Locations – Northern Reynolds County, 2022



Source: See citation in Figure 3.12

Figure 3.16. Sinkhole Locations – Southern Reynolds County, 2022



Strength/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

While sinkholes are a regular occurrence in the planning area, they are rarely events of any significance. Per the 2018 Missouri State Hazard Mitigation Plan, “one notable sinkhole event occurring in Reynolds County involved the development of multiple sinkholes during April 2014 near the West Fork mine at the Doe Run lead mining facility. A sinkhole more than 100 feet wide opened near the historic West Fork Sutterfield Cemetery. It is possible that mining operations may have been linked to this event.” The event did not cause serious damage.

Probability of Future Occurrence

The probability of a sinkhole occurring within Reynolds County in the future is 100%. It should be noted that there exists no centralized database for sinkhole occurrences in the state or the county. There are no records of damage, injury, or death resulting from sinkholes within the county, consequently, the probability of an event resulting in damage, injury or death cannot be estimated.

Changing Future Conditions Considerations

Per the 2018 Missouri State Hazard Mitigation Plan, “direct effects from changing climate conditions such as an increase in droughts and could contribute to an increase in sinkholes. These changes raise the likelihood of extreme weather, meaning the torrential rain and flooding conditions which often lead to the exposure of sinkholes are likely to become increasingly common. Certain events such as a heavy precipitation following a period of drought can trigger a sinkhole due to low levels of groundwater combined with a heavy influx of rain.”

Vulnerability Overview

The authors of the *2018 Missouri State Hazard Mitigation Plan* analyzed data regarding sinkholes from across the state to determine each county’s vulnerability to the hazard. The authors overlaid Missouri Spatial Data Information System (MSDIS) structure data with the sinkhole hazard layer available via the State of Missouri’s GeoSTRAT tool. Doing so, allowed the authors “to determine structures that fall within sinkhole areas as well as structures that are within a buffered distance of 50 feet of sinkholes.” Based on the analysis, Reynolds County was classified as Low-Medium for sinkhole rating with no structures potentially impacted by sinkholes within the county. Furthermore, the authors determined that no persons within the planning area are at risk of injury or death due to sinkholes occurring in the county.

Potential Losses to Existing Development

There is no known existing development within the planning area which could be damaged by sinkholes. Previous events have not resulted in financial losses, consequently, future losses cannot

be estimated based upon historical losses.

Impact of Previous and Future Development

There are no abandoned mines within the planning area. Neither Reynolds County, nor its participating jurisdictions limit construction over near sinkholes or over abandoned mines.

Hazard Summary by Jurisdiction

Susceptibility to sinkholes does vary throughout the planning area, with the unincorporated portion of the county being more susceptible. There are no critical facilities located near any known sinkholes.

Reynolds County – As shown in Figures 3.15 and 3.16, the west central portion of the county has more sinkholes than other parts of the county.

City of Bunker – There are no known sinkholes in or near the City of Ellington.

City of Centerville – There is one sinkhole located immediately southeast of the City of Centerville; however, the area is isolated and not close to developed areas.

City of Ellington – There are no known sinkholes in or near the City of Ellington.

Lesterville R-IV School District – There are no known districts assets located upon or near known sinkholes.

Problem Statement

The primary area of the county at a somewhat higher risk for sinkholes is the west central unincorporated portion of the county. This area is home to a large portion of the Logan Creek Conservation Area and is primarily undeveloped. There are no critical facilities or school district assets located or housed in the vicinity of any sinkholes. Because of this, the risk for damages due to sinkholes is limited and unlikely within the planning area. A public education effort regarding the existence and location of sinkholes within the planning area could help mitigate against damages to future development.

3.4.5 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 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.

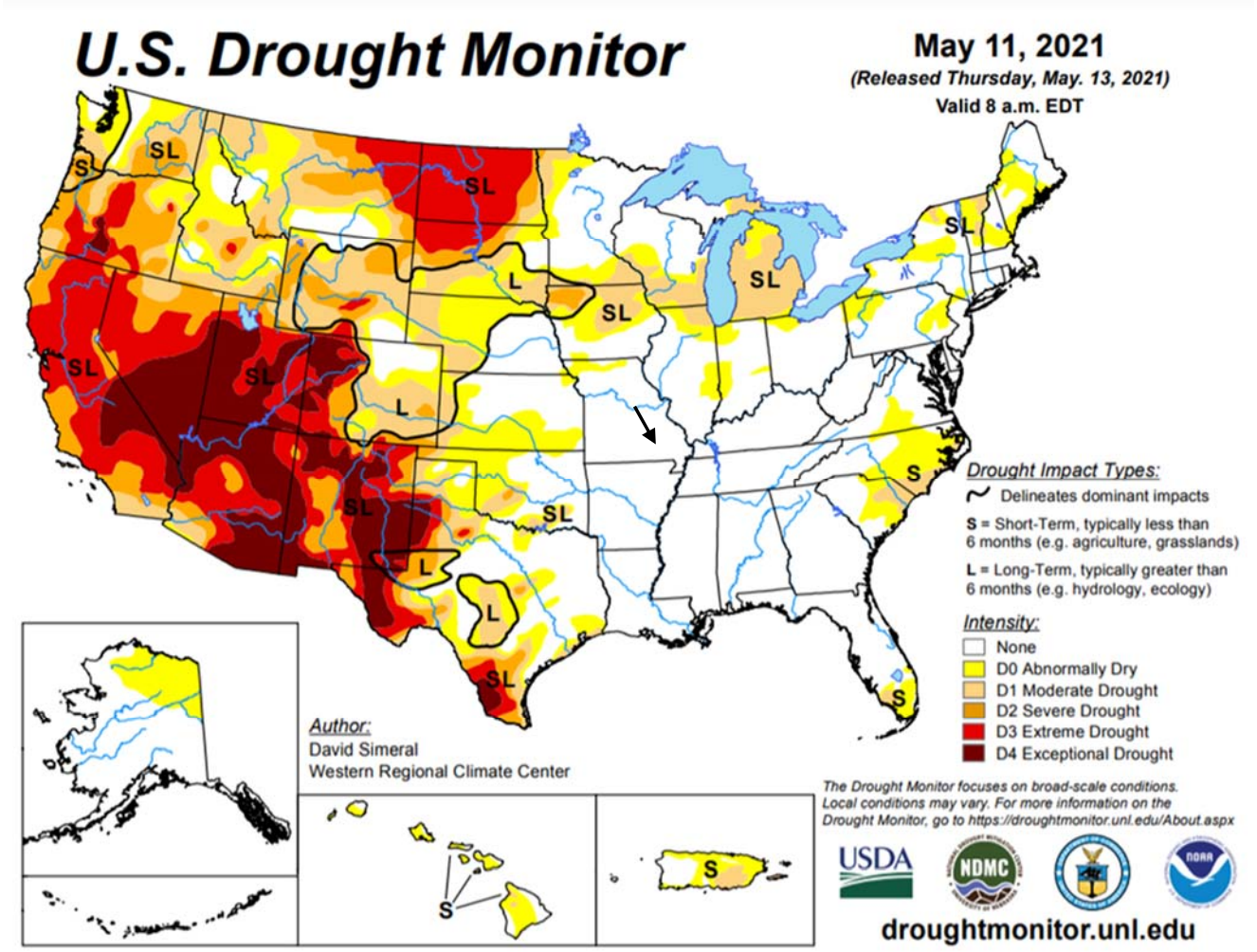
- Socioeconomic drought refers to when physical water shortage begins to affect people.

Geographic Location

The entire planning area is at risk to drought, but drought most directly impacts the agricultural sector. Approximately 16.6% of the surface land in the county, or 86,614 acres, is used for agriculture purposes. Farming tends to be focused upon livestock and pastureland located in the unincorporated portion of the county. While the numbers of farms in the county is decreasing, the farmland is not being converted to development land. Woodlands comprise 53.4% of all farmland in the county, while pastureland comprises 37.5%.

The map below in Figure 3.17 was taken from the U.S. Drought Monitor. It shows a depiction of the geographic areas within Reynolds County that could be in drought at any given moment in time. An arrow indicates the location of the planning area on the map.

Figure 3.17. U.S. Drought Monitor Map of Missouri, May 11, 2021



Source: U.S. Drought Monitor, https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Strength/Magnitude/Extent

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.

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 National Drought Monitor Center at the University of Nebraska at Lincoln describes the potential severity of drought in more detail. 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 reduces 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. Finally, while drought is rarely a direct cause of death, the associated heat, dust and stress can all contribute to increased mortality.

Previous Occurrences

Per the USDA's Risk Management Agency (RMA), no insured crop loss payments had been issued due to damage resulting from drought within the planning area as of 2012. This is likely due to the fact that most agricultural land in the county is used for livestock and not crop production.

Previous drought events and their duration are listed in the table below. It should be noted that drought is often a multi-month event and can last multiple years.

8/1/2005 – 8/31/2005 An agricultural and hydrologic drought continued across the area. Even though conditions did improve in some areas as a large part of east central and southeast Missouri were raised from D3 status (severe drought) to D0 status (abnormally dry), all but 2 counties in the state were declared disaster areas due to the drought. Most of northeast Missouri remained in D2 status (severe drought).

8/1/2007 - 8/31/2007 Several counties in southeast Missouri were moved to D2, severe, drought status.

6/19/2012 – 6/30/2012 Several counties in Northeast, East Central, and Southeast Missouri were placed in severe drought (D2) status by the United States Drought Monitor. The months of May and June were very dry, one of the driest two-month periods in Missouri history.

7/1/2012 – 7/31/2012 Drought conditions spread across all of Eastern Missouri as very hot and dry weather continued through July. On July 3rd , 13 counties across Central and East Central Missouri were added to D2 severe, drought status. By the end of the month, all counties were placed in D3 extreme, drought status.

8/1/2012 – 8/31/2012 Extreme Drought (D3) conditions continued across all of the area through the month of August. By the middle of the month, most of Boone and Moniteau counties were moved into Exceptional Drought (D4) status.

9/1/2012 – 9/10/2012 Severe Drought (D2) conditions continued into early September across parts of Southeast Missouri. However, rainfall from the remains of Hurricane Isaac and other weather systems in early September lowered the drought status to Moderate (D1).

Probability of Future Occurrence

The six incidents reported above span five months within a twenty-year time period, or 240 months. During this 240-month timeframe, Reynolds County experienced drought conditions for 5 months. Dividing the number of months in drought by the total number of months within the given time period

results in a probability calculation. Therefore, using the above-reported drought statistics provided by the National Centers for Environmental Information for the planning area, there is a 2.08% probability of drought in Reynolds County in any given month, or a 15% chance of drought in any given year (3 years/20 years). The timing of a drought is not predictable, but long-range outlooks and predicted impacts of climate change could indicate an increased chance of drought conditions.

Changing Future Conditions Considerations

Severe drought is a significant risk to areas dependent upon agriculture. Future increases in evaporation rates due to higher temperatures may increase the intensity of naturally-occurring droughts. Although springtime in Missouri is likely to be wetter, summer droughts are likely to be more severe. Higher evaporation and lower summer rainfall are likely to reduce river flows. The number of heavy rainfall events is predicted to increase, yet researchers currently expect little change in total rainfall amounts, indicating that the periods between heavy rainfalls will be marked by an increasing number of dry days. Higher temperatures and increased evapotranspiration increase the likelihood of drought. This could lead to agricultural drought and suppressed crop yields.

Vulnerability

Vulnerability Overview

According to the High Plains Regional Climate Center, average monthly precipitation in the planning area ranges from a low of 3.11 inches in January to a high of 5.76 inches in May. Per the same source, average annual precipitation in the planning area amounts to 49.78 inches.

County level data from the *2018 Missouri State Hazard Mitigation Plan* was use as the best and most recent data available to determine the county's vulnerability to drought. As stated in the plan on page 3.242, Southeast Missouri (including Reynolds County) "has very little drought susceptibility. As a region underlain by sands and gravel (alluvial deposits), surface and groundwater resources are generally adequate for domestic, municipal, and agricultural needs."

To determine vulnerability, the State of Missouri conducted a statistical analysis of data from several sources: USDA Risk Management Agency's insured crop losses as a result of drought (2007-2016), USDA crop exposure by county, the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina, storm events data (1950 to December 31, 2016) and probability of severe drought based on historic Palmer Drought Severity Index. The USDA crop exposure by county is from the 2012 Agricultural Census and assumes that the larger the exposure, the greater potential for loss and impact on the local economy.

From the statistical data collected, four factors were considered in determining overall vulnerability to drought as follows: social vulnerability, crop exposure ratio, annualized crop claims paid, and likelihood of occurrence. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms:

1) Low
2) Low-medium
3) Medium
4) Medium-high
5) High.

Using this system, Reynolds County and all of its jurisdictions were assigned a drought vulnerability classification of low-medium. Per the data cited above, the county has a 2.08% chance of experiencing a severe drought in any given year.

Potential Losses to Existing Development

The National Drought Mitigation Center at the University of Nebraska at Lincoln has assembled accounts of past impacts of drought upon the planning area. Per review of the information, drought has impacted agriculture and related sectors economically, including cattle farming and forestry, because of the reliance of these sectors on surface and subsurface water supplies. In addition to losses in yields in hay and livestock production, drought is associated with increases in insect infestations and plant stress/disease thereby reducing growth. For livestock owners in the county, water levels may become critically low and nitrate and alkaloid concentrations in hay and silage can become toxic rendering further declines in available roughages. Too, the incidence of forest and range fires increases substantially during extended droughts, which, in turn, place both human and wildlife populations at risk.

Losses due to drought in the county have been limited. Using insurance claims data over an eleven-year period from USDA's Risk Management Agency, crop losses were totaled at $177,995, or $16,181 per year. Therefore, it is reasonable to assume similar losses will continue into the future. Per USDA, farms in the county numbered 341 as of 2017 and consumed 86,614 acres within unincorporated portion of the county. Farms were classified primarily woodlands and pastureland (for livestock), as opposed to croplands. Cattle in the county numbered 8,360 as of 2017, with 4,366 head of cattle sold during the year.

Impact of Previous and Future Development

Little future development is anticipated within Reynolds County. Any future development will not result in increased impacts from droughts. All of the public water supply districts have ample capacity to meet all foreseen future development. No increase is anticipated in the number of acres farmed.

Changing Future Conditions Considerations

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 2050 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 already be described as experiencing water shortages of some degree.

Hazard Summary by Jurisdiction

There is little variation among jurisdictions with regard to drought. For example, some communities could be more at risk because the public water supply is a single source well. There are three publicly-owned and operated water supply districts in Reynolds County: the City of Bunker, the City of Centerville, and the City of Ellington. Residents living outside of these service areas rely on private wells for their water supply. The Lesterville R-IV School District receives its water from a the Lesterville Water Supply District.

There is no farmland within the city limits of Bunker, Centerville, or Ellington, therefore drought

impacts may be experienced as lawn or garden losses as opposed to large-scale crop or livestock losses. In addition, it should be noted that building foundations within all jurisdictions could be weakened over time due to shrinking and expanding.

Reynolds County – The unincorporated portion of the county is at higher risk of negative impacts from drought when compared to the remainder of the planning area due to its pasture lands and concentration of forests. Drought vulnerability for the county, however, remains low.

City of Bunker – The City of Bunker has low vulnerability to the negative impacts of drought.

City of Centerville – The City of Centerville has low vulnerability to the negative impacts of drought.

City of Ellington – The City of Ellington has low vulnerability to the negative impacts of drought.

Lesterville School District – The Lesterville R-IV School District has low vulnerability to the negative impacts of drought.

Problem Statement

Drought is a hazard that impacts large geographic regions of the country. The sector that is most impacted in Reynolds County is agriculture—which spans the unincorporated areas of the county. Drought causes damages to livestock and can negatively impact the livestock production depending on the length and severity of the drought. Fortunately, water supplies within the county are abundant, thereby limiting the negative impacts of this hazard upon the county. No mitigation actions related solely to drought were identified by the MPC.

3.4.6 Extreme Temperatures

Hazard Profile

Hazard Description

Extreme temperature events, both hot and cold, can impact human health and mortality, natural ecosystems, agriculture and other economic sectors. 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 3.18** uses both of these factors to produce a guide for the apparent temperature or relative intensity of heat conditions.

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.

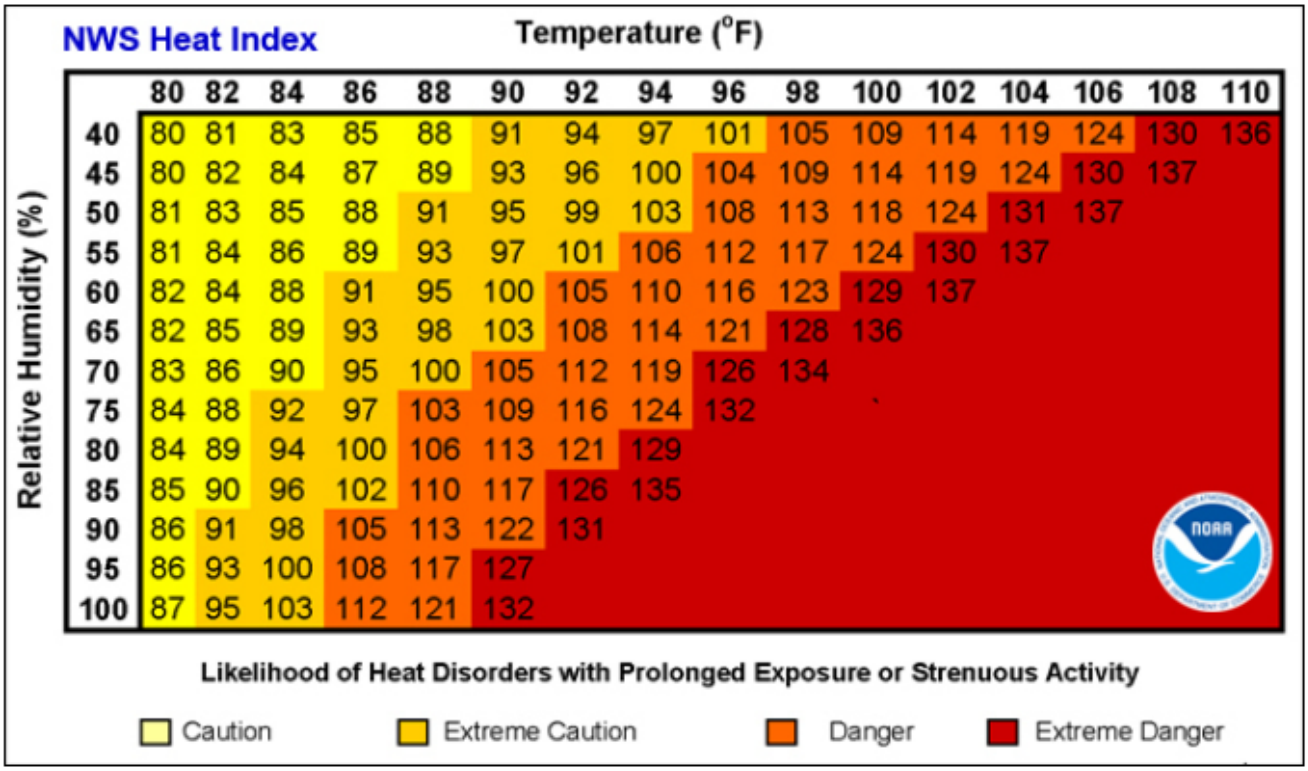
Geographic Location

Like drought, extreme heat is an area-wide hazard event, and that the risk of extreme heat does not vary across the planning area.

Strength/Magnitude/Extent

The National Weather Service (NWS) 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) 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.

Figure 3.18. Heat Index (HI) Chart

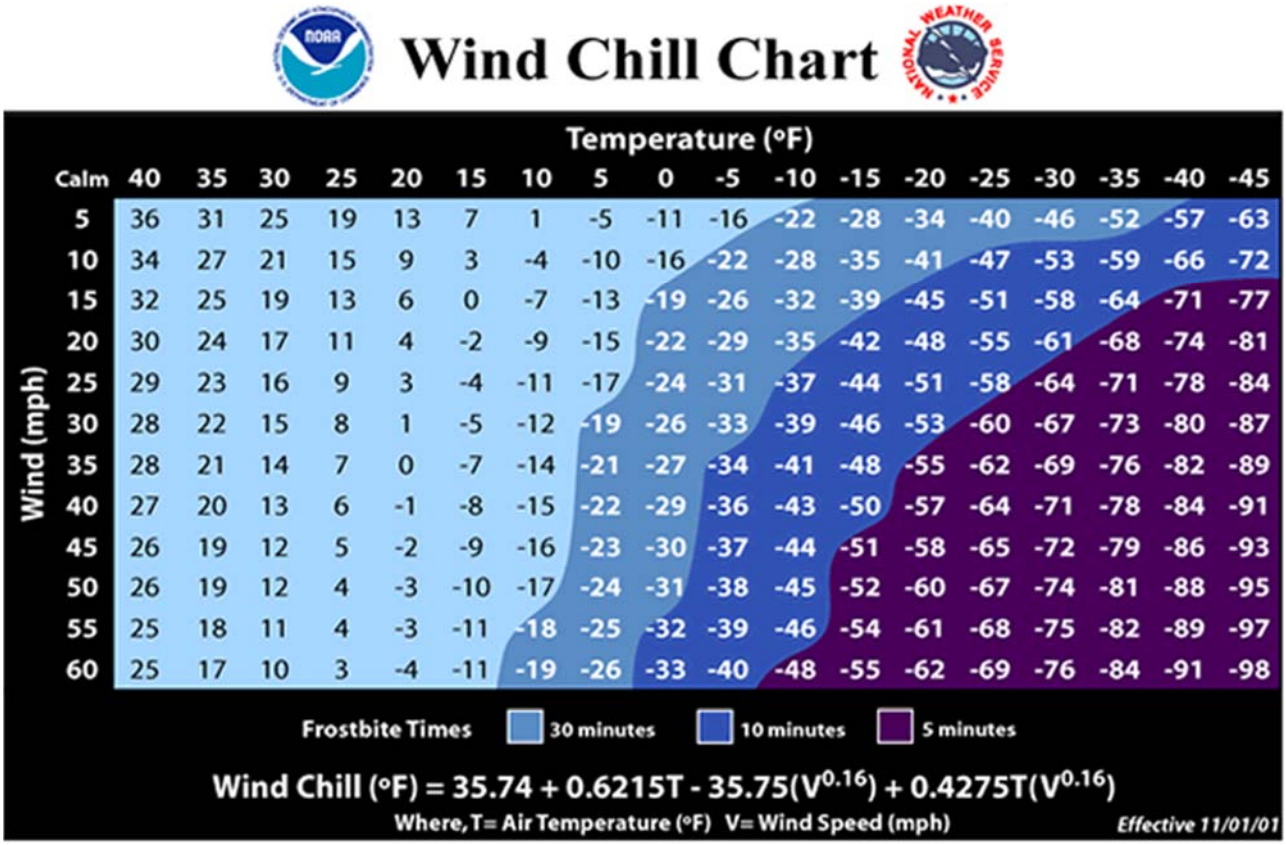


Source: National Weather Service (NWS); https://www.weather.gov/safety/heat-index

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.

The NWS Wind Chill Temperature (WCT) index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures. The figure below presents wind chill temperatures which are based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 3.19. Wind Chill Chart



Source: https://www.weather.gov/safety/cold-wind-chill-chart

Previous Occurrences

Per NCEI data from the past twenty years, Reynolds County experienced twenty-two recorded incidences of extreme heat spanning 105 days and listed as follows:

8/5/2007 - 8/16/2007 The first and only Heat Wave of the summer started in August 4th and lasted through August 16th. Eight deaths were reported in the St. Louis Metro area. The city of St. Louis reported 422 heat related injuries. St. Louis County reported 519 heat related injuries. At least 450 people were injured at an outdoor concert held on August 6th, and another 50 were injured at another outdoor concert on the 14th. Many schools across the region went to an early dismissal schedule to combat the heat. St. Louis hit 100 degrees on the 7th and 8th, 102 on the 12th, 103 on the 14th, and

105 on the 15th. The highs on the 14th and 15th set new records. Columbia hit 100 or higher on six days and set a new record of 103 degrees on the 16th. August 2007 ended up being the 3rd warmest on record for St. Louis and the 4th warmest on record for Columbia. The Department of Health and Senior Services reported at least 1300 heat related injuries across the state.

6/21/2009 - 6/27/2009 The first Heat Wave of the summer hit from June 21 through June 27. Heat Index values ranged from 100 to 107 during the period with high temperatures in the lower to upper 90s.

6/18/2010 - 6/23/2010 The first of several Heat Waves for the summer of 2010 started on June 18 and lasted through June 23. High temperatures were in the middle 90s with the heat index ranging from 100 - 105.

7/14/2010 - 7/14/2010 High temperatures rose to the lower to middle 90s. High humidity levels push Heat Index from 105 to near 110. St. Louis County reported 34 people treated at area hospitals.

7/17/2010 - 7/17/2010 High temperatures rose into the middle 90s with the Heat Index around 105. St. Louis County reported 13 people treated at area hospitals.

7/22/2010 - 7/24/2010 A three day heat wave hit the area. High temperatures were in the middle to upper 90s with the Heat Index from 105 - 110. St. Louis County reported 23 people treated at area hospitals for the event.

8/2/2010 - 8/4/2010 A short but intense heat wave hit the area. High temperatures on the 3rd and 4th were around 100 with the Heat Index around 110. St. Louis hit 102 on the 3rd and 101 on the 4th. There was one death reported in the City of St. Louis. The St. Louis County Health Department reported 13 heat related injuries.

8/8/2010 - 8/14/2010 A significant heat wave gripped the area for a week. High temperatures were mostly in the upper 90s to around 100. High moisture levels pushed the Heat Index to 110 - 115, the highest in several years. St. Louis hit 100 degrees on 8/11 and 8/13. There was one death in the City of St. Louis and one death in St. Louis County. The St. Louis County Health Department also reported 85 heat related injuries.

7/17/2011 - 7/31/2011 A major Heat Wave started on July 17th and continued into August. High temperatures ranged from the lower 90s to around 100. Columbia hit 100 on July 28 while St. Louis topped the century mark on six days, including four in a row from July 20 - 23. Low temperatures at night were generally around 80. The Heat Index ranged from around 105 to 110. There were five deaths reported in the City of St. Louis with three in St. Louis County. Over 100 people were treated at a U2 concert held at Busch Stadium the evening of the 17th.

8/1/2011 - 8/3/2011 The Heat Wave that started in mid July continued into the first three days of August. Many locations across the area topped the 100 degree mark on the 1st and 2nd. Columbia set a record for August 2nd hitting 108 degrees. The Heat Index ranged from 105 to 115.

6/27/2012 - 6/30/2012 Some of the hottest temperatures in many years occurred the last 4 days of June and continued into July. St. Louis, MO recorded its highest ever June temperature hitting 108 degrees on June 28. Nearly all reporting stations were over 100 degrees the last 3 to 4 days of June with most sites around 105. The 28th was the hottest day. Some high temperatures across the Missouri counties on the 28th included 109 degrees at Spirit of St. Louis Airport in Chesterfield, 108 in Farmington and Fredericktown, 107 in Washington, Columbia, and Jefferson City, and 106 in Warrenton. The good thing was the air was very dry, thus the Heat Index was not much different than the air temperature. The City of St. Louis reported two heat related deaths on June 30. St. Louis County reported 20 heat related injuries on June 29, and 23 on June 30.

7/1/2012 - 7/8/2012 A record setting heat wave continued from late June into July, finally breaking

on July 9. Columbia, MO was over 100 degrees from June 27 - July 7. St. Louis, MO was over 100 degrees from June 28 - July 7. St. Louis had a high of at least 105 degrees from July 4 - 7, peaking at 107 on the 7th. The heat wave was not typical for the area since the air was very dry. The relative humidity would usually fall to around 20% by late mid-afternoon. There were 17 heat related deaths confirmed in the Missouri Counties. St. Louis County Health Department reported 88 heat related injuries treated at area hospitals. The City of St. Louis reported 84 heat related cases at City hospitals.

7/22/2012 - 7/27/2012 After a brief break, excessive heat returned once again. St. Louis hit 108 degrees on July 25 and Columbia hit 106 on the 25th. Again the air was relatively dry thus the heat index was only a couple of degrees higher. St. Louis County reported 67 people treated at local emergency rooms for heat related reasons. The City of St. Louis reported 8 cases.

7/31/2012 - 7/31/2012 A two-day heat wave hit parts of Central, Eastern and Southeast Missouri the last day of July to the first day of August. High temperatures were around 105 degrees with the Heat Index 105 - 110. St. Louis County reported 6 people treated at area emergency rooms for heat related causes on July 31.

8/1/2012 - 8/1/2012 A two-day heat wave that started on July 31 continued into August 1. High temperatures were around 105 degrees with the Heat Index from 105 to 110. The St. Louis County Health Department reported 6 people treated for heat at area emergency rooms.

8/20/2014 - 8/27/2014 The first extended heat wave of the summer started on August 20 and lasted through August 27. High temperatures in the mid to upper 90s along with high humidity pushed the Heat Index from 105 to 110 degrees. St. Louis County health authorities reported 56 heat related injuries during the event.

7/12/2015 - 7/14/2015 The first excessive heat event of the summer produced max heat index values around 110 with high temperatures in the middle to upper 90s.

7/18/2015 - 7/19/2015 The heat index ranged from 105 - 110 with high temperatures in the lower to middle 90s.

7/25/2015 - 7/25/2015 A hot and very humid air mass produced Heat Index values around 105 with high temperatures in the lower 90s.

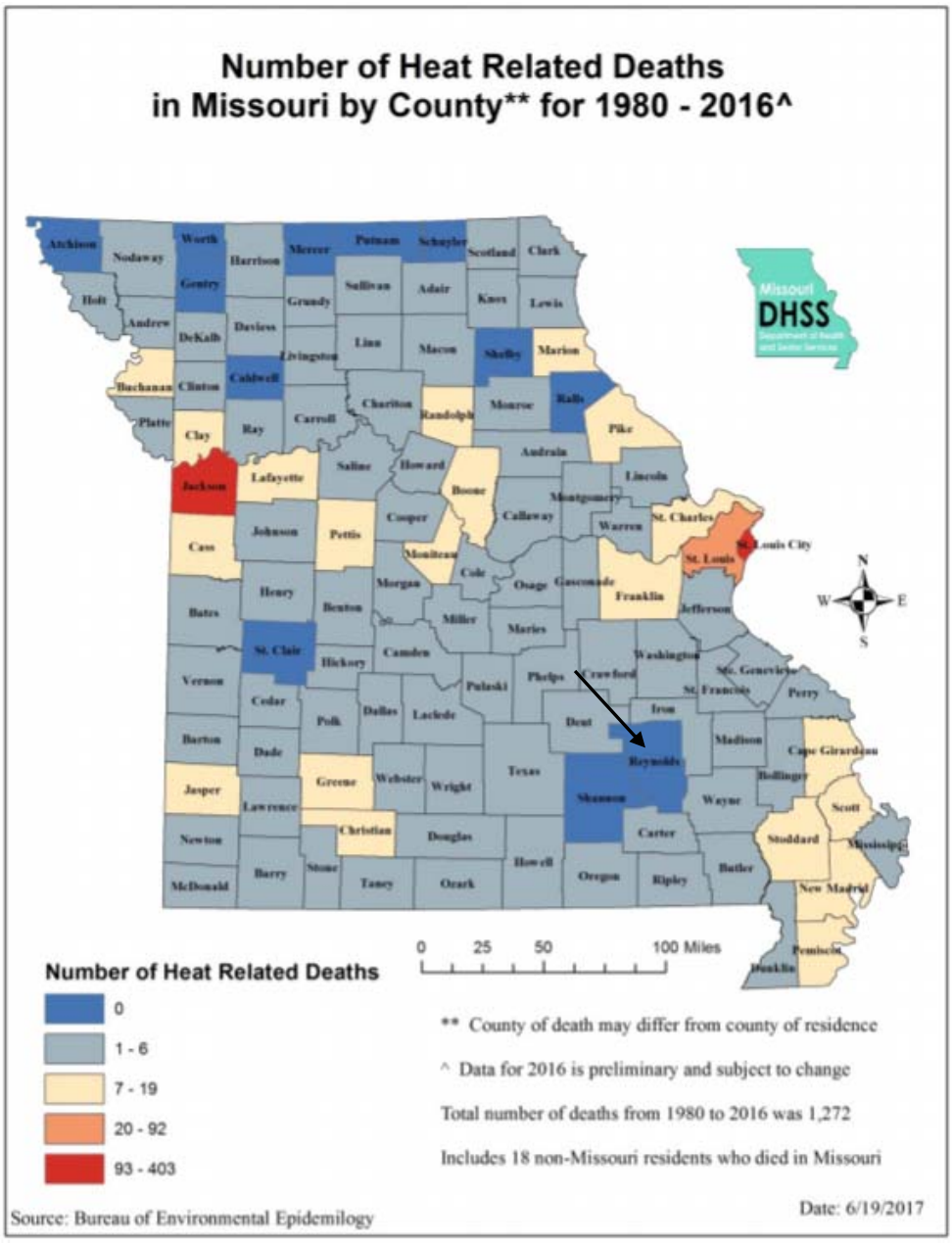
7/27/2015 - 7/29/2015 A hot and humid air mass produced Heat Index values from 105 - 110 degrees with high temperatures in the middle 90s.

7/18/2016 - 7/24/2016 Excessive Heat gripped the area July 18th - July 24th. High temperatures ranged from the middle to upper 90s with the Heat Index up to 110 degrees. The St. Louis County Health Department reported 1 death and 70 injuries.

7/21/2017 - 7/23/2017 An excessive heat wave hit southeast Missouri July 21 through July 23. High temperatures were in the upper 90s to around 100 with the heat index from 105 to 110 degrees.

Per the source, there were no reported injuries or deaths attributed to extreme heat events in the planning area. The following map shows the number of heat-related deaths in the State and planning area. Reynolds County is indicated by the black arrow.

Figure 3.20. Heat Related Deaths in Missouri 2000 - 2016



Source: https://health.mo.gov/living/healthcondiseases/hyperthermia/pdf/stat-report.pdf

Extreme heat can cause stress to crops and animals. According to USDA Risk Management Agency, there were have been no recorded crop losses due to any cause within the planning area. 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, no deaths were recorded in the planning area, according to NCEI data. The National Weather Service stated that among natural hazards within the nation, as a whole, no other natural disaster—not lightning, hurricanes, tornadoes, floods, or earthquakes—causes more deaths.

Within the planning area, however, extreme cold events have proven to be more deadly when compared to extreme heat events. The NCEI lists the following recorded extreme cold events as affecting Reynolds County. The three events include a total of 16 days of extreme cold temperatures. The event occurring in January 2013 resulted in three deaths. No injuries, crop or property damage were reported as a result of the events. While it is the best source of data currently available, it should be noted that extreme cold events could, just as extreme heat events, be underreported in the NCEI.

1/1/2010 - 1/12/2010 The first twelve days of January 2010 were the coldest in many years. For some locations, it was the first time the temperature dropped below zero in approximately 10 years. Some of the coldest temperatures observed included Fredericktown, MO (near Reynolds County) at -9 degrees F.

1/13/2013 - 1/13/2013 A cold front moved south through the region, triggering showers and a few thunderstorms over southern Missouri. Between one and three inches of rain fell over an extended amount of time onto partially frozen ground causing runoff. Numerous creeks and rivers rose due to the runoff. Several low water crossings were flooded. A father and his two young sons, as well as their four-month-old Labrador retriever, went on an approximately 16-mile round trip hike on the Ozark Trail in the Mark Twain National Forest on January 12th. They were heading south to Sutton's Bluff. The weather had been unusually warm with a high of 62 degrees recorded at the co-op station at Belleview 4SE. The family was dressed for the warmer weather and not prepared for cold temperatures. The cold front moved in during the day bringing in much colder temperatures. On their way back to their camp, they missed the turnoff to the Brushy Creek Lodge where they were staying and became lost further north along the trail. When they did not return, a search party was sent out to find them Saturday evening. The search was called off shortly after midnight and resumed the next morning at daybreak. By Sunday morning the temperature had dropped to 28 degrees at Belleview 4SE. The search party found the father and boys about a mile north of the turnoff to the lodge. The father, 36 years old, was pronounced dead at the scene. The two boys, 10 and 8 years old, were pronounced dead several hours later at a local hospital. The puppy survived.

1/6/2014 - 1/7/2014 The winter storm that brought heavy snow to much of the area followed that up with the coldest temperatures in 20 years. Some of the temperatures included Fredericktown, MO (near Reynolds County) at -12 degrees F. Wind Chill values the morning of the 6th ranged from -25 to -33 degrees F.

Probability of Future Occurrence

Per the above data regarding extreme heat, it can be reasonably estimated that the probability of a future occurrence of extreme heat in Reynolds County as 1.1 events per year with the event spanning an average of four to five days.

Using data from the NCEI, it can also be determined that, in the future, .15 extreme cold events are likely to occur each year within Reynolds County. Stated another way, an extreme cold event lasting an average of five to six days occurs about once every six to seven years somewhere in the planning area.

Changing Future Conditions Considerations

Per the Missouri State Hazard Mitigation Plan, 2018, “under a higher emissions pathway, historically unprecedented warming is projected by the end of the century. Even under a pathway of lower greenhouse gas emissions, average annual temperatures are projected to most likely exceed historical record levels by the middle of the 21st century. For example, in southern Missouri, the annual maximum number of consecutive days with temperatures exceeding 95 degrees F is projected to increase by up to 20 days! Temperature increases will cause future heat waves to be more intense, a concern for this region which already experiences hot and humid conditions.” At the same time, extreme cold events are expected to decrease in likelihood.

“The impacts of extreme heat events are experienced most acutely by the elderly and other vulnerable populations. Higher demand for electricity as people try to keep cool amplifies stress on power systems and may lead to an increase in the number of power outages. Atmospheric concentrations of ozone occur at higher air temperatures, resulting in poorer air quality, while harmful algal blooms flourish in warmer water temperatures, resulting in poorer water quality.”

Vulnerability

Vulnerability Overview

Extreme heat and extreme cold events are common occurrences in the planning area. Within the Missouri State Hazard Mitigation Plan, 2018, the method used to determine vulnerability to extreme temperatures across Missouri involved statistical analysis of data from several sources: the National Centers for Environmental Information (NCEI) storm events data (1996 to December 31, 2016), total population and percentage of population over 65 data from the U.S. Census (2015 ACS), and the calculated Social Vulnerability Index for Missouri counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina.

From the statistical data collected, four factors were considered in determining overall vulnerability to extreme temperatures as follows: total population, percentage of population over 65, likelihood of 3.264 3 Risk Assessment occurrence, and social vulnerability. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms:

1) Low
2) Low-medium
3) Medium
4) Medium-high
5) High

Using the process described above, Reynolds County was assigned a total vulnerability rating of “13” for extreme heat and “10” for extreme cold. This is due in large part to the high percentage of persons over age 65 residing in the county. A vulnerability rating of “13” equates to a medium-high vulnerability description, while a rating of “10” equates to a medium vulnerability. It should be noted that the 2015 ACS population estimate for Reynolds County used within the calculation is inaccurate. This could have resulted in a higher vulnerability estimate.

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

Table 3.25. **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

Potential Losses to Existing Development

According to USDA Risk Management Agency, losses to insurable crops during the eleven-year time period from 2010 to 2020 were $0, resulting in an average annual loss of $0.

Deaths due to extreme heat within the planning area are not recorded within the available data. It should be noted that, with climate, change, the frequency of death due to extreme heat within the planning area could increase slightly.

There were three deaths due to extreme cold within the planning area during the twenty-year time period analyzed. Historical information indicates that one death every twenty years is likely to occur as a result of extreme heat.

Impact of Previous and 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.

Presently, there are no jurisdictions in a growth mode in within the planning area. No large-scale conversion of non-agricultural land to farmland is anticipated.

Hazard Summary by Jurisdiction

Although it was not always the case, all three participating school districts furnish air-conditioning within student classrooms. Too, all three districts have policies which mandate school closure during high heat events.

Reynolds County – Per the 2020 American Community Survey (ACS) Five-Year Data, the unincorporated portion of the planning area is at risk to both extreme heat and extreme cold. Vulnerable populations comprise 31.0% of the total population in the county.

City of Bunker – Per the 2020 ACS Five-Year Data, the unincorporated portion of the planning area is at risk to both extreme heat and extreme cold. Vulnerable populations comprise 28.8% of the total population in the city.

City of Centerville – Per the 2020 ACS Five-Year Data, the unincorporated portion of the planning area is at risk to both extreme heat and extreme cold. Vulnerable populations comprise 21.52% of the total population in the city.

City of Ellington – Per the 2020 ACS Five-Year Data, the unincorporated portion of the planning area is at risk to both extreme heat and extreme cold. Vulnerable populations also comprise 21.5% of the total population in the city.

Lesterville R-IV School District – Because district operations are limited primarily to the fall, winter, and spring seasons, the risk of damage or injury due to extreme heat is low. The school district provides air conditioning within all classroom buildings. The district does not have a policy by which it cancels class during excessive heat and/or excessive cold days.

Adequate, heating infrastructure exists within the school facility to mitigate injury or death due to extreme cold. However, damaged infrastructure (i.e. frozen pipes) due to extreme cold should be mitigated.

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 2010 census 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 3.26, below, summarizes vulnerable populations in the participating jurisdictions. Note that school districts are not included in the table because students and those working for the school districts are not customarily in these age groups.

Table 3.26. **Reynolds County Population Under Age 5 and Over Age 65, 2020 Census Data**

Jurisdiction	Population Under 5 yrs *	Population 65 yrs and over *
Reynolds County	269	1,465
City of Bunker	8	68
City of Centerville	2	38
City of Ellington	95	202

Source: U.S. Census Bureau, (*) includes entire population of each city or county

Problem Statement

The risks resulting from extreme heat within the planning area are limited, however, per historical records, the residents of and visitors to the county are at risk of injury or death due to extreme cold and exposure to the elements. This may be due, in large part, to the lack of cellular communication signal within the county. Those engaging in outdoor activities within the unincorporated portion of the county are at greatest risk. To mitigate death or injury due to extreme cold, potential mitigation actions may include:

- Install communication towers which provide or enhance cellular data signals; and,
- Provide satellite phones to emergency medical personnel in the absence cellular infrastructure.

3.4.7 Severe Thunderstorms Including High Winds, Hail, and Lightning

Hazard Profile

Hazard Description

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 3.4.1**) and tornadoes (discussed separately in **Section 3.4.9**).

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 encounter 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.

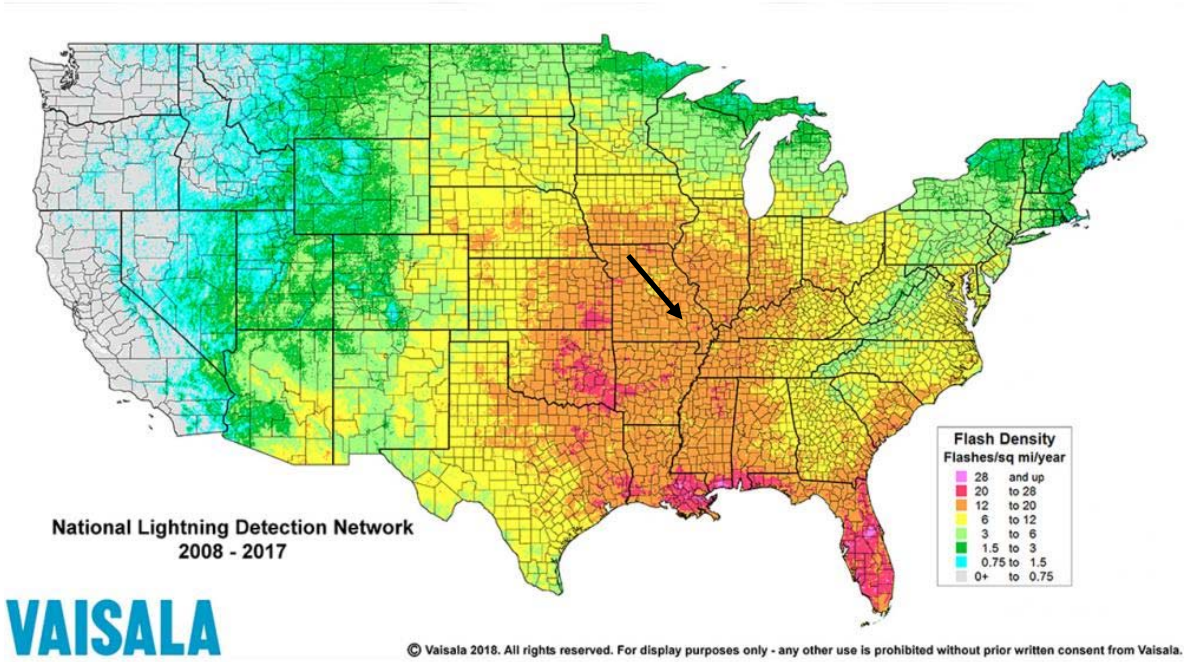
At the time when the updraft can no longer support the hailstone, it will fall down to the earth. For example, a ¼" diameter or pea sized hail requires updrafts of 24 miles per hour, while a 2 ¾" diameter or baseball sized hail requires an updraft of 81 miles per hour. According to the NOAA, the largest 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 populated areas. In addition, damages are more likely to occur in more heavily populated areas.

Figure 3.21, below, shows lightning frequency in the state. The planning area is indicated by the black arrow.

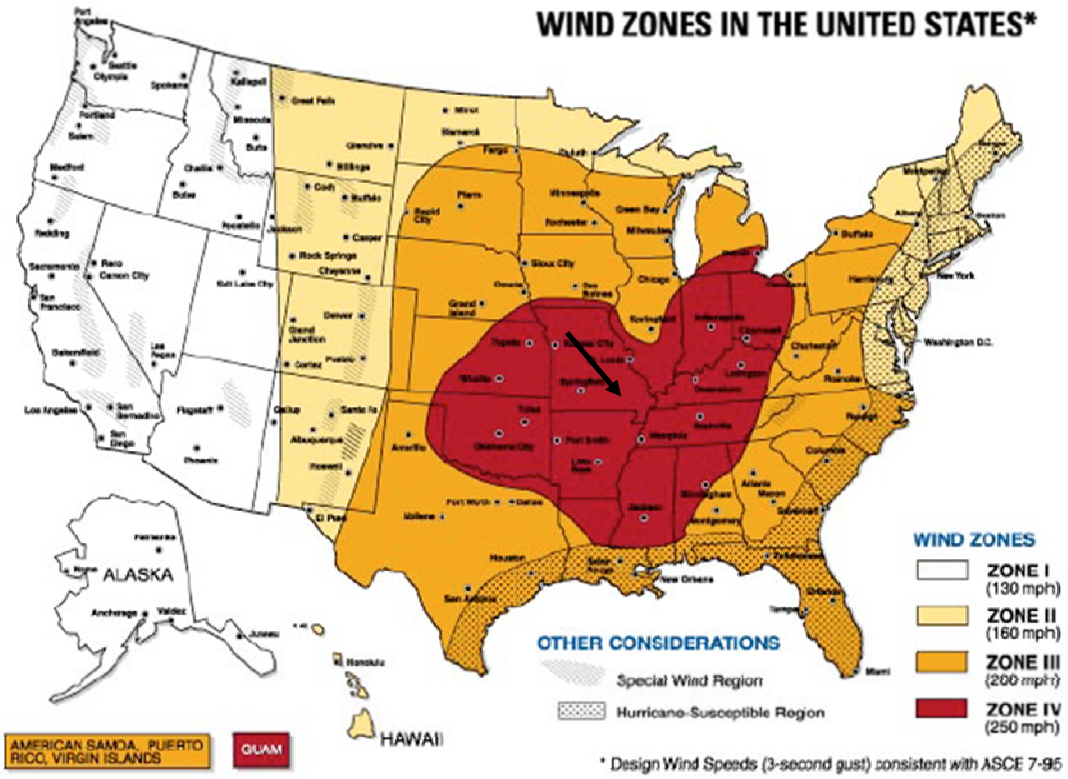
Figure 3.21. Location and Frequency of Lightning in Missouri



Source: National Weather Service, http://www.vaisala.com/en/products/thunderstormandlightningdetectionsystems/Pages/NLDN.aspx . Note: indicate location of planning area with a colored square or arrow.

Figure 3.22 shows wind zones in the United States. The black arrow indicates the location of the planning area.

Figure 3.22. Wind Zones in the United States



Source: FEMA 320, Taking Shelter from the Storm, 3rd edition, https://www.fema.gov/pdf/library/ism2_s1.pdf

Strength/Magnitude/Extent

Based on information provided by the Tornado and Storm Research Organization (TORRO), Table 3.27, below, describes typical damage impacts of the various sizes of hail.

Table 3.27. **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

Intensity Category	Diameter (mm)	Diameter (inches)	Size Description	Typical Damage Impacts
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. http://www.torro.org.uk/site/hscale.php

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

The narrative below discusses the frequency of thunderstorms, as well as the resulting damages and injuries. Thunderstorms are no longer included as a separate reporting category within the NCEI database. High winds, lightning, and hail—all component of thunderstorms—are included within the searchable database. Each thunderstorm component was analyzed with the results shown below. It should be noted that, limitations to the use of NCEI reported lightning events do exist. Only lightning events resulting in fatality, injury and/or property and crop damage are in the NCEI.

High Winds

The NCEI reports nine high wind events as occurring within the planning area between 2012 and 2022 and ranging in speed from 52 to 63 knots. All high wind events reported were associated with thunderstorms. Unfortunately, no deaths, injuries, or property damage were reported as resulting directly from the events. However, within the *2018 Missouri State Hazard Mitigation Plan*, which presents event data spanning a longer timeframe (21 years), property losses resulting from high wind did occur. When annualized, the historical losses amounted to $286 per year.

Lightning

No lightning events were reported within the planning area between 1950 and 2020. As stated above, only lightning events resulting in fatality, injury and/or property and crop damage are recorded by the NCEI. Therefore, it can be reasonably assumed that little to neither property, nor crop damage occurred as a result of lightning within the planning area. However, within the *2018 Missouri State Hazard Mitigation Plan*, which presents event data spanning a longer timeframe (21 years), property losses resulting from lightning events did occur within the county. When annualized, the historical losses amounted to $2,619 per year.

Hail

Per the NCEI, there were 11 hail events occurring within the county between 2012 and 2022. March, April, and May were the most common months during which hail fell within the planning area. Hailstones ranged in size from .75 of one inch to 3.00 inches. Of all the events, neither injuries/deaths, nor damage to property/crops was reported. Seven of the events were reported as occurring in unincorporated portion of the county, with two occurring in Centerville and two in Ellington.

Per the USDA, there have been no past crop damages as indicated by crop insurance claims. It can be deduced that the planning area's agricultural economy is not significantly impacted by thunderstorms, lightning, hail, and high-wind events.

Probability of Future Occurrence

High Wind

In reviewing the ten-year history presented above, the probability of a high wind event with winds greater than 50 knots is 100% in any given year. In other words, one high wind event resulting in minimal damage could reasonably be anticipated to occur every year.

Lightning

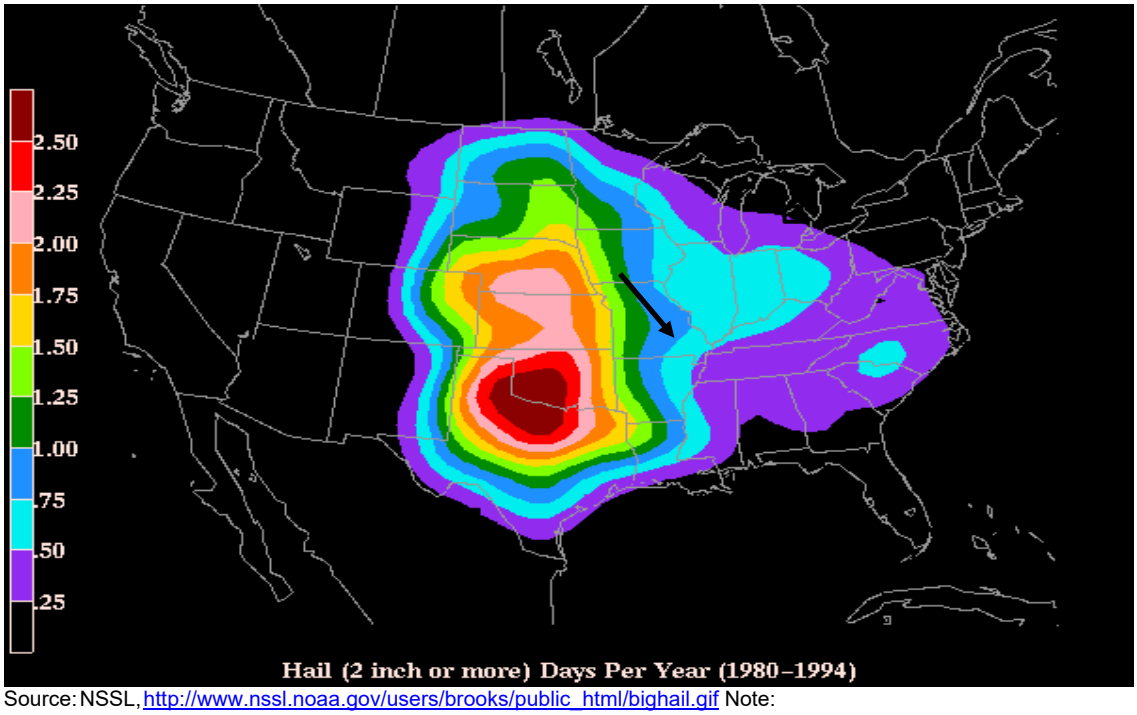
Although lightning will occur somewhere within the planning area every year, historical data—as reported by the NCEI—indicate that resulting damage is not likely. When a longer timeframe is examined, however, damage to property resulting was lightning is apparent and, though infrequent, should reasonably be anticipated to occur.

Hail

As reported earlier, there were 11 hail events reported for the ten-year period between 2012 and 2022, resulting in an estimated probability of little more than one event per year. All but two of the 11 events, involved hailstones one inch in diameter or larger. It can also be concluded from this data that at least one event producing a minimum of 1" diameter hail can be expected annually somewhere within the planning area.

The map in Figure 3.23 below is 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. Reynolds County is located within the light aqua blue and dark blue zones, which indicates a probability of .5 to 1 days per year during which hail 2 inches or larger in diameter is expected to occur.

Figure 3.23. Annual Hailstorm Probability (2'' diameter or larger), 1980-1994



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

Changing Future Conditions Considerations

Per the *Missouri State Hazard Mitigation Plan, 2018*, "NASA's Earth Observatory provides an analysis on how climate change could, theoretically, increase potential storm energy by warming the surface and putting more moisture in the air through evaporation. The presence of warm, moist air near the surface is a key ingredient for summer storms that meteorologists have termed "convective available potential energy," or CAPE. With an increase in CAPE, there is greater potential for cumulus clouds to form. The study also counters this theory with the theory that warming in the Arctic could lead to less wind shear in the mid-latitude areas prone to summer storms, making the storms less likely.

Predicted increases in temperature could help create atmospheric conditions that are fertile breeding grounds for severe thunderstorms and tornadoes in Missouri. Possible impacts include an increased risk to life and property in both the public and private sectors. Public utilities and manufactured housing developments will be especially prone to damages. Jurisdictions already affected should be prepared for more of these events and prioritize mitigation actions such as construction of safe rooms for vulnerable populations, retrofitting and/or hardening existing structures, improving warning systems and public education, and reinforcing utilities and additional critical infrastructure."

Vulnerability

Vulnerability Overview

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. Though it is not recorded as having occurred in the planning area, hailstorms can result in damage to property, crops, and the environment, and can injure and 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 quickly destroy plants. 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.

The method used to determine vulnerability to severe thunderstorms across Missouri was statistical analysis of data from several sources: National Centers for Environmental Information (NCEI) storm events data (1996 to December 31, 2016), HAZUS Building Exposure Value data, housing density and mobile home data from the U.S. Census (2015 ACS), and the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina.

From the statistical data collected, six factors were considered in determining overall vulnerability to lightning as follows: housing density, building exposure, percentage of mobile homes, social vulnerability, likelihood of occurrence, and average annual property loss. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms which were used to classify Missouri's 114 counties by vulnerability:

1) Low
2) Low-medium
3) Medium
4) Medium-high
5) High

Based on the analysis, Reynolds County's vulnerability to thunderstorm events was classified as "low-medium."

Potential Losses to Existing Development

Per HAZUS, total building exposure in the county is $423,248,000. Per data reported by the NCEI between 2012 and 2022, there were no property losses estimated as resulting from high wind, lightning, or hail events.

Previous and Future Development

Significant development is neither ongoing, nor anticipated within any jurisdictions in the planning area. As a result, the exposure of more households and businesses vulnerable to damages from severe thunderstorms/ high winds/lightning/hail is not expected.

Hazard Summary by Jurisdiction

Although thunderstorm events (high winds/lightning/hail) are most often area-wide, there are demographics indicating higher losses in one jurisdiction as compared to another. The primary factor for differences in the higher losses in one jurisdiction than another is population density. The population density for the unincorporated portion of Reynolds County is 5.3 persons per square mile of land area. As the size of Ellington is on 1.378 square miles and the population according to the 2020 ACS Five-Year Estimate is 1,380, the density is 1,001.5 persons per square mile. The Cities of Bunker and Centerville have lower populations; and, consequently, their population densities are much lower than that of Ellington at approximately 264 and 186 persons per square mile, respectively. The damages resulting from a thunderstorm have the potential to be greater within the City of Ellington than in the sparsely populated remainder of the county.

Unfortunately, information about jurisdictions with high percentages of housing built before 1939, is not calculated by the American Community Survey for the small rural cities of Bunker, Centerville and Ellington. No participating school districts reported previous losses involving school assets due to the hazard.

Reynolds County – The unincorporated portion of Reynolds County is likely to experience 1.2 hail events every two years and endure 1.4 wind events with winds greater than 50 knots once every two years. With an extraordinarily low population density, damages resulting from such events are not anticipated to be as significant as would in the City of Ellington, for example. This is due solely to the population density of the county as compared to its largest city (Ellington).

City of Bunker – With a low population density and no previously reported events of either hail, lightning, or high wind, the City of Bunker is most likely of all participating jurisdictions to incur damage resulting from thunderstorm activity.

City of Centerville – The City of Centerville is likely to experience 1 hail event producing stones greater than one inch in diameter every five years and endure winds greater than 50 knots once every 3 years. Due to the city's increased population density when compared to the county, its vulnerability to damage from thunderstorms, high wind, and hail is somewhat higher.

City of Ellington– Per the data reported by the NCEI, the City of Ellignton is likely to experience a hail event producing stones larger than one inch every five years and endure winds greater than 50 knots once every five years. Due to the city's significantly increased population density when compared to the county, its vulnerability to damage resulting from hail and high wind is considerably higher; it is most vulnerable of all of the participating jurisdictions to damage from such events.

Lesterville R-IV School District – While thunderstorms, high winds, and hail can occur anywhere within the school district's service area, damages to district assets can be projected based upon prior damage. Fortunately, no previous losses were reported by the sole participating school district in the planning area.

Problem Statement

Thunderstorms and their characteristics of high winds, lightning, and hail can result in property damage and have the potential to cause injuries and death to residents. These storms are common occurrences in Reynolds County; however, due in large part to the sparse population density of the planning area, the damages resulting from these events is relatively limited. The probability of a high

wind event with winds greater than 50 knots is 100% in the county in any given year. Electrical outages frequently accompany these events. There also exists a 100% chance that a 1" diameter hail event will occur in the county in any given year, with an average of one event per year. Lightning can accompany both types of events. Though damages resulting from these types of events are historically quite limited, potential mitigation actions for the planning are may include the following:

- seek funding for emergency generator installation at critical facilities; and,
- ensure critical facilities—particularly those outfitted with communications equipment and emergency responders (e.g. the 911 call center, ambulance district headquarters, etc.)—are protected from lightning strikes.

3.4.8 Severe Winter Weather

Hazard Profile

Hazard Description

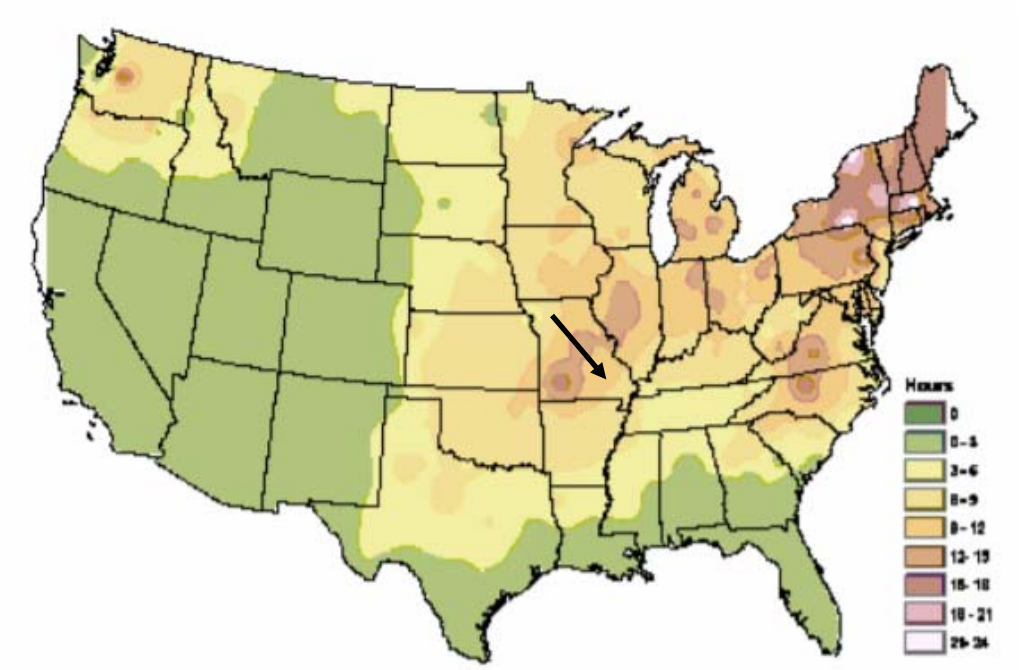
A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. The National Weather Service describes different types of winter storm events as follows.

- **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. The map in Figure 3.24 below shows the average number of hours of freezing rain experienced within the country annually. The planning area is indicated by the black arrow. Per this source, the county should anticipate eight to nine hours of freezing rain per year.

Figure 3.24. 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

Strength/Magnitude/Extent

Severe winter storms include heavy snowfall, ice, and strong winds which can push the wind chill well below zero degrees in the planning area.

For severe weather conditions, the National Weather Service issues some or all of the following products as conditions warrant across the State of Missouri. NWS local offices in Missouri may collaborate with local partners to determine when an alert should be issued for a local area.

- Winter Weather Advisory — Winter weather conditions are expected to cause significant inconveniences and may be hazardous. If caution is exercised, these situations should not become life threatening. Often the greatest hazard is to motorists.
- Winter Storm Watch — Severe winter conditions, such as heavy snow and/or ice are possible within the next day or two.
- Winter Storm Warning — Severe winter conditions have begun or are about to begin.
- Blizzard Warning — Snow and strong winds will combine to produce a blinding snow (near zero visibility), deep drifts, and life-threatening wind chill.
- Ice Storm Warning -- Dangerous accumulations of ice are expected with generally over one quarter inch of ice on exposed surfaces. Travel is impacted, and widespread downed trees and power lines often result.
- Wind Chill Advisory -- Combination of low temperatures and strong winds will result in wind chill readings of -20 degrees F or lower.

- Wind Chill Warning -- Wind chill temperatures of -35 degrees F or lower are expected. This is a life-threatening situation.

Previous Occurrences

Per the NCEI Storm Events Database, Reynolds County and its participating jurisdictions experienced forty-three winter weather events in the ten-year timeframe spanning 2012-2021. Table 3.28, below, lists NCEI reported events and damages within the planning area for the past ten years.

Table 3.28. **NCEI Reynolds County Winter Weather Events Summary, 2012-2022**

Type of Event	Inclusive Dates	# of Injuries/ Deaths	Property Damages ($)	Crop Damages ($)
Cold Wind Chill	01/13/2013	3 deaths	0	0
Winter Storm	02/21/2013	0	0	0
Winter Storm	12/5/2013	0	0	0
Winter Storm/Cold Wind	01/52014-1/6/2014	0	0	0
Winter Storm	3/1/2014	0	0	0
Heavy Snow	2/15/2015	0	0	0
Heavy Snow	2/22/2015	0	0	0
Heavy Snow	2/14/2021	0	0	0
Sleet	2/24/2022	0	0	0

Source: NCEI, data accessed June 2022

Most noteworthy is the event occurring on 1/13/2013. Per the NCEI, "a cold front moved south through the region, triggering showers and a few thunderstorms over southern Missouri. Between one and three inches of rain fell over an extended amount of time onto partially frozen ground. A father and his two young sons, as well as their 4-month-old Labrador retriever, went on an approximately 16-mile round trip hike on the Ozark Trail in Mark Twain National Forest on January 12th." The man and his two sons became lost and perished in the night due to cold temperatures. The three were dressed for warm weather as they had departed prior to the cold front's arrival.

Since 1979, five winter storms have resulted in presidential disaster declarations within the planning area. They include the following:

- DR 1673, Severe Winter Storm, Declared 12/29/2006;
- DR 3281, Severe Winter Storm, Declared 12/12/2007;
- DR 1748, Severe Ice Storm, Declared 3/1/2008;
- DR 1822, Severe Winter Storm, Declared 2/17/2009; and,
- DR 3303, Severe Winter Storm, Declared 1/30/2009.

Per the FEMA data found at https://www.fema.gov/data-visualization/disaster-declarations-states-and-counties, such disasters resulted in public assistance awards amounting to $2,047.77 in debris removal, $33,126.18 in emergency protective measures.

While winter storms, cold, frost and freeze can diminish crop production, this is not the case in Reynolds County. Per the USDA's Risk Management Agency payments for insured crop losses in the planning area as a result of cold conditions and snow for the past 10 years were $0.

Probability of Future Occurrence

The probability of a future occurrence of severe winter weather within the planning area in any given

year is 100%. According to the ten years of incident data reported above, each year, Reynolds County experiences and average of one winter weather event ranging from cold wind chill to winter storm with heavy snow. It should be noted that one episode of severe winter weather generally multiple types of events.

Changing Future Conditions Considerations

Per the *2018 Missouri State Hazard Mitigation Plan*, "a shorter overall winter season and fewer days of extreme cold may have both positive and negative indirect impacts. Warmer winter temperatures may result in changing distributions of native plant and animal species and/or an increase in pests and non-native species. Warmer winter temperatures will result in a reduction of lake ice cover. Reduced lake ice cover impacts aquatic ecosystems by raising water temperatures. Water temperature is linked to dissolved oxygen levels and many other environmental parameters that affect fish, plant, and other animal populations. A lack of ice cover also leaves lakes exposed to wind and evaporation during a time of year when they are normally protected. As both temperature and precipitation increase during the winter months, freezing rain will be more likely. Additional wintertime precipitation in any form will contribute to saturation and increase the risk and/or severity of spring flooding. A greater proportion of wintertime precipitation may fall as rain rather than snow."

Vulnerability

Vulnerability Overview

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.

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.

From the statistical data collected, five factors were considered in determining overall winter storm vulnerability: housing density, likelihood of occurrence, building exposure, total annualized property loss, and social vulnerability. To complete the vulnerability analysis utilizing the factors above, a

rating value of 7-22 was assigned to the data obtained for each factor. These rating values correspond to the following descriptive terms:

- 7-8 – Low
- 8-10 – Medium-Low
- 10-12 – Medium
- 12-15 – Medium-High
- 15-22 – High

The rating values of all factors were then considered in determining overall vulnerability rating. As was determined through this vulnerability analysis, Reynolds County, with a score of 9, has a low-medium vulnerability to future winter weather events. The county's social vulnerability rating of 4 was the most heavily negatively weighted rating factor of the five factors analyzed.

Potential Losses to Existing Development

In reviewing the loss data as presented by the NCEI for for the planning area for the timeframe encompassing 2012-2022, there occurred nine severe winter weather events none of which resulted in property damage. Future losses, based on this historic data, could be estimated at $0 annually. It should be noted that many property loss incidents are indirectly related to winter weather event and result from utility failure or loss of power (e.g. broken pipes due to the expansion of frozen water). Such incidents would not be included within the event data reported by the NCEI.

Previous and Future Development

There is little future development projected for Reynolds County, therefore the potential impact of winter weather is not expected to increase due to development within the planning area.

Hazard Summary by Jurisdiction

Some jurisdictions may suffer heavier damages during winter weather events due to demographic factors. For example, as with thunderstorms, high wind, hail, and lightning, more densely populated areas are more vulnerable to damages from winter weather. Per the completed, Data Collection Questionnaires, no damage was caused to school district assets as a result of winter weather.

Due to the rural nature of the area, there are few buildings with a high occupancy such as apartment buildings, condominium complexes, etc. Mobile homes, for the most part, are scattered singly throughout the balance of the county and sometimes grouped together in sets of two or three.

Reynolds County – The unincorporated portion of the county is likely to experience one winter weather event per year. Damages are not anticipated to be as significant as would be expected within the City of Ellington. This is due solely to the low population density of the county—5.3 persons per square mile—as compared to Ellington's at 1,001.5.

City of Bunker – While the City of Bunker is also likely to experience an average of one winter weather event per year, its vulnerability to damage from these types of events is lower than in Ellington, but higher than the remainder of the county. This is because of the city's population density (264 persons per square mile) is significantly higher than that of the county (5.3 persons per square mile), but much lower than in the City of Ellington (1,001.5 persons per square mile).

City of Centerville – While the City of Centerville is also likely to experience an average of one

winter weather event per year, its vulnerability to damage from these types of events is considerably lower than its neighboring cities. This is because of the city's population density—168 persons per square mile—is significantly lower than that of the county—5.3 persons per square mile.

City of Ellington – While the City of Ellington is also likely to experience one winter weather events per year, its vulnerability to damage from these types of events in considerably higher than that of the remainder of the planning area. This is because the city's population density (1,001.5 persons per square mile) is significantly higher than that of any other participating jurisdiction.

Lesterville R-IV School District – Severe winter weather can occur anywhere within the school district's service area, however, damages to district assets can be projected to be similar to those of other properties located throughout the unincorporated portion of the county.

Problem Statement

Winter weather comes with a myriad of impacts that including health concerns related to extreme cold temperatures, personal injury from falling, injury or death due to motor vehicle accidents caused by icy surfaces, and power outages caused by ice accumulating on overhead powerlines. All jurisdictions within the planning area are at risk of severe winter weather.

Potential actions to mitigate damage and injury resulting from this hazard could include the following:

- Developing a standard for tree pruning around the powerlines.
- provision of emergency power generators at critical facilities (including water and wastewater treatment plants, nursing homes, schools, and police and fire stations).

3.4.9 Tornado

Hazard Profile

Hazard Description

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. The unique geography of the central United States allows for the development of thunderstorms that spawn tornadoes. The jet stream, which is a high-velocity stream of air, determines which area of the central United States will be prone to tornado development. The jet stream normally 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.

Tornadoes spawn from the largest thunderstorms. The associated cumulonimbus clouds can reach heights of up to 55,000 feet above ground level and are commonly formed when Gulf air is warmed by solar heating. The moist, warm air is overridden by the dry cool air provided by the jet stream. This

cold air presses down on the warm air, preventing it from rising, but only temporarily. Soon, the warm air forces its way through the cool air and the cool air moves downward past the rising warm air. This air movement, along with the deflection of the earth's surface, can cause the air masses to start rotating. This rotational movement around the location of the breakthrough forms a vortex, or funnel. If the newly created funnel stays in the sky, it is referred to as a funnel cloud. However, if it touches the ground, the funnel officially becomes a tornado.

A typical tornado can be described as a funnel-shaped cloud that is "anchored" to a cloud, usually a cumulonimbus that is also in contact with the earth's surface. 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

Given the nature of the weather phenomenon, tornadoes can occur anywhere within the planning area.

Strength/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 3.29) 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.

Table 3.29. **Enhanced F Scale for Tornado Damage**

FUJITA SCALE			DERIVED EF SCALE		OPERATIONAL EF SCALE	
F Number	Fastest ¼-mile (mph)	3 Second Gust (mph)	EF Nu	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

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

The wind speeds for the EF scale and damage descriptions are based on information on the NOAA Storm Prediction Center as listed in Table 3.30. 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. Information on the Enhanced Fujita Scale's damage indicators and degrees or damage is located online at www.spc.noaa.gov/efscale/ef-scale.html.

Table 3.30. **Enhanced Fujita Scale with Potential Damage**

Enhanced Fujita Scale			
Scale	Wind Speed (mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e. those that remain in open fields) are always rated EF0).
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stores of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.
EF5	>200	<0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300 ft.; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA Storm Prediction Center, http://www.spc.noaa.gov/efscale/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 3.31 lists NCEI reported tornado events and damages since 1993 in the planning area. Prior to 1993, only really destructive tornadoes were recorded. There are limitations to the use of NCEI 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 NCEI. Also, a tornado that lifts off the ground for less than five minutes or 2.5 miles is considered a separate segment. If the tornado lifts off the ground for greater than five minutes or 2.5 miles, it is considered a separate tornado. Tornadoes reported by the NCEI within its Storm Event Database are reported in segments.

Table 3.31. **Recorded Tornadoes in Reynolds County, 1993 – 2022**

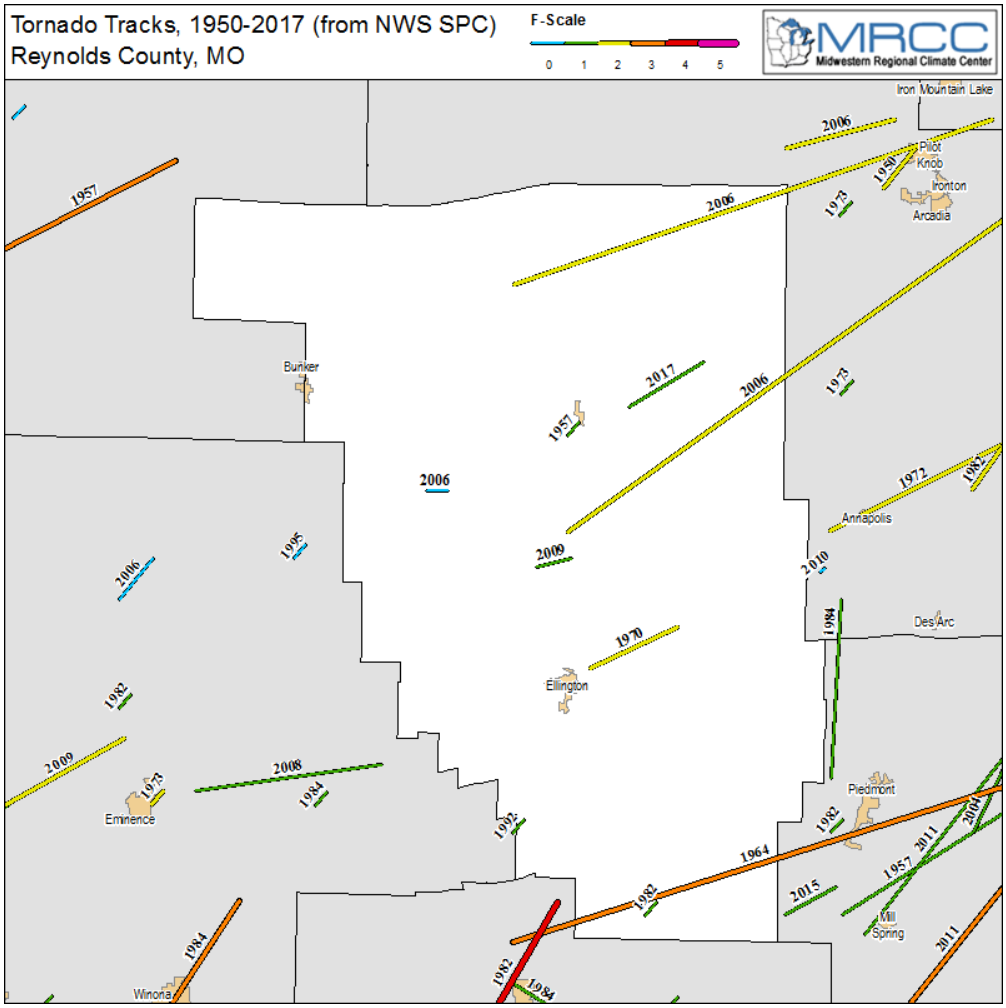
Date	Beginning & Ending Location	Start Time	Length (miles)	Width (yards)	F/EF Rating	# Death	# Injury	Property Damage ($)	Crop Damages ($)
5/18/2001	ELLINGTON	1620	0.1	50	F0	0	0	0	0
5/20/2001	ELLINGTON	2135	0.1	50	F0	0	0	0	0
5/30/2004	REYNOLDS	1645	0.1	40	F0	0	0	0	0
10/18/2004	REDFORD	1537	0.5	40	F0	0	0	100,000	0
1/2/2006	REYNOLDS	445	0.5	50	F0	0	0	0	0
3/11/2006	CENTERVILLE	1955	12.5	75	F1	0	0	0	0
9/22/2006	OATES	1342	12.8	550	F2	0	0	0	0
5/8/2009	REDFORD	925	1.8	440	EF1	0	0	0	0
2/28/2017	CENTERVILLE	1840	4.36	80	EF1	0	0	0	0
10/24/2021	MONTEREY	1843	1.17	100	EF1	0	0	0	0
12/10/2021	REDFORD	2205	6.86	300	EF2	0	0	0	0
TOTAL						**0**	**0**	**$100,000**	**0**

Source: National Centers for Environmental Information, http://www.NCEI.noaa.gov/stormevents/

Of all of the events listed above as occurring within the planning area, only one resulting in damages per the NCEI. Per the event narrative, on October 18, 2004, “a small tornado hit the Redford area of Reynolds County. Several structures suffered minor damage, primarily roof shingles and siding blown off. One garage and two barns also suffered roof damage.” Fortunately, no tornado events occurring within the county resulted in injury or death.

Figure 3.25 shows historic tornado paths in the planning area form 1950 through 2017. It should be noted that data limitations exist as the map does not depict the October 2004 event cited above.

Figure 3.25. Reynolds County Map of Historic Tornado Events, 1950-2017



Source: Midwestern Regional Climate Center, https://mrcc.purdue.edu/

The USDA Risk Management Agency reports no crop insurance payments issued to landowners within the county due to tornado or any other natural hazard for the ten-year time-period extending 2012-2022.

Probability of Future Occurrence

Based on historical data collected between 1993 and 2022, eleven tornado events occurred in the planning area during the 30-year period. Using this data, it can be calculated that there is a 34% chance a tornado (of any magnitude) striking somewhere in the county in any given year. This percentage was calculated by dividing the number of events (11) by the number of years within the specified timeframe (30) and multiplying the product by 100. More simply sated, there has been an average of one tornado (of any magnitude) somewhere within the planning area every 33 months.

Changing Future Conditions Considerations

According to the *Missouri State Hazard Mitigation Plan, 2018*, "scientists do not know how the frequency and severity of tornadoes will change. Research published in 2015 suggests that changes

in heat and moisture content in the atmosphere, brought on by a warming world, could be playing a role in making tornado outbreaks more common and severe in the U.S. The research concluded that the number of days with large outbreaks have been increasing since the 1950s and that densely concentrated tornado outbreaks are on the rise. It is notable that the research shows that the area of tornado activity is not expanding, but rather the areas already subject to tornado activity are seeing the more densely packed tornadoes. Because Missouri experiences on average around 39.6 tornadoes a year, such research is closely followed by meteorologists in the state."

Vulnerability

Vulnerability Overview

Reynolds County's is located in a region of the U.S. with high frequency of dangerous and destructive tornadoes referred to as "Tornado Alley". The map shown in the figure below illustrates areas where dangerous tornadoes historically have occurred.

Figure 3.26. Tornado Alley in the U.S.

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

The State of Missouri determine vulnerability to tornadoes across Missouri using a statistical analysis of data from several sources: HAZUS building exposure value data, population density and mobile home data from the U.S. Census (2015 ACS), the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina, and storm events data (1950 to December 31, 2016) from the National Centers for Environmental Information (NCEI). The statistical model used for this analysis was probabilistic based purely on tornado frequency and historic losses. It is based on past experience and forecasts the expected results for the immediate or extended future.

From the statistical data collected, six factors were considered in determining overall vulnerability to tornadoes as follows: building exposure, population density, social vulnerability, percentage of mobile homes (25% for the planning area), likelihood of occurrence, and annual property loss. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms:

1) Low
2) Low-medium

3) Medium
4) Medium-high
5) High

Once the ranges were determined and applied to all factors considered in the analysis, the ratings were combed to determine an overall vulnerability rating for tornadoes. Reynolds County's overall vulnerability to tornado events was determined, based on the analysis described above, to be low-medium. The county was rated as a "4" on two of the factors (percentage of mobile home and social vulnerability). Consequently, eight of the county's 12 points were attributed to those two measures. It should be noted that, per historical records, there have been no EF 3, EF 4, or EF 5 tornados within the planning area. The data used in this vulnerability analysis was determined to be best available at the time of analysis.

Potential Losses to Existing Development

Per tornado history data provided from the NCEI from May 1, 1993 through March 1, 2021, there were eleven tornado events in Reynolds County, resulting in property damages amounting to $100,000. This equates to $9,091 in property damage per event. With a probability of one event every 33 months, it can be assumed that a tornado will occur somewhere in the county every 33 months and result in property damages of valued at less than $10,000.

Total building and contents exposure for the planning is available via MSDIS for each jurisdiction within the planning area and is as follows:

- Unincorporated Reynolds County: 4,483 structures valued at $342,716,000 with contents valued at $184,479,000;
- City of Bunker: 115 structures valued at $13,945,000 with contents valued at $7,926,000;
- City of Centerville: 81 structures valued at $9,711,000 with contents valued at $5,421,000; and,
- City of Ellington: 484 structures valued at $56,876,000 with contents valued at $35,538,000.

Previous and Future Development

Little future development is anticipated in to occur in Reynolds County or its two incorporated municipalities, therefore, the vulnerability to tornadoes and the resulting damages are not expected to increase.

Hazard Summary by Jurisdiction

A tornado can occur anywhere in the planning area, although, some jurisdictions may suffer heavier damages due to the age or type of their housing stock, or high concentration of people and property—particularly mobile homes. As with thunderstorm, high winds, hail and lightning, higher population density increases the vulnerability of a jurisdiction to tornado events.

None of the communities within the planning area have adopted building codes, and, therefore, all may be more vulnerable to damages resulting from tornados. No dependable data was available regarding the percentage of residents with homeowner's insurance.

The City of Ellington has a higher concentration of people and housing than the remainder of the planning area; therefore, the risk for damages and injuries and deaths due to tornado are higher in Ellington. The age and type of housing stock is consistent throughout the planning area. There are no large concentrations of mobile homes in any one particular area.

The Southern Reynolds county R-II School District—headquartered in Ellington—completed a tornado safe room in 2011. The safe room reduces the risk of death and injury for those seeking shelter during a tornado. The only participating school district reported no assets lost to previous tornado occurrences. No special districts participating within the plan update.

Reynolds County – The unincorporated portion of the county is likely to experience a tornado once every 33 months with minimal damage and no loss of life. This is due solely to the low population density of the county—5.3 persons per square mile.

City of Bunker – While the City of Bunker is also likely to experience a tornado once every 33 months, its vulnerability to damage from these types of events is low. This is because of the city's population density is also lo at 264 persons per square miles.

City of Centerville – While the City of Centerville can reasonably expect to experience a tornado once every twenty-seven months, its vulnerability to damage from these types of events in considerably lower than that of the City of Ellington. This is because of the city's population density at 168 persons per square mile is significantly lower than that of Ellington.

City of Ellington – While the City of Ellington is also likely to experience a tornado every 33 months, its vulnerability to damage from these types of events in considerably higher than the remainder of the county. This is because of the city's population density is much higher than that of the county—1,001.5 persons per square mile compared to 5.3 persons per square mile.

Lesterville R-IV School District – Tornadoes can occur anywhere within the school district's service area, however, damages to district assets can be projected to be similar to those of other properties located within balance of the unincorporated portion of the county.

Problem Statement

There is a 34% chance a tornado will occur somewhere in Reynolds County within the next year. The event will likely be short lived and result in minimal damage. There is no way to predict the point or origin or termination of such an event. To avoid potential injury and/or loss of life resulting from tornado in the planning area, the following thoughts are offered.

- Ensure tornado sirens exist and are functioning within each population center in the county (i.e. Bunker, Centerville, Ellington-North, Ellington-South, Garwood, and Lesterville) and at all major employers sites, campgrounds, and state parks.

3.4.10 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,

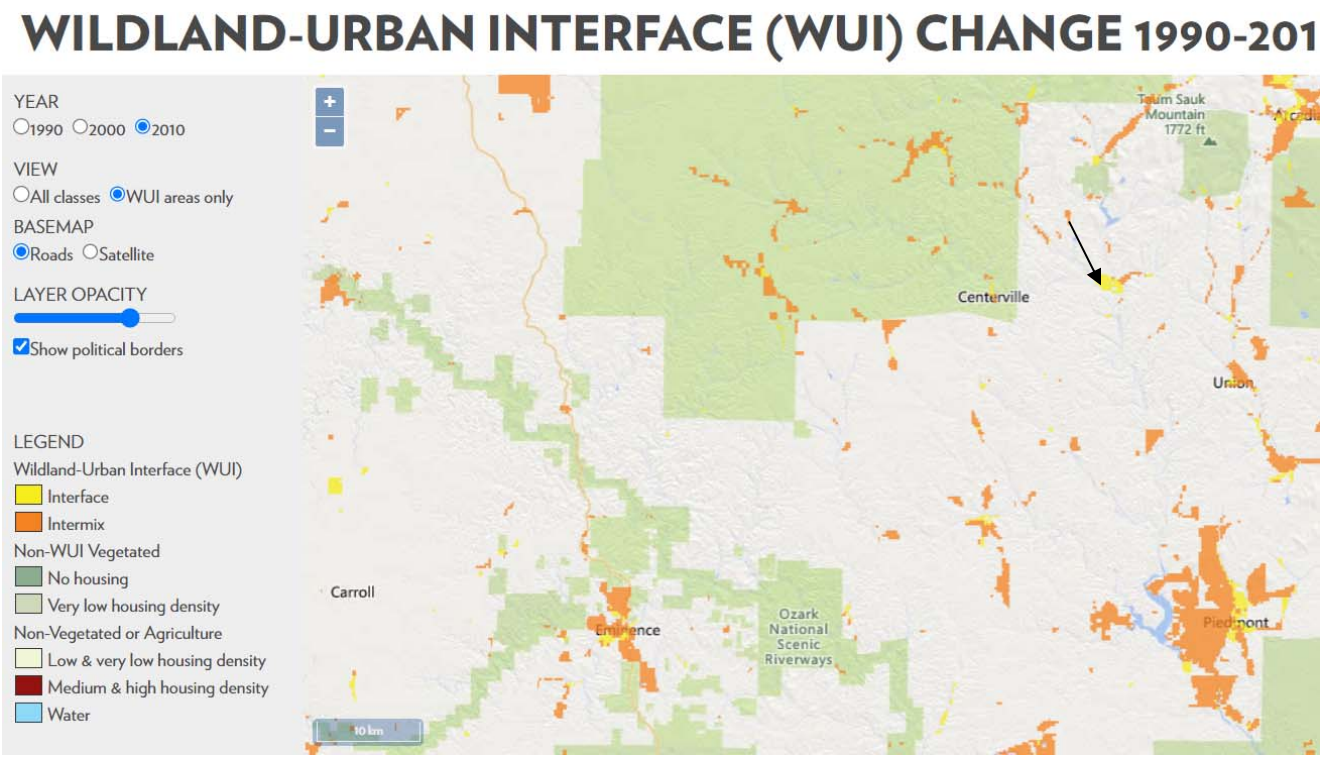
eight forestry regions have been established in Missouri for fire suppression. The Forestry Division works closely with volunteer fire departments and federal partners to assist with fire suppression activities. Currently, more than 900 rural fire departments in Missouri have mutual aid agreements with 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

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. Such areas within Reynolds County are limited and consist primarily of intermix. One large area of interface exists in the northeast portion of the county at Lesterville. The Lesterville R-IV School District is located within this wildland urban interface area. The map in Figure 3.27 below shows all WUI areas in the county. The black arrow indicates the location of the Lesterville R-IV School District headquarters.

Figure 3.27. Reynolds County Map of Wildland Urban Interface/Intermix Areas, 2010



Source: University of Wisconsin Slivis Lab, http://silvis.forest.wisc.edu/maps/wui/2010/download

Strength/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.

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.

No information was available regarding notable planning area structural fires and wildland fires.

Previous Occurrences

Data regarding wildland fires was pulled from the Missouri Department of Conversation (MDC) Wildfire Data Search at: https://mdc12.mdc.mo.gov/Applications/MDCFireReporting/Home/FireReportSearch. Reports were made by paid and volunteer fire department serving the county, as well as the U.S. Forest Service and the Missouri Department of Conservation.

According to the source, 370 wildfires were reported to have occurred within the planning area in a ten-year period between 2012 and 2022. Acres consumed per event ranged from one-tenth of an acres to 1,061 acres and totaled 11,490. Of the fires, 174, or 47%, burned less than five acres. Another 11 events burned more than 200 acres each. Two of the wildfire events consumed 16.3% of the total acreage burned in the 10-year period at 810 and 1,061 acres. The cause of both fires was reported as arson, as was the case with 65 other wildfire events. Arson accounted for 4,165, or 36.3% of the total acres burned within the planning area.

Of all the causes, "Debris" was listed as the fire's source in 40.5% of cases, with children, smoking, arson, equipment, smoking, miscellaneous, and unknown listed as other possible causes. Interestingly, lightning was not cited as causing any wildfires within the ten-year period.

No wildfire events were recorded within the NCEI database. Furthermore, no school districts reported information regarding fire events within their Data Collection Questionnaires.

Probability of Future Occurrence

Per the thorough MDC data provided above, the planning area regularly experiences wildfires. Based on this data, a wildfire is likely to occur somewhere within the planning area nearly thirty-seven times each year. Per the *Missouri State Hazard Mitigation Plan, 2018*, the county's likelihood to wildfire is very similar to this probability per year. This calculation was based on data regarding events occurring between 2012 and 2022. Review of the MDC data cited above indicates that wildfires regularly occur in all months of the year with many occurring in the spring months when winds are high. The wildfires are not primarily limited to periods of dry weather (July & August). Wind seems to be more of a factor in wildfire spread than does moisture level.

Changing Future Conditions Considerations

Per the *Missouri State Hazard Mitigation Plan, 2018*, "higher temperatures and changes in rainfall are unlikely to substantially reduce forest cover in Missouri, although the composition of trees in the forests may change. More droughts would reduce forest productivity, and changing future conditions are also likely to increase the damage from insects and diseases. But longer growing seasons and increased carbon dioxide concentrations could more than offset the losses from those factors.

Forests cover about one-third of the state, dominated by oak and hickory trees. As the climate changes, the abundance of pines in Missouri's forests is likely to increase, while the population of hickory trees is likely to decrease. Higher temperatures will also reduce the number of days prescribed burning can be performed. Reduction of prescribed burning will allow for growth of understory vegetation – providing fuel for destructive wildfires. Drought is also anticipated to increase in frequency and intensity during summer months under projected future scenarios. Drought can lead to dead or dying vegetation and landscaping material close to structures which creates fodder for wildfires within both the urban and rural settings."

Vulnerability

Vulnerability Overview

Per the *Missouri State Hazard Mitigation Plan, 2018,* the average amount of land burned in one year as a result of wildfires in Reynolds County was 1,672 acres. This average was based on 559 wildfires occurring in the county between 2004 and 2016. The total acreage burned during this thirteen-year time period was 21,737.05 acres. Per the data, while the county was in the medium category for number of fires per year, it was in the medium-high category for number of acres burned per year when compared to other counties in the state. This could be explained by the high concentration of woodlands (wildfire fuel) in the county.

Per the MDC data, the total acreage burned in all 370 Reynolds County wildfire events between 2012 and 2022 was 11,490—an event average of 31.1 acres burned per wildfire event and 1,149 acres per year.

Potential Losses to Existing Development

To estimate potential damage to existing development, WUI areas should be closely examined. Per the *2018 Missouri State Hazard Mitigation Plan*, there are 20,394.53 acres of land located within WUI areas in the county. Within those WUI areas are 1,788 structures, valued at $303,704,533, and 3,758 persons vulnerable to wildfire. When categorized by type, the majority of structures at risk were determined to be residential (1,540 structures valued at $261,597,455). The breakdown of the properties in the planning area determined vulnerable to wildfire is as follows:

- Agricultural, 92 structures valued at $372,875;
- Commercial, 99 structures valued as $28,032,950;
- Educational, 2 structures valued at $5,707,913;
- Government, 2 structures valued at $2,626,000;
- Industrial, 53 structures valued at $5,367,339; and,
- Residential, 1,540 structures valued at $261,597,455.

The state hazard mitigation plan also estimated potential loss estimates for each county in the state using the average acreage burned each year per county as a result of wildfire, as well as the average value of structures per acre in WU-Interface / Intermix areas. Using these figures, the state valued one acre of land located in the WUI in Reynolds County at $14,891. This average value per acre was then multiplied by the average number of county acres burned per year (1,672 acres) to arrive at an "average annualized land burned potential loss." For Reynolds County, the potential property loss due to wildfire was estimated at $24,898,534—the 14th highest value in the state of all Missouri's 114 counties.

Impact of Previous and Future Development

No development is anticipated in areas of special hazard, such as WUI areas.

Hazard Summary by Jurisdiction

Risk of wildfire does not vary greatly across the planning area, however, communities with more WUI areas (interface and intermix) are more vulnerable to wildland fires. A WUI map of Reynolds County is included in Figure 3.26. Headquarters locations—where the majority of assets are located—are noted for each participating school district.

Reynolds County – The unincorporated portion of the county is at risk of damage, potential injury/death due to wildland fires. However, it should be noted that despite a large number of fires

each year, very few areas of intermix and interface—outside of the community of Lesterville—exist within the unincorporated portions of the county.

City of Bunker – Residents of the City of Bunker—due to its proximity to woodland areas and designation as wildland-urban interface—are at risk of property damage and potential injury/death due to wildland fires.

City of Centerville— Residents of the City of Centerville—due to its proximity to woodland areas and designation as wildland-urban interface—are at risk of property damage and potential injury/death due to wildland fires.

City of Ellington – Residents of the City of Ellington—due to its proximity to woodland areas—are at risk of property damage and potential injury/death due to wildland fires. The City of Ellington is designated as both wildland-urban interface and intermix.

Reynolds County R-IV School District – Due to its proximity to wooded areas and location within a WUI intermix area, assets owned by the Lesterville R-IV School District is vulnerable to wildfire.

Problem Statement

Given the rural nature of Reynolds County and its expansive wooded areas, wildland fires are inevitable. The greatest risk to property damages occur in the wildland/urban interface and intermix (WUI) areas where residential areas intersect with wildland areas, which—within Reynolds County—are often heavily wooded. Based upon historical data, residences, outbuildings, and pasture land have been damaged and destroyed by wildland fires in the planning area.

In reviewing the risk of wildland fires and the historical data related to wildland fires, the three cities and community of Lesterville are at greatest risk of wildland fires. Mitigation actions could be developed to help reduce the impacts of wildland fires within the planning area.

- Seek funding to develop a fire safety awareness program addressing the causes, risk factors, and potential damage resulting from wildfires; and,
- Heavily advertise the institution of “burn bans” with cooperation from the county commissioners, county emergency management director, local fire departments, the National Forest Service and the Missouri Department of Conservation.

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 [updated] 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[6(a)]

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 Reynolds County's existing hazard mitigation plan approved by FEMA on September 6, 2017. Therefore, the goals from the *2017 Reynolds County Hazard Mitigation 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 second meeting to review and update the plan goals. To ensure that the goals developed for this update were comprehensive and supported State goals, the *2018 Missouri State Hazard Mitigation Plan* goals were also reviewed. The MPC also reviewed the goals from current surrounding county plans.

The MPC reviewed the goals from the prior plan update following the discussion of risk during the risk assessment planning meeting. After a breakout discussion, which included a review of state plan goals, the MPC determined to leave the goals unamended. The same four goals identified within the 2017 plan update were carried forward to this 2022 plan update. The four goals are as follows:

1. *Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disasters.*
2. *Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.*
3. *Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.*
4. *Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.*

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.

Some specific sources for mitigation action ideas include the following:

- FEMA's Mitigation Action Ideas Publication, https://www.fema.gov/media-library/assets/documents/30627
- FEMA's Climate Resilient Activities for Hazard Mitigation Assistance, https://www.fema.gov/media-library/assets/documents/110202
- EPA's Hazard Mitigation for Natural Disasters Publication, https://www.epa.gov/waterutilityresponse/hazard-mitigation-natural-disasters
- EPAs Planning for an Emergency Drinking Water Supply Publication, https://www.epa.gov/waterutilityresponse/water-utility-planning-emergency-drinking-water-supply

During the risk assessment meeting of the MPC, held on June 13, 2022, the results of the risk assessment update were provided to the MPC members for review and key issues were identified for specific hazards. Changes in risk since adoption of the previously approved plan were discussed. 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 included problem statements in the plan update at the end of each hazard profile. 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 mitigation strategy meeting held on July 11, 2022, was update of the mitigation strategy. For a comprehensive range of mitigation actions to consider[7(a)], the MPC reviewed the following information during the meeting:

- A list of actions proposed in the previous mitigation plan, as well as samples from 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 HMA grants; and,
- Public input during meetings, responses to data collection questionnaires, and other efforts to involve the public in the plan development process.

During the risk assessment meeting, individual jurisdictions, including school districts, developed

their 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 plan had been adopted. Prior to the mitigation strategy meeting, a list of actions for each jurisdiction was provided to that jurisdiction's MPC representative along with the worksheets. Each jurisdiction was instructed to provide information regarding the "Action Status" with one of the following status choices:

- Completed, with a description of the progress;
- Ongoing, with a description of the progress made to date; or
- Not Yet Started, with a discussion of the reasons for lack of progress.

Additionally, the future inclusion of each mitigation action in the plan update was identified as either keep, delete, or modify. Based on the status updates, there were five completed actions, thirty continuing actions (either ongoing or modified), and eleven deleted actions.

Table 4.1 provides a summary of the action statuses for each jurisdiction.

Table 4.1. Action Status Summary

Jurisdiction	Completed Actions	Continuing Actions (ongoing or modify)	Deleted Actions
Reynolds County	▪ Establish alternate transportation routes ▪ Issue burn bans and provide safe burn information ▪ Integrate mitigation actions into other planning documents/mechanisms	▪ Extreme heat education ▪ Provide satellite phones for emergency communications ▪ Warning siren mapping ▪ Improve retention of volunteers and assemble list of active EMA volunteers ▪ Replace low water crossing ▪ Prioritize work on bridges and roadways vulnerable to earthquakes ▪ Participate in flood buyout programs to	▪ Fire education and alarms ▪ Promote proper and safe use of emergency power generators to local businesses and industry

		relocate residents from flood prone areas ▪ Upgrade water systems ▪ Install lightning protection ▪ Map sinkholes ▪ Maintain participation in the National Flood Insurance Program (NFIP)	
City of Bunker	None	▪ Prioritize work on bridges and roadways vulnerable to earthquakes ▪ Issue burn bans and provide safe burn information ▪ Upgrade water systems ▪ Install lightning protection ▪ Integrate mitigation actions into other planning documents/mechanisms	▪ Replace low water crossing ▪ Participate in flood buyout programs to relocate residents from flood prone areas ▪ Maintain participation in the National Flood Insurance Program (NFIP)
City of Centerville	None	▪ Maintain/enforce floodplain ordinance ▪ Upgrade water systems ▪ Integrate mitigation actions into other planning documents/mechanisms ▪ Maintain participation in the National Flood Insurance Program (NFIP)	▪ Replace low water crossings with bridges ▪ Prioritize work on bridges and roadways vulnerable to earthquakes ▪ Participate in flood buyout programs to relocate residents from flood prone areas ▪ Install lightning protection

City of Ellington	▪ Participate in flood buyout programs to relocate residents from flood prone areas	▪ Maintain/enforce floodplain ordinance ▪ Replace low water crossings with bridges ▪ Prioritize work on bridges and roadways vulnerable to earthquakes ▪ Upgrade water systems ▪ Install lightning protection ▪ Integrate mitigation actions into other planning documents/mechanisms ▪ Maintain participation in the National Flood Insurance Program (NFIP)	▪ Issue burn bans and provide safe burn information
Lesterville R-IV School District	Increase awareness of the potential for damage/injuries resulting from earthquakes	▪ Implement tornado safety drills ▪ Establish alternate transportation routes ▪ Integrate mitigation actions into other planning documents/mechanisms	▪ Install lightning protection

Table 4.2 on the following page, provides a summary of the completed and deleted actions from the previous plan.

Table 4.2. Summary of Completed and Deleted Actions from the Previous Plan

Completed Actions	Completion Details (date, amount, funding source)
Reynolds County	
Establish alternate transportation routes	Alternate transportation routes were designated.
Issue burn bans and provide safe burn information	Completed. Burn bans are issued every dry season as needed.
Integrate mitigation actions into other planning documents/mechanisms	Completed. Actions were integrated into the 2018 Comprehensive Economic Development Strategy and 2018 Ozark Foothills Regional Transportation Plan as appropriate.
City of Ellington	
Participate in flood buyout programs to relocate residents from flood prone areas	Completed. The city purchased and acquired numerous residential properties previously damaged by floodwaters.
Lesterville R-IV School District	
Increase awareness of the potential for damage/injuries resulting from earthquakes	Information was provided to the community, students, and parents, and incorporated into the school crisis manual.
Deleted Actions	**Reason for Deletion**
Reynolds County	
Fire education and alarms	No legal authority to implement.
Promote proper and safe use of emergency power generators to local businesses and industry	No financial resources to fund action beyond encouragement.
City of Bunker	
Replace low water crossing	The city has no low water crossings.
Participate in flood buyout programs to relocate residents from flood prone areas	The city has no residences located within the floodplain.
Maintain participation in the National Flood Insurance Program (NFIP)	The city does not participate in the NFIP.
City of Centerville	
Replace low water crossings with bridges	The city does not have a road crew.
Prioritize work on bridges and roadways vulnerable to earthquakes	The city does not have a road crew.
Participate in flood buyout programs to relocate residents from flood prone areas	The city has no qualifying residences.
Install lightning protection	
City of Ellington	
Issue burn bans and provide safe burn information	The county is the entity responsible for issuing burn bans.
Lesterville R-IV School District	
Install lightning protection	The district wishes to delete this mitigation action.

Source: *2017 Reynolds County Hazard Mitigation Plan*; Data Collection Questionnaires

All incomplete mitigation actions identified within the *2017 Reynolds County Hazard Mitigation Plan* (with the exception of fifteen completed/deleted actions) have been carried forward within the current plan update. Jurisdictional members of the MPC determined the deletion of sixteen prior mitigation actions necessary—five due to completion and the others due to either irrelevance, financial infeasibility, or a lack of local capacity. The deleted actions are listed above within Table 4.2. In many cases the previously identified mitigation actions were no longer relevant to the particular jurisdiction. The lack of funding and implementation resources, however, is the primary barrier for all incomplete mitigation actions. In some circumstances, a lack of political support exists. Implementation barriers for nearly all participating jurisdictions consisted primarily of lack of resources (both financial and human). Specifically, the lack of funding with which to compensate a facilitator for the plan maintenance process continues to be the prevailing reason why mitigation actions rarely come to fruition.

The goals and actions of this updated plan were developed through review by and discussions held among the members of the mitigation planning committee (MPC). MPC members were encouraged to view proposed actions within the broad priorities of hazard mitigation and weigh the cost of each project relative to future cost savings. All actions were found to be cost effective, environmentally sound, and technically feasible.

Certain operating principles can improve fiscal and operational efficiency, help maintain focus on the overall goal of community improvement and well-being, and help ensure implementation of the actions. The MPC committed to implementing each mitigation action according to the following principals:

1. Incorporate mitigation actions into existing and future plans, regulations, programs, and projects.
2. Promote and encourage collaboration between disparate agencies and departments to create synergy resulting in benefits that would not be possible through a single agency.
3. Employ sustainable principles and techniques in the implementation of each action to attain maximum benefits.
4. Create and implement a prioritization process that includes monetary, environmental and sociological considerations.

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.

Jurisdictional MPC members were encouraged to meet with others in their community to finalize the actions to be submitted for the updated mitigation strategy. Throughout the MPC consideration and discussion, emphasis was placed on the importance of a benefit-cost analysis in determining future implementation feasibility. (The *Disaster Mitigation Act* requires benefit-cost review as the primary method by which mitigation projects should be prioritized.) The benefit/cost review at the planning stage primarily consisted of a qualitative analysis and was not the detailed process required grant funding application.

The MPC decided to pursue implementation according to when and where damage occurs, available funding, political will, jurisdictional priority, and priorities identified in the *2018 Missouri State Hazard Mitigation Plan*. 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.

The prioritization process methodology did not change from that used in the prior plan update process. Actions were prioritized independently for participating jurisdiction.

FEMA's STAPLEE methodology was used to assess the costs and benefits, overall feasibility of mitigation actions, and other issues impacting project[7(a)]. During the prioritization process, the jurisdictions used worksheets to assign scores. The worksheets posed questions based on the STAPLEE elements as well as the potential mitigation effectiveness of each action. Scores were based on the responses to the questions as follows:

Definitely YES = 3 points
Maybe YES = 2 points
Probably NO = 1 points
Definitely NO = 0 points

The following questions were asked for each proposed action.

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? (score "3" if positive and "2" if neutral)

Will the implemented action result in lives saved? (5-10 points)
Will the implanted action result in a reduction of disaster damage? (5-10 points)

The final scores are listed below in the analysis of each action. The worksheets are attached to this plan as Appendix E. 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 were those that had a total score of between 0 and 24. Moderate priority actions were those scoring between 25 and 29. High priority actions scored 30 or above. A blank STAPLEE worksheet is shown in Figure 4.1

Figure 4.1. Blank STAPLEE Worksheet

STAPLEE Worksheet		
Name of Jurisdiction:		
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)	
Name of Action or Project:		
Mitigation Category:	Prevention; Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; Emergency Services	
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 jurisdiction 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 either a neutral or positive impact on the natural **Environment**?		
Will historic structures be saved or protected?		
Could it be implemented quickly?		
STAPLEE SCORE		
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	
MITIGATION EFFECTIVENESS SCORE		
TOTAL SCORE (STAPLEE + Mitigation Effectiveness)		

☐ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Each participating jurisdiction identified mitigation actions addressing those hazards with the highest probability of occurrence in their community/service area and dollar value of historic damage. Additional mitigation actions were developed specific to each jurisdiction and based on the community's/service area's risk and vulnerabilities. Jurisdictional MPC members were encouraged to meet with others in their community to identify the actions to be submitted for the updated mitigation strategy.

Throughout the planning process, emphasis was placed upon 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 consisted primarily of a qualitative analysis.

For each action, the plan sets forth a narrative describing the benefit(s) that could be realized from action implementation as well as the responsible parties and planning mechanism to be used during implementation. The cost was estimated as closely as possible with further refinement to be supplied as project development occurs.

The table below (Table 4.3) lists the mitigation actions identified via the current planning process. The worksheets that follow are action specific, arranged by jurisdiction, and provide a succinct, yet comprehensive, description of each action.

Table 4.3. Mitigation Action Matrix

#	Action	Jurisdiction	Priority	Goals Addressed (see page v)	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
	Prevention Public Education							
1.2	Extreme heat education	Reynolds County	Medium (27)	#1	Extreme Heat			
1.3	Implement tornado drills	Lesterville R-IV School District	High (34)	#1	Tornado			
3.6	Map sinkholes	Reynolds County	Medium (25)	#3	Sinkholes		X	
	Structure and Infrastructure Projects							
1.4	Build a tornado safe room	Lesterville R-IV School District	High (30)	#1	Tornado		X	
3.1	Prioritize work on bridges & roadways vulnerable to earthquakes	Reynolds County	High (34)	#3	Earthquake	X		
3.1	Prioritize work on bridges & roadways vulnerable to earthquakes	City of Bunker	High (34)	#3	Earthquake	X		
3.1	Prioritize work on bridges & roadways vulnerable to earthquakes	City of Ellington	High (34)	#3	Earthquake	X		
3.3	Install lightning protection	Reynolds County	High (31)	#3	Thunderstorm	X		
3.3	Install lightning protection	City of Bunker	High (31)	#3	Thunderstorm	X		
3.3	Install lightning protection	City of Ellington	High (31)	#3	Thunderstorm	X		
3.4	Participate in flood buyout programs to relocate residents from flood prone areas	Reynolds County	Medium (29)	#3	Flood	X	X	
3.5	Replace low water crossings with bridges	Reynolds County	Medium (27)	#3	Flood	X	X	

#	Action	Jurisdiction	Priority	Goals Addressed (see page v)	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
3.5	Replace low water crossings with bridges	City of Ellington	Medium (27)	#3	Flood	X	X	
1.6	Upgrade water systems	Reynolds County	Low (22)	#1	Drought	X	X	
1.6	Upgrade water systems	City of Bunker	Low (19)	#1	Drought	X	X	
1.6	Upgrade water systems	City of Centerville	Low (19)	#1	Drought	X	X	
1.6	Upgrade water systems	City of Ellington	Low (19)	#1	Drought	X	X	
4.1	Adopt/enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas	Reynolds County	High (39)	#4	Flood		X	X
4.1	Adopt/enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas	City of Centerville	High (39)	#4	Flood		X	X
4.1	Adopt/enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas	City of Ellington	High (39)	#4	Flood		X	X
4.2	Explore CRS institution	Reynolds County	High (32)	#4	Flood	X	X	X
4.2	Explore CRS institution	City of Ellington	High (32)	#4	Flood	X	X	X
	Natural Systems Protection							
1.1	Provide satellite phones for emergency communications	Reynolds County	High (38)	#1	All			
2.1	Increase training & retention efforts for EMA volunteers	Reynolds County	Medium (29)	#2	All			

#	Action	Jurisdiction	Priority	Goals Addressed (see page v)	Hazards Addressed	Address Current Development	Address Future Development	Continued Compliance with NFIP
1.5	Warning siren mapping	Reynolds County	High (32)	#1	Tornado			
2.2	Install emergency generator	Lesterville R-IV School District	High (32)	#2	All			
2.3	Identify alternate transportation routes	Lesterville R-IV School District	Medium (29)	#3	Flood			
	Education and Outreach							
3.2	Integrate mitigation actions into other planning documents/mechanisms	Reynolds County	High (33)	#3	All	X	X	
3.2	Integrate mitigation actions into other planning documents/mechanisms	City of Bunker	High (33)	#3	All	X	X	
3.2	Integrate mitigation actions into other planning documents/mechanisms	City of Centerville	High (33)	#3	All	X	X	
3.2	Integrate mitigation actions into other planning documents/mechanisms	City of Ellington	High (33)	#3	All	X	X	
3.2	Integrate mitigation actions into other planning documents/mechanisms	Lesterville R-IV School District	High (33)	#3	All	X	X	

Goal 1: *Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disaster*

Action 1.1: Satellite Phones

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Inadequate communication infrastructure during hazard warning scenarios and emergency response
Hazard(s) Addressed:	Flooding, Dam Failure, Levee Failure
Action or Project	
Action/Project Number:	1.1
Name of Action or Project:	Satellite Phones
Action or Project Description:	Provide satellite phones for emergency communications
Applicable Goal Statement:	Improve the protection of human life, health, and safety from adverse effects of disaster
Estimated Cost:	$100,000
Benefits:	Improved and dependable communication among emergency services personnel when coordinating public warnings and to reduce loss of life following a hazard event due to poor cellular and radio service.
Plan for Implementation	
Responsible Organization/Department:	County Emergency Management Director
Action/Project Priority:	High (38)
Timeline for Completion:	1-3 years
Potential Fund Sources:	USDA Rural Development, Delta Regional Authority
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Reynolds County Budget and Employment of Ozark Foothills Regional Planning Commission for Technical Assistance in Funds Acquisition
Progress Report	
Action Status	New
Report of Progress	N/A

Action 1.2 Extreme Heat Education

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Death and injury due to heat-induced illness
Hazard(s) Addressed:	Extreme Heat
Action or Project	
Action/Project Number:	1.2
Name of Action or Project:	Extreme Heat Education
Action or Project Description:	Provide educational resources to residents on avoiding heat related illnesses and/or death.
Applicable Goal Statement:	Improve the protection of human life, health, and safety from adverse effects of disaster.
Estimated Cost:	$1,000
Benefits:	Reduction in illness, death, and loss wages due to heat exposure.
Plan for Implementation	
Responsible Organization/Department:	County Health Department
Action/Project Priority:	Medium (27)
Timeline for Completion:	1-3 years
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	Nutrition Center Seminars, Radio Advertisements, Newspaper Advertisement, and Social Media Campaigns
Progress Report	
Action Status	Continued, Not Started
Report of Progress	Not started due to lack of coordination and interruption of services due to COVID 19.

Action 1.3 Tornado Safety Drills

Action Worksheet	
Name of Jurisdiction:	Southern Reynolds County R-II, Bunker R-III, Lesterville R-IV, Centerville R-I
Risk / Vulnerability	
Problem being Mitigated:	Injury or death due to flying debris resulting from high wind events.
Hazard(s) Addressed:	Tornado
Action or Project	
Action/Project Number:	1.3
Name of Action or Project:	Tornado Safety Drills
Action or Project Description:	Regularly practice tornado safety drills within the school.
Applicable Goal Statement:	Improve the protection of human life, health, and safety from adverse effects of disasters.
Estimated Cost:	N/A
Benefits:	Reduction in injuries and deaths due to tornados.
Plan for Implementation	
Responsible Organization/Department:	Lesterville R-IV School District Superintendent
Action/Project Priority:	High (34)
Timeline for Completion:	Ongoing
Potential Fund Sources:	N/A
Local Planning Mechanisms to be Used in Implementation, if any:	Lesterville R-IV Schools District Safety Protocols
Progress Report	
Action Status	Ongoing
Report of Progress	Tornado drills are practiced at least once annually when classes are in session. Printed tornado reaction instructions are placed in each classroom.
Completed by:	Jason St. Gemme, Principal

Action 1.4 Tornado Saferoom

Action Worksheet	
Name of Jurisdiction:	Lesterville R-IV School District
Risk / Vulnerability	
Problem being Mitigated:	Lack of shelter during high wind events.
Hazard(s) Addressed:	Tornado
Action or Project	
Action/Project Number:	1.4
Name of Action or Project:	Tornado Saferoom
Action or Project Description:	Build a tornado safe room adjacent to the Lesterville R-IV School.
Applicable Goal Statement:	Improve the protection of human life, health, and safety from adverse effects of disasters.
Estimated Cost:	$1,500,000
Benefits:	Prevention of injuries and deaths due to high winds resulting from tornados.
Plan for Implementation	
Responsible Organization/Department:	School Superintendent
Action/Project Priority:	High (30)
Timeline for Completion:	5 years
Potential Fund Sources:	School district capital improvement funds & HMGP funding
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process
Progress Report	
Action Status	New
Report of Progress	N/A
Completed by:	Jason St. Gemme, Principal

Action 1.5 Warning Siren Mapping

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Warning Sirens
Hazard(s) Addressed:	Tornado
Action or Project	
Action/Project Number:	1.5
Name of Action or Project:	Warning Siren Mapping & Testing
Action or Project Description:	Created an updated map of functioning warning sirens in the area and test sirens regularly to confirm functionality.
Applicable Goal Statement:	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
Estimated Cost:	$1,000
Benefits:	Warn those in dangers of tornado hazards with sufficient time to seek shelter thereby reducing potential for injury/death.
Plan for Implementation	
Responsible Organization/Department:	County Emergency Management Director
Action/Project Priority:	High (32)
Timeline for Completion:	1 year
Potential Fund Sources:	Local
Local Planning Mechanisms to be Used in Implementation, if any:	County Commission Meeting Departmental Reports
Progress Report	
Action Status	Continue, Not Started
Report of Progress	None
Completed by:	Renee Horn, Emergency Management Director

Action 1.6 Upgrade Water Systems

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Inadequate water supply during drought conditions
Hazard(s) Addressed:	Drought
Action or Project	
Action/Project Number:	1.6
Name of Action or Project:	Upgrade water systems
Action or Project Description:	Seek funding to increase the availability of potable water during drought conditions.
Applicable Goal Statement:	Improve the protection of human life, health, and safety from adverse effects of disasters.
Estimated Cost:	$2,000,000
Benefits:	Improve public water supply
Plan for Implementation	
Responsible Organization/Department:	Public Water Supply Districts in Reynolds County
Action/Project Priority:	Low (19)
Timeline for Completion:	5-10 years
Potential Fund Sources:	USDA Loan/Grant Funds & Community Development Block Grants
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process Technical Assistance Provided via Membership within the Ozark Foothills Regional Planning Commission
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of funding
Completed by:	Amy Moore, City Clerk

Action 1.6 Upgrade Water Systems

Action Worksheet	
Name of Jurisdiction:	City of Bunker
Risk / Vulnerability	
Problem being Mitigated:	Inadequate water supply during drought conditions
Hazard(s) Addressed:	Drought
Action or Project	
Action/Project Number:	1.6
Name of Action or Project:	Upgrade water systems
Action or Project Description:	Seek funding to increase the availability of potable water during drought conditions.
Applicable Goal Statement:	Improve the protection of human life, health, and safety from adverse effects of disasters.
Estimated Cost:	$1,000,000
Benefits:	Improve public water supply
Plan for Implementation	
Responsible Organization/Department:	Board of Aldermen
Action/Project Priority:	Low (19)
Timeline for Completion:	5-10 years
Potential Fund Sources:	USDA Loan/Grant Funds & Community Development Block Grants
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process Technical Assistance Provided via Membership within the Ozark Foothills Regional Planning Commission
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of funding
Completed by:	Kendra Ritter, City Clerk

Action 1.6 Upgrade Water Systems

Action Worksheet	
Name of Jurisdiction:	City of Centerville
Risk / Vulnerability	
Problem being Mitigated:	Inadequate water supply during drought conditions
Hazard(s) Addressed:	Drought
Action or Project	
Action/Project Number:	1.6
Name of Action or Project:	Upgrade water systems
Action or Project Description:	Seek funding to increase the availability of potable water during drought conditions.
Applicable Goal Statement:	Improve the protection of human life, health, and safety from adverse effects of disasters.
Estimated Cost:	$1,000,000
Benefits:	Improve public water supply
Plan for Implementation	
Responsible Organization/Department:	Board of Aldermen
Action/Project Priority:	Low (19)
Timeline for Completion:	5-10 years
Potential Fund Sources:	USDA Loan/Grant Funds & Community Development Block Grants
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process Technical Assistance Provided via Membership within the Ozark Foothills Regional Planning Commission
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of funding
Completed by:	Linda Miller, City Clerk

Action 1.6 Upgrade Water Systems

Action Worksheet	
Name of Jurisdiction:	City of Ellington
Risk / Vulnerability	
Problem being Mitigated:	Inadequate water supply during drought conditions
Hazard(s) Addressed:	Drought
Action or Project	
Action/Project Number:	1.6
Name of Action or Project:	Upgrade water systems
Action or Project Description:	Seek funding to increase the availability of potable water during drought conditions.
Applicable Goal Statement:	Improve the protection of human life, health, and safety from adverse effects of disasters.
Estimated Cost:	$2,000,000
Benefits:	Improve public water supply
Plan for Implementation	
Responsible Organization/Department:	Ellington City Council
Action/Project Priority:	Low (19)
Timeline for Completion:	3-5 years
Potential Fund Sources:	USDA Loan/Grant Funds & Community Development Block Grants
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process Technical Assistance Provided via Membership within the Ozark Foothills Regional Planning Commission
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of funding
Completed by:	Amy Moore, City Clerk

Goal 2: *Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.*

Action 2.1 EMA Recruitment & Training

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Few and inadequately trained EMA volunteers
Hazard(s) Addressed:	All
Action or Project	
Action/Project Number:	2.1
Name of Action or Project:	EMA Recruitment & Training
Action or Project Description:	Initiate marketing efforts to recruit emergency management volunteers and provide adequate training.
Applicable Goal Statement:	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
Estimated Cost:	$5,000
Benefits:	Improve the emergency response time following a hazard event thereby reducing injuries/death and restoring continuity of essential services.
Plan for Implementation	
Responsible Organization/Department:	City or local government and all emergency services.
Action/Project Priority:	Medium, 29
Timeline for Completion:	1 -5 years
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	County Commission Meetings Departmental Report Annual County Budget Process
Progress Report	
Action Status	Continuing
Report of Progress	None provided
Completed by:	Renee Horn, Emergency Management Director

Action 2.2 Generator Installation

Action Worksheet	
Name of Jurisdiction:	Lesterville R-IV School District
Risk / Vulnerability	
Problem being Mitigated:	School closure during power outages.
Hazard(s) Addressed:	Tornado, Thunderstorm, Severe Winter Weather
Action or Project	
Action/Project Number:	2.2
Name of Action or Project:	Generator Installation
Action or Project Description:	Purchase and install an emergency power generator at the school campus.
Applicable Goal Statement:	Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
Estimated Cost:	$60,000
Benefits:	Continuity of instruction, prevention of injury due to severe heat and cold, and protection of food inventory.
Plan for Implementation	
Responsible Organization/Department:	School Superintendent
Action/Project Priority:	Medium (29)
Timeline for Completion:	Ongoing
Potential Fund Sources:	USDA Community Facility Grants/Loans & CDBG Funding
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process
Progress Report	
Action Status	New
Report of Progress	N/A
Completed by:	Jason St. Gemme, Elementary Principal

Action 2.3 Establish Alternate Transportation Routes

Action Worksheet	
Name of Jurisdiction:	Lesterville R-IV School District
Risk / Vulnerability	
Problem being Mitigated:	Blocked transportation routes following a natural hazard event.
Hazard(s) Addressed:	Dam Failure, Earthquake, Flood, Severe Winter Weather, Thunderstorm, Tornado, & Wildfire
Action or Project	
Action/Project Number:	2.3
Name of Action or Project:	Establish Alternate Transportation Routes
Action or Project Description:	Predetermine alternate transportation routes considering bridge failure and/or impassable roadways due to flood and/or debris resulting from a natural hazard event.
Applicable Goal Statement:	
Estimated Cost:	N/A
Benefits:	Safety
Plan for Implementation	
Responsible Organization/Department:	EMA Director, County Highway Dept, MoDOT, City Street Depts.
Action/Project Priority:	Medium (29)
Timeline for Completion:	Ongoing
Potential Fund Sources:	N/A
Local Planning Mechanisms to be Used in Implementation, if any:	School Board Meeting Reports, Ozark Foothills Transportation Advisory Committee Meetings
Progress Report	
Action Status	Ongoing
Report of Progress	Alternate transportation routes have been identified on an as-needed basis.
Completed by:	Jason St. Gemme, Elementary School Principal

Goal 3: *Implement mitigation actions that improve the protections of public and private property from the adverse effects of disasters.*

Action 3.1 Road & Bridge Work Prioritization

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Transportation disruptions
Hazard(s) Addressed:	Earthquake
Action or Project	
Action/Project Number:	3.1
Name of Action or Project:	Road & Bridge Work Prioritization
Action or Project Description:	Identify roads and bridges most at risk of damage resulting from earthquakes and prioritize such structures when planning improvements to the county's transportation infrastructure.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.
Estimated Cost:	N/A
Benefits:	Preservation of transportation infrastructure following an earthquake event.
Plan for Implementation	
Responsible Organization/Department:	County Road & Bridge Department
Action/Project Priority:	High (34)
Timeline for Completion:	Ongoing
Potential Fund Sources:	County funds & BRO funding (MODOT)
Local Planning Mechanisms to be Used in Implementation, if any:	County Annual Budget Process
Progress Report	
Action Status	Continue, Not Started
Report of Progress	None provided
Completed by:	Joe Loyd, Presiding Commissioner

Action 3.1 Road & Bridge Work Prioritization

Action Worksheet	
Name of Jurisdiction:	City of Ellington
Risk / Vulnerability	
Problem being Mitigated:	Transportation disruptions
Hazard(s) Addressed:	Earthquake
Action or Project	
Action/Project Number:	3.1
Name of Action or Project:	Road & Bridge Work Prioritization
Action or Project Description:	Identify roads and bridges most at risk of damage resulting from earthquakes and prioritize such structures when planning improvements to the city's transportation infrastructure.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.
Estimated Cost:	N/A
Benefits:	Preservation of transportation infrastructure following an earthquake event.
Plan for Implementation	
Responsible Organization/Department:	City Street Department
Action/Project Priority:	High (34)
Timeline for Completion:	Ongoing
Potential Fund Sources:	Local Funds
Local Planning Mechanisms to be Used in Implementation, if any:	City Council Meetings & Department Reports
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of resources
Completed by:	Amy Moore, City Clerk

Action 3.2 Plan Integration

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Consistency in planning for public safety and resource protection
Hazard(s) Addressed:	All
Action or Project	
Action/Project Number:	3.2
Name of Action or Project:	Plan Integration
Action or Project Description:	Integrate updated mitigation actions into other community/regional plans, such as the comprehensive plans to streamline planning initiatives and promote efficient use of limited resources.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	n/a
Benefits:	Efficient use of limited resources and project implementation.
Plan for Implementation	
Responsible Organization/Department:	County Commission
Action/Project Priority:	High, 33
Timeline for Completion:	Ongoing
Potential Fund Sources:	n/a
Local Planning Mechanisms to be Used in Implementation, if any:	County Commission Meetings Technical Assistance Provided via Membership within the Ozark Foothills Regional Planning Commission (RPC)
Progress Report	
Action Status	Continue
Report of Progress	Mitigation actions were considered during development of the regional economic development strategy during 2018
Completed by:	Felicity Ray, Planner, Ozark Foothills RPC

Action 3.2 Plan Integration

Action Worksheet	
Name of Jurisdiction:	City of Bunker
Risk / Vulnerability	
Problem being Mitigated:	Consistency in planning for public safety and resource protection
Hazard(s) Addressed:	All
Action or Project	
Action/Project Number:	3.2
Name of Action or Project:	Plan Integration
Action or Project Description:	Integrate updated mitigation actions into other community/regional plans, such as the comprehensive plans to streamline planning initiatives and promote efficient use of limited resources.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	n/a
Benefits:	Efficient use of limited resources and project implementation.
Plan for Implementation	
Responsible Organization/Department:	Board of Aldermen
Action/Project Priority:	High, 33
Timeline for Completion:	Ongoing
Potential Fund Sources:	n/a
Local Planning Mechanisms to be Used in Implementation, if any:	Meetings of the Board of Aldermen Technical Assistance Provided via Membership within the Ozark Foothills Regional Planning Commission (RPC)
Progress Report	
Action Status	Continue
Report of Progress	Mitigation actions were considered during development of the regional economic development strategy during 2018
Completed by:	Felicity Ray, Planner, Ozark Foothills RPC

Action 3.2 Plan Integration

Action Worksheet	
Name of Jurisdiction:	City of Centerville
Risk / Vulnerability	
Problem being Mitigated:	Consistency in planning for public safety and resource protection
Hazard(s) Addressed:	All
Action or Project	
Action/Project Number:	3.2
Name of Action or Project:	Plan Integration
Action or Project Description:	Integrate updated mitigation actions into other community/regional plans, such as the comprehensive plans to streamline planning initiatives and promote efficient use of limited resources.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	n/a
Benefits:	Efficient use of limited resources and project implementation.
Plan for Implementation	
Responsible Organization/Department:	Board of Aldermen
Action/Project Priority:	High, 33
Timeline for Completion:	Ongoing
Potential Fund Sources:	n/a
Local Planning Mechanisms to be Used in Implementation, if any:	Meetings of the Board of Aldermen Technical Assistance Provided via Membership within the Ozark Foothills Regional Planning Commission (RPC)
Progress Report	
Action Status	Continue
Report of Progress	Mitigation actions were considered during development of the regional economic development strategy during 2018
Completed by:	Felicity Ray, Planner, Ozark Foothills RPC

Action 3.2 Plan Integration

Action Worksheet	
Name of Jurisdiction:	City of Ellington
Risk / Vulnerability	
Problem being Mitigated:	Consistency in planning for public safety and resource protection
Hazard(s) Addressed:	All
Action or Project	
Action/Project Number:	3.2
Name of Action or Project:	Plan Integration
Action or Project Description:	Integrate updated mitigation actions into other community/regional plans, such as the comprehensive plans to streamline planning initiatives and promote efficient use of limited resources.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	n/a
Benefits:	Efficient use of limited resources and project implementation.
Plan for Implementation	
Responsible Organization/Department:	City Council
Action/Project Priority:	High, 33
Timeline for Completion:	Ongoing
Potential Fund Sources:	n/a
Local Planning Mechanisms to be Used in Implementation, if any:	City Council Meetings Technical Assistance Provided via Membership within the Ozark Foothills Regional Planning Commission (RPC)
Progress Report	
Action Status	Continue
Report of Progress	Mitigation actions were considered during development of the regional economic development strategy during 2018
Completed by:	Felicity Ray, Planner, Ozark Foothills RPC

Action 3.2 Plan Integration

Action Worksheet	
Name of Jurisdiction:	Lesterville R-IV School District
Risk / Vulnerability	
Problem being Mitigated:	Consistency in planning for public safety and resource protection
Hazard(s) Addressed:	All
Action or Project	
Action/Project Number:	3.2
Name of Action or Project:	Plan Integration
Action or Project Description:	Integrate updated mitigation actions into other community/regional plans, such as the comprehensive plans to streamline planning initiatives and promote efficient use of limited resources.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	n/a
Benefits:	Efficient use of limited resources and project implementation.
Plan for Implementation	
Responsible Organization/Department:	School Superintendent
Action/Project Priority:	High, 33
Timeline for Completion:	Ongoing
Potential Fund Sources:	n/a
Local Planning Mechanisms to be Used in Implementation, if any:	School Board Meetings
Progress Report	
Action Status	Continue
Report of Progress	Mitigation actions were considered during development of the regional economic development strategy during 2018
Completed by:	Felicity Ray, Planner, Ozark Foothills RPC

Action 3.3 Lightning Protection

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Incapacitation of critical facilities and communication infrastructure
Hazard(s) Addressed:	Thunderstorm
Action or Project	
Action/Project Number:	3.3
Name of Action or Project:	Lightning Protection
Action or Project Description:	Install needed lightning protection at critical facilities and upon essential communication equipment.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
Estimated Cost:	$100,000
Benefits:	Continuity of essential public services and communication infrastructure during and following thunderstorm events.
Plan for Implementation	
Responsible Organization/Department:	County Commission
Action/Project Priority:	High (31)
Timeline for Completion:	3-5 years
Potential Fund Sources:	Local Funds, USDA Rural Development Community Facility Grants
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of funding
Completed by:	Renee Horn, Emergency Management Director

Action 3.3 Lightning Protection

Action Worksheet	
Name of Jurisdiction:	City of Bunker
Risk / Vulnerability	
Problem being Mitigated:	Incapacitation of critical facilities and communication infrastructure
Hazard(s) Addressed:	Thunderstorm
Action or Project	
Action/Project Number:	3.3
Name of Action or Project:	Lightning Protection
Action or Project Description:	Install needed lightning protection at critical facilities and upon essential communication equipment.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
Estimated Cost:	$25,000
Benefits:	Continuity of essential public services and communication infrastructure during and following thunderstorm events.
Plan for Implementation	
Responsible Organization/Department:	Board of Aldermen
Action/Project Priority:	High (31)
Timeline for Completion:	3-5 years
Potential Fund Sources:	Local Funds, USDA Rural Development Community Facility Grants
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of funding
Completed by:	Kendra Ritter, City Clerk

Action 3.3 Lightning Protection

Action Worksheet	
Name of Jurisdiction:	City of Ellington
Risk / Vulnerability	
Problem being Mitigated:	Incapacitation of critical facilities and communication infrastructure
Hazard(s) Addressed:	Thunderstorm
Action or Project	
Action/Project Number:	3.3
Name of Action or Project:	Lightning Protection
Action or Project Description:	Install needed lightning protection at critical facilities and upon essential communication equipment.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disaster.
Estimated Cost:	$75,000
Benefits:	Continuity of essential public services and communication infrastructure during and following thunderstorm events.
Plan for Implementation	
Responsible Organization/Department:	City Council
Action/Project Priority:	High (31)
Timeline for Completion:	3-5 years
Potential Fund Sources:	Local Funds, USDA Rural Development Community Facility Grants
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of funding
Completed by:	Amy Moore, City Clerk

Action 3.4 Resident Relocation

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Residential & commercial structural/contents damage due to flooding
Hazard(s) Addressed:	Flash and Riverine Floods
Action or Project	
Action/Project Number:	3.4
Name of Action or Project:	Resident Relocation
Action or Project Description:	Participate in flood buyout programs to relocate residents from flood prone areas
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.
Estimated Cost:	$1,000,000
Benefits:	Eliminate damage to structures and personal property, as well as avoid displacement of residents due to flash and riverine flooding.
Plan for Implementation	
Responsible Organization/Department:	Reynolds County Commission
Action/Project Priority:	Medium (29)
Timeline for Completion:	5 years
Potential Fund Sources:	HMGP Grant Funding & CDBG Funding
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process Technical Assistance Provision via Membership within the Ozark Foothills Regional Planning Commission
Progress Report	
Action Status	Continue, Not Started
Report of Progress	None Provided
Completed by:	Joe Loyd, Presiding Commissioner

Action 3.5 Low Water Crossing Replacement

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Flooding
Hazard(s) Addressed:	Flood & Dam Failure
Action or Project	
Action/Project Number:	
Name of Action or Project:	Low Water Crossing Replacement
Action or Project Description:	Replace low-water crossings with culverts
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.
Estimated Cost:	$200,000 per crossing
Benefits:	Protection of roadways, surrounding property, and preventive measure for damages.
Plan for Implementation	
Responsible Organization/Department:	Reynolds County Road & Bridge Department
Action/Project Priority:	Medium (27)
Timeline for Completion:	1 -5 years
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	County Annual Budget Process
Progress Report	
Action Status	Continue
Report of Progress	Two low water crossings were replaced with bridges (Alcorn Hollow & Mill Creek Chute)
Completed by:	Joe Loyd, Presiding Commissioner

Action 3.5 Low Water Crossing Replacement

Action Worksheet	
Name of Jurisdiction:	City of Ellington
Risk / Vulnerability	
Problem being Mitigated:	Injury, death, & property damage due to crossing flooded low water crossings during high water conditions
Hazard(s) Addressed:	Flood & Dam Failure
Action or Project	
Action/Project Number:	3.5
Name of Action or Project:	Low Water Crossing Replacement
Action or Project Description:	Replace low-water crossings with culverts
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.
Estimated Cost:	$200,000 per crossing
Benefits:	Prevention of injury & death ,as well as protection of roadways and surrounding property.
Plan for Implementation	
Responsible Organization/Department:	Ellington Street Department
Action/Project Priority:	Medium (27)
Timeline for Completion:	1 -5 years
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	City Annual Budget Process
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not started due to lack of funding
Completed by:	Amy Moore, City Clerk

Action 3.6 Mapping of Sinkholes

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Property damage due to ground disturbance resulting from karst topography
Hazard(s) Addressed:	Sinkholes
Action or Project	
Action/Project Number:	3.6
Name of Action or Project:	Mapping of Sinkholes
Action or Project Description:	Create a county wide map of active and potential sinkholes.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.
Estimated Cost:	$8,000
Benefits:	Prevention of future property damage due to sinkholes
Plan for Implementation	
Responsible Organization/Department:	County Commission
Action/Project Priority:	Medium (25)
Timeline for Completion:	1-3 years
Potential Fund Sources:	Local funds
Local Planning Mechanisms to be Used in Implementation, if any:	Annual Budget Process
Progress Report	
Action Status	Continue, Not Started
Report of Progress	Not yet started due to lack of resources
Completed by:	Renee Horn, Emergency Management Director

Goal 4: Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.

Action 4.1 Floodplain Management

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Construction/development in areas prone to flooding.
Hazard(s) Addressed:	Flood
Action or Project	
Action/Project Number:	4.1
Name of Action or Project:	Floodplain Management
Action or Project Description:	Enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	N/A
Benefits:	Elimination of property damage due to flooding for all new construction.
Plan for Implementation	
Responsible Organization/Department:	Floodplain Administrator & County Commission
Action/Project Priority:	High (39)
Timeline for Completion:	Ongoing
Potential Fund Sources:	N/A
Local Planning Mechanisms to be Used in Implementation, if any:	County Commission Meeting Department Reports
Progress Report	
Action Status	Continue, Ongoing
Report of Progress	The county's floodplain requirements were enforced from 2017-2022.
Completed by:	Joe Loyd, Presiding Commissioner

Action 4.1 Floodplain Management

Action Worksheet	
Name of Jurisdiction:	City of Centerville
Risk / Vulnerability	
Problem being Mitigated:	Construction/development in areas prone to flooding.
Hazard(s) Addressed:	Flood
Action or Project	
Action/Project Number:	4.1
Name of Action or Project:	Floodplain Management
Action or Project Description:	Enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	N/A
Benefits:	Elimination of property damage due to flooding for all new construction.
Plan for Implementation	
Responsible Organization/Department:	Board of Aldermen
Action/Project Priority:	High (39)
Timeline for Completion:	Ongoing
Potential Fund Sources:	N/A
Local Planning Mechanisms to be Used in Implementation, if any:	Board of Aldermen Meetings Department Reports
Progress Report	
Action Status	Continue, Ongoing
Report of Progress	The city's floodplain requirements were enforced from 2017-2022.
Completed by:	Kendra Ritter, City Clerk

Action 4.1 Floodplain Management

Action Worksheet	
Name of Jurisdiction:	City of Ellington
Risk / Vulnerability	
Problem being Mitigated:	Construction/development in areas prone to flooding.
Hazard(s) Addressed:	Flood
Action or Project	
Action/Project Number:	4.1
Name of Action or Project:	Floodplain Management
Action or Project Description:	Enforce floodplain management requirements, including regulating new construction in Special Flood Hazard Areas.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	N/A
Benefits:	Elimination of property damage due to flooding for all new construction.
Plan for Implementation	
Responsible Organization/Department:	City Council
Action/Project Priority:	High (39)
Timeline for Completion:	Ongoing
Potential Fund Sources:	N/A
Local Planning Mechanisms to be Used in Implementation, if any:	City Council Meetings Department Reports
Progress Report	
Action Status	Continue, Ongoing
Report of Progress	The city's floodplain requirements were enforced from 2017-2022.
Completed by:	Amy Moore, City Clerk

Action 4.2 Community Rating System

Action Worksheet	
Name of Jurisdiction:	Reynolds County
Risk / Vulnerability	
Problem being Mitigated:	Public Awareness
Hazard(s) Addressed:	Flood
Action or Project	
Action/Project Number:	4.2
Name of Action or Project:	Community Rating System
Action or Project Description:	Explore CRS county wide. Receive a community rating.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	$2,500
Benefits:	Reduced flood insurance premiums and mitigation of property damages due to flood.
Plan for Implementation	
Responsible Organization/Department:	Floodplain Administrator County Commission
Action/Project Priority:	High (32)
Timeline for Completion:	1-3 years
Potential Fund Sources:	Local Funds
Local Planning Mechanisms to be Used in Implementation, if any:	County Commission Meetings and Technical Assistance Provided via Membership with the Ozark Foothills Regional Planning Commission
Progress Report	
Action Status	New
Report of Progress	N/A
Completed by:	Joe Loyd, Presiding Commissioner

Action 4.2 Community Rating System

Action Worksheet	
Name of Jurisdiction:	City of Ellington
Risk / Vulnerability	
Problem being Mitigated:	Public Awareness
Hazard(s) Addressed:	Flood
Action or Project	
Action/Project Number:	4.2
Name of Action or Project:	Community Rating System
Action or Project Description:	Explore CRS county wide. Receive a community rating.
Applicable Goal Statement:	Implement mitigation actions that improve the protection of community tranquility from the adverse effects of disasters.
Estimated Cost:	$2,500
Benefits:	Reduced flood insurance premiums and mitigation of property damages due to flood.
Plan for Implementation	
Responsible Organization/Department:	City Council
Action/Project Priority:	High (32)
Timeline for Completion:	1-3 years
Potential Fund Sources:	Local Funds
Local Planning Mechanisms to be Used in Implementation, if any:	City Council Meetings and Technical Assistance Provided via Membership with the Ozark Foothills Regional Planning Commission
Progress Report	
Action Status	New
Report of Progress	N/A
Completed by:	Paul Wood, Mayor

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[10(a)]

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 Mitigation Planning Committee (MPC) will be a standing committee, with oversight by the Reynolds County Commission, the Bunker Board of Aldermen, the Centerville Board of Aldermen, the Ellington City Council and the elected board of the Lesterville R-IV School District. The MPC will be responsible for plan monitoring, evaluation and maintenance. Maintenance will involve agreement of the participating jurisdictions, including school, to conduct the following activities and take the following actions:

- Meet annually[10(b)], on the anniversary of the 2022 plan update FEMA approval date, to monitor and evaluate plan implementation;
- 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 Reynolds County Commission and governing bodies of participating jurisdictions; and
- Inform and solicit input from the public.

The MPC 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[10(a)]. Other duties include reviewing and promoting mitigation proposals, fielding 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 MPC agrees to meet annually[10(b)] and after a state or federally declared hazard event as appropriate to monitor progress and update the mitigation strategy. The Reynolds County Emergency Management Director will be responsible for initiating the plan reviews and will invite members of the MPC to the meeting.

In coordination with all participating jurisdictions and the regional planning commission, the Emergency Management Director will be responsible for initiating a five-year written update of the plan to 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 will be monitored by evaluating changes in vulnerabilities identified in the plan. The MPC, during the annual[10(b)] 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 five-year updates to this plan will include the following activities as appropriate:

- 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.

To best evaluate any changes in vulnerability resulting from plan implementation, the participating jurisdictions will adopt the following process:

- Each mitigation action proposed within the plan identifies an individual, office, or agency representative responsible for action implementation. This individual will track and report on an annual[10(b)] basis to the jurisdictional MPC member on action status. The

individual 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 MPC 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 no longer 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 MPC deems appropriate and necessary. Changes will be approved by the Reynolds 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 all the Lesterville R-IV School Districts, will use existing plans and/or programs to implement hazard mitigation actions. Those existing plans and programs were described in Section 2 of this plan. Based on the capability assessments of the participating jurisdictions, communities in Reynolds 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:

- Ordinances of participating jurisdictions;
- Reynolds County Emergency Operations Plan;
- Annual budgets;
- Other community plans that incorporate the county, such as its Regional Transportation Plan and the Comprehensive Economic Development Strategy;
- School District budget; and,
- Other plans and policies outlined in the capability assessment sections for each jurisdiction in Chapter 2 of this plan.

The MPC (or designated responsible entity) members involved in updating these existing planning mechanisms will be responsible for integrating the findings and actions of the mitigation plan, as appropriate. The MPC (or designated responsible entity) 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[10(b)] review of the Hazard Mitigation Plan, the Reynolds County Emergency Management Director will provide the updated Mitigation Strategy with the current status of each mitigation action to the County Commission as well as all Mayors, City Clerks, and the School District Superintendent[10(a)]. The Emergency Manager Director will request that the mitigation strategy be incorporated, where appropriate, within other planning mechanisms.

The table below lists the planning mechanisms by jurisdiction into which the Hazard Mitigation Plan will be integrated.

Table 5.1. Planning Mechanisms Identified for Integration of Hazard Mitigation Plan

Jurisdiction	Planning Mechanisms		Integration Process for Previous Plan	Integration Process for Current Plan
Reynolds County	Comprehensive Economic Development Strategy (CEDS)		County representative(s) attended CEDS planning meetings and recommended goals and strategies related to hazard mitigation for inclusion within the regional planning document as appropriate.	County representative(s) will attend all CEDS planning meetings and identify mitigation actions for inclusion within the regional planning document as appropriate.
City of Bunker	Comprehensive Economic Development Strategy (CEDS)		City representative(s) attended CEDS planning meetings and recommended goals and strategies related to hazard mitigation for inclusion within the regional planning document as appropriate.	City representative(s) will attend all CEDS planning meetings and identify mitigation actions for inclusion within the regional planning document as appropriate.
City of Centerville	Comprehensive Economic Development Strategy (CEDS)		City representative(s) attended CEDS planning meetings and recommended goals and strategies related to hazard mitigation for inclusion within the regional planning document as appropriate.	City representative(s) will attend all CEDS planning meetings and identify mitigation actions for inclusion within the regional planning document as appropriate.

City of Ellington	Comprehensive Economic Development Strategy (CEDS)		City representative(s) attended CEDS planning meetings and recommended goals and strategies related to hazard mitigation for inclusion within the regional planning document as appropriate.	City representative(s) will attend all CEDS planning meetings and identify mitigation actions for inclusion within the regional planning document as appropriate.
Lesterville R-IV School District	Annual Budget Process		Implemented annual planning and budget process meetings and recommended goals and strategies related to hazard mitigation for inclusion within the annual budget of expenditures as applicable.	School district administrators will execute goals and strategies identified within this hazard mitigation plan via its annual budget process.
Reynolds County	Regional Transportation Plan (RTP)		County representatives (as members of the regional transportation advisory committee) attended regular planning meetings (four per year) and identified transportation maintenance and new construction projects. When possible and appropriate, project recommendations incorporated hazard mitigation actions. The	County officials and Highway Department employees will attend all RTP planning meetings to identify new actions and/or ongoing actions relating to transportation infrastructure for inclusion within the annual RTP update.

			regional planning document was updated every two years with the previous year's recommendations.	
City of Bunker	Regional Transportation Plan (RTP)		City representatives (as members of the regional transportation advisory committee) attended planning and identified transportation maintenance and new construction projects. When possible and appropriate, project recommendations incorporated hazard mitigation actions. The regional planning document was updated every two years with the previous year's recommendations.	City officials will attend all RTP planning meetings and identify new actions and/or ongoing actions relating to transportation infrastructure to be included within the annual RTP update.
City of Centerville	Regional Transportation Plan (RTP)		City representatives (as members of the regional transportation advisory committee) attended planning meetings and identified transportation maintenance and new construction projects. When possible and appropriate, project	City officials will attend all RTP planning meetings and identify new actions and/or ongoing actions relating to transportation infrastructure to be included within the annual RTP update.

			recommendations incorporated hazard mitigation actions. The regional planning document was updated every two years with the previous year's recommendations.	
City of Ellington	Regional Transportation Plan (RTP)		City representatives (as members of the regional transportation advisory committee) attended planning meetings and identified transportation maintenance and new construction projects. When possible and appropriate, project recommendations incorporated hazard mitigation actions. The regional planning document was updated every two years with the previous year's recommendations.	City officials will attend all RTP planning meetings and identify new actions and/or ongoing actions relating to transportation infrastructure to be included within the annual RTP update.

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[10(b)] reviews will be posted in the local newspaper, as well as, on a regional website following each annual[10(b)] review of the mitigation plan[10(a)] and will solicit comments from the public based on the annual review. 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 MPC 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.

Reynolds County Hazard Mitigation Plan, 2022

Appendix A – Floodplain Maps

1. Centerville Flood Insurance Rate Map

2. Ellington Flood Insurance Rate Map – Overview
   - Central Ellington
   - East Ellington
   - Far North Ellington
   - Far West Ellington
   - North Central Ellington
   - North Ellington
   - Northeast Ellington
   - South Central Ellington
   - Southeast Ellington
   - West Central Ellington

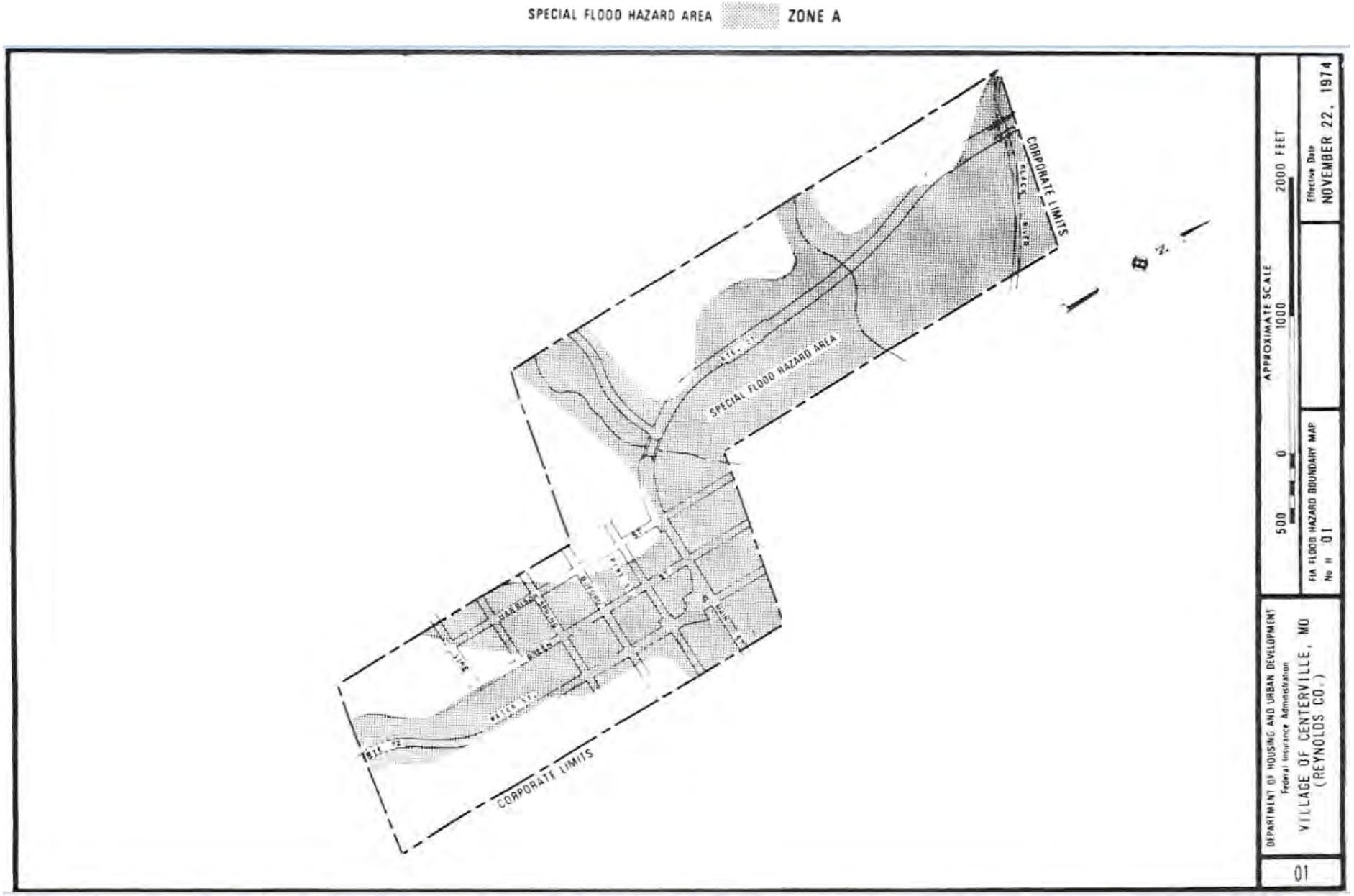
3. Lesterville Area Flood Insurance Rate Map

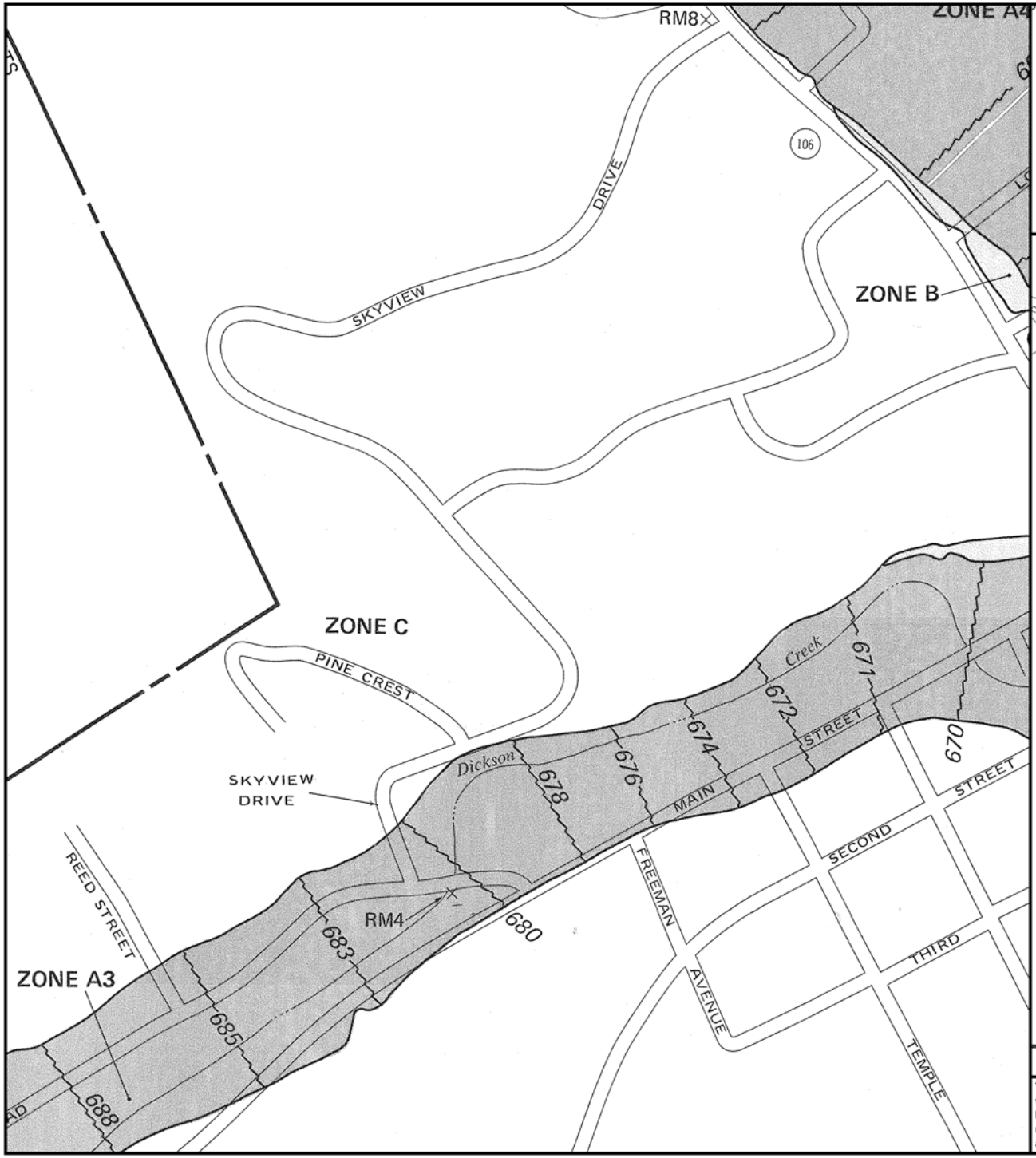
City of Centerville

Flood Hazard Boundary Map*

November 22, 1974

**Special Flood Hazard Area (Zone A) Converted by Letter 8-1-1986*





APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

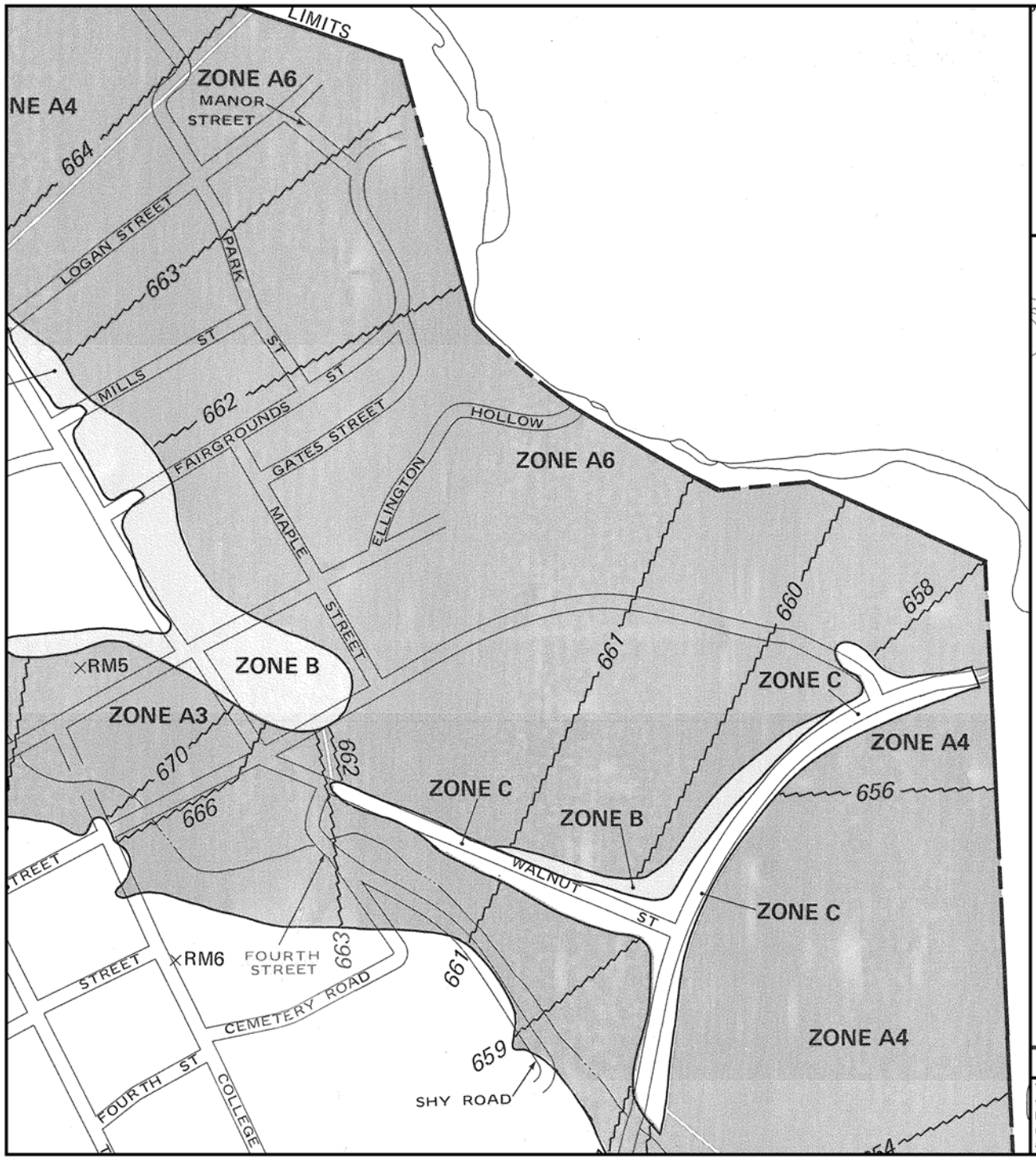
CITY OF
ELLINGTON,
MISSOURI
REYNOLDS COUNTY

(ONLY PANEL PRINTED)

COMMUNITY-PANEL NUMBER
290312 0001 B

EFFECTIVE DATE:
JANUARY 16, 1981

federal emergency management agency
federal insurance administration



APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
ELLINGTON,
MISSOURI
REYNOLDS COUNTY

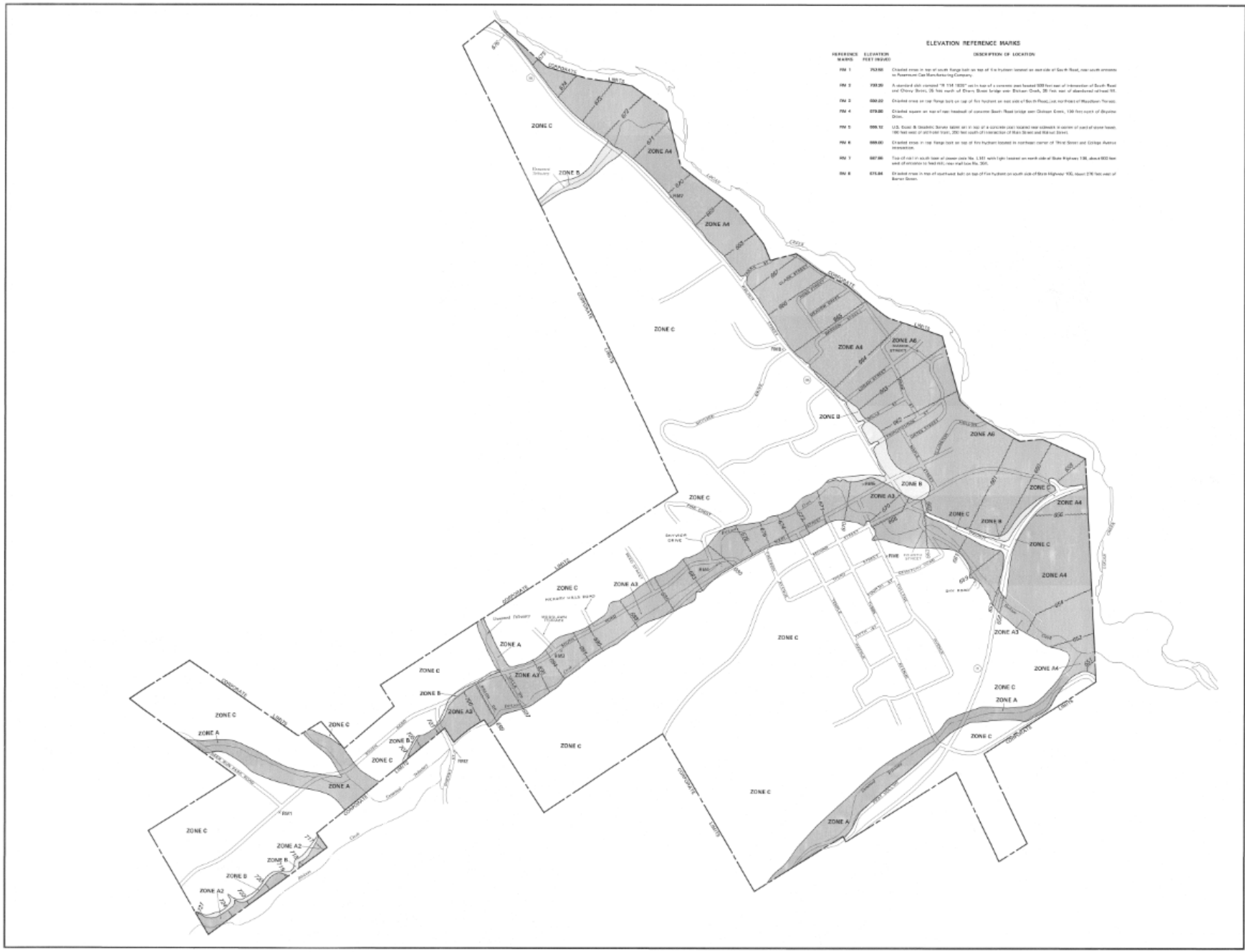
(ONLY PANEL PRINTED)

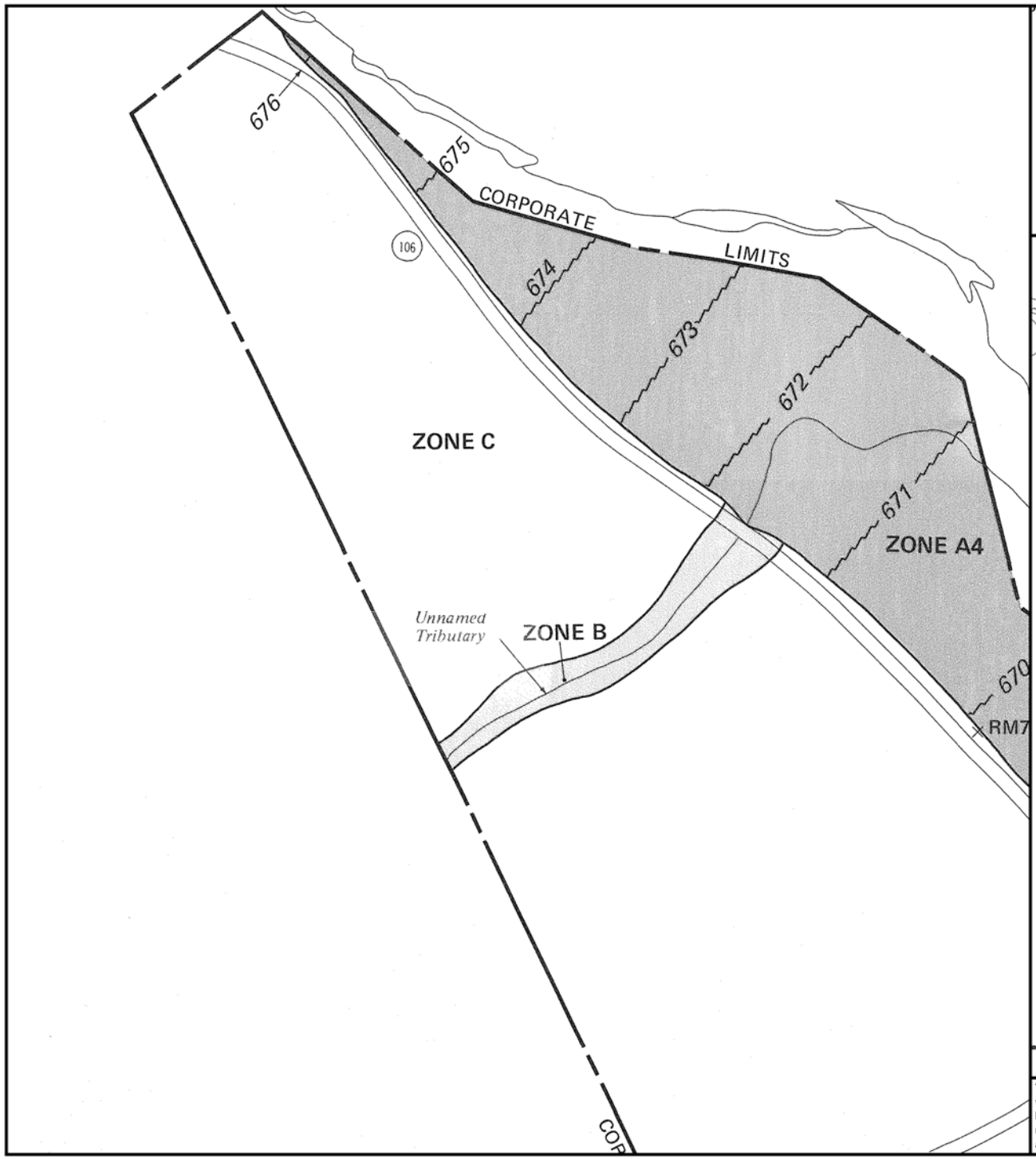
COMMUNITY-PANEL NUMBER
290312 0001 B

EFFECTIVE DATE:
JANUARY 16, 1981

federal emergency management agency
federal insurance administration

City of Ellington, Missouri
Flood Insurance Rate Map
January 16, 1981





APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

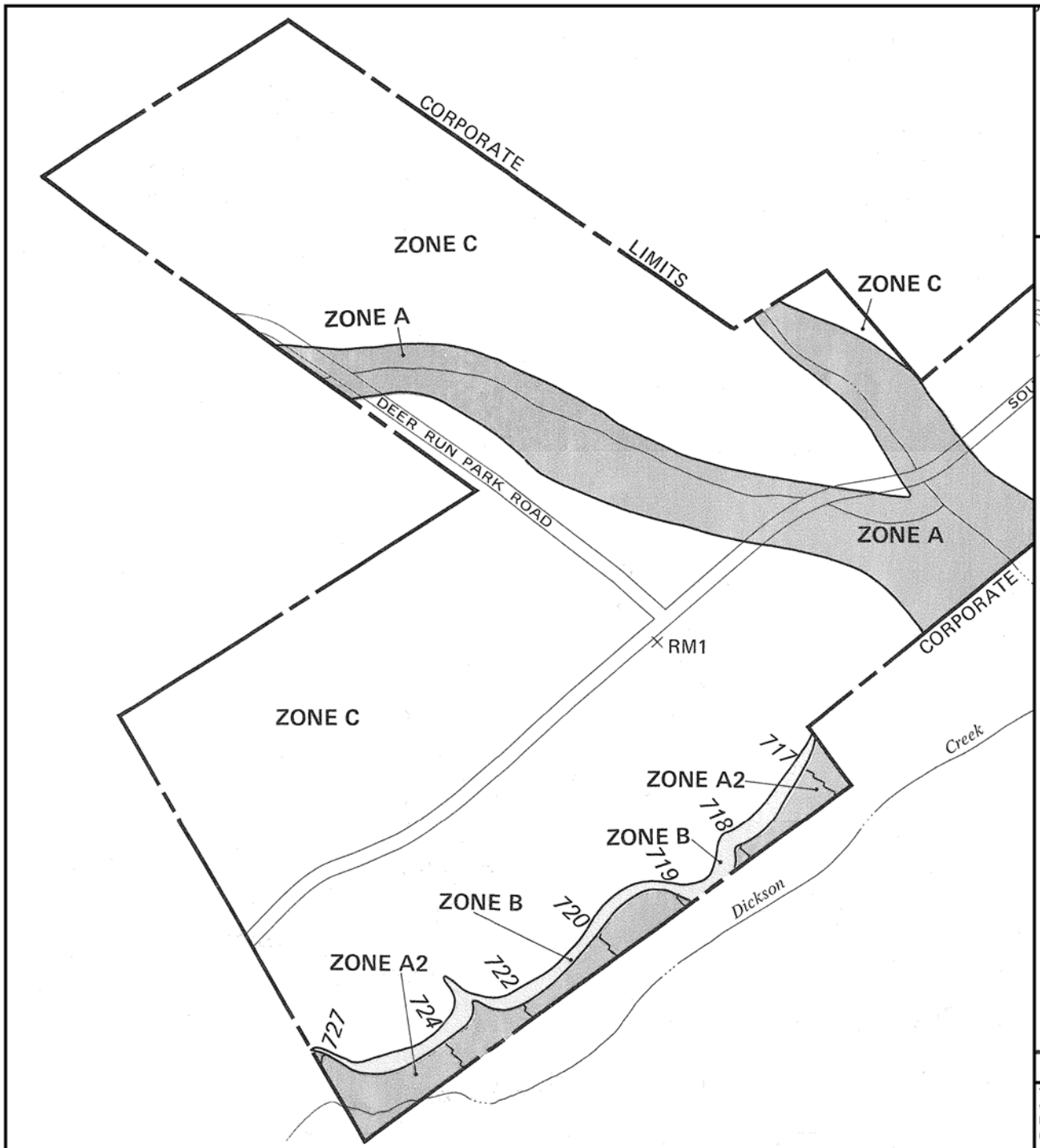
CITY OF
ELLINGTON,
MISSOURI
REYNOLDS COUNTY

(ONLY PANEL PRINTED)

COMMUNITY-PANEL NUMBER
290312 0001 B

EFFECTIVE DATE:
JANUARY 16, 1981

federal emergency management agency
federal insurance administration



APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

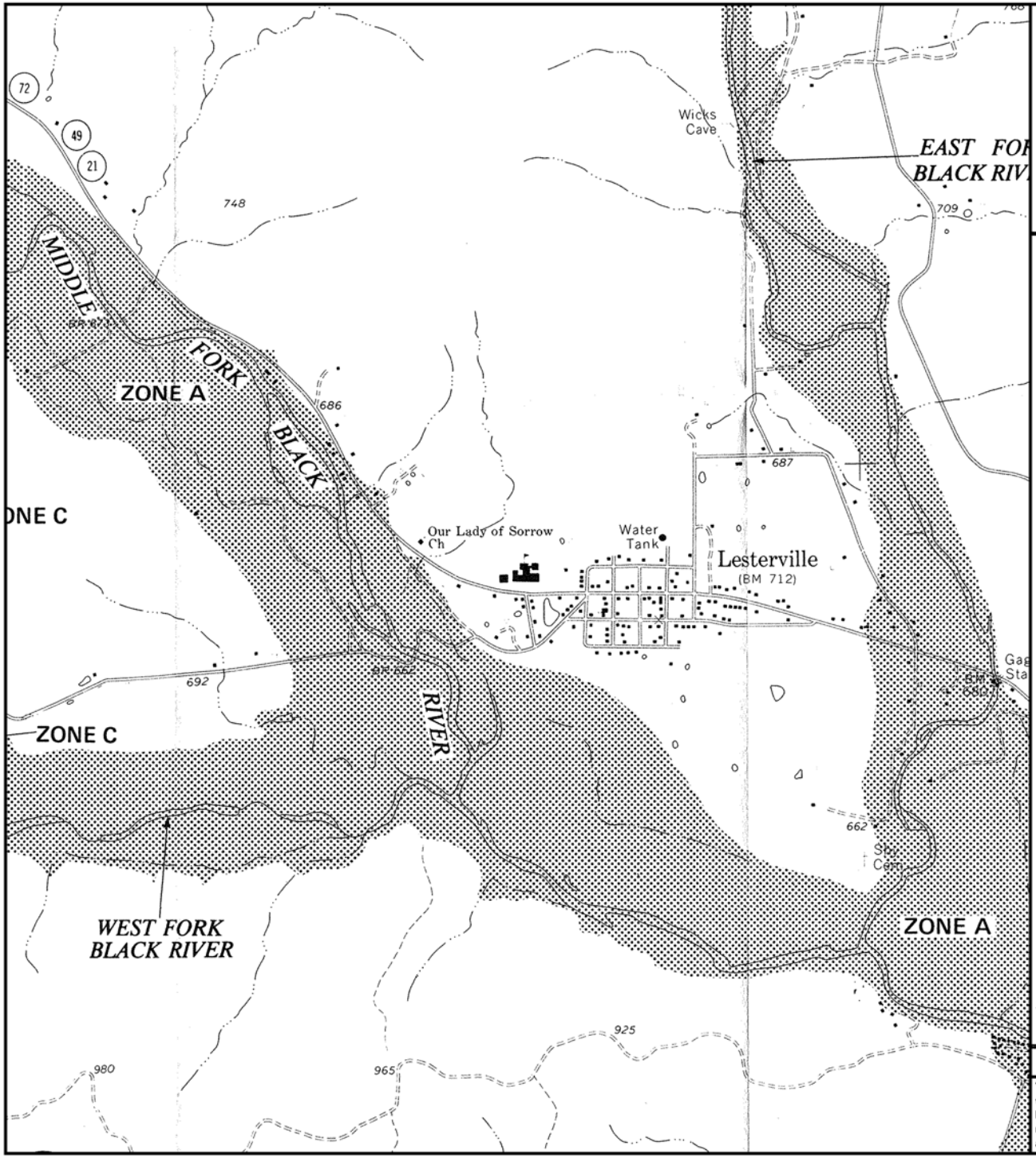
CITY OF
ELLINGTON,
MISSOURI
REYNOLDS COUNTY

(ONLY PANEL PRINTED)

COMMUNITY-PANEL NUMBER
290312 0001 B

EFFECTIVE DATE:
JANUARY 16, 1981

federal emergency management agency
federal insurance administration



APPROXIMATE SCALE

2000 0 2000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

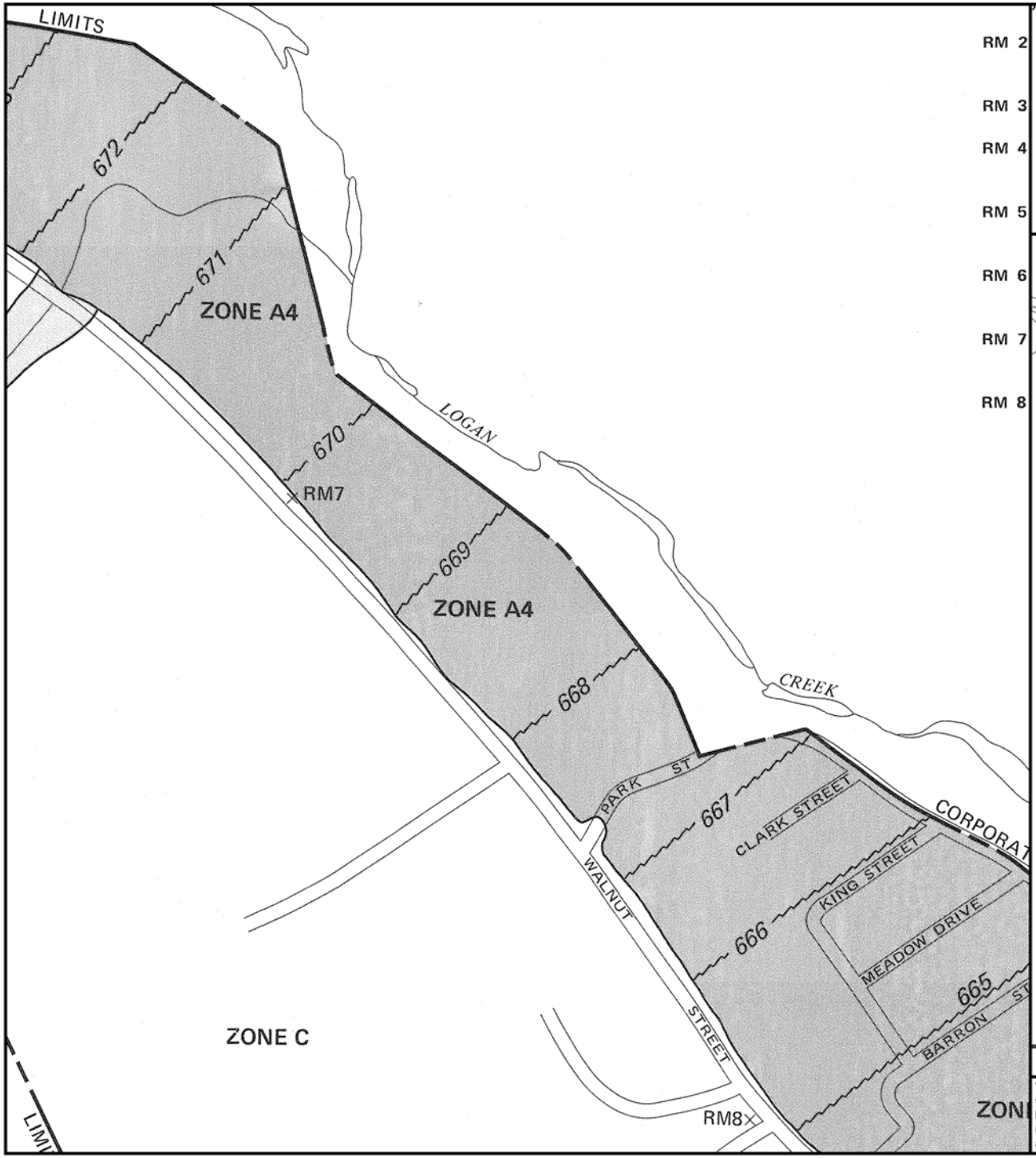
REYNOLDS COUNTY, MISSOURI
(UNINCORPORATED AREAS)

PANEL 225 OF 450

COMMUNITY-PANEL NUMBER
290829 0225 A

EFFECTIVE DATE:
SEPTEMBER 30, 1988

Federal Emergency Management Agency



APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

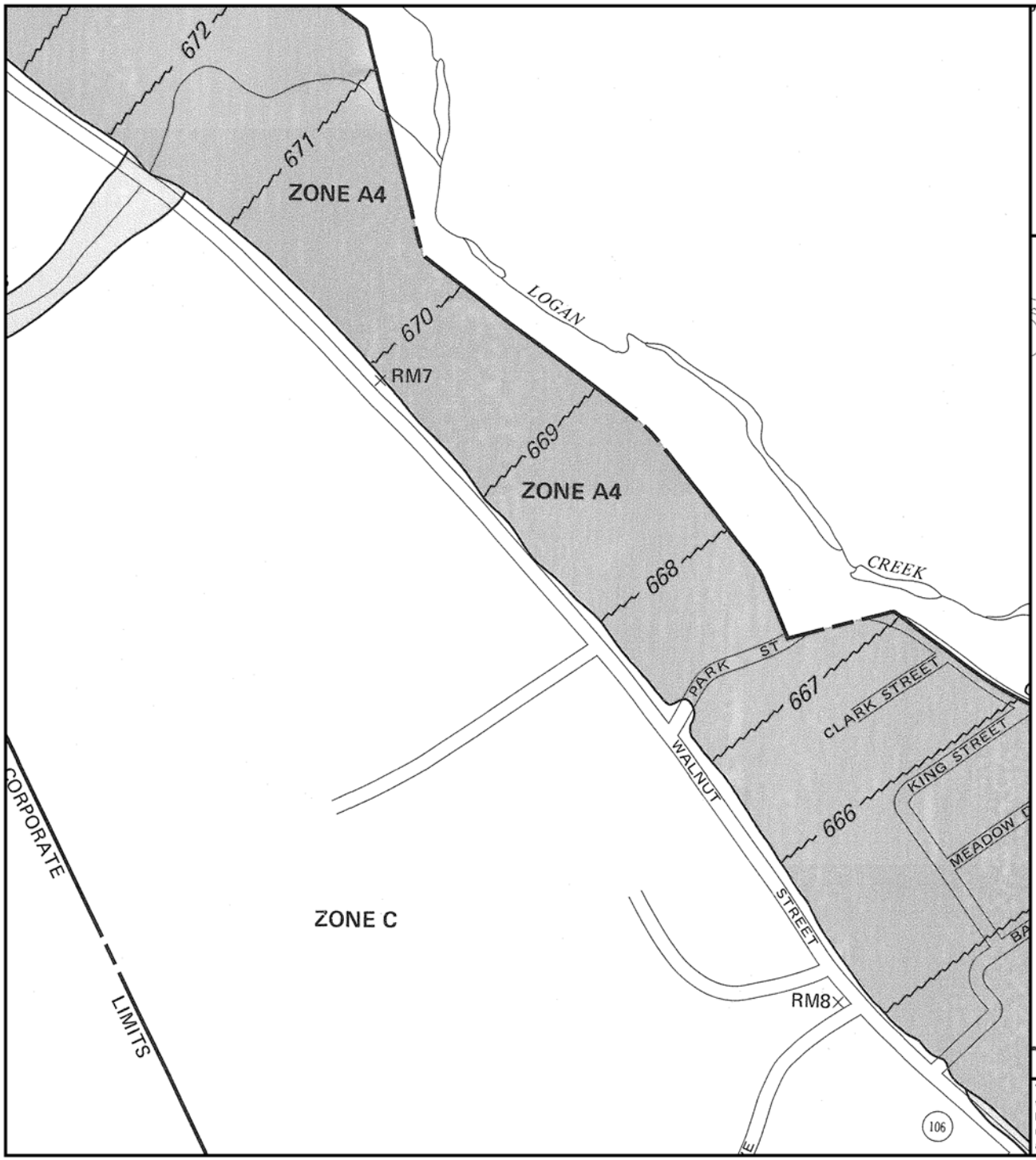
CITY OF
ELLINGTON,
MISSOURI
REYNOLDS COUNTY

(ONLY PANEL PRINTED)

COMMUNITY-PANEL NUMBER
290312 0001 B

EFFECTIVE DATE:
JANUARY 16, 1981

federal emergency management agency
federal insurance administration



APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
ELLINGTON,
MISSOURI
REYNOLDS COUNTY

(ONLY PANEL PRINTED)

COMMUNITY-PANEL NUMBER
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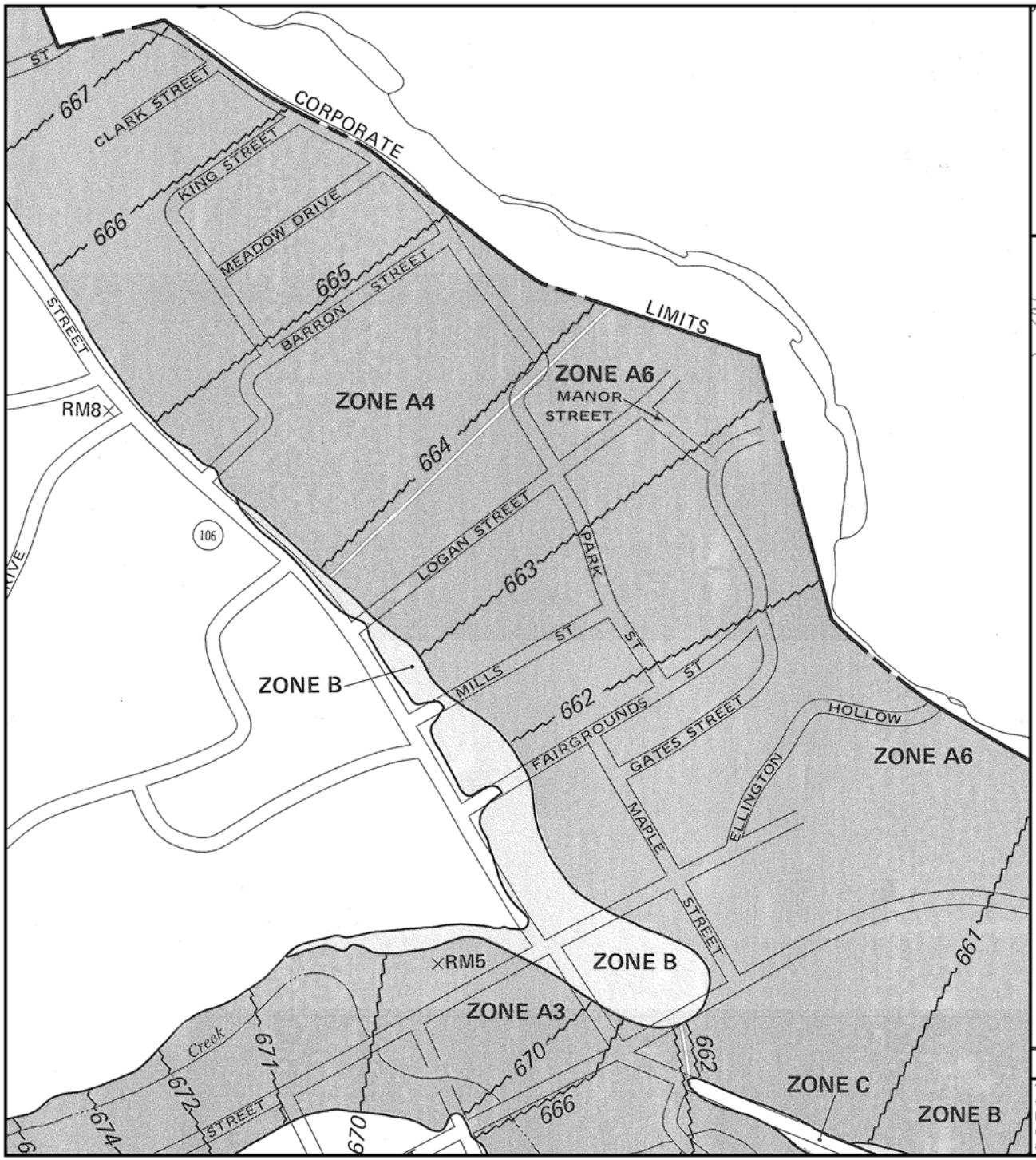

APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
ELLINGTON,
MISSOURI
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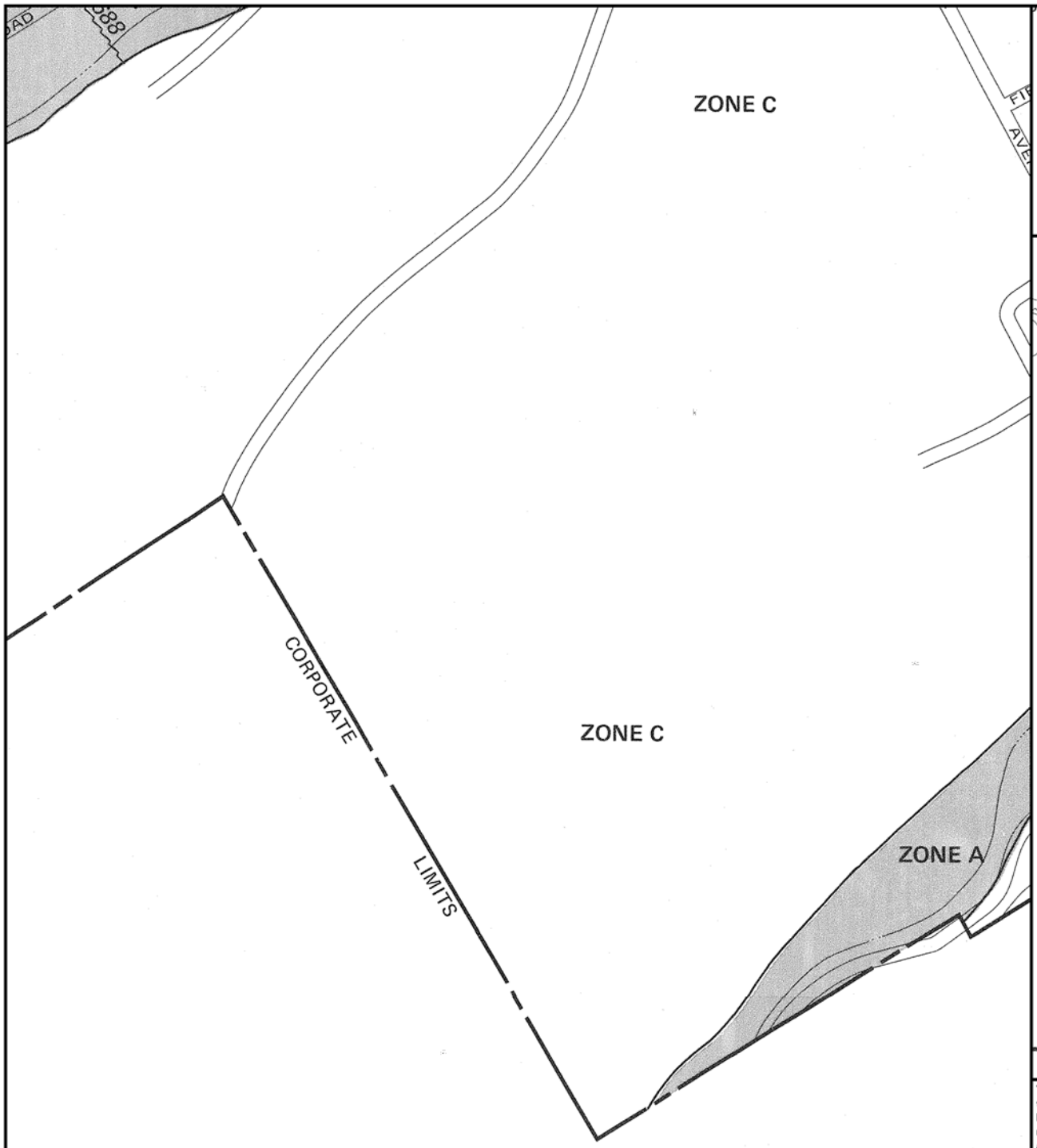

ogram, at (800) 638-6620, or (800) 424-8872.

APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
ELLINGTON,
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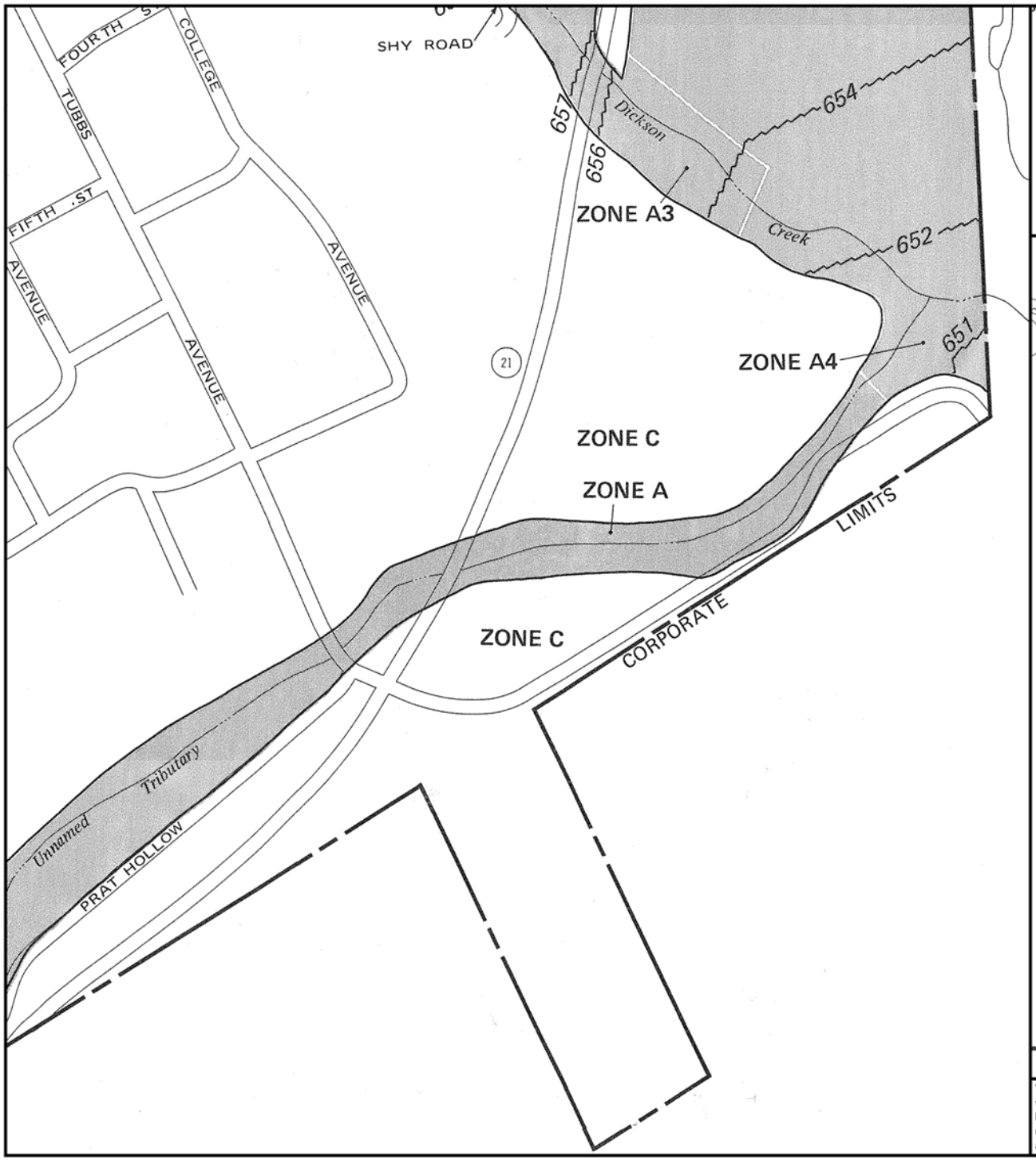

APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

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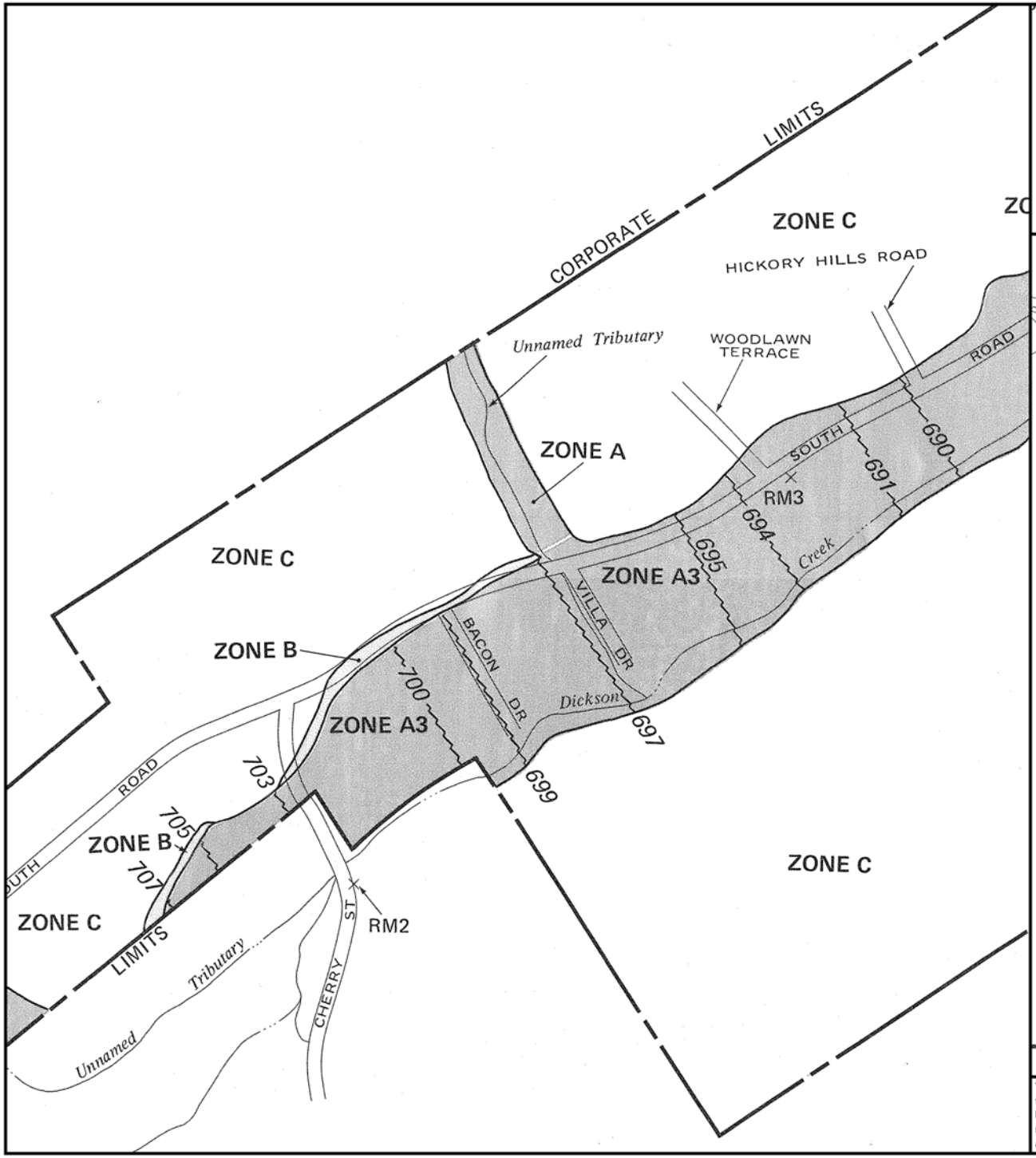

APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

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ELLINGTON,
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REYNOLDS COUNTY

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290312 0001 B

EFFECTIVE DATE:
JANUARY 16, 1981

federal emergency management agency
federal insurance administration

Reynolds County Hazard Mitigation Plan, 2022

Appendix B – Dam Inundation Maps and Emergency Action Plans

1. Brushy Creek Tailings EAP (Reynolds County)
2. Buick Mine EAP (Reynolds County)
3. Firepit Lake Dam Inundation Map (Reynolds County)
4. Fletcher Mine Clarification Dam Inundation Map (Reynolds County)
5. Fletcher Mine Tailings Dam EAP (Reynolds County)
6. Magmont Mine Tailings Dam EAP (Iron County)
7. Sweetwater Tailings Dam EAP (Reynolds County)
8. West Fork Dams EAP (Reynolds County)

Emergency Action Plan, or EAP

Brushy Creek Tailings 1

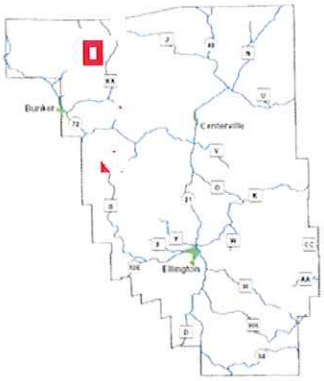
National Inventory of Dams, or NID, MO30951

Reynolds County, Missouri

SEMA Area C

Reviewed and Updated:

12/15/2017



The Doe Run Company

Dan Buxton

Owner/operator

5-11-18

Date

County Emergency Management Director

Renee Horn

Reynolds County, Missouri

Date

Basic EAP Data

Purpose

The purpose of this EAP is to reduce the risk to human life and minimize property damage during an unusual or emergency event at Brushy Creek Tailings 1 Dam.

Notification Procedure

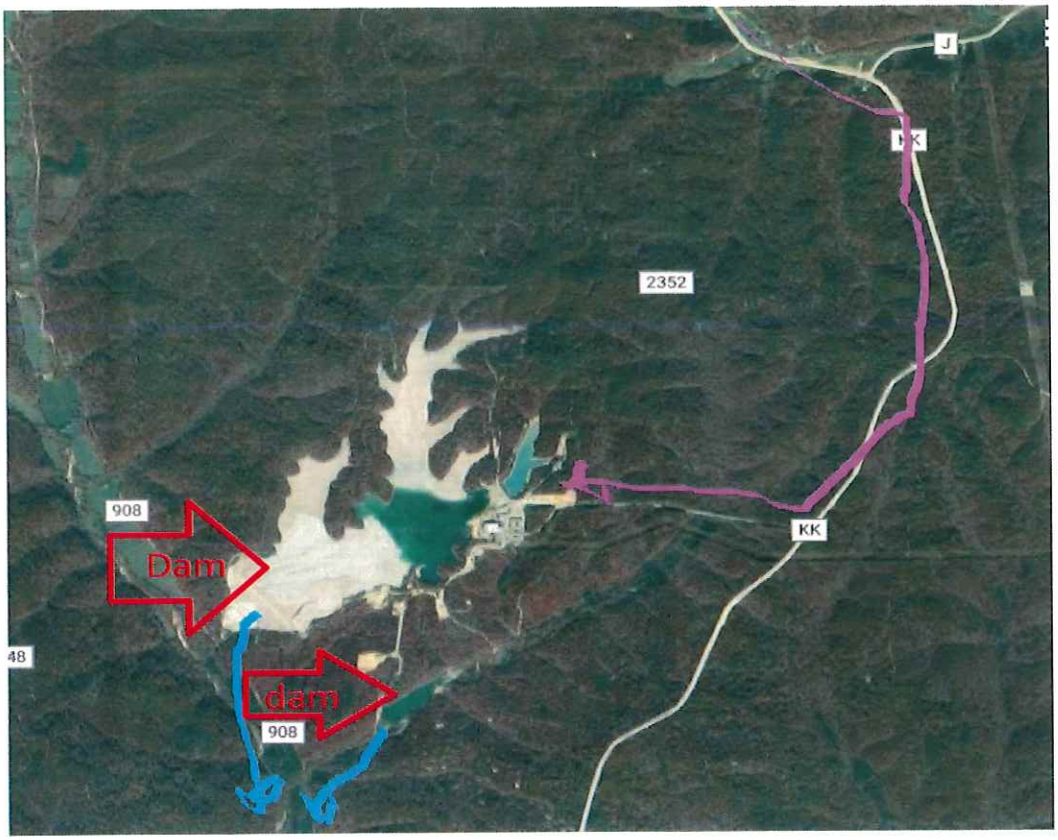
This EAP provides general guidance for recognizing and characterizing an emergency situation occurring at the dam. The dam owner should act quickly to evaluate the emergency situation and then follow the notification procedures according to the corresponding level of emergency.

Potential Impacted Area

See *Inundation Map* (Appendix A) and *Residents/Businesses/Entities at Risk* table for the locations and contact information of the following residents and businesses that may be flooded if the dam should fail This list may also include critical infrastructure such as pipelines, power plants, substations, or sewer plants.

Four homes one highway and the West Fork Mill are in the inundation zone.

Directions to dam (Review Arrival Time Map that shows major roads to the dam)From the intersection of highways 32 and KK near Bixby go south on KK. Then from the intersection of highways KK and J continue south on KK for 3.2 miles then take a right back into the mine and dam area.



Guidance for Determining the Emergency Level

This information should be used as a general guide for recognizing and characterizing the type of emergency situation occurring at the dam. The dam owner should notify the appropriate emergency contacts based upon the emergency level assigned to each situation.

Level 1 Emergency - Nonemergency, unusual event, slow to develop

- Reservoir water surface elevation at emergency spillway crest or spillway is flowing with no active erosion.
- New seepage areas in or near the dam.
- New cracks in the embankment greater than ¼-inch wide without seepage.
- Visual movement/slippage of the embankment slope.
- Instrumentation readings beyond predetermined values.
- Measurable earthquake felt or reported on or within 50 miles of the dam.
- Damage (vandalism/sabotage) to dam or appurtenances with no impacts to the functioning of the dam.
- Modification (vandalism/sabotage) to the dam or appurtenances that could adversely impact the functioning of the dam.

Level 2 Emergency - Potential dam failure situation, rapidly developing

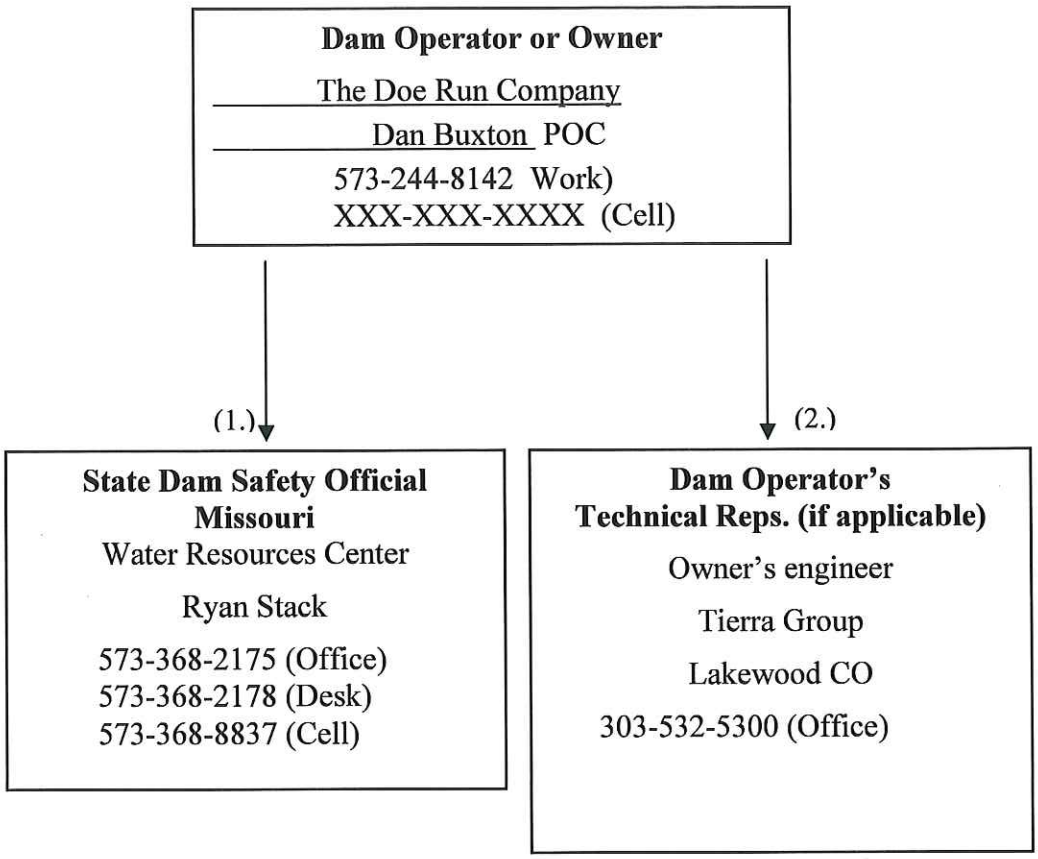
- Spillway flowing with active gully erosion.
- Spillway flow that could result in flooding of people downstream, if the reservoir level continues to rise.
- Reservoir level is 1 foot below the top of the dam.
- New seepage areas with cloudy discharge or increasing flow rate.
- Observation of new sinkhole in reservoir area, on embankment or downstream of dam.
- Cracks in the embankment with seepage.
- Earthquake resulting in visible damage to the dam or appurtenances.
- Verified bomb threat that, if carried out, could result in damage to the dam.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in seepage flow.

Level 3 Emergency - Urgent; dam failure imminent or is in progress

- Spillway flowing with an advancing headcut that is threatening the control section.
- Spillway flow that is flooding people downstream.
- Water from the reservoir is flowing over the top of the dam (not just auxiliary/emergency spillway).
- Seepage that is obviously eroding soil from within the embankment or rapidly increasing in flow rate.
- Rapidly enlarging sinkhole.
- Sudden or rapidly progressing slides of the embankment slopes.
- Earthquake resulting in uncontrolled release of water from the dam.
- Detonated bomb that has resulted in damage to the dam or appurtenances.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in uncontrolled water release.

Emergency Level 1 Notifications

Nonemergency, unusual event; slowly developing.



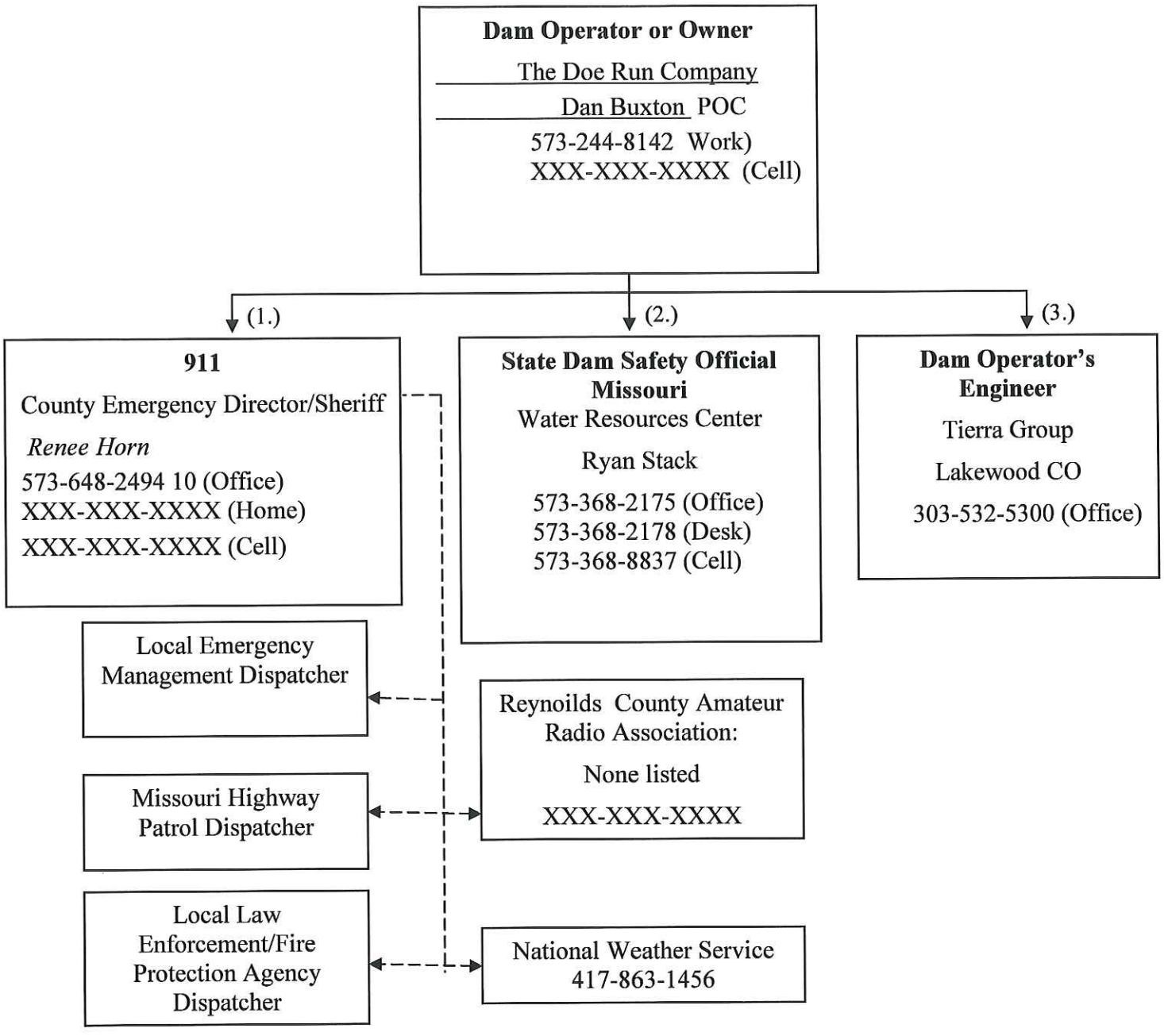
Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Emergency Level 2 Notifications

Emergency event, potential dam failure situation; rapidly developing.



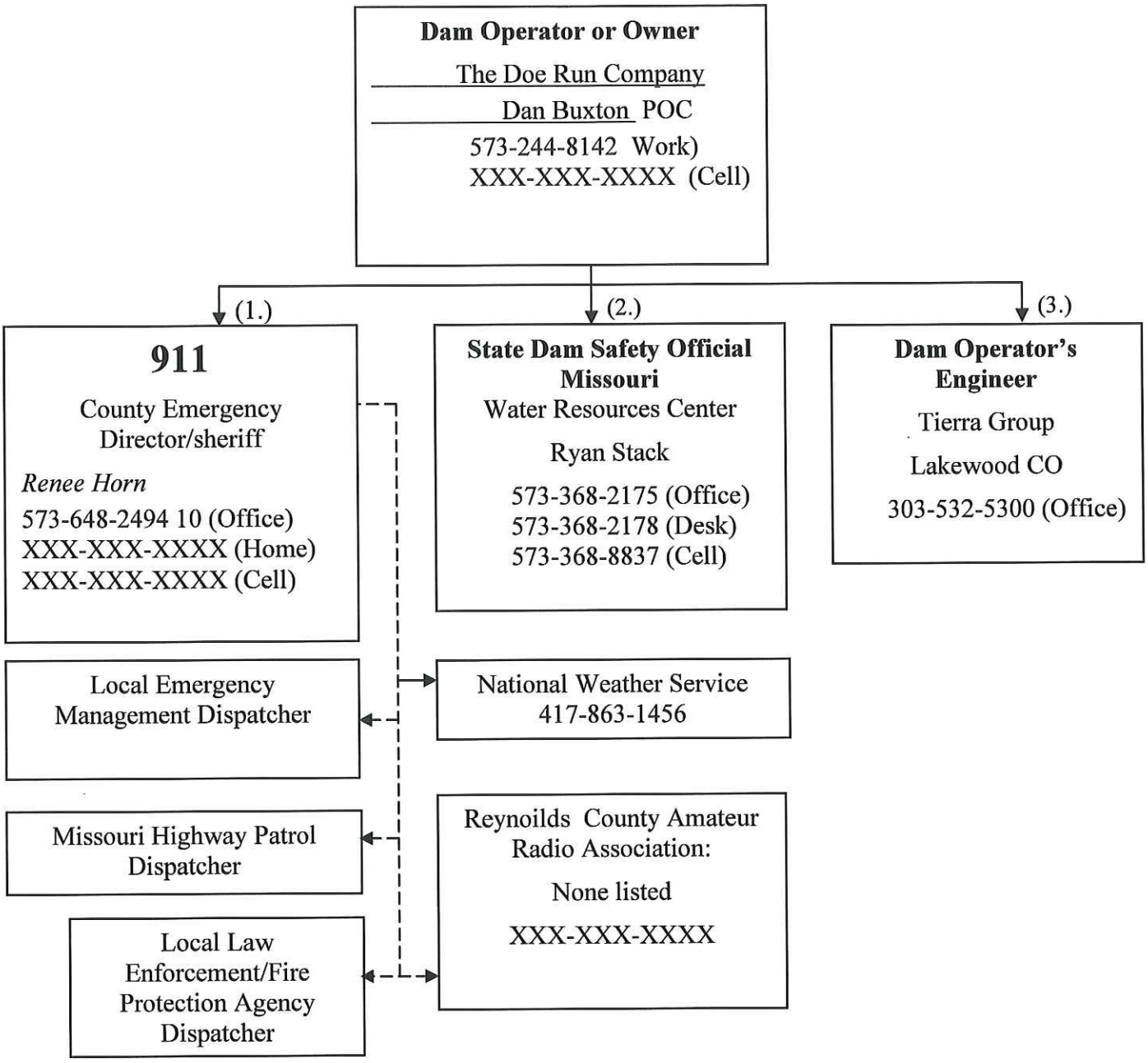
Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Emergency Level 3 Notifications

Urgent event, dam failure appears imminent or is in progress.



Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information for back-ups to the persons shown above and other emergency personnel.

Emergency Services Contacts

Agency / Organization	Principal Contact	Address	Office Phone No. with Area Code	Alternate Telephone Numbers
Reynolds County Sheriff	Sheriff Tom Volner	2319 Green street Centerville MO	573-648-2491	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Owner/Representative of Brushy Creek Tailings 1 and 2 Dam	Mr. Dan Buxton	P.O. Box 500 Vibrunurm MO 65566	573-244-8142	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
County Emergency Management Director	*Renee Horn*	P.O. Box 10 Centerville MO	573-648-2494 ext 10	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Ellington Fire Department		PO Box 430St Ellington, Missouri	(573) 663-2324	
Ellington Police	Stan Qualls	PO Box 7 Ellington, Missouri	(573)660-7717	
Troop G Highway Patrol	desk	1226 W. Bus. US-60/63Willow Springs	(417) 469-3121	
Reynolds County Road Department		450 Highway V, Centerville, MO	(573) 648-2483	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Water Resources Center Dam and Reservoir Safety Program	Ryan Stack Chief Engineer	111 Fairgrounds Rd. Rolla, MO 65401	573-368-2175	573-368-2178 (Desk) 573-368-8837 (Cell)
Department of Natural Resources Emergency Response	Duty Officer EER	P.O. Box 176 Jefferson City, MO 65102	**24 HOUR NO:** 573-634-2436	573-526-3380 (Brian Allen, Chief, EER)
SEMA Duty Officer			573-751-2748	
National Weather Service	Jim Kramper	St. Charles, MO	636-447-1876	1-800-852-7497 636-447-1769 (Fax)
Missouri Department of Transportation	Emergency Operation Center 24-hour cell no.		573-522-9503	
Missouri Department of Transportation	County Shed		XXX-XXX-XXXX	XXX-XXX-XXXX
KFVS12	Contact Name Manager	310 Broadway Cape Girardeau, MO	(573) 335-1212	(800) 455-KFVS
Radio Station KPPL 92.5 FM	Contact Name Manager	ROUTE #2, BOX 496 Poplar Bluff, Missouri	XXX-XXX-XXXX	

Residents/Businesses/Entities/Infrastructure at Risk

Brief summary of number of entities within inundation zone.

Entity No.	Resident/business or other impacted entity	Address	Phone No. with area code	Distance downstream from dam (miles)
1	home	2294 County Road 908, Boss MO		1.6 miles
2	home	1042 County Road 908, Boss MO		1.8 miles
3	Temp Trailer	County Road 908, Boss MO		2.0 miles
4	Hills	183 County Road 908, Boss MO		2.05miles
5	home	AC		2.3 miles
6	Happy Hollow Baptist Church			2.6 miles
7	West Fork Mill	Doe Run Company		3.1 miles

(Use additional sheets if necessary)

Resources Available

Locally available resources include: (if not available please note)

Heavy Equipment Service and Rental	Sand and Gravel Supply	Ready-mix Concrete Supply
Tony Abney Construction PO Box 760 Vibrunum MO 573-244-3145	K & D Crushing 14097 Highway KK Boss MO 573-269-4320 573-269-4415	Politte Read Mix 92 Highway 49 Viburnum MO 573-244-5463
Pumps	**Pipe**	**Sand Bags**
Hearth Land Pumps 1800 Supply Road Suite 8 Carterville IL 63918 618-985-5510	Poly Pipe Systems PO Box 1157 Steelville MO 573-775-3300 573-775-4634 573-775-2024	The Mine Supply Company PO Box 345 85 Highway 49 Viburnum MO. 573-244-5416

The above list was taken from the EAP for MO31141 Fletcher Mine water dam.,

Other options that might be useful.

Schrum Ready Mix, Caledonia 573-779-3708

Mills Ready Mix Annapolis, 573-598-3400

Lead Belt Pump and Supply Park Hills 573-431-2476 pumps

A7 M Pump Festus 636-931-0275

Mid State Paving Sullivan MO 573-627-2039

Zoellner Construction 573-547-8030

Yoder and Sons Bonne Terre 573-358-40585

Hall and Co Leadwood 573-562-7685

Gibson Excavating 573-438-2372

Tony Selz, Lonedell, MO 636-629-0939 or 636-744-1575

5M Welding & Excavation Joe Medwick Cuba, MO 573-308-5138 or 573-885-4105

NOTE: *This list is **not** an endorsement of the service but design as a starting point. **Other sources of information should be used and it is up to the owner of the dam to select the choices for the EAP**. Putting a source name in the box on the EAP does not great an obligation by the owner to use that source if and when an emergency arise, but is meant to assist the owner if during an emergency he does not have the time to do research into what choice he will make on short notice to obtain the needed services.*

Appendix A
Inundation Study

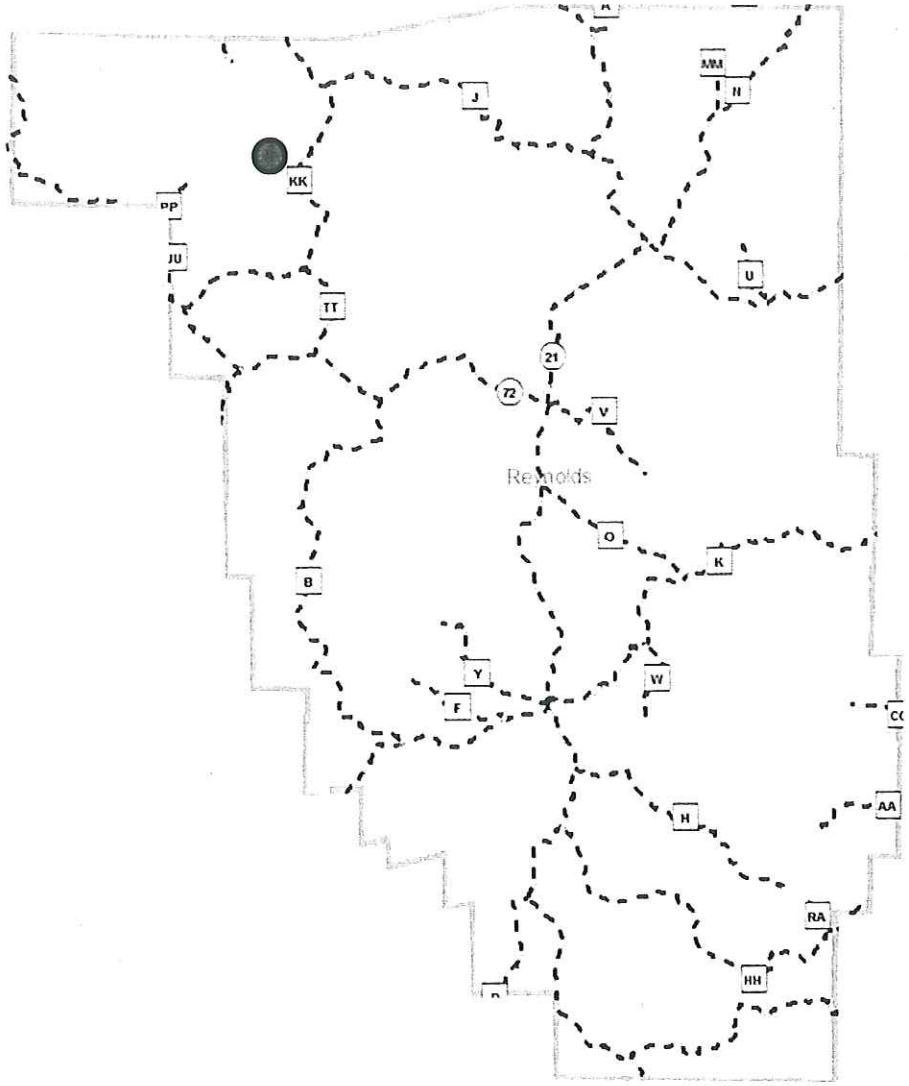
Inundation Map vs. Evacuation Area

Inundation maps have been developed from best available information using reasonable assumptions and standardized methods. They are approximations of the maximum water surface extents resulting from a complete dam breach and draining of the full reservoir. Inundation maps are empirical hydrologic and hydraulic simulations that can only be field verified in the event of an actual breach.

Evacuation areas and call lists should take into consideration the anticipated local impacts of flooding; knowledge of local infrastructure, both occupancy and ownership; and potentially interrupted services or cut-off access, which would be caused by dam failure. Depending upon actual circumstances, appropriate alert and evacuation areas could be more or less extensive than the simulated inundation zones.

Insert inundation map here. It is suggested this section be denoted by a tabbed divider to allow quick access to the inundation map during an emergency.

Brushy Creek Tailings 1 & 3 Dam
Potentially Affected Structures Map



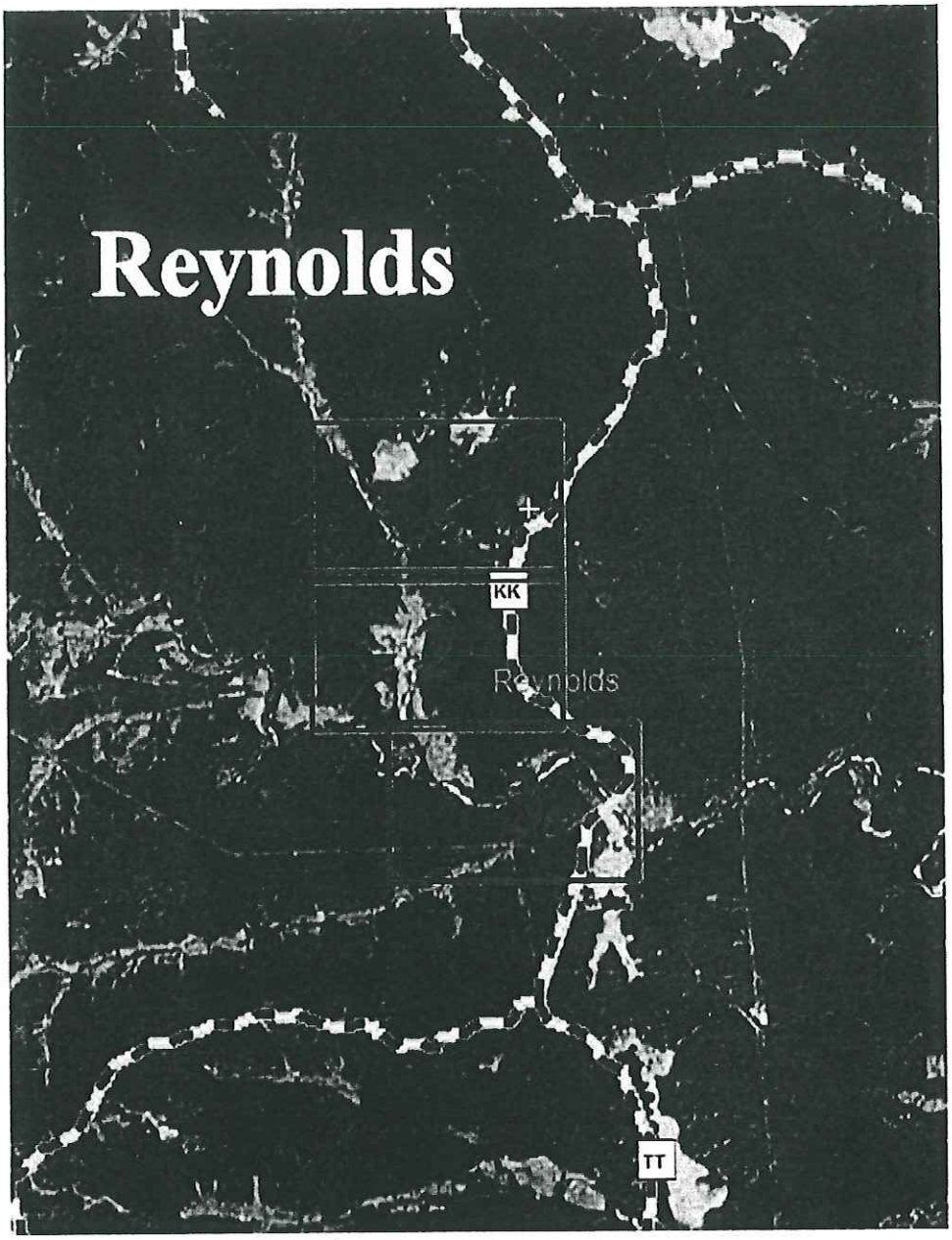
Reynolds, Missouri

Reynolds MO30951/ MO40196

Date: August 14, 2017

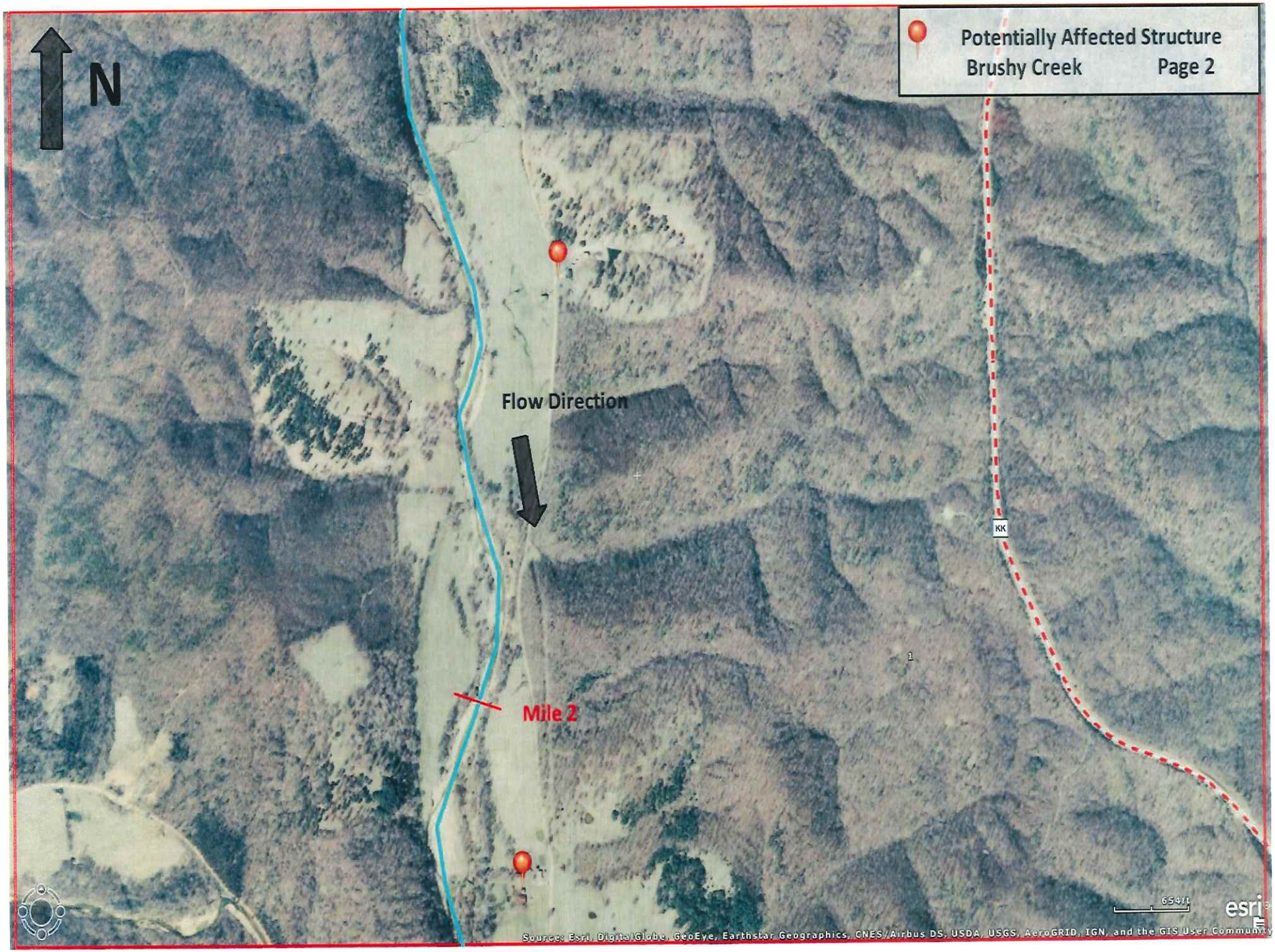
Note: Actual areas affected will depend on the actual dam failure criteria and may differ from the areas shown. Due to limitations, methods, assumptions, and procedures used to develop the map area, the map may not show structures that have been recently constructed so some information may be inaccurate. Additional downstream information should be completed by proper authorities.

Reynolds County

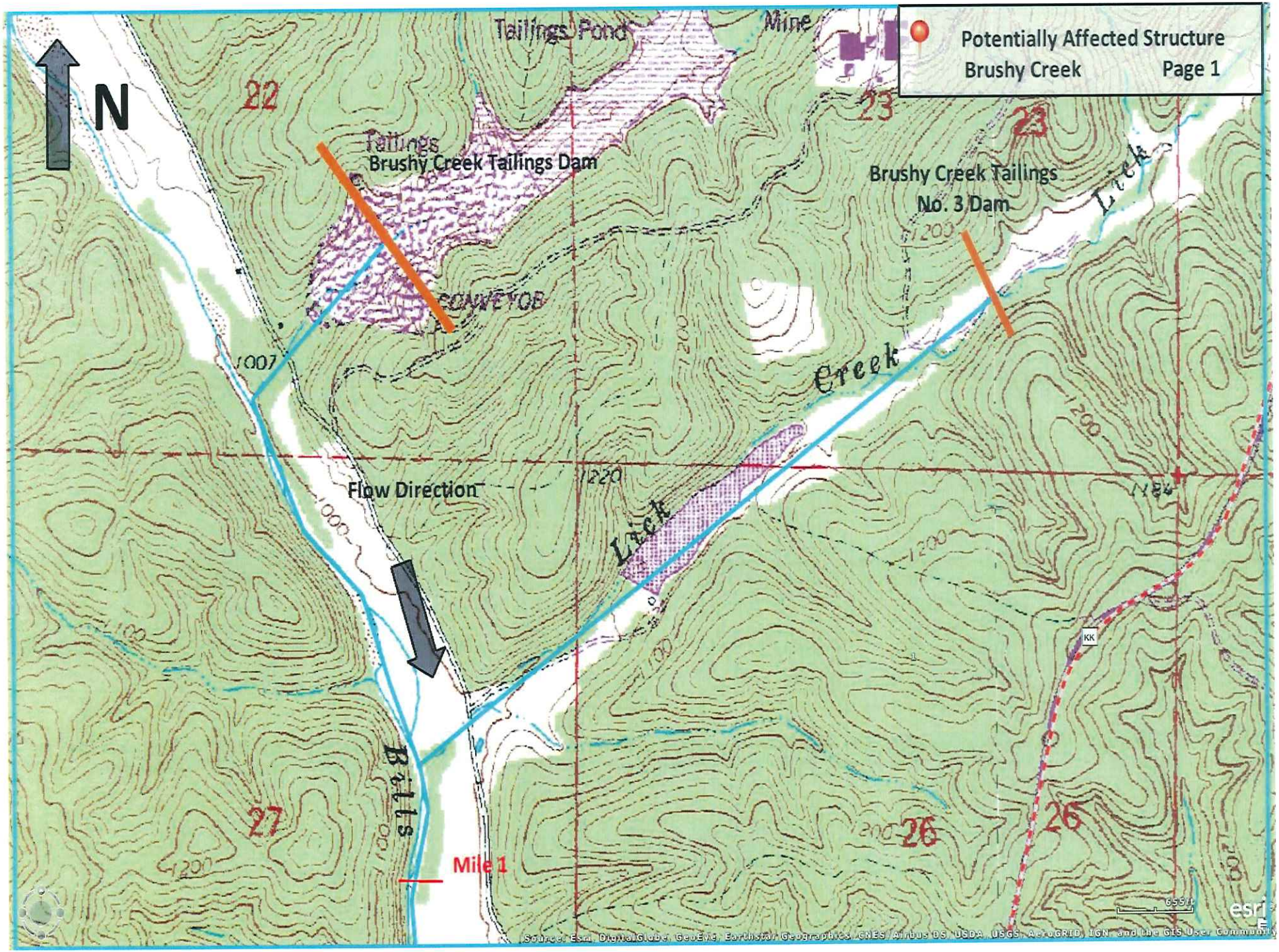


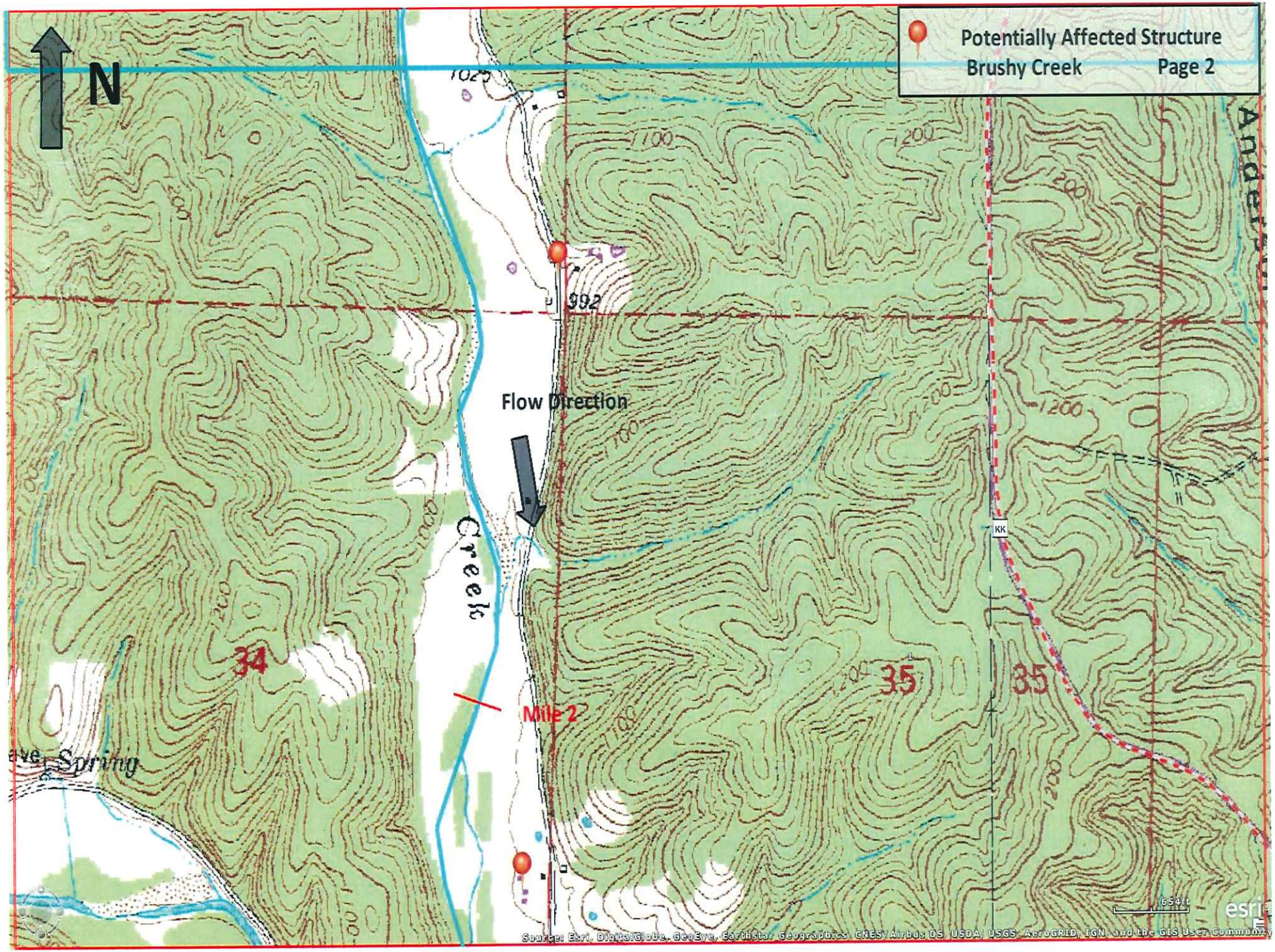
Note: Red rectangular areas indicate each page of the affected areas map

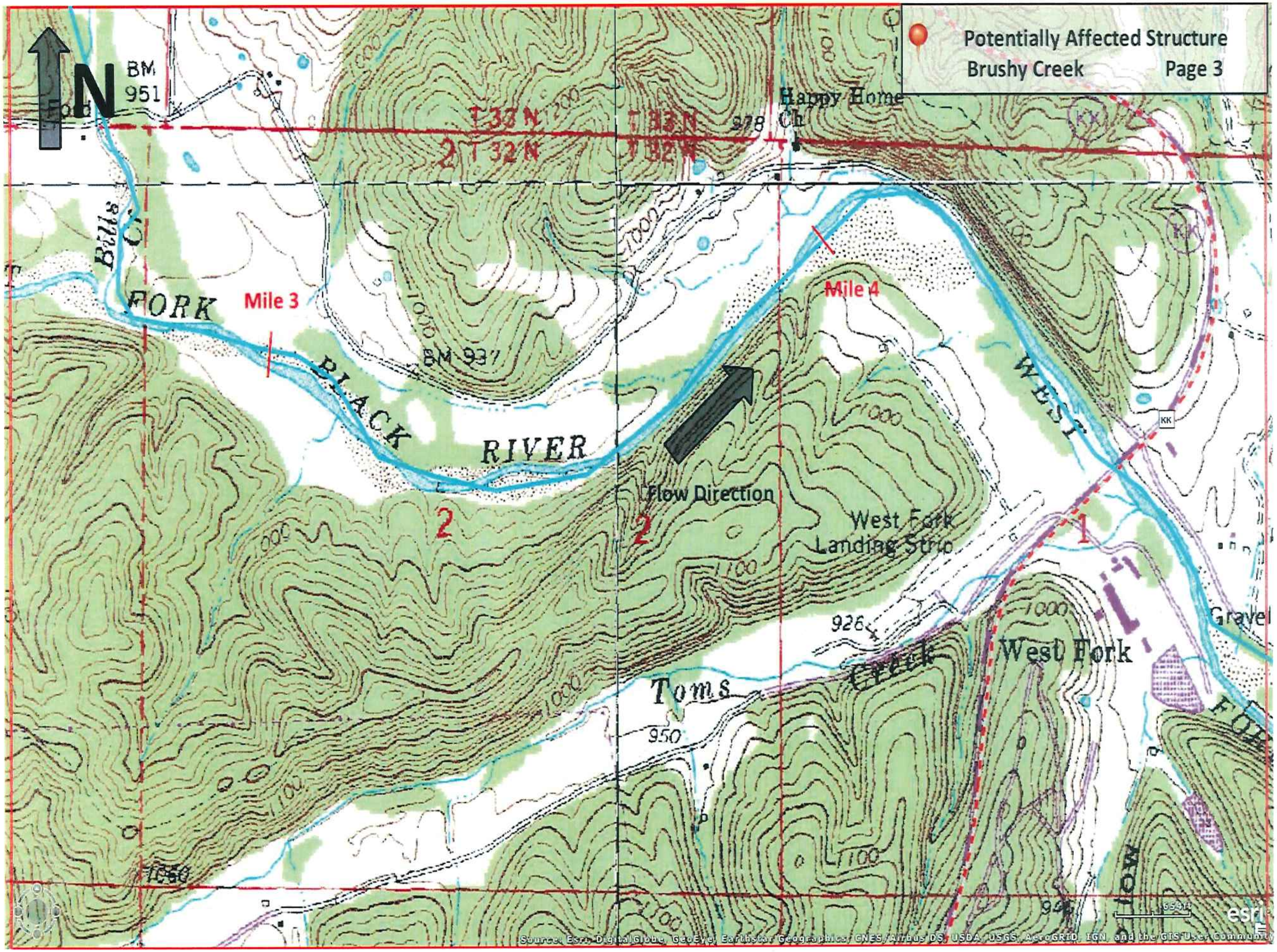

N
Potentially Affected Structure
Brushy Creek
Page 1
Brushy Creek Tailings Dam
Brushy Creek Tailings
No. 3 Dam
Flow Direction
Mile 1
KK
654ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Potentially Affected Structure
Brushy Creek Page 2
Flow Direction
KK
Mile 2
654ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Potentially Affected Structure
Brushy Creek Page 3
Mile 3
Mile 4
Flow Direction
KK
654ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Potentially Affected Structure
Brushy Creek Page 1
N
Tailings Pond
Mine
Tailings
Brushy Creek Tailings Dam
Brushy Creek Tailings
No. 3 Dam
Flow Direction
Mile 1
Creek
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Potentially Affected Structure
Brushy Creek
Page 2
Flow Direction
Creek
Mile 2
34
35
35
992
KK
Spring
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Potentially Affected Structure
Brushy Creek
Page 3
N
BM 951
Ford
Bills Cr
FORK
BLACK
RIVER
Mile 3
Mile 4
BM 937
T 33 N
T 32 N
Happy Home Ch
978
Flow Direction
West Fork Landing Strip
WEST
FORK
West Fork
Toms Creek
926
950
Gravel
KK
1
2
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
esri

Appendix B-1
National Inventory of Dams (NID) Data

Brushy Creek Tailings #1 Dam:

State: Missouri

NID ID: MO30951

Sec: 22 Township: 33N Range: R02W

Longitude: -91.1433 decimal degree
Latitude: 37.5344 decimal degree

Longitude: -91 ° 08' 44"
Latitude: 37° 31' 58"

County: Reynolds

Stream: Trib Bills Creek

Nearest town downstream: West Fork

Distance to nearest town downstream: 6.1 mi

Year constructed: 1970

Nearest town: West Fork

Distance to nearest town: 6.1 mi

Type of dam: (indicate only one)

tailings

Max. discharge: 1067 $ft.^3/s$

Max. storage: 4438 acre-ft.

Normal storage: 500 acre-ft.

Surface area: 69 acres

Drainage area: 639 acres

Inspection frequency: 2 yrs.

State regulatory agency:
Missouri DNR WRC DRSP

Dam height: 205 ft.

Dam length: 1500 ft.

Current hazard class: 1

Principal spillway type: Open channel on left abutment

Emergency spillway type: none

Comments: _____

_____

_____

_____

Appendix B-2
National Inventory of Dams (NID) Data

Brushy Creek Tailings # 2 Dam: Not yet built

State: Missouri

NID ID: MO40196

Sec: 23 Township: 33N Range: R02W

Longitude: -91.1301 decimal degree
Latitude: 37.5307 decimal degree

Longitude: not listed"
Latitude: not listed

County: Reynolds

Stream: Lick Creek

Nearest town downstream: West Fork

Distance to nearest town downstream: 5.2 mi

Year constructed: 1970

Nearest town: West Fork

Distance to nearest town: 5.21 mi

Type of dam: (indicate only one)

tailings

Max. discharge: 2200 $ft.^3/s$

Max. storage: 25626 acre-ft.

Normal storage: 21294 acre-ft.

Surface area: 147 acres

Drainage area: 915 acres

Inspection frequency: 2 yrs.

State regulatory agency:
Missouri DNR WRC DRSP

Dam height: 184 ft.

Dam length: 2450 ft.

Current hazard class: 1

Principal spillway type: Open channel on left abutment

Emergency spillway type: none

Comments: _____

_____

_____

_____

Appendix C

Unusual or Emergency Event Log

(To be completed during the emergency)

Brushy Creek Tailings 1 and 2 Dam County: Perry

When and how was the event detected?

Weather conditions:

General description of the emergency situation:

Emergency level determination: Made by:

Actions and Event Progression

Date	Time	Action/event progression	Recorded by

Appendix D

Glossary

Abutment	The part of the valley side against which the dam is constructed. The left and right abutments of dams are defined with the observer looking downstream from the dam.
Appurtenances	Structures incident to or annexed to dams essential to the proper operation, maintenance or functioning of the dam. This includes such structures as spillways, low level outlet works and water conduits, such as tunnels, pipelines or penstocks, either through a dam or its abutments.
Breach	An opening through the dam that allows draining of the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintended failure of the dam.
Control section	An usually level segment in the profile of an open channel spillway above which water in the reservoir discharges through the spillway.
Dam	An artificial barrier generally constructed across a watercourse for the purpose of impounding or diverting water.
Emergency spillway	The appurtenant structure that provides the controlled conveyance of excess water through, over, or around the dam.
Instrumentation	An arrangement of devices installed into or near dams that provide measurements to evaluate the structural behavior and other performance parameters of the dam and spillway structures. Examples include seepage measuring weirs, piezometers, inclinometers and survey monuments.
Low level outlet works	An appurtenant structure, usually consisting of a pipe through the embankment or principal spillway structure equipped with a valve, whose purpose is to allow lowering the lake level.
Principal spillway	The appurtenant structure that conveys normal inflow through or around the embankment.
Reservoir	The body of water impounded or potentially impounded by the dam.
Seepage	The natural movement of water through the embankment, foundation, or abutment of the dam.

Appendix E

Record of Holders of Control Copies of this EAP

Copy Number	Organization	Person receiving copy	E-mail Address
1	The Doe Run Company Fletcher Mine Clarification Dam	Mr. Dan Buxton	573-244-8142
2	Reynolds County EMD	Renee Horn	573-648-2494 (Office
3	Missouri Department of Natural Resources Dam Safety Program and address	Ryan Stack	mowaters@dnr.mo.gov

Record of Revisions and Updates Made to EAP

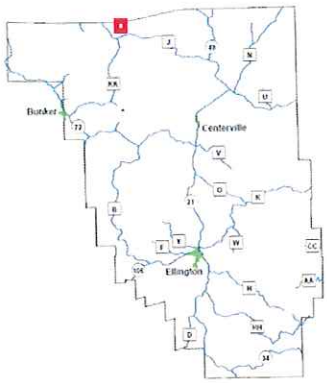
Revision Number	Date	Revisions made	By whom
1	Date	Describe revision to EAP	Name

Emergency Action Plan, or EAP

Buick Mine Dam

National Inventory of Dams, or NID, MO30162
Reynolds County, Missouri

SEMA Area C
Reviewed and Updated:
12/15/2017



The Doe Run Company
Dan Buxton
Owner/operator

5-1-18
Date

County Emergency Management Director
Renee Horn
Reynolds County, Missouri

Date

Basic EAP Data

Purpose

The purpose of this EAP is to reduce the risk to human life and minimize property damage during an unusual or emergency event at Buick Mine Dam.

Notification Procedure

This EAP provides general guidance for recognizing and characterizing an emergency situation occurring at the dam. The dam owner should act quickly to evaluate the emergency situation and then follow the notification procedures according to the corresponding level of emergency.

Potential Impacted Area

See *Inundation Map* (Appendix A) and *Residents/Businesses/Entities at Risk* table for the locations and contact information of the following residents and businesses that may be flooded if the dam should fail This list may also include critical infrastructure such as pipelines, power plants, substations, or sewer plants.

Numerous homes and county roads will be affected

Directions to dam (Review Arrival Time Map that shows major roads to the dam)

From Bixby MO at the intersection of highways 49 and 32, head west on 32 for 2.2 miles until you come to Highway KK. Turn left or south and the dam will be on your left side of the road 2.9 miles.

e.

Guidance for Determining the Emergency Level

This information should be used as a general guide for recognizing and characterizing the type of emergency situation occurring at the dam. The dam owner should notify the appropriate emergency contacts based upon the emergency level assigned to each situation.

Level 1 Emergency - Nonemergency, unusual event, slow to develop

- Reservoir water surface elevation at emergency spillway crest or spillway is flowing with no active erosion.
- New seepage areas in or near the dam.
- New cracks in the embankment greater than ¼-inch wide without seepage.
- Visual movement/slippage of the embankment slope.
- Instrumentation readings beyond predetermined values.
- Measurable earthquake felt or reported on or within 50 miles of the dam.
- Damage (vandalism/sabotage) to dam or appurtenances with no impacts to the functioning of the dam.
- Modification (vandalism/sabotage) to the dam or appurtenances that could adversely impact the functioning of the dam.

Level 2 Emergency - Potential dam failure situation, rapidly developing

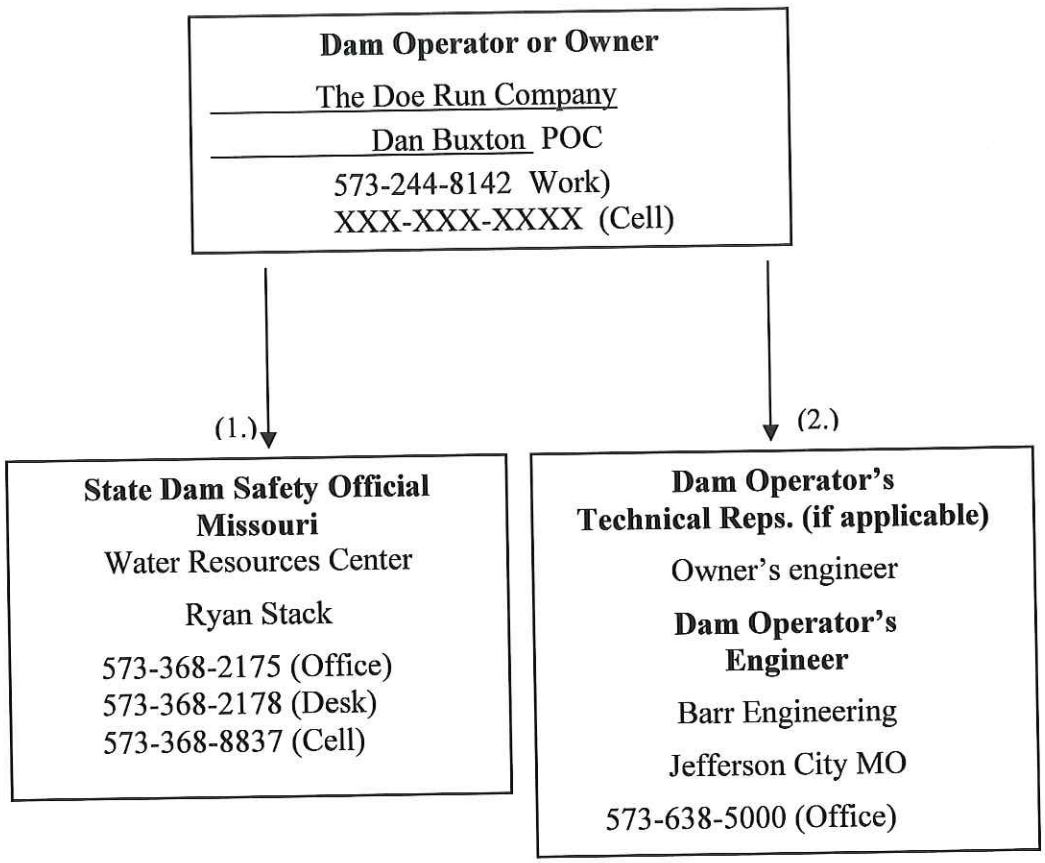
- Spillway flowing with active gully erosion.
- Spillway flow that could result in flooding of people downstream, if the reservoir level continues to rise.
- Reservoir level is 1 foot below the top of the dam.
- New seepage areas with cloudy discharge or increasing flow rate.
- Observation of new sinkhole in reservoir area, on embankment or downstream of dam.
- Cracks in the embankment with seepage.
- Earthquake resulting in visible damage to the dam or appurtenances.
- Verified bomb threat that, if carried out, could result in damage to the dam.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in seepage flow.

Level 3 Emergency - Urgent; dam failure imminent or is in progress

- Spillway flowing with an advancing headcut that is threatening the control section.
- Spillway flow that is flooding people downstream.
- Water from the reservoir is flowing over the top of the dam (not just auxiliary/emergency spillway).
- Seepage that is obviously eroding soil from within the embankment or rapidly increasing in flow rate.
- Rapidly enlarging sinkhole.
- Sudden or rapidly progressing slides of the embankment slopes.
- Earthquake resulting in uncontrolled release of water from the dam.
- Detonated bomb that has resulted in damage to the dam or appurtenances.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in uncontrolled water release.

Emergency Level 1 Notifications

Nonemergency, unusual event; slowly developing.



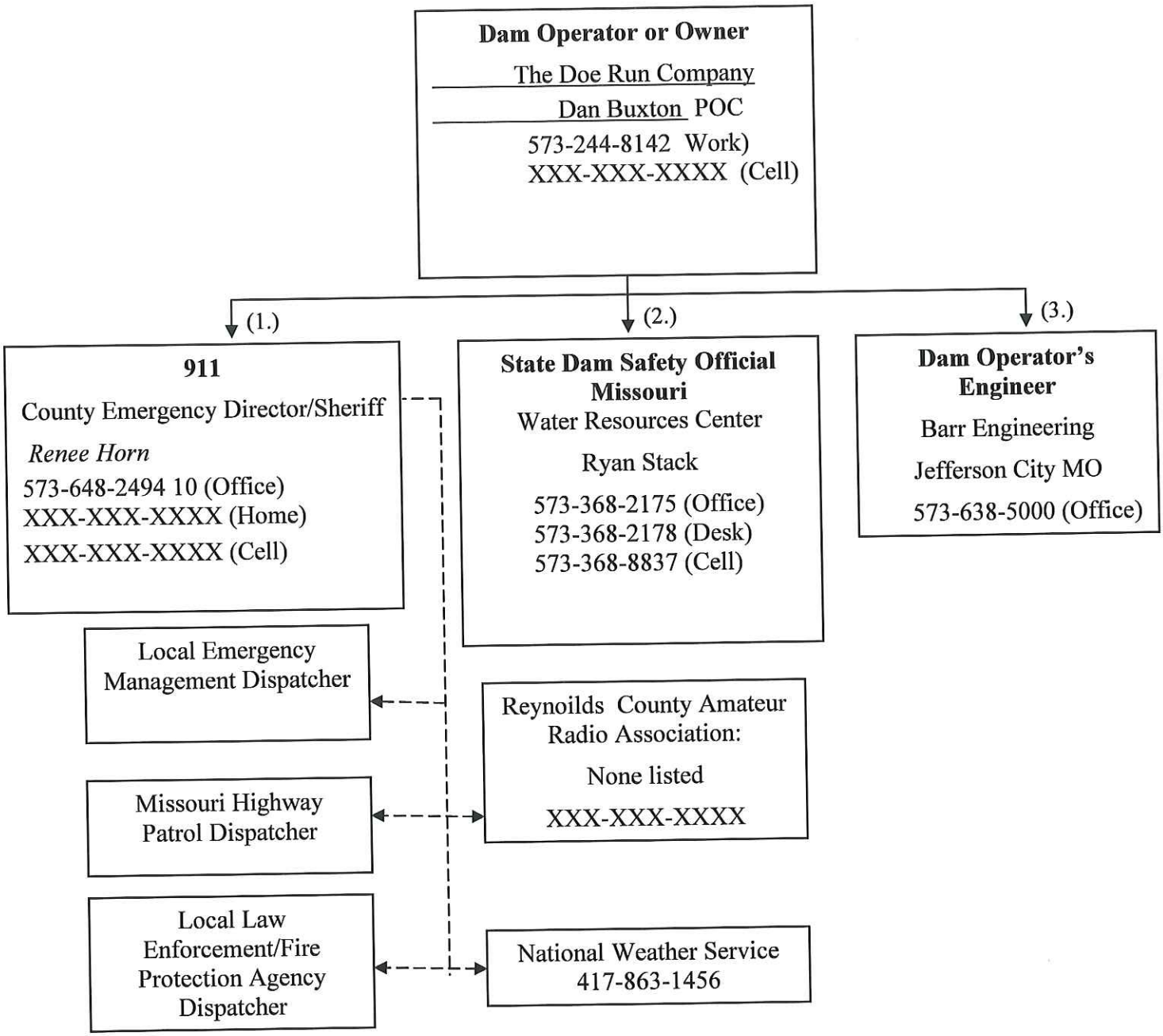
Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Emergency Level 2 Notifications

Emergency event, potential dam failure situation; rapidly developing.



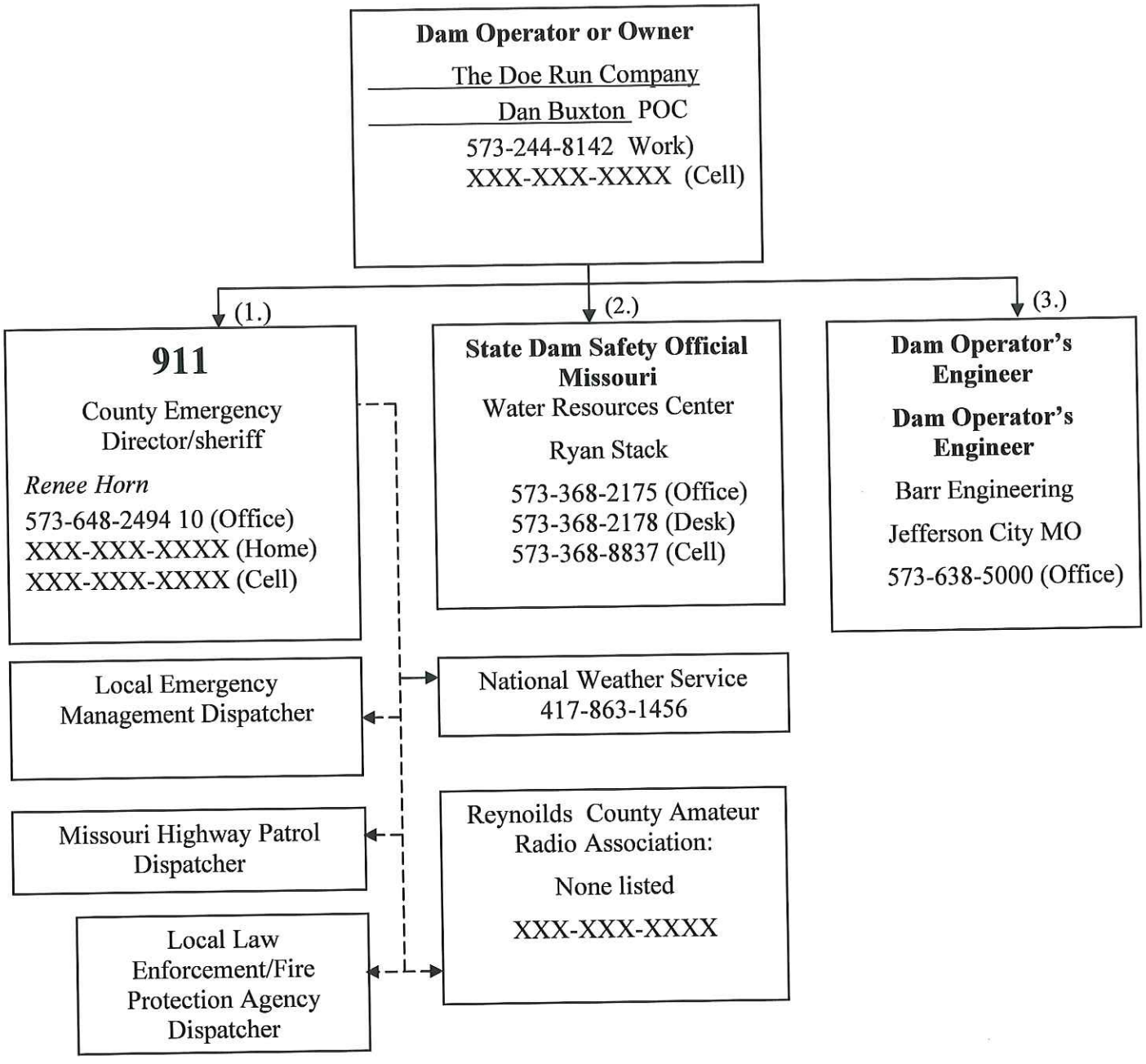
Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Emergency Level 3 Notifications

Urgent event, dam failure appears imminent or is in progress.



Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information for back-ups to the persons shown above and other emergency personnel.

Emergency Services Contacts

Agency / Organization	Principal Contact	Address	Office Phone No. with Area Code	Alternate Telephone Numbers
Reynolds County Sheriff	Sheriff Tom Volner	2319 Green street Centerville MO	573-648-2491	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Owner/Representative of Buick Mine Dam	Mr. Dan Buxton	P.O. Box 500 Vibrunurm MO 65566	573-244-8142	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
County Emergency Management Director	*Renee Horn*	P.O. Box 10 Centerville MO	573-648-2494 ext 10	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Ironton Fire Department		222 S Main St Ironton, Missouri (573) 546-3473	(573) 546-3473	
Ironton Police	Harold Yarbrough	123 N Main St Ironton, Missouri	(573)546-7132	
Troop G Highway Patrol	desk	1226 W. Bus. US-60/63Willow Springs	(417) 469-3121	
Reynolds County Road Department		450 Highway V, Centerville, MO	(573) 648-2483	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Water Resources Center Dam and Reservoir Safety Program	Ryan Stack Chief Engineer	111 Fairgrounds Rd. Rolla, MO 65401	573-368-2175	573-368-2178 (Desk) 573-368-8837 (Cell)
Department of Natural Resources Emergency Response	Duty Officer EER	P.O. Box 176 Jefferson City, MO 65102	**24 HOUR NO:** 573-634-2436	573-526-3380 (Brian Allen, Chief, EER)
SEMA Duty Officer			573-751-2748	
National Weather Service	Jim Kramper	St. Charles, MO	636-447-1876	1-800-852-7497 636-447-1769 (Fax)
Missouri Department of Transportation	Emergency Operation Center 24-hour cell no.		573-522-9503	
Missouri Department of Transportation	County Shed		XXX-XXX-XXXX	XXX-XXX-XXXX
KFVS12	Contact Name Manager	310 Broadway Cape Girardeau, MO	(573) 335-1212	(800) 455-KFVS
Radio Station KPPL 92.5 FM	Contact Name Manager	ROUTE #2, BOX 496 Poplar Bluff, Missouri	XXX-XXX-XXXX	

Residents/Businesses/Entities/Infrastructure at Risk

Brief summary of number of entities within inundation zone.

Entity No.	Resident/business or other impacted entity	Address	Phone No. with area code	Distance downstream from dam (miles)
1	home	4243 county road 836, Black MO		2.7 miles
2	home	4059 county road 836, Black MO		2.7 miles
3	home	1670 county road 69, Black MO		3.8 miles
4	home	539 county road 69, Black MO		4.0 miles
5	home	2970 county road 69, Black MO		4.2 miles
6	home	3448 county road 69, Black MO		4.3 miles
7	home	2989 county road 66, Black MO		4.6 miles
8	home	1681 county road 66, Black MO		4.8 miles
9	home	201331 county road 66, Black MO		5.0 miles
10	home	2037 county road 66, Black MO		5.3 miles
11	home	20xx county road 66, Black MO		5.3 miles

12	home	unk county road 66, Black MO		5.7 miles
13	home	unk county road 66, Black MO		5.8 miles
14	home	1326 county road 66, Black MO		6.2 miles
15	home	1231 county road 66, Black MO		6.5 miles
16	home	unk county road 66, Black MO		6.5 miles
17	home	78 county road 60, Black MO		6.7 miles
18	home	371 county road 60, Black MO		6.8 miles

(Use additional sheets if necessary)

Resources Available

Locally available resources include: (if not available please note)

Heavy Equipment Service and Rental	Sand and Gravel Supply	Ready-mix Concrete Supply
Tony Abney Construction PO Box 760 Vibrunum MO 573-244-3145	K & D Crushing 14097 Highway KK Boss MO 573-269-4320 573-269-4415	Politte Read Mix 92 Highway 49 Viburnum MO 573-244-5463
Pumps	**Pipe**	**Sand Bags**
Hearth Land Pumps 1800 Supply Road Suite 8 Carterville IL 63918 618-985-5510	Poly Pipe Systems PO Box 1157 Steelville MO 573-775-3300 573-775-4634 573-775-2024	The Mine Supply Company PO Box 345 85 Highway 49 Viburnum MO. 573-244-5416

The above list was taken from the EAP for MO31141 Fletcher Mine water dam.,

Other options that might be useful.

Schrum Ready Mix, Caledonia 573-779-3708

Mills Ready Mix Annapolis, 573-598-3400

Lead Belt Pump and Supply Park Hills 573-431-2476 pumps

A7 M Pump Festus 636-931-0275

Mid State Paving Sullivan MO 573-627-2039

Zoellner Construction 573-547-8030

Yoder and Sons Bonne Terre 573-358-40585

Hall and Co Leadwood 573-562-7685

Gibson Excavating 573-438-2372

Tony Selz, Lonedell, MO 636-629-0939 or 636-744-1575

5M Welding & Excavation Joe Medwick Cuba, MO 573-308-5138 or 573-885-4105

NOTE: *This list is **not** an endorsement of the service but design as a starting point. **Other sources of information should be used and it is up to the owner of the dam to select the choices for the EAP**. Putting a source name in the box on the EAP does not great an obligation by the owner to use that source if and when an emergency arise, but is meant to assist the owner if during an emergency he does not have the time to do research into what choice he will make on short notice to obtain the needed services.*

Appendix A
Inundation Study

Inundation Map vs. Evacuation Area

Inundation maps have been developed from best available information using reasonable assumptions and standardized methods. They are approximations of the maximum water surface extents resulting from a complete dam breach and draining of the full reservoir. Inundation maps are empirical hydrologic and hydraulic simulations that can only be field verified in the event of an actual breach.

Evacuation areas and call lists should take into consideration the anticipated local impacts of flooding; knowledge of local infrastructure, both occupancy and ownership; and potentially interrupted services or cut-off access, which would be caused by dam failure. Depending upon actual circumstances, appropriate alert and evacuation areas could be more or less extensive than the simulated inundation zones.

Insert inundation map here. It is suggested this section be denoted by a tabbed divider to allow quick access to the inundation map during an emergency.

Appendix B
National Inventory of Dams (NID) Data

Buick Mine Dam:

State: Missouri

NID ID: MO30162

Sec: 06 Township: 33N Range: R0W

Longitude: -91.0830 decimal degree
Latitude: 37.5835 decimal degree

Longitude: -91 ° 04' 58"
Latitude: 37° 35' 0"

County: Reynolds

Stream: Strother Creek

Nearest town downstream: Oates

Distance to nearest town downstream: 0.5 mi

Year constructed: 1961

Nearest town: Bixby

Distance to nearest town: 2.3 mi

Type of dam: (indicate only one)

tailings

Max. discharge: 270 $ft.^3/s$

Max. storage: 5400 acre-ft.

Normal storage: 4700 acre-ft.

Surface area: 141 acres

Drainage area: 2400 acres

Inspection frequency: 2 yrs.

State regulatory agency:
Missouri DNR WRC DRSP

Dam height: 147 ft.

Dam length: 1490 ft.

Current hazard class: 1

Principal spillway type: 2 54 inch diameter RCP inlets to Open channel on right abutment

Emergency spillway type: none

Comments: _____

_____

_____

_____

Appendix C

Unusual or Emergency Event Log

(To be completed during the emergency)

Buick Mine Dam

County: Perry

When and how was the event detected?

Weather conditions:

General description of the emergency situation:

Emergency level determination:

Made by:

Actions and Event Progression

Date	Time	Action/event progression	Recorded by

Appendix D

Glossary

Abutment	The part of the valley side against which the dam is constructed. The left and right abutments of dams are defined with the observer looking downstream from the dam.
Appurtenances	Structures incident to or annexed to dams essential to the proper operation, maintenance or functioning of the dam. This includes such structures as spillways, low level outlet works and water conduits, such as tunnels, pipelines or penstocks, either through a dam or its abutments.
Breach	An opening through the dam that allows draining of the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintended failure of the dam.
Control section	An usually level segment in the profile of an open channel spillway above which water in the reservoir discharges through the spillway.
Dam	An artificial barrier generally constructed across a watercourse for the purpose of impounding or diverting water.
Emergency spillway	The appurtenant structure that provides the controlled conveyance of excess water through, over, or around the dam.
Instrumentation	An arrangement of devices installed into or near dams that provide measurements to evaluate the structural behavior and other performance parameters of the dam and spillway structures. Examples include seepage measuring weirs, piezometers, inclinometers and survey monuments.
Low level outlet works	An appurtenant structure, usually consisting of a pipe through the embankment or principal spillway structure equipped with a valve, whose purpose is to allow lowering the lake level.
Principal spillway	The appurtenant structure that conveys normal inflow through or around the embankment.
Reservoir	The body of water impounded or potentially impounded by the dam.
Seepage	The natural movement of water through the embankment, foundation, or abutment of the dam.

Appendix E

Record of Holders of Control Copies of this EAP

Copy Number	Organization	Person receiving copy	E-mail Address
1	The Doe Run Company Fletcher Mine Clarification Dam	Mr. Dan Buxton	573-244-8142
2	Reynolds County EMD	Renee Horn	573-648-2494 (Office
3	Missouri Department of Natural Resources Dam Safety Program and address	Ryan Stack	mowaters@dnr.mo.gov

Record of Revisions and Updates Made to EAP

Revision Number	Date	Revisions made	By whom
1	Date	Describe revision to EAP	Name

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Guidelines for owner completion of the Emergency Action Plan, or EAP, Template

- Replace all highlighted text (including MAGENTA and GREEN with appropriate names, descriptions, or phone numbers. You can remove the highlighting when items are replaced.

- State Emergency Management Agency area letters for all counties in the state are available at http://sema.dps.mo.gov/sacp.htm

- Assistance is available from your local Emergency Management Director for the items in the template designated in GREEN. A list of Emergency Management Directors is available at http://sema.dps.mo.gov/All%20EMDs%20Dec%2009.pdf

- Appendix A, inundation maps will be provided by the department when they become available. However all other portions of the Emergency Action Plan can be completed prior to the addition of the inundation map.

- Owners can begin completing the **Residents/Businesses/Entities/Infrastructure at Risk** table using their best judgment and updating the list when an inundation map becomes available.

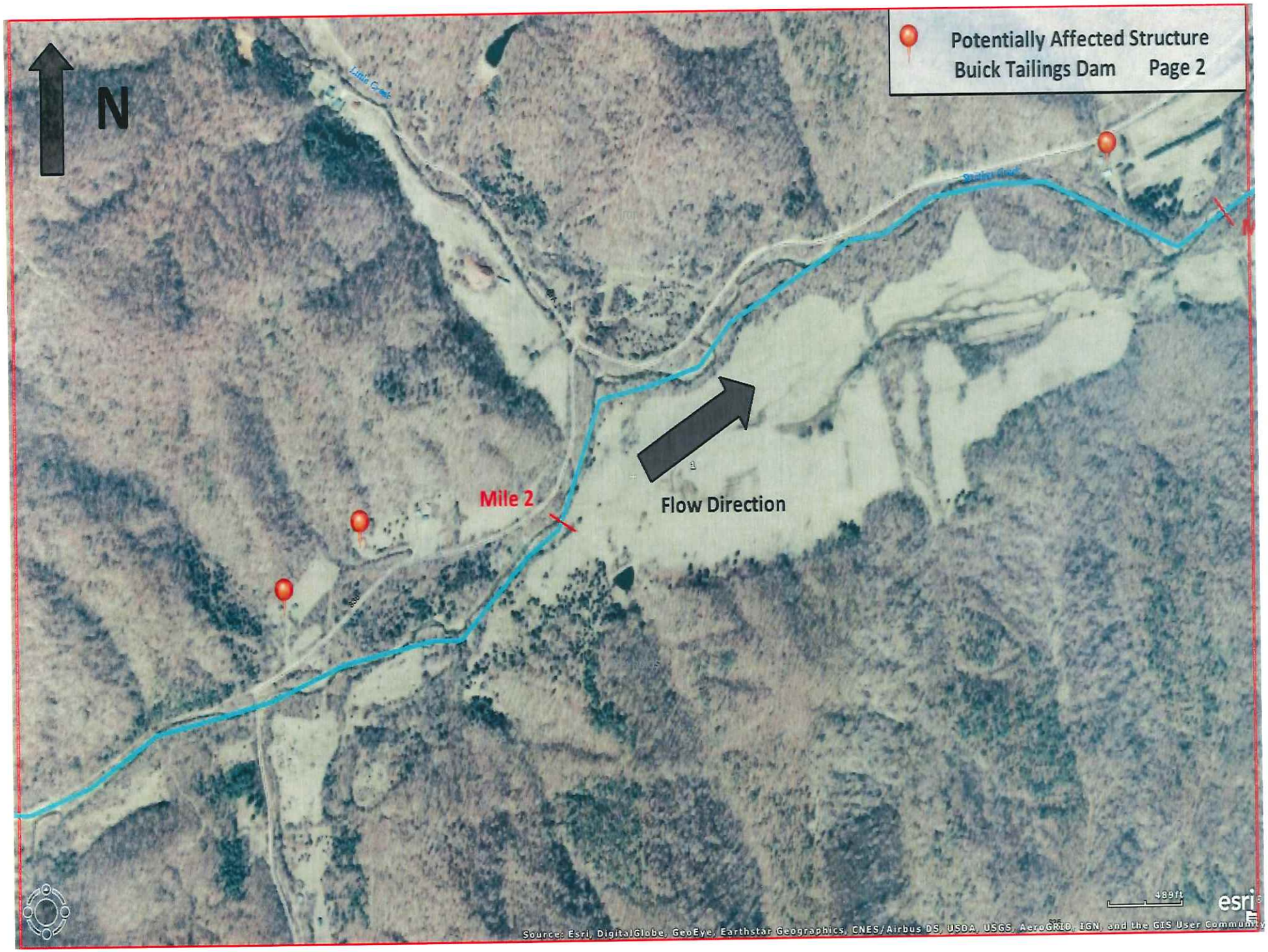
- The Water Resources Center Dam and Reservoir Safety Program will assist in completing Appendix B highlighted in YELLOW. Please contact the department at 573-368-2175.

- When completed, a minimum of three copies are required. See appendix E for the required record holders.

For questions concerning the EAP process contact:
Missouri Dept. of Natural Resources
Dam and Reservoir Safety Program
Phone: 573-368-2175

Other sources of information:
www.damsafetyaction.org


N
Potentially Affected Structure
Buick Tailings Dam Page 1
Flow Direction
Mile 1
Buick Tailings Dam
489ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community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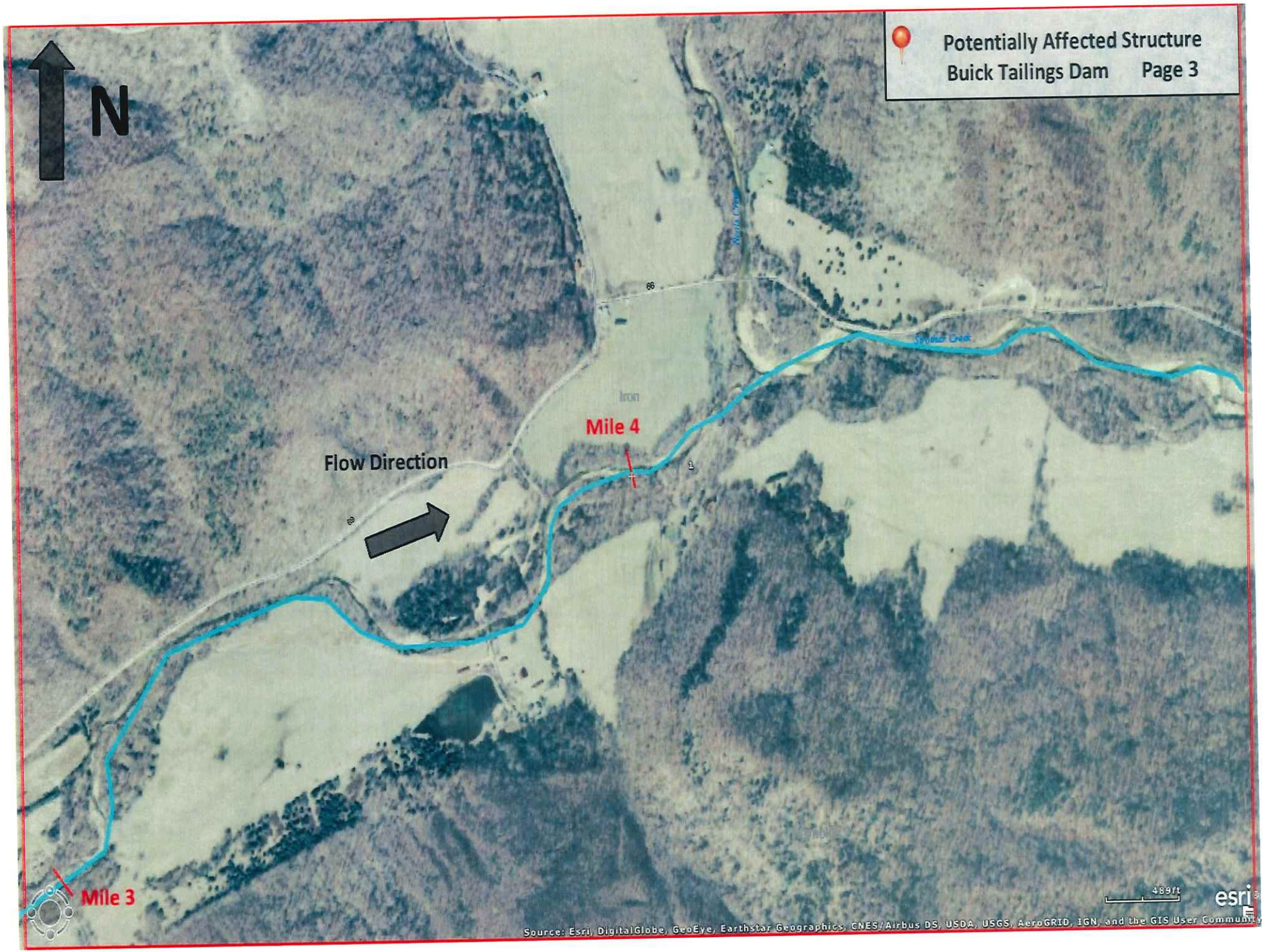
Potentially Affected Structure
Buick Tailings Dam Page 2
Mile 2
Flow Direction
489ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community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Buick Tailings Dam Page 3
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Flow Direction
Mile 4
Mile 3
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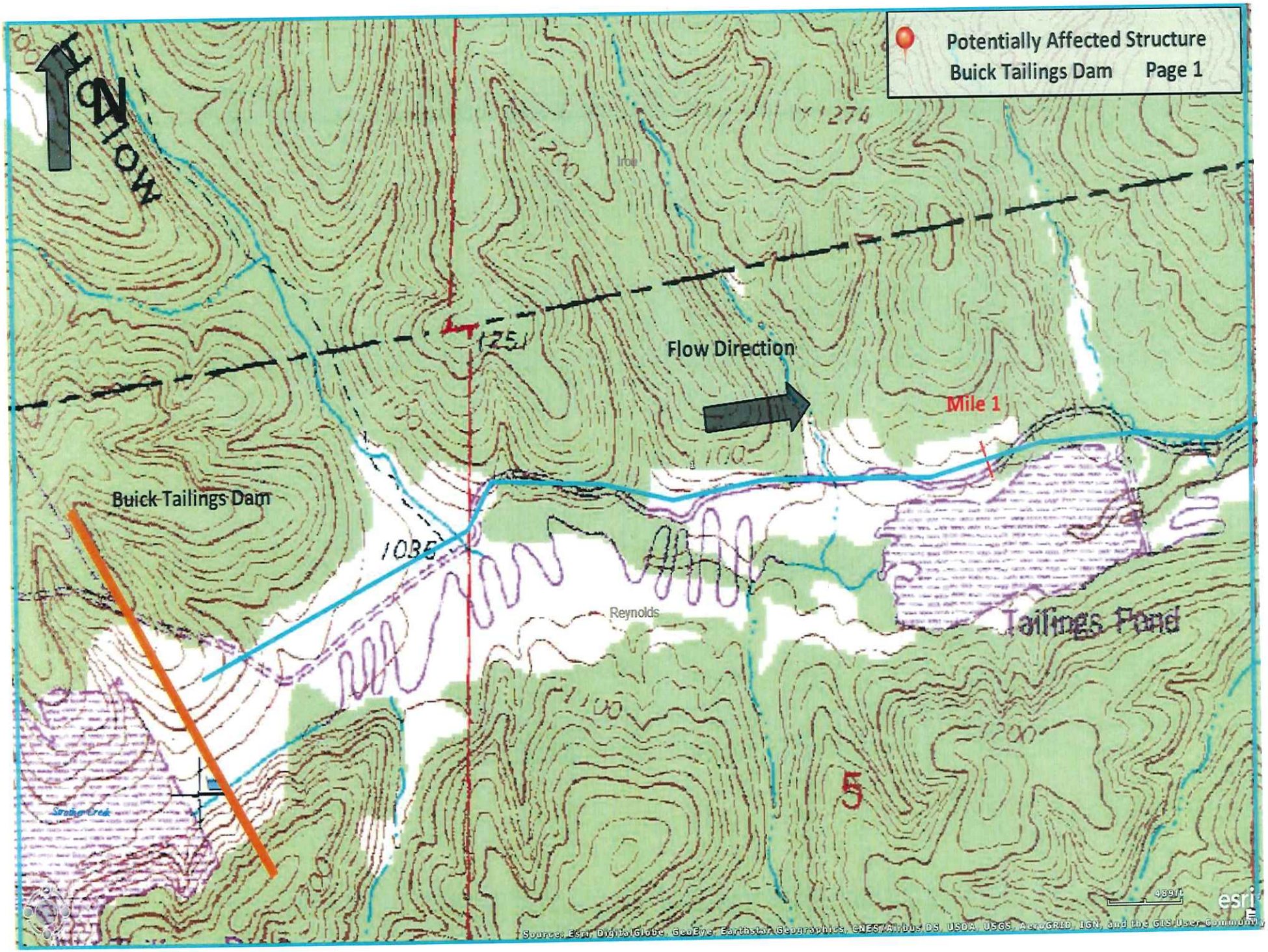
489ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community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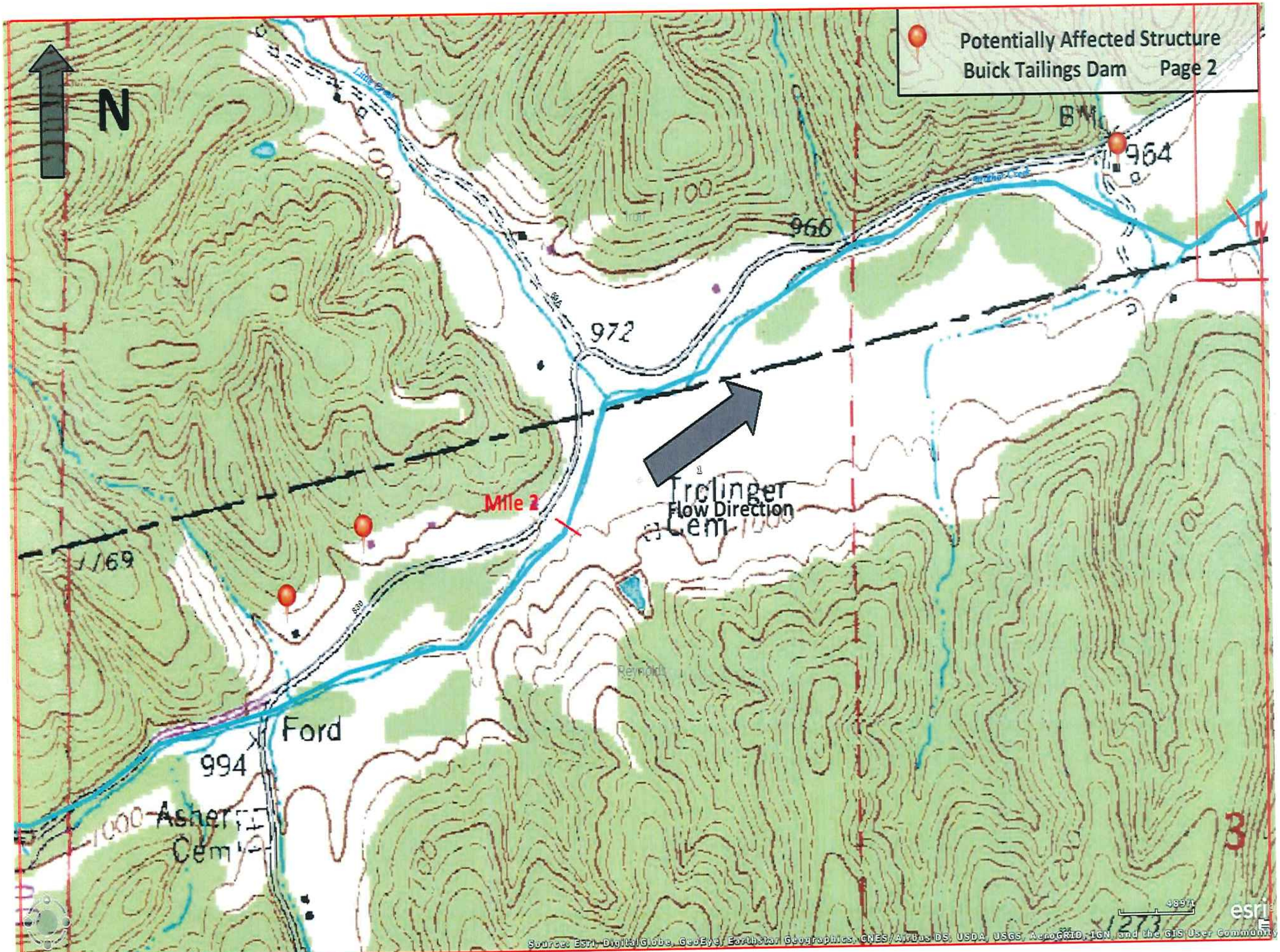
Buick Tailings Dam Page 1
FLOW
Flow Direction
Mile 1
Buick Tailings Dam
Reynolds
Tailings Pond
5
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Potentially Affected Structure
Buick Tailings Dam Page 2
N
Flow Direction
Mile 2
Trolinger
Cem
Asher
Cem
Ford
994
972
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964
BM
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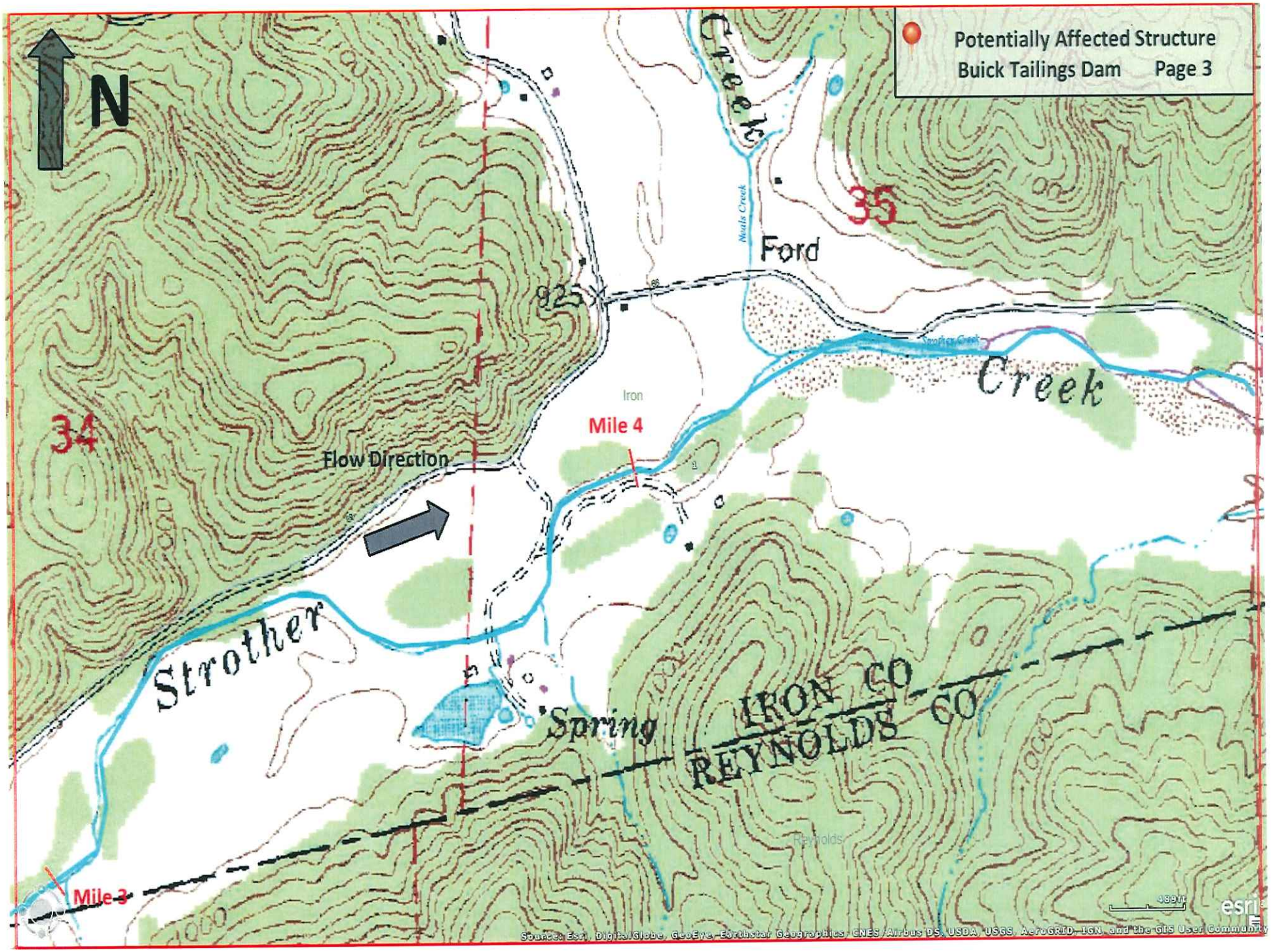
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Potentially Affected Structure
Buick Tailings Dam Page 3
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Creek
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Ford
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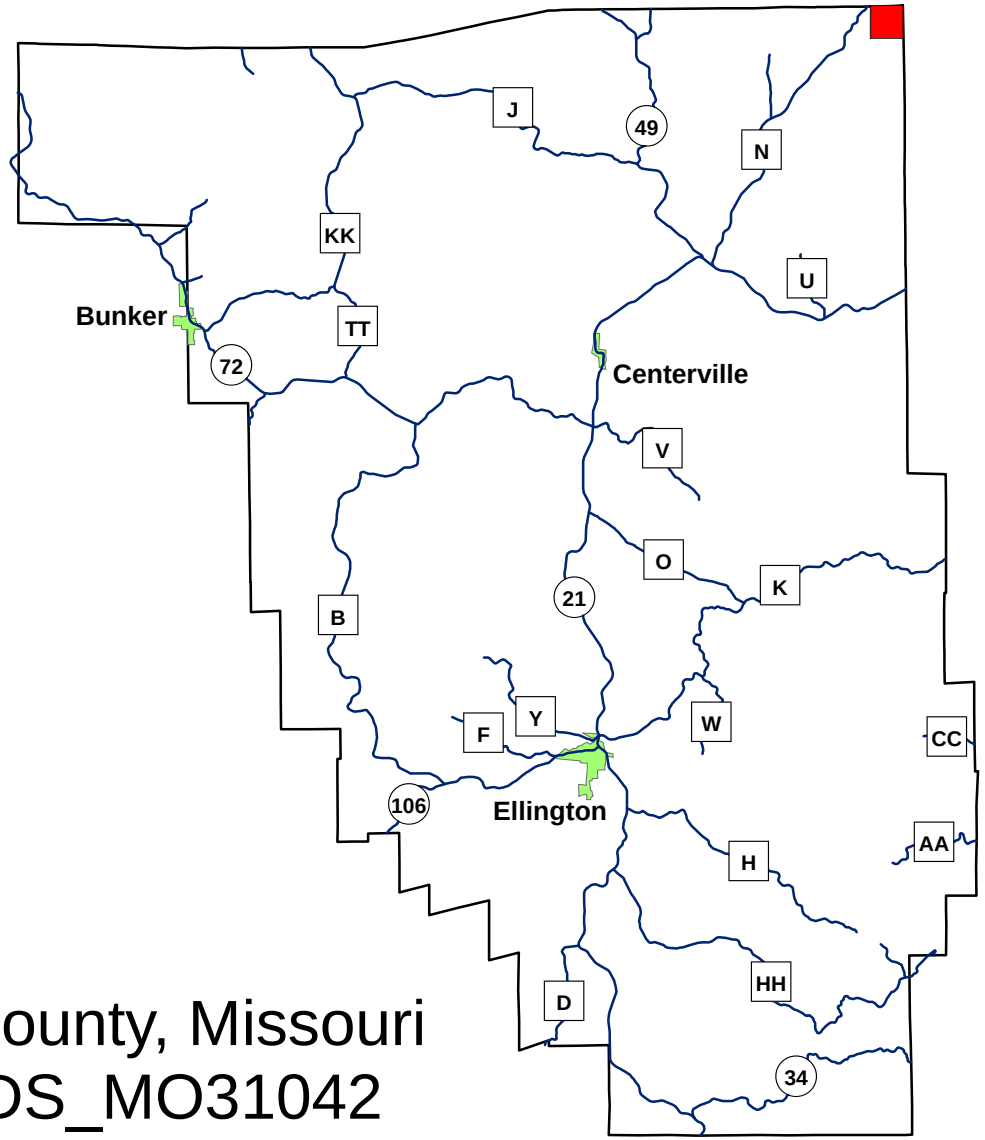
34
Flow Direction
Strother
Spring
IRON CO
REYNOLDS CO
Reynolds
Mile 3
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
esri

5/9/2013

Firepit Lake Dam

Breach Inundation Map



Reynolds County, Missouri
REYNOLDS_MO31042

Note: Actual areas inundated will depend on the actual dam failure criteria and may differ from the areas shown. Due to limitations, methods, assumptions, and procedures used to develop the inundation area, the map should only be used for evacuation planning and emergency purposes.

Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102

Explanation Sheet

Project: **Firepit Lake Dam Breach Analysis**

Drawing Title: **Explanation Sheet** **1 of 1**

Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102

Project ID: REYNOLDS_MO31042

Explanation of Maps

The following maps indicate the areas which are predicted to be inundated during the occurrence of a sunny day breach of the dam. The pool elevation at failure is assumed to be at the emergency spillway crest elevation or at the crest of the dam in the absence of an emergency spillway.

Use of Maps

The following maps provide a baseline for evaluation of existing emergency action plans and environmental hazards downstream of the regulated structure.

Definition of Terms

Pool Elevation- Water level in the reservoir.

Dam Crest- The lowest elevation measured along the dam crest.

Spillway Crest- The lowest elevation measured along the crest of the spillway.

Arrival Time- Elapsed time between the breach initiation and the time that water levels first begin to rise at any given point.

Assumed Conditions of Flooding

The pool elevation at failure is assumed to be at the emergency spillway crest elevation or at the crest of the dam in the absence of an emergency spillway. The assumed overtopping erodes a section of the dam resulting in a dangerous and quick release of water. For the hydraulic analysis flow initiation is required and therefore a baseflow of water has been included in the analysis.

Dam Facts

ID: MO31042

County: Reynolds

Location: S01, T33 N, R02 E

Height of Dam: 58 ft

Stream: Unnamed trib. to East Fork Black River

Lake Area: 48 acres

Volumes

Emergency Spillway: 1228 ac-ft
Top of Dam: 1693 ac-ft

Breach Parameters (Froehlich, 1995)

Side slopes: 1.4:1

Bottom width: 70 ft

Bottom elevation: 1050 ft

Breach formation time: 0.43 hr

Pool Elevation at Failure: 1100.03 ft

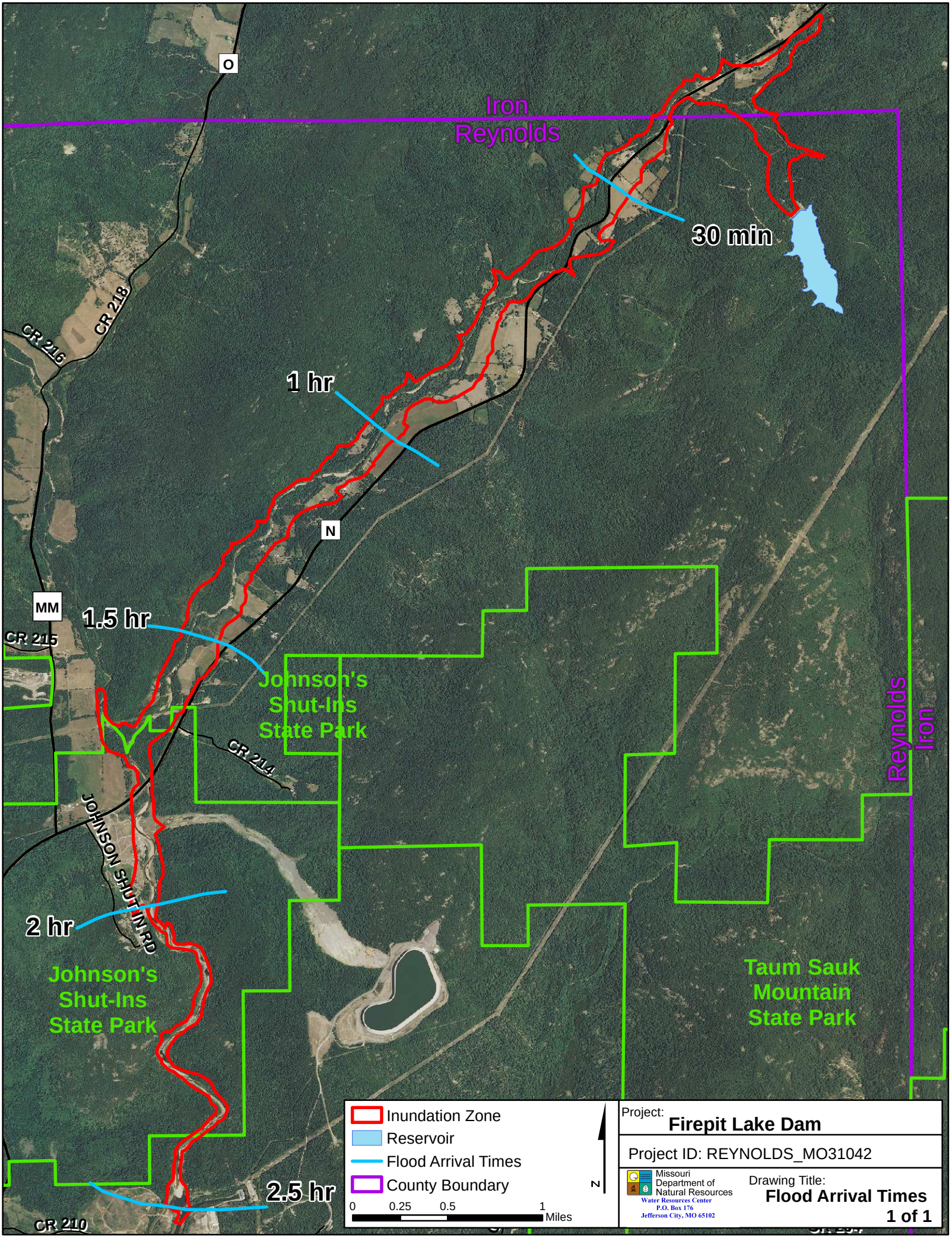
Pool Volume at Failure: 1228 ac-ft

Downstream Crossings

RT N (2x)

NOTE: Analysis was completed with 10 meter Digital Elevation Model.

Date of Aerial Photo: 2012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CR 218
CR 216
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CR 215
Johnson's
Shut-Ins
State Park
CR 214
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JOHNSON SHUT-IN RD
2 hr
Johnson's
Shut-Ins
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Taum Sauk
Mountain
State Park
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CR 210
Inundation Zone
Reservoir
Flood Arrival Times
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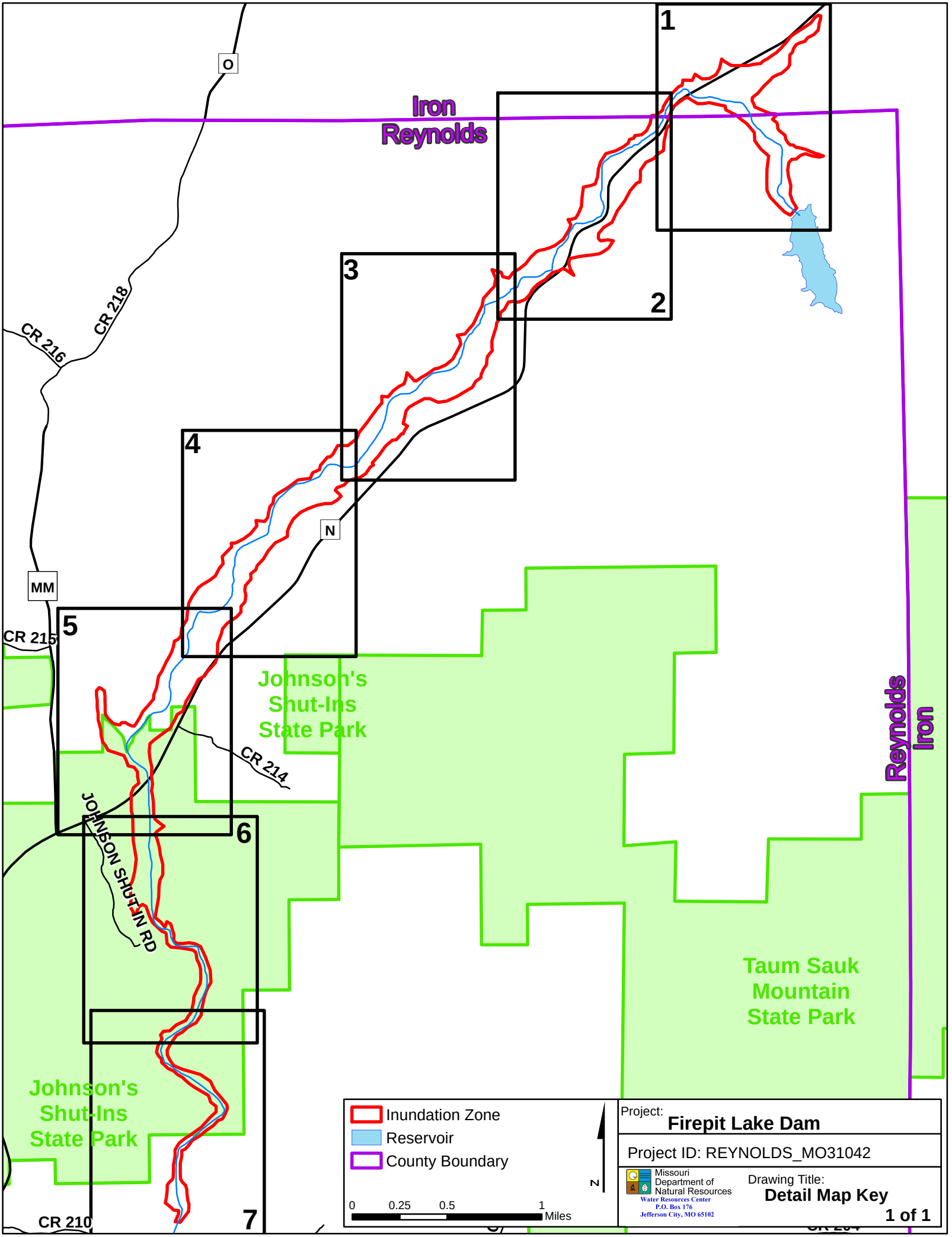
Firepit Lake Dam
Project ID: REYNOLDS_MO31042
Missouri
Department of
Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Flood Arrival Times
1 of 1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JOHNSON SHUT-IN RD
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Johnson's
Shut-Ins
State Park
Johnson's
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State Park
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Inundation Zone
Reservoir
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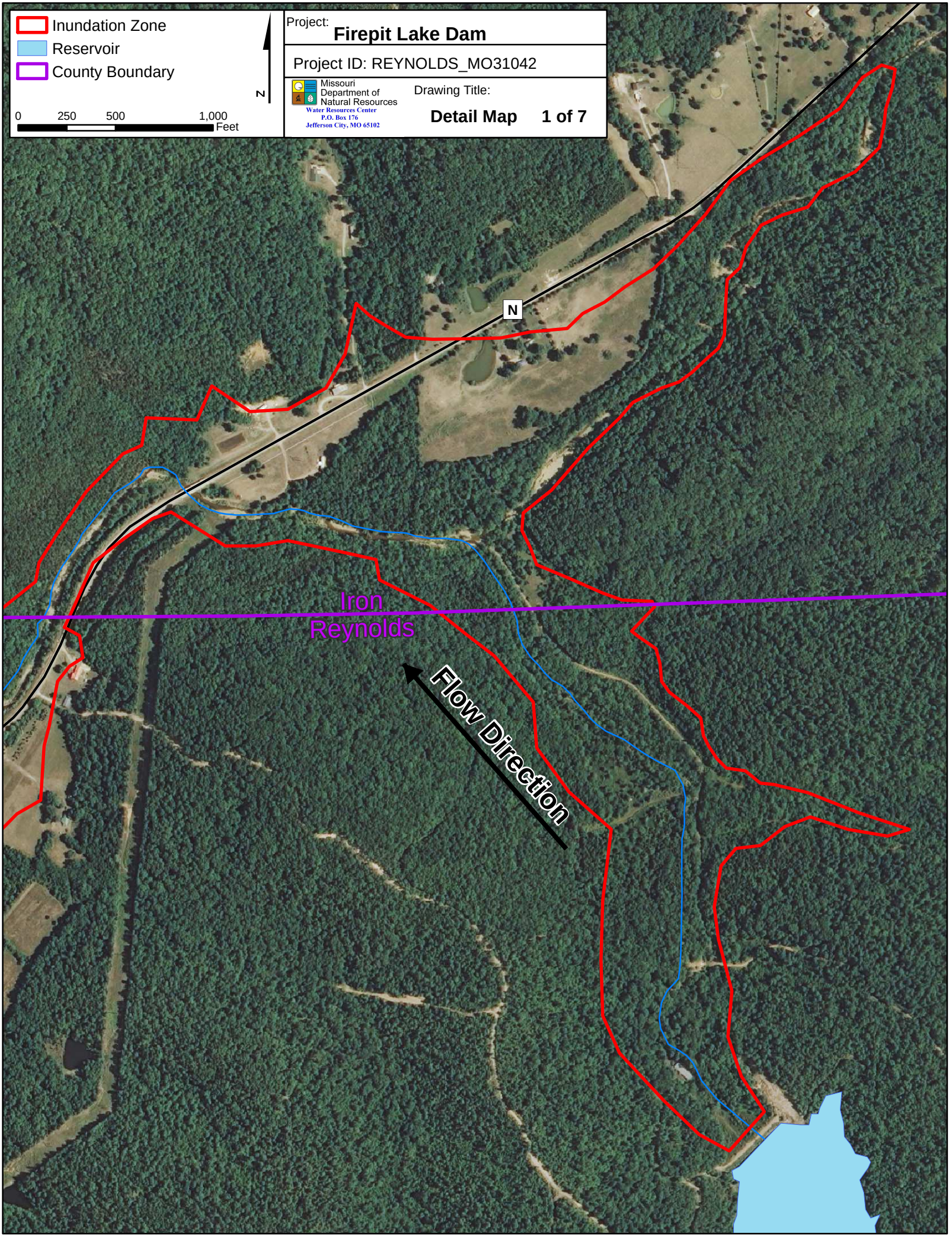
Firepit Lake Dam
Project ID: REYNOLDS_MO31042
Missouri
Department of
Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map Key
1 of 1


Inundation Zone
Reservoir
County Boundary
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0 250 500 1,000
Feet
Project:
Firepit Lake Dam
Project ID: REYNOLDS_MO31042
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map 1 of 7
N
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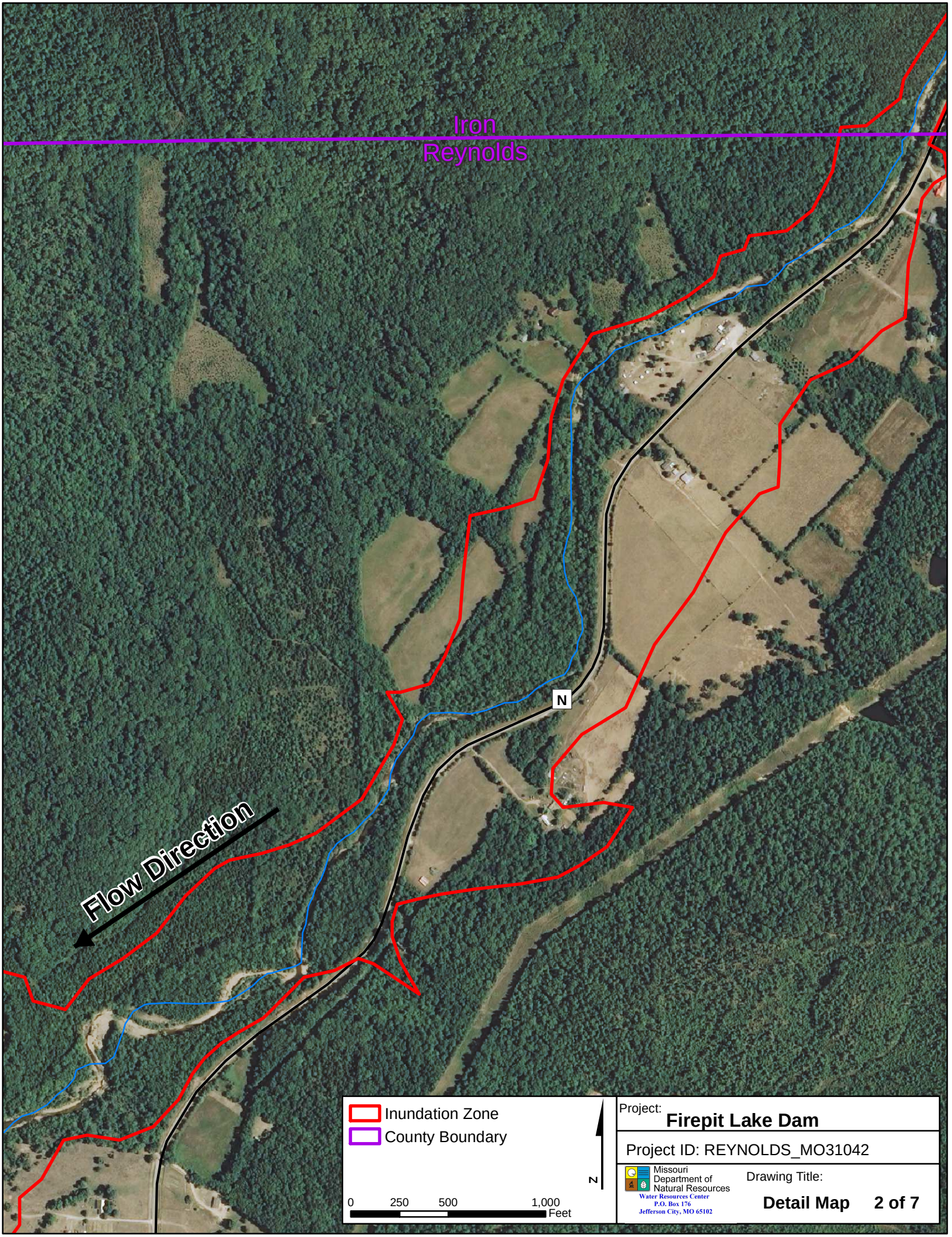
Reynolds
Flow Direction

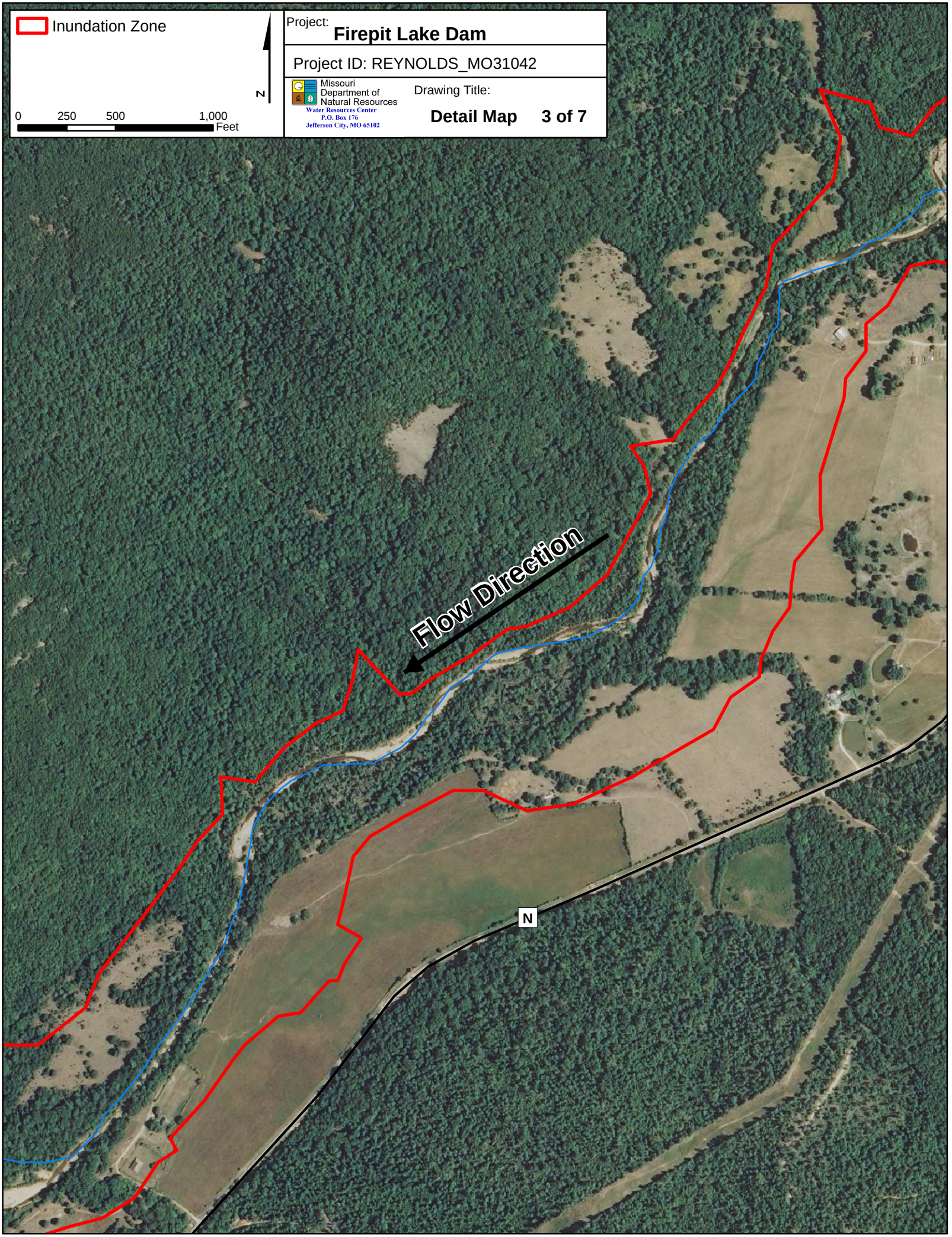


Project: **Firepit Lake Dam**

Project ID: REYNOLDS_MO31042

Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102

Drawing Title: **Detail Map** **2 of 7**


Inundation Zone
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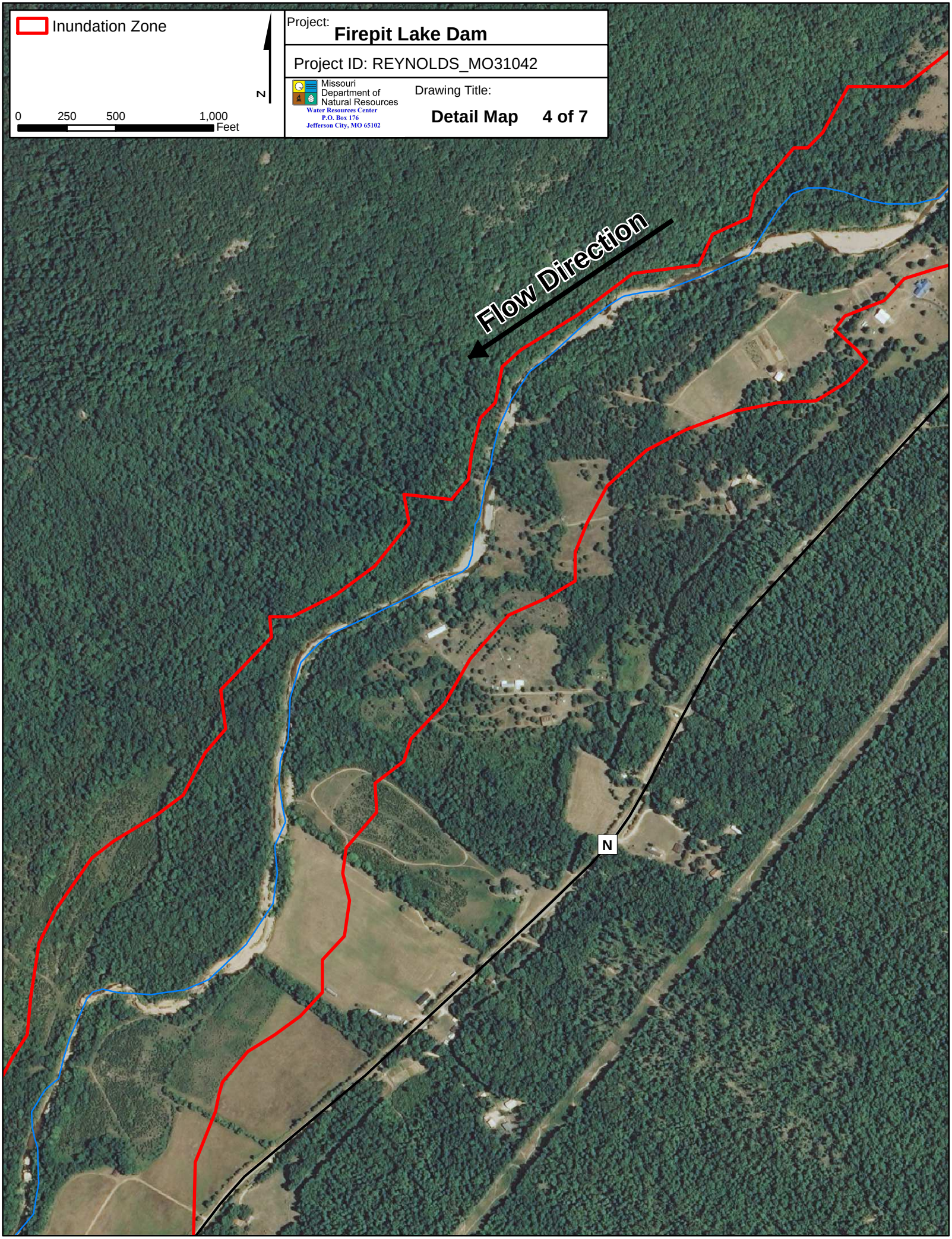
0 250 500 1,000 Feet
Project:
Firepit Lake Dam
Project ID: REYNOLDS_MO31042
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map 3 of 7
Flow Direction
N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0 250 500 1,000
Feet
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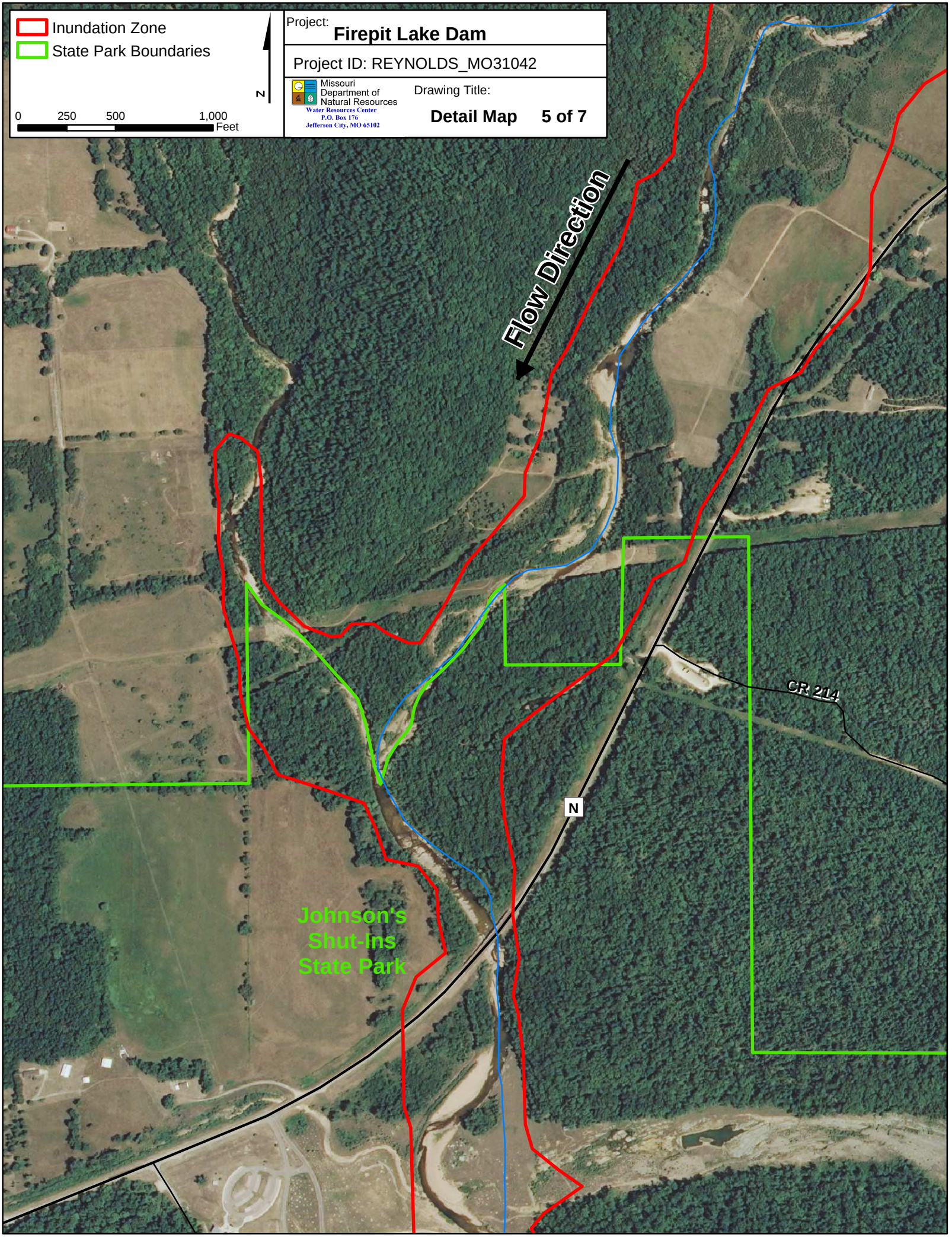
Firepit Lake Dam
Project ID: REYNOLDS_MO31042
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map 4 of 7
Flow Direction
N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State Park Boundaries
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Feet
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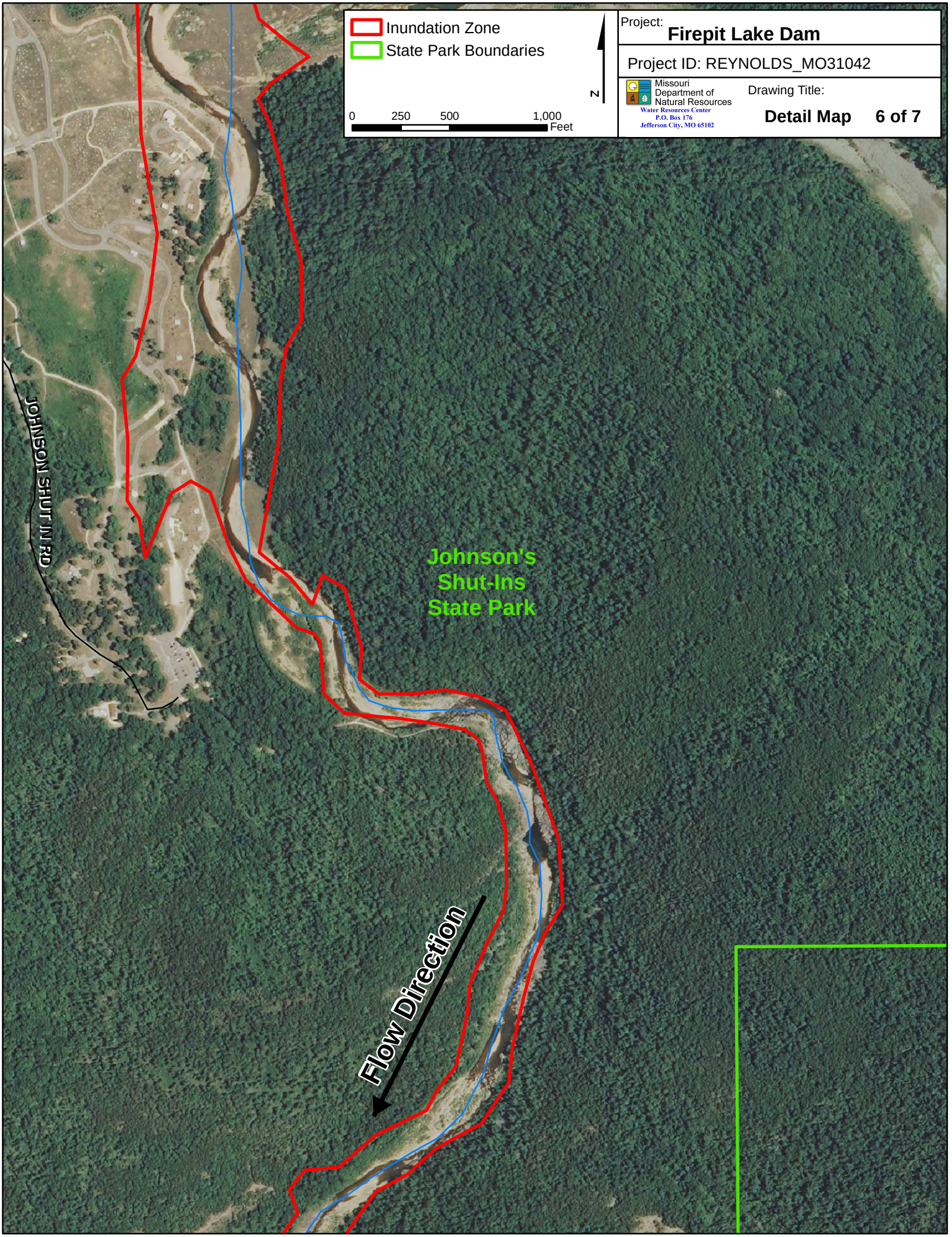
Project ID: REYNOLDS_MO31042
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map 5 of 7
Flow Direction
CR 214
N
Johnson's Shut-Ins State Park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State Park Boundaries
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250
500
1,000
Feet
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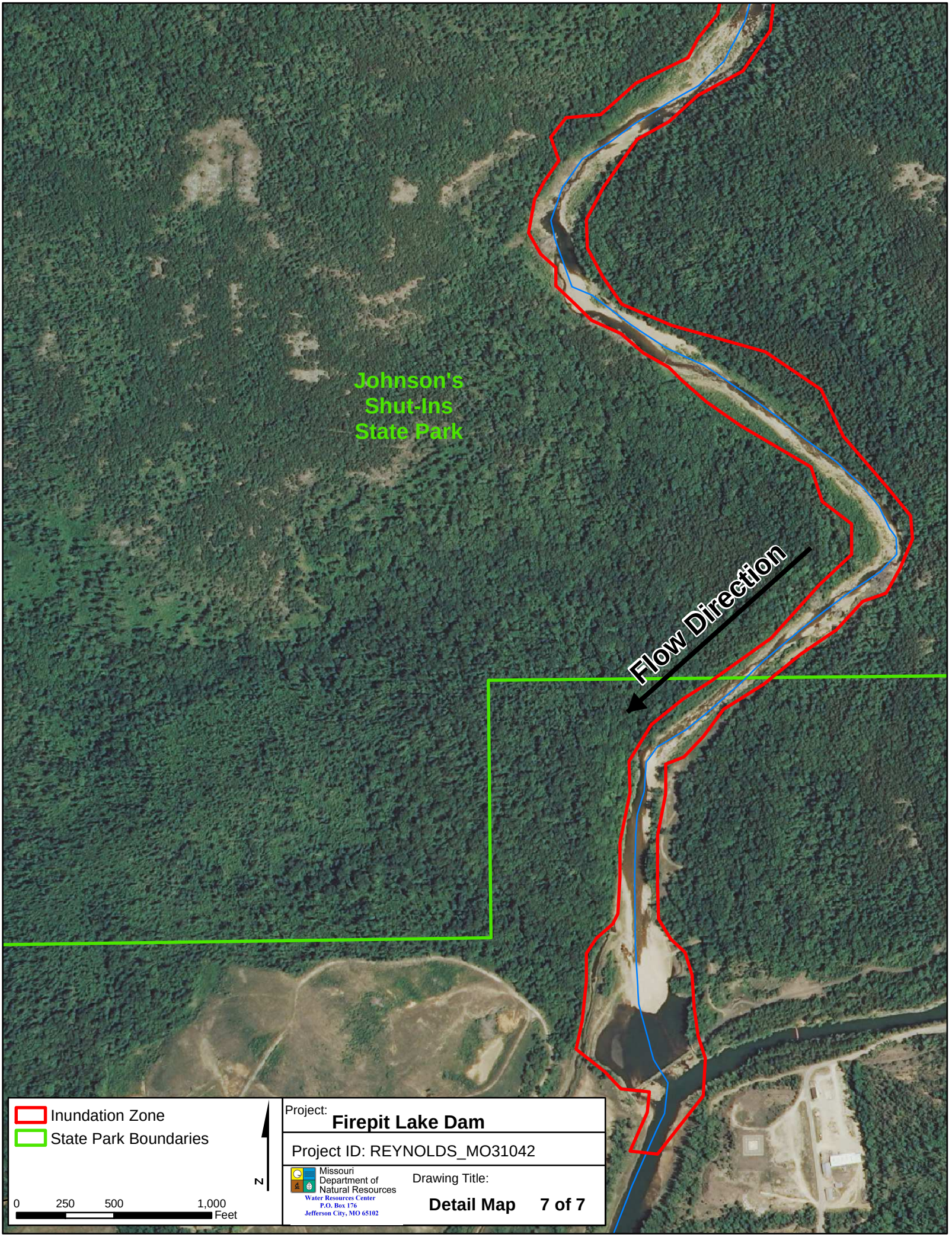
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map
6 of 7
JOHNSON SHUT IN RD
Johnson's Shut-Ins State Park
Flow Direction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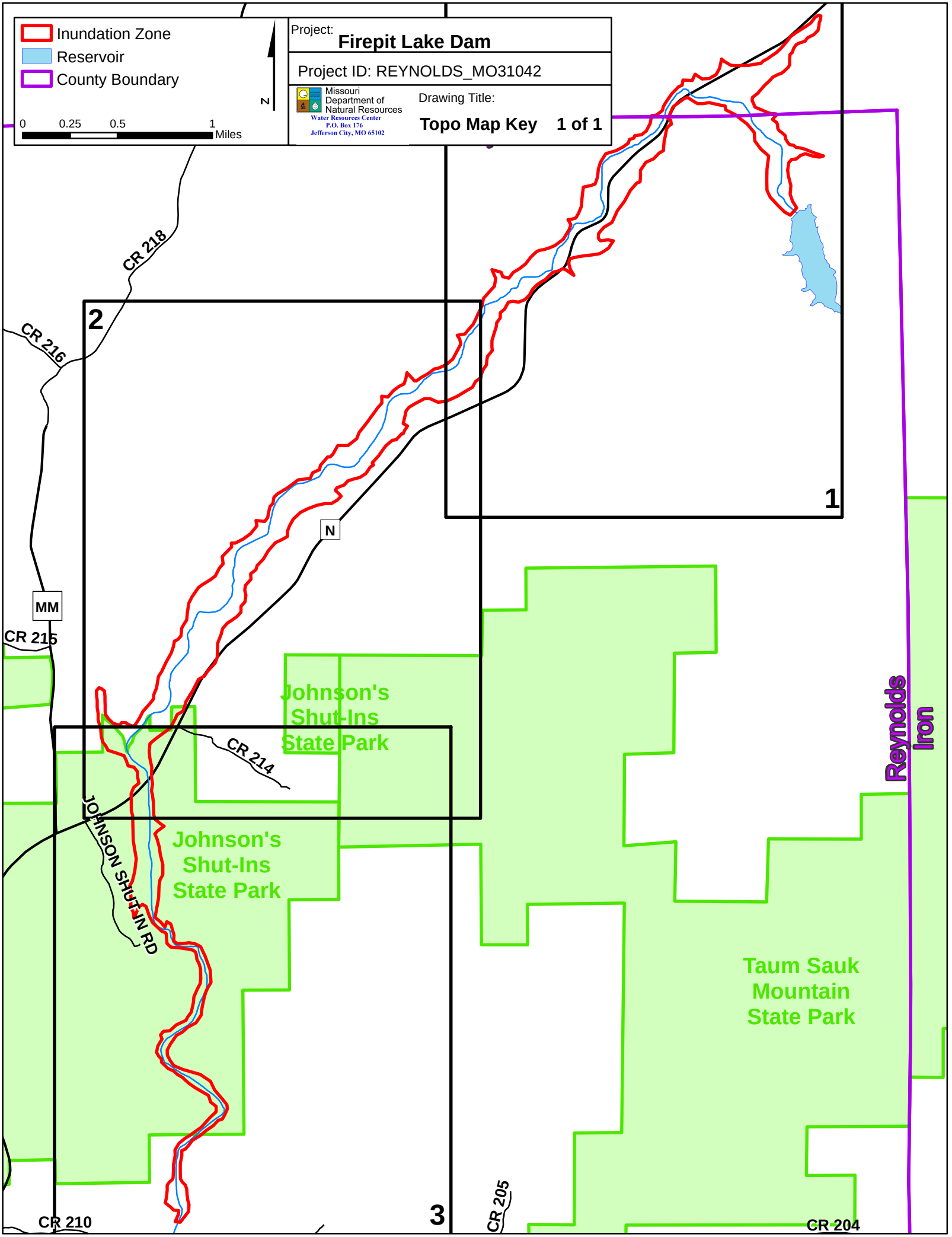
Shut-Ins
State Park
Flow Direction
Inundation Zone
State Park Boundaries
N
0
250
500
1,000
Feet
Project:
Firepit Lake Dam
Project ID: REYNOLDS_MO31042
Missouri
Department of
Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map
7 of 7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Reservoir
County Boundary
N
0 0.25 0.5 1 Miles
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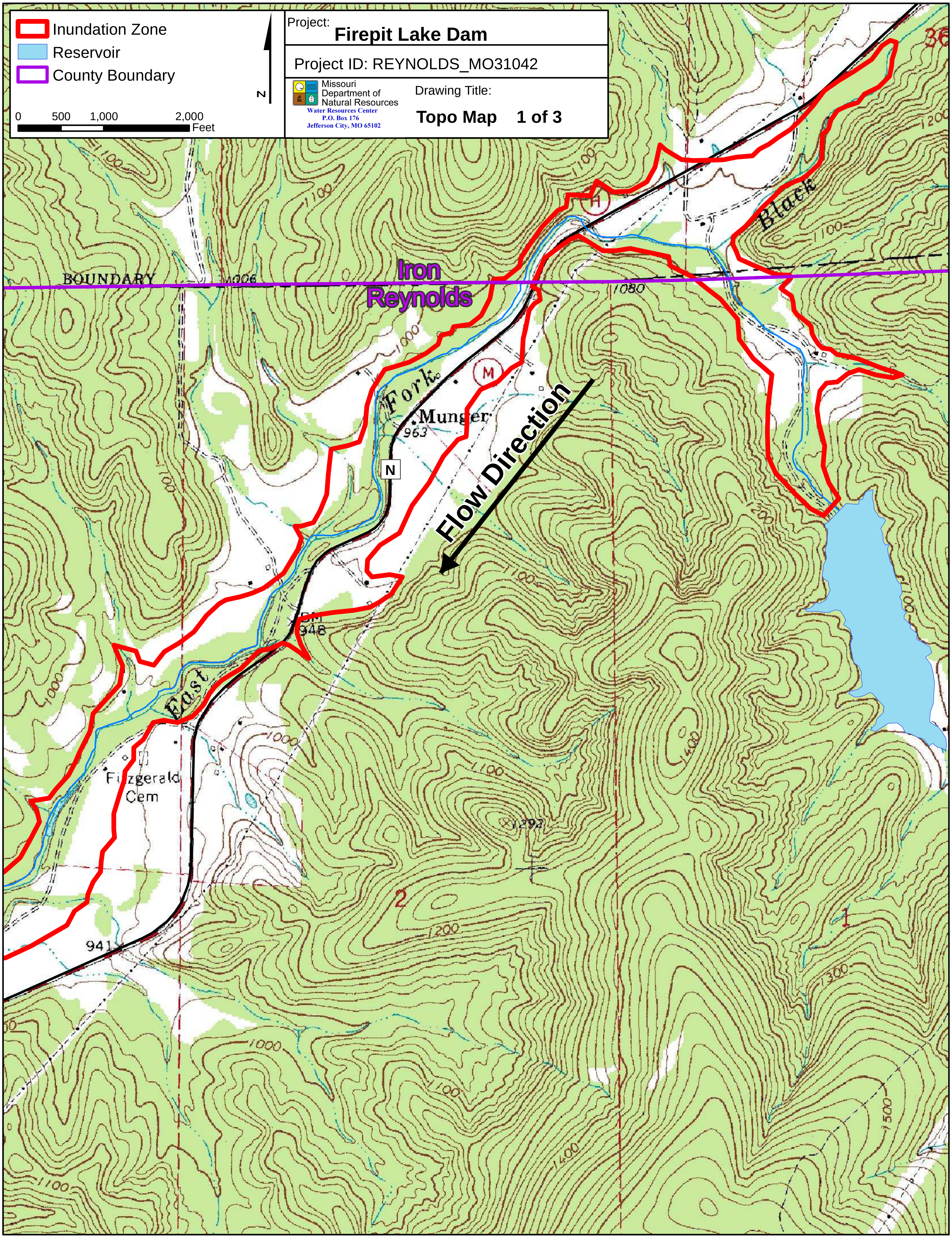
Project ID: REYNOLDS_MO31042
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Topo Map Key 1 of 1
CR 218
CR 216
CR 215
CR 214
CR 210
CR 205
CR 204
JOHNSON SHUT-IN RD
MM
N
1
2
3
Johnson's Shut-Ins State Park
Johnson's Shut-Ins State Park
Taum Sauk Mountain State Park
Reynolds
Iron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Reservoir
County Boundary
0 500 1,000 2,000
Feet
N
Project:
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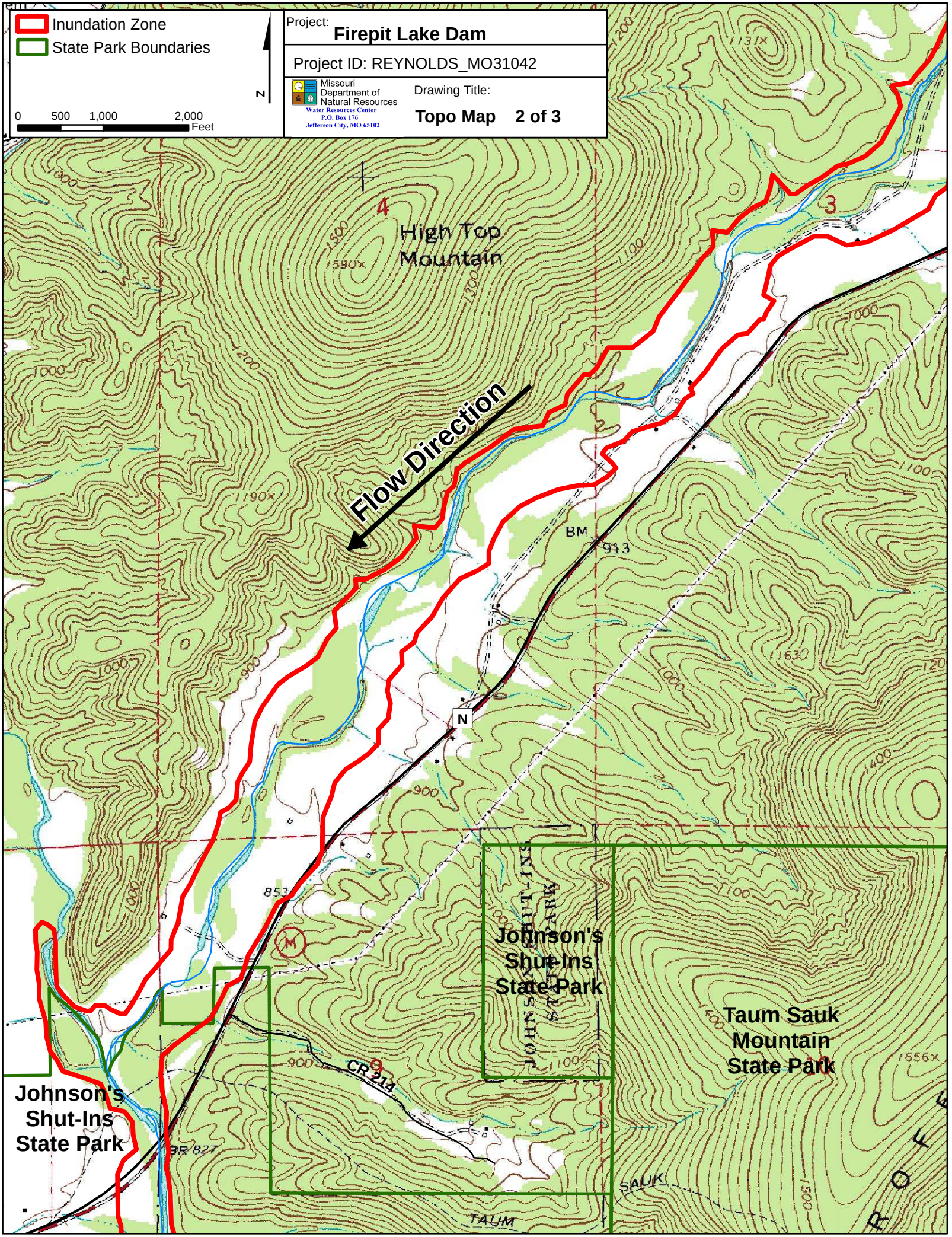
Missouri
Department of
Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Topo Map 1 of 3
Iron
Reynolds
BOUNDARY
Flow Direction
Fork
Munger
963
East
Black
Fitzgerald
Cem
948
941
1080
1292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State Park Boundaries
N
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Feet
Project:
Firepit Lake Dam
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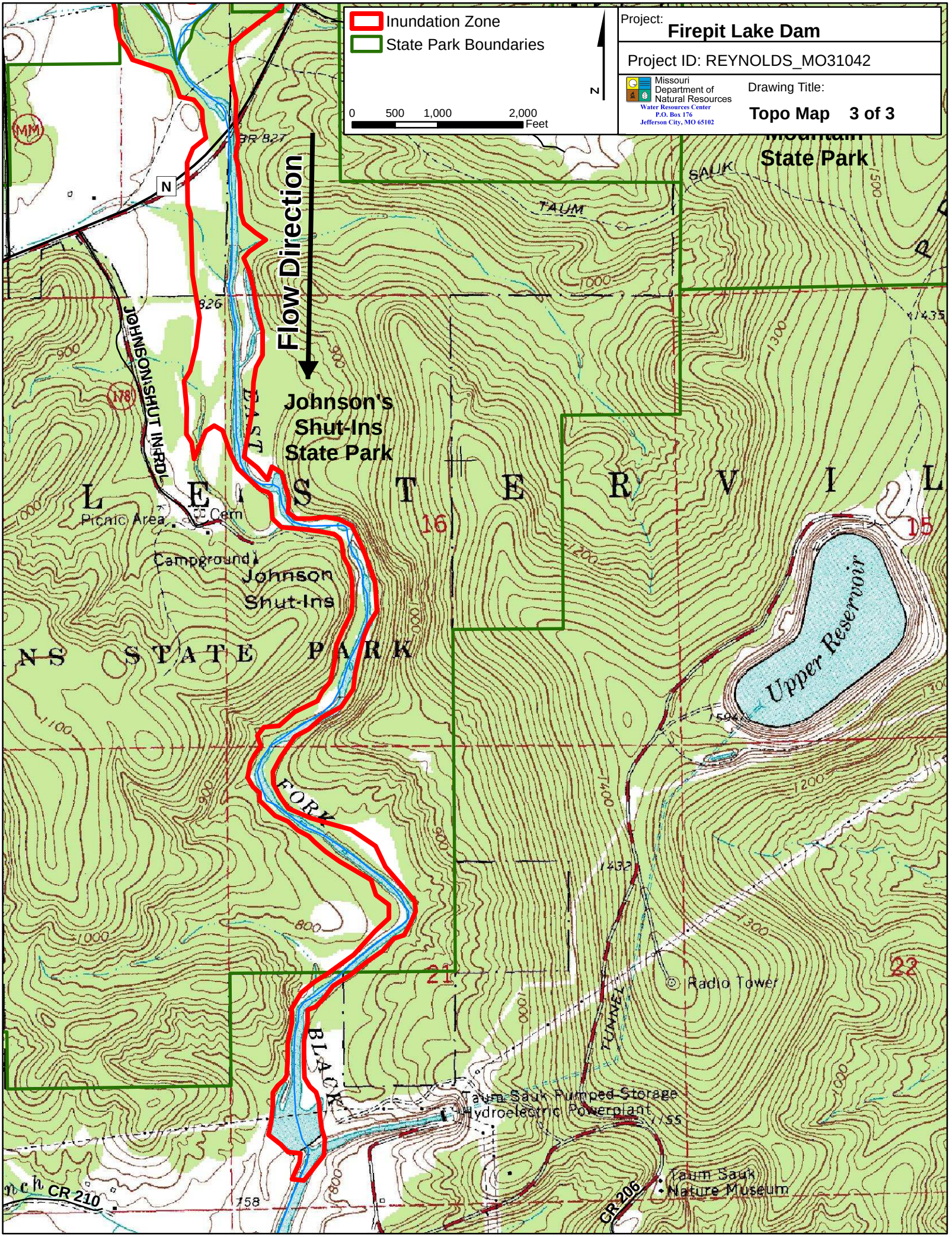
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Topo Map 2 of 3
High Top Mountain
Flow Direction
BM 913
Johnson's Shut-Ins State Park
Taum Sauk Mountain State Park
CR 214
CR 827
SAUK
TAUM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State Park Boundaries
N
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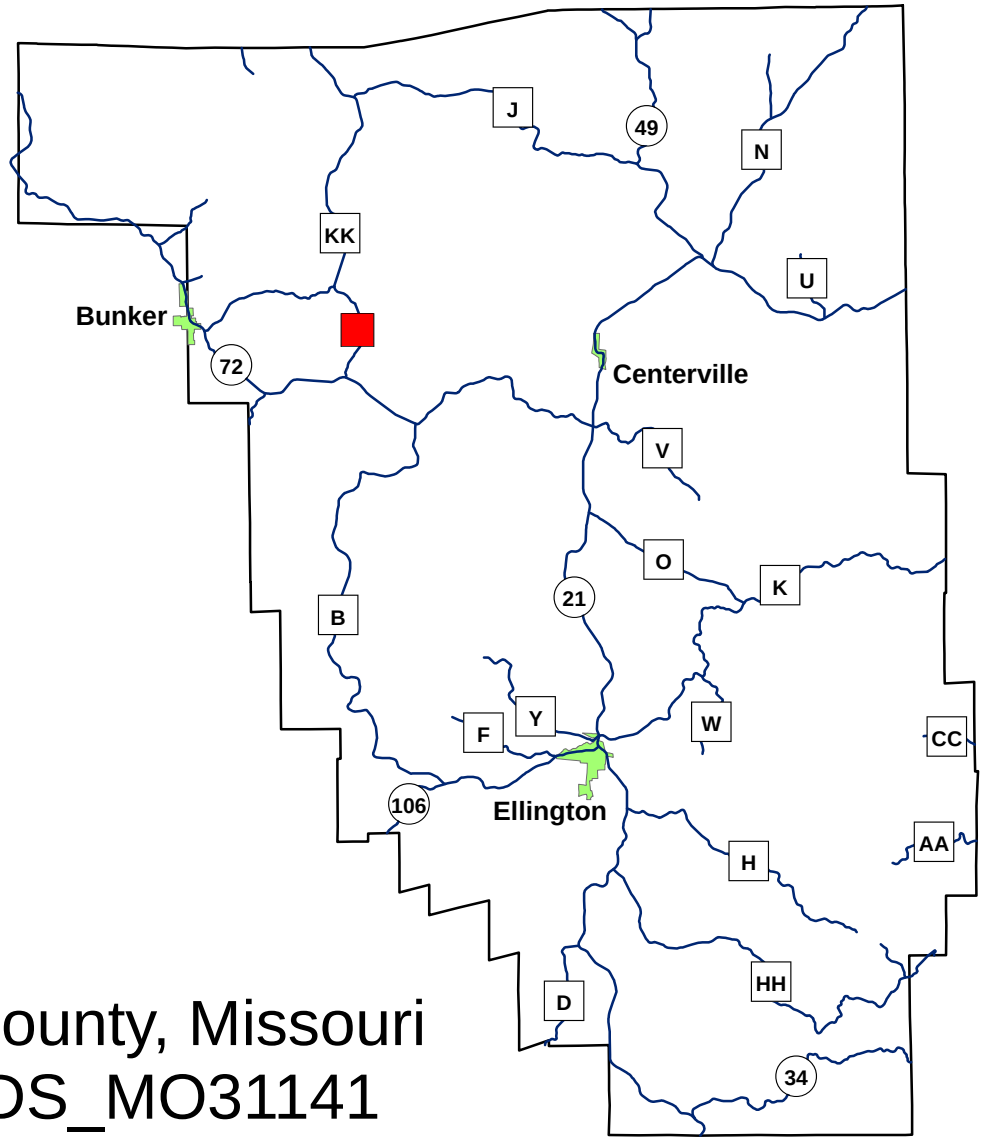
Project: Firepit Lake Dam
Project ID: REYNOLDS_MO31042
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title: Topo Map 3 of 3
Flow Direction
Johnson's Shut-Ins State Park
Johnson Shut-Ins
Picnic Area
Campground
Upper Reservoir
Radio Tower
Taum Sauk Pumped-Storage Hydroelectric Powerplant
Taum Sauk Mountain State Park
Nature Museum
JOHNSON SHUT IN RD
BR 827
CR 210
CR 206
EAST FORK BLACK
TUNNEL
TAUM SAUK

5/6/2013

Fletcher Mine Clarification Dam

Breach Inundation Map



Reynolds County, Missouri
REYNOLDS_MO31141

Note: Actual areas inundated will depend on the actual dam failure criteria and may differ from the areas shown. Due to limitations, methods, assumptions, and procedures used to develop the inundation area, the map should only be used for evacuation planning and emergency purposes.

Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102

Explanation Sheet

Project: **Fletcher Mine Clarification Dam Breach Analysis**

Drawing Title: **Explanation Sheet 1 of 1**

Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102

Project ID: REYNOLDS_MO31141

Explanation of Maps

The following maps indicate the areas which are predicted to be inundated during the occurrence of a sunny day breach of the dam. The pool elevation at failure is assumed to be at the emergency spillway crest elevation or at the crest of the dam in the absence of an emergency spillway.

Use of Maps

The following maps provide a baseline for evaluation of existing emergency action plans and environmental hazards downstream of the regulated structure.

Definition of Terms

Pool Elevation- Water level in the reservoir.

Dam Crest- The lowest elevation measured along the dam crest.

Spillway Crest- The lowest elevation measured along the crest of the spillway.

Arrival Time- Elapsed time between the breach initiation and the time that water levels first begin to rise at any given point.

Assumed Conditions of Flooding

The pool elevation at failure is assumed to be at the emergency spillway crest elevation or at the crest of the dam in the absence of an emergency spillway. The assumed overtopping erodes a section of the dam resulting in a dangerous and quick release of water. For the hydraulic analysis flow initiation is required and therefore a baseflow of water has been included in the analysis.

Dam Facts

ID: MO31141

County: Reynolds

Location: S24, T32 N, R02 W

Height of Dam: 51 ft

Stream: Unnamed trib. to Bee Fork

Lake Area: 25 acres

Volumes

Emergency Spillway: 483 ac-ft
Top of Dam: 778 ac-ft

Breach Parameters (Froehlich, 1995)

Side slopes: 1.4:1

Bottom width: 21 ft

Bottom elevation: 982 ft

Breach formation time: 0.23 hr

Pool Elevation at Failure: 1029.86 ft

Pool Volume at Failure: 483 ac-ft

Downstream Crossings

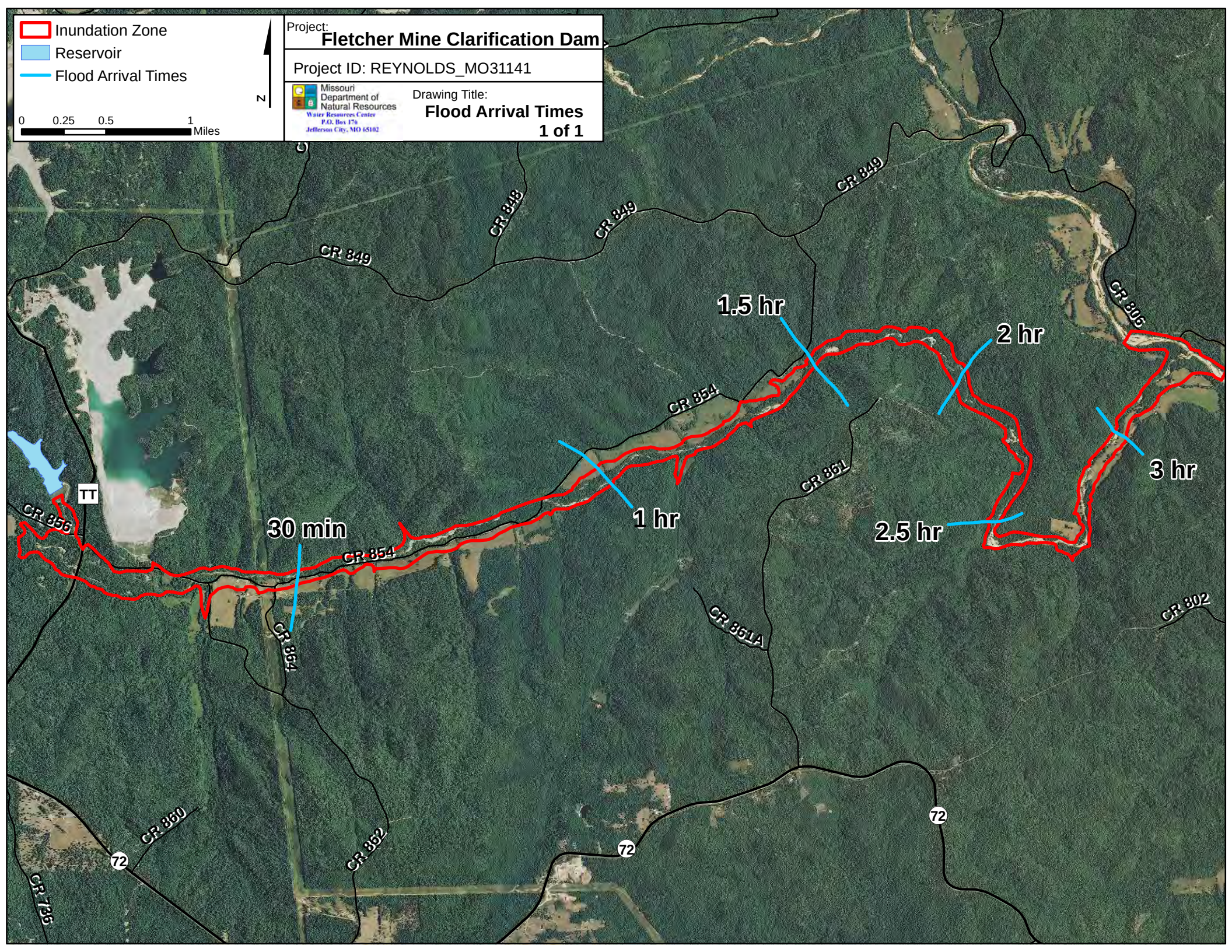
CR 856

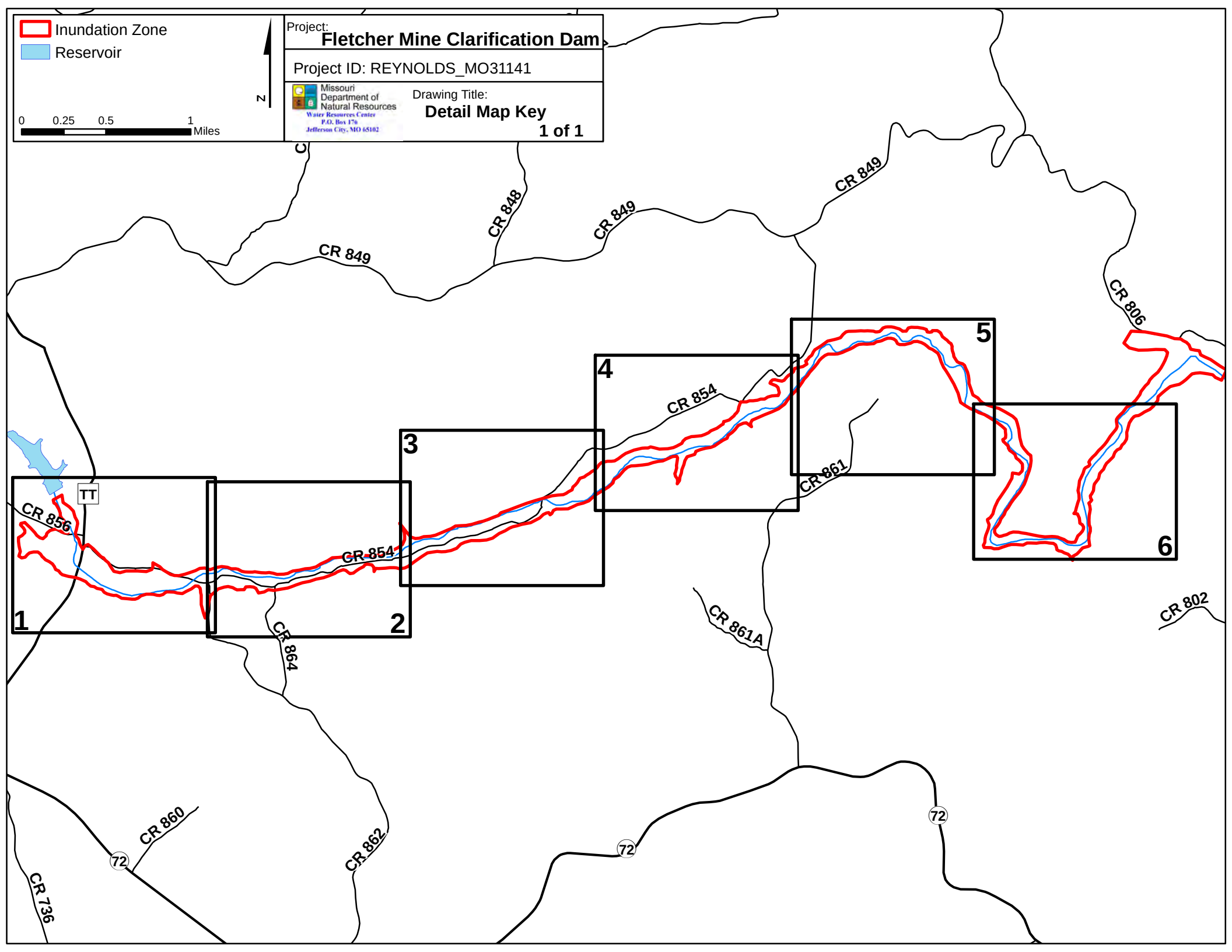
RT TT

CR 854 (2x)

NOTE: Analysis was completed with 10 meter Digital Elevation Model.

Date of Aerial Photo: 2012


Inundation Zone
Reservoir
Flood Arrival Times
N
0 0.25 0.5 1 Miles
Project:
Fletcher Mine Clarification Dam
Project ID: REYNOLDS_MO31141
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Flood Arrival Times
1 of 1
1.5 hr
2 hr
3 hr
1 hr
2.5 hr
30 min
TT
CR 849
CR 848
CR 854
CR 856
CR 851
CR 805
CR 864
CR 861A
CR 802
CR 860
CR 862
CR 735
72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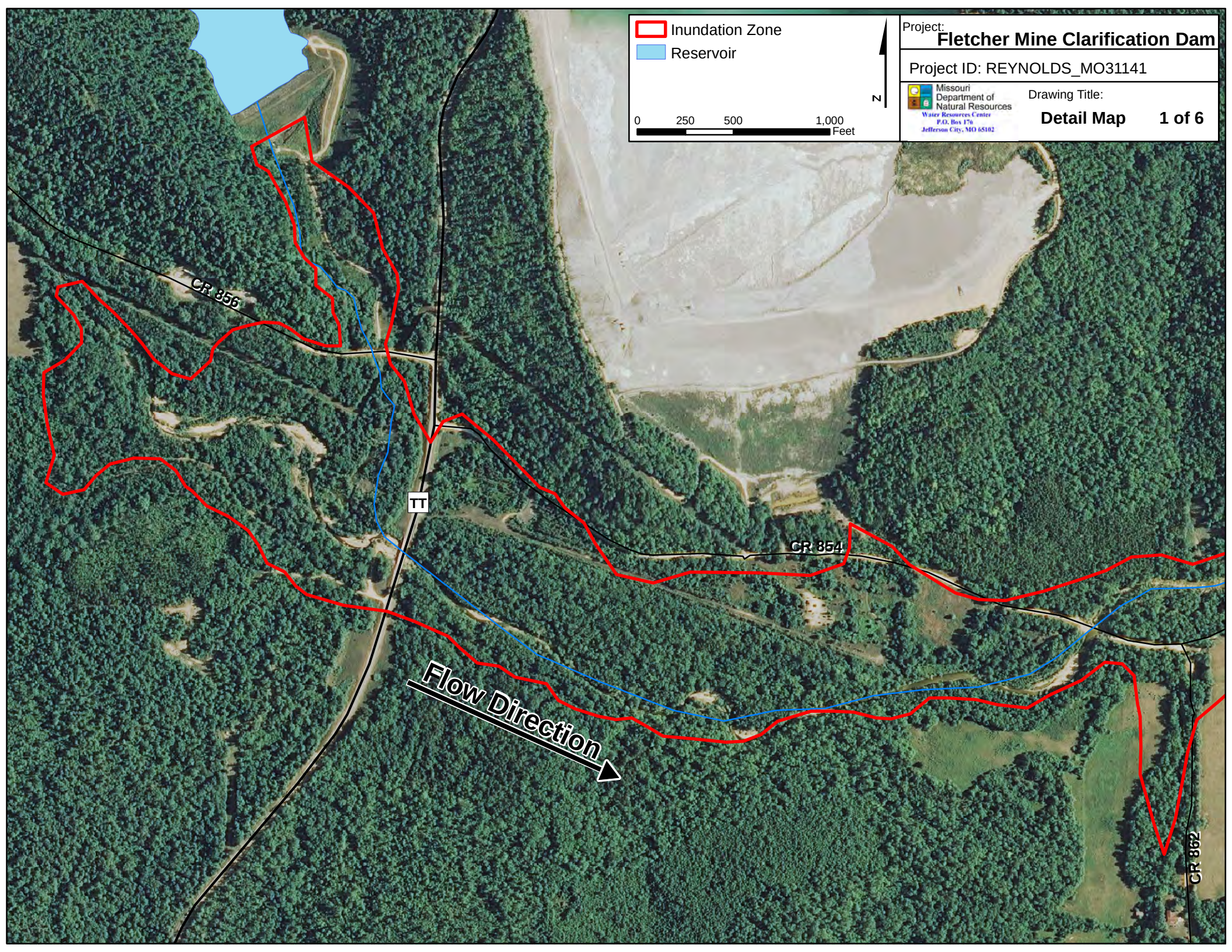
Reservoir
N
0 0.25 0.5 1 Miles
Project:
Fletcher Mine Clarification Dam
Project ID: REYNOLDS_MO31141
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map Key
1 of 1
CR 849
CR 848
CR 849
CR 849
CR 806
CR 854
CR 861
CR 856
CR 854
CR 864
CR 861A
CR 802
CR 860
CR 862
CR 736
72
72
72
TT
1
2
3
4
5
6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Reservoir
N
0 250 500 1,000
Feet
Project:
Fletcher Mine Clarification Dam
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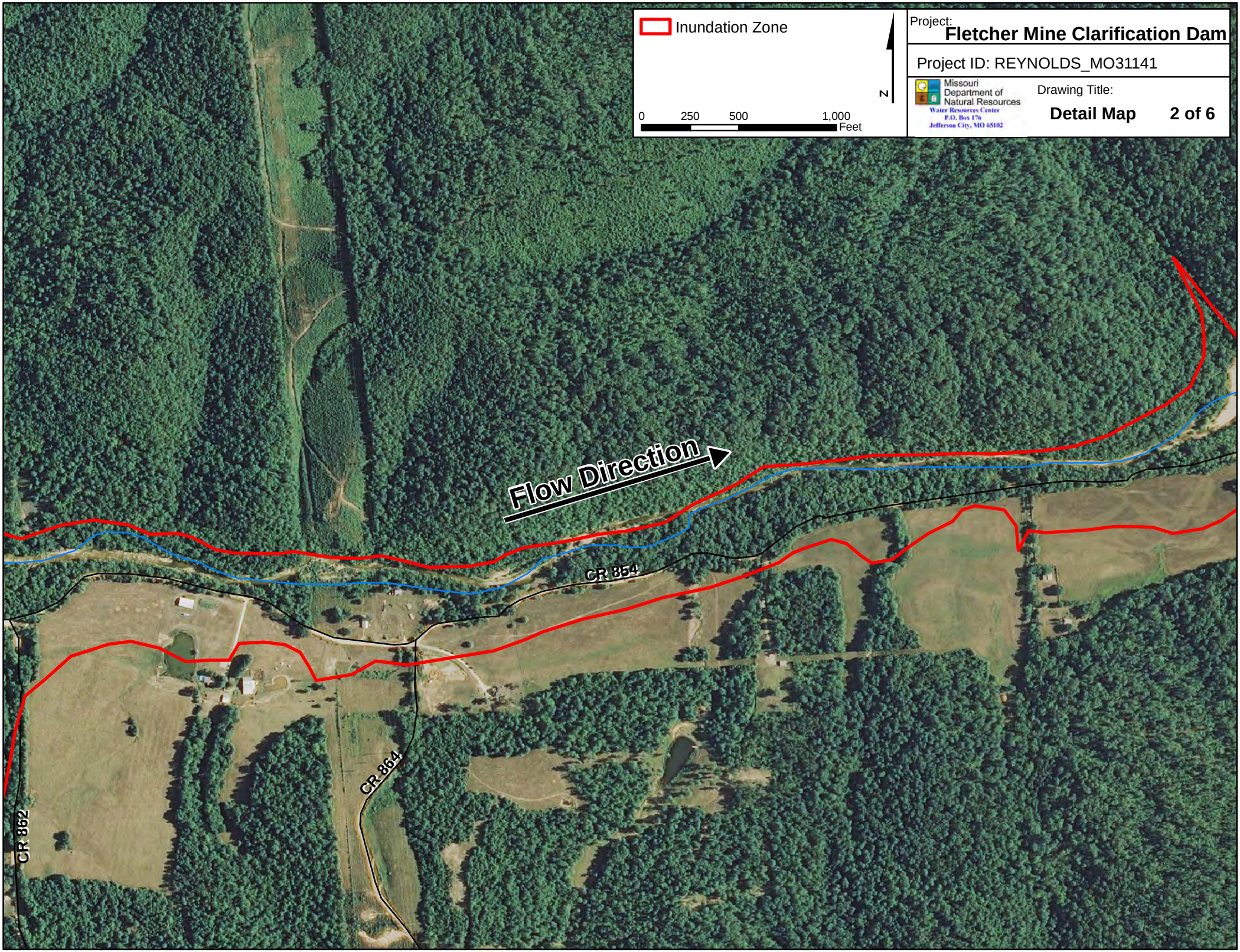
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map
1 of 6
CR 856
TT
CR 854
Flow Direction
CR 862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Feet
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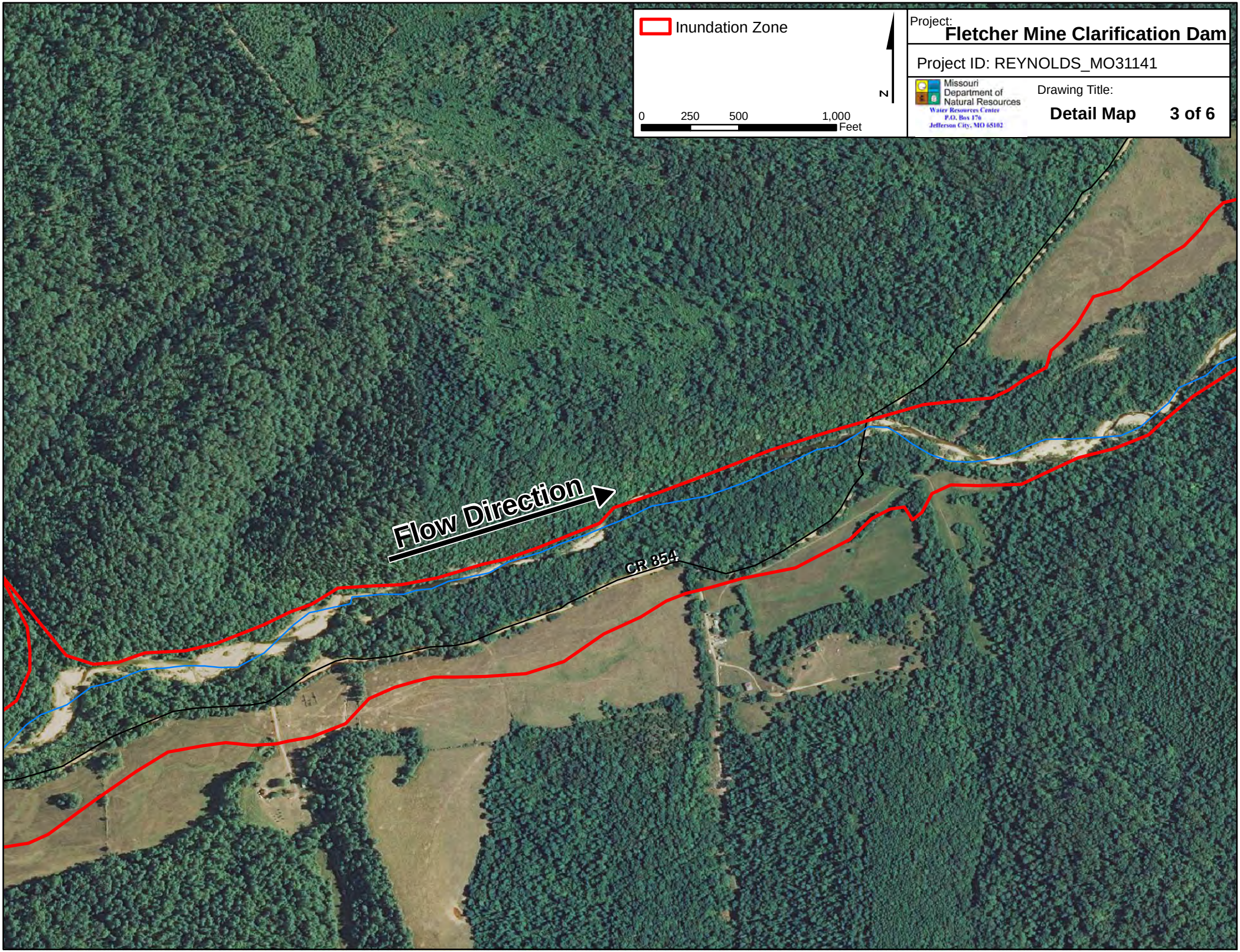
Jefferson City, MO 65102
Drawing Title:
Detail Map
2 of 6
Flow Direction
CR 854
CR 864
CR 862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Feet
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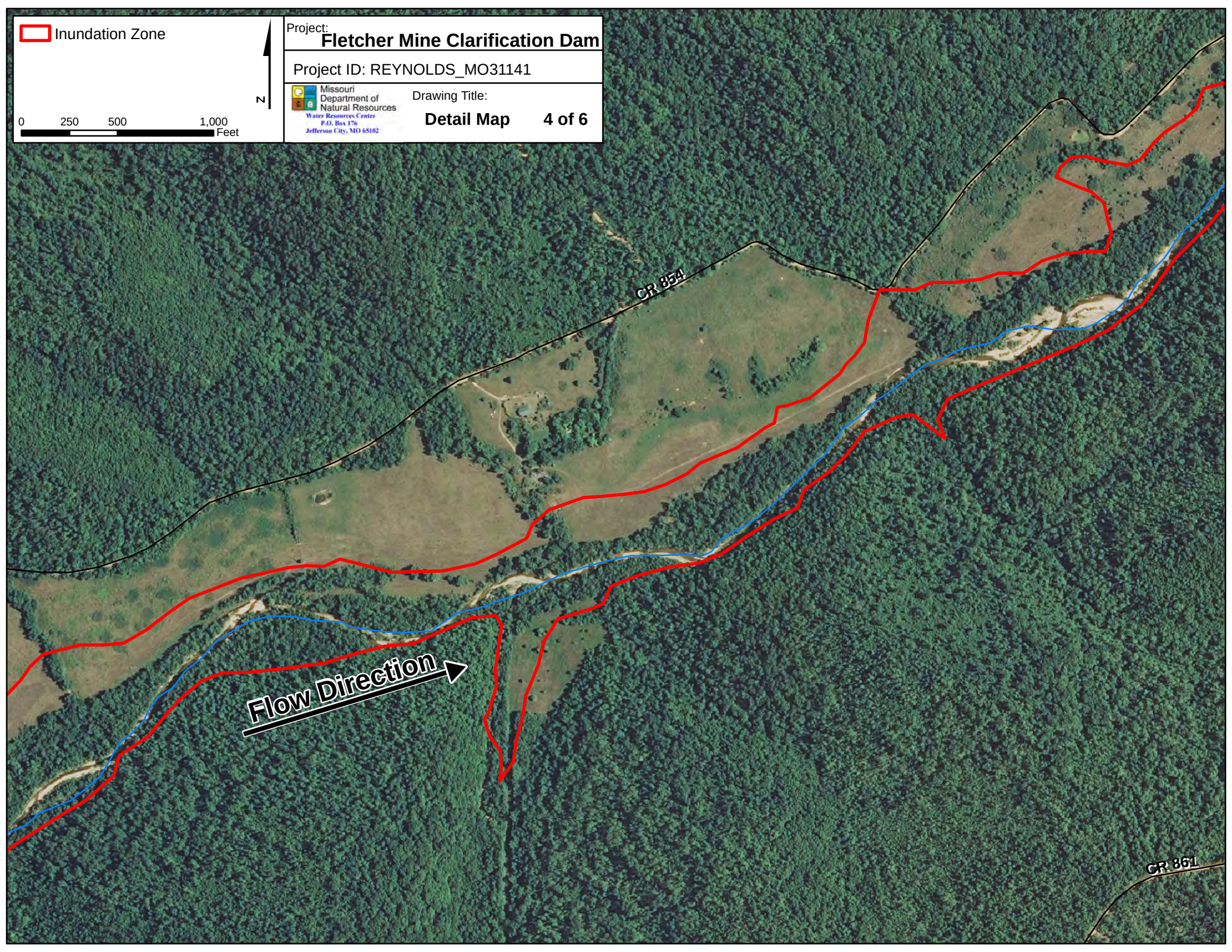
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map
3 of 6
Flow Direction
CR 854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N
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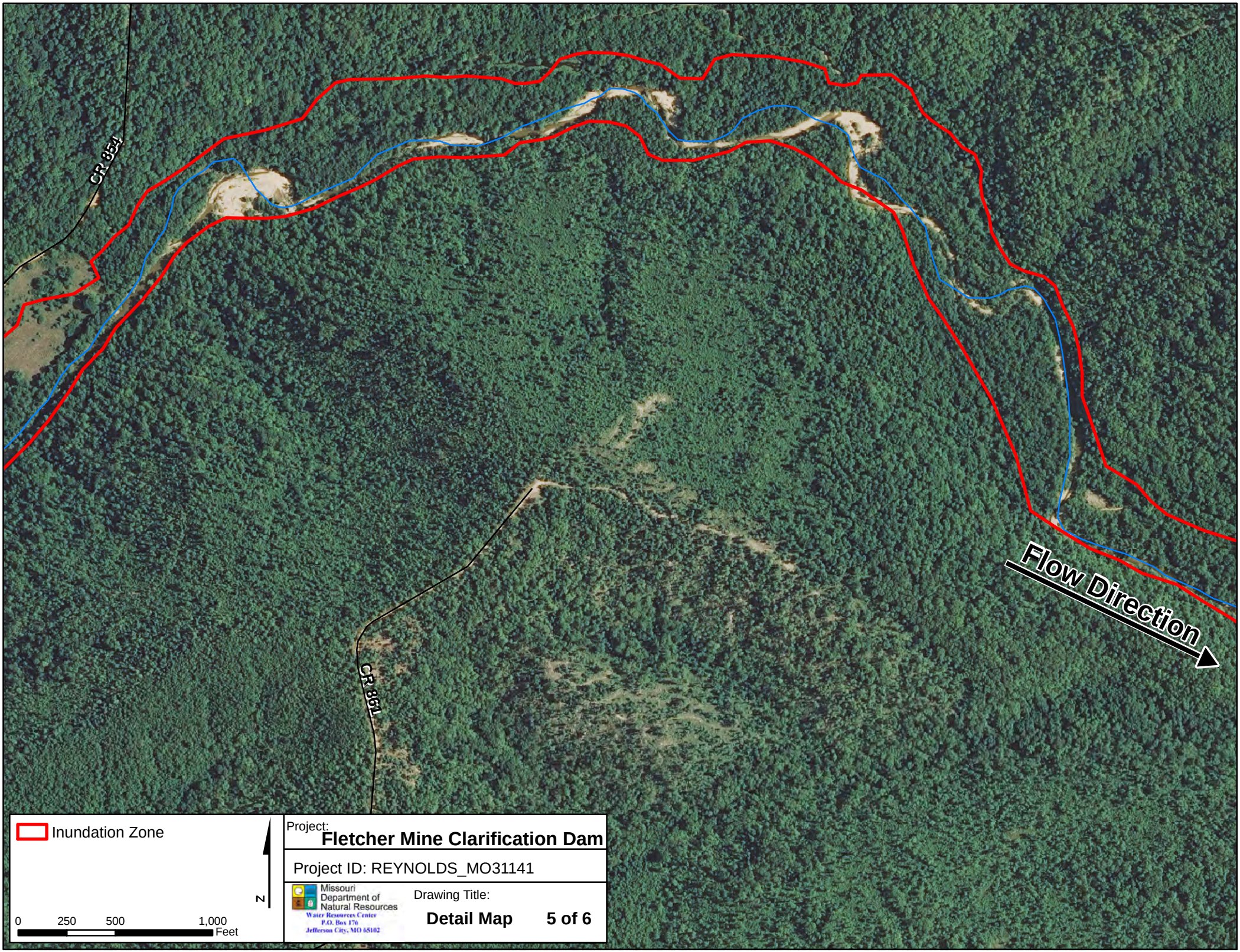
Project:
Fletcher Mine Clarification Dam
Project ID: REYNOLDS_MO31141
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map
4 of 6
CR 854
Flow Direction
CR 851


CR 854
CR 861
Flow Direction
Inundation Zone
N
0
250
500
1,000
Feet
Project:
Fletcher Mine Clarification Dam
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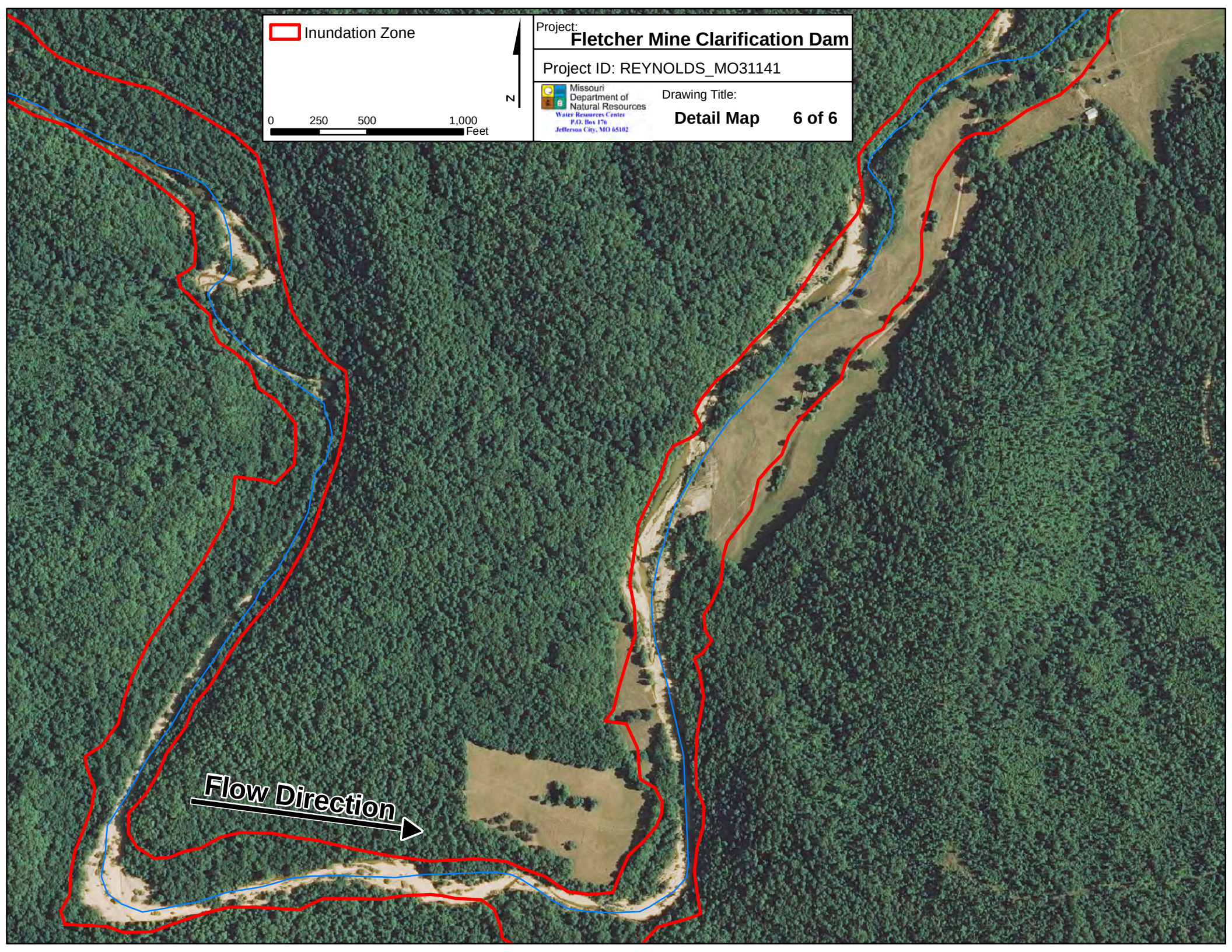
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map
5 of 6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N
0 250 500 1,000
Feet
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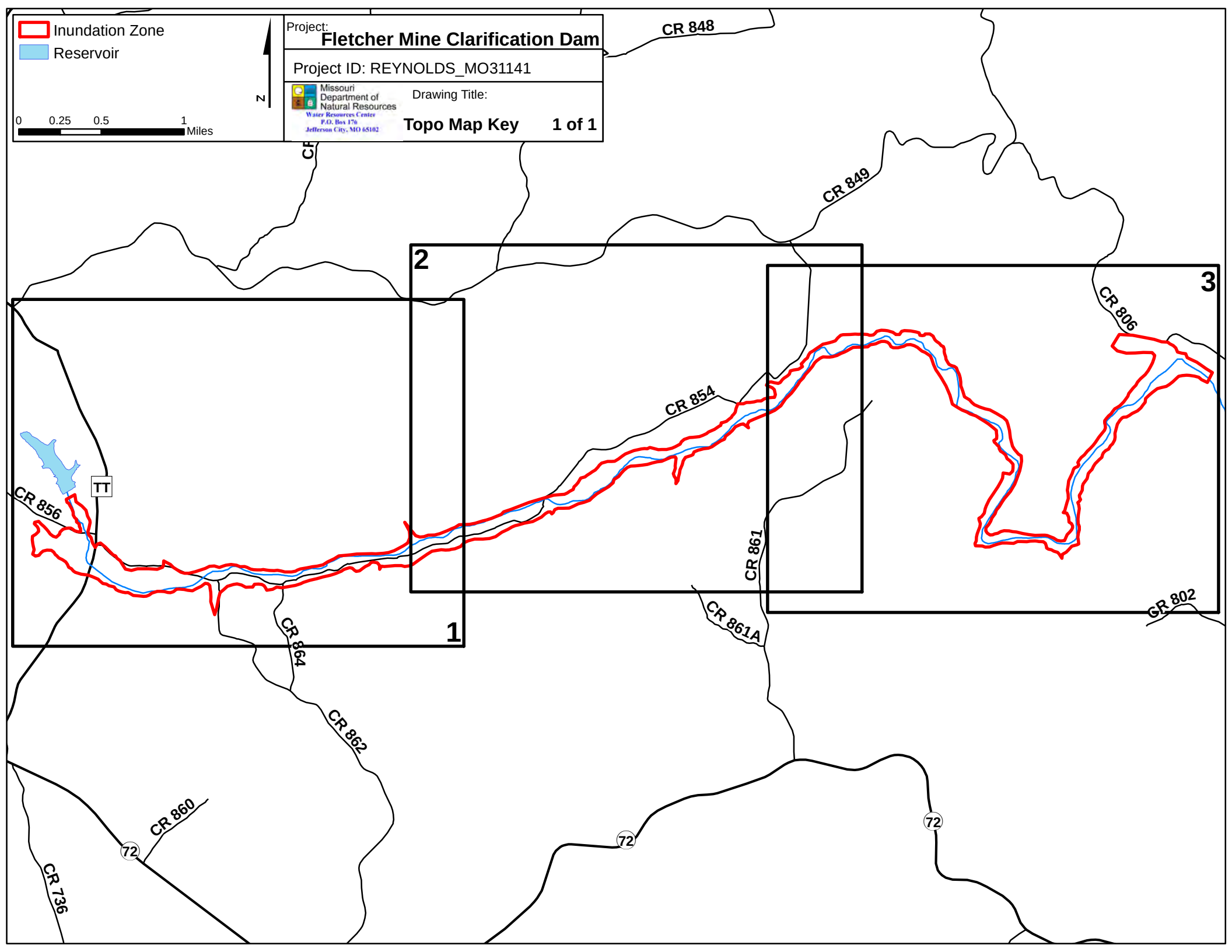
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Detail Map
6 of 6
Flow Direction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Reservoir
N
0 0.25 0.5 1 Miles
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Fletcher Mine Clarification Dam
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Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
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1 of 1
CR 848
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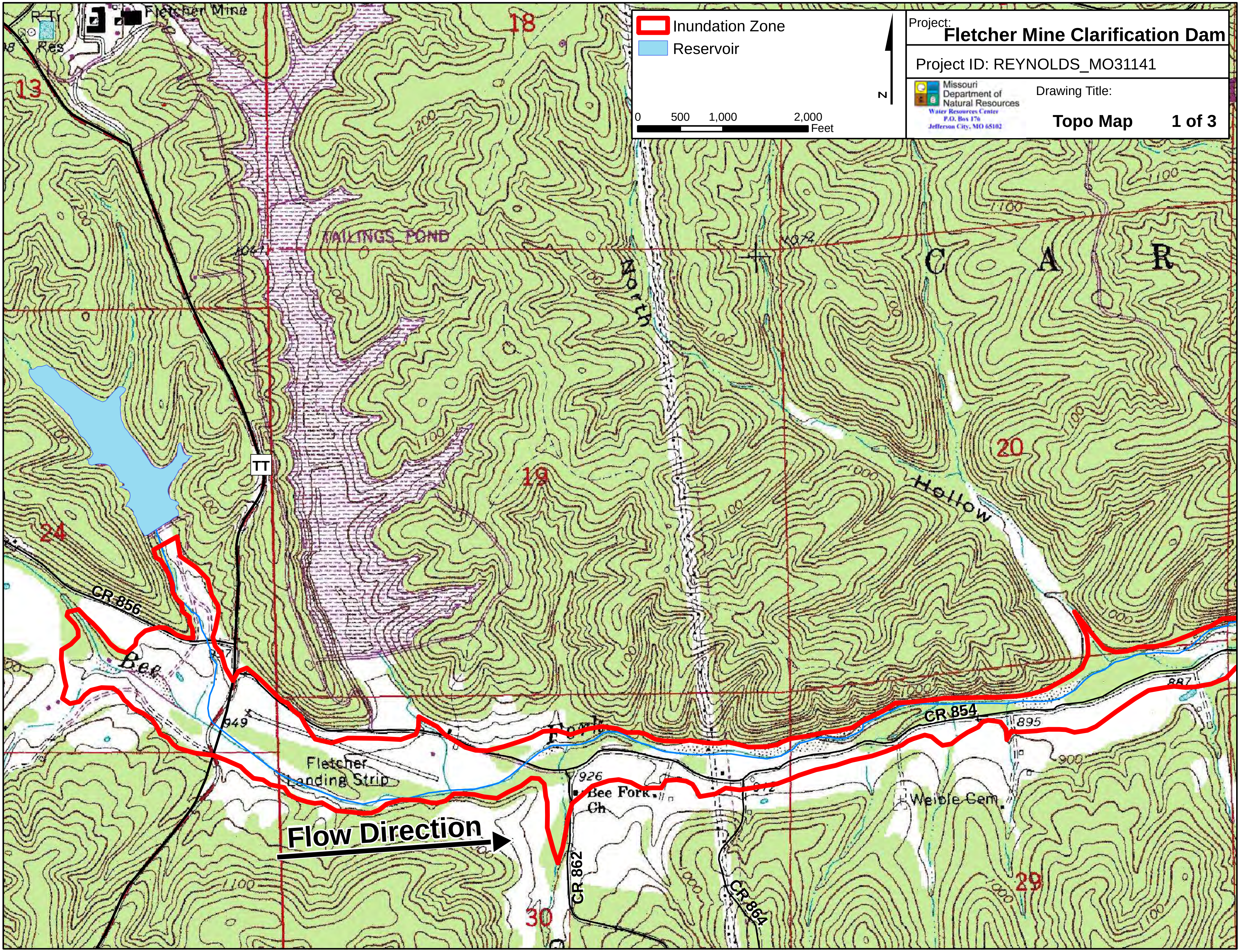
CR 806
GR 802
72
1
2
3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Reservoir
N
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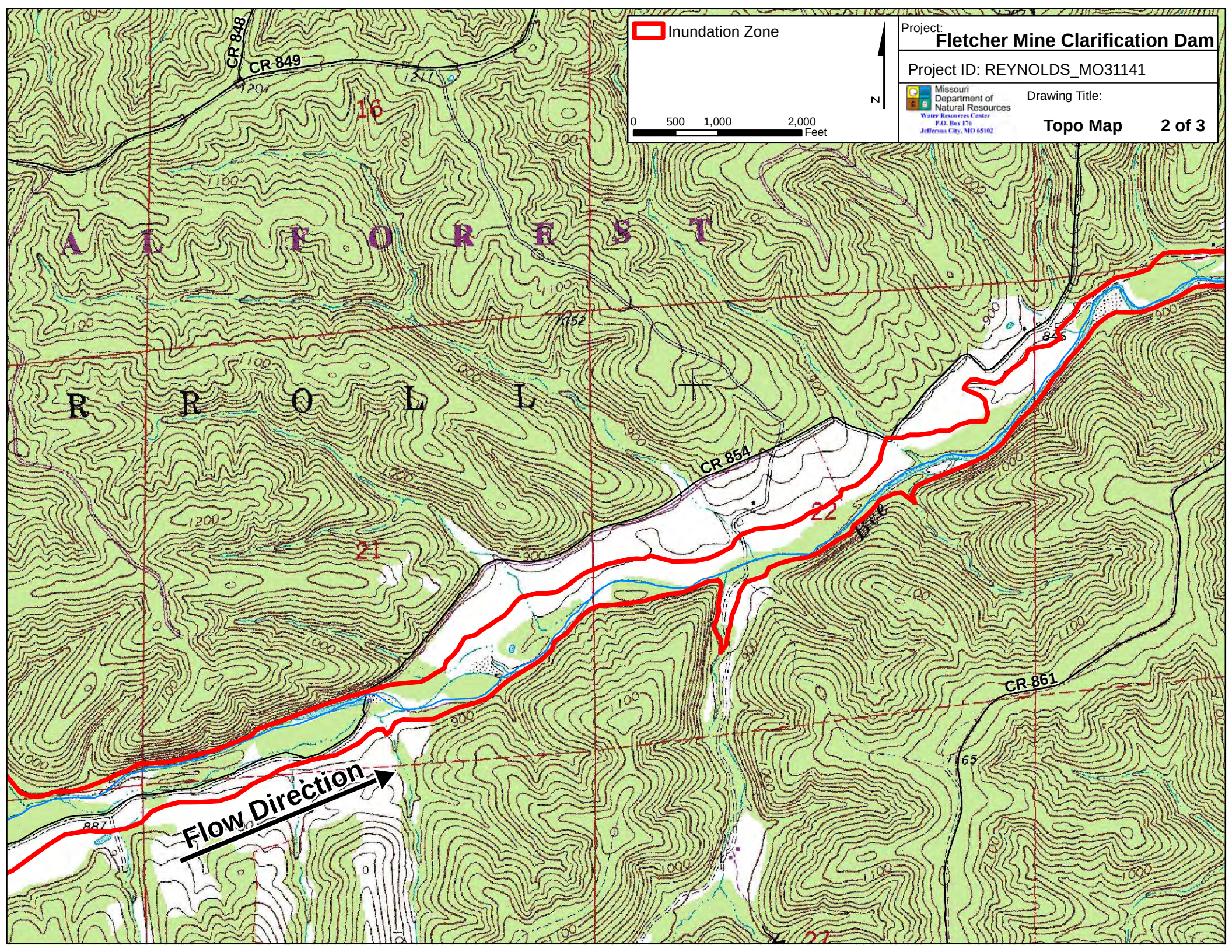
Project:
Fletcher Mine Clarification Dam
Project ID: REYNOLDS_MO31141
Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
Drawing Title:
Topo Map
1 of 3
Fletcher Mine
TAILINGS POND
North
C A R
Hollow
TT
CR 856
Bee
Fork
CR 854
Fletcher Landing Strip
Bee Fork Ch
Weible Cem
CR 862
CR 864
Flow Direction
13
18
19
20
24
29
30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Feet
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Water Resources Center
P.O. Box 176
Jefferson City, MO 65102
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2 of 3
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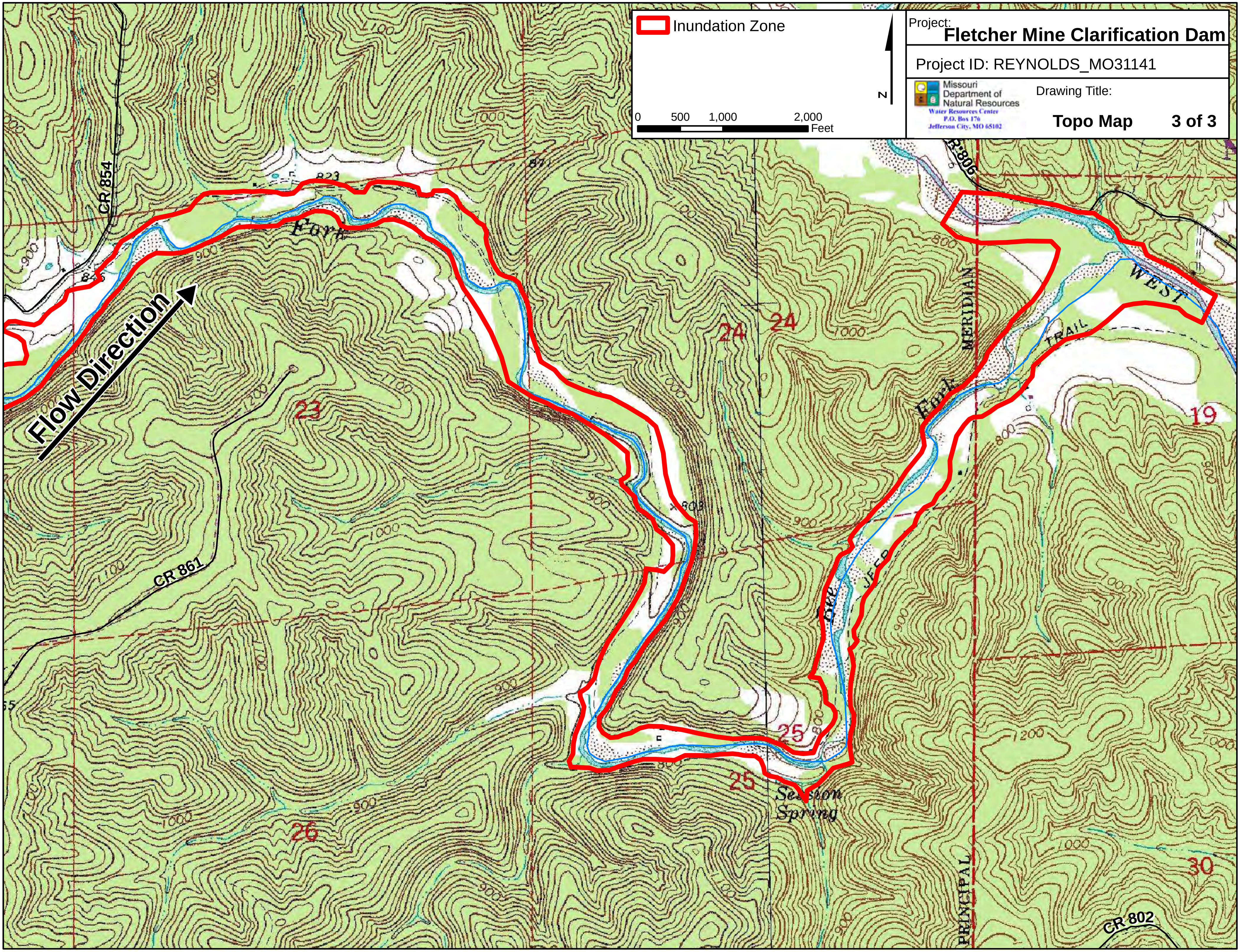
16
21
22
27
ALFORREST
Flow Direction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Missouri Department of Natural Resources
Water Resources Center
P.O. Box 176
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Drawing Title:
Topo Map
3 of 3
0
500
1,000
2,000
Feet
N
Flow Direction
CR 854
CR 861
CR 802
Fork
WEST
TRAIL
MERIDIAN
PRINCIPAL
Session Spring
23
24
25
26
19
30

Emergency Action Plan, or EAP

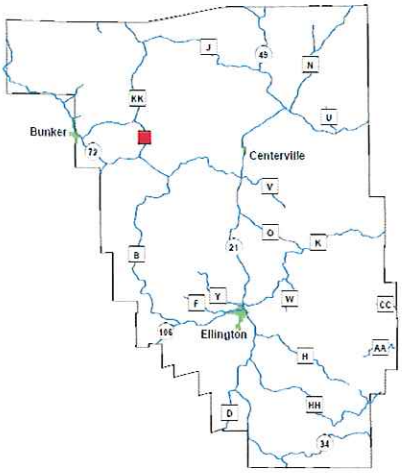
Fletcher Mine Dam

National Inventory of Dams, or NID, MO30160

Reynolds County, Missouri

SEMA Area C

Reviewed and Updated:
12/15/2017



The Doe Run Company
Dan Buxton
Owner/operator

5-1-18
Date

County Emergency Management Director
Renee Horn
Reynolds County, Missouri

Date

Basic EAP Data

Purpose

The purpose of this EAP is to reduce the risk to human life and minimize property damage during an unusual or emergency event at Fletcher Mine Dam.

Notification Procedure

This EAP provides general guidance for recognizing and characterizing an emergency situation occurring at the dam. The dam owner should act quickly to evaluate the emergency situation and then follow the notification procedures according to the corresponding level of emergency.

Potential Impacted Area

See *Inundation Map* (Appendix A) and *Residents/Businesses/Entities at Risk* table for the locations and contact information of the following residents and businesses that may be flooded if the dam should fail This list may also include critical infrastructure such as pipelines, power plants, substations, or sewer plants.One highway and approximately 7 homes appear to be affected fby the failure of this dam.

Directions to dam (Review Arrival Time Map that shows major roads to the dam)

From Reynolds MO head west on highway 72 and then take right on to Highway TT and go 1.5 mile and the dam in the right side of the highway

Guidance for Determining the Emergency Level

This information should be used as a general guide for recognizing and characterizing the type of emergency situation occurring at the dam. The dam owner should notify the appropriate emergency contacts based upon the emergency level assigned to each situation.

Level 1 Emergency - Nonemergency, unusual event, slow to develop

- Reservoir water surface elevation at emergency spillway crest or spillway is flowing with no active erosion.
- New seepage areas in or near the dam.
- New cracks in the embankment greater than ¼-inch wide without seepage.
- Visual movement/slippage of the embankment slope.
- Instrumentation readings beyond predetermined values.
- Measurable earthquake felt or reported on or within 50 miles of the dam.
- Damage (vandalism/sabotage) to dam or appurtenances with no impacts to the functioning of the dam.
- Modification (vandalism/sabotage) to the dam or appurtenances that could adversely impact the functioning of the dam.

Level 2 Emergency - Potential dam failure situation, rapidly developing

- Spillway flowing with active gully erosion.
- Spillway flow that could result in flooding of people downstream, if the reservoir level continues to rise.
- Reservoir level is 1 foot below the top of the dam.
- New seepage areas with cloudy discharge or increasing flow rate.
- Observation of new sinkhole in reservoir area, on embankment or downstream of dam.
- Cracks in the embankment with seepage.
- Earthquake resulting in visible damage to the dam or appurtenances.
- Verified bomb threat that, if carried out, could result in damage to the dam.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in seepage flow.

Level 3 Emergency - Urgent; dam failure imminent or is in progress

- Spillway flowing with an advancing headcut that is threatening the control section.
- Spillway flow that is flooding people downstream.
- Water from the reservoir is flowing over the top of the dam (not just auxiliary/emergency spillway).
- Seepage that is obviously eroding soil from within the embankment or rapidly increasing in flow rate.
- Rapidly enlarging sinkhole.
- Sudden or rapidly progressing slides of the embankment slopes.
- Earthquake resulting in uncontrolled release of water from the dam.
- Detonated bomb that has resulted in damage to the dam or appurtenances.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in uncontrolled water release.

Emergency Level 1 Notifications

Nonemergency, unusual event; slowly developing.

Dam Operator or Owner

The Doe Run Company

Dan Buxton POC

573-244-8142 Work)

XXX-XXX-XXXX (Cell)

(1.)

State Dam Safety Official
Missouri
Water Resources Center

Ryan Stack

573-368-2175 (Office)
573-368-2178 (Desk)
573-368-8837 (Cell)

(2.)

Dam Operator's
Technical Reps. (if applicable)

Owner's engineer

Dam Operator's
Engineer

Barr Engineering

Jefferson City MO

573-638-5000 (Office)

Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Emergency Level 2 Notifications

Emergency event, potential dam failure situation; rapidly developing.

Dam Operator or Owner

The Doe Run Company

Dan Buxton POC

573-244-8142 Work)

XXX-XXX-XXXX (Cell)

(1.)

911

County Emergency Director/Sheriff

Renee Horn

573-648-2494 10 (Office)

XXX-XXX-XXXX (Home)

XXX-XXX-XXXX (Cell)

(2.)

State Dam Safety Official Missouri

Water Resources Center

Ryan Stack

573-368-2175 (Office)

573-368-2178 (Desk)

573-368-8837 (Cell)

(3.)

Dam Operator's Engineer

Barr Engineering

Jefferson City MO

573-638-5000 (Office)

Local Emergency Management Dispatcher

Missouri Highway Patrol Dispatcher

Local Law Enforcement/Fire Protection Agency Dispatcher

Reynoilds County Amateur Radio Association:

None listed

XXX-XXX-XXXX

National Weather Service

417-863-1456

Note:

1., 2., etc., denotes call sequence

Legend:

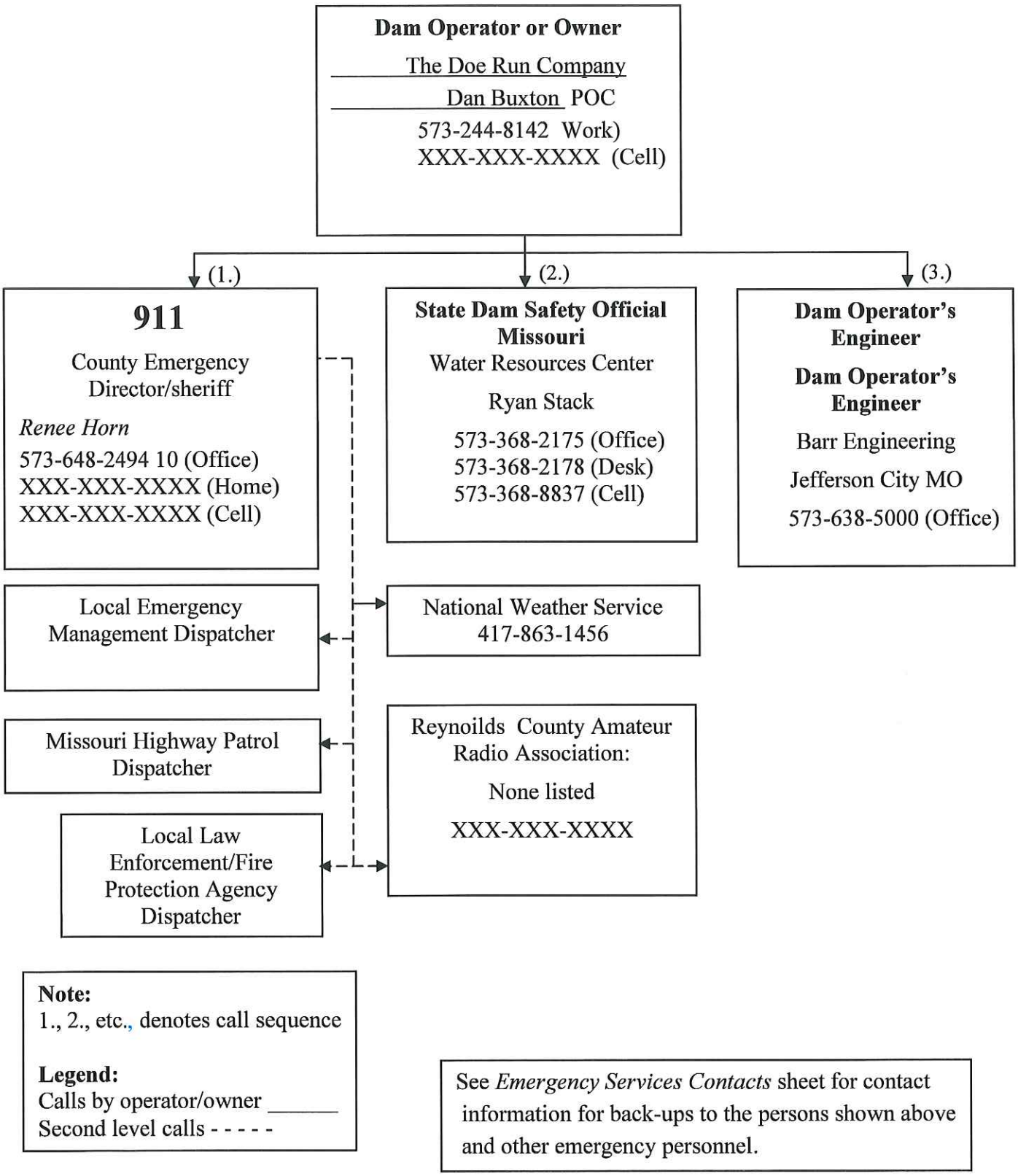
Calls by operator/owner _____

Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Emergency Level 3 Notifications

Urgent event, dam failure appears imminent or is in progress.



Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information for back-ups to the persons shown above and other emergency personnel.

Emergency Services Contacts

Agency / Organization	Principal Contact	Address	Office Phone No. with Area Code	Alternate Telephone Numbers
Reynolds County Sheriff	Sheriff Tom Volner	2319 Green street Centerville MO	573-648-2491	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Owner/Representative of Fletcher Mine Dam	Mr. Dan Buxton	P.O. Box 500 Vibrunurm MO 65566	573-244-8142	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
County Emergency Management Director	*Renee Horn*	P.O. Box 10 Centerville MO	573-648-2494 ext 10	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Ironton Fire Department		222 S Main St Ironton, Missouri (573) 546-3473	(573) 546-3473	
Ironton Police	Harold Yarbrough	123 N Main St Ironton, Missouri	(573)546-7132	
Troop G Highway Patrol	desk	1226 W. Bus. US-60/63 Willow Springs	(417) 469-3121	
Reynolds County Road Department		450 Highway V, Centerville, MO	(573) 648-2483	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Water Resources Center Dam and Reservoir Safety Program	Ryan Stack Chief Engineer	111 Fairgrounds Rd. Rolla, MO 65401	573-368-2175	573-368-2178 (Desk) 573-368-8837 (Cell)
Department of Natural Resources Emergency Response	Duty Officer EER	P.O. Box 176 Jefferson City, MO 65102	**24 HOUR NO:** 573-634-2436	573-526-3380 (Brian Allen, Chief, EER)
SEMA Duty Officer			573-751-2748	
National Weather Service	Jim Kramper	St. Charles, MO	636-447-1876	1-800-852-7497 636-447-1769 (Fax)
Missouri Department of Transportation	Emergency Operation Center 24-hour cell no.		573-522-9503	
Missouri Department of Transportation	County Shed		XXX-XXX-XXXX	XXX-XXX-XXXX
KFVS12	Contact Name Manager	310 Broadway Cape Girardeau, MO	(573) 335-1212	(800) 455-KFVS
Radio Station KPPL 92.5 FM	Contact Name Manager	ROUTE #2, BOX 496 Poplar Bluff, Missouri	XXX-XXX-XXXX	

Residents/Businesses/Entities/Infrastructure at Risk

Brief summary of number of entities within inundation zone.

Entity No.	Resident/business or other impacted entity	Address	Phone No. with area code	Distance downstream from dam (miles)
1	County road 854			0.1 miles
2	Site of old Barn destroyed by fire			0.1 miles
3	Abandoned home site			0.1 miles
4	Bee Fork Church (not begin used)			0.5 miles
5	Robert Bryson	1048 CR 854 Centerville MO	573-689-2714	0.7 miles
6	Ronnie Lester	1175 CR 854 Centerville MO	573-689-1958	0.8 miles
7	Denver Bryant	1226 CR 854 Centerville MO	573-689-1425	1.1 miles
8	County road 853			4.3 miles

(Use additional sheets if necessary)

Resources Available

Locally available resources include: (if not available please note)

Heavy Equipment Service and Rental	Sand and Gravel Supply	Ready-mix Concrete Supply
Tony Abney Construction PO Box 760 Vibrunum MO 573-244-3145	K & D Crushing 14097 Highway KK Boss MO 573-269-4320 573-269-4415	Politte Read Mix 92 Highway 49 Viburnum MO 573-244-5463
Pumps	**Pipe**	**Sand Bags**
Hearth Land Pumps 1800 Supply Road Suite 8 Carterville IL 63918 618-985-5510	Poly Pipe Systems PO Box 1157 Steelville MO 573-775-3300 573-775-4634 573-775-2024	The Mine Supply Company PO Box 345 85 Highway 49 Viburnum MO. 573-244-5416

The above list was taken from the EAP for MO31141 Fletcher Mine water dam.,

Other options that might be useful.

Schrum Ready Mix, Caledonia 573-779-3708

Mills Ready Mix Annapolis, 573-598-3400

Lead Belt Pump and Supply Park Hills 573-431-2476 pumps

A7 M Pump Festus 636-931-0275

Mid State Paving Sullivan MO 573-627-2039

Zoellner Construction 573-547-8030

Yoder and Sons Bonne Terre 573-358-40585

Hall and Co Leadwood 573-562-7685

Gibson Excavating 573-438-2372

Tony Selz, Lonedell, MO 636-629-0939 or 636-744-1575

5M Welding & Excavation Joe Medwick Cuba, MO 573-308-5138 or 573-885-4105

NOTE: *This list is **not** an endorsement of the service but design as a starting point. **Other sources of information should be used and it is up to the owner of the dam to select the choices for the EAP**. Putting a source name in the box on the EAP does not great an obligation by the owner to use that source if and when an emergency arise, but is meant to assist the owner if during an emergency he does not have the time to do research into what choice he will make on short notice to obtain the needed services.*

Appendix A
Inundation Study

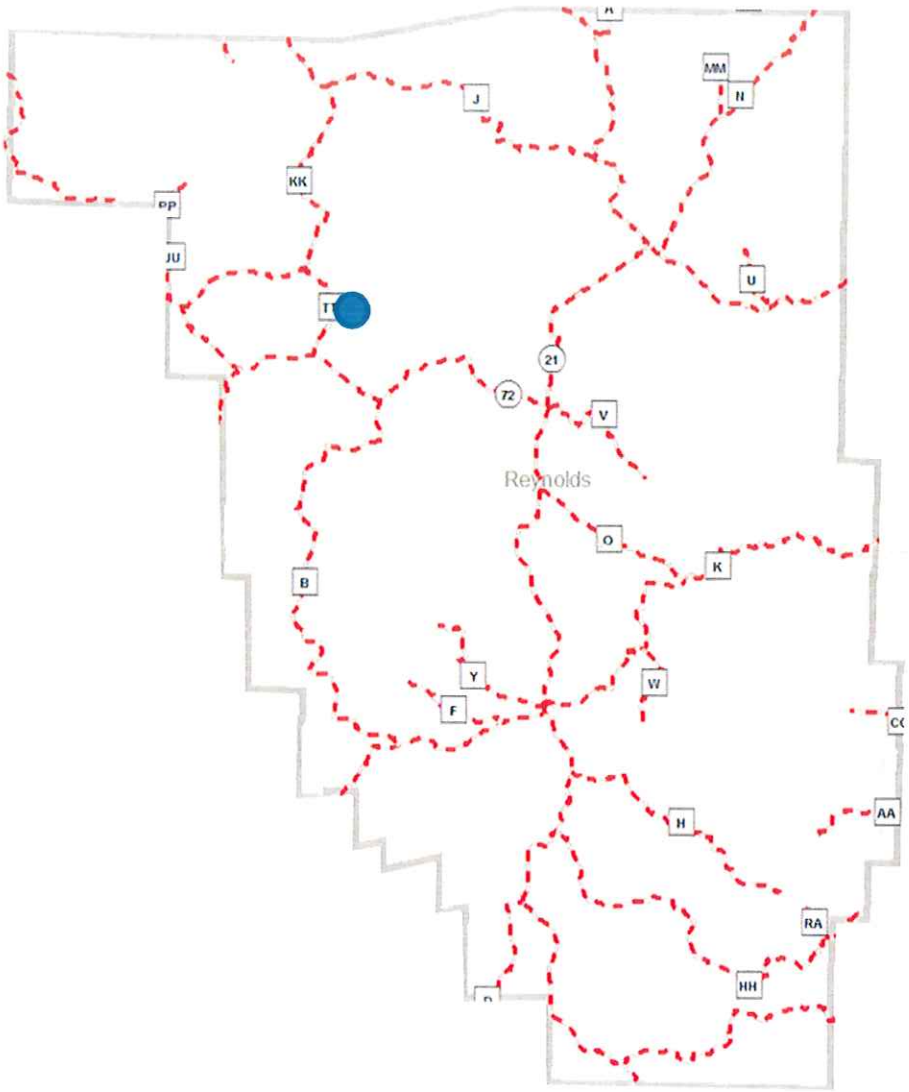
Inundation Map vs. Evacuation Area

Inundation maps have been developed from best available information using reasonable assumptions and standardized methods. They are approximations of the maximum water surface extents resulting from a complete dam breach and draining of the full reservoir. Inundation maps are empirical hydrologic and hydraulic simulations that can only be field verified in the event of an actual breach.

Evacuation areas and call lists should take into consideration the anticipated local impacts of flooding; knowledge of local infrastructure, both occupancy and ownership; and potentially interrupted services or cut-off access, which would be caused by dam failure. Depending upon actual circumstances, appropriate alert and evacuation areas could be more or less extensive than the simulated inundation zones.

Insert inundation map here. It is suggested this section be denoted by a tabbed divider to allow quick access to the inundation map during an emergency.

Fletcher Mine Dam
Potentially Affected Structures Map



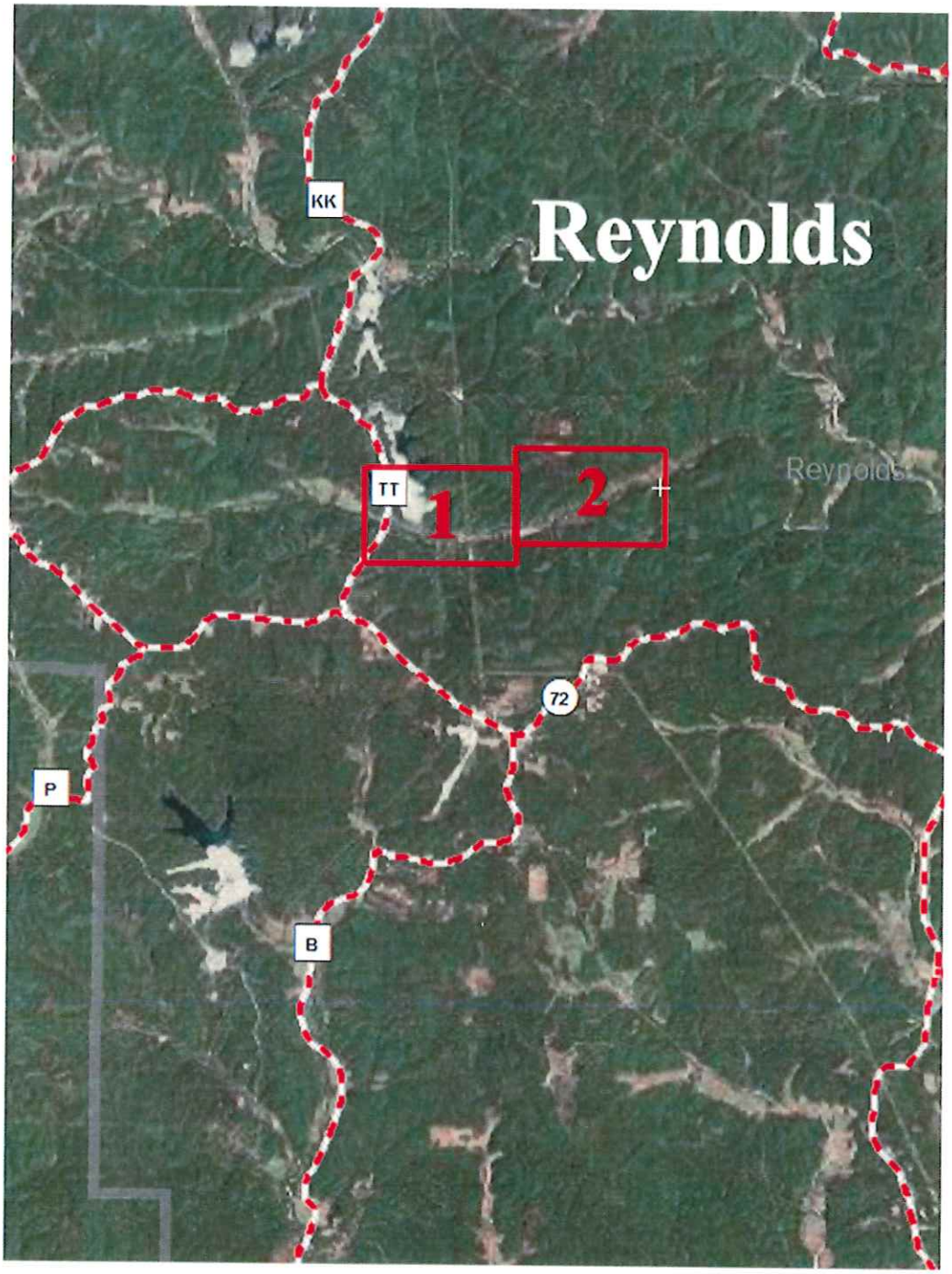
Reynolds, Missouri

Reynolds MO30160

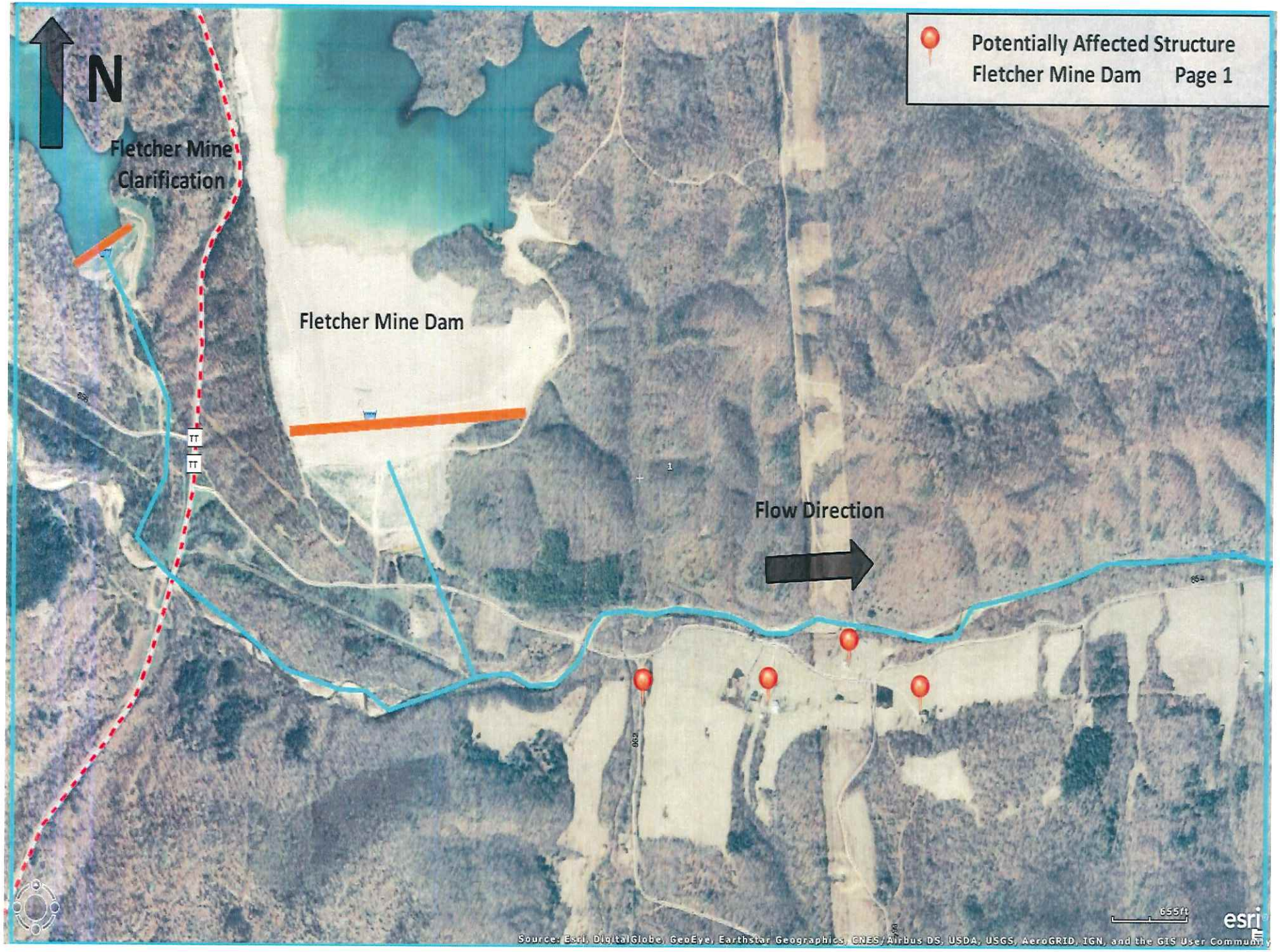
Date: July 31, 2017

Note: Actual areas affected will depend on the actual dam failure criteria and may differ from the areas shown. Due to limitations, methods, assumptions, and procedures used to develop the map area, the map may not show structures that have been recently constructed so some information may be inaccurate. Additional downstream information should be completed by proper authorities.

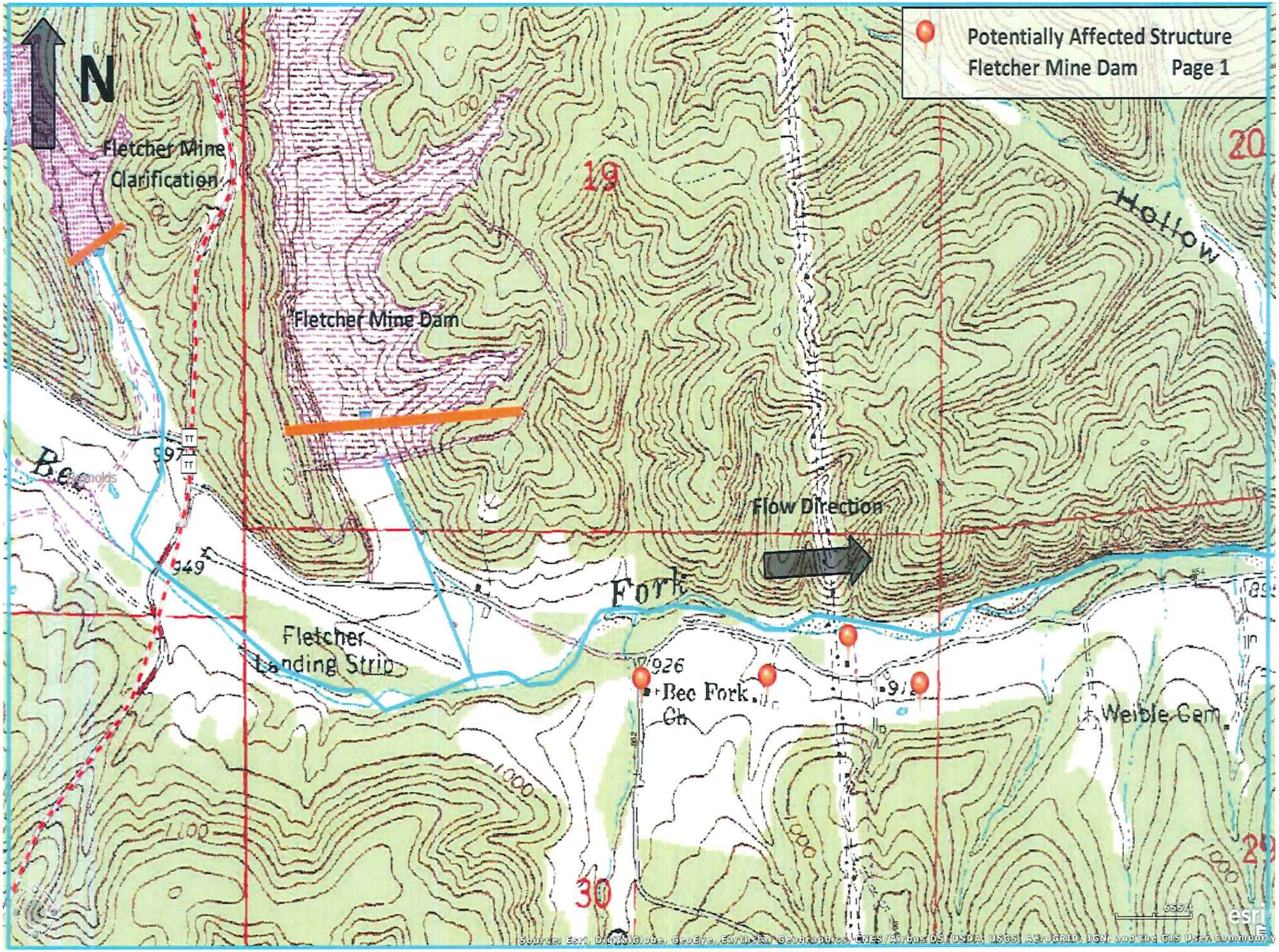
Reynolds County

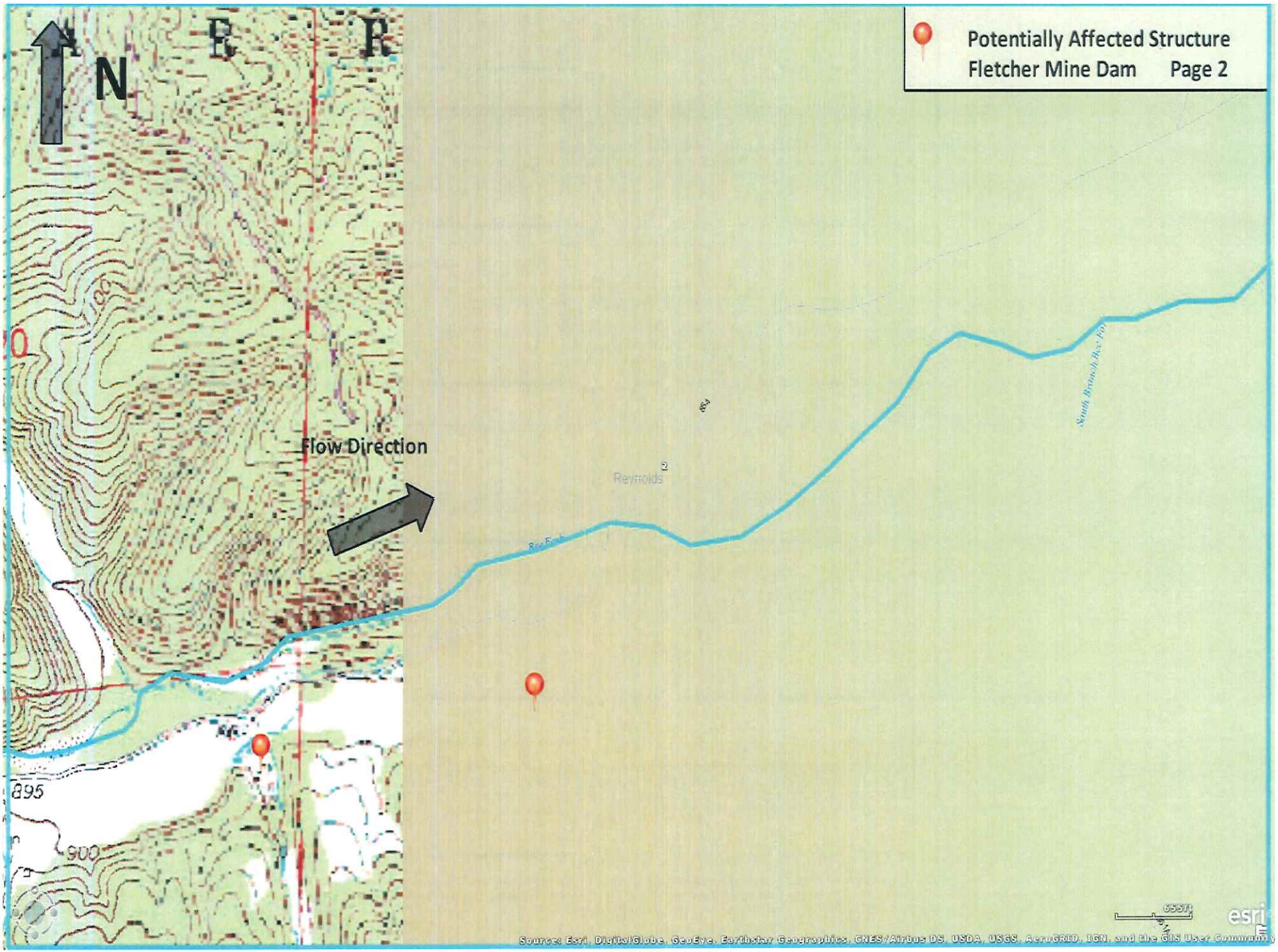


Note: Red rectangular areas indicate each page of the affected areas map


N
Fletcher Mine
Clarification
Fletcher Mine Dam
Flow Direction
Potentially Affected Structure
Fletcher Mine Dam Page 1
655ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Potentially Affected Structure
Fletcher Mine Dam Page 2
Flow Direction
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Potentially Affected Structure
Fletcher Mine Dam
Page 1
N
Fletcher Mine Clarification
Fletcher Mine Dam
19
20
Hollow
Flow Direction
Fork
Bee
Fletcher Landing Strip
926
Bee Fork Ch
Weible Cem
949
30
1000
1100
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Potentially Affected Structure
Fletcher Mine Dam Page 2
Flow Direction
Reynolds
South Branch Rock Fork
895
900
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix B
National Inventory of Dams (NID) Data

Fletcher Mine Dam:

State: Missouri

NID ID: MO30160

Sec: 24 Township: 32N Range: R02W

Longitude: -91.1674 decimal degree
Latitude: 37.4499 decimal degree

Longitude: -91 ° 06' 26"
Latitude: 37° 26' 59"

County: Reynolds

Stream: Tributary to Bee Fork

Nearest town downstream: Centerville

Distance to nearest town downstream: 15.4 mi

Year constructed: 1965

Nearest town: Bunker

Distance to nearest town: 6.7 mi

Type of dam: (indicate only one)

tailings

Max. discharge: 2346 $ft.^3/s$

Max. storage: 516 acre-ft.

Normal storage: 340 acre-ft.

Surface area: 23 acres

Drainage area: 570 acres

Inspection frequency: 2 yrs.

State regulatory agency:
Missouri DNR WRC DRSP

Dam height: 51 ft.

Dam length: 650 ft.

Current hazard class: 1

Principal spillway type: 2 feet by 6 feet concrete drop inlet to 24 inch reinforced concrete pipe

Emergency spillway type: Open channel on left abutment

Comments: _____

_____

_____

_____

Appendix C

Unusual or Emergency Event Log

(To be completed during the emergency)

Fletcher Mine Dam County: Perry

When and how was the event detected?

Weather conditions:

General description of the emergency situation:

Emergency level determination: Made by:

Actions and Event Progression

Date	Time	Action/event progression	Recorded by

Appendix D

Glossary

Abutment The part of the valley side against which the dam is constructed. The left and right abutments of dams are defined with the observer looking downstream from the dam.

Appurtenances Structures incident to or annexed to dams essential to the proper operation, maintenance or functioning of the dam. This includes such structures as spillways, low level outlet works and water conduits, such as tunnels, pipelines or penstocks, either through a dam or its abutments.

Breach An opening through the dam that allows draining of the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintended failure of the dam.

Control section An usually level segment in the profile of an open channel spillway above which water in the reservoir discharges through the spillway.

Dam An artificial barrier generally constructed across a watercourse for the purpose of impounding or diverting water.

Emergency spillway The appurtenant structure that provides the controlled conveyance of excess water through, over, or around the dam.

Instrumentation An arrangement of devices installed into or near dams that provide measurements to evaluate the structural behavior and other performance parameters of the dam and spillway structures. Examples include seepage measuring weirs, piezometers, inclinometers and survey monuments.

Low level outlet works An appurtenant structure, usually consisting of a pipe through the embankment or principal spillway structure equipped with a valve, whose purpose is to allow lowering the lake level.

Principal spillway The appurtenant structure that conveys normal inflow through or around the embankment.

Reservoir The body of water impounded or potentially impounded by the dam.

Seepage The natural movement of water through the embankment, foundation, or abutment of the dam.

Appendix E

Record of Holders of Control Copies of this EAP

Copy Number	Organization	Person receiving copy	E-mail Address
1	The Doe Run Company Fletcher Mine Clarification Dam	Mr. Dan Buxton	573-244-8142
2	Reynolds County EMD	Renee Horn	573-648-2494 (Office
3	Missouri Department of Natural Resources Dam Safety Program and address	Ryan Stack	mowaters@dnr.mo.gov

Record of Revisions and Updates Made to EAP

Revision Number	Date	Revisions made	By whom
1	Date	Describe revision to EAP	Name

Emergency Action Plan or EAP
Magmont Tailings Dam

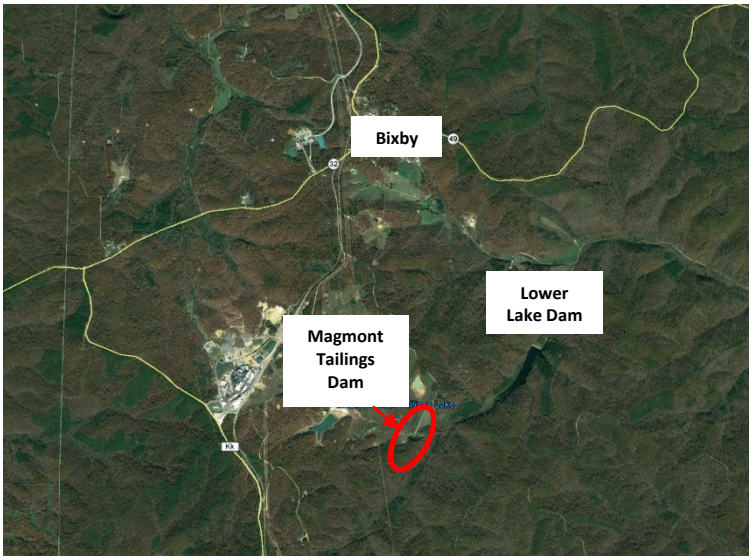
National Inventory of Dams, or NID, MO30917

Iron County, Missouri

SEMA Area E

Reviewed and Updated:

June 6, 2018



Teck American Incorporated
Dave Enos, Manager, Dormant Properties

Roger Medley
Iron County Emergency Management Director
Iron County, Missouri

_____
Date:

_____
Date:

Table of Contents

Basic Emergency Action Plan Data

PURPOSE

The purpose of this Emergency Action Plan (EAP) is to reduce the risk to human life and property damage, during an unusual or emergency event at the Magmont Tailings Dam (the dam). This EAP contains guidance for identifying and responding to possible emergency situations associated with the dam. This plan was developed to assist the dam operator (TAI) and emergency management officials to facilitate timely notification and, if necessary, evacuation of areas downstream of the dam potentially affected by a dam failure or flood conditions. The plan was developed assuming a modeled theoretical dam failure, and is not intended to represent an indication of the likelihood of a potential failure.

Early detection and evaluation of the situation(s), and identifying event(s) that initiate or require an emergency action are crucial. It is imperative to ensure that the appropriate course of action is taken based on the urgency of the situation. It is better to activate the EAP while confirming the extent of the emergency than to wait for the emergency to occur.

DAM DESCRIPTION

The Magmont Tailings Dam is approximately 135 feet tall and approximately 1,200 feet long. The dam crest is approximately 15 feet wide and the downstream slope varies from approximately 2.0H:1V to 4.5H:1V. The tailings dam is inactive and both the dam and impoundment has been reclaimed and revegetated. The total storage volume of the entire tailings storage facility is approximately 12,500 acre feet and covers approximately 293 acres.

Surface water is conveyed across the tailings impoundment surface via multiple drainage swales and channels to six surface ponds, designated as Ponds 1 through 6. Water stored within the surface ponds will either be allowed to evaporate or infiltrate into the tailings impoundment. Excess surface water reporting to each of these ponds will overflow the individual pond and report the next pond downstream. In general, water will flow from Pond 1 to Pond 2 to Pond 3 to Pond 4 and then to Pond 5 from the north side of the impoundment. In general, water will flow from Pond 6 to Pond 5 on the west side of the impoundment. Excess surface water from Pond 5 is conveyed off the Magmont Dam reservoir through an open channel spillway. The lower portion of the spillway cross section, identified as the primary spillway, is lined with concrete. The remaining upper portion, identified as the emergency spillway, is earthen and lined with grass or other vegetation.

NOTIFICATION PROCEDURE

This EAP provides general guidance for recognizing and characterizing an emergency situation(s) occurring at the dam. The dam owner, or dam owner's representative, should act quickly to evaluate the emergency situation and then follow the notification procedures according to the corresponding level of emergency. A summary of emergency service contacts is provided in Table 1.

After the emergency level has been determined, the people on the notification charts for the appropriate emergency level shall be notified immediately. Expected actions to be taken once this EAP has been activated are summarized in the Expected Actions section of this EAP.

ROLES AND RESPONSIBILITIES

Dam Owner (Teck American Incorporated)

- As soon as an emergency event is observed or reported, immediately determine the emergency level.
  - Level 1: Unusual event, slowly developing
  - Level 2: Potential dam failure situation, rapidly developing

    - Level 3: Dam failure appears imminent or is in progress
- Immediately notify the personnel in the order shown on the notification chart for the appropriate level.
- Provide situation updates to the State Emergency Management Agency to assist them in making timely and accurate decisions regarding warnings and evacuations.
- Provide leadership to assure the EAP is reviewed and updated annually and copies of the revised EAP are distributed to all who received copies of the original EAP.

Dam Owner's Engineer of Record (Haley & Aldrich, Inc.)

- Advise the dam owner of the emergency level determination, if time permits.
- Advise the dam owner of remedial actions to take if a Level 2 event occurs, if time permits.

State Engineer

- Advise the dam owner of the emergency level determination, if time permits.
- Advise the dam owner of remedial actions to take if a Level 2 event occurs, if time permits.
- Decide when to terminate the emergency situation (only if emergency situation stays in Level 1).

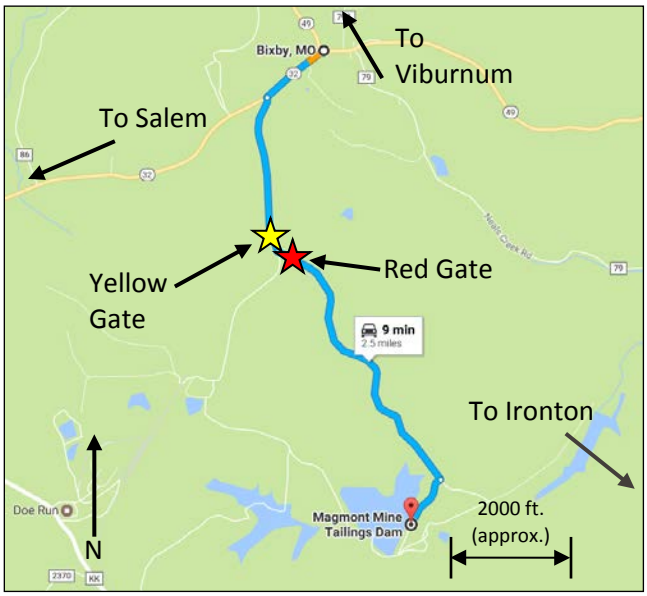
Iron County Sheriff

- Serve as the primary contact person responsible for coordination of all emergency actions.
- When a Level 2 situation occurs: Prepare emergency management personnel for possible evacuations that may be needed if a Level 3 situation occurs.
- When a Level 3 situation occurs:
    - Initiate warnings and order evacuation of people at risk downstream of the dam.
    - Notify local emergency management services to carry out the evacuations of people and close roads within the evacuation area.
- Decide when to terminate the emergency situation (when emergency situation progresses to Level 2 or 3).
- Participate in annual review and update of the EAP.

POTENTIAL IMPACTED AREA

See *Inundation Maps* (Appendix A) and *Residents/Businesses/Entities at Risk* (Table 2) for the locations and contact information of the residents and businesses that may be flooded if the dam should fail and the estimated time for the floodwave to travel from the dam to these locations.

DIRECTIONS TO DAM



Source: Google Maps

From Viburnum, Missouri:

Proceed south along MO-49 to Bixby, Missouri. From Bixby, proceed southwest (turn right) on MO-32W for approximately 0.3 miles then make a left just after the railroad tracks. Proceed 0.7 miles through a yellow gate, then take a slight left through a red gate and continue for 1.3 miles. Turn right and the dam is located approximately 0.3 miles on the right.

The yellow and red gates mentioned above may potentially be locked. These locks may be unlocked by calling 573-626-4813 (Buick, a Doe Run Subsidiary 24-hour emergency phone number).

From Salem, Missouri:

Proceed east on MO-32E towards Bixby. Travel approximately 26 miles turning right approximately 2 miles east of Road KK, just before the railroad tracks. Proceed 0.7 miles through a yellow gate, then in approximately 100 feet take a left passing through a red gate and continue for 1.3 miles. Turn right and the dam is located approximately 0.3 miles on the right.

The yellow and red gates mentioned above may potentially be locked. These locks may be unlocked by calling 573-626-4813 (Buick, a Doe Run Subsidiary 24-hour emergency phone number).

From Ironton, Missouri:

Travel north on MO-21 for approximately 4.3 miles. Turn left to continue on MO-21. After turning, travel approximately 6.8 miles and turn left on MO-32. Proceed approximately 25.0 miles to Bixby. Approximately 0.3 miles past Bixby, turn left just after the railroad tracks. Proceed 0.7 miles through a yellow gate, then in approximately 100 feet take a left passing through a red gate and continue for 1.3 miles. Turn right and the dam is located approximately 0.3 miles on the right.

The yellow and red gates mentioned above may potentially be locked. These locks may be unlocked by calling 573-626-4813 (Buick, a Doe Run Subsidiary 24-hour emergency phone number).

Guidance for Determining the Emergency Level

This information should be used as a general guide for recognizing and characterizing the type of emergency situation occurring at the dam. The dam owner should notify the appropriate emergency contacts based upon the emergency level assigned to each situation. Not all emergency conditions may be listed, and the dam owner is urged to use conservative judgment in determining whether a specific condition should be defined as an emergency situation at the dam.

LEVEL 1 EMERGENCY: NONEMERGENCY, UNUSUAL EVENT, SLOW TO DEVELOP

This situation is not normal but has not yet threatened the operation or structural integrity of the dam but possibly could if it continues to develop. The Engineer of Record and State of Missouri Dam Safety Officials should be contacted to investigate the situation and recommend actions to be taken. The condition of the dam should be closely monitored, especially during storm events, to detect any development of a potential or imminent dam failure situation. The Iron County Sheriff should be informed if it is determined that the conditions may possibly develop into a worse condition that may require emergency actions.

Examples of a Level 1 Emergency include:

- Reservoir level rises to within 10 feet below the dam crest.
- New seepage areas in or near the dam.
- New cracks in the embankment greater than ¼-inch wide without seepage.
- Visual movement/slippage/sloughs/bulges of the embankment greater than 10 cubic feet of material.
- Subsidence of the embankment slope or crest with a depth greater than 2 feet deep.
- Greater than usual observed flow from the toe drains or in the left fork of Neals Creek.
- Instrumentation readings beyond threshold values.
- Measurable earthquake felt or reported at the site or near the towns of Salem and/or Farmington.
- Damage (vandalism/sabotage) to dam or appurtenances with no obvious impact to the functioning of the dam.
- Modification (vandalism/sabotage) to the dam or appurtenances that could adversely impact the functioning of the dam.

LEVEL 2 EMERGENCY: POTENTIAL DAM FAILURE SITUATION, RAPIDLY DEVELOPING

This situation may eventually lead to dam failure and flash flooding downstream, but there is not an immediate threat of dam failure. The Iron County Sheriff should be notified of this emergency and placed on alert. The dam owner should closely monitor the condition of the dam and periodically report the situation to the Iron County Sheriff. If the dam conditions worsens and failure becomes imminent, the Iron County Sheriff must be notified immediately to evacuate the people at risk downstream.

If time permits, the Engineer of Record and State of Missouri Dam Safety Officials should be contacted to evaluate the situation and recommend remedial actions to prevent failure of the dam. The dam owner should initiate remedial repairs (see Appendix E for lists of expected actions for different observations). Time available to employ remedial actions may be hours or days.

Examples of a Level 2 Emergency include:

- Spillway flowing with active gully erosion.
- Reservoir level rises to within 5 feet below the dam crest.
- Cloudy discharge in the toe drains or in Left Fork of Neals Creek.
- New seepage areas with cloudy discharge or increasing flow rate or sand boils in or downstream of the dam.
- Observation of sinkhole in impoundment area or in the embankment, or observation of tailings downstream in the vicinity of the dam.

- Cracks in the embankment with seepage.
- Earthquake resulting in visible damage to the dam or appurtenances.
- Verified bomb threat that, if carried out, could result in damage to the dam.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in seepage flow.

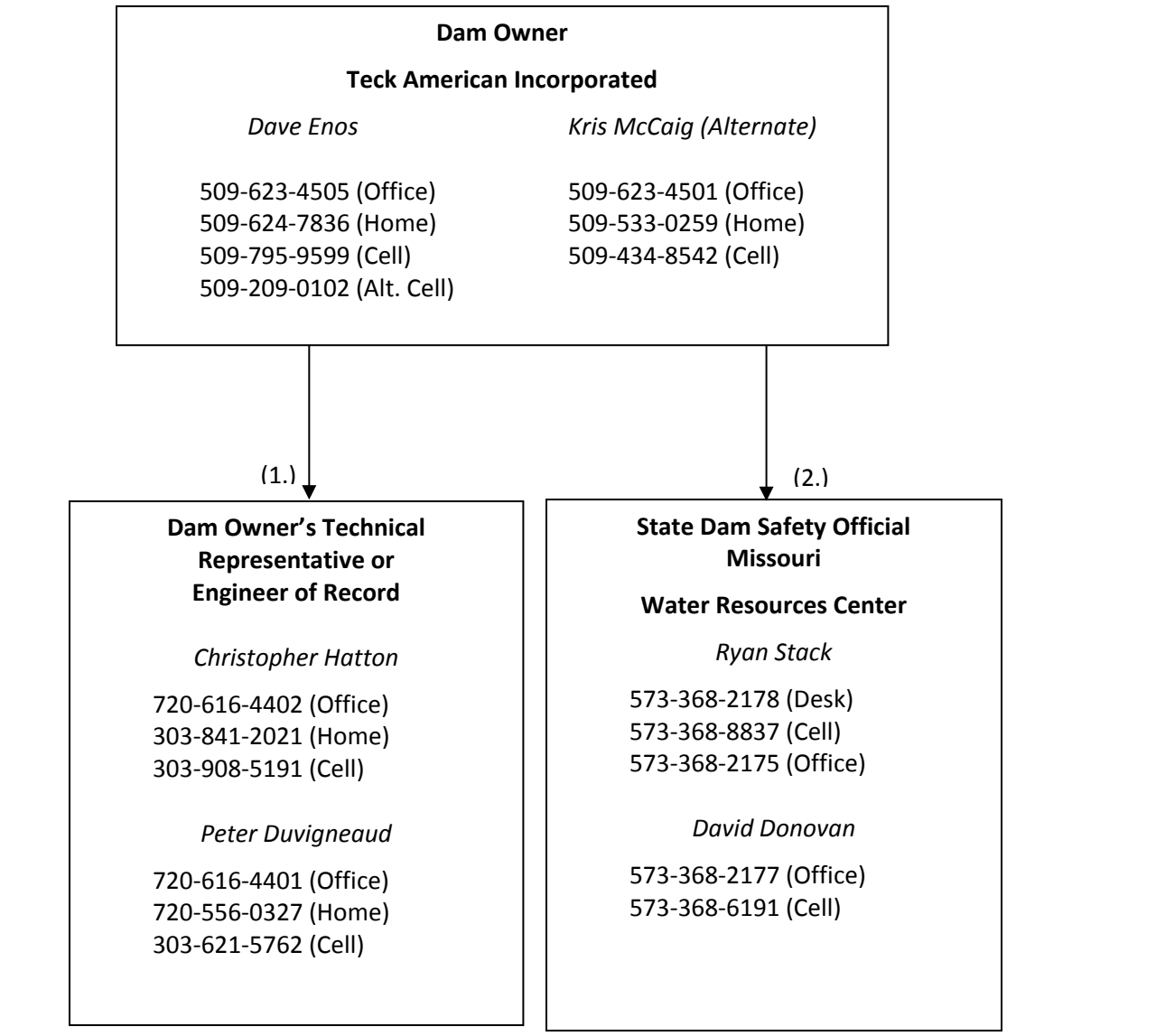
LEVEL 3 EMERGENCY: URGENT; DAM FAILURE IMMINENT OR IS IN PROGRESS

This is an extremely urgent situation when a dam failure is occurring or obviously about to occur and cannot be prevented. Flash flooding will occur downstream of the dam. The Iron County Sheriff should be contacted immediately so emergency services can begin evacuations of all at-risk people and close roads as needed (see Inundation Maps in Appendix A).

Examples of a Level 3 Emergency include:

- Spillway flowing with an advancing headcut that is threatening the dam crest and/or spillway entrance (control section).
- Reservoir water level rises to within 1 foot below the dam crest.
- Seepage that is eroding soil from within the embankment or rapidly increasing in flow rate.
- Rapidly enlarging sinkhole or crack.
- Sudden or rapidly progressing slides of the embankment slopes.
- Earthquake resulting in uncontrolled release of water or solids from the dam.
- Detonated bomb that has resulted in damage to the dam or appurtenances.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in uncontrolled water release.

Level 1 Emergency Notifications
Nonemergency, Unusual Event; Slow to Develop

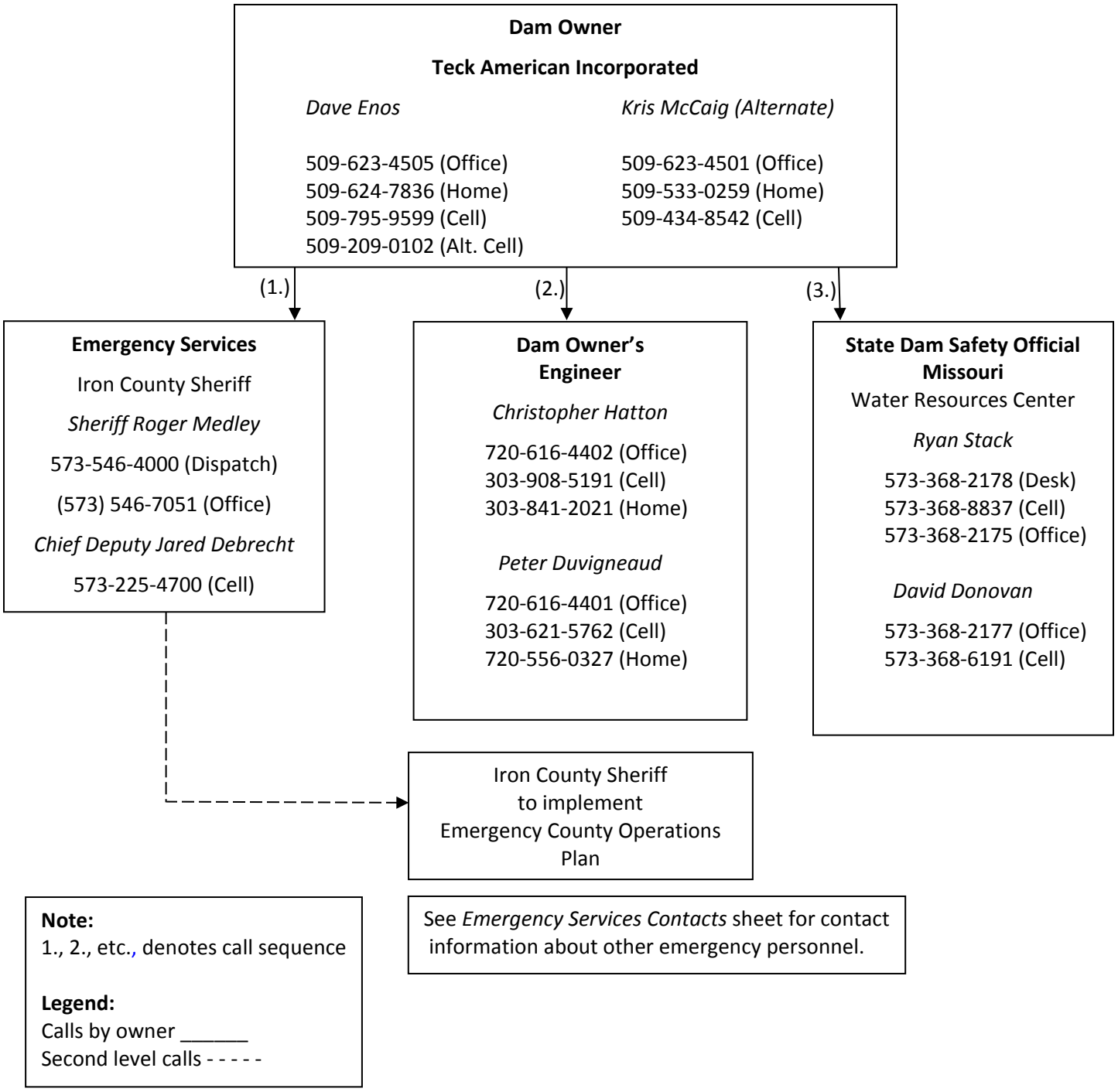


Note:
1., 2., etc., denotes call sequence

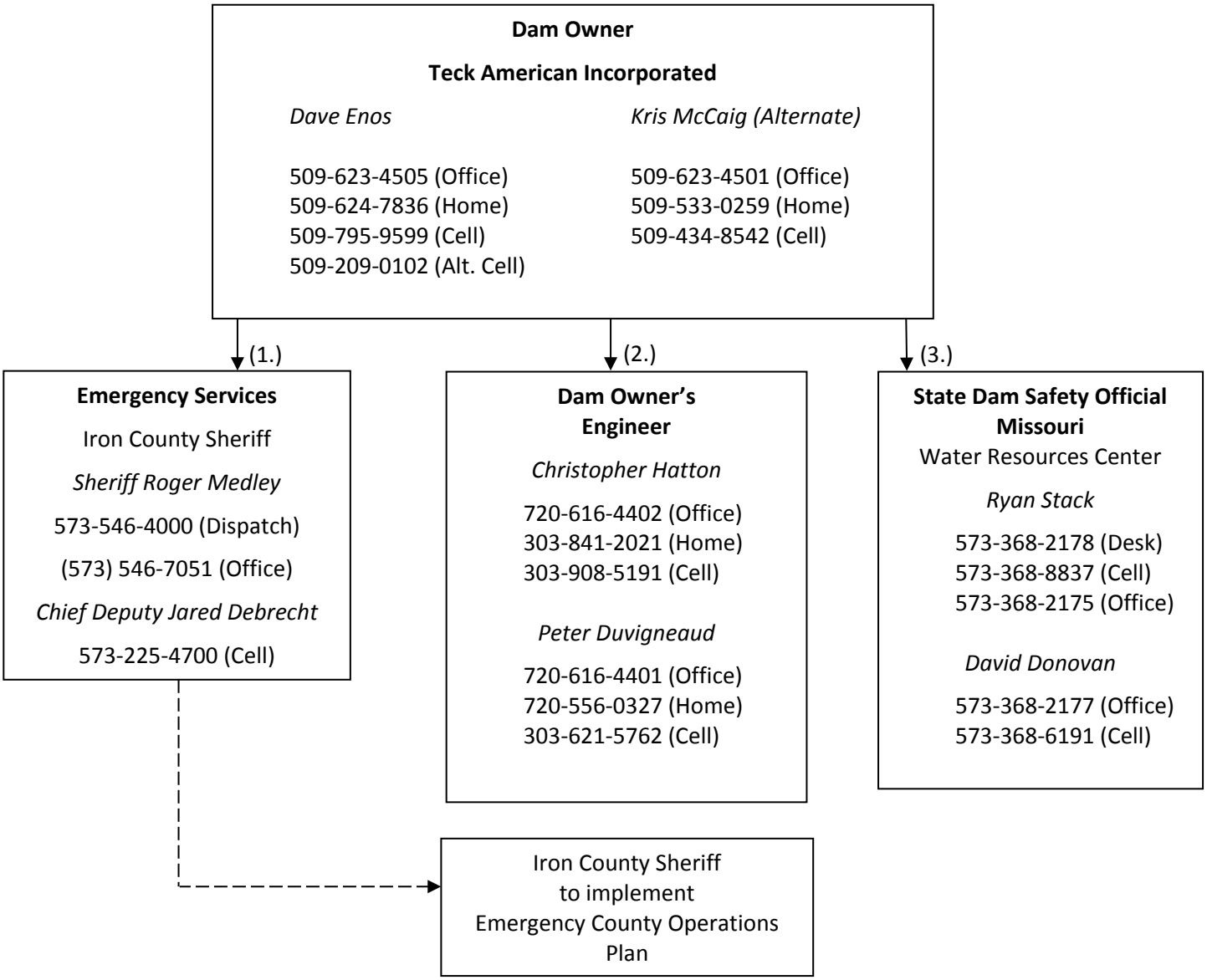
Legend:
Calls by owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Level 2 Emergency Notifications
Emergency Event, Potential Dam Failure Situation, Rapidly Developing



Level 3 Emergency Notifications
Urgent Event, Dam Failure Imminent or Is In Progress



Note:
1., 2., etc., denotes call sequence

Legend:
Calls by owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about other emergency personnel.

Table 1: Emergency Services Contacts

Agency / Organization	Principal Contact	Address	Office Phone No. with Area Code	Alternate Telephone Numbers
Owner/Representative of Magmont Lower Lake Dam Teck American Incorporated	Dave Enos	501 N. Riverpoint Blvd., Suite 300 Spokane, WA 99202	509-623-4505 (W) 509-795-9599 (C)	509-264-7836 (H) 509-209-0102 (C)
	Kris McCaig (Alt)	501 N. Riverpoint Blvd., Suite 300 Spokane, WA 99202	509-623-4501 (O)	509-533-0259 (H) 509-434-8542 (C)
Owner's Engineer (Resident Engineer)	Terry Perkins	199 CR 5013 Salem, MO 65560	573-247-2201	573-729-9173 (M) 573-247-2201 (C)
	Mark Nations (Alt)	1001 Diamond Ridge Jefferson City, MO	573-638-6015	573-604-2772 (C)
Owner's Engineer of Record	Chris Hatton	8101 E. Prentice Ave., Ste. 600 Greenwood Village, CO 80111	720-616-4402 (O)	303-841-2021 (H) 303-908-5191 (C)
	Peter Duvigneaud (Alt)	8101 E. Prentice Ave., Ste. 600 Greenwood Village, CO 80111	720-616-4401 (O)	720-556-0327 (H) 303-621-5762 (C)
Site Watchman	Lee Zufelt	63 Dent County Road 2135 Rolla, MO 65401		573-729-5652 (H) 573-247-8495 (M)
Water Resources Center Dam and Reservoir Safety Program	Ryan Stack, Chief Engineer	111 Fairgrounds Rd. Rolla, MO 65401	573-368-2178	573-368-8837
SEMA Duty Officer	Mark Winkler	Clinton Building 501 Campanella Dr. Sikeston, MO 63801	(573) 290-5125	
Department of Natural Resources Emergency Response	Duty Officer EER	P.O. Box 176 Jefferson City, MO 65102	**24 HOUR NO:** 573-634-2436	573-526-3348 (Heather Rustemeyer, Support Staff, EER)
Buick, a Doe Run Subsidiary 24-hour emergency phone number			573-626-4813	
Iron County Sheriff/ Iron County Emergency Management Coordinator	Roger Medley	220 S. Shepherd St Ironton, MO 63650	573-546-7051 573-546-7052 (Alt)	573-546-4000 (24 hour Dispatch No.)
Quad County Fire Protection District	Robert Hicks	Viburnum, MO	573-244-5220 573-244-5575 (Alt)	
Viburnum Police and Emergency Management Director	David Hedrick, Chief of Police	#1 Missouri Ave., Viburnum, MO 65566	573-244-5220 573-244-5528 (Alt)	
Iron County Highway Department	Supervisor	36620 Hwy 21, Lesterville, MO 63654	573-637-2668 (work hours)	573-558-2475 Patty Pogue (non-work hours)

Table 1: Emergency Services Contacts Continued

Agency / Organization	Principal Contact	Address	Office Phone No. with Area Code	Alternate Telephone Numbers
National Weather Service	Steve Runnels	Springfield, MO	417-863-1456	
Missouri Department of Transportation	Emergency Operation Center 24-hour cell no.		(573) 522-9503	
Missouri Department of Transportation	County Shed	3956 E. Main St. Willow Springs, MO 65793	417-469-3134	888-275-6636
Missouri Highway Patrol (Troop E)	Captain George Ridens	4947 Highway 67 North Poplar Bluff, MO 63901	573-840-9500	
Mark Twain National Forest (Potosi District)		10019 W State Hwy 8 Potosi, MO 63664	(573) 438-5427	
St. Louis TV Stations	**Contact Name**	Contact Address	**Primary Phone**	**Alternate Phone**
KTVI Channel 2 – Fox		2250 Ball Dr. Saint Louis, MO 63146	(314) 647-2222	Assignment Desk: (314) 213-7831
KMOV Channel 4 – CBS		One Memorial Drive St. Louis, MO 63102	314-621-4444	News: 314-444-6333
KSDK Channel 5 – NBC		1000 Market Street St. Louis, MO 63101	314-421-5055	News: 314-444-5125
KETC Channel 9 – PBS		3655 Olive St St. Louis, MO 63108-6915	314-512-9000	Public Relations: (314) 512-9036
KPLR Channel 11		2250 Ball Dr. Saint Louis, MO 63146	(314) 213-2222	Assignment desk: (314) 213-7831
KDNL Channel 30 – ABC		1215 Cole Street Saint Louis, MO 63106	314-436-3030	
Local Radio Stations	**City**	**Contact Address**	**Primary Phone**	**Alternate Phone**
J-98 (KREI)	Farmington	P.O. Box 461 Farmington, MO 63640	573-756-6476	573-756-6000
KFMO	Park Hills		573-431-2000	431-5588
KSMO	Salem	800 S. Main Salem, MO 65560	573-729-6117	
Froggy 96	Farmington	900 East Karsch Boulevard Farmington, MO 63640-3405	573-701-9590	
KTTR – KZNN	Rolla	1505 Soest Road Rolla, MO 65401	573-364-2525	
KMST	Rolla	400 W. 14th Street G-6 Library Rolla, MO 65409	573-341-4386	
KGNN	Cuba	P.O. Box 187 Washington, MO 63090	877-385-3787	

Table 2: Residents/Businesses/Entities/Infrastructure at Risk

Entity No.	Resident/business or other impacted entity	Address	Distance downstream from dam (miles)	Time to 2-ft Inundation (minutes)
1	Mabel Asher (Residence)	4281 County Road 79 Bixby, MO 65439	1.7	45
2	Neals Creek Rd (Co Rd 79)	N/A	1.7 to 2.7	45
3	U.S. Government Owned Structure	625 County Road 79 Bixby, MO 65439	2.4	55
4	Co Rd 78	N/A	3.7	100
5	Co Rd 79 from CR Rd 78 to CR Rd 74	N/A	3.7 to 4.7	100-200
6	Vernon Etal Asher (Residence)	County Road 79 Bixby, MO 65439	4.1	140
7	Co Rd 74 from CR Rd 78 North 0.3 miles	N/A	4.7	210
8	Jeff & Angela Asher (Residence)	1537 County Road 74 Bixby, MO 65439	4.8	240
9	Co Rd 74 from CR Rd 78 South to Co Rd 70	N/A	4.7 to 6.4	210-600
10	Roger Henson (Residence)	2830 County Road 74 Bixby, MO 65439	6.0	460
11	Montie Asher (Residence)	3297 County Road 74 Bixby, MO 65439	6.4	600
12	Co Rd 74 from CR Rd 70 South to Co Rd 69 and Junction with Buick Rd	N/A	6.4 to 6.9	600-840
13	Co Rd 66	N/A	7.7 to 9.4	1170-2400

Table 2: Residents/Businesses/Entities/Infrastructure at Risk Continued

Entity No.	Resident/business or other impacted entity	Address	Distance downstream from dam (miles)	Time to 2-ft Inundation (minutes)
14	Steven & Kathy Crocker (Residence)	1681 County Road 66 Black, MO 63625	8.5	2100

Resources Available

Locally available resources include: (if not available please note)

Heavy Equipment Service and Rental	**Sand and Gravel Supply**	**Ready-mix Concrete Supply**
Tony Abney Construction, LLC 45 Vine Street Viburnum, MO 65566 573-244-3145 (o) 573-729-5773 (f) Zoellner Construction Co., Inc. 875 Pcr 500 Perryville, MO 63775 573-547-8030 Yoder Jr. & Sons 1472 State Hwy 47 Bonne Terre, MO 63628 573-358-4085 Hall & Co 1518 Main Street Leadwood, MO 63653 573-562-7685	Central Stone 2339 Hwy H, Farmington, MO 63640 573-747-3000	Politte Ready Mix, Inc. 21 Thompson Road Arcadia, MO 63621 573-546-7316 Schrum Ready Mix 22885 MO-21 Caledonia MO, 63631 573-779-3708 Mills Ready Mix 350 Iron 144 Annapolis MO 573-598-3577
Pumps	**Other**	**Sand Bags**
Heartland Pumps 1800 Supply Road Suite A Cartville, IL 62918 618-985-5110 Lead Belt Pump and Supply 204 Elvins Blvd. E Park Hills, MO 63601 573-431-2476	Poly Systems 3 Industrial Drive Steelville, MO 573-775-3300 Mid State Paving, Inc. 7653 Hardecke Road Sullivan, MO 63080 573-627-2039	The Mine Supply CO 85 Highway 49 Viburnum, MO 573-244-5416

Call-Out Procedures

The following sections provide guidance and procedures that may be used when calling out to notify appropriate personnel when activating appropriate emergency levels of this Emergency Action Plan.

LEVEL 1 EMERGENCY: NONEMERGENCY, UNUSUAL EVENT SLOW TO DEVELOP

The Dam Owner and Engineer of Record should contact the Missouri State Engineer. Describe the situation and request technical assistance on the next steps to take.

LEVEL 2 EMERGENCY: POTENTIAL DAM FAILURE SITUATION, RAPIDLY DEVELOPING

The following message may be used to help describe the emergency situation to the Sheriff or Emergency Management Personnel:

"This is _____(Identify yourself, name, position)_____.

We have an emergency condition at the Magmont Tailings Dam, located approximately 6.5 miles south of Viburnum and 2 miles south of Bixby.

We have activated the Emergency Action Plan for this dam and are currently under a Level 2 Emergency.

We are implementing predetermined actions to respond to a rapidly developing situation that could result in dam failure.

Please prepare to evacuate the area along low-lying portions of Neals Creek between the towns of Bixby and Black.

Reference the flood inundation maps in your copy of the Emergency Action Plan.

We will advise you when the situation is resolved or if the situation gets worse.

I can be contacted at the following number_(state your number)__. If you cannot reach me, please call the following alternative number _(state that number)__. "

LEVEL 3 EMERGENCY: URGENT; DAM FAILURE IMMINENT OR IS IN PROGRESS

The Sheriff should be contacted immediately and the area evacuated. The following actions should be taken:

1) Call the Sheriff's dispatch center. Be sure to say, "This is an emergency." They will call other authorities and begin the evacuation. The following message may be used to help describe the emergency situation to the Sheriff or Emergency Management Personnel

   "This is an emergency. This is _____(Identify yourself, name, position)_____.

   The Magmont Tailings Dam located approximately 6.5 miles south of Viburnum and 2 miles south of Bixby, is failing. The downstream area must be evacuated immediately. Repeat, the Magmont Tailings Dam is failing; evacuate the area along low-lying portions of Neals Creek between the towns of Bixby and Black immediately.

We have activated the Emergency Action Plan for this dam and are currently under Level 3 Emergency. Reference the inundation map in your copy of the Emergency Action Plan.

I can be contacted at the following number __(state your number)_. If you cannot reach me, please call the following alternative number _(state that number)__."

2) Do whatever is necessary to bring people in immediate danger (anyone on the dam, downstream from the dam, or evacuees) to safety if directed by the Sheriff.

3) Keep in frequent contact with the Sheriff and Emergency Services to keep them up-to-date on the condition of the dam. They will tell you how you can help handle the emergency.

4) If all means of communication are lost: 1) try to find out why, 2) try to get to another radio or telephone that works, or 3) get someone else to try to re-establish communications. If these means fail, handle the immediate problems as well as you can, and periodically try to re-establish contact with the Sheriff and Emergency Services.

The following pre-scripted message may be used as a guide for the Sheriff or Emergency Services personnel to communicate the status of the emergency with the public.

Attention: This is an emergency message from the Sheriff. Listen carefully, Your life may depend on immediate action.

The Magmont Tailings Dam, located approximately 6.5 miles south of Viburnum and 2 miles south of Bixby, is failing. This will impact low lying areas along Neals Creek between the towns of Bixby and Black. If you are near this area, proceed immediately to high ground away from the valley. Do not travel west on Neals Creek Road (County Road 79) or return to your home to recover your possessions. You cannot outrun or drive away from the floodwave. Proceed immediately to high ground away from the valley.

Repeat message.

Expected Actions

The following actions should be taken after the Dam Owner determines the emergency level. If time permits, the Engineer of Record and the State of Missouri Dam Safety Officials should be contacted for technical consultation.

LEVEL 1 EMERGENCY: NONEMERGENCY, UNUSUAL EVENT, SLOW TO DEVELOP

A. The Dam Owner should inspect the dam and spillways. At a minimum, inspect the full length of the upstream slope, crest, downstream slope, and downstream toe. Also, check the impoundment area, abutments, and downstream channel for signs of changing conditions. **If increased seepage, erosion, cracking, or settlement are observed, immediately report the observed conditions to the Engineer of Record and the State of Missouri Dam Safety Officials; refer to pages 6 and 7 for guidance for determining the appropriate event level for the new condition and refer to Appendix E for recommended actions.**

B. Record all contacts that were made on the Unusual or Emergency Event Log form. Record all information, observations, and actions taken on the Event Log Form. Note the time of changing conditions. Document the situation with photographs and video, if possible.

C. The Dam Owner should contact the Engineer of Record and the State of Missouri Dam Safety Officials to request technical staff to investigate the situation and recommend corrective actions.

LEVEL 2 EMERGENCY: POTENTIAL DAM FAILURE SITUATION, RAPIDLY DEVELOPING

A. The Dam Owner should contact Emergency Services to inform him/her that the EAP has been activated and if current conditions get worse, an emergency situation may require evacuation. Preparations should be made for possible road closures.

B. The Dam Owner should contact the Engineer of Record and the State of Missouri Dam Safety Officials to report the situation and, if time permits, request technical staff to investigate the situation and recommend corrective actions.

C. The Dam Owner should provide updates to Emergency Services personnel to assist them in making timely decisions concerning the need for warnings, road closures, and evacuations.

D. Emergency Services shall implement the Incident Command System and execute the Emergency County Operations Plan.

E. If time permits, the Dam Owner should inspect the dam. At a minimum, inspect the full length of the upstream slope, crest, downstream slope, and downstream toe. Also, check the impoundment area, abutments, and downstream channel for signs of changing conditions. If increased seepage, erosion, cracking, or settlement are observed, immediately report the observed conditions to the Engineer of Record and the State of Missouri Dam Safety Officials; refer to the emergency level table for guidance in determining the appropriate event level for the new condition and recommended actions.

F. Record all contacts that were made on the Contact Checklist. Record all information, observations, and actions taken on the Event Log Form. Note the time of changing conditions. Document the situation with photographs and video, if possible.

G. If time permits, emergency remedial actions should be taken as appropriate. Suggested remedial actions for various events are provided in Appendix E.

LEVEL 3 EMERGENCY: URGENT; DAM FAILURE IMMINENT OR IS IN PROGRESS

A. The Dam Owner shall immediately contact Emergency Services and others shown in the notification chart.

B. Emergency Services shall implement the Incident Command System and execute the Emergency County Operations Plan.

C. Emergency Services shall lead the efforts to carry out warnings, close roads, and evacuate people at risk downstream of the dam (See Inundation Map in Appendix A).

D. Emergency Services shall notify the public and immediately evacuate at-risk people and close roads, as necessary.

E. The Dam Owner shall maintain continuous communication and provide Emergency Services with updates of the situation to assist him/her in making timely decisions concerning warnings and evacuations.

F. Record all contacts that were made on the Contact Checklist. Record all information, observations, and actions taken on the Event Log Form. Note the time of changing conditions. Document the situation with photographs and video, if possible.

G. Advise people monitoring the dam to follow safe procedures. Everyone should stay away from any of the failing structures or slopes and out of the potential breach inundation areas.

EAP Termination

Whenever the EAP has been activated, an emergency level has been declared, all EAP actions have been completed, and the emergency is over, the EAP operations must eventually be terminated and follow-up procedures completed.

TERMINATION RESPONSIBILITIES

The State Engineer is responsible for terminating EAP operations for Level 1 emergencies and relaying this decision to the Dam Owner. It is then the responsibility of the Dam Owner to notify the Engineer of Record that the event has been terminated.

Emergency services is responsible for terminating EAP operations for Levels 2 and 3 and relaying this information to the Dam Owner. It is then the responsibility of each person to notify the same group of contacts that were notified during the original event notification process to inform those people that the event has been terminated.

Prior to the termination of an Emergency Level 3 event that has not caused actual dam failure, the Engineer of Record or a Missouri State Dam Safety Official will inspect the dam or require inspection of the dam to determine whether any damage has occurred that could potentially result in loss of life, injury, or property damage. If it is determined that conditions do not pose a threat to people or property, Emergency Services will be advised to terminate EAP operations as described above.

The Dam Owner shall assure that the Dam Safety Emergency Situation Report is completed to document the emergency event and all actions that were taken. The Dam Owner shall distribute copies of the completed report to the State of Missouri Dam Safety Engineer and the Engineer of Record.

Appendix A: Inundation Study

Inundation Map vs. Evacuation Area

Inundation maps have been developed from best available information using reasonable assumptions and standardized methods. They are approximations of the maximum water surface extents resulting from a complete dam breach and draining of the full reservoir. Inundation maps are empirical hydrologic and hydraulic simulations that can only be field verified in the event of an actual breach.

Evacuation areas and call lists should take into consideration the anticipated local impacts of flooding; knowledge of local infrastructure, both occupancy and ownership; and potentially interrupted services or cut-off access, which would be caused by dam failure. Depending upon actual circumstances, appropriate alert and evacuation areas could be more or less extensive than the simulated inundation zones.

See attached pages

HALEY & ALDRICH, INC.
8101 E. Prentice Avenue
Suite 600
Greenwood Village, CO 80111
720.616.4400

MEMORANDUM

31 May 2018
File No. 129123-003

TO: Mr. Dave Enos
Manager, Dormant Properties

FROM: Haley & Aldrich, Inc.
Bradley W. Rastall, P.E.
Chris Jones, P.G.

SUBJECT: Flood Hydrology and Dam Failure Modeling for Magmont Tailings Dam to Support Emergency Action Plan (EAP) Development

Background

The Magmont Tailings Dam is an inactive tailings storage facility located approximately 2 miles south of Bixby, Missouri, on the left fork of Neal's Creek in Iron County. The dam is maintained by Teck American, Inc, (TAI). The tailings dam is a jurisdictional structure that has been reclaimed and is currently under care and maintenance. The dam's current estimated height at the time of this analyses is approximately 135 feet (ft) with a crest length of approximately 1,350 ft as scaled from topographic mapping. TAI reports the impoundment surface is covered with approximately 2 to 3 ft of clay, the gravity decant structure has been grouted closed, and the spillway located on the right abutment reportedly can convey stormwater flows from the 5,000-year event demonstrated by results in previous studies.

Table 1
Summary of Magmont Tailings Dam Information

Feature	Units	Tailings Dam
Dam Crest Elevation	ft MSL	1315.8
Dam Crest Length	ft	1350
Spillway Elevation	ft MSL	1303.4
Spillway Capacity (1)	cfs	4265
Water Volume at Normal Pool (2)	af	0
Volume at Maximum Pool (1)	af	559

Notes:
1. When reservoir pool is at dam crest elevation.
2. Water detention volume.

Scope of Work

TAI guidelines require the Magmont Tailings Dam can safely pass and/or store the volume of water identified as being 1/3 between the 1,000-year flood and the Probable Maximum Flood (PMF). The State of Missouri requires that the Magmont Tailings Dam spillway safely pass 75 percent of the Probable Maximum Precipitation (PMP). Analyses performed by Brian Swenty in 2004 indicated the Magmont Tailings Dam met State of Missouri requirements of the PMP. The 2004 analyses did not include an evaluation of the 1,000-year event.

Haley & Aldrich, Inc. (Haley & Aldrich) identified the volumes of water generated by the 1,000-year storm, the TAI and State of Missouri design storms, and the PMF as well as updating the PMP analyses. The calculated inflow hydrographs and resulting water volumes were routed through our model of the watershed to evaluate the capacity of each spillway to verify conformity to State requirements and to evaluate estimated storage capacity for TAI requirements.

State of Missouri and TAI guidelines for EPRP (designated as Emergency Action Plan by State of Missouri) development require a dam breach analysis with flood inundation mapping to identify potential downstream impacts and hazards. The dam breach analysis was developed using a computer program to model theoretical failure scenarios including overtopping and piping (“sunny day”) failure of the dam. The model was used to generate a flow hydrograph during a theoretical failure. The hydrograph was routed downstream to estimate the inundation limits, flow depth, velocity and the timing of the modeled flood wave.

This memorandum provides a summary of the modeling methodologies, results, and inundation mapping to be included as an appendix to the EPRP.

We have made the following general assumptions and modeled the following conditions:

1. Breach opening was assumed to occur at the maximum section of the tailings dam embankment.
2. The dam break analysis with corresponding flood inundation limits for the Magmont Tailings Dam will only be modeled for sunny day dam break conditions.

A cascading overtopping failure of the Lower Lake Dam was not being modeled as the water volume stored in the Lower Lake Dam is considered to be a negligible contributor to the overall volume of material released from the tailings dam for this scenario.

Previous Studies (Swenty, 2004)

The following report contains information pertaining to inflow flood hydrology studies performed at the Magmont Facility.

1. Swenty, Brian, J., Registration Permit Application Magmont Tailings Dam Iron County, Missouri, 30 January 2004.

Outflows from the Magmont Tailings Dam spillway flow into the Lower Lake Dam, located approximately 1 mile downstream. Both hydrologic studies included creating a hydrologic model using the HEC-1 computer program to calculate the inflow flood hydrograph resulting from the PMP and routing the flood through the dams. The following table contains a summary of the previous hydrology for the Magmont Tailings Dam.

Table 2
Hydrologic Summary of Previous Probable Maximum Flood Analysis, Magmont Tailings Dam (Swenty, 2003)

Result	Units	Value
Watershed Area	sq. mi	1.277
Probable Maximum Precipitation (75 percent PMP)	inches	21.38
Storm Duration	hours	6
Peak Inflow	cfs	4682
Inflow Volume	af	1147
Time of Peak Inflow	hr:mn	1:36
Peak Outflow	cfs	2429
Time of Peak Outflow	hr:mn	3:12
Peak Stage at Magmont Dam	ft MSL	1313.38

Updated Hydrologic Analysis (Haley & Aldrich, 2017)

The contributing watershed to the Magmont Tailings Dam includes both undisturbed naturally vegetated wooded areas and the reclaimed and revegetated Magmont tailings impoundment surface. Several tributary watersheds contribute runoff to Magmont Tailings Dam and runoff from many of these tributary watersheds is detained on the tailings impoundment behind berms or in depressions existing at the impoundment surface perimeter.

The watershed upstream Magmont Tailings Dam was subdivided to account for runoff reporting to berms and depressions located on the tailings impoundment surface. The sub watershed areas are shown in Table 3, and on Figure 1, included in the Attachments.

Table 3
Magmont Tailings Dam Watershed areas

Watershed Name	Area, acres	Area, square miles
Watershed 1	53.76	0.084
Watershed 2	206.72	0.323
Watershed 3	111.36	0.174
Watershed 4	209.92	0.328
Watershed 5	33.6	0.0525
Magmont Tailings Dam Watershed	105.6	0.165
Total	720.96	1.1265

Haley & Aldrich evaluated the 100-year, 1000-year and PMP rainfall events. The 100-year and 1000-year precipitation values were obtained from NOAA Atlas 14 for Missouri http://www.nws.noaa.gov/oh/hdsc/PF_documents/Atlas14_Volume8. The PMP rainfall was obtained from Hydrometeorlogical Report 52. The precipitation depths for storms of 24-hour duration are shown in Table 4. The 24-hour PMP was selected as it would produce more runoff volume than the previously used 6-hour PMP (Swenty, 2004).

Table 4
Precipitation Summary

Storm	24-hour rainfall depth, inches
100-year	7.43
1000-year	10.20
52.1 Percent PMP (1)	18.87
75 Percent PMP	27.15
100 Percent PMP	36.2

Notes:
1. One third between the 1000-year precipitation and the PMF.

Several precipitation distribution patterns were evaluated to confirm which distribution resulted in the largest peak inflow to Magmont Tailings Dam. These distributions included:

- SCS Type II Distribution
- Huff First Quartile Distribution
- Huff Third Quartile Distribution
- Frequency Based Hypothetical Storm Distribution
- NRCS 5 Point Distribution
- NOAA Atlas Distribution

The Huff 24-hr Q3 distribution resulted in the largest peak flow so this distribution was used for both the 1000-year storm and the PMP.

The SCS Curve Number (CN) was used to calculate infiltration losses assuming initial losses of 0 inches/hour (saturated conditions). The SCS Lag time equation was also used to calculate lag time.

$$T_l = \frac{L^{0.8}(S+1)^{0.7}}{1900 \times Slope^{0.5}}$$

Where:

T_l = Lag Time, hours
L = Channel Length, ft
S = Potential Maximum Retention, inches
Slope = Slope, percent

Lag time was used with the SCS dimensionless hydrograph to convert rainfall excess to runoff. Table 5 shows the curve number and lag time for the sub watersheds.

Table 5
Watershed Parameters

Watershed Name	Curve Number	Lag Time, minutes
1WS	68	9.70
2WS	54	34.13
3WS	54	18.07
4WS	54	18.75
5WS	54	5.86
6WS	54	44.85

Flood Routing

The runoff from the watershed contributing to the Magmont Tailings Dam reports to the tailings impoundment surface where impounded tailings extends up the tributary watersheds. At these locations, the topographic mapping indicates that some water will temporarily be impounded at these locations, and via existing channels and conveyance features between the ponds, be routed toward the spillway. In addition, there are two prominent berms located on the tailings impoundment surface. These are commonly referred to as the North Retention Dike and the West Retention Dike and are modeled and referred to as Ponds 2 and 4, respectively. These features were incorporated into the rainfall runoff model to account for flood attenuation due to detention, and travel time through conveyance features on the tailings impoundment surface. A summary of these features is shown in Table 6.

Table 6
Routing Element Description for Features Located on Magmont Tailings Impoundment Top Surface

Feature	Units	Pond 1	Pond 2 North Retention Dike	Pond 3	Pond 4 West Retention Dike	Pond 5	Magmont Tailings Dam
Description		Small Pond resulting from tailings top surface sloping back toward watershed	Berm on impoundment top surface.	Small Berm on impoundment top surface	Berm on impoundment top surface	Small Pond resulting from tailings top surface sloping back toward watershed	Tailings Dam
Impoundment Max. Elevation	Ft MSL	1336	1333	1347.4	1317.7	1316.6	1315.8
Crest Type		Low point on pond rim	Embankment	Embankment	Embankment	Low point on pond rim	Embankment
Outflow Structure Type		Low point on pond rim	Earth cut channel	Earth cut channel	Earth cut channel	Earth cut channel	Concrete Spillway
Outflow Structure Invert Elevation	Ft MSL	1336	1320	1343	1310	1304.34	1303.4
Maximum Water Storage Volume	af	35.96	375.11	3.36	775.5	204.5	559
Normal Water Surface Elevation	Ft MSL	1330	1318	1343	1290	1294.32	1303.4
Starting Water Surface Elevation for Flood Routing	ft MSL	1333.4	1320	1343	1295	1304.34	1303.4

Hydrologic Results

The HEC-HMS computer program was used to model rainfall over the watershed and convert rainfall excess to runoff on to the watershed surrounding and including the Magmont Tailings Impoundment. The flood routing results at Magmont Tailings Dam are shown in Table 7. The results shown include the detention provided by the structures listed in Table 6 and located on the Magmont tailings impoundment surface.

Table 7
Inflow Flood Hydrology Summary at Magmont Tailings Dam
Starting Water Surface Elevation Existing Conditions

Result	Units	1000-year	52.1 percent PMP	75 percent PMP	100 percent PMP	100 percent PMP (no upstream detention) (2)
Total Rainfall	in	10.2	18.87	27.15	36.2	36.2
Storm Duration	hr	24	24	24	24	24
Runoff Volume	af	67.8	303.4	616.0	1083.4	1675.9
Peak Inflow	cfs	71.4	438.3	763.4	1580.0	2173.4
Starting Water Surface Elevation	ft MSL	1303.4	1303.4	1303.4	1303.4	1303.4
Time of Peak Inflow	hr:mn	22:56	17:52	17:04	17:28	16:00
Peak Outflow	cfs	60.9	335	673.1	1269.4	1833
Time of Peak Outflow	hr:mn	24:54	19:58	18:34	19:06	17:14
Peak Stage	ft MSL	1305.1	1307.7	1309.1	1311.0	1312.3
Freeboard (1)	ft	10.7	8.1	6.7	4.8	3.5

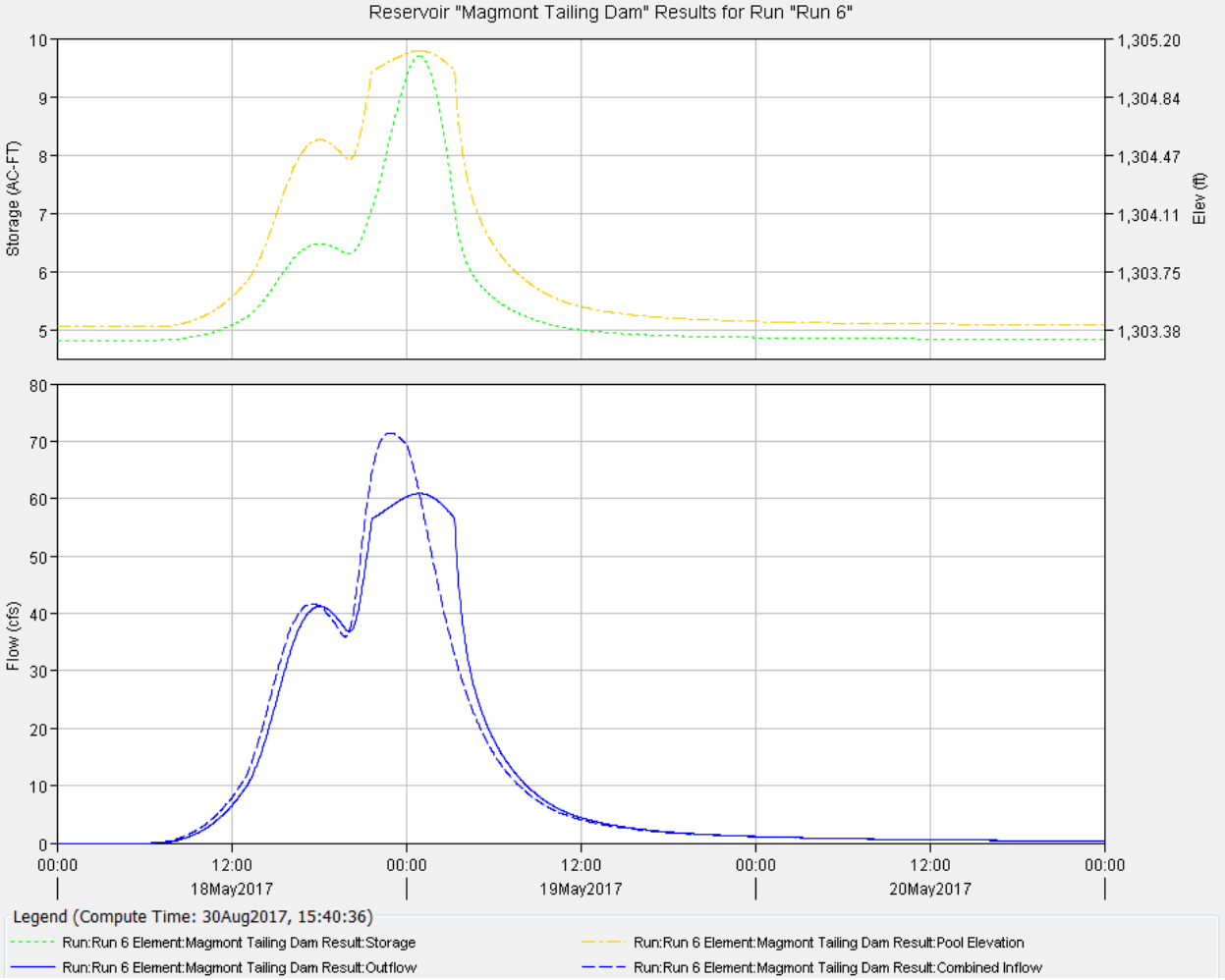
Notes:

1. Freeboard is the vertical distance from the Peak Stage (maximum water surface elevation) to the embankment crest elevation.
2. These results assume no detention (Ponds 1-5) upstream of Magmont Tailings Dam.

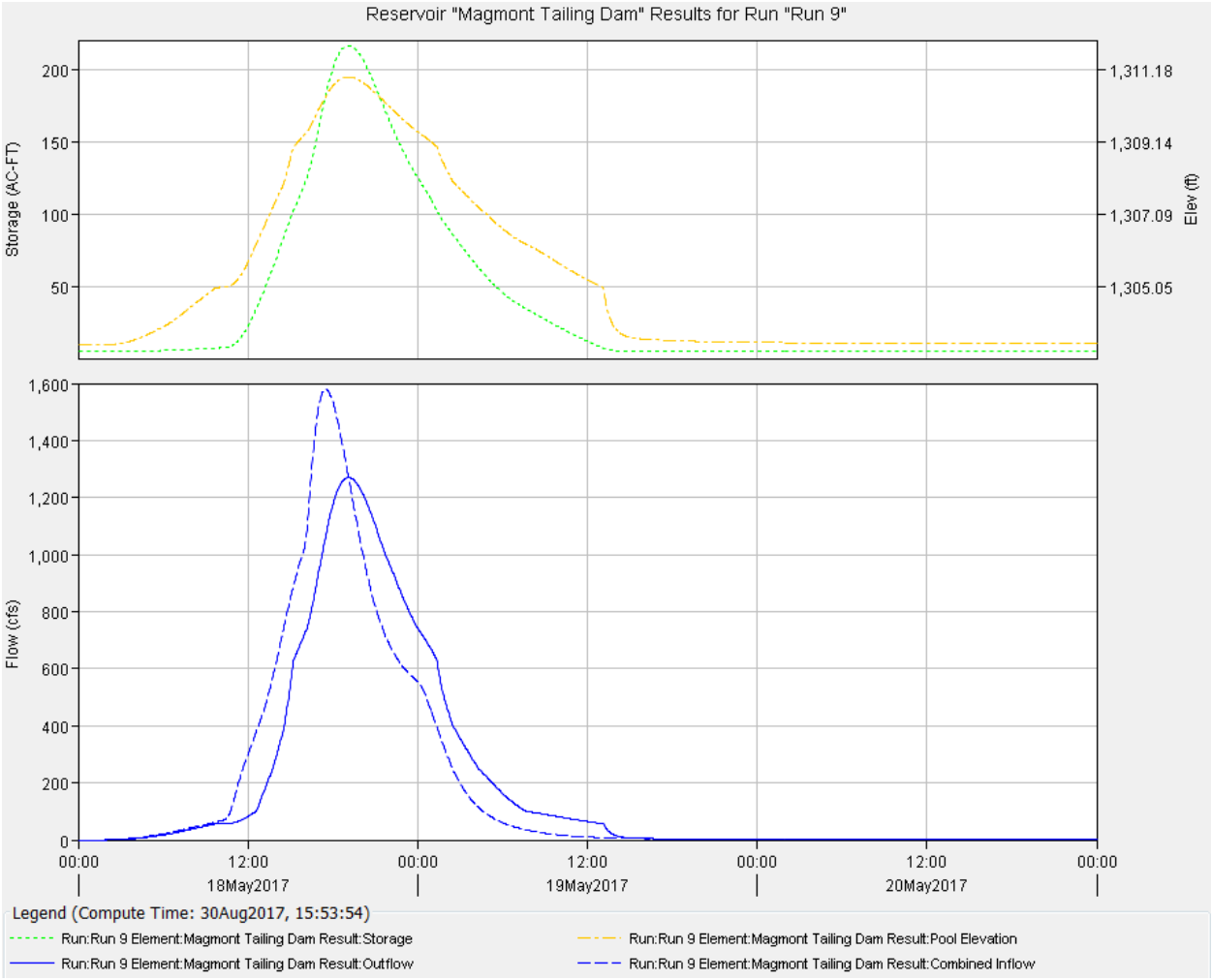
The flood routing results shown in Table 7 include the tailings impoundment surface detention with the assumption that each detention structure located upstream of the Magmont Tailings Dam is full to the level of the 100-year 24-hour storm, or the lowest uncontrolled outlet elevation. These elevations are listed in Table 6. The results for this scenario indicate a peak stage of 1311 feet with approximately 4.8 feet of freeboard. An additional scenario was modeled that included the 100 percent PMF assuming no detention on the tailings impoundment top surface. The routing results indicated a peak stage of 1312.3 with approximately 3.5 ft of freeboard.

The resulting inflow hydrographs for the 1000-year storm, and PMF, are shown in memorandum Details 1 and 2, respectively.

Detail 1
1000-year Inflow and Outflow Hydrographs for Magmont Tailings Dam



Detail 2
PMF Inflow and Outflow Hydrographs for Magmont Tailings Dam



Modeling the Failure of Magmont Tailings Dam

The objective of this tailings dam failure modeling study was to establish the extent of the hypothetical dam failure flood inundation limits downstream of Magmont Tailings Dam. The results were used to prepare flood inundation mapping shown in the Emergency Action Plan (EAP). The process of modeling Tailings dam failure and estimating the resulting flood inundation is not standardized and requires making several assumptions and applying engineering judgment.

Haley and Aldrich, Inc. used a calculation module provided by FLO-2D Software Inc. This module estimates the total tailings release volume and associated outflow hydrograph based on conditions observed at over 60 tailings dam failures over the past four decades. The Magmont Tailings storage facility was entered into the model and the resulting breach flood hydrograph was subsequently routed

in the FLO-2D computer program. The FLO-2D computer program was also used to route the dam breach outflow hydrograph from the tailings dam downstream toward the town of Black, Missouri approximately 17 miles downstream of the tailings storage facility. Material released during a breach of the tailings dam was assumed to behave as a non-Newtonian fluid and as such predicted to travel downstream slower than clear water. Tailings of extremely high concentration (volumetric concentration greater than 50 percent) will flow slowly exhibiting laminar flow. However, under high solids concentration, the downstream movement of the tailings is limited. Hence, the model result indicated that tailings released during a breach would flow approximately 8 miles downstream before stopping. Solids concentrations lower than 45 percent typically act as a turbulent non-Newtonian flow and can often travel significant distance downstream from the tailings dam. We have assumed a maximum sediment concentration of 45 percent.

FLO-2D is a 2-dimensional hydraulic model that is specifically designed for debris flow/ mud flow simulations in channels and floodplains. It is a finite difference model requiring creating a system of square grid elements overlaid on the downstream topographic mapping. The flood hydrograph is routed downstream using the full dynamic wave approximation of the momentum equation. The flood hydrograph is assumed to have hyper concentrated sediment flows and as such the momentum equation includes viscous and yield stresses as a function of sediment concentration.

Breach Assumptions

Tables 8 and 9 show the dam breach parameters used for modeling the failure of Magmont Tailings Dam. These parameters were developed using the tailings dam breach calculation tool included with the FLO-2D computer program.

Table 8
Dam Breach Parameters Magmont Tailings Dam

Parameter	Units	Modeled Value
Modeled Embankment Height	ft	120
Breach Bottom Elevation	ft	1190
Impounded Tailings Volume	ac-ft	7630
Tailings Volume Released (Solids)	ac-ft	298.9
Total Volume Released (Bulked)	ac-ft	668.3
Breach Formation Time	hr:mn	1:00
Modeled Peak Breach Discharge	cfs	30,309

Table 9
Hyperconcentrated Sediment Flow Parameters

Parameter	Coefficient	Exponent
Viscosity vs. Sediment Concentration	0.128	12
Yield Stress vs. Sediment Concentration	0.0473	21.1

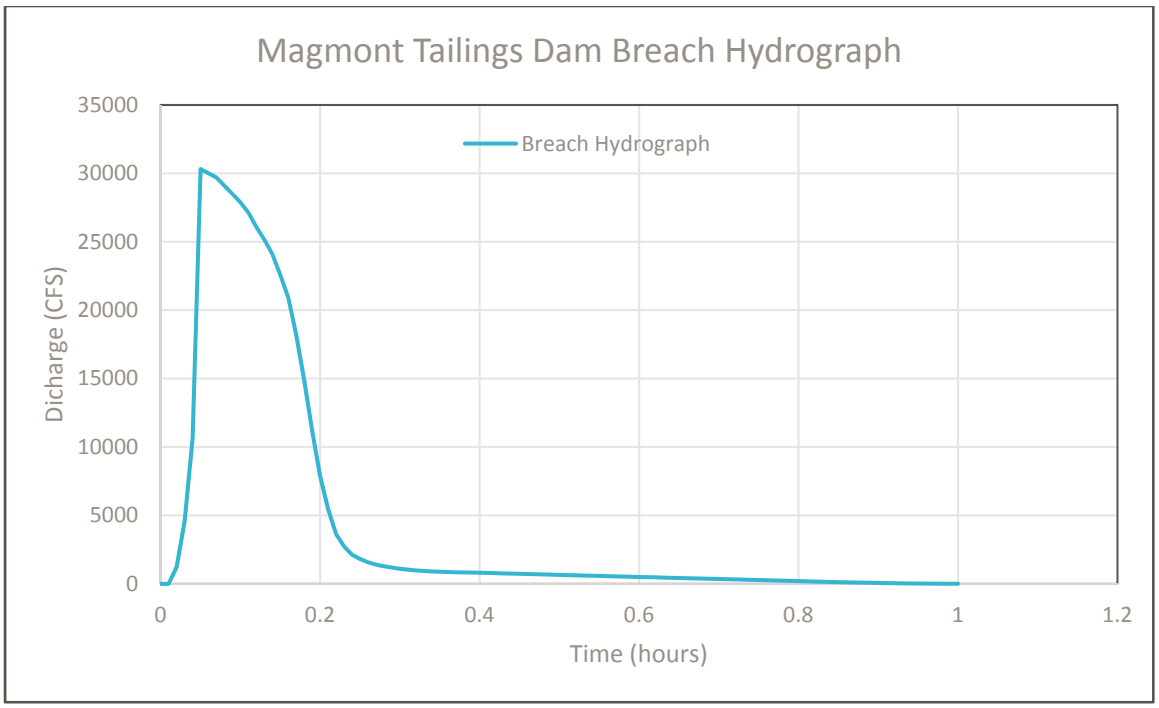
The sunny day failure of Magmont Tailings Dam was modeled assuming the top of the tailings impoundment immediately upstream of the dam was dry, as there is the impoundment is no longer in use. Other assumptions included:

1. The tailings volume released is approximately 668.3 af (1,078,191 cy). The volume of tailings released versus elevation was based on site topographic information.
2. A piping failure was assumed to be the mode of failure occurring at the base of the tailings dam, El. 1190.
3. Tailings dam composition was assumed to be non-cohesive soils.
4. To be conservative, failure of the starter dam was assumed.

Selecting the grid element size, it was necessary to balance the mapping resolution with the inflow peak discharge flux. The selected grid element size was 100 ft, which resulted in 51,649 elements. Manning's n-values were assumed to be 0.1 and 0.04 for the floodplain and river channel respectively. These high n-values reflect the extremely heavy vegetation along the channel downstream of the dam.

The breach hydrograph at Magmont Tailings Dam is shown in Detail 3.

Detail 3
Magmont Tailings Dam Breach Hydrograph



The resulting flow depths, velocities, peak stage, time to 2 ft of rise, and flood wave arrival time are shown in Figures 2-4.

Conclusion

The Magmont Tailings Dam, in its existing condition, can safely pass the 100 percent 24-hour PMF. The upstream ponds and detention facilities provide benefit in flood attenuation when compared to the modeled case where no detention was assumed.

The sunny day failure scenario was modeled for the Magmont Tailings Dam. Several residential structures and out buildings are located downstream of the dam. These structures may be inundated by up to 6 ft tailings depending on their location within the estimated inundated limits. The tailings dam breach opening was modeled to fully form in 1 hour. The resulting flood wave, comprised of saturated tailings, would flow out of the dam approximately 8 miles downstream, and provided minimal warning time for evacuation of residential and structures road closure. The inundation limits present represent a travel time of up to 50 hours from the time of the breach initiation. A sunny day failure of Magmont Tailings Dam could cause loss of life, and significant economic damage including road closure, environmental clean-up, road repairs, and restoration of natural areas.

Limitations

Professional judgments are presented in this report. They are based on evaluation of technical information gathered, on our experience with similar sub surface conditions, on our understanding of the characteristics of the Magmont Tailings Dam.

It is important to note that the condition of a tailings dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through updated inspections and ongoing monitoring can unsafe conditions be detected, so that corrective action can be taken. Likewise, continued care and maintenance are necessary to minimize the risk of unsafe conditions.

Haley & Aldrich represents that our services are performed within the limits prescribed by the client, in a manner consistent with the level of car and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation to the client, expressed or implied, and no warranty or guarantee is included or intended.

References

1. FLO-2D GDS Pro Manual 2014, FLO-2D Software Inc., Nutrioso, Arizona.

2. FLO-2D Pro Version Two-Dimensional Flood Routing Model, Channel Guidelines June 2016, FLO-2D Software Inc., Nutrioso, Arizona.

3. FLO-2D Reference Manual. 2014. FLO-2D Software, Inc. Nutrioso, Arizona.

4. FLO-2D Simulating Mudflow, FLO-2D Software Inc., Nutrioso, Arizona.

5. O'Brien, J.S. and Tocher, R.J., Predicting Tailings Dams Breach Volumes and Flood Hazard Delineation, 2014, FLO-2D Software Inc. Nutrioso, Arizona.

6. Swenty, Brian, J., Registration Permit Application Magmont Tailings Dam Iron County, Missouri, January 30, 2004.

7. U.S. Army Corps of Engineers, Hydrologic Modeling System HEC-HMS User's Manual, Version 4.2, August 2016.

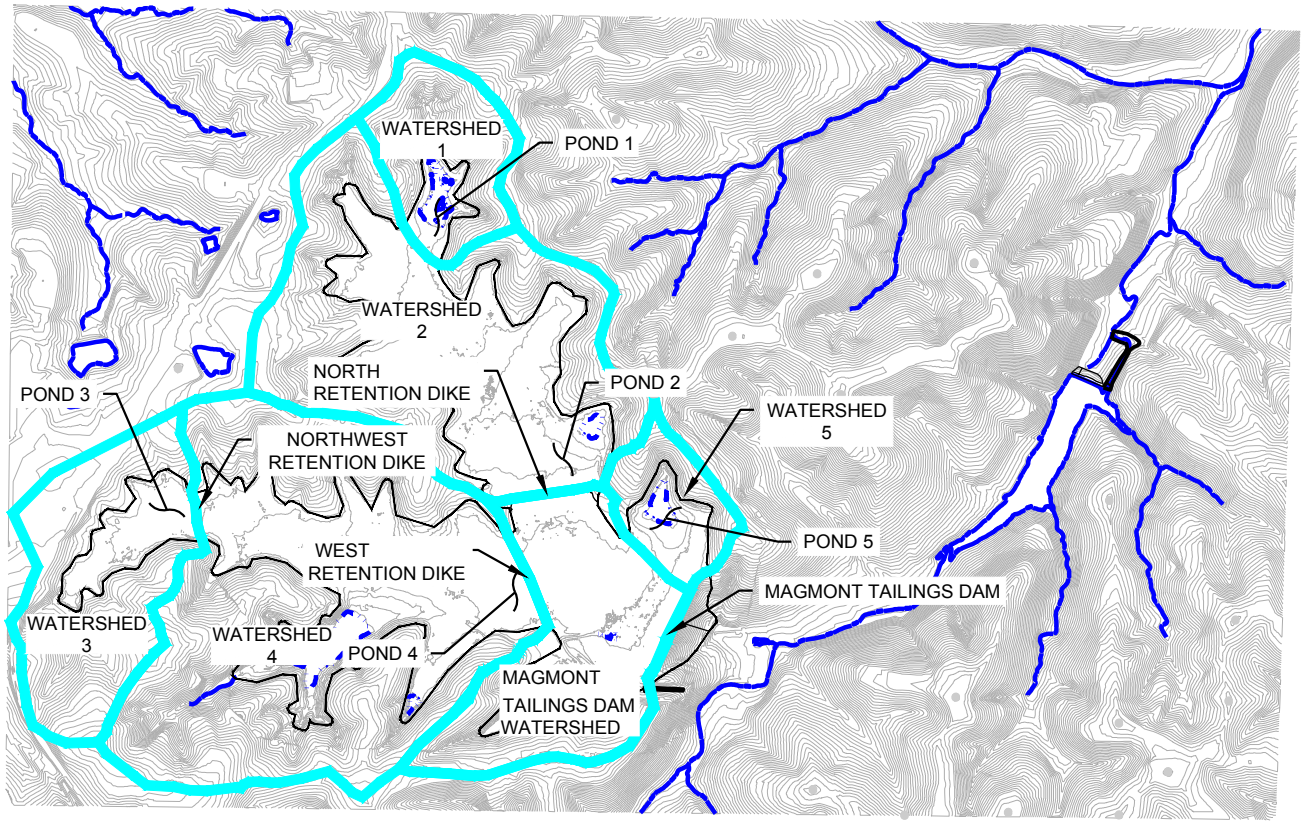
8. U.S. Department of Agriculture, Natural Resources Conservation Service, National Engineering Handbook Part 630, Hydrology, Chapter 15, May 2010.

9. U.S. Department of Commerce, National Oceanic and Atmospheric Administration: http://www.nws.noaa.gov/oh/hdsc/PF_documents/Atlas14_Volume8.

10. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Hydrometeorlogical Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, Washington, DC, June 1978.

Attachments

Figure 1 – Magmont Tailings Dam Watershed Limits
Figure 2 – Magmont Tailings Dam Key Map
Figures 3-4 Magmont Tailings Dam: Time to 2' Inundation Maps



0 2000 4000
SCALE IN FEET

LEGEND

- WATERSHED BOUNDARY
- 2017 WATERWAYS AND BODIES OF WATER

NOTES

1. THE BASE MAP OUTSIDE THE APPROXIMATE EXTENT OF TAILINGS USED TO DEVELOP THIS FIGURE IS BASED ON TOPOGRAPHY DEVELOPED BY SURDEX CORPORATION DATED 22 MARCH 2003. THE HORIZONTAL DATUM USED IS NORTH AMERICAN DATUM 83, MISSOURI STATE PLANE, EAST ZONE. THE VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88.
2. TAILINGS EXTENT TOPOGRAPHY IS BASED ON TOPOGRAPHY DATA COLLECTED BY SAM, LLC ON 30 JANUARY 2015.

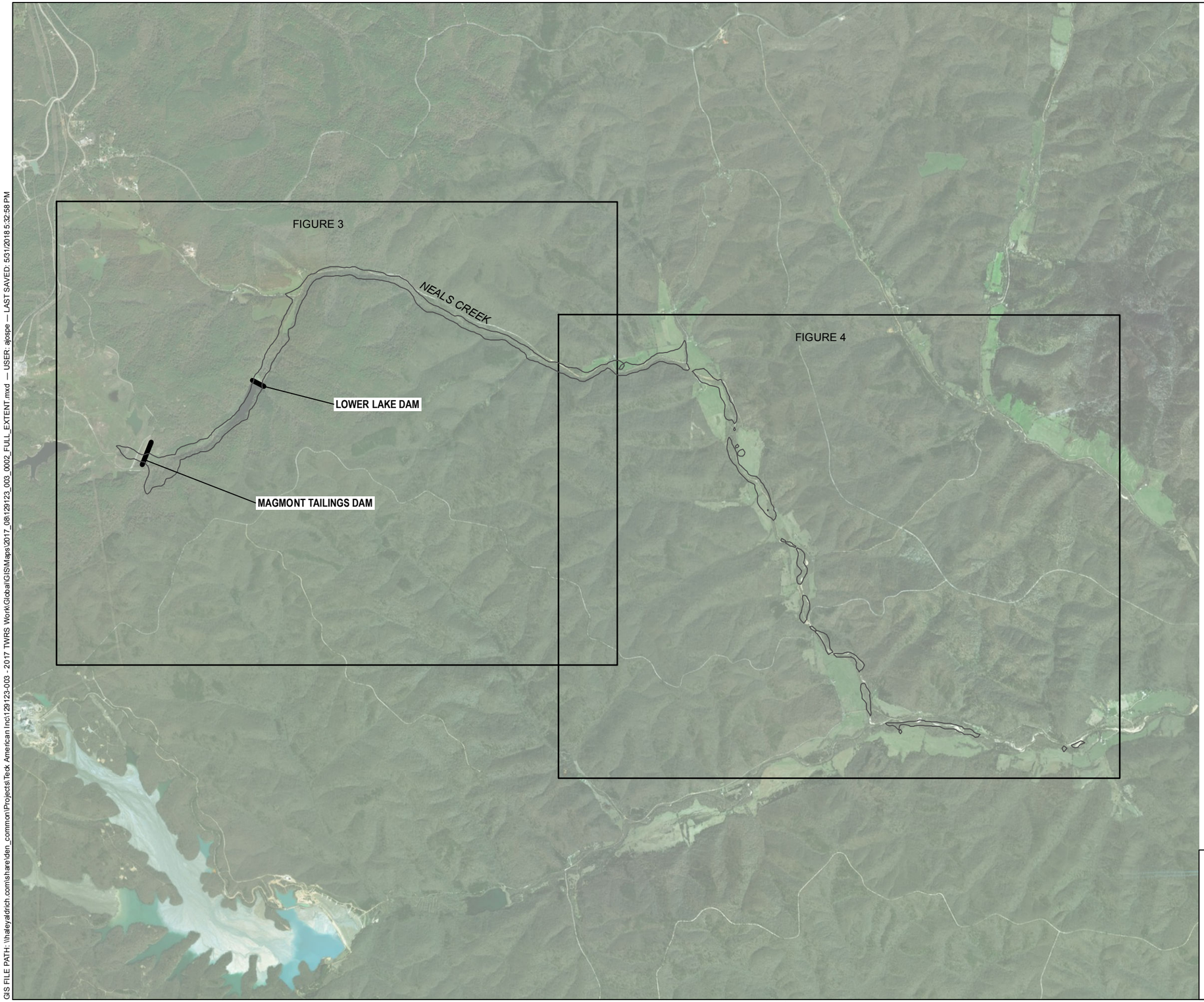
HALEY ALDRICH

MAGMONT TAILINGS DAM EMERGENCY ACTION PLAN
TECK AMERICAN, INC.
BIXBY, MISSOURI

MAGMONT TAILINGS DAM WATERSHED LIMITS

SCALE: AS SHOWN
MAY 2018

FIGURE 1



LEGEND

———— TWO-FOOT INUNDATION LIMITS

NOTES

1. FLOOD MODELING COMPLETED USING FLOW-2D MODEL

2. BASE MAP SOURCE: ESRI

3. THE FLOOD INUNDATION INFORMATION SHOWN ON THIS MAP IS AN APPROXIMATION OF DAM FAILURE FLOODING EXPECTED FOR A SUNNY DAY FAILURE AT MAGMONT TAILINGS DAM. THE FLOOD INUNDATION INFORMATION SHOWN SHOULD BE USED AS A GUIDELINE ONLY. ACTUAL FLOODING CONDITIONS WILL VARY DEPENDING ON ACTUAL CONDITIONS DURING A FLOOD EMERGENCY.

N

0 3,600 7,200
SCALE IN FEET

HALEY ALDRICH

MAGMONT LOWER LAKE DAM EMERGENCY ACTION PLAN
TECK AMERICAN, INC.
BIXBY, MISSOURI

MAGMONT TAILINGS DAM
KEY MAP

JUNE 2018

FIGURE 2

GIS FILE PATH: \\haleyaldrich.com\share\den_common\Projects\Teck American Inc\129123-003 - 2017 TWRS Work\Global\GIS\Maps\2017_08\129123_003_0002_FULL_EXTENT.mxd — USER: ajospe — LAST SAVED: 5/31/2018 5:32:58 PM

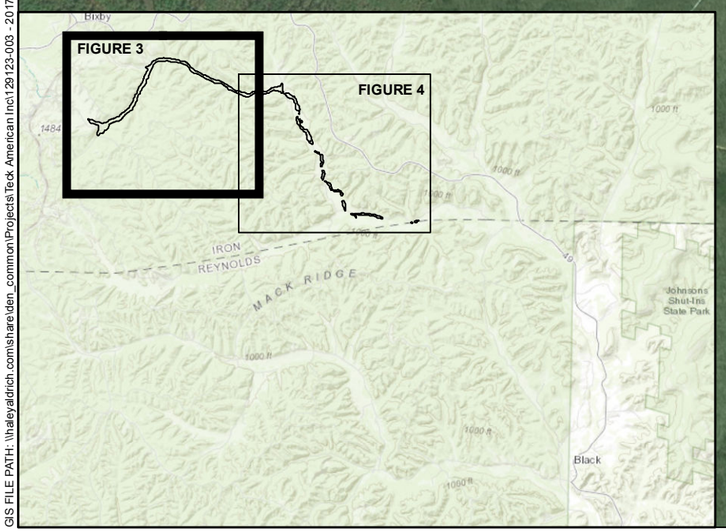
SECTION 1	
MILES DOWNSTREAM	1.06
MIN. TO PEAK FLOOD STAGE	0.36
PEAK DISCHARGE (CFS)	10996.53
PEAK ELEVATION (FT NAVD)	1146.06
PEAK STAGE (FT)	9.12

SECTION 2	
MILES DOWNSTREAM	1.85
MIN. TO PEAK FLOOD STAGE	0.74
PEAK DISCHARGE (CFS)	4563.55
PEAK ELEVATION (FT NAVD)	1110.82
PEAK STAGE (FT)	8.12

SECTION 3	
MILES DOWNSTREAM	2.33
MIN. TO PEAK FLOOD STAGE	1.03
PEAK DISCHARGE (CFS)	3378.15
PEAK ELEVATION (FT NAVD)	1089.72
PEAK STAGE (FT)	7.11

SECTION 4	
MILES DOWNSTREAM	3.27
MIN. TO PEAK FLOOD STAGE	1.71
PEAK DISCHARGE (CFS)	2063.84
PEAK ELEVATION (FT NAVD)	1052.19
PEAK STAGE (FT)	10.39

SECTION 5	
MILES DOWNSTREAM	4.15
MIN. TO PEAK FLOOD STAGE	2.51
PEAK DISCHARGE (CFS)	1318.37
PEAK ELEVATION (FT NAVD)	1016.82
PEAK STAGE (FT)	3.82



LEGEND

CROSS SECTION

AREA OF TWO-FOOT INUNDATION

NOTES

1. FLOOD MODELING COMPLETED USING FLOW-2D MODEL

2. BASE MAP SOURCE: ESRI

3. THE FLOOD INUNDATION INFORMATION SHOWN ON THIS MAP IS AN APPROXIMATION OF DAM FAILURE FLOODING EXPECTED FOR A SUNNY DAY FAILURE AT MAGMONT TAILINGS DAM. THE FLOOD INUNDATION INFORMATION SHOWN SHOULD BE USED AS A GUIDELINE ONLY. ACTUAL FLOODING CONDITIONS WILL VARY DEPENDING ON ACTUAL CONDITIONS DURING A FLOOD EMERGENCY.

N

0 1,600 3,200

SCALE IN FEET

HALEY ALDRICH

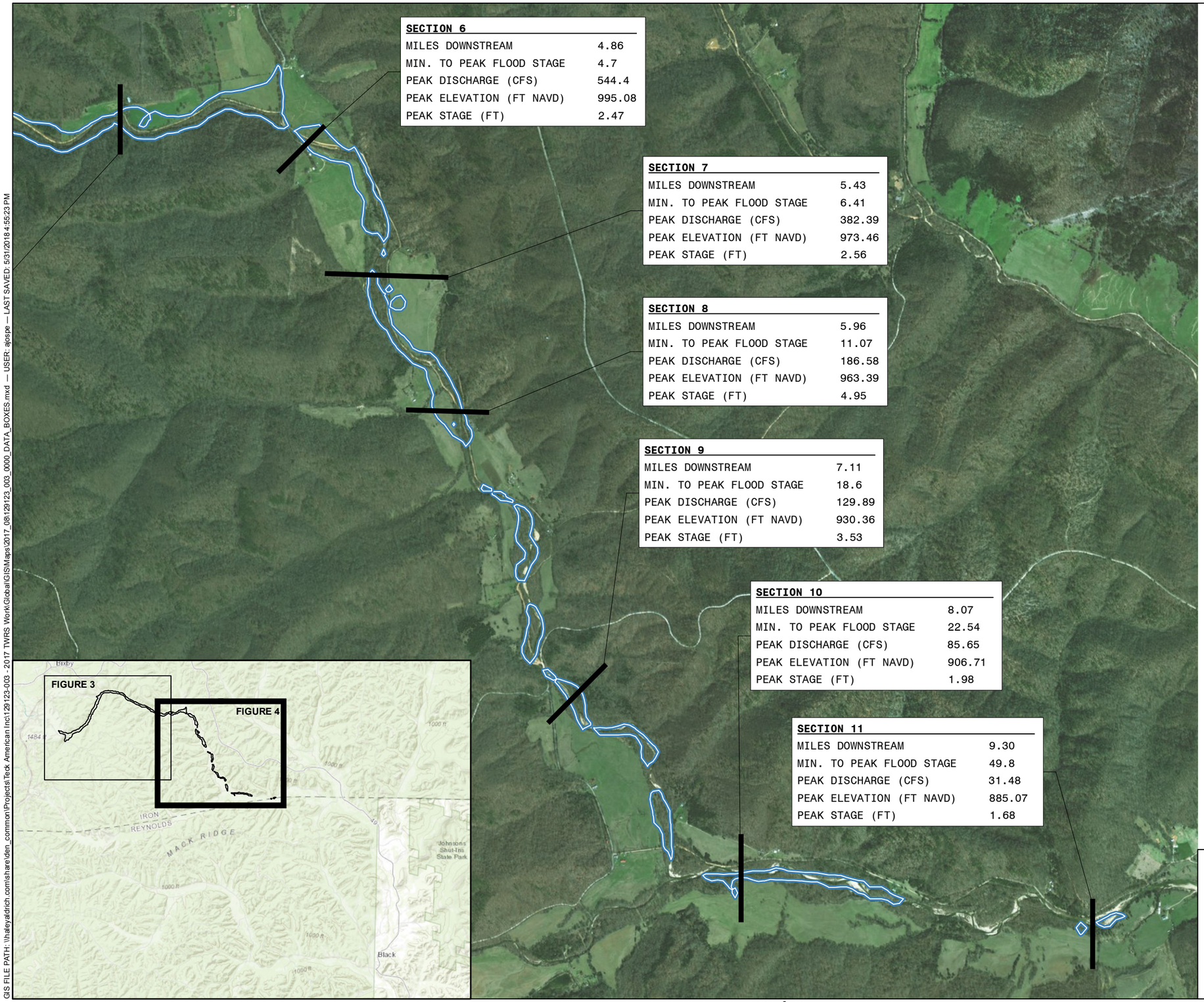
MAGMONT TAILINGS DAM EMERGENCY ACTION PLAN
TECK AMERICAN, INC.
BIXBY, MISSOURI

MAGMONT TAILINGS DAM: TIME TO 2' INUNDATION (1 OF 2)

MAY 2018

FIGURE 3

GIS FILE PATH: \\haleyaldrich.com\share\den_common\Projects\Teck American Inc\129123-003 - 2017 TWRS Work\Global\GIS\Maps\2017_08\129123_003_0000_DATA_BOXES.mxd — USER: ajospe — LAST SAVED: 5/31/2018 4:55:23 PM



LEGEND

CROSS SECTION

AREA OF TWO-FOOT INUNDATION

NOTES

1. FLOOD MODELING COMPLETED USING FLOW-2D MODEL

2. BASE MAP SOURCE: ESRI

3. THE FLOOD INUNDATION INFORMATION SHOWN ON THIS MAP IS AN APPROXIMATION OF DAM FAILURE FLOODING EXPECTED FOR A SUNNY DAY FAILURE AT MAGMONT TAILINGS DAM. THE FLOOD INUNDATION INFORMATION SHOWN SHOULD BE USED AS A GUIDELINE ONLY. ACTUAL FLOODING CONDITIONS WILL VARY DEPENDING ON ACTUAL CONDITIONS DURING A FLOOD EMERGENCY.

N

0 1,600 3,200

SCALE IN FEET

HALEY ALDRICH

MAGMONT TAILINGS DAM EMERGENCY ACTION PLAN
TECK AMERICAN, INC.
BIXBY, MISSOURI

MAGMONT TAILINGS DAM: TIME TO 2' INUNDATION (2 OF 2)

MAY 2018

FIGURE 4

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Appendix B: National Inventory of Dams (NID) Data

Dam Name:	Magmont Tailings Dam
River:	TR-Left Fork Neals Creek
State:	Missouri
County:	Iron
Owner Name:	Teck American Incorporated
NID ID:	MO30917
Sec:	13 and 24 Township T34N Range R02W
Longitude:	-91.1085 decimal degrees
Latitude:	37.6315 decimal degrees
Nearest town downstream:	Black, MO
Distance to nearest downstream town:	18 miles
Year Complete:	1979
Year Modified:	1998
Nearest Town:	Bixby, MO
Type of dam:	Earth fill/Tailings
Maximum discharge (cfs):	5,500
Maximum storage (ac-ft):	4,600
Normal storage (ac-ft):	3,500
Surface area (acres):	370
Drainage area (acres):	817

Inspection frequency:	Two years with permit renewal
State Regulatory Agency:	Missouri DNR WRC DRSP
Dam Height (ft):	135
Structural Height (ft):	134
Hydraulic Height (ft):	0
Dam Length (ft):	1,343
Dam Crest Elevation (ft):	1316.8 (site datum)
Current Hazard Class:	I
Principal Spillway Type:	4 foot wide trapezoidal concrete lined channel
Emergency Spillway type:	60 foot wide earth cut channel
Core:	Upstream facing, earthen, known
Foundation:	Rock, known
Spillway Type:	Uncontrolled
Spillway Width (ft):	4 (primary) 60 (emergency)
Primary Purpose:	Tailings
Outlet Gates:	None
Volume:	0
Number of Locks:	0
Length of Locks:	0
Width of Locks:	0

Comments:

Appendix C: Unusual or Emergency Event Log

(To be completed during the emergency)

Dam Name: Magmont Tailings Dam County: Iron

When and how was the event detected?

_____
_____

Weather conditions:

_____
_____

General description of the emergency situation:

_____
_____
_____

Emergency level determination:_____ Made by: _____

Actions and Event Progression

Date	Time	Action/event progression	Recorded by

Appendix D: Glossary

Abutment	The part of the valley side against which the dam is constructed. The left and right abutments of dams are defined with the observer looking downstream from the dam.
Appurtenances	Structures incident to or annexed to dams essential to the proper operation, maintenance or functioning of the dam. This includes such structures as spillways, low level outlet works and water conduits, such as tunnels, pipelines or penstocks, either through a dam or its abutments.
Breach	An opening through the dam that allows draining of the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintended failure of the dam.
Control Section	An usually level segment in the profile of an open channel spillway above which water in the reservoir discharges through the spillway.
Dam	An artificial barrier generally constructed across a watercourse for the purpose of impounding or diverting water.
Emergency Spillway	The appurtenant structure that provides the controlled conveyance of excess water through, over, or around the dam.
Instrumentation	An arrangement of devices installed into or near dams that provide measurements to evaluate the structural behavior and other performance parameters of the dam and spillway structures. Examples include seepage measuring weirs, piezometers, inclinometers and survey monuments.
Principal Spillway	The appurtenant structure that conveys normal inflow through or around the embankment.
Reservoir	The body of water impounded or potentially impounded by the dam.
Seepage	The natural movement of water through the embankment, foundation, or abutment of the dam.

Appendix E: Event Response Procedures

Dam failures can have devastating impacts on people, property, and the environment. Therefore, it is necessary to have event response procedures (ERPs) in place and to be prepared in advance of unusual occurrences and emergency situations.

The purpose of the ERPs is as follows:

- Protect lives, property, and the environment if an emergency condition develops at a dam.
- To provide advanced preparation to owners, technical representatives, and emergency management personnel for the emergency event.
- Detail actions and measures that will be taken by all parties responsible for responding to an emergency.
- Facilitate the coordination and cooperation of the various emergency responders.

The Dam Owner will take action, using the event-specific response procedures described below as a guide. These response procedures are based on emergency levels described in the "Guidance for Determining the Emergency Level" Section of this EAP. If a specific event is not covered, an event with a similar response procedure and alert level will be adapted. If resources described in the response procedure are not available, suitable alternative resources will be identified.

The following procedures should be followed after an unusual event is observed.

Embankment Overtopping

1) Cover weak areas or low areas of the dam crest and downstream slope with riprap, sandbags, plastic sheets, or other materials to provide erosion-resistant protection.

Cloudy Seepage/Piping

1) If the entrance to the seepage origination point is observed and is accessible, attempt to reduce the flow by plugging the entrance with readily available materials such as hay bales, bentonite, soil fill, or plastic sheathing.
2) Cover the seepage exit area(s) with several feet of sand/gravel to hold fine-grained embankment or foundation materials in place. Alternatively, construct sandbag or other types of ring dikes around the seepage exit areas to retain a pool of water, providing backpressure and reduce the erosive nature of the seepage.
3) Prevent vehicles and equipment from driving between the seepage exit points and the embankment to avoid potential loss from the collapse of a potential underground void.

Sinkhole

1) Activate pumps and/or syphons to remove any water impounded on the tailings impoundment surface as necessary.
2) Attempt to backfill the sinkhole with readily available materials such as hay bales, bentonite, soil fill, or plastic sheathing.
3) Prevent vehicles and equipment from driving between the decant failure exit points and entrance points to avoid potential loss from the collapse of a potential underground void.

Decant Failure

1) Activate pumps and/or syphons to remove any water impounded on the tailings impoundment surface.

2) If the entrance to the decant failure is observed and is accessible, attempt to reduce the decant failure size by plugging the entrance with readily available materials such as hay bales, bentonite, soil fill, or plastic sheathing.
3) Cover the decant failure exit area(s) with several feet of sand/gravel to hold fine-grained embankment or foundation materials in place. Alternatively, construct sandbag or other types of ring dikes around the seepage exit areas to retain a pool of water, providing backpressure and reduce the erosive nature of the seepage.
4) Prevent vehicles and equipment from driving between the decant failure exit points and entrance points to avoid potential loss from the collapse of a potential underground void.

Embankment Movement (Cracks/Settlements/slides/misalignments)

1) Activate pumps and/or syphons to remove any water impounded on the tailings impoundment surface.
2) Repair settlement of the crest by placing sandbags or earth fill materials in the damaged area to restore freeboard.
3) Stabilize slides by placing a soil or rockfill buttress against the toe of the slide.

Earthquakes

1) Immediately conduct a general overall visual inspection of the dam and appurtenant structures.
2) Perform a field survey to determine if there has been any settlement and movement of the dam and spillway.
3) Perform expected actions for seepage or embankment movement if seepage or embankment movement is observed.

Tornado

1) Immediately conduct a general overall visual inspection of the dam and appurtenant structures.
2) Perform a field survey to determine if there has been any settlement and movement of the dam and spillway.
3) Perform expected actions for seepage or embankment movement if seepage or embankment movement is observed.

Sabotage/Vandalism

1) Immediately conduct a general overall visual inspection of the dam and appurtenant structures.
2) Perform a field survey to determine if there has been any settlement and movement of the dam and spillway.
3) Perform expected actions for seepage or embankment movement if seepage or embankment movement is observed.

Appendix F: EAP Review and Revision

EAP ANNUAL REVIEW

The Dam Owner will review and, if needed, update the EAP at least once each year. The EAP annual review will include the following:

- Calling all contacts on the notification charts in the EAP to verify that the phone numbers and persons in the specified positions are current. The EAP will be revised if any of the contacts have changed.
- Contacting the local law enforcement agency to verify the phone numbers and persons in the specified positions. In addition, the Dam Owner will ask if the person contacted knows were the EAP is kept and if responsibilities described in the EAP are understood.
- Calling the locally available resources to verify that the phone numbers, addresses, and services are current.

REVISIONS

The Dam Owner is responsible for updating the EAP document. The EAP document held by the Dam Owner is the master document. When revisions occur, the Dam Owner will provide the revised pages and a revised revision summary page to all of the EAP document holders. The document holders are responsible for revising the outdated copy of the respective document(s) whenever revisions are received. Outdated pages shall be immediately discarded to avoid any confusion with the revisions.

EAP PERIODIC TEST

The Dam Owner will host and facilitate a periodic test of the EAP at least once every 5 years. The periodic test will consist of a meeting and include a table top exercise. Attendance should include the Dam Owner, key Dam Operations Staff, the Engineer of Record, at least one representative of the local law enforcement agency, and others with key responsibilities listed in this EAP. At the discretion of the Dam Owner, other organizations that may be involved with an unusual or emergency event at the dam are encouraged to participate. Before the tabletop exercise begins, meeting participants will visit the dam during the periodic test to familiarize themselves with the dam site.

The tabletop exercise will begin with the facilitator presenting a scenario of an unusual or emergency event at the dam. The scenario will be developed prior to the exercise. Once the scenario has been presented, the participants will discuss the responses and actions that they would take to address and resolve the scenario. The facilitator will control the discussion, ensuring realistic responses and developing the scenario throughout the exercise. The Dam Owner should complete an event log as they would during an actual event.

After the table top exercise, the EAP will be reviewed and discussed. Mutual aid agreements and other emergency procedures can be discussed. The Dam Owner will prepare a written summary of the periodic test and revise the EAP, as necessary.

Record of Holders of Control Copies of this EAP

Copy Number	Organization	Person receiving copy	E-mail Address
1	Teck American Incorporated 501 N. Riverpoint Boulevard Suite 300 Spokane, WA 99202	Dave Enos	Dave.Enos@teck.com
2	Teck American Incorporated 501 N. Riverpoint Boulevard Suite 300 Spokane, WA 99202	Kris McCaig	Kris.McCaig@teck.com
3	Iron County Emergency Management Coordinator 220 S. Shepherd St. Ironton, MO 63650	Roger Medley	rmedley@icsomo.org
4	Missouri Department of Natural Resources Dam Safety Program 111 Fairgrounds Road Rolla, MO 65401	Ryan Stack	Ryan.stack@dnr.mo.gov
5	State of Missouri Emergency Management (SEMA) Duty Officer Clinton Building 501 Campanella Drive Sikeston, MO 63801	Mark Winkler	mwinkler@mail.mo.gov
6	Owner's Engineer of Record 8101 E. Prentice Avenue Suite 600 Greenwood Village, CO 80111	Christopher Hatton	CHatton@haleyaldrich.com
7	Owner's Engineer 199 CR 5013 Salem, MO 65560	Terry Perkins	terperk@yahoo.com
8	Alternate Owner's Engineer 1001 Diamond Ridge Jefferson City, MO 65109	Mark Nations	mnations@barr.com

Record of Revisions and Updates Made to EAP

Revision Number	Date	Revisions made	By whom
0	6/6/2018	Initial Development	Dave Enos, Teck American Incorporated

Emergency Action Plan, or EAP

Sweetwater Tailings Dam

National Inventory of Dams, or NID, MO30166 2

Reynolds County, Missouri

SEMA Area C

Reviewed and Updated:
12/15/2017

The Doe Run Company
Dan Buxton
Owner/operator

Dan Buxton
5-1-18
Date

County Emergency Management Director
Renee Horn
Reynolds County, Missouri

Date

Basic EAP Data

Purpose

The purpose of this EAP is to reduce the risk to human life and minimize property damage during an unusual or emergency event at Sweetwater Tailings Dam.

Notification Procedure

This EAP provides general guidance for recognizing and characterizing an emergency situation occurring at the dam. The dam owner should act quickly to evaluate the emergency situation and then follow the notification procedures according to the corresponding level of emergency.

Potential Impacted Area

See *Inundation Map* (Appendix A) and *Residents/Businesses/Entities at Risk* table for the locations and contact information of the following residents and businesses that may be flooded if the dam should fail This list may also include critical infrastructure such as pipelines, power plants, substations, or sewer plants.

Numerous homes and Highway B will be affected

Directions to dam (Review Arrival Time Map that shows major roads to the dam)

From Reynolds MO head south on from the intersection of highway 72 and b and go south on B and the dam will be 5.0 miles from Reynolds on the right..

Guidance for Determining the Emergency Level

This information should be used as a general guide for recognizing and characterizing the type of emergency situation occurring at the dam. The dam owner should notify the appropriate emergency contacts based upon the emergency level assigned to each situation.

Level 1 Emergency - Nonemergency, unusual event, slow to develop

- Reservoir water surface elevation at emergency spillway crest or spillway is flowing with no active erosion.
- New seepage areas in or near the dam.
- New cracks in the embankment greater than ¼-inch wide without seepage.
- Visual movement/slippage of the embankment slope.
- Instrumentation readings beyond predetermined values.
- Measurable earthquake felt or reported on or within 50 miles of the dam.
- Damage (vandalism/sabotage) to dam or appurtenances with no impacts to the functioning of the dam.
- Modification (vandalism/sabotage) to the dam or appurtenances that could adversely impact the functioning of the dam.

Level 2 Emergency - Potential dam failure situation, rapidly developing

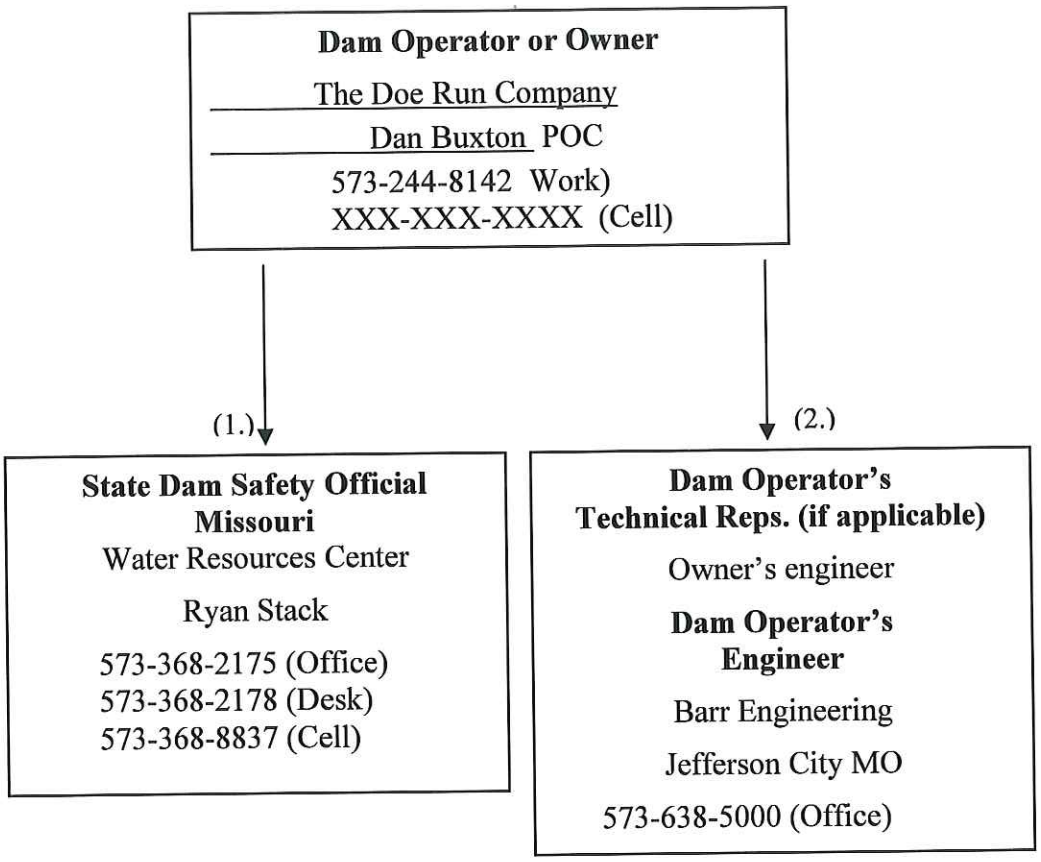
- Spillway flowing with active gully erosion.
- Spillway flow that could result in flooding of people downstream, if the reservoir level continues to rise.
- Reservoir level is 1 foot below the top of the dam.
- New seepage areas with cloudy discharge or increasing flow rate.
- Observation of new sinkhole in reservoir area, on embankment or downstream of dam.
- Cracks in the embankment with seepage.
- Earthquake resulting in visible damage to the dam or appurtenances.
- Verified bomb threat that, if carried out, could result in damage to the dam.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in seepage flow.

Level 3 Emergency - Urgent; dam failure imminent or is in progress

- Spillway flowing with an advancing headcut that is threatening the control section.
- Spillway flow that is flooding people downstream.
- Water from the reservoir is flowing over the top of the dam (not just auxiliary/emergency spillway).
- Seepage that is obviously eroding soil from within the embankment or rapidly increasing in flow rate.
- Rapidly enlarging sinkhole.
- Sudden or rapidly progressing slides of the embankment slopes.
- Earthquake resulting in uncontrolled release of water from the dam.
- Detonated bomb that has resulted in damage to the dam or appurtenances.
- Damage to dam (vandalism/sabotage) or appurtenances that has resulted in uncontrolled water release.

Emergency Level 1 Notifications

Nonemergency, unusual event; slowly developing.



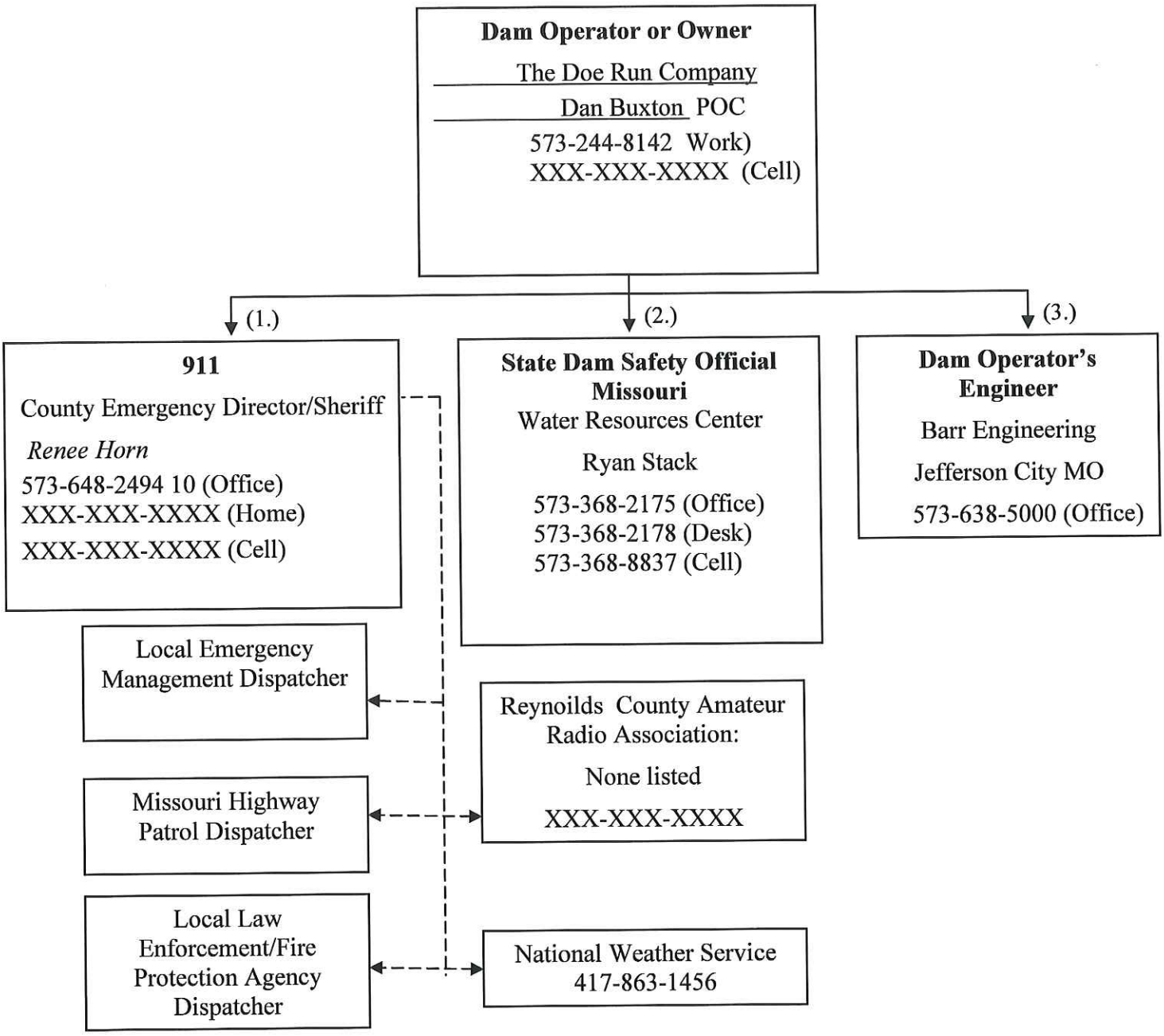
Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Emergency Level 2 Notifications

Emergency event, potential dam failure situation; rapidly developing.



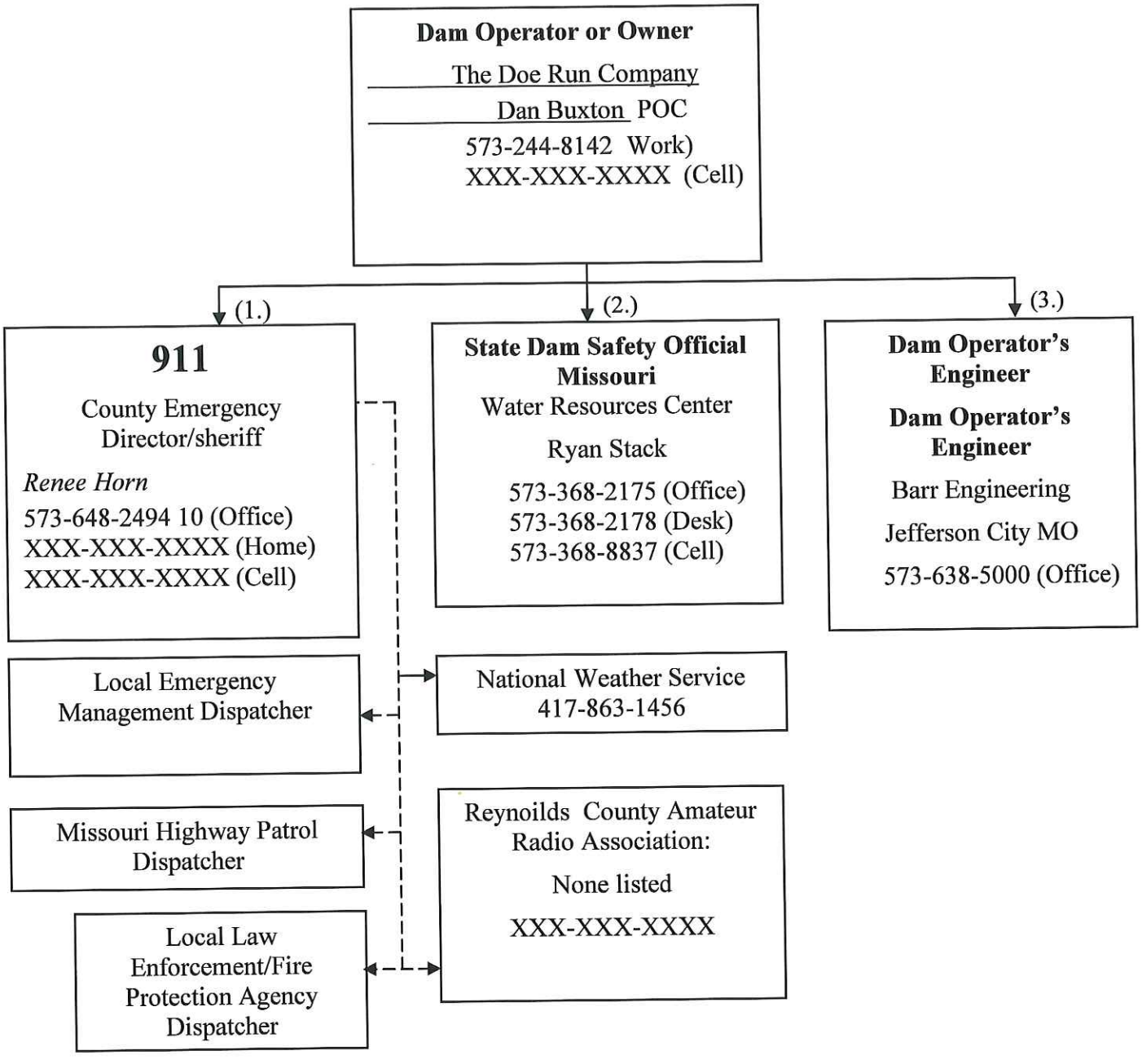
Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information about back-ups to the persons shown above and other emergency personnel.

Emergency Level 3 Notifications

Urgent event, dam failure appears imminent or is in progress.



Note:
1., 2., etc., denotes call sequence

Legend:
Calls by operator/owner _____
Second level calls - - - - -

See *Emergency Services Contacts* sheet for contact information for back-ups to the persons shown above and other emergency personnel.

Emergency Services Contacts

Agency / Organization	Principal Contact	Address	Office Phone No. with Area Code	Alternate Telephone Numbers
Reynolds County Sheriff	Sheriff Tom Volner	2319 Green street Centerville MO	573-648-2491	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Owner/Representative of Sweetwater Tailings Dam	Mr. Dan Buxton	P.O. Box 500 Vibrunurm MO 65566	573-244-8142	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
County Emergency Management Director	*Renee Horn*	P.O. Box 10 Centerville MO	573-648-2494 ext 10	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Ellington Fire Department		PO Box 430St Ellington, Missouri	(573) 663-2324	
Ellington Police	Stan Qualls	PO Box 7 Ellington, Missouri	(573)660-7717	
Troop G Highway Patrol	desk	1226 W. Bus. US-60/63Willow Springs	(417) 469-3121	
Reynolds County Road Department		450 Highway V, Centerville, MO	(573) 648-2483	XXX-XXX-XXXX (H) XXX-XXX-XXXX (C)
Water Resources Center Dam and Reservoir Safety Program	Ryan Stack Chief Engineer	111 Fairgrounds Rd. Rolla, MO 65401	573-368-2175	573-368-2178 (Desk) 573-368-8837 (Cell)
Department of Natural Resources Emergency Response	Duty Officer EER	P.O. Box 176 Jefferson City, MO 65102	**24 HOUR NO:** 573-634-2436	573-526-3380 (Brian Allen, Chief, EER)
SEMA Duty Officer			573-751-2748	
National Weather Service	Jim Kramper	St. Charles, MO	636-447-1876	1-800-852-7497 636-447-1769 (Fax)
Missouri Department of Transportation	Emergency Operation Center 24-hour cell no.		573-522-9503	
Missouri Department of Transportation	County Shed		XXX-XXX-XXXX	XXX-XXX-XXXX
KFVS12	Contact Name Manager	310 Broadway Cape Girardeau, MO	(573) 335-1212	(800) 455-KFVS
Radio Station KPPL 92.5 FM	Contact Name Manager	ROUTE #2, BOX 496 Poplar Bluff, Missouri	XXX-XXX-XXXX	

Residents/Businesses/Entities/Infrastructure at Risk

Brief summary of number of entities within inundation zone.

Entity No.	Resident/business or other impacted entity	Address	Phone No. with area code	Distance downstream from dam (miles)
1	home	13241 Highway B Centerville MO		1.6 miles
2	home	12880 Highway B Centerville MO		1.8 miles
3	home	12827 Highway B Centerville MO		2.0 miles
4	home	12756 Highway B Centerville MO		2.2 miles
5	home	11922 Highway B Centerville MO		2.3 miles
6	home	1067 Goose Drive Ellington MO		3.1 miles
7	home	1067 Goose Drive Ellington MO		3.1 miles
8	home	1067 Goose Drive Ellington MO		3.1 miles
9	home	No number CR 768 Ellington MO		3.5 miles
10	home	No number CR 768 Ellington MO		3.6 miles
11	State highway B	Modot		6 to7 miles below dam

(Use additional sheets if necessary)

Resources Available

Locally available resources include: (if not available please note)

Heavy Equipment Service and Rental	Sand and Gravel Supply	Ready-mix Concrete Supply
Tony Abney Construction PO Box 760 Vibrunum MO 573-244-3145	K & D Crushing 14097 Highway KK Boss MO 573-269-4320 573-269-4415	Politte Read Mix 92 Highway 49 Viburnum MO 573-244-5463
Pumps	**Pipe**	**Sand Bags**
Hearth Land Pumps 1800 Supply Road Suite 8 Carterville IL 63918 618-985-5510	Poly Pipe Systems PO Box 1157 Steelville MO 573-775-3300 573-775-4634 573-775-2024	The Mine Supply Company PO Box 345 85 Highway 49 Viburnum MO. 573-244-5416

The above list was taken from the EAP for MO31141 Fletcher Mine water dam.,

Other options that might be useful.

Schrum Ready Mix, Caledonia 573-779-3708

Mills Ready Mix Annapolis, 573-598-3400

Lead Belt Pump and Supply Park Hills 573-431-2476 pumps

A7 M Pump Festus 636-931-0275

Mid State Paving Sullivan MO 573-627-2039

Zoellner Construction 573-547-8030

Yoder and Sons Bonne Terre 573-358-40585

Hall and Co Leadwood 573-562-7685

Gibson Excavating 573-438-2372

Tony Selz, Lonedell, MO 636-629-0939 or 636-744-1575

5M Welding & Excavation Joe Medwick Cuba, MO 573-308-5138 or 573-885-4105

NOTE: *This list is **not** an endorsement of the service but design as a starting point. **Other sources of information should be used and it is up to the owner of the dam to select the choices for the EAP**. Putting a source name in the box on the EAP does not great an obligation by the owner to use that source if and when an emergency arise, but is meant to assist the owner if during an emergency he does not have the time to do research into what choice he will make on short notice to obtain the needed services.*

Appendix A
Inundation Study

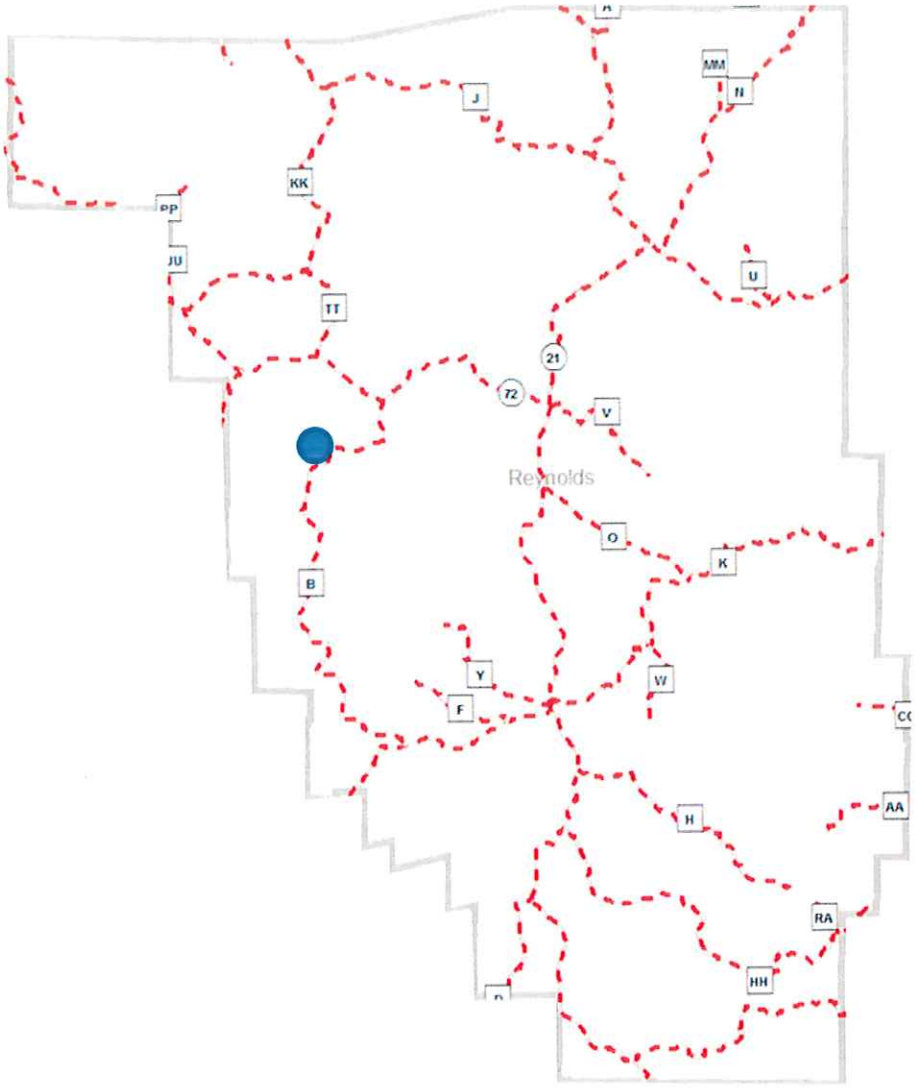
Inundation Map vs. Evacuation Area

Inundation maps have been developed from best available information using reasonable assumptions and standardized methods. They are approximations of the maximum water surface extents resulting from a complete dam breach and draining of the full reservoir. Inundation maps are empirical hydrologic and hydraulic simulations that can only be field verified in the event of an actual breach.

Evacuation areas and call lists should take into consideration the anticipated local impacts of flooding; knowledge of local infrastructure, both occupancy and ownership; and potentially interrupted services or cut-off access, which would be caused by dam failure. Depending upon actual circumstances, appropriate alert and evacuation areas could be more or less extensive than the simulated inundation zones.

Insert inundation map here. It is suggested this section be denoted by a tabbed divider to allow quick access to the inundation map during an emergency.

Sweetwater Tailings Dam
Potentially Affected Structures Map



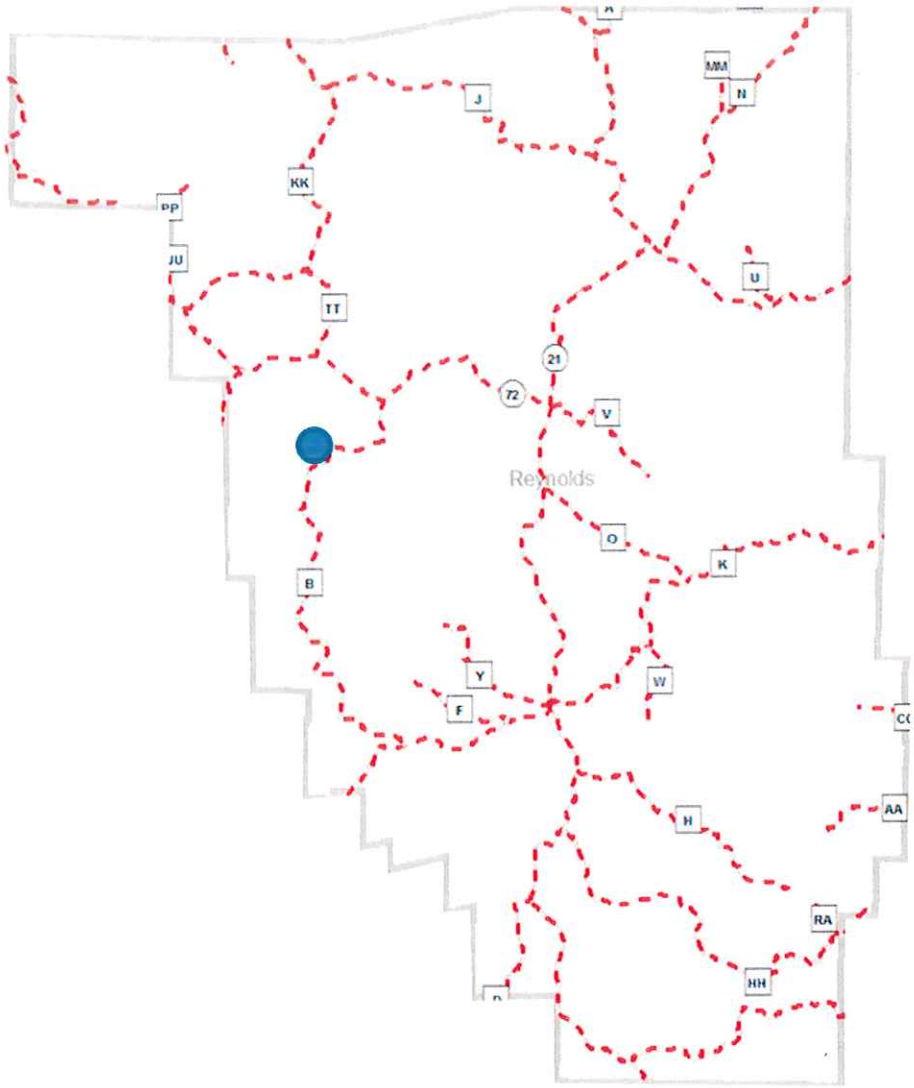
Reynolds, Missouri

Reynolds MO30166

Date: July 31, 2017

Note: Actual areas affected will depend on the actual dam failure criteria and may differ from the areas shown. Due to limitations, methods, assumptions, and procedures used to develop the map area, the map may not show structures that have been recently constructed so some information may be inaccurate. Additional downstream information should be completed by proper authorities.

Sweetwater Tailings Dam
Potentially Affected Structures Map



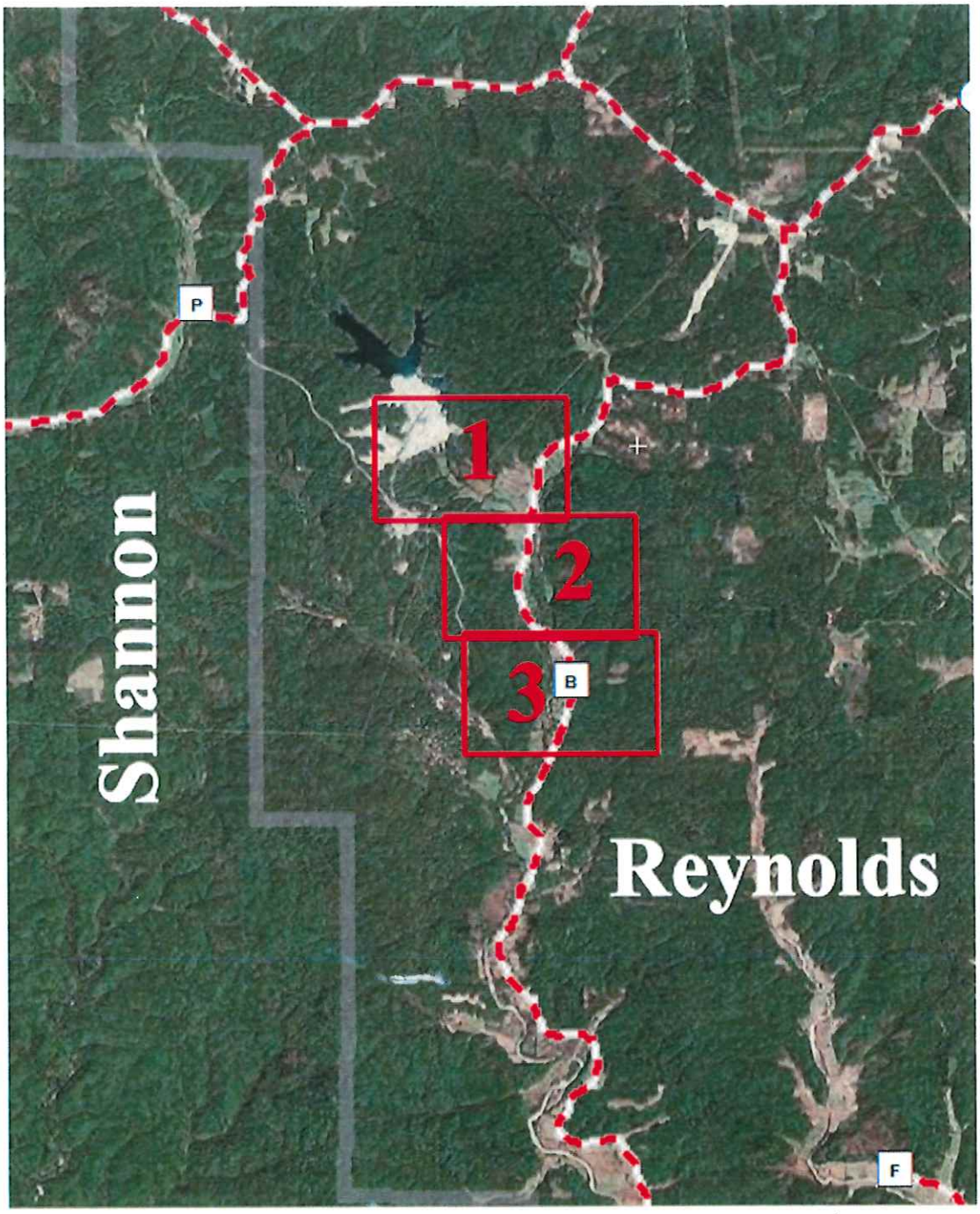
Reynolds, Missouri

Reynolds MO30166

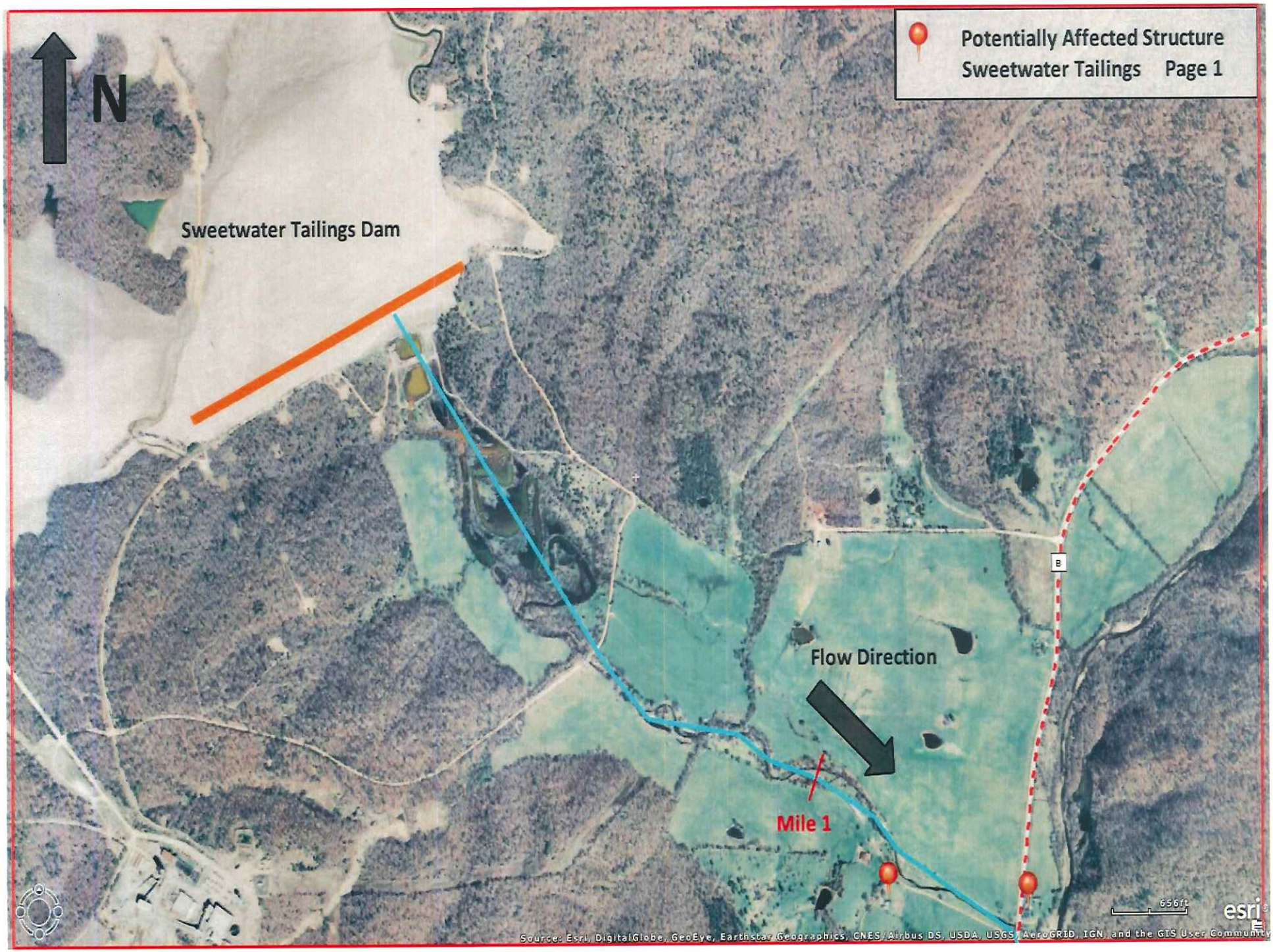
Date: July 31, 2017

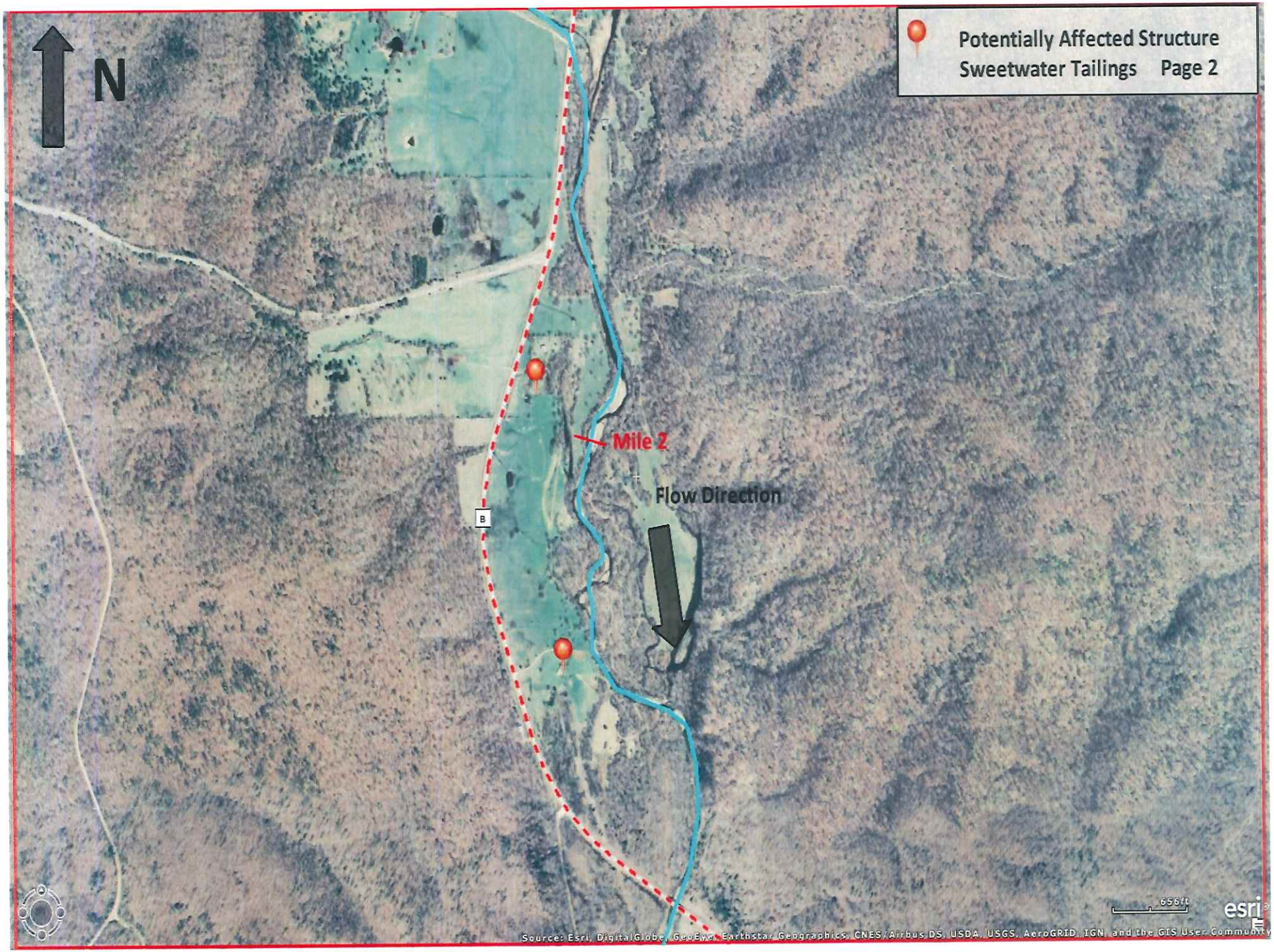
Note: Actual areas affected will depend on the actual dam failure criteria and may differ from the areas shown. Due to limitations, methods, assumptions, and procedures used to develop the map area, the map may not show structures that have been recently constructed so some information may be inaccurate. Additional downstream information should be completed by proper authorities.

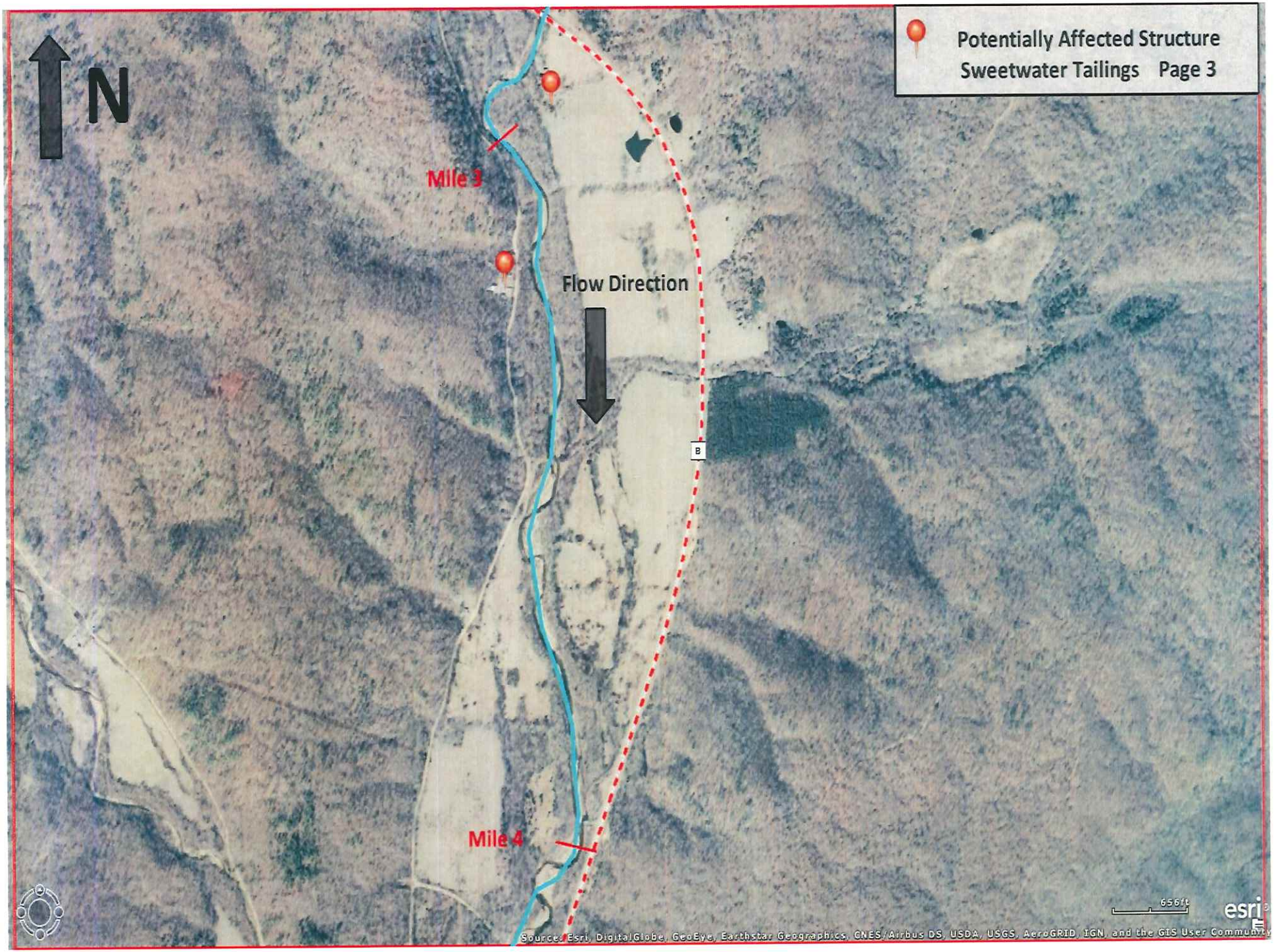
Reynolds County

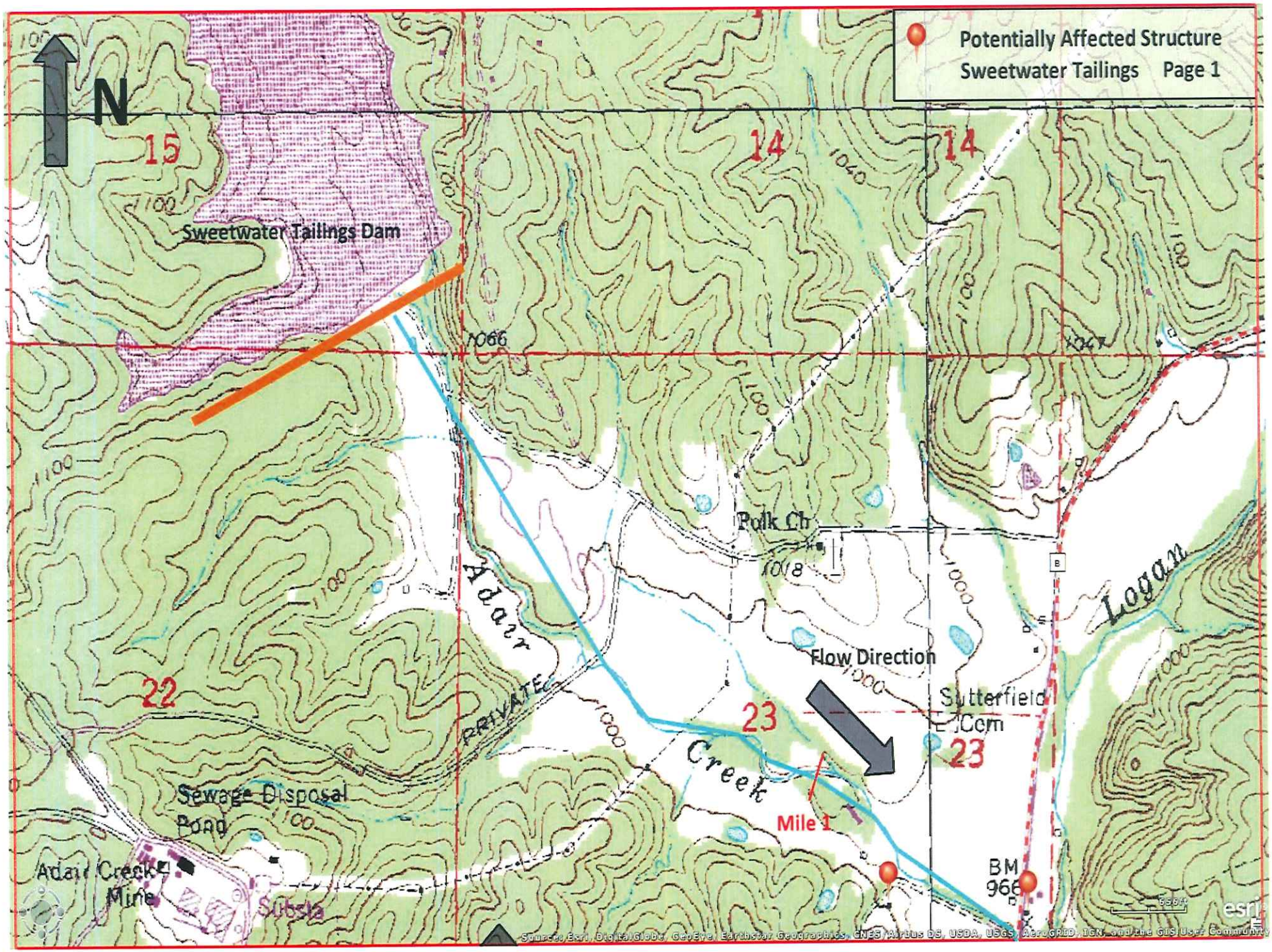


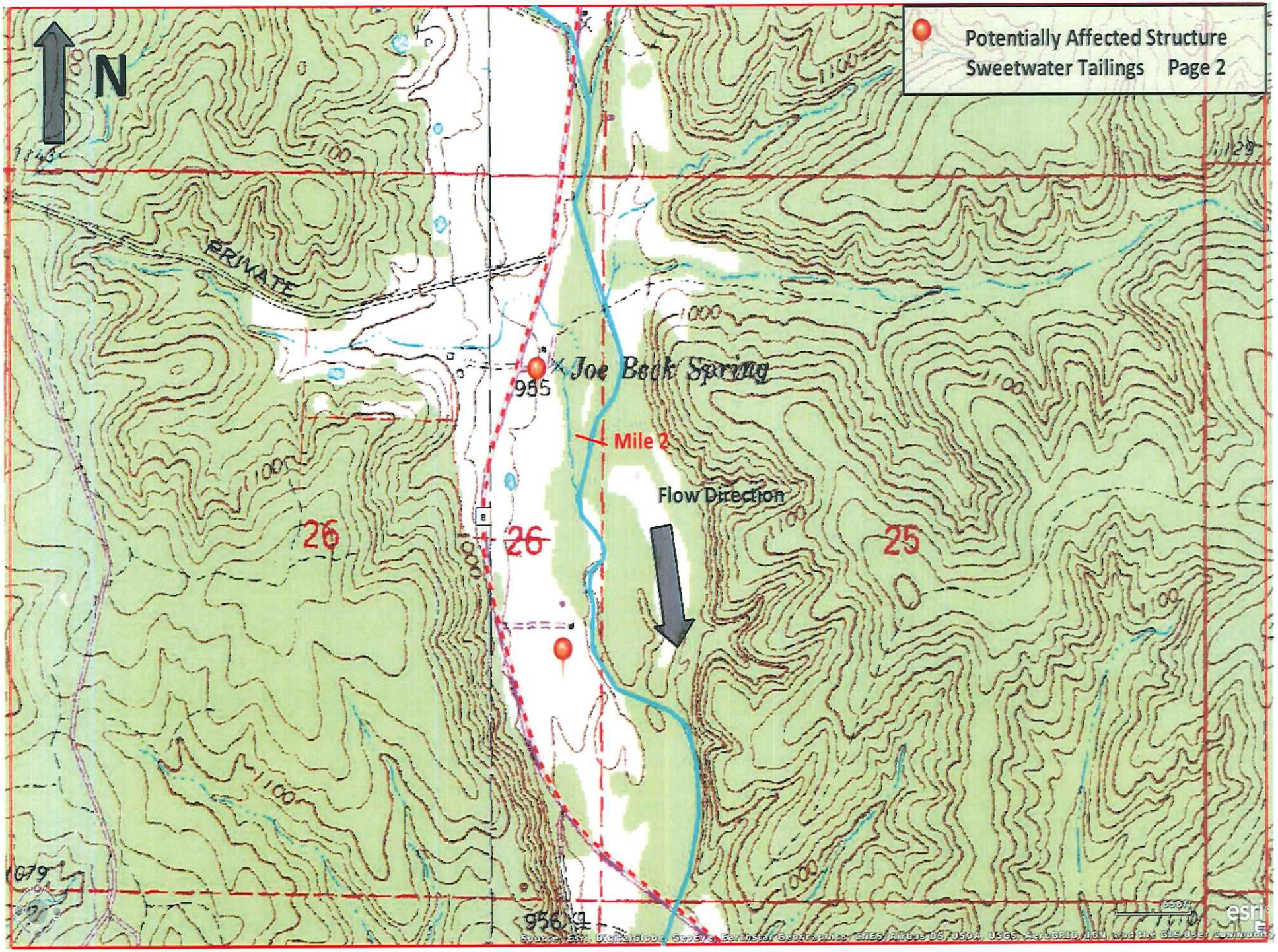
Note: Red rectangular areas indicate each page of the affected areas map

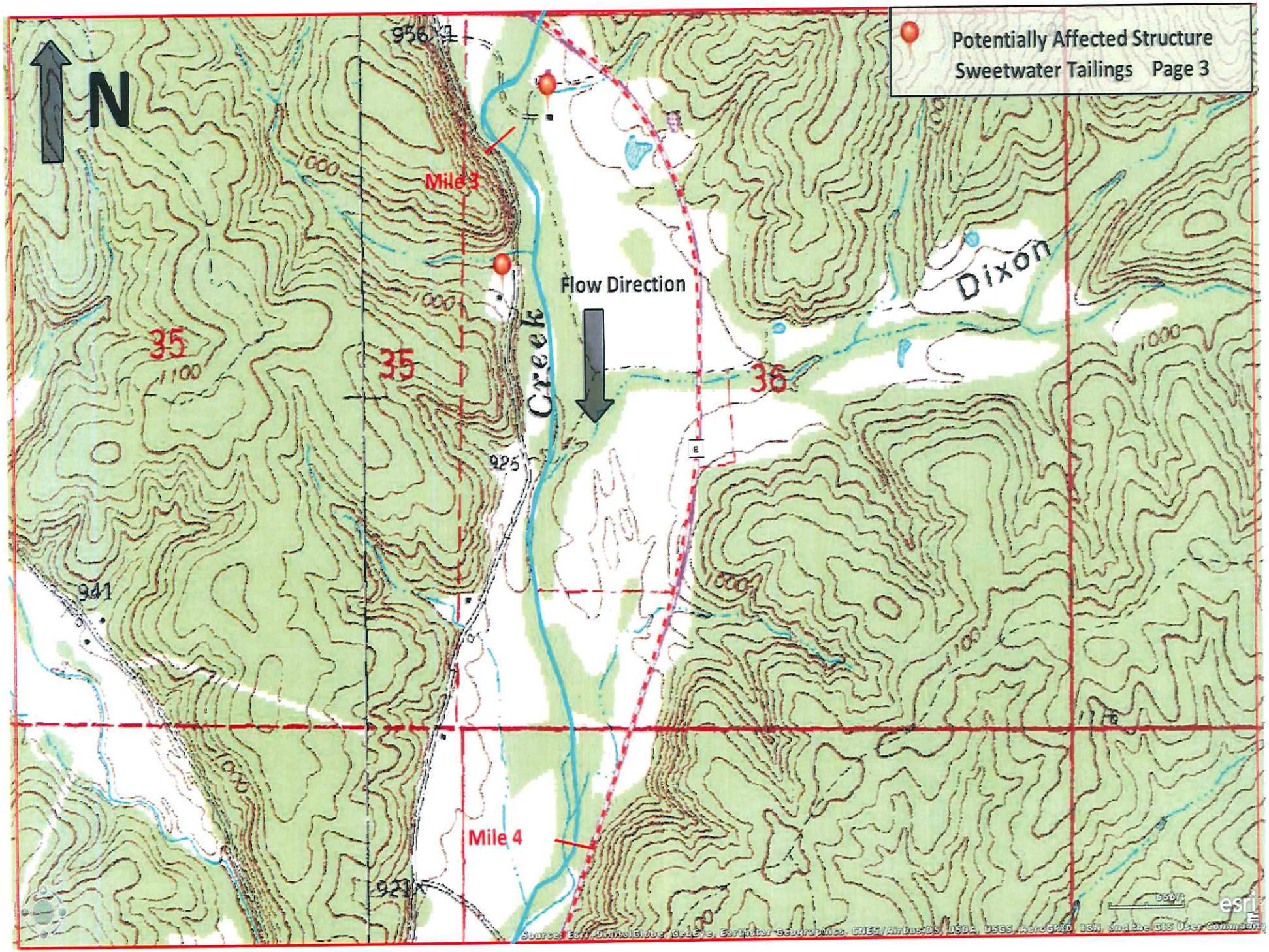

N
Potentially Affected Structure
Sweetwater Tailings Page 1
Sweetwater Tailings Dam
Flow Direction
Mile 1
B
656ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Potentially Affected Structure
Sweetwater Tailings Page 2
Mile 2
Flow Direction
B
656ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Potentially Affected Structure
Sweetwater Tailings Page 3
Mile 3
Flow Direction
B
Mile 4
656ft
esri
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Potentially Affected Structure
Sweetwater Tailings Page 1
N
15
14
14
Sweetwater Tailings Dam
1066
1100
1040
1000
Polk Ch
1018
Adair
Logan
Flow Direction
22
23
23
PRIVATE
Creek
Mile 1
Sutterfield
Cem
Sewage Disposal
Pond
Adair Creek
Mine
Substa
BM
966
Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
esri


N
Potentially Affected Structure
Sweetwater Tailings Page 2
PRIVATE
955
Joe Beck Spring
Mile 2
Flow Direction
26
26
25
956
1079
esri


N
Potentially Affected Structure
Sweetwater Tailings Page 3
Mile 3
Flow Direction
Creek
Dixon
35
35
36
956
1000
925
941
921
Mile 4
esri

Appendix B
National Inventory of Dams (NID) Data

Sweetwater Tailings Dam:

State: Missouri

NID ID: MO30166

Sec: 15 Township: 31N Range: R02W

Longitude: -91.1411 decimal degree
Latitude: 37.3716 decimal degree

Longitude: -91 ° 08' 27"
Latitude: 37° 22' 15"

County: Reynolds

Stream: Adair Creek

Nearest town downstream: Ellington

Distance to nearest town downstream: 19 mi

Year constructed: 1960

Nearest town: Reynolds

Distance to nearest town: 5.0 mi

Type of dam: (indicate only one)

tailings

Max. discharge: 9800 $ft.^3/s$

Max. storage: 23467 acre-ft.

Normal storage: 10470 acre-ft.

Surface area: 640 acres

Drainage area: 3880 acres

Inspection frequency: 2 yrs.

State regulatory agency:
Missouri DNR WRC DRSP

Dam height: 130 ft.

Dam length: 1400 ft.

Current hazard class: 1

Principal spillway type: Open channel on left abutment

Emergency spillway type: none

Comments: _____

_____

_____

_____

Appendix C

Unusual or Emergency Event Log

(To be completed during the emergency)

Sweetwater Tailings Dam County: Perry

When and how was the event detected?

Weather conditions:

General description of the emergency situation:

Emergency level determination: Made by:

Actions and Event Progression

Date	Time	Action/event progression	Recorded by

Appendix D

Glossary

Abutment The part of the valley side against which the dam is constructed. The left and right abutments of dams are defined with the observer looking downstream from the dam.

Appurtenances Structures incident to or annexed to dams essential to the proper operation, maintenance or functioning of the dam. This includes such structures as spillways, low level outlet works and water conduits, such as tunnels, pipelines or penstocks, either through a dam or its abutments.

Breach An opening through the dam that allows draining of the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintended failure of the dam.

Control section An usually level segment in the profile of an open channel spillway above which water in the reservoir discharges through the spillway.

Dam An artificial barrier generally constructed across a watercourse for the purpose of impounding or diverting water.

Emergency spillway The appurtenant structure that provides the controlled conveyance of excess water through, over, or around the dam.

Instrumentation An arrangement of devices installed into or near dams that provide measurements to evaluate the structural behavior and other performance parameters of the dam and spillway structures. Examples include seepage measuring weirs, piezometers, inclinometers and survey monuments.

Low level outlet works An appurtenant structure, usually consisting of a pipe through the embankment or principal spillway structure equipped with a valve, whose purpose is to allow lowering the lake level.

Principal spillway The appurtenant structure that conveys normal inflow through or around the embankment.

Reservoir The body of water impounded or potentially impounded by the dam.

Seepage The natural movement of water through the embankment, foundation, or abutment of the dam.

Appendix E

Record of Holders of Control Copies of this EAP

Copy Number	Organization	Person receiving copy	E-mail Address
1	The Doe Run Company Fletcher Mine Clarification Dam	Mr. Dan Buxton	573-244-8142
2	Reynolds County EMD	Renee Horn	573-648-2494 (Office
3	Missouri Department of Natural Resources Dam Safety Program and address	Ryan Stack	mowaters@dnr.mo.gov

Record of Revisions and Updates Made to EAP

Revision Number	Date	Revisions made	By whom
1	Date	Describe revision to EAP	Name

THE DOE RUN COMPANY
ENGINEERING DEPARTMENT
VIBURNUM, MO 65566
EMERGENCY ACTION PLAN FOR DAM FAILURE

THIS PLAN SHOULD BE IMPLEMENTED WITH THE SITE CRISIS COMMUNICATION PLAN

Job no. 1292-R

Name of Dam:	**West Fork Tailings Dam (MO 31833)**
Forest: Mark Twain	**Ranger District:** Salem
Location of Dam (Section, Township, Range): UTM 4,150,465N, 667,005E, Zone 15	Section 1, T32N, R2W Reynolds County Latitude 37.29.15 Longitude –91.06.38
Route to Dam (from nearest town on highway):	0.6 road miles southeast of Bunker, Reynolds County, Missouri on State Highway 72, then 6.8 miles north-east on State Highway K-K, and then 0.3 miles southeast on private road.
Height: 132 Feet	**Length:** 800 Feet **Elevation** 1057.3 ft.
Reservoir Area: 25 acres	**NID Storage** 7500 ac-ft **Drainage Area** 685 acres
	2.44 billion gallons
Spillway elevation: 1047 ft Elev.	Open channel, no gates or valves
Type of structure (earth fill, concrete, etc.):	Earth fill and Coarse Tailings
Plan Prepared by: Dan Buxton	Date: Aug 15, 2012
Responsible for Keeping Plan Current:	Dan Buxton

Possible affected areas: West Fork Black River valley from KK bridge east to Sutton Bluff

Reynolds County Rd 844 from KK highway east to Mill Branch Ford, including private road east of Mill Branch junction
Reynolds County Rd 848 from junction with Rd 849 east to Cooks Spring
Reynolds County Rd 849 from junction with Reynolds County Rd 848 east to Sutton Bluff
Reynolds County Rd 850, Rd 847
South end of Reynolds County Rd 846
North end of Reynolds County Rd 888, north end of Forest Rd 2456, north end of Forest Rd. 2683

NOTE:
The following items are numbered for clarity only. It is expected that these actions would be taken as concurrently as possible by those responsible for each. The responsibility must be assigned to someone who will see that the job gets done, whether he does it himself or through others.

CONDITION A: Severe upstream flooding results from an isolated thunderstorm, rain on snow, or general rain. Our dam will be threatened by the flood.

1. Make immediate inspection; establish communications:

Responsible:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Alternate:

Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)

2. Notify Appropriate Personnel:

Responsible:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Alternate:

Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)

Notify		(Office)	(Home)	(Mobile)
Steve Batts	Desoto	(573) 244-8117	(636) 933-0230	(314) 239-2610
Jason England	Park Hills	(573) 689-4504	None	(573) 218-2152
Mark Cummings	Salem	(573) 244-8152	None	(573) 604-0144
Gene Hites	Leadington	(573) 689-2251 ext. 4151	(573) 631-9810 (Cell)	(636) 208-1678
Dan Buxton	Farmington	(573) 244-8142	(573) 760-0704	(573) 701-1744

3. Move in and use equipment to lower reservoir level or raise dam crest if required: freeboard per Dam Safety in 2010 is 10.3 feet, Minimum required is 5.7. Spillway can be raised 4.6ft. Use minesite equipment or SEE Contractor list page 16.

Responsible:

Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)

Alternate:

Randy Blount	(573) 689-2251 Ext. 4122 (Office)	(573) 244-3221 (Home)

4. Maintain on-site observation and communications until danger passes, or situation becomes condition C or D:

Responsible:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Alternate:

Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)

CONDITION B: Dam is partially or totally failing when condition is discovered - failure cannot be prevented. (Overtopping, sudden increase in seepage, serious earthquake damage, large downstream slope slides, serious piping, whirlpools, rapidly enlarging sinkholes, etc.) Significant erosion or headcutting of the spillway and a breach of the control section seems imminent. Flow through the spillway is causing flooding that is threatening people, homes, and/or roads downstream.

1. Make immediate inspection; establish communications; notify appropriate personnel:

Responsible:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Alternate:

Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)

Notify		(Office)	(Home)	(Mobile)
Steve Batts	Desoto	(573) 244-8117	(636) 933-0230	(314) 239-2610
Jason England	Park Hills	(573) 689-4504	None	(573) 218-2152
Mark Cummings	Salem	(573) 244-8152	None	(573) 604-0144
Gene Hites	Leadington	(573) 689-2251 ext. 4151	(573) 631-9810 (Cell)	(636) 208-1678
Dan Buxton	Farmington	(573) 244-8142	(573) 760-0704	(573) 701-1744

2. Notify Authorities:

Responsible:

Steve Batts	(573) 244-8117 (Office)	(636) 933-0230 (Home) (314) 239-2610 (Cell)

Alternate:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Sample text:

"This is _____. We have an emergency condition at West Fork Tailings Dam, located at the West Fork Black River bridge on KK highway northeast of Bunker. We have activated the Emergency Action Plan. The dam is failing. Evacuate the area along low lying portions of West Fork Black River west of Sutton Bluff. I can be contacted at the following number _____. If you cannot reach me, please call the following alternative number. _____"

Notify:

Name	Phone No.
a. Missouri Department of Natural Resources, Dam and Reservoir Safety Program Robert Clay	(573) 368-2175 Office (573) 341-5761 Home (573) 368-6169 Cell (573) 634-2436

b. MSHA	(800) 746-1553
c. (After Business Hours) State Emergency Management Agency	(573) 526-9100 (573) 751-2748
d. National Weather Service Jim Kramer	(800) 852-7497 (636) 447- 1876
e. Local emergency services	911 or (573) 648-2491
f. Bunker Fire Department	(573) 689-2444
g. Reynolds County Emergency Management Director Renee Horn	(573) 648-2494 ext. 10
h. Reynolds County Sheriff	(573) 648-2491
i. Missouri State Highway Patrol and Water Patrol Emergency Number	(800) 525-5555
j. Mark Twain National Forest (Salem District)	(573) 729-6656
k. Bunker R-4 School, Superintendent	(573) 689-2507
l. Centerville R-1 School	(573) 648-2285
m. Missouri Department of Conservation	(573) 751-4115
n. Missouri Department of Transportation	(888) 275-6636
o. Global Security – Central Services Office – Global Command Post	(573) 244-8477
p. West Fork Mine (gate)	(573) 689-4500
q. Flubor (control room)	(573) 689-4541

3. Advise Radio, TV, and Press Media:

Responsible:

Steve Batts	(573) 244-8117 (Office)	(636) 933-0230 (Home) (314) 239-2610 (Cell)

Alternate:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Notify:

Name		Phone No.
Local Radio Stations	KTJJ, Farmington	(573) 756-6476 756-6000
	KFMO, Park Hills	(573) 431-2000 431-5588
	KSMO, Salem	(573) 729-6117
	Froggy 96, Farmington	(573) 701-9590
	KTTR-KZNN, Rolla	(573) 364-2525
	KUMR, Rolla	(573) 341-4386
	KGNN, Cuba	(877) 385-3787
St. Louis TV Stations	KTVI Channel 2 - FOX	(314) 647-2222
	KMOV Channel 4 - CBS	(314) 621-4444
	KSDK Channel 5 - NBC	(314) 421-5055
	KETC Channel 9 - PBS	(314) 512-9000
	KPLR Channel 11	(314) 447-1111

	KDNL Channel 30 - ABC	(314) 436-3030
Cape Girardeau TV	KFVS Channel 12	(573) 335-1212

4. Warn Downstream Residents:

Responsible: Same as 2f –i see page 13 for list of downstream residents

Sample text:

Attention: This is an emergency message from the Sheriff. Listen carefully. Your life may depend on immediate action. West Fork Tailings Dam located at the West Fork Black River bridge on KK highway northeast of Bunker is failing. Repeat. West Fork Tailings Dam located at the West Fork Black River bridge on KK highway northeast of Bunker is failing.. If you are in or near this area, proceed immediately to high ground away from the valley. Do not travel on Reynolds County Rd 844, Rd 846, Rd 847, Rd 849, Rd 850, Rd 888, or Rd 848. Do not travel on Forest Roads 2456 or 2683. ~~Do not return~~ to your home to recover your possessions. You cannot outrun or drive away from the floodwave. Proceed immediately to high ground away from the valley.

5. Rescue and Evacuate: Close roads, review map on final page of document

Responsible: Same as 2f- i

a. Advise people monitoring the dam to follow safe procedures.
b. Do whatever is necessary to bring people in immediate danger to safety.
c. Keep in frequent contact with the Sheriff and emergency services to keep them up-to-date on the condition of the dam
d. Record all contacts made, information, observations, and actions taken. Note the time of changing conditions. Document the situation with photographs and video if possible.

CONDITION C: Dam shows signs of rapidly developing failure. (Piping, seepage with turbidity, very much reduced freeboard, serious erosion, downstream slope slides, etc.) Significant erosion or headcutting of the spillway is occurring, but the rate does not appear to threaten an imminent failure of the spillway. Flow through the spillway is expected to caused flooding that could threaten people, homes, and/or roads. Time may be available for action to save the dam, such as reducing the reservoir level by enlarging spillway, using pumps or siphons; sandbagging crest; blanketing seepage areas, etc. and shutting off inflows to basin.

1. Make immediate inspection; establish communications; notify appropriate personnel:

Responsible:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Alternate:

Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)

Notify		(Office)	(Home)	(Mobile)
Steve Batts	Desoto	(573) 244-8117	(636) 933-0230	(314) 239-2610
Jason England	Park Hills	(573) 689-4504	None	(573) 218-2152
Mark Cummings	Salem	(573) 244-8152	None	(573) 604-0144
Gene Hites	Leadington	(573) 689-2251 ext. 4151	(573) 631-9810 (Cell)	(636) 208-1678
Dan Buxton	Farmington	(573) 244-8142	(573) 760-0704	(573) 701-1744

Move in and use equipment to lower reservoir level or raise dam crest if required: freeboard per Dam Safety in 2010 is 10.3 feet, Minimum required is 5.7. Spillway can be raised 4.6 ft. Use minesite equipment or SEE Contractor list page 16.

2. Notify Authorities:

Responsible:

Steve Batts	(573) 244-8117 (Office)	(636) 933-0230 (Home) (314) 239-2610 (Cell)

Alternate:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Sample text:

"This is _____. We have an emergency condition at West Fork Tailings Dam located at the West Fork Black River bridge on KK highway northeast of Bunker. We have activated the Emergency Action Plan. We are implementing predetermined actions to respond to a rapidly developing situation that could result in dam failure. Please prepare to evacuate the area along low lying portions of West Fork Black River west of

Sutton Bluff. We will advise you when the situation is resolved or if the situation gets worse. I can be contacted at the following number _____. If you cannot reach me, please call the following alternative number. _____"

Notify:

Name	Phone No.
a. Missouri Department of Natural Resources, Dam and Reservoir Safety Program Robert Clay	(573) 368-2175 Office (573) 341-5761 Home (573) 368-6169 Cell (573) 634-2436
b. MSHA	(800) 746-1553
c. (After Business Hours) State Emergency Management Agency	(573) 526-9100 (573) 751-2748
d. National Weather Service Jim Kramer	(800) 852-7497 (636) 447-1876
e. Local emergency services	911 or (573) 648-2491
f. Bunker Fire Department	(573) 689-2444
g. Reynolds County Emergency Management Director Renee Horn	(573) 648-2494 ext. 10
h. Reynolds County Sheriff	(573) 648-2491
i. Missouri State Highway Patrol and Water Patrol Emergency Number	(800) 525-5555
j. Mark Twain National Forest (Salem District)	(573) 729-6656
k. Bunker R-4 School, Superintendent	(573) 689-2507
l. Centerville R-1 School	(573) 648-2285
m. Missouri Department of Conservation	(573) 751-4115
n. Missouri Department of Transportation	(888) 275-6636
o. Global Security – Central Services Office – Global Command Post	(573) 244-8477
p. West Fork Mine (gate)	(573) 689-4500
q. Flubor (control room)	(573) 689-4541

3. Advise Radio, TV, and Press Media:

Responsible:

Steve Batts	(573) 244-8117 (Office)	(636) 933-0230 (Home) (314) 239-2610 (Cell)

Alternate:

John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

Notify:

Name		Phone No.
Local Radio Stations	KTJJ, Farmington	(573) 756-6476 756-6000
	KFMO, Park Hills	(573) 431-2000 431-5588
	KSMO, Salem	(573) 729-6117
	Froggy 96, Farmington	(573) 701-9590

	KTTR-KZNN, Rolla	(573) 364-2525
	KUMR, Rolla	(573) 341-4386
	KGNN, Cuba	(877) 385-3787
St. Louis TV Stations	KTVI Channel 2 - FOX	(314) 647-2222
	KMOV Channel 4 – CBS	(314) 621-4444
	KSDK Channel 5 – NBC	(314) 421-5055
	KETC Channel 9 – PBS	(314) 512-9000
	KPLR Channel 11	(314) 447-1111
	KDNL Channel 30 - ABC	(314) 436-3030
Cape Girardeau TV Station	KFVS Channel 12	(573) 335-1212

4. Warn Downstream Residents:

Responsible: Same as 2f –i see page 13 for list of downstream residents

Sample text:

Attention: This is an emergency message from the Sheriff. Listen carefully. Your life may depend on your actions. West Fork Tailings Dam located at the West Fork Black River bridge on KK highway northeast of Bunker is in a rapidly developing situation that could result in dam failure . If you are in or near this area, prepare to evacuate the area along low-lying portions of West Fork Black River west of Sutton Bluff . We will advise you when the situation is resolved or if the situation gets worse.

5. Rescue and Evacuate: Close roads, review map on last page of document

Responsible: Same as 2f -i

a. Advise people monitoring the dam to follow safe procedures.
b. Do whatever is necessary to bring people in immediate danger to safety.
c. Keep in frequent contact with the Sheriff and emergency services to keep them up-to-date on the condition of the dam
d. Record all contacts made, information, observations, and actions taken. Note the time of changing conditions. Document the situation with photographs and video if possible.

6. Take action on Dam, upstream and downstream structures as required:

Responsible:

Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)

Alternate:

Randy Blount	(573) 689-2251 Ext. 4122 (Office)	(573) 244-3221 (Home)

ACTION

Move in and use equipment to lower reservoir level or raise dam crest if required: freeboard per Dam Safety in 2010 is 10.3 feet, Minimum required is 5.7. Spillway can be raised 4.6 ft. Use minesite equipment or SEE Contractor list page 16.

Shut off all inflow diversions to the West Fork Creek Tailings Basin including mine pump discharges and storm ditch. Use available minesite equipment or see Contractor list page 16.

Establish maximum water release from the West Fork Tailings Basin by enlarging spillway, using pumps, or siphons.

Sandbag crest and/or blanket seepage areas.

Cover weak areas of the dam and downstream slope with riprap, sandbags, plastic sheets, or other materials to provide erosion resistance..

Cover seepage areas with several feet of sand/gravel to hold fine-grained embankment or foundation materials in place.

Stabilize slides by placing a soil or rockfill buttress against the toe of the slide.

Initiate immediate investigation to determine conditions and appropriate remedial measures.

CONDITION D: Dam shows evidence of a slowly developing failure. (Slow increase in volume of seepage or turbidity, appearance of sand boils, slope cracking, transverse cracks in embankment crest, etc.) Time should be available to lower reservoir level and get equipment to the site for further action.

Note: If an earthquake of Richter 5.0 or greater has been reported in the vicinity, or the operators have felt ground motions and experienced the following earthquake features: "Felt by all. Persons walk unsteadily, Windows, dishes, glassware broken. Knickknacks, books etc. knocked off shelves. Furniture moved or overturned. Weak plaster and masonry cracked. Trees bushes shaken visibly, or heard to rustle."

1. Immediately conduct a general overall visual inspection of the dam including toe drains for excess flow and turbidity.
2. If the dam is failing, or is damaged to the extent that there is increased flow passing downstream, immediately implement emergency action plan procedures.
3. Check the dam crest for settlement. If the dam crest has dropped more than 0.5 feet, lower the reservoir pool level the same amount as the settlement. It may be necessary to install siphon pipes or pumps to lower the pool level. The pool should remain drawn down until the dam can be examined by Missouri Dam Safety or other qualified professional engineers.
4. Otherwise, if damage has occurred, but is not judged serious enough to cause failure of the dam, quickly observe the nature, location, and extent of the damage, and evaluate the potential for failure. Then notify appropriate personnel per step 1 of this Emergency Action Plan.
5. If there appears to be no imminent danger of dam failure, thoroughly inspect the following:
   a. Both faces of the dam for cracks, settlement, or seepage:
   b. Abutments for possible displacement:
   c. Spillway structure to confirm continued safe operation"
   d. Drains and seeps for any turbidity, muddy water or increased flow:
   e. Reservoir and downstream areas for landslides:
   f. Toe for wet and flowing areas and sand boils.
   g. Also make sure to keep close watch on the dam for the next four weeks as some damage may not show up immediately after the quake.

1. Make immediate inspection; establish communications; notify appropriate personnel:

Responsible:

John Boyer		(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (573) 247-1510 (Cell)

Alternate:

West Fork En[illegible]m, Reynolds County, NID 31833

Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)

Notify		(Office)	(Home)	(Mobile)
Steve Batts	**Desoto**	**(573) 244-8117**	**(636) 933-0230**	**(314) 239-2610**
Jason England	**Park Hills**	**(573) 689-4504**	**None**	**(573) 218-2152**
Mark Cummings	**Salem**	**(573) 244-8152**	**None**	**(573) 604-0144**
Gene Hites	**Leadington**	**(573) 689-2251 ext. 4151**	**(573) 631-9810 (Cell)**	**(636) 208-1678**
Dan Buxton	**Farmington**	**(573) 244-8142**	**(573) 760-0704**	**(573) 701-1744**

2. Advise Missouri Department of Natural Resources, Dam and Reservoir Safety Program: Robert Clay phone (573) 368-2175 Office (573) 341-5761 Home, (573) 368-6169 Cell or, (573) 634-2426 Missouri Department of Natural Resouces Emergency Response Agency (573) 634-2436. or

Responsible:		
Steve Batts	(573) 244-8117 (Office)	(636) 933-0230 (Home) (314) 239-2610 (Cell)
Alternate:		
John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

3. Take action on Dam, upstream and downstream structures as required:

Responsible:		
Dwain Beck	(573) 689-2251 Ext. 4120 (Office)	(573) 663-2498 (Home)
Alternate:		
Randy Blount	(573) 689-2251 Ext. 4122 (Office)	(573) 244-3221 (Home)

ACTION

Shut off all inflow diversions to the West Fork Tailings Basin including mine pump discharges and storm ditch. Use available minesite equipment or see Contractor list page 16.
Establish maximum water release from the West Fork Tailings Basin by enlarging spillway, using pumps, or siphons.

Sandbag crest and/or blanket seepage areas.

Cover weak areas of the dam and downstream slope with riprap, sandbags, plastic sheets, or other materials to provide erosion resistance..

Cover seepage areas with several feet of sand/gravel to hold fine-grained embankment or foundation materials in place.

Stabilize slides by placing a soil or rockfill buttress against the toe of the slide.

Initiate immediate investigation to determine conditions and appropriate remedial measures.

Prepare for future evacuation if warranted..

Sample text:

"This is _____. We have an emergency condition at West Fork Tailings Dam located at the West Fork Black River bridge on KK highway northeast of Bunker. We have activated the Emergency Action Plan. We are implementing predetermined actions to respond to a rapidly developing situation that could result in dam failure. Please prepare to evacuate the area along low lying portions of West Fork Black River west of Sutton Bluff. We will advise you when the situation is resolved or if the situation gets worse. I can be contacted at the following number _____. If you cannot reach me, please call the following alternative number. _____"

4. Advise Authorities, Media, and Others as situation warrants:

Responsible:		
Steve Batts	(573) 244-8117 (Office)	(636) 933-0230 (Home) (314) 239-2610 (Cell)
Alternate:		
John Boyer	(573) 689-2228 Ext 4263 (Office)	(573) 244-5293 (Home) (636) 232-7132 (Cell)

KNOWN RESIDENCES/LANDOWNERS
DOWNSTREAM OF DAM As of Aug 2009
Other individuals may be affected that were not known at time of plan inception.
See Drawing 01Z6

Map Key	Name	Address	Phone No.	Remarks	Miles from Dam	Section, Township, Range
M	Happy Home Baptist Church	737 Cnty Rd 906 Boss, MO 65440	(573) 689-2065	Church Deacon: Carl Wayne Callahan	.8	01-32-2W
N	Highway KK & 906 Junction			Road Intersection	.1	01-32-2W
O	Highway KK & 844 Junction			Road Intersection	.1	01-32-2W
P	Doe Run - West Fork Mine & New Technology	6854 Hwy KK Bunker, MO 63629	(573) 689-4500 (573) 689-4541	Mine & Demonstration Plant	0.0	01-32-2W 06-32-1W
Q	Doe Run Warehouse	6858 Hwy KK Bunker, MO 63629	(573) 689-4500	Office in West Fork Supply House	0.0	01-32-2W
R		179 Cnty Rd 844 Bunker, MO 63629		Stone house Doe Run owns land	.1	01-32-2W
S	West Fork Cemetery (Sutterfield Cemetery)	Wayne Parker Chairman of the Board of Directors	573-689-2757	Cemetery	.4	06-32-1W
		Terry Patterson Member BOD	(573) 626-4468	Cemetery		
T	Bob Hafeli	25 Bangert Ave. St. Louis, MO 63135	(314) 395-5992	Land Owner	.66	06-32-1W
U	Tom Elmore	819 Cnty Rd 844 was Rt. 1 Box 1195 Bunker, MO 63629	(573) 689-2719	Resident Across creek	.6	06-32-1W
V	Donald Gill			Land Owner Across West Fork	.7	06-32-1W
W	Cheryl Brawley			Non-resident Land Owner	.8	06-32-1W
X	Doe Run County Road 844(former Bailey property)	Bunker, MO 63629		Doe Run Owns Land	.8	06-32-1W
Y	County Road 844 & Private Road Intersection (Brooks Lane)			Road Intersection	1.4	06-32-1W
Z	Mill Branch Stream Ford			Ford	1.5	06-32-1W

	on Road 844					
A1	Dale & Rosalee Brooks	1366 Cnty Rd 844 (Private Rd – Brooks Lane) was Rt. 1 Box 1205 Bunker, MO 63629	(573) 689-2791	Resident	2.2	06-32-1W 05-32-1W
B1	Brian & Heather Mullens	#5 Dogwood Trail Pacific, MO 63069		Non Resident Land Owner	1.8	05-32-1W
C1	Alan Peters	11 HC 1 Eminence, MO 65466	(573) 226-5601	Non-resident Land Owner	3.3	05-32-1W
Map Key	Name	Address	Phone No.	Remarks	Miles from Dam	Section, Township, Range
D1	Dennis Dinges	2621 Cnty Rd 846 Bunker , MO 63629 9815 Lenor Drive St. Louis, MO 63123	(573) 689-2085	Resident	3.5	05-32-1W
E1	William Townsend			Non-resident Land Owner	5.0	05-32-1W
E1A	Howard Jarvis Jr	PO box 780 Osage Beach, MO 65065	(573) 348-5574	121 acres Non-resdient access from Forest Service Rd 2683	5.0	04-32-1W
F1	Robert Lenzen & others	2206 StoneBriar Ridge Dr. Chesterfield, MO 63017	(636) 530-0541	Non-resident Land Owner	5.1	09-32-1W
G1	Little Radford Cemetery			Cemetery	5.2	09-32-1W
H1	Viola Self	1285 Cnty Rd 848 or 424 RR 1 Ellington, MO 63638	(573) 924-2434	Vacant cabin Non resident	5.7	09-32-1W
I1	County Road Intersection 850 & 848			Road intersection	5.7	09-32-1W
I1A	Kenneth & Mae Sellers	603 Cnty Rd 847 was Rt 1 Box 280 Centerville, MO 63633	(573) 648-2305	Resident	6.3	04-32-1W
J1	Radford	1352 Cnty Rd 848 Centerville, MO 63633		RV pad	5.7	09-32-1W
K1	Shirley Radford	1362 Cnty Rd 848 was Rt. 2 Box 278 Centerville, MO 63633	(573) 648-2318	Resident	5.7	09-32-1W
L1	Radford	1366 Cnty Rd 848 Centerville, MO 63633		Resident	5.7	09-32-1W
M1	Radford	1370 Cnty Rd 848 Centerville, MO 63633		Resident	5.7	09-32-1W
N1	Peter McAdams	1968 Seminary Rd. Brighton, IL 62012	(618) 372-8968	Part Time Resident	5.7	09-32-1W 10-32-1W
O1	William Oliver	2279 Cnty Rd 848 Centerville, MO 63633	(573) 648-2249	Nice Cabin Part time resident	7.0	03-32-1W 10-32-1W
P1	Greg Hedrick X/0 William Hedrick	2147 Dead End Rd Rose Bud, MO 63091	(573) 764-3842	Non-resident Land Owner	7.2	10-32-1W
Q1	USA Forest Service	Hwy 19 South Salem, MO 65560	(573) 729-6656	Non-resident Land Owner	7.7	2-32-1W 10-32-1W 11-32-1W

Map Key	Name	Address	Phone No.	Remarks	Miles from Dam	Section, Township, Range
R1 Off map	Dennis & Marilyn Vance	4941 Cnty Rd 806 Centerville, MO 63633	(573) 648-2326	Resident	8.2	11-32-1W 12-32-1W
S1 Off map	Ronald & Judy Cook	2269 Cnty Rd 806 was Rt. 1 Box 261 Centerville, MO 63633	(573) 648-2280	Non- resident land owner	8.7	11-32-1W
T1 Off Map	Gates	6963 Cnty Rd 849 was Rt 1 Box 265 Centerville, MO 63633		Resident	8.7	11-32-1W
U1 Off Map	Alexander James	6959 Cnty Rd 849 was Rt. 1 Box 265 Centerville, MO 63633	(573) 648-8800	Resident	8.7	12-32-1W
V1 Off Map	Anthony Rolls	Centerville, MO 63633		Land Owner	8.7	12-32-1W
W1 Off Map	Ralph Tate	964 Cnty Rd 726 Centerville, MO 63633	(573) 648-2380	Non Resident land owner	9.0	13-32-1W
X1 Off Map	USA Forest Service Sutton Bluff Campground	Hwy 19 South PO Box 460 Salem, MO 65560	(573) 729-6656	Campground not open all year round	9.2	12-32-1W 13-32-1W 14-32-1W
	William F. & Rita Mitchell	8860 Burntoak St. Louis, MO 63123			5.7	13-32-1W
	Raymond H. Theismann –Etal	11654 Olive Blvd. Creve Coeur, MO 63141			5.7	13-32-1W

CONTRACTOR LISTING

1.	Abney, Tony Construction	Viburnum	MO	573-244-3145
2.	Adams, Ted Drilling	Potosi	MO	573-438-8641
3.	All-Type Drilling – Bryan Blair	Cadet	MO	573-438-5038
4.	B & B Drilling (Mark Brewington)	Fredericktown	MO	573-783-8506
5.	Barr Engineering	Jefferson City	MO	573-638-5000
6.	Boart Longyear	Wytheville	VA	276-228-7811
7.	C & C Brokering (Coleman Trucking)	Mineral Point	MO	573-562-2723
8.	Carr Engineering	Bonne Terre	MO	573-358-7865
9.	Christensen, Layne	Grayson	KY	606-474-6285
10.	Conway's Drilling Company	Bunker	MO	573-689-2811
11.	CWI of Missouri	Jackson	MO	800-844-3151
12.	Dent County Glass & Door	Salem	MO	573-729-7141
13.	Dunn, Robert G.	Viburnum	MO	573-244-3159
14.	Ebers Drilling (Lonny Ebers)	Chester	IL	618-826-5398
15.	Ed's Drilling & Blasting	Washington	MO	314-239-4762
16.	Environmental Analysis South	Jackson	MO	573-204-8817
17.	Fabick Tractor Company	Fenton	MO	636-343-5900
18.	Faith Technologies	Rogersville	MO	417-886-7667
19.	Frontier-Kemper Constructors, Inc.	Evansville	IN	812-426-2741
20.	Gibbs, Tom	Davisville	MO	573-743-6490
21.	Global Security	Viburnum	MO	573-244-8477
22.	Golder Associates	Burnaby	BC	604-298-6623
23.	Gradient Geophysics	Missoula	MT	406-626-1553
24.	Grouting Services (Dave Taylor)	Bridgeton	MO	314-291-1111
25.	Herbig Mechanical Inc.	O'Fallon	MO	314-978-5550
26.	Huffman, Bill	Salem	MO	573-729-7096
27.	Johnson, Ray Inc.	Ellington	MO	573-663-7570
28.	Jones, James A. (Chip)	Viburnum	MO	573-244-5282
29.	K & D Crushing	Mineral Point	MO	573-562-7400
30.	Kirkwood, David Welding	Boss	MO	573-626-4247
31.	Lanham Drilling (Scott Lanham)	Bunker	MO	573-689-2293
32.	Lee Mechanical Contractors	Park Hills	MO	573-431-6628

33.	Matthews, George	Fredericktown	MO	573-783-6871
34.	Matthews, Jerry	Fredericktown	MO	573-783-5038
35.	Merrill Drilling	Irondale	MO	573-749-3239
36.	Mine Mappers, LLC	Marshfield	WI	715-389-1671
37.	Nations, Mark (Remediation)	Cell Phone		314-452-6063
38.	Nickelson, Sid	Caledonia	MO	573-779-3377
39.	Ozark Testing	Rolla	MO	573-364-3301
40.	Palmer, James	Rolla	MO	573-364-1872
41.	Pense Drilling	Fredericktown	MO	573-783-3347
42.	Politte Ready Mix	Viburnum	MO	573-244-5463
43.	Purcell Tire & Rubber Company	Viburnum	MO	573-244-3303
44.	Quad County Plumbing	Viburnum	MO	573-244-5202
45.	Ragsdale Core Drilling	Desloge	MO	573-431-5951
46.	Ray, Harold	Potosi	MO	573-438-2892
47.	Ridge Runner Drilling & Pump Co.	Salem	MO	800-575-4261
48.	Roland Machinery Co.	Cape Girardeau	MO	800-274-7210
49.	Rudd Equipment Co	St. Louis	MO	800-946-4050
50.	Sandvik	Bunker	MO	573-689-2286
51.	Schultz Engineering Services, Inc.	Poplar Bluff	MO	573-686-0806
52.	Scott Mechanical	Sullivan	MO	573-860-3123
53.	Shoal Creek Electric (Greg Walls)	Davisville	MO	573-743-6513
54.	SSI Global Security Service	Festus	MO	314-931-6905
55.	Steffan, Robertson, Kirsten	Lakewood	MO	303-985-1333
56.	Strata Services	St. Charles	MO	314-828-5858
57.	Tapp, E. George	Viburnum	MO	573-244-5234
58.	Tetra Tech	Golden	CO	303-217-5700
59.	Thomas Roofing Construction	Ironton	MO	573-431-2205
60.	Total Electric	Farmington	MO	573-756-1709
61.	Trend Machine Works, LLC	Viburnum	MO	573-244-8478
62.	Victor Plumbing Company	Salem	MO	573-729-3143
63.	Wadlow, Brad	St. Louis	MO	314-576-6657
64.	Weaver & Associates, LLC	Memphis	TN	901-452-7554
65.	Well's Contracting Service	Park Hills	MO	573-431-0853
66.	Wills, Robert	Rolla	MO	573-364-0380
67.	Wishon, Ray Drilling	Desloge	MO	573-431-5206
68.	Workforce	Farmington	MO	800-311-0006

Cell Phone Numbers

Steve Batts	314-239-2610
Greg Sutton	314-616-6659
John Boyer	573-247-1510
Gene Hites	636-208-1678
Jason England	573 218-2152
Cliff Asberry	573-701-6642 or 573-915-9180
Mark Cummings	573-604-0144
Aaron Miller	314-724-2529
Mark Nations	314-452-6063
Bill Courtney	573-247-0267
Randy Parks	573-241-5172
Amy Sanders	573-453-0660
Randy Blount	573-330-7552
Brian Mangogna	573-247-1804
Adam Steimel	573-465-3185
Elinor Dotson	636-209-8426
T.J. Bowers	573-247-3457
Cheryl Bays	314-954-3663 or 573-366-6859
Kim Archer	573-631-6384
Gary Skaggs	573-453-8989
Gen Bodnar	573-705-8612
Kevin James	573-247-8766

CONTACT RECORD

1.	**Date:**	**Time:**
2.	**Report from:**	
3.	**Description of Emergency:**	
4.	**Dam condition is (circle one):** Failing (B), Failure is imminent (C), Shows signs of slowly developing failure (D), severe upstream flooding (A)	
5.	**Evacuation reqd:** Yes/ no	**Notifications made:** Yes/ no
6.	**Search/rescue reqd:** Yes/no	**Search/rescue made:** Yes/no
7.	**Describe mitigation actions planned or in progress:**	
8.	**Other actions planned:**	
9.	**Resources available or reqd for response:**	
10.	**Support requested from state:**	

11.	**Plan for communication and contact during the event:**
12.	**Call log, etc:**

13.	**Notes:**

PLEASE DESTROY COPY SENT OUT August 2011!

Dist.:

John Boyer
R. Blount
Steve Batts
Jason England
M. Cummings
M.R. Reed
G. Hites
M. Yingling
M. LaRue
Dwain Beck
K.A. Midgett

Reynolds County Hazard Mitigation Plan, 2022

Appendix C – Planning Meeting Documentation

1. Initial Coordination Meeting – 4/26/2021
2. Project Kick-Off Meeting #1 – 5/24/2021
3. Project Kick-Off Meeting #2 – 6/28/2021
4. Risk Assessment Meeting – 6/13/2022
5. Mitigation Strategy Meeting – 7/11/2022

Reynolds County
Multi-Jurisdictional Hazard Mitigation Plan Update
Kick-off Planning Meeting
4/26/2021
9:00AM

Agenda

Welcome/Introductions — Ashley Hart, Community Development Specialist,

Ozark Foothills Regional Planning Commission

Hazard Mitigation Planning Purpose

Grant Programs Linked to Approved Plan

Planning Tasks-Multi Jurisdictional Approach

Participation Requirements

Public Involvement

Data Collection Questionnaires

Discussion of Hazards

Critical Facilities

Next Steps in the Planning Process

SAVE THE DATE:
Meeting #2
May 24, 2021
Reynolds County Courthouse

REYNOLDS COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE
KICKOFF MEETING—SIGN-IN SHEET

Project: Reynolds County, Missouri Multi-jurisdictional Hazard Mitigation Plan Update	**Meeting:** 1 **Date/Time:** 04/26/2021 9:00AM
Facilitator: Ashley Hart, Community Development Specialist Ozark Foothills Regional Planning Commission	**Place/Room:** Reynolds County Courthouse

Name	Title	Department/Agency	Email	Phone #	Signature
Ashley Hart	Community Development Specialist	Ozark Foothills Regional Planning Commission	ashley@ofrpc.org	573-785-6402	Ashley Hart
Amy Moore	City Clerk	City of Ellington	[illegible]	573 663 [illegible]	[illegible]
Linda Miller	City Clerk	City of Centerville	[illegible]	573 648-2441	[illegible]
Joe Loyd	Commission Reynolds	Reynolds Co.	[illegible]	573-366-[illegible]	[illegible]
Jason St Gemme	HS Principal	Lesterville R-IV	jstgemme@lesterville.k12.mo.us	[illegible]	[illegible]
Joseph Minks	Superintendent	Centerville R-1	jminks@ces.k12.mo.us	573-648-2285	[illegible]
Larry [illegible]	Commissioner Reynolds	Reynolds Co.	[illegible]	[illegible]	[illegible]

REYNOLDS COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE
SECOND MEETING—SIGN-IN SHEET

Project: Reynolds County, Missouri Multi-jurisdictional Hazard Mitigation Plan Update	**Meeting:** 2 **Date/Time:** 05/24/2021 9:00AM
Facilitator: Ashley Bolt, Community Development Specialist Ozark Foothills Regional Planning Commission	**Place/Room:** Reynolds County Courthouse

Name	Title	Department/Agency	Email	Phone #	Signature
Ashley Bolt	Cm Development Specialist	OFRPC	Ashley@ofrpc.org	785-6402	Ashley Bolt
Frances Vermillion	Director/ Admin.	Reynolds Co. Health Dept.	Frances.Vermillion @lpha.mo.gov	573-648-2498	Frances Vermillion
Amy Moore	City Clerk	City of Ellington	City@mcmo.net	663-7715	Amy Moore
Lisa Beardsley	Public Health Nurse	Reynolds Co Health Center	Lisa.Beardsley@lpha.mo.gov	648-2498	Lisa Beardsley
Brittany Hime	elem. Bunker principal	Bunker R-III	brittany.hime@bunkerr3.k12.mo.us	689-2211	B. Hime
Larry Pogue	commissioner	Reynolds CO.	larrypogue1364@yahoo.com	330-4049	[illegible]
Joe Loyd	Presiding Comm.	Reynolds Co.	rcloyd@live.com	573-366-4543	[illegible]
Eddie Wilson	Dis 2 commissioner	Reynolds CO	[illegible]36@yahoo.com	573 915 3667	[illegible]
R. Renee Horn	Reynolds Co. EMD	Reynolds Co. Emergency Management	runts33@hotmail.com	573-648-2494 x110	R. Renee Horn
Joseph Minks	Superintendent	Centerville R-1	jminks@[illegible].k12.mo.us	573-648-2285	[illegible]
Kendra Ritter	City Clerk	City of Bunker	cityofbunker@centurytel.net	573 689 2444	Kendra Ritter

REYNOLDS COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE
3rd MEETING—SIGN-IN SHEET

Project: Reynolds County, Missouri Multi-jurisdictional Hazard Mitigation Plan Update	**Meeting:** 3 **Date/Time:** 06/28/2021 9:00AM
Facilitator: Ashley Bolt, Community Development Specialist Ozark Foothills Regional Planning Commission	**Place/Room:** Reynolds County Courthouse

Name	Title	Department/Agency	Email	Phone #	Signature
Ashley Bolt	Com Dev Specialist OFRPC	OFRPC	ashley@ofrpc.org	573 785 6402	[signature]
Lisa Beardsley	RN, Public Health Nurse	Reynolds County Health Dept.	Lisa.Beardsley@lpha.mo.gov	573-648-2498 Ex 232	[signature]
Natasha Chitwood	Receptionist / Clerk	Reynolds County Health Dept	natasha.chitwood@lpha.mo.gov	573-648-2498 Ext 211	[signature]
Kendra Ritter	City Clerk	City of Bunker	cityofbunker@centurylink.net	573.689.2444	[signature]
Larry Pogue Jr	County Commission	Reynolds	larrypogue1364@yahoo.com	573-330-9099	[signature]
Joe Loyd	Reynold County	Presiding Commissioner	rcloyd@live.com	573-366-4543	[signature]
[illegible]	"	District 2		573 915 36[illegible]	[signature]

To	**Reynolds County Hazard Mitigation Planning Committee**
From	**Felicity Ray, Planner** **Ozark Foothills Regional Planning Commission**
Tel / E-mail	**573-300-9399 / felicity@ofrpc.org**
Date	**June 13, 2022**
Subject	**Minutes for the Reynolds County Hazard Mitigation Plan Update Risk Assessment Meeting held on June 13, 2022**

This document is a record of attendance and a summary of the issues discussed during the above-referenced meeting.

Attendees

Name	*Title*	Department	Jurisdiction
See Attached			

Introductions

Felicity Ray, Planner with the Ozark Foothills Regional Planning Commission began the meeting by welcoming and thanking the attendees for coming and having all attendees introduce themselves and the jurisdiction or entity they were representing. All attendees were directed to sign the Attendance Roster. Mayor Paul Wood, City of Ellington, was introduced as attending via landline telephone.

Review Purpose/Participation Status

Mrs. Ray provided a brief summary of the purpose of the Hazard Mitigation Plan and the Disaster Mitigation Act of 2000 that codified the requirement of local governments to adopt a hazard mitigation plan to maintain eligibility for FEMA Hazard Mitigation Assistance Grants. The nine-task planning process was summarized and participants were informed that, once the meeting was concluded, the planning committee will have completed Tasks 1-5 as well as a portion of Task 6.

A review of the requirements for jurisdictions to officially participate within the Multi-jurisdictional Hazard Mitigation Plan update process was provided. A record of prior meeting attendance was reviewed. Not all MPC members had attended 100% of prior planning meetings. Meeting attendance was offered both virtually or in-person. All jurisdictions were reminded of the Data Collection Questionnaire completion requirement and a submission deadline of June 30, 2022 was agreed upon and established.

Previous Actions

Handouts were provided to each jurisdiction listing all actions submitted in the previous Hazard Mitigation Plan. The action handouts included the updated action status that was provided for all previous actions by each jurisdiction after meeting #2.

The MS Excel spreadsheet was discussed that has been created including details for each jurisdiction's previous actions. This spreadsheet includes cells to capture the information on the Mitigation Action Plan worksheet. For Continuing and New actions, jurisdictions have their choice of either completing the action plan details on the spreadsheet OR completing an action plan worksheet for each action

Purpose/Public Survey/Participation Status

Mrs. Ray provided a brief summary of the purpose of the Hazard Mitigation Plan and the *Disaster Mitigation Act of 2000* that codified the requirement of local governments to adopt a hazard mitigation plan to maintain eligibility for FEMA Hazard Mitigation Assistance Grants. The nine-task planning process was summarized and participants were informed that, at the conclusion of the meeting, the planning committee will have completed all of Tasks 1-5 and the majority of Task 6. Mrs. Ray also provided a status update and summary of responses to date for the Public Survey that had been disseminated via survey monkey at: https://www.surveymonkey.com/r/GZBL5QJ. To date, five surveys had been completed. Committee members were encouraged to continue to disseminate the online survey link to members of the public.

A review of the requirements for jurisdictions to officially participate in the Multi-jurisdictional Hazard Mitigation Plan was provided, as well as a table summarizing each jurisdiction's participation (meeting attendance and Data Collection Questionnaire completion) to date.

Plan Format/Sample Results of Countywide Risk Assessment

Mrs. Ray presented a slide showing the overall format of the plan update document as follows:

- Executive Summary
- Chapter 1—Planning Process
- Chapter 2—Jurisdiction Profiles
- **Chapter 3—Risk Assessment**
- Chapter 4—Mitigation Strategy
- Chapter 5—Plan Maintenance
- Appendices

The summary of the risk assessment portion of the plan update was presented via PowerPoint and discussed by those in attendance. The planning committee, along with other representatives from the participating jurisdiction(s), were requested to review the risk assessment data and provide comments/additional data by June 30, 2022.

Mitigation Goals

Following the discussion of the risk assessment, Mrs. Ray facilitated a discussion regarding the mitigation goals. Common categories of mitigation goals were presented, as well as the 2017 Reynolds County Hazard Mitigation Plan goals and the 2018 State Hazard Mitigation Plan goals.

This planning effort is an update to an existing hazard mitigation plan. The goals from the previous hazard mitigation plan were reviewed and discussed. Discussed ensued which distinguished goals from actions. Each mitigation action was identified as pertaining to one or more mitigation goal(s). The definition of mitigation—as opposed to emergency preparedness/response—was reiterated.

Those in attendance were divided into groups by jurisdiction for the purpose of goal identification. The goals for the current plan update remained unchanged from those selected during the 2017 plan update conducted five years prior. They were confirmed as follows:

1. Implement mitigation actions that improve the protection of human life, health, and safety from the adverse effects of disasters.
2. Implement mitigation actions that improve the continuity of government and essential services from the adverse effects of disasters.
3. Implement mitigation actions that improve the protection of public and private property from the adverse effects of disasters.
4. Implement mitigation actions that improve the protection of each community from the adverse effects of disasters.

Mitigation Actions

The next meeting will focus upon the evaluation of existing and the creation of new actions. The status updates of all previous actions are due by July 15, 2022.

Next Steps

The meeting concluded with a discussion of the remaining steps to complete the planning process:

- June 30, 2022—Risk Assessment Comments and Action Status Due
- July 11, 2022—Final Meeting, Updating/Developing Mitigation Actions
- July 15, 2022— All Mitigation Action Forms Due (Continuing & New)
- July 16, 2022—Final Draft of Plan Update for Committee Review
- July 25, 2022—Final Public Comment Period / State Review Begins
- August 25, 2022— Submit Plan to FEMA
- September 30, 2022–Anticipate FEMA’s Approval Pending Adoption
- July 31, 2022 –Jurisdictions Adopt Plan

REYNOLDS COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE
RISK ASSESSMENT MEETING—SIGN-IN SHEET

Project: Reynolds County, Missouri Multi-Jurisdictional Hazard Mitigation Plan Update	**Meeting:** #4 **Date/Time:** 06/13/2022 10:00AM
Facilitator: Felicity Ray, Planner Ozark Foothills Regional Planning Commission	**Place/Room:** Reynolds County Courthouse

Name	Title	Department/Agency	Email	Phone #	Signature
Felicity Ray	Planner	Ozark Foothills RPC	felicity@ofrpc.org	573-300-9399	F. C. Ray
Eddie Williams	Dis 2 comm.	Reynolds Co.	newdogn36@yahoo.com	573 915 3663	Eddie [illegible]
Jim Loyd	Pres Comm	Reynolds Co.	rccloyd@live.com	573-366-4543	[signature]
Natasha Chitwood	Rep.	Reynolds County Health Center	natasha.chitwood@lpha.mo.gov	573-648-2498	Natasha Chitwood
Janet Kile	RN, BSN Risk Manager	MO Highlands HC	jkile@mohigh.org	573 996-6369	[signature]
Linda Miller	City Clerk	City of Centerville	cityofcenterville@semo.net	573-648-2441	Linda Miller
William Wood	Maint.	City of Bunker	CityofBunker@[illegible]	573-689-2444	William E. Wood
Jason St. Gemme	HS Principal	Lesterville R-IV School	jstgemme@lesterville.k12.mo.us	573-637-2201	Jason St Gemme
Renee Horn	Reynolds County Emerg. Mgmt Dir.	Reynolds Co. Emergent Mangement	runts33@hotmail.com	573-648-2494 x110	R. Renee Horn
Larry Pogue Jr.	1st District Commissioner	Reynolds County	reynolds@sos.mo.gov	573-648-2494 x 114	L M P[illegible]
Paul Wood	Mayor	City of Ellington		573-663-7715	(by phone)

To	**Reynolds County Hazard Mitigation Planning Committee**
From	**Felicity Ray, Planner** **Ozark Foothills Regional Planning Commission**
Tel / E-mail	**573-300-9399 / felicity@ofrpc.org**
Date	**July 11, 2022**
Subject	**Minutes for the Reynolds County Hazard Mitigation Plan Update Mitigation Strategy Meeting held on July 11, 2022**

This document is a record of attendance and a summary of the issues discussed during the above-referenced meeting.

Attendees

Name	*Title*	Department	Jurisdiction
See Attached			

Review Purpose/Participation Status

Felicity Ray, Planner with the Ozark Foothills Regional Planning Commission provided a brief summary of the purpose of the Hazard Mitigation Plan and the Disaster Mitigation Act of 2000 that codified the requirement of local governments to adopt a hazard mitigation plan to maintain eligibility for FEMA Hazard Mitigation Assistance Grants. The nine-task planning process was summarized and participants were informed that, at the conclusion of the meeting, the planning committee will have completed Tasks 1-5 as well as portions of Task 6.

A review of the requirements for jurisdictions to officially participate in the Multi-jurisdictional Hazard Mitigation Plan was provided. Not all meetings were attended by all jurisdictions. A record of meeting attendance was reviewed. Meeting attendance was offered both virtually or in-person. All jurisdictions were reminded that the Data Collection Questionnaire completion deadline had passed.

Public Survey Results

A summary of the public survey results was provided. To date, thirteen surveys had been completed. Committee members were encouraged to continue to disseminate the online survey link to members of the public.

According to the survey responses, of the hazards evaluated, the top three in terms of probability of occurrence across all jurisdictions were: severe thunderstorm, winter weather, and flood. The top three hazards in terms of potential magnitude across all jurisdictions as rated by the respondents were: tornado, flood, and winter weather.

Previous Actions

Handouts were provided to each jurisdiction listing all actions submitted in the previous Hazard Mitigation Plan. The action handouts included the updated action status that was provided for all previous actions by each jurisdiction after meeting #2.

The MS Excel spreadsheet was discussed that has been created including details for each jurisdiction's previous actions. This spreadsheet includes cells to capture the information on the Mitigation Action Plan worksheet. For Continuing and New actions, jurisdictions have their choice of either completing the action plan details on the spreadsheet OR completing an action plan worksheet for each action

Mitigation Strategy

To determine any new actions that should be added to the mitigation strategy update, the following information was reviewed:

- Plan Goals
- Problem Statements for each hazard
- Previously Identified actions for each hazard
- FEMA's Mitigation Ideas booklet
- Public Opinion from Surveys

Handouts were provided to each jurisdiction listing all actions submitted in the previous Hazard Mitigation Plan dated 2017. Mitigation Action Assessments (MAA) for each jurisdiction were also distributed as well as blank Mitigation Action Worksheets (MAW). All participating jurisdictions were asked to complete the MAA during the meeting and return to the planner. A deadline of was set for the submission of MAW's—both for previously identified mitigation actions and for newly-identified mitigation actions.

Meeting participants were reminded that each jurisdiction must submit at least one action for participation in the plan. Communities participating in the National Flood Insurance Program were also reminded that they must also have an action addressing continued program compliance.

STAPLEE Worksheets

For each Continuing and New action to be included in the plan, the responsible jurisdiction must complete the STAPLEE Worksheet and record the results on either the spreadsheet OR action plan worksheet. The STAPLEE worksheet provides a framework to determine the general effectiveness in accomplishing the goals of life safety and/or reduction or prevention of damage from a hazard event. This method analyzes the Social, Technical, Administrative, Political, Legal, Economic and Environmental aspects of a project and is commonly used by public administration officials and planners for making planning decisions.

Hazard Mitigation Assistance Grants

The Hazard Mitigation Plan is a requirement for jurisdictions to be eligible to apply for FEMA's Hazard Mitigation Assistance Grants. Jurisdictions were informed that the Missouri State Emergency Management Agency is the State agency responsible for administration of these grant dollars. If jurisdictions are considering applying for hazard mitigation assistance funding, they were instructed to contact the director of the Ozark Foothills Regional Planning Commission, Mr. Alan Lutes, at 573-785-6402 to begin the proposal preparation process.

The Lesterville R-IV School District expressed an interest in submitting a proposal for mitigation planning dollars to fund a tornado safe room upon their campus.

Plan Maintenance

The requirements for the plan to provide a formal plan maintenance process were discussed. This is required to ensure that the mitigation plan remains an active and relevant document. After discussion, the following plan maintenance process was agreed to by group consensus:

- The HMPC will meet annually upon the plan approval anniversary date to review the jurisdiction-specific mitigation actions and progress towards the attainment thereof;
- The county's emergency management director will organize the annual meetings;
- The county commission in conjunction with director of the Ozark Foothills Regional Planning Commission will coordinate the update/re-submittal to SEMA and FEMA every 5 years;
- Individual representatives on the HMPC will oversee the integration of the identified mitigation actions, to the extent practicable, during the process to update other jurisdictional plans such as Comprehensive Plans, Capital Improvement Plans, Infrastructure Plans, and School Emergency Plans;
- After the annual review, the emergency management director will forward the meetin minutes (with status updates) to mayors, city clerks, and school superintendents for consideration in other planning mechanisms/discussions; and
- The public will be involved in the plan maintenance process by publication of a Press Release indicating the team has met to review the progress in executing each jurisdiction's hazard mitigation strategy and to highlight specific completed mitigation actions.

Next Steps

The meeting concluded with a discussion of the remaining steps to complete the planning process as follows:

- April July 31, 2022— Action Forms Due
- August 2022— Jurisdictions Adopt Plan
- August 1 – August 15, 2022— Committee Comment Period
- August 15 – August 31, 2022— Public Comment Period
- August 2022— Submit Plan to SEMA
- September 2022— Anticipate FEMA’s Approval

REYNOLDS COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE MITIGATION STRATEGY MEETING—SIGN-IN SHEET	
Project: Reynolds County, Missouri Multi-Jurisdictional Hazard Mitigation Plan Update	**Planning Meeting:** #4 **Date/Time:** 07/11/2022 10:00AM
Facilitator: Felicity Ray, Planner Ozark Foothills Regional Planning Commission	**Place/Room:** Reynolds County Courthouse

Name	Title	Department/Agency	Email	Phone #	Signature
Felicity Ray	Planner	Ozark Foothills RPC	felicity@ofrpc.org	573-300-9399	F. Ray
Eddie Wilson	Comm.	Reynolds Co.		573 915-3603	
Joe Loyd	Pres. comm.	Reynolds Co.	rccloyd@live.com	573-366-4543	
Larry Pogue Sr	Dist 1 Comm.	Reynolds Co.	larrypogue1324@yahoo.com	573-339-4049	
Kendra Ritter	City of Bunker Clerk	City of Bunker	cityofbunker@centurylink.net	573-685-2444	Kendra Ritter
Linda Miller	City of Centerville	City of Centerville	cityofcentervillemo@gmail.net	573 618 2441	Linda Miller
Jason St. Gemme	MS Principal	Lesterville R-IV School	jstgemme@lesterville.k12.mo.us	573-637-2201	Jason St. Gemme
Renee Horn	Reg. Co. EMD	Emergency Mgmt. Reynolds Co.	runts33@hotmail.com	573 648-2494 x110	Renee Horn
Lisa Beardsley	Adm.	Reynolds County Health Center	Lisa.Beardsley@lpha.mo.gov	573-648-2498 Ext 202	Lisa Beardsley
Janet Kile	RN - Risk mgr	MO Highlands Healthcare	jkile@mohigh.org	573 996 6369	

REYNOLDS COUNTY MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE MITIGATION STRATEGY MEETING—SIGN-IN SHEET	
Project: Reynolds County, Missouri Multi-Jurisdictional Hazard Mitigation Plan Update	**Planning Meeting:** #4 **Date/Time:** 07/11/2022 10:00AM
Facilitator: Felicity Ray, Planner Ozark Foothills Regional Planning Commission	**Place/Room:** Reynolds County Courthouse

Name	Title	Department/Agency	Email	Phone #	Signature
Gary Morgeson	Exec.-P		[illegible]		[signature]
Mandy		City of Ellington		(573) 663-7715	via phone

Reynolds County Hazard Mitigation Plan, 2022

Appendix E – STAPLEE Worksheets

High -38

STAPLEE Worksheet	
Name of Jurisdiction:	All Identifying Jurisdictions (I.J.)
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) 1.1
Name of Action or Project:	Satellite Phones
Mitigation Category:	Prevention; Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; Emergency Services

STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0	**Score**
S: Is it **Socially** Acceptable	3
T: Is it **Technically** feasible and potentially successful?	3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?	3
P: Is it **Politically** acceptable?	3
L: Is there **Legal** authority to implement?	3
E: Is it **Economically** beneficial?	1
E: Will the project have either a neutral or positive impact on the natural **Environment?**	2
Will historic structures be saved or protected?	1
Could it be implemented quickly?	3
STAPLEE SCORE	22

Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	9
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	7
	MITIGATION EFFECTIVENESS SCORE	16
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	38

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Medium (27)

STAPLEE Worksheet		
Name of Jurisdiction:	All J. J.	
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) 1.2	
Name of Action or Project:	Extreme Heat Education	
Mitigation Category:	Prevention; Structure and Infrastructure Projects; Natural Systems Protection; (Education and Outreach); Emergency Services	
STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		3
T: Is it **Technically** feasible and potentially successful?		3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		2
P: Is it **Politically** acceptable?		3
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		0
E: Will the project have either a neutral or positive impact on the natural **Environment?**		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		2
	STAPLEE SCORE	16
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	6
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	5
	MITIGATION EFFECTIVENESS SCORE	11
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	27

☐ **High Priority (30+ points)**	☒ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High (34)

STAPLEE Worksheet		
Name of Jurisdiction:	Lesterville R-IV School District	
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) 1. 3	
Name of Action or Project:	Tornado Drills	
Mitigation Category:	(Prevention) Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; Emergency Services	
STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		3
T: Is it **Technically** feasible and potentially successful?		3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		3
P: Is it **Politically** acceptable?		3
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		1
E: Will the project have either a neutral or positive impact on the natural Environment?		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		3
	STAPLEE SCORE	19
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	10
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	5
	MITIGATION EFFECTIVENESS SCORE	15
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	34

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High (30)

STAPLEE Worksheet		
Name of Jurisdiction:	Lesterville R-IV School District	
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) 1.4	
Name of Action or Project:	Tornado Saferoom	
Mitigation Category:	Prevention; (Structure and Infrastructure Projects); Natural Systems Protection; Education and Outreach; Emergency Services	
STAPLEE Criteria **Evaluation Rating** **Definitely YES = 3** **Maybe YES = 2** **Probably NO = 1** **Definitely NO = 0**		**Score**
S: Is it **Socially** Acceptable		3
T: Is it **Technically** feasible and potentially successful?		2
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		3
P: Is it **Politically** acceptable?		2
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		2
E: Will the project have either a neutral or positive impact on the natural **Environment**?		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		0
	STAPLEE SCORE	15
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	10
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	5
	MITIGATION EFFECTIVENESS SCORE	15
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	30

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High (32)

STAPLEE Worksheet		
Name of Jurisdiction:	All I. J.	
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)	1.5
Name of Action or Project:	Warning Siren Mapping	
Mitigation Category:	Prevention; Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; (Emergency Services)	
STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		3
T: Is it **Technically** feasible and potentially successful?		3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		2
P: Is it **Politically** acceptable?		3
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		1
E: Will the project have either a neutral or positive impact on the natural **Environment?**		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		3
	STAPLEE SCORE	18
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	9
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	5
	MITIGATION EFFECTIVENESS SCORE	14
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	32

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Low (22)

STAPLEE Worksheet		
Name of Jurisdiction:	All I. J.	
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) 1.6	
Name of Action or Project:	Upgrade Water Systems	
Mitigation Category:	Prevention; (Structure and Infrastructure Projects); Natural Systems Protection; Education and Outreach; Emergency Services	
STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		3
T: Is it **Technically** feasible and potentially successful?		1
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		1
P: Is it **Politically** acceptable?		3
L: Is there **Legal** authority to implement?		1
E: Is it **Economically** beneficial?		2
E: Will the project have either a neutral or positive impact on the natural **Environment?**		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		0
	STAPLEE SCORE	11
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	5
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	6
	MITIGATION EFFECTIVENESS SCORE	11
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	22

☒ **High Priority (30+ points)**	☒ **Medium Priority (25 - 29 points)**	☒ **Low Priority (<25 points)**

Medium (29)

STAPLEE Worksheet	
Name of Jurisdiction:	All J.J.
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) 2.1
Name of Action or Project:	EM Personnel Recruitment / Training
Mitigation Category:	Prevention; Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; (Emergency Services)

STAPLEE Criteria Evaluation Rating Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0	Score
S: Is it **Socially** Acceptable	2
T: Is it **Technically** feasible and potentially successful?	2
A: Does the jurisdiction have the **Administrative** capacity to execute this action?	1
P: Is it **Politically** acceptable?	2
L: Is there **Legal** authority to implement?	3
E: Is it **Economically** beneficial?	1
E: Will the project have either a neutral or positive impact on the natural **Environment?**	1
Will historic structures be saved or protected?	1
Could it be implemented quickly?	1
STAPLEE SCORE	14

Mitigation Effectiveness Criteria	Evaluation Rating	Score
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	9
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	6
	MITIGATION EFFECTIVENESS SCORE	15
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	29

☐ **High Priority (30+ points)**	☒ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High - 32

STAPLEE Worksheet	
Name of Jurisdiction:	Lesterville R-IV School District
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)
Name of Action or Project:	Generator Installation
Mitigation Category:	Prevention; Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; (Emergency Services) 2.2

STAPLEE Criteria Evaluation Rating Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0	Score
S: Is it **Socially** Acceptable	3
T: Is it **Technically** feasible and potentially successful?	3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?	3
P: Is it **Politically** acceptable?	3
L: Is there **Legal** authority to implement?	3
E: Is it **Economically** beneficial?	2
E: Will the project have either a neutral or positive impact on the natural **Environment?**	1
Will historic structures be saved or protected?	0
Could it be implemented quickly?	2
STAPLEE SCORE	20

Mitigation Effectiveness Criteria	Evaluation Rating	Score
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	6
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	6
	MITIGATION EFFECTIVENESS SCORE	12
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	32

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Medium (29)

STAPLEE Worksheet	
Name of Jurisdiction:	Lesterville R-IV School District
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) 2.3
Name of Action or Project:	Identify Alternate Transportation Routes
Mitigation Category:	Prevention; (Structure and Infrastructure Projects); Natural Systems Protection; Education and Outreach; Emergency Services

STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0	**Score**
S: Is it **Socially** Acceptable	3
T: Is it **Technically** feasible and potentially successful?	2
A: Does the jurisdiction have the **Administrative** capacity to execute this action?	3
P: Is it **Politically** acceptable?	3
L: Is there **Legal** authority to implement?	3
E: Is it **Economically** beneficial?	1
E: Will the project have either a neutral or positive impact on the natural **Environment?**	0
Will historic structures be saved or protected?	0
Could it be implemented quickly?	2
STAPLEE SCORE	17

Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	7
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	5
MITIGATION EFFECTIVENESS SCORE		12
TOTAL SCORE (STAPLEE + Mitigation Effectiveness)		29

☐ **High Priority (30+ points)**	☒ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High (34)

STAPLEE Worksheet		
Name of Jurisdiction:	All (I. J.)	
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) 3.1	
Name of Action or Project:	Prioritize Bridge/Road Work	
Mitigation Category:	Prevention (Structure and Infrastructure Projects) Natural Systems Protection; Education and Outreach; Emergency Services	
STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		3
T: Is it **Technically** feasible and potentially successful?		3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		3
P: Is it **Politically** acceptable?		3
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		2
E: Will the project have either a neutral or positive impact on the natural Environment?		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		1
	STAPLEE SCORE	18
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	7
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	9
	MITIGATION EFFECTIVENESS SCORE	16
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	34

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High (33)

STAPLEE Worksheet	
Name of Jurisdiction:	All I. J.
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) 3.2
Name of Action or Project:	Integration Into Other Plans
Mitigation Category:	(Prevention); Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; Emergency Services

STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0	**Score**
S: Is it **Socially** Acceptable	3
T: Is it **Technically** feasible and potentially successful?	3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?	3
P: Is it **Politically** acceptable?	3
L: Is there **Legal** authority to implement?	3
E: Is it **Economically** beneficial?	2
E: Will the project have either a neutral or positive impact on the natural **Environment**?	2
Will historic structures be saved or protected?	1
Could it be implemented quickly?	3
STAPLEE SCORE	23

Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from S-10 points based on the likelihood that lives will be saved.	5
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	5
	MITIGATION EFFECTIVENESS SCORE	10
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	33

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High (31)

STAPLEE Worksheet	
Name of Jurisdiction:	All I. J.
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) 3.3
Name of Action or Project:	Lightning Protection
Mitigation Category:	Prevention; (Structure and Infrastructure Projects); Natural Systems Protection; Education and Outreach; Emergency Services

STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0	**Score**
S: Is it **Socially** Acceptable	3
T: Is it **Technically** feasible and potentially successful?	2
A: Does the jurisdiction have the **Administrative** capacity to execute this action?	1
P: Is it **Politically** acceptable?	3
L: Is there **Legal** authority to implement?	3
E: Is it **Economically** beneficial?	2
E: Will the project have either a neutral or positive impact on the natural **Environment?**	1
Will historic structures be saved or protected?	2
Could it be implemented quickly?	2
STAPLEE SCORE	19

Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	5
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	7
	MITIGATION EFFECTIVENESS SCORE	12
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	31

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Medium (29)

STAPLEE Worksheet		
Name of Jurisdiction:	All I. J.	
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) 3.4	
Name of Action or Project:	Flood Buyout	
Mitigation Category:	(Prevention) Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; Emergency Services	
STAPLEE Criteria **Evaluation Rating** **Definitely YES = 3 Maybe YES = 2** **Probably NO = 1 Definitely NO = 0**		**Score**
S: Is it **Socially** Acceptable		2
T: Is it **Technically** feasible and potentially successful?		1
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		3
P: Is it **Politically** acceptable?		2
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		3
E: Will the project have either a neutral or positive impact on the natural Environment?		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		0
	STAPLEE SCORE	14
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	5
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	10
	MITIGATION EFFECTIVENESS SCORE	15
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	29

☐ **High Priority (30+ points)**	☒ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Medium (27)

STAPLEE Worksheet		
Name of Jurisdiction:	All I. J.	
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) 3.5	
Name of Action or Project:	Replace Low Water Crossings	
Mitigation Category:	Prevention; (Structure and Infrastructure Projects); Natural Systems Protection; Education and Outreach; Emergency Services	
STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		3
T: Is it **Technically** feasible and potentially successful?		1
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		1
P: Is it **Politically** acceptable?		3
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		2
E: Will the project have either a neutral or positive impact on the natural **Environment?**		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		0
	STAPLEE SCORE	13
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	9
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	5
	MITIGATION EFFECTIVENESS SCORE	14
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	27

☐ **High Priority (30+ points)**	☒ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Medium (25)

STAPLEE Worksheet		
Name of Jurisdiction:	All I. J.	
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) 3.6	
Name of Action or Project:	Sinkhole Mapping	
Mitigation Category:	(Prevention); Structure and Infrastructure Projects; Natural Systems Protection; Education and Outreach; Emergency Services	
STAPLEE Criteria **Evaluation Rating** Definitely YES = 3 Maybe YES = 2 Probably NO = 1 Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		2
T: Is it **Technically** feasible and potentially successful?		2
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		1
P: Is it **Politically** acceptable?		2
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		1
E: Will the project have either a neutral or positive impact on the natural Environment?		0
Will historic structures be saved or protected?		0
Could it be implemented quickly?		1
	STAPLEE SCORE	12
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	6
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	7
	MITIGATION EFFECTIVENESS SCORE	13
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	25

☐ **High Priority (30+ points)**	☒ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High (39)

STAPLEE Worksheet		
Name of Jurisdiction:	All Identifying Jurisdictions (I.J.)	
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)	
Name of Action or Project:	NFIP Participation 4.1	
Mitigation Category:	Prevention; Structure and Infrastructure Projects; (Natural Systems Protection); Education and Outreach; Emergency Services 4.1	
STAPLEE Criteria **Evaluation Rating** **Definitely YES = 3 Maybe YES = 2** **Probably NO = 1 Definitely NO = 0**		**Score**
S: Is it **Socially** Acceptable		3
T: Is it **Technically** feasible and potentially successful?		3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		3
P: Is it **Politically** acceptable?		3
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		3
E: Will the project have either a neutral or positive impact on the natural **Environment?**		2
Will historic structures be saved or protected?		1
Could it be implemented quickly?		3
	STAPLEE SCORE	24
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	5
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	10
	MITIGATION EFFECTIVENESS SCORE	15
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	39

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

High (32)

STAPLEE Worksheet		
Name of Jurisdiction:	All Identifying Jurisdictions	
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) 4.2.	
Name of Action or Project:	CRS Implementation	
Mitigation Category:	(Prevention); Structure and Infrastructure Projects; (Natural Systems) (Protection); Education and Outreach; Emergency Services	
STAPLEE Criteria Evaluation Rating: Definitely YES = 3, Maybe YES = 2, Probably NO = 1, Definitely NO = 0		**Score**
S: Is it **Socially** Acceptable		2
T: Is it **Technically** feasible and potentially successful?		3
A: Does the jurisdiction have the **Administrative** capacity to execute this action?		3
P: Is it **Politically** acceptable?		2
L: Is there **Legal** authority to implement?		3
E: Is it **Economically** beneficial?		3
E: Will the project have either a neutral or positive impact on the natural **Environment?**		2
Will historic structures be saved or protected?		1
Could it be implemented quickly?		0
	STAPLEE SCORE	19
Mitigation Effectiveness Criteria	**Evaluation Rating**	**Score**
Will the implemented action result in lives saved?	Assign from 5-10 points based on the likelihood that lives will be saved.	5
Will the implemented action result in a reduction of disaster damages?	Assign from 5-10 points based on the relative reduction of disaster damages.	8
	MITIGATION EFFECTIVENESS SCORE	13
	TOTAL SCORE (STAPLEE + Mitigation Effectiveness)	32

☒ **High Priority (30+ points)**	☐ **Medium Priority (25 - 29 points)**	☐ **Low Priority (<25 points)**

Reynolds County Hazard Mitigation Plan, 2022

Appendix F – Adoption Resolutions

REYNOLDS COUNTY COMMISSION

Reynolds County Courthouse * P.O. Box 10 * Centerville, MO 63633
Phone (573) 648-2494 Fax (573) 648-2449
reynolds@sos.mo.gov

JOE LOYD
Presiding Commissioner

EDDIE WILLIAMS
Commissioner 2nd District

LARRY POGUE, JR.
Commissioner 1st District

MIKE HARPER
County Clerk

REYNOLDS COUNTY, MISSOURI

RESOLUTION NO. 101722

A RESOLUTION OF THE COUNTY OF REYNOLDS IN MISSOURI ADOPTING THE *2022 REYNOLDS COUNTY HAZARD MITIGATION PLAN.*

WHEREAS the County of Reynolds recognizes the threat that natural hazards pose to people and property within the County of Reynolds; and,

WHEREAS the County of Reynolds has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the *2022 Reynolds County Hazard Mitigation Plan*, 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 County of Reynolds from the impacts of future hazards and disasters; and,

WHEREAS the Reynolds County Commission recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the County of Reynolds will endeavor to integrate the *Plan* into the comprehensive planning process; and,

WHEREAS adoption by the County of Reynolds demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

NOW THEREFORE, BE IT RESOLVED BY THE COUNTY OF REYNOLDS, in the State of Missouri, THAT:

The County of Reynolds adopts the final FEMA-approved *Plan*.

ADOPTED by a vote of 3 in favor and 0 against, and abstaining, this 17th day of October, 2022.

By (Sig): Joe Loyd
Print name: Joe Loyd

By (Sig.): Larry Pogue Jr.
Print name: Larry Pogue Jr.

By (Sig): Eddie Williams
Print name: Eddie Williams

ATTEST:
By (Sig.): Mike Harper
Print name: Mike Harper

CITY OF BUNKER, MISSOURI

RESOLUTION NO. 2022(1)

A RESOLUTION OF THE CITY OF BUNKER IN MISSOURI ADOPTING THE *2022 REYNOLDS COUNTY HAZARD MITIGATION PLAN.*

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

WHEREAS the City of Bunker has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the *2022 Reynolds County Hazard Mitigation Plan*, 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 Bunker from the impacts of future hazards and disasters; and,

WHEREAS the Bunker Board of Aldermen recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the City of Bunker will endeavor to integrate the *Plan* into the comprehensive planning process; and,

WHEREAS adoption by the City of Bunker demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

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

The City of Bunker adopts the final FEMA-approved *Plan*.

ADOPTED by a vote of 4 in favor and 0 against, and 0 abstaining, this 17 day of October, 2022.

By (Sig): Betty Wisdom
Print name: Betty Wisdom

ATTEST:
By (Sig.): Kendra Ritter
Print name: Kendra Ritter

CITY OF CENTERVILLE, MISSOURI RESOLUTION NO. 11-22

A RESOLUTION OF THE CITY OF CENTERVILLE IN MISSOURI ADOPTING THE *2022 REYNOLDS COUNTY HAZARD MITIGATION PLAN.*

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

WHEREAS the City of Centerville has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the *2022 Reynolds County Hazard Mitigation Plan*, 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 Centerville from the impacts of future hazards and disasters; and,

WHEREAS the Centerville Board of Aldermen recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the City of Centerville will endeavor to integrate the *Plan* into the comprehensive planning process; and,

WHEREAS adoption by the City of Centerville demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

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

The City of Centerville adopts the final FEMA-approved *Plan*.

ADOPTED by a vote of 3 in favor and ~~0~~ against, and ~~0~~ abstaining, this 10th day of November, 2022.

By (Sig): Stanley Barton
Print name: Stanley Barton

ATTEST:
By (Sig.): Linda Miller
Print name: Linda Miller

CITY OF ELLINGTON, MISSOURI RESOLUTION NO. 22-01

A RESOLUTION OF THE CITY OF ELLINGTON IN MISSOURI ADOPTING THE *2022 REYNOLDS COUNTY HAZARD MITIGATION PLAN.*

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

WHEREAS the City of Ellington has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the *2022 Reynolds County Hazard Mitigation Plan*, 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 Ellington from *the impacts* of future hazards and disasters; and,

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

WHEREAS adoption by the City of Ellington demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

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

The City of Ellington adopts the final FEMA-approved *Plan*.

ADOPTED by a vote of 4 in favor and 0 against, and 0 abstaining, this 11th day of October, 2022.

By (Sig): Paul W. Wood
Print name: Paul W. Wood, Mayor

ATTEST: Amy Moore
By (Sig.):
Print name: Amy Moore, Clerk

LESTERVILLE R-IV SCHOOL DISTRICT RESOLUTION NO. __

A RESOLUTION OF THE LESTERVILLE R-IV SCHOOL DISTRICT IN MISSOURI ADOPTING THE *2022 REYNOLDS COUNTY HAZARD MITIGATION PLAN.*

WHEREAS the Lesterville R-IV School District recognizes the threat that natural hazards pose to people and property within the Lesterville R-IV School District's service area; and,

WHEREAS the Lesterville R-IV School District has participated in the preparation of a multi-jurisdictional local hazard mitigation plan, hereby known as the *2022 Reynolds County Hazard Mitigation Plan*, 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 Lesterville R-IV School District's service area from the impacts of future hazards and disasters; and,

WHEREAS the board of the Lesterville R-IV School District recognizes that land use policies have a major impact on whether people and property are exposed to natural hazards, the Lesterville R-IV School District will endeavor to integrate the *Plan* into the comprehensive planning process; and,

WHEREAS adoption by the Lesterville R-IV School District demonstrates their commitment to hazard mitigation and achieving the goals outlined in the *Plan*.

NOW THEREFORE, BE IT RESOLVED BY THE LESTERVILLE R-IV SCHOOL DISTRICT, in the State of Missouri, THAT:

The Lesterville R-IV School District adopts the final FEMA-approved *Plan*.

ADOPTED by a vote of 7 in favor and Ø against, and Ø abstaining, this 21st day of September, 2022.

By (Sig): Jacob Laughman
Print name: Jacob Laughman

ATTEST:
By (Sig.): Robin S. Meredith
Print name: Robin S. Meredith

U.S. Department of Homeland Security
FEMA Region 7
11224 Holmes Road
Kansas City, MO 64131

FEMA

December 5, 2022

Director Remillard
State Emergency Management Agency
P. O. Box 116
Jefferson City, Missouri 65102

Subject: Approval of the Reynolds County Local Mitigation Plan

Director Remillard:

In accordance with applicable[1] laws, regulations and policy, the Risk Analysis Branch, Mitigation Division, Federal Emergency Management Agency (FEMA) has approved the Reynolds County local mitigation plan. The attached Local Mitigation Plan Review Tool lists participants receiving approval that have submitted required adoption documentation.

The approval period for this plan is from December 1, 2022, through November 30, 2027. The same official plan expiration date applies to all participating jurisdictions, regardless of adoption date.

An approved mitigation plan is one of the conditions for applying for and receiving FEMA mitigation grants from the following programs:

- Hazard Mitigation Grant Program
- Building Resilient Infrastructure and Communities
- Flood Mitigation Assistance

Having an approved mitigation plan does not mean that mitigation grant funding will be awarded. Specific application and eligibility requirements for the programs listed above can be found in each FEMA grant program's respective policies and annual Notice of Funding Opportunities, as applicable.

To avoid a lapsed plan, the next plan update must be approved before the end of the approval period, including adoption by the participating jurisdictions. Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for the jurisdiction to formally adopt the plan after the review, if not adopted prior to submission. This will enable them to remain eligible to apply for and receive funding from FEMA's mitigation grant programs with a mitigation plan requirement. Local governments, including special districts, with a plan status of "Approvable Pending Adoption" are not eligible for FEMA's mitigation grant programs with a mitigation plan requirement.

[1] Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended; the National Flood Insurance Act of 1968, as amended; and National Dam Safety Program Act, as amended; 44 CFR Part 201, Mitigation Planning; and Local Mitigation Plan Review Guide.

We look forward to discussing options for implementing this mitigation plan. If you should have any questions or concerns, please contact Joe Chandler, Planning Team Lead, at (816) 808-9016 or joe.chandler@fema.dhs.gov.

Sincerely,

Catherine R. Sanders, Director
Mitigation Division

Attachment: Local Mitigation Plan Review Tool

Update 7-24-19

Jurisdiction: **Reynolds County**	**Title of Plan:** *2022 Reynolds County Hazard Mitigation Plan*	**Date of Plan:** 9/7/2022
Local Point of Contact: Joe Loyd	**Address:**	
Title: Presiding Commissioner	Reynolds County Courthouse P.O. Box 10 Centerville, MO 63633	
Agency: Reynolds County, Missouri		
Phone Number: 573-648-2494	**E-Mail:** reynolds@sos.mo.gov	
Funding Source:		
State Reviewer: Mary Smith	**Title:** Planner	**Date:** 10/28/2022
MOA Sign Date:	**Data Collection Date:**	**Start Risk Assessment Date:**
FEMA Reviewer: Joseph Green	**Title:** Community Planner	**Date:** 12/1/2022
Date Received in FEMA Region VII	10/28/2022	
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved	12/1/2022	

Only Plan Participating Jurisdiction(s):	NFIP Status*			
	Y	**NP**	**S-Date**	**R-Date**
1. Reynolds County (Adopted 10/17/2022)	Y			
2. City of Bunker (Adopted 10/17/2022)	NP			
3. City of Centerville (APA)	Y			
4. City of Ellington (Adopted 10/11/2022)	Y			
5. Lesterville R-IV School District (Adopted 9/21/2022)	N/A			
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				

*** Notes: Y= Participating NP = Not Participating in NFIP S- Sanctioned R- Rescinded**

SECTION 1: REGULATION CHECKLIST

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Section 1.4	✓	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Section 1.4.2, Step 3	✓	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Section 1.4.2, Step 2	✓	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Section 1.4.2, Step 3	✓	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Section 5.3	✓	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Section 5.1.1 & 5.1.2	✓	

ELEMENT A: REQUIRED REVISIONS

None.

Plan Strengths:

- P.1.10-11 – 16 responses for the community survey is good! Seek to build off that number in future updates
- Good use of figures and tables to present information throughout the plan
- Good presentation of the updates from the previous plan
- Well-documented planning process
- Plan utilized many valuable data sources in this revision, and utilized FEMA's recommended planning process in their update

Opportunities for Improvement:

- P.1.14, Table 1.8 – A name appears to be missing from the middle of this table. The person's title is "Chairperson", but no name or jurisdiction follows.
- P1.10-11 - The main body of the plan should summarize the results of the survey. Placing the results in the appendices can be fine, but giving a brief summary of the results or trends that developed from the survey here would be useful.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Section 3.1.4	✓	
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	p.p. 3.26-30, 3.39-42, 3.51-52, 3.61, 3.65-66, 3.70-74, 3.81-83, 3.88-89, 3.93-95, 3.101	✓	
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	p.p. 3.30-33, 3.42-46, 3.61-62, 3.66-68, 3.75-77, 3.83-85, 3.89-91, 3.96-98, 3.101-103	✓	
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	p. 3.25-26	✓	

ELEMENT B: REQUIRED REVISIONS

None.

Plan Strengths:

- Thorough documentation of hazards across the region
- Good use of charts, maps, tables and figures to display hazard areas and describe vulnerability.
- Figure 3.13 – Good presentation on the bridges and their conditions within the county, along with the probability of bridge damage/failure. This is the first plan I have seen that uses the probability. Nice touch.
- Individual community sections do a good job of identifying some of the unique mitigation needs. Lesterville R-IV is the exception, and their profile could be expanded a fair amount to capture their hazard mitigation needs.
- P.2.7 – Good inclusion of social vulnerability. Consider in the future using the graphic from the SoVi website that shows the SoVi rating of Reynolds County in relation to the rest of the state and US. It would be beneficial to explore this further in future updates and expand on the current data. Are there major differences between communities within the county? Are there ways to reduce vulnerability in the future?

Opportunities for Improvement:

- P.2.23 – Mr. Mike Dickerson's name is highlighted in green for some reason. Proofreading error.
- Figure 3.27 – Break out the individual communities WUI into maps similar to the way the flood maps are broken out on a by-community basis. This allows for better detail in seeing the hazard per community.
- P.3.15-3.16 – Red and yellow colors are used, but there is not a legend that differentiates what the colors represent

ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	2.20, 2.24, & 2.28	✓	
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	2.20, 2.29, 2.33, 2.36, 3.25-26, 4.12, 4.41-4.45	✓	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	p.p. 4.2	✓	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Section 4	✓	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	p.p. 4.7 & 4.10	✓	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	p.p. 4.13, 4.29-4.33	✓	

ELEMENT C: REQUIRED REVISIONS

None.

Plan Strengths:

- Table 1, Table 4.3 – Great summary of all the mitigation actions included in section 4.

Opportunities for Improvement:

- The education and outreach actions regarding plan integration are already requirements of the hazard mitigation plan. They cannot be mitigation actions when they are already a requirement of the plans approval.
- Mitigation actions are "*specific actions, projects, activities or process taken to reduce or eliminate long-term risk".* In general, mitigation strategies should avoid beginning with "encourage", "ensure" or "continue/maintain" as these are not specific actions, nor can their progress be measured. Planning teams are encouraged to reformulate these statements into measurable actions, e.g., "Encourage participation in or continued compliance with the NFIP" could be revised to, "Develop informational packets on the costs and benefits of XXXX city joining the NFIP to encourage participation in the NFIP" or a similar sentiment.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan (section and/or page number)**	**Met**	**Not Met**
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Section 4.2	✓	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	p.p. 4.2-4.3	✓	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Section 4.2	✓	
ELEMENT D: REQUIRED REVISIONS None.			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))		✓	
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	Final adoption received 11/15/2022	✓	
ELEMENT E: REQUIRED REVISIONS None. **Note:** If the plan is not adopted by a participating jurisdiction, that jurisdiction would not be eligible for project grants under the following hazard mitigation assistance programs: HMGP, PDM, FMA, and SRL.			
ELEMENT F. ADDITIONAL STATE REQUIREMENT (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1. The use of SEMA's Hazard Mitigation Plan Outline Format is **required** for County level/multi-jurisdictional Local Hazard Mitigation Plans. Does the Plan follow the Plan Outline Format in accordance this state requirement?	Yes	✓	
ELEMENT F: REQUIRED REVISIONS None.			

SECTION 2: PLAN ASSESSMENT (For FEMA)

B. Resources for Implementing Your Approved Plan

A variety of mitigation resources are available to communities. SEMA's mitigation website: http://sema.dps.mo.gov/programs/mitigation_management.asp provides planning and project related information as well as details on how major FEMA mitigation programs are implemented in the State.

SEMA's training website provides information on upcoming training opportunities within the State: http://training.dps.mo.gov/sematraining.nsf/TrainingSchedule?OpenForm.

Benefit-Cost Analysis (BCA) is a method that determines the future risk reduction benefits of a hazard mitigation project and compares those benefits to its cost. The Benefit-Cost Ratio (BCR) must be 1.0 or greater to be an eligible project. https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis

Review of the Local Mitigation Plan Review Guide (10/1/11) https://www.fema.gov/media-library/assets/documents/23194 is encouraged as guidance for the Hazard Mitigation Plan Review Tool. The FEMA HMA guidance (FY15 is the most current) is also encouraged as guidance provides information about application and eligibility requirements. This guidance is available from http://sema.dps.mo.gov/programs/mitigation_management.asp or through FEMA's grant applicant resources page at http://www.fema.gov/government/grant/hma/grant_resources.shtm.

As noted above, various funding programs are available from several state and federal agencies to assist local jurisdictions in accomplishing their mitigation activities and goals. A detailed listing of programs, information on each program, and contact information is available from the 2013 State Hazard Mitigation Plan on page 4.72/PDF 775. Heidi Carver, State Hazard Mitigation Officer, (Heidi.Carver@sema.dps.mo.gov), and Sarah Crawford, State Hazard Mitigation Specialist, (Sarah.Crawford@sema.dps.mo.gov) can provide additional contacts for specific programs.

There are several RiskMAP projects that are currently in Discovery phase. As a Cooperating Technical Partner (CTP), the NFIP and Floodplain Section at SEMA, has a role in implementing these projects. Jurisdictions that are part of these projects have been contacted directly regarding these efforts and have been asked to participate in one or more RiskMAP/ Discovery meetings. These meetings have been scheduled throughout Missouri to present similar information, and all meetings offer opportunities for questions about the program and process.

Karen McHugh (State NFIP Coordinator and State Floodplain Administrator), Linda Olsen, and Lynn Welch. Darryl Rockfield (with the NFIP and Floodplain Section at SEMA) can be contacted for additional information on RiskMAP or Discovery meetings through http://sema.dps.mo.gov/about/staff.asp.