Lincoln Trail Region

Hazard Mitigation Plan 2015 Update

HAZARD MITIGATION

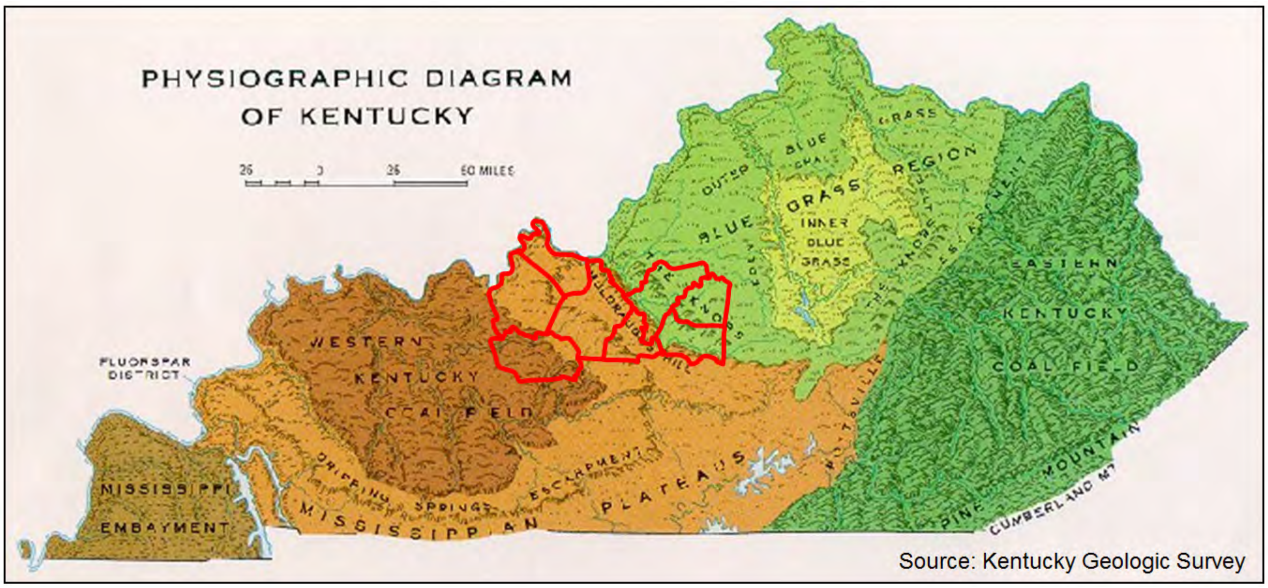
LINCOLN TRAIL REGION

LINCOLN TRAIL AREA DEVELOPMENT DISTRICT

Table of Contents

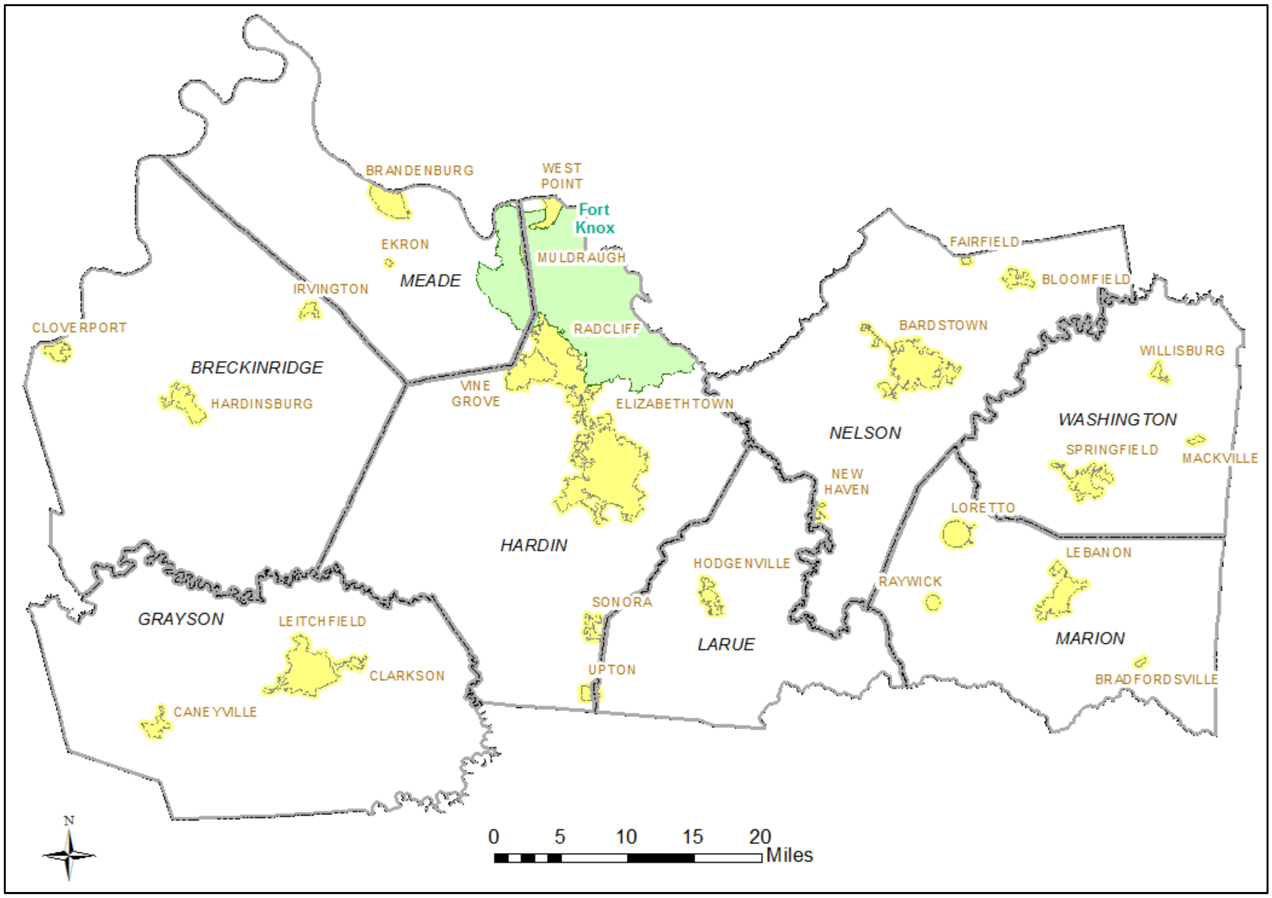
Introduction

The Lincoln Trail Area Development District (LTADD) was officially designated as one of Kentucky's fifteen Area Development Districts on March 23, 1968. Composed of eight counties and twenty-seven cities, Lincoln Trail Area Development District is located immediately south of and contiguous to, the Louisville Metropolitan Statistical Area (MSA). LTADD is bordered by the Western Coal Field on its western border and is part of the Bluegrass Physiographic Region to its east. The District transects the Knobs Region, but the majority of the land is flat to gently rolling. The area is endowed with numerous physical attributes, including a temperate climate, generally uniform terrain, and great scenic beauty. The people of this rural region are self reliant, and strongly rooted in traditional values.



Prior to the Civil War, the LTADD region exerted a strong influence on the development of Kentucky and the United States west of the Appalachian Mountains. However, for approximately seventy-five years following 1860, the area remained agrarian and did not benefit from the rapid commercial and industrial development of the time. The creation of Fort Knox in 1933 and completion of the Kentucky Turnpike between Louisville and Elizabethtown in 1956, thrust the region into rapid commercial and industrial development. Since the 1950's, significant industrial growth has impacted the area and provided diverse employment opportunities and new payrolls. Tourism also developed based on the historic significance of the region, as well as its scenic beauty, and numerous man-made attractions. The Lincoln Trail Area Development District is still predominantly rural, but has experienced significant growth in population. The Hardin County area that includes Fort Knox, remains the region's "growth center" with a population equal to about 39% of the entire eight-county area. It is considered a major growth area in Kentucky, aided in part by the transportation corridors of I65, the Bluegrass Parkway, the Western Kentucky Parkway, and KY Highway 313 that run through it.

The Lincoln Trail Regional Hazard Mitigation Plan is the result of the region's desire to preserve all local natural resources and protect the lives and property of the people who live here. The Hazard Mitigation Plan is a guide for determining the best methods for reducing or eliminating the loss of life, property or damage as the result of both natural and man-made disasters. The following table gives a brief summary of each governmental organization within the LTADD region and its respective size and population. The map shows the region with the locations of each county and city. All eight counties and twenty-seven cities within the region have participated in the plan update.



The Lincoln Trail Region

Existing Governmental Structures

Table 3.1.1 briefly outlines the jurisdictions that are included in the Lincoln Trail Regional Hazard Mitigation Plan as well as, the characteristics of each governing body.

Table I - Lincoln Trail Regional Units of Government		
Jurisdiction	**Population 2010 Census**	**Type of Government**
Breckinridge County encompasses 567.17 square miles with a population density of approximately 35.4 people per square mile. Elevations in the County range from 383 to 920 feet above sea level.		
Breckinridge County	20,059 18,888 (2014 estimate)	One County Judge/Executive & Six Fiscal Court Magistrates
City of Cloverport	1,152	One Mayor & Six City Council Members
City of Hardinsburg	2,343	One Mayor & Six City Council Members
City of Irvington	1,181	One Mayor & Six City Council Members
Grayson County encompasses 496.7 square miles with a population density of approximately 51.8 people per square mile. Elevations in the County range from 395 to 963 feet above sea level.		
Grayson County	25,746 26,194 (2014 estimate)	One County Judge/Executive & Six Fiscal Court Magistrates
City of Caneyville	608	One Mayor & Four City Commissioners
City of Clarkson	875	One Mayor & Four City Commissioners
City of Leitchfield	6,699	One Mayor & Six City Council Members
Hardin County encompasses 623.28 square miles with a population density of approximately 169.3 people per square mile. Elevations in the County range from 383 to 1,017 feet above sea level.		
Hardin County	105,543 108,266 (2014 estimate)	One County Judge/Executive & Eight Fiscal Court Magistrates
City of Elizabethtown	28,531	One Mayor & Six City Council Members
City of Radcliff	21,688	One Mayor & Six City Council Members
City of Sonora	513	One Mayor & Four City Commissioners
City of Upton	683	One Mayor & Four City Commissioners
City of Vine Grove	4,520	One Mayor & Six City Council Members
City of West Point	797	One Mayor & Six City Council Members
LaRue County encompasses 261.52 square miles of land with a population density of approximately 54.3 people per square mile.		
LaRue County	14,193 14,180 (2014 estimate)	One County Judge/Executive & Four Fiscal Court Magistrates
City of Hodgenville	3,206	One Mayor & Six City Council Members

Marion County encompasses 343.01 square miles of land with a population density of approximately 57.8 people per square mile.		
Marion County	19,820 20,007 (2014 estimate)	One County Judge/Executive & Five Fiscal Court Magistrates
City of Bradfordsville	294	One Mayor & Four City Commissioners
City of Lebanon	5,539	One Mayor & Six City Council Members
City of Loretto	713	One Mayor & Four City Commissioners
City of Raywick	134	One Mayor & Four City Commissioners
Meade County encompasses 305.42 square miles of land with a population density of approximately 93.6 people per square mile.		
Meade County	28,602 29,139 (2014 estimate)	One County Judge/Executive & Six Fiscal Court Magistrates
City of Brandenburg	2,643	One Mayor & Six City Council Members
City of Ekron	135	One Mayor & Four City Commissioners
City of Muldraugh	947	One Mayor & Six City Council Members
Nelson County encompasses 417.51 square miles of land with a population density of approximately 104.0 people per square mile.		
Nelson County	43,437 44,812 (2014 estimate)	One County Judge/Executive & Five Fiscal Court Magistrates
City of Bardstown	11,700	One Mayor & Six City Council Members
City of Bloomfield	838	One Mayor & Six City Council Members
City of Fairfield	113	One Mayor & Four City Commissioners
City of New Haven	855	One Mayor & Four City Commissioners
Washington County encompasses 297.27 square miles of land with a population density of approximately 39.4 people per square mile.		
Washington County	11,717 11,959 (2014 estimate)	One County Judge/Executive & Six Fiscal Court Magistrates
City of Mackville	222	One Mayor & Four City Commissioners
City of Springfield	2,519	One Mayor & Six City Council Members
City of Willisburg	282	One Mayor & Four City commissioners

Area Development Staff

The professional staff of the Lincoln Trail Area Development District has experience and knowledge in the areas of economic and community development, human services, transportation, land use planning and mapping. LTADD provides services and assistance to the local units of government within its region that they might not otherwise have access to due to size and/or fiscal constraints.

LTADD staff assisted in the research and development of the 2015 Lincoln Trail Regional Hazard Mitigation Plan Update.

Kentucky Area Development Districts receive Federal funding through the Public Works and Economic Development Act of 1965. The intention behind creation of the ADDs was to assist locally elected officials, and business and civic leaders in expanding economic development opportunities.

Lincoln Trail Regional Hazard Mitigation Planning Effort

Officially approved by FEMA in September of 2005, the Lincoln Trail Regional Mitigation Plan is the result of a partnership created by the Kentucky Emergency Management Agency and LTADD through a Federal Emergency Management Agency (FEMA) Mitigation Planning Grant. In 2008, LTADD applied for funding through the Pre-Disaster Mitigation Grant Program to do a comprehensive review and update of the regional plan. In 2013, LTADD applied for funding through the Pre-Disaster Mitigation Planning Grant and through the FEMA Flood Mitigation Assistance Program to complete a comprehensive review and update of the Lincoln Trail Regional Hazard and Flood Mitigation Plan.

Lincoln Trail ADD assisted the Regional Mitigation Council (LTHMC) with the review and update process by pursuing broad based and diverse community participation. To insure that the plan is relevant and complies with the Robert T. Stafford Disaster Relief and Emergency Assistance Act as amended by the Disaster Mitigation Act of 200 (Public Law 106-390, October 30, 2000), the plan as been reviewed regularly as each FEMA grant is announced. The regional mitigation plan is comprised of the following sections:

- 3.1: Prerequisites – Adoption by Local Units of Government
- 3.2: A description of the Planning Process/ Plan Maintenance Procedures (added to planning process)
- 3.3: Risk Assessment
- 3.4: Mitigation Strategies

3.1 Prerequisites

3.1.1 Adoption by Local Governing Body

Once each local unit of government has reviewed the Lincoln Trail multi-jurisdictional plan update, it will be brought before the Lincoln Trail Area Development District Board of Directors for adoption.

3.1.2 Multi-Jurisdictional Plan Adoption

Upon acceptance and approval by FEMA, the Lincoln Trail Regional Hazard Mitigation Plan Update will be submitted to each participating jurisdiction for adoption. Each local unit of government will be given an adoption resolution to be passed and signed and attached to the final plan. (attachment #2 – draft resolution)

3.1.3 Multi-Jurisdictional Participation

The Lincoln Trail Regional Hazard Mitigation Plan Update planning process was designed to incorporate data and input from each of the eight counties and twenty-seven cities within the region, on an active and equitable basis. Participation in this plan is defined as an active and extensive involvement in the planning and data gathering process that is extended to every citizen within each jurisdiction. The head of each jurisdiction and/or his/her designee became part of the Lincoln Trail Hazard Mitigation Committee (LTHMC). The entire region was advised of the Plan Update at the December, 2014 LTADD Board of Directors Meeting. A regional meeting was convened to provide insight, guidance and training on the review and update process on January 29, 2015. All components of the plan update were discussed in accordance with 44CFR 201.3, and each jurisdiction received information packets designed to steer them through the review and update process. Packets included an extensive questionnaire designed to help each jurisdiction review its past data and provide input on new data critical to ascertaining each community's risks, critical facilities, resiliency, preparedness, capabilities, and mitigation projects. Each jurisdiction was also provided with citizen surveys to be circulated within their respective jurisdictions for the purpose of soliciting participation from every citizen. This survey was also posted on the LTADD website for easy accessibility by the entire region. Jurisdictions were instructed to include local business and industry, as well as all agencies providing services or care within their community, in their planning effort to ensure that all aspects of preparedness and recovery were addressed. Also included were resolutions stating each jurisdiction's intention of participating in the planning process for passage by each community's governing body. Training was provided concerning community preparedness and resiliency, individual and family preparedness, continuity of operations, and land use planning as it pertains to hazard mitigation. All thirty-five jurisdictions were instructed on the importance of planning, resiliency, and the inclusion of a broad range of community partners and citizens in their mitigation planning process.

LTADD staff then worked with County Emergency Managers and all participating jurisdictions to evaluate risks, strategies and plans for inclusion in the Regional Plan. An emphasis was placed on planning, preparedness and resiliency. In addition, staff worked diligently to review extensive sources of information about weather events and regional data for the last five years. Incorporated into the regional plan, this information formed the basis for planning and review at each jurisdictional meeting.

LTADD staff guided the entire planning process to ensure that it was complete and in compliance with federal guidelines. Public meetings were held in each county with public notices published in local newspapers. Meetings were conducted in all eight counties during the autumn months of 2015. This reinforced the planning commitment to be active and equitable across the entire region. LTADD staff also researched data pertaining to weather events, demographic information, and regional progress in mitigation efforts. ADD staff organized all meetings, trainings, and planning efforts. ADD staff worked with each county emergency manager to plan for and reach a countywide level of preparedness and resiliency known as "StormReady."

Throughout the planning and update process for the Lincoln Trail Regional Hazard Mitigation Plan, the impetus has been on inclusive participation, extensive research, and increased regional preparedness and resiliency. LTADD staff has been instrumental in this process to plan for all aspects of hazard mitigation from safeguarding local water systems to planning for emergency evacuations. Research sources include, but are not limited to local emergency managers, community leaders and citizens; the National Climate Data Center; Kentucky MESONET; and FEMA data. The Lincoln Trail Hazard Mitigation Committee (LTHMC) was not only a source of information on the update, but also was the group that reviewed each element of the plan update. LTHMC has:

- Encouraged public participation
- Reviewed public comments
- Reviewed and approved incorporation of existing documentation and information
- Reviewed and approved each component of risk assessment, mitigation strategy, and plan maintenance procedures
- Reviewed the contents of the draft plan update prior to submission to the State

Since the LTHMC was completely composed of people from all participating jurisdictions, it was an inclusive group able to access information from all people within their respective jurisdictions to include first responders, business and insurance people, city and county workers, social service agencies, the media, and the general public. This inclusive approach was instrumental in gathering information and developing strategies in keeping with each jurisdiction's culture, values and local situations. Also considered, were the discrepancies in resources available to each of the thirty-five unique communities within the region.

In addition to a regional meeting and one public meeting within each county, other meetings were convened as necessary, to gather and review all of the information contained in the Lincoln Trail Regional Hazard Mitigation Plan Update.

Section Update Summary: The "Prerequisites" section of the Lincoln Trail Regional Hazard Mitigation Plan Update required some changes to the content during the update process.

Updates to tables 3.1.3.1 and 3.1.3.1 reflect changes in people participating in regional positions.

The following table outlines the Lincoln Trail Area Development District's Board of Directors and their respective County affiliations.

Table 3.1.3.1 - Regional Council	
Breckinridge County Maurice Lucas, County Judge/Executive Rick Corley, Mayor of Cloverport Wayne Macy, Mayor of Hardinsburg Yvonne Kennedy, Mayor of Irvington Ted Brown, Citizen Member Gwan Bickett, Citizen Member	**Grayson County** Gary Logsdon, County Judge/Executive William Thomason, Mayor of Leitchfield Paul Steenbergen, Citizen Member Linda Clements, Citizen Member
Hardin County Harry Berry, County Judge/Executive Edna Berger, Mayor of Elizabethtown Mike Weaver, Mayor of Radcliff Blake Profitt, Mayor of Vine Grove William Ash, Mayor of West Point Mo Miller, WIB Chair Brad Richardson, Citizen Member Sheila Enyart, Citizen Member Donna Broadway, Citizen Member	**LaRue County** Tommy Turner, County Judge/Executive Kenny DeVore, Mayor of Hodgenville Bobby Claycomb, Citizen Member Vacant Position, Citizen Member
Marion County David Daugherty, County Judge/Executive Gary Crenshaw, Mayor of Lebanon John Thomas, City of Lebanon Designated Representative Ernest Taylor, Aging Advisory Council Chair/Citizen Member George Spragens, Citizen Member Jerry Evans, Citizen Member	**Meade County** Gerry Lynn, County Judge/Executive Ronnie Joyner, Mayor of Brandenburg Joseph Noon, Mayor of Muldraugh Greg Beavin, Citizen Member
Nelson County Dean Watts, County Judge/Executive John Royalty, Mayor of Bardstown Rhonda Hagan, Mayor of Bloomfield	**Washington County** John Settles, County Judge/Executive Debbie Wakefield, Mayor of Springfield Kathy Elliott, City of Springfield Designated Representative Dorothy Logsdon, Citizen Member Vacant Position, Citizen Member
Legislative Representatives Jim DuPlessis, Representative Dennis Parrett, Senator	**Fort Knox** Patrick Walsh, Director of Public Works

The following table outlines the representatives from each of the eight counties and twenty-seven cities in the Lincoln Trail Region who have provided input in the planning, review and update of the Lincoln Trail Regional Hazard Mitigation Plan Update.

Table 3.1.3.2 - Lincoln Trail Region Representatives

Jurisdiction	Name	Title/Affiliation
Breckinridge County	Maurice Lucas	Breckinridge County Judge/Executive
	Eric Ventress	County Emergency Manager
	Steve Crichelow	County Road Supervisor
City of Cloverport	Rick Corley	Mayor
	Kathy McCoy Moore	City Clerk/Treasurer
City of Hardinsburg	Wayne Macy	Mayor
	Holly Fowler	City Clerk
City of Irvington	Yvonne Kennedy	Mayor
	Lisa Ballman	City Clerk/Treasurer
Grayson County	Gary Logsdon	Grayson County Judge/Executive
	Ernie Perkins	County Emergency Manager
	Deedee Whitely	Emergency Management
	Chandra Glenn	Administrative Assistant
City of Caneyville	James Embry	Mayor
	Connie Gootee	City Clerk
	Anthony Clark	Police & Fire Chief
City of Clarkson	Bonnie Henderson	Mayor
	Alicia Hayes	City Clerk/Treasurer
City of Leitchfield	William Thomason	Mayor
	Sheila Puckett	Public Works Director
Hardin County	Harry Berry	Hardin County Judge/Executive
	Olivia Berry	EM Coordinator
	Doug Finlay	County Emergency Manager
City of Elizabethtown	Edna Burger	Mayor
	Mark Malone	Elizabethtown Fire
City of Radcliff	Mike Weaver	Mayor
	Murray Wanner	Radcliff Planning
	Jamie Henderson	Fire Chief
	Ashley Russo	Radcliff
City of Sonora	Larry Copeland	Mayor
City of Upton	Melissa Smith	Mayor
City of Vine Grove	Blake Proffitt	Mayor
	Jackie Johnson	City Clerk/Treasurer
	Steven New	Fire Chief/EM

City of West Point	William Ash	Mayor
	Missy Goodwin	City Clerk/Treasurer
Fort Knox	Joel Tiotiuco	Emergency Planning
LaRue County	Tommy Turner	LaRue County Judge/Executive
	Dennis Wells	LaRue County EM
	Nathaniel Hall	LaRue County EM
City of Hodgenville	Kenny DeVore	Mayor
	Toni Burton	City Clerk/Treasurer
	Steven Johnson	Hodgenville Police
Marion County	David Daugherty	Marion County Judge/Executive
City of Bradfordsville	David Edelen	Mayor
	George Edelen	Weather Collector
	Wanda Marlow	City Clerk
City of Lebanon	Gary Crenshaw	Mayor
	Nikki Wheatley	City Clerk
	John L. Thomas	City Administrator
City of Loretto	Tom Brahm	Mayor
	Pat Edelen	City Clerk/Treasurer
City of Raywick	Kelly Lucas	Mayor
Meade County	Jerry Lynn	Meade County Judge/Executive
	Ron Dodson	Meade County EMA
	Angel Gates	Meade County EMA
City of Brandenburg	Ronnie Joyner	Mayor
	Molly Janes	City Clerk/Treasurer
City of Ekron	Gwynne Ison	Mayor
City of Muldraugh	Joseph Noon	Mayor
	Caroline Cline	City Clerk/Treasurer
	Anthony Lee	Public Works Director
	Charlie Ashbaugh	Police Chief
Nelson County	Dean Watts	Nelson County Judge/Executive
	Joe Prewitt	EM Director
	Eva Prewitt	Nelson County EM
	Johnathan Hendricks	Deputy EM Director
City of Bardstown	John Royalty	Mayor
	Greg Ashworth	Risk Manager
	Barbie Bryant	City Clerk
City of Bloomfield	Rhonda Hagan	Mayor
	Janet Graves	City Council
	Jim Glisson	City Council
	Scott Thompson	Maintenance Tech
City of Fairfield	Angela Ford	Mayor
City of New Haven	Jeff Rogers	Mayor
	Tim Bartley	Public Works Director

Washington County	John Settles	Washington County Judge/Executive
	Kevin Devine	Emergency Manager/Flood Plain Manager
City of Mackville	Carl Gabhart	Mayor
City of Springfield	Debbie Wakefield	Mayor
	Laurie Smith	City Clerk/Treasurer
City of Willisburg	Pat Kirsch	Mayor

3.2 The Planning Process

3.2.1 - Open Public Involvement

To facilitate developing mitigation measures endorsed by a majority of public and private sector stakeholders, and be indicative of community needs; public participation was an integral part of the planning process. This broad approach to public participation was encouraged to build partnerships, and to solicit the most comprehensive amount of information possible, so that the Lincoln Trail Regional Hazard Mitigation Plan Update can be as inclusive as possible. Please see sub-sections 3.1.3, 3.2.2, and 3.2.3 for additional information. To further enhance an inclusive approach, the Regional Plan and all of the planning information, has been put on the LTADD website (http://ltadd.org/hazardmitigation) for review and comment from interested persons, businesses, educators and agencies across the State. Comments can be made during the entire update process, from draft stage to final plan approval. Comments may be directed to LTADD via the website, by phone or by mail.

3.2.2 - Opportunity for Public Comment

Public meetings were held during the drafting stage of the planning process and prior to plan approval, to encourage public review of, and comment on the plan. In addition, individual citizen surveys were given to each participating jurisdiction to solicit input into the planning process (See Appendix A "Forms"). This survey was also posted to the LTADD website for easy access by the entire region. The individual surveys could be completed by those people unable to attend local or public meetings, and vastly expanded opportunities for input from the general public. In addition, direct access to plan drafts provided residents of the region with the opportunity to learn about local risks, and the strategies developed to mitigate them. Table 3.2.2.1 outlines meetings held throughout the planning and review process.

Table 3.2.2.1 - City & County Meetings (To Gather and Analyze Data)				
Jurisdiction	Meeting Date		Jurisdiction	Meeting Date
Breckinridge Co.	2/10/2015		Marion Co.	5/12/2015
Cloverport	2/24/2015		Bradfordsville	2/23/2015
Hardinsburg	2/20/2015		Lebanon	2/25/2015
Irvington	2/20/2015		Loretto	3/24/2015
			Raywick	3/25/2015
Grayson Co.	2/19/2015		Meade Co.	2/22/2015
Caneyville	2/13/2015		Brandenburg	2/12/2015
Clarkson	3/10/2015		Ekron	2/26/2015
Leitchfield	2/05/2015		Muldraugh	2/24/2015
Hardin Co.	3/26/2015		Nelson Co.	2/19/2015
Elizabethtown	3/11/2015		Bardstown	2/20/2015
Radcliff	2/25/2015		Bloomfield	4/21/2015
Sonora	4/21/2015		Fairfield	3/30/2015
Upton	4/23/2015		New Haven	3/31/2015

Vine Grove West Point	3/12/2015 3/31/2015			
LaRue Co. Hodgenville	2/05/2015 03/11/2015		Washington Co. Mackville Springfield Willisburg	5/14/2015 5/28/2015 3/23/2015 3/09/2015

In addition to the meetings noted above, Hazard Mitigation was discussed with the municipal clerks at regional meetings held 12/10/2014, 02/25/2015, 03/27/2015/ 05/27/2015 and 09/30/2015.

A meeting with local and regional members of planning commissions and boards of adjustment was held September 17, 2015.

Throughout the first three quarters of 2015, meetings were held with every county emergency manager at least once. These meetings included discussion about the Hazard Mitigation Planning process and data analysis. Several meetings with emergency managers were held during the entire plan update and rewrite to solidify regional projects and gather accurate data.

Several meetings with County Judge Executives also took place to discuss the Regional Plan rewrite.

Hazard Mitigation was discussed and presented at the Meetings of the Lincoln Trail ADD Board of Directors on November 19, 2014, January 21, 2015 and August 19, 2015. Information about the plan and the data it contains was presented; discussion about contents was encouraged.

An advertised regional meeting was held on January 29, 2015 and was open to every Lincoln Trail Region city and county, other Area Development Districts, State Officials and interested stakeholders. It was an all-day event with in-depth discussion of the Regional Hazard Mitigation Plan, the planning and review process, and training in several aspects of community resiliency and preparedness.

Hazard Mitigation Regional Kick-Off Meeting

The general public was able to review plan drafts, as well as the Lincoln Trail Regional Hazard Mitigation Plan Update, at the offices of local units of government and the LTADD website. Instructions for submitting comments were attached to the drafts. All planning meetings were open to the public and meeting notification was sent to all media outlets (See Appendix A "Forms") (44 CFR §201.6(b)(1).

3.2.3 - Opportunity for Public/Private Participation

The tables in subsection 3.1.3 outline local communities, local and regional agencies involved in hazard mitigation activities, agencies authorized to regulate development, businesses, academia and other private and non-profit organizations that were invited to meetings, and actively encouraged to participate in the planning process. LTADD staff was responsible for informing each jurisdiction in the region of the requirements of the mitigation plan, and the impact of the plan on each jurisdiction. Local units of government, agencies and organizations, which may be affected by the mitigation plan, were invited to attend all meetings and given the opportunity to participate.

Invitations to participate were extended to locally elected officials, disaster relief agencies, county/city employees, emergency management personnel, first response agencies, local business and industry, educational facilities, other area development districts, and private citizens, by the LTADD staff or LTHMC members. In addition, appropriate State and Federal representatives were notified and invited to attend scheduled planning meetings. (See sub-sections 3.1.3 and 3.2.2 for additional information on Public/Private Participation)

3.2.4 Review and Incorporation of Existing Plans, Studies, Reports, and Technical Information

LTADD staff has reviewed and, when applicable, incorporated other regional plans into the Lincoln Trail Regional Hazard Mitigation Plan. Those plans include, but are not limited to, the *LTADD Area Agency on Aging Disaster Preparedness Plan*, the *LTADD Water Management Plan*, the *LTADD Comprehensive Economic Development Strategy*, local City and/or County Comprehensive Plans, local Capital Improvement Plans, and County Emergency Operation Plans. Conversely, all local units of government are encouraged to incorporate the regional hazard mitigation plan into their comprehensive plans, community planning efforts, county emergency operations plans and all planning and zoning ordinances. This is evidenced in the mitigation strategy section of this plan.

Other materials reviewed and considered for inclusion in the plan were studies, reports, and technical information obtained from local communities, research, State and Federal agencies, and universities. These materials included, but were not limited to: relevant USACE mitigation documents, the National Flood Insurance Program's *Answers to Questions About Substantially Damaged Buildings*, *The HUD Disaster Recovery Initiative: A Flexible Tool for Rebuilding Communities*, *The Long Term Flood Economic Recovery Strategy for Lincoln Trail Area Development District, Addressing Your Community's Flood Problems.*

The Lincoln Trail Regional Hazard Mitigation Plan received dual approval from FEMA. It was the first plan in Kentucky to be approved as a Multi-Jurisdictional Mitigation Plan and a Flood Mitigation Assistance (FMA) plan. With this dual designation, all Lincoln Trail jurisdictions covered by the plan are eligible for all FEMA mitigation grant programs.

Several jurisdictions have utilized FEMA grant opportunities to undertake mitigation activities and projects. These actions are incorporated in the Section 3.4, Community Projects. Local mitigation planning activities have been reviewed and included in the plan and referenced throughout.

The City of Radcliff in Hardin County is currently the only jurisdictions in the Lincoln Trail Regional participating in the Community Rating System (CRS) program. Radcliff has an effective date of 10/95 and has a class rating of 9, which provides residents with a 5% discount on flood insurance for properties in a Special Flood Hazard Area.

LTADD staff along with representatives and citizens from every participating jurisdiction, have researched and collected data from numerous sources as cited throughout the plan. All data and information collected has been reviewed for relevancy, comprehensiveness, and accuracy before inclusion in the mitigation plan. Once the review and comment process was complete, the information was evaluated and incorporated into the regional plan as deemed appropriate, and in keeping with 44 CFR §201.6(c)(i) and 44 CFR §201.6(b)(2).

3.2.5 Documentation of the Planning/Update Process

The staff of Lincoln Trail Area Development District has a broad range of knowledge, skills, and abilities, and work with each of the thirty-five jurisdictions within the region to facilitate economic development, compliance with federal and state laws and regulations, community health and safety, quality of life, job opportunities, and educational achievement. This is accomplished with educational opportunities, regional planning councils, project management, land use planning, grant writing, and general assistance. All of these efforts are interrelated and lend themselves to ongoing hazard mitigation planning and mitigation projects. Helping each jurisdiction recognize its potential and developing a plan for dealing with each unique environment, enables LTADD staff to know and win the trust of each community. This plan update was another opportunity to evaluate regional hazards, and their related risks, with what each community has accomplished over the last five years, and to determine what each still needs to plan for. Regional grant funds from the Kentucky Area Development Fund (ADF), Community Development Block Grant (CDBG), Citizen Corps funds, and Homeland Security have enabled our communities to purchase first responder communication equipment, outdoor siren warning systems, generators, and facilities that could be used for shelters.

As with the Lincoln Trail Regional Hazard Plan Updates in 2004 and 2009/2010, every jurisdiction in the region participated in the 2015 update. Opportunities for participation existed at every local and regional meeting when discussion ensued about risk assessment, plan maintenance and the review of findings and data. Each of the LTADD counties, submitted a resolution to participate in the planning and update of the Lincoln Trail Regional Hazard Mitigation Plan.

The update planning process began with a regional meeting to apprise agencies, businesses, educators and representatives from every jurisdiction of the opportunity to review the existing plan, evaluate progress and events that occurred over the past five years, and think about how to proceed in the near future. This meeting included training about community resiliency and preparedness, continuity of operations, individual and family preparedness, and incorporating hazard mitigation into land use planning and community decision-making.

Local mitigation committees participated in each phase of the review and update process. Sub-section 3.1.3 describes the methods used for selecting the members who participated. The risk assessment portion of the plan is covered in section 3.3. Local participants were aided in the process with information pertaining to hazard identification and vulnerability assessment that included historic and technical data, and input from individual jurisdictions. The risk assessment section was researched and prepared by LTADD staff and reviewed by subcommittees, before being presented to the Regional Mitigation Council for inclusion in the plan update. Each section of the Lincoln Trail Regional Hazard Mitigation Plan Update, was reviewed by committee members, during the update process. Data and information collected from each individual jurisdiction, as well as that researched by LTADD staff, was incorporated into the update along with that from the original document. The information gained from each jurisdiction greatly enhanced the data from state and national sources. Meeting notes, maps, information and attendance records are on file at the Lincoln Trail Area Development District office.

All sections of the plan were originally developed and updated using the best available data in the Lincoln Trail Region. Past Geographic Information Systems (GIS) mapping in conjunction with information gathered from each jurisdiction was used to forecast future losses. During the process of identifying hazards, each hazard was discussed and rated as a potential threat or categorized as “low” or “no risk.” Additional information regarding the physical and economic impacts of hazards was gathered and added to existing data. Sources used to gather information from the last five years included county emergency management offices, local media, insurance records, local planning and zoning commissions, the general public, each participating jurisdiction and historical knowledge.

Utilizing data from numerous sources, the information contained in the Lincoln Trail Regional Hazard Mitigation Plan Update, defined the vulnerabilities each participating jurisdiction must address. A review of the 2010 mitigation strategy gave the region a base from which to draft community specific mitigation projects. A review of projects that were in progress when the original plan was completed enabled the committee to create the status report shown in section 3.4. From there information about complaints and problems related to recent storms and events was compiled. Review and discussion of this data resulted in a list of projects with the propensity to serve the greatest number of people, prevent the greatest economic losses and be the most cost effective.

The completed list was then presented to elected officials for review and prioritization. Discussion on both city and county levels produced additional projects for consideration.

All appropriate feedback received from elected officials and community members was considered and incorporated into the Lincoln Trail Hazard Mitigation Plan Update.

3.2.6 Plan Maintenance Procedures

Monitoring, Evaluating and Updating the Lincoln Trail Regional Hazard Mitigation Plan

The Lincoln Trail Regional Hazard Mitigation Plan is updated every five years per 44 CFR §201.6(c)(4)(i). However, the twenty-seven cities and eight counties in the Region are committed to keeping the plan up-to-date per 44 CFR §201.6(c)(4)(iii).

Monitoring Implementation and Evaluating Effectiveness Annually

Each local unit of government will review and discuss the Regional Plan at an officially called meeting of the city council/commission or fiscal court, on an annual basis. At that time, each will review the goals of the plan and gauge how those goals have been addressed during the preceding year. Elected officials will evaluate the progress of the community they represent in meeting the goals of the plan, and implementing the actions described for accomplishing each goal.

This review will also include consideration of hazard events that have occurred over the year and the effectiveness of the plan in helping the community handle the effects of the hazard(s). The review will also afford officials the opportunity to assess the efforts made to mitigate the hazards the community is vulnerable to, and determine if additional actions need to be added to the Plan before the next 5-year update process. At this time, each community can review the comments and concerns contributed by local citizens through the *Hazard Mitigation Public Opinion Survey* forms available to them on the LTADD website, or from direct contact. Local leaders from business, education, and service provider agencies, as well as residents, will be encouraged to attend the review sessions and contribute ideas, changes that have occurred over the past year, and concerns.

This review by each jurisdiction will take place in November of each year; LTADD will send out reminders to each participating jurisdiction. The Lincoln Trail Hazard Mitigation Committee will be responsible for the annual review and provide *The Hazard Mitigation Plan Update Evaluation Worksheet* for each jurisdiction to use during the annual review process (See Appendix A "Forms"). This will enable each community to evaluate the same criteria, and report the information to Lincoln Trail Area Development District for inclusion in the annual regional review. LTADD will then report any annual changes to the regional plan, to the State. LTADD will also incorporate any comments or information it receives in responses from the citizen Hazard Mitigation Public Opinion Surveys. Both the *Hazard Mitigation Plan Update Evaluation Worksheet* and *Hazard Mitigation Public Opinion Surveys* are available on the LTADD website.

Section Update Summary: The planning process required a few changes in order to be more inclusive and specific. However, it closely adhered to the process developed for the original plan that proved to be very successful. Review of the mitigation projects completed since the 2010 update, renewed the interest and understanding the regional communities have in planning for community resiliency and the ability to recover from a disaster. The Regional Plan Maintenance Policy was incorporated into the Planning section of the 2015 Regional Hazard Mitigation Plan.

Lincoln Trail Region Hazards

The geographic location of the Lincoln Trail Region makes it vulnerable to variety of natural hazard events that have the potential to threaten life and property. The following list of natural hazard events is inclusive; not all of these hazards impact this region, but all are profiled in this chapter.

- **Flooding**
- **Tornados**
- **Severe Thunderstorms**
- **Severe Winter Storms**
- **Lightning**
- **Hail**
- **Landslides**
- **Karst/Sinkhole Topography**
- **Subsidence**
- **Drought**
- **Wildfire**
- **Dam Safety**
- **Earthquakes**
- **Hurricanes**
- **Tsunamis**

Some of these hazard events are interrelated; severe thunderstorms can cause flooding and include lightning, they can also produce hail, high winds and tornados. This chapter provides the characteristics and potential impacts associated with each of these events. Those hazards that affect the Lincoln Trail Region are identified along with their associated potential risks. Historical data is used to determine which events the region is vulnerable to, and the level of associated potential risk. The degree of risk is dependent upon the reliability and accuracy of the data collected.

3.3 Risk Assessment

All sections of the risk assessment were developed utilizing the best available data in the Lincoln Trail Region. Lincoln Trail staff used GIS resources to assess the physical impact that specific natural hazard events have on the region. When GIS information was not available or applicable, research data and local historic records, such as those obtained from regional emergency management offices, the media, insurance records, and the knowledge of local officials and residents, were used. Research sources include, but are not limited to the following:

- The National Oceanic and Atmospheric Administration (NOAA)
- The Kentucky Energy and Environment Cabinet
- US Geological Survey (USGS)
- National Severe Storms Laboratory

- FEMA
- Kentucky Office of Emergency Management
- Kentucky Geological Survey
- National Center for Environmental Information (NCEI)

Table 3.3.1 - Hazard Maps by Jurisdiction

JURISDICTION	*MAP TYPE*					
	FLOODING	*TORNADO*	*LANDSLIDE*	*KARST*	*EARTHQUAKE*	*RISK*
BRECKINRIDGE	Y	Y	Y	Y	Y	Y
CLOVERPORT	Y	Y	Y	Y	NA	Y
HARDINSBURG	Y	Y	Y	Y	NA	Y
IRVINGTON	Y	NA	NA	Y	NA	Y
GRAYSON	Y	Y	Y	Y	Y	Y
CANEYVILLE	Y	Y	Y	NA	NA	Y
CLARKSON	Y	Y	NA	Y	NA	Y
LEITCHFIELD	Y	Y	Y	Y	NA	Y
HARDIN	Y	Y	Y	Y	Y	Y
ELIZABETHTOWN	Y	Y	Y	Y	NA	Y
RADCLIFF	Y	Y	Y	Y	NA	Y
SONORA	Y	NA	NA	Y	NA	Y
UPTON	Y	NA	NA	Y	NA	Y
VINE GROVE	Y	Y	Y	Y	NA	Y
WEST POINT	Y	NA	Y	Y	NA	Y
LARUE	Y	Y	Y	Y	Y	Y
HODGENVILLE	Y	Y	Y	Y	NA	Y
MARION	Y	Y	Y	Y	Y	Y
BRADFORDSVILLE	Y	Y	Y	NA	NA	Y
LEBANON	Y	Y	Y	Y	NA	Y
LORETTO	Y	NA	Y	Y	NA	Y
RAYWICK	Y	NA	Y	NA	NA	Y
MEADE	Y	Y	Y	Y	Y	Y
BRANDENBURG	Y	Y	Y	Y	NA	Y
EKRON	Y	NA	NA	Y	NA	Y
MULDRAUGH	NA	NA	NA	Y	NA	Y
NELSON	Y	Y	Y	Y	Y	Y
BARDSTOWN	Y	Y	Y	Y	NA	Y
BLOOMFIELD	Y	NA	Y	NA	NA	Y
FAIRFIELD	Y	NA	NA	NA	NA	Y
NEW HAVEN	Y	Y	Y	NA	NA	Y
WASHINGTON	Y	Y	Y	Y	Y	Y
MACKVILLE	Y	NA	Y	NA	NA	Y
SPRINGFIELD	Y	Y	Y	NA	NA	Y
WILLISBURG	Y	Y	Y	NA	NA	Y

Y = Map Available
NA = Not Applicable

3.3.1 Identifying Hazards

The Lincoln Trail Region encompasses an area of 3,342 square miles and is vulnerable to several natural hazard events. The events outlined in Table 3.3.1.1 have a 100% chance of occurring in any given year within this region, and cost the area an average of $134,000 per event. Due to the size of the region, events may be more prevalent in one portion of the area than in others. This phenomenon makes it imperative to include as many research sources as possible, and to look at mitigation strategies appropriate for every jurisdiction within the region. The events listed below were identified using information from local emergency management offices and review of local past disasters in addition to those listed.

Table 3.3.1.1 Lincoln Trail Region Significant Hazard Events

Hazard	How Identified	Reason Identified
Thunderstorm Wind Total Cost-$74,457,996.00 Number of Events-1,679 48-60-years	Media Coverage Insurance Records SHELDUS National Center for Environmental Information (NCEI)	Historic Regional Significance (Affects all Jurisdictions)
Floods Total Cost-$132,991,112.0 Number of Events-423 48-60-years	Public Input Insurance Records FIRM/DFIRM Maps SHELDUS National Center for Environmental Information (NCEI)	Historic Regional Significance (Affects all Jurisdictions) Presence of Waterways Presence of Flood Prone Areas
Hail Total Cost-$130,364,632.0 Number of Events-563 48-60-years	Media Coverage Insurance Records SHELDUS National Center for Environmental Information (NCEI)	Historic Regional Significance (Affects all Jurisdictions)
Lightning Total Cost-$3,765,207.00 Number of Events-271 48-60-years	Media Coverage Insurance Records SHELDUS National Center for Environmental Information (NCEI)	Historic Regional Significance (Affects all Jurisdictions
Snow & Ice Total Cost-$16,342,589.00 Number of Events-320 48-60-years	Community Input Media Coverage National Center for Environmental Information (NCEI)	Historic Regional Significance (Affects all Jurisdictions

Tornado Total Cost-$93,649,450.00 Number of Events-113 48-60-years	Public Input Insurance Records FEMA Data Wind Zone Maps SHELDUS National Center for Environmental Information (NCEI)	High Wind Risk Area Historic Regional Significance (Affects all Jurisdictions
Earthquake Total Cost-NA Number of Events-6 235-years	National Center for Environmental Information (NCEI) Media Coverage	Media Coverage NEIC
Total Number of Events 3,375		

Table 3.3.1.2 profiles natural hazards that can affect this region, but which historically, have not posed a significant risk to the area. Most of these hazards do not pose a significant threat to this region, but cannot be overlooked. Most have either no reports of past occurrence and/or an adverse impact on local communities.

Table 3.3.1.2 Lincoln Trail Region Hazard Events With Negligible Risk

Hazard	How Identified	Reason Identified
Landslides (road slides)	Local Input Hazard Areas Identified by KY Geological Survey	Topographic Maps Show Significant Potential Regional Impact
Karst/Sinkhole & Subsidence Topography	USGS & KGS Topographic Maps Local Input	Topographic Maps Indicate High Risk of Development
Drought & Heat	KY Mesonet Data Local Input National Center for Environmental Information (NCEI)	Rural Area With Potential for Economic Impact
Wildfires	Public Input National Center for Environmental Information (NCEI)	Area Prone to Grass/Brush Fires
Earthquakes	Historic Data Media Coverage USGS & KGS	Peak Ground Acceleration Maps (PGA Maps)
Dam Safety	KY Energy & Environment Cabinet	No Significant Historic Data
Tsunamis	Historic Data	No Historic Data

Hurricanes	Media Coverage National Center for Environmental Information (NCEI)	Little Historic Data

3.3.2 Profiling Hazard Events

This section provides a profile of each hazard identified in the Lincoln Trail Region. This part of the Lincoln Trail Regional Hazard Mitigation Plan provides the following information based on the best data available:

1. A description of each hazard identified within the planning area and the impact that each hazard has on the area.
2. The historical background of each identified hazard in the planning area and the probability of it occurring again.
3. Maps indicating the locations and areas within the region impacted by Hazard events.

Lincoln Trail staff used GIS resources to assess the physical and economic impact of certain natural disasters on the region. In situations where GIS data was not available, state websites and local records were used to give plan reviewers a more comprehensive understanding of past hazard events. Local records included county emergency management records, media, local officials, community members and the historical knowledge of subcommittee members. Credible websites accessed and cited throughout the plan include the Kentucky State Climatology Center, the Spatial Hazard Events and Losses Database for the United States (SHELDUS), the National Center for Environmental Information (NCEI), FEMA's Hazard Mapping website, the Kentucky Geological Survey (KGS), the United States Geologic Survey (USGS), and Kentucky MESONET centers. In addition, leaders from regional educational institutions, business, emergency management, and first response agencies were contacted and involved with the planning process per 44 CFR §201.6(b)(2).

As subcommittees reviewed the best available data gathered, several gaps were identified. In order to project a more accurate and comprehensive record of past hazard events, researching public input and local records played a significant role in augmenting the data. The consensus of subcommittee reviewers is that some local data is not being forwarded to all interested parties. In particular, property damage estimates are not accurately calculated. To bridge this void, local and regional insurance estimates were gathered from providers in the region and incorporated into the plan.

One goal of the Lincoln Trail Regional Mitigation Committee, is to capture new data with every update, that will be useful in preparing future proposals and in developing local environmental and economic plans. All information in this regional plan is dated, and should be easily discernable from the original data. The plan should guide community development, improve regional resiliency and preparedness, and enhance quality of life throughout the Lincoln Trail Region.

Review: The Lincoln Trail Region has a documented history of several different types of Hazards with various impacts. The impact of these hazards is measured by both the frequency of occurrence and by the cost of the event; both economic and social. This section is focused on the types and frequency of hazards in the Lincoln Trail Region. The costs of events will be addressed in section 3.3.4, and will focus on the potential losses that may be incurred with a future event. The following tables provide an analytical review of documented hazard events in the Lincoln Trail Region. For planning purposes, the historic frequencies will be used in subsequent vulnerability analysis. The tables are presented for each county including incorporated and unincorporated areas and for the region as a whole.

Table 3.3.2.1 - Summary of Hazard Events and Cost by County

BRECKINRIDGE

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1]	206	54.5	53	95	195	0.26	377.98%	5.3	4.75	3.9
Floods[1, 3]	53	48.5	13	31	53	0.92	109.28%	1.3	1.55	1.06
Hail[1,3]	77	51.5	36	52	74	0.67	149.51%	3.60	2.60	1.48
Lightning[1,3]	25	54.5	0	0	21	2.18	45.87%	0	0	0.42
Snow & Ice[1]	40	54.5	14	20	35	1.36	73.39%	1.4	1	0.7
Tornado[1]	16	54.5	7	10	15	3.41	29.36%	0.7	0.5	0.3
Earthquake[2]	0	235	0	0	0	0.00	0.00%	0.00	0.00	0.00

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1]	$1,211,803	206	54.5	0.25	2.21	$22,235	$5,883	0.00	0.00	0.04	0.01
Floods[1, 3]	$7,801,684	53	48.5	2.09	0.11	$160,859	$147,202	0.04	0.04	0.00	0.00
Hail[1, 3]	$4,925,750	77	51.5	0.01	0.52	$95,646	$63,971	0.00	0.00	0.01	0.01
Lightning[1,3]	$289,285	25	54.5	0.04	0.36	$5,308	$11,571	0.00	0.00	0.01	0.01
Snow & Ice[1]	$1,411,082	40	54.5	0.31	1.83	$25,891	$35,277	0.01	0.01	0.03	0.05
Tornado[1,3]	$5,185,260	16	54.5	1.09	20.00	$95,142	$324,079	0.02	0.07	0.37	1.25
Earthquake[2]		0	235	No Information Available							

GRAYSON

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1]	196	56.5	41	78	185	0.29	346.90%	4.1	3.9	3.7
Floods[1, 3]	46	48.5	12	26	46	1.05	94.85%	1.2	1.3	0.92
Hail[1, 3]	84	50.5	34	54	82	0.60	166.34%	3.40	2.70	1.64
Lightning[1,3]	31	54.5	1	1	26	1.76	56.88%	0.1	0.05	0.52
Snow & Ice[1]	42	54.5	15	21	38	1.30	77.06%	1.5	1.05	0.76
Tornado[1,3]	15	55.5	5	6	10	3.70	27.03%	0.5	0.3	0.2
Earthquake[2]	0	235	0	0	0	0.00	0.00%	0.00	0.00	0.00

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1]	$1,215,287	196	56.5	0.25	6.62	$21,510	$6,200	0.00	0.00	0.12	0.03
Floods[1, 3]	$8,185,065	46	48.5	0.04	0.11	$168,764	$177,936	0.00	0.00	0.00	0.00
Hail[1, 3]	$2,438,935	84	50.5	0.01	0.5	$48,296	$29,035	0.00	0.00	0.01	0.01
Lightning[1,3]	$423,574	31	54.5	0.04	2.36	$7,772	$13,664	0.00	0.00	0.04	0.08
Snow & Ice[1]	$1,981,398	42	54.5	0.29	3.41	$36,356	$47,176	0.01	0.01	0.06	0.08
Tornado[1,3]	$56,483,213	15	55.5	3.00	23.09	$1,017,716	$3,765,548	0.05	0.20	0.42	1.54
Earthquake[2]		0	235	No Information Available							

HARDIN

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1]	300	58.5	70	139	285	0.20	512.82%	7	6.95	5.7
Floods[1, 3]	69	48.5	23	44	69	0.70	142.27%	2.3	2.2	1.38
Hail[1, 3]	95	51.5	33	54	92	0.54	184.47%	3.30	2.70	1.84
Lightning[1,3]	34	54.5	2	3	29	1.60	62.39%	0.2	0.15	0.58
Snow & Ice[1]	45	54.5	17	23	41	1.21	82.57%	1.7	1.15	0.82
Tornado[1,3]	24	54.5	8	11	21	2.27	44.04%	0.8	0.55	0.42
Earthquake[2]	1	235	0	1	1	235.00	0.43%	0.00	0.05	0.02

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1]	$64,735,949	300	58.5	4.45	133.17	$1,106,597	$215,786	0.08	0.01	2.28	0.44
Floods[1, 3]	$47,893,889	69	48.5	2.17	0.11	$987,503	$694,114	0.04	0.03	0.00	0.00
Hail[1, 3]	$26,768,252	95	51.5	0.01	0.52	$519,772	$281,771	0.00	0.00	0.01	0.01
Lightning[1,3]	$869,962	34	54.5	1.11	2.36	$15,963	$25,587	0.02	0.03	0.04	0.07
Snow & Ice[1]	$2,792,155	45	54.5	0.29	3.47	$51,232	$62,048	0.01	0.01	0.06	0.08
Tornado[1,3]	$16,118,723	24	54.5	2.00	73.09	$295,756	$671,613	0.04	0.08	1.34	3.05
Earthquake[2]		1	235	No Information Available							

LARUE

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1]	193	54.5	36	64	176	0.28	354.13%	3.6	3.2	3.52
Floods[1, 3]	37	48.5	8	15	37	1.31	76.29%	0.8	0.75	0.74
Hail[1, 3]	59	58.5	20	23	54	0.99	100.85%	2.00	1.15	1.08
Lightning[1,3]	33	54.5	0	0	26	1.65	60.55%	0	0	0.52
Snow & Ice[1]	38	54.5	12	17	34	1.43	69.72%	1.2	0.85	0.68
Tornado[1,3]	11	62.5	4	6	9	5.68	17.60%	0.4	0.3	0.18
Earthquake[2]	1	235	0	0	1	235.00	0.43%	0.00	0.00	0.02

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1]	$1,509,787	193	54.5	1.32	11.6	$27,703	$7,823	0.02	0.01	0.21	0.06
Floods[1, 3]	$8,067,971	37	48.5	0.17	0.11	$166,350	$218,053	0.00	0.00	0.00	0.00
Hail[1, 3]	$1,969,355	59	58.5	0.06	0.56	$33,664	$33,379	0.00	0.00	0.01	0.01
Lightning[1,3]	$61,022	33	54.5	0	0	$1,120	$1,849	0.00	0.00	0.00	0.00
Snow & Ice[1]	$1,050,662	38	54.5	0.29	3.36	$19,278	$27,649	0.01	0.01	0.06	0.09
Tornado[1,3]	$5,110,111	11	62.5	0.00	19.12	$81,762	$464,556	0.00	0.00	0.31	1.74
Earthquake[2]		1	235	No Information Available							

MARION

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1]	180	54.5	22	55	62	0.30	330.28%	2.2	2.75	1.24
Floods[1, 3]	44	48.5	9	19	44	1.10	90.72%	0.9	0.95	0.88
Hail[1, 3]	58	53.5	11	18	50	0.92	108.41%	1.10	0.90	1.00
Lightning[1,3]	35	54.5	0	0	27	1.56	64.22%	0	0	0.54
Snow & Ice[1]	32	54.5	7	11	28	1.70	58.72%	0.7	0.55	0.56
Tornado[1,3]	11	54.5	2	4	8	4.95	20.18%	0.2	0.2	0.16
Earthquake[2]	0	235	0	0	0	0.00	0.00%	0.00	0.00	0.00

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1]	$1,247,735	180	54.5	0.24	1.63	$22,894	$6,932	0.00	0.00	0.03	0.01
Floods[1, 3]	$9,740,835	44	48.5	0.31	2.54	$200,842	$221,383	0.01	0.01	0.05	0.06
Hail[1, 3]	$35,497,179	58	53.5	0.06	2.56	$663,499	$612,020	0.00	0.00	0.05	0.04
Lightning[1,3]	$154,253	35	54.5	0.14	0.39	$2,830	$4,407	0.00	0.00	0.01	0.01
Snow & Ice[1]	$2,681,555	32	54.5	0.29	3.36	$49,203	$83,799	0.01	0.01	0.06	0.11
Tornado[1,3]	$735,833	11	54.5	0.00	4.15	$13,502	$66,894	0.00	0.00	0.08	0.38
Earthquake[2]		0	235	No Information Available							

MEADE

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1]	208	55.5	46	84	196	0.27	374.77%	4.6	4.2	3.92
Floods[1, 3]	42	48.5	8	19	42	1.15	86.60%	0.8	0.95	0.84
Hail[1, 3]	68	59.5	20	40	63	0.88	114.29%	2.00	2.00	1.26
Lightning[1,3]	28	54.5	0	0	24	1.95	51.38%	0	0	0.48
Snow & Ice[1]	40	54.5	15	19	36	1.36	73.39%	1.5	0.95	0.72
Tornado[1,3]	12	54.5	5	7	10	4.54	22.02%	0.5	0.35	0.2
Earthquake[2]	4	235	1	4	4	58.75	1.70%	0.10	0.20	0.08

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1]	$1,679,733	208	55.5	3.45	46.26	$30,265	$8,076	0.06	0.02	0.83	0.22
Floods[1, 3]	$7,284,005	42	48.5	1.14	0.11	$150,186	$173,429	0.02	0.03	0.00	0.00
Hail[1, 3]	$25,032,572	68	59.5	0.01	2.52	$420,715	$368,126	0.00	0.00	0.04	0.04
Lightning[1,3]	$129,715	28	54.5	0	0	$2,380	$4,633	0.00	0.00	0.00	0.00
Snow & Ice[1]	$1,420,840	40	54.5	0.29	1.81	$26,070	$35,521	0.01	0.01	0.03	0.05
Tornado[1,3]	$6,142,325	12	54.5	31.00	267.09	$112,703	$511,860	0.57	2.58	4.90	22.26
Earthquake[2]		4	235	No Information Available							

NELSON

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1]	228	54.5	45	51	210	0.24	418.35%	4.5	2.55	4.2
Floods[1, 3]	93	48.5	34	67	93	0.52	191.75%	3.4	3.35	1.86
Hail[1, 3]	71	53.5	22	39	64	0.75	132.71%	2.20	1.95	1.28
Lightning[1,3]	41	54.5	1	5	34	1.33	75.23%	0.1	0.25	0.68
Snow & Ice[1]	41	54.5	13	18	37	1.33	75.23%	1.3	0.9	0.74
Tornado[1,3]	13	54.5	2	3	13	4.19	23.85%	0.2	0.15	0.26
Earthquake[2]	0	235	0	0	0	0.00	0.00%	0.00	0.00	0.00

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1]	$1,404,130	228	54.5	0.3	12.58	$25,764	$6,158	0.01	0.00	0.23	0.06
Floods[1, 3]	$35,033,005	93	48.5	3.17	2.11	$722,330	$376,699	0.07	0.03	0.04	0.02
Hail[1, 3]	$22,857,556	71	53.5	0.06	1.56	$427,244	$321,937	0.00	0.00	0.03	0.02
Lightning[1,3]	$907,717	41	54.5	2.12	2.34	$16,655	$22,139	0.04	0.05	0.04	0.06
Snow & Ice[1]	$2,307,155	41	54.5	1.29	3.47	$42,333	$56,272	0.02	0.03	0.06	0.08
Tornado[1,3]	$2,033,978	13	54.5	1.00	28.15	$37,321	$156,460	0.02	0.08	0.52	2.17
Earthquake[2]		0	235	No Information Available							

WASHINGTON

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1]	168	54.5	18	45	150	0.32	308.26%	1.8	2.25	3
Floods[1, 3]	39	48.5	4	12	39	1.24	80.41%	0.4	0.6	0.78
Hail[1, 3]	51	53.5	11	18	44	1.05	95.33%	1.10	0.90	0.88
Lightning[1,3]	36	54.5	0	0	29	1.51	66.06%	0	0	0.58
Snow & Ice[1]	42	54.5	10	14	34	1.30	77.06%	1	0.7	0.68
Tornado[1,3]	11	54.5	5	7	11	4.95	20.18%	0.5	0.35	0.22
Earthquake[2]	0	235	0	0	0	0.00	0.00%	0.00	0.00	0.00

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1]	$1,453,572	168	54.5	0.22	3.58	$26,671	$8,652	0.00	0.00	0.07	0.02
Floods[1, 3]	$8,984,658	39	48.5	0.17	0.11	$185,251	$230,376	0.00	0.00	0.00	0.00
Hail[1, 3]	$10,875,034	51	53.5	0.06	3.56	$203,272	$213,236	0.00	0.00	0.07	0.07
Lightning[1,3]	$223,179	36	54.5	0.12	0.34	$4,095	$6,199	0.00	0.00	0.01	0.01
Snow & Ice[1]	$2,697,743	42	54.5	0.37	3.48	$49,500	$64,232	0.01	0.01	0.06	0.08
Tornado[1,3]	$1,840,007	11	54.5	0.00	5.15	$33,762	$167,273	0.00	0.00	0.09	0.47
Earthquake[2]		0	235	No Information Available							

LINCOLN TRAIL REGION

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
Thunderstorm Wind[1,4]	1679	58.5	331	611	1459	0.03	2870.09%	33.1	30.55	29.18
Floods[1,4]	423	48.5	111	233	423	0.11	872.16%	11.1	11.65	8.46
Hail[1,4]	563	50.5	187	298	523	0.12	848.15%	17.40	11.40	8.94
Lightning	263	49	4	9	216	0.19	536.73%	0.4	0.45	4.32
Snow & Ice[1,4]	320	54.5	103	143	283	0.17	587.16%	10.3	7.15	5.66
Tornado[1,4]	113	56	38	54	97	0.49	203.15%	3.8	2.7	1.94
Earthquake[2]	6	235	1	5	6	39.17	2.55%	0.10	0.25	0.12

Hazard	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
Thunderstorm Wind[1,4]	$74,457,996	1679	58.5	10.48	217.65	$1,272,786	$44,347	0.18	0.01	3.72	0.13
Floods[1,4]	$132,991,112	423	48.5	9.26	5.31	$2,742,085	$314,400	0.19	0.02	0.11	0.01
Hail[1,4]	$130,364,632	563	59.5	0.28	12.3	$2,414,160	284638.94	0.01	0.00	0.23	0.03
Lightning	$3,765,207	271	54.5	5.57	11.15	$69,086	$13,894	0.10	0.02	0.20	0.04
Snow & Ice[1,4]	$16,342,589	320	54.5	3.42	24.19	$299,864	$51,071	0.06	0.01	0.44	0.08
Tornado[1,4]	$93,649,450	113	56	38.09	439.84	$1,683,586	$828,756	0.68	0.34	7.91	3.89
Earthquake[2]		6	235	No Information Available							

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically, that would average two events a year. Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 20 years (NCDC & NEIC weather records). 3) It is important to include all significant recorded hazard events that will include periodic updates to this table.

The values in the preceding tables should be considered low. More events have occurred than are documented by the sources used in these tables.

1. Compilation of SHELDUS, NCDC & NEIC, SHELDUS Data Base, Hazard Research Lab, University of South Carolina, 2009. Dates 1960-2009. National Climate Data Center (NCDC), NOAA & National Weather Service, various ranges 1950-2009. National Environmental Information Center (NEIC) July 1 2009 - June 30 2015.

2. USGS & National Earthquake Information Center (NEIC) Databases, "USGS/NEIC 1973-Sept. 9, 2015" & "Eastern, Central and Mountain States of U.S., 1534 - 1986".

3. Includes cumulative reports of claims filed from various insurance providers.

4. Consolidated based on review of repeated events in individual counties.

3.3.2.1 <u>Flooding</u>

I. Background

Definition: "An overflow of water onto lands that are used or usable by man and not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, lake, or ocean."
(Water Science Glossary of Terms; http://ga.water.usgs.gov/edu/dictionary.html)

A **Flood,** as defined by the National Flood Insurance Program (NFIP) is: "A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is your property) from:

- Overflow of inland or tidal waters,
- Unusual and rapid accumulation or runoff of surface waters from any source, or
- A mudflow

Or, it can be a collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood."

Description
A flood is a natural event around rivers and streams. Excessive water from snowmelt, rainfall, or a storm surge accumulates and overflows onto the banks and adjacent floodplains. **Floodplains** are lowlands, adjacent to rivers, lakes, and oceans that are subject to recurring floods. Over nine million U.S. households are located in floodplains.

Flooding is caused in a variety of ways. Winter or spring rains, coupled with melting snows, can fill river basins too quickly. Torrential rains from decaying hurricanes or other tropical systems can also produce river flooding.

During the 20th century, flooding was the leading cause of property damage and loss of life of all natural disasters in the United States. Most U.S. communities have experienced some kind of flooding due to spring rains, heavy thunderstorms, or winter snow thaws. Floods can be either slow or fast rising, but generally develop over a period of days. Hundreds of floods occur each year, making it one of the most common hazards in all U.S. states.

In most years, 75% of all Federal disaster declarations involve flooding either in part or exclusively. Flooding claims an average of 140 lives per year and is responsible for more annual property damage than any other type of weather hazard according to the National Severe Storms Laboratory.

Factors that determine flooding severity and/or exacerbate the effects of floods:

- Rainfall Intensity and Duration
- Large amounts of rain over a short time can result in Flash Flooding
- Small amounts of rain can cause flooding where soil is saturated

- Small amounts of rain can cause flooding if concentrated in an area of impermeable surfaces
- Topography and Ground Cover
- Water runoff is greater in areas of steep slopes and little vegetation
- Development without adequate elevation or Flood Proofing
- Storm Sewer or Sinkhole backup
- Debris or Obstructions

The frequency of flooding depends on the climate, soil, and channel slope. In regions without prolonged periods of below-freezing temperatures, floods usually occur in the season with the highest precipitation.

Types of Flooding:
While floods can be the result of numerous naturally occurring and manmade factors, all floods can be defined as the accumulation of too much water, in too little time, within a specific area. Types of floods include regional, river or riverine, flashfloods, urban, ice-jam, storm surge, dam or levee failure, and debris, landslide, and mudflow.

Regional Flooding
Seasonal, regional flooding can occur when winter or spring rains, coupled with melting snow, fill river basins with too much water too quickly. Frozen ground further reduces water infiltration into the soil and causes runoff. Extended wet periods, at any time during the year, can result in saturated soils and exacerbates runoff into streams and rivers until their water containment capabilities are exceeded.

River or Riverine Floods
River/riverine flooding occurs when a high volume of water from a river or similar body of water occurs over a period of time too long to be considered a flash flood.

Flash Floods
Flash floods are the result of quickly rising waters that occur as the result of heavy rains over

The spillway at Rough River Lake April 27 2011 Falls of Rough, Ky. - Heavy rains in the area caused Rough River Lake to reach a record pool causing water to run into the spillway for the first time since the dam became operational in 1961. *Image: US Army Corps of Engineers photo by Mike Lush* the period of a few hours or less. Flash flooding can occur within several seconds to several hours, and with little warning. Flash floods are deadly because they produce rapid increases in water volume that often has swift velocities.

Several factors can contribute to flash flooding including rainfall intensity, rainfall duration, surface conditions, topography, and the slope of the receiving basin. Urban areas are more susceptible to flash flooding since a great percentage of the surface area is composed of impervious surfaces such as roads, roofs and parking lots causing rapid runoff of water. They can also be caused by ice jams on rivers in conjunction with a winter or spring thaw, or even a dam break. Flash flooding is characterized by the rapid and constant influx of water that caused a treacherous overflow with volume and velocity sufficient to sweep vehicles away, roll boulders onto roadways, uproot trees, level buildings, and sweep bridges off of their piers.

Urban Flooding

As land is developed from fields and woodlands into roads, parking lots and built environments, it loses its ability to absorb rainfall. Urbanization of a watershed changes the hydrologic systems of a basin. Heavy rainfall collects and flows faster on impervious surfaces such as asphalt and concrete. Water falls from the clouds and moves along the surface and into streams at a much faster rate in urban areas. Adding a built environment into hydrologic systems can result in floodwaters rising very quickly and moving extremely swiftly. During periods of urban flooding, streets can become rapidly moving rivers and basements can fill with water. Often, storm drains become clogged with debris causing additional, localized flooding.

Most People are Unaware that:

- 80% of deaths due to flooding occur in vehicles. Most happen when drivers try to navigate through floodwaters.
- Just 6 inches of rapidly moving floodwater can knock a person down.
- It only takes 2 feet of water to float a large vehicle.
- One-third of all flooded roads and bridges are so damaged by water, that any vehicle trying to cross stands only a 50% chance of making it to the other side.
- 95% of people killed in a flash flood try to outrun rapidly moving water rather than seeking higher grounds.

Ice-Jam Floods

Ice-jam floods can occur when rivers become totally or partially frozen. A rise in stream stage will break up a totally frozen river and create ice flows that can pile up on channel obstructions such as shallow riffles, log jams, or bridge piers. The jammed ice creates a dam across the channel that water and ice cannot breach. The mixture can then rise rapidly and overflow the channel banks. Flooding then moves downstream when the ice dam fails, and the water stored behind the dam is released. At this juncture, the flood takes on the characteristics of a flash flood, with the added danger of ice flows gaining velocity. Such flooding can seriously damage structures in its path.

Storm-Surge Floods
Storm-surge flooding occurs when water is pushed up onto otherwise dry land by onshore winds. Friction between the water and the moving air creates drag that, depending on the distance of the water (fetch) and the velocity of the wind, can pile water up to depths greater than twenty feet. Intense, low-pressure systems and hurricanes can create storm-surge flooding. Storm surge is unquestionably the most dangerous part of a hurricane when pounding waves create very hazardous flood currents.

Dam and Levee Failure floods
Dam failures are potentially the worst flood events. Dam failure is usually the result of neglect, poor design, or structure damage caused by a major event such as an earthquake. When a dam fails, an immense volume of water is sent speeding downstream, destroying everything in its path. Dams and levees are designed and built for flood protection and are usually engineered to withstand a flood with a calculated risk of occurrence. For example, a dam or levee may be designed to contain a flood at one location on a stream that has a certain probability of occurring in any given year. If a larger flood occurs, that structure will be overtopped. If a dam or levee is overtopped, it could result in the structure being washed out and the water behind it becomes a flash flood. A failed dam or levee can create a flood that is catastrophic to life and property due to the tremendous energy of the water that is released.

Debris and Landslide Floods
Debris and landslide flooding occurs when the accumulation of debris, mud, rocks, and logs in a channel form a temporary dam. Flooding occurs upstream as water becomes trapped behind the temporary dam and quickly becomes a flash flood as water breaches the dam and rapidly washes away. Landslides can also create large waves on lakes or embayments and can be deadly.

Most loss of life occurs when people are swept away by flood currents, while most property damage results from inundation by sediment-laden water. Floodwaters have the potential to be an extremely destructive force. Lateral forces can demolish buildings while erosion can undermine bridge foundations and footings that can lead to collapse of structures.

Flood Facts
- Most flood related deaths are due to flash floods. The national, 30-year average for flood related deaths in the U.S. is 94 according to the National Weather Service (NWS).
- Fifty percent of all flash-flood fatalities are vehicle related.
- Most homeowner insurance policies do not cover floodwater damage.
- Estimated property damage in the U.S. in 2013 and 2014 was over $3 billion each year according to the National Weather Service. Over the last 30 years, the average annual flood damage estimate was $7.96 billion.

Common Terms:

100-Year Flood Plain: An area with a 1% chance of flooding in any given year. This is also known as the Base Flood level.

500-Year Flood Plain: An area with a 0.2% chance of flooding in any given year.

Base Flood: A flood that has a 1% chance of being equaled or exceeded in any given year. In this respect, it is also the regulatory standard for the "100-yeard flood." The base flood is the national standard used by the National Flood Insurance Program (NFIP) and all federal agencies for the purpose of requiring the purchase of flood insurance and the regulation of new development. Base Flood Elevations (BFEs) are usually shown on Flood Insurance Rate Maps (FIRMs)(DFIRMs).

Floodplain: A floodplain is an area of land adjacent to a river, stream, lake, estuary, or other body of water that is subject to flooding. This area of land, if left undisturbed, serves the purpose of storing excess floodwater. A floodplain has two sections, the floodway and the flood fringe.

Floodway: The NFIP defines floodway as "the channel of a river or other watercourse and adjacent land areas that must be reserved, in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot." The floodway carries the majority of floodwater downstream and is usually the area where water velocity and force is greatest. NFIP regulations require the floodway be kept open and free from any development or construction that would obstruct or divert floodwaters onto other properties. Floodways are not mapped for all rivers and streams, but are generally mapped in developed areas.

Flood Fringe: The flood fringe is the area of a floodplain outside of the floodway. The land area outside of a floodway is subject to inundation by regular flooding.

Annual Flooding: Annual flooding occurs far more frequently than indicated by the term "100-year flood." Over time, a structure located within a 100-year floodplain is at a much greater risk than indicated by the time frame of 100-year.

History of Flooding in Kentucky

As of May, 2013, Kentucky had declared fifty-six major disasters since 1953 according to FEMA's website. That is the eighth highest in the United States. Of Kentucky's 56 major disaster declarations, most were due to flooding. While Kentucky ranks 8th overall for major disaster declarations, it ranks 5th for flooding declarations. Flooding in Kentucky occurs almost every year, and it is not unusual for several flooding events to occur in any given year.

An Overview of Kentucky Water and Water Events
13 = Number of Major Basins in Kentucky 40 to 50 Inches = Average Rainfall Maximum Rainfall occurs in Winter and Spring Minimum Rainfall occurs in Late Summer and Fall 89,431 = Miles of Rivers and Streams in the Commonwealth 637,000 = Acres of Wetlands 18 = Number of Reservoirs over 1000 acres in Size 228,385 = Acres of Publicly owned Lakes and Reservoirs

Significant Kentucky floods, resulting in declarations, occurred in 1973, 1975, 1977, 1978, 1982, 1984, three in 1989, 1991, 1997, 1998, 2000, 2001, 2002, 2003, 2004, 2007, 2008, 2009, 2010, 2011, 2012, 2014, and 2015. The flooding in 1997 involved disaster declarations in 101, Kentucky Counties. The two types of flooding most common in Kentucky are *flash floods* and *river basin* or riverine floods.

Flash Flooding: Resulting from excessive rainfall in a short amount of time, flash flooding occurs in the entire state, but is more common in Eastern Kentucky due to the region's mountainous terrain, narrow gorges, and numerous streams and riverbeds. Flash floods can occur at any time of the year, but are more prevalent during the spring and summer months.

River Basin Flooding: River basin flooding is common along Kentucky's major streams such as the Kentucky, Green, Licking, Ohio and Mississippi Rivers. It is most likely to occur during late winter and early spring and seriously affects the major Kentucky cities of Frankfort, Louisville, Owensboro and Paducah. Every two to three years, serious flooding occurs along one or more of Kentucky's major streams and it is not uncommon for flooding to occur several years in succession.

Aerial photo of Rough River Lake 29 April 2011. On April 30 Rough River Lake pool is recoreded at 524.7ft, a new record. *Image: US Army Corps of Engineers*

II. Profile

The Lincoln Trail Area Development District is bordered on the north in part by the Ohio River. Numerous rivers and streams crisscross the region including Rough River, Nolin River, Beech Fork, Rolling Fork, Chaplin River, Salt River, Clover Creek, Sinking Creek and Otter Creek. These waterways and their tributaries drain an immediate area of 4,600 square miles. Since the Lincoln Trail Region consists of only 3,342 square miles, the potential for flooding is obvious.

Historically, flooding has occurred on all of these waterways. Ohio River flooding in the towns of West Point, Brandenburg, and Cloverport has resulted in tremendous property damage and loss of life. Localized flooding resulting in property damage and loss of life has also occurred on most other major streams within the region and has affected the communities of Fredericktown, Bradfordsville and New Haven.

Several flood control projects have been completed within the region, over the years. Most have been construction projects initiated by the U.S. Corps of Engineers and USDA on the Ohio, Rough and Nolin River systems and their tributaries. Local projects have also been completed to deal with storm water runoff and bank erosion issues.

Bradfordsville: South Rolling Fork flooding KY 49, March 2015. *Photo Courtesy: David Edelen.*

Based on FEMA DFIRM data from 2007 – 2012, 6.23 square miles of land or 0.2% of the Lincoln Trail Region lies in a 500-year floodplain and 256.68 square miles of land or 7.6% of the area lies within a 100-year floodplain. Since approval of the original plan in 2005 all of the eight Lincoln Trail counties have gone through the map modernization program of the floodplains.

DFIRM versions

Breckinridge (8/4/2008)	Grayson (9/19/2012)	Hardin (8/16/2007)
LaRue (1/16/2009)	Marion (1/6/2010)	Meade (7/18/2010)
Nelson (5/24/2011)	Washington (2/17/2010)	

Overview of the Kentucky Floodplain Management Program	
Number of Kentucky communities that Participate in the National Flood Insurance Program	114 out of 120 counties 372 cities out of 422
Number of Lincoln Trail communities that Participate in the National Flood Insurance Program	8 out of 8 counties 18 out of 27 cities
Presidential flood declarations between 2005 And April of 2015	14
Presidential flood declaration between 1970 and 2004	26
Source: FEMA.gov and the Kentucky Office of Emergency Management	

Table 3.3.2.1.1 lists repetitive losses across the Lincoln Trail region between January 1, 1978 and February 28, 2015 as a result of flooding events. It should be noted that the claims reported to the National Flood Insurance Program (NFIP) may not be the only assistance available to property owners. Flood assistance is also available from FEMA and other state or federal agencies as a result of a disaster declaration.

Table 3.3.2.1.1 - Repetitive Losses

Jurisdiction	Number of Repetitive Losses	Number of Closed Losses	Total Payments
Breckinridge County	2	2	$131,776.08
City of Cloverport	15	12	$87,993.59
City of Irvington	4	4	$27,373.18
Grayson County	1	0	$0
City of Caneyville	1	0	$0
Hardin County	89	70	$1,623,486.27
City of Elizabethtown	49	33	$305,618.01
City of Radcliff	16	12	$309,225.46
City of Vine Grove	2	2	$23,071.02
City of West Point	161	147	$2,147,578.67
LaRue County	21	20	$203,045.28
Marion County	6	4	$100,125.44
City of Bradfordsville	1	1	$32,000.00
City of Lebanon	14	12	$176,997.42
Meade County	4	2	$30,701.94
City of Brandenburg	3	3	$161,330.46

Nelson County	53	46	$1,350,575.90
City of Bardstown	7	7	$90,663.15
City of Bloomfield	2	2	$1,883.24
City of New Haven	23	20	$472,456.97
Washington County	11	10	$396,666.11
City of Springfield	10	10	$172,515.39
Source: http://bsa.nfipstat.fema.gov/reports/1040.htm From 1/1/1978-2/28/2015			

The National Flood Insurance Program (NFIP) defines a repetitive loss (RL) as any insurable building for which two or more claims of $1,000.00 were paid by the NFIP within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by NFIP. Currently, there are over 122,000 RL properties nationwide. The National Flood Insurance Reform Act of 2004 recognized repetitive loss as a significant problem. The Act also defined severe repetitive loss (SRL) as "a single family property consisting of 1 to 4 residences that is covered under flood insurance by the NFIP and has incurred flood related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000.00 and with the cumulative amount of such claims payments exceeding $20,000.00; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property." Currently, there are approximately 6,000 properties nationwide, meeting the definition of SRL.

Table 3.3.2.1.2	
Flood or Flash Flood Related Disaster Declarations In Lincoln Trail Region	
Declaration Date and Number	**Lincoln Trail Counties Included in the Declaration**
2-5-2008 #1746	Hardin and Meade Counties (Assistance to Individuals and Households) Hardin, Meade and Grayson Counties (Public Assistance)
2-26-2009 #1818	Breckinridge, Grayson, Hardin, LaRue, Marion, Meade, Nelson, and Washington Counties (Public Assistance)
5-29-2009 #1841	Grayson County (Public Assistance)
5-11-2010 #1912	Breckinridge and Grayson Counties (Public Assistance), Hardin County (Individual Assistance) LaRue, Marion, Meade and Washington Counties (Public and Individual Assistance)
05-04-2011 #1976	Breckinridge, Grayson, Marion, Meade, Nelson and Washington Counties (Public Assistance) Hardin County (Individual Assistance)
04-30-2015 #4216	Washington County (Public Assistance)
Source: www.fema.gov/disasters/grid/state-tribal-government	

In 1973 Congress made the purchase of Flood Insurance mandatory for many properties. Lending institutions could not increase, extend or renew funds secured by real estate located in a flood hazard area, unless the property was covered under the NFIP.

Participation: The Lincoln Trail area has seen a 25% increase in the number of NFIP policies since 2009 and a 70% overall increase since 2004. Through conversations with local insurance providers and floodplain managers it was determined the increase is a result of new flood mapping in some areas and increased emphasis on the National Flood Insurance Program.

Non-participation: Jurisdictions not actively participating in the NFIP have deemed it unnecessary to do so, due to the absence of identified flood prone areas within their boundaries.
These include:
Clarkson, Which sits on a ridge and only has an edge of their corporate boundary in a mapped flood plain, no structures within the floodplain and no history of loss.
Sonora, Which only has an edge of their corporate boundary in a mapped flood plain, no structures within the floodplain and no history of loss.
Upton, Which has no flood plains in mapped section. LaRue County section has not been mapped. It has no streams and no history of loss.
Loretto, Which sits on a ridge and has no flood plain, and no history of loss.
Ekron, Has no flood plain, no streams and no history of loss.
Muldraugh, Which sits on a ridge and has no steams, no flood plain, and no history of loss.
Fairfield, Has no flood plain and no history of loss.
Mackville, Which sits on a ridge, has no flood plain, and no history of loss.
Willisburg, Which sits on a ridge, has no flood plain, and no history of loss.
Fairfield, Has no flood plain and no history of loss
All this is illustrated in the Table 3.3.2.1.3 and the subsequent maps included in this plan.

Table 3.3.2.1.3 - NFIP and Mapping Summary

Jurisdiction	Affected by 100/500 year floodplain	Flood area mapped by FEMA	Map Status Date	NFIP	Total # of Active Policies as of 2004	Total # of Active Policies as of 2009	Total # of Active Policies as of 6/30/2015	Annual Written Premium In Force
				Participant				6/30/2015
Breckinridge	**Yes**	**Yes**	**8/4/2008**	**YES**	**8**	**19**	**30**	**$15,185**
-Cloverport	Yes	Yes		YES	13	19	12	$8,078
-Hardinsburg	Yes	Yes		YES	0	0	1	$315
-Irvington	No	Yes		YES	3	1	1	$547
Grayson	**Yes**	**Yes**	**9/19/2012**	**YES**	**2**	**14**	**15**	**$6,343**
-Caneyville	Yes	Yes		YES	1	1	3	$3,544
-Clarkson	Yes	Yes		NO	0	0	0	
-Leitchfield	Yes	Yes		YES	1	0	0	
Hardin	**Yes**	**Yes**	**8/16/2007**	**YES**	**46**	**97**	**154**	**$75,063**
-Elizabethtown	Yes	Yes		YES	30	113	161	$143,119
-Radcliff	Yes	Yes		YES	21	29	30	$13,695
-Sonora	Yes	Yes		NO	0	0	0	
-Upton	No	Partial		NO	0	0	0	
-Vine Grove	Yes	Yes		YES	7	16	29	$19,033
-West Point	Yes	Yes		YES	176	159	145	$131,137
LaRue	**Yes**	**Yes**	**1/16/2009**	**YES**	**12**	**13**	**13**	**$5,560**
-Hodgenville	Yes	Yes		YES	2	9	4	$1,788
Marion	**Yes**	**Yes**	**1/6/2010**	**YES**	**6**	**10**	**19**	**$9,597**
-Bradfordsville	Yes	Yes		YES	1	2	4	$1,648
-Lebanon	Yes	Yes		YES	2	2	6	$1,921
-Loretto	No	Yes		NO	0	0	0	
-Raywick	Yes	Yes		YES	0	0	0	
Meade	**Yes**	**Yes**	**7/18/2011**	**YES**	**8**	**12**	**20**	**$9,160**
-Brandenburg	Yes	Yes		YES	1	2	3	$1,932
-Ekron	No	Yes		NO	7	0	0	
-Muldraugh	No	Yes		NO	0	0	0	
Nelson	**Yes**	**Yes**	**5/24/2011**	**YES**	**47**	**38**	**31**	**$22,352**
-Bardstown	Yes	Yes		YES	6	5	5	$2,038
-Bloomfield	Yes	Yes		YES	7	12	21	$19,756
-Fairfield	No	Yes		NO	0	0	0	
-New Haven	Yes	Yes		YES	21	19	25	$17,118
Washington	**Yes**	**Yes**	**2/17/2010**	**YES**	**10**	**9**	**15**	**$7,703**
-Mackville	No	Yes		NO	0	0	0	
-Springfield	Yes	Yes		YES	7	4	9	$14,529
-Willisburg	No	Yes		NO	0	0	0	

Original Source: http://www.fema.gov/nfip/10110309.html
Source of 2009 Update: http://bsa.nfipstat.com/reports/1040.html & http://bsa.nfipstat.com/reports/1011.html
Source of 2015 Update: http://bsa.nfipstat.fema.gov/reports/reports.html

Table 3.3.2.1.4 - Claims Summary

Jurisdiction	Total # of Claims Between 1978 & 2004	Total # of Claims Between 2004 & 2009	Total # of Claims 2010 - 6/30/2015	Total # of Crop Claims Between 1978 & 2004	Total # of Crop Claims Between 2004 & 2009	Total # of Crop Claims 2010 - 6/30/2015	Total Payments Between 1978 & 2004	Total Payments Between 2004 & 2009	Total Payments Between 2010 - 6/30/2015
Breckinridge	**0**	**0**	**3**	**0**	**0**	**1**	**0**	**0**	**$131,776**
-Cloverport	8	2	5	3	0	0	$50,421	$8,215	$29,358
-Hardinsburg	0	0	0	0	0	0	0	0	$0
-Irvington	2	2	0	0	0	0	$13,093	$14,280	$0
Grayson	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	$0
-Caneyville	1	0	0	1	0	0	0	0	$0
-Clarkson	0	0	0	0	0	0	0	0	$0
-Leitchfield	0	0	0	0	0	0	0	0	$0
Hardin	**39**	**18**	**34**	**5**	**5**	**10**	**$594,850**	**$249,568**	**$818,046**
-Elizabethtown	13	22	15	5	5	7	$43,632	$208,835	$53,151
-Radcliff	2	6	8	1	1	2	$35,245	$18,104	$255,876
-Sonora	0	0	0	0	0	0	0	0	$0
-Upton	0	0	0	0	0	0	0	0	$0
-Vine Grove	0	2	0	0	0	0	0	$23,071	$0
-West Point	134	2	35	11	0	4	$1,595,810	$6,841	$699,619
LaRue	**16**	**0**	**5**	**1**	**0**	**0**	**$61,371**	**0**	**$141,674**
-Hodgenville	0	0	0	0	0	0	0	0	$0
Marion	**2**	**0**	**4**	**1**	**0**	**1**	**$3,768**	**0**	**$96,357**
-Bradfordsville	0	0	1	0	0	0	0	0	$32,000
-Lebanon	14	0	0	2	0	0	$176,997	0	$0
-Loretto	0	0	0	0	0	0	0	0	$0
-Raywick	0	0	0	0	0	0	0	0	$0
Meade	**0**	**2**	**2**	**0**	**1**	**1**	**0**	**$7,642**	**$23,060**
-Brandenburg	3	0	0	0	0	0	$161,330	0	$0
-Ekron	0	0	0	0	0	0	0	0	$0
-Muldraugh	0	0	0	0	0	0	0	0	$0
Nelson	**36**	**0**	**17**	**4**	**0**	**3**	**$760,866**	**0**	**$589,710**
-Bardstown	4	0	3	0	0	0	$71,909	0	$18,754
-Bloomfield	2	0	0	0	0	0	$1,882	0	$1
-Fairfield	0	0	0	0	0	0	0	0	$0
-New Haven	13	0	10	2	0	1	$97,751	0	$374,706
Washington	**3**	**1**	**7**	**0**	**0**	**1**	**$76,627**	**$48,123**	**$271,916**
-Mackville	0	0	0	0	0	0	0	0	$0
-Springfield	6	0	4	0	0	0	$95,651	0	$76,864
-Willisburg	0	0	0	0	0	0	0	0	$0

Original Source: http://www.fema.gov/nfip/10110309.html
Source of 2009 Update: http://bsa.nfipstat.com/reports/1040.html & http://bsa.nfipstat.com/reports/1011.html
Source of 2015 Update: http://bsa.nfipstat.fema.gov/reports/reports.html

III. Analysis

To identify flooding as a threat to the Lincoln Trail Region, the types of floods and their causes were analyzed; areas of vulnerability were determined; historical data was researched; and maps were created to identify the vulnerable areas. The Sources for this information include FEMA, the National Center for Environmental Information (NCEI), the Kentucky Climatic Data Center, the National Weather Service, the National Flood Insurance Program, and the Atlas of Kentucky.

One date that will stand out in the history of the Lincoln Trail Region, is March 1997. Ninety-two counties in Kentucky and 14 counties in southern Indiana were declared disaster areas. Tens of thousands of people were evacuated from their homes, with total damage across the region estimated at $400,000,000. In the small city of West Point in Hardin County, it was estimated that 85% of the city was under water leaving residents devastated and property destroyed.

The following tables outline the history of flooding events that have been recorded in a given county/jurisdiction within the Lincoln Trail region since 1967. The impact, of these flooding events, is documented by the number of lives lost, individual injuries reported, and the estimated cost of property and crop damage. This information was reported to the Spatial Hazard Events and Losses Databases for the United States (SHELDUS) and later the National Climate Data Center (NCDC) and was subsequently rolled into the National Centers for Environmental Information (NCEI) database. For the original, plan data was only available through 2003. The 2010 update provided data thru 30 June 2009. This update shows only individual events for the period 1 July 2009 through 30 June 2015. The summary tables, 3.3.2.1.5 & 3.3.2.1.6 show data for the entire period covered by the various sources. Note that there are many variations in recording the locations of the events over time. In the past this was typically done at a county level. More recently, nearest place names have been used. Because of this, the records in the summation tables that pertain to individual incorporated areas should not be considered all encompassing.

Table 3.3.2.1.5 - County Specific Data – Flooding, *Source: NCEI*

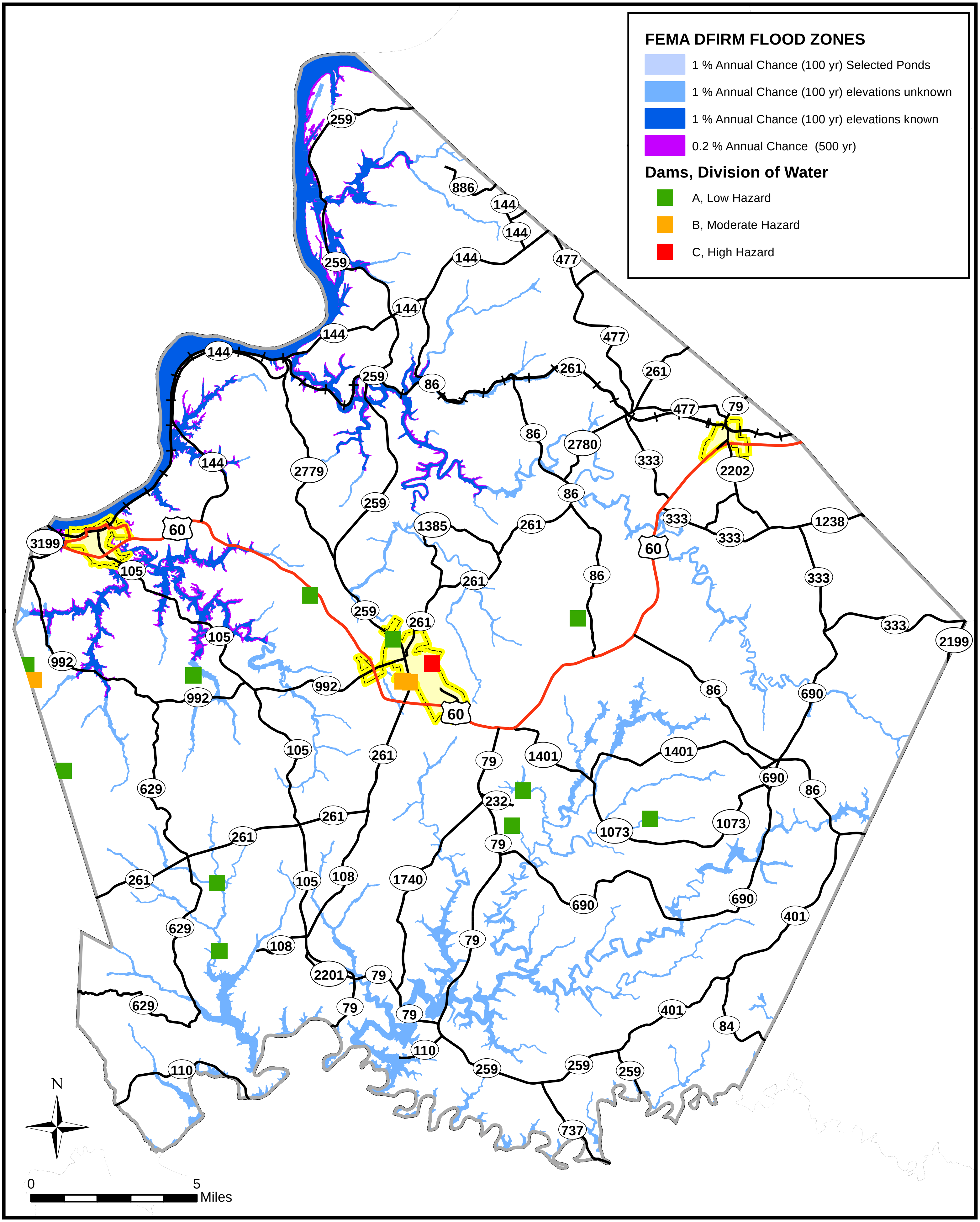
BRECKINRIDGE

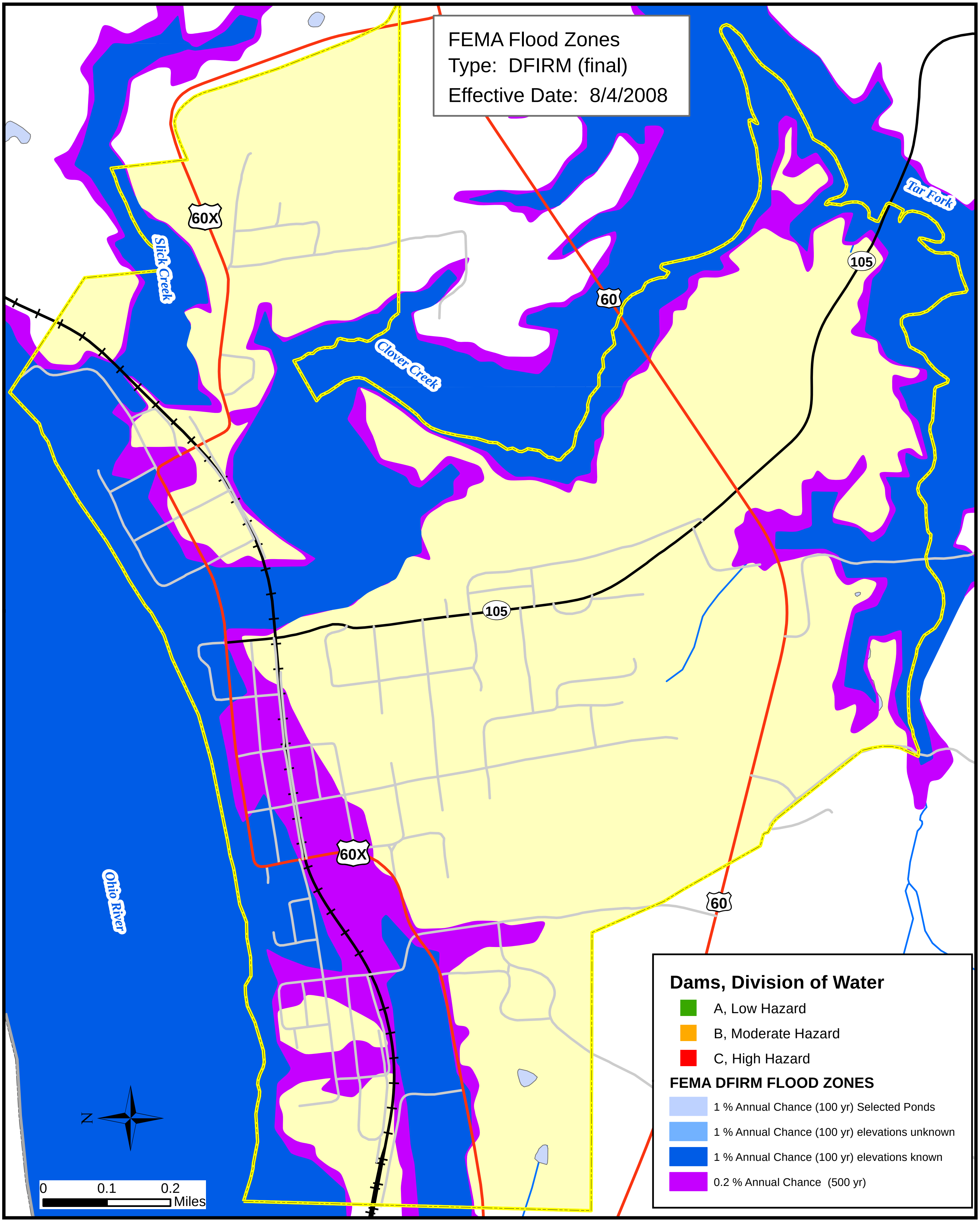
45 FLOOD/FLASHFLOOD event(s) were recorded between 1967 and 6/30/2009 by SHELDUS and the NCDC.

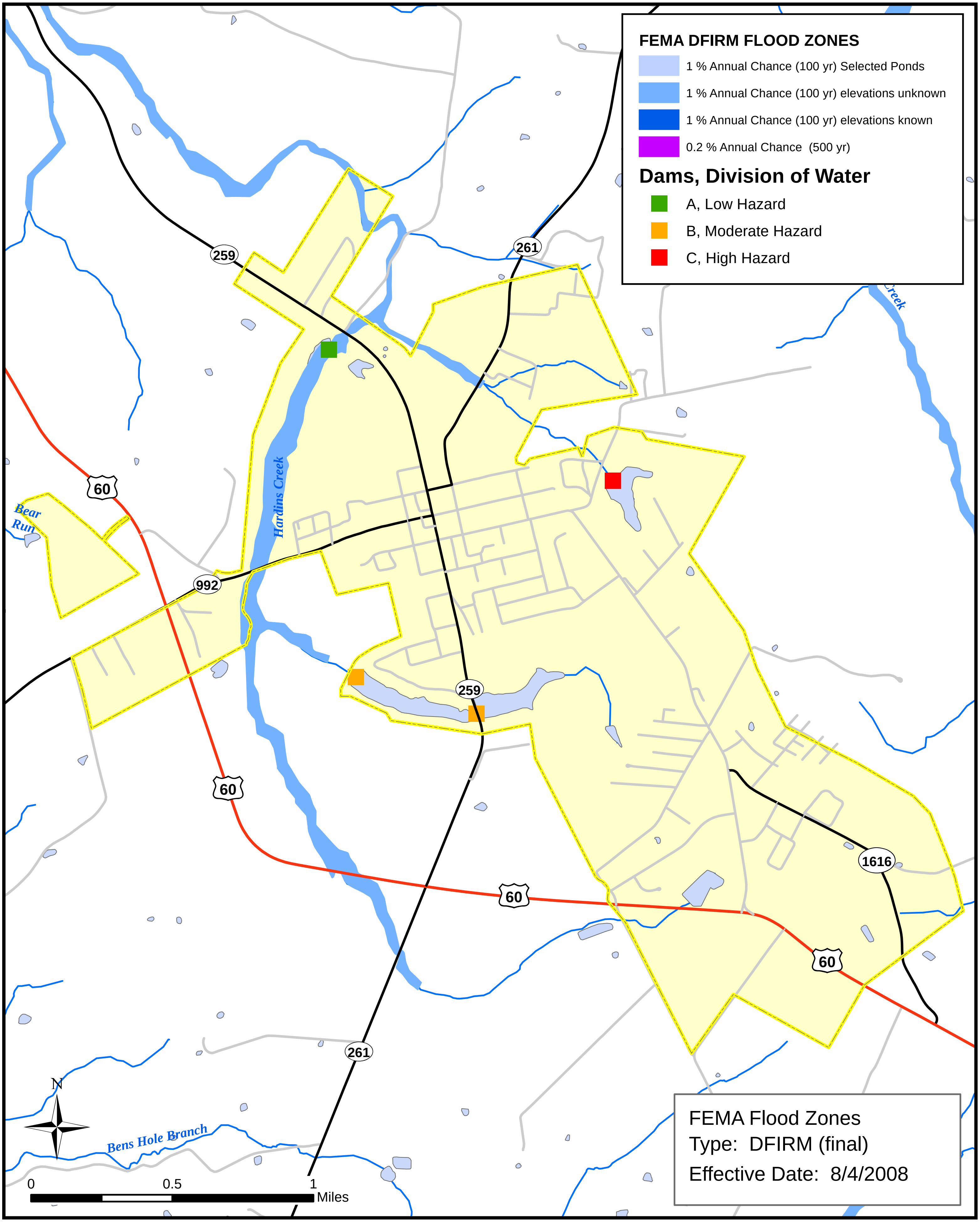
There have been an additional 8 FLOOD/FLASHFLOOD events recorded from 7/1/2009 through 6/30/2015 in NCEI.

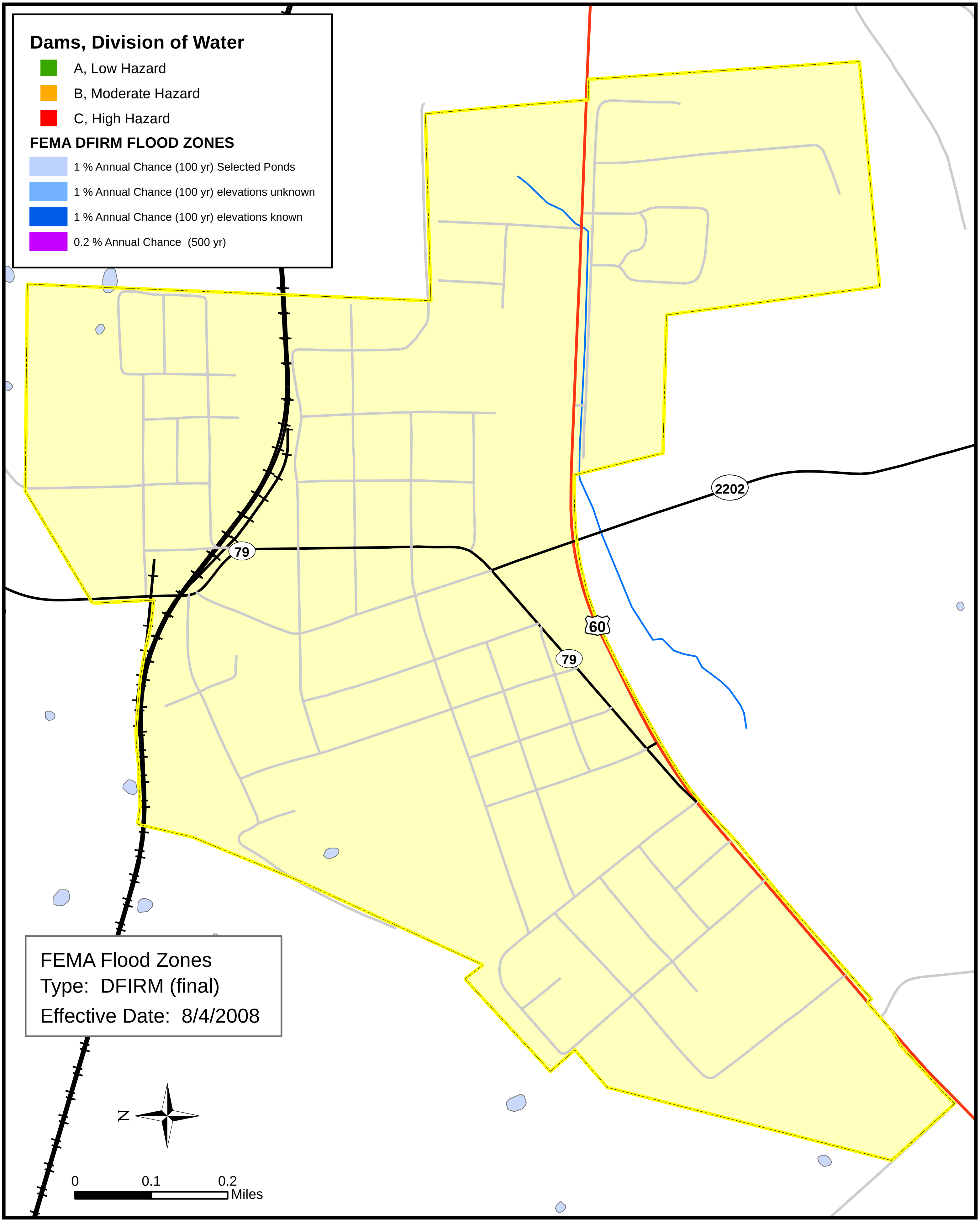
LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
WEBSTER	5/2/2010	0	0	0	0
CORNERS	4/23/2011	0	0	0	0
BIG SPG	4/24/2011	0	0	0	0
IRVINGTON	12/21/2013	0	0	0	0
MYSTIC	12/22/2013	0	0	0	0
BRECKINRIDGE	3/4/2015	0	0	0	0
BRECKINRIDGE	4/3/2015	0	0	0	0
BRECKINRIDGE	4/7/2015	0	0	0	0

BRECKINRIDGE COUNTY
FLOODING




FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/4/2008
60X
60
105
Slick Creek
Clover Creek
Tar Fork
Ohio River
N
0 0.1 0.2
Miles
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)


FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
259
261
60
992
1616
Hardins Creek
Bear Run
Bens Hole Branch
Creek
N
0
0.5
1
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/4/2008


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
79
2202
60
79
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/4/2008
N
0
0.1
0.2
Miles

GRAYSON

41 FLOOD/FLASHFLOOD event(s) were recorded between 1967 and 6/30/2009 by SHELDUS and the NCDC.

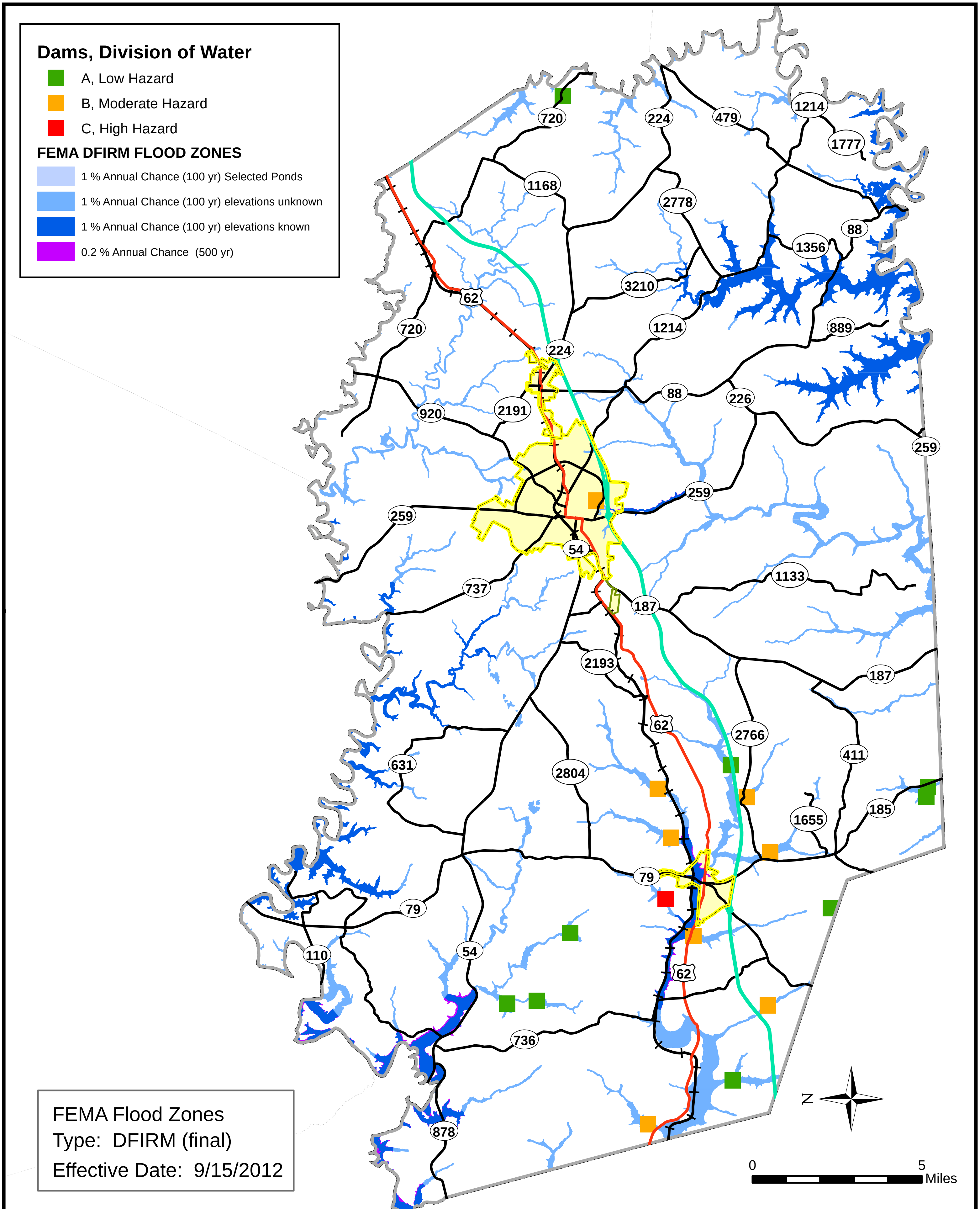
There have been an additional 5 FLOOD/FLASHFLOOD events recorded from 7/1/2009 through 6/30/2015 in NCEI.

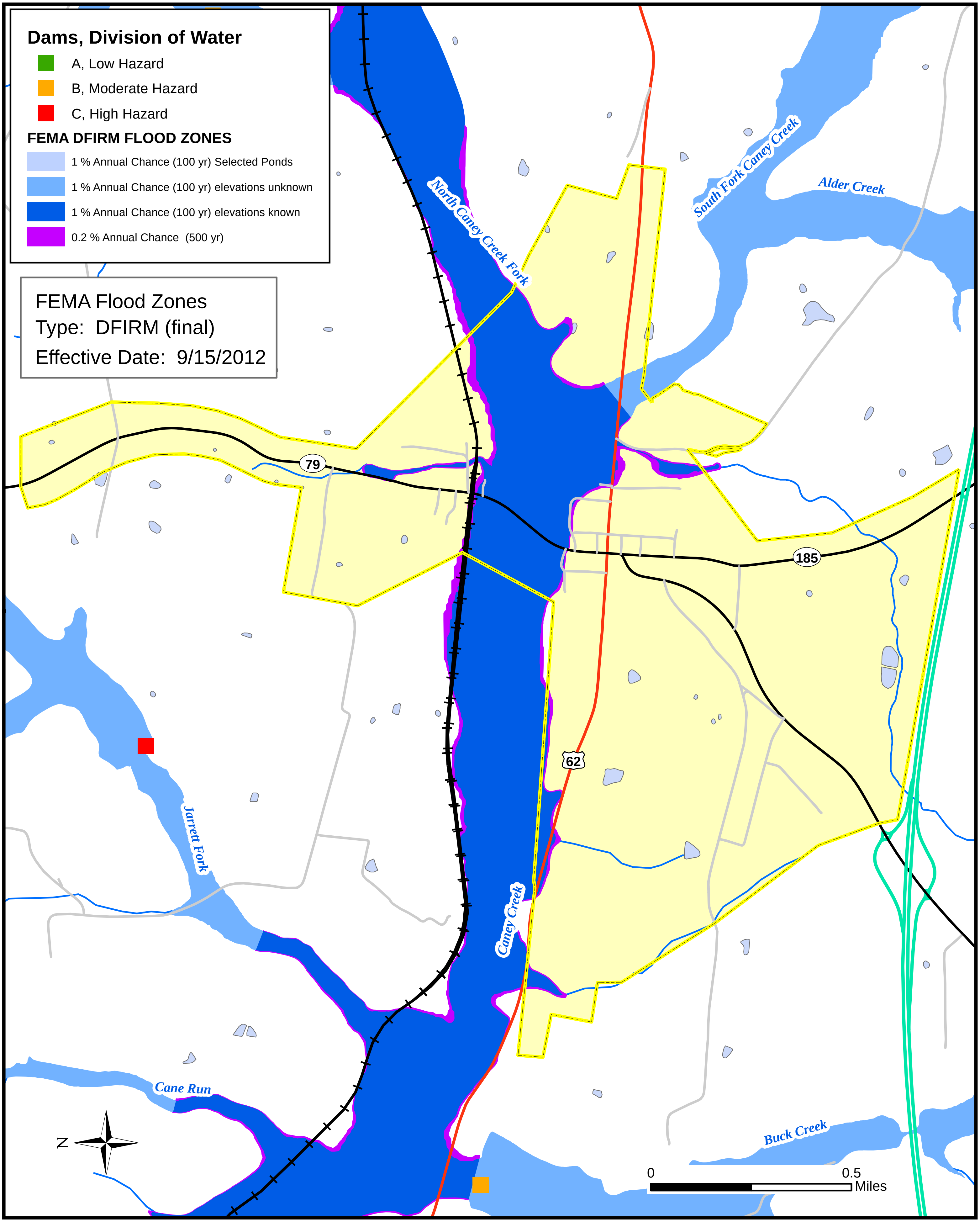
LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
SPRING LICK	5/2/2010	0	0	0	0
SPRING LICK	7/21/2010	0	0	0	0
LEITCHFIELD	8/12/2010	0	0	0	0
READY	6/27/2011	0	0	5000	0
LEITCHFIELD	12/21/2013	0	0	0	0

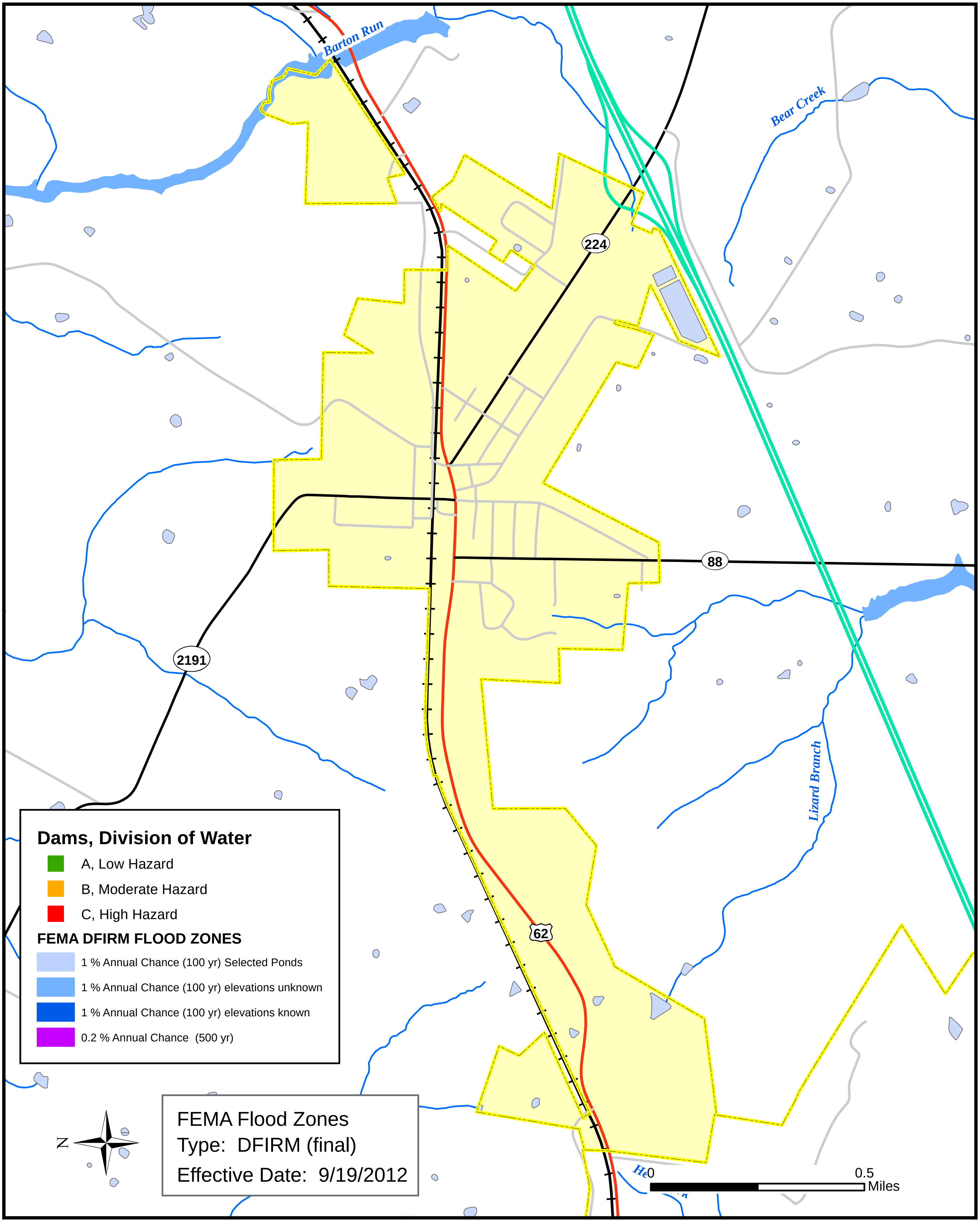
Road Washout in Grayson County, May 8, 2009.

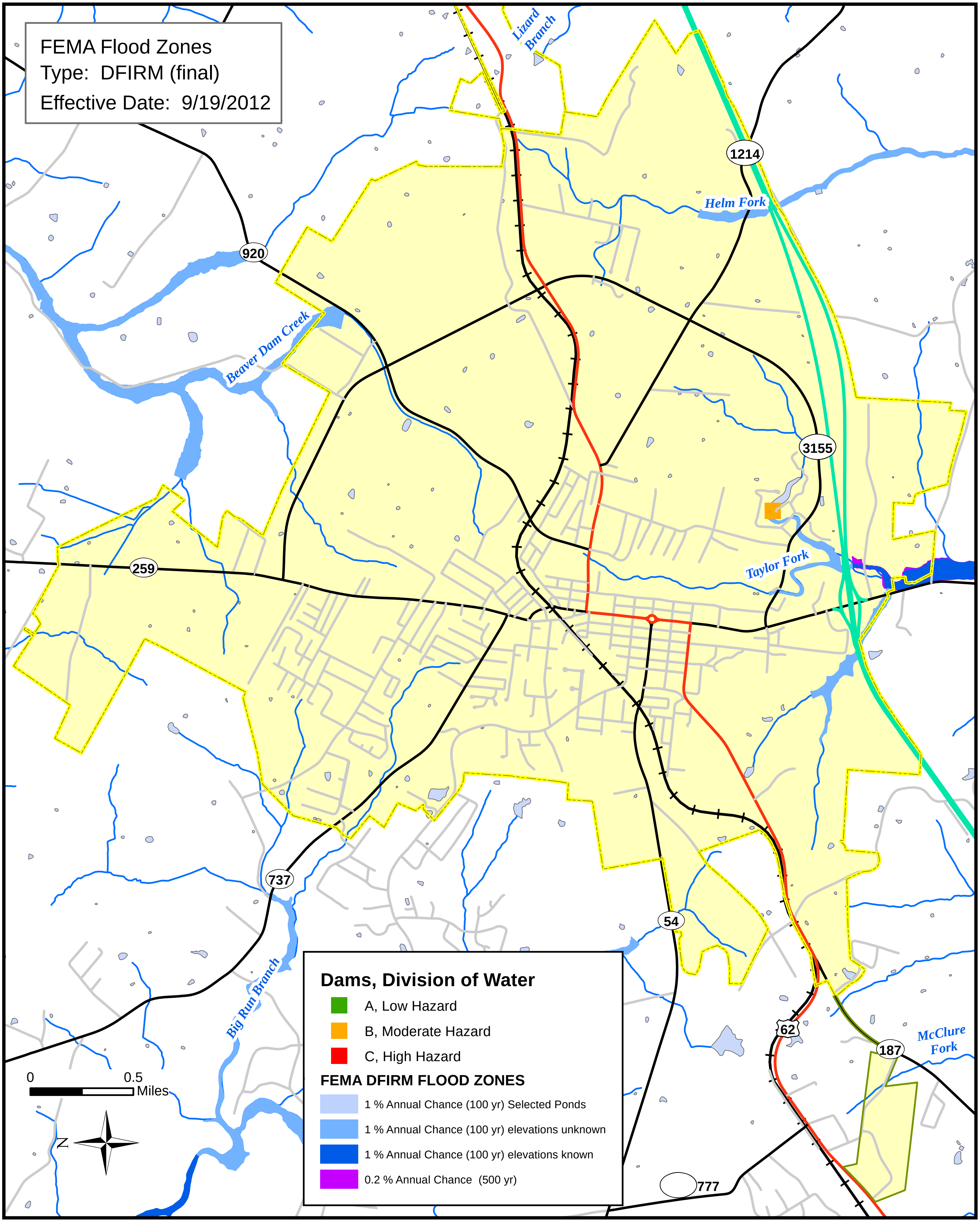
Flooded cornfield, Grayson County June 15 2009.

LTADD Archives.


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
720
224
479
1214
1777
1168
2778
88
1356
3210
62
720
1214
889
224
88
226
920
2191
259
259
259
54
1133
737
187
2193
187
62
2766
411
631
2804
185
1655
79
79
110
54
62
736
878
N
0
5
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 9/15/2012


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 9/15/2012
North Caney Creek Fork
South Fork Caney Creek
Alder Creek
79
185
62
Jarrett Fork
Caney Creek
Cane Run
Buck Creek
N
0
0.5
Miles


Barton Run
Bear Creek
Lizard Branch
224
88
2191
62
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 9/19/2012
N
0
0.5
Miles


FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 9/19/2012
Lizard Branch
1214
Helm Fork
920
Beaver Dam Creek
3155
Taylor Fork
259
737
54
Big Run Branch
62
187
McClure Fork
777
0
0.5
Miles
N
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)

HARDIN

53 FLOOD/FLASHFLOOD event(s) were recorded between 1967 and 6/30/2009 by SHELDUS and the NCDC.

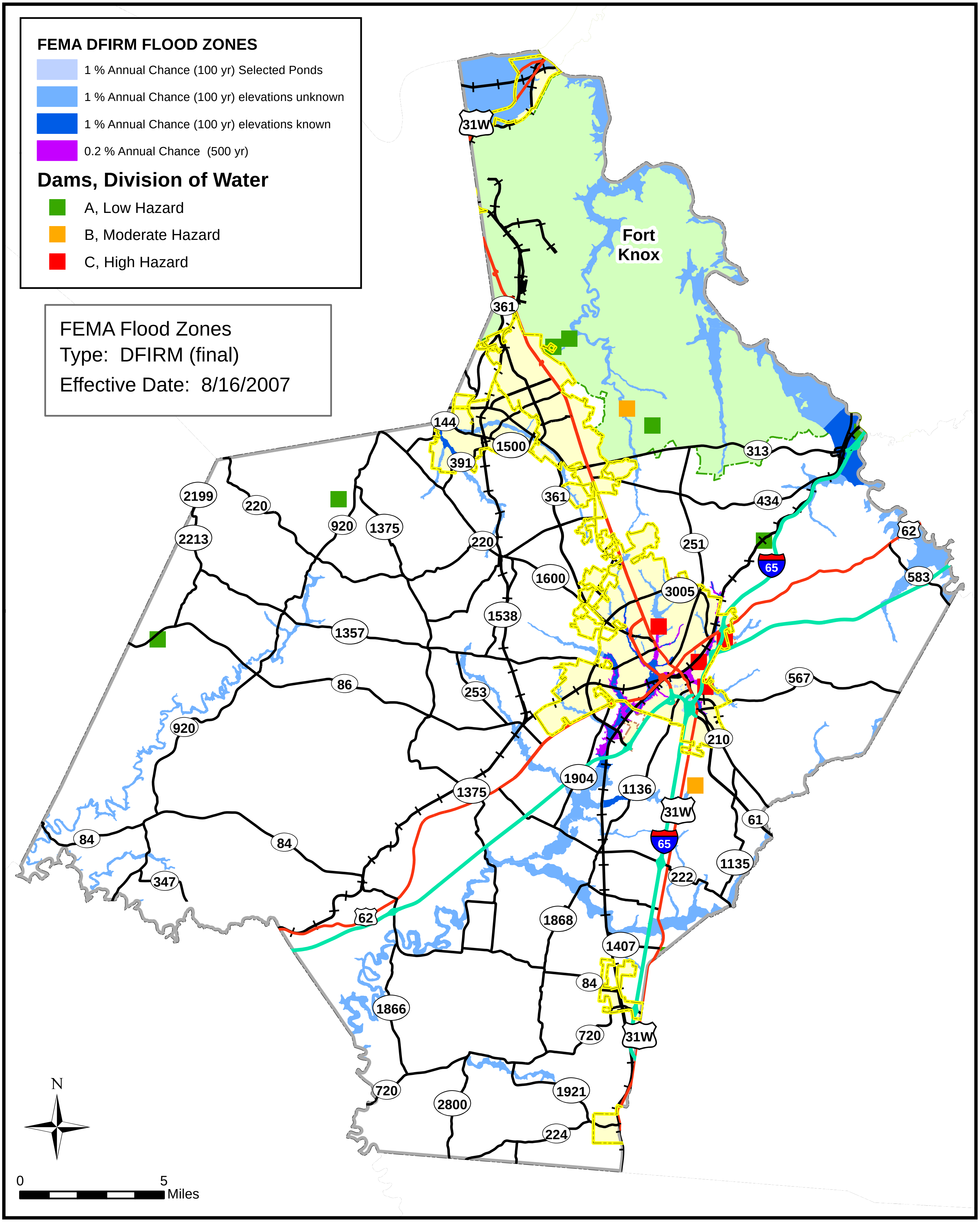
There have been an additional 16 FLOOD/FLASHFLOOD events recorded from 7/1/2009 through 6/30/2015 in NCEI.

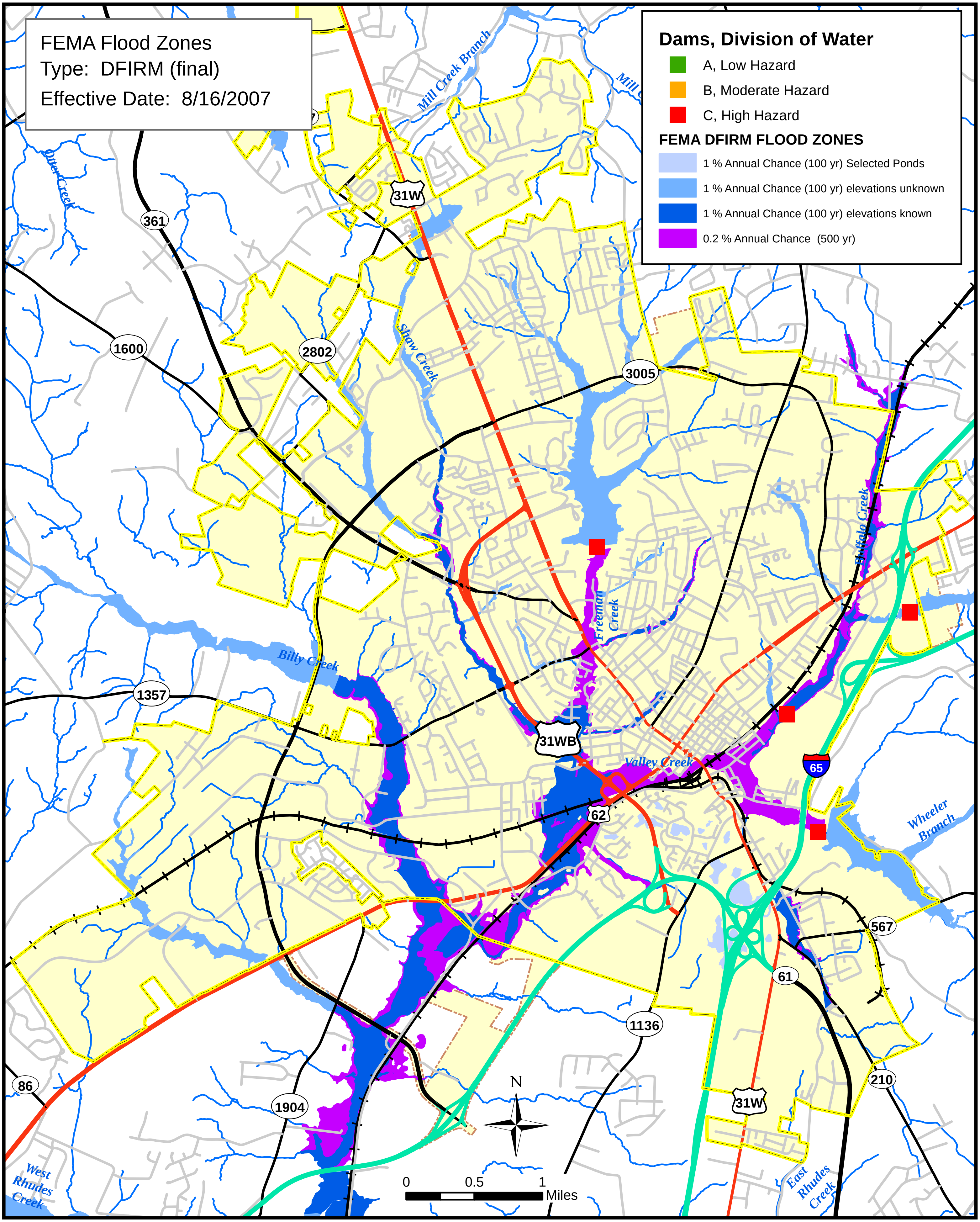
LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
ROGERSVILLE	9/20/2009	0	0	0	0
ELIZABETH TOWN ARPT	9/20/2009	0	0	0	0
TUNNEL HILL	5/2/2010	0	0	0	0
MARTIN BOX	4/12/2011	0	0	0	0
OLD STEPHENSBURG	4/23/2011	0	0	0	0
LONG VIEW	4/23/2011	0	0	0	0
STAR MILLS	4/27/2011	0	0	0	0
ELIZABETH TOWN	5/3/2011	0	0	0	0
ELIZABETH TOWN	7/24/2011	0	0	0	0
RINEYVILLE	7/24/2011	0	0	0	0
ELIZABETH TOWN	8/5/2012	0	0	0	0
RINEYVILLE	8/5/2012	0	0	0	0
CECILIA	8/5/2012	0	0	0	0
MARTIN BOX	8/5/2012	0	0	5000	0
GLENDALE	12/22/2013	0	0	0	0
ELIZABETH TOWN	8/23/2014	0	0	0	0

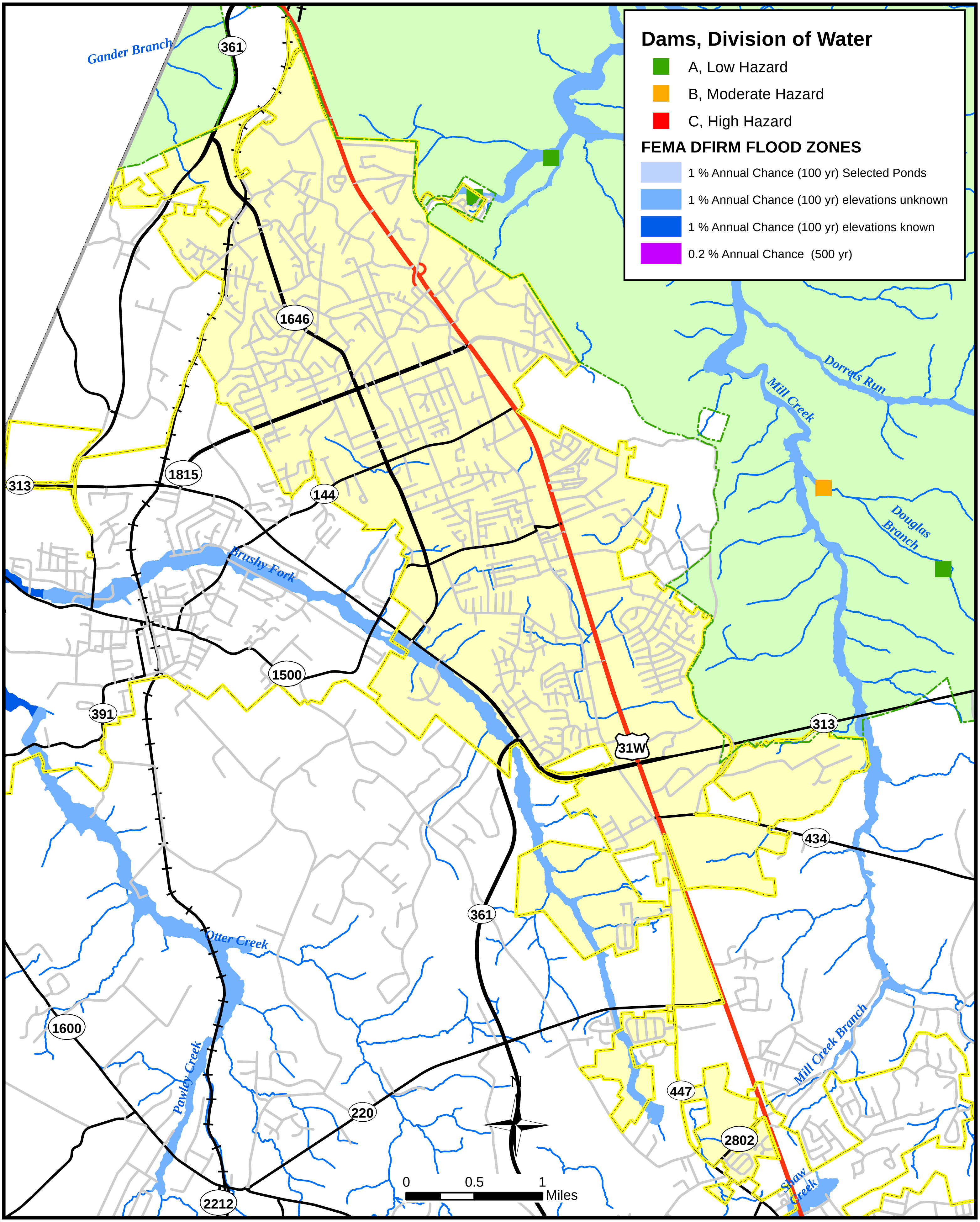
Flood damage in Vine Grove parks, Spring 2008. *Photos courtesy of City of Vine Grove.*

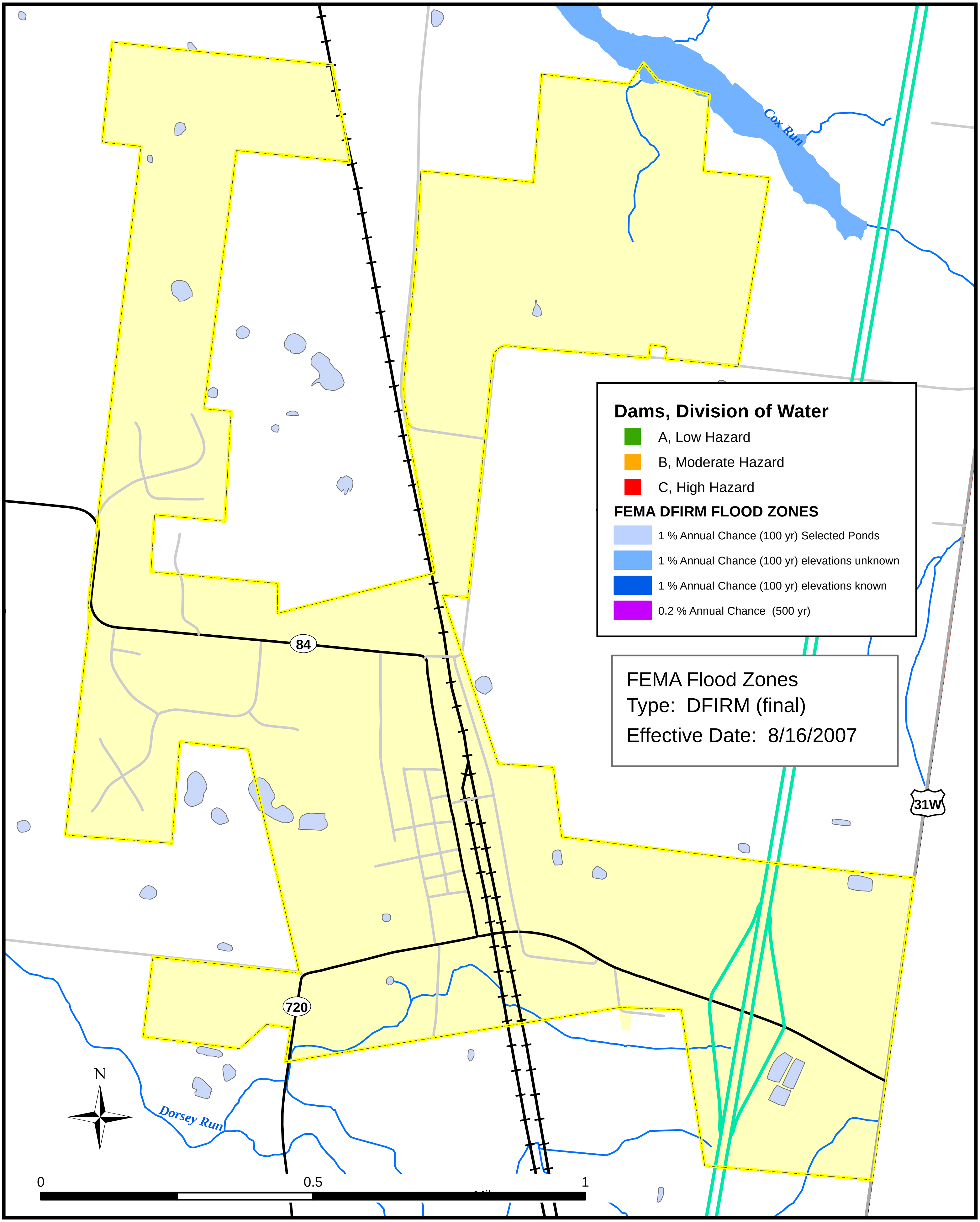
2011 Flooding in Vine Grove - Cars under water. *Photo courtesy of the City of Vine Grove*

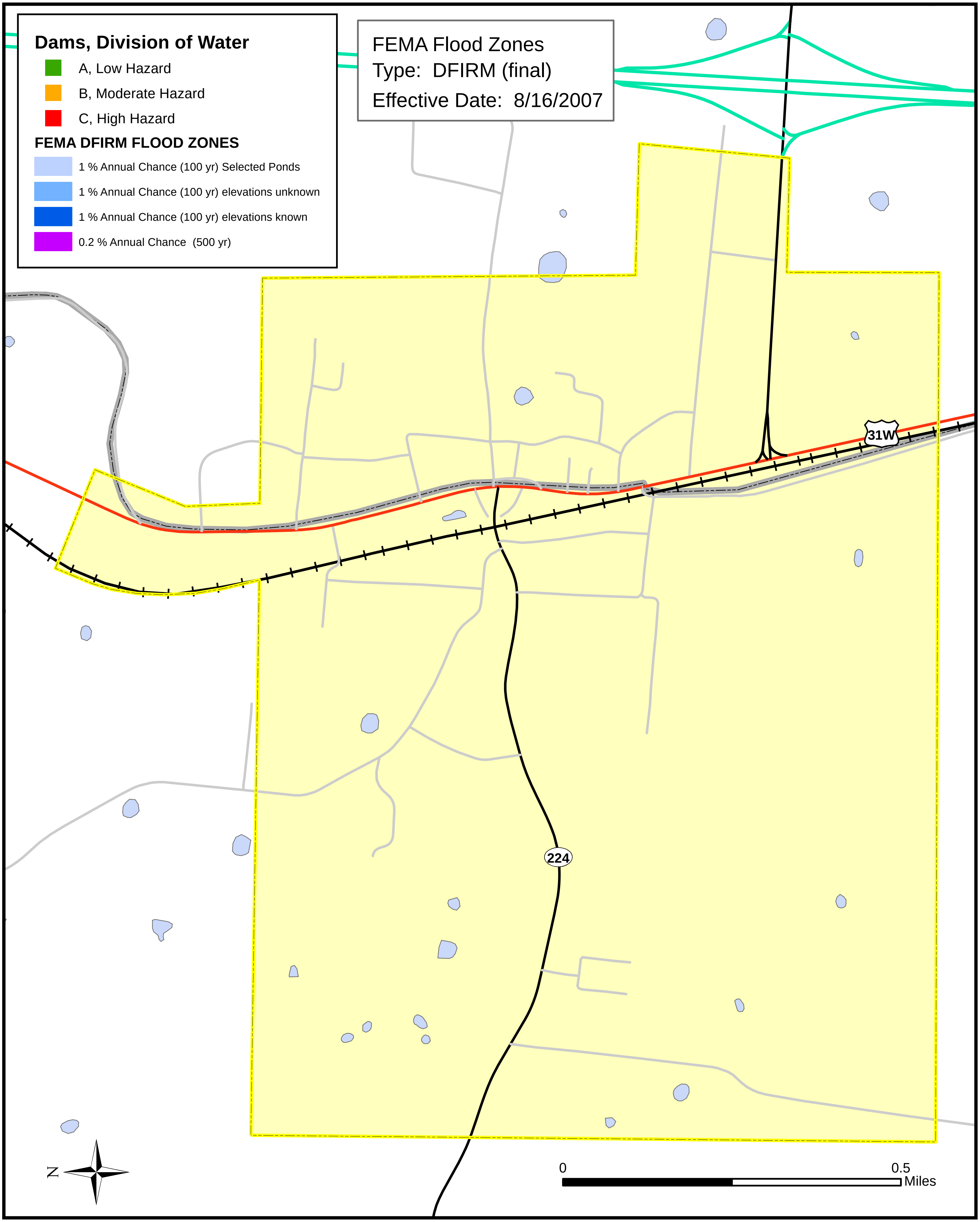
2011 Flooding in Vine Grove - Zoom of previous photo. *Photo courtesy of the City of Vine Grove*

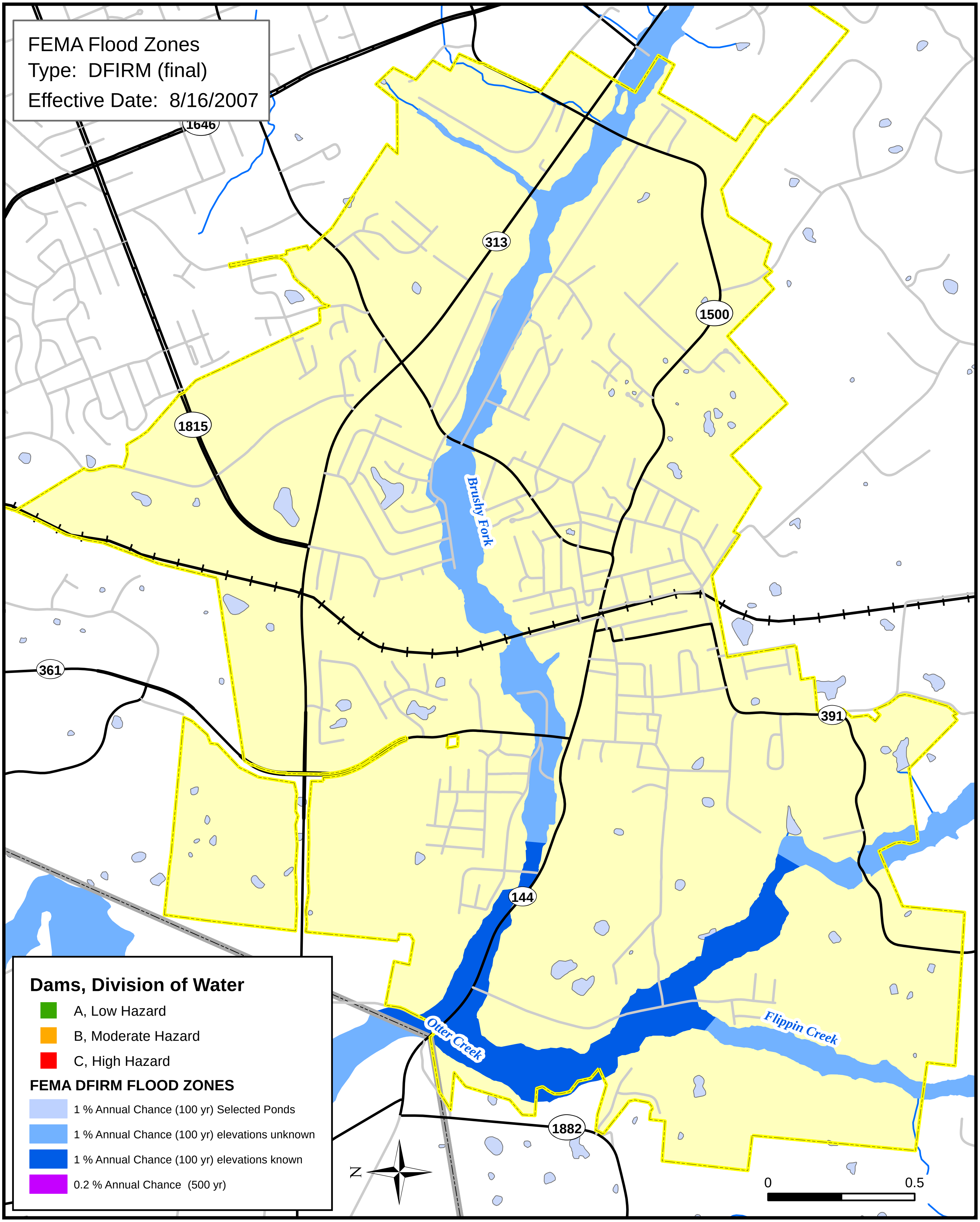

FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/16/2007
Fort Knox
N
0
5
Miles

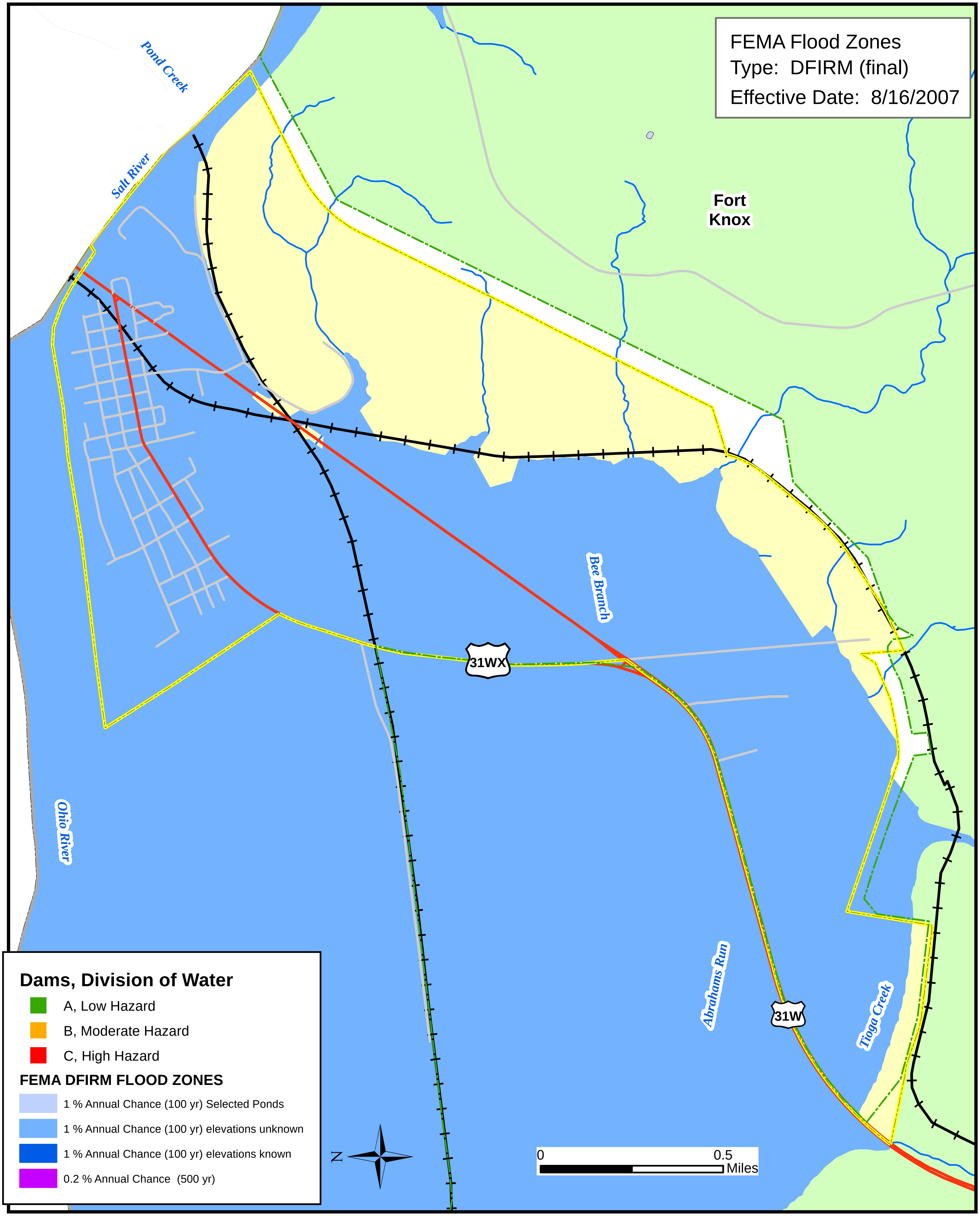

FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/16/2007
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
Mill Creek Branch
Otter Creek
Shaw Creek
Billy Creek
Freeman Creek
Valley Creek
Buffalo Creek
Wheeler Branch
West Rhudes Creek
East Rhudes Creek
31W
361
1600
2802
3005
1357
31WB
62
65
567
61
1136
86
1904
210
N
0
0.5
1
Miles


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
Gander Branch
361
1646
1815
313
144
Brushy Fork
1500
391
Dorretts Run
Mill Creek
Douglas Branch
313
31W
434
361
Otter Creek
1600
Pawley Creek
220
2212
447
2802
Mill Creek Branch
Shaw Creek
0
0.5
1
Miles
N


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/16/2007
Cox Run
Dorsey Run
84
720
31W
N
0
0.5
1


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/16/2007
31W
224
N
0
0.5
Miles


FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/16/2007
1646
313
1500
1815
361
391
144
1882
Brushy Fork
Otter Creek
Flippin Creek
N
0
0.5
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)

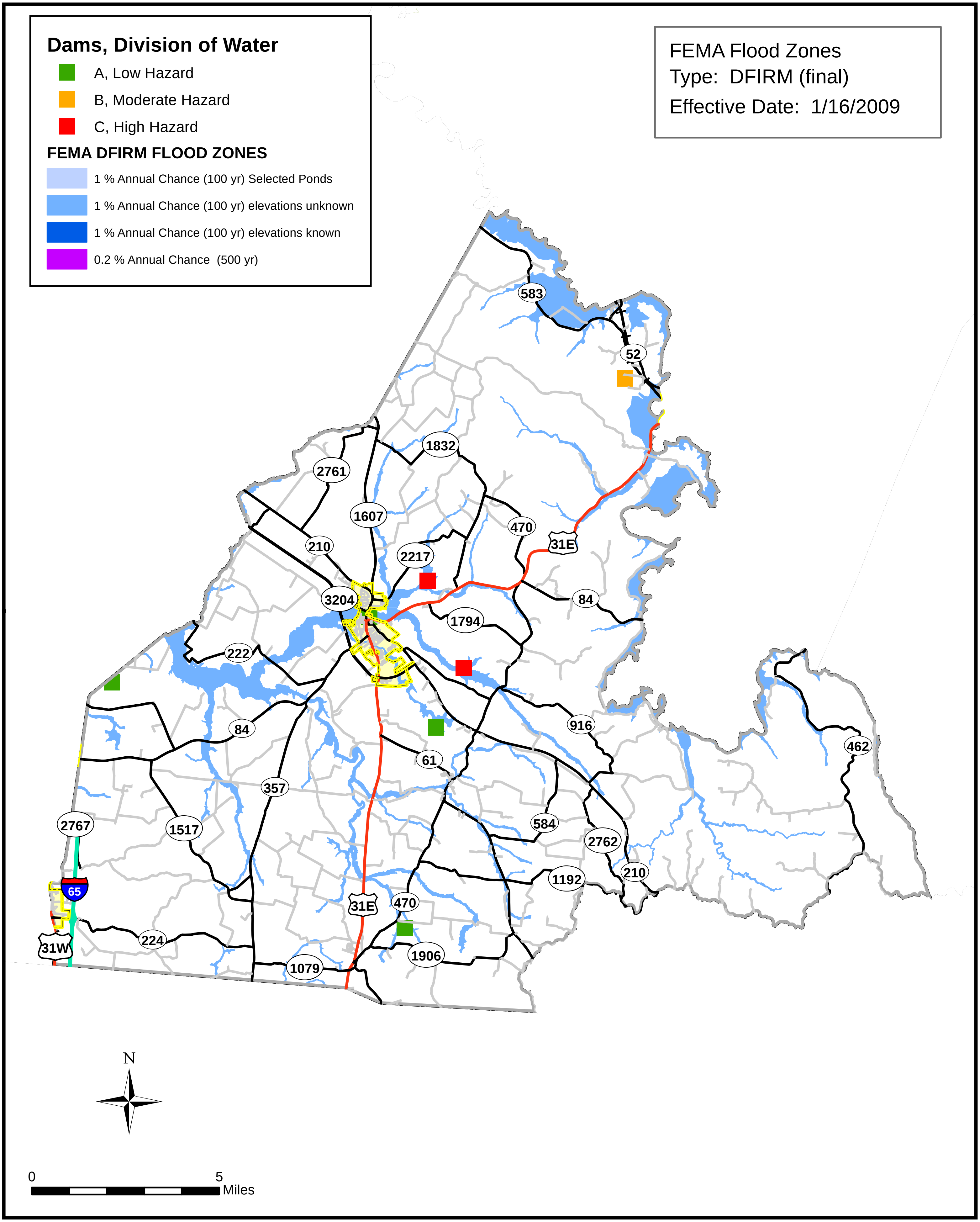

FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 8/16/2007
Pond Creek
Salt River
Fort Knox
Bee Branch
31WX
Ohio River
Abrahams Run
31W
Tioga Creek
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
N
0
0.5
Miles

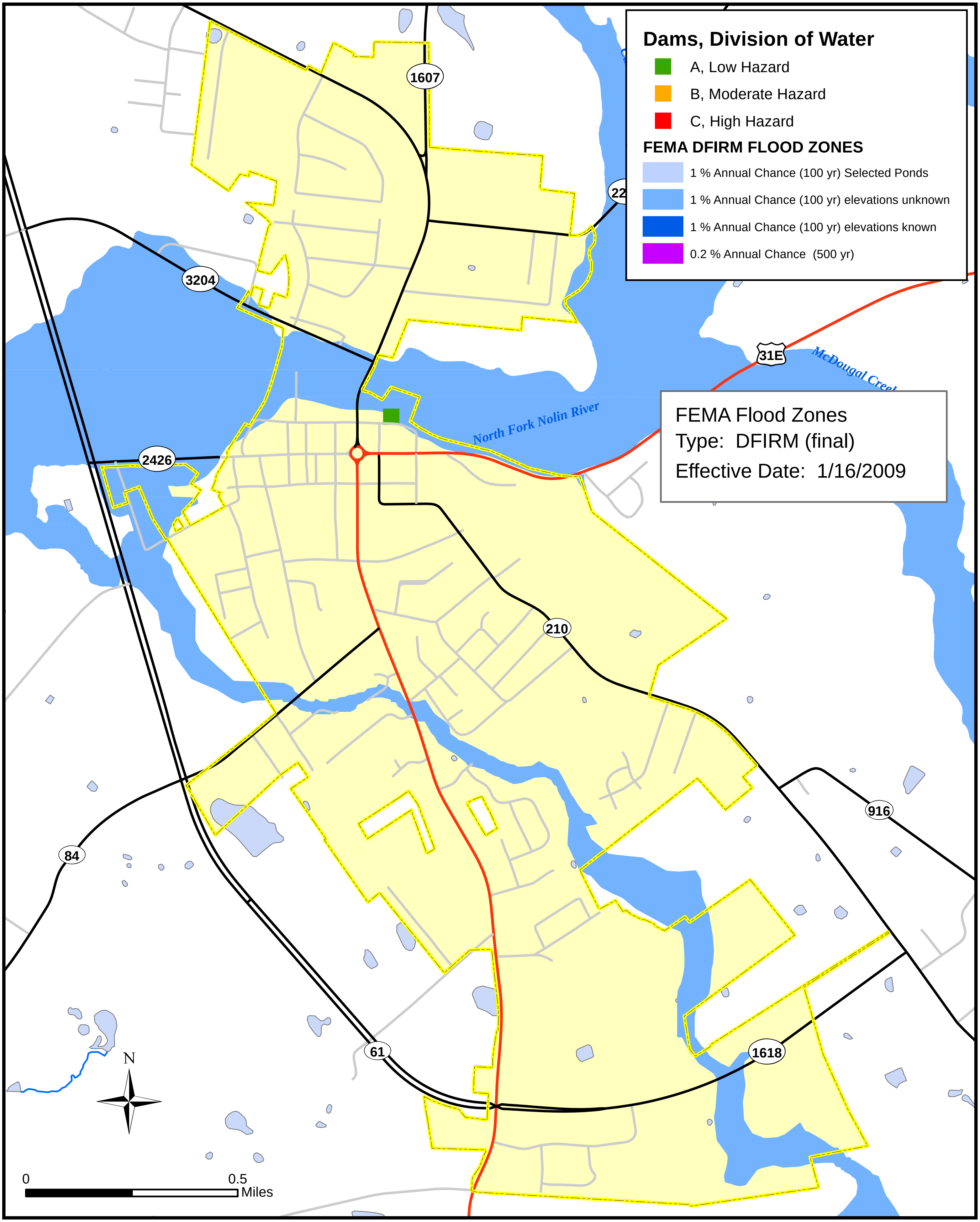
LARUE
32 FLOOD/FLASHFLOOD event(s) were recorded between 1967 and 6/30/2009 by SHELDUS and the NCDC.

There have been an additional 5 FLOOD/FLASHFLOOD events recorded from 7/1/2009 through 6/30/2015 in NCEI.

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
GATTON	5/2/2010	0	0	0	0
HODGENVILLE	4/12/2011	0	0	0	0
TANNER	4/17/2013	0	0	0	0
KEMP	4/3/2014	0	0	0	0
LARUE	3/4/2015	0	0	0	0


Flooding in Hodgenville. *Photo courtesy of City of Hodgenville.*


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 1/16/2009
583
52
1832
2761
1607
470
31E
210
2217
3204
84
1794
222
916
84
462
61
357
584
2767
1517
2762
210
1192
65
31E
470
224
1906
31W
1079
N
0
5
Miles


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 1/16/2009
North Fork Nolin River
McDougal Creek
1607
3204
2426
31E
210
916
84
61
1618
N
0
0.5
Miles

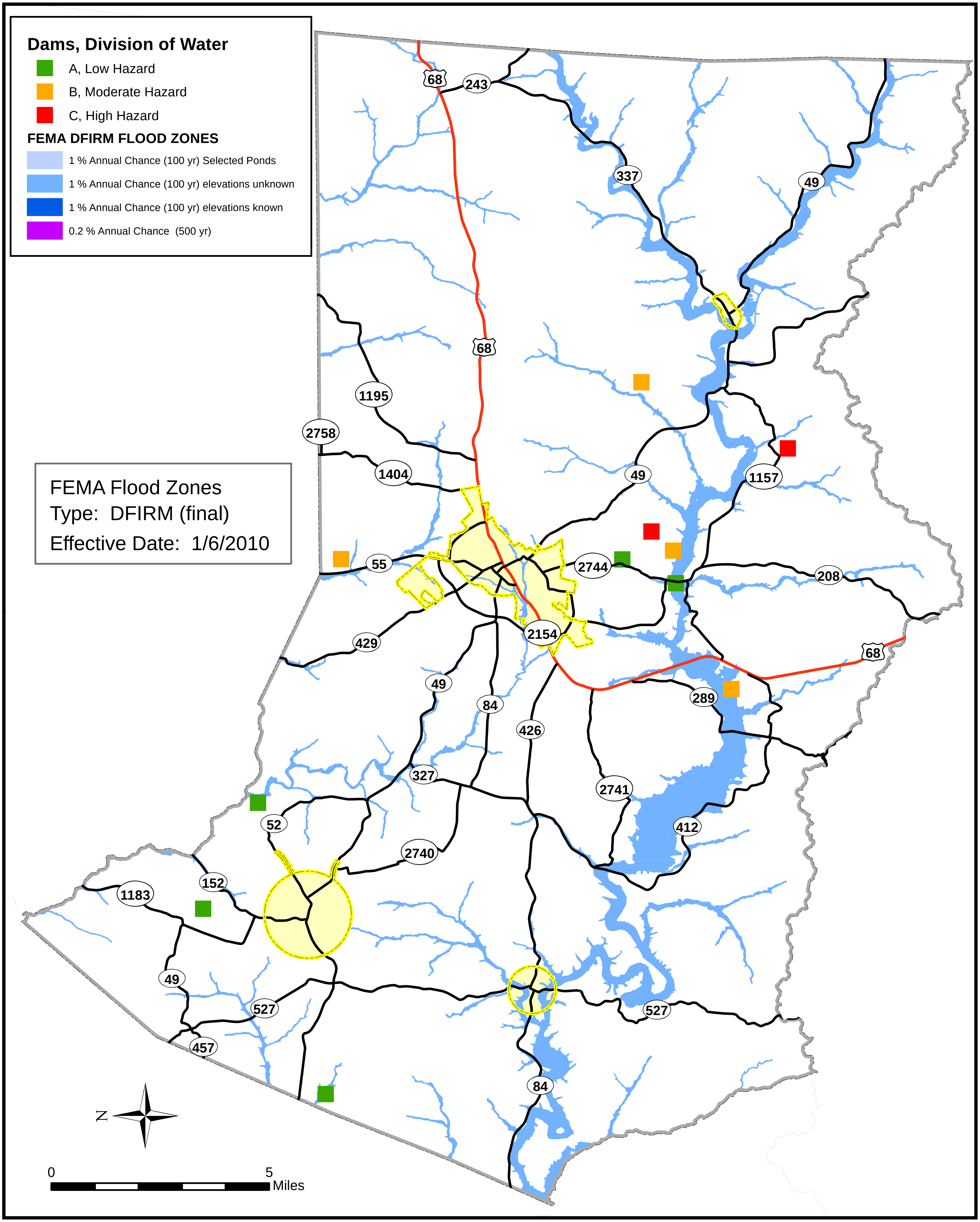
MARION

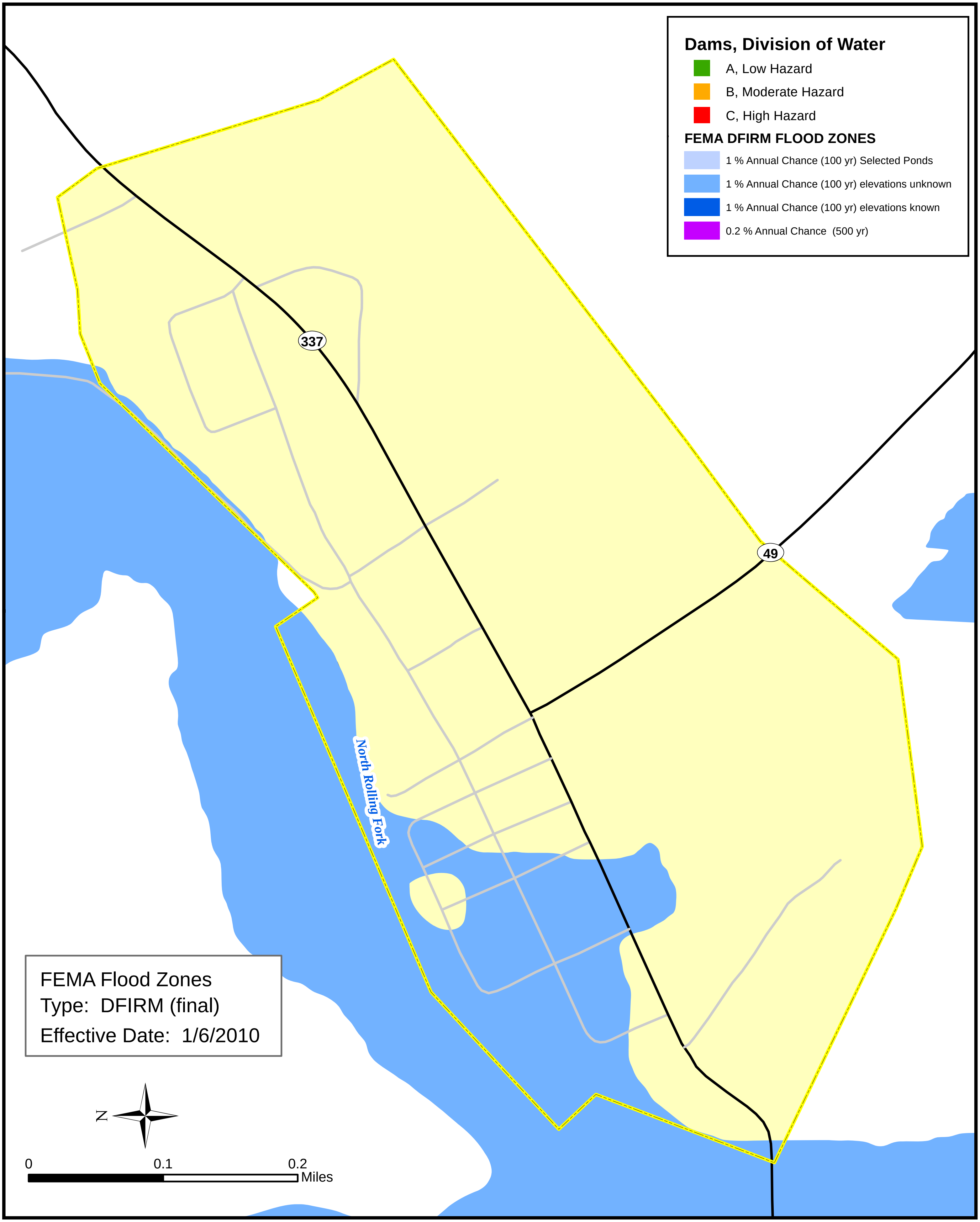
37 FLOOD/FLASHFLOOD event(s) were recorded between 1967 and 6/30/2009 by SHELDUS and the NCDC.

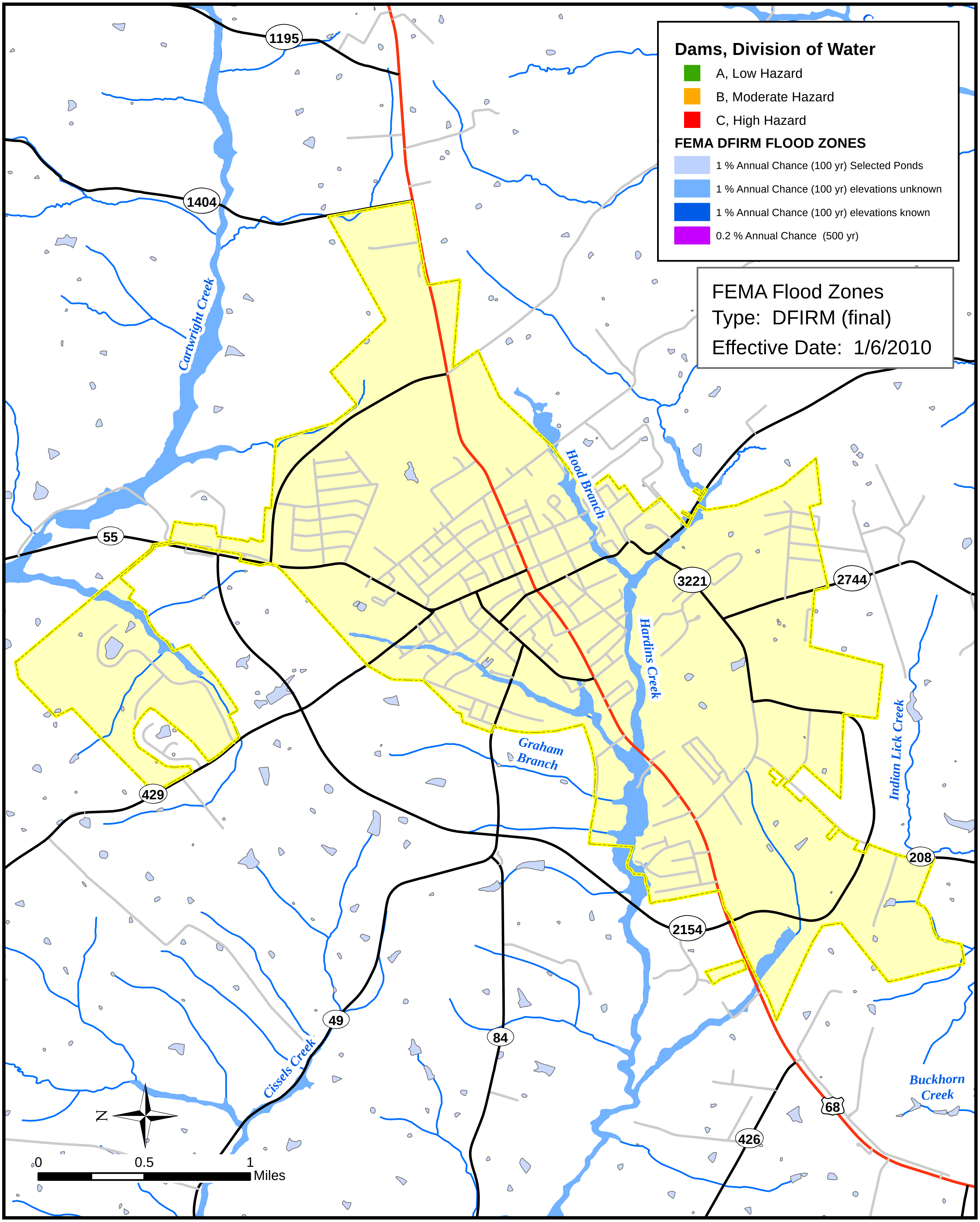
There have been an additional 7 FLOOD/FLASHFLOOD events recorded from 7/1/2009 through 6/30/2015 in NCEI.

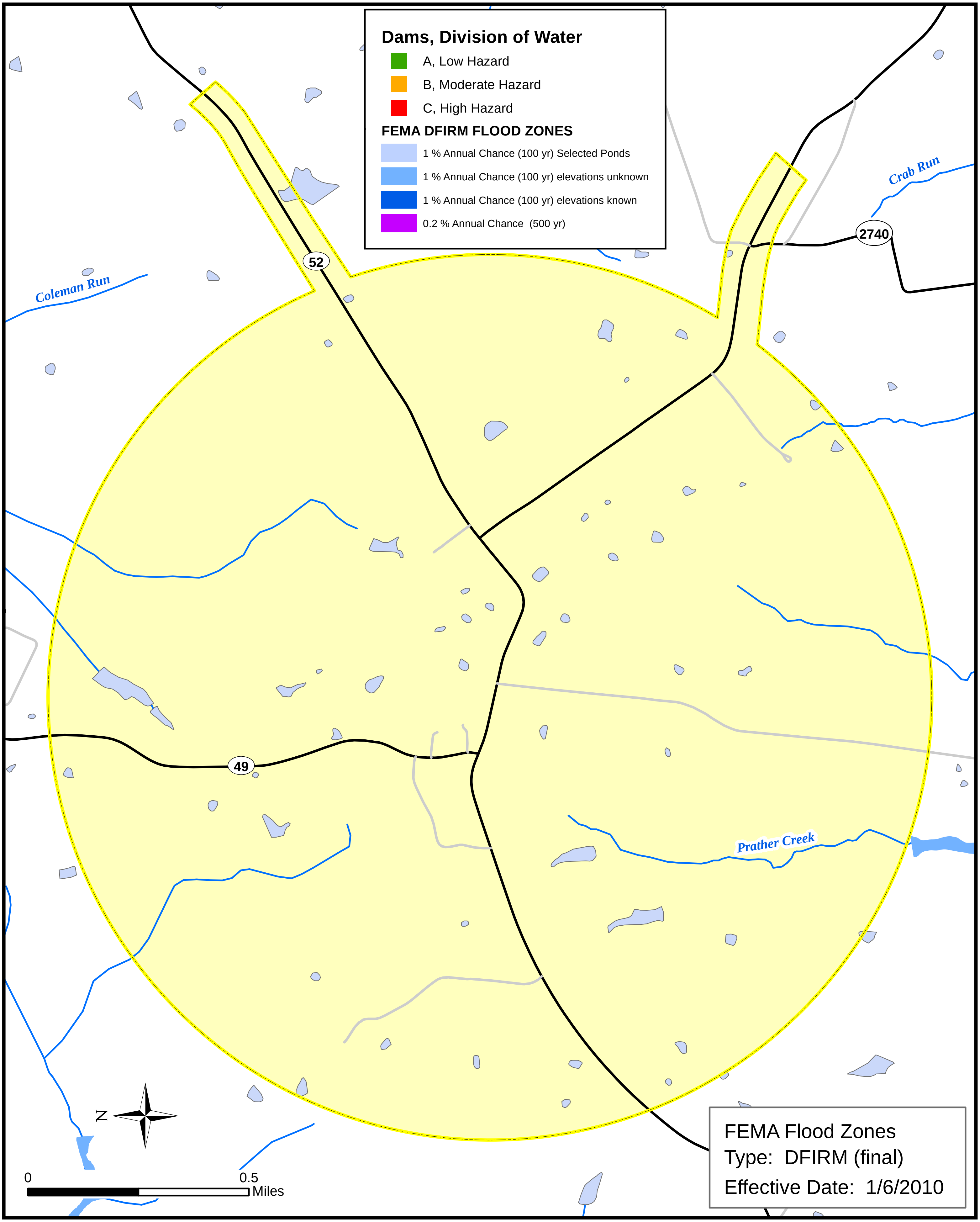
LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
PENICKS	9/21/2009	0	0	0	0
CALVARY	9/21/2009	0	0	0	0
RAYWICK	5/2/2010	0	0	2000	0
CALVARY	11/28/2011	0	0	0	0
LEBANON	6/17/2013	0	0	20000	0
LEBANON	8/11/2014	0	0	50000	0
MARION	3/4/2015	0	0	0	0

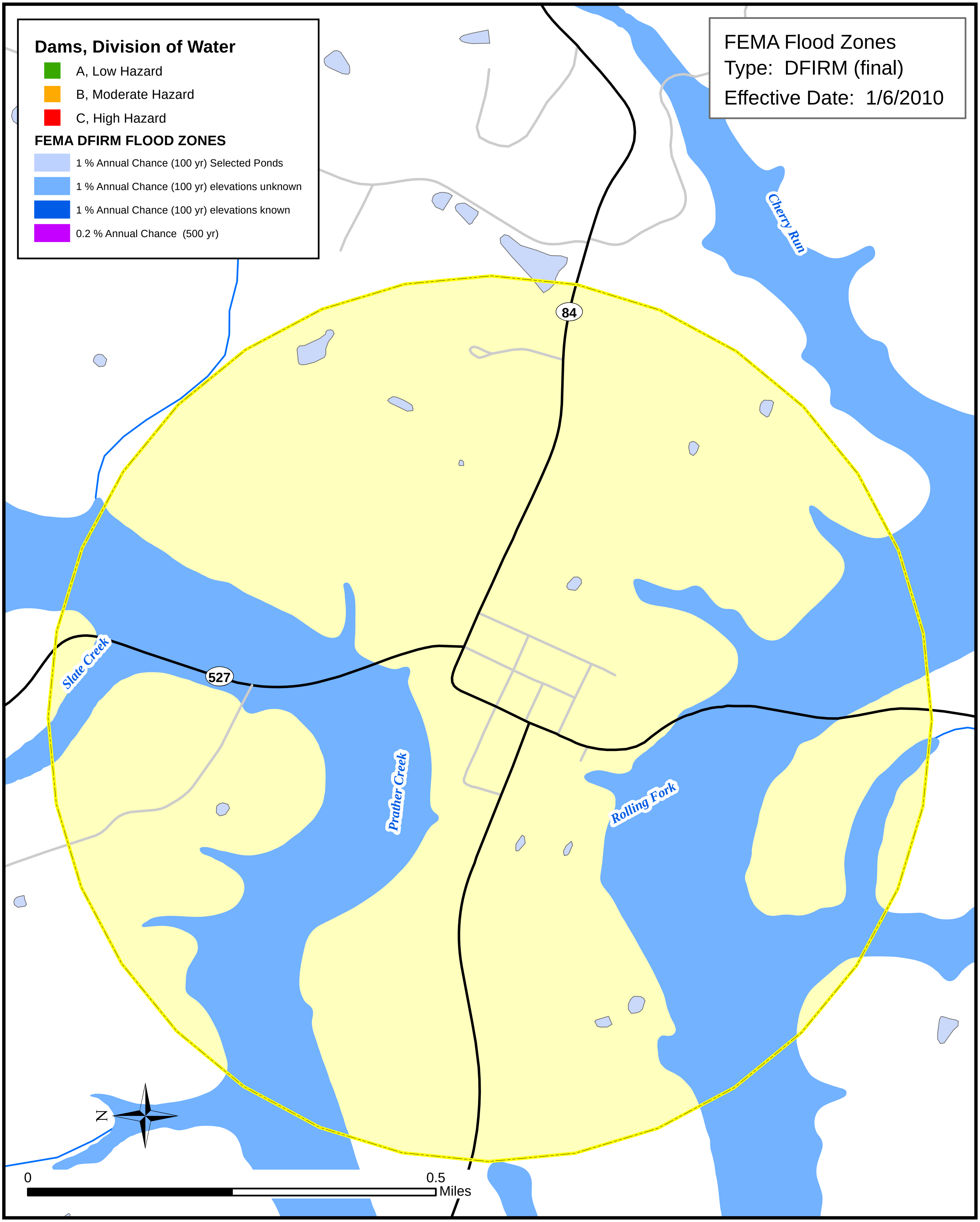
Bradfordsville, North Rolling Fork Flooding, March 2015, *Photo: David Edelen.*


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 1/6/2010
68
243
337
49
68
1195
2758
1404
49
1157
55
2744
208
2154
429
68
49
84
289
426
327
2741
412
52
2740
152
1183
49
527
527
457
84
N
0
5
Miles


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
337
49
North Rolling Fork
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 1/6/2010
N
0
0.1
0.2
Miles


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 1/6/2010
1195
1404
55
429
3221
2744
208
2154
49
84
68
426
Cartwright Creek
Hood Branch
Hardins Creek
Graham Branch
Indian Lick Creek
Cissels Creek
Buckhorn Creek
N
0
0.5
1
Miles


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
Coleman Run
Crab Run
2740
52
49
Prather Creek
N
0
0.5
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 1/6/2010

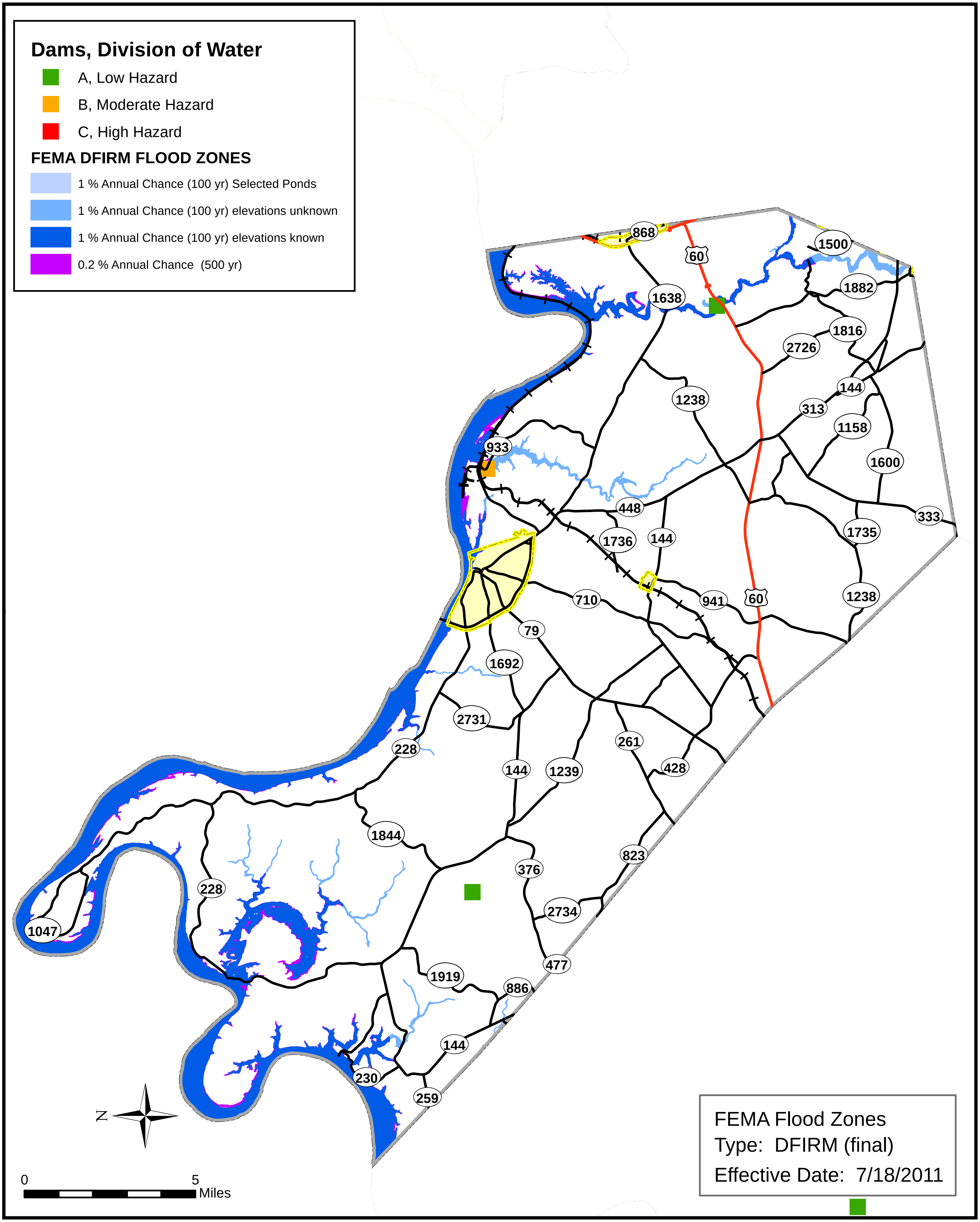

Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 1/6/2010
Cherry Run
84
Slate Creek
527
Prather Creek
Rolling Fork
N
0
0.5
Miles

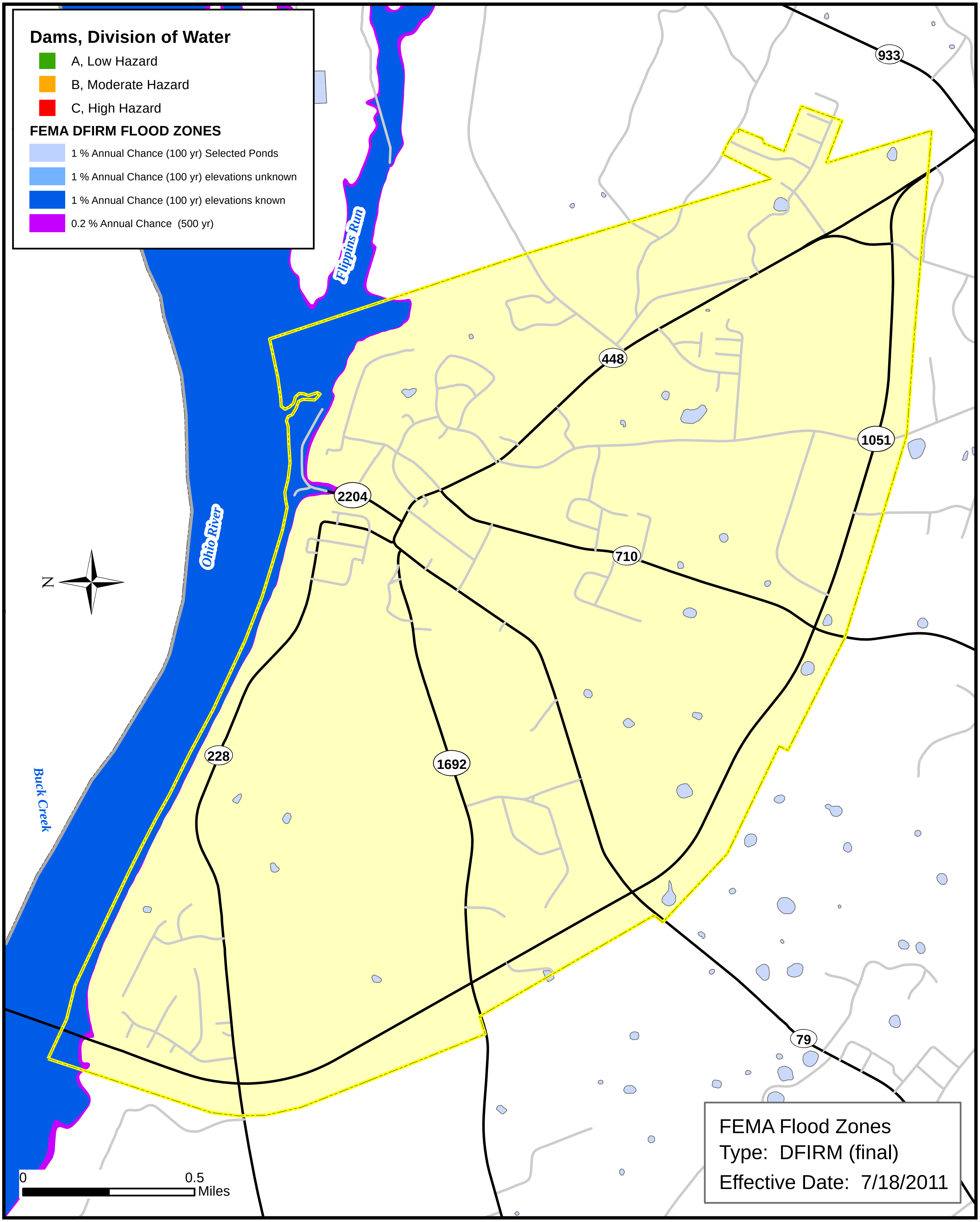
MEADE

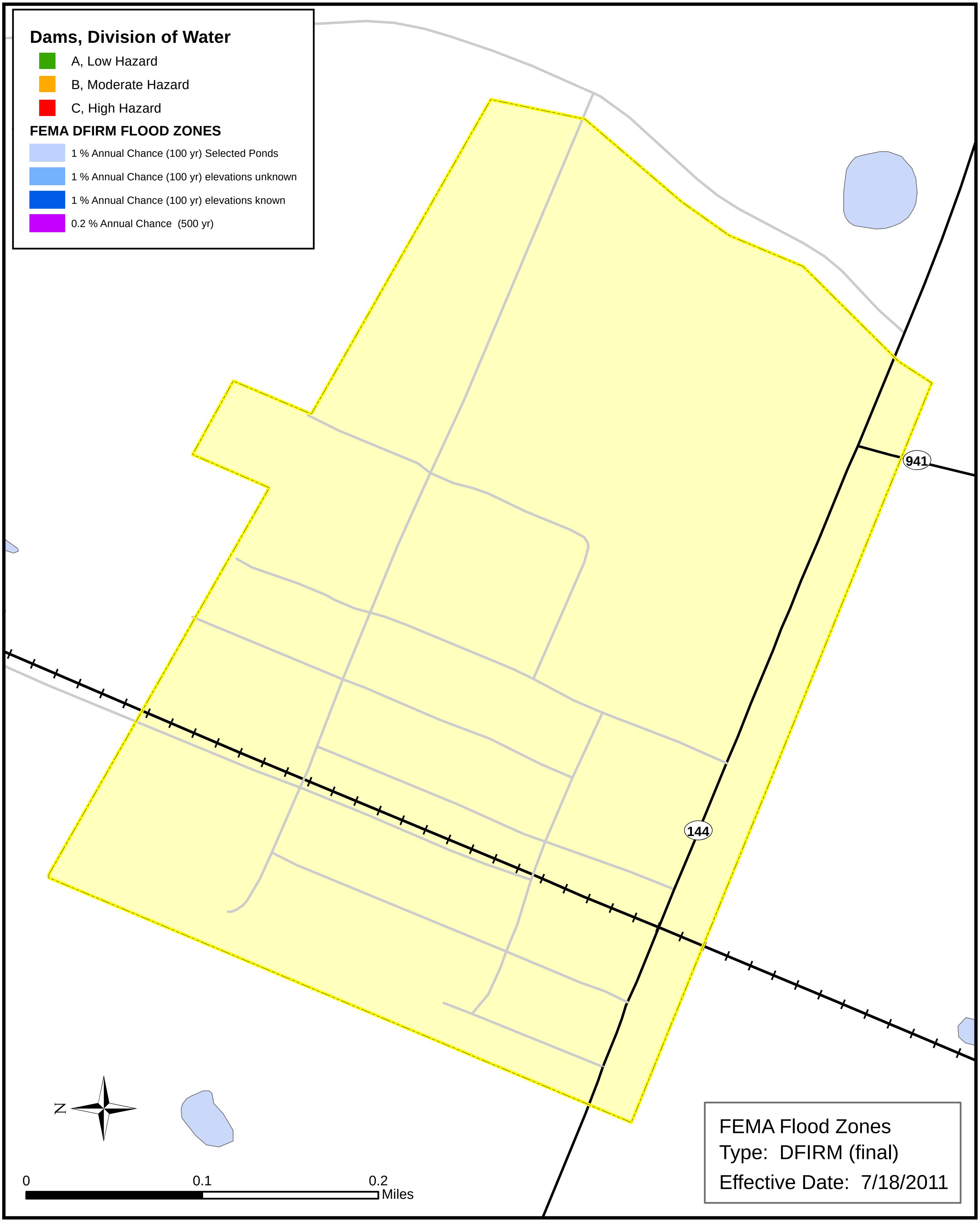
37 FLOOD/FLASHFLOOD event(s) were recorded between 1967 and 6/30/2009 by SHELDUS and the NCDC.

There have been an additional 5 FLOOD/FLASHFLOOD events recorded from 7/1/2009 through 6/30/2015 in NCEI.

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
HAYSVILLE	5/2/2010	0	0	0	0
FLAHERTY	7/12/2011	0	0	0	0
MIDWAY	7/27/2014	0	0	0	20000
BUCK GROVE	7/27/2014	0	0	0	0
MEADE	4/3/2015	0	0	0	0


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
868
60
1500
1882
1638
1816
2726
144
1238
313
1158
933
1600
448
333
1735
1736
144
710
941
60
1238
79
1692
2731
261
228
428
144
1239
1844
823
376
228
2734
1047
477
1919
886
144
230
259
N
0
5
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 7/18/2011

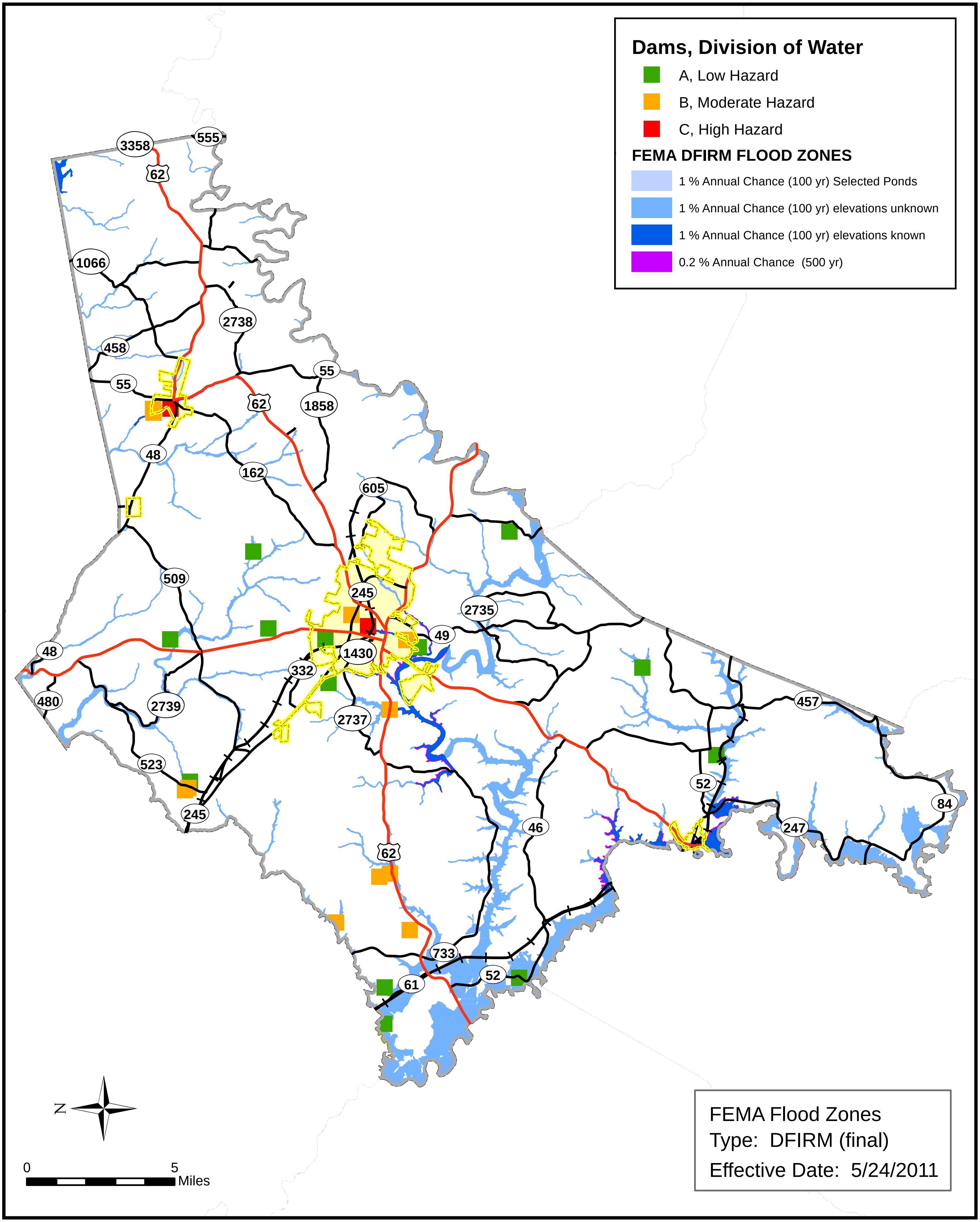

Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
Flippins Run
Ohio River
Buck Creek
N
933
448
1051
2204
710
228
1692
79
0
0.5
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 7/18/2011

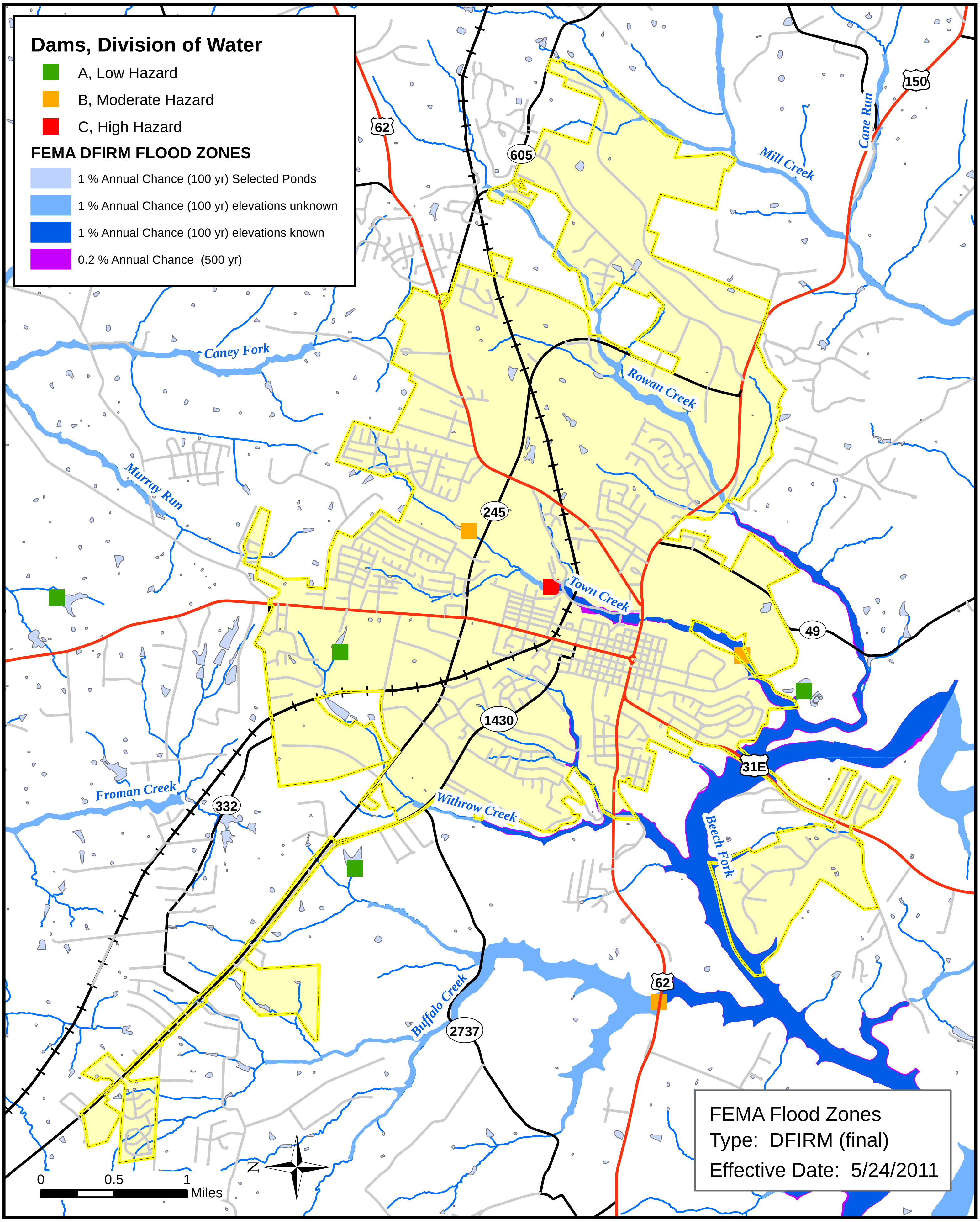

Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
941
144
N
0
0.1
0.2
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 7/18/2011

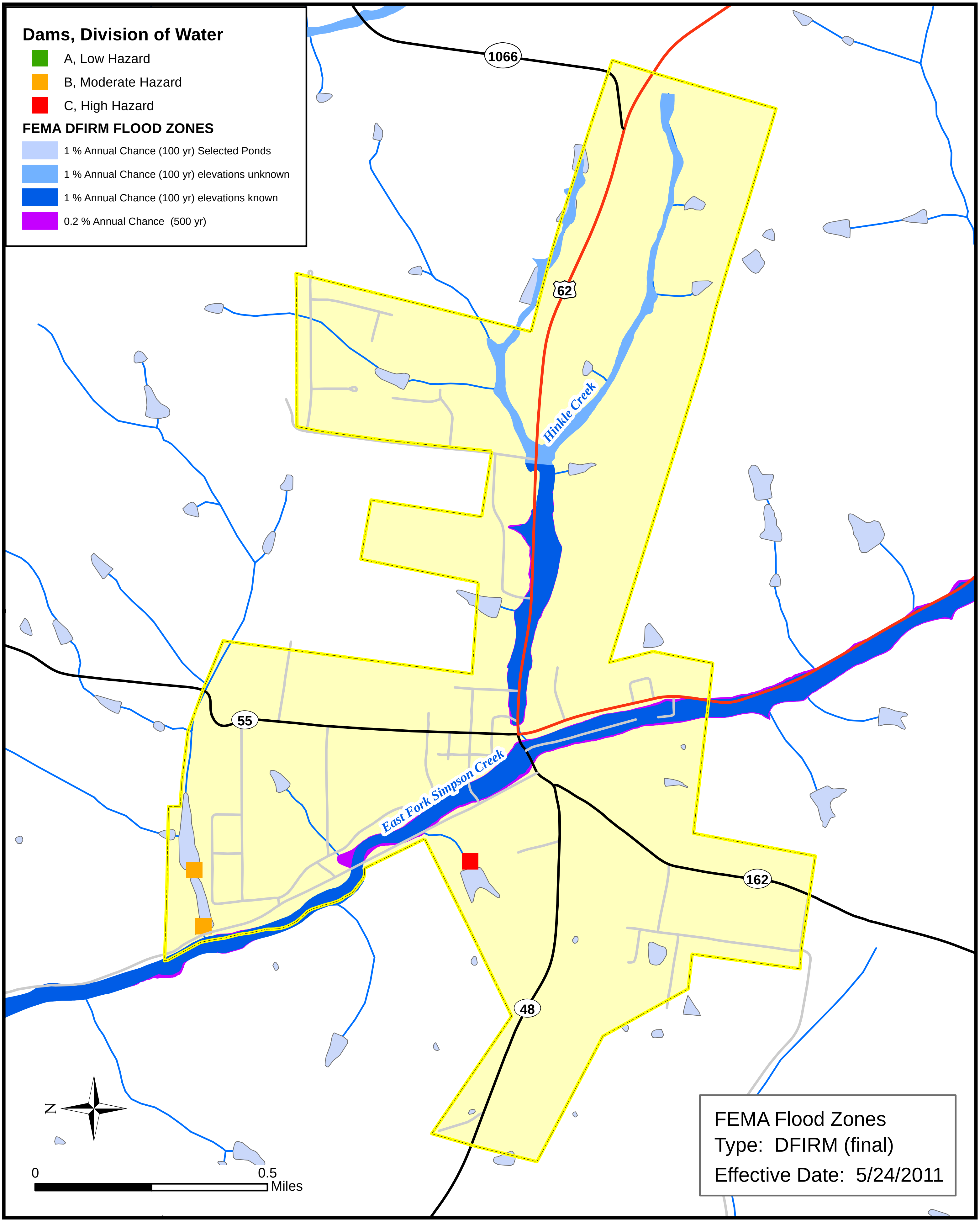
NELSON
71 FLOOD/FLASHFLOOD event(s) were recorded between 1967 and 6/30/2009 by SHELDUS and the NCDC.

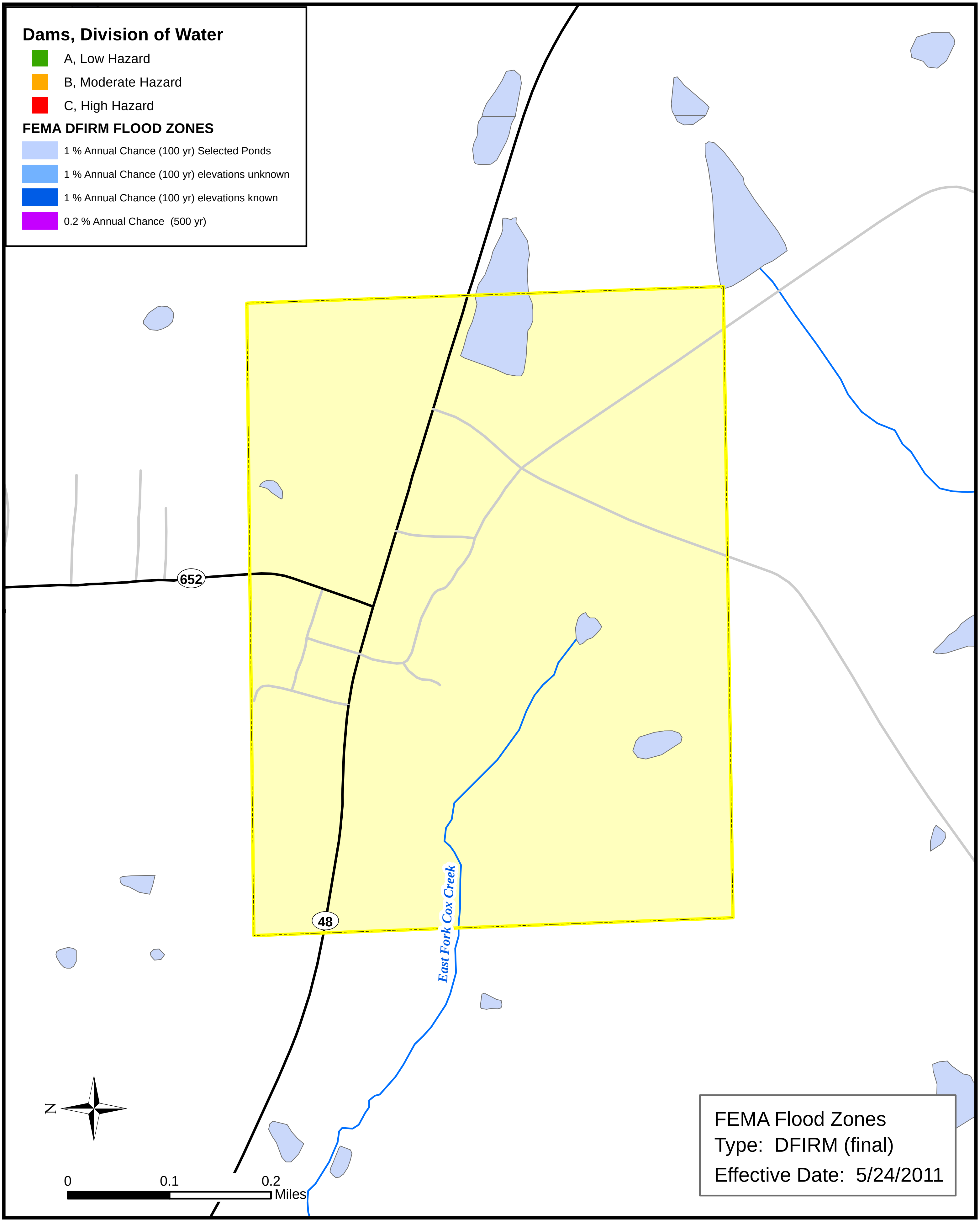
There have been an additional 22 FLOOD/FLASHFLOOD events recorded from 7/1/2009 through 6/30/2015 in NCEI.

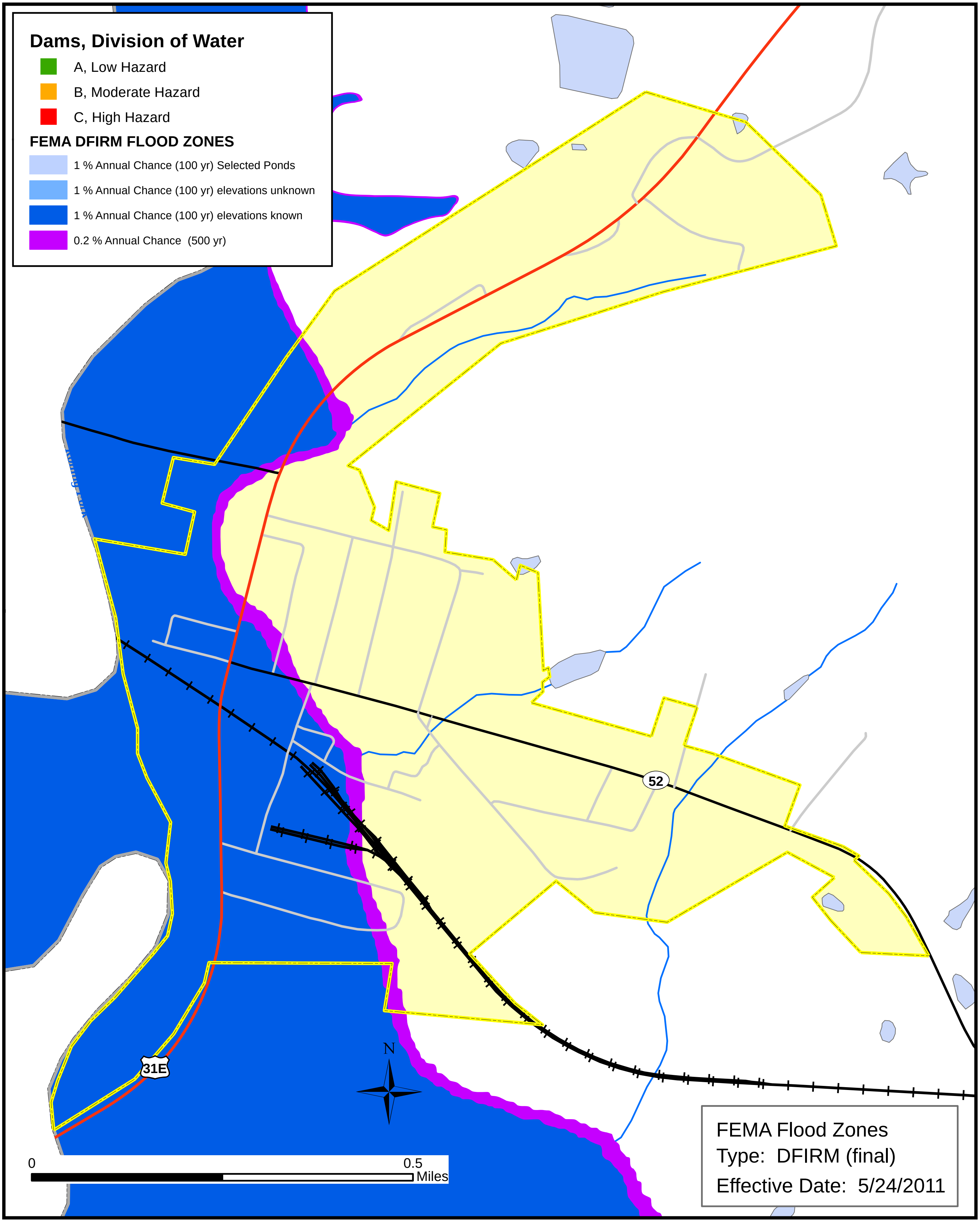
LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
BOSTON	5/2/2010	0	0	750000	0
BOSTON	3/1/2011	0	0	0	0
BOSTON	3/10/2011	0	0	0	0
BOSTON	4/12/2011	0	0	0	0
BOSTON	4/24/2011	0	0	0	0
BOSTON	5/1/2011	0	0	0	0
BOSTON	5/3/2011	0	0	0	0
BOSTON	11/29/2011	0	0	0	0
CULVERTOWN	11/29/2011	0	0	15000	0
BOSTON	12/1/2011	0	0	0	0
BOSTON	12/7/2011	0	0	0	0
BOSTON	1/15/2013	0	0	0	0
BOSTON	3/20/2013	0	0	0	0
BOSTON	7/6/2013	0	0	0	0
GETHSEMANE	12/21/2013	3	2	15000	0
BOSTON	4/5/2014	0	0	0	0
BOSTON	4/30/2014	0	0	0	0
NELSON	3/5/2015	0	0	0	0
NELSON	3/10/2015	0	0	0	0
NELSON	3/14/2015	0	0	0	0
NELSON	4/4/2015	0	0	0	0
NELSON	4/15/2015	0	0	0	0


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
3358
555
62
1066
2738
458
55
1858
48
162
605
509
245
2735
49
1430
332
48
480
2739
2737
457
523
52
84
245
46
247
62
733
52
61
N
0
5
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 5/24/2011


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
Caney Fork
Murray Run
Froman Creek
Withrow Creek
Buffalo Creek
Town Creek
Rowan Creek
Mill Creek
Cane Run
Beech Fork
62
605
150
245
49
1430
31E
332
2737
0
0.5
1
Miles
N
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 5/24/2011


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
1066
62
Hinkle Creek
55
East Fork Simpson Creek
162
48
N
0
0.5
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 5/24/2011


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
652
48
East Fork Cox Creek
N
0
0.1
0.2
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 5/24/2011


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
52
31E
N
0
0.5
Miles
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 5/24/2011

WASHINGTON

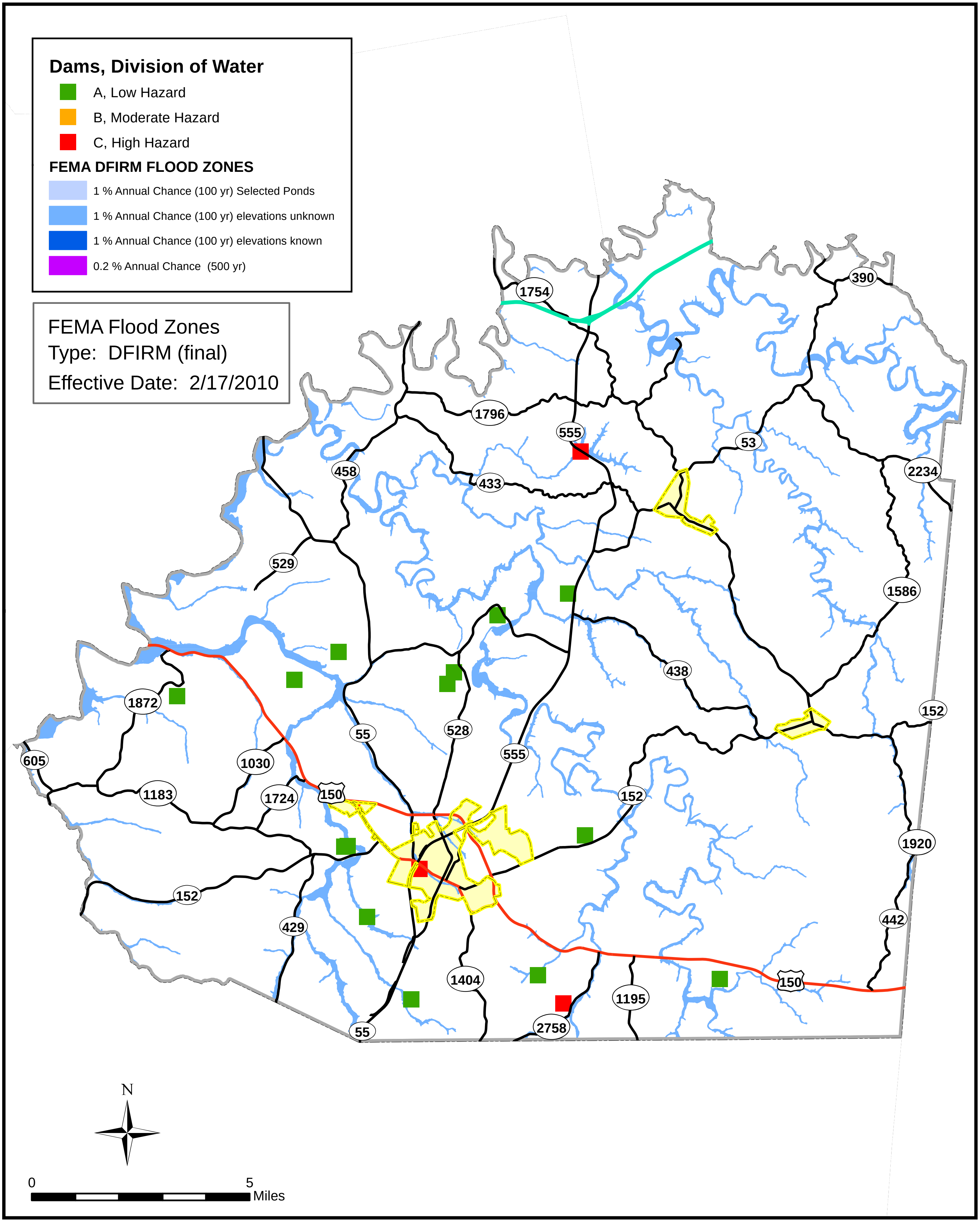
35 FLOOD/FLASHFLOOD event(s) were recorded between 1967 and 6/30/2009 by SHELDUS and the NCDC.

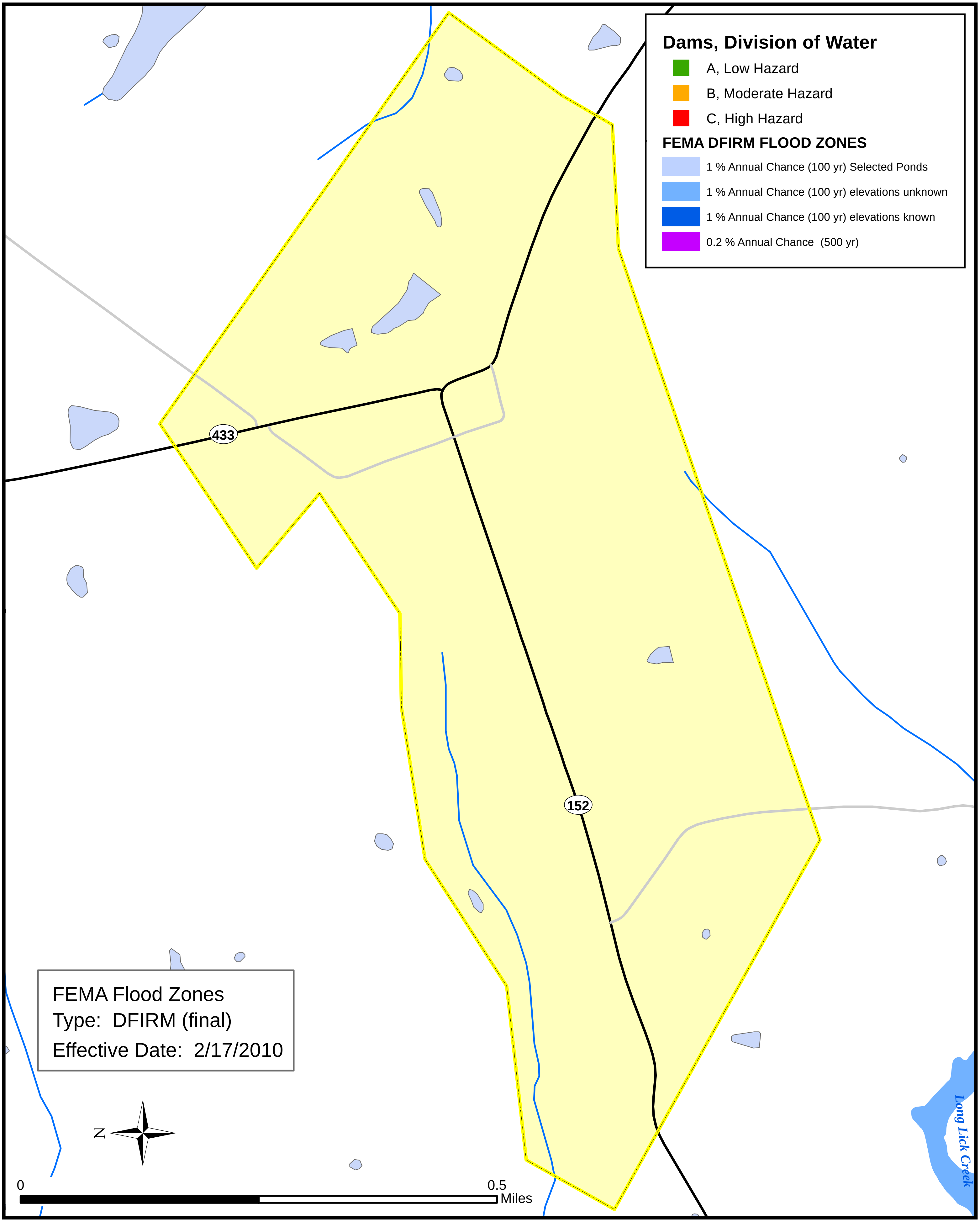
There have been an additional 4 FLOOD/FLASHFLOOD events recorded from 7/1/2009 through 6/30/2015 in NCEI.

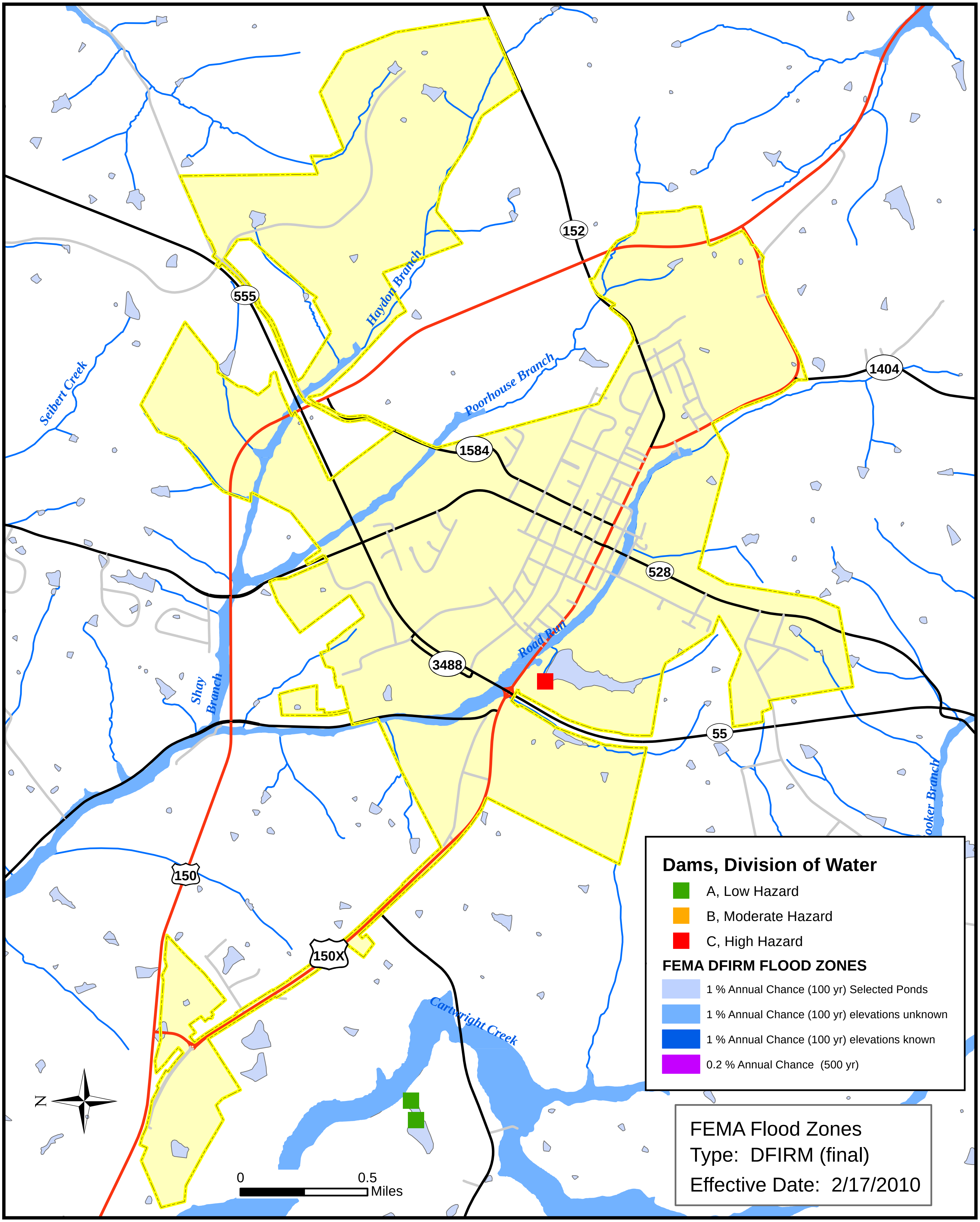
LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
SPRINGFIELD	5/2/2010	0	0	75000	0
SPRINGFIELD	4/12/2011	0	0	0	0
TATHAM SPGS	7/6/2013	0	0	0	0
WASHINGTON	4/14/2015	0	0	0	0

Barn under water, Washington Co. April 2008. *LTADD Archives*.

County road under water near Frederickstown, Washington Co. April 2008. *LTADD Archives*.


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 2/17/2010
1754
390
1796
555
53
458
433
2234
529
1586
438
152
1872
55
528
555
605
1030
1183
1724
150
152
1920
152
429
442
1404
150
1195
55
2758
N
0
5
Miles


Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
433
152
Long Lick Creek
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 2/17/2010
N
0
0.5
Miles


Haydon Branch
Seibert Creek
Poorhouse Branch
Road Run
Shay Branch
Cartwright Creek
555
152
1404
1584
528
3488
55
150
150X
N
0
0.5
Miles
Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 2/17/2010

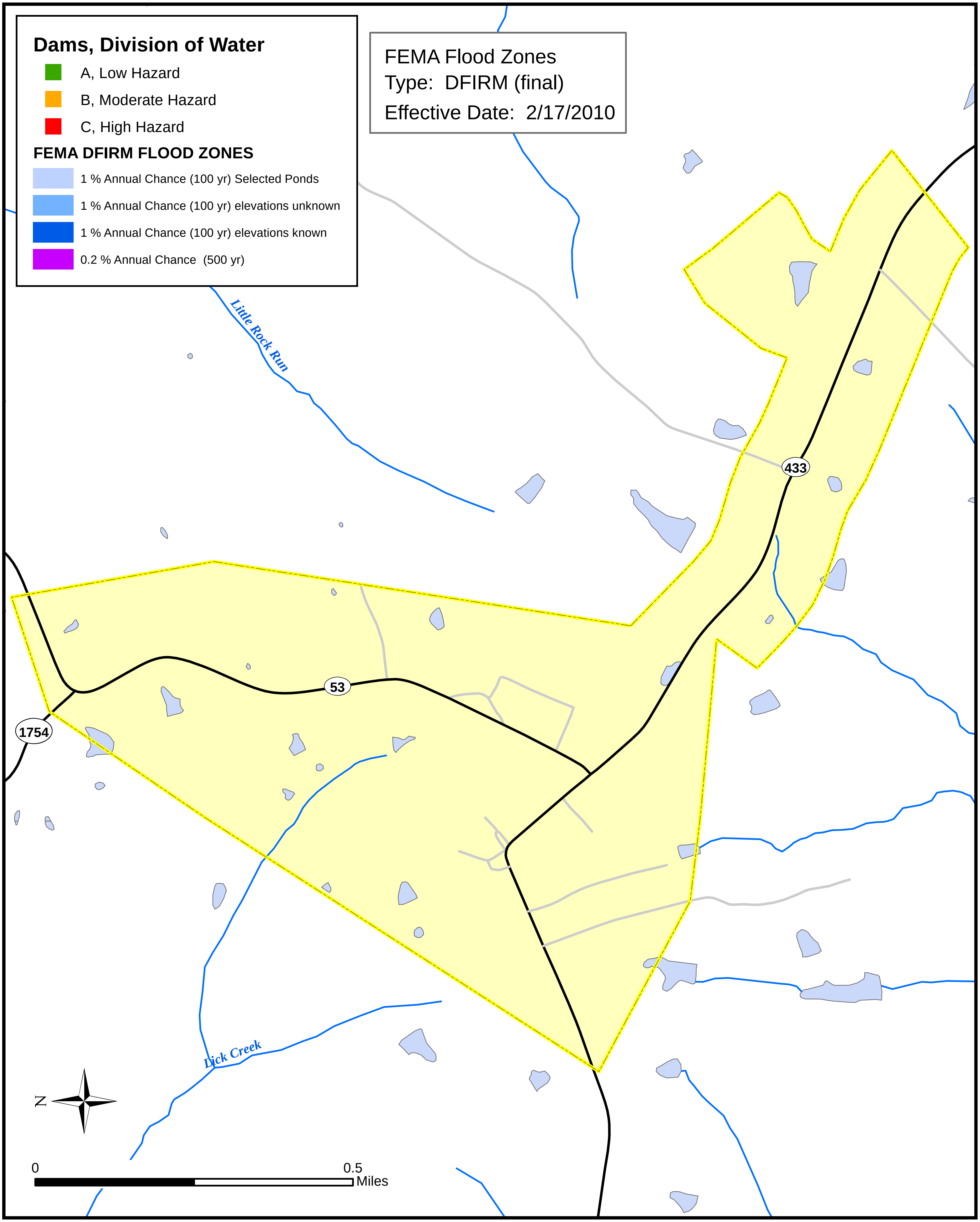

Dams, Division of Water
A, Low Hazard
B, Moderate Hazard
C, High Hazard
FEMA DFIRM FLOOD ZONES
1 % Annual Chance (100 yr) Selected Ponds
1 % Annual Chance (100 yr) elevations unknown
1 % Annual Chance (100 yr) elevations known
0.2 % Annual Chance (500 yr)
FEMA Flood Zones
Type: DFIRM (final)
Effective Date: 2/17/2010
Little Rock Run
Lick Creek
433
53
1754
N
0
0.5
Miles

Table 3.3.2.1.6 - Summary of Flooding Data, Costs

FLOODS	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$7,801,684	53	48.5	2.09	0.11	$160,859	$147,202	0.04	0.04	0.00	0.00
Cloverport	$0	1	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Hardinsburg	$0	1	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Irvington	$10,000	4	48.5	1	0	$206	$2,500	0.02	0.25	0.00	0.00
GRAYSON	$8,185,065	46	48.5	0.04	0.11	$168,764	$177,936	0.00	0.00	0.00	0.00
Caneyville	$0	1	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Clarkson	$0	1	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Leitchfield	$0	5	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
HARDIN	$47,893,889	69	48.5	2.17	0.11	$987,503	$694,114	0.04	0.03	0.00	0.00
Elizabethtown	$5,130,000	11	48.5	0	0	$105,773	$466,364	0.00	0.00	0.00	0.00
Radcliff	$0	1	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Sonora	$0	1	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Upton	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Vine Grove	$250,000	3	48.5	0	0	$5,155	$83,333	0.00	0.00	0.00	0.00
West Point	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
LARUE	$8,067,971	37	48.5	0.17	0.11	$166,350	$218,053	0.00	0.00	0.00	0.00
Hodgenville	$0	2	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
MARION	$9,740,835	44	48.5	0.31	2.54	$200,842	$221,383	0.01	0.01	0.05	0.06
Bradfordsville	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Lebanon	$75,000	6	48.5	0	0	$1,546	$12,500	0.00	0.00	0.00	0.00
Loretto	$0	1	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Raywick	$2,000	1	48.5	0	0	$41	$0	0.00	0.00	0.00	0.00
MEADE	$7,284,005	42	48.5	1.14	0.11	$150,186	$173,429	0.02	0.03	0.00	0.00
Brandenburg	$0	5	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Ekron	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Muldraugh	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
NELSON	$35,033,005	93	48.5	3.17	2.11	$722,330	$376,699	0.07	0.03	0.04	0.02
Bardstown	$2,000	4	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Bloomfield	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Fairfield	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
New Haven	$0	2	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
WASHINGTON	$8,984,658	39	48.5	0.17	0.11	$185,251	$230,376	0.00	0.00	0.00	0.00
Mackville	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Springfield	$75,000	3	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Willisburg	$0	0	48.5	0	0	$0	$0	0.00	0.00	0.00	0.00
LTADD	$132,991,112	423	48.5	9.26	5.31	$2,742,085	$314,400	0.19	0.02	0.11	0.01

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

Table 3.3.2.1.6 - Summary of Flooding Data, Events

FLOODS	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
BRECKINRIDGE	53	48.5	13	31	53	0.92	109.28%	1.3	1.55	1.06
Cloverport	1	48.5	1	1	1	48.50	2.06%	0.1	0.05	0.02
Hardinsburg	1	48.5	0	1	1	48.50	2.06%	0	0.05	0.02
Irvington	4	48.5	2	3	4	12.13	8.25%	0.2	0.15	0.08
GRAYSON	46	48.5	12	26	46	1.05	94.85%	1.2	1.3	0.92
Caneyville	1	48.5	1	1	1	48.50	2.06%	0.1	0.05	0.02
Clarkson	1	48.5	1	1	1	48.50	2.06%	0.1	0.05	0.02
Leitchfield	5	48.5	2	5	5	9.70	10.31%	0.2	0.25	0.1
HARDIN	69	48.5	23	44	69	0.70	142.27%	2.3	2.2	1.38
Elizabethtown	11	48.5	5	9	11	4.41	22.68%	0.5	0.45	0.22
Radcliff	1	48.5	0	1	1	48.50	2.06%	0	0.05	0.02
Sonora	1	48.5	1	1	1	48.50	2.06%	0.1	0.05	0.02
Upton	0	48.5	0	0	0	0.00	0.00%	0	0	0
Vine Grove	3	48.5	2	3	3	16.17	6.19%	0.2	0.15	0.06
West Point	0	48.5	0	0	0	0.00	0.00%	0	0	0
LARUE	37	48.5	8	15	37	1.31	76.29%	0.8	0.75	0.74
Hodgenville	2	48.5	2	2	2	24.25	4.12%	0.2	0.1	0.04
MARION	44	48.5	9	19	44	1.10	90.72%	0.9	0.95	0.88
Bradfordsville	0	48.5	0	0	0	0.00	0.00%	0	0	0
Lebanon	6	48.5	4	5	6	8.08	12.37%	0.4	0.25	0.12
Loretto	1	48.5	0	1	1	48.50	2.06%	0	0.05	0.02
Raywick	1	48.5	1	1	1	48.50	2.06%	0.1	0.05	0.02
MEADE	42	48.5	8	19	42	1.15	86.60%	0.8	0.95	0.84
Brandenburg	5	48.5	2	4	5	9.70	10.31%	0.2	0.2	0.1
Ekron	0	48.5	0	0	0	0.00	0.00%	0	0	0
Muldraugh	0	48.5	0	0	0	0.00	0.00%	0	0	0
NELSON	93	48.5	34	67	93	0.52	191.75%	3.4	3.35	1.86
Bardstown	4	48.5	1	3	4	12.13	8.25%	0.1	0.15	0.08
Bloomfield	0	48.5	0	0	0	0.00	0.00%	0	0	0
Fairfield	0	48.5	0	0	0	0.00	0.00%	0	0	0
New Haven	2	48.5	1	2	2	24.25	4.12%	0.1	0.1	0.04
WASHINGTON	39	48.5	4	12	39	1.24	80.41%	0.4	0.6	0.78
Mackville	0	48.5	0	0	0	0.00	0.00%	0	0	0
Springfield	3	48.5	2	3	3	16.17	6.19%	0.2	0.15	0.06
Willisburg	0	48.5	0	0	0	0.00	0.00%	0	0	0
LTADD	423	48.5	111	233	423	0.11	872.16%	11.1	11.65	8.46

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

Extent

The extent of flooding in the Lincoln Trail eight-county region is difficult to document. However, on April 30, 2011, the pool at Rough River Lake in Grayson County was recorded at a depth of 524.7 feet, a new record. Grayson County received FEMA assistance in funding two bridge elevation projects under DR-1818-0027 and DR-1818-0153 on Lake Shore Road and on Bloomington Church Road. Widespread flooding in these areas would reach a depth of up to 24 inches and closed these roads for days. Another bridge elevation project was funded in the City of Leitchfield in Grayson County, under DR-1818-0063. Floodwaters reaching depths of twelve to twenty-four inches closed a road there.

In April of 2011, Ohio River flooding affected the City of West Point in Hardin County. On 4/26/2011, the River crested at 61.8 feet, about 6.8 feet above flood stage.

The Rolling Fork River meanders through Hardin County and becomes the boundary between Hardin and Nelson County. The flood stage of the Rolling Fork is thirty-five feet, moderate flooding occurs at forty-two feet with major flooding occurring at forty-five feet. The Rolling Fork often floods rural areas of Hardin County as well as the Boston and New Haven regions of Nelson County. The Chart below documents recent flood stage levels of the Rolling Fork.

Table 3.3.2.1.7 - Flood Stages of the Rolling Fork River (Flood Stage = 35')	
Date	**Depth in Feet**
12/28/15	39.27 feet
7/16/15	38.85 feet
3/07/15	41.64 feet
5/01/14	35.64 feet
4/06/14	36.71 feet
2/07/14	37.28 feet
7/08/13	42.19 feet
3/20/13	35.93 feet
1/15/13	36.19 feet
12/01/11	40.22 feet
Source: NOAA	

3.3.2.2 <u>Tornados</u>

I. Background

According to the National Severe Storms Laboratory (NSSL) of the National Oceanic and Atmospheric Administration (NOAA) a tornado is "a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. Because wind is invisible, it is hard to see a tornado unless it forms a condensation funnel made up of water droplets, dust and debris. Tornados are the most violent of all atmospheric storms."

Attributes: About 1,200 tornados hit the United States annually. Historical data pertaining to tornados only date back to 1950 and methodology for spotting and reporting tornados has greatly evolved over the last few decades.

Tornado season in the U.S. usually refers to the time of year when tornados are most likely to occur. For the southern plains, it occurs during May and into early June. On the Gulf Coast, it is earlier in the spring. In the northern plains and upper Midwest, tornado season is in June or July. However, a tornado can occur at any time during the year, and can happen at any time of day or night. Most tornados occur between 4 and 9 p.m.

The most destructive and deadly tornados are spawned from supercells with a well-defined radar circulation called a mesocyclone. Supercells can also produce damaging hail, severe non-tornadic winds, frequent lightning and flash floods.

Analysis of damage caused by the storm, is a common and practical method for determining the strength of a tornado. From the extent of damage, an estimated wind speed can be determined. The "Enhanced Fujita Scale" was implemented by the National Weather Service in 2007 to rate tornados in a consistent and accurate manner. The EF-Scale accounts for more variables than the original Fujita Scale (F-Scale) when determining wind speed rating to a tornado by incorporating 28 damage indicators such as building type, structures and trees. For each damage indicator, there are 8 degrees of damage ranging from the beginning of visible damage to complete destruction of the damage indicator. The original F-scale did not take degrees of damage into account. The historic F-Scale database will not change. A tornado rated F5 years ago is still an F5, but wind speed may have been slightly less than previously estimated.

A comparison between the Fujita Scale and the Enhanced Fujita Scale is shown below. The Enhanced Fujita Scale is a set of wind estimates (not measurements) based on damage evaluations. According to the National Oceanic and Atmospheric Administration the Enhance Fujita Scale "uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to 28 indicators." These 28 indicators are based on the structure type, ranging from manufactured housing to institutional buildings, and from trees to light poles. It is important to note that a 3 second gust is not the same speed of wind observed in standard surface wind. Measurements are taken by weather stations located in open exposures and using a directly measured, "one minute mile" speed.

Table 3.3.2.2.1 - Fujita/Enhanced Fujita Scale						
FUJITA SCALE			DERIVED EF SCALE		**OPERATIONAL EF SCALE**	
F Number	Fastest ¼ mile (mph)	3 Second Gust (mph)	EF Number	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: NOAA						

Tornado - Feburary 29, 2012, Near LaRue County High School in Hodgenville
Photo Tara Wooden

Tornado Facts and Effects

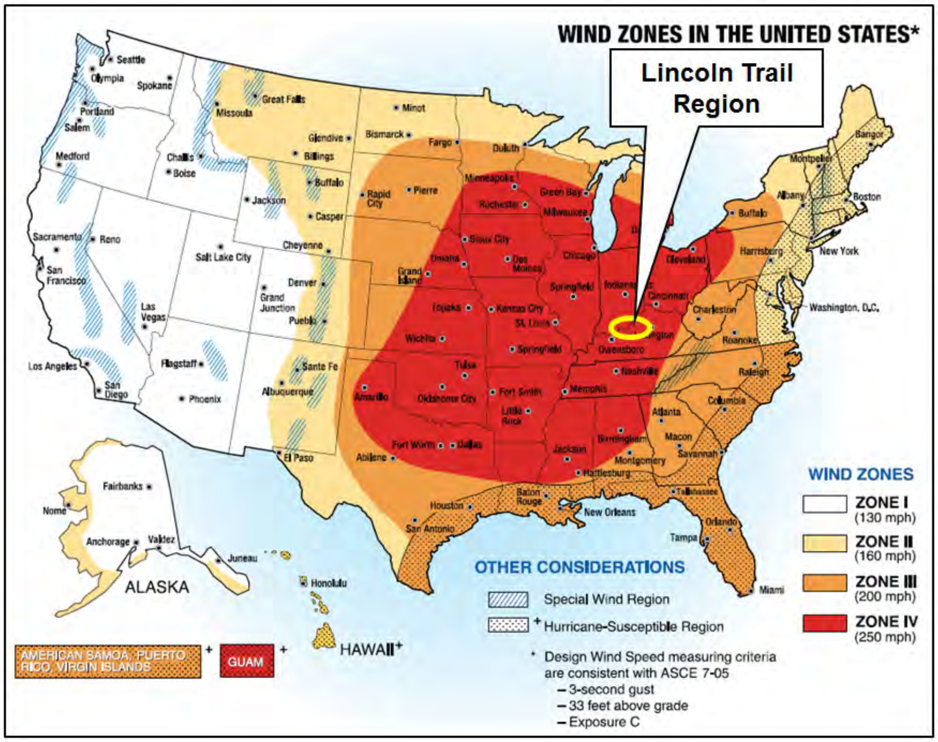
- Tornadoes can last from several seconds to more than an hour.
- A tornado is considered "significant" if it is rated EF2 or greater on the Enhanced Scale or at least F2 on the old F-Scale.

- Hurricanes and tropical storms can spawn tornados.
- Tornados are forecast when the development of temperature and wind flow patterns in the atmosphere can cause enough moisture, instability, life, and wind shear for the formation of tornadic thunderstorms. These are the four main factors for the formation of tornados.
- Tornado damage occurs as the result of exposure to extreme winds or the impact of flying debris. Another hazard exists when hazardous materials are released by tornados such as natural gas, medical waste, gasoline, and other dangerous chemicals or sewage. Winds can topple trees and power lines resulting in long-term power outages.
- Wind associated with tornados can loft debris several miles into the air and carry it for long distances. Small items and paper can be carried over 100 miles away.
- Tornados vary in size with the widest ground width measured at about 4.3 miles. Wind speed also varies. The greatest ground-level speeds have never been measured, but on May 3, 1999, 302 mph winds were recorded near Bridge Creek, OK.
- April is the month with the greatest number of tornado outbreaks. In April, 2011, the NOAA Storm Prediction Center data shows 817 tornados occurred.
- The tornados with the greatest death toll occurred on March 18, 1925 when 695 people were killed when tornados raced across Missouri, Illinois and Indiana producing F5 damage. On April 3, 1974, the main day of a two-day "Super Outbreak," tornados killed 310 people. During that outbreak, seven F5 tornados occurred in one day. The Dixie outbreak of April 27, 2011 killed about 316 people.
- Approximately 1300 tornados occur in the United States each year. On average, 60 people are killed annually as a result of tornados, most from flying or falling debris. Since records have been kept, the greatest number of deaths from tornados occurred in 2011 when 550 people died in 15 states.
- Funnel clouds have rotation, but do not touch the ground. Only a true tornado has ground contact.
- The size or shape of a tornado does not have anything to do with its strength.

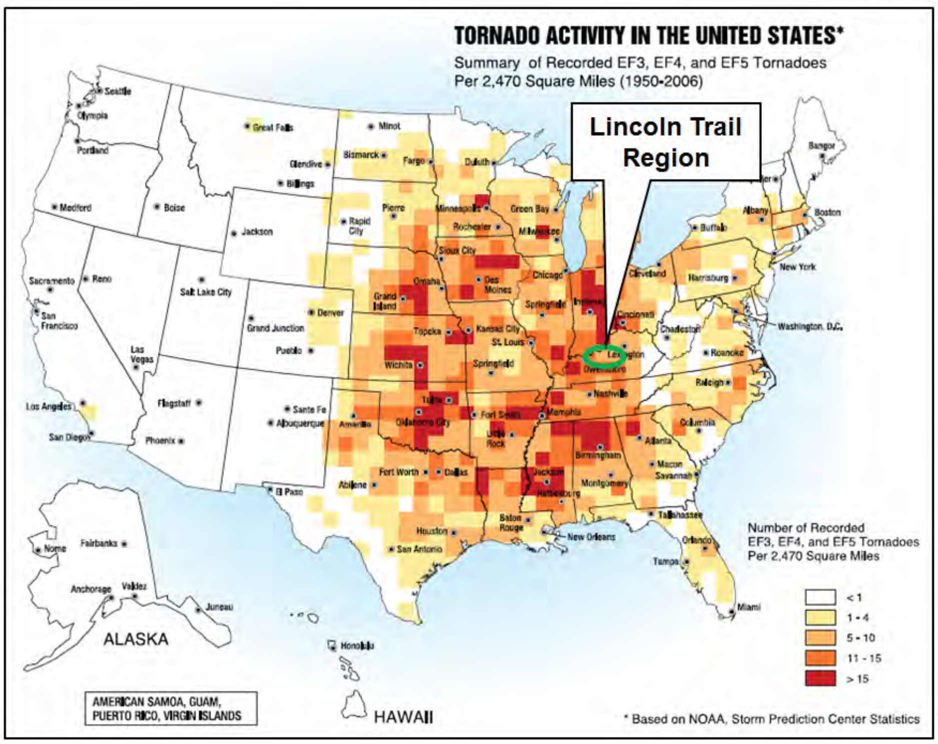
II. Profile

Kentucky is located in Wind Zone IV; the most severe wind zone in the United States. The states most vulnerable to tornado activity are located within this wind zone.

The risk associated with tornados in Kentucky is illustrated in Chart 3.3.2.2.1. Of the 908 tornados reported throughout the State between 1950 and 2014, each of the counties within the Lincoln Trail Region experienced at least 9. Kentucky averages 14 tornados



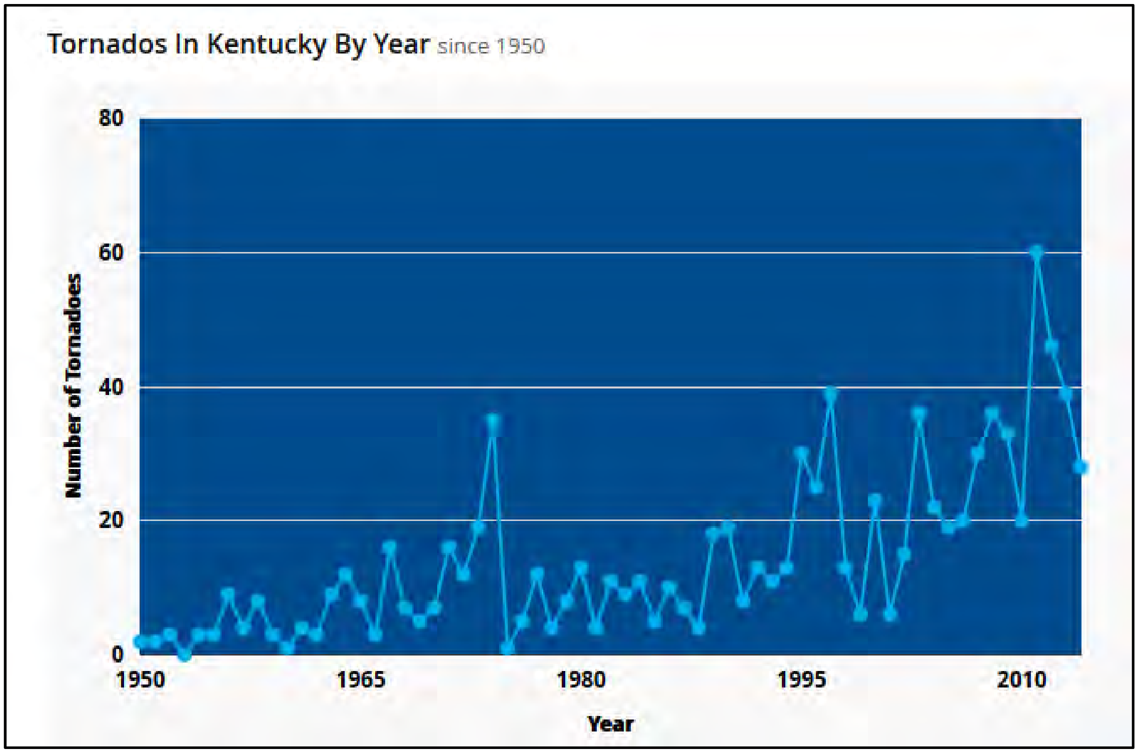
Source: FEMA, *Taking Shelter from the Storm*, 3rd Edition, Fig 1-4.



Source: FEMA, *Taking Shelter from the Storm*, 3rd Edition, Fig 1-2.

annually. Of the 220 people killed in Kentucky due to tornados, 81 were killed in the Lincoln Trail Region. Tornado data has only been collected since 1950 and the history of tornado events in the Lincoln Trail Region dates from 1950 through 2013. Clearly, the Lincoln Trail Region is at risk for tornado activity.

Chart 3.3.2.2.1



Source: www.homefacts.com/tornadoes/Kentucky

Table 3.3.2.2.2 – Tornado Activity

Tornado Activity in Kentucky and the 8-County Lincoln Trail Region Between 1950 and 2014							
Jurisdiction	Dates Yr.,Month,Day	Tornados	Fatalities	Injuries	Highest Injuries	Longest Path	Widest Path
Kentucky	1950/11/20 – 2014/10/07	908	220 People	3,601 People	364 People	84.99 Miles	3,000 Yards
Breckinridge County	1974/04/03 – 2012/03/02	14	32 People	289 People	270 People	32.3 Miles	440 Yards
Grayson Co.	1959/01/21 – 2012/02/29	12	3 People	26 People	16 People	58 Miles	880 Yards
Hardin Co.	1964/01/24 – 2012/02/29	22	3 People	95 People	81 People	37.9 Miles	440 Yards

LaRue Co.	1952/03/22 – 2013/06/26	9	0 People	19 People	18 People	6.65 Miles	1200 Yards
Marion Co.	1952/03/22 – 2013/06/26	9	0 People	19 People	18 People	6.65 Miles	1200 Yards
Meade Co.	1974/04/03 – 2013/01/30	10	32 People	299 People	270 People	32.3 Miles	440 Yards
Nelson Co.	1969/05/08 – 2008/02/05	9	3 People	85 People	81 People	37.9 Miles	1500 Yards
Washington County	1954/08/02 – 2012/03/02	9	11 People	5 People	4 People	46.6 Miles	800 Yards
Source: Storm Prediction Center, Historical Tornado Data File (NOAA)							

III. Anaylsis

To analyze tornados as a hazard threat to the Lincoln Trail Region historical data was researched. The sources of this information include the National Weather Service, National Climatic Data Center, Kentucky Climatic Data Center, ESRI, FEMA, Kentucky Emergency Management Area III, and LTADD GIS.

The following map and tables illustrate a number of the documented tornadic events that have occurred in the Lincoln Trail Region. Note that the general paths are consistent with tornados in this region of the United States. They do affect a widespread region and are not affected in general by geography.

The level of impact is evidenced through the number of lives lost or individual injuries reported, as well as the estimated property and crop damage based on information reported to the National Climate Data Center. This information was subsequently rolled into the data from the National Centers for Environmental Information (NCEI). Data for the original plan was only available through 2003. The 2010 update provided data thru 30 June 2009. This update shows only individual events for the period 1 July 2009 through 30 June 2015. The summary tables show data for the entire periods covered by the various sources. Note that there are many variations in recording the locations of the events over time. In the past, this was typically done at a county level. More recently, nearest place names have been used. Because of this, the records in the summation tables regarding the individual incorporated areas should not be considered all encompassing.

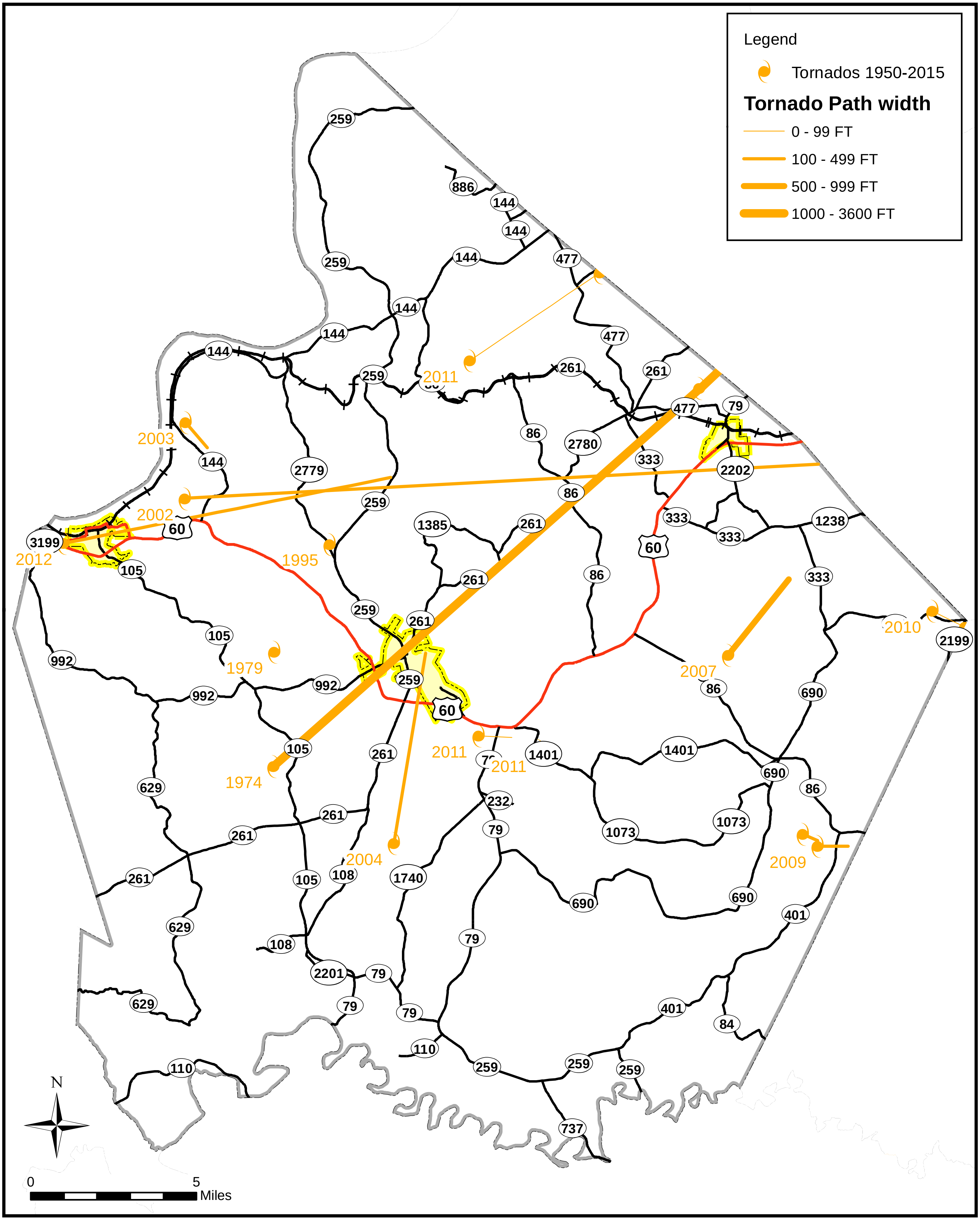
Throughout the following tables, April 3, 1974 will stand out and is probably the most significant day to remember in our region, if not the state, as it pertains to natural hazards and the devastating effects they can have on us all. In what is labeled the worst tornado outbreak in U.S. history, 148 twisters touched down in 13 states, killing 330 people and injuring 5,484. Between the hours of 3:40pm and midnight 26 of those tornados touched down in Kentucky and affected 39 of our 120 counties, killing 77 people and injuring 1,377. Closer to home, within the Lincoln Trail Region a total of 36 of our residents were killed and 353 were injured. The tornado causing the most destruction hit Meade County and had an intensity rating of F5 on the Fujita scale and a path 550 yards wide.

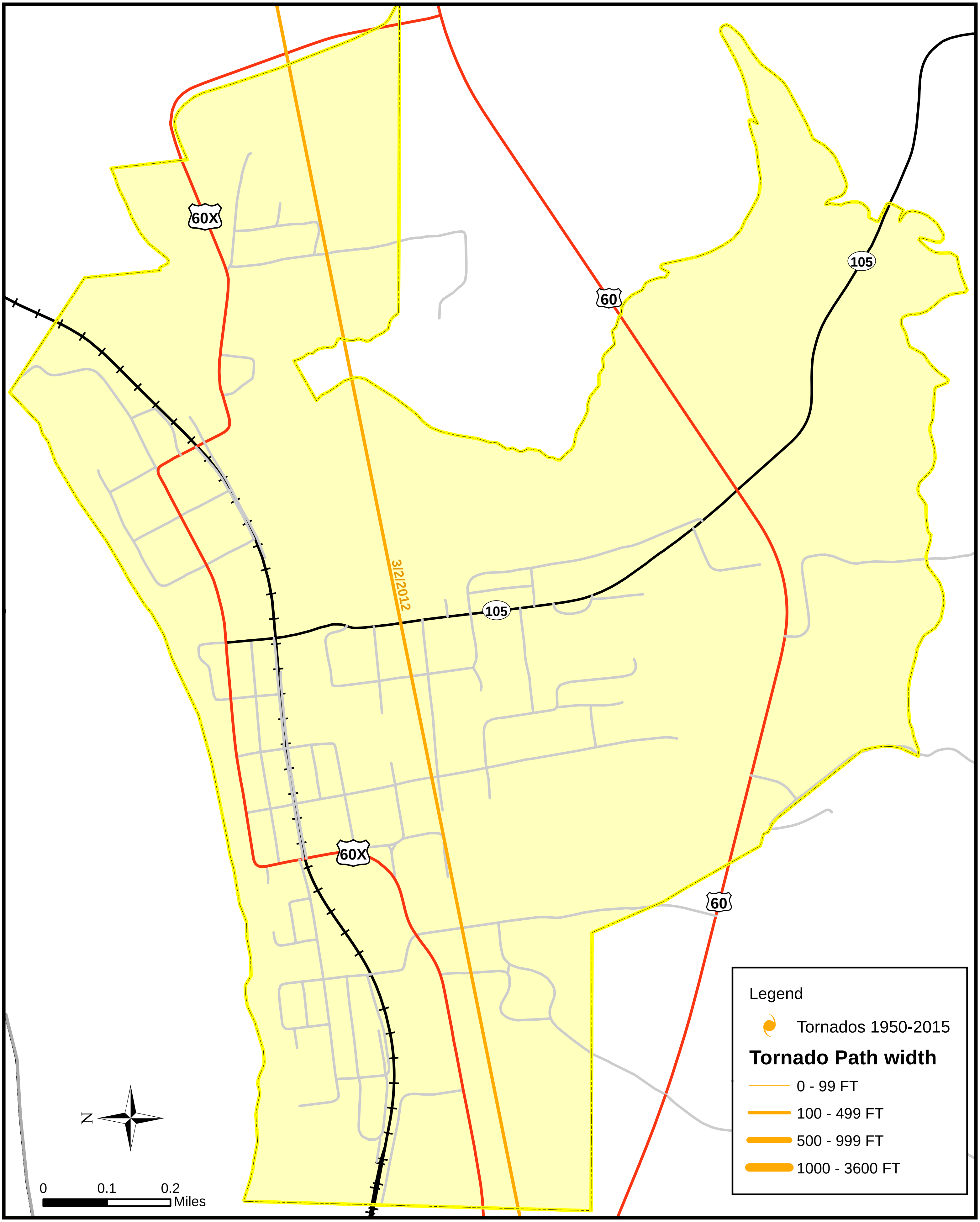
Table 3.3.2.2.3 - County Specific Data – Tornados, *Source: NCEI*

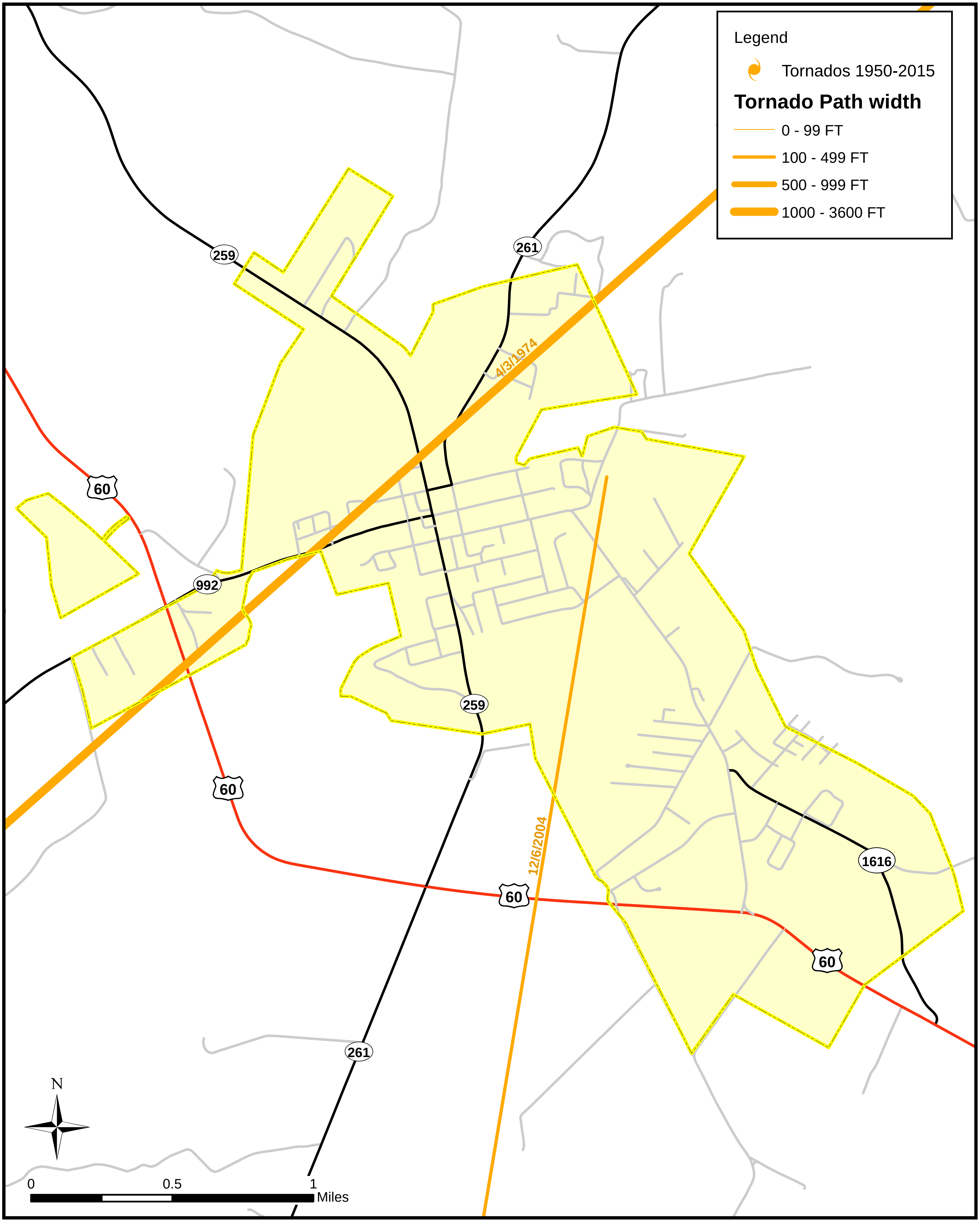
BRECKINRIDGE

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE	F SCALE
HARDINSBURG	10/9/2009	0	0	$0	$0	EF0
BIG SPG	5/21/2010	0	0	$25,000	$0	EF1
MYSTIC	4/19/2011	0	0	$0	$0	EF0
HARNED	6/19/2011	0	0	$50,000	$0	EF2
LOCUST HILL	6/19/2011	0	0	$5,000	$0	EF0
CLOVERPORT	3/2/2012	0	0	$150,000	$0	EF2

Local Story - June 19, 2011: "The National Weather Service confirms two tornadoes touched down in Breckinridge County Sunday. An EF-0 and EF-2 twister hit the town of Harned. There were no reported injuries, but strong wind ripped the roof off a house and blew it into the back yard. A twister also flattened a barn. On another farm, winds lifted a barn off its foundation and moved it several feet. One of the tornadoes ripped away chunks of an outer wall on Breckinridge County High School." *Source: WLEX TV 18, Lexington KY, 6/21/2011.*

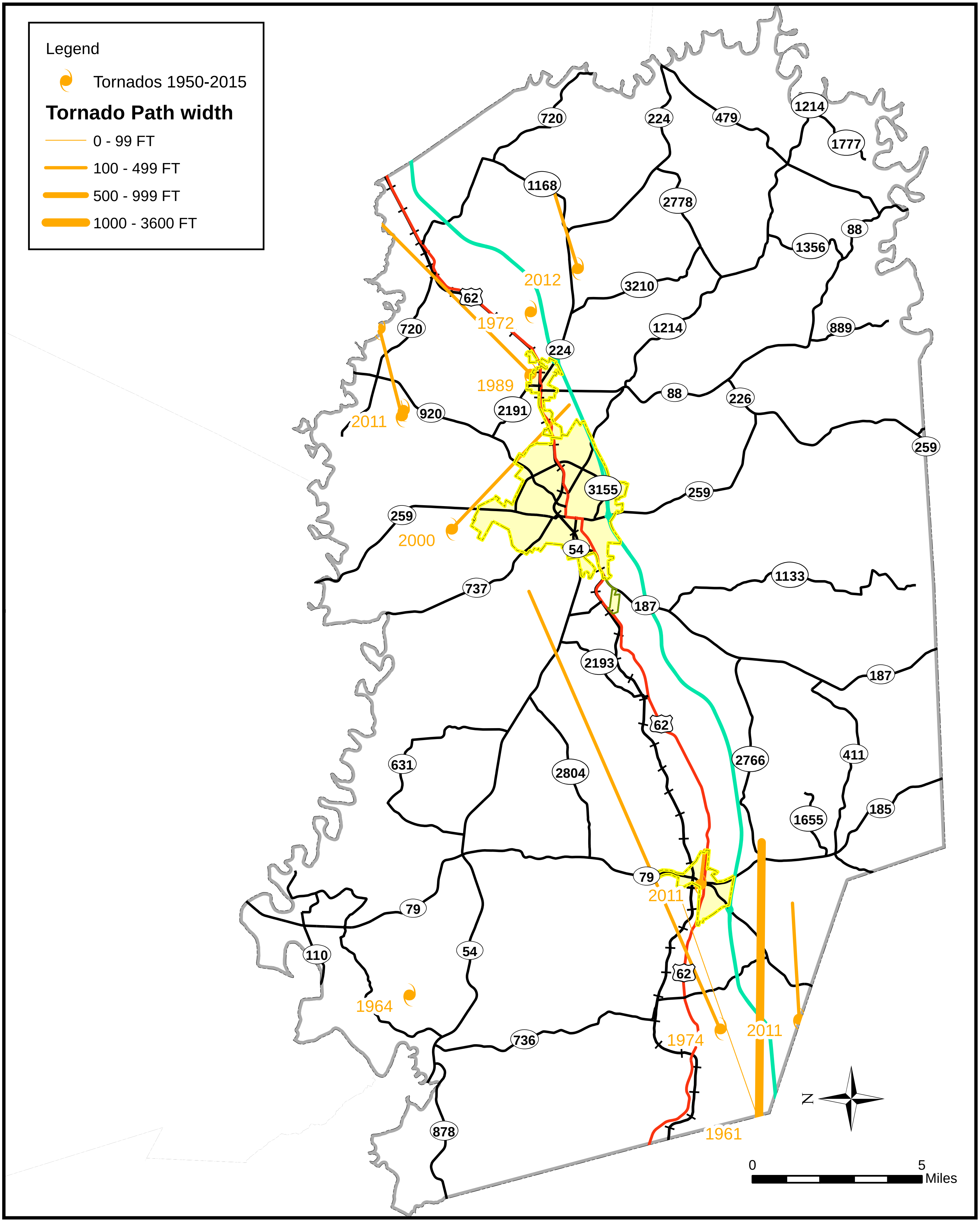

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
2011
2003
2002
2012
1995
1979
1974
2011
2011
2004
2007
2010
2009
N
0
5
Miles

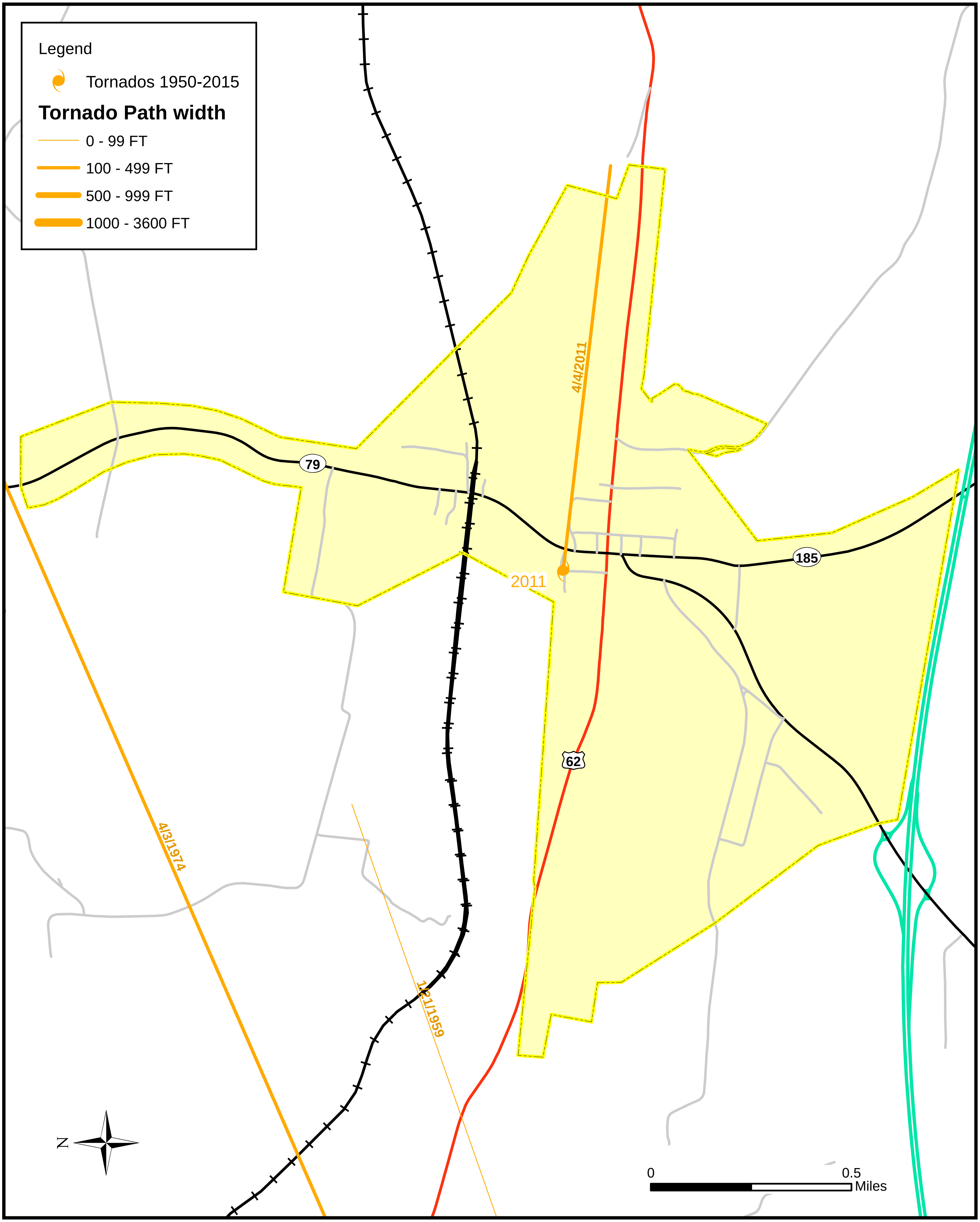

60X
60
105
3/2/2012
105
60X
60
N
0
0.1
0.2
Miles
Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT

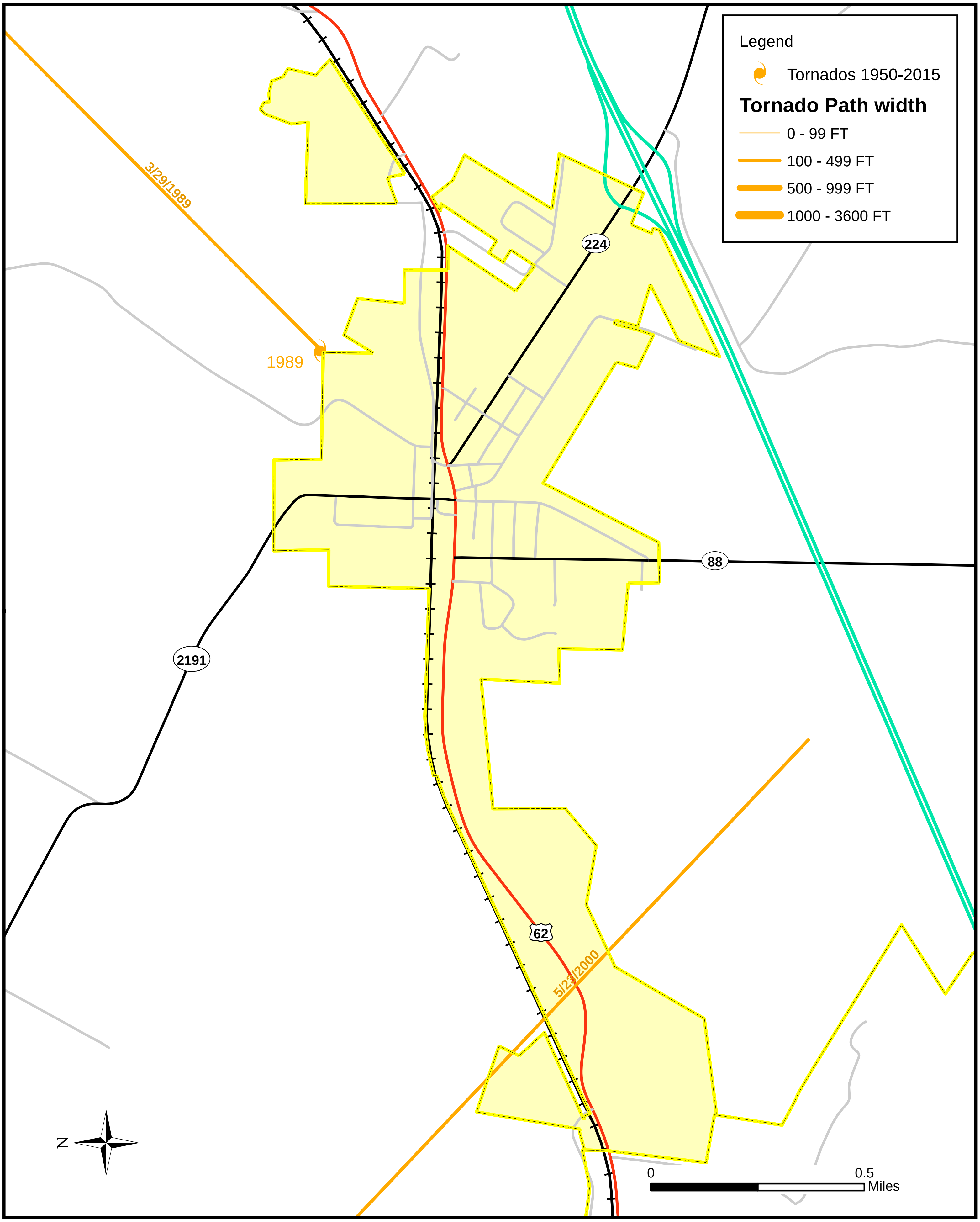

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
259
261
60
992
1616
4/3/1974
12/6/2004
N
0
0.5
1
Miles

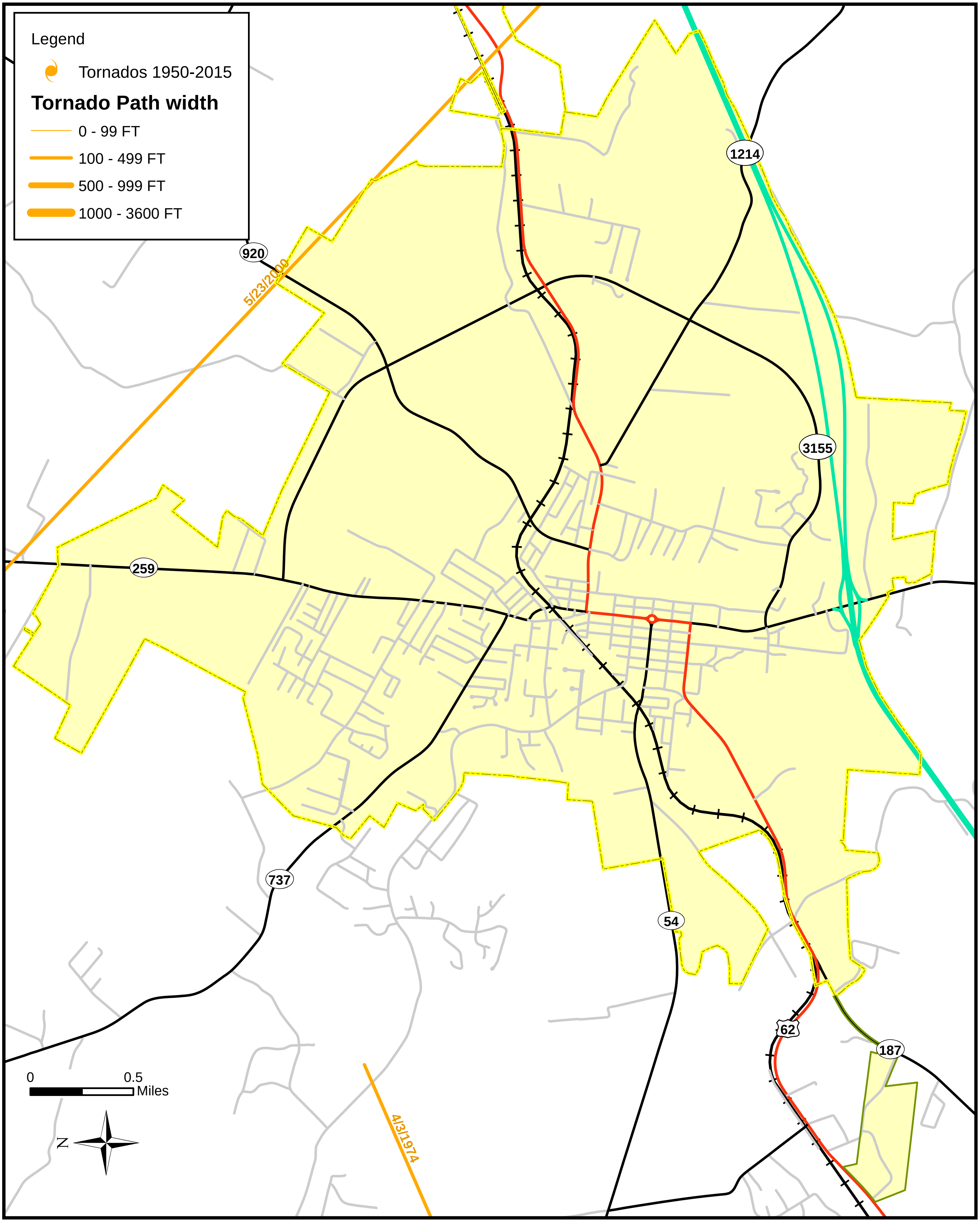
GRAYSON

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE	F SCALE
NEAFUS	4/4/2011	0	0	$0	$0	EF1
CANEYVILLE	4/4/2011	0	0	$0	$0	EF1
TAR HILL	4/26/2011	0	0	$0	$0	EF2
TAR HILL	4/26/2011	0	0	$0	$0	EF0
WEST CLIFTY	2/29/2012	0	1	$50,000	$0	EF2


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
2012
1972
1989
2011
2000
2011
1964
1974
2011
1961
0
5
Miles
N

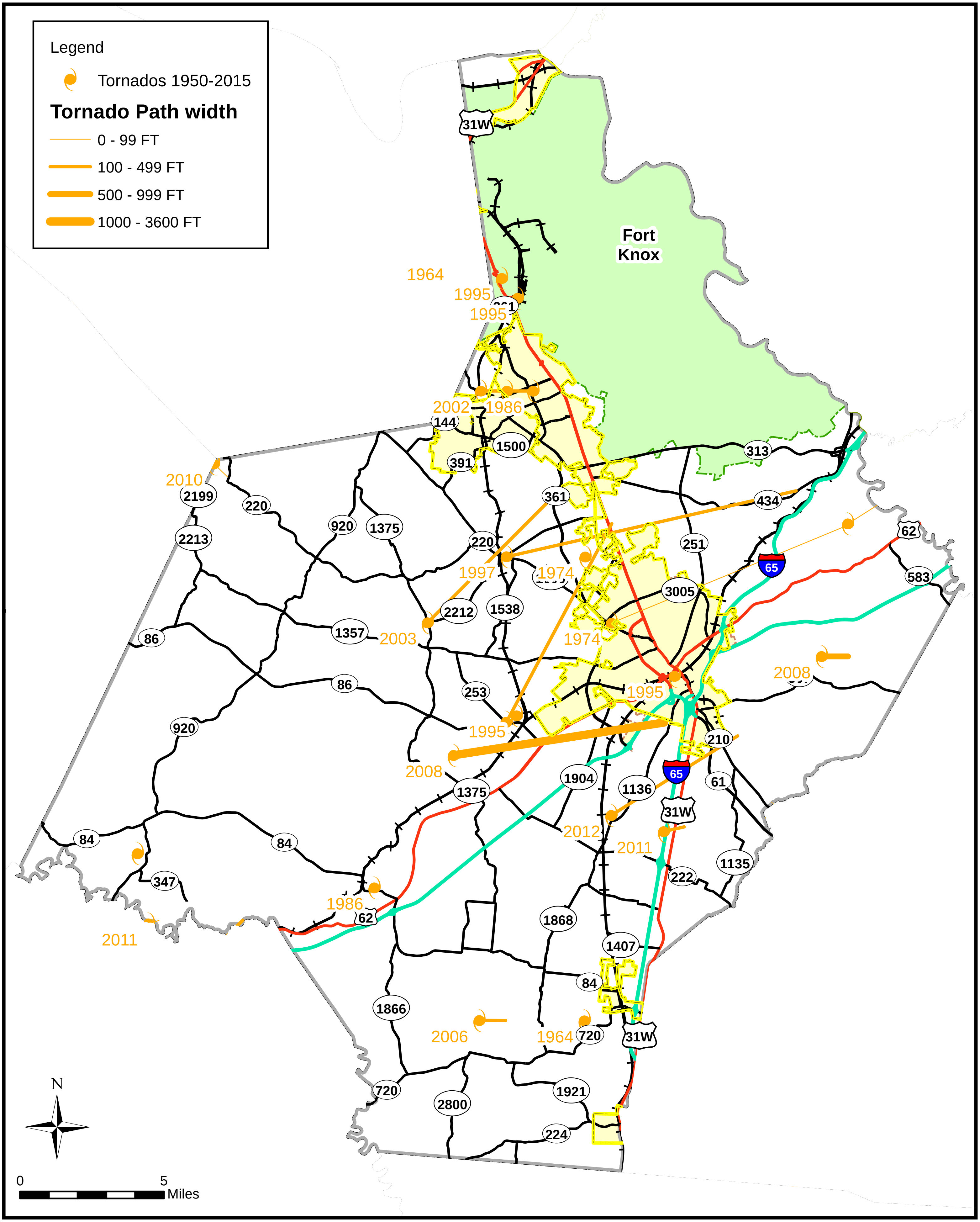

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
4/4/2011
2011
4/3/1974
1/21/1959
79
185
62
N
0
0.5
Miles

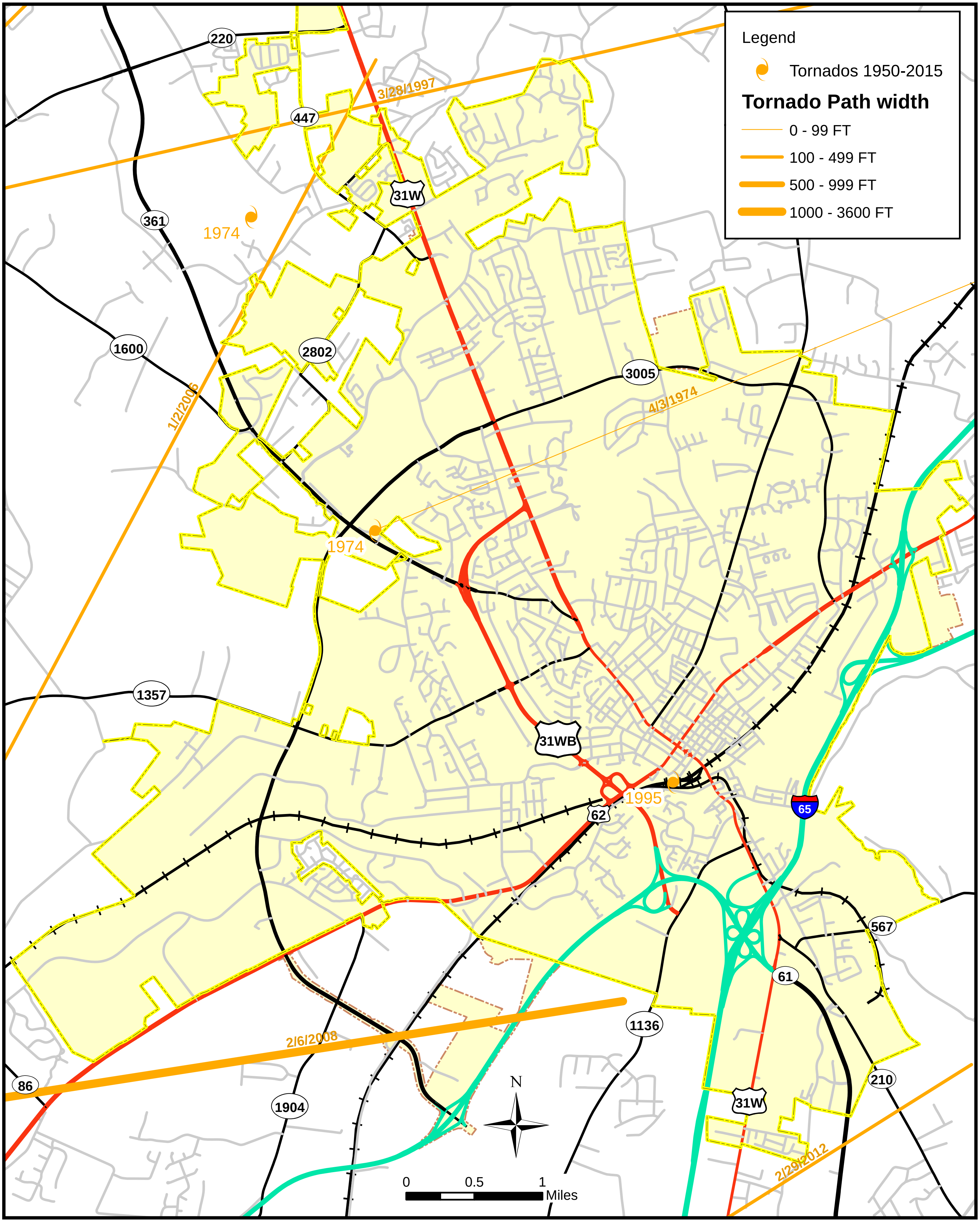

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
3/29/1989
1989
5/23/2000
224
88
2191
62
N
0
0.5
Miles

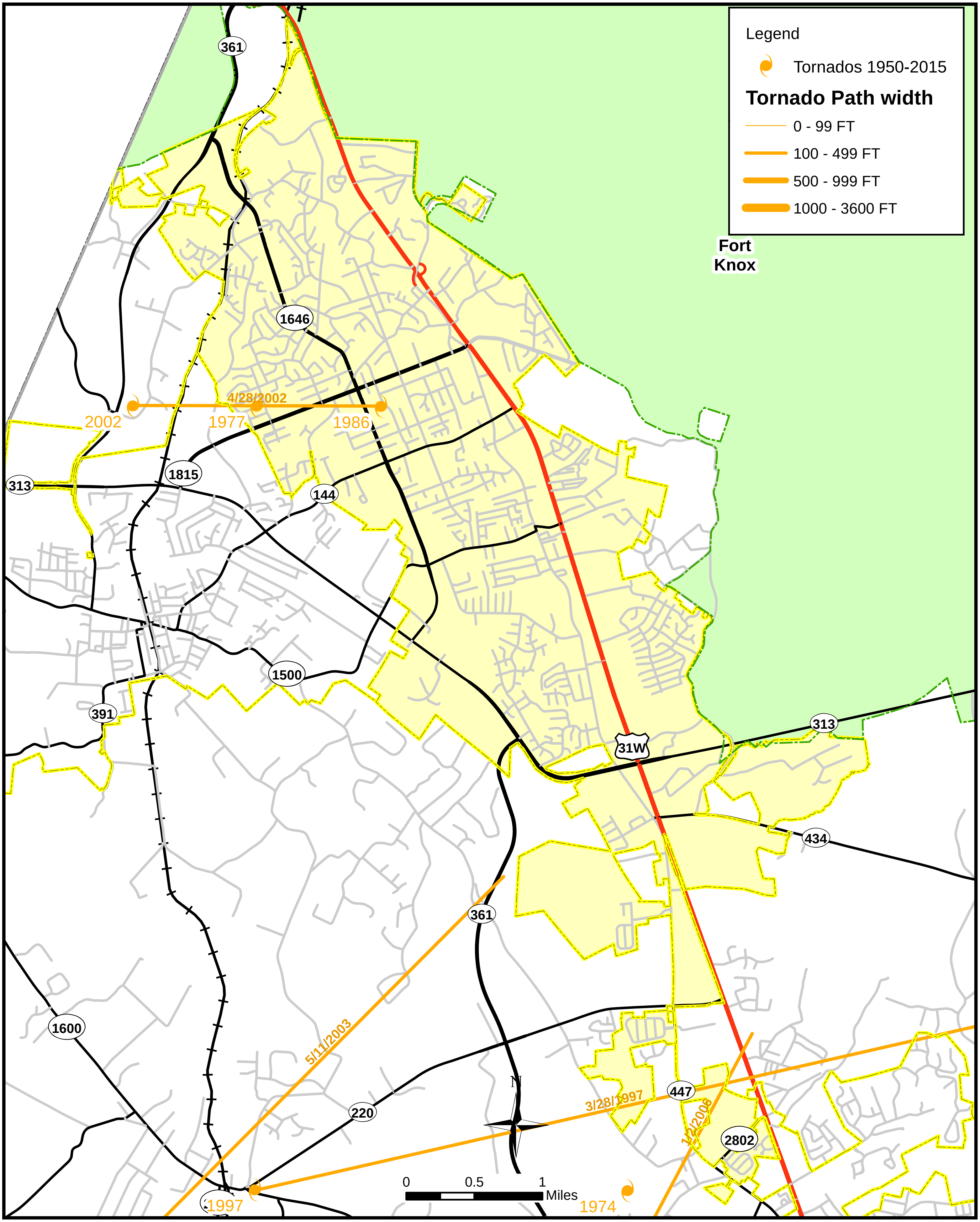

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
920
5/23/2000
1214
3155
259
737
54
62
187
4/3/1974
0
0.5
Miles
N

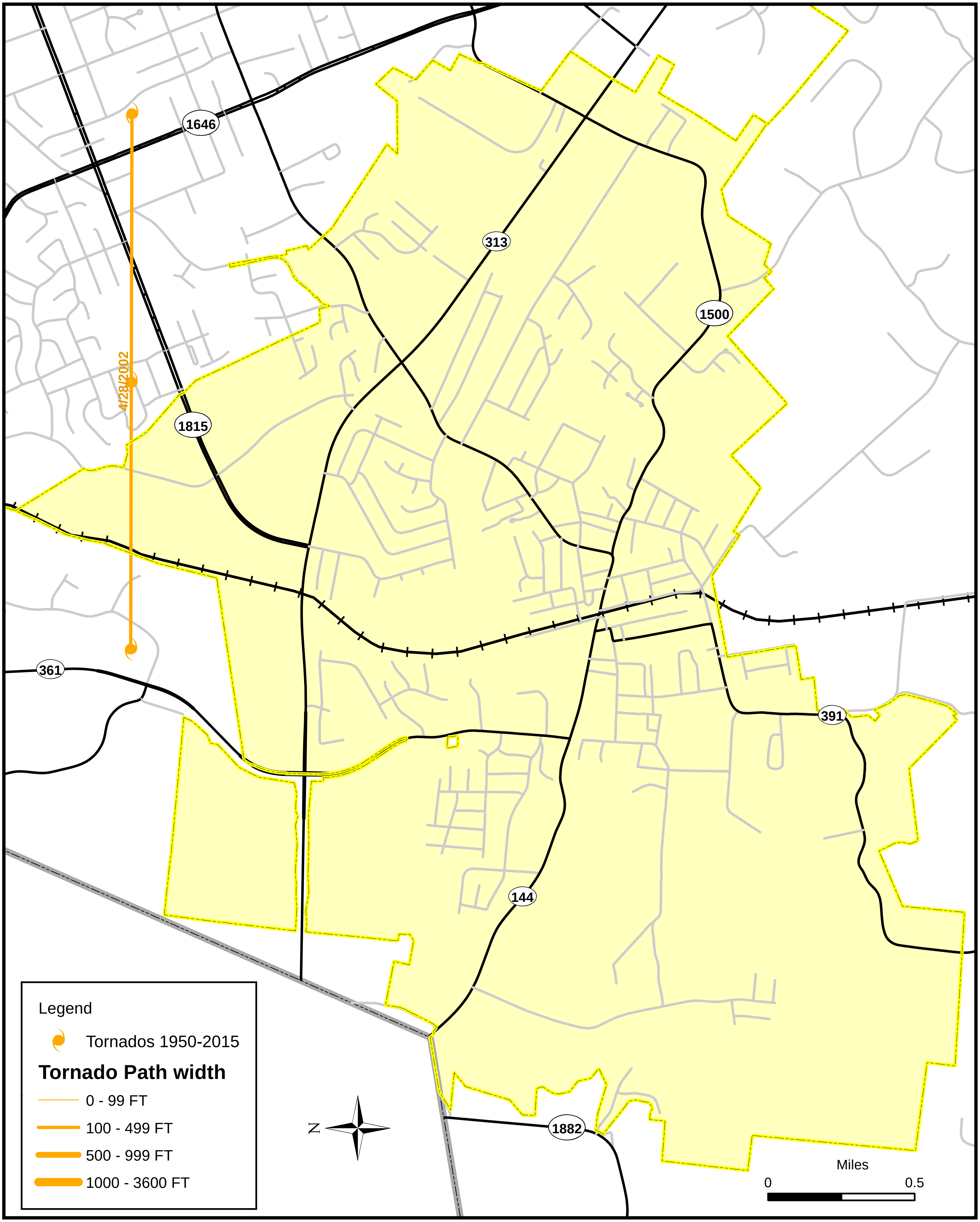
HARDIN

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE	F SCALE
NORTH FOUR CORNERS	5/21/2010	0	0	$10,000	$0	EF0
SOLWAY	4/26/2011	0	0	$0	$0	EF0
GLENDALE JCT	4/26/2011	0	0	$0	$0	EF1
GLENDALE	2/29/2012	0	0	$200,000	$0	EF2


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
Fort Knox
1964
1995
1995
2002
1986
2010
1997
1974
2003
1974
2008
1995
1995
2008
2012
2011
1986
2011
2006
1964
31W
65
N
0
5
Miles


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
3/28/1997
1974
1974
4/3/1974
1/2/2006
1995
2/6/2008
2/29/2012
220
447
31W
361
1600
2802
3005
1357
31WB
62
65
567
61
1136
210
86
1904
N
0
0.5
1
Miles


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
Fort Knox
361
1646
1815
313
144
1500
391
31W
434
220
447
2802
1600
4/28/2002
2002
1977
1986
5/11/2003
3/28/1997
1997
1974
0
0.5
1
Miles
N

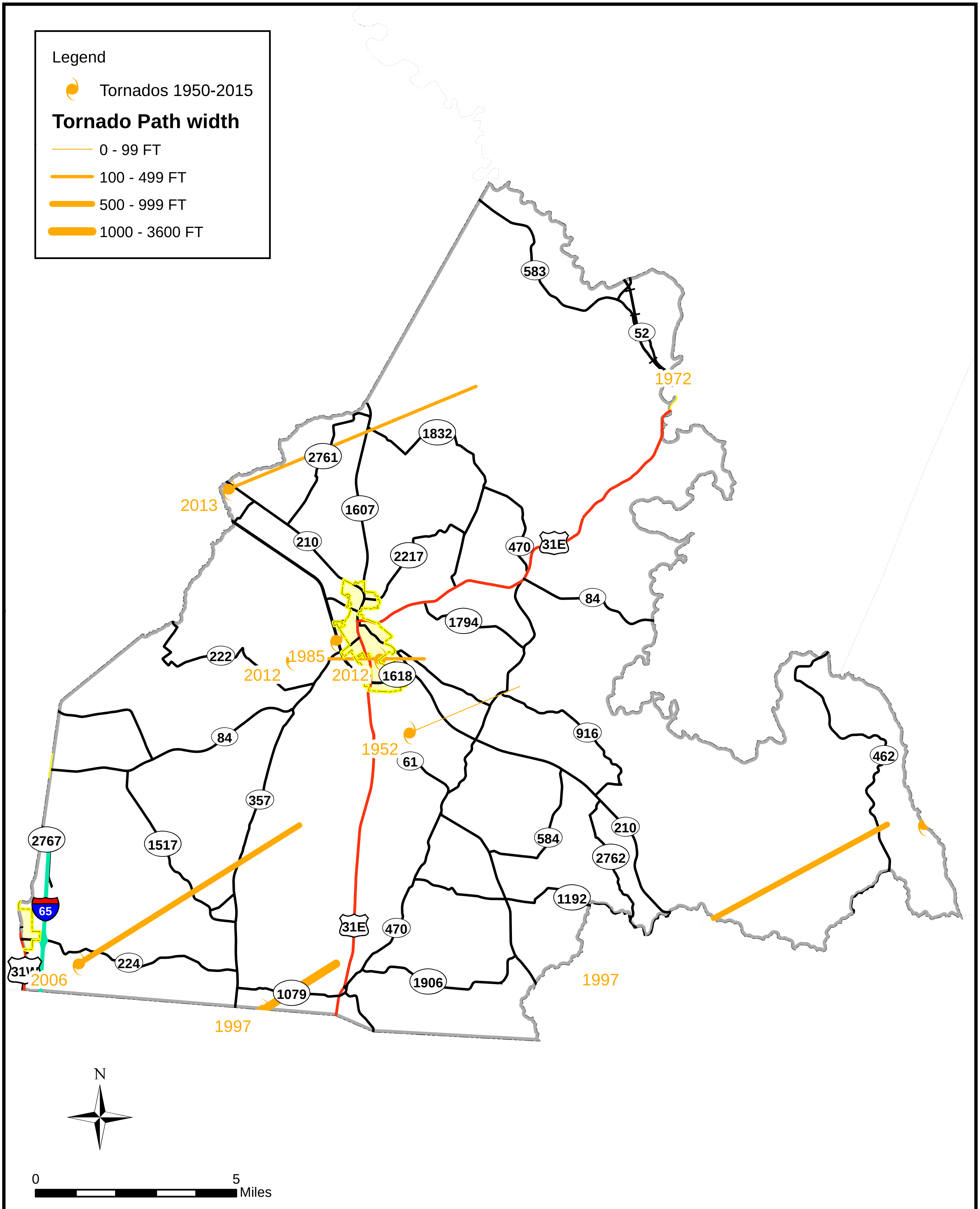

1646
313
1500
1815
4/28/2002
361
391
144
1882
Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
N
Miles
0
0.5

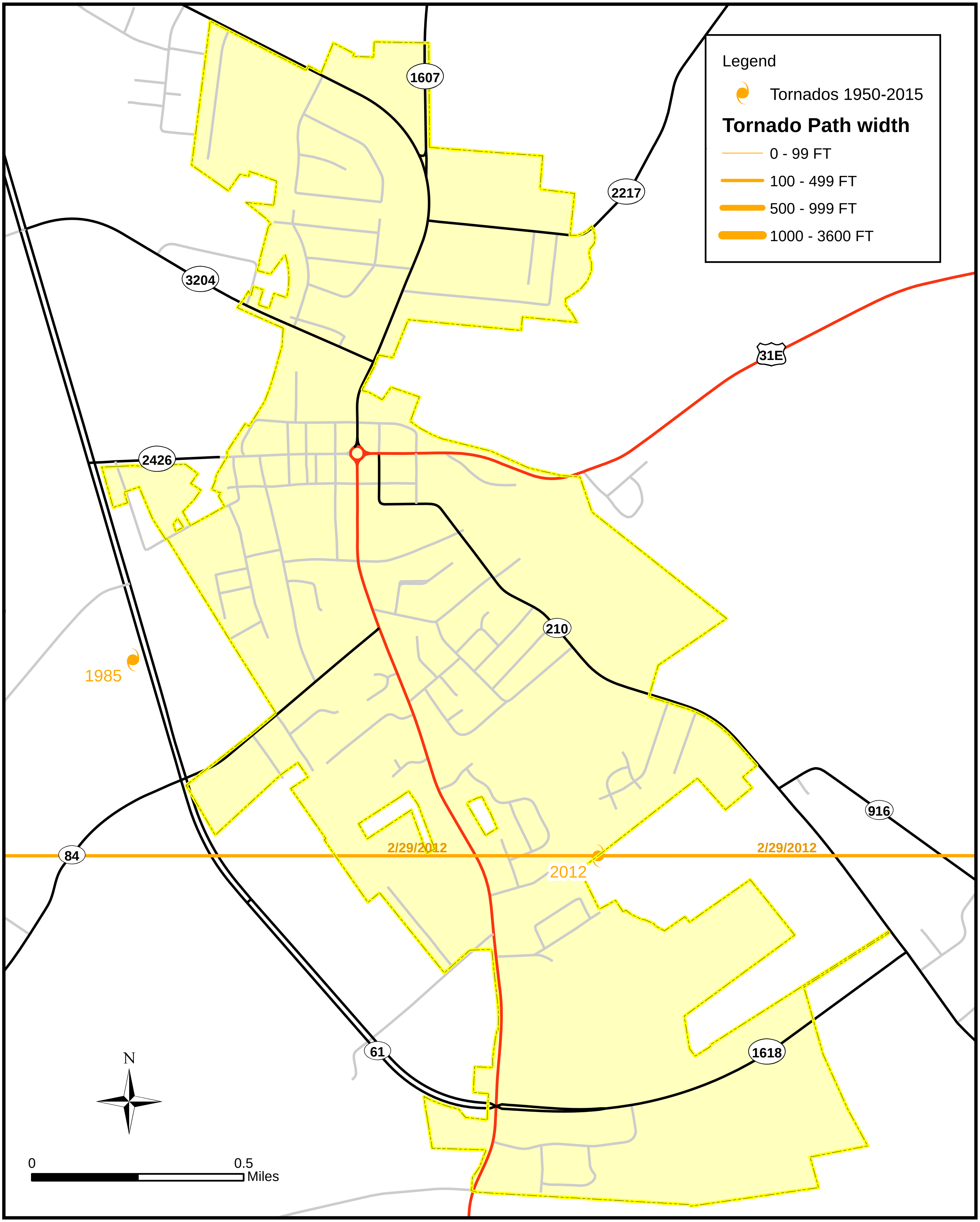
LARUE

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE	F SCALE
HODGENVILLE	2/29/2012	0	0	$200,000	$0	EF2
HODGENVILLE	2/29/2012	0	0	$20,000	$0	EF2
TONIEVILLE	6/26/2013	0	0	$500,000	$0	EF2

Tornado Damage in LaRue County, Feb 29, 2012. *Source: Nolin RECC, "Kentucky Living" magazine, April 2012.*

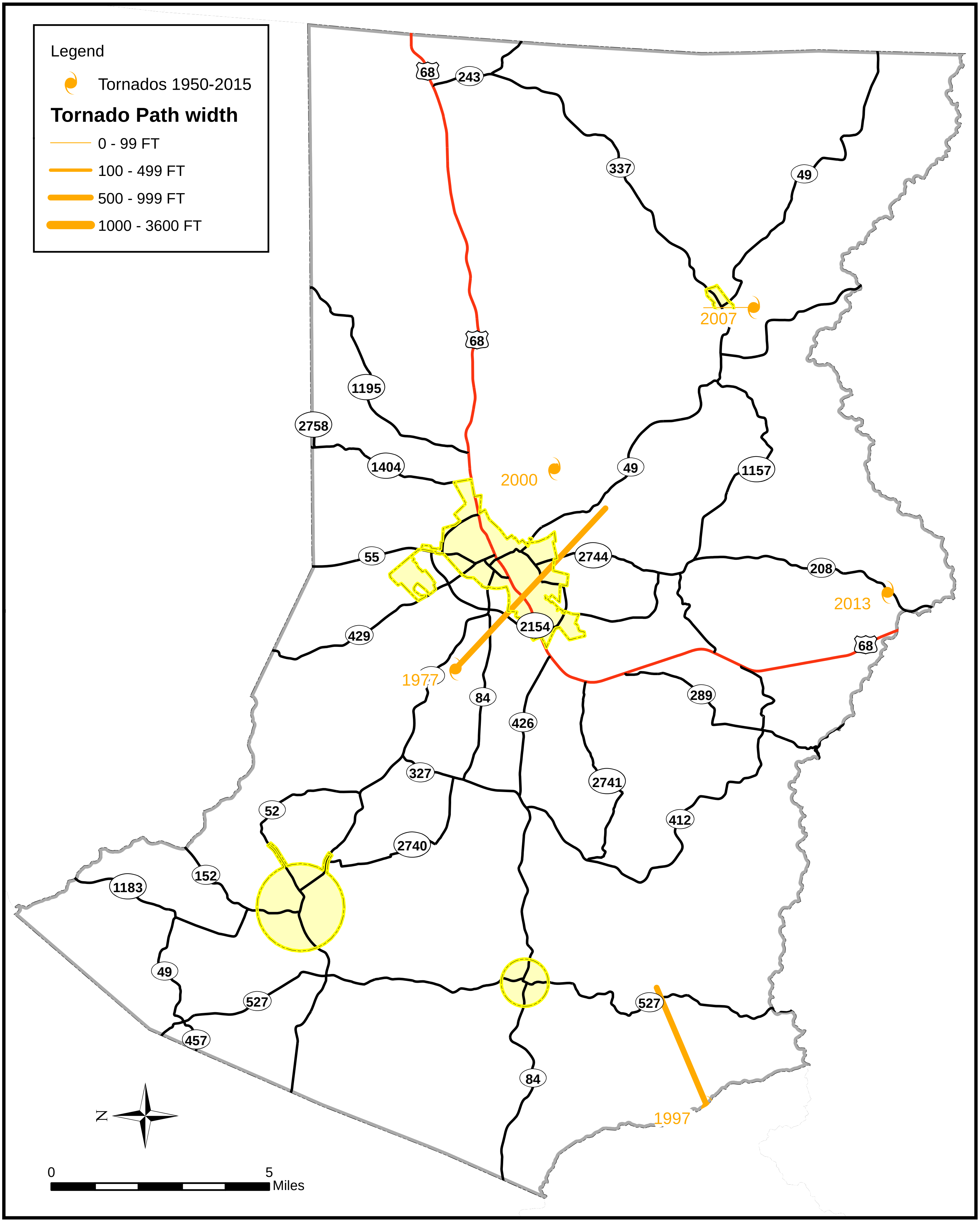
Cleanup work in LaRue County, Feb 29, 2012. *Source: Nolin RECC, "Kentucky Living" magazine, April 2012.*

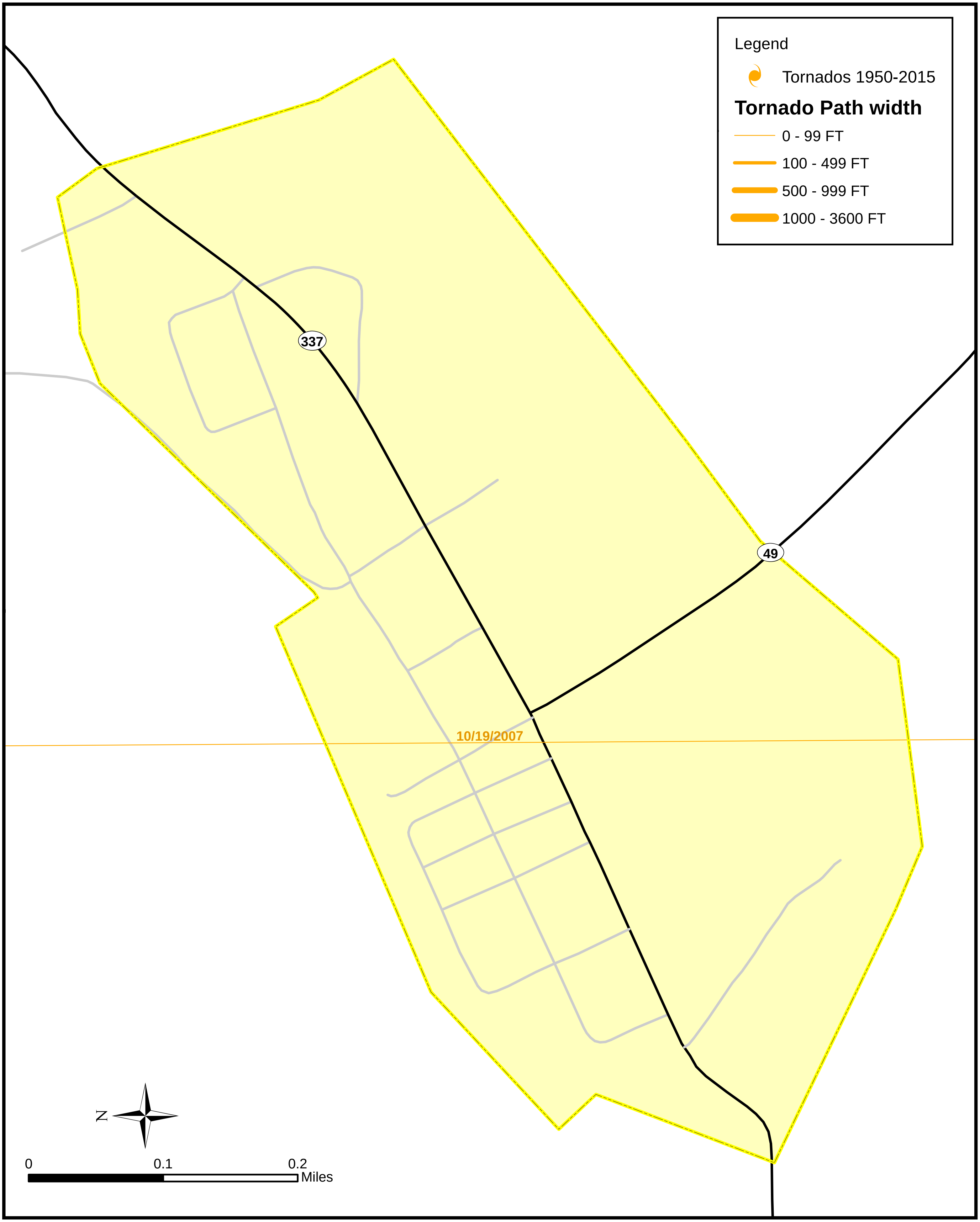

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
583
52
1972
1832
2761
2013
1607
210
2217
470
31E
84
1794
222
1985
2012
2012
1618
916
84
1952
61
462
357
210
2767
1517
584
2762
65
1192
31E
470
224
31W
2006
1079
1906
1997
1997
N
0
5
Miles


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
1607
2217
3204
31E
2426
210
1985
2/29/2012
2/29/2012
2012
84
916
61
1618
N
0
0.5
Miles

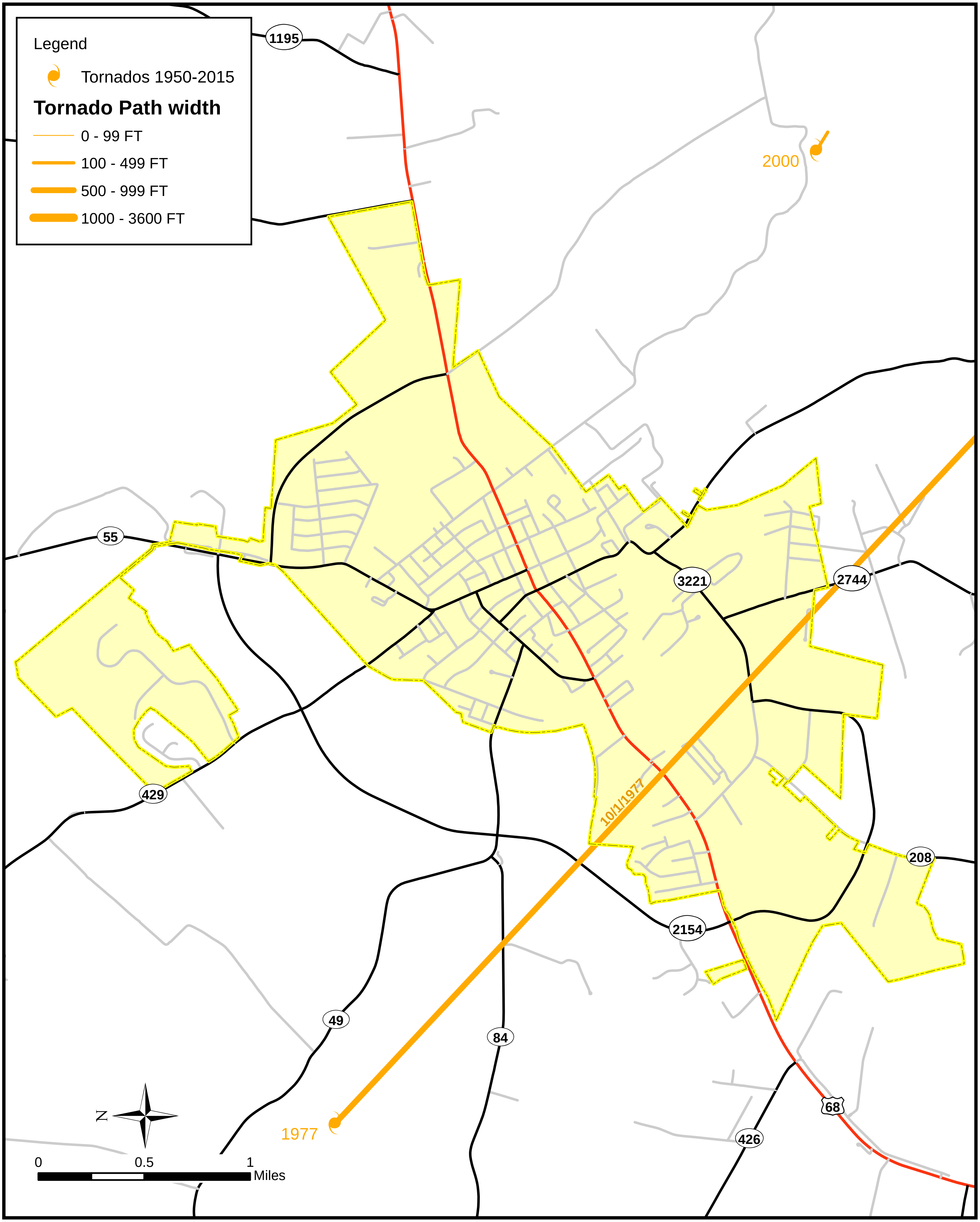
MARION

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE	F SCALE
PHILLIPSBURG	1/30/2013	0	2	$25,000	$0	EF0


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
68
243
337
49
2007
68
1195
2758
1404
2000
49
1157
55
2744
208
2013
429
2154
68
1977
84
289
426
327
2741
52
412
2740
152
1183
49
527
527
457
84
1997
N
0
5
Miles


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
337
49
10/19/2007
N
0
0.1
0.2
Miles

LEBANON
TORNADO

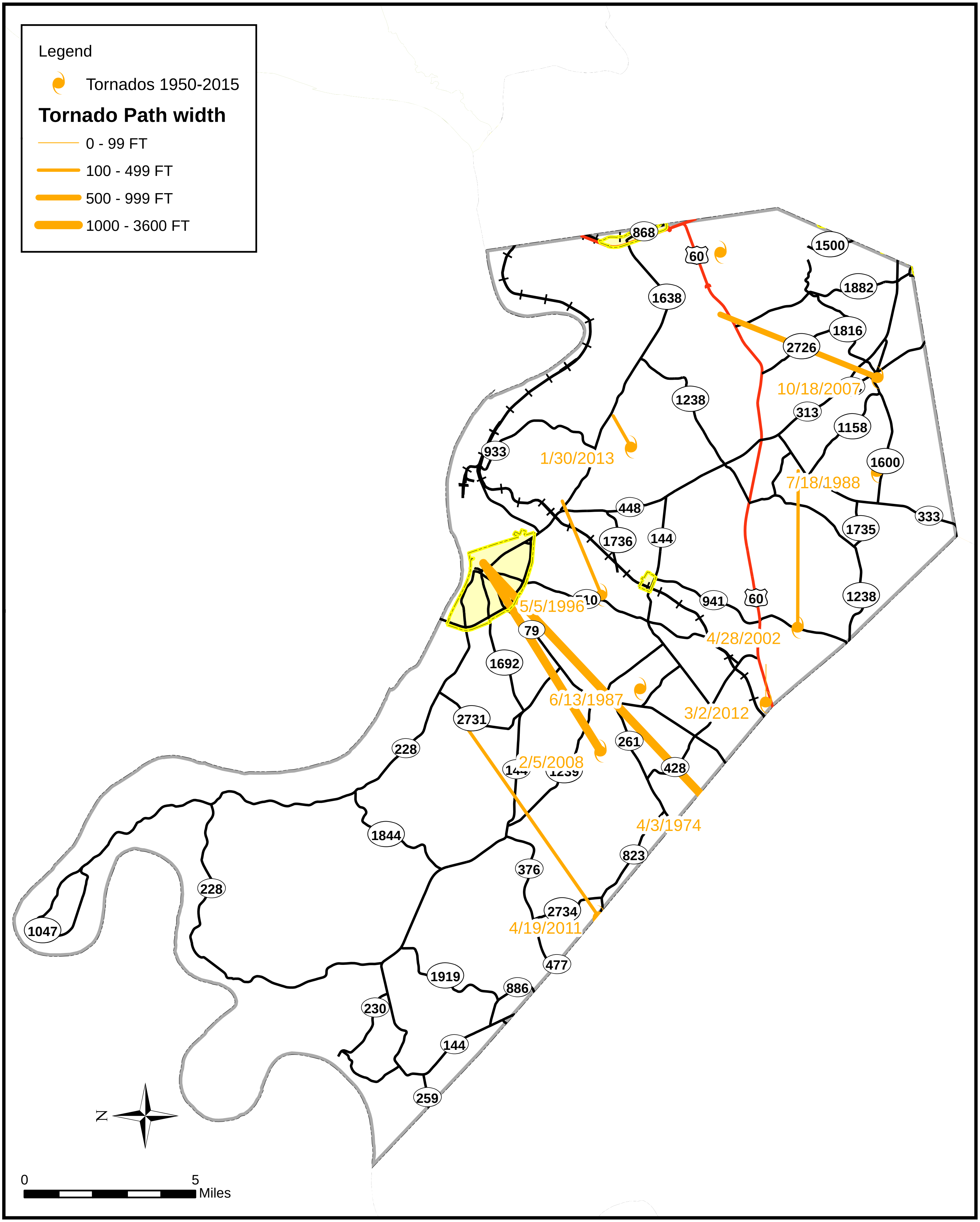


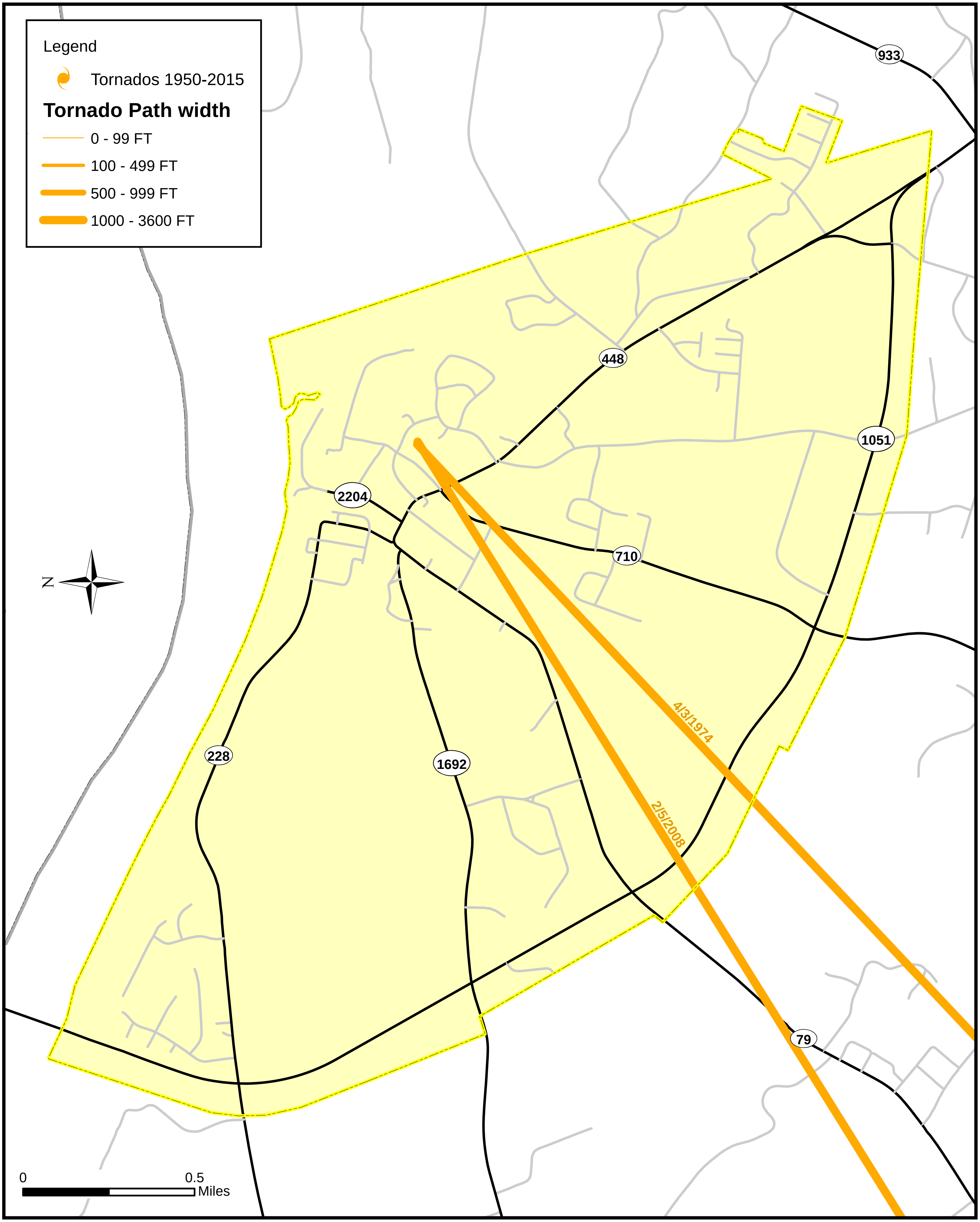
MEADE

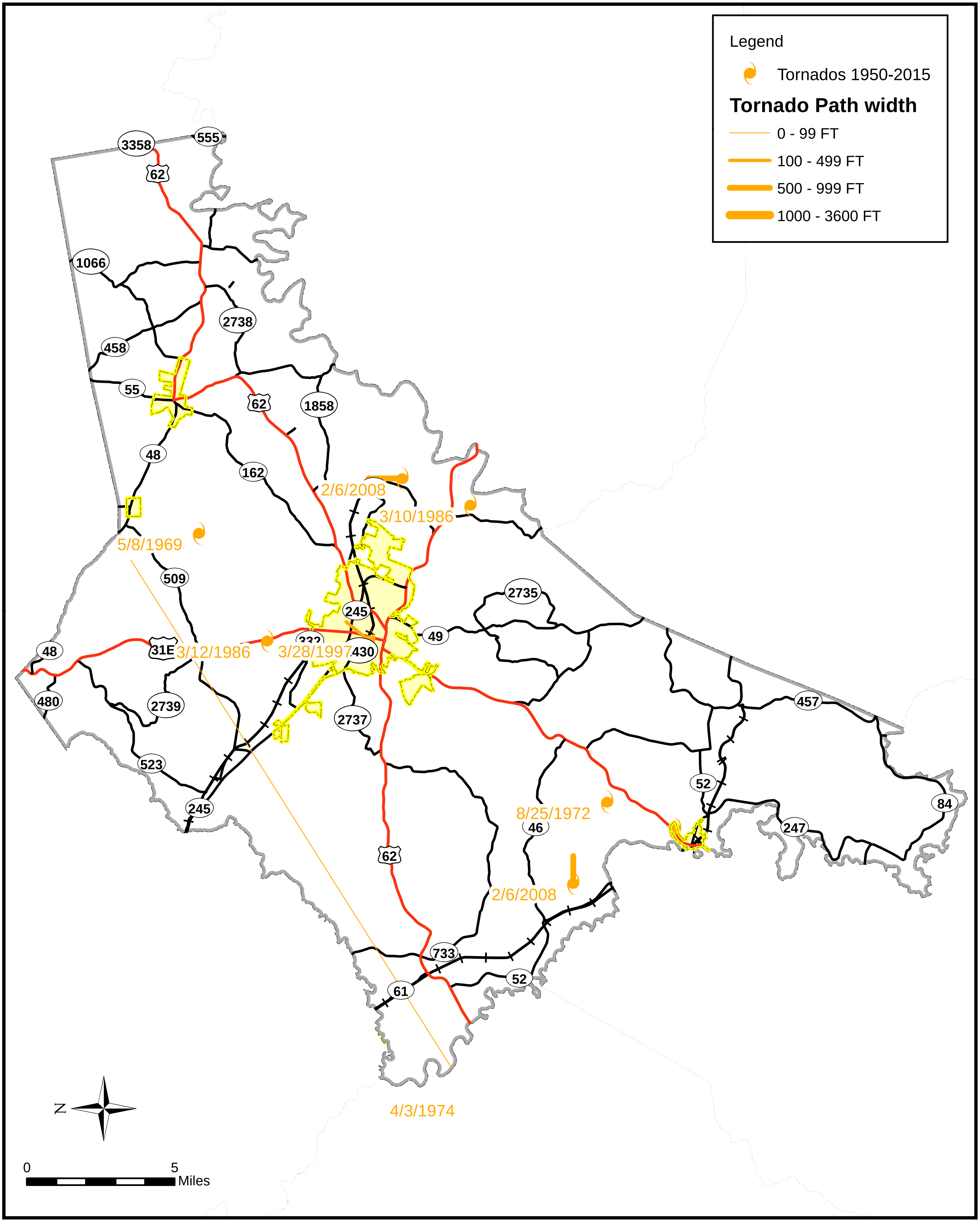
LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE	F SCALE
PAYNEVILLE	4/19/2011	0	0	$0	$0	EF0
GUSTON	3/2/2012	0	0	$2,000	$0	EF0
BUCK GROVE	1/30/2013	0	0	$50,000	$0	EF0

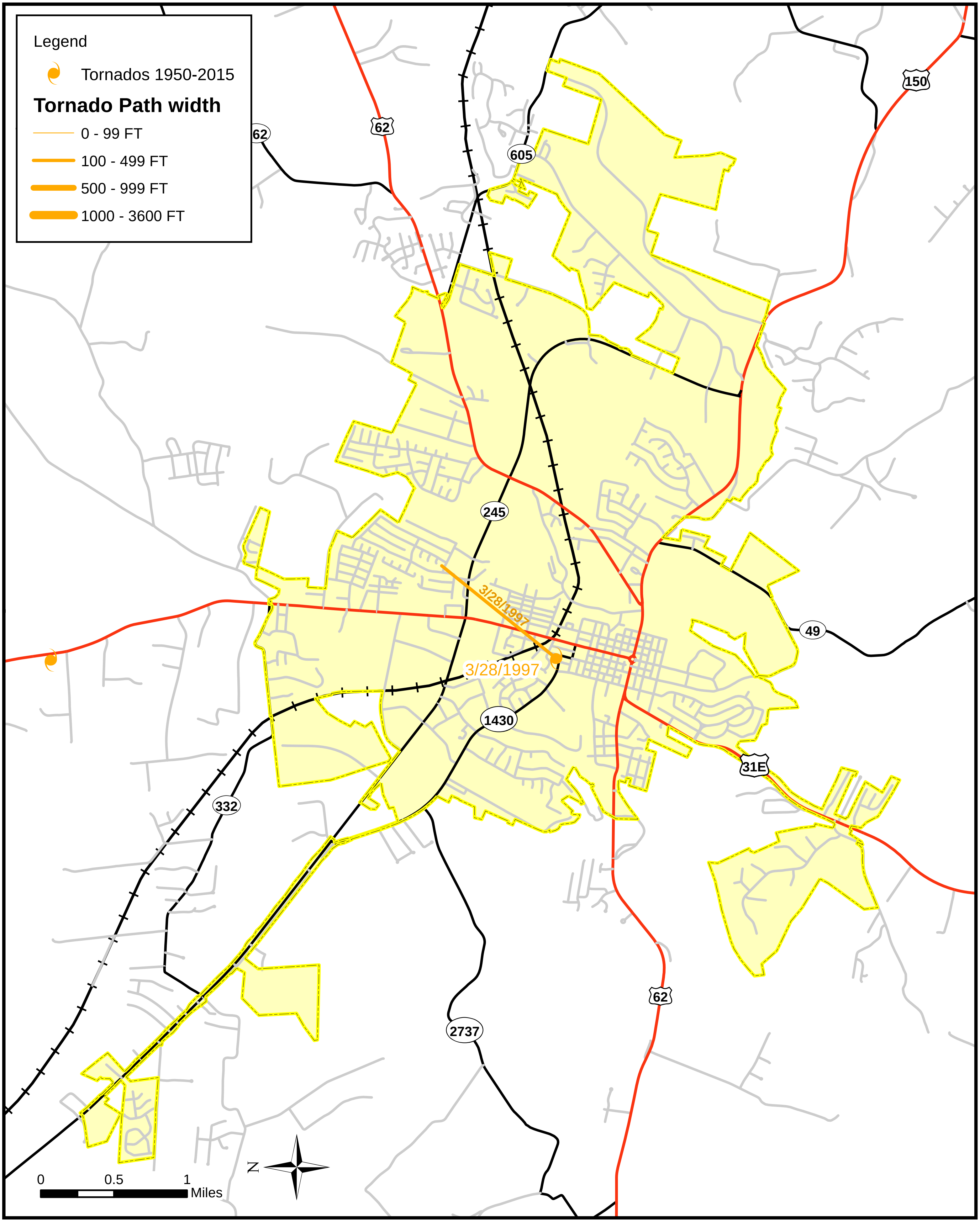
NELSON – No new events recorded 1 July 2009-30 June 2015.

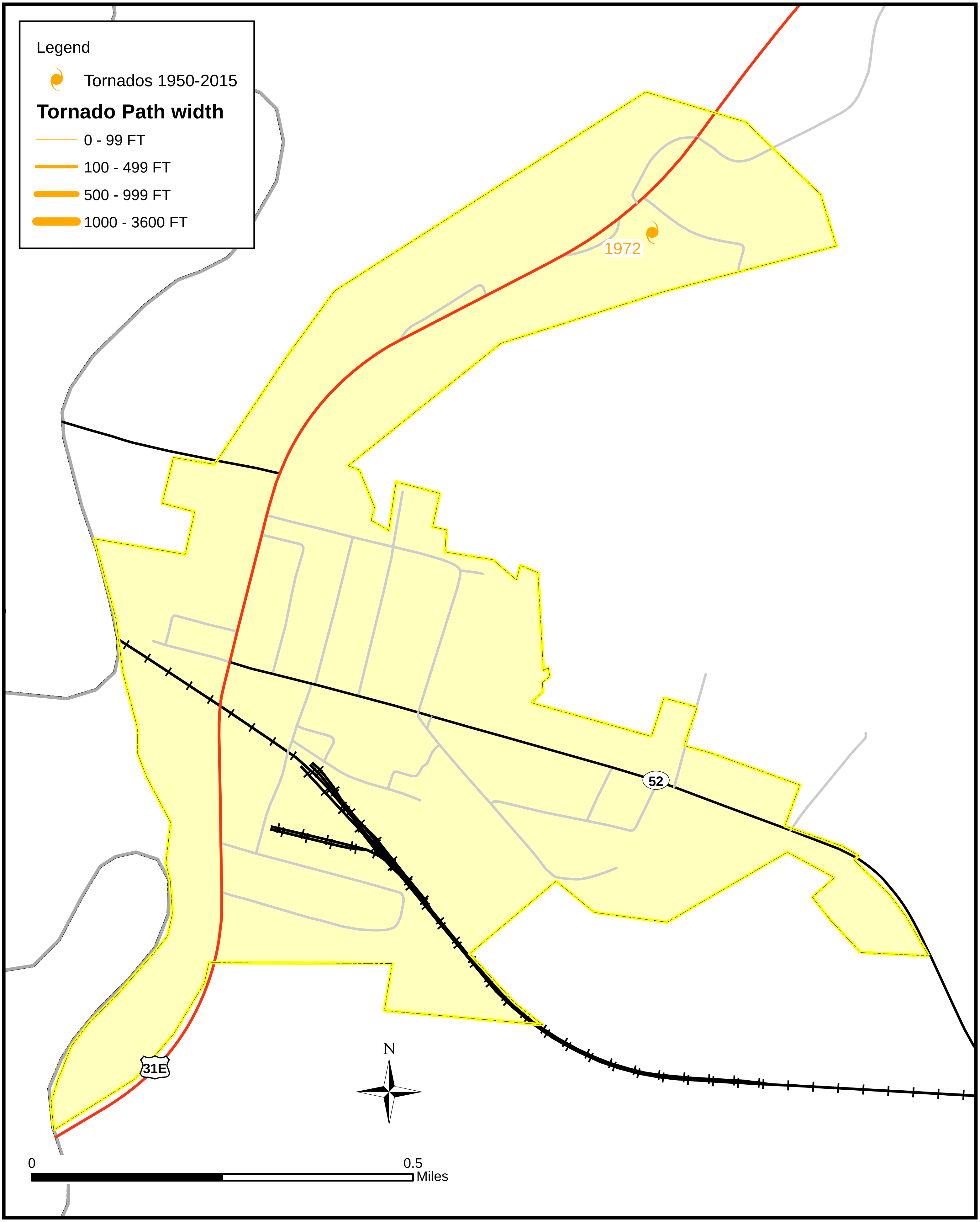
WASHINGTON – No new events recorded 1 July 2009-30 June 2015.

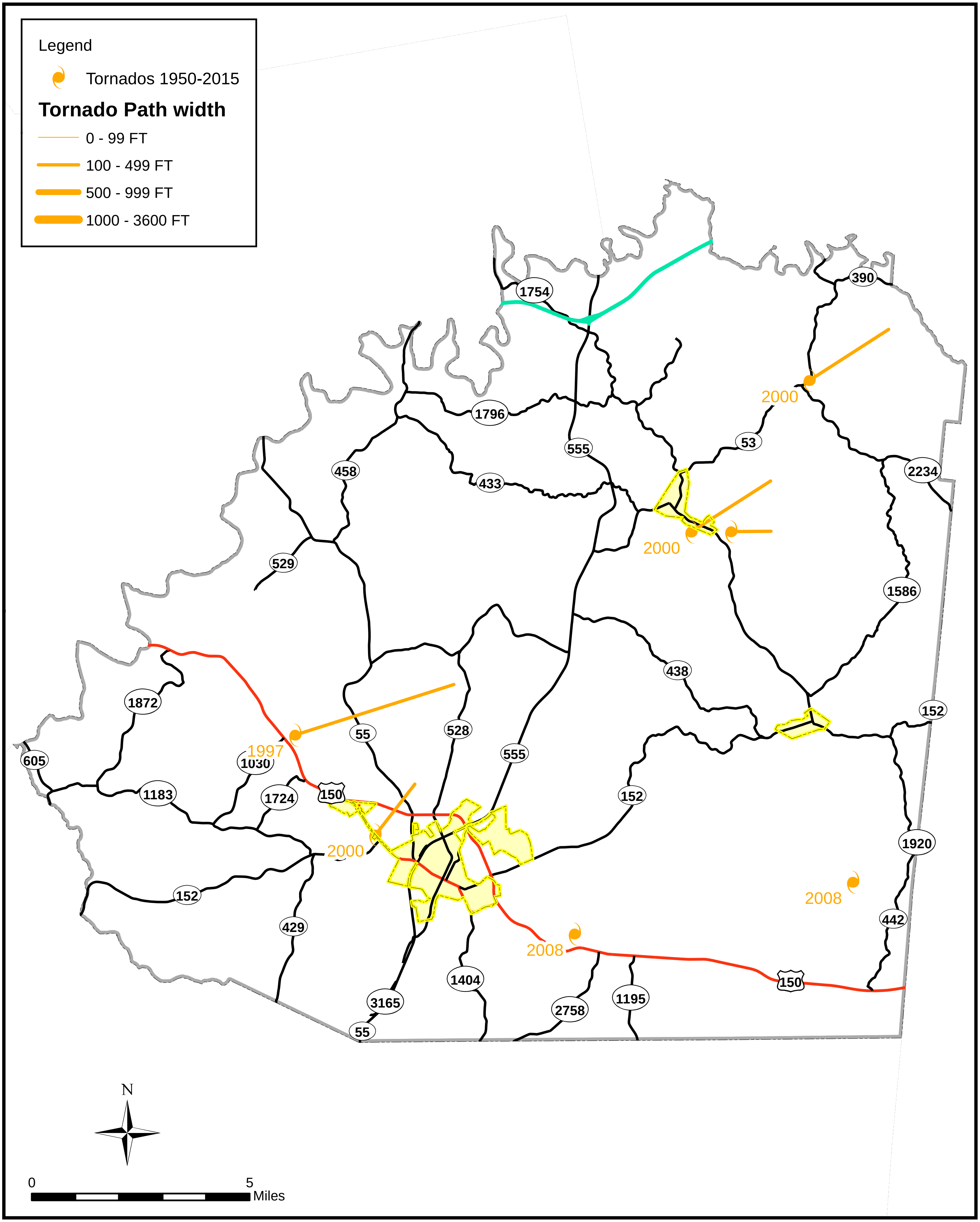

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
10/18/2007
1/30/2013
7/18/1988
5/5/1996
4/28/2002
6/13/1987
3/2/2012
2/5/2008
4/3/1974
4/19/2011
N
0
5
Miles


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
933
448
1051
2204
710
228
1692
79
4/3/1974
2/5/2008
N
0
0.5
Miles

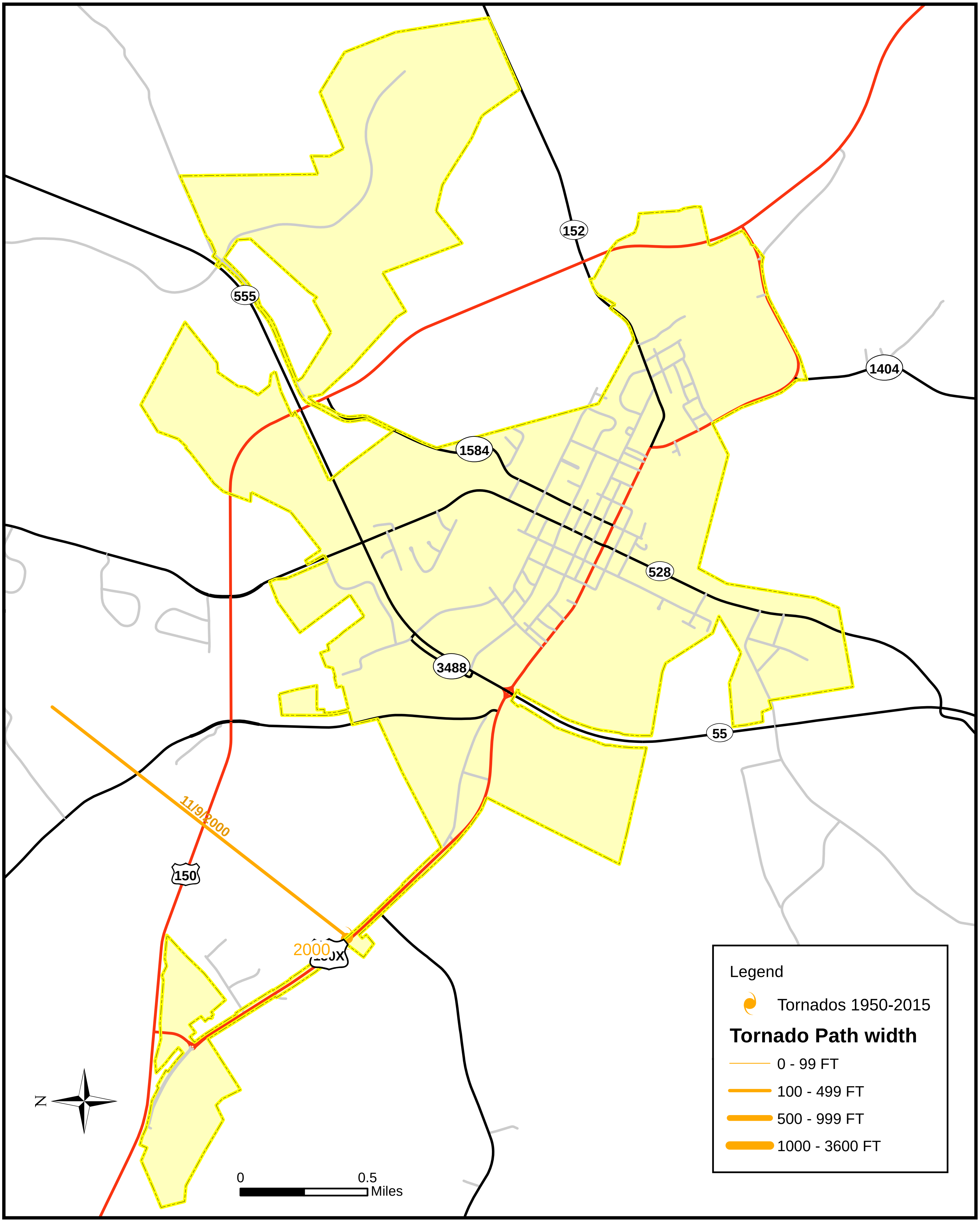

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
2/6/2008
3/10/1986
5/8/1969
3/12/1986
3/28/1997
8/25/1972
2/6/2008
4/3/1974
3358
555
62
1066
2738
458
55
62
1858
48
162
509
2735
245
49
48
31E
332
430
480
2739
2737
457
523
52
84
245
46
247
62
733
52
61
N
0
5
Miles


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
62
62
605
150
245
3/28/1997
3/28/1997
49
1430
31E
332
62
2737
N
0
0.5
1
Miles


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
1972
52
31E
N
0
0.5
Miles


Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
1754
390
1796
555
53
2000
2234
458
433
2000
529
1586
438
152
1872
55
528
1997
605
1030
555
1183
1724
150
152
2000
1920
152
2008
442
429
2008
1404
1195
3165
2758
150
55
N
0
5
Miles

SPRINGFIELD TORNADO



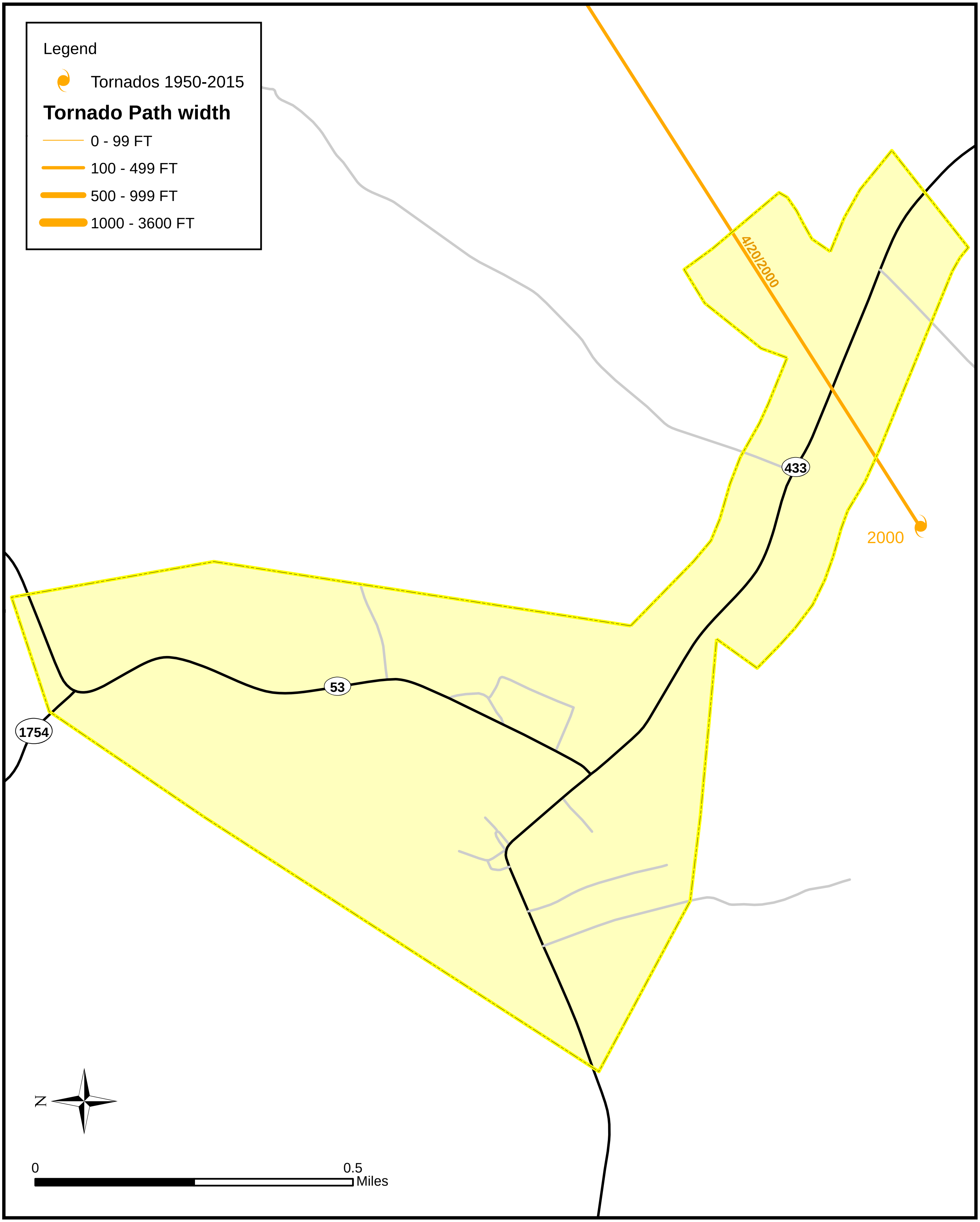

Legend
Tornados 1950-2015
Tornado Path width
0 - 99 FT
100 - 499 FT
500 - 999 FT
1000 - 3600 FT
4/20/2000
2000
433
53
1754
N
0
0.5
Miles

Table 3.3.2.2.4 - Summary of Tornado Data, Costs

TORNADOS	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$5,185,260	16	54.5	1.09	20.00	$95,142	$324,079	0.02	0.07	0.37	1.25
Cloverport	$900,000	2	54.5	1.00	7.00	$16,514	$450,000	0.02	0.50	0.13	3.50
Hardinsburg	$100,000	2	54.5	0.00	0.00	$1,835	$50,000	0.00	0.00	0.00	0.00
Irvington	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
GRAYSON	$56,483,213	15	55.5	3.00	23.09	$1,017,716	$3,765,548	0.05	0.20	0.42	1.54
Caneyville	$0	1	55.5	0.00	0.00	$0	na	0.00	na	0.00	na
Clarkson	$0	0	55.5	0.00	0.00	$0	na	0.00	na	0.00	na
Leitchfield	$50,000,000	1	55.5	0.00	16.00	$900,901	$50,000,000	0.00	0.00	0.29	16.00
HARDIN	$16,118,723	24	54.5	2.00	73.09	$295,756	$671,613	0.04	0.08	1.34	3.05
Elizabethtown	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
Radcliff	$650,000	2	54.5	0.00	0.00	$11,927	$325,000	0.00	0.00	0.00	0.00
Sonora	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
Upton	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
Vine Grove	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
West Point	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
LARUE	$5,110,111	11	62.5	0.00	19.12	$81,762	$464,556	0.00	0.00	0.31	1.74
Hodgenville	$220,000	2	62.5	0.00	0.00	$3,520	na	0.00	na	0.00	na
MARION	$735,833	11	54.5	0.00	4.15	$13,502	$66,894	0.00	0.00	0.08	0.38
Bradfordsville	$100,000	1	54.5	0.00	0.00	$1,835	$100,000	0.00	0.00	0.00	0.00
Lebanon	$100,000	1	54.5	0.00	0.00	$1,835	$100,000	0.00	0.00	0.00	0.00
Loretto	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
Raywick	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
MEADE	$6,142,325	12	54.5	31.00	267.09	$112,703	$511,860	0.57	2.58	4.90	22.26
Brandenburg	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
Ekron	$500,000	1	54.5	0.00	10.00	$9,174	$500,000	0.00	0.00	0.18	10.00
Muldraugh	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
NELSON	$2,033,978	13	54.5	1.00	28.15	$37,321	$156,460	0.02	0.08	0.52	2.17
Bardstown	$50,000	1	54.5	0.00	0.00	$917	$50,000	0.00	0.00	0.00	0.00
Bloomfield	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
Fairfield	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
New Haven	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
WASHINGTON	$1,840,007	11	54.5	0.00	5.15	$33,762	$167,273	0.00	0.00	0.09	0.47
Mackville	$0	0	54.5	0.00	0.00	$0	na	0.00	na	0.00	na
Springfield	$15,000	1	54.5	0.00	0.00	$275	$15,000	0.00	0.00	0.00	0.00
Willisburg	$70,000	2	54.5	0.00	4.00	$1,284	$35,000	0.00	0.00	0.07	2.00
LTADD	$93,649,450	113	56	38.09	439.84	$1,683,586	$828,756	0.68	0.34	7.91	3.89

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

Table 3.3.2.2.5 - Summary of Tornado Data, Events

TORNADOS	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
BRECKINRIDGE	16	54.5	7	10	15	3.41	29.36%	0.7	0.5	0.3
Cloverport	2	54.5	1	2	2	27.25	3.67%	0.1	0.1	0.04
Hardinsburg	2	54.5	1	2	2	27.25	3.67%	0.1	0.1	0.04
Irvington	0	54.5	0	0	0	0.00	0.00%	0	0	0
GRAYSON	15	55.5	5	6	10	3.70	27.03%	0.5	0.3	0.2
Caneyville	1	55.5	1	1	1	55.50	1.80%	0.1	0.05	0.02
Clarkson	0	55.5	0	0	0	0.00	0.00%	0	0	0
Leitchfield	1	55.5	0	1	1	55.50	1.80%	0	0.05	0.02
HARDIN	24	54.5	8	11	21	2.27	44.04%	0.8	0.55	0.42
Elizabethtown	0	54.5	0	0	0	0.00	0.00%	0	0	0
Radcliff	2	54.5	0	1	2	27.25	3.67%	0	0.05	0.04
Sonora	0	54.5	0	0	0	0.00	0.00%	0	0	0
Upton	0	54.5	0	0	0	0.00	0.00%	0	0	0
Vine Grove	0	54.5	0	0	0	0.00	0.00%	0	0	0
West Point	0	54.5	0	0	0	0.00	0.00%	0	0	0
LARUE	11	62.5	4	6	9	5.68	17.60%	0.4	0.3	0.18
Hodgenville	2	62.5	0	0	0	31.25	3.20%	0	0	0
MARION	11	54.5	2	4	8	4.95	20.18%	0.2	0.2	0.16
Bradfordsville	1	54.5	1	1	1	54.50	1.83%	0.1	0.05	0.02
Lebanon	1	54.5	0	1	1	54.50	1.83%	0	0.05	0.02
Loretto	0	54.5	0	0	0	0.00	0.00%	0	0	0
Raywick	0	54.5	0	0	0	0.00	0.00%	0	0	0
MEADE	12	54.5	5	7	10	4.54	22.02%	0.5	0.35	0.2
Brandenburg	0	54.5	0	0	0	0.00	0.00%	0	0	0
Ekron	1	54.5	0	1	1	54.50	1.83%	0	0.05	0.02
Muldraugh	0	54.5	0	0	0	0.00	0.00%	0	0	0
NELSON	13	54.5	2	3	13	4.19	23.85%	0.2	0.15	0.26
Bardstown	1	54.5	0	1	1	54.50	1.83%	0	0.05	0.02
Bloomfield	0	54.5	0	0	0	0.00	0.00%	0	0	0
Fairfield	0	54.5	0	0	0	0.00	0.00%	0	0	0
New Haven	0	54.5	0	0	0	0.00	0.00%	0	0	0
WASHINGTON	11	54.5	5	7	11	4.95	20.18%	0.5	0.35	0.22
Mackville	0	54.5	0	0	0	0.00	0.00%	0	0	0
Springfield	1	54.5	0	1	1	54.50	1.83%	0	0.05	0.02
Willisburg	2	54.5	1	2	2	27.25	3.67%	0.1	0.1	0.04
LTADD	113	56	38	54	97	0.49	203.15%	3.8	2.7	1.94

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

3.3.2.3 <u>Severe Thunderstorms</u>

I. Background

Definition: Thunderstorm. The National Oceanic and Atmospheric Administration (NOAA) defines a thunderstorm as "a rain shower during which you hear thunder. Since thunder comes from lightning, all thunderstorms have lightning."

Severe Thunderstorm: NOAA classifies a thunderstorm as severe " when it contains one or more of the following: hail one inch or greater, winds gusting in excess of 50 knots (57.5 mph), or a tornado."

Cause and Types of Thunderstorms

Three basic ingredients are necessary for a thunderstorm to form: moisture, rising unstable air (air that keeps rising when given a nudge), and a lifting mechanism to provide the "nudge." Lifts can form from fronts, sea breezes or mountains. Upward moving air is an updraft. Cooler air tends to sink and produces downdraft winds. Downdraft winds can result in one of four different storms; single cell, multicell cluster, multicell line, or supercell.

When sun heats the surface of the earth, it warms the air above the ground. If this warm air is forced to rise as a result of "bumping" into cooler or damper air, it will continue to rise for as long as it weighs less and remains warmer than the air around it. As the air rises, it transfers heat from the earth's surface to the upper levels of the atmosphere; a process know as convection. The water vapor in the air begins to cool, releases heat, condenses and forms a cloud. This cloud gradually grows upward into areas where the temperature is below freezing. These Cumulonimbus clouds are also known as "thunderhead" clouds and produce lightning.

As a storm rises up into freezing air, ice particles can form and grow by condensing vapor and collecting smaller liquid drops that haven't yet frozen (a state called "supercooled"). When two ice particles collide, they usually bounce off of each other, but one particle can rip off a little bit of ice from another and grab some electric charge. When lots of these collisions build up big areas of electric charges, it causes a bolt of lightning and creates sound waves that are heard as thunder.

Thunderstorms can occur year-round and at all hours, and happen in every US state. However, they are most likely to occur in the spring and summer months and during the afternoon and evening hours. It is estimated that approximately 1,800 thunderstorms occur across our planet every day. About 100,000 thunderstorms occur in the U.S. each year.

A typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. All thunderstorms produce lightning and are dangerous. Lightning kills between 75 to 100 people annually. Lightning can also cause fires. In addition, thunderstorms can cause flash floods that kill more people each year than hurricanes, tornadoes or lightning. Severe thunderstorms can produce hail up to the size of softballs that damages cars and property, and kills livestock caught out in the open. Strong, straight-line winds associated with thunderstorms knock down trees, power lines and mobile homes. Severe thunderstorms can spawn tornadoes with winds up to 300 mph that can destroy well-built man-made structures.

Shelf Cloud

A shelf cloud is a low, horizontal wedge-shaped cloud associated with a thunderstorm gust front or, occasionally, with a cold front. Shelf clouds can be attached to the front side of lines of storms or even a single storm. Usually, there isn't any persistent rotation on a vertical axis within shelf clouds or within individual cloud fragments that extend down from the shelf cloud. Shelf clouds often resemble snow plows, big waves or tsunamis and can look very threatening.

Meade County Thunderstorm, 10/27/2009, *Source: Meade County Emergency Management Office.*

Single Cell or Pulse Storm

A pulse storm is short-lived and usually lasts 30 to 60 minutes. Pulse storms are common in summer and are usually not severe. Pulse storms may produce heavy rain, thunder, lightning, and possible hail and gusty winds. Brief severe weather is possible during a pulse storm in the form of a microburst. These storms are moderately dangerous to the public and moderately to highly dangerous to aviation.

Multicell Cluster

A multicell cluster is a group of severe or non-severe cells in various stages of development. The most common of thunderstorms, mature thunderstorms are located near the center of the cluster, while dissipating thunderstorms exist on their downwind side. Each cluster may only last 20 minutes, but the storm itself may persist for hours. Multicell cluster storms are stronger than single cell storms, but much weaker than a supercell storm. A multicell cluster is capable of producing moderate-sized hail, flash flooding, and weak tornados.

Multicell Line

A multicell line, also known as squall line, is an elongated line of severe thunderstorms that can form along and/or ahead of a cold front. It has the potential to produce heavy precipitation, hail, frequent lightning, strong straight-line winds, and possibly tornados and waterspouts. Severe weather in the form of strong straight-line winds can be expected in areas of the squall line where the line itself is in the shape of a bow echo and within that portion of the line that bows out the most. Tornados can be found along waves within the line echo wave pattern, or LEWP, where mesoscale low-pressure areas are present.

Supercells

Supercell storms are large, usually severe storms that form in an environment where wind speed or wind direction varies with height (an area of "wind shear"), and they have separate downdrafts and updrafts with a strong, rotating updraft ("mesocyclone"). A supercell storm can be 15 miles wide. Research shows that at least 90% of supercell storms cause severe weather. Sometimes these storms produce F3 or higher tornados, extremely large hail (4 inches in diameter), straight-line winds in excess of 80 mph and flash floods. Supercell storms are the most powerful type of thunderstorm and a danger to the public and aviation.

Visible Warning Signs of Thunderstorms

- Dark, towering, threatening clouds
- Distant lightning and thunder

General Facts

- The National Weather Service estimates that there approximately 1,800 thunderstorms daily, on our planet
- There are about 100,000 thunderstorms annually in the U.S. and about 10% of those are severe
- All thunderstorms are dangerous and produce lightning
- Lightning can reach a temperature of 53,540 degrees Fahrenheit; the surface of sun reaches 10,340 degrees Fahrenheit

Dangers Associated with Thunderstorms

- Cloud to ground lightning
- Hail
- Tornados and Waterspouts
- Flash Floods
- Downbursts (Downburst winds are generally very powerful and are often mistaken for wind speeds produced by tornados. These winds are capable of destroying

unstable or weakly constructed infrastructures, damaging agricultural crops, displacing automobiles, and crashing aircraft engaged in takeoff or landing.

Damaging Winds

According to the National Severe Storms Laboratory, severe and damaging winds can be produced by any type of thunderstorm, even one that is dying. There are several types of damaging wind as outlined below:

Straight-line wind is the term used to define any wind associated with a thunderstorm that is not a result of rotation and tornadic winds.

A **downdraft** is a small-scale column of air that rapidly sinks toward the ground.

A **downburst** is the result of a strong downdraft with horizontal dimensions larger than 2.5 miles that results in an outward burst of damaging wind on or near the ground. A downburst may begin as a microburst and spread out over a larger area. It can produce damage similar to a strong tornado.

A **microburst** is a small concentrated downburst that produces an outward burst of damaging wind at the surface. They are usually small and last only 5 to 10 minutes, with wind speeds up to 168 mph.

The leading edge of rain-cooled air that clashes with warmer thunderstorm inflow is called a **gust front.** Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. At times, these winds push up air above them and form a shelf cloud or detached roll cloud.

A **derecho** is a widespread, long-lived wind storm associated with a band of rapidly moving showers or thunderstorms. It consists of numerous microbursts, downbursts, and clusters of downbursts. A derecho includes winds of at least 58 mph or greater and a swath of damage that extends more than 240 miles, by definition.

A wall of dust that is pushed out along the ground from a thunderstorm downdraft at high speeds is called a **haboob**.

Table 3.3.2.3.1 - International Tornado Intensity Scale (TORRO)	
Tornado Intensity	Description of Tornado and Windspeeds
T0	Light Tornado 17 – 24 m s-1 (39 – 54 mi h-1)
T1	Mild Tornado 25 – 32 m s-1 (55 – 72 mi h-1)
T2	Moderate Tornado 33 – 41 m s-2 (73 – 92 mi h-1)
T3	Strong Tornado 42 – 51 m s-1 (93 – 114 mi h-1)
T4	Severe Tornado 52 – 61 m s-1 (115 – 136 mi h-1)
T5	Intense Tornado 62 – 72 m s-1 (127 – 160 mi h-1)
T6	Moderately-Devastating Tornado 73 – 83 m s-1 (161 – 186 mi h-1)
T7	Strongly-Devastating Tornado 84 – 95 m s-1 (187 – 212 mi h-1)
T8	Severely-Devastating Tornado 96 – 107 m s-1 (213 – 240 mi h-1)
T9	Intensely-Devastating Tornado 108 – 120 mi s-1 (241 – 269 mi h-1)
T10	Super Tornado 121 – 134 m s-1 (270 – 299 mi h-1)
Source: The Tornado and Storm Research Organization	

II. Anaylsis

To analyze severe thunderstorms as a threat to the Lincoln Trail Region, the generalized threat of thunderstorms was identified by reviewing historical data on wind and hail events.

The following tables outline the mean number of days precipitation and thunderstorms occur in an average year and the history of thunderstorms that have been recorded in a given county/jurisdiction within the Lincoln Trail region since 1960. The level of impact is evidenced through the number of lives lost or individual injuries recorded, as well as the estimated cost of property and crop damage based on information reported to the National Climate Data Center which was subsequently rolled into the National Centers for Environmental Information (NCEI). For the original plan, data was only available through 2003. The 2010 update provided data thru 30 June 2009. This update shows only individual events for the period 1 July 2009 through 30 June 2015. The summary tables show data for the entire period as reported by various sources. Note that there are many variations in recording the locations of the events over time. In the past this was typically done at a county level. More recently they have used nearest place names. Because of this, the records in the summation tables that pertain to individual incorporated areas, should not be considered all encompassing.

Table 3.3.2.3.2 - County Specific Data – Severe Thunderstorms, *Source: NCEI*

BRECKINRIDGE

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
CLOVERPORT	8/4/2009	0	0	$0	$0
HARNED	8/4/2009	0	0	$0	$0
BIG SPG	5/21/2010	0	0	$5,000	$0
CLOVERPORT	6/15/2010	0	0	$0	$0
CLOVERPORT	7/19/2010	0	0	$0	$0
HARDINSBURG ARPT	7/19/2010	0	0	$0	$0
HIGH PLAINS	8/12/2010	0	0	$0	$0
ROFF	8/14/2010	0	0	$0	$0
FALLS OF ROUGH	2/28/2011	0	0	$0	$0
HARDINSBURG ARPT	4/19/2011	0	0	$0	$0
HARDINSBURG ARPT	4/19/2011	0	0	$0	$0
WEBSTER	4/19/2011	0	0	$0	$0
HARDINSBURG	5/25/2011	0	0	$0	$0
MC QUADY	6/27/2011	0	0	$0	$0
CLOVERPORT	1/17/2012	0	0	$0	$0
HARDINSBURG ARPT	1/17/2012	0	0	$2,000	$0
HARNED	1/17/2012	0	0	$8,000	$0
MC QUADY	1/17/2012	0	0	$2,000	$0
ROFF	1/17/2012	0	0	$0	$0
CLOVERPORT	1/23/2012	0	0	$0	$0
CLOVERPORT	7/1/2012	0	0	$0	$0
BIG SPG	7/18/2012	0	0	$0	$0
CUSTER	7/18/2012	0	0	$0	$0
FALLS OF ROUGH	1/30/2013	0	0	$0	$0
CLOVERPORT	6/26/2013	0	0	$5,000	$0
MC DANIELS	6/26/2013	0	0	$0	$0
MC QUADY	6/26/2013	0	0	$2,000	$0
STEPHENSPORT	6/26/2013	0	0	$0	$0
GARFIELD	7/10/2013	0	0	$0	$0
HARDINSBURG ARPT	12/21/2013	0	0	$0	$0
MC DANIELS	12/21/2013	0	0	$0	$0
IRVINGTON	7/26/2014	0	0	$0	$0
IRVINGTON	7/26/2014	0	0	$30,000	$0

GRAYSON

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
LEITCHFIELD	5/15/2010	0	0	$5,000	$0
CLARKSON	6/2/2010	0	0	$0	$0
ROYAL	10/26/2010	0	0	$0	$0
SADLER	10/26/2010	0	0	$0	$0
LEITCHFIELD	4/19/2011	0	0	$0	$0
LEITCHFIELD	4/19/2011	0	0	$0	$0
CANEYVILLE	4/26/2011	0	0	$0	$0
LEITCHFIELD	4/26/2011	0	0	$0	$0
CLARKSON	5/12/2011	0	0	$0	$0
CLARKSON	5/22/2011	0	0	$0	$0
LEITCHFIELD	1/23/2012	0	0	$0	$0
CANEYVILLE	3/2/2012	0	0	$0	$0
CANEYVILLE	3/2/2012	0	0	$0	$0
LEITCHFIELD	5/5/2012	0	0	$10,000	$0
SHREWSBURY	7/19/2012	0	0	$0	$0
CANEYVILLE	1/30/2013	0	0	$10,000	$0
SKAGGSTOWN	6/23/2014	0	0	$0	$0
SHREWSBURY	5/30/2015	0	0	$0	$0

HARDIN

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
ELIZABETH TOWN	8/4/2009	0	0	$0	$0
STEPHENSBURG	8/4/2009	0	0	$3,000	$0
ELIZABETH TOWN	10/9/2009	0	0	$0	$0
RINEYVILLE	10/9/2009	0	0	$0	$0
SONORA	10/9/2009	0	0	$0	$0
FRANKLIN XRDS	4/7/2010	0	0	$0	$0
FLINT HILL	6/2/2010	0	0	$0	$0
RINEYVILLE	8/12/2010	0	0	$0	$0
ELIZABETH TOWN	10/26/2010	0	0	$0	$0
RADCLIFF	4/4/2011	0	0	$0	$0
ST JOHN	4/4/2011	0	0	$0	$0
ELIZABETH TOWN	4/19/2011	0	0	$0	$0
GLENDALE	4/26/2011	0	0	$0	$0
ELIZABETH TOWN	6/27/2011	0	0	$0	$0
ROGERSVILLE	1/23/2012	0	0	$0	$0
(FTK)GODMAN AAF FT K	3/2/2012	0	0	$0	$0
ELIZABETH TOWN	3/2/2012	0	0	$0	$0
GAITHERS	3/2/2012	0	0	$0	$0
SONORA	3/2/2012	0	0	$0	$0
ROGERSVILLE	3/15/2012	0	0	$0	$0
ROGERSVILLE	7/8/2012	0	0	$0	$0
FRANKLIN XRDS	7/19/2012	0	0	$0	$0
VINE GROVE JCT	7/19/2012	0	0	$0	$0
ROGERSVILLE	7/26/2012	0	0	$0	$0
ELIZABETH TOWN	7/27/2012	0	0	$0	$0
VINE GROVE	7/27/2012	0	0	$10,000	$0
RADCLIFF	9/7/2012	0	0	$0	$0
(FTK)GODMAN AAF FT K	1/30/2013	0	0	$0	$0
(FTK)GODMAN AAF FT K	6/17/2013	0	0	$0	$0
CECILIA	6/26/2013	0	0	$2,000	$0
ELIZABETH TOWN	6/26/2013	0	0	$2,000	$0
ROGERSVILLE	6/26/2013	0	0	$0	$0
CREST	7/10/2013	0	0	$0	$0
TUNNEL HILL	9/11/2013	0	0	$0	$0
ELIZABETH TOWN	12/21/2013	0	0	$0	$0
FRANKLIN XRDS	12/21/2013	0	0	$0	$0

HOWE VLY	12/21/2013	0	0	$1,000	$0
ROGERSVILLE	12/21/2013	0	0	$0	$0
VINE GROVE	12/21/2013	0	0	$0	$0
RED HILL	5/22/2014	0	0	$150,000	$0
ELIZABETH TOWN	7/26/2014	0	0	$0	$0
ROGERSVILLE	7/26/2014	0	0	$0	$0
WEST PT	7/26/2014	0	0	$0	$0
VINE GROVE	8/23/2014	0	0	$0	$0
CECILIA	10/6/2014	0	0	$0	$0
HARDIN CO.	4/7/2015	0	0	$0	$0
HARDIN CO.	4/7/2015	0	0	$0	$0

LARUE

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
LARUE (ZONE)	10/31/2013	0	0	$10,000	$0
LYONS	10/9/2009	0	0	$0	$0
BARREN RUN	4/24/2010	0	0	$0	$0
HODGENVILLE	4/24/2010	0	0	$0	$0
LEAFDALE	4/24/2010	0	0	$0	$0
TONIEVILLE	4/24/2010	0	0	$0	$0
BUFFALO	7/10/2010	0	0	$0	$0
BARREN RUN	10/26/2010	0	0	$0	$0
MAGNOLIA	2/24/2011	0	0	$0	$0
MAGNOLIA	2/24/2011	0	0	$0	$0
MAGNOLIA	2/28/2011	0	0	$0	$0
MAGNOLIA	4/4/2011	0	0	$0	$0
JERICHO	4/20/2011	0	0	$0	$0
MAGNOLIA	4/20/2011	0	0	$0	$0
WHITE CITY	1/17/2012	0	0	$0	$0
HODGENVILLE	7/19/2012	0	0	$0	$0
BUFFALO	7/26/2012	0	0	$0	$0
HODGENVILLE	7/26/2012	0	0	$0	$0
HODGENVILLE	7/27/2012	0	0	$10,000	$0
MAXINE	5/13/2014	0	0	$30,000	$0
HODGENVILLE	5/22/2014	0	0	$100,000	$0
LEAFDALE	5/22/2014	0	0	$0	$0
MAGNOLIA	7/26/2014	0	0	$0	$0
BUFFALO	7/27/2014	0	0	$0	$0
LEAFDALE	10/6/2014	0	0	$0	$0

MARION

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
MARION (ZONE)	12/9/2009	0	0	$0	$0
LORETTO	10/9/2009	0	0	$0	$0
LEBANON	4/24/2010	0	0	$0	$0
LEBANON	8/14/2010	0	0	$0	$0
LEBANON	10/26/2010	0	0	$0	$0
LEBANON	4/26/2011	0	0	$0	$0
LEBANON	8/18/2011	0	0	$0	$0
ST MARY	9/4/2011	0	0	$0	$0
PENICKS	1/23/2012	0	0	$0	$0
BRADFORDSVILLE	7/1/2012	0	0	$0	$0
NEW MARKET	7/26/2012	0	0	$0	$0
GRAVEL SWITCH	6/26/2013	0	0	$1,000	$0
LEBANON	7/10/2013	0	0	$0	$0
RAYWICK	7/10/2013	0	0	$0	$0
LORETTO	7/13/2013	0	0	$0	$0

MEADE

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
BATTLETOWN	10/26/2010	0	0	$0	$0
BRANDENBURG	10/26/2010	0	0	$0	$0
EKRON	3/23/2011	0	0	$0	$0
BRANDENBURG	4/19/2011	0	0	$0	$0
MULDRAUGH	4/23/2011	0	0	$0	$0
BATTLETOWN	6/19/2011	0	0	$0	$0
FLAHERTY	6/19/2011	0	0	$0	$0
BRANDENBURG	6/22/2011	0	0	$0	$0
BRANDENBURG	2/29/2012	0	0	$0	$0
MIDWAY	2/29/2012	0	0	$0	$0
BRANDENBURG	3/2/2012	0	0	$0	$0
MIDWAY	3/15/2012	0	0	$0	$0
DOE VLY ESTATES	5/29/2012	0	0	$0	$0
SIROCCO	5/29/2012	0	0	$25,000	$0
BATTLETOWN	5/31/2012	0	0	$0	$0
BRANDENBURG	7/8/2012	0	0	$0	$0
BRANDENBURG	7/19/2012	0	0	$0	$0
BRANDENBURG	7/27/2012	0	0	$0	$0
FLAHERTY	7/27/2012	0	0	$10,000	$0
EKRON	9/7/2012	0	0	$0	$0
EKRON	9/7/2012	0	0	$0	$0
BATTLETOWN	1/30/2013	0	0	$0	$0
BRANDENBURG	7/10/2013	0	0	$0	$0
BRANDENBURG	7/10/2013	0	0	$0	$0
BRANDENBURG	7/26/2014	0	0	$0	$0
MEADE CO.	4/7/2015	0	0	$100,000	$0
MEADE CO.	4/7/2015	0	0	$0	$0

NELSON

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
BARDSTOWN	8/4/2010	0	0	$0	$0
BLOOMFIELD	9/7/2010	0	0	$0	$0
COXS CREEK	9/7/2010	0	0	$10,000	$0
FAIRFIELD	9/7/2010	0	0	$0	$0
BLOOMFIELD	10/26/2010	0	0	$0	$0
BALLTOWN	4/9/2011	0	0	$0	$0
BARDSTOWN	4/20/2011	0	0	$0	$0
BARDSTOWN	4/26/2011	0	0	$0	$0
HIGHGROVE	7/19/2011	0	0	$3,000	$0
BARDSTOWN	8/13/2011	0	0	$0	$0
HIGHGROVE	1/17/2012	0	0	$0	$0
BALLTOWN	3/2/2012	0	0	$0	$0
BOURBON SPGS	5/4/2012	0	0	$0	$0
BOSTON	7/18/2012	0	0	$40,000	$0
GREENBRIER	7/18/2012	0	0	$0	$0
BARDSTOWN ARPT	7/19/2012	0	0	$0	$0
BOTLAND	7/19/2012	0	0	$0	$0
CHAPLIN	7/19/2012	0	0	$0	$0
CHAPLIN	7/26/2012	0	0	$0	$0
CHAPLIN	7/1/2013	0	0	$0	$0
CRAVENS	7/10/2013	0	0	$0	$0
WOODLAWN	8/12/2013	0	0	$0	$0
BARDSTOWN	12/21/2013	0	0	$0	$0
BARDSTOWN	4/27/2014	0	0	$0	$0
BARDSTOWN	7/26/2014	0	0	$0	$0

WASHINGTON

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
SPRINGFIELD	4/24/2010	0	0	$0	$0
ST CATHERINE	4/20/2011	0	0	$0	$0
MAUD	5/23/2011	0	0	$0	$0
SPRINGFIELD	6/19/2011	0	0	$0	$0
WILLISBURG	8/8/2011	0	0	$0	$0
WILLISBURG	7/1/2012	0	0	$0	$0
WASHINGTON CO.	4/7/2015	0	0	$0	$0
WASHINGTON CO.	4/7/2015	0	0	$0	$0

Table 3.3.2.3.3 **- Summary of Thunderstorm/Winds Data, Costs**

THUNDERSTORMS WINDS	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$1,211,803	206	54.5	0.25	2.21	$22,235	$5,883	0.00	0.00	0.04	0.01
Cloverport	$5,000	10	54.5	0	0	$92	$500	0.00	0.00	0.00	0.00
Hardinsburg	$105,000	24	54.5	0	0	$1,927	$4,375	0.00	0.00	0.00	0.00
Irvington	$55,000	5	54.5	0	0	$1,009	$11,000	0.00	0.00	0.00	0.00
GRAYSON	$1,215,287	196	56.5	0.25	6.62	$21,510	$6,200	0.00	0.00	0.12	0.03
Caneyville	$0	20	56.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Clarkson	$0	6	56.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Leitchfield	$202,000	27	56.5	0	0	$3,575	$7,481	0.00	0.00	0.00	0.00
HARDIN	$64,735,949	300	58.5	4.45	133.17	$1,106,597	$215,786	0.08	0.01	2.28	0.44
Elizabethtown	$80,000	35	58.5	0	0	$1,368	$2,286	0.00	0.00	0.00	0.00
Radcliff	$5,050,000	13	58.5	0	46	$86,325	$388,462	0.00	0.00	0.79	3.54
Sonora	$1,000	8	58.5	0	0	$17	$125	0.00	0.00	0.00	0.00
Upton	$0	1	58.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Vine Grove	$50,020,000	10	58.5	0	0	$855,043	$5,002,000	0.00	0.00	0.00	0.00
West Point	$0	4	58.5	0	0	$0	$0	0.00	0.00	0.00	0.00
LARUE	$1,509,787	193	54.5	1.32	11.6	$27,703	$7,823	0.02	0.01	0.21	0.06
Hodgenville	$150,000	20	54.5	0	0	$2,752	$7,500	0.00	0.00	0.00	0.00
MARION	$1,247,735	180	54.5	0.24	1.63	$22,894	$6,932	0.00	0.00	0.03	0.01
Bradfordsville	$0	1	54.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Lebanon	$175,000	25	54.5	0	0	$3,211	$7,000	0.00	0.00	0.00	0.00
Loretto	$10,000	4	54.5	0	0	$183	$2,500	0.00	0.00	0.00	0.00
Raywick	$0	2	54.5	0	0	$0	$0	0.00	0.00	0.00	0.00
MEADE	$1,679,733	208	55.5	3.45	46.26	$30,265	$8,076	0.06	0.02	0.83	0.22
Brandenburg	$57,000	22	55.5	0	0	$1,027	$2,591	0.00	0.00	0.00	0.00
Ekron	$0	4	55.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Muldraugh	$10,000	4	55.5	0	0	$180	$2,500	0.00	0.00	0.00	0.00
NELSON	$1,404,130	228	54.5	0.3	12.58	$25,764	$6,158	0.01	0.00	0.23	0.06
Bardstown	$55,000	41	54.5	0	0	$1,009	$1,341	0.00	0.00	0.00	0.00
Bloomfield	$0	3	54.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Fairfield	$0	1	54.5	0	0	$0	$0	0.00	0.00	0.00	0.00
New Haven	$50,000	3	54.5	0	0	$917	$16,667	0.00	0.00	0.00	0.00
WASHINGTON	$1,453,572	168	54.5	0.22	3.58	$26,671	$8,652	0.00	0.00	0.07	0.02
Mackville	$175,000	4	54.5	0	0	$3,211	$43,750	0.00	0.00	0.00	0.00
Springfield	$70,000	16	54.5	0	0	$1,284	$4,375	0.00	0.00	0.00	0.00
Willisburg	$1,000	7	54.5	0	0	$18	$143	0.00	0.00	0.00	0.00
LTADD	$74,457,996	1679	58.5	10.48	217.65	$1,272,786	$44,347	0.18	0.01	3.72	0.13

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

Table 3.3.2.3.4 **- Summary of Thunderstorm/Winds Data, Events**

THUNDERSTORMS WINDS	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
BRECKINRIDGE	206	54.5	53	95	195	0.26	377.98%	5.3	4.75	3.9
Cloverport	10	54.5	8	10	10	5.45	18.35%	0.8	0.5	0.2
Hardinsburg	24	54.5	9	21	24	2.27	44.04%	0.9	1.05	0.48
Irvington	5	54.5	3	4	5	10.90	9.17%	0.3	0.2	0.1
GRAYSON	196	56.5	41	78	185	0.29	346.90%	4.1	3.9	3.7
Caneyville	20	56.5	12	20	20	2.83	35.40%	1.2	1	0.4
Clarkson	6	56.5	4	6	6	9.42	10.62%	0.4	0.3	0.12
Leitchfield	27	56.5	12	26	27	2.09	47.79%	1.2	1.3	0.54
HARDIN	300	58.5	70	139	285	0.20	512.82%	7	6.95	5.7
Elizabethtown	35	58.5	18	35	35	1.67	59.83%	1.8	1.75	0.7
Radcliff	13	58.5	3	12	13	4.50	22.22%	0.3	0.6	0.26
Sonora	8	58.5	4	8	8	7.31	13.68%	0.4	0.4	0.16
Upton	1	58.5	0	1	1	58.50	1.71%	0	0.05	0.02
Vine Grove	10	58.5	4	9	10	5.85	17.09%	0.4	0.45	0.2
West Point	4	58.5	3	4	4	14.63	6.84%	0.3	0.2	0.08
LARUE	193	54.5	36	64	176	0.28	354.13%	3.6	3.2	3.52
Hodgenville	20	54.5	9	20	20	2.73	36.70%	0.9	1	0.4
MARION	180	54.5	22	55	62	0.30	330.28%	2.2	2.75	1.24
Bradfordsville	1	54.5	1	1	1	54.50	1.83%	0.1	0.05	0.02
Lebanon	25	54.5	10	24	25	2.18	45.87%	1	1.2	0.5
Loretto	4	54.5	4	4	4	13.63	7.34%	0.4	0.2	0.08
Raywick	2	54.5	1	2	2	27.25	3.67%	0.1	0.1	0.04
MEADE	208	55.5	46	84	196	0.27	374.77%	4.6	4.2	3.92
Brandenburg	22	55.5	13	22	22	2.52	39.64%	1.3	1.1	0.44
Ekron	4	55.5	4	4	4	13.88	7.21%	0.4	0.2	0.08
Muldraugh	4	55.5	2	4	4	13.88	7.21%	0.2	0.2	0.08
NELSON	228	54.5	45	51	210	0.24	418.35%	4.5	2.55	4.2
Bardstown	41	54.5	18	40	41	1.33	75.23%	1.8	2	0.82
Bloomfield	3	54.5	3	3	3	18.17	5.50%	0.3	0.15	0.06
Fairfield	1	54.5	1	1	1	54.50	1.83%	0.1	0.05	0.02
New Haven	3	54.5	0	2	3	18.17	5.50%	0	0.1	0.06
WASHINGTON	168	54.5	18	45	150	0.32	308.26%	1.8	2.25	3
Mackville	4	54.5	2	4	4	13.63	7.34%	0.2	0.2	0.08
Springfield	16	54.5	5	15	15	3.41	29.36%	0.5	0.75	0.3
Willisburg	7	54.5	3	7	7	7.79	12.84%	0.3	0.35	0.14
LTADD	1679	58.5	331	611	1459	0.03	2870.09%	33.1	30.55	29.18

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

3.3.2.4 <u>Severe Winter Storms</u>

I. Background

Definitions:

Winter Storm: According to the National Severe Storms Laboratory (NSSL), a winter storm is an event in which the main types of precipitation are snow, sleet or freezing rain. A winter storm is a combination of heavy snow, blowing snow and/or dangerous wind chills. A winter storm can be a life-threatening event. A **severe winter storm** consists of one or more of the following elements; blinding wind-driven snow, extreme cold, icy roads, avalanches and downed trees and power lines. All winter storms can be dangerous and result in injuries, loss of life and property damage. The effects of a winter storm can impact a region for extended periods of time. Most deaths from winter storms are not a direct result of the storm itself, but rather a result of traffic accidents on icy roads, heart attacks while shoveling snow and hypothermia from prolonged exposure to cold.

Winter storms form just like any other storm at other times of the year. The right combination of ingredients is necessary for a winter storm to develop. The three basic components of a winter storm are cold air, lift and moisture. Below freezing temperatures in the clouds and near the ground are essential to make snow and/or ice. Lift is necessary to raise moist air to form clouds and cause precipitation. Lift occurs when warm air collides with cold air and is forced to rise over the cold dome. The boundary between a warm and cold air mass is called a front. Moisture must be present to form clouds and result in precipitation. Air moving across a lake or large body of water such as an ocean, is an excellent source of moisture.

Blizzard: A blizzard is a dangerous winter storm composed of a combination of blowing snow and wind that results in very low visibility. Heavy snowfalls and severe cold often accompany blizzards, but are not required elements. At times, strong wind picks up ground snow and creates a ground blizzard. Blizzards contain winds over 35 mph and reduce visibility to ¼ miles or less for at least three hours.

Ice Storm: An ice storm results in the accumulation of at least .25" of ice on exposed surfaces. Ice storms create hazardous driving and walking conditions. Power outages and property damage can occur when tree branches and power lines snap under the weight of the accumulated ice.

Snow: Snowflakes are collections of ice crystals that cling to each other as they fall to the ground. Wintertime clouds will produce snow as long as the top layer of the storm is cold enough to create snowflakes. Precipitation will continue to fall as snow when the temperature remains at or below 0 degrees Celsius. The following is a summary of snow events:

- Snow Flurries: Light snow falling for a short duration and resulting in no accumulation or a light dusting

- Snow Shower: Snow falling at differing intensities for brief periods of time with some accumulation possible
- Snow Squall: A brief, intense snow shower, accompanied by strong and gusty winds with possible significant accumulation, defines a snow squall. This event usually occurs in the Great Lakes Region.
- Blowing Snow: Wind driven snow that reduces visibility and causes significant drifting. Blowing snow may occur when snow is falling and/or loose ground snow is picked up by the wind.

Sleet: Sleet occurs when snowflakes partially melt when falling through a shallow layer of warm air resulting in slushy drops that refreeze as they fall through a deep layer of freezing air above the surface and reach the ground as frozen rain drops that bounce on impact.

Freezing Rain/Ice Storm: Freezing rain occurs when snowflakes fall through a warmer layer of air and melt completely. When this rain falls through another thin layer of freezing air just above the surface of the ground, it doesn't have time to refreeze before hitting the ground. Because the rain is "supercooled," it instantly freezes upon contact with anything that is at or below 0 degrees C, and creates a glaze of ice on the ground, trees, power lines, or other objects. A significant accumulation of freezing rain lasting several hours or more is called an ice storm.


2009 Ice Storm, Vine Grove. *Source: LTADD Archive*.

Facts

- Winter storms come in different sizes and are created by different combinations of atmospheric conditions and local geography, but can occur anywhere in the United States.
- Winter storms usually occur between the end of October and the end of March in the U.S.
- Winter storms can last for days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures.

- The aftermath of a winter storm can impact a community or region for a day, weeks, or even months.

Effects

Snow and Ice Accumulation

Snow and ice accumulation on roads and surfaces can result in several adverse effects. Roads and sidewalks become dangerous and, at times, impassable resulting in vehicular accidents, falls, road closures, and delayed response time from emergency agencies. Snow and ice accumulation on trees, poles, power lines and roofs can result in falling debris that causes property damage and human injuries. People attempting to shovel snow can suffer injuries from their efforts as well. 70% of all weather related injuries are the result of vehicle accidents. Black ice on roadways is another dangerous hazard, as is thawing and refreezing of snow and ice on surfaces.

Power Outages

Snow and ice events can result in area and regional power outages. Power outages can have a significant social and economic impact on an area and may last for an extended period of time. Fires and dangerous situations arise from the improper use of kerosene lamps and heaters, candles and space heaters.

2009 Ice Storm, Nelson County. *Source: LTADD Archive*.

2009 Ice Storm, Vine Grove. *Source: LTADD Archive*.

Extreme Cold

Cold air outbreaks can send temperatures plummeting to single digits or lower and it is far more dangerous to be outside for prolonged periods of time. Some of the major threats are:

- Wind Chill: Wind chill is a measure of what the temperature outside *feels* like when wind speed is factored in. As wind speed increases, more heat can be removed from a body by the wind.

- Frostbite: Frostbite results from prolonged exposure to very cold air. Injury is caused by body tissue becoming frozen. Extremities such as fingers and toes are the most susceptible to frostbite.
- Hypothermia: Hypothermia is similar to frostbite and occurs when the body is exposed to prolonged cold. Hypothermia occurs when the body temperature drops below 95 degrees Fahrenheit.

Flooding

Depending on the amount of accumulation on the ground, flooding can result when ice and snow begin to melt as temperatures begin to rise.

Snow runoff flooding at White Mills (Hardin County) *Source: News-Enterprise, Neal Cardin Photo.*

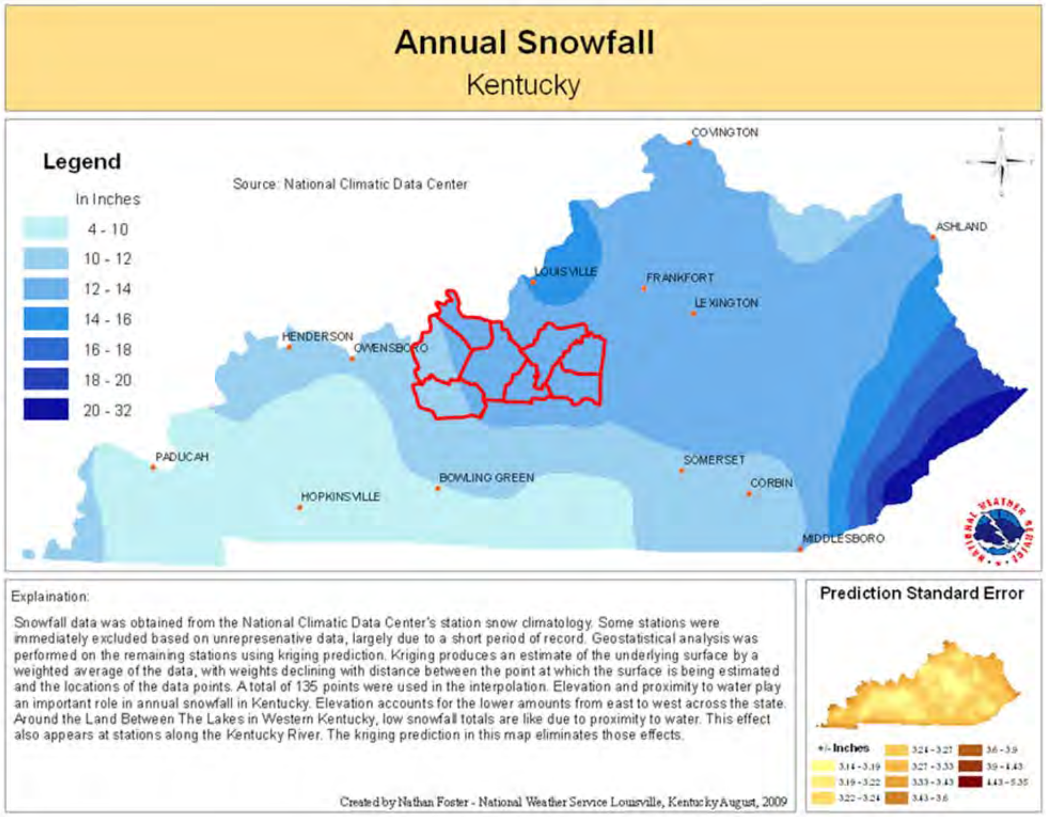
II. Profile

The Kentucky Mesonet data presented below shows minimum temperatures in the Lincoln Trail Region over the last 3 to 4 years. Cold temperatures and the severe weather conditions that often accompany them, make the region susceptible to severe winter storms.

Table 3.3.2.4.1

Minimum Temperature Table for Lincoln Trail Region from 2010 to 2015 ***Source: Kentucky Mesonet***							
Mesonet Station	2010	2011	2012	2013	2014	2015 Jan. – March 3	Average Station 5 Year Average 2010 – 2014
Breckinridge Co. (MQDY)	1.9	-1.5	12.1	7.9	-4.5	-10.2	5.7
Grayson Co. (BLRK)	0.9	-3.0	11.3	9.3	-3.4	-15.1	15.1
Hardin Co. (CCLA)	-0.4	-2.4	10.8	8.8	-3.8	-18.0	2.6
LaRue Co. (HDGV)	NA	18.0 Sept. – Dec.	13.4	8.3	-3.8	-12.1	NA
Marion Co. (LRTO)	NA	17.1 May – Dec.	14.8	8.4	-4.6	-16.2	NA
Meade Co. (BRND)	NA	13.4 March – Dec.	7.7	5.4	-4.0	-21.8	NA
Average	0.8	-2.3 Full Year Sites Only	11.68	8.02	-4.02	-15.57 Jan. – March 3	-0.232 Annual 8-County Regional 5 Year Average 2010 – 2014

Kentucky's geographic location makes it vulnerable to extreme winter weather. The State's close proximity to the Gulf of Mexico, provides the moisture source for precipitation, while the region is far enough north to be influenced by polar air masses. Low-pressure systems can bring heavy snow to Kentucky that normally track eastward across the southern United States before tracking toward the northeast.



The Lincoln Trail Region is outlined in red above. Breckinridge and Grayson County fall predominately in the 10-12 inch range. Hardin, LaRue, Marion, Meade, Nelson and Washington Counties fall entirely in the 12-14 inch range.

III. Analysis

The analysis for determining the threat of winter storms as a local hazard, involved identifying the conditions that produce winter storms, along with the types of severe winter weather that occur. Data was also tracked concerning the number of events that occur in the Region over time. Sources used to gather information include the National Weather Service, Kentucky Mesonet, the National Climatic Data Center, and Kentucky and County Emergency Management.

The Winter Storm of 2009 began on January 28, 2009 and left the Region devastated. Icy rain turned into solid ice that left the entire eight-county area without power, water and phone service. Roads were closed and power lines and poles snapped. Many were without power for weeks and the cleanup effort ran well into the late summer months. The State declared a disaster and FEMA issued disaster declaration #1818. Mitigation money from this disaster enabled many local jurisdictions to purchase emergency backup generators, bury power lines, and replace or repair damaged bridges. The chart below illustrates the impact the local Counties reported as a result of the 2009 Ice Storm.

Table 3.3.2.4.2 – 2009 Winter Storm Impact

County	Days Without Power	Injuries Reported	Deaths Reported	Local Economic Impact*
Breckinridge	Up to 3 weeks	3	0	$1.2-1.5 million
Grayson	Up to 3 weeks	0	0	$2.2 million
Hardin	Up to 2 weeks	0	1	$1.2 million
LaRue	Up to 2 weeks	0	0	$600,000
Marion	Up to 1 week	2	0	$245,000
Meade	Up to 2 weeks	24	0	$1.2 million
Nelson	Up to 3 weeks	0	0	$260,000
Washington	Up to 3 weeks	1	0	$375,000
Totals		30	1	$7,280,000
** Reported by local government; Does not include private utility losses, or individuals' losses of property or wages*				

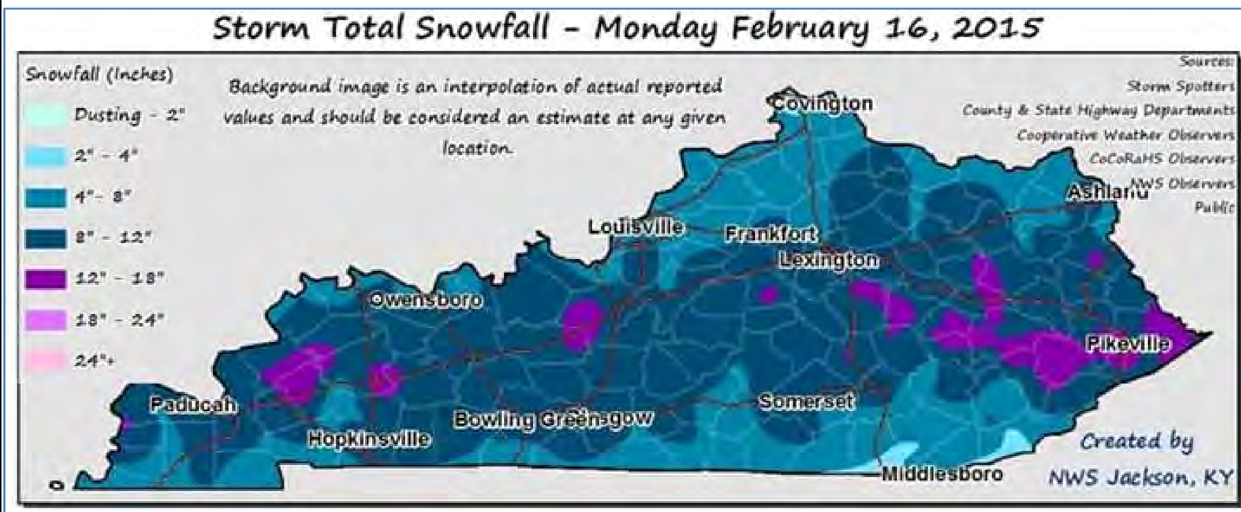
2015 Overturned snowplow in Meade County. *Source: Meade County Emergency Management.*

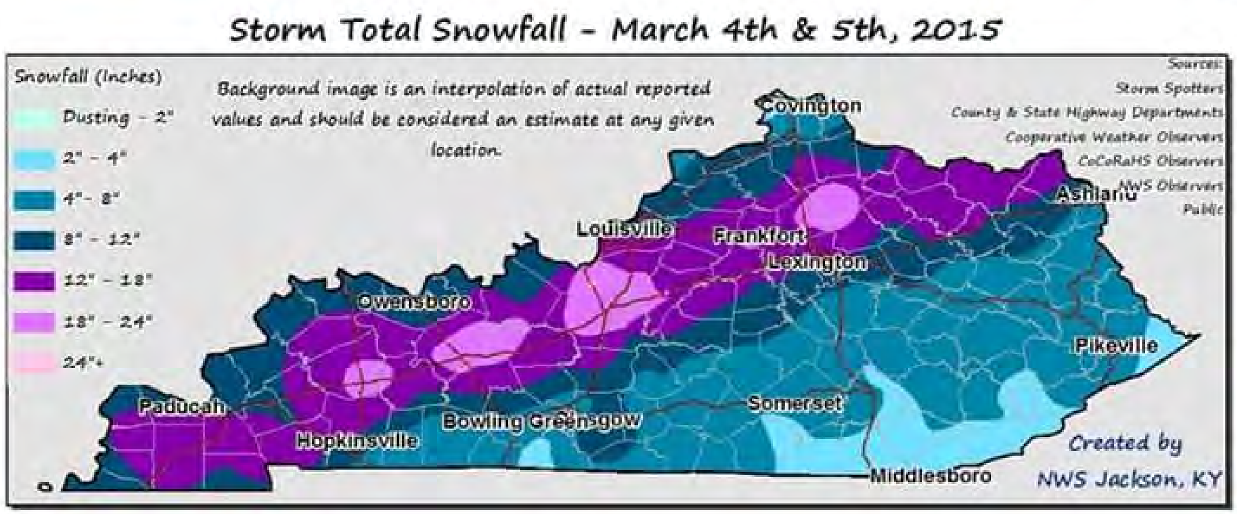
The winter of 2015 was another devastating one for this region. On February 21, Kentucky Mesonet data shows that between 18 and 19 inches of snow fell in the Hardin County area. Beginning on March 4, 2015 almost 30" of snow fell throughout the region and shut down I65 through Hardin County for over 14 hours. Thousands of cars, trucks and people were stranded on the interstate.

Table 3.3.2.4.3 - 2015 Winter Storm Snow Records

County	February 16, 2015 Snowfall Amount	March 4-5, 2015 Snowfall Amount	Record Place of March 4-5 Snow
Breckinridge	NA	20 inches	1st
Grayson	10 inches	16 inches	
Hardin	13.3 inches	23 inches	1st
LaRue	10 inches	18.3 inches	1st
Marion	11 inches	11 inches	2nd
Meade	8 inches	17 inches	1st
Nelson	13 inches	22 inches	2nd
Washington	12 inches	7.1 inches	

Source: National Weather Service – Louisville, KY





The following tables detail the history of winter storms that have been recorded in a given county/jurisdiction within the Lincoln Trail region since 1993. The level of impact is evidenced through the number of lives lost or individual injuries reported, as well as the estimated cost of property and crop damage. This information is reported to the National Climate DataCenter (NCDC) and subsequently rolled into the data of the National Centers for Environmental Information (NCEI). For the original plan, data was only available through 2003. The 2010 update provided data thru 30 June 2009. This update shows only individual events for the period 1 July 2009 through 30 June 2015. The summary tables show data for the entire periods covered by the various sources. Note that there are many variations in recording the locations of the events over time. In the past this was typically done at a county level. More recently, nearest place names have been used. Because of this, the records in the summation tables regarding the individual incorporated areas should not be considered all encompassing.

When reviewing the tables below, there may appear to be duplication of data across counties. This is due to the nature of a winter storm. One winter storm system most often affects multiple counties and is logged as one event but recorded in each county. Detailed individual county information is not always available; therefore some data may not reflect the true impact at the county or city level.

Table 3.3.2.4.4 - County Specific Data – Winter Storms, *Source: NCEI*

BRECKINRIDGE

LOCATION	DATE	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
BRECKINRIDGE	1/29/2010	Heavy Snow	0	0	0	0
BRECKINRIDGE	2/8/2010	Heavy Snow	0	0	0	0
BRECKINRIDGE	2/14/2010	Heavy Snow	0	0	0	0
BRECKINRIDGE	1/25/2011	Heavy Snow	0	0	0	0
BRECKINRIDGE	12/6/2013	Winter Storm	0	0	0	0
BRECKINRIDGE	2/2/2014	Heavy Snow	0	0	0	0
BRECKINRIDGE	2/4/2014	Winter Storm	0	0	0	0
BRECKINRIDGE	3/2/2014	Winter Storm	0	0	0	0
BRECKINRIDGE	2/16/2015	Heavy Snow	0	0	0	0
BRECKINRIDGE	3/4/2015	Heavy Snow	0	0	0	0

GRAYSON

LOCATION	DATE	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
GRAYSON	1/29/2010	Heavy Snow	0	0	0	0
GRAYSON	2/8/2010	Heavy Snow	0	0	0	0
GRAYSON	1/26/2011	Heavy Snow	0	0	0	0
GRAYSON	2/7/2011	Heavy Snow	0	0	0	0
GRAYSON	12/6/2013	Winter Storm	0	0	0	0
GRAYSON	2/2/2014	Winter Storm	0	0	0	0
GRAYSON	2/4/2014	Winter Storm	0	0	0	0
GRAYSON	3/2/2014	Winter Storm	0	0	0	0
GRAYSON	1/23/2015	Heavy Snow	0	0	0	0
GRAYSON	2/16/2015	Heavy Snow	0	0	0	0
GRAYSON	3/4/2015	Heavy Snow	0	0	0	0

HARDIN

LOCATION	DATE	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
HARDIN	1/29/2010	Heavy Snow	0	0	0	0
HARDIN	2/8/2010	Heavy Snow	0	0	0	0
HARDIN	12/15/2010	Ice Storm	0	0	0	0
HARDIN	1/25/2011	Heavy Snow	0	0	0	0
HARDIN	1/25/2013	Winter Weather	0	0	$100,000	0
HARDIN	12/6/2013	Winter Storm	0	0	0	0
HARDIN	2/2/2014	Heavy Snow	0	0	0	0
HARDIN	2/4/2014	Winter Storm	0	0	0	0
HARDIN	3/2/2014	Winter Storm	0	0	0	0
HARDIN	1/23/2015	Heavy Snow	0	0	0	0
HARDIN	2/16/2015	Heavy Snow	0	0	0	0
HARDIN	3/4/2015	Heavy Snow	0	0	0	0

LARUE

LOCATION	DATE	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
LARUE	1/29/2010	Heavy Snow	0	0	0	0
LARUE	12/24/2010	Heavy Snow	0	0	0	0
LARUE	1/20/2011	Heavy Snow	0	0	0	0
LARUE	2/2/2014	Winter Storm	0	0	0	0
LARUE	2/4/2014	Winter Storm	0	0	0	0
LARUE	3/2/2014	Winter Storm	0	0	0	0
LARUE	2/16/2015	Heavy Snow	0	0	0	0
LARUE	3/4/2015	Heavy Snow	0	0	0	0

MARION

LOCATION	DATE	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
MARION	1/29/2010	Heavy Snow	0	0	0	0
MARION	3/2/2014	Winter Storm	0	0	0	0
MARION	2/16/2015	Heavy Snow	0	0	0	0
MARION	3/4/2015	Heavy Snow	0	0	0	0

MEADE

LOCATION	DATE	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
MEADE	1/29/2010	Heavy Snow	0	0	0	0
MEADE	2/8/2010	Heavy Snow	0	0	0	0
MEADE	2/14/2010	Heavy Snow	0	0	0	0
MEADE	12/15/2010	Ice Storm	0	0	0	0
MEADE	12/6/2013	Winter Storm	0	0	0	0
MEADE	2/2/2014	Heavy Snow	0	0	0	0
MEADE	2/4/2014	Winter Storm	0	0	0	0
MEADE	3/2/2014	Winter Storm	0	0	0	0
MEADE	2/16/2015	Heavy Snow	0	0	0	0
MEADE	3/4/2015	Heavy Snow	0	0	0	0
MEADE	3/4/2015	Heavy Snow	0	0	0	0

NELSON

LOCATION	DATE	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
NELSON	1/29/2010	Heavy Snow	0	0	0	0
NELSON	12/15/2010	Ice Storm	0	0	0	0
NELSON	2/7/2011	Heavy Snow	0	0	0	0
NELSON	2/2/2014	Heavy Snow	0	0	0	0
NELSON	2/4/2014	Winter Storm	0	0	0	0
NELSON	3/2/2014	Winter Storm	0	0	0	0
NELSON	1/23/2015	Heavy Snow	0	0	0	0
NELSON	2/16/2015	Heavy Snow	0	0	0	0
NELSON	3/4/2015	Heavy Snow	0	0	0	0

WASHINGTON

LOCATION	DATE	EVENT TYPE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
WASHINGTON	1/29/2010	Heavy Snow	0	0	0	0
WASHINGTON	12/16/2010	Ice Storm	0	0	0	0
WASHINGTON	3/2/2014	Winter Storm	0	0	0	0
WASHINGTON	1/23/2015	Heavy Snow	0	0	0	0
WASHINGTON	2/16/2015	Heavy Snow	0	0	0	0
WASHINGTON	3/4/2015	Heavy Snow	0	0	0	0

Table 3.3.2.4.5 - Summary of Winter Storm Data, Costs

SNOW & ICE	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$1,411,082	40	54.5	0.31	1.83	$25,891	$35,277	0.01	0.01	0.03	0.05
Cloverport	$0	0									
Hardinsburg	$0	0									
Irvington	$0	0									
GRAYSON	$1,981,398	42	54.5	0.29	3.41	$36,356	$47,176	0.01	0.01	0.06	0.08
Caneyville	$0	0									
Clarkson	$0	0									
Leitchfield	$0	0									
HARDIN	$2,792,155	45	54.5	0.29	3.47	$51,232	$62,048	0.01	0.01	0.06	0.08
Elizabethtown	$0	0									
Radcliff	$0	0									
Sonora	$0	0									
Upton	$0	0									
Vine Grove	$0	0									
West Point	$0	0									
LARUE	$1,050,662	38	54.5	0.29	3.36	$19,278	$27,649	0.01	0.01	0.06	0.09
Hodgenville	$0	0									
MARION	$2,681,555	32	54.5	0.29	3.36	$49,203	$83,799	0.01	0.01	0.06	0.11
Bradfordsville	$0	0									
Lebanon	$0	0									
Loretto	$0	0									
Raywick	$0	0									
MEADE	$1,420,840	40	54.5	0.29	1.81	$26,070	$35,521	0.01	0.01	0.03	0.05
Brandenburg	$0	0									
Ekron	$0	0									
Muldraugh	$0	0									
NELSON	$2,307,155	41	54.5	1.29	3.47	$42,333	$56,272	0.02	0.03	0.06	0.08
Bardstown	$0	0									
Bloomfield	$0	0									
Fairfield	$0	0									
New Haven	$0	0									
WASHINGTON	$2,697,743	42	54.5	0.37	3.48	$49,500	$64,232	0.01	0.01	0.06	0.08
Mackville	$0	0									
Springfield	$0	0									
Willisburg	$0	0									
LTADD	$16,342,589	320	54.5	3.42	24.19	$299,864	$51,071	0.06	0.01	0.44	0.08

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

Table 3.3.2.4.6 - Summary of Winter Storm Data, Events

SNOW & ICE	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
BRECKINRIDGE	40	54.5	14	20	35	1.36	73.39%	1.4	1	0.7
Cloverport	0									
Hardinsburg	0									
Irvington	0									
GRAYSON	42	54.5	15	21	38	1.30	77.06%	1.5	1.05	0.76
Caneyville	0									
Clarkson	0									
Leitchfield	0									
HARDIN	45	54.5	17	23	41	1.21	82.57%	1.7	1.15	0.82
Elizabethtown	0									
Radcliff	0									
Sonora	0									
Upton	0									
Vine Grove	0									
West Point	0									
LARUE	38	54.5	12	17	34	1.43	69.72%	1.2	0.85	0.68
Hodgenville	0									
MARION	32	54.5	7	11	28	1.70	58.72%	0.7	0.55	0.56
Bradfordsville	0									
Lebanon	0									
Loretto	0									
Raywick	0									
MEADE	40	54.5	15	19	36	1.36	73.39%	1.5	0.95	0.72
Brandenburg	0									
Ekron	0									
Muldraugh	0									
NELSON	41	54.5	13	18	37	1.33	75.23%	1.3	0.9	0.74
Bardstown	0									
Bloomfield	0									
Fairfield	0									
New Haven	0									
WASHINGTON	42	54.5	10	14	34	1.30	77.06%	1	0.7	0.68
Mackville	0									
Springfield	0									
Willisburg	0									
LTADD	320	54.5	103	143	283	0.17	587.16%	10.3	7.15	5.66

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

3.3.2.5 <u>Lightning</u>

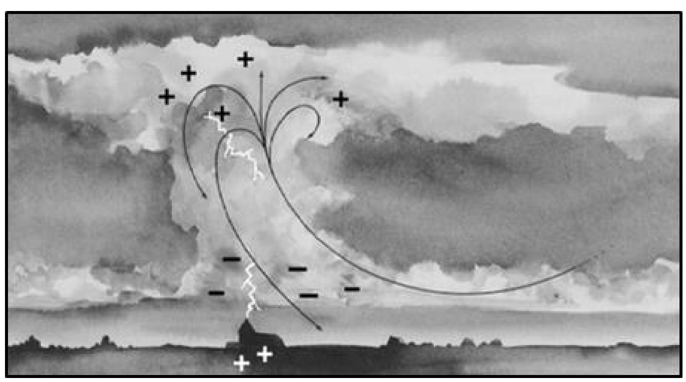
I. Background

Definition: Lightning is a sudden electrostatic discharge during an electrical storm between electrically charged regions of a cloud, between that cloud and another cloud, or between a cloud and the ground. This discharge temporarily equalizes the charged regions in the atmosphere and is called a strike if it hits the ground. Although lightning is always accompanied by thunder, distant lightning may be seen, but be too far away to be heard.

Formation of Lightning

Lightning is usually produced by cumulonimbus clouds, which have bases that are typically 0.6 to 1.25 miles above the ground and tops up to 9.3 miles in height. Lightning originates about 15,000 to 25,000 feet above sea level when raindrops are lifted upward until some of them convert to ice. Cloud to ground lightning begins in this mixed water and ice region. As these particles collide, they create an electric charge and these charges accumulate, filling up the entire cloud. Positive charges or protons form at the top of the cloud while the negative charges or electrons, form at the bottom of the cloud. Because opposites attract, this activity causes a positive charge to build up on the ground beneath the cloud. The electric charge on the ground builds up around anything that sticks up, such as mountains, people or a single tree. The charge coming up from these points eventually connects with a charge coming down from the clouds and creates a lightning strike. As a charge moves downward from a cloud, it does so in 50-yard increments called step leaders. It keeps moving toward the ground in these steps and produces a channel along which the charge is deposited until it encounters something on the ground that is a good connection. Once a conductive channel form bridges the ionized air between the negative

Lightning strike in Brandenburg, 2008. *Source: Meade County Emergency Management.*



Source: National Oceanic and Atmospheric Administration; National Lightning Safety Institute charges in the cloud and the positive charges on ground, a massive electrical discharge follows and neutralization of the positive surface charges occurs first. Then an enormous current of positive charges races up the channel toward the thundercloud. This is the "return stroke" and is the most luminous and noticeable part of the lightning discharge.

Types of Lightning

According to the National Oceanic and Atmospheric Administration (NOAA), there are three primary types of lightning. The type of lightning is determined by what is at the "ends" of a flash channel. Intracloud (IC) occurs within a single thundercloud; cloud-to-cloud (CC) starts and ends between two different "functional" thunderclouds; and cloud to ground (CG) lightning primarily starts in a thundercloud and terminates on the Earth's surface. Occasionally, it may reverse direction, and run from the ground to a cloud. There are variations of each type of lightning such as "positive" versus "negative" CG flashes. Each has distinct characteristics that can be measured.

IC lightning is the most frequently occurring type of lightning. This kind of lightning may be observed at great distances at night and is often referred to as "heat lightning."

CC lightning is sometimes referred to as "Anvil Crawler" due to its characteristic of originating from beneath or within the anvil and scrambling through the upper layers of the thunderstorm usually producing multiple branches of dramatic strokes.

CG lightning can occur with both positive and negative polarity. "Negative" lightning is the most common type of CG lightning and originates in the lower negatively charged portion of a thundercloud. Positive lightning originates in the positively charged anvil of the cumulonimbus and may travel several miles from the anvil of the thunderstorm horizontally before veering towards the ground. A positive lightning strike can occur anywhere within several miles of the thunderstorm anvil. Positive lightning makes up less than 5% of all lightning strikes. Positive lightning bolts are considerably hotter and longer than negative lightning. Ground to Cloud lightning is a type of CG lightning that is artificially triggered when tall, positively charged structures on the ground, such as towers on mountains, have been inductively charged by a negative cloud layer above, and is the origin of the lightning strike.

Lightning Dangers

Cloud to ground lightning can damage or destroy property and inanimate objects, and can kill or injure people and animals. According to NOAA, lightning strikes the United States about 25 million times a year and kills an average of 49 people annually. Almost all lightning occurs in summer, but can strike at any time of the year. The following safety precautions are recommended:

- If you see lightning or hear thunder, seek safe shelter immediately, preferably in a building with plumbing and electricity or a metal-topped vehicle with the windows closed.

- Stay off of corded phones.
- Avoid Plumbing, electrical equipment and cords, bodies of water or standing water.
- Stay away from windows and doors and stay off of porches.
- Do not lie on concrete floors or lean against concrete walls.
- Stay away from trees.
- Stay away from groups of people in the open.
- Rubber soled shoes will not give a person any meaningful protection from lightning.
- A lightning flash is no more than one inch wide.

Vulnerability

Lightning is a hazard that should be taken very seriously. Knowledge about the effects of lightning will help save lives and prevent injuries from lightning. In addition to death and injuries to people and animals alike, lightning causes fires and property damage.

Fatalities and Injuries
In addition to fatalities due to lightning strikes, many injuries occur as well. The chart below illustrates U.S. lightning fatalities between 2006 and May of 2015.

Table 3.3.2.5.1 - U.S. Lightning Fatalities from 2006 to May of 2015			
Year	Male	Female	Total
2006	38	10	48
2007	40	5	45
2008	22	6	28
2009	28	6	34
2010	22	7	29
2011	19	7	26
2012	25	3	28
2013	17	6	23
2014	21	5	26
2015 (Jan.-May)	3	2	5
Source: NOAA and National Weather Service			

Injuries that occur from lightning strikes can range from cardiac arrest to personality changes, and include severe burns, brain damage, memory loss and other long-term effects. It should be noted that deaths and injuries to animals also occurs. The information below compares human fatalities to injury numbers between 1995 and 2013.

Table 3.3.2.5.2

Number of Deaths and Injuries Due to Lightning in the U.S. from 1995 to 2013		
Year	Deaths	Injuries
1995	85	433
2000	51	364

2001	44	371
2002	51	256
2003	44	237
2004	32	280
2005	38	309
2006	48	246
2007	45	138
2008	28	216
2009	34	201
2010	29	182
2011	26	187
2012	28	139
2013	23	14
TOTAL	606	3,573
Source: NOAA		

Fires and Damage

Fires and property damage result from lightning strikes every year. According to the Insurance Information Institute (III), lightning strikes cost homeowners in the United States about $674 million in 2013 alone, down 30.5% from 2012. The Insurance Information Institute estimates the average lightning claim in 2013 at $5,869, down 24% from 2012. The U.S. Department of Commerce and NOAA attributed $23.89 million in property damage as the result of lightning in 2013 and $0.06 million in crop damage, for a total of $23.95 million dollars in damages.

In addition to property damage, lightning starts fires. According to the National Fire Protection Association (NFPA), during the time period from 2007 to 2011, U.S. local fire departments responded to an estimated average of 22,600 fires per year as a result of lightning. Fires started by lightning peak during summer months, are more common in the months of June through August, and usually occur later in the afternoon and early evening. In the years 2008 – 2012, federal and state wildland firefighting agencies reported an average of 9,000 wildland fires started by lightning, to the National Interagency Fire Center. These fires tended to be larger than fires started by human causes. The average fire caused by lightning burned 402 acres, nine times the average area of 45 acres seen in fires caused by human action. Over the ten-year period from 2003 to 2012, forty-two U.S. firefighters were killed as the result of fighting fires caused by lightning strikes.

The table below shows homeowners' insurance claims and payouts for lightning losses between 2009 and 2013.

Table 3.3.2.5.3

Homeowners Insurance Claims and Payouts for Lightning Losses from 2009 to 2013							
	2009	2010	2011	2012	2013	Percent Change 2012-2013	Percent Change 2009-2013
Number Of Claims	185,789	213,278	186,307	151,000	114,740	-24.0%	-38.2%
Insured Losses ($ millions)	$798.1	$1,033.5	$952.5	$969.0	$673.5	-30.5%	-15.6%
Average Cost Per Claim	$4,296	$4,846	$5,112	$6,400	$5,869	-8.3%	36.6%
Source: Insurance Information Institute, State Farm®							

Lightning Facts:

- Lightning is a giant discharge of electricity accompanied by a brilliant flash of light and a loud crack of thunder.
- A spark of lightning can reach over 5 miles in length and raise the air temperature by as much as 50,000 degrees Fahrenheit.
- A lightning strike contains a hundred million electrical volts.
- The immense heat and other energy given off during a lightning stroke has been found to convert elements in compounds that are found in organisms and may have played a part in the evolution of living things.
- The odds of being struck by lightning in the U.S. in any given year is 1 in 700,00 while the odds of being struck in your lifetime is 1 in 3,000.
- Positive lightning is especially dangerous because it can strike away from the rain core, either ahead of or behind the thunderstorm and can strike as far as 5 to 10 miles from the storm.
- Victims of a lightning strike do not retain any charge and are not "electrified." It is safe to help them.
- An umbrella can increase your chance of being struck by lightning.
- Lightning often strikes the same place repeatedly if it is a tall, isolated object.
- Most lightning victims are in open areas or near a tree.
- Lightning can heat its path through the air to a temperature that is five times hotter than the surface of the sun.
- All thunderstorms contain lightning.
- Volcanic material thrust high into the atmosphere can trigger lightning.
- Lightning also occurs in extremely intense forest fires, surface nuclear detonations, heavy snowstorms, and in large hurricanes.

III. Analysis

To analyze lightning as a threat to the Lincoln Trail Region, the generalized threat of lightning was identified by reviewing historical data.

The following tables outline the occurrences of lightning that have been recorded in a given county/jurisdiction within the Lincoln Trail region since 1960. The level of impact is evidenced through the number of lives lost or individual injuries recorded, as well as the estimated cost of property and crop damage based on information reported to the National Climate Data Center which was subsequently rolled into the National Centers for Environmental Information (NCEI). For the original plan, data was only available through 2003. The 2010 update provided data thru 30 June 2009. This update shows only individual events for the period 1 July 2009 through 30 June 2015. The summary tables show data for the entire period as reported by various sources. Note that there are many variations in recording the locations of the events over time. In the past this was typically done at a county level. More recently, nearest place names have been used. Because of this, the records in the summation tables that pertain to individual incorporated areas, should not be considered all encompassing.

Table 3.3.2.5.4 - County Specific Data – Lightning, *Source: NCEI*

No Lightning events were recorded from 1 July 2009 to 30 June 2015 for BRECKINRIDGE, LARUE, MARION, MEADE or WASHINGTON Counties.

GRAYSON

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
LEITCHFIELD	2/22/2012	0	0	$15,000	0

HARDIN

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
(FTK)GODMAN AAF FT K	7/27/2010	1	2	$0	0
SUMMIT	7/19/2012	0	0	$300,000	0

NELSON

LOCATION	DATE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
BARDSTOWN	7/26/2012	0	1	$0	0

Table 3.3.2.5.5 - Summary of Lightning Data, Costs

LIGHTNING	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$289,285	25	54.5	0.04	0.36	$5,308	$11,571	0.00	0.00	0.01	0.01
Cloverport											
Hardinsburg											
Irvington											
GRAYSON	$423,574	31	54.5	0.04	2.36	$7,772	$13,664	0.00	0.00	0.04	0.08
Caneyville											
Clarkson											
Leitchfield	$51,500	2	54.5	0	1	$945	$25,750	0.00	0.00	0.02	0.50
HARDIN	$869,962	34	54.5	1.11	2.36	$15,963	$25,587	0.02	0.03	0.04	0.07
Elizabethtown											
Radcliff	$100,000	1	54.5	0	0	$1,835	$100,000	0.00	0.00	0.00	0.00
Sonora											
Upton											
Vine Grove											
West Point											
LARUE	$61,022	33	54.5	0	0	$1,120	$1,849	0.00	0.00	0.00	0.00
Hodgenville											
MARION	$154,253	35	54.5	0.14	0.39	$2,830	$4,407	0.00	0.00	0.01	0.01
Bradfordsville											
Lebanon											
Loretto											
Raywick											
MEADE	$129,715	28	54.5	0	0	$2,380	$4,633	0.00	0.00	0.00	0.00
Brandenburg											
Ekron											
Muldraugh											
NELSON	$907,717	41	54.5	2.12	2.34	$16,655	$22,139	0.04	0.05	0.04	0.06
Bardstown	$30,000	3	54.5	0	1	$550	$10,000	0.00	0.00	0.02	0.33
Bloomfield											
Fairfield											
New Haven	$525,000	2	54.5	2	1	$9,633	$262,500	0.04	1.00	0.02	0.50
WASHINGTON	$223,179	36	54.5	0.12	0.34	$4,095	$6,199	0.00	0.00	0.01	0.01
Mackville											
Springfield											
Willisburg											
LTADD	$3,765,207	271	54.5	5.57	11.15	$69,086	$13,894	0.10	0.02	0.20	0.04

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

Table 3.3.2.5.6 - Summary of Lightning Data, Events

LIGHTNING	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
BRECKINRIDGE	25	54.5	0	0	21	2.18	45.87%	0	0	0.42
Cloverport										
Hardinsburg										
Irvington										
GRAYSON	31	54.5	1	1	26	1.76	56.88%	0.1	0.05	0.52
Caneyville										
Clarkson										
Leitchfield	2	54.5	1	1	2	27.25	3.67%	0.1	0.05	0.04
HARDIN	34	54.5	2	3	29	1.60	62.39%	0.2	0.15	0.58
Elizabethtown										
Radcliff	1	54.5	0	1	1	54.50	1.83%	0	0.05	0.02
Sonora										
Upton										
Vine Grove										
West Point										
LARUE	33	54.5	0	0	26	1.65	60.55%	0	0	0.52
Hodgenville										
MARION	35	54.5	0	0	27	1.56	64.22%	0	0	0.54
Bradfordsville										
Lebanon										
Loretto										
Raywick										
MEADE	28	54.5	0	0	24	1.95	51.38%	0	0	0.48
Brandenburg										
Ekron										
Muldraugh										
NELSON	41	54.5	1	5	34	1.33	75.23%	0.1	0.25	0.68
Bardstown	3	54.5	1	3	3	18.17	5.50%	0.1	0.15	0.06
Bloomfield										
Fairfield										
New Haven	2	54.5	0	1	2	27.25	3.67%	0	0.05	0.04
WASHINGTON	36	54.5	0	0	29	1.51	66.06%	0	0	0.58
Mackville										
Springfield										
Willisburg										
LTADD	263	49	4	9	216	0.19	536.73%	0.4	0.45	4.32

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

3.3.2.6 <u>Hail</u>

I. Background

According to Merriam Webster, hailstones are layered and can be irregular and clumped together. Hail is composed of transparent ice or alternating layers of transparent and translucent ice at least 1 millimeter (0.039 inch) thick. This ice is deposited on the hailstone as it travels through the cloud. The ice is suspended aloft by air and strong upward motion until its weight is too much to be supported by the updraft and it falls to the ground. Although varied in size, the diameter of hail in the U.S. averages between 2.5cm (1 inch) and golf ball-sized (1.75 inches).

1Hail stones in Meade Co. April 2015. *Source: Meade County Emergency Management. Photo Geraldine Shanahan.*

Hailstones larger than 2 cm (0.80 inch) are considered large enough to cause damage. In the United States, the National Weather Service will issue a severe thunderstorm warning if it predicts hail that is 2.5 cm (1 inch) or greater in diameter.

Any thunderstorm that produces hail that reaches the ground is known as a hailstorm. Hailstones can grow to 15 cm (6 inches) and weight more than 0.5 kilograms (1.1 pounds).

Formation

The National Center for Atmospheric Research states that hail is possible within most thunderstorms because it is produced by cumulonimbi, and can occur within 2 nautical miles of the parent storm. Hail formation requires an environment of strong, upward air motion within the parent thunderstorm, high liquid content, great vertical extent, large water droplets, and lowered heights of the freezing level. Although hail and sleet are often confused for one another, and both are forms of solid precipitation, sleet falls generally in cold weather while hail growth is greatly inhibited at cold temperatures.

Facts

- The speed at which hail is falling when it hits the ground is determined by the size of the hailstone, the friction of the air it is falling through, the motion of the wind it is falling through, collisions with raindrops or other hailstones, and melting that occurs as the stones fall through warmer air.
- Speeds can range from 20 mph to 110 mph.
- The heaviest hailstone weighed 2.25 pounds and fell in the Gopalganj District of Bangladesh on April 14, 1986,

- The hailstone with the largest diameter officially measured 8 inches and fell in Vivian, South Dakota on July 23, 2010.
- The hailstone with the largest circumference officially measured 18.75 inches and fell in Aurora, Nebraska on June 22, 2003.
- Hailstones can accumulate, and depths of up to a metre have been reported.
- On July 29, 2010, a foot of hail accumulation was reported in Boulder, Colorado.

Source: National Weather Service and National Severe Storms Laboratory

Hazards/Vulnerability

According to the Federal Aviation Association, hail is one of the most significant thunderstorm hazards to aircraft. Hailstones that exceed .5 inches in diameter can cause serious damage to an aircraft within seconds. Accumulations of hailstones on the ground can be a major hazard to aircraft trying to land.

Table 3.3.2.6.1 - Hail Conversion Chart

Diameter of Hailstones (inches)	Description
0.50	Marble
0.70	Dime
0.75	Penny
0.88	Nickel
1.00	Quarter
1.25	Half Dollar
1.50	Walnut
1.75	Golf Ball
2.00	Hen Egg
2.50	Tennis Ball
2.75	Baseball
3.00	Tea Cup
4.00	Grapefruit
4.50	Softball

Accumulations of hailstones on the ground can also cause flooding by blocking drains, and hail carried by floodwaters can turn into a snow-like slush that accumulates at lower elevations. Accumulation of hailstones on streets and highways can cause traffic accidents.

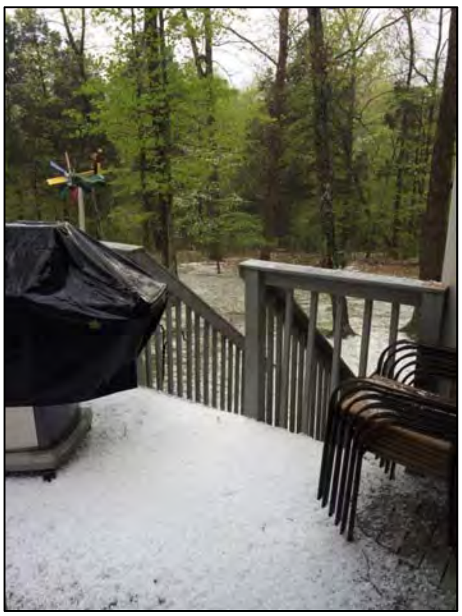
Hail can cause damage to automobiles, aircraft, skylights, glass, livestock, and most commonly, agricultural crops. Wheat, corn, soybeans and tobacco crops are the most sensitive crops to hail damage. Hailstorms have historically been the cause of costly and deadly events throughout history.

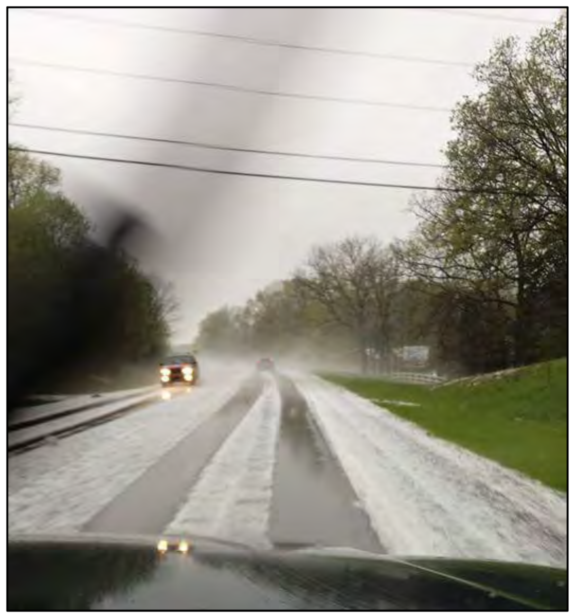
TORRO Hailstorm Intensity Scale (www.torro.org.uk/hscale.php)

	Intensity Category	Typical Diameter (mm)	
H0	Hard Hail	5	No Damage
H1	Potentially Damaging	5 - 15	Slight general damage to plants, crops
H2	Significant	10 - 20	Significant damage to fruit, crops, vegetation
H3	Severe	20 - 30	Severe damage to fruit and crops, damage to glass & plastic structures, paint & wood scored
H4	Severe	25 - 40	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30 - 50	Wholesale destruction of glass, tiled roof damage, significant risk of injury
H6	Destructive	40 - 60	Grounded aircraft bodywork dented, brick walls pitted
H7	Destructive	50 - 75	Severe roof damage, risk of injuries
H8	Destructive	60 - 90	Severe damage to aircraft bodywork (severest recorded in British Isles)
H9	Super Hailstorm	75 - 100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open.
H10	Super Hailstorm	> 100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open.

II. Analysis

To analyze Hail as a threat to the Lincoln Trail Region the generalized threat of hail was identified and historical data on it was researched. The sources of this information are the National Weather Service and the National Climatic Data Center. As the sub-committees reviewed data gathered from these two sources it became very clear that additional sources needed to be consulted. Property and crop damage was not included in the following tables. Insurance estimates from several local providers, indicated a drastically different scenario. For example, in 2002, straight-line winds hurled golf ball and larger size Hail causing an estimated $109M in damages to residential, commercial and city owned properties across the Lincoln Trail Region. Trees were reported down throughout the region. In Marion County, the hardest hit of the eight counties, an estimated two thirds of the county was affected. Thirty windows in the Marion County courthouse were damaged. One local insurance provider reported over 2000 auto and 1000 property claims due to hail.





Hail stones in Meade County, February and March, 2015. *Source: Meade County Emergency Management.*

Other local events of note:

Grayson, Hardin & LaRue Counties

4/26/2011 – National Weather Service reported hail of 2 inches or more. Damage was reported to buildings at Hardin County Fairgrounds. Storms also included confirmed tornados, wind and flooding.

LaRue County

5/19/2013 - Sheriff's Department Reported: "The ground in some areas in LaRue County was white from the amount of hail that fell Sunday afternoon…the hail reached golf ball size."

Summary of Hail in the Lincoln Trail Region

Hailstorms do not adhere to geographic boundaries and have affected each of the eight counties in the Lincoln Trail Region. Many of these storms contained golf ball size or larger hail. The average hailstorm in the Lincoln Trail Region causes damage estimated to be

$231,554 per event. The following tables summarize the history of hail events that have been recorded in a given county/jurisdiction within the Lincoln Trail Region since 1950. The impact of these storms is shown by the number of lives lost, individual injuries reported, and estimated economic losses. The level of impact is evidenced through the number of lives lost, individual injuries reported, and the estimated property and crop damage costs. This information was reported to the National Climate Data Center and subsequently rolled into data from the National Centers for Environmental Information (NCEI). Data for the original Regional Plan was only available through 2003. The 2010 update provided data through June 30, 2009. This update shows only individual events for the period 1 July 2009 through 30 June 2015. The summary tables illustrate data for entire periods covered by the different sources. Note that there are many variations in recording the locations of the events over time. In the past, data was not recorded at a county level. More recently, scientists have used nearest place names. Because of this, data in the summation tables pertaining to individual incorporated areas should not be considered all encompassing.

Table 3.3.2.6.2 - County Specific Data – Hail, *Source: NCEI*

BRECKINRIDGE

LOCATION	DATE	MAGNITUDE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
MC DANIELS	5/15/2010	1	0	0	0	0
HARDINSBURG ARPT	5/17/2010	0.88	0	0	0	0
HARNED	5/17/2010	1.25	0	0	0	0
GARFIELD	3/23/2011	1	0	0	0	0
MC QUADY	3/23/2011	1	0	0	0	0
BIG SPG	4/23/2011	1	0	0	0	0
HARDINSBURG ARPT	4/23/2011	1	0	0	0	0
CLOVERPORT	4/26/2011	1	0	0	0	0
MC DANIELS	4/26/2011	0.88	0	0	0	0
MC QUADY	4/26/2011	1	0	0	0	0
CLOVERPORT	6/15/2011	1	0	0	0	0
MC DANIELS	6/15/2011	1.5	0	0	0	0
HARDINSBURG ARPT	3/15/2012	1	0	0	0	0
MC DANIELS	4/26/2012	1	0	0	0	0
CUSTER	5/1/2012	1	0	0	0	0
IRVINGTON	5/31/2012	1	0	0	0	0
UNION STAR	5/31/2012	1	0	0	0	0
BASIN SPG	4/17/2013	1	0	0	0	0
GARFIELD	4/17/2013	1.75	0	0	0	0
IRVINGTON	4/17/2013	1.5	0	0	0	0
MC DANIELS	10/6/2014	1.25	0	0	0	0
BRECKINRIDGE CO.	4/2/2015	0.75	0	0	0	0
BRECKINRIDGE CO.	4/2/2015	1	0	0	0	0

GRAYSON

LOCATION	DATE	MAGNITUDE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
CLARKSON	5/15/2010	1.5	0	0	0	0
BIG CLIFTY	6/2/2010	1	0	0	0	0
LEITCHFIELD	4/19/2011	0.88	0	0	0	0
DUFF	4/26/2011	1	0	0	0	0
SHORT CREEK	4/26/2011	1	0	0	0	0
CLARKSON	6/15/2011	1	0	0	0	0
YEAMAN	6/15/2011	2.5	0	0	0	0
BIG CLIFTY	2/29/2012	1	0	0	0	0
BIG CLIFTY	2/29/2012	1	0	0	0	0
LEITCHFIELD	2/29/2012	1.75	0	0	0	0
CANEYVILLE	3/2/2012	1.75	0	0	0	0
CANEYVILLE	3/2/2012	1	0	1	0	0
LEITCHFIELD	3/2/2012	1.75	0	0	0	0
CANEYVILLE	4/3/2014	1.75	0	0	0	0
LEITCHFIELD	4/3/2014	1.75	0	0	0	0
SKAGGSTOWN	6/23/2014	1.5	0	0	0	0
CLARKSON	10/6/2014	1	0	0	0	0
LEITCHFIELD	10/6/2014	1	0	0	0	0
GRAYSON CO.	4/2/2015	0.75	0	0	0	0
GRAYSON CO.	4/2/2015	0.88	0	0	0	0

HARDIN

LOCATION	DATE	MAGNITUDE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
GLENDALE JCT	5/15/2010	0.88	0	0	0	0
ELIZABETH TOWN	5/17/2010	1	0	0	0	0
ELIZABETH TOWN	5/17/2010	1	0	0	0	0
HOWE VLY	5/17/2010	1.25	0	0	0	0
RADCLIFF	3/23/2011	1	0	0	0	0
ELIZABETH TOWN	4/20/2011	0.88	0	0	0	0
VINE GROVE	4/23/2011	0.88	0	0	0	0
EASTVIEW	4/26/2011	0.88	0	0	0	0
ELIZABETH TOWN	4/26/2011	0.88	0	0	0	0
ELIZABETH TOWN	3/15/2012	1	0	0	0	0
ELIZABETH TOWN	7/19/2012	1.75	0	0	0	0
ROGERSVILLE	12/17/2012	1	0	0	0	0
ELIZABETH TOWN	5/22/2014	1.25	0	0	0	0
HARDIN CO.	4/25/2015	0.88	0	0	0	0

LARUE

LOCATION	DATE	MAGNITUDE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
BROOKS	4/24/2010	0.88	0	0	0	0
BROOKS	4/24/2010	0.88	0	0	0	0
MAGNOLIA	5/15/2010	1	0	0	0	0
UPTON	5/15/2010	1	0	0	0	0
MATHERS MILL	6/2/2010	0.88	0	0	0	0
GATTON	3/15/2012	1.5	0	0	0	0
HODGENVILLE	4/17/2013	1	0	0	0	0
MAGNOLIA	4/17/2013	1	0	0	0	0
HODGENVILLE	5/19/2013	1	0	0	0	0
HODGENVILLE	5/19/2013	1.75	0	0	0	0
LARUE CO.	4/8/2015	0.75	0	0	0	0

MARION

LOCATION	DATE	MAGNITUDE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
GRAVEL SWITCH	3/23/2011	1	0	0	0	0
LEBANON	3/23/2011	0.88	0	0	0	0
LEBANON	3/23/2011	0.75	0	0	0	0
GRAVEL SWITCH	3/2/2012	1.75	0	0	0	0
GRAVEL SWITCH	3/2/2012	1.75	0	0	0	0
GREENBRIAR	7/13/2013	1.5	0	0	0	0
LEBANON	7/13/2013	1	0	0	0	0
BURKES SPG	7/13/2013	1.25	0	0	0	0

MEADE

LOCATION	DATE	MAGNITUDE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
BRANDENBURG	3/2/2012	2.75	0	0	0	0
DOE VLY ESTATES	3/2/2012	1.25	0	0	0	0
RHODELIA	3/14/2012	1.5	0	0	0	0
BRANDENBURG	3/17/2012	1	0	0	0	0
BRANDENBURG	5/29/2012	1	0	0	0	0
MEADE CO.	4/25/2015	1	0	0	0	0
MEADE CO.	4/25/2015	0.75	0	0	0	0
MEADE CO.	4/25/2015	1	0	0	0	0

NELSON

LOCATION	DATE	MAGNITUDE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
BARDSTOWN	3/12/2010	0.88	0	0	0	0
COXS CREEK	3/12/2010	0.88	0	0	0	0
BOSTON	4/23/2011	1	0	0	0	0
NAZARETH	4/23/2011	1	0	0	0	0
BARDSTOWN	4/26/2011	1.25	0	0	0	0
CHAPLIN	4/26/2011	0.88	0	0	0	0
BARDSTOWN	5/23/2011	0.88	0	0	0	0
NELSON CO.	4/8/2015	0.75	0	0	0	0
NELSON CO.	4/25/2015	0.75	0	0	0	0
NELSON CO.	4/25/2015	1	0	0	0	0
NELSON CO.	4/25/2015	1.5	0	0	0	0
NELSON CO.	4/25/2015	1.25	0	0	0	0
NELSON CO.	4/25/2015	0.75	0	0	0	0

WASHINGTON

LOCATION	DATE	MAGNITUDE	DEATHS DIRECT	INJURIES DIRECT	PROPERTY DAMAGE	CROP DAMAGE
WILLISBURG	3/15/2012	1	0	0	0	0
ST CATHERINE	5/1/2012	1	0	0	0	0
BEARWALLOW	7/13/2013	1.25	0	0	0	0
WASHINGTON CO.	4/8/2015	1	0	0	0	0
WASHINGTON CO.	4/8/2015	0.88	0	0	0	0
WASHINGTON CO.	4/25/2015	1.5	0	0	0	0
WASHINGTON CO.	4/25/2015	2.5	0	0	0	0
WASHINGTON CO.	4/25/2015	0.75	0	0	0	0

Table 3.3.2.6.3 - Summary of Hail Data, Costs

HAIL	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$4,925,750	77	51.5	0.01	0.52	$95,646	$63,971	0.00	0.00	0.01	0.01
Cloverport	$0	8	51.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Hardinsburg	$15,000	13	51.5	0	0	$291	$1,154	0.00	0.00	0.00	0.00
Irvington	$0	7	51.5	0	0	$0	$0	0.00	0.00	0.00	0.00
GRAYSON	$2,438,935	84	50.5	0.01	0.5	$48,296	$29,035	0.00	0.00	0.01	0.01
Caneyville	$0	10	50.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Clarkson	$0	4	50.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Leitchfield	$0	19	50.5	0	0	$0	$0	0.00	0.00	0.00	0.00
HARDIN	$26,768,252	95	51.5	0.01	0.52	$519,772	$281,771	0.00	0.00	0.01	0.01
Elizabethtown	$0	19	51.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Radcliff	$0	4	51.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Sonora	$1,000	7	51.5	0	0	$19	$143	0.00	0.00	0.00	0.00
Upton	$0	1	51.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Vine Grove	$0	1	51.5	0	0	$0	$0	0.00	0.00	0.00	0.00
West Point	$0	2	51.5	0	0	$0	$0	0.00	0.00	0.00	0.00
LARUE	$1,969,355	59	58.5	0.06	0.56	$33,664	$33,379	0.00	0.00	0.01	0.01
Hodgenville	$0	5	58.5	0	0	$0	$0	0.00	0.00	0.00	0.00
MARION	$35,497,179	58	53.5	0.06	2.56	$663,499	$612,020	0.00	0.00	0.05	0.04
Bradfordsville	$0	1	53.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Lebanon	$30,000	6	53.5	0	2	$561	$5,000	0.00	0.00	0.04	0.33
Loretto	$0	2	53.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Raywick	$0	1	53.5	0	0	$0	$0	0.00	0.00	0.00	0.00
MEADE	$25,032,572	68	59.5	0.01	2.52	$420,715	$368,126	0.00	0.00	0.04	0.04
Brandenburg	$35,000	13	59.5	0	0	$588	$2,692	0.00	0.00	0.00	0.00
Ekron	$0	2	59.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Muldraugh	$0	0	59.5	0	0	$0		0.00		0.00	
NELSON	$22,857,556	71	53.5	0.06	1.56	$427,244	$321,937	0.00	0.00	0.03	0.02
Bardstown	$0	16	53.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Bloomfield	$0	1	53.5	0	0	$0	$0	0.00	0.00	0.00	0.00
Fairfield	$0	0	53.5	0	0	$0		0.00		0.00	
New Haven	$0	4	53.5	0	0	$0	$0	0.00	0.00	0.00	0.00
WASHINGTON	$10,875,034	51	53.5	0.06	3.56	$203,272	$213,236	0.00	0.00	0.07	0.07
Mackville	$0	0	53.5	0	0	$0		0.00		0.00	
Springfield	$150,000	6	53.5	0	3	$2,804	$25,000	0.00	0.00	0.06	0.50
Willisburg	$0	3	53.5	0	0	$0	$0	0.00	0.00	0.00	0.00
LTADD	$130,364,632	563	59.5	0.28	12.3	$2,191,002	$231,554	0.00	0.00	0.21	0.02

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

Table 3.3.2.6.4 - Summary of Hail Data, Events

HAIL	Number of Events in Historic Record	Number of Years in Historic Record	Number of Events in Past 10 Years	Number of Events in Past 20 Years	Number of Events in Past 50 Years	Historic Recurrence Interval (years)	Historic Frequency % chance/year	Past 10 Year Record Frequency Per Year	Past 20 Year Record Frequency Per Year	Past 50 Year Record Frequency Per Year
BRECKINRIDGE	77	51.5	36	52	74	0.67	149.51%	3.6	2.6	1.48
Cloverport	8	51.5	5	8	8	6.44	15.53%	0.5	0.4	0.16
Hardinsburg	13	51.5	7	12	13	3.96	25.24%	0.7	0.6	0.26
Irvington	7	51.5	4	7	7	7.36	13.59%	0.4	0.35	0.14
GRAYSON	84	50.5	34	54	82	0.60	166.34%	3.4	2.7	1.64
Caneyville	10	50.5	5	9	10	5.05	19.80%	0.5	0.45	0.2
Clarkson	4	50.5	4	4	4	12.63	7.92%	0.4	0.2	0.08
Leitchfield	19	50.5	9	18	19	2.66	37.62%	0.9	0.9	0.38
HARDIN	95	51.5	33	54	92	0.54	184.47%	3.3	2.7	1.84
Elizabethtown	19	51.5	12	19	19	2.71	36.89%	1.2	0.95	0.38
Radcliff	4	51.5	2	3	4	12.88	7.77%	0.2	0.15	0.08
Sonora	7	51.5	4	7	7	7.36	13.59%	0.4	0.35	0.14
Upton	1	51.5	1	1	1	51.50	1.94%	0.1	0.05	0.02
Vine Grove	1	51.5	1	1	1	51.50	1.94%	0.1	0.05	0.02
West Point	2	51.5	2	1	2	25.75	3.88%	0.2	0.05	0.04
LARUE	59	58.5	20	23	54	0.99	100.85%	2	1.15	1.08
Hodgenville	5	58.5	4	5	5	11.70	8.55%	0.4	0.25	0.1
MARION	58	53.5	11	18	50	0.92	108.41%	1.1	0.9	1
Bradfordsville	1	53.5	0	1	1	53.50	1.87%	0	0.05	0.02
Lebanon	6	53.5	3	6	6	8.92	11.22%	0.3	0.3	0.12
Loretto	2	53.5	1	2	2	26.75	3.74%	0.1	0.1	0.04
Raywick	1	53.5	1	1	1	53.50	1.87%	0.1	0.05	0.02
MEADE	68	59.5	20	40	63	0.88	114.29%	2	2	1.26
Brandenburg	13	59.5	8	13	13	4.58	21.85%	0.8	0.65	0.26
Ekron	2	59.5	0	2	2	29.75	3.36%	0	0.1	0.04
Muldraugh	0	59.5	0	0	0	0.00	0.00%	0	0	0
NELSON	71	53.5	22	39	64	0.75	132.71%	2.2	1.95	1.28
Bardstown	16	53.5	6	15	16	3.34	29.91%	0.6	0.75	0.32
Bloomfield	1	53.5	0	1	1	53.50	1.87%	0	0.05	0.02
Fairfield	0	53.5	0	0	0	0.00	0.00%	0	0	0
New Haven	4	53.5	1	3	4	13.38	7.48%	0.1	0.15	0.08
WASHINGTON	51	53.5	11	18	44	1.05	95.33%	1.1	0.9	0.88
Mackville	0	53.5	0	0	0	0.00	0.00%	0	0	0
Springfield	6	53.5	2	6	6	8.92	11.22%	0.2	0.3	0.12
Willisburg	3	53.5	1	3	3	17.83	5.61%	0.1	0.15	0.06
LTADD	563	50.5	187	298	523	0.09	1114.85%	18.7	14.9	10.46

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

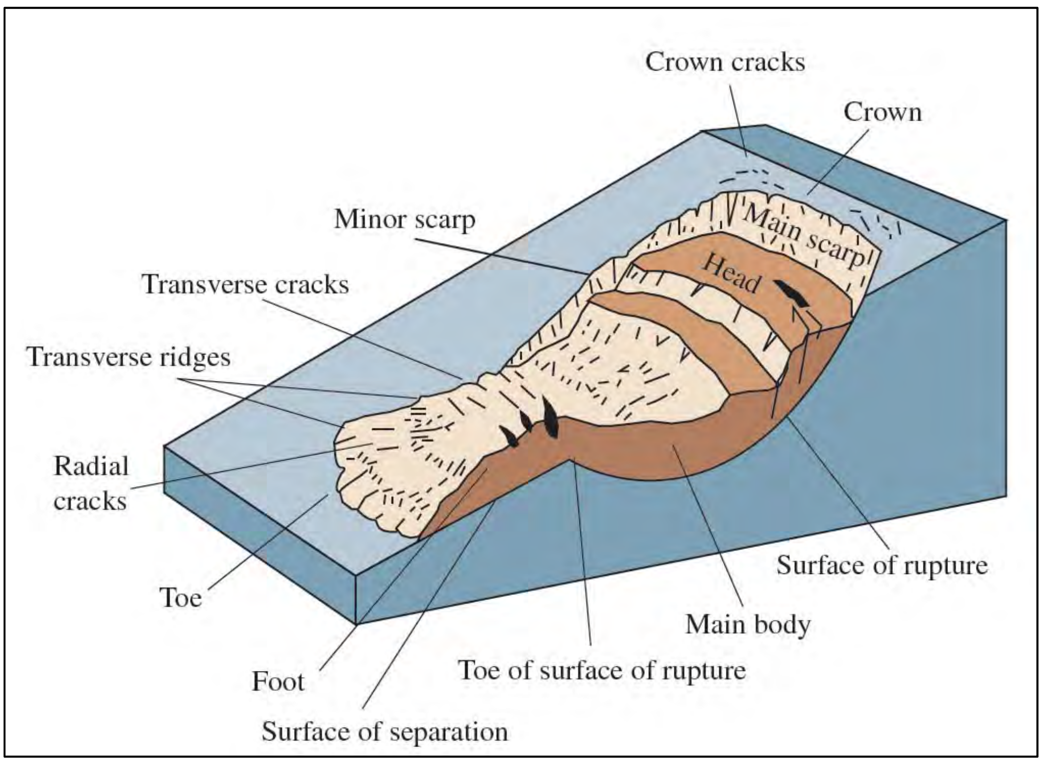
3.3.2.7 <u>Landslides</u>

<u>I. Background</u>

Definition

According to the United States Search and Rescue Task Force, "landslides are rock, earth, or debris flows on slopes due to gravity. They can occur on any terrain given the right conditions of soil, moisture, and the angle of the slope. Integral to the natural process of the earth's surface geology, landslides serve to redistribute soil and sediments in a process that can be in abrupt collapses or in slow gradual slides."

While there are numerous kinds of landslides, they can be triggered by rains, floods, earthquakes, and other natural events, as well as human-made causes such as grading, terrain cutting and filling, excessive development and vibrations. The factors that cause landslides can be geophysical or man-made and can occur in developed areas, undeveloped areas, or any area where the terrain was altered for roads, houses, utilities, buildings, and even residential lawns. Landslides occur in all fifty states with varying frequency and more than half of U.S. States have landslide rates sufficient to be classified as a significant natural hazard.



Slump-earth flow showing nomenclature, *Source: USGS Fact Sheet 2004-3072.*

Cause

Landslide is a term frequently used to mean any fairly rapid movement of rocks and sediment downslope. However, a more accurate term to use is "mass wasting." Mass wasting refers to a large variety of mass movement processes that wear away to the Earth's surface.

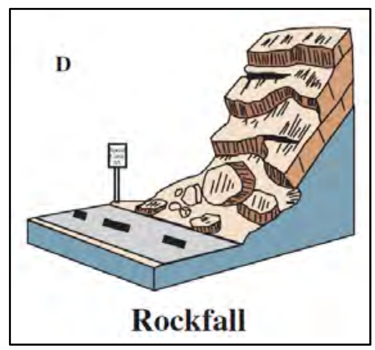
There are three main factors that control the type and rate of mass wasting that occurs at the Earth's surface:

- Slope gradient: The steeper the slope of the land, the more likely that mass wasting will occur.
- Slope consolidation: Sediments and fractured or poorly cemented rocks and sediments are weak, and more prone to wasting.
- Water: When slope materials become saturated with water, they may lose cohesion and begin to flow easily.

The three basic types of mass wasting are:

- Falls – rocks fall or bounce through the air
- Slides – rocks and/or sediment slide along the Earth's surface
- Flows – sediment flows across the Earth's surface

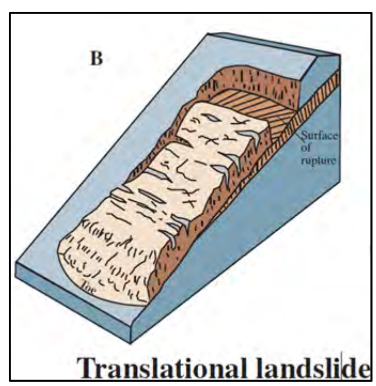
Falls occur as a result of weathering. Steep mountain or hillside slopes are constantly wasting away and are characterized by rocks falling and bouncing down slopes. These falls are triggered by freezing and thawing water, the growth of plants and their roots, earthquakes, or by people hiking on a slope. Falls occur in a matter of seconds, so they are difficult to observe.



USGS Fact Sheet 2004-3072.

Slides occur when a mass of slope material moves as an entire block. The most common form of a slide is a **slump**. A slump happens when a portion of the hillside moves downslope as a result of gravity.

A landslide is called a **flow** if the material moving downslope is being transported as a very thick fluid, rather than as a unified block of material.



USGS Fact Sheet 2004-3072.

Areas prone to landslides include:

- Existing landslides, old or recent
- On or at the base or top of slopes
- In or at the base of minor drainage hollows
- At the base or top of an old fill slope
- At the base or top of a steep cut slope

Areas that are generally safe from Landslides include:

- On hard, non-joined bedrock that has not moved in the past
- On relatively flat-lying areas away from slopes and steep river banks
- At the top or along the nose of ridges, set back from the tops of slopes

Features that may be present prior to a major landslide include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main structure
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Sudden decrease in creek water levels though rain is still falling or has just recently stopped.
- Sticking doors and windows, and visible open spaces; indication jambs and frames are out of plumb.

Landslide area in Nelson County along the Chaplin River. *Source: LTADD Archive.*

A landslide occurs when the stability of a slope changes from a stable condition to an unstable one. A change in slope stability can occur from a number of factors that act alone or in concert with one another. Natural causes of landslides include:

- Groundwater (pore water) pressure acting to destabilize a slope
- Loss or absence of vertical vegetative structure, soil nutrients and soil structure; all of these factors can be the result of a wildfire
- Erosion of the toe of a slope by rivers or ocean waves
- Intense rainfall
- Weakening of a slope due to saturation by melting snow and glaciers or by heavy rains

- Earthquakes that add loads to barely stable slopes or earthquake-caused liquefaction that destabilizes slopes
- Volcanic eruptions

Human activities that can affect the occurrence of a landslide include:

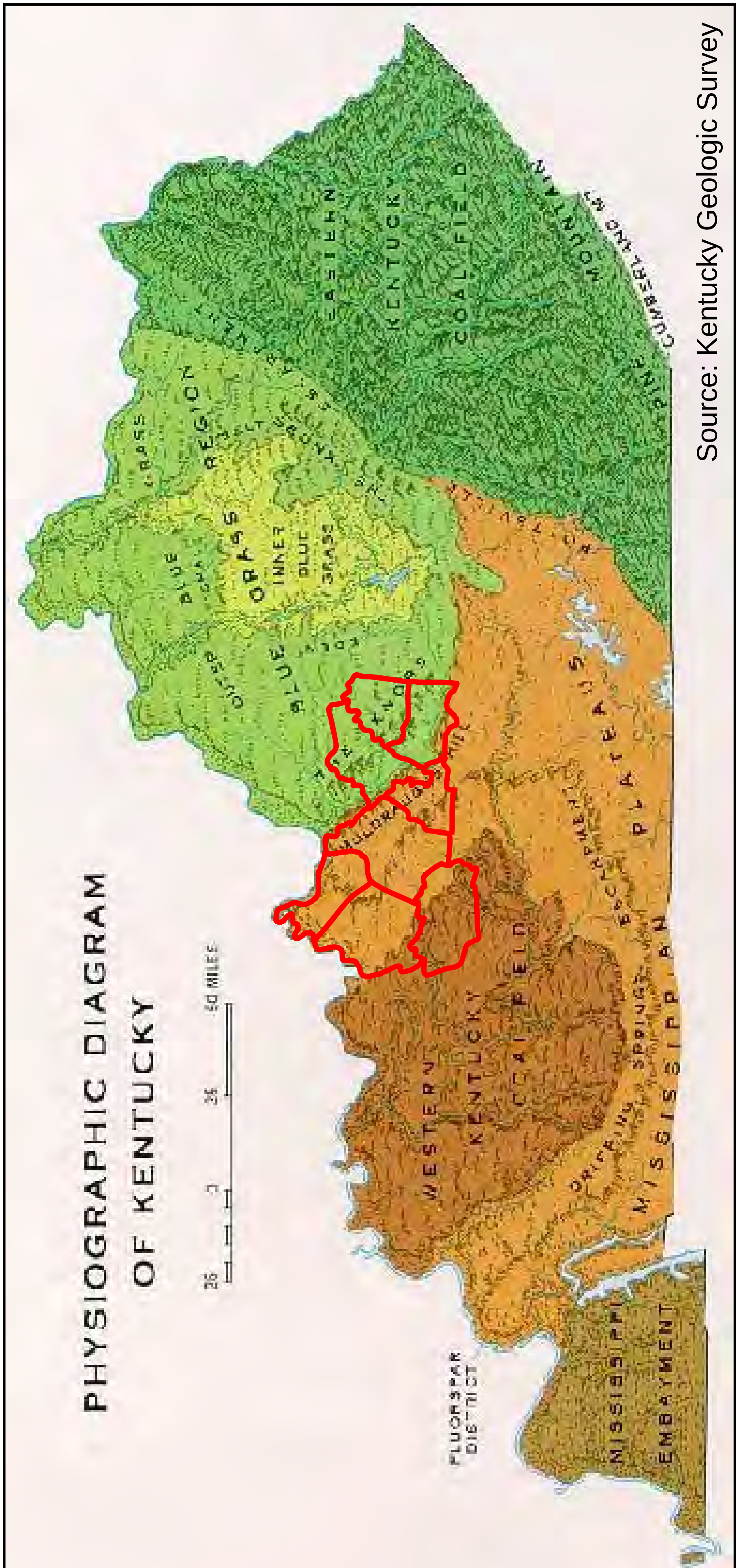
- Deforestation, cultivation and construction that contributes to the destabilization of a fragile slope
- Vibrations from machinery or traffic
- Blasting
- Earthwork that alters the shape of a slope or contributes new loads on an existing slope
- Removal of deep-rooted vegetation that binds colluvium to bedrock in shallow soils
- Construction, agricultural or forestry activities that changes the amount of water which infiltrates the soil

Hazards/Vulnerability

According to the United States Geological Survey Fact Sheet 2004-3072, landslides cause approximately $3.5 billion (in 2001 dollars) in damages, and kill between 25 and 50 people in the United States annually. Landslides occur in all fifty of the states in the U.S. The casualties in the United States are caused primarily by rockfalls, rockslides, and debris flows. Natural disasters are a prime example of humans living in conflict with the environment. Because landslides can cause catastrophic damage and loss of life, it is imperative to have a good understanding of what causes disasters in order to prevent them from occurring or to avoid development in areas prone to disasters. Sustainable land management and development is an essential tool in reducing the negative impacts that can happen as a result of landslides.

II. Analysis

It is helpful to understand the physiographic characteristics of the Lincoln Trail Region to analyze the risk of landslides in the area. The Kentucky Physiographic Regions map included, shows that our region lies in four Kentucky physiographic regions; the Knobs, the Western Coal Field, the Outer Bluegrass and the Mississipppian Plateau or Western Pennyroyal. Each has distinct characteristics that define it and help determine the propensity for landslides. Information for this analysis comes from ARCGIS, Kentucky Geological Survey and historical information from County Emergency Management Agencies.


Source: Kentucky Geologic Survey
PHYSIOGRAPHIC DIAGRAM
OF KENTUCKY
50 MILES
EASTERN
KENTUCKY
COALFIELD
WESTERN
KENTUCKY
COALFIELD
INNER
BLUE
GRASS
MISSISSIPPI
EMBAYMENT
FLUORSPAR
DISTRICT

According to the Kentucky Geological Survey, Kentucky has a combination of steep slopes, excessive water amounts, geology, and slope modifications that are the main causes of landslides. The Kentucky Transportation Cabinet has compiled 870 geotechnical reports documenting landslides that have affected roads in Kentucky and resulted in significant costs. Between fiscal years 2002 to 2009, the Transportation Cabinet's records show repairs due to landslides and rockfalls totaled $31.8 million. While damage totals specific

Rock Slide on the Blue Grass Parkway in Hardin County. *Source: Kentucky Geological Survey.*

to the Lincoln Trail Region are not documented, it is definite that some of Transportation Cabinets repairs were done on local roads. From 2003 to 2013, the Kentucky Hazard Mitigation Grant program funded or will fund projects to acquire landslide-damaged homes or to stabilize an area, totaling $5.3 million. In general, the State and local agencies that respond to or document landslides vary, and data pertaining to the collection, assessment, and documentation of occurrences is not consistent.

To date, Hazard Mitigation funds were used in Nelson County to buy out a home in danger of sliding down a slope. The property was purchased in 2006 and the structure demolished. The land was rezoned to green space in perpetuity. Meade County has imminent need to stabilize a bank slope on the Ohio River that threatens the local water supply, and Breckinridge County has project plans to stabilize slopes that threaten local roads.

Extent

While there are few documented reports of extensive damage as a result of landslide activity, the eight-county region has natural topographic and geologic features that render it susceptible to landslides when natural events such as ground water, intense rainfall, melting snow and seismic activity are factored in. This is substantiated by the 2006 *Landslide* review written by Yoshimatsu and Abe. Yoshimatsu and Abe identify the Analytical Hierarchic Process (AHP) as a method to determine areas susceptible to landslides. Aerial photographs of areas prone to landslides are "layered." Scores are assigned to each "layer" of the micro-topography and susceptibility to landslides is a function of the summation of scores assigned to each factor of the photographed micro-topography in the landslide prone area. Based on this technology, and the topographic features of the Lincoln Trail Area including karst topography, steep slopes, alluvial soils and underground water movement, coupled with the regional propensity for heavy rains and melting snow; it can be determined that the region has the potential for landslide hazards.

Table 3.3.2.7.1 - AHP Score of Ranking of Susceptibility of Landslides

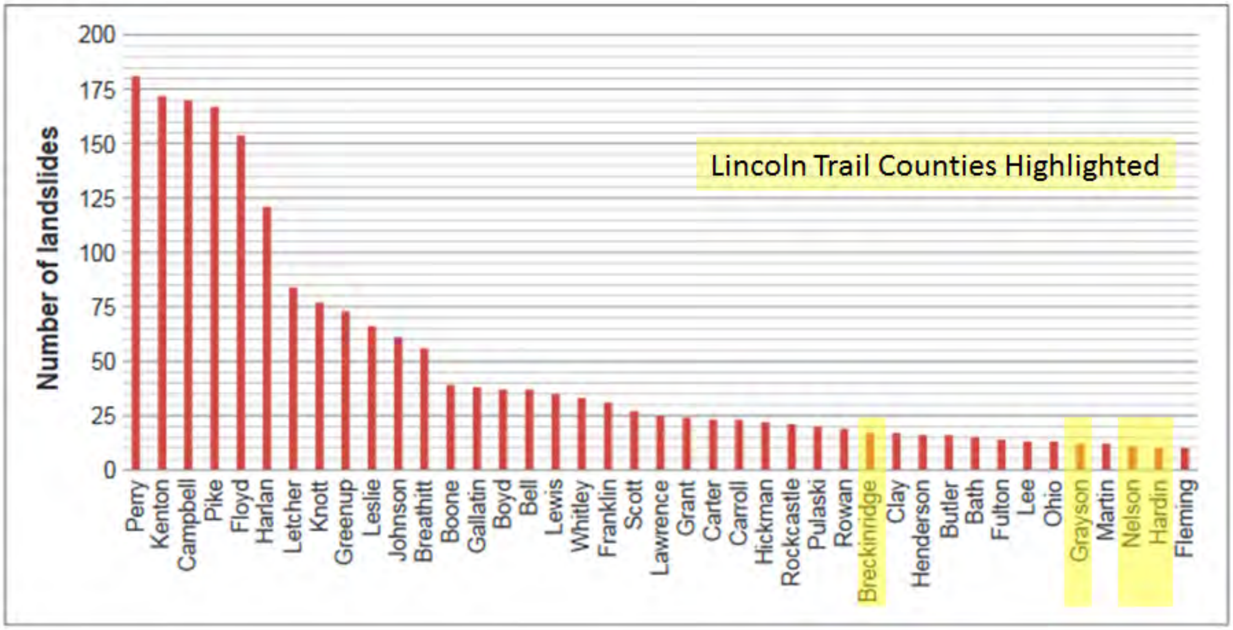
Susceptibility Level	AHP Score	Percentage to Total Number of Landslides (%)
Level 1 (High)	62 > AHP Score	5%
Level 2 (Slightly High)	38 < AHP Score	25%
Level 3 (Slightly Stable)	24 < AHP Score	30%
Level 4 (Stable)	AHP Score < 24	40%
Source: Yoshimatsu, H.; & Abe, S. (2006). "A Review of Landslide Hazards in Japan and Assessment of Their Susceptibility Using an Analytical Hierarchic Process (HP) Method." *Landslides*, 3, 149-158		

As previously cited, landslides in this region have the potential to destroy structures, interrupt transportation lines and decimate regional water sources.

Probablity

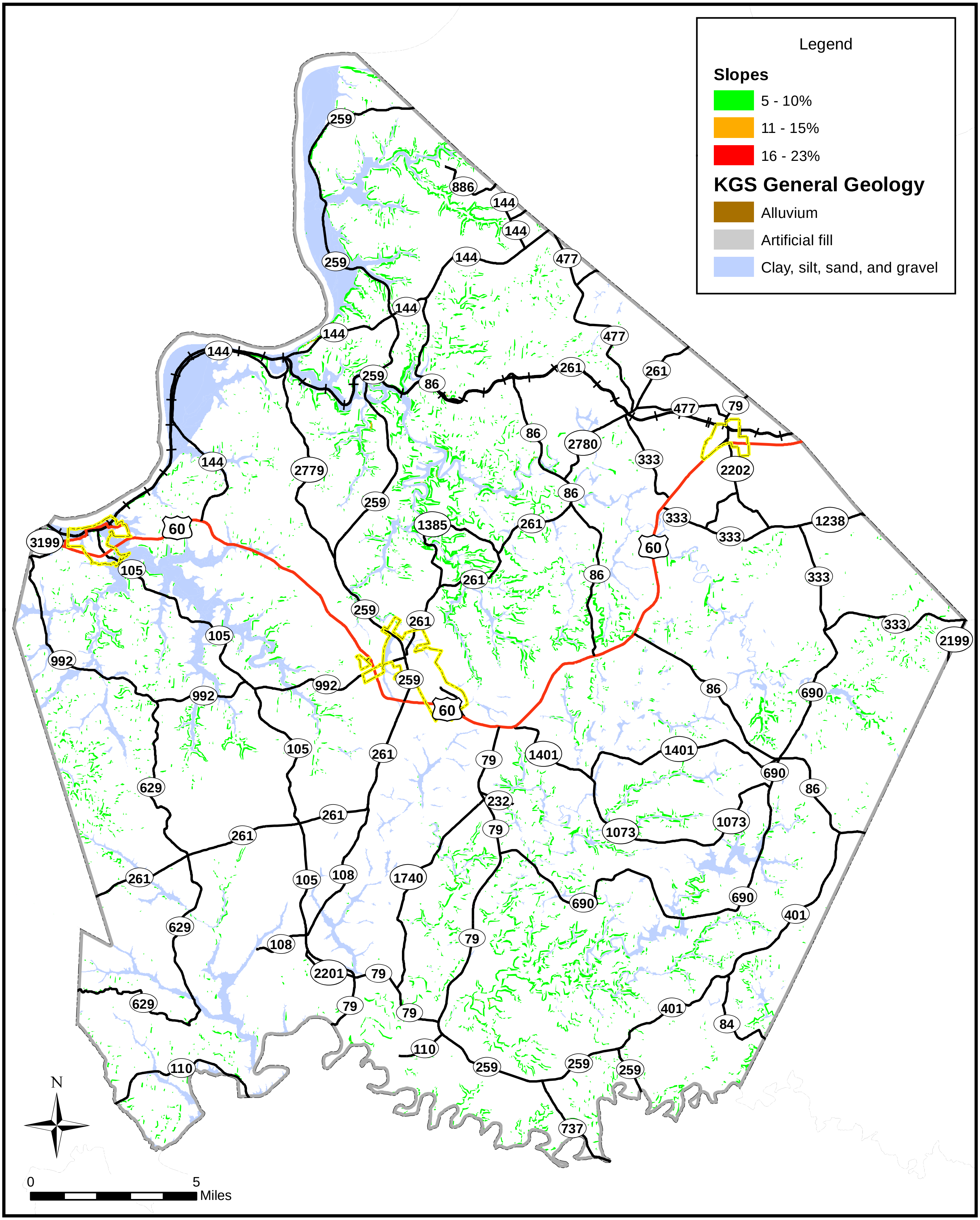
In 2011, Kentucky Geological Survey (KGS) began constructing a landslide inventory database. As of August 20, 2014 the Kentucky Landslide Inventory illustrated by the above chart was completed. The inventory shows the number of documented landslides in the database per county for those counties with 10 or more landslides. In the Lincoln Trail Region there are 49 documented landslides; 16 in Breckinridge County, 12 in Grayson County, 11 in Nelson County and 10 in Hardin County. This yields approximately 3.5 years of data. A raw value for probability for an event occurrence for the Lincoln Trail Region would be historic recurrence interval of 0.07 and a historic frequency, chance per year of 1400%.

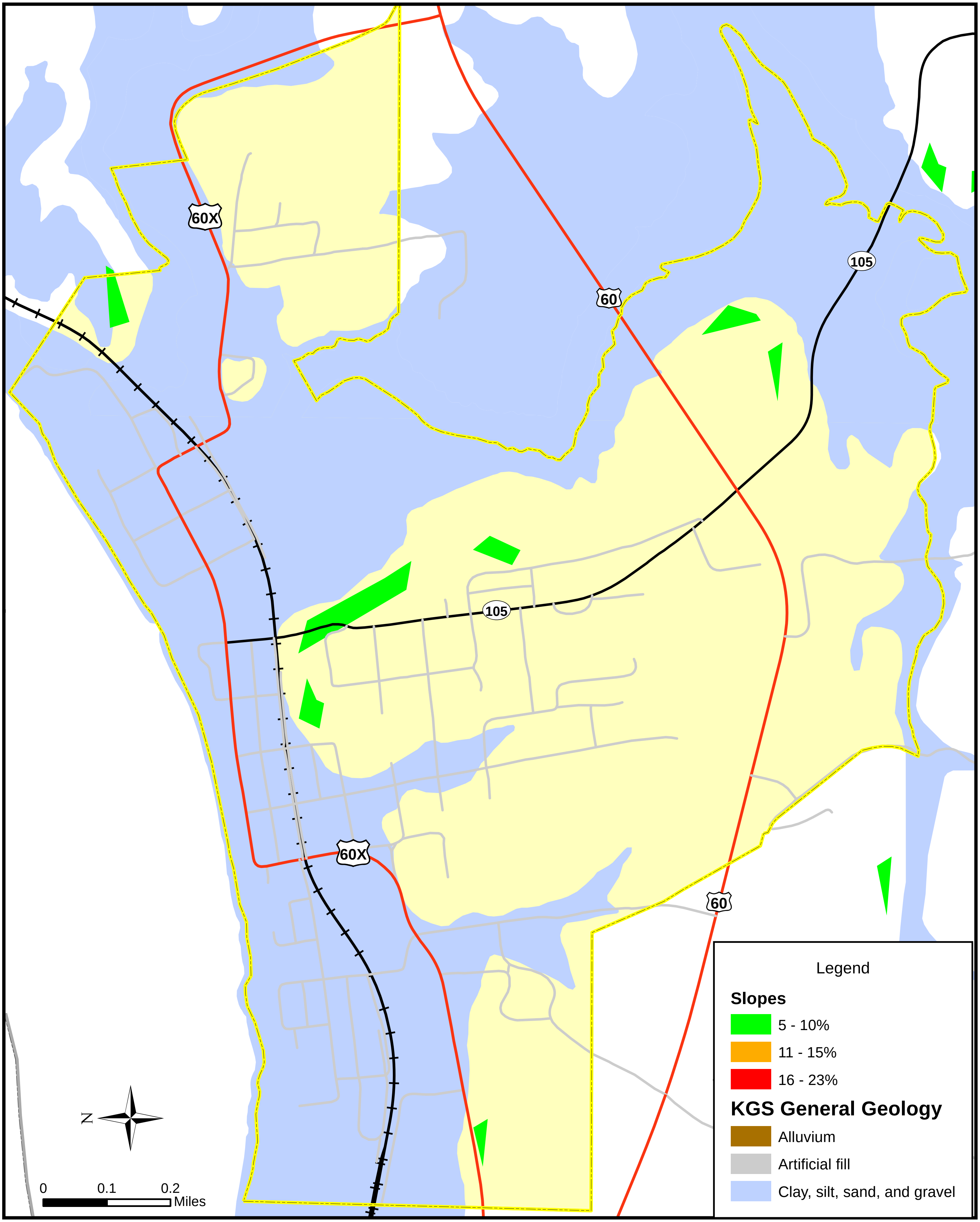
Chart 3.3.2.7.1 - KGS Landslide Inventory, Distribution of Landslides

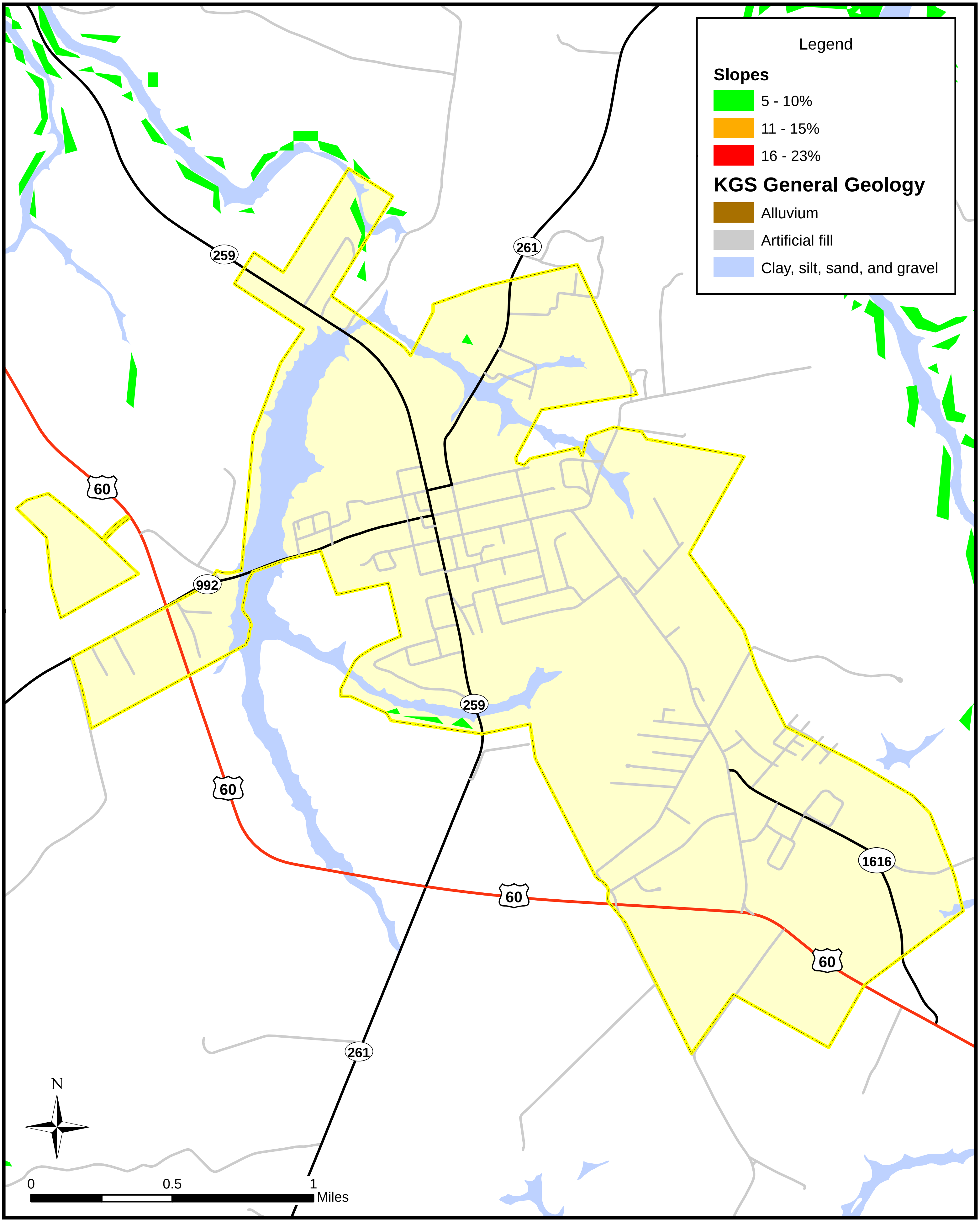


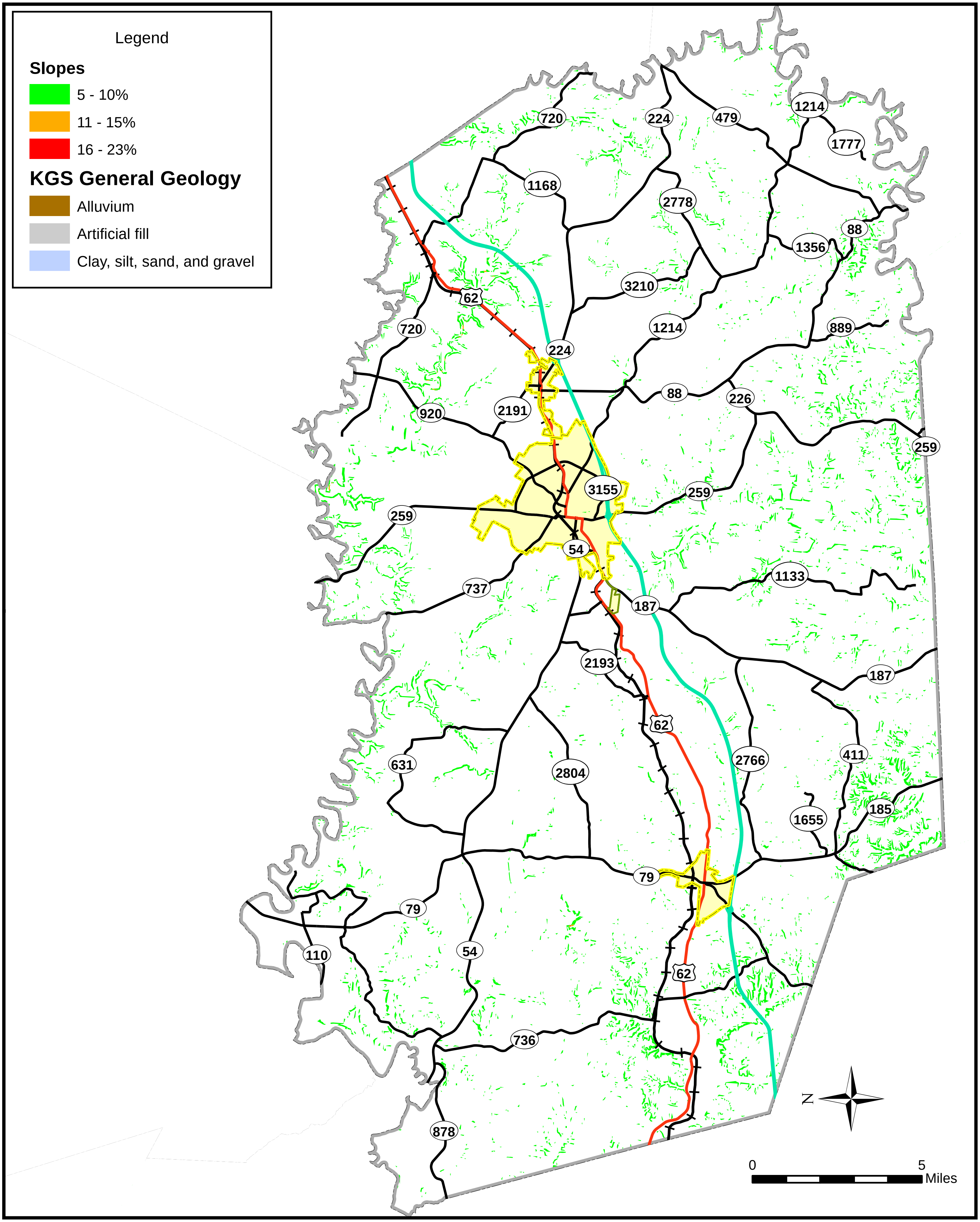
Modified from "Distribution of landslides by county (10 or more landslides)", *Source: KGS "Landslide Inventory: From Design to Application, 2014.*

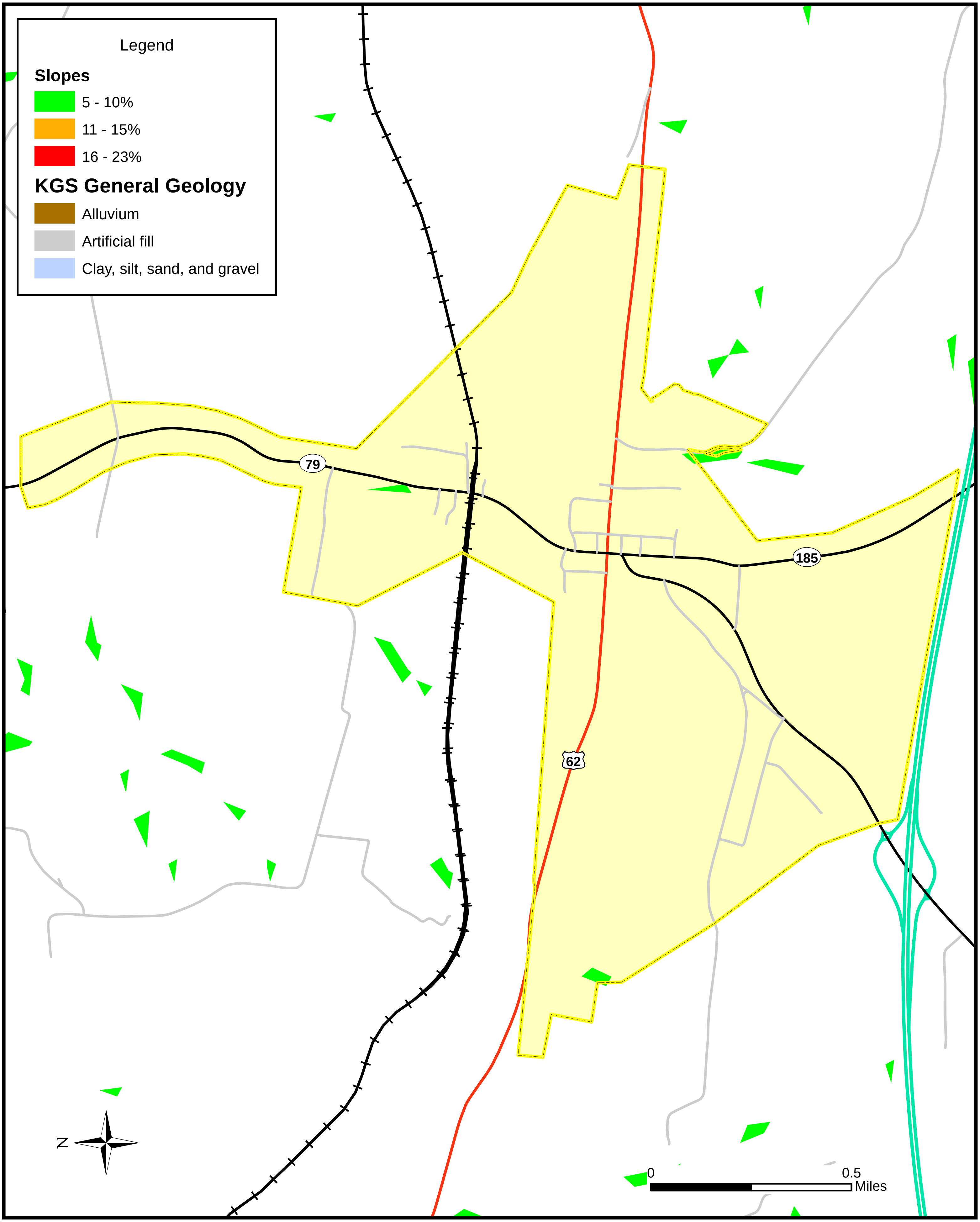
Note that according to KGS, there is currently no best practice or standard methodology to develop a database that could effectively model landslide susceptibility or risk. Much depends on the ability to collect locations and occurrences.

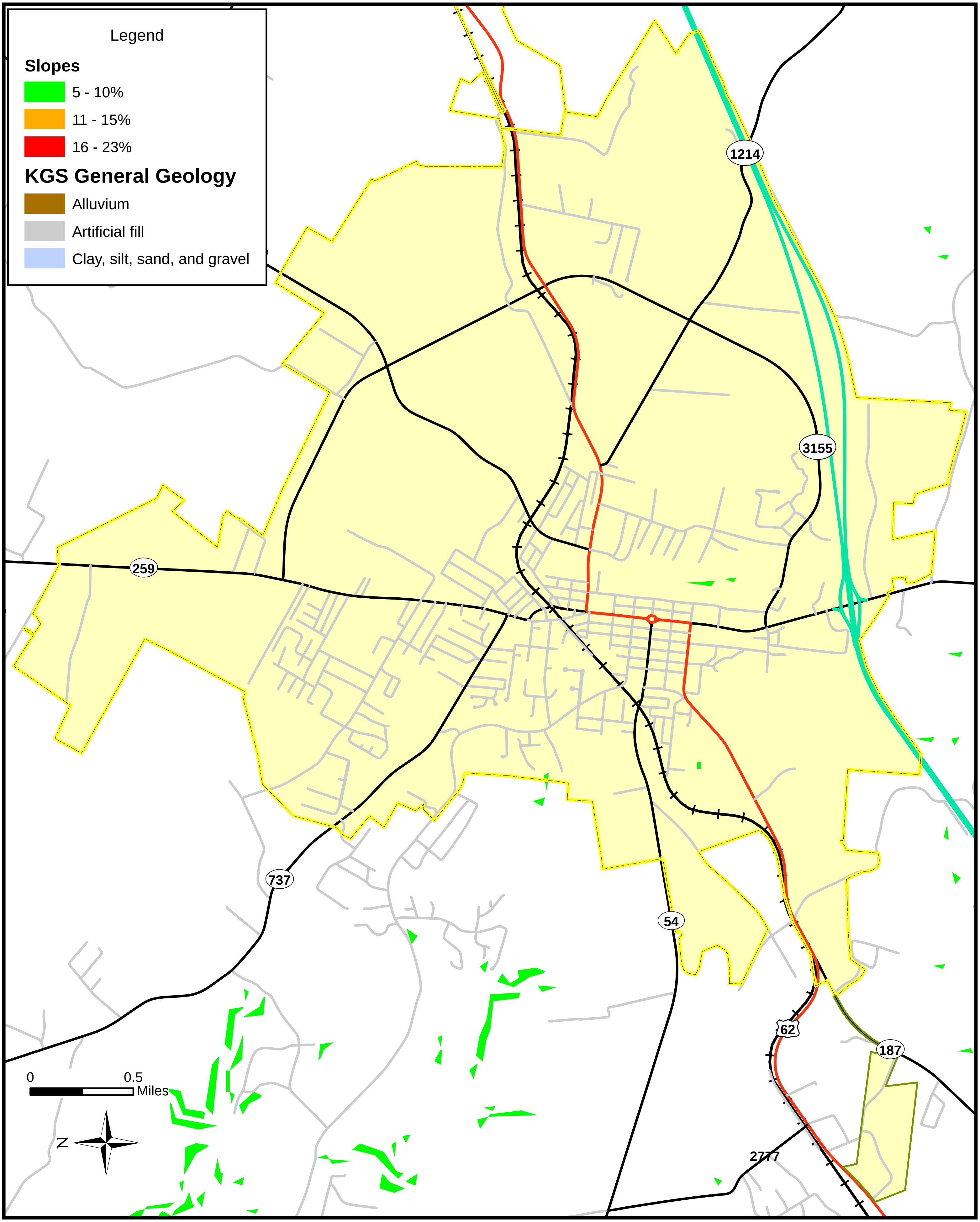

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
N
0
5
Miles

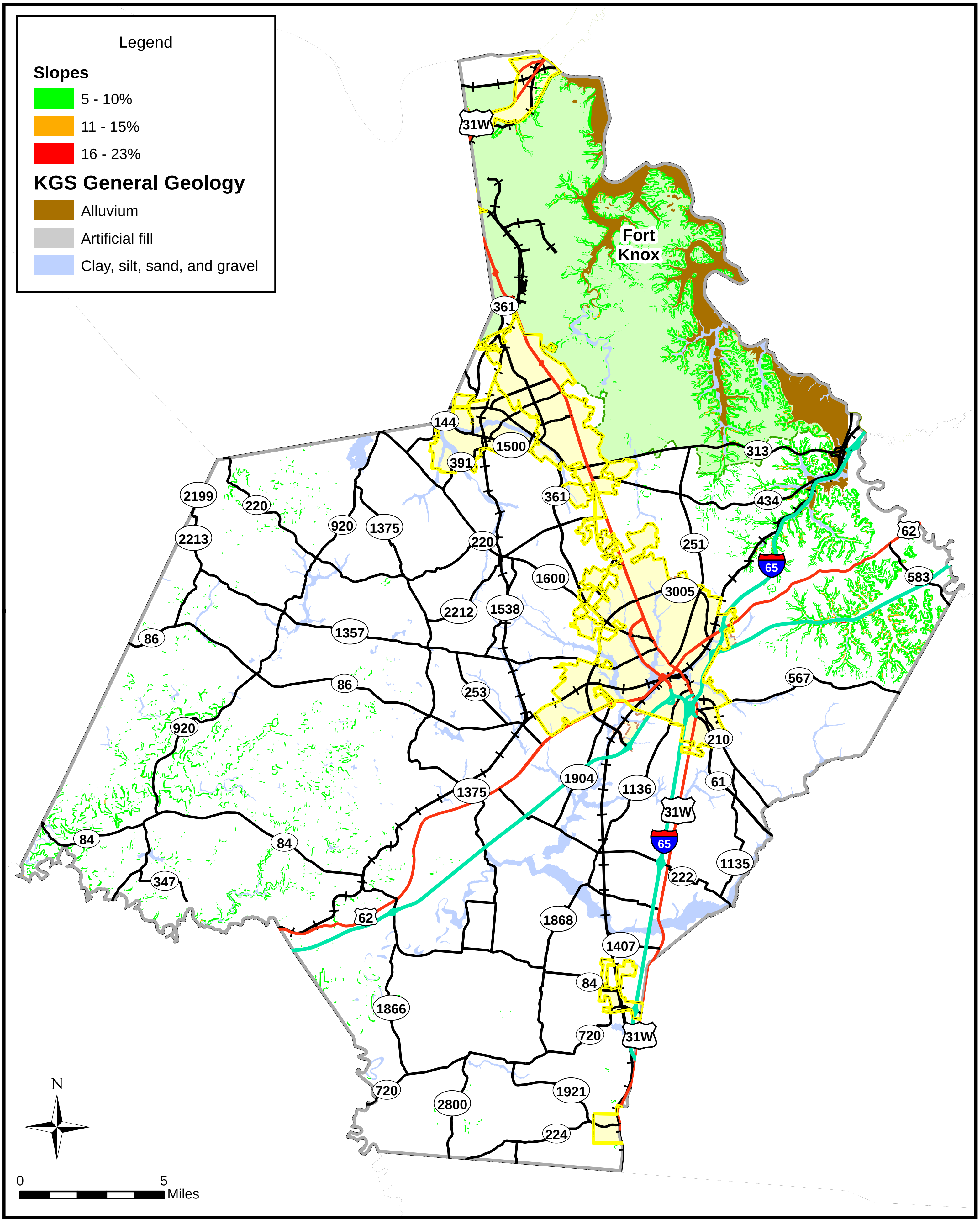

60X
60
105
105
60X
60
N
0
0.1
0.2
Miles
Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel

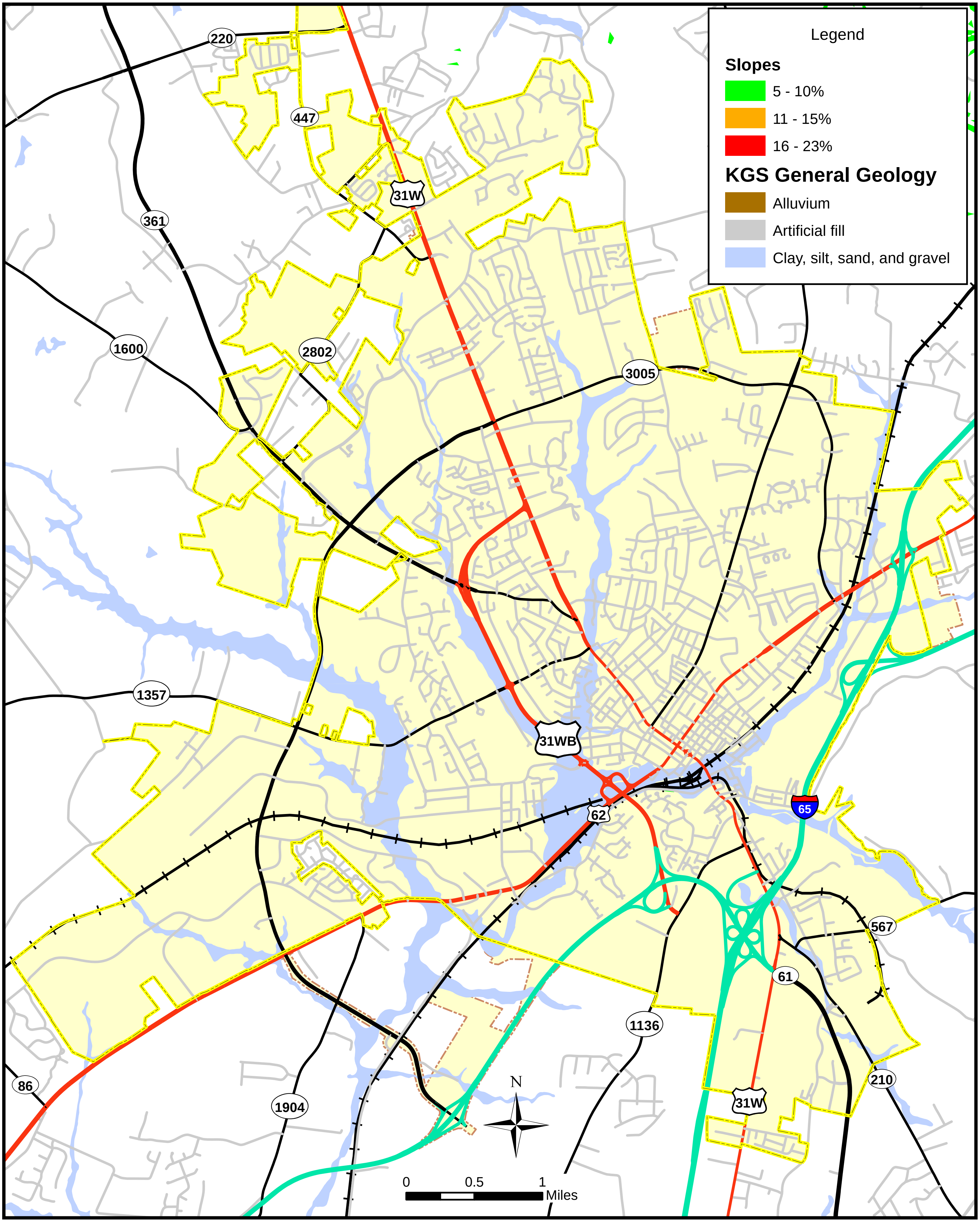

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
259
261
60
992
259
60
60
1616
60
261
N
0
0.5
1
Miles

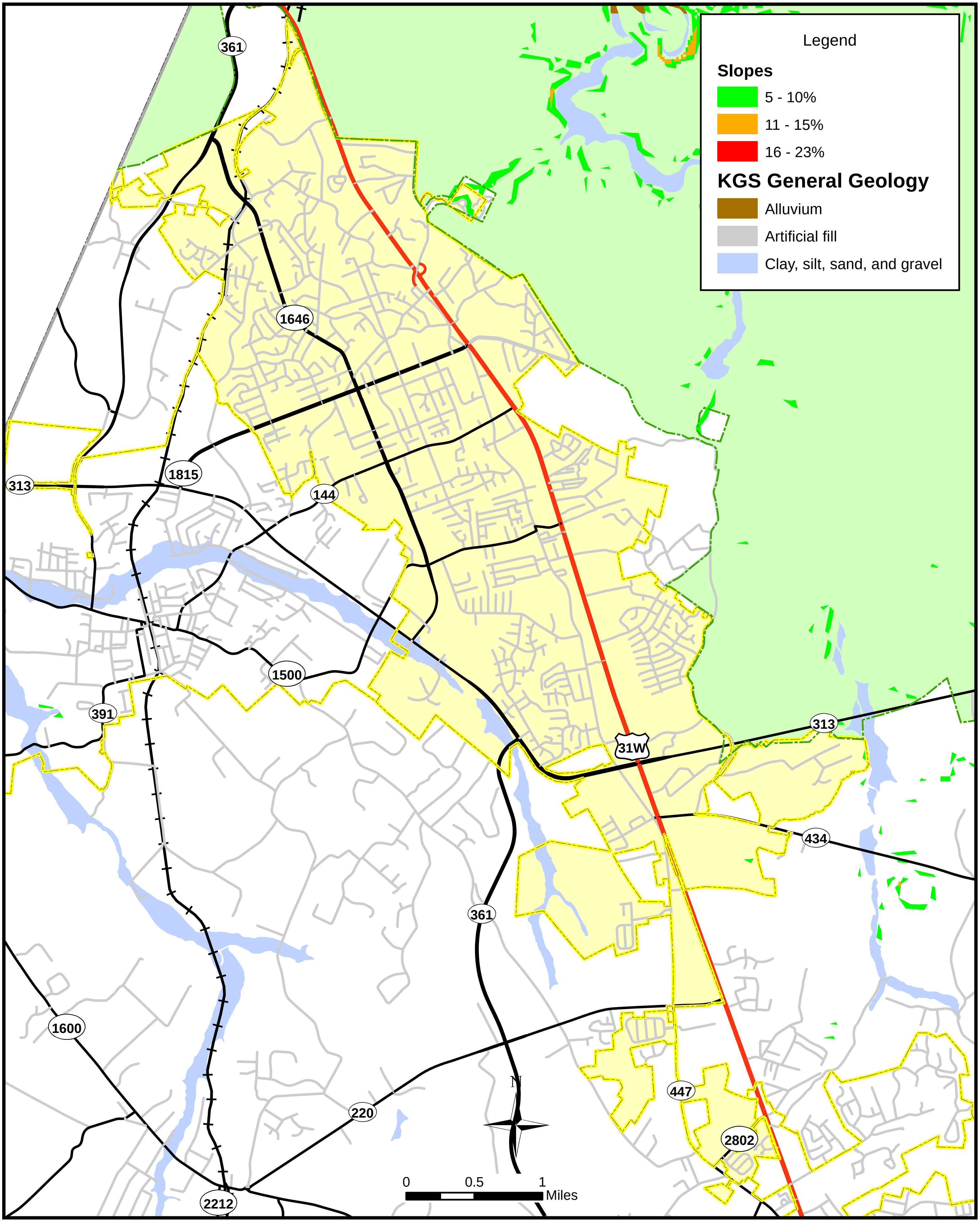

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
720
224
479
1214
1777
1168
2778
88
1356
3210
62
720
224
1214
889
88
226
920
2191
259
3155
259
259
54
1133
737
187
2193
187
62
2766
411
631
2804
185
1655
79
79
110
54
62
736
878
N
0
5
Miles

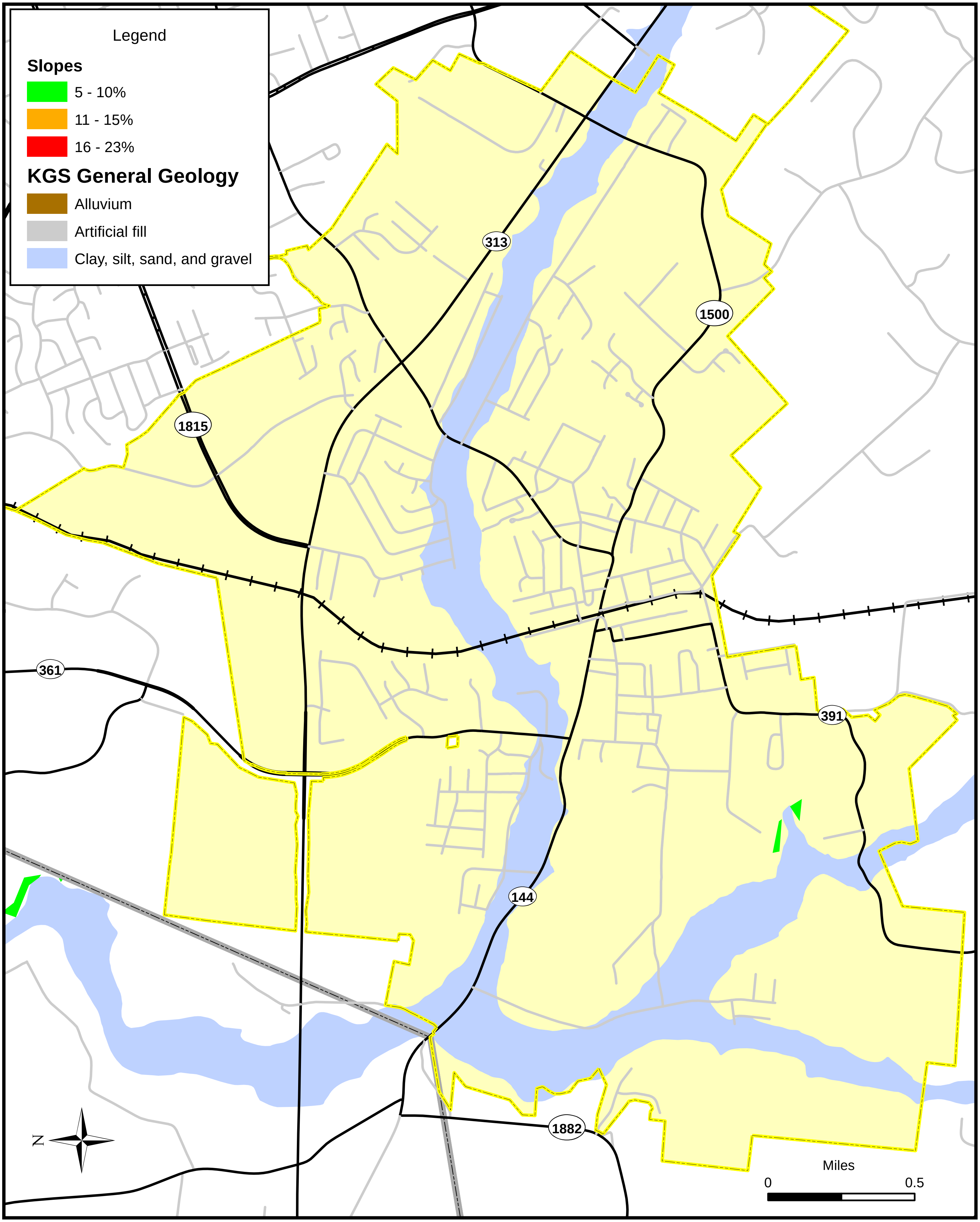

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
79
185
62
N
0
0.5
Miles

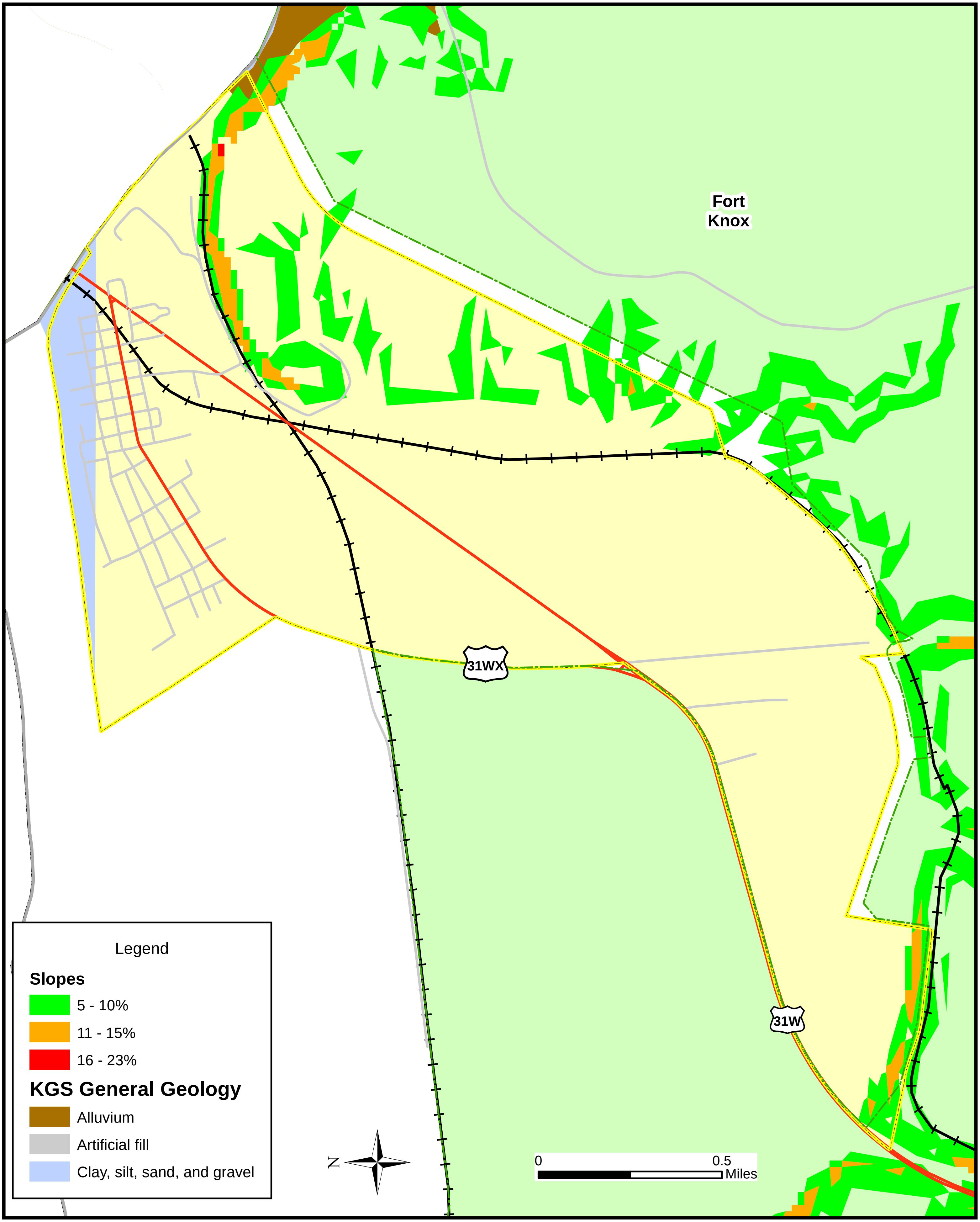

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
1214
3155
259
737
54
62
187
2777
0
0.5
Miles
N

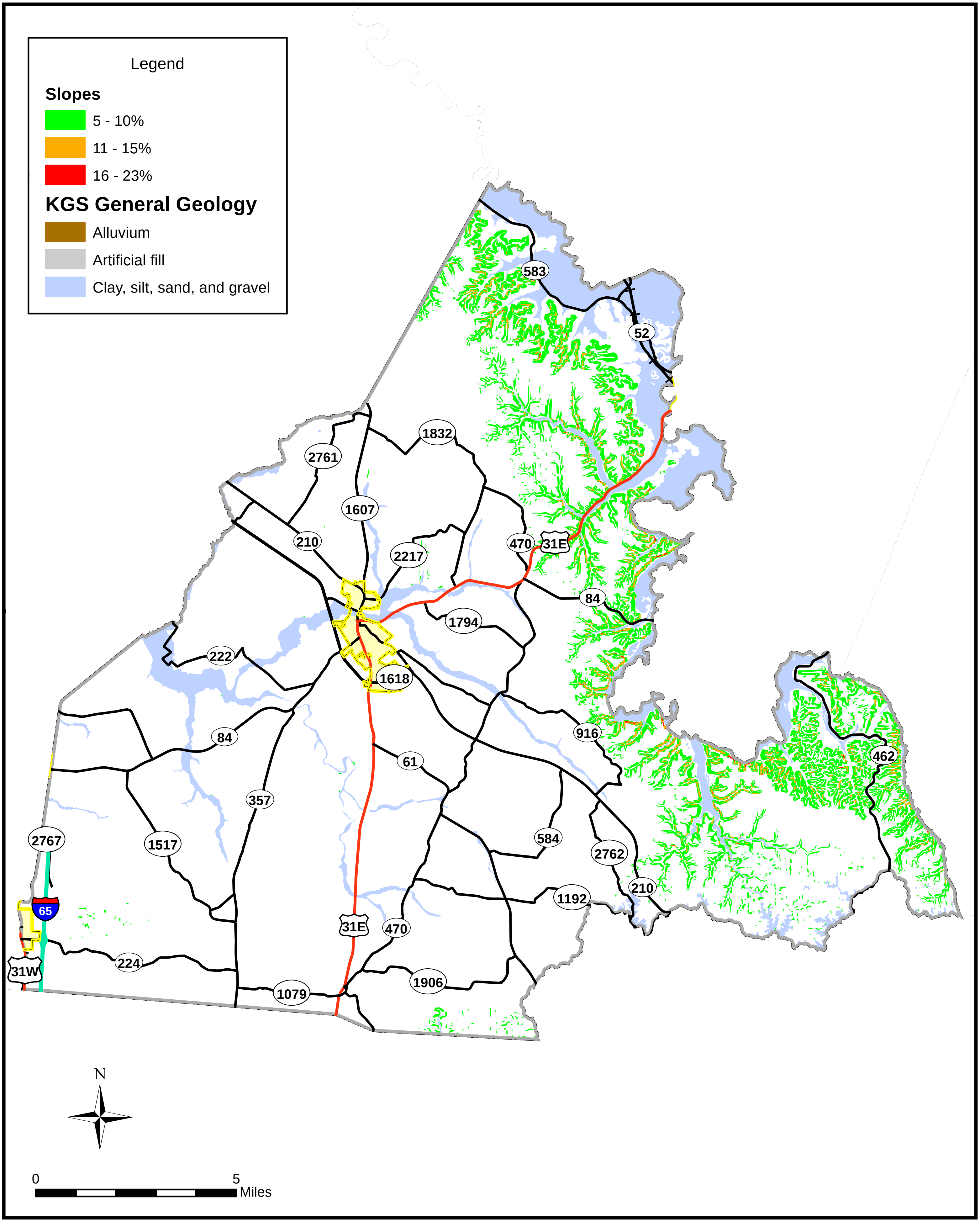

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
Fort Knox
N
0
5
Miles

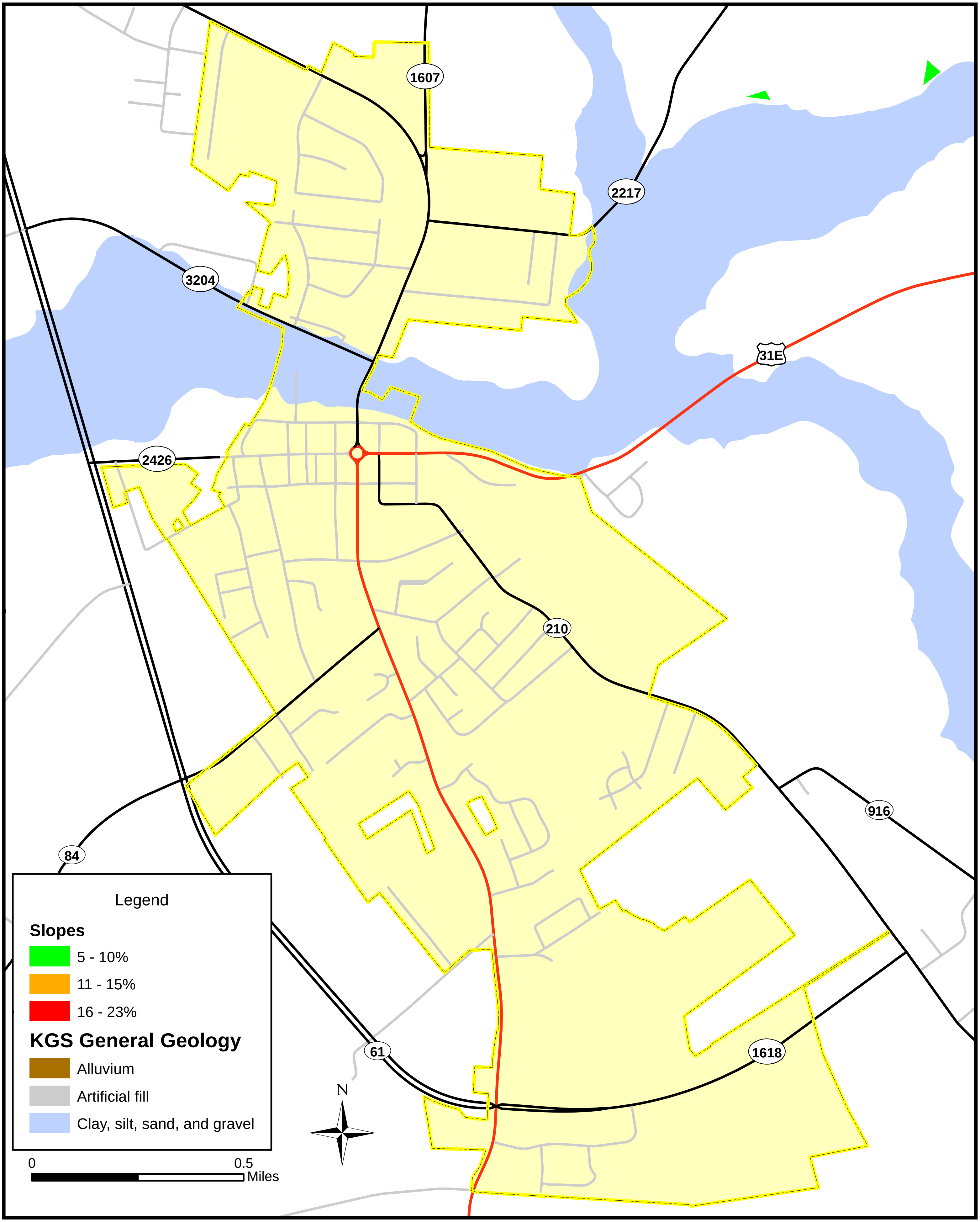

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
220
447
31W
361
1600
2802
3005
1357
31WB
62
65
567
61
1136
210
86
1904
31W
N
0
0.5
1
Miles

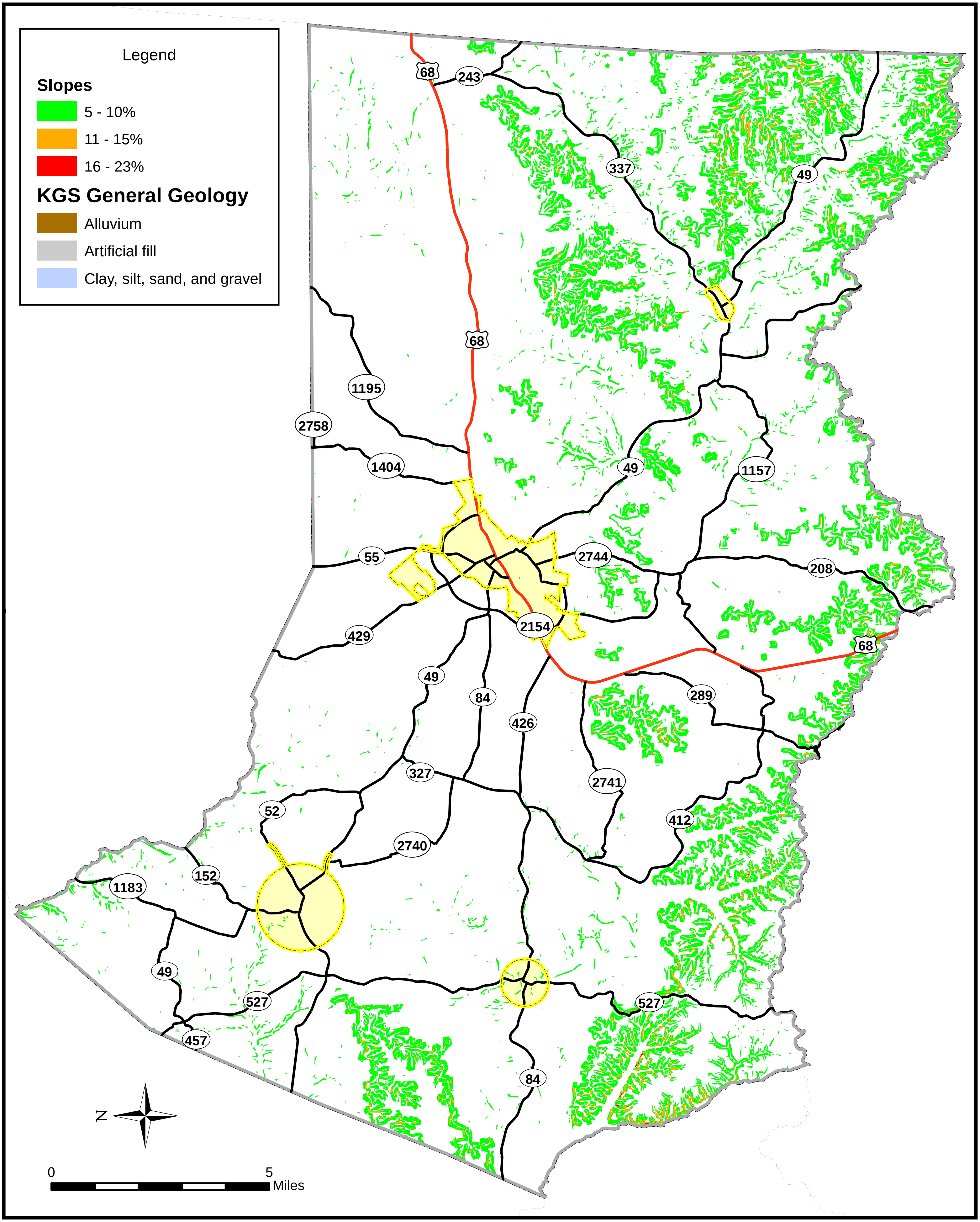

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
361
1646
1815
313
144
1500
391
31W
313
434
361
1600
220
447
2802
2212
N
0
0.5
1
Miles

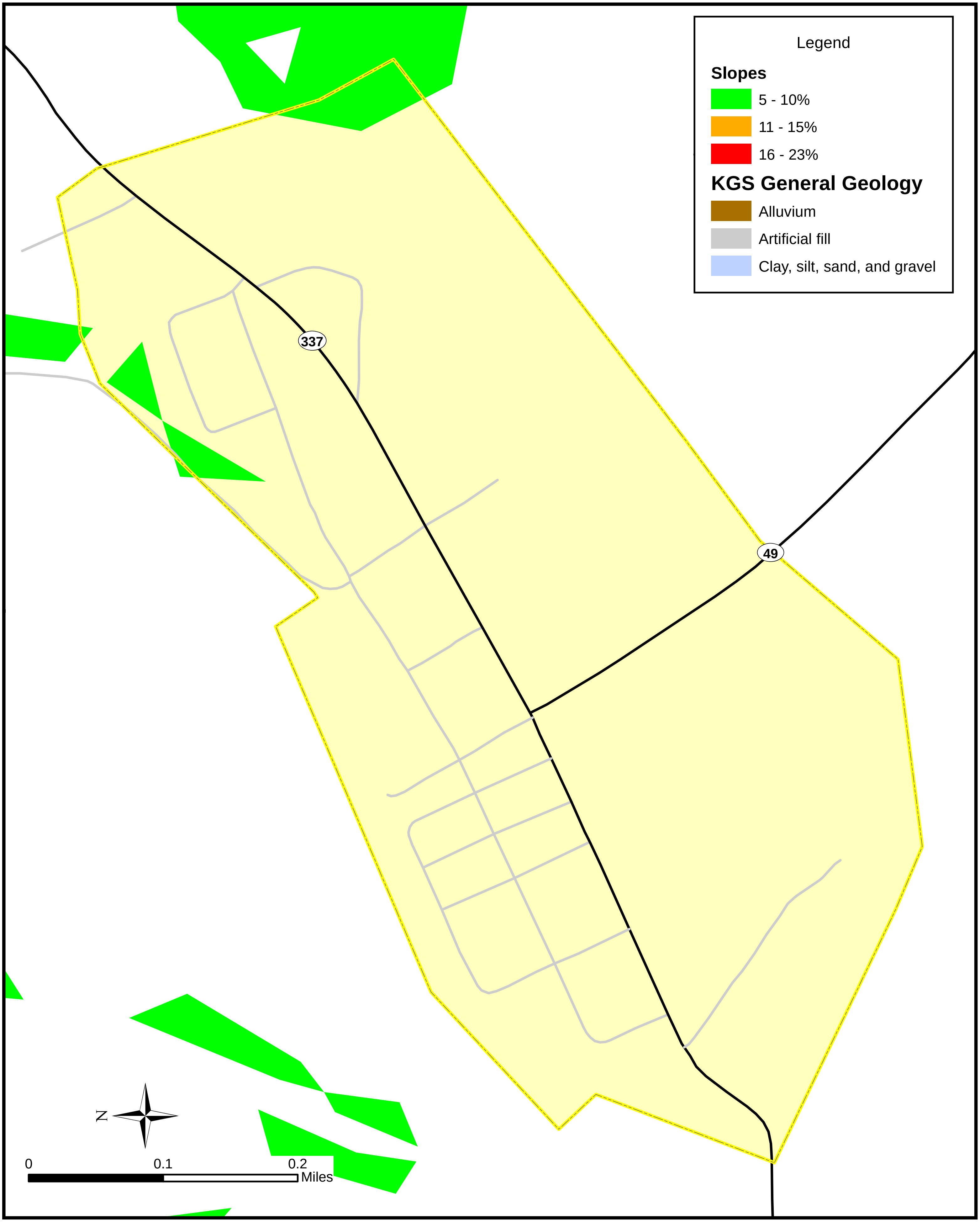

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
313
1500
1815
361
391
144
1882
N
Miles
0
0.5

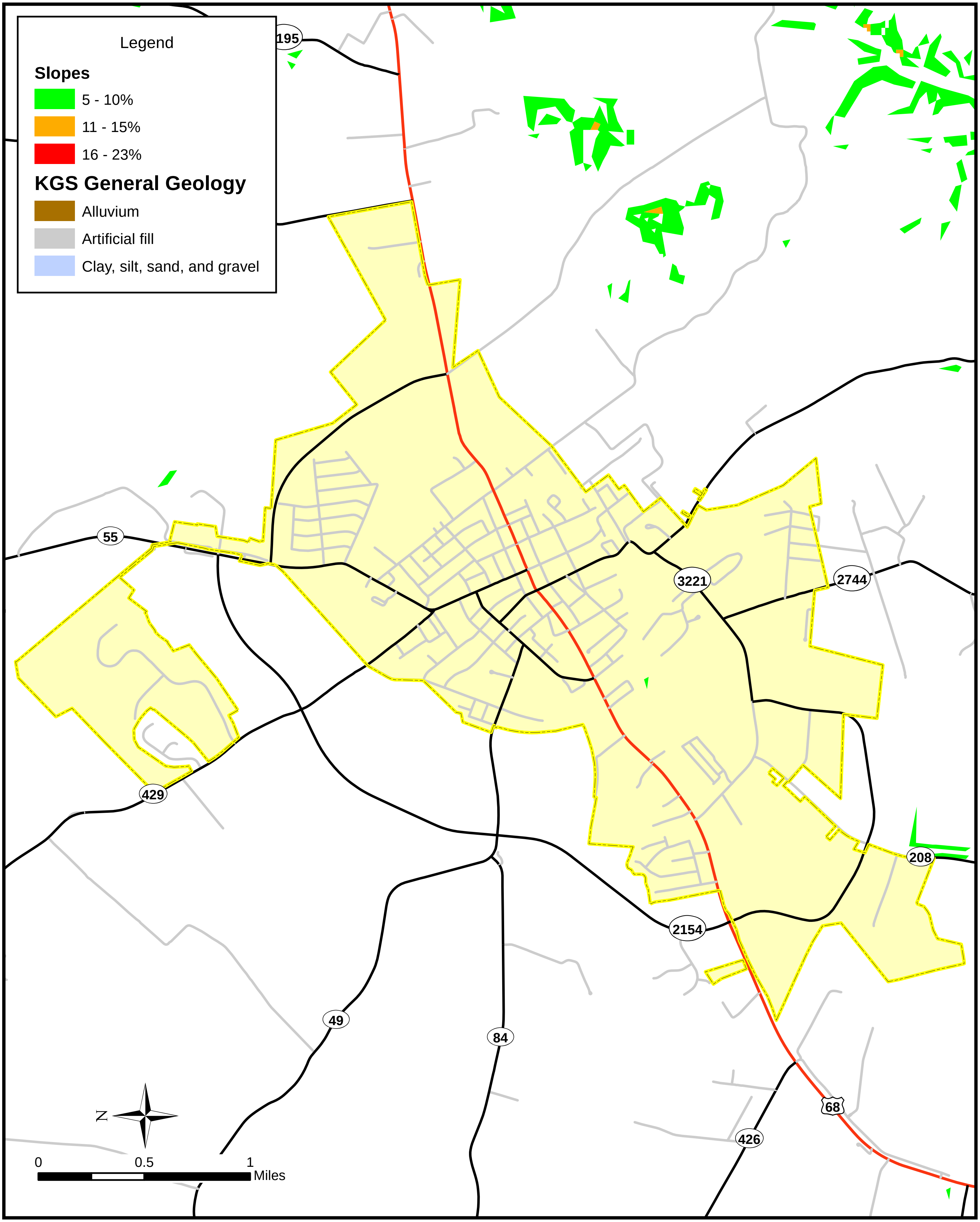

Fort
Knox
31WX
31W
Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
N
0
0.5
Miles

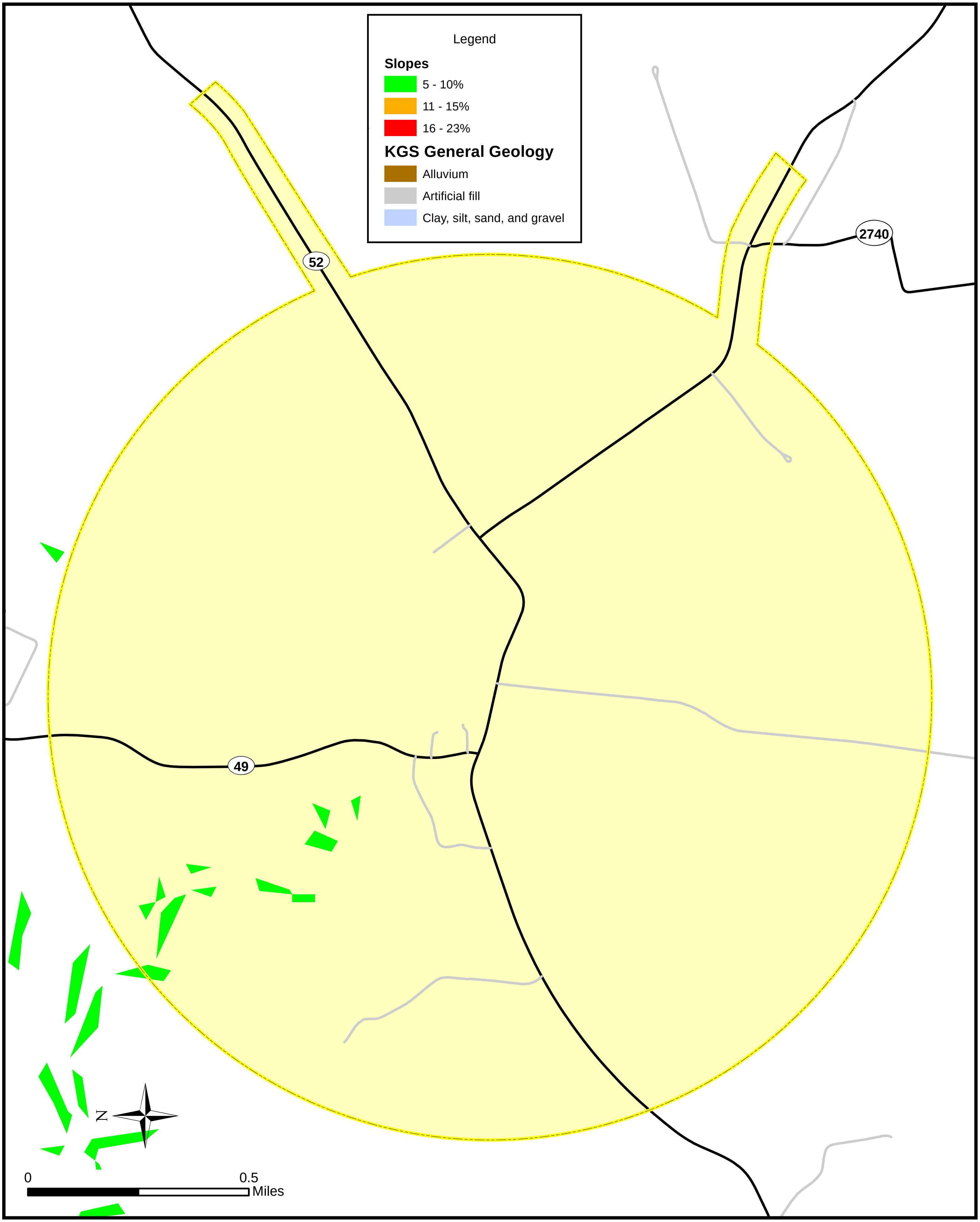

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
583
52
1832
2761
1607
210
2217
470
31E
84
1794
222
1618
916
462
84
61
357
2767
1517
584
2762
210
1192
65
31E
470
224
31W
1079
1906
N
0
5
Miles

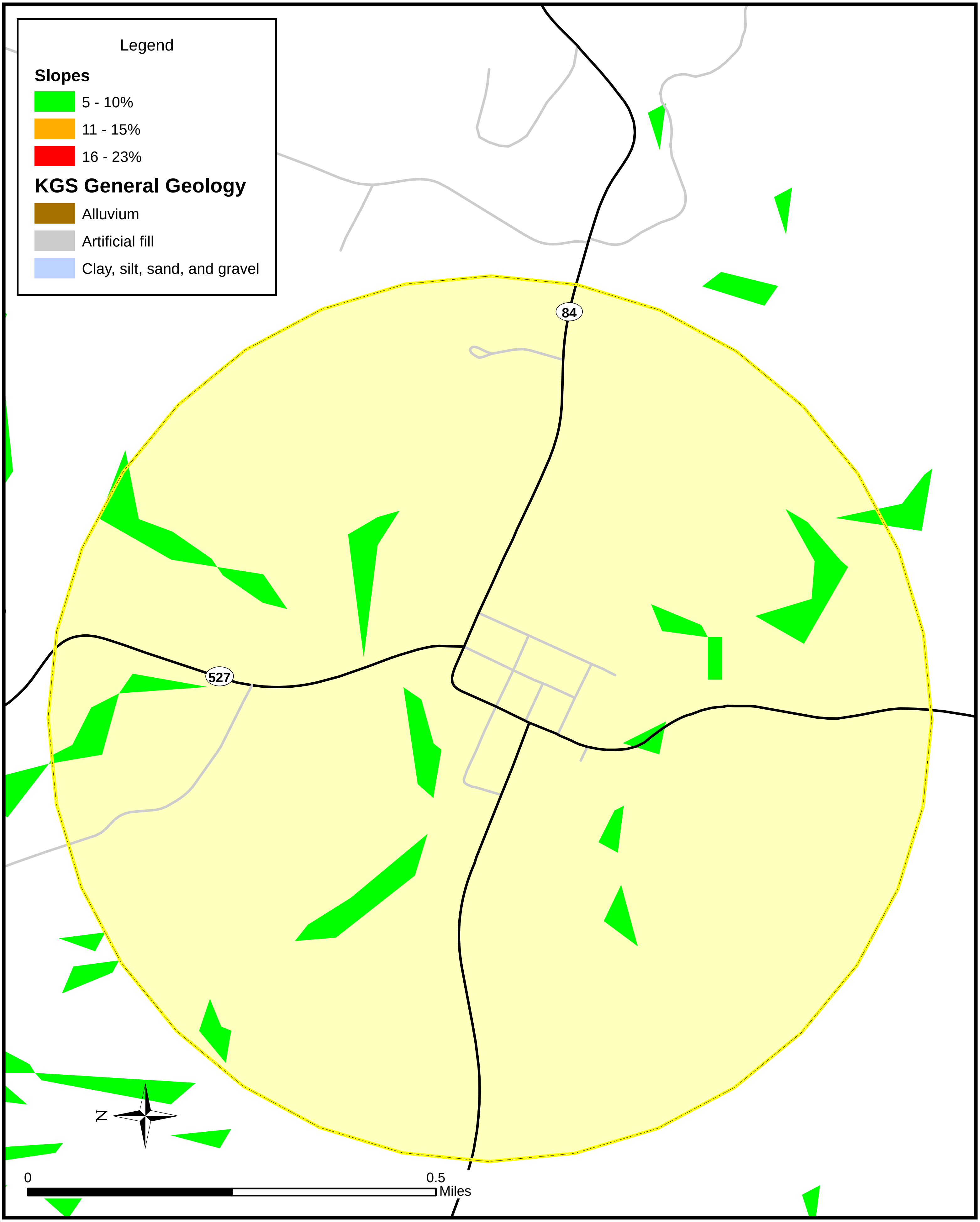

1607
2217
3204
31E
2426
210
916
84
61
1618
Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
0
0.5
Miles
N

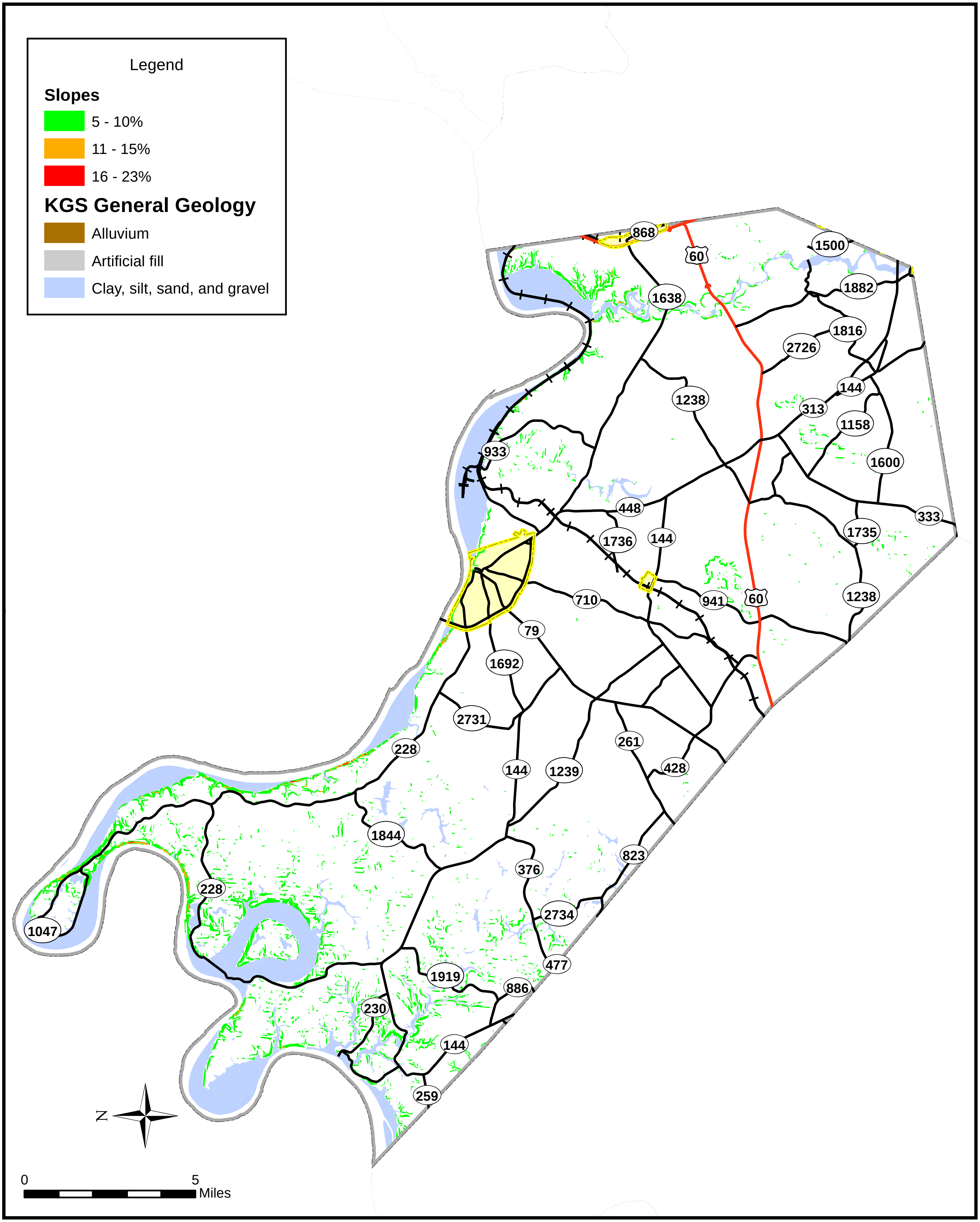

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
68
243
337
49
68
1195
2758
1404
49
1157
55
2744
208
429
2154
68
49
84
289
426
327
2741
52
412
2740
152
1183
49
527
527
457
84
N
0
5
Miles

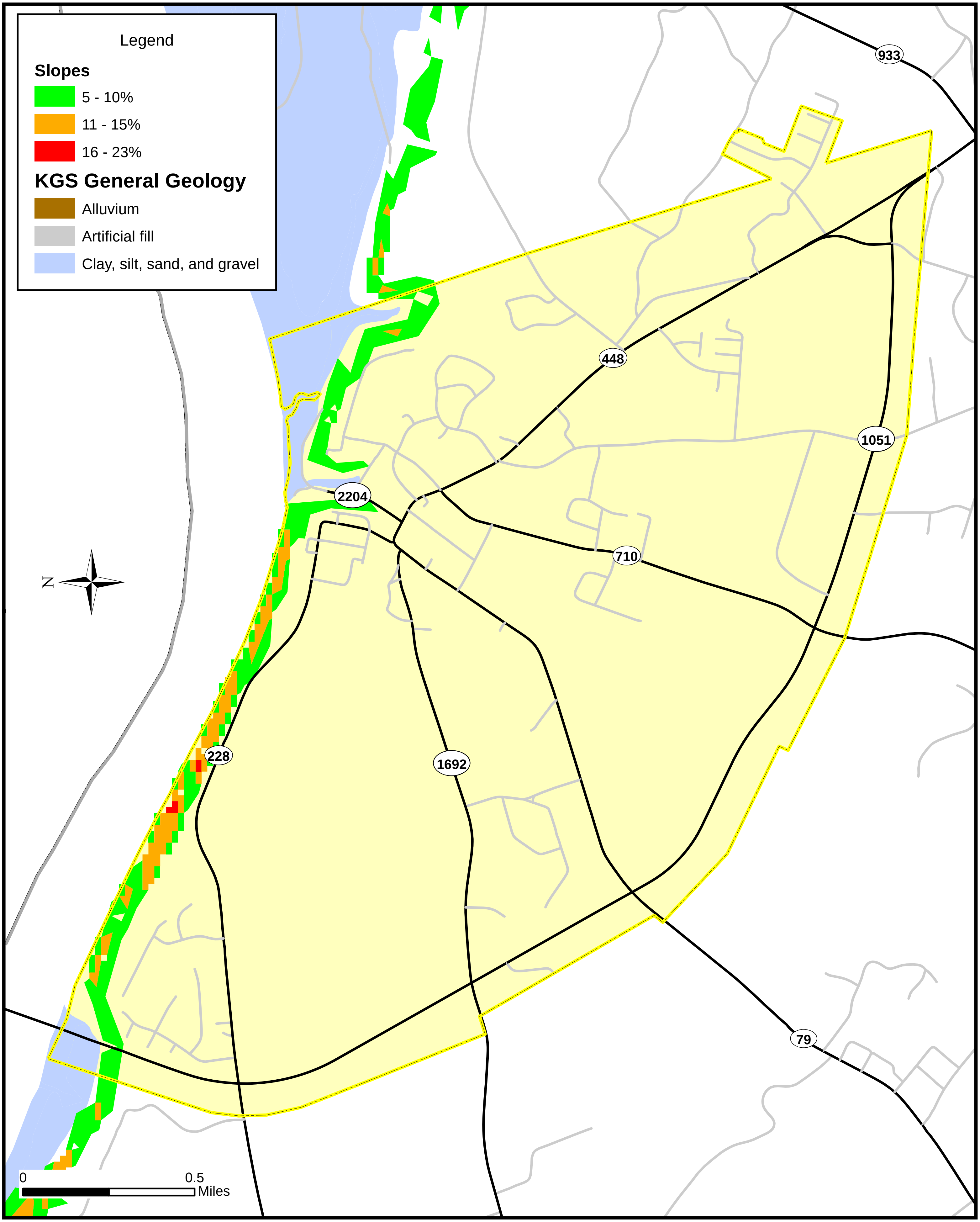

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
337
49
N
0
0.1
0.2
Miles

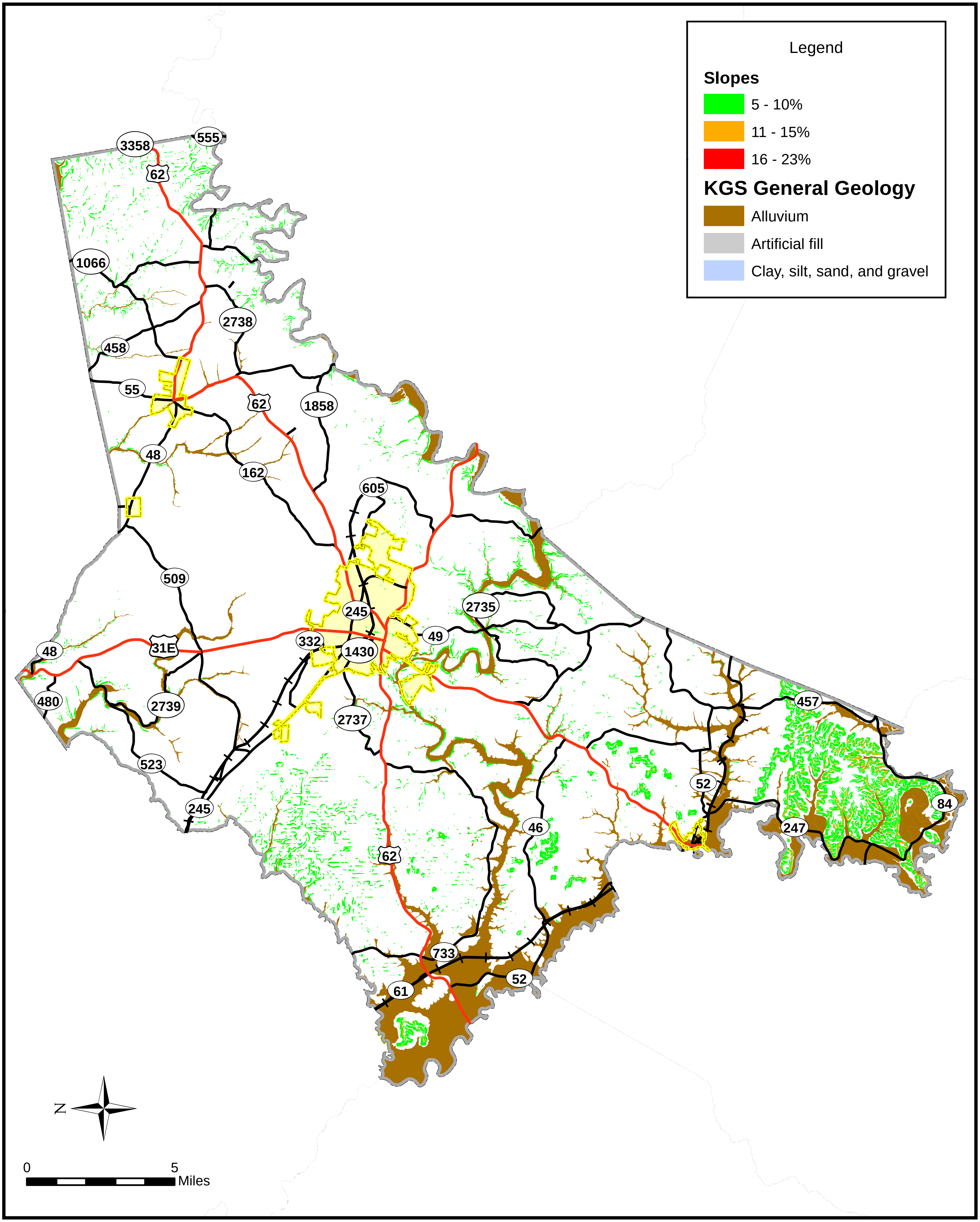

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
195
55
429
3221
2744
208
2154
49
84
426
68
N
0
0.5
1
Miles

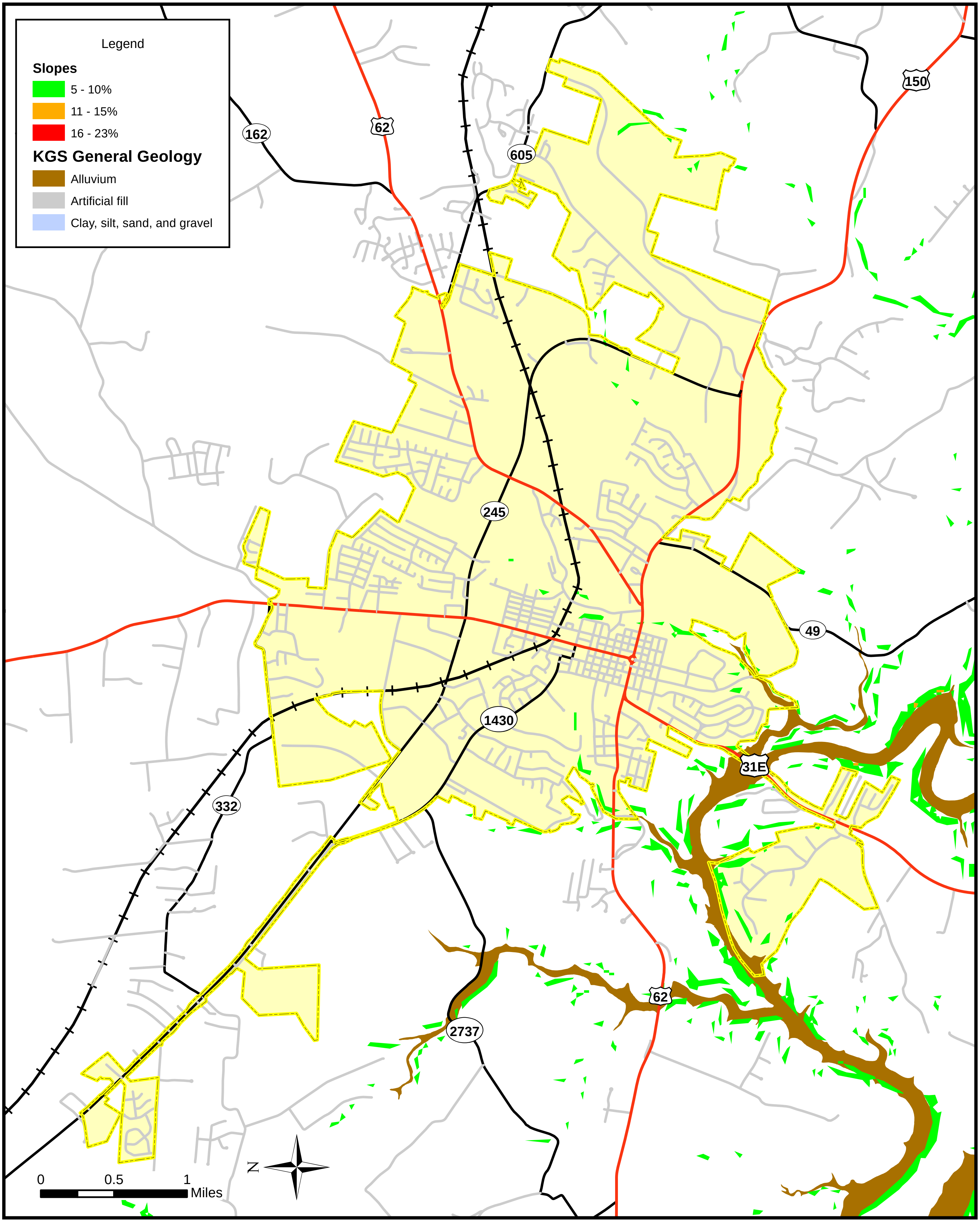

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
52
2740
49
N
0
0.5
Miles

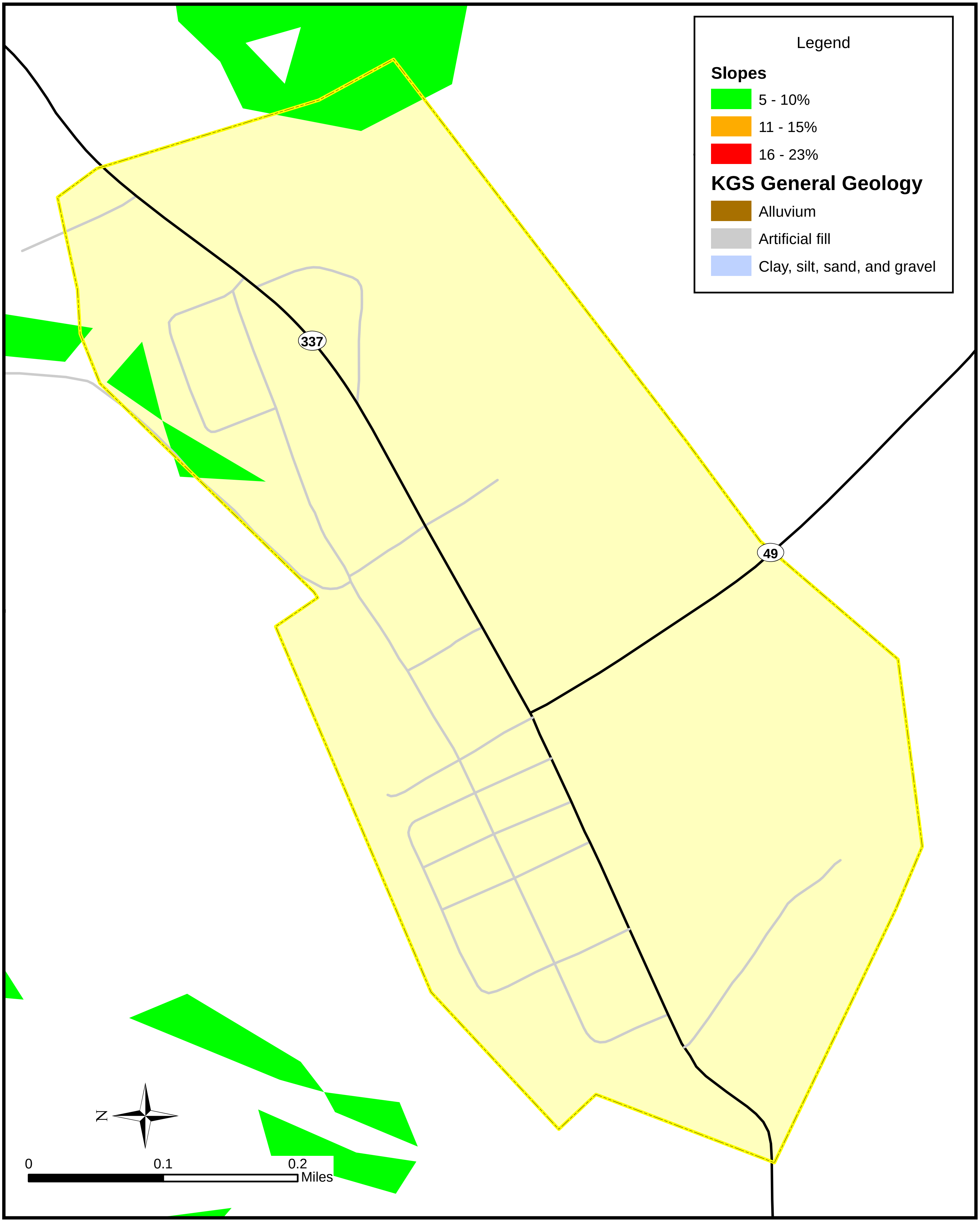

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
84
527
N
0
0.5
Miles

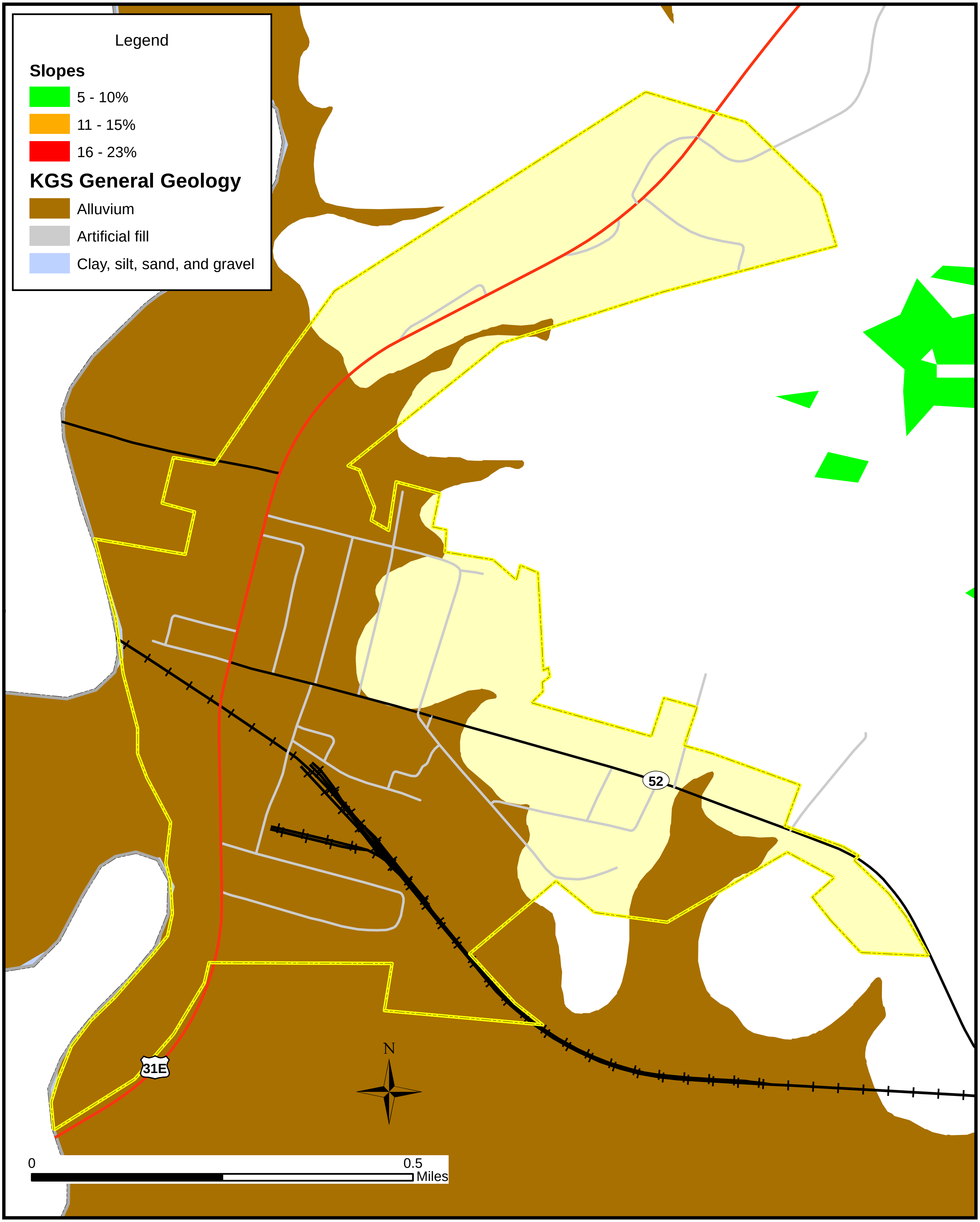

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
868
60
1500
1638
1882
1816
2726
144
1238
313
1158
933
1600
448
333
1736
144
1735
710
941
60
1238
79
1692
2731
228
261
144
1239
428
1844
823
376
228
2734
1047
477
1919
886
230
144
259
N
0
5
Miles

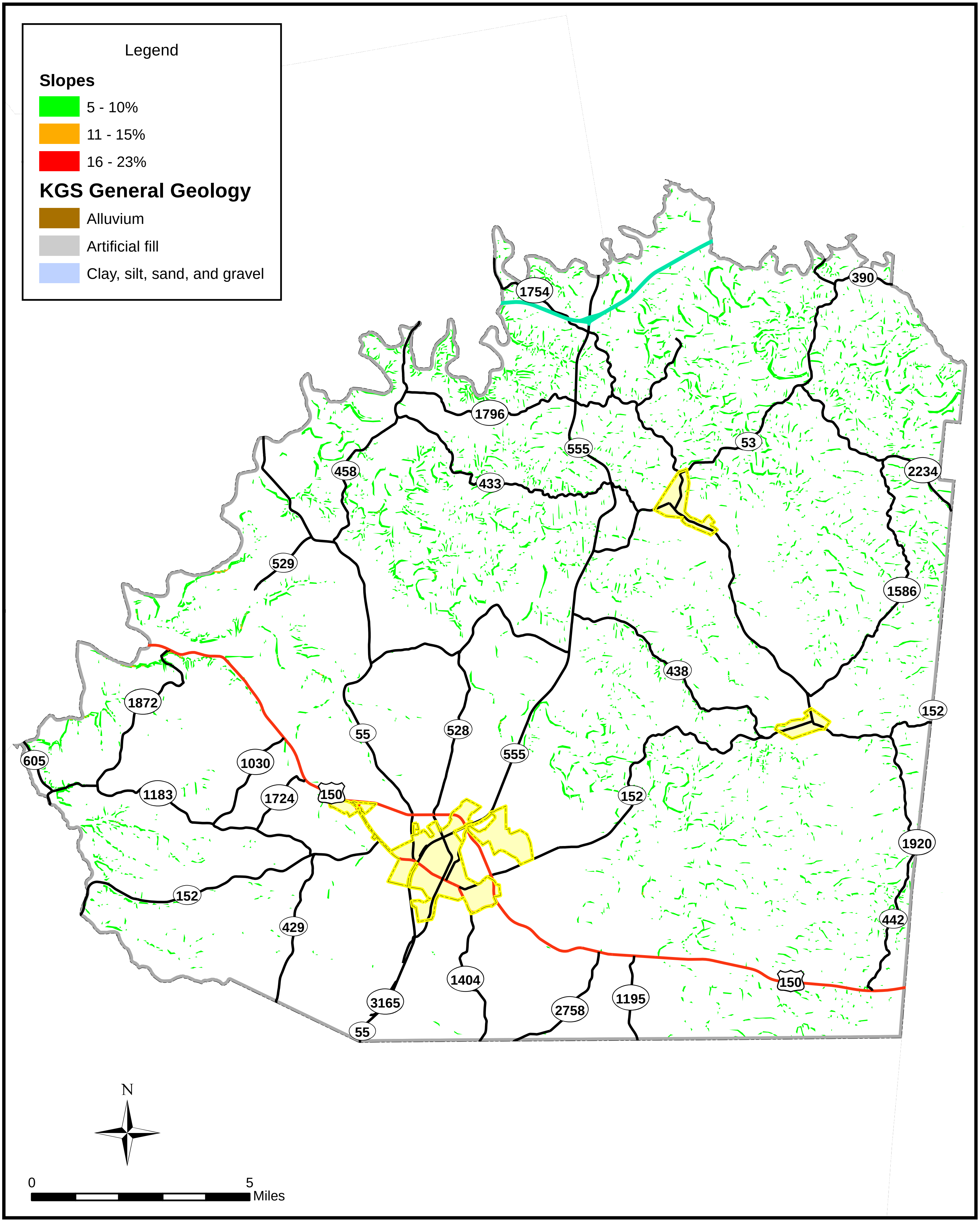

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
933
448
1051
2204
710
228
1692
79
N
0
0.5
Miles

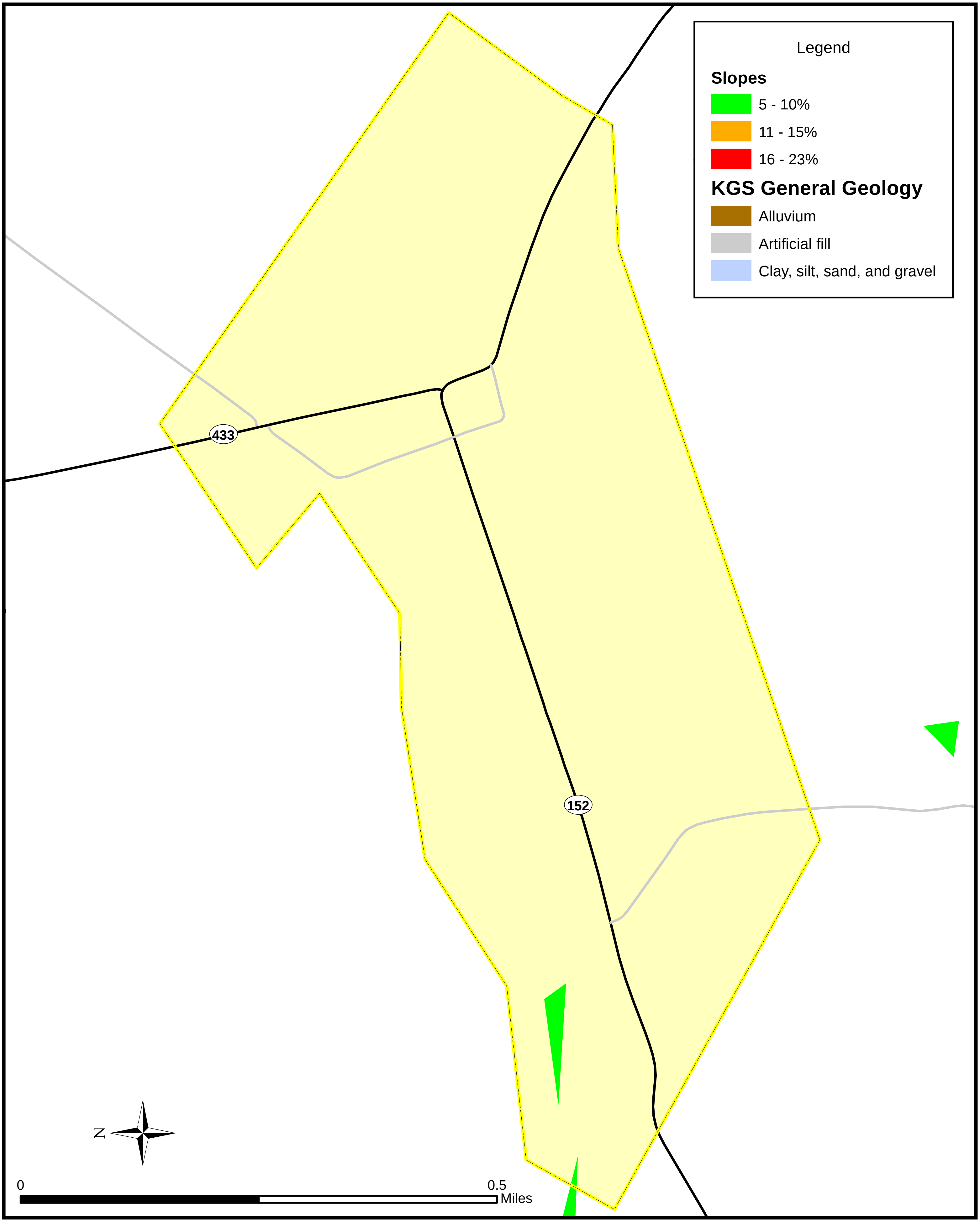

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
3358
555
62
1066
2738
458
55
62
1858
48
162
605
509
245
2735
49
48
31E
332
1430
480
2739
2737
457
523
52
84
245
46
247
62
733
52
61
N
0
5
Miles

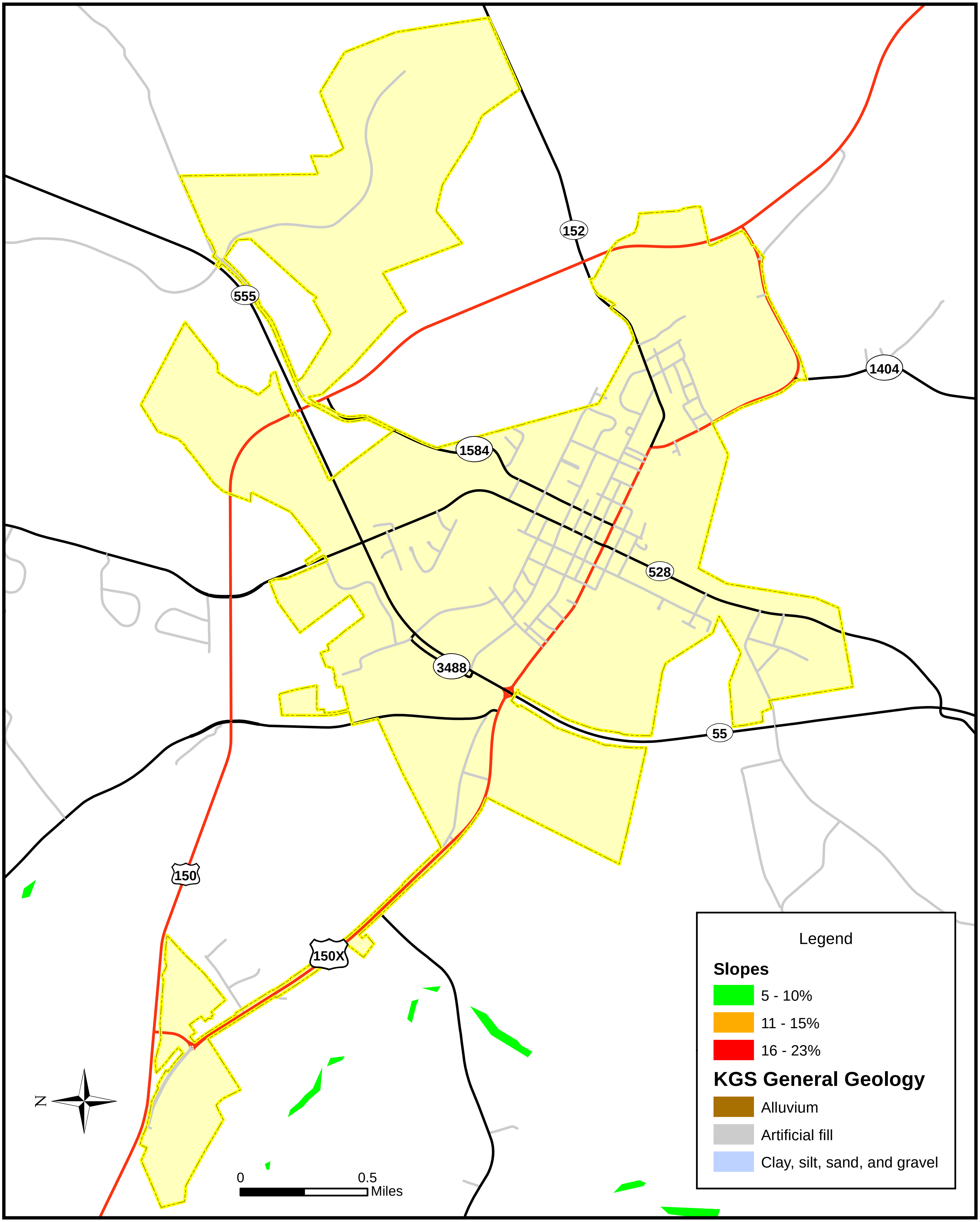

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
162
62
605
150
245
49
1430
31E
332
62
2737
N
0
0.5
1
Miles

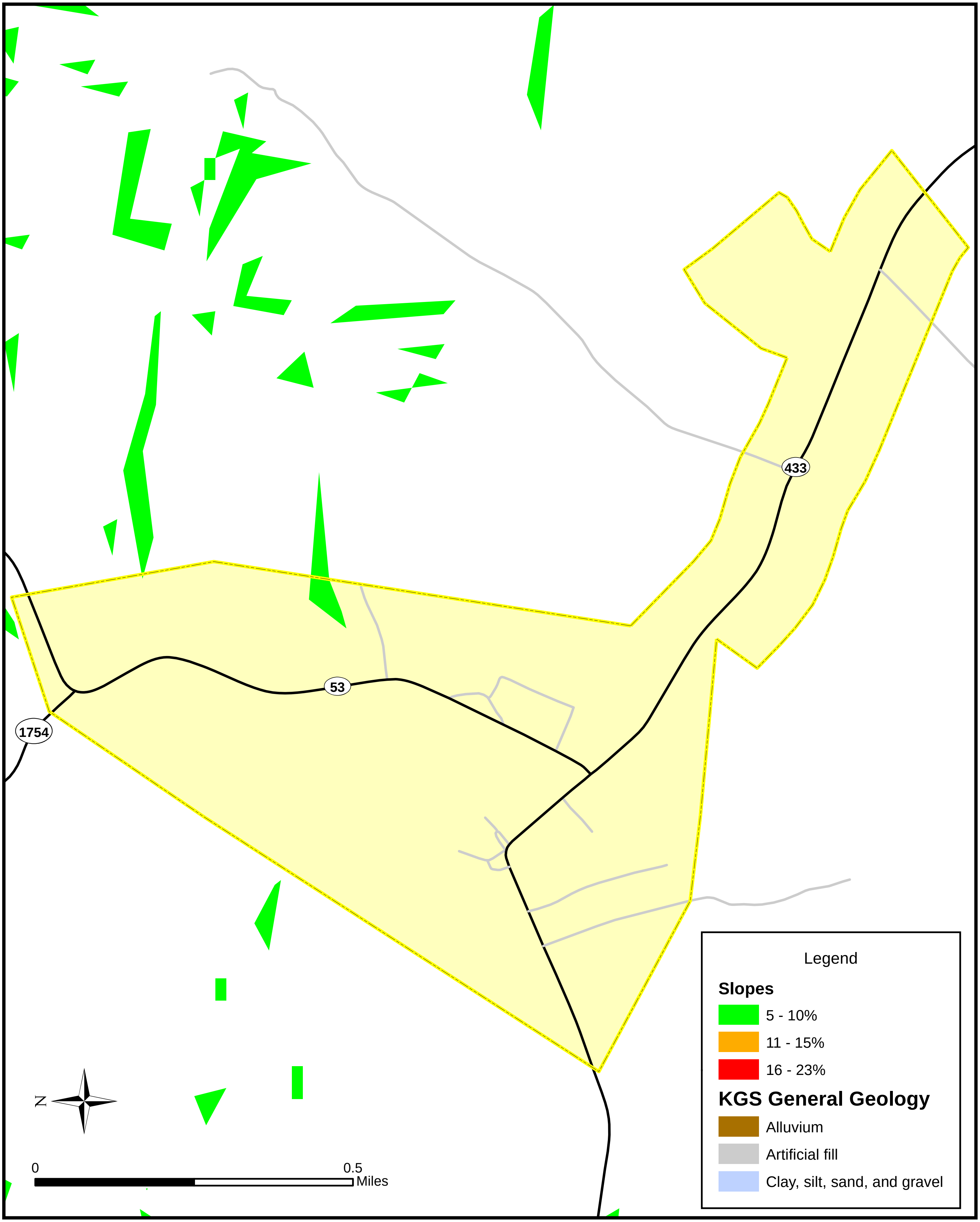

Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
337
49
N
0
0.1
0.2
Miles


Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
52
31E
N
0
0.5
Miles


Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
1754
390
1796
555
53
458
433
2234
529
1586
438
1872
152
55
528
555
605
1030
1183
1724
150
152
1920
152
429
442
1404
3165
150
1195
2758
55
N
0
5
Miles


Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel
433
152
N
0
0.5
Miles


152
555
1404
1584
528
3488
55
150
150X
N
0
0.5
Miles
Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel


433
53
1754
N
0
0.5
Miles
Legend
Slopes
5 - 10%
11 - 15%
16 - 23%
KGS General Geology
Alluvium
Artificial fill
Clay, silt, sand, and gravel

3.3.2.8 <u>Karst/Sinkhole</u>

<u>I. Background</u>

Karst Topography:

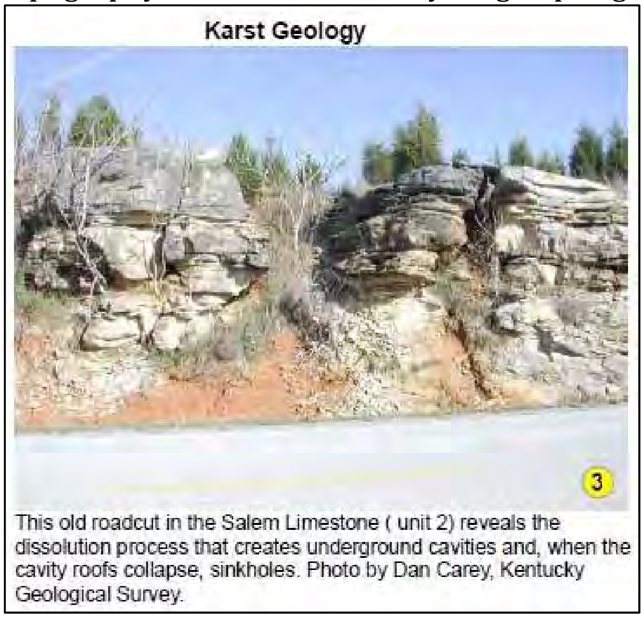
According to the *Encyclopedia Britannica,* karst topography is characterized by barren, rocky ground, caves, sinkholes, underground rivers, and the absence of surface streams and lakes. This type of landscape results from the excavating effects of underground water movement on massive soluble limestone. While the term *Karst* originally was applied to a region of limestone on the Dalmatian coast of the Adriatic Sea, it has now been extended to mean all areas with similar features.

Karsts are found in widely scattered regions of the world such as the Causses of France; the Kwangsi area of China; the Yucatan Peninsula; and the Middle East, they are also found in Kentucky, Texas, Tennessee, Missouri, Pennsylvania and Florida in the United States. Although the karst topography in Kentucky is mostly on limestone, it can also occur in different types of rock such as dolomite, gypsum, and salt.

Certain conditions promote karst development such as well-jointed, dense limestone near the ground surface, a moderate to heavy rainfall; and good groundwater circulation. Limestone or calcium carbonate, is easily dissolved by slightly acidic water, which occurs widely in nature. Rain becomes slightly acidic as it passes through the air and picks up carbon dioxide (CO_2). Rainwater percolates along both horizontal and vertical cracks, dissolving the limestone and carrying it away in solution. Limestone pavements are produced when surface material is removed, and the vertical fissures along joints gradually widen and deepen, producing a grooved and jagged terrain. As the water continues to flow underground, it widens and deepens the cracks until they become cave systems or underground stream channels. All but a few of the cave areas in the world are areas of karst topography. A karst landscape is characterized by sinkholes, sinking streams, caves and springs.

Kentucky is one of the most famous karst areas in the world. Much of the beautiful scenery throughout Kentucky is the result of the development of karst landscape. The springs and wells inherent to karst landscape, provide water to many Kentucky cities. About fifty-five percent of Kentucky is underlain by rocks that could develop karst, given enough time, and about thirty-eight percent of the state has some karst development. Twenty-five percent of the state is known to have well-developed karst features. Karst topography forms the world's longest cave system; the Mammoth Cave System in Kentucky is over 350 miles long.

Karst topography is found throughout the Lincoln Trail ADD region. Parts of Meade and Breckinridge Counties, in the vicinity of Irvington and Brandenburg have extensive areas of karst topography that can be seen by driving the roadways through these communities. Saunders Springs Nature Preserve in the Fort Knox Military Reservation just west of Radcliff is an excellent example of karst topography. In addition, many large springs can be found west of Fort Knox in Meade and Breckinridge Counties. There are springs and caves within Otter Creek Park in Meade County and a spring at the Lincoln Birthplace National Historic Site in LaRue County called Sinking Spring.



Limestone formation in Meade County, 2005.

Sinkholes

When a cave becomes large enough and its top extends close enough to the surface, the top collapses. This produces depressions called sinkholes. Sinkholes are characteristic features of karst topography. Sinkholes can coalesce into larger depressions called poljen. Sinkholes collect surface water running off the surrounding land, and the runoff goes directly into the groundwater. A sinkhole is an area of ground that has no natural external surface drainage. When it rains, water stays inside the sinkhole and usually drains into the subsurface. Sinkholes vary in size from a few feet to hundreds of acres, and range in depth from between one foot to several hundred feet. Some sinkholes hold water to form natural ponds.

Types of Sinkholes

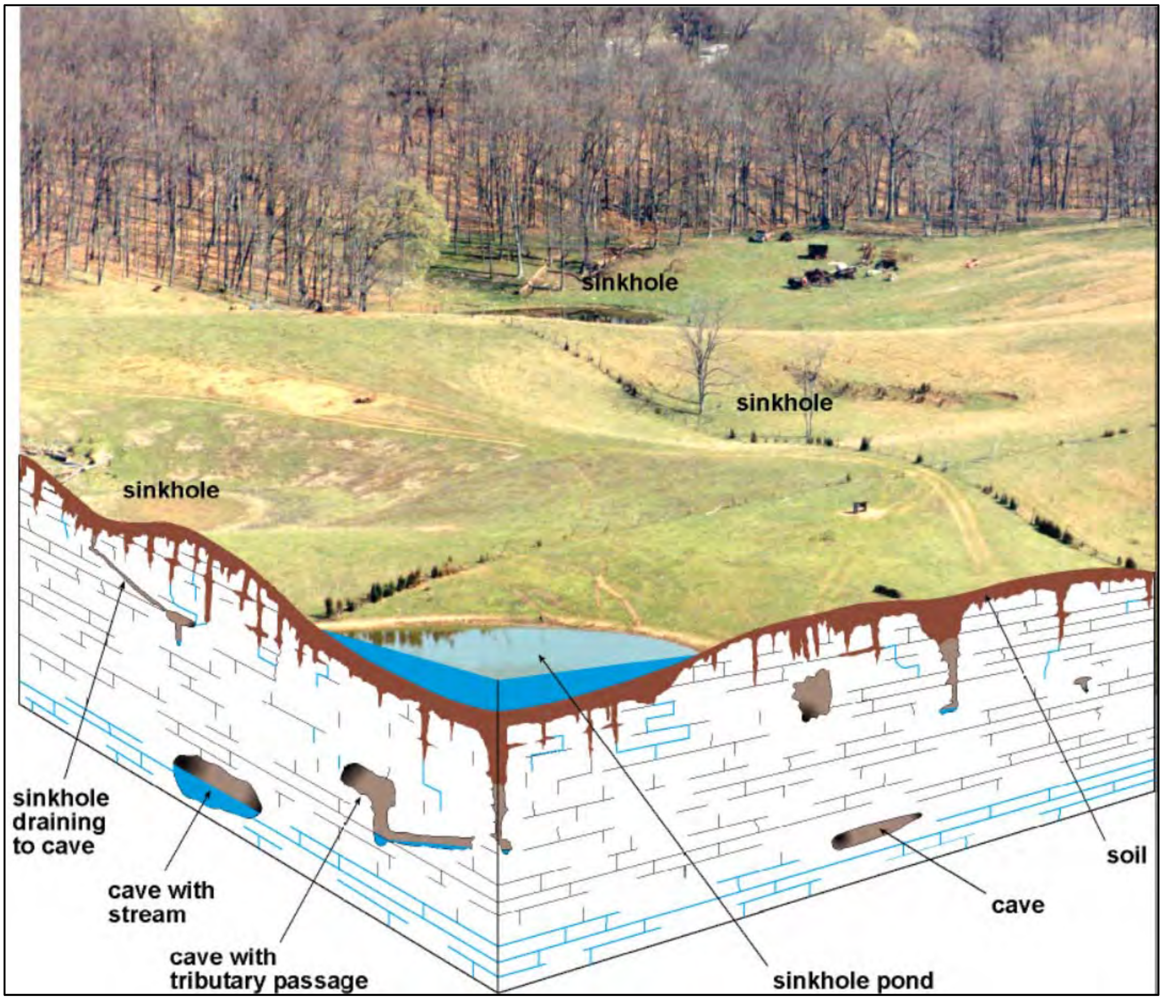
Dissolution sinkholes are formed when bedrock is dissolved and carried away underground. These sinkholes develop gradually, over time, with occasional episodes of soil or cover collapse.

Cover-subsidence sinkholes develop gradually where the covering sediments are permeable and contain sand. In areas where cover material is thicker or sediments contain more clay, cover-subsidence sinkholes are relatively uncommon, are smaller, and may go undetected for long periods.

Cover-collapse sinkholes can develop abruptly over a period of a few hours, and cause catastrophic damage. These sinkholes occur where covering sediments contain a significant amount of clay. Over time, surface drainage, erosion, and deposition of a sinkhole turn it into a shallower bowl-shaped depression. Land Subsidence which can be a result of this action is included in a separate narrative at the end of this section.

Geologic Hazards in Karst

Human safety and economic losses are the results of most naturally occurring geologic hazards. There are two common karst-related geologic hazards: cover-collapse sinkholes and sinkhole flooding.



Karst System. *Source: Kentucky Geological Survey*

According to the Kentucky Geologic Survey, *cover-collapse* sinkhole occurs in the soil or other loose material overlying bedrock. As overlying soil is repeatedly wetted and dried, small amounts of soil are dislodged and carried away by the cave conduit draining the sinkhole. The collapse only occurs in the overlying soil, and not in the limestone bedrock.

Cover-collapse sinkholes can vary in size from 1 or 2 feet deep and wide, to tens of feet deep and wide. Soil thickness and cohesiveness determine the size of a cover-collapse sinkhole. Cover-collapse sinkholes in Kentucky are rarely more than 20 feet in diameter due to the thickness of soil, sand or clay, and bedrock fragments that overlay the limestone bedrock. Unlike cover-collapse sinkholes in Florida that swallow entire houses and businesses, that is unlikely to happen in Kentucky where the overlay is less dense. However, cover-collapse sinkholes in Kentucky do severely damage buildings, drain farm ponds, damage roads, and wreck farming equipment.

The most effective way to avoid cover-collapse sinkhole hazards and damage is to avoid buying or building a structure on any sinkhole that has been filled. Before buying property, look for previous damage such as foundation damage and/or door frames and windows that are out of square. Also check all surrounding land for shallow impressions and arch-shaped cracks in the soil.

Sinkhole flooding occurs when there is more precipitation than the conduits and caves can handle. Unlike a normal stream channel, the cave conduit channel has a fixed diameter and cannot expand as flow increases. There are two types of sinkhole flooding. In the first type, the sinkhole conduit may be constricted and unable to carry water away as fast as it flows in. This can occur when the throat of the sinkhole is clogged by trash and junk, soil eroded from fields or construction sites, and sometimes by rock fall within the conduit. Or, at times, the diameter of the conduit is too narrow to handle the volume of water flow. The second type of sinkhole flooding is caused by discharge capacity being limited farther downstream. This can happen when caves are blocked by trash or rock fall, have limited conduit size, or from backflooding from other sinkholes. Sinkholes that may drain normally during moderate rain, may become springs and discharge water from their throats during intense storms.

Sinkhole plain before a rain. Sinkhole plain after a rain.

Source: Kentucky Geological Survey

All structures built in a sinkhole or karst valley are prone to flooding, and little can be done to mitigate future flood damage, except to move the structure. Some sinkholes are so large, that it is difficult to determine that a building site is actually a closed depression. It is always the best practice to consult a topographical map, inspect an area to determine its relative elevation, look for previous signs of water damage, and research historic flooding events.

Probability/Impact

The Lincoln Trail Region is dotted with sinkholes and underlain by karst topography. Extensive mapping of the area has been incorporated into local land use plans and most of these karst/sinkhole sites have not been developed or had structures built on them. The maps included in this section illustrate how prevalent karst topography is in the Lincoln Trail Region. However, there is little quantitative data on historic sinkhole-related events that enables the prediction of the probability of occurrence, or to articulate the extent of impact that the hazard poses for the Lincoln Trail Region. The prevalence of karst topography in the region results in a 100% chance that either a sinkhole collapse or sinkhole flooding event could occur in any given year. Either scenario could result in the destruction or damage of structures and infrastructure and/or the loss of human life. The impact of local sinkhole hazards, is exemplified by the Quiggins Sinkhole Flooding event. Since quantitative impact reports for sinkhole hazards do not exist within the Lincoln Trail Region, research must focus on the type of karst topography prevalent in the area. The region is mostly underlain with a system of roofed-over creeks as opposed to actual sinkholes. Consequently, the majority of sinkhole related hazards have been those related to sinkhole flooding, and have been aggregated into damages and hazard events associated with flooding. Thus, the Quiggins Sinkhole flooding stands as an identified example of the impact and existence of regional sinkhole hazards.

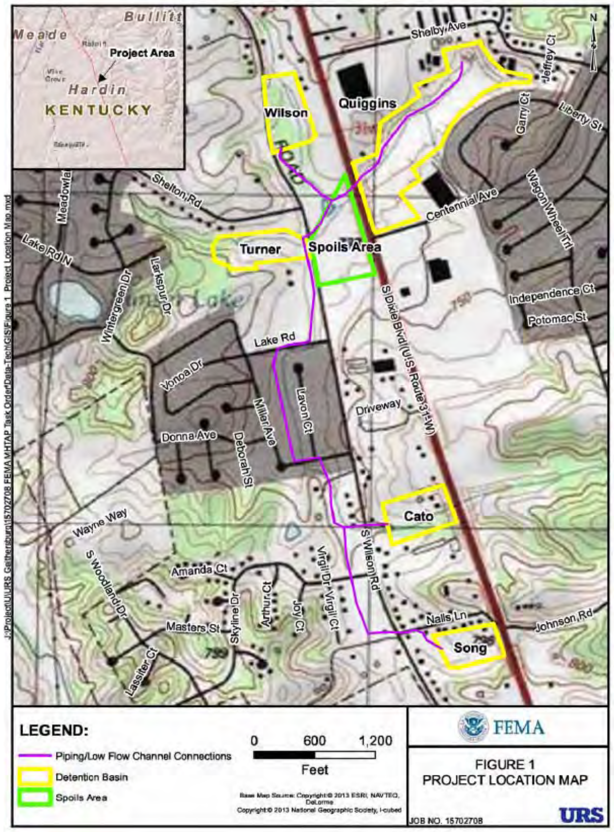
A large area sinkhole is located in Radcliff in Hardin County. The significance and impact of the hazard was enough to justify the 2015 FEMA Hazard Mitigation Grant financing of a sinkhole mitigation project that exceeds $5 million. The Quiggins Sinkhole lies within the Happy Valley watershed and is concentrated around 24 acres of land. A primary hydrology study and FEMA environmental analysis used for the project's application relied on impacts to housing and public works within this area in the City of Radcliff. From this single event, hydrology studies determined damages based upon recurrence probability. Work to prevent sinkhole related flooding is currently underway and should improve water management in the area. The Quiggins Sinkhole Flood Mitigation Project will construct four retention basins and expand a fifth to mitigate the effects of widespread flooding. The Quiggins Sinkhole is one of 86 known sinkholes into which the City of Radcliff drains. Using the recurrence intervals cited, only impacts to housing and public works within the 24-acre site, for this one sinkhole were calculated.

Table 3.3.2.8.1 - Quiggins Sinkhole Impact Costs

Recurrence Interval	Housing Damages (In Dollars)	Public Works Damages (In $)	Total Damages (In Dollars)
200	$969,123	$91,697	$1,737,628
100	$623,019	$80,381	$1,296,687
50	$420,027	$69,455	$1,002,128
25	$264,344	$59,310	$761,419
10	$171,617	$46,824	$564,045
5	$56,176	$37,849	$373,388
2	$13,210	$27,704	$245,397
1	$358,408*	$19,900	$525,190
* Refers to "Less Than One-Year Damages"			

When adjusted for inflation, the total benefits of mitigating the impacts of one sinkhole, using assumptions of one representative hazard event that occurred in Radcliff in 2008, was calculated at $5,679,173.

Ongoing work on Quiggins Project, *Source: Greg Thompson, News-Enterprise, March 2016.*



Quiggins Sinkhole Flood Mitigation Project Location Map. *Source: FEMA Environmental Assessment Feb. 2015.*

In addition to sinkhole flooding effects, the prevalence of karst terrain within the Lincoln Trail Region must be considered when analyzing and thinking about the number and value of significant historic sites located in the area that may be situated on or near sinkholes. Rich in Lincoln history, the Lincoln Trail Region is home to many valuable historic sites such as the Joseph Holt House located on KY 144 in Breckinridge County and Lincoln's grandfather's homestead, the Lincoln Homestead, located outside of Springfield in Washington County. The Abraham Lincoln Birthplace, part of the National Parks system, is located outside of Hodgenville in LaRue County, on a site that was called the Sinking Springs Farm, an area underlain by twelve (12) sinkholes. All of these sites are valuable historic sites, priceless and irreplaceable. The 2003 Executive Order 13287: Preserve America states: "The Federal government shall recognize and manage the historic properties in its ownership as assets that can support department and agency missions while contributing to the vitality and economic well-being of the Nation's communities." The federal government recognizes not only the intrinsic value of historic sites, but also the economic benefits associated with them that positively impact local property values, jobs, tourism and revenue. Consequently, the impact of sinkhole collapse at the Birthplace site would have a significant financial impact far exceeding the hazard event itself.

Extent

To exemplify impact, the Radcliff Quiggins Sinkhole Flooding event was used and shall be used again to address the extent of a sinkhole/karst hazard. Based on one 2008 event, multiple hydrology studies and an environmental assessment conducted by FEMA, determined that it was feasible that over $5.5 million in damages could potentially result from the Quiggins Sinkhole in Radcliff. It was determined that the Quiggins Sinkhole was capable of discharging floodwaters at 11.9 cubic feet per second (cfs), analogous to the flow capacity of a 12-inch pipe. This could easily result in major flooding with as little as one inch of rainfall over a six hour period according to FEMA's 2/12/2015 "Environmental Assessment: Quiggins Sinkhole Flood Mitigation Project. City of Radcliff, Hardin County, Kentucky, DR-KY-1818-0012."

3.3.2.8.1 Land Subsidence

NOTE: This section previously stood alone as a specific Hazard in the Lincoln Trail Hazard Mitigation Plans from 2005 & 2010. It has been moved to this section as of the 2015 Plan.

I. Background

According to the U.S. Geological Survey (USGS), land subsidence is defined as the gradual settling or sudden sinking of the Earth's surface due to subsurface movement of earth materials.

USGS goes on to say that while land subsidence is a global problem, it impacts the United States substantially. More than 17,000 square miles in 45 states, have been affected by subsidence. The principal causes of land subsidence are aquifer-system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost. More than 80% of land subsidence in the United States is a consequence of human impact on subsurface water, and is an often, overlooked environmental consequence of our land water-use practices. Increased development of our land and water resources threatens to exacerbate existing land-subsidence problems and initiate new ones.

Cause of Subsidence

Several causes of land subsidence have been identified and include dissolution of limestone, mining, extraction of natural gas, groundwater-related subsidence, faulting induced, isostatic subsidence, drainage of organic soils, and seasonal effects. This section will only describe those that have a potential of threat in the Lincoln Trail Region.

Dissolution of limestone occurs in karst terrains where dissolution of limestone by fluid flow in the subsurface causes the creation of voids or caves. When the roof of a void becomes too weak, it can collapse and overlying rock and earth fill fall into the void and causes subsidence on the surface. This type of subsidence can result in sinkholes that can be hundreds of meters deep.

Seasonal effects impact land subsidence. Many soils contain significant proportions of clay that are affected by changes in soil moisture due to their very small particle size. Seasonal drying of soils results in a reduction of soil volume and a lowering of the soil surface. If building foundations are above the level to which the seasonal drying reaches they will move and this can result in damage to the building in the form of tapering cracks. Trees and other vegetation can have a significant effect on local drying of soils. Cumulative drying over a number of years occurs as the tree grows and this can lead to the opposite of subsidence, known as heave or swelling of the soil, when the tree declines or is felled. As the cumulative moisture deficit is reversed, over a period of time that can last as many as 25 years, the surface level around the tree will rise and expand laterally. This can be more damaging to buildings unless the foundations have been strengthened or designed to cope with the effect.

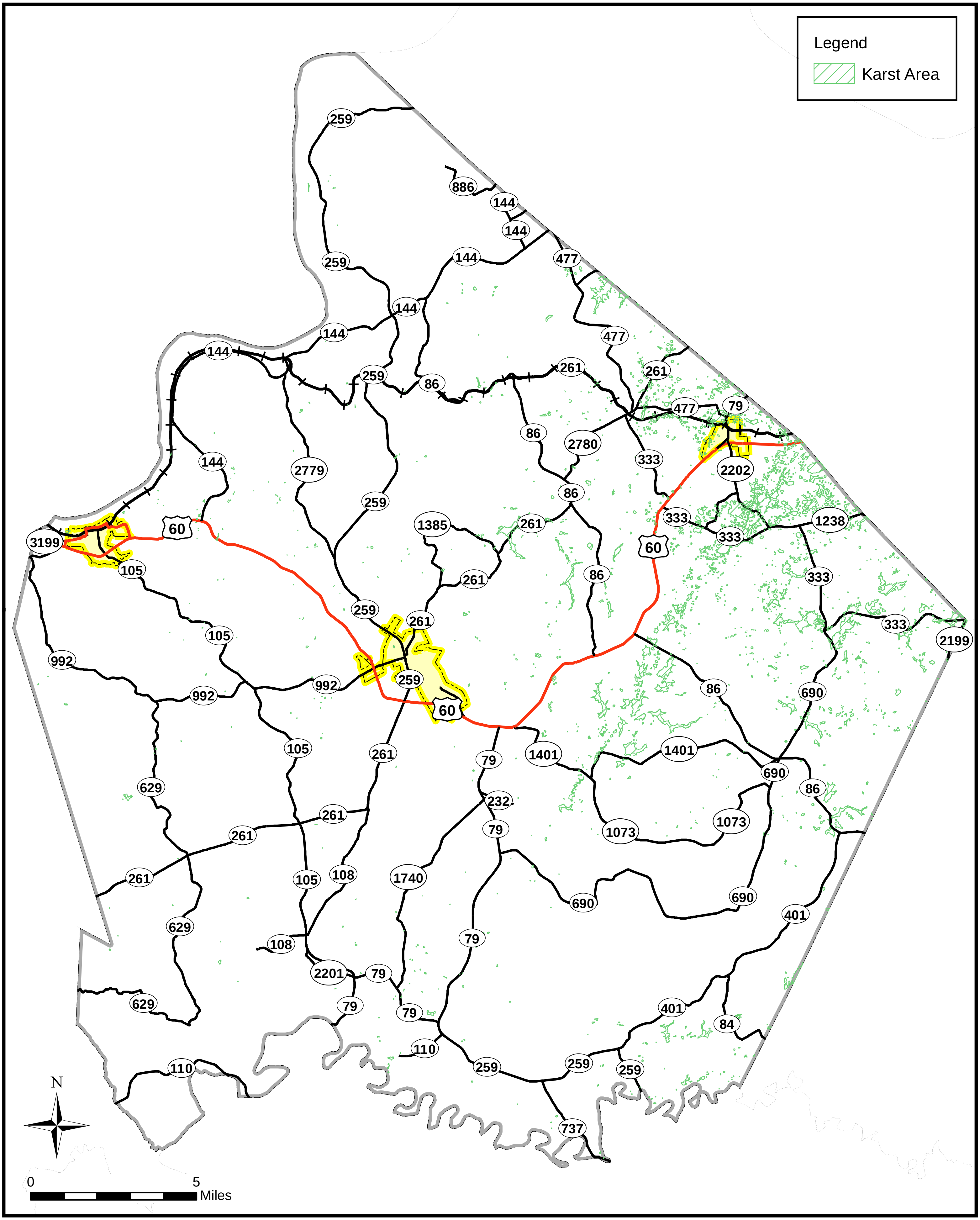
II. Analysis

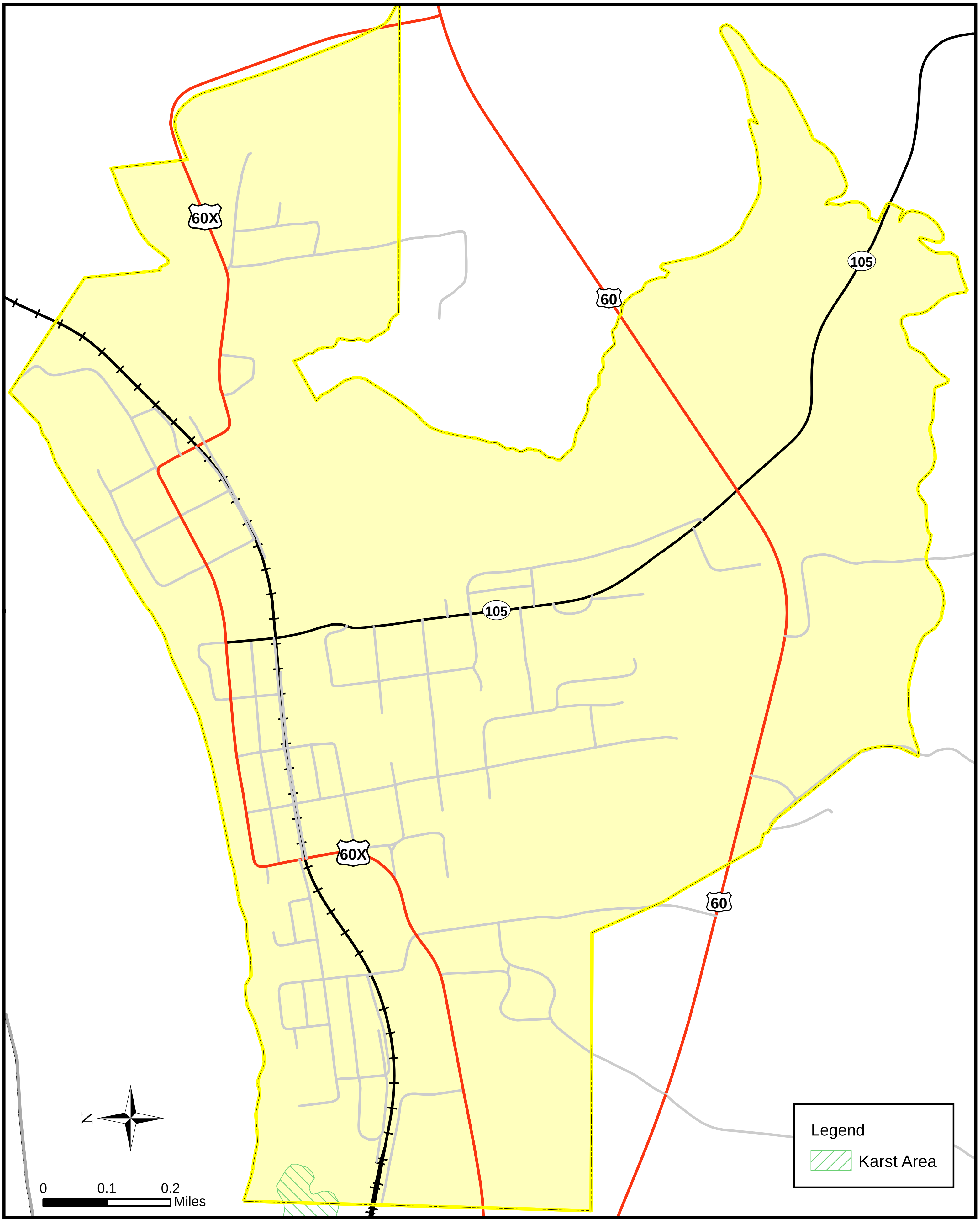
To analyze land subsidence as a hazard in the Lincoln Trail Region, much research was done. Sources included FEMA, the Kentucky Geological Survey, the United States Geological Survey and County Emergency Management Agencies.

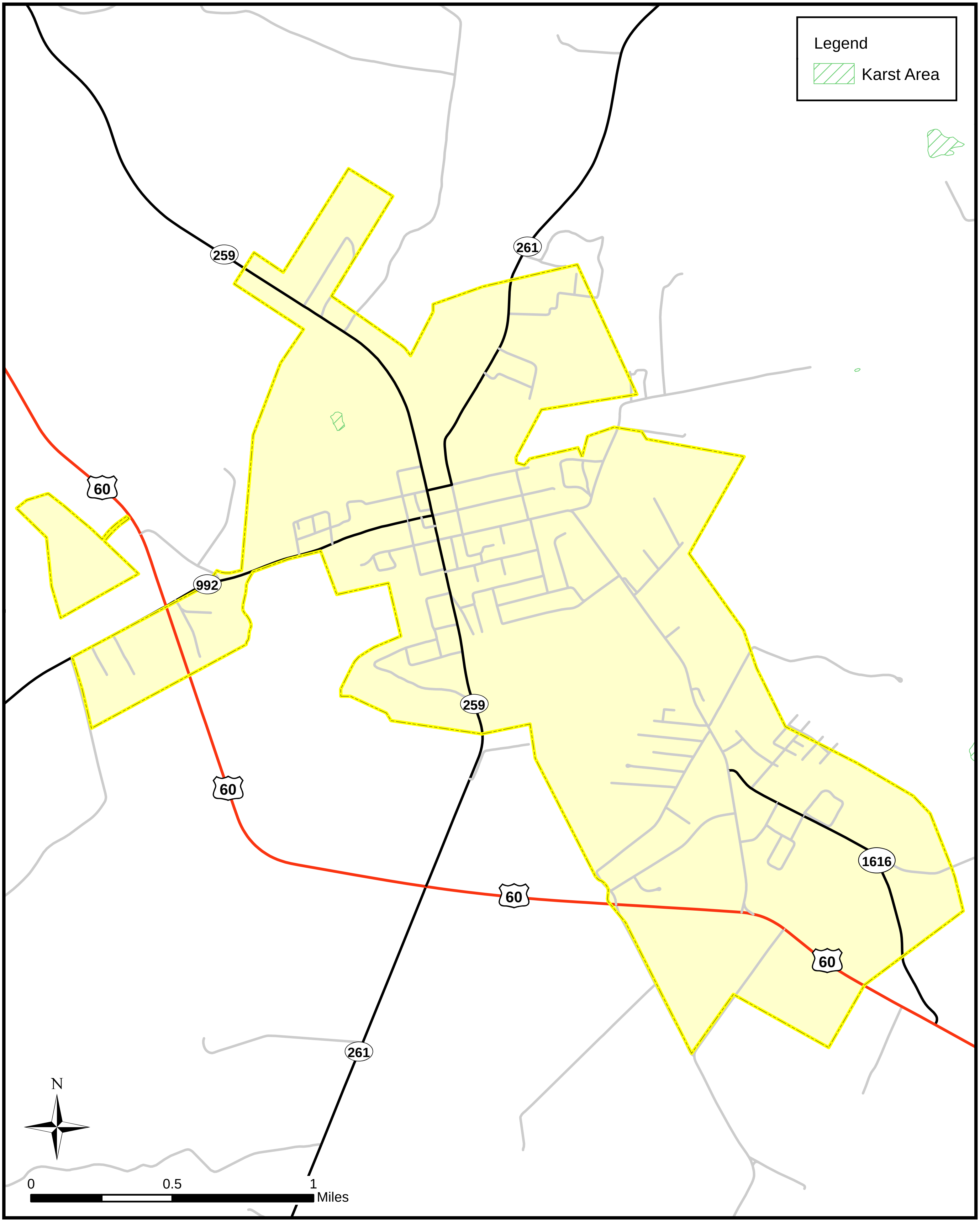
Lincoln Trail Region Subsidence

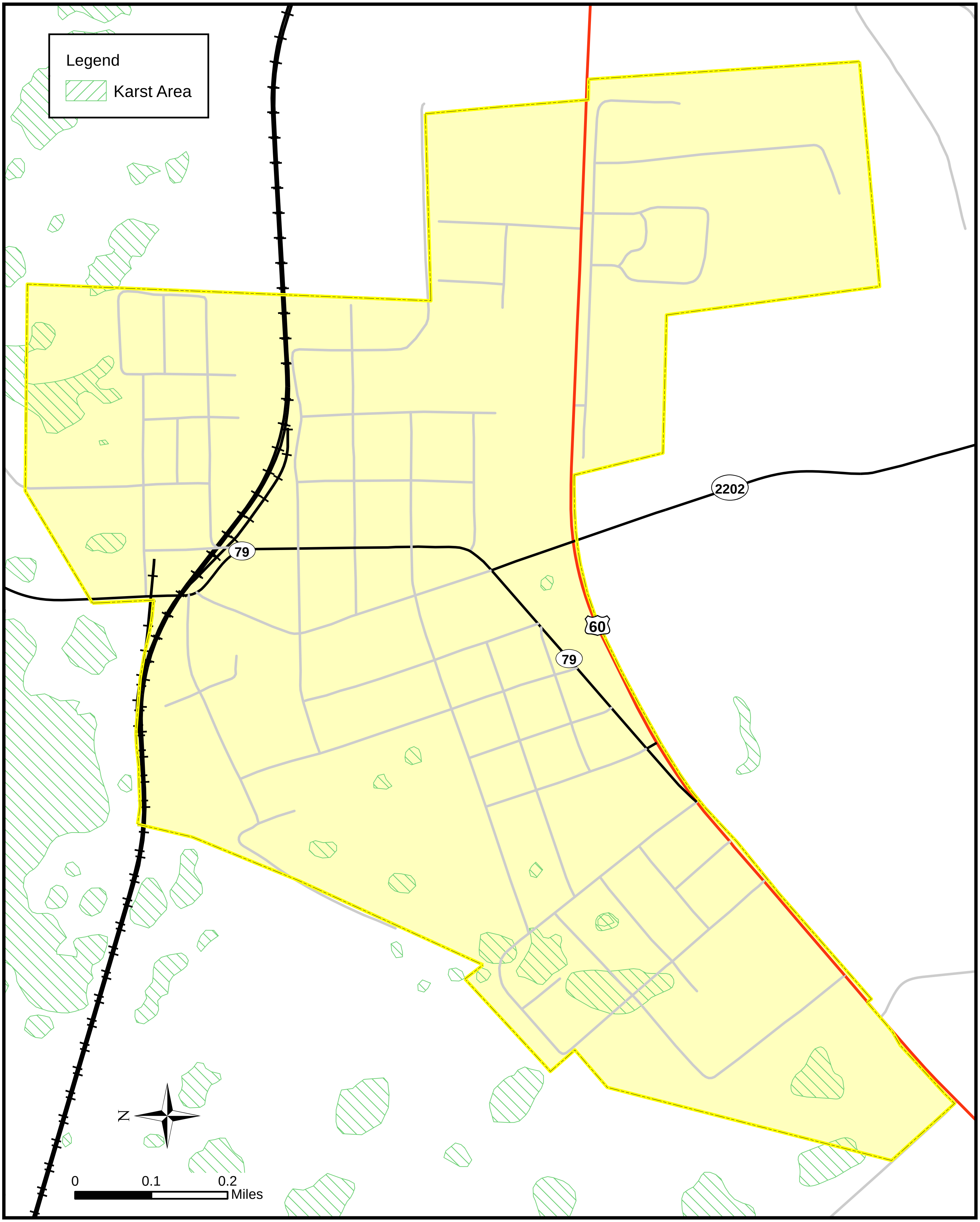
Subsidence is common in the Lincoln Trail Region; mostly as the result of erosion in areas along creek banks and in the karst topography. Quarry activity is common in the region, but the limestone rock extracted leaves highwalls that are fairly stable. Use of preventative agricultural practices and the proper use of land use management when siting construction projects will alleviate most of the effects of land subsidence in the Lincoln Trail region.

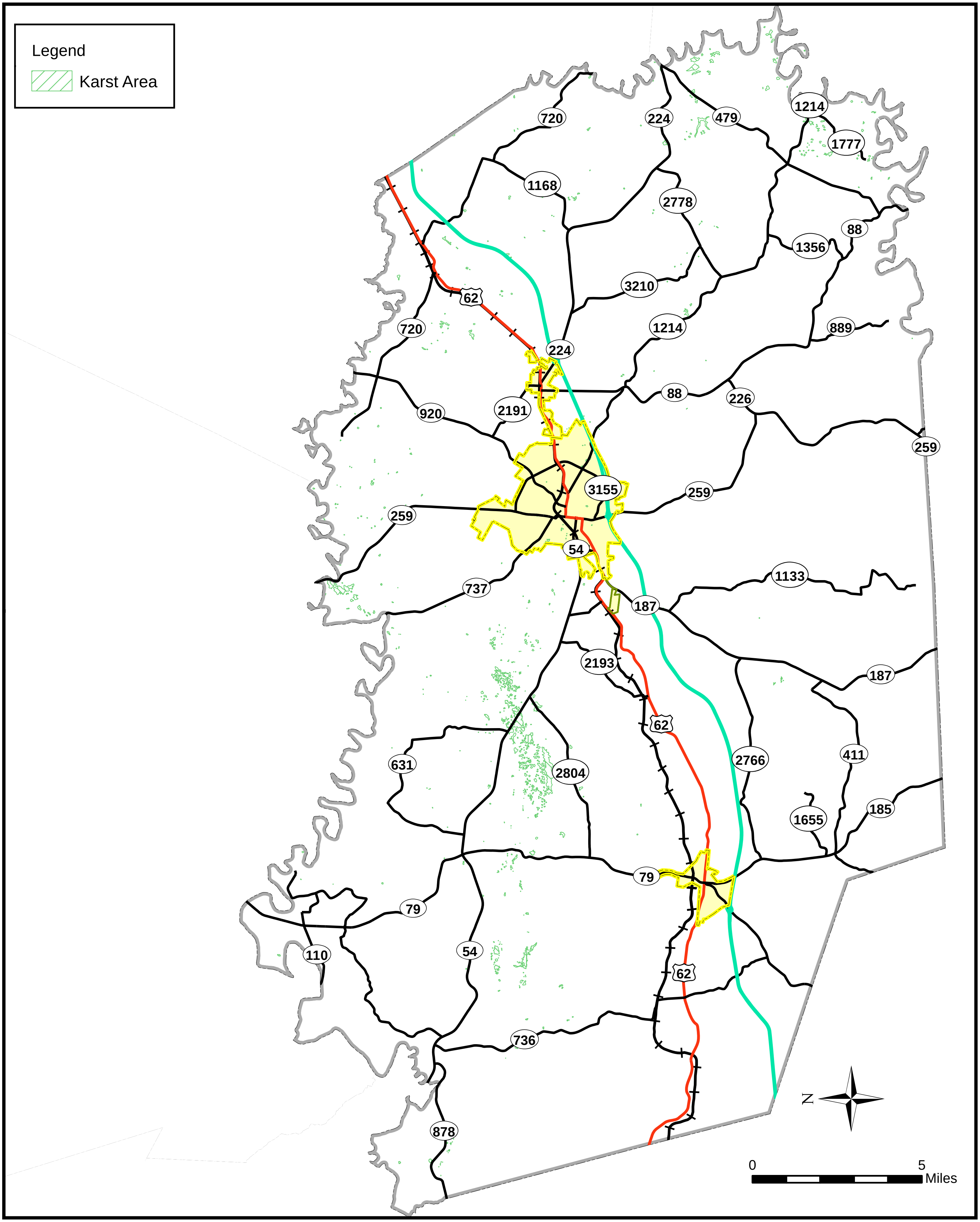
On the Ohio River in Meade County – Feb. 25, 2010,
Source: LTADD Archive.


Legend
Karst Area
N
0
5
Miles
60
259
144
86
261
477
79
333
2202
1238
2199
690
1401
1073
401
84
737
110
108
2201
1740
232
105
992
629
3199
2779
1385
2780
886

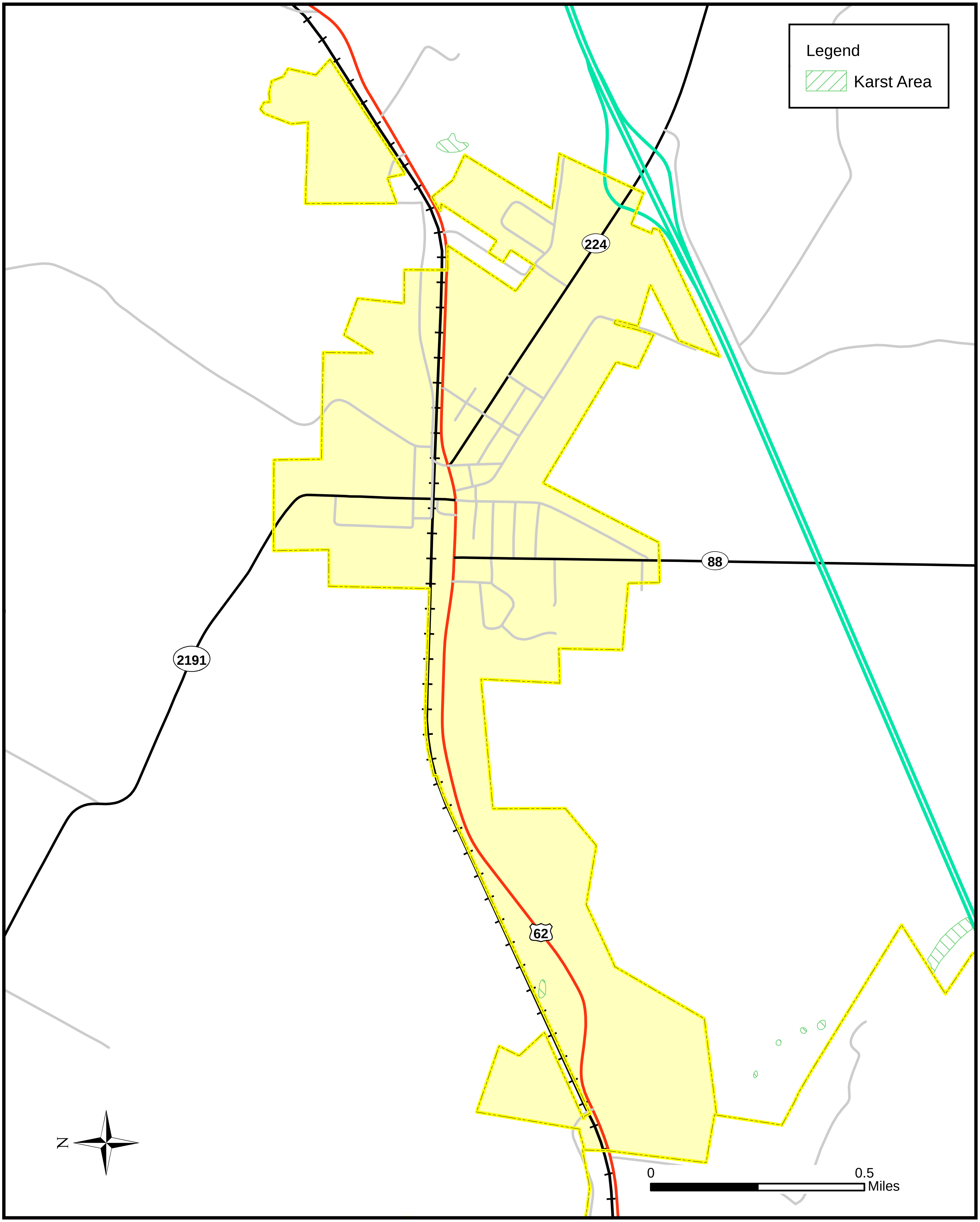

60X
60
105
105
60X
60
N
0
0.1
0.2
Miles
Legend
Karst Area

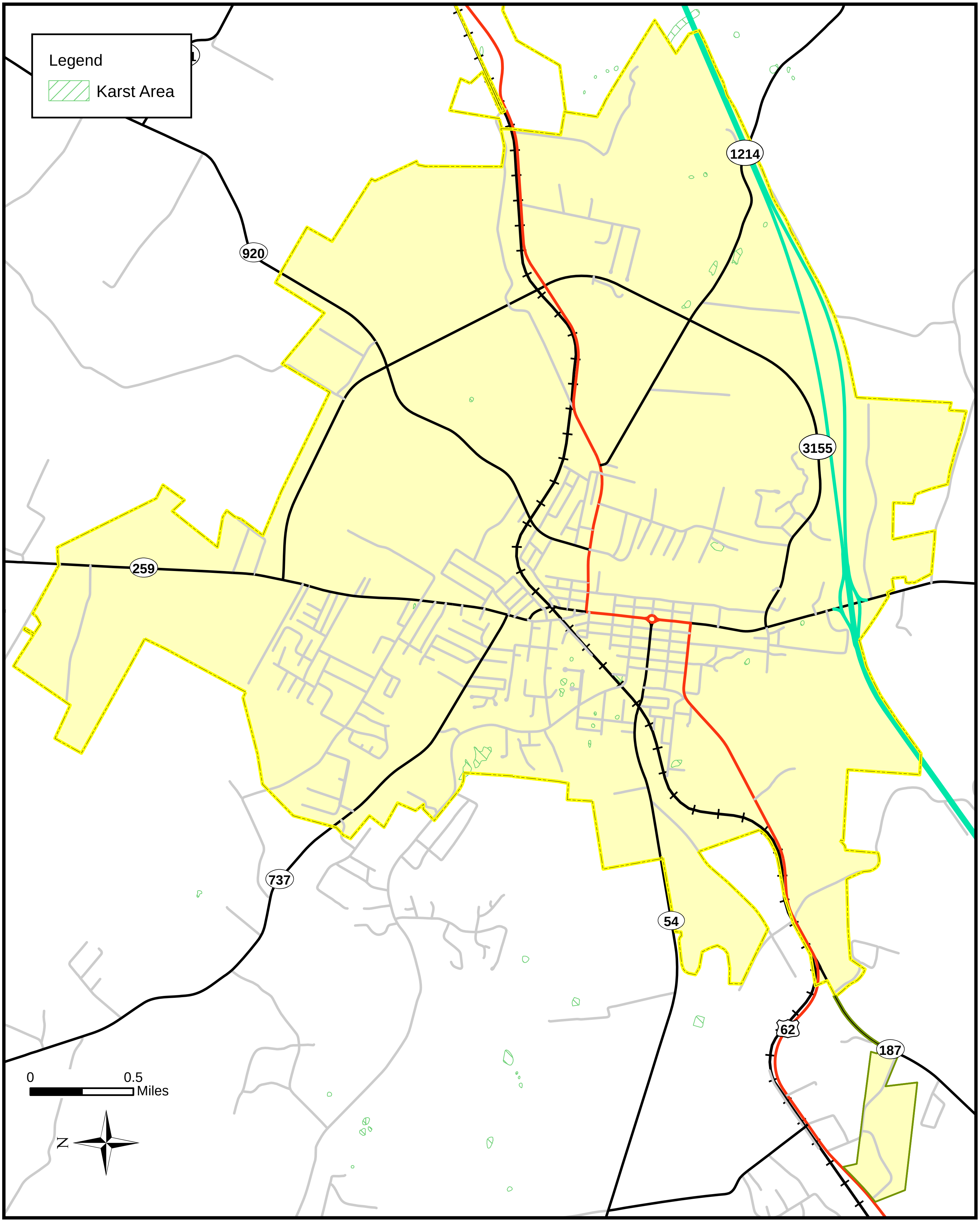

Legend
Karst Area
259
261
60
992
259
60
60
1616
60
261
N
0
0.5
1
Miles

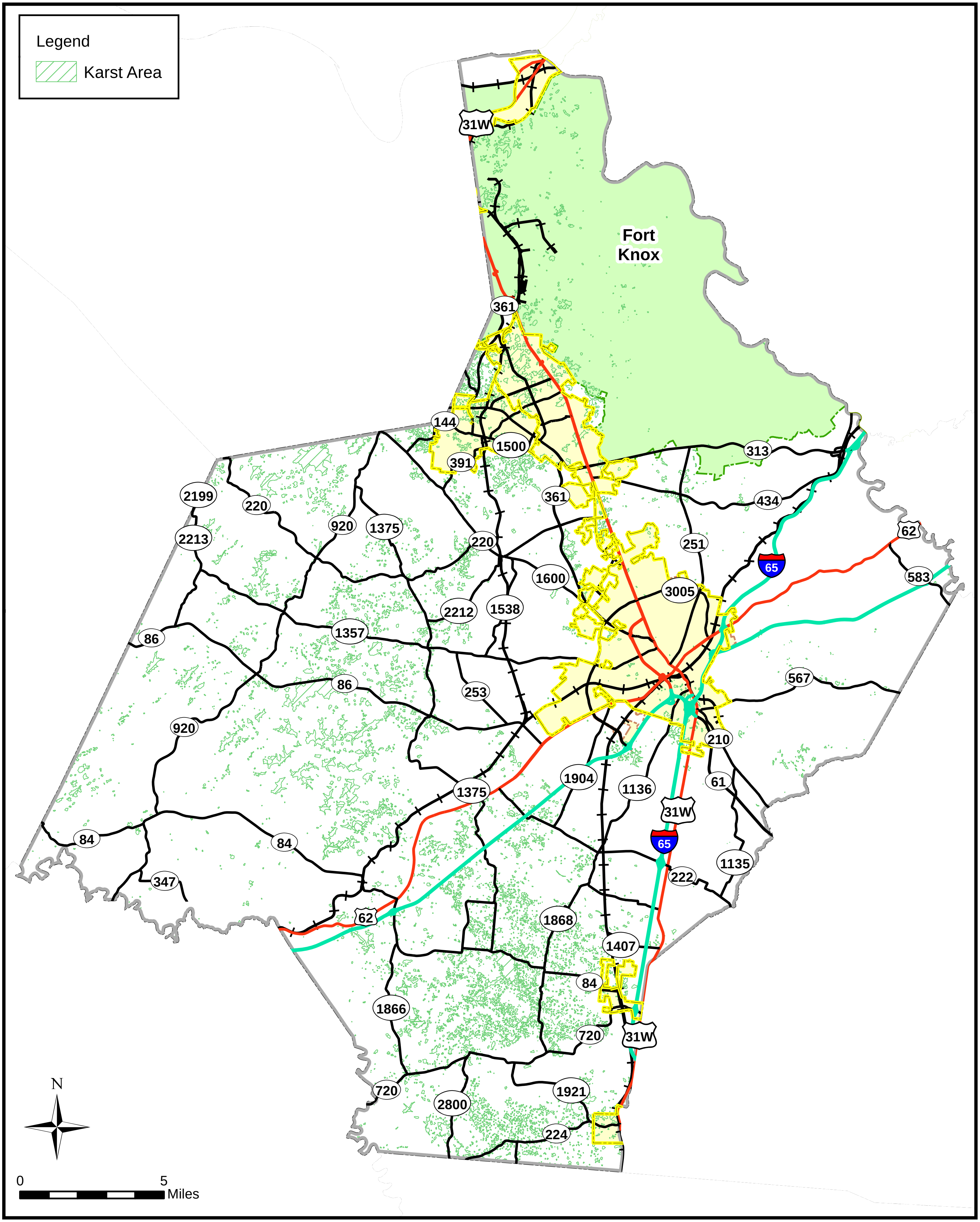

Legend
Karst Area
79
2202
60
79
N
0
0.1
0.2
Miles


Legend
Karst Area
720
224
479
1214
1777
1168
2778
88
1356
3210
62
1214
889
720
224
88
226
920
2191
259
3155
259
259
54
737
1133
187
2193
187
62
631
2804
2766
411
185
1655
79
79
110
54
62
736
878
N
0
5
Miles

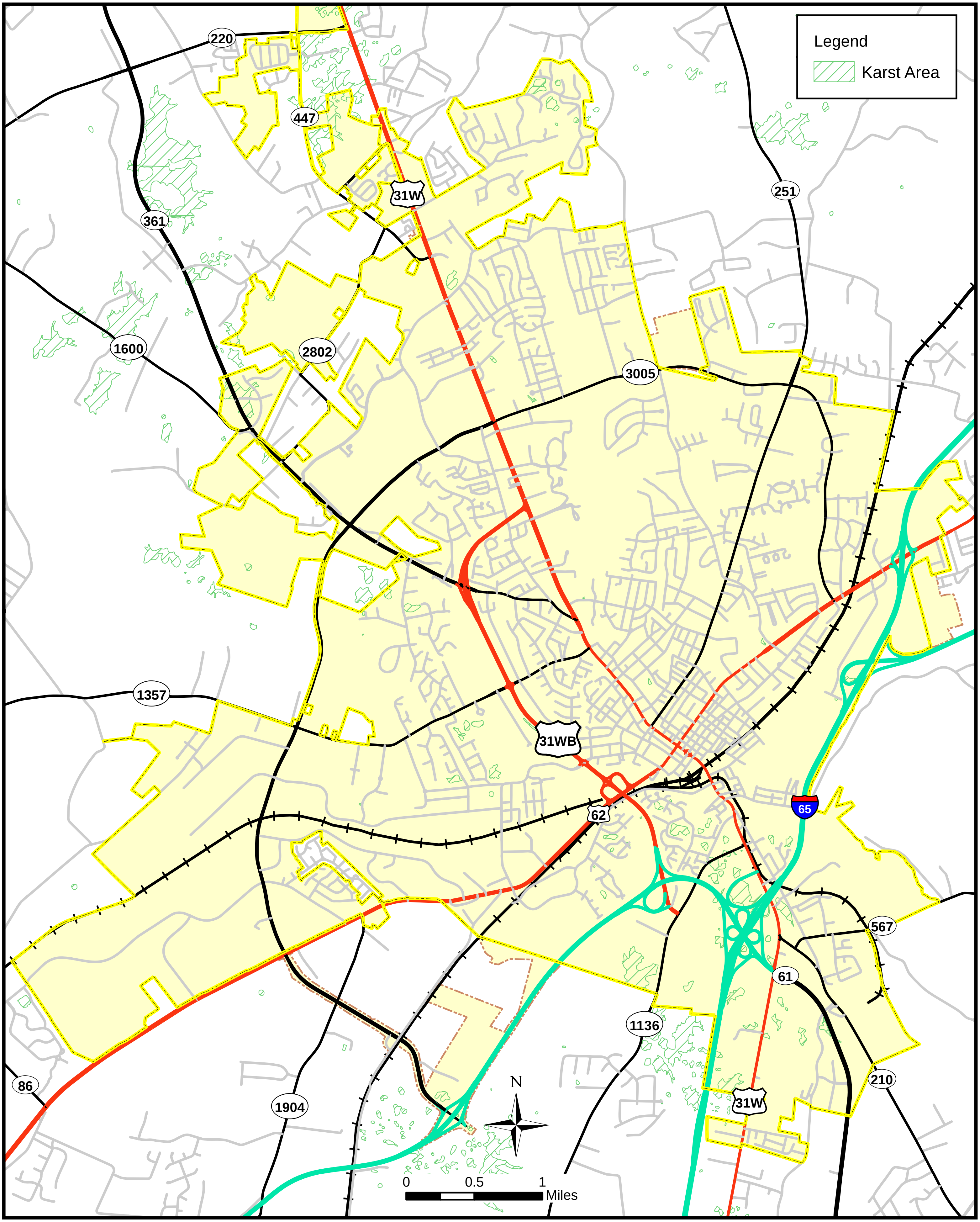
CLARKSON
KARST

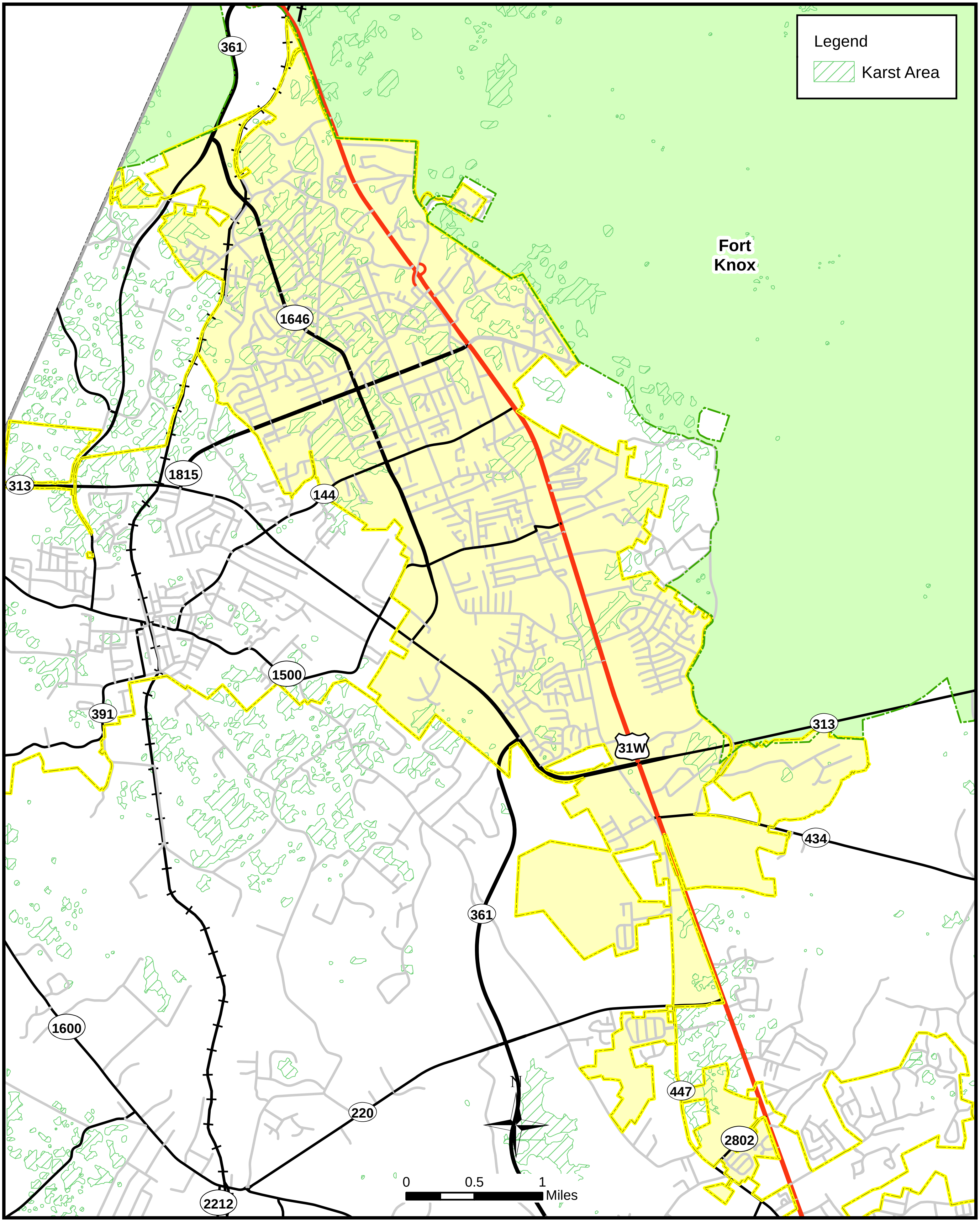


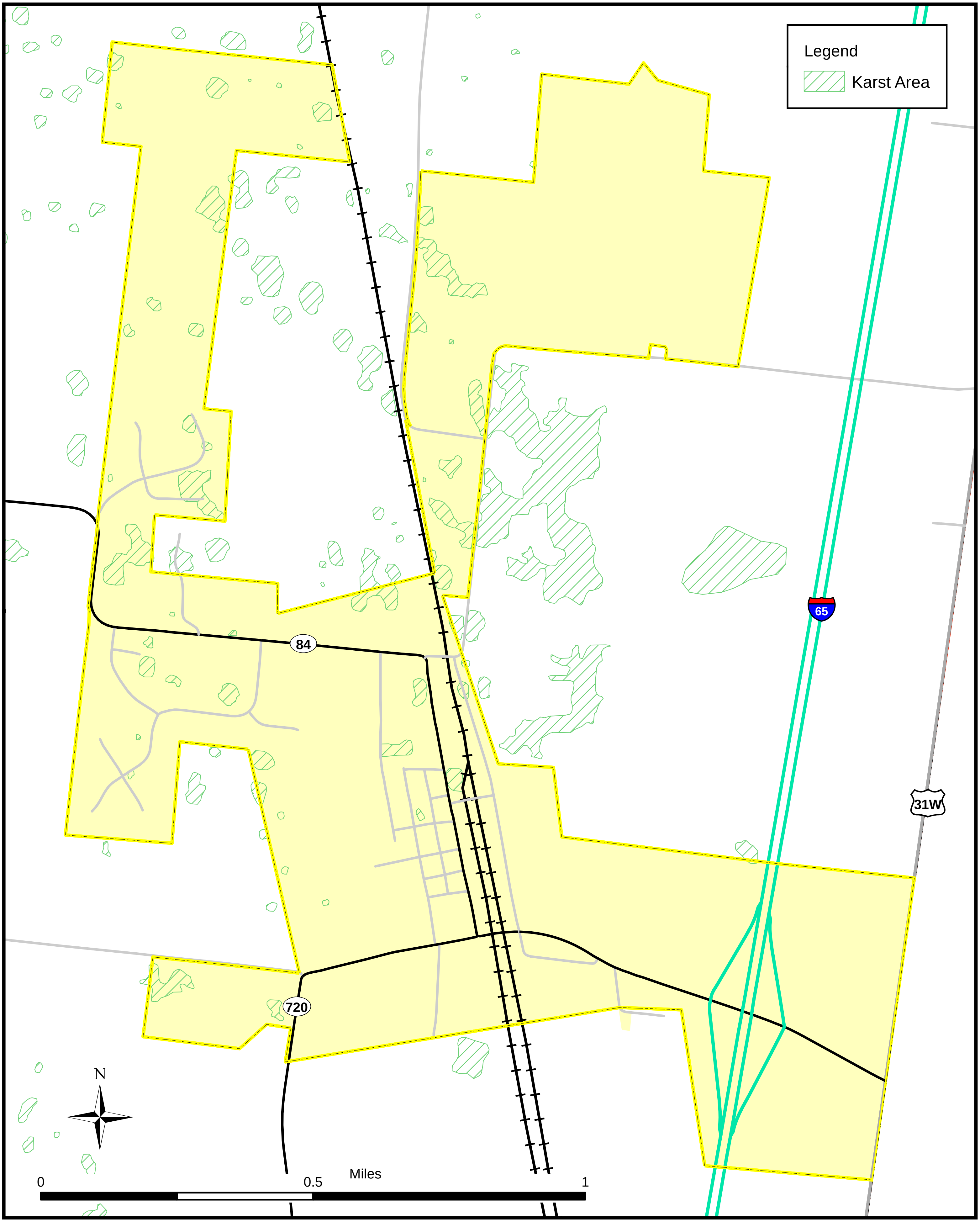

Legend
Karst Area
920
1214
3155
259
737
54
62
187
0
0.5
Miles
N


Legend
Karst Area
Fort Knox
31W
361
144
1500
391
2199
220
920
1375
2213
1600
251
3005
313
434
62
583
65
2212
1538
1357
86
567
253
210
1904
1136
61
31W
84
347
1135
222
1868
1407
1866
720
2800
1921
224
N
0
5
Miles

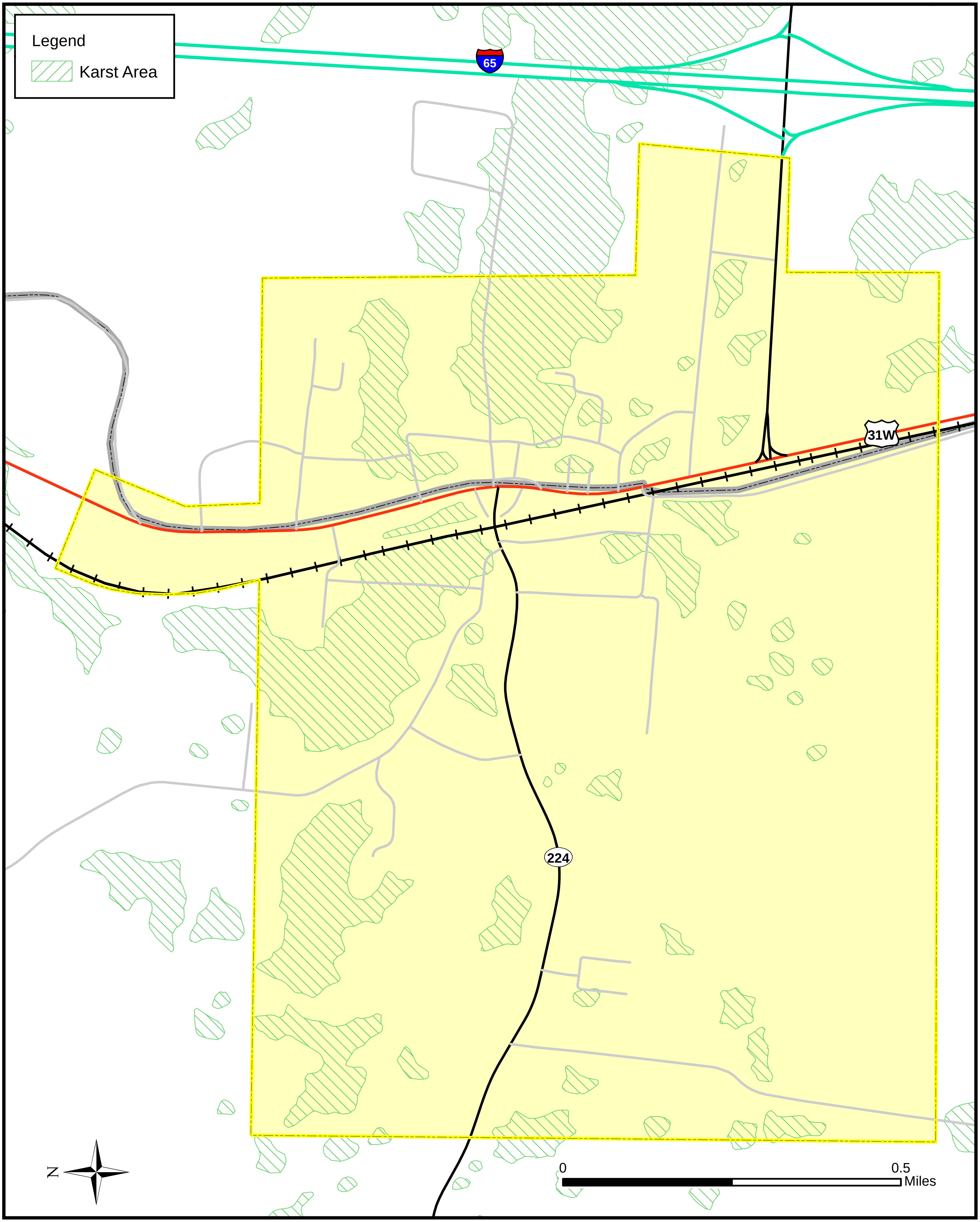
ELIZABETHTOWN
KARST

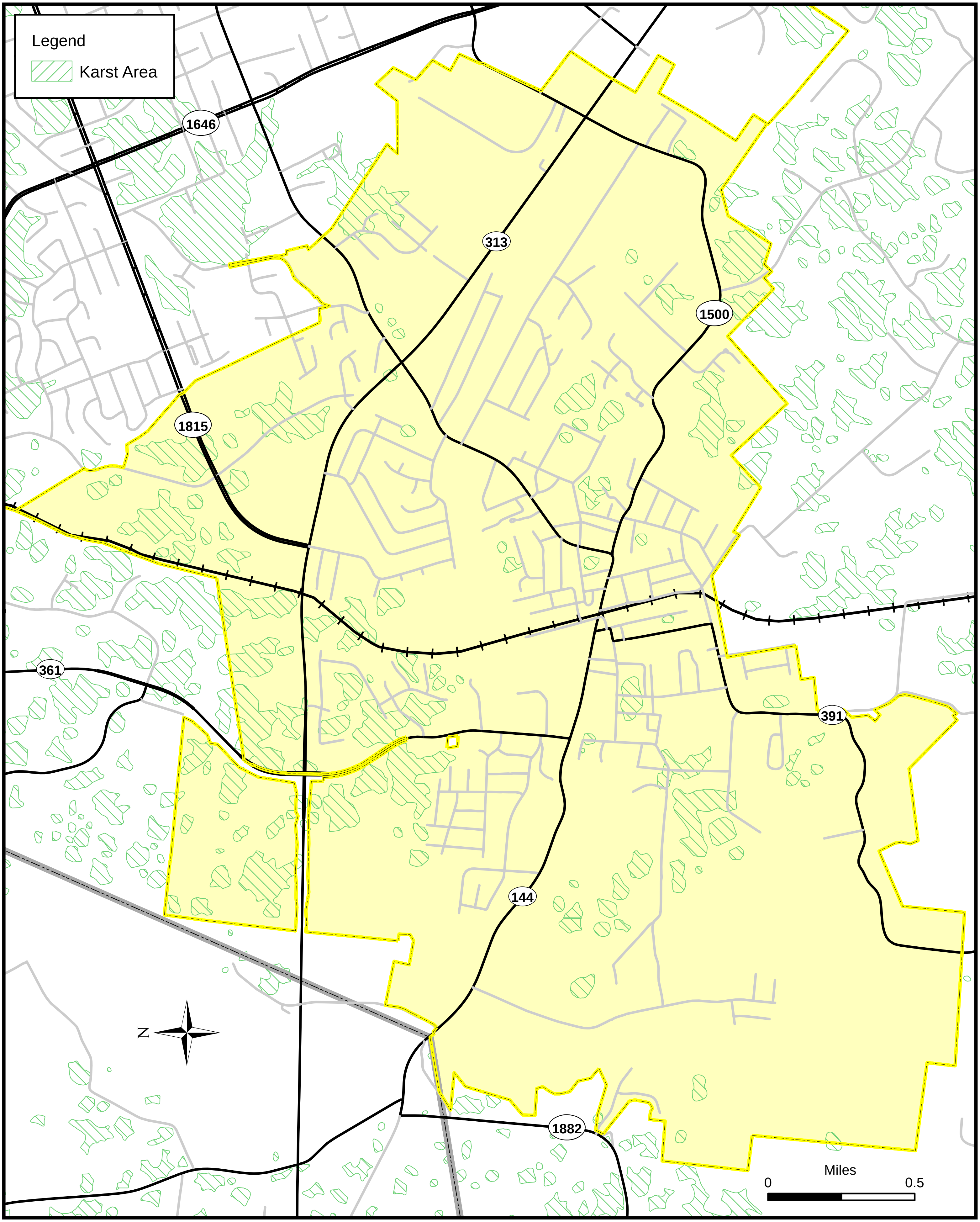


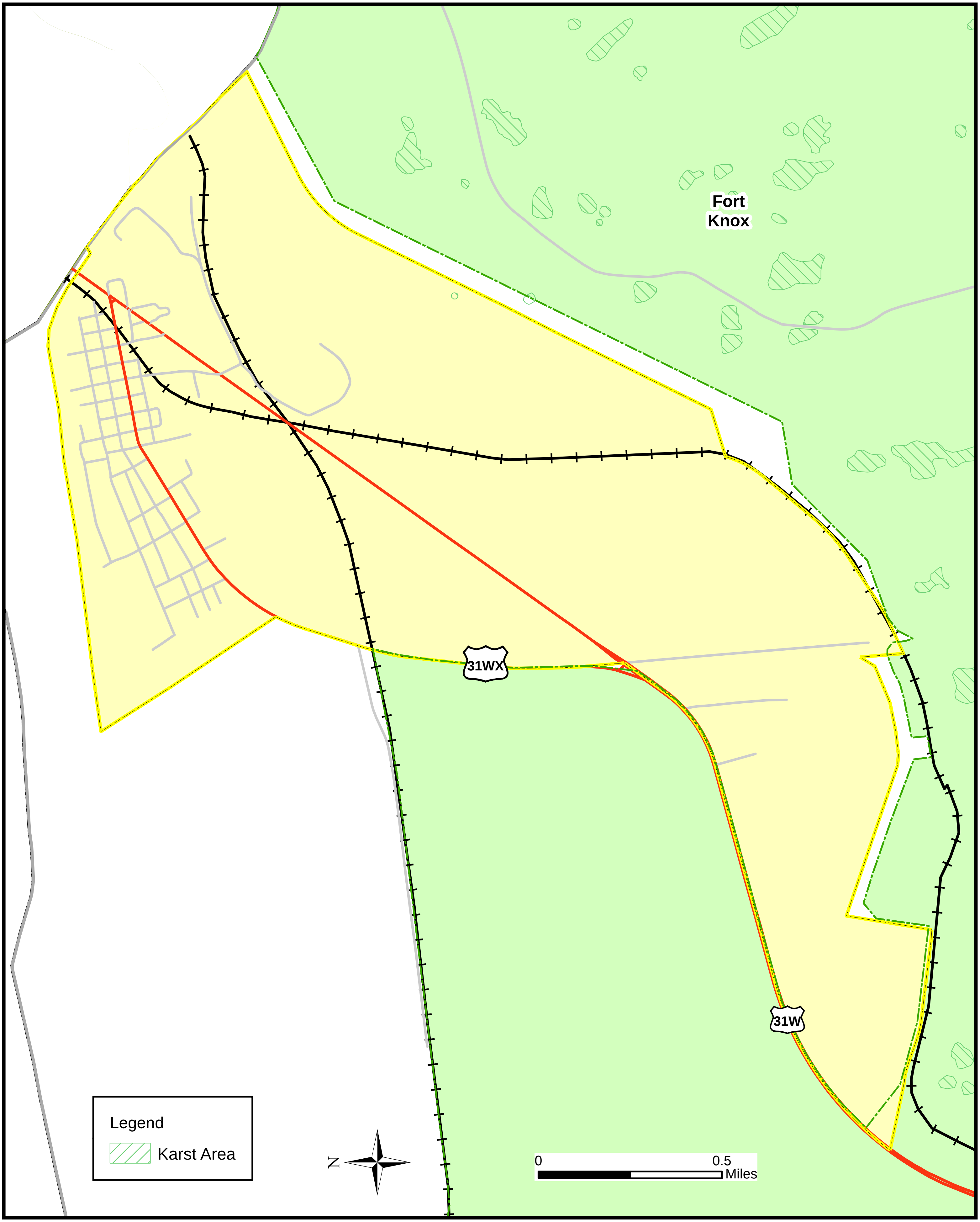

Legend
Karst Area
Fort Knox
361
1646
1815
313
144
1500
391
31W
434
361
1600
220
447
2802
2212
N
0
0.5
1
Miles


Legend
Karst Area
84
720
65
31W
N
0
0.5
Miles
1

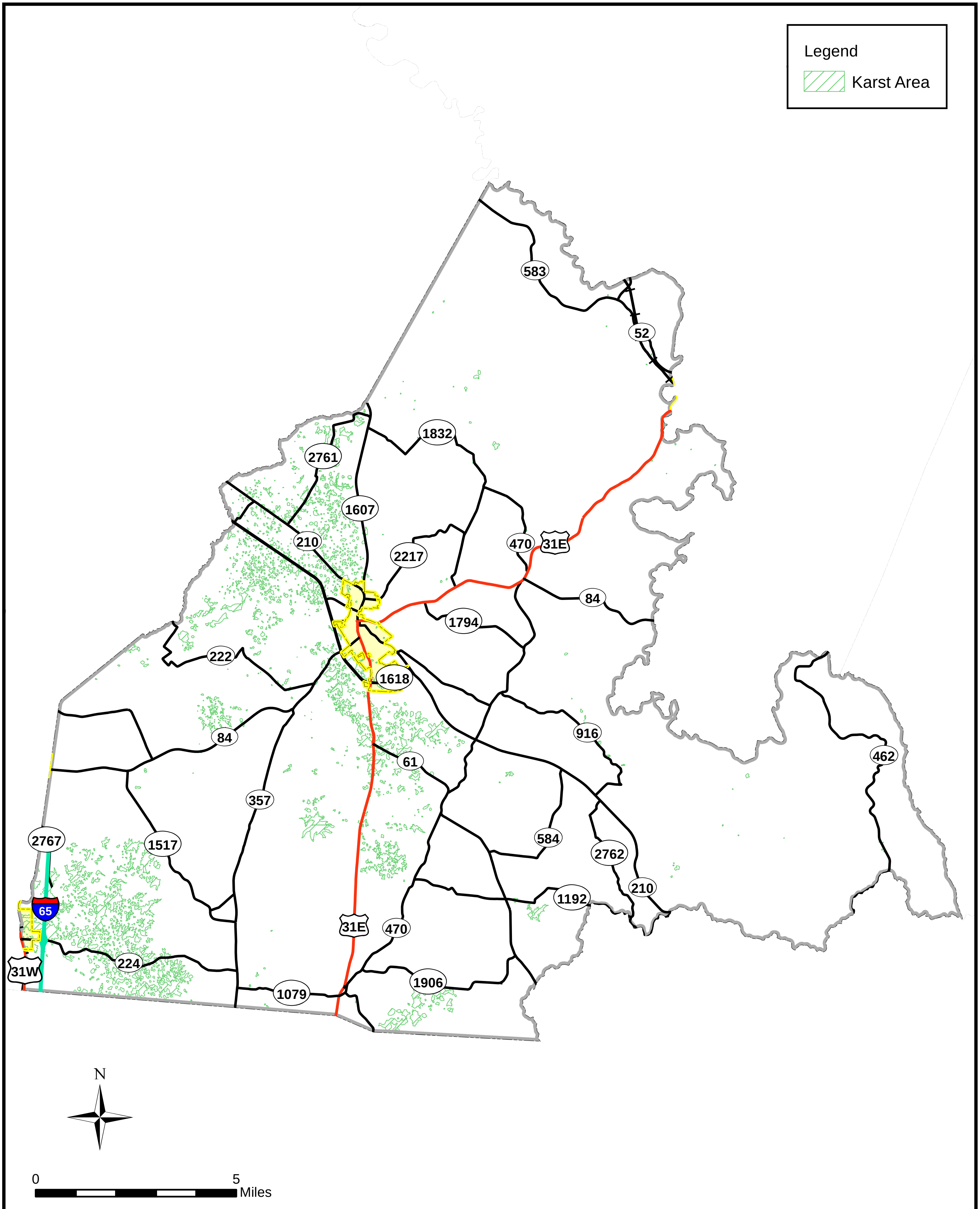
UPTON
KARST



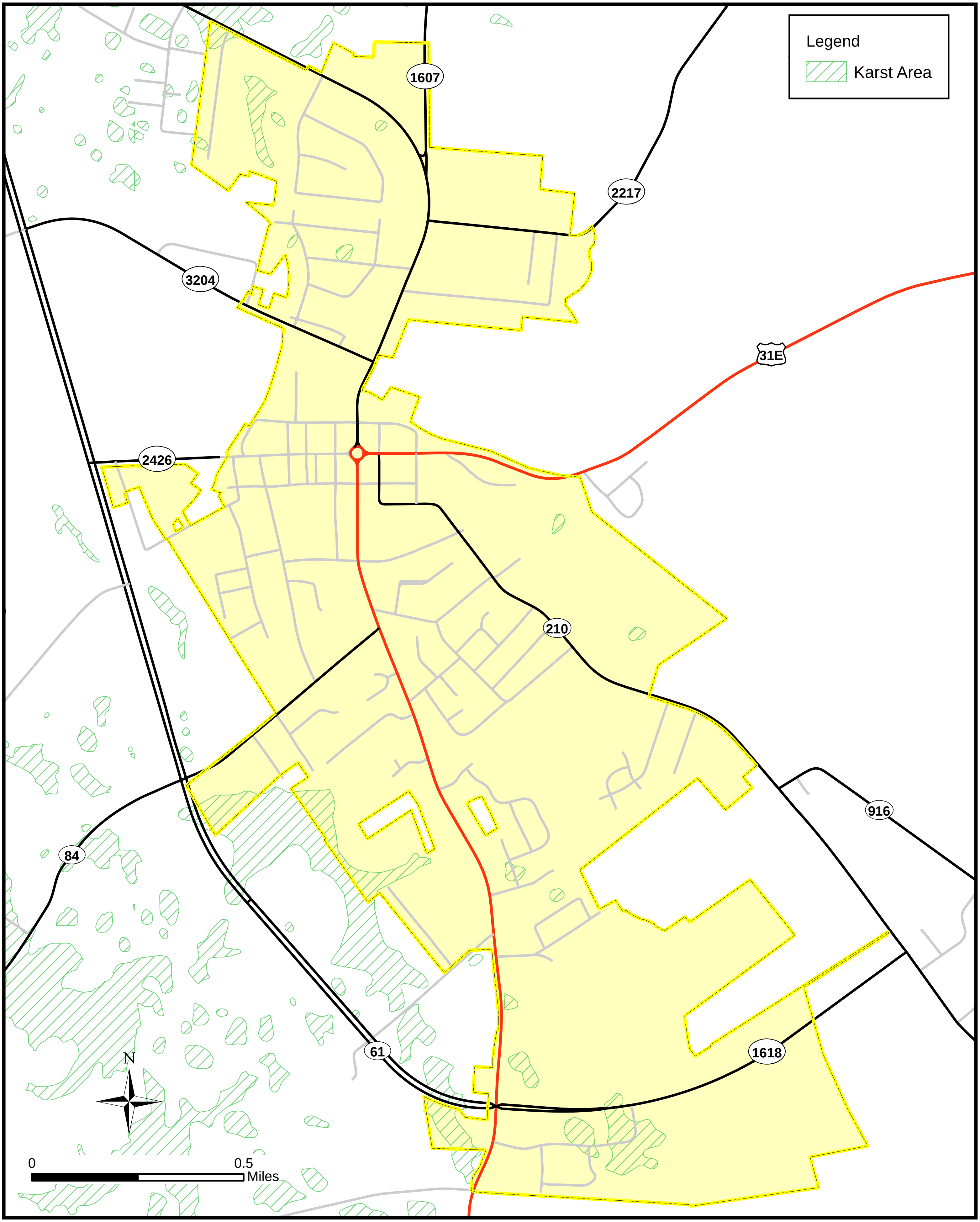

Legend
Karst Area
1646
313
1500
1815
361
391
144
1882
N
Miles
0
0.5

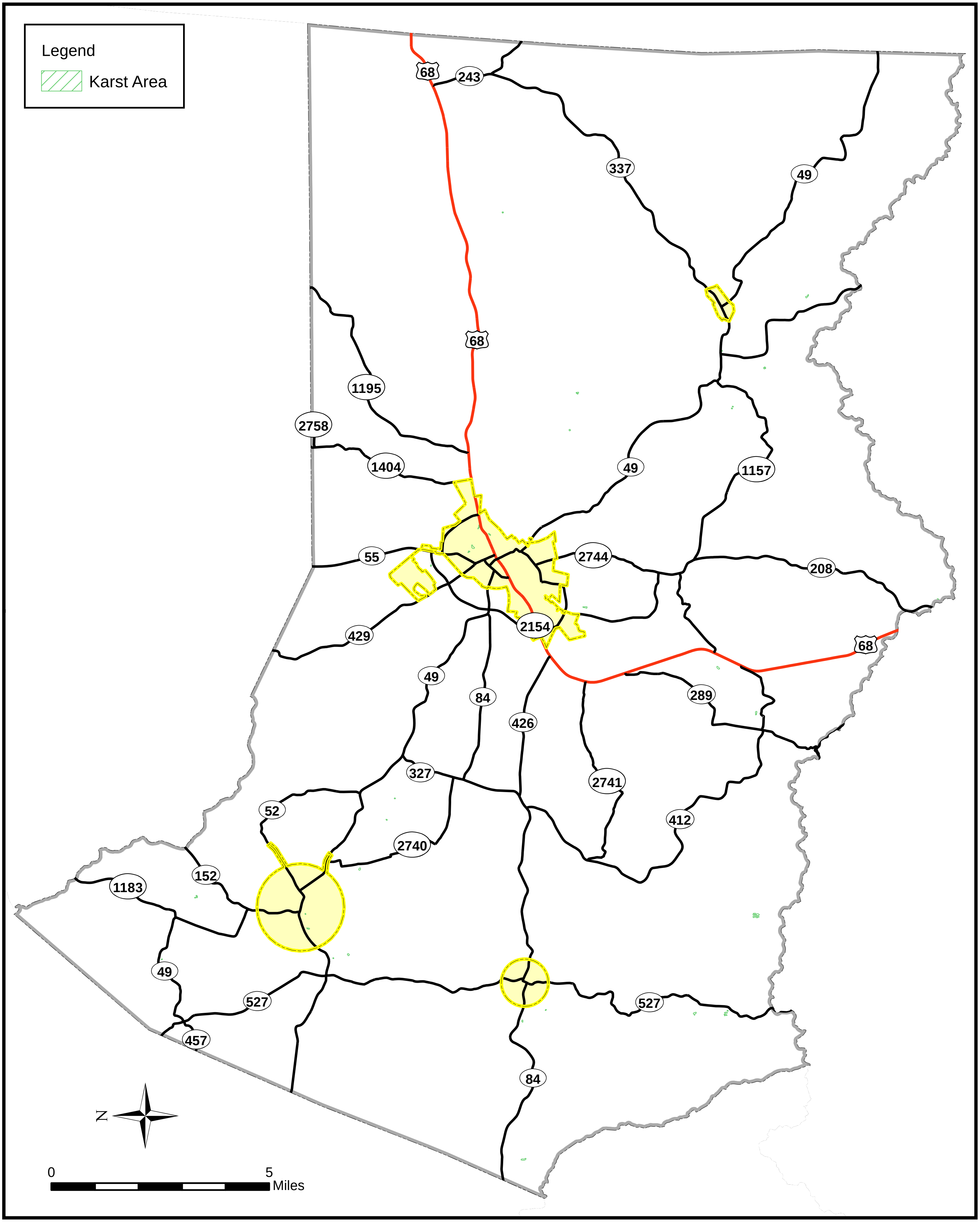

Fort
Knox
31WX
31W
Legend
Karst Area
N
0
0.5
Miles

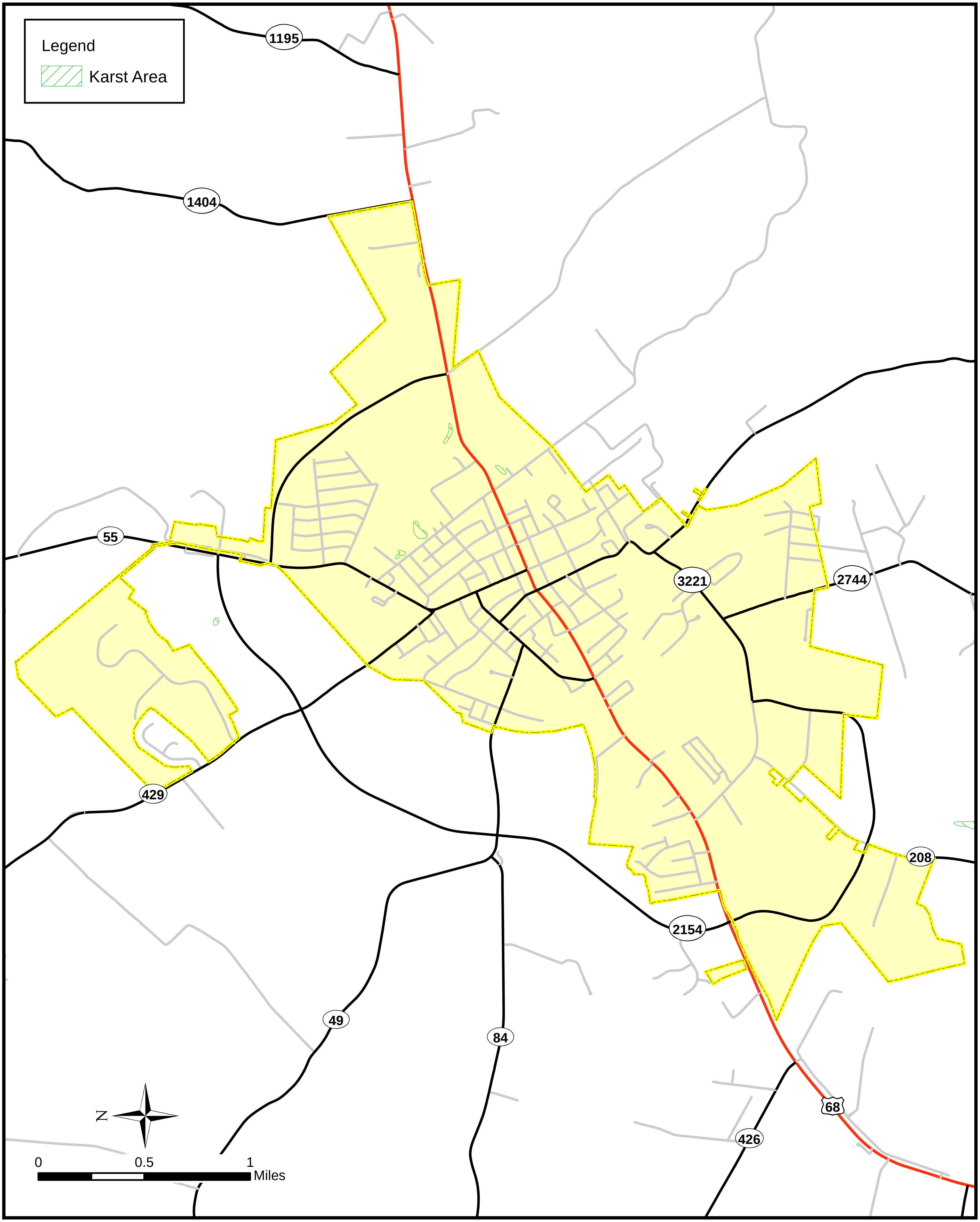
LARUE
KARST

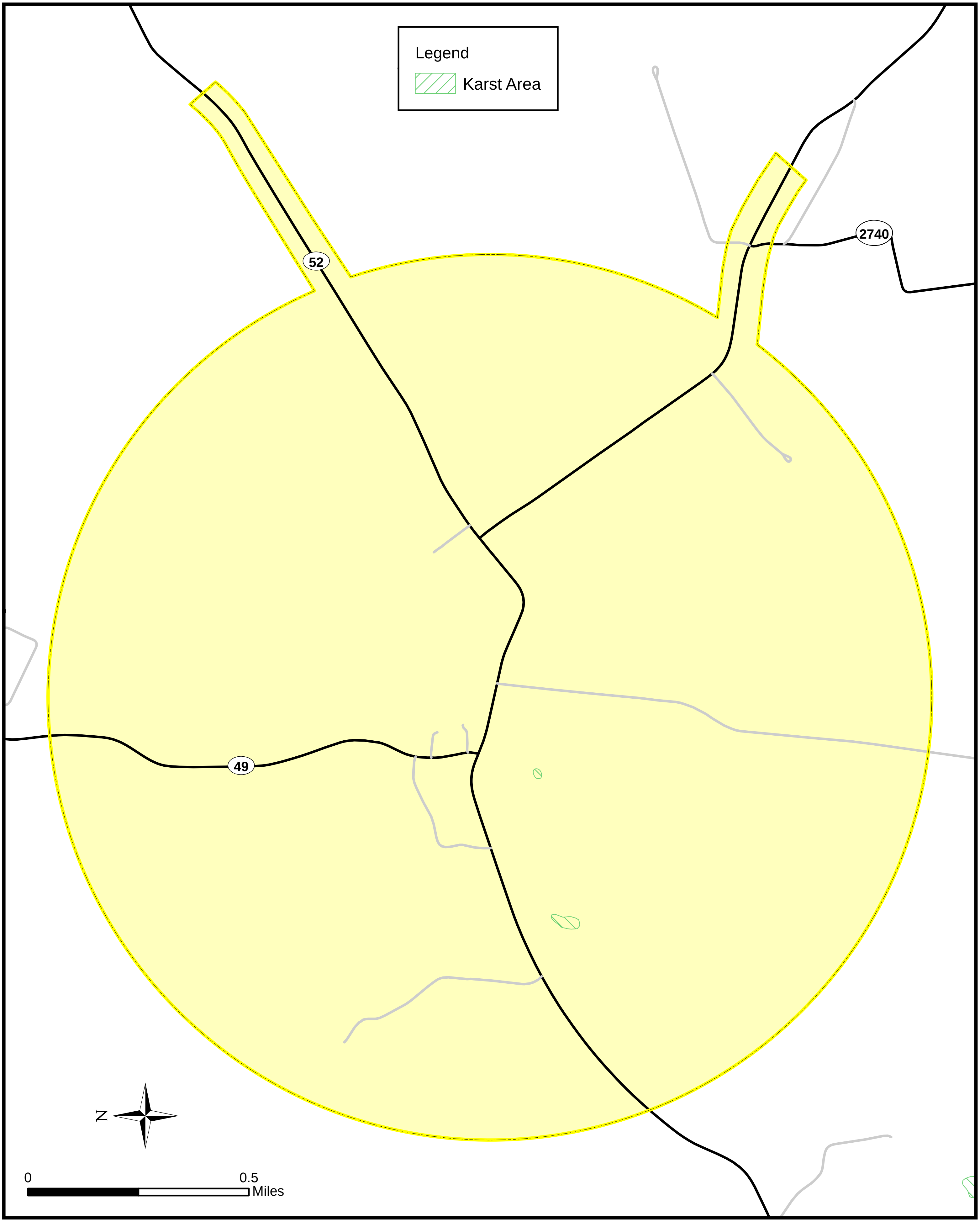


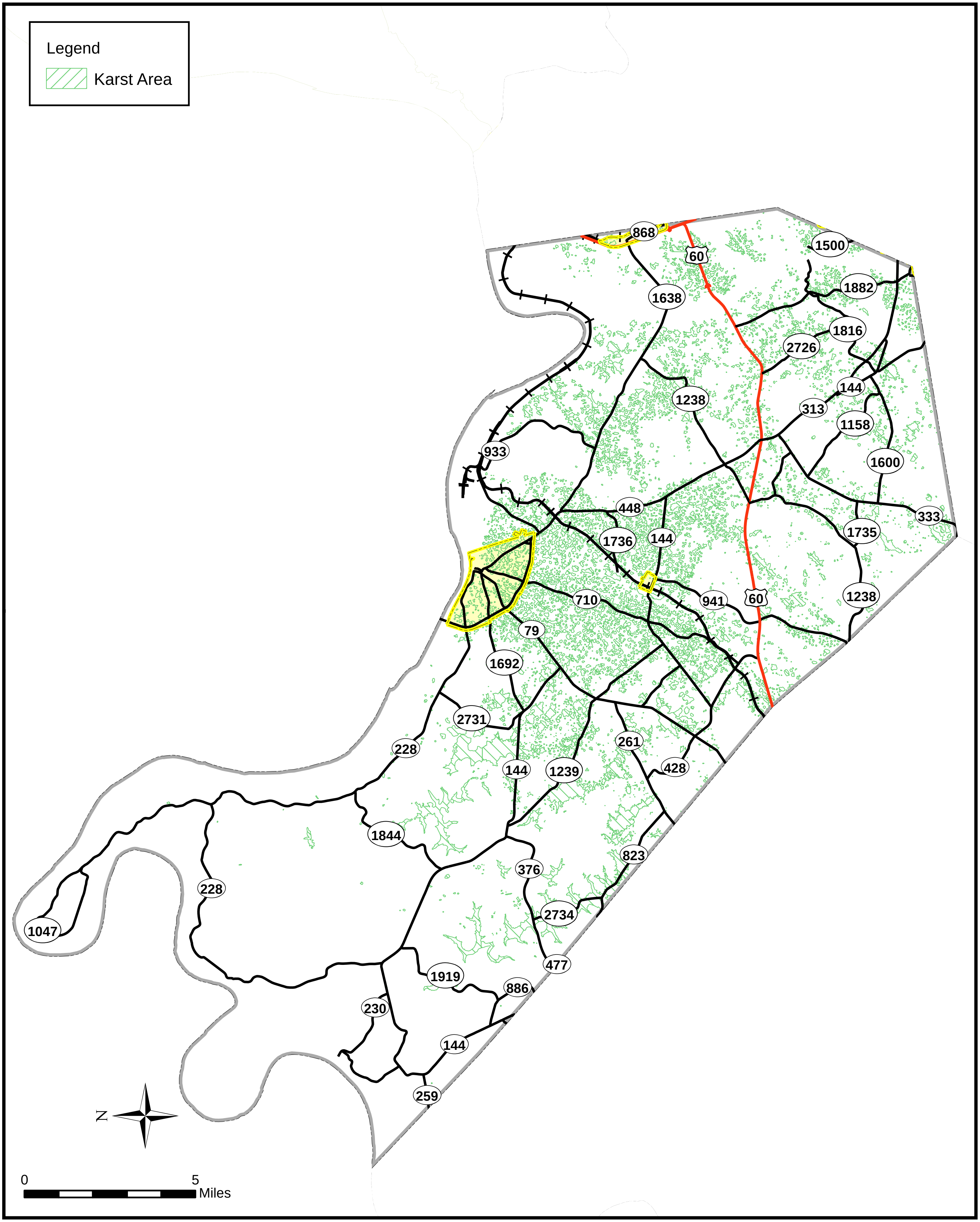
Legend
Karst Area
583
52
1832
2761
1607
210
2217
470
31E
84
1794
222
1618
916
84
61
462
357
2767
1517
584
2762
210
65
1192
31E
470
224
31W
1906
1079
N
0
5
Miles

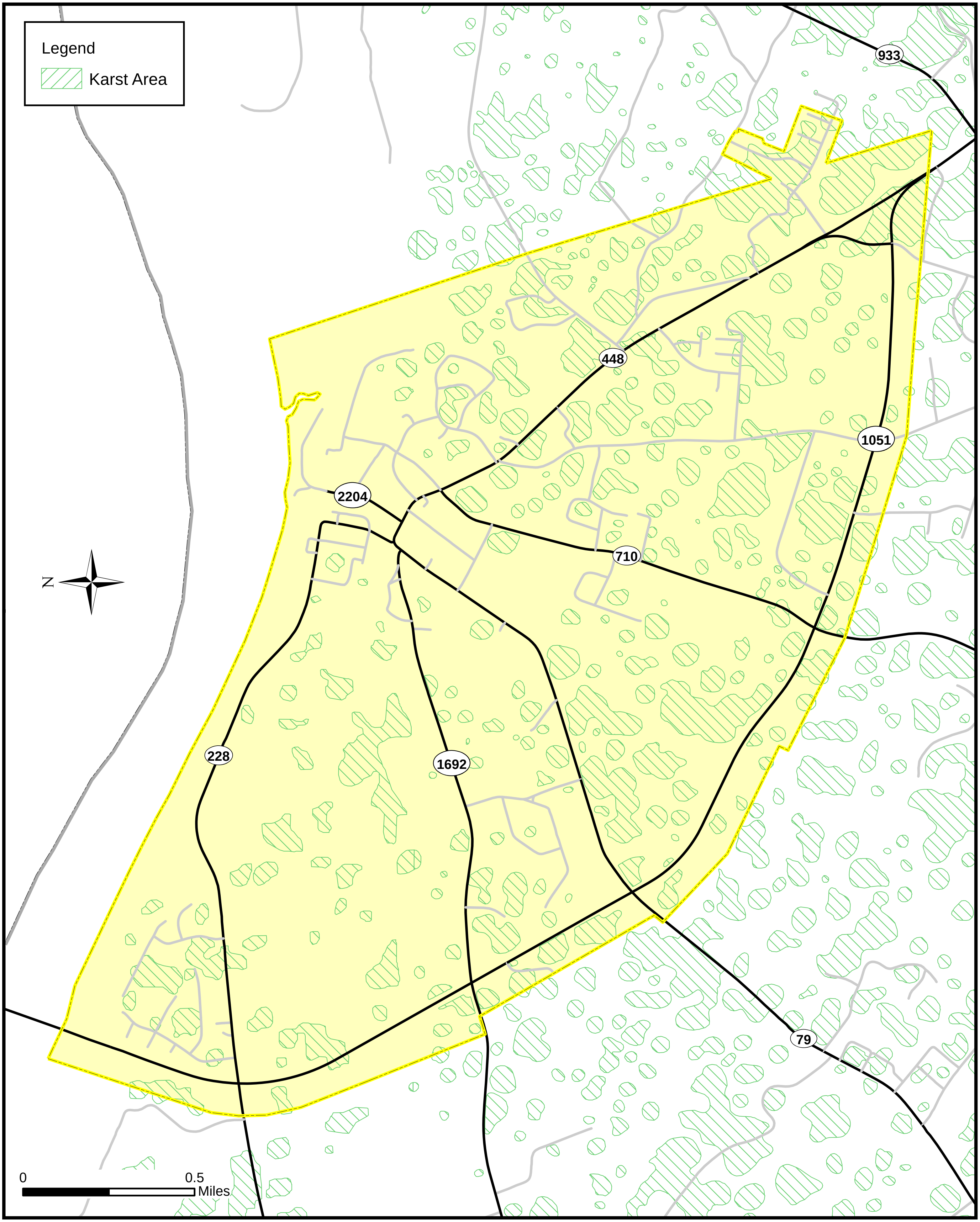

Legend
Karst Area
1607
2217
3204
31E
2426
210
916
84
61
1618
N
0
0.5
Miles

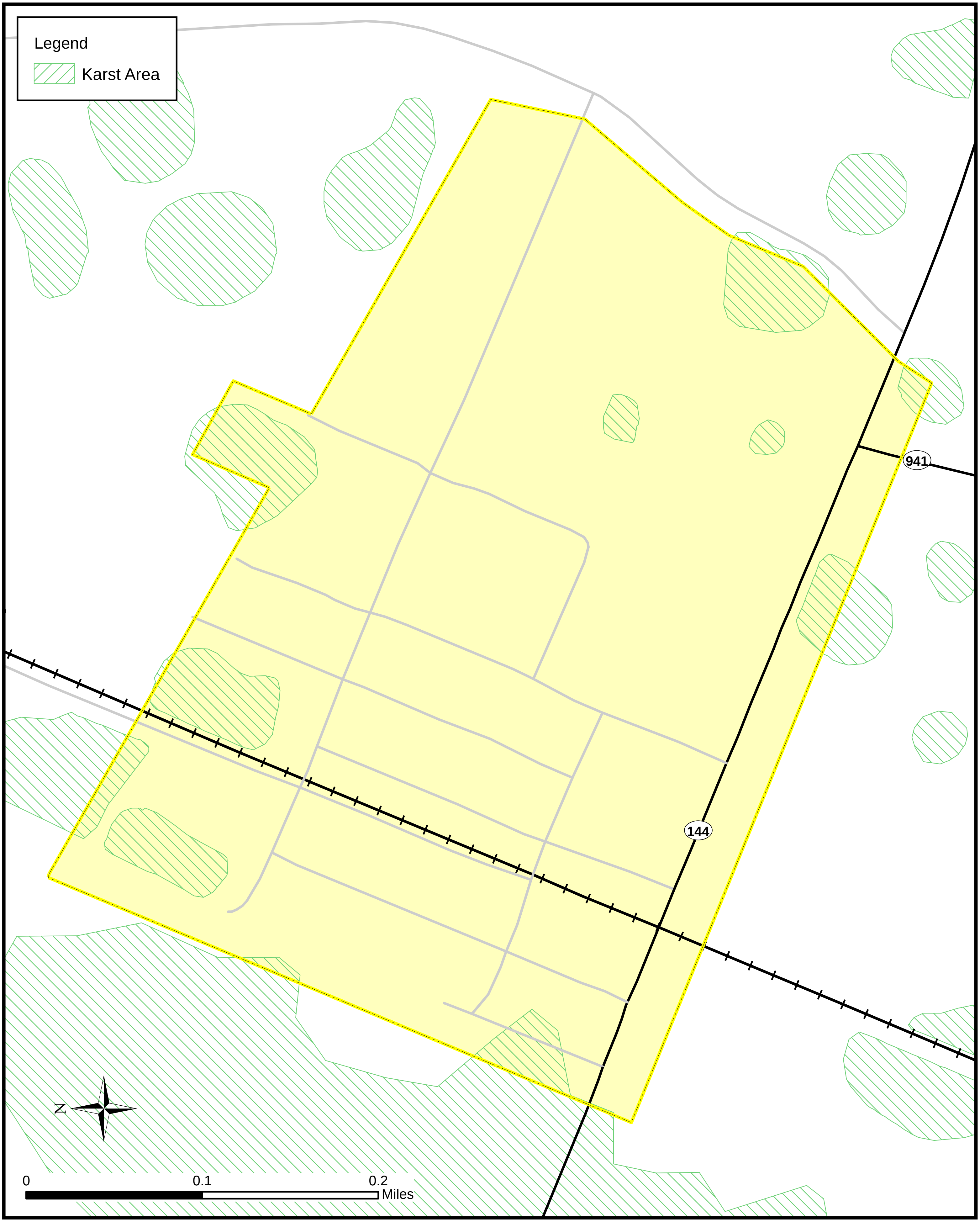

Legend
Karst Area
68
243
337
49
1195
2758
1404
49
1157
55
2744
208
429
2154
68
49
84
426
289
327
2741
52
412
2740
152
1183
49
527
527
457
84
N
0
5
Miles

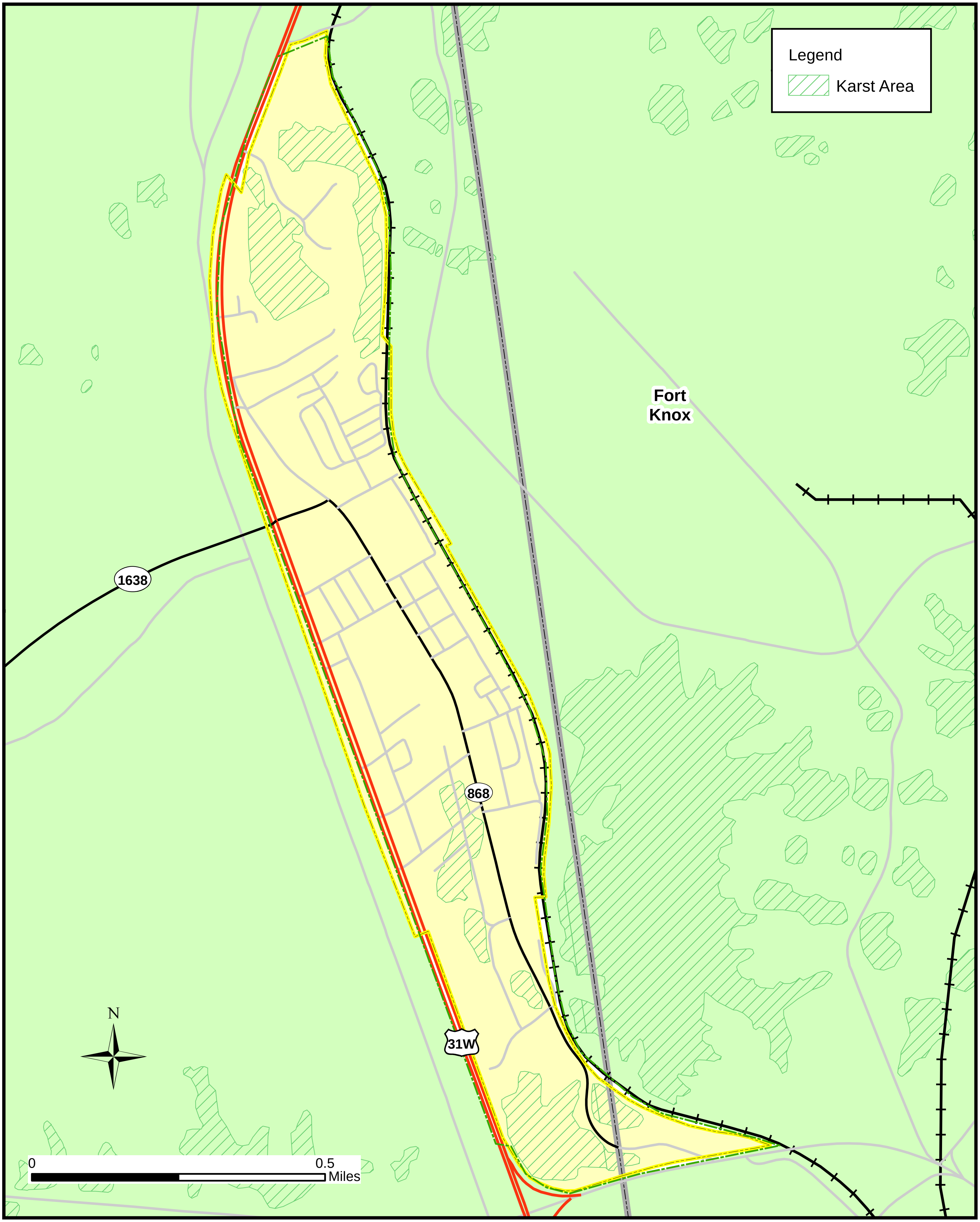

Legend
Karst Area
1195
1404
55
429
3221
2744
208
2154
49
84
426
68
N
0
0.5
1
Miles

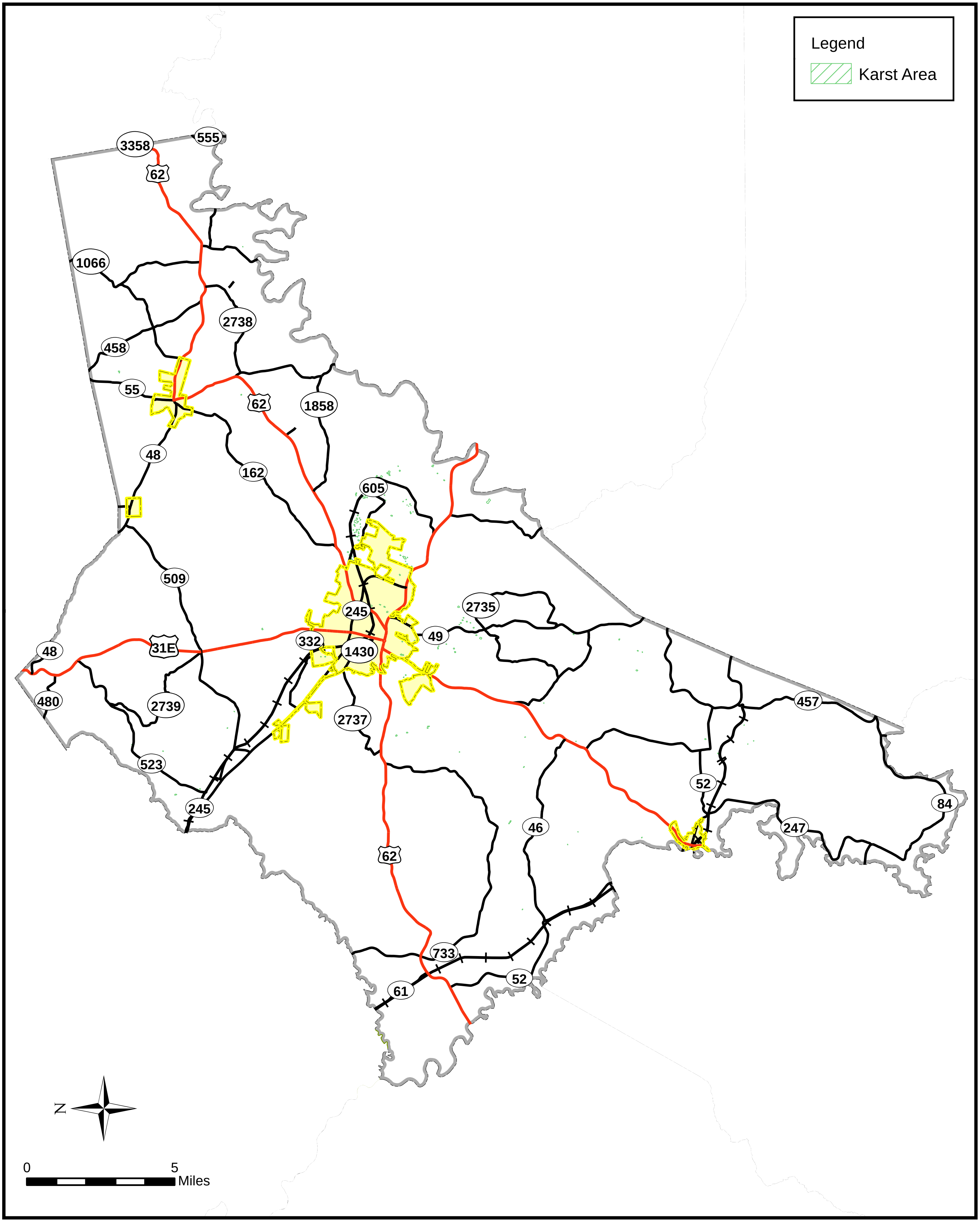

Legend
Karst Area
52
2740
49
N
0
0.5
Miles

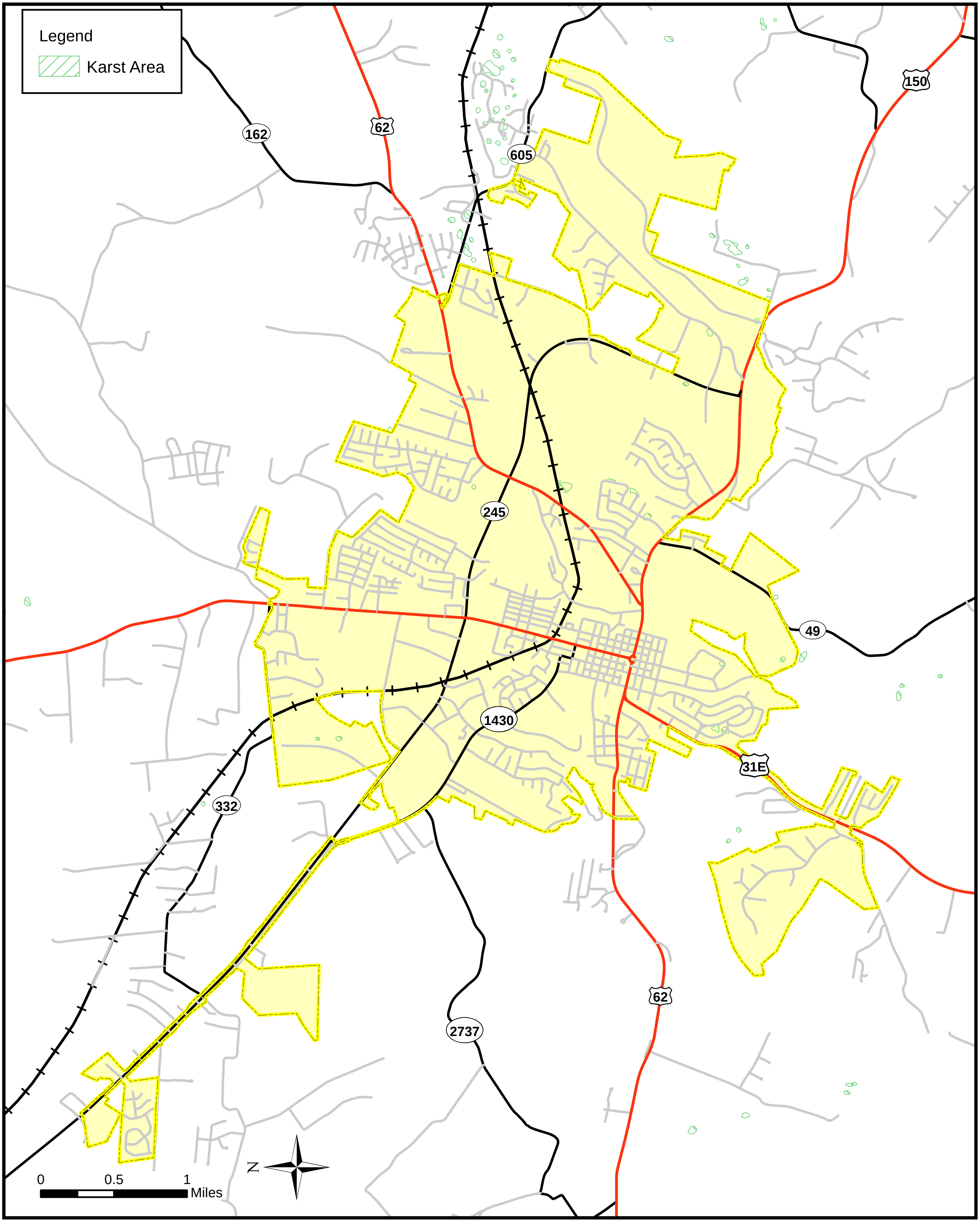

Legend
Karst Area
868
60
1500
1882
1638
1816
2726
144
1238
313
1158
933
1600
448
333
1736
144
1735
710
941
60
1238
79
1692
2731
228
261
144
1239
428
1844
823
376
228
2734
1047
477
1919
886
230
144
259
N
0
5
Miles

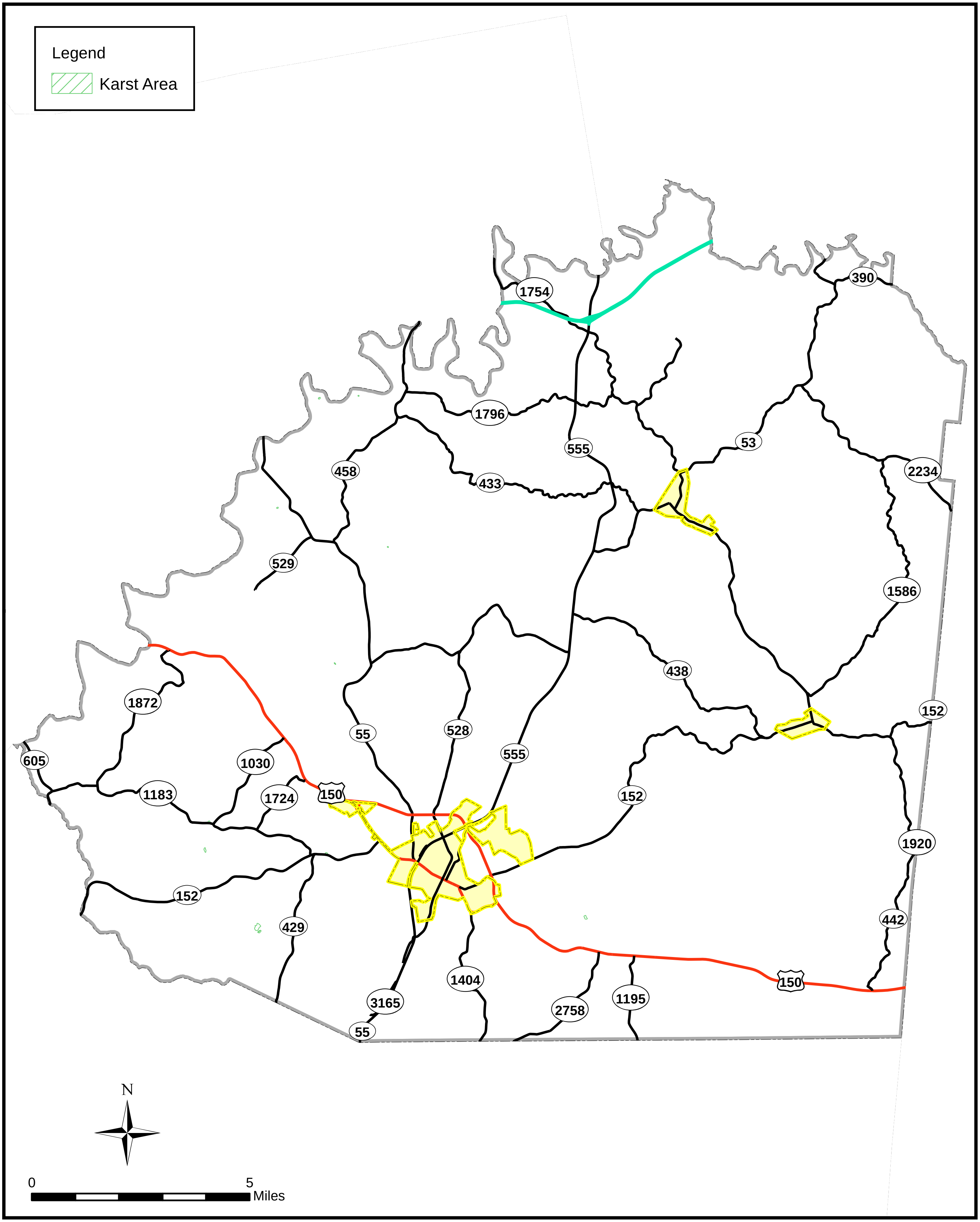

Legend
Karst Area
933
448
1051
2204
710
228
1692
79
N
0
0.5
Miles


Legend
Karst Area
941
144
N
0
0.1
0.2
Miles


Legend
Karst Area
Fort Knox
1638
868
31W
N
0
0.5
Miles


Legend
Karst Area
3358
555
62
1066
2738
458
55
62
1858
48
162
605
509
245
2735
332
49
48
31E
1430
480
2739
2737
457
523
52
84
245
46
247
62
733
52
61
N
0
5
Miles


Legend
Karst Area
162
62
605
150
245
49
1430
31E
332
62
2737
N
0
0.5
1
Miles


Legend
Karst Area
1754
390
1796
555
53
458
433
2234
529
1586
438
152
1872
55
528
555
605
1030
1183
1724
150
152
1920
152
429
442
1404
3165
2758
1195
150
55
N
0
5
Miles

3.3.2.9 <u>Drought</u>

I. Background

The National Oceanic and Atmospheric Administration (NOAA) defines drought as a deficiency in precipitation over an extended period. It is a normal, recurrent feature of climate that occurs in virtually all climate zones. There are cases when drought develops relatively quickly and lasts a very short period of time, exacerbated by extreme heat and/or wind, and there are other cases when drought spans multiple years, or even decades.

The United States is vulnerable to the social, economic, and environmental impacts of drought. Historical weather records of United States indicate that there have been three or four major droughts over the last 100 years. Two of these disasters, the 1930's Dust Bowl drought and the 1950's drought, each lasted 5 to 7 years and covered large areas of the U.S.

According to the National Climatic Data Center (NCDC), during the 31 years prior to 2011, the United States has experienced 114 weather/climate disasters where overall damages/costs reached or exceeded $1 billion. The standardized losses for the entire 114 events exceeded $800 billion. During that period, there were 16 drought events that totaled $195 billion in losses; an average of slightly over $12 billion per each drought event.

Drought is a normal, recurring global occurrence in most parts of the world. Drought is among the earliest documented climatic events, and tied to several biblical stories. Migrations of Hunter-gatherer populations in 9,500 BC Chile have been linked to drought, as has the exodus of early humans out of Africa and into the rest of the world about 135,000 years ago.

Measuring Drought

The Palmer Drought Index, sometimes called the Palmer Drought Severity Index (PDSI), is used to measure drought and is based on recent precipitation and temperature. Developed by meteorologist Wayne Palmer, the index is based on a supply-and-demand model of soil moisture to measure the departure of the moisture supply. The index is most effective in determining long-term drought and not as good dealing with conditions over a time period of weeks. The index uses 0 as normal with drought shown in terms of negative numbers. It also works to describe wet spells, using corresponding positive numbers. The PDSI is calculated based on precipitation and temperature data, as well as the local Available Water Content (AWC) of the soil.

NOAA utilizes the index to publish weekly, Palmer maps for the United States. Global Palmer data sets have been developed based on instrumental records beginning in the 19th century. The chart below illustrates the Palmer Drought Index.

Table 3.3.2.9.1 - Palmer Classifications	
4.0 or more	Extremely wet
3.0 to 3.99	Very wet
2.0 to 2.99	Moderately wet
1.0 to 1.99	Slightly wet
0.5 to 0.99	Incipient wet spell
0.49 to -0.49	Near normal
-0.5 to -0.99	Incipient dry spell
-1.0 to -1.99	Mild drought
-2.0 to -2.99	Moderate drought
-3.0 to -3.99	Severe drought
-4.0 or less	Extreme drought
Source: National Drought Mitigation Center	

An alternative method is the Drought Severity Classification used by the U.S. Drought Monitor service. (http://droughtmonitor.unl.edu/Home.aspx).
It uses a scale of D0-D4 that has a direct relationship to the Palmer method illustrated above.

Table 3.3.2.9.2

Drought Severity Classification

Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)
D0	Abnormally Dry	Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

Source: http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

Types of Droughts

Droughts are typically defined in three main ways:

1. Meteorological droughts occur when there is a prolonged period of time with less than average precipitation. A meteorological drought usually precedes the other kinds of droughts.
2. Agricultural droughts affect crop production or the ecology of the range. An agricultural drought can occur independently with any change in precipitation levels when soil conditions and erosion, triggered by poorly managed agricultural endeavors, cause a shortfall in the amount of water available to the crops.
3. Hydrological droughts happen when water reserves available in sources such as aquifers, lakes, and reservoirs fall below the statistical average. A hydrological drought tends to show up more slowly because it involves stored water that is used, but not replenished. As with an agricultural drought, this type of drought can be triggered by more than just a loss of rainfall.

Hazards/Consequences of Drought

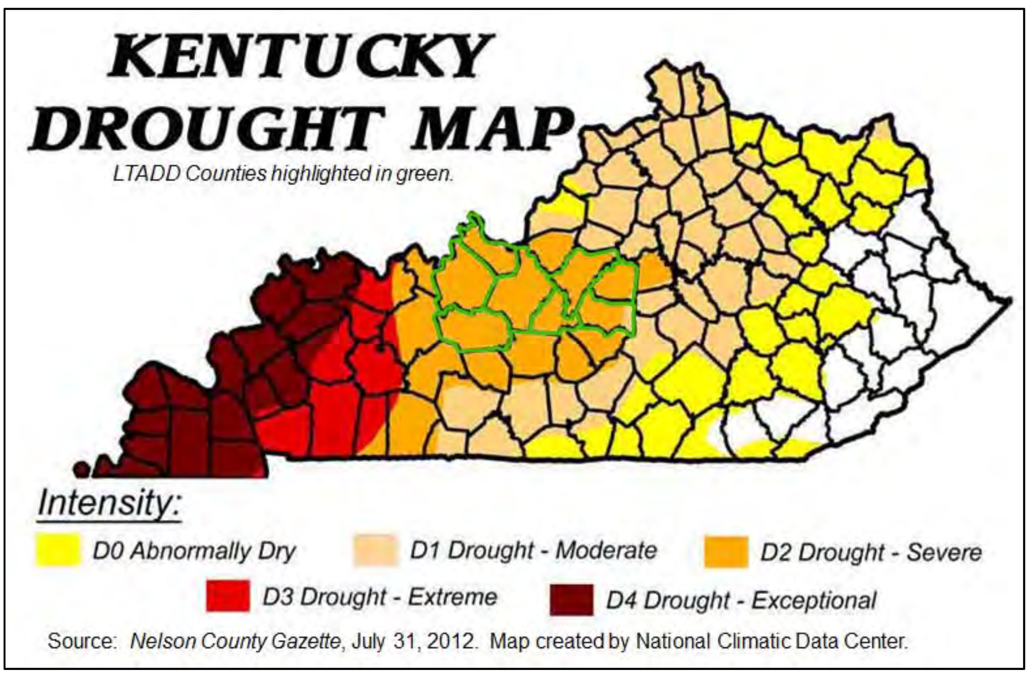
Periods of drought can cause significant environmental, agricultural, health, economic and social consequences. Subsistence farmers and populations dependent on water sources for food are more vulnerable to famine and diminished economic means. Drought can cause a reduction in overall water quality when reduced water flows increase contamination of remaining water sources. Other consequences of drought include:

- Reduced crop growth or yield productions and carrying capacity for livestock
- Dust bowls and landscape erosion
- Dust storms when drought reduces the water content of the soil
- Damage to terrestrial and aquatic life habitats
- Hunger and famine due to reduced food crops
- Malnutrition, dehydration and related diseases
- Mass migration of humans and wildlife resulting in displaced people and animals
- Reduced electricity as a result of low water flow through hydroelectric dams
- Water shortages for residential and industrial users
- Snake migration that results in increased snakebites
- Social unrest
- Wildfires are more common during periods of drought and often result in loss of life and widespread property damage
- Exposure and oxidation of acid sulfate soils due to falling surface and groundwater levels
- Navigable waters can become unsafe for navigation as a result of drought
- Degradation of the environment in the form of erosion and ecological damage may occur as the result of drought

II. Profile

According to NOAA, there have been 17 recorded drought events in Kentucky since 1996. Three of these droughts caused serious damage to agricultural crops. In 1996, drought affected 20 Western Kentucky Counties and crop damage was estimated at $154 million. In 2002, 22 counties were affected by drought with damages estimated at $70 million. The drought of 2012 was a Level 2 drought in 24 Kentucky Counties and a Level 1 drought in an additional 66 Counties. The entire State was at least abnormally dry. Total crop production for State was at 47% of the usual annual yield and crop damage was severe. There was widespread shortage of animal feed as well. There were no deaths attributed to these drought events, however, they did affect agriculture, tourism, wildlife, residential and commercial water use, recreation, wildlife habitat, increased wildfires, electric power generation and water quality.

The map below illustrates the widespread effect and severity of the 2012 drought in Kentucky.



Source: *Nelson County Gazette*, July 31, 2012. Map created by National Climatic Data Center.

North Rolling Fork at Bradfordsville, Summer 2008.
Source: LTADD Archive.

The chart below outlines significant drought events in Kentucky since May of 1930. The Lincoln Trail Region lies within the Central region of the Commonwealth. The 2012 drought affected the entire State with PDSI ratings ranging from -0.5 to -3.99.

Table 3.3.2.9.2 - Significant Kentucky Drought Events

Time Period	Location/Region	PDSI Rating	Crop Losses
May 1930 – December 1931	Bluegrass, Central, East, West	-4.73	NA
Fall 1939 – Spring 1942	Central, Bluegrass, East	-3.97	NA
Summer 1952 – Winter 1955	West, Bluegrass, Central	NA	NA
Summer 1996	West	NA	$154 million
Summer 2002	West	NA	$70 million
Summer 2007	Statewide	-2.75	Unknown
Fall 2008	Statewide	-2.75	Unknown
Spring/Summer 2012	Statewide	-0.5 to -3.99	Unknown

Source: NOAA, KY Energy and Environment Cabinet

III. Analysis

To analyze drought as a hazard threat to the Lincoln Trail Region, research was done to determine what constitutes a drought and the far-reaching effects that it has. Historical events were researched and documented as well. Resources for information gathered include NOAA, the National Weather Service, the National Climatic Data Center, the National Drought Mitigation Center and the Commonwealth of Kentucky Energy and Environment Cabinet.

One drought event was recorded for any part of the Lincoln Trail Region between May, 1930 and June, 2015 per the sources cited above.

While drought events are not easily captured and reported, the table above is evidence of their occurrence. The back-to-back droughts of 2007 and 2008 were a hardship on local farmers and the 2012 drought adversely impacted the entire State.

Heat in concert with lack of precipitation often exacerbates drought conditions. The Kentucky Mesonet data below tracks maximum temperatures for the region over the last five years.

Table 3.3.2.9.3

Maximum Temperature Table for Lincoln Trail Region from 2010 to 2015 ***Source: Kentucky Mesonet***							
Mesonet Station	2010	2011	2012	2013	2014	2015 Jan. – March 3	Average Station 5 Year Average 2010 – 2014
Breckinridge Co. (MQDY)	100.1	98.6	103.1	94.2	93.5	61.9	97.9
Grayson Co. (BLRK)	96.3	98.3	102.5	92.1	92.9	63.5	96.42
Hardin Co. (CCLA)	99.6	98.1	103.0	93.3	92.3	61.1	97.26
LaRue Co. (HDGV)	NA	82.1 Sept. – Dec.	103.1	90.0	90.6	62.3	NA
Marion Co. (LRTO)	NA	100.8 May – Dec.	102.7	90.5	92.6	62.8	NA
Meade Co. (BRND)	NA	100.4 March – Dec.	103.6	93.1	90.7	61.9	NA
Average	98.67	99.24	103.0	92.2	92.1	62.25 Jan. – March 3	97.04 Annual 8-County Regional 5 Year Average 2010 – 2014

Kentucky Mesonet data for local precipitation over the last five years is included below. The region will closely monitor and track Mesonet data to help track drought conditions specific to the eight-county area.

Table 3.3.2.9.4

Precipitation Data for Lincoln Trail Region from 2010 to 2015 ***Source: Kentucky Mesonet***							
Mesonet Station	2010	2011	2012	2013	2014	2015 Jan. – March 3	Total
Breckinridge Co. (MQDY)	29.63”	72.20”	39.77”	47.44”	45.28”	5.11”	239.43”
Grayson Co. (BLRK)	44.34”	71.22”	39.69”	55.93”	40.85”	5.82”	257.86”
Hardin Co. (CCLA)	38.70”	71.21”	50.07”	46.20”	42.21”	4.95”	253.34
LaRue Co. (HDGV)	NA	16.72” Sept – Dec.	44.77”	51.02”	43.38”	6.22”	NA
Marion Co. (LRTO)	NA	27.53” May – Dec.	48.22”	54.38”	42.51”	5.44”	NA
Meade Co. (BRND)	NA	48.80” March – Dec.	47.56”	49.55”	48.07”	4.11”	NA
Average	37.557”	71.543”	45.013”	50.753”	43.717”	5.275”	49.7166” annual 8-county regional 5 year average

Table 3.3.2.9.6 Summary of Drought Index Data

	Percentage of Area in each drought category, Jan 1, 2000 to July 12, 2016.					
		Abnormally Dry	Moderate Drought	Severe Drought	Extreme Drought	Exceptional Drought
	NONE	D0	D1	D2	D3	D4
Breckinridge	78.0	22.0	9.6	3.3	0.7	0.0
Grayson	77.1	22.9	11.1	3.3	0.5	0.0
Hardin	78.6	21.4	10.3	2.5	0.5	0.0
Larue	77.6	22.4	9.9	3.4	0.6	0.0
Marion	76.3	23.7	10.5	4.0	0.7	0.0
Meade	79.4	20.6	9.2	2.9	0.8	0.0
Nelson	77.7	22.3	10.5	3.0	0.6	0.0
Washington	77.0	23.0	11.3	3.8	0.7	0.0
Lincoln Trail Region	77.7	22.3	10.3	3.3	0.6	0.0

Source: U.S. Drought Monitor (http://droughtmonitor.unl.edu/MapsAndData/DataTables.aspx)

Note: This data is based on the "Traditional Statistics" and may include multiple data in each category. It is possible to have a higher percent area for a higher category. Thus it may exceed 100% for any given area. This data is over a very short time span so it has limited use at this time to predict drought probability or correlate with any loss data. However, in the future further monitoring and data collection may yield more robust analysis.

3.3.2.10 <u>Earthquakes</u>

I. Background

According to the United State Geological Survey (USGS), an earthquake is "what happens when two blocks of the earth suddenly slip past one another. The surface where they slip is called the fault or fault plane. The location below the earth's surface where the earthquake starts is called the hypocenter, and the location directly above it on the surface of the earth is called the epicenter." This phenomenon results in a shaking, trembling, or concussion of the earth, often accompanied by a rumbling noise. The seismicity, seismism, or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.

At times, an earthquake will be preceded by a foreshock. A foreshock is smaller than an actual earthquake and will occur in the same place as the larger earthquake that follows. A foreshock cannot be identified as such until the larger earthquake has happened. The larger earthquake is called the mainshock and may be followed by aftershocks. Aftershocks are smaller earthquakes that follow a mainshock and can continue for weeks or months after the mainshock.

USGS explains "the earth has four major layers: the inner core, outer core, mantle and crust. The crust and the top of the mantle make up a thin skin on the surface of our planet. However, this skin is not all in one piece, it is made up of many pieces like a puzzle covering the surface of the earth. These pieces are slowly moving around, sliding past one another and bumping into one another. These pieces are called tectonic plates, and the edges of the plates are called the plate boundaries. The plate boundaries are made up of many faults, and most of the earthquakes around the world occur in these faults. Since the edges of the plates are rough, they get stuck while the rest of the plate keeps moving. When the plate has moved far enough, the edges unstick on one of the faults and there is an earthquake."

When the edges of the fault are stuck together, the rest of the block keeps moving, and the energy that would normally allow the blocks to slide past one another is being stored up. The force of the moving blocks eventually overcomes the friction of the jagged edges of the faults and causes them to break apart. All of the stored up energy is released and radiates outward from the fault in all directions as seismic waves. The seismic waves shake the ground as they move through it and as the waves reach the earth's surface, they shake the ground and anything on it.

Measuring Earthquakes

There are three scales for measuring the intensity of an earthquake. The *Mercalli scale* was invented in 1902 by Guiseppe Mercalli and uses observations of the people who experience the earthquake to estimate its intensity. This scale was subjective and dependent on the opinions of witnesses.

In 1934, Charles Richter developed the *Richter scale*. The Richter scale measured the magnitude of an earthquake using a formula based on amplitude of the largest wave recorded on a specific type of seismometer and the distance between the earthquake and the seismometer. Richter's scale was specific to earthquakes in California, but other scales, based on wave amplitudes and total earthquake duration, were developed for use in other situations and were consistent with Richter's scale.

The following chart compares equivalents for the Mercalli scale to the Richter scale and identifies some of the hazards associated with earthquakes.

Table 3.3.2.10.1 - Modified Mercalli Intensity Scale

Mercalli Intensity	Equivalent Richter Magnitude	Witness Observations
I	1.0 to 2.0	Felt by very few people; barely noticeable.
II	2.0 to 3.0	Felt by a few people, especially on upper floors.
III	3.0 to 4.0	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	4.0	Felt by many indoors. May feel like heavy truck passing by.
V	4.0 to 5.0	Felt by almost everyone, some people awakened. Small objects moved, trees and poles may shake.
VI	5.0 to 6.0	Felt by everyone. Difficult to stand. Some heavy furniture moved, some plaster falls. Chimneys may be slightly damaged.
VII	6.0	Slight to moderate damage in well built ordinary structures. Considerable damage to poorly built structures. Some walls may fall.
VIII	6.0 to 7.0	Little damage in specially built structures. Considerable damage to ordinary buildings, severe damage to poorly built structures. Same walls collapse.
IX	7.0	Considerable damage to specially built structures, buildings shifted off foundations. Ground cracked noticeably. Wholesale destruction. Landslides.
X	7.0 to 8.0	Most masonry and frame structures and their foundations destroyed. Ground badly cracked. Landslides. Wholesale destruction.
XI	8.0	Total damage. Few, if any structures standing. Bridges destroyed. Wide cracks in ground. Waves seen on ground.
XII	8.0 or greater	Total damage. Waves seen on ground. Objects thrown up into the air.

Source: Michigan Technological University

As the chart below illustrates, earthquakes are also categorized ranging from minor to great, depending on magnitude.

Table 3.3.2.10.2 - Earthquake Magnitude Classes	
Class	**Magnitude**
Great	8 or more
Major	7.0 – 7.9
Strong	6.0 – 6.9
Moderate	5.0 – 5.9
Light	4.0 – 4.9
Minor	3.0 – 3.9
Source: Michigan Technological University	

Table 3.3.2.10.3 - Earthquake Magnitude Scale		
Magnitude	**Earthquakes Effects**	**Estimated Number Each Year**
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake. Serious Damage.	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.	One every 50 to 10 years
Source: Michigan Technological University		

The newest scale for measuring the magnitude of an earthquake is the **Moment Magnitude Scale**. The moment magnitude scale is based on the total moment release of the earthquake. Moment is a product of the distance a fault moved and force required to move it. The moment magnitude scale estimates are about the same as Richter magnitudes for small and large earthquakes, but only the moment magnitude scale is capable of measuring M8 (read 'magnitude 8') and greater events accurately.

Causes/Prevention of Earthquakes

Earthquakes occur naturally due to the makeup of the earth and the constant movement that takes place between its tectonic plates. These quakes cannot be predicted ahead of time. However, scientists have mapped the major fault lines in the world and know where the greatest likelihood of an earthquake will occur.

While we cannot prevent natural earthquakes from occurring, we can significantly mitigate their effects by identifying hazards, avoid building structures in hazardous areas, building safer structures, and educating the public on earthquake safety. Earthquakes caused by human activity have been documented in the United States and various locations around the world. Earthquakes resulting from human activity include impoundment of reservoirs, surface and underground mining, withdrawal of fluids and gas from the subsurface, and the injection of fluids into underground formations. Most man-made earthquakes are small and present little hazard, larger and potentially damaging man-made earthquakes have occurred in the past.

Hazards, resulting from man-made earthquakes, can be mitigated by minimizing or eliminating the human activity that causes them.

Effects of Earthquakes

The effects of earthquakes include, but are not limited to, the following:

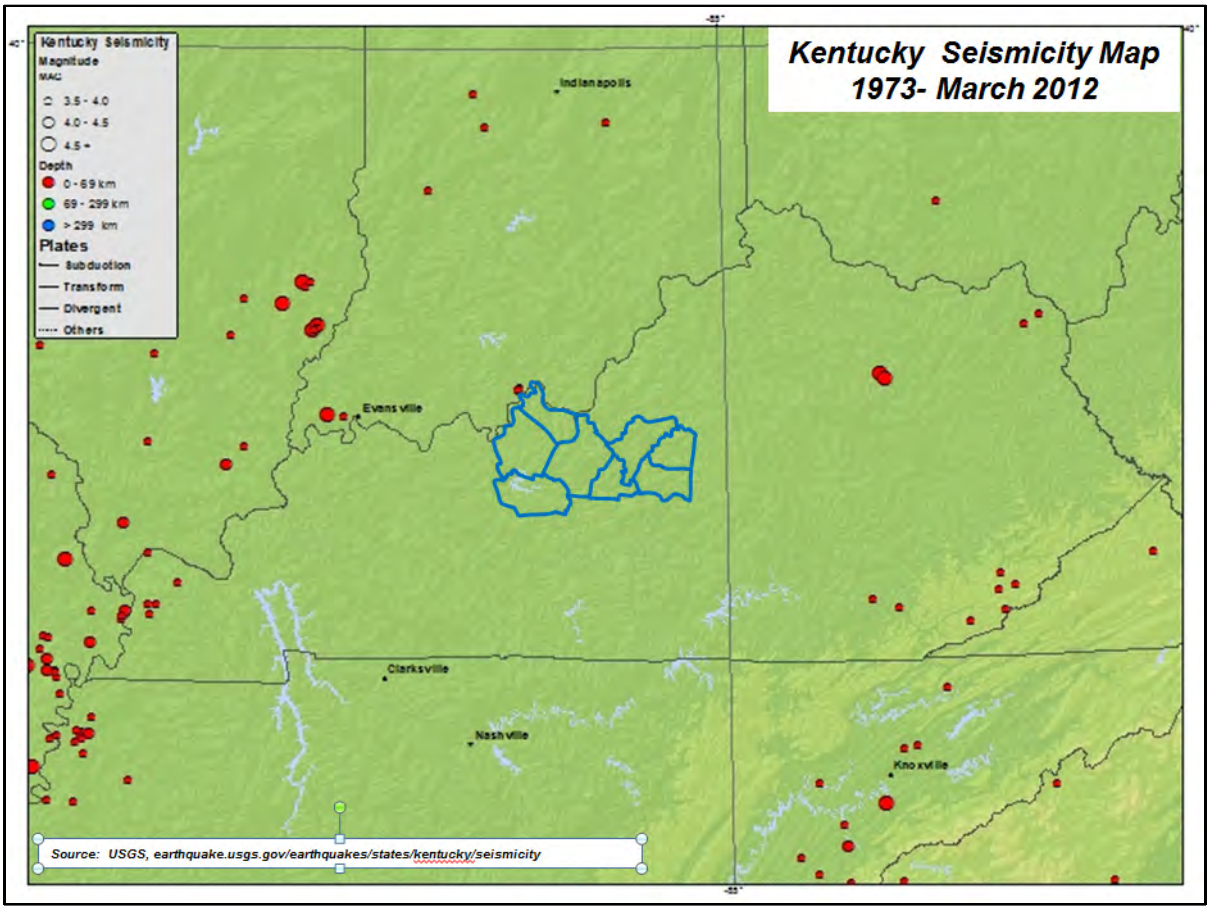
- Shaking and ground rupture are the main effects of an earthquakes. This will result in damage to buildings and other rigid structures. The severity of the local effect will depend on the complex combination of the earthquake magnitude, the distance of the site from the epicenter, and the local geological and geomorphological conditions, which may amplify or reduce wave propagation. The degree of ground shaking is measured by ground acceleration. Ground rupture is a major risk for large engineering structures such as dams, bridges, and nuclear power stations.
- Fires can result from earthquakes when shaking or ground rupture damages electrical power or gas lines. When water mains rupture as the result of an earthquake, it becomes very difficult to stop the spread of fire once it is started.
- Landslide and avalanches can be the effect of an earthquake when the quake results in slope instability.
- Soil liquefaction occurs when shaking, water-saturated granular material (such as sand) temporarily loses its strength and changes from a solid form into a liquid. This can cause structures to sink into the ground and collapse upon themselves.
- Tsunamis are long-wavelength, long-period sea waves produced by the sudden or abrupt movement of large volumes of water. This can occur when an earthquake takes place under a sea or other large body of water. Large waves produced by an earthquake can overrun nearby coastal areas in a matter of minutes. Tsunamis can also travel thousands of kilometers across open-ocean and wreak destruction on far shores hours after the earthquake that generated them.
- Floods may be a secondary effect of earthquakes, if dams are damaged or destroyed. Earthquakes may also cause landslips to dam rivers, which collapse and cause floods.
- Human impacts as a result of an earthquake include injury and loss of life, road and bridge damage, general property damage, and collapse or destabilization of buildings. The aftermath of an earthquake may bring disease, lack of basic necessities and higher insurance premiums.

II. Profile

Kentucky Earthquake History

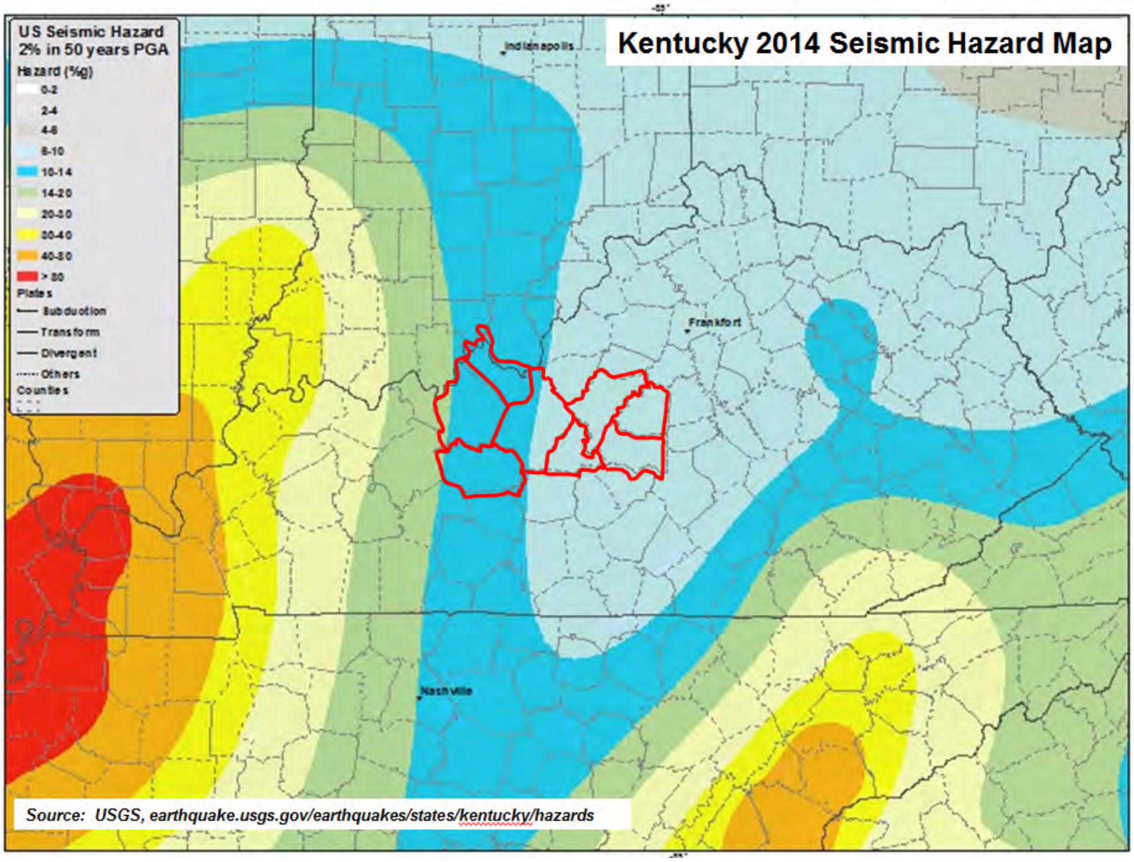
Most earthquake activity in Kentucky has occurred in the western portion of the State near the New Madrid seismic zone. As early as 1779, 1791 and 1792 earthquake activity was recorded in the northern and eastern portions of Kentucky. Between 1811 and 1812, about 2,000 to 3,000 tremors were felt in Kentucky as a result of an initial shock on December 16, 1811.

Over the next 100 years, a number of moderate earthquakes occurred in the State. A shock at Columbus, Kentucky on March 12, 1878 caused a section of bluff on the Mississippi River



to cave in. On October 26, 1915, an earthquake at Mayfield was reported to have shaken pictures from walls. A sharp earthquake, with an epicenter near the mouth of the Ohio River, occurred on December 7, 1915 and shook western Kentucky and adjoining regions. It was an intensity V to VI and was felt over an area of 60,000 square miles.

Other earthquake events were recorded in 1841, 1916, 1915 and 1924. About 75,000 square miles of land in Kentucky, Illinois, Indiana, and Tennessee were affected by an earthquake, on September 2, 1925. The epicenter of the quake was near Henderson and landslides were noted in the damage reports. At Louisville, about 100 miles away, a chimney fell and a house reportedly sank.



Slight damage was reported near Middlesboro Kentucky as the result of an intensity V earthquake on January 1, 1954. The earthquake that occurred on November 9, 1968 was measured as an intensity VII and did considerable masonry damage at the City Building in Henderson, Kentucky which was about 50 miles east, southeast of the epicenter.

III. Analysis

The data below is from the United States Geological Survey and depicts the chance of a major earthquake (5.0 to 9.2) in each of the Lincoln Trail Region's eight counties within a 50km area, within the next 50 years.

Table 3.3.2.10.4 - Earthquake Chance for the Lincoln Trail Region Counties

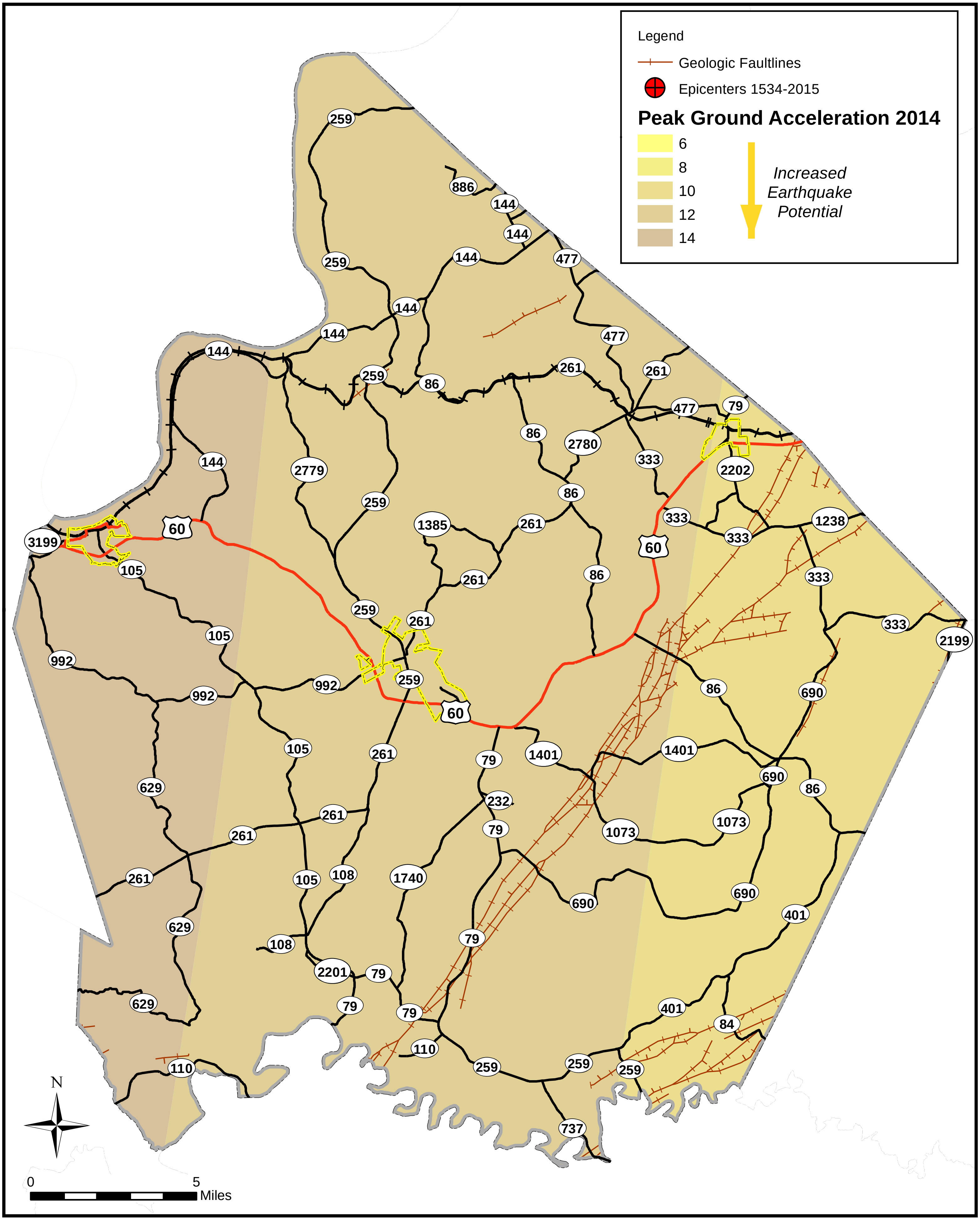
County	Chance of Major Earthquake within Next 50 years
Breckinridge	1.09%
Grayson	0.73%
Hardin	0.50%
LaRue	0.30%
Marion	0.30%

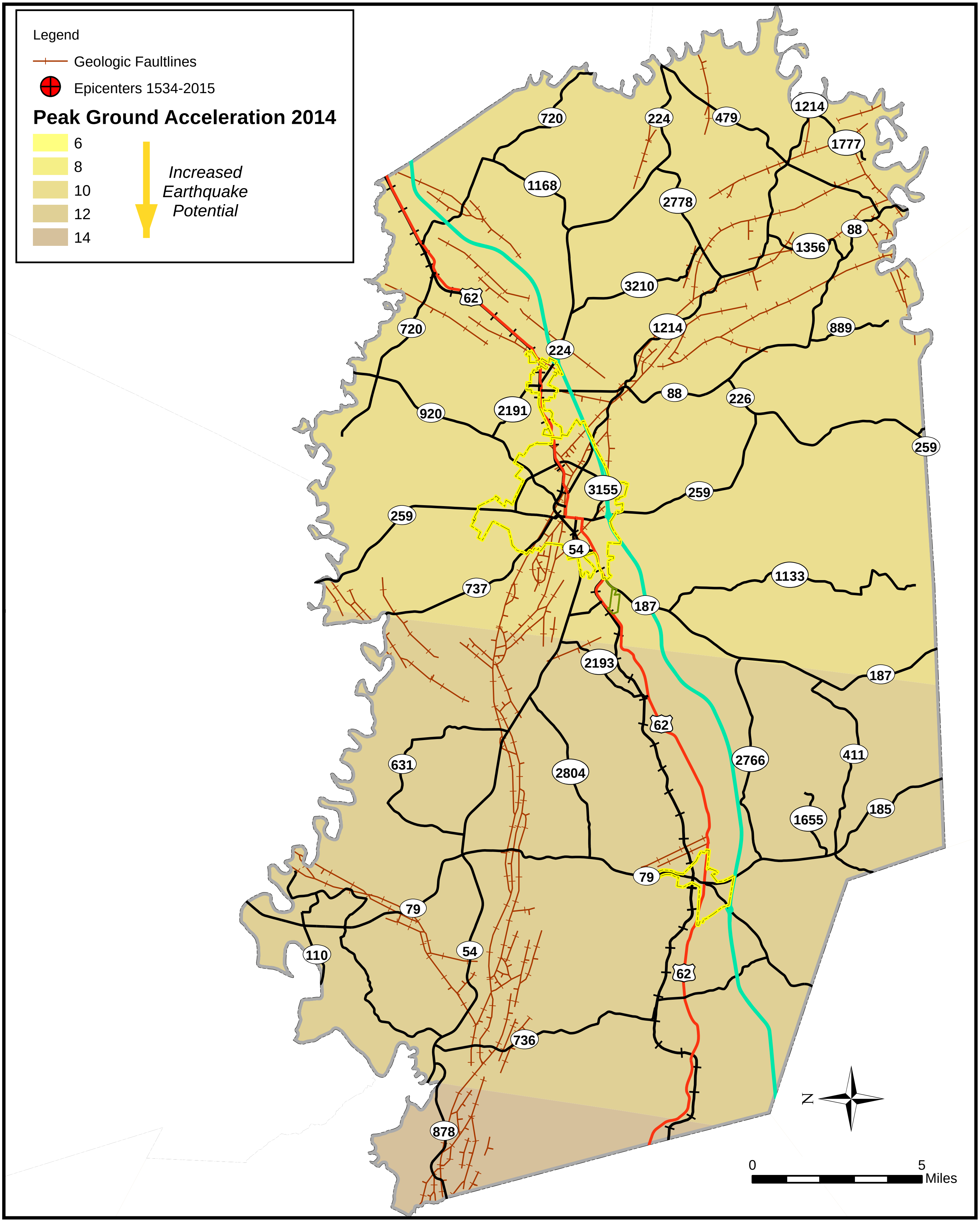
Meade	0.83%
Nelson	0.39%
Washington	0.41%
Source: USGS Database	

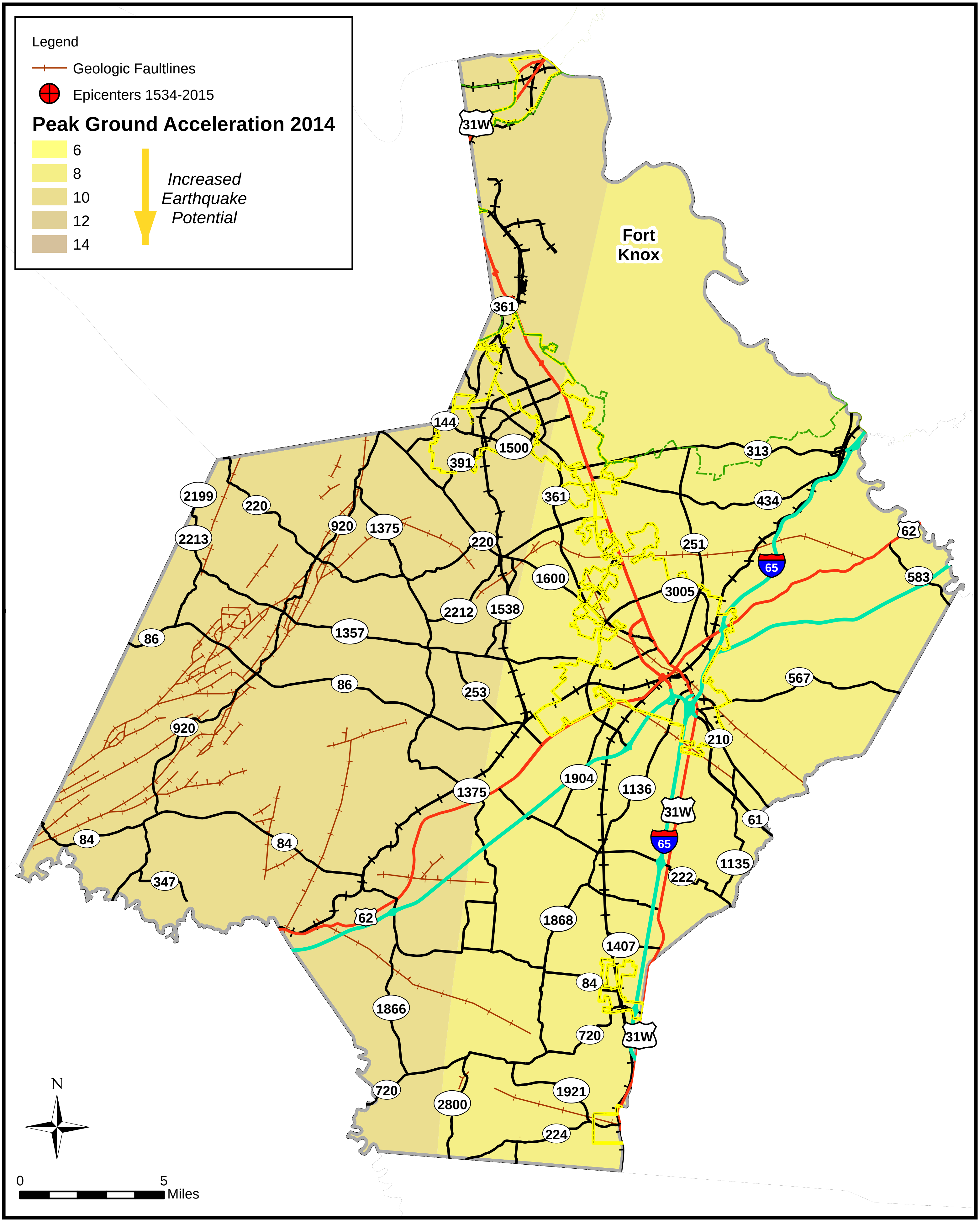
There is little likelihood that any part of the Lincoln Trail Region will experience a disaster as a result of an earthquake. However, the region must plan preparedness measures, and mitigate hazards by educating the public on earthquakes, using wise land use guidelines and by avoiding activities that increase the chance of creating a man-made earthquake.

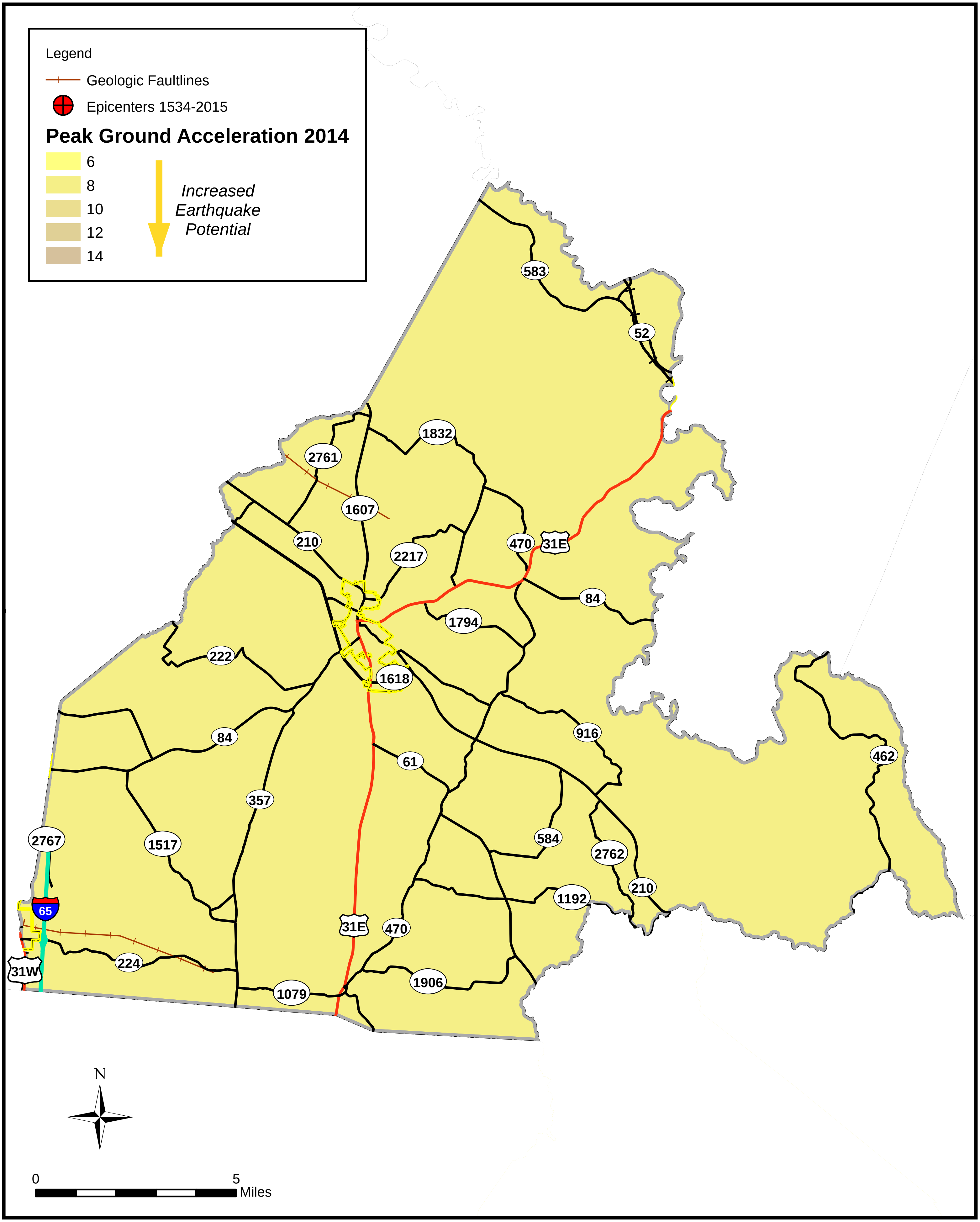
There have been no recorded earthquakes with its epicenter in the region since the 2010 update was published per USGS. Source: earthquake.usgs.gov/earthquakes/search.

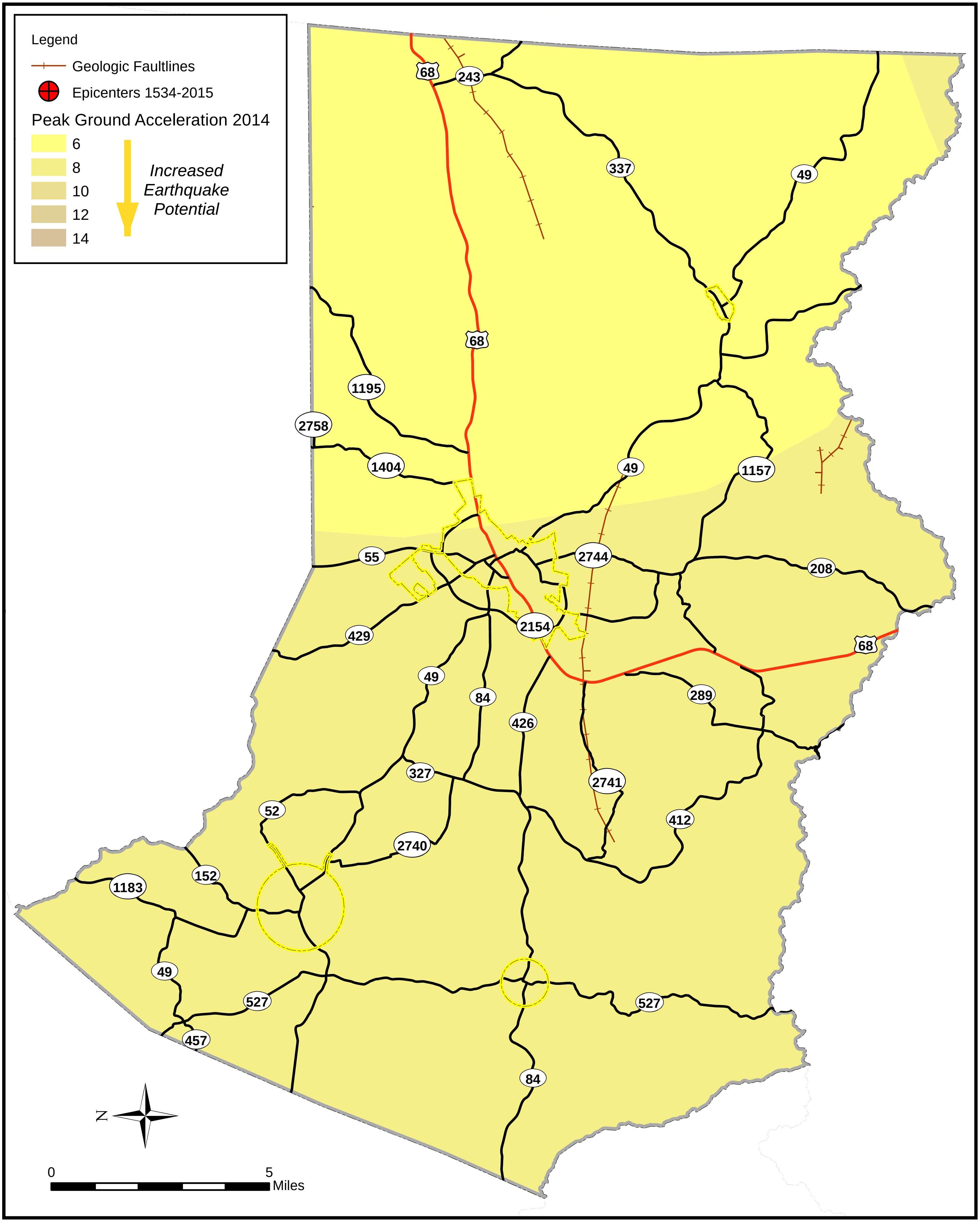
The following maps illustrate the few documented historic earthquakes that have had their epicenter in the Lincoln Trail Region. It also shows the potential for future events by portraying the Peak Ground Acceleration (PGA) values in shades of yellow and alluvial soils that have a higher potential for liquefaction. The PGA in the region decreases from west to east. The faults that exist in the Region are very old and inactive but are portrayed on the map by the black, ticked lines for reference.

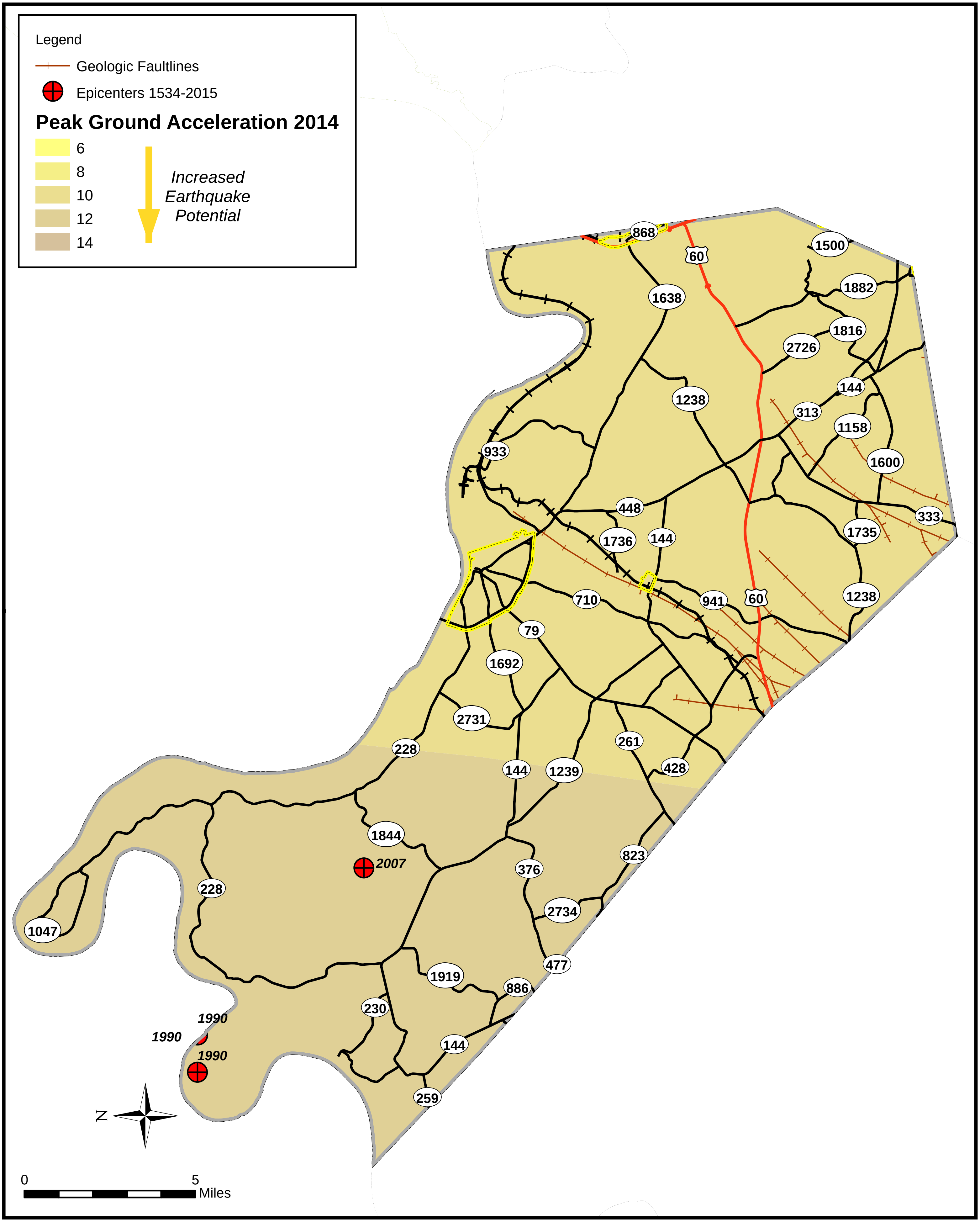

Legend
Geologic Faultlines
Epicenters 1534-2015
Peak Ground Acceleration 2014
6
8
10
12
14
Increased Earthquake Potential
N
0
5
Miles

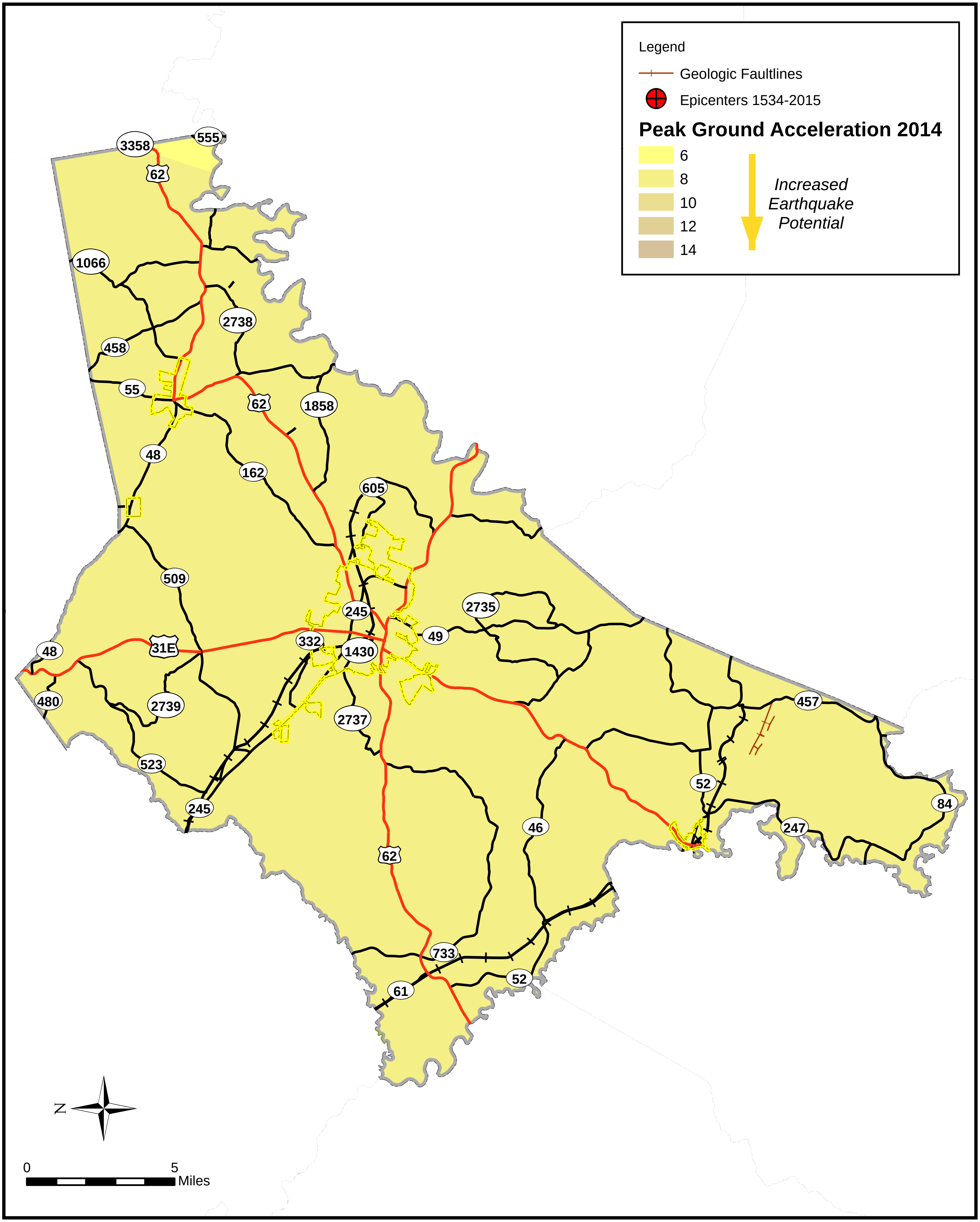

Legend
Geologic Faultlines
Epicenters 1534-2015
Peak Ground Acceleration 2014
6
8
10
12
14
Increased Earthquake Potential
720
224
479
1214
1777
1168
2778
88
1356
3210
62
1214
889
720
224
88
226
920
2191
259
3155
259
259
54
1133
737
187
2193
187
62
631
2804
2766
411
185
1655
79
79
54
110
62
736
878
N
0
5
Miles

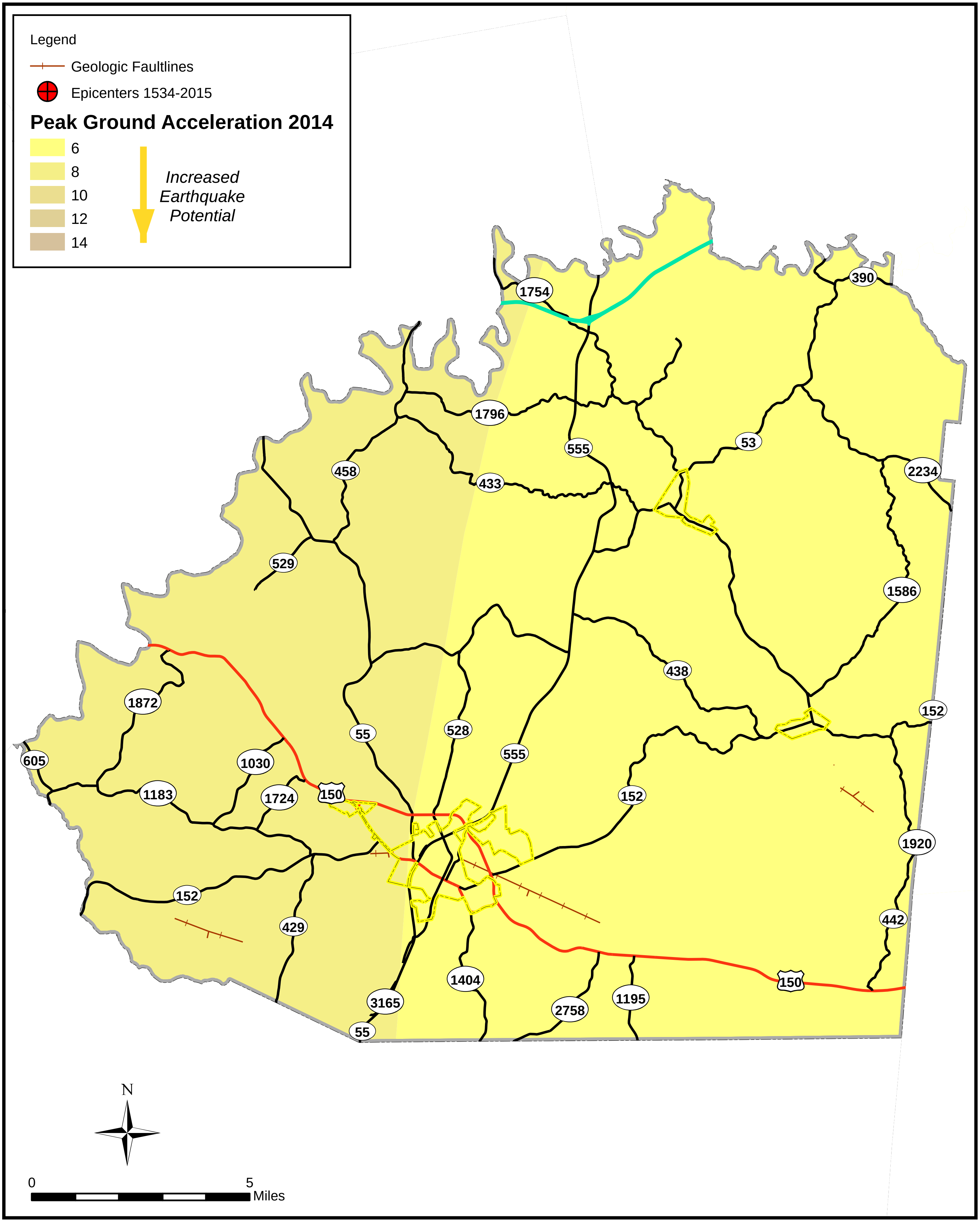

Legend
Geologic Faultlines
Epicenters 1534-2015
Peak Ground Acceleration 2014
6
8
10
12
14
Increased Earthquake Potential
Fort Knox
N
0
5
Miles


Legend
Geologic Faultlines
Epicenters 1534-2015
Peak Ground Acceleration 2014
6
8
10
12
14
Increased Earthquake Potential
583
52
1832
2761
1607
210
2217
470
31E
84
1794
222
1618
916
84
61
462
357
2767
1517
584
2762
210
1192
65
31E
470
224
31W
1906
1079
N
0
5
Miles


Legend
Geologic Faultlines
Epicenters 1534-2015
Peak Ground Acceleration 2014
6
8
10
12
14
Increased Earthquake Potential
68
243
337
49
68
1195
2758
1404
49
1157
55
2744
208
429
2154
68
49
84
289
426
327
2741
52
412
2740
152
1183
49
527
527
457
84
N
0
5
Miles


Legend
Geologic Faultlines
Epicenters 1534-2015
Peak Ground Acceleration 2014
6
8
10
12
14
Increased Earthquake Potential
2007
1990
1990
1990
N
0
5
Miles
868
60
1500
1882
1638
1816
2726
144
1238
313
1158
1600
933
448
333
1736
144
1735
710
941
60
1238
79
1692
2731
228
261
144
1239
428
1844
823
376
228
2734
1047
477
1919
886
230
144
259


Legend
Geologic Faultlines
Epicenters 1534-2015
Peak Ground Acceleration 2014
6
8
10
12
14
Increased Earthquake Potential
3358
555
62
1066
2738
458
55
62
1858
48
162
605
509
245
2735
49
48
31E
332
1430
480
2739
2737
457
523
52
84
245
46
247
62
733
52
61
N
0
5
Miles


Legend
Geologic Faultlines
Epicenters 1534-2015
Peak Ground Acceleration 2014
6
8
10
12
14
Increased Earthquake Potential
1754
390
1796
555
53
2234
458
433
529
1586
438
1872
152
55
528
555
605
1030
1183
1724
150
152
1920
152
429
442
1404
150
3165
2758
1195
55
N
0
5
Miles

3.3.2.11 Hurricane

I. Background

Merriam-Webster defines a hurricane as "an extremely large, powerful and destructive storm with very strong winds that occurs especially in the western part of the Atlantic Ocean." Typically, a hurricane is considered a tropical storm with winds of 74 miles per hour or greater. The storm or cyclone is accompanied by rain, thunder, and lightning.

Hurricanes are unique. Unlike any other storms on earth, hurricanes can be viewed from space as powerful, tightly coiled weather systems. Also called cyclones; the general term for all circulating weather systems, the storms move counterclockwise in the Northern Hemisphere over tropical waters. There are three classes of tropical cyclones:

1. **Tropical Depression** - A tropical depression is an organized system of clouds and thunderstorms with a defined circulation and maximum sustained winds of 38 mph or less.

2. **Tropical Storm** - A tropical storm is an organized system of strong thunderstorms with a defined circulation and maximum sustained wind of 39 to 73 mph.

3. **Hurricane** - A hurricane is an intense tropical storm with a well-defined circulation and maximum sustained winds of 74 mph or greater. In the western Pacific, hurricanes are called typhoons," and similar storms in the Indian Ocean are called cyclones.

The National Atmospheric and Oceanic Agency (NOAA) further defines the attributes of a hurricane. "Hurricanes are products of the tropical oceans and atmosphere. Powered by heat from the sea, they are steered by the easterly trade winds and the temperate westerlies, as well as by their own ferocious energy. Around their core, winds grow with great velocity, generating violent seas. Moving ashore, they sweep the ocean inward while spawning tornadoes and producing torrential rains and floods. Each year on average, ten tropical storms (of which six become hurricanes) develop over the Atlantic Ocean, Caribbean Sea, or Gulf of Mexico. Many of these remain over the ocean. However, about five hurricanes strike the United States coastline every 3 years. Of these five, two will be major hurricanes (category 3 or greater on the Saffir-Simpson Hurricane Scale)."

Saffir-Simpson Hurricane Scale and Associated Damages

The intensity of a hurricane is measured by 5 categories. The following scale provides examples of the impacts and damages associated with each category in the United States.

Table 3.3.2.11.1 - Saffir-Simpson Hurricane Wind Scale		
Category	**Wind Speed (mph)**	**Damage**
1	74 - 95	Very dangerous winds will produce some damage
2	96 - 110	Extremely dangerous winds will cause extensive damage
3	111 - 129	Devastating damage will occur
4	130 - 156	Catastrophic damage will occur
5	> 156	Catastrophic damage will occur
Source: NOAA - National Hurricane Center		

II. Analysis

Hurricanes in Kentucky

Although catastrophic damage can result from hurricanes, the geographic location of the Lincoln Trail Region and Kentucky precludes the State from experiencing this level of damage.

However, in September of 2008, Hurricane Ike caused widespread damage across eleven states including Arkansas, Illinois, Indiana, Kentucky, Michigan, Missouri, New York, Ohio, Pennsylvania, Tennessee, and West Virginia. Although the storm made landfall in Texas and Louisiana, the effects were even felt in parts of Ontario due to the incredible strength and size of Ike.

In Kentucky, the Louisville area declared a state of emergency due to major damage, and the Louisville International Airport was temporarily closed. A utility spokesperson indicated that the area suffered its worst power outage in 30 years as a result of Ike. Near Covington, the Cincinnati – Northern Kentucky International Airport was also temporarily closed and the control tower evacuated. An apartment building in Covington also lost its entire roof. The Kentucky Governor declared a statewide state of emergency and many schools were closed or delayed in the first 3 days following the storm. Statewide, over 600,000 customers lost electricity as a result of the winds, and a boy was struck and killed by a blown tree limb in Simpsonville.

3.3.2.12 Tsunami

I. Background

The Nation Oceanic and Atmospheric Administration defines a tsunami as "a series of ocean waves generated by sudden displacements in the sea floor, landslides, or volcanic activity. In the deep ocean, the tsunami wave may come gently ashore or may increase in height to become a fast moving wall of turbulent water several meters high."

While a tsunami cannot be mitigated, the impact of a tsunami can be mitigated through public education, community preparedness, timely warnings, and effective response efforts.

Tsunami waves do not resemble normal sea waves. Instead of appearing as a normal breaking wave, a tsunami may initially resemble a rapidly rising tide. Tsunamis usually consist of a series of waves with periods ranging from minutes to hours, arriving in a "wave train." The height of waves can be tens of meters in large events. The impact of tsunamis is limited to coastal areas, but their destructive force can be disastrous and may affect entire ocean basins.

II. Analysis

Due to the geographic location of Kentucky and the eight-county Lincoln Trail Region, tsunamis do not pose a threat to Kentucky jurisdictions.

3.3.3 Assessing Vulnerability: Identifying Assets

Summary: The geographic location of the Lincoln Trail Region, lends itself to some risk from most natural hazards. Therefore no community facility or location should be considered “safe” from any type of natural hazard event that could occur in the region. The following section summarizes the physical assets in the Lincoln Trail Region. This portion of the plan identifies information such as critical facilities, transportation infrastructure, and population patterns. In part, the definition of an “asset” is its value. When possible, an effort was made to determine a dollar value for each asset. Because parcel data originates from numerous, diverse sources, this information is difficult to quantify and summarize. The cumulative product of this research, is a “snapshot” of the vulnerabilities to the natural hazard events, that exist in the Lincoln Trail Region. In conjunction with the economic value of regional assets, risk has been evaluated as part of the section 3.3.4; “Estimating Potential Losses.”

Note: for the purpose of compilation of data the City of Upton while lying in both Hardin and LaRue Counties is considered to be in Hardin County.

Various Critical Facilities in Lincoln Trail Region. ***Source: LTADD Archive.***

Table 3.3.3.1 - Population Characteristics

Name	Population	Total Households	Median Household Income	Total Families	Median Family Income	Per Capita Income	Individuals Below Poverty Level	Percent Below Poverty Level
BRECKINRIDGE	20,040	7,213	$38,907	5,178	$46,870	$18,101	3,928	19.6
Cloverport	1,285	509	$24,637	327	$32,039	$15,014	438	34.1
Hardinsburg	2,477	929	$30,673	548	$38,056	$16,534	473	19.1
Irvington	1,220	482	$27,361	312	$31,667	$22,421	338	27.7
GRAYSON	25,997	9,897	$32,339	6,803	$41,216	$19,115	6,057	23.3
Caneyville	564	509	$25,417	140	$39,375	$18,084	129	22.9
Clarkson	1,105	929	$24,464	267	$35,938	$12,651	349	31.6
Leitchfield	6,750	482	$26,325	1,685	$29,832	$15,386	2,059	30.5
HARDIN	108,191	39,401	$48,687	28,277	$58,565	$24,147	17,094	15.8
Elizabethtown	28,940	11,394	$42,904	7200	$56,650	$24,834	5,354	18.5
Radcliff	22,552	8,856	$45,550	5993	$52,968	$22,777	4,533	20.1
Sonora	552	197	$42,386	141	$56,250	$28,711	52	9.5
Upton	1,131	314	$32,593	231	$34,076	$12,348	543	48
Vine Grove	5,043	2,036	$54,125	1430	$62,391	$26,193	545	10.8
West Point	914	380	$28,547	248	$34,583	$16,120	265	29
LARUE	14,064	5,221	$39,753	3,866	$50,559	$19,611	2,377	16.9
Hodgenville	3,223	1,283	$29,464	857	$33,306	$16,836	774	24
MARION	20,045	7,368	$38,719	4,755	$47,360	$28,865	3,408	17
Bradfordsville	424	171	$27,083	112	$33,810	$12,610	63	14.9
Lebanon	5,587	2,464	$21,983	1288	$32,197	$18,595	1,631	29.2
Loretto	668	280	$29,231	173	$41,458	$15,868	197	29.5
Raywick	282	122	$43,636	98	$44,318	$20,876	45	16
MEADE	29,210	10,342	$46,756	7,872	$50,574	$20,898	4,936	16.9
Brandenburg	2,759	1,007	$36,020	671	$43,935	$18,114	775	28.1
Ekron	129	36	$31,667	28	$30,833	$14,005	46	35.7
Muldraugh	1,100	448	$28,676	228	$29,412	$13,914	399	36.3
NELSON	44,540	16,571	$43,833	12,171	$54,708	$23,545	8,106	18.2
Bardstown	12,568	4,949	$30,354	3219	$34,803	$21,665	3,821	30.4
Bloomfield	1,124	439	$37,344	317	$43,036	$20,888	155	13.8
Fairfield	128	48	$52,500	36	$53,750	$24,514	4	3.1
New Haven	849	377	$27,604	250	$38,438	$19,424	213	25.1
WASHINGTON	11,875	4,480	$40,845	3,322	$48,578	$19,837	1,686	14.2
Mackville	249	105	$55,288	80	$62,500	$23,005	44	17.7
Springfield	2,553	1,061	$34,542	647	$41,642	$18,896	585	22.9
Willisburg	329	106	$41,875	77	$48,482	$16,235	64	19.6
LTADD	273,962	100,493		171,091			47,593	17.4
Source US Census, American Community Survey - 2013, 5 Year.								

Residential: Housing is an integral component of the social and physical environment of any community. The provision of adequate housing should be regarded as an element of the overall planning process. Although a challenging goal, the provision of sound and affordable housing for all citizens of the region can be aided by comprehensive planning programs as well as, sensible hazard mitigation strategies. The table below details selected housing characteristics across the region. As illustrated, the median value of homes ranged from the mid $50,000s to the upper $90,000s, in 2013. The exception is in the Cities of Cloverport and Ekron, where the median home value was below $51,000, in 2013. The counties within the Lincoln Trail region have continued to realize an increase in the median housing value since 1990. The increase over the last eight-year period was not as significant as in the period between 1990 and 2000. However, compared to the state housing increase, all eight counties surpass the state's 37% increase.

Table 3.3.3.2 - Housing Characteristics

Name	Population	Total Housing Units	Occupied Housing Units	% Mobile Homes	Vacant Housing Units	Owner Occupied	Renter Occupied	Median Housing Value [1]			
								1990	2000	2008	2013
BRECKINRIDGE	20,040	10,592	7,213	28	3,379	5,769	1,444	$37,700	$64,600	$93,000	$82,700
Cloverport	1,285	566	509	19	57	339	170	$24,400	$39,000	$56,000	$44,100
Hardinsburg	2,477	1,058	929	8	129	554	375	$45,800	$72,700	$104,800	$82,500
Irvington	1,220	596	482	7	114	318	164	$37,500	$58,100	$84,100	$71,800
GRAYSON	25,997	13,506	9,897	23	3,609	7,158	2,739	$35,700	$65,600	$95,800	$87,700
Caneyville	564	336	258	14	78	157	101	$29,800	$56,900	$76,800	$65,900
Clarkson	1,105	498	444	26	54	212	232	$26,000	$50,600	$72,100	$71,700
Leitchfield	6,750	2,956	2,674	6	282	1,289	1,385	$40,100	$66,900	$95,200	$83,000
HARDIN	108,191	44,211	39,401	11	4,810	24,780	14,621	$58,300	$88,300	$143,500	$140,600
Elizabethtown	28,940	12,757	11,394	3	1,363	6,020	5,374	$59,500	$98,300	$162,800	$155,400
Radcliff	22,552	10,222	8,856	13	1,366	4,063	4,793	$65,000	$83,500	$134,400	$121,400
Sonora	552	207	197	2	10	171	26	$30,600	$62,500	$101,500	$106,500
Upton	1,131	398	314	13	84	226	88	$32,100	$56,900	$97,100	$70,500
Vine Grove	5,043	2,230	2,036	6	194	1,569	467	$52,200	$81,100	$136,000	$121,200
West Point	914	441	380	14	61	202	178	$25,600	$54,500	$79,900	$81,100
LARUE	14,064	6,198	5,221	14	977	3,984	1,237	$39,500	$72,100	$111,000	$101,000
Hodgenville	3,223	1,457	1,283	3	174	567	716	$39,300	$65,900	$93,000	$79,900
MARION	20,045	8,164	7,368	13	796	5,664	1,704	$39,500	$70,300	$105,000	$100,200
Bradfordsville	424	193	171	46	22	103	68	$16,100	$27,500	$37,500	$54,200
Lebanon	5,587	2,720	2,464	6	256	1,427	1,037	$39,600	$64,100	$93,900	$95,400
Loretto	668	315	280	14	35	230	50	$33,600	$65,400	$97,700	$93,900
Raywick	282	124	122	13	2	113	9	$24,200	$68,500	$109,000	$111,800
MEADE	29,210	11,891	10,342	18	1,549	7,426	2,916	$49,700	$85,500	$114,000	$120,500
Brandenburg	2,759	1,165	1,007	5	158	511	496	$47,900	$75,400	$108,000	$106,800
Ekron	129	39	36	28	3	31	5	$28,300	$50,300	$52,000	$50,600
Muldraugh	1,100	513	448	18	65	130	318	$37,000	$54,900	$58,000	$70,000
NELSON	44,540	18,189	16,571	9	1,618	12,491	4,080	$45,800	$87,100	$129,700	$124,500
Bardstown	12,568	5,651	4,949	3	702	2,695	2,254	$46,900	$76,000	$107,600	$102,500
Bloomfield	1,124	509	439	10	70	328	111	$37,700	$72,900	$108,000	$95,500
Fairfield	128	52	48	8	4	41	7	$40,400	$49,121	$52,000	$82,500
New Haven	849	467	377	2	90	231	146	$36,800	$68,600	$105,300	$94,300
WASHINGTON	11,875	5,034	4,480	16	554	3,713	767	$40,700	$72,000	$112,000	$107,300
Mackville	249	109	105	0	4	85	20	$32,200	$56,700	$85,800	$88,300
Springfield	2,553	1,247	1,061	1	186	692	369	$40,900	$74,900	$114,200	$86,300
Willisburg	329	123	106	8	17	72	34	$38,800	$66,300	$73,000	$96,700
LTADD	273,962	117,785	100,493	15	17,292	70,985	29,508				$121,802

Source US Census, American Community Survey - 2013, 5 Year.

1 - This includes values of owner occupied housing only. It does not include Mobile Homes or homes on lots over 10 acres.

The data for 1990 and 2000 are Decennial Census, 2008 and 2013 are US Census Estimates.

Commercial: Currently, there is no inventory of commercial structures in the Lincoln Trail Region or for any of its eight counties or twenty-seven cities.

Industrial: The 2015 Kentucky Directory of Manufacturers, from the Economic Development Cabinet, reports that there are 172 industries in the Lincoln Trail Region. An estimated 18,960 people are employed by these industries. Due to rapid industrial growth, the dynamic nature of employment and the absence of individual dollar values, no further analysis for potential loss can be completed at this time. However, the number of companies and employees can't be disregarded when considering the economic impact of any hazard event.

Table 3.3.3.3 - Lincoln Trail Region Industries

Jurisdiction	Number of Industries	Number of Employees
Breckinridge County	6	260
Garfield	1	5
Hardinsburg	5	255
Grayson County	31	3,270
Clarkson	2	142
Leitchfield	28	3,092
Millwood	1	36
Hardin County	46	5,871
Cecilia	3	147
Elizabethtown	38	5,466
Radcliff	4	155
Sonora	1	103
LaRue County	8	426
Hodgenville	7	424
Magnolia	1	2
Marion County	26	3,812
Lebanon	24	3,681
Loretto	2	131
Meade County	3	88
Brandenburg	3	88
Nelson County	42	4,318
Bardstown	32	4,104
Boston	2	79
Cox's Creek	5	86
New Haven	2	40
New Hope	1	10
Washington County	10	915
Springfield	10	915
Lincoln Trail Region	172	18,960
Source: Report: 2015 Kentucky Directory of Manufacturers		

Agricultural: Agricultural lands are particularly susceptible to damage from drought, flooding, hail, and storms. The frequency and magnitude of events during a growing season is a major determinant of the impact of any natural hazard on crops. The natural hazards listed above, as well as lightning, could also affect livestock. The total estimated value of livestock, crops and agricultural related lands at risk in the region, is detailed in the following table.

Table 3.3.3.4 - Agricultural Assets

Location	Number of Farms	Farmland	Cropland	Cropland in Floodplain[1]	Harvested Cropland	Estimated Market Value Cropland and Structures Per Acre	Estimated Market Value Crop & Livestock Production
		Acres				Dollars	
BRECKINRIDGE	1,304	259,774	116,614	1,614	94,705	$2,399	$79,537,000
GRAYSON	1,407	200,895	87,091	2,260	65,408	$2,270	$45,663,000
HARDIN	1,357	202,970	114,429	4,145	100,480	$3,505	$57,949,000
LARUE	720	111,975	66,947	3,600	60,759	$3,422	$41,877,000
MARION	1,016	166,417	70,227	6,101	61,911	$2,693	$56,491,000
MEADE	754	119,495	63,718	2,121	57,249	$3,244	$36,571,000
NELSON	1,326	187,755	97,168	9,325	87,325	$3,363	$64,439,000
WASHINGTON	1,011	140,948	55,949	2,368	48,388	$2,560	$33,770,000
LTADD	8,895	1,390,229	672,143	31,534	576,225	$23,456	$416,297,000

Source: USDA 2012 Ag Census

1 - Comparison using USGS National Gap Analysis Program Landcover data, version 2, May 2011 and FEMA DFIRM Flood Elevation data 2007-2012.

This comparision reflects more the current landuse for agriculture versus the potential landuse as with previous plans.

In addition unlike past plan data it focuses on land used for crops and excludes pasture lands.

Agriculture is an important economic factor in Lincoln Trail Region. ***Source: LTADD Archive.***

Transportation: Each County has a fully equipped road department to maintain county roads and bridges. The Kentucky Transportation Cabinet is responsible for the remaining state roads.

Table 3.3.3.5 - Transportation Assets

Location	Road Miles[1]	Bridges[2]	Airports[3]	Rail Miles[4]
BRECKINRIDGE	873	90	1	30
Cloverport	11			
Hardinsburg	19		1	
Irvington	11			
GRAYSON	934	117	2	34
Caneyville	4			
Clarkson	6			
Leitchfield	48			
HARDIN	1,152	221	2	70
Elizabethtown	169		1	
Radcliff	102			
Sonora	5			
Upton	7			
Vine Grove	34			
West Point	9			
LARUE	450	57		3
Hodgenville	14			
MARION	475	142		0
Bradfordsville	2			
Lebanon	32			
Loretto	2			
Raywick	1			
MEADE	554	22		24
Brandenburg	13			
Ekron	2			
Muldraugh	7			
NELSON	699	145	1	30
Bardstown	78			
Bloomfield	7			
Fairfield	1			
New Haven	4			
WASHINGTON	449	102	1	0
Mackville	1			
Springfield	16			
Willisburg	1			
LTADD	5,586	896	7	191

1. County Mileage includes Federal, state and County roads, KYTC July 2015.
2. Bridges are on Federal and State roads only, Bureau of Transportatin Statistics, 2015
3. Paved Runways with some services, Bureau of Transportatin Statistics, 2015
4. Main Lines only, Bureau of Transportatin Statistics, 2015

Transportation Facilities in Lincoln Trail Region. ***Source: LTADD Archive.***

Utilities: The Lincoln Trail Region is served by numerous utilities, provided by various sources. The following tables detail the wastewater and water treatment systems currently operating in the Lincoln Trail Region. Due to future growth projections, there are several projects currently being considered by the regional water management council that pertain to line expansions and/or system upgrades.

Table 3.3.3.6 - Wastewater Utility Assets

County	Owner	Treatment Plant	Max Hydraulic Capacity (MGD)	Ave Daily Flow (MG)	Population Served
Breckinridge	Cloverport	Cloverport Stp	0.20	0.10	1,071
	Hardinsburg	Hardinsburg Stp	0.73	0.56	2,169
	Irvington	Irvington Wwtp	0.15	0.05	1,181
Grayson	Caneyville	Caneyville Wwtp	0.12	0.05	609
	Clarkson	Clarkson Wwtp	0.04	0.03	899
	Leitchfield	Leitchfield Wwtp	2.00	1.22	5,666
Hardin	Airview Estates Subdivision	Airview Estates Wwtp	Design - 0.055	na	na
	Elizabethtown	Valley Creek Wwtp	29.00	6.09	28,475
	Hardin County Water Dist #1	Radcliff	4.00	1.98	23,296
	Hardin County Water Dist #1	Ft Knox	6.00	3.30	*included in above*
	Vine Grove	Vine Grove Wwtp	0.71	0.35	4,226
	West Point	West Point Wwtp	0.10	0.78	839
Larue	Hodgenville	Hodgenville Wwtp	0.78	0.56	3,558
Marion	Bradfordsville	Bradfordsville Wwtp	0.04	0.01	305
	Lebanon	Lebanon Wwtp	3.00	1.20	6,011
	Loretto	*Collection System Only*	with Lebanon	with Lebanon	803
Meade	Brandenburg	Brandenburg Wwtp	0.91	0.25	2,782
	Doe Valley Association, Inc.	Doe Valley Wwtp	Design - 0.15	na	1,878
	Muldraugh	*Collection System Only*	with Ft Knox	with Ft Knox	936
Nelson	Bardstown	Bardstown	3.00	2.50	17,207
	Bardstown	Jerry L. Riley	4.00	0.75	0
	Bloomfield	*Collection System Only*	with Bardstown	with Bardstown	978
	New Haven	New Haven Wwtp	0.16	0.10	935
Washington	Springfield Water & Sewer Commission	Springfield Stp	0.88	0.47	2,705

Source: Kentucky Infrastructure Authority, Water Resources Information System, Sept. 2015

Table 3.3.3.7 - Water Utility Assets

County	Owner	Water Treatment Plant Name	Design Capacity (MGD)	Total Population	Useage (Million Gallons)
Breckinridge	Hardinsburg Water	Hardinsburg Water	2.00	14,015	455.62
Grayson	Leitchfield Utilities Commission	Leitchfield	2.88	20,656	588.50
Grayson	Grayson County Water District	Grayson County	2.30	15,787	371.12
Hardin	Hardin County Water District #1	Pirtle Springs	2.70	124,996	964.44
Hardin	Hardin County Water District #1 Fort Knox System	Muldraugh Plant	7.00	38,241	677.09
		Fort Knox/Central	3.50		
Hardin	Hardin County Water District #2	City Springs	3.00	75,922	1,579.22
		Freeman Lake	3.00		
		White Mills	8.10		
Hardin	West Point Water Dept	West Point	0.35	898	21.95
LaRue	Hodgenville Water Works	Hodgenville	0.50	11,161	192.76
Marion	Lebanon Water Works County Inc	Lebanon	5.20	20,820	786.28
Meade	Brandenburg Water Works	Barney Johnson	1.00	19,254	246.76
Nelson	Bardstown Municipal Water Dept	Sympson Lake	6.00	51,304	1,348.02
Washington	Springfield Water Works	Springfield	3.00	10,413	394.29
Source: Kentucky Infrastructure Authority, Water Resources Information System, Sept. 2015					


Critical Facilities are exposed to many hazards in the Lincoln Trail Region. ***Source: LTADD Archive.***

Critical Facilities: These facilities may be public or private: they are critical components of effective loss mitigation and recovery efforts during and after any hazard event. When planning for and implementing hazard mitigation strategies, communities should give top priority to their critical facilities. For the purposes of this document the Lincoln Trail Region has identified their critical facilities to be those listed. The list identifies the location of each facility, not a specific government authority. The number of critical facilities remained constant with the only changes, as noted below, in the categories of government buildings, water storage tanks and wells.

Table 3.3.3.8 Critical Facilities

Jurisdiction	Communications – Pubic Radio Transmitters (1)	Fire Stations(2)	Police Stations(2)	Government Buildings(2)	Hospitals(2)	Waste Water Treatment Plants(3)	Water Treatment Plants(3)	Pumping Stations(3)	Storage Tanks(3)	Wells(3)	Schools(4)
Breckinridge	0	6	0	1	0	0	1	6	7	3	4
Cloverport	0	1	1	1	0	1	0	0	2	0	3
Hardinsburg	2	1	2	5	1	1	0	0	2	0	2
Irvington	0	1	1	1	0	1	0	0	1	0	1
Grayson	0	4	0	0	0	0	2	8	10	0	1
Caneyville	0	1	1	1	0	1	0	0	0	0	1
Clarkson	0	1	1	1	0	1	0	0	1	0	1
Leitchfield	2	2	2	5	1	1	0	2	4	0	5
Hardin	1	8	0	0	1	2	3	8	11	0	10
Elizabethtown	3	5	2	7	1	0	2	2	10	0	12
Radcliff	2	2	1	3	0	1	0	3	2	0	9
Sonora	0	1	0	1	0	0	0	0	0	0	1
Upton	0	1	0	1	0	0	0	0	0	0	1
Vine Grove	2	1	1	1	0	1	0	1	3	0	5
West Point	0	1	1	1	0	1	1	0	1	2	1
Larue	1	2	0	0	0	0	0	6	8	0	2
Hodgenville	0	2	2	4	0	1	1	1	3	0	4
Marion	0	1	0	0	0	0	1	3	8	0	1
Bradfordsville	0	1	0	2	0	1	0	0	1	0	0
Lebanon	2	2	2	8	1	1	0	1	1	0	7
Loretto	0	1	0	1	0	0	0	0	1	0	1
Raywick	0	1	0	1	0	0	0	0	0	0	0
Meade	0	5	0	0	0	1	1	7	7	0	3
Brandenburg	2	1	2	5	0	0	1	0	1	3	5
Ekron	0	1	0	1	0	0	0	0	0	0	1
Muldraugh	0	1	1	1	0	0	0	0	0	0	0
Nelson	0	3	0	0	0	1	1	9	17	0	3
Bardstown	1	2	2	8	1	1	0	3	4	0	12
Bloomfield	0	1	1	1	0	0	0	1	1	0	2
Fairfield	0	0	0	1	0	0	0	0	0	0	0
New Haven	0	1	1	1	0	1	0	0	0	0	2
Washington	0	0	0	0	0	0	0	4	5	0	1
Mackville	0	1	0	0	0	0	0	0	0	0	1
Springfield	0	2	2	5	0	1	1	1	4	0	4
Willisburg	0	1	0	1	0	0	0	0	0	0	2
Total in Region	18	65	26	69	6	19	15	66	115	8	108

Source: 1 - FCC

2 - LTADD Structure Inventory

3 - Kentucky Infrastructure Authority, Water Resources Information System, Sept. 2015

4 - KY Dept. of Education, Sept 2015

Special Critical Facilities: Dams represent a unique critical facility situation where the loss of the facility itself due to any disaster can lead to an additional disaster in the form of flooding.

Within the Lincoln Trail, eight-county region, there are 112 dams. Of the 112 dams in the region, 16 are owned by local municipalities, 67 are privately owned, 4 are federal, 3 belong to the Dept. of Transportation, 19 are owned by conservation districts, 2 by the Department of Parks and 1 by Fish and Wildlife.

The following chart lists all of the 112 dams in the Lincoln Trail Region by county, and shows each dam's current hazard class. The information below, was provided by the Department for Environmental Protection of the Kentucky Energy and Environment Cabinet. The various dams listed are portrayed on the maps in section 3.3.2.1 Flooding.

Table 3.3.3.9.-. Lincoln Trail Region Dams

Breckinridge County Dams				
Name of Dam	**County**	**Hazard Class**	**Owner Type**	**TOPO**
Hardinsburg Dam	Breckinridge	Low	Municipality	Hardinsburg
Hardinsburg FFA Camp Lake Dam	Breckinridge	Moderate	Dept. of Transportation	Hardinsburg
Dry fork Lake Dam	Breckinridge	Low	Private	Glen Dean
N. Fork Rough River FRS #2	Breckinridge	Low	Conservation District	Custer
N. Fork Rough River FRS #1	Breckinridge	Low	Conservation District	Kingswood
Honey Locust Dam	Breckinridge	Low	Private	Cloverport
John Smith Dam	Breckinridge	Low	Private	Mattingly
GE Bennette Dam	Breckinridge	Low	Private	Mattingly
Norfleet Dam	Breckinridge	Low	Private	Glen Dean
Blancehtte Dam	Breckinridge	High	Private	Hardinsburg
Breckinridge	Breckinridge	Moderate	Private	Hardinsburg
Walter Stennett Lake Dam	Breckinridge	Low	Private	Kingswood
Lee Thomas Lake Dam	Breckinridge	Moderate	Private	Cloverport
Mattingly Dam	Breckinridge	Low	Private	Garfield
Pape Dam	Breckinridge	Low	Private	Fordsville

Grayson County Dams				
Name of Dam	**County**	**Hazard Class**	**Owner Type**	**TOPO**

Caney Creek FRS #1	Grayson	Moderate	Conservation District	Caneyville
Short Creek FRS #7	Grayson	Low	Conservation District	Falls of Rough
Leitchfield Reservoir Dam	Grayson	Moderate	Municipality	Leitchfield
Pine Knob Dam	Grayson	Low	Private	Spring Lick
Caney Creek FRS #13	Grayson	Moderate	Conservation District	Caneyville
Big Reedy Creek FRS #8	Grayson	Low	Conservation District	Ready
Caney Creek FRS #6	Grayson	High	Conservation District	Caneyville
Caney Creek FRS #9	Grayson	Moderate	Conservation District	Spring Lick
Caney Creek MPS #2	Grayson	Moderate	Conservation District	Caneyville
Short Creek FRS #8A	Grayson	Low	Conservation District	Spring Lick
Caney Creek FRS #5	Grayson	Moderate	Conservation District	Caneyville
Caney Creek FRS #12	Grayson	Moderate	Conservation District	Spring Lick
Wolford Lake Dam	Grayson	Low	Private	Millerstown
Caney Creek FRS #10	Grayson	Low	Conservation District	Spring Lick
Caney Creek FRS #3	Grayson	Low	Conservation District	Caneyville
Caney Creek FRS #7	Grayson	Moderate	Conservation District	Spring Lick
Ray Carter Farm Lake Dam	Grayson	Low	Private	Ready
Hickory Hollow Lake Dam	Grayson	Low	Private	Welch's Creek

Hardin County Dams				
Name of Dam	**County**	**Hazard Class**	**Owner Type**	**TOPO**
Valley Creek MPS #4	Hardin	High	Conservation District	Elizabethtown
Valley Creek FRS #8	Hardin	High	Conservation District	Elizabethtown
Hardin Co. Sportsman	Hardin	Moderate	Private	Elizabethtown

Lake Dam				
Sanders Spring Branch FRS #5	Hardin	Low	Federal	Vine Grove
Valley Creek FRS #12	Hardin	High	Conservation District	Elizabethtown
Valley Creek FRS #3	Hardin	High	Conservation District	Elizabethtown
Sanders Spring Reservoir	Hardin	Low	Municipality	Vine Grove
CL Ratcliff Dam	Hardin	Low	Private	Constantine
Paradise Dam	Hardin	Low	Private	Lebanon Junction
Tom Murphy Dam	Hardin	Low	Private	Colesburg
Douglas Dam (Upper) #1	Hardin	Low	Federal	Colesburg
Douglas Dam (Lower) #2	Hardin	Moderate	Federal	Vine Grove
Russell Knight Lake Dam	Hardin	Low	Private	Flaherty

LaRue County Dams				
Name of Dam	**County**	**Hazard Class**	**Owner Type**	**TOPO**
Hodgenville RES (NF Nolin River)	LaRue	Low	Municipality	Hodgenville
LaRue Co. Sportsman's Lake Dam	LaRue	Low	Private	Hodgenville
Dixie Stock Farm Dam	LaRue	Low	Private	Tonieville
N. Fork Nolin River MPS 3	LaRue	High	Municipality	Hodgenville
Doug Sprowls Lake Dam	LaRue	Low	Private	Magnolia
Walter Smith Lake Dam	LaRue	Moderate	Private	New Haven
N. Fork Nolin River MPS # 15	LaRue	High	Municipality	Hodgenville

Marion County Dams				
Name of Dam	**County**	**Hazard Class**	**Owner Type**	**TOPO**
Marion Co. Sportsman's Dam	Marion	Moderate	Dept. of Fish and Wildlife	Lebanon East

Lebanon Impound #1	Marion	Low	Municipality	Lebanon West
Lebanon Impound #2	Marion	Moderate	Municipality	Spurlington
Langford Dam	Marion	High	Private	Bradfordsville
Montgomery Dam	Marion	Moderate	Private	Lebanon West
George Dam	Marion	Low	Private	Lebanon West
Nerinx Dam	Marion	Low	Private	Loretto
Coon Hollow Hereford Dam	Marion	Low	Private	Loretto
Star Hill Distillery Dam	Marion	Low	Private	Saint Catherine
John Angel Lake Dam	Marion	Moderate	Private	Lebanon East
Lebanon Water Works	Marion	High	Municipality	Lebanon East

Meade County Dams				
Name of Dam	**County**	**Hazard Class**	**Owner Type**	**TOPO**
Doe Valley Lake Dam	Meade	Moderate	Private	Rock Haven
Grayhamton Lake Dam	Meade	Low	Federal	Rock Haven
Hayes Dam	Meade	Low	Private	New Amsterdam

Nelson County Dams				
Name of Dam	**County**	**Hazard Class**	**Owner Type**	**TOPO**
Maywood Dam	Nelson	Low	Private	Bardstown
Lake Sympson Dam	Nelson	Moderate	Dept. of Transportation	Cravens
Spooky Hollow (Lower) Dam	Nelson	Moderate	Private	Cravens
Hurricane Lake Dam	Nelson	Moderate	Private	Lebanon Junction
JW Dant Distillery Dam	Nelson	Low	Private	New Haven
Lake Johnson Dam	Nelson	Low	Private	Nelsonville
Eagle Lake Dam	Nelson	Low	Private	Lebanon Junction
TW Samuels Distillery Dam #3	Nelson	Low	Private	Samuels

Melody Lake Dam	Nelson	Low	Private	Loretto
Ballard Lake Dam	Nelson	Low	Private	Loretto
Timber Trails Lake Dam	Nelson	Moderate	Private	Lebanon Junction
Heaven Hill Distillery Dam	Nelson	Low	Private	Bardstown
Holt Dam	Nelson	Low	Private	Bardstown
Barton Dam	Nelson	Moderate	Private	Bardstown
Bardstown Dam (Upper)	Nelson	Moderate	Municipality	Bardstown
Bardstown Dam (Lower)	Nelson	High	Municipality	Bardstown
TW Samuels Distillery Dam #1	Nelson	Moderate	Private	Samuels
TW Samuels Distillery Dam #2	Nelson	Moderate	Private	Samuels
Bloomfield Dam (Upper)	Nelson	Moderate	Municipality	Bloomfield
Bloomfield Dam (Lower)	Nelson	Moderate	Municipality	Bloomfield
Edwin Hagen Lake Dam	Nelson	Low	Private	Bardstown
Daffodil Hills Farm Dam	Nelson	Low	Private	Bardstown
Gobins Lake Dam	Nelson	Low	Private	Fairfield
Spooky Hollow Upper Lake Dam	Nelson	Moderate	Private	Cravens
Bloomfield City Park Dam	Nelson	High	Municipality	Bloomfield
Jim Beam #3	Nelson	Low	Private	Lebanon Junction
Monterra Dam	Nelson	Low	Private	Lebanon Junction
Stone Creek Farm Dam	Nelson	Low	Private	Bardstown

Washington County Dams				
Name of Dam	**County**	**Hazard Class**	**Owner Type**	**TOPO**
Springfield Reservoir (Old)	Washington	High	Municipality	Springfield

Springfield Reservoir (New)	Washington	Low	Municipality	Saint Catherine
Willisburg Lake Dam	Washington	High	Dept. of Transportation	Brush Grove
Sam Nally Dam	Washington	Low	Private	Saint Catherine
Hays Farm Dam	Washington	Low	Private	Brush Grove
John Barber Dam	Washington	Low	Private	Maud
Hugh L. Grundy Farm Dam	Washington	Low	Private	Maud
St. Rose Lake (Upper)	Washington	Low	Private	Saint Catherine
St. Rose Lake (Lower)	Washington	Low	Private	Saint Catherine
Morrison Onan Farm Dam	Washington	Low	Private	Springfield
Goode Pay Lake	Washington	Low	Private	Mackville
Willis Walker Farm Dam	Washington	Low	Private	Brush Grove
Lincoln Homestead State Park Dam	Washington	Low	Department of Parks	Brush Grove
Sam Smith Dam	Washington	High	Private	Springfield
AW Tate Dam	Washington	Low	Private	Springfield
Truman Lawson Dam	Washington	Low	Private	Springfield
Lincoln Homestead Dam #2	Washington	Low	Department of Parks	Brush Grove

Source: Kentucky Division of Water

3.3.4 Assessing Vulnerability: Potential Losses

I. Estimating Potential Losses:

The following section provides a compilation of potential economic and human losses that could occur as a result of a natural hazard in the Lincoln Trail Region. To determine this potential loss, the vulnerability (or risk) of a natural hazard must be determined and combined with the value of the assets, both human and economic. The resulting values are to be considered estimates, only due to an overall lack of comprehensive and complete data (event data and asset value data) and the limited sophistication of the methodology. While considered restricted in their use, the values do allow for the identification of various scenarios and should be helpful in the relative evaluation and prioritization of any proposed mitigation strategies.

Vulnerability Methodology: A review of the profiled hazards and the assets inventory, leads to a need to determine which physical areas are the most vulnerable to risk, in order to best devise solutions and allocate resources to mitigate potential hazard events. This results in a two phase approach. The first phase is the determination of the total potential economic and human cost of a particular event. In the second phase, these potential losses are allocated to the geographic areas that are identified with the highest risk for any particular natural hazard event.

A. Social Vulnerability: The published literature regarding natural hazard risk assessment notes that there is a definite social factor associated with each level of vulnerability of any particular area.[1] To incorporate this factor into the study the following methodology was used.

To establish a geographic area for the data used in this analysis, the basic US Census Bureau *Block* was used since it ensures the finest possible granularity. The statistical information used was readily available at this level for the entire LTADD region. The block boundaries used were from the 2010 Census.

Table 3.3.4.1 - Social Vulnerability Source Units

Social Vulnerability Category	Basic Unit	Source
Female Population	Block	2010 Census
Under 18 Population	Block	2010 Census
Over 65 Population	Block	2010 Census
Minority Population	Block	2010 Census
Total Population	Block	2010 Census
Family Poverty Population	Block Group	2013 5 Year ACS
Housing Units	Block	2010 Census
Housing Type, Mobile Homes	Block	2010 Census

1 See Cutter & Odeh.

In addition, the 2013 American Community Survey 5-Year cycle for family units below poverty level by Block Group was used, and included an economic standing risk in the calculations. This value was assigned to each Block that makes up the Block Group since the data is not available at a lower level. The values for each block were analyzed, according to its county as a whole, to generate a *Social Vulnerability (SV)*score[2]. For example, the minority population score for an individual block is determined as follows:

$$SV(minority\ pop) = \left(\frac{\text{minority pop in block}}{\text{minority pop in county}} \right) \Big/ \left(\frac{\text{minority pop in block}^{[max\ value]}}{\text{minority pop in county}} \right)$$

This calculation resulted in a SV score for each value in each block. The sum of these scores yields the *Total Social Vulnerability (TSV)* score for the block as a whole.

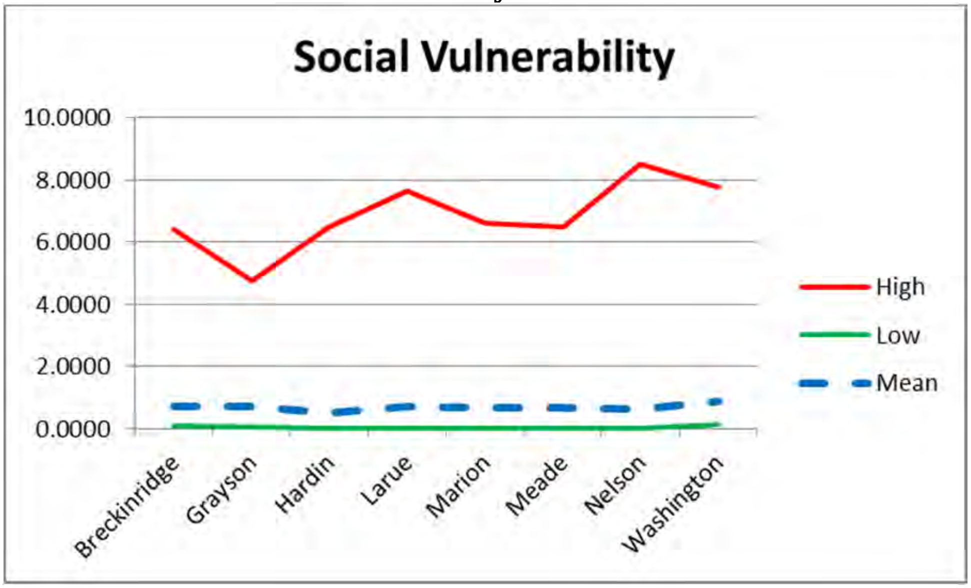
Below is a table that reflects the range and mean of the block scores for each county and for the region as a whole.

Table 3.3.4.2 - Social Vulnerability Scores

Social Vulnerability Scores	High	Low	Mean
Breckinridge	6.4188	0.1116	0.6908
Grayson	4.7429	0.0416	0.7122
Hardin	6.4849	0.0000	0.5165
Larue	7.6549	0.0000	0.6933
Marion	6.6224	0.0000	0.6697
Meade	6.4976	0.0000	0.6699
Nelson	8.5105	0.0000	0.6178
Washington	7.7614	0.1121	0.8838
Lincoln Trail	8.5105	0.0000	0.6372
Note: Zero values are generally the result of no population in a block. This is typical for areas of open water but may occur in other areas of unused land.			

2 Each block's score was determined on a county basis and not as regional value to better reflect the highest risk areas in the individual county. The following maps of the vulnerability are scaled based on region-wide values.

Chart 3.3.4.1 - Social Vulnerability



B. Geographic Vulnerability

Several of the natural hazard events determined to be a significant threat (section 3.3, table 3.3.1.1) to the Lincoln Trail Region, are not typically bound by geography. The risk potential is therefore assumed to be the same throughout the Region for all natural hazards except for ones that generally have a specific geographic component such as karst (sinkholes), landslides / subsidence, earthquakes and especially flooding. Flooding (except for some flash flooding and Dam failure related flooding) is considered to be confined to the predetermined flood zones as defined by the FEMA DFIRM mapping data.

Because of its significant threat to the region, flooding is used for mapping and analysis. This version also includes a value score for data that is available for karst terrain, earthquakes and landslides.

To determine the *Geographic Vulnerability (GV)* score, the US Census block polygons from the 2010 Census were used in conjunction with the social vulnerability calculations. The historic frequencies for each county from the "Hazard Frequency Table" 3.3.2.1 were assigned to the individual blocks for non-geographic specific events. For events that are geographically based blocks, values were assigned based on the referenced geographic type as a percentage of each block area, for karst and landslide (slopes greater than 5%.) For earthquakes it was based on the Peak Ground Acceleration zone the centroid of the block was located in. For flooding it was allocated based on the presence of a 100 or 500-year flood zones in each block.

Table 3.3.4.3 - Geographic Vulnerability Source Units

Geographic Vulnerablity Category	Basic Unit	Range	Source
Hail	Block	county wide	NEIC, NCDC & SHELDUS Cumulative as reported in tables in previous sections.
Lightning	Block	county wide	
Snow / Ice	Block	county wide	
Tornado	Block	county wide	
Thunderstorm	Block	county wide	
Flooding	Block	100 & 500 Year Flood Plains	FEMA DFIRM 2007 - 2011
Karst	Block	Mapped Karst based on 1:24K USGS Topographic Maps	KY Geological Survey, 2003
Landslide / Subsidence	Block	Areas of Slope Greater than 5% based on 30ft Digital Elevation Models	US Geological Survey, 2000
Earthquake	Block	Peak Ground Acceleration - 2% probability of exceedance in 50 years.	US Geological Survey, 2014

Table 3.3.4.4 – Geographic Specific Event Factors

	County Wide				
	Hail	Lightning	Snow_Ice	Tornado	Thunderstorm
Breckinridge	1.4951	0.4587	0.7339	0.2936	3.7798
Grayson	1.6634	0.5688	0.7706	0.2703	3.469
Hardin	1.8447	0.6239	0.8257	0.4404	5.1282
Larue	1.0085	0.6055	0.6972	0.176	3.5413
Marion	1.0841	0.6422	0.5872	0.2018	3.3028
Meade	1.1429	0.5138	0.7339	0.2202	3.7477
Nelson	1.3271	0.7523	0.7523	0.2385	4.1835
Washington	0.9533	0.6606	0.7706	0.2018	3.0826

Table 3.3.4.4 – Geographic Specific Event Factors (cont.)

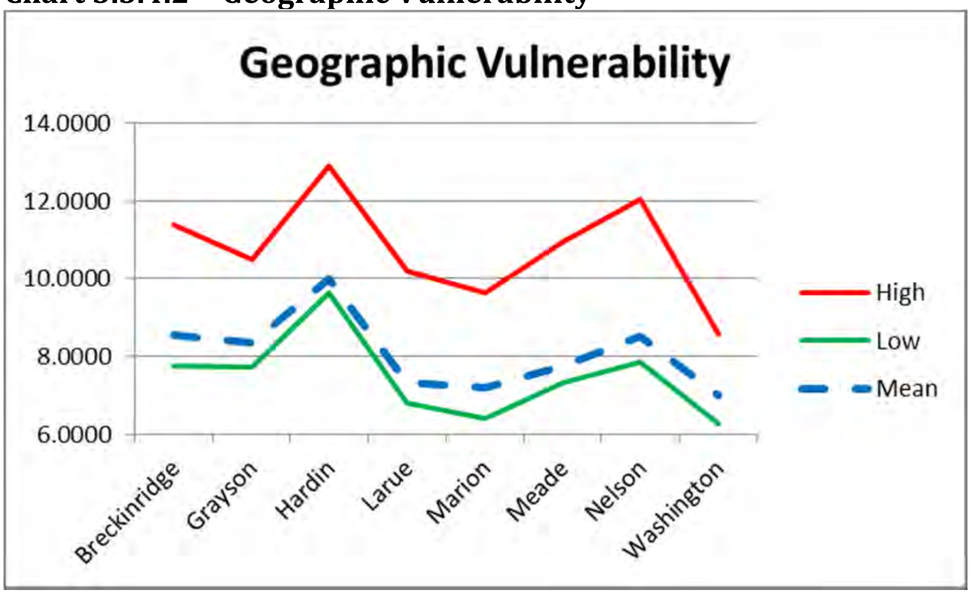
	Geographic Specific			
	Flooding	Karst	Landslide/Subsidence	Earthquake
Breckinridge Grayson Hardin Larue Marion Meade Nelson Washington	1 for 100 year, 0.2 for 500 year	County-wide score value calced against Karst acres per block as a %	County-wide score value calced against Slope acres per block as a %	PGA Value from USGS: 6% *g = 0.589 8% *g = 0.785 10% *g = 0.981 12% *g = 1.177 14% *g = 1.373

The total GV score *(TGV)* is determined by the sum of the GV score for each of the hazard event types used.

Table 3.3.4.5 - Geographic Vulnerability Scores

Geographic Vulnerability Scores	High	Low	Mean
Breckinridge	11.3707	7.7421	8.5487
Grayson	10.4976	7.7231	8.3619
Hardin	12.9113	9.6479	10.0125
Larue	10.2072	6.8135	7.3392
Marion	9.6250	6.4071	7.1887
Meade	10.9476	7.3395	7.7633
Nelson	12.0387	7.8427	8.5284
Washington	8.5911	6.2579	6.9921
Lincoln Trail	12.9113	6.2579	8.6130

Chart 3.3.4.2 - Geographic Vulnerability



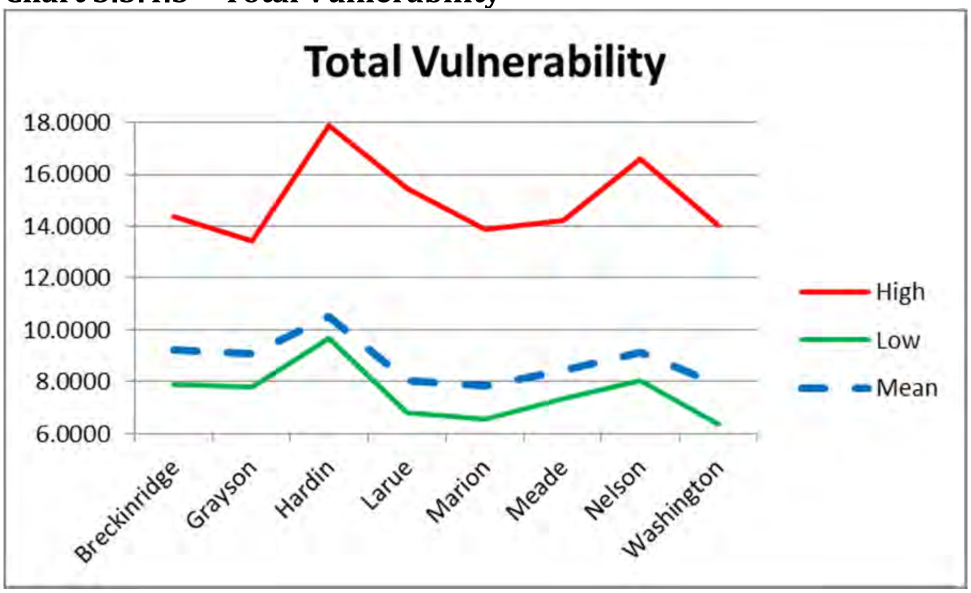
C. Total Vulnerability Score

The factor of the SV and GV yields the *Total Vulnerability (TV)* score for each Census block.

Table 3.3.4.6 - Total vulnerability Scores

Total Vulnerability Scores	High	Low	Mean
Breckinridge	14.3569	7.9044	9.2394
Grayson	13.4313	7.8062	9.0741
Hardin	17.8846	9.6479	10.5290
Larue	15.4703	6.8135	8.0326
Marion	13.8898	6.5767	7.8585
Meade	14.2297	7.3395	8.4332
Nelson	16.5869	8.0387	9.1462
Washington	14.0193	6.3700	7.8759
Lincoln Trail	17.8846	6.370007	9.2502

Chart 3.3.4.3 - Total Vulnerability



This score allows a determination of the relative vulnerability of each block to a hazard event. The scores were classified using a natural breaks method of four categories. The classification ranges are as follows:

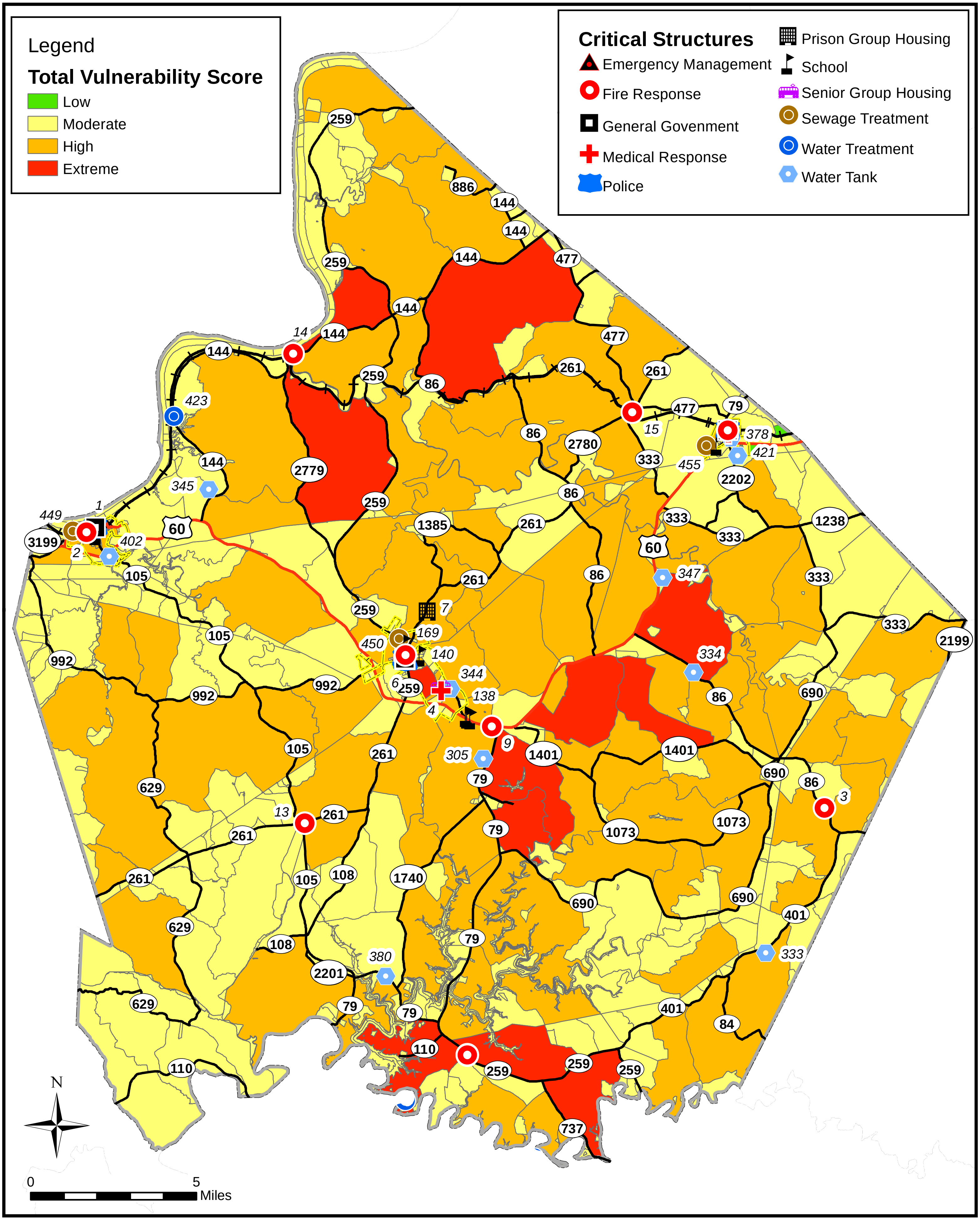
Low	6.3700 – 7.9306
Moderate	7.9307 – 9.1590
High	9.1591 – 10.4813
Extreme	10.4814– 17.8846 (maximum value)

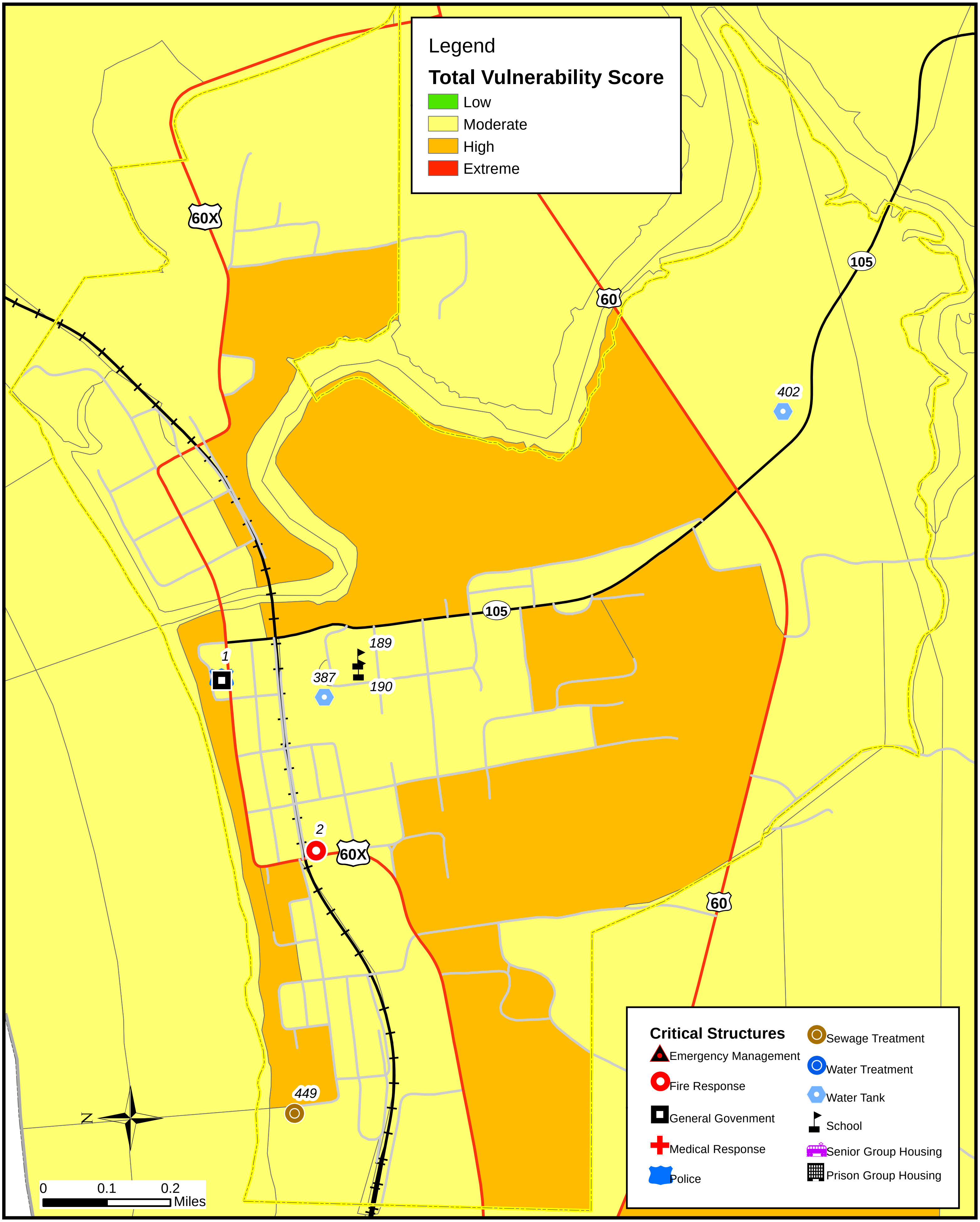
The results of this analysis aids in providing focus areas for the evaluation of current mitigation strategies and implementation of future strategies. The following table and individual entity maps illustrate the block vulnerability for each county and plot, and the critical structures that currently fall within the extreme or high zones.

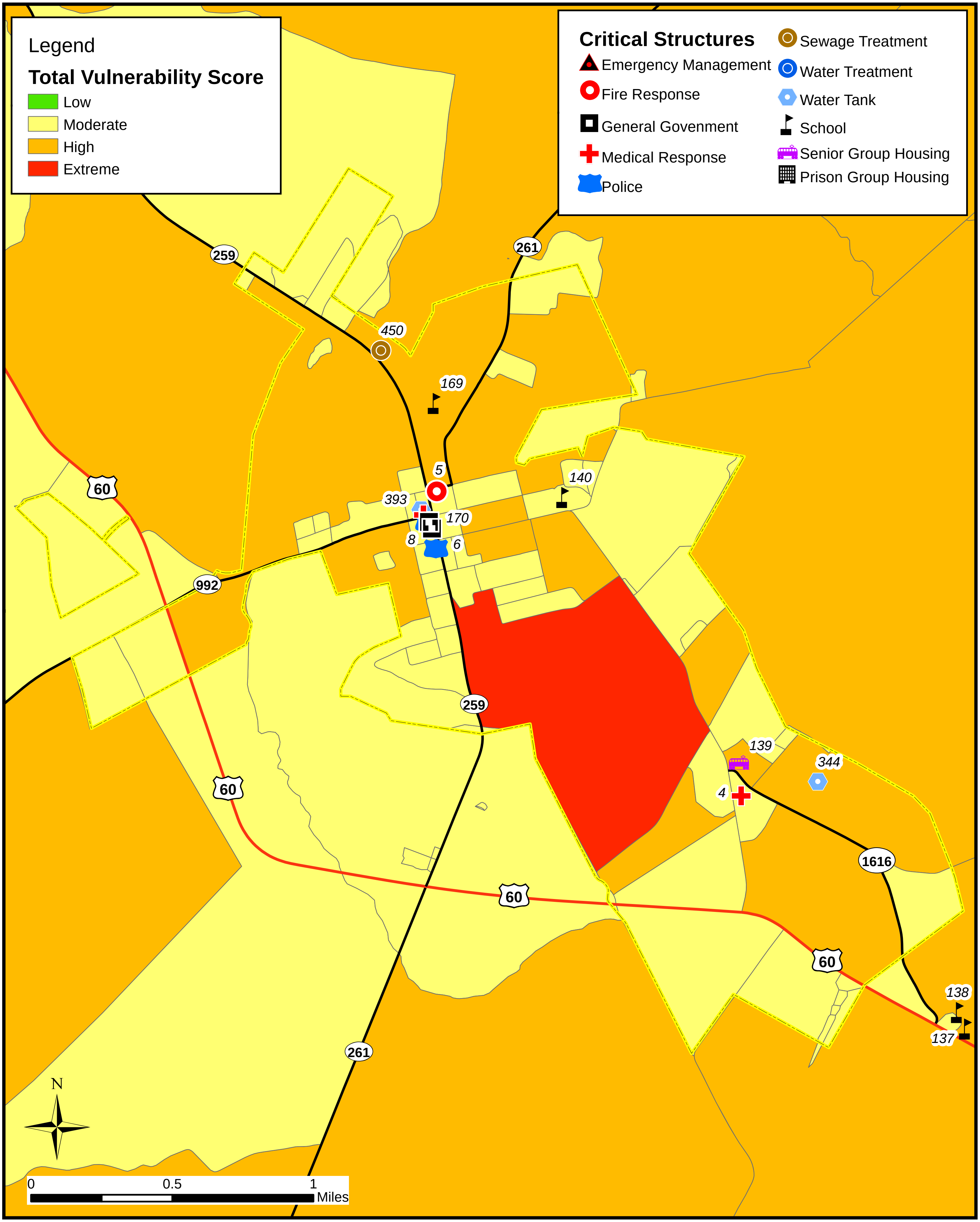
Table 3.3.4.7 - Critical Facilities located in combined Socially and Geographically Vulnerable Area by County.

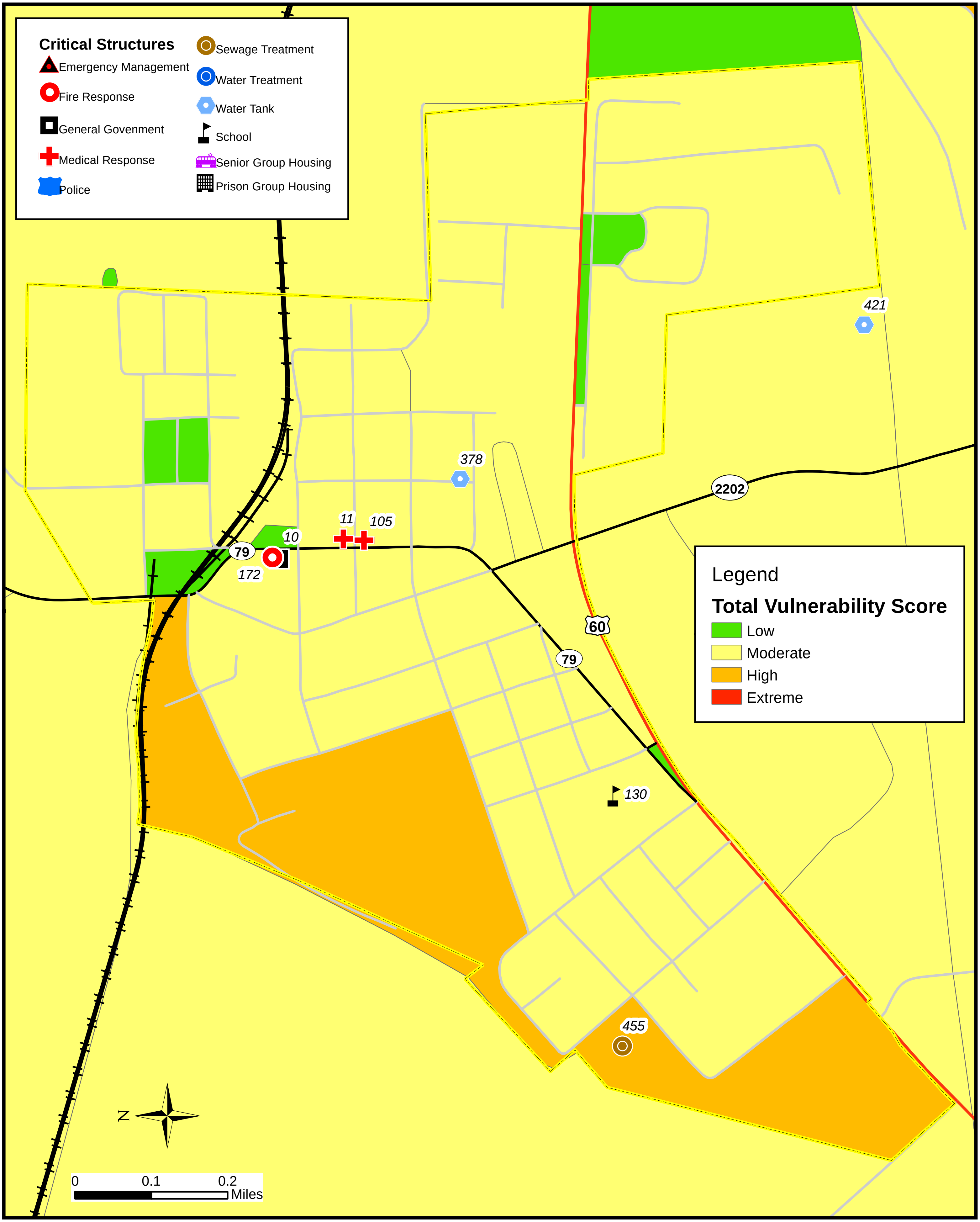
Breckinridge County

MAP NUMBER	FACILITY NAME	COUNTY	FUNCTION
1	CLOVERPORT POLICE	BRECKINRIDGE	POLICE
2	CLOVERPORT VFD	BRECKINRIDGE	FIRE RESPONSE
3	CUSTER FIRE DEPT	BRECKINRIDGE	FIRE RESPONSE
4	BRECKINRIDGE MEMORIAL HOSPITAL	BRECKINRIDGE	MEDICAL RESPONSE
5	HARDINSBURG VFD	BRECKINRIDGE	FIRE RESPONSE
6	HARDINSBURG POLICE	BRECKINRIDGE	POLICE
7	BRECKINRIDGE COUNTY JAIL	BRECKINRIDGE	PRISON GROUP HOUSING
8	BRECKINRIDGE COUNTY SHERIFF	BRECKINRIDGE	POLICE
9	HARNED VFD	BRECKINRIDGE	FIRE RESPONSE
10	IRVINGTON POLICE	BRECKINRIDGE	POLICE
11	IRVINGTON AREA EMERGENCY MEDICAL HQ	BRECKINRIDGE	MEDICAL RESPONSE
12	MCDANIELS EMS FIRE & RESCUE SERVICE	BRECKINRIDGE	MEDICAL RESPONSE
13	MCQUADY VFD	BRECKINRIDGE	FIRE RESPONSE
14	STEPHENSPORT VFD	BRECKINRIDGE	FIRE RESPONSE
15	WEBSTER VFD	BRECKINRIDGE	FIRE RESPONSE
105	IRVINGTON AREA AMBULANCE SERVICE	BRECKINRIDGE	MEDICAL RESPONSE
106	MCDANIELS FIRE-RESCUE, INC.	BRECKINRIDGE	FIRE RESPONSE
113	CLOVERPORT CITY HALL	BRECKINRIDGE	GENERAL GOVENMENT
130	IRVINGTON ELEMENTARY SCHOOL	BRECKINRIDGE	SCHOOL
131	IRVINGTON CITY HALL	BRECKINRIDGE	GENERAL GOVENMENT
136	BRECKINRIDGE COUNTY HIGH SCHOOL	BRECKINRIDGE	SCHOOL
137	BRECKINRIDGE COUNTY AREA TECHNOLOGY CENTER	BRECKINRIDGE	SCHOOL
138	BRECKINRIDGE COUNTY MIDDLE SCHOOL	BRECKINRIDGE	SCHOOL
139	MEDCO CENTER	BRECKINRIDGE	SENIOR GROUP HOUSING
140	HARDINSBURG ELEMENTARY SCHOOL	BRECKINRIDGE	SCHOOL
169	ST. ROMUALD ELEMEMTARY SCHOOL	BRECKINRIDGE	SCHOOL
170	HARDINSBURG CITY HALL	BRECKINRIDGE	GENERAL GOVENMENT
171	BRECKINRIDGE COUNTY COURTHOUSE	BRECKINRIDGE	GENERAL GOVENMENT
172	IRVINGTON VFD	BRECKINRIDGE	FIRE RESPONSE
189	FREDERICK FRAIZE HIGH SCHOOL	BRECKINRIDGE	SCHOOL
190	WILLIAM H. NATCHER ELEMENTARY SCHOOL	BRECKINRIDGE	SCHOOL
281	BRECKINRIDGE COUNTY HEALTH DEPARTMENT	BRECKINRIDGE	MEDICAL RESPONSE
287	MCDANIELS VFD	BRECKINRIDGE	FIRE RESPONSE
305	BEN WRIGHT	BRECKINRIDGE	WT
333	HUDSON	BRECKINRIDGE	WT
334	STINNETTSVILLE TANK	BRECKINRIDGE	WT
344	FAIRGROUNDS RD.	BRECKINRIDGE	WT
345	PERSIMMON FLATS TANK	BRECKINRIDGE	WT
347	IRVINGTON	BRECKINRIDGE	WT
378	IRVINGTON WATER TANK	BRECKINRIDGE	WT
380	AXTEL	BRECKINRIDGE	WT
387	ELEVATED TANK	BRECKINRIDGE	WT
393	DOWNTOWN	BRECKINRIDGE	WT
402	STANDPIPE TANK	BRECKINRIDGE	WT
421	SAM DOWELL RD	BRECKINRIDGE	WT
423	HARDINSBURG REVERSE OSMOSIS WATER TREATMENT FACIL*	BRECKINRIDGE	WTP
449	CLOVERPORT STP	BRECKINRIDGE	STP
450	HARDINSBURG STP	BRECKINRIDGE	STP
455	IRVINGTON WWTP	BRECKINRIDGE	STP


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Prison Group Housing
School
Senior Group Housing
Sewage Treatment
Water Treatment
Water Tank
N
0
5
Miles

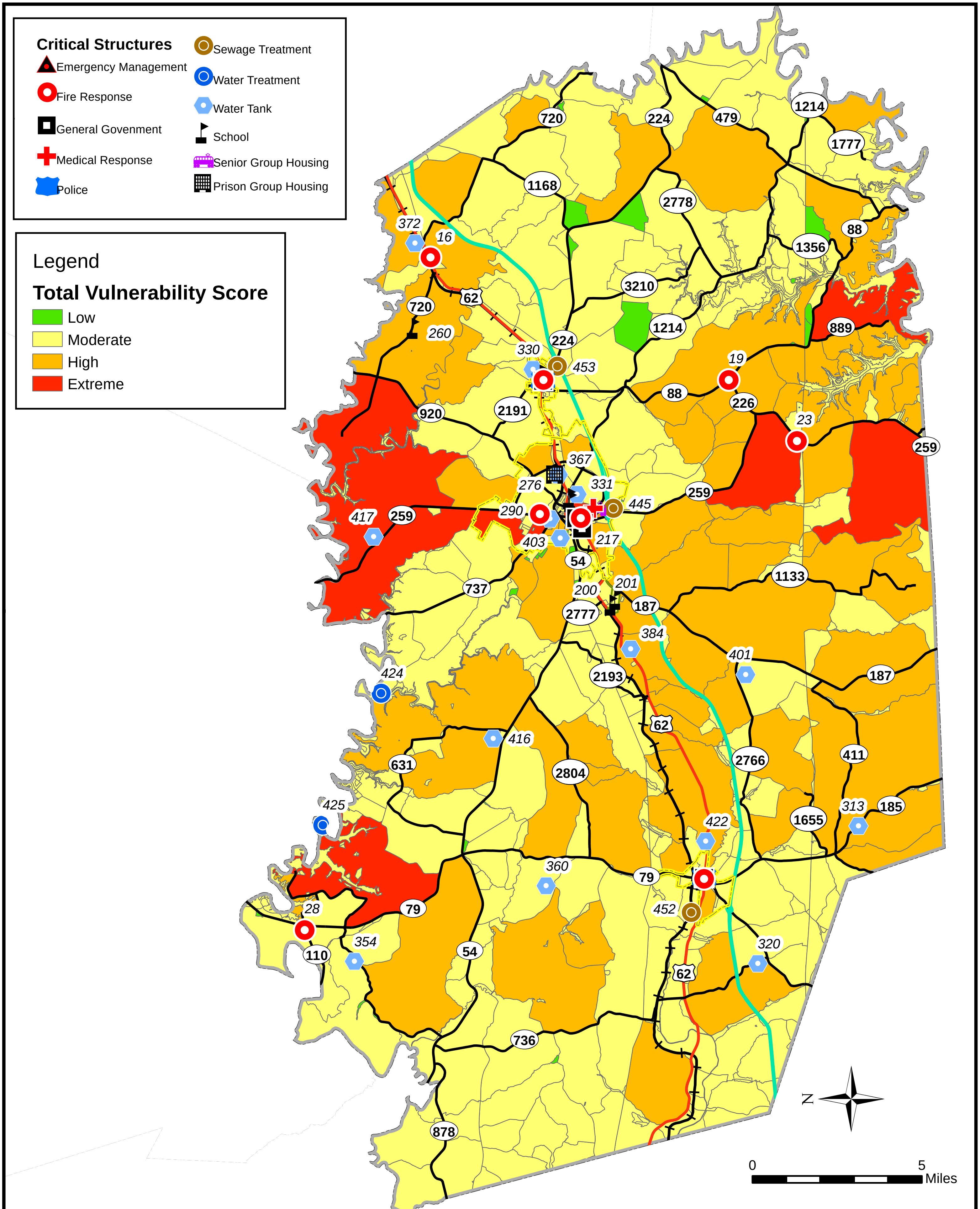

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
60X
60
105
402
105
189
1
387
190
2
60X
60
449
N
0
0.1
0.2
Miles
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing

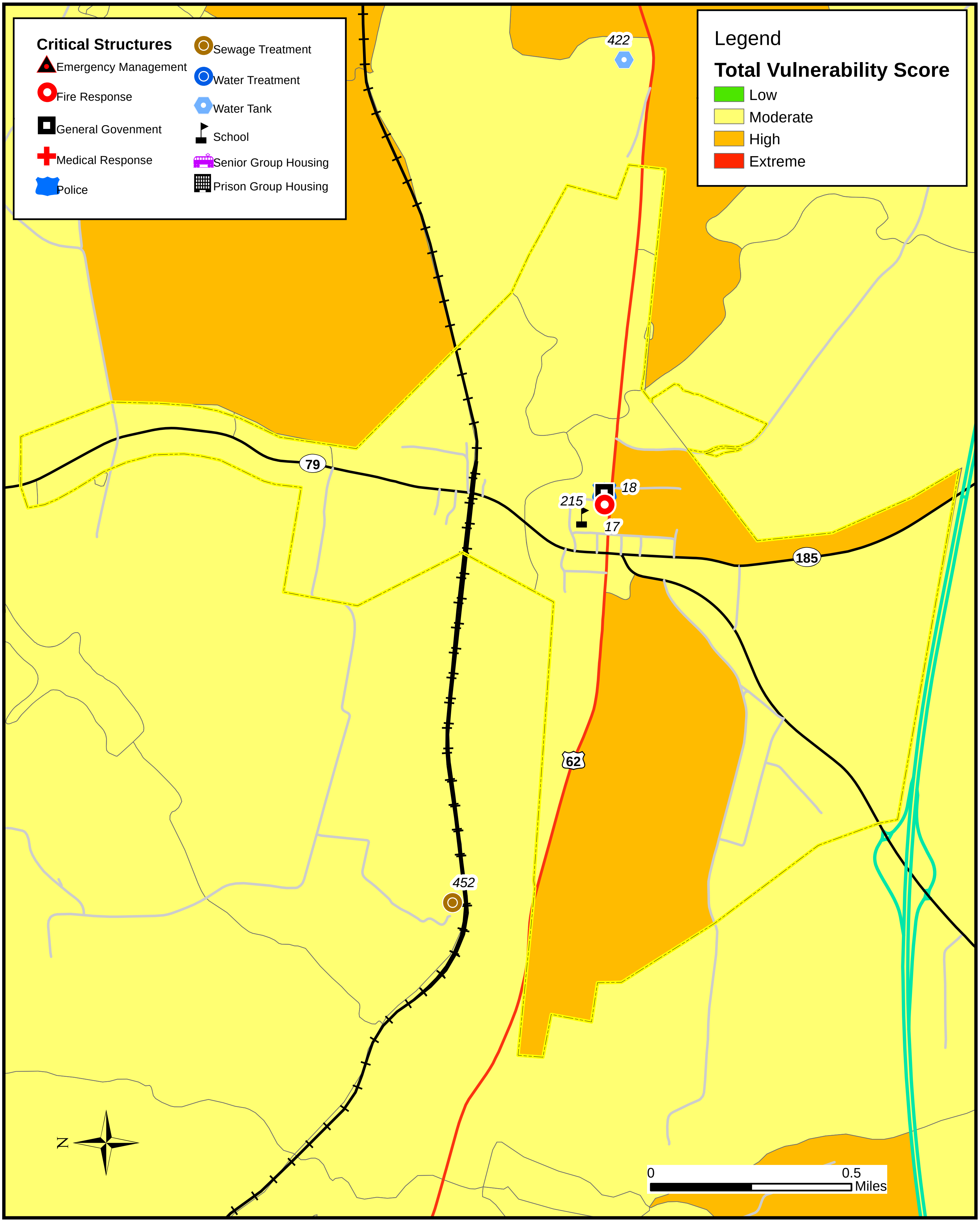

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
259
261
450
169
5
393
170
140
8
6
60
992
259
139
344
4
60
1616
60
60
138
137
261
N
0
0.5
1
Miles

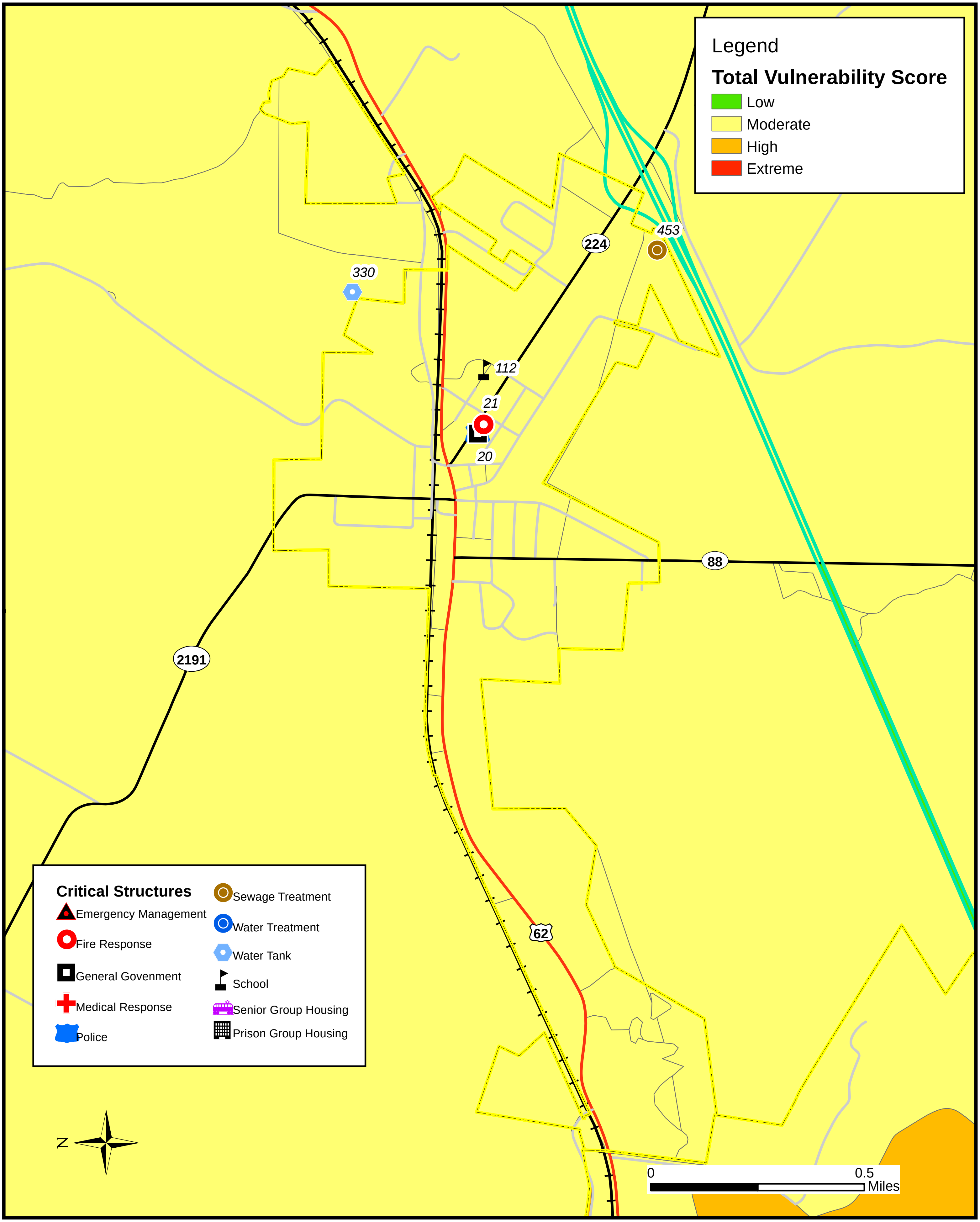

Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
421
378
2202
11
105
10
79
172
60
79
130
455
N
0
0.1
0.2
Miles

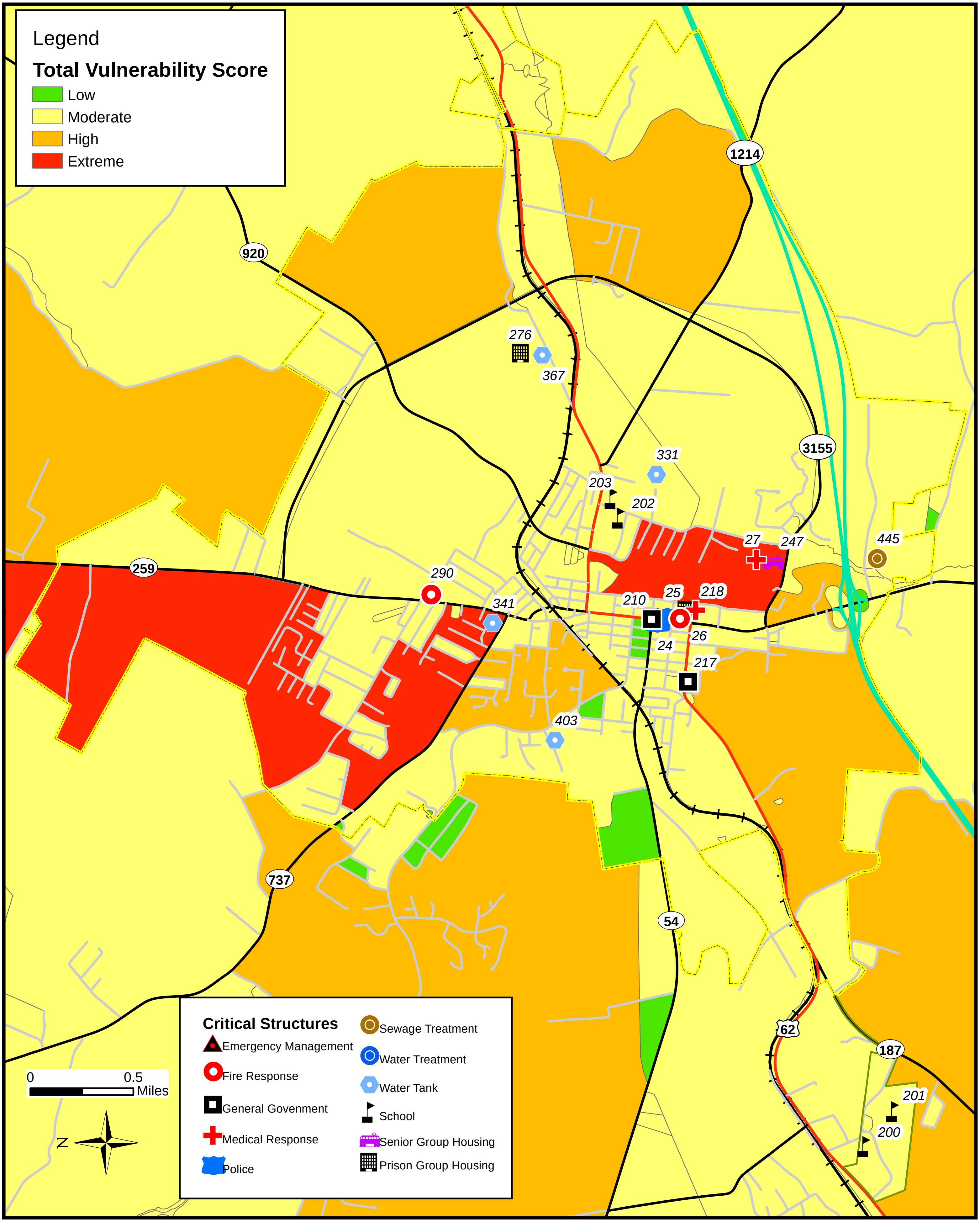
Grayson County

16	EAST GRAYSON COUNTY FIRE DEPT	GRAYSON	FIRE RESPONSE
17	CANEYVILLE VFD	GRAYSON	FIRE RESPONSE
18	CANEYVILLE POLICE	GRAYSON	POLICE
19	WAX FIRE DEPT	GRAYSON	FIRE RESPONSE
20	CLARKSON POLICE	GRAYSON	POLICE
21	CLARKSON VFD	GRAYSON	FIRE RESPONSE
22	LEITCHFIELD PD	GRAYSON	POLICE
23	ANETA FIRE DEPT	GRAYSON	FIRE RESPONSE
24	GRAYSON COUNTY SHERIFF	GRAYSON	POLICE
25	GRAYSON COUNTY JAIL	GRAYSON	PRISON GROUP HOUSING
26	LEITCHFIELD VFD	GRAYSON	FIRE RESPONSE
27	TWIN LAKES REGIONAL MEDICAL CENTER	GRAYSON	MEDICAL RESPONSE
28	FALLS OF ROUGH VFD	GRAYSON	FIRE RESPONSE
112	CLARKSON ELEMENTRY SCHOOL	GRAYSON	SCHOOL
200	ORAN P LAWLER ELEMENTARY SCHOOL	GRAYSON	SCHOOL
201	GRAYSON COUNTY HIGH SCHOOL	GRAYSON	SCHOOL
202	H W WILKEY ELEMENTARY SCHOOL	GRAYSON	SCHOOL
203	GRAYSON COUNTY MIDDLE SCHOOL	GRAYSON	SCHOOL
210	GRAYSON COUNTY COURTHOUSE	GRAYSON	GENERAL GOVENMENT
214	CANEYVILLE CITY HALL	GRAYSON	GENERAL GOVENMENT
215	CANEYVILLE ELEMENTARY SCHOOL	GRAYSON	SCHOOL
216	CLARKSON CITY HALL	GRAYSON	GENERAL GOVENMENT
217	LEITCHFIELD CITY HALL	GRAYSON	GENERAL GOVENMENT
218	GRAYSON COUNTY HEALTH DEPARTMENT	GRAYSON	MEDICAL RESPONSE
247	GRAYSON MANOR NURSING HOME	GRAYSON	SENIOR GROUP HOUSING
260	ST. PAUL ELEMENTARY SCHOOL	GRAYSON	SCHOOL
276	GRAYSON COUNTY CORRECTIONAL FACILITY	GRAYSON	PRISON GROUP HOUSING
290	LEITCHFIELD VFD	GRAYSON	FIRE RESPONSE
313	185 TANK	GRAYSON	WT
320	WINDY RIDGE	GRAYSON	WT
330	CLARKSON	GRAYSON	WT
331	SCHOOL ST.	GRAYSON	WT
341	ORCHARD ST.	GRAYSON	WT
354	LONE HILL	GRAYSON	WT
360	POST TOUSEY	GRAYSON	WT
367	DETENTION CENTER	GRAYSON	WT
372	BIG CLIFTY	GRAYSON	WT
384	BLACK ROCK	GRAYSON	WT
401	SHREWSBURY	GRAYSON	WT
403	SUNBEAM RD.	GRAYSON	WT
416	DUFF RD	GRAYSON	WT
417	CONKLIN TANK	GRAYSON	WT
422	HWY 62 EAST	GRAYSON	WT
424	LEITCHFIELD	GRAYSON	WTP
425	GRAYSON COUNTY	GRAYSON	WTP
445	LEITCHFIELD WWTP	GRAYSON	STP
452	CANEYVILLE WWTP	GRAYSON	STP
453	CLARKSON WWTP	GRAYSON	STP


Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
0
5
Miles
N


Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
422
79
18
215
17
185
62
452
N
0
0.5
Miles


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
453
224
330
112
21
20
88
2191
62
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
N
0
0.5
Miles

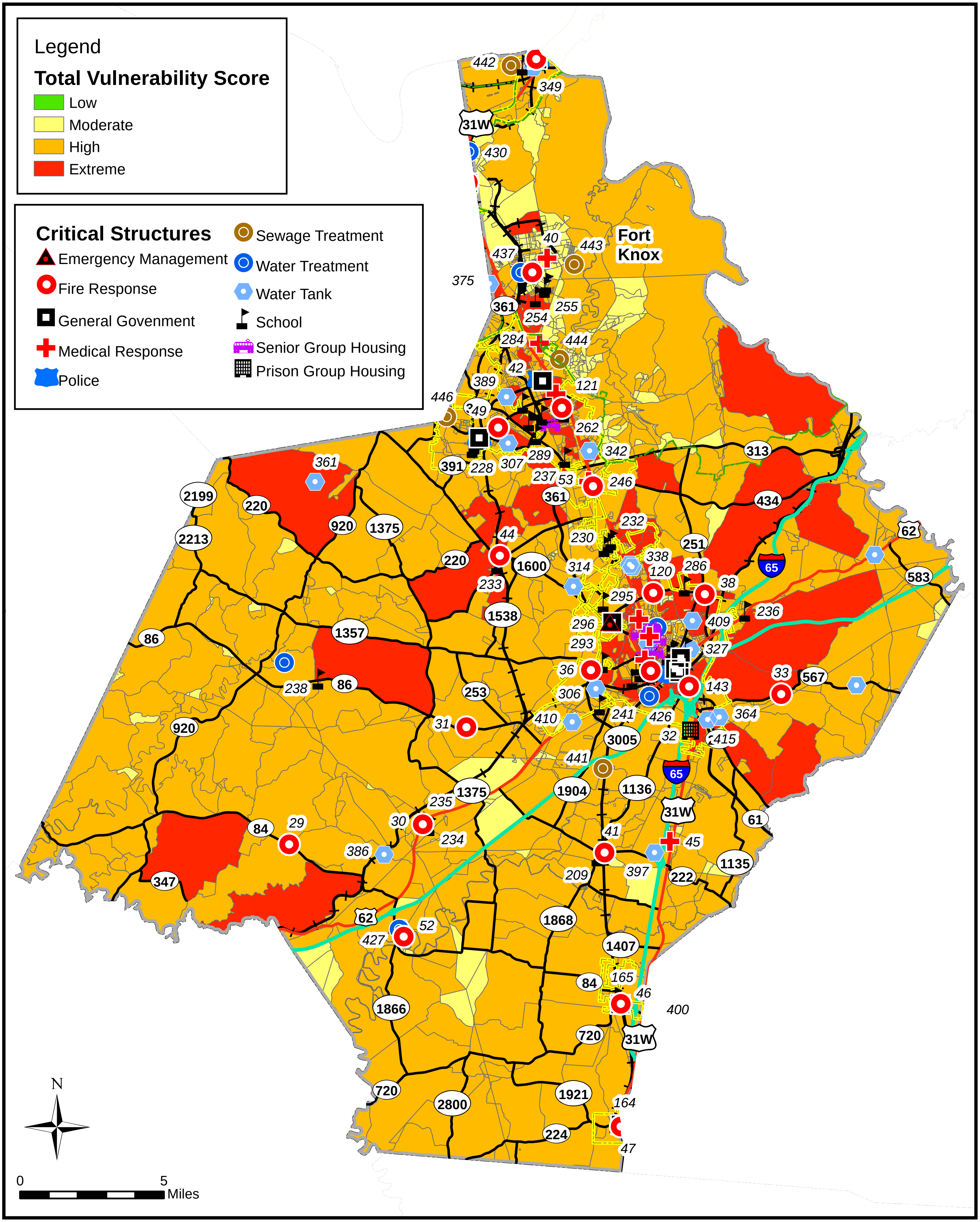

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
0
0.5
Miles
N
920
259
737
54
62
187
1214
3155
276
367
331
203
202
27
247
445
290
341
210
25
218
26
24
217
403
201
200

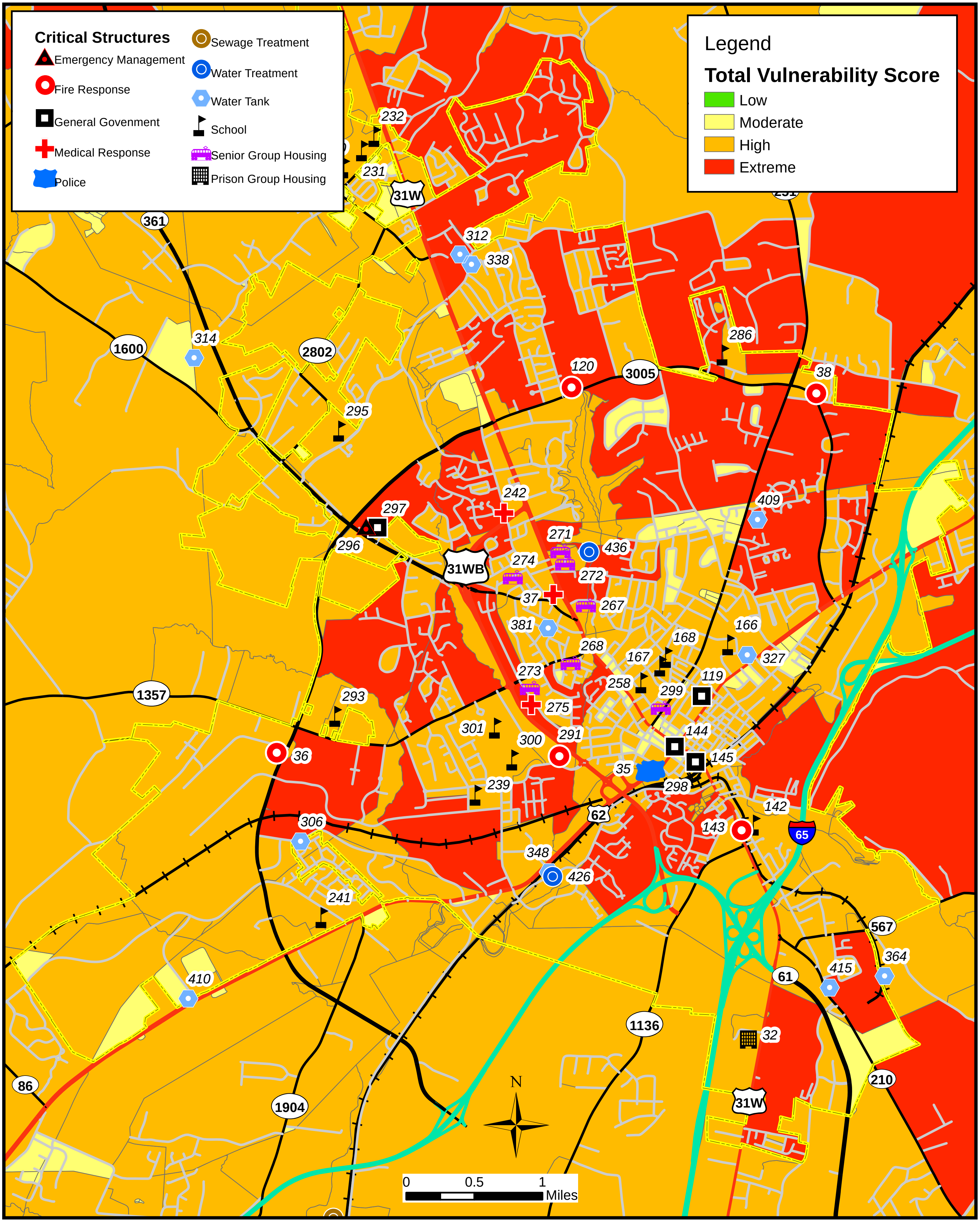
Hardin County

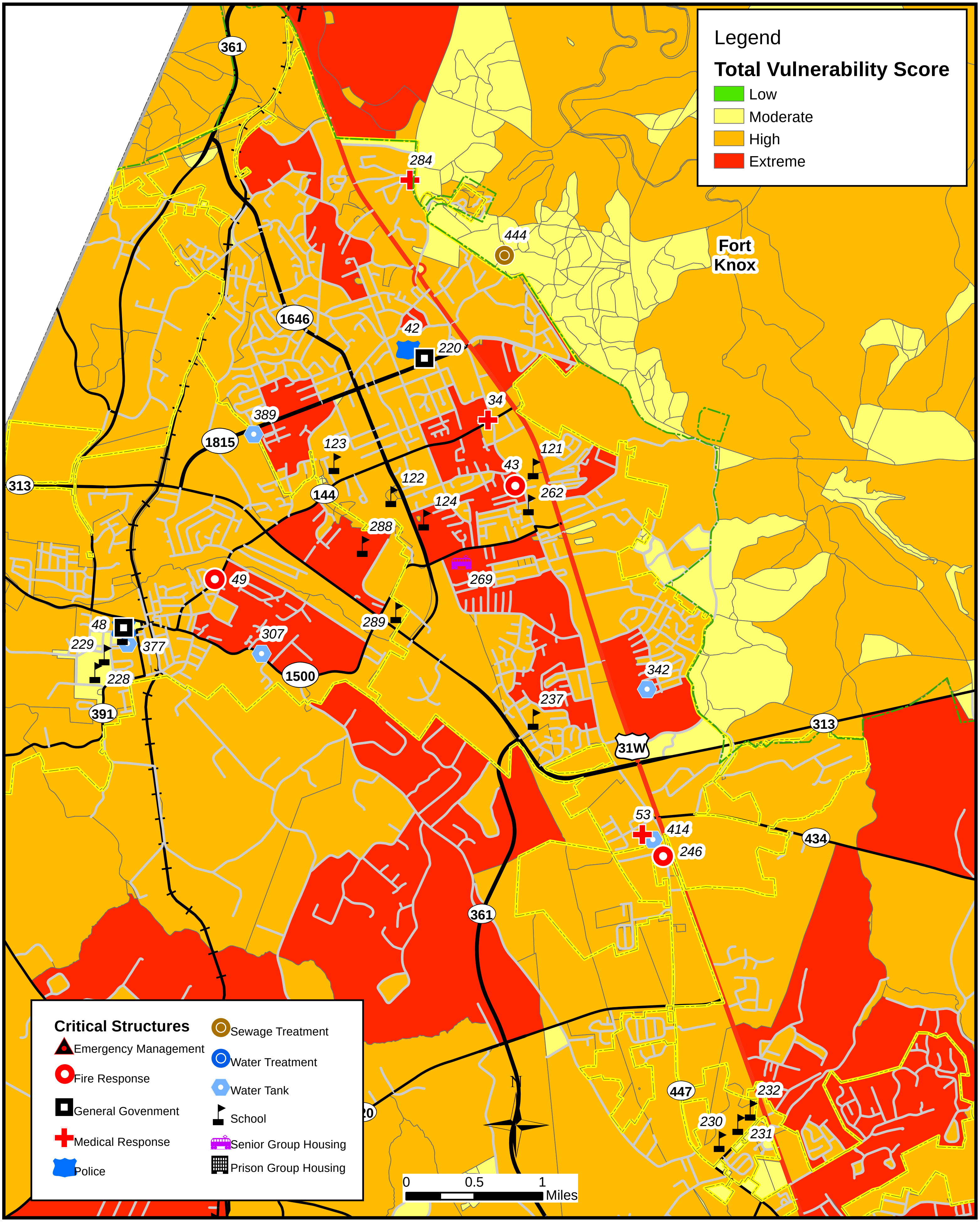
29	WEST 84 FIRE DEPT	HARDIN	FIRE RESPONSE
30	STEPHENSBURG VFD	HARDIN	FIRE RESPONSE
31	KENTUCKY 86 FIRE DEPT	HARDIN	FIRE RESPONSE
32	HARDIN COUNTY JAIL	HARDIN	PRISON GROUP HOUSING
33	VALLEY CREEK FIRE DEPT	HARDIN	FIRE RESPONSE
34	HARDIN COUNTY AMBULANCE SERVICE, NORTH HARDIN	HARDIN	MEDICAL RESPONSE
35	ELIZABETHTOWN POLICE	HARDIN	POLICE
36	ELIZABETHTOWN FIRE STATION #1	HARDIN	FIRE RESPONSE
37	HARDIN MEMORIAL HOSPITAL	HARDIN	MEDICAL RESPONSE
38	CENTRAL HARDIN COUNTY FIRE DEPT	HARDIN	FIRE RESPONSE
39	FORT KNOX FIRE DEPT	HARDIN	FIRE RESPONSE
40	IRELAND ARMY HOSPITAL	HARDIN	MEDICAL RESPONSE
41	GLENDALE FIRE DEPT	HARDIN	FIRE RESPONSE
42	RADCLIFF POLICE	HARDIN	POLICE
43	RADCLIFF FD #1	HARDIN	FIRE RESPONSE
44	RINEYVILLE FIRE DEPT	HARDIN	FIRE RESPONSE
45	HARDIN COUNTY AMBULANCE SERVICE, SOUTH HARDIN	HARDIN	MEDICAL RESPONSE
46	SONORA FIRE DEPT	HARDIN	FIRE RESPONSE
47	UPTON FIRE DEPT	HARDIN	FIRE RESPONSE
48	VINE GROVE POLICE	HARDIN	POLICE
49	VINE GROVE FIRE DEPT	HARDIN	FIRE RESPONSE
50	WEST POINT FIRE DEPT	HARDIN	FIRE RESPONSE
51	WEST POINT POLICE	HARDIN	POLICE
52	WHITE MILLS FIRE DEPT	HARDIN	FIRE RESPONSE
53	LINCOLN TRAIL HOSPITAL	HARDIN	MEDICAL RESPONSE
119	NATIONAL GUARD ARMORY	HARDIN	GENERAL GOVENMENT
120	ELIZABETHTOWN FIRE STATION #3	HARDIN	FIRE RESPONSE
121	RADCLIFF MIDDLE SCHOOL	HARDIN	SCHOOL
122	NORTH HARDIN HIGH SCHOOL	HARDIN	SCHOOL
123	MEADOW VIEW ELEMENTARY SCHOOL	HARDIN	SCHOOL
124	PARKWAY ELEMETARY SCHOOL	HARDIN	SCHOOL
141	VINE GROVE CITY HALL	HARDIN	GENERAL GOVENMENT
142	VALLEY VIEW EDUCATION CENTER	HARDIN	SCHOOL
143	ELIZABETHTOWN FIRE STATION #2	HARDIN	FIRE RESPONSE
144	ELIZABETHTOWN CITY HALL	HARDIN	GENERAL GOVENMENT
145	HARDIN COUNTY JUSTICE CENTER	HARDIN	GENERAL GOVENMENT
163	UPTON CITY HALL	HARDIN	GENERAL GOVENMENT
164	UPTON ELEMENTARY SCHOOL	HARDIN	SCHOOL
165	SONORA ELEMENTARY SCHOOL	HARDIN	SCHOOL
166	ELIZABETHTOWN HIGH SCHOOL	HARDIN	SCHOOL
167	MORNINGSIDE ELEMENTARY SCHOOL	HARDIN	SCHOOL
168	T. K. STONE MIDDLE SCHOOL	HARDIN	SCHOOL
209	EAST HARDIN MIDDLE SCHOOL	HARDIN	SCHOOL
213	WEST POINT CITY HALL	HARDIN	GENERAL GOVENMENT
219	SONORA CITY HALL	HARDIN	GENERAL GOVENMENT
220	RADCLIFF CITY HALL	HARDIN	GENERAL GOVENMENT
228	JAMES T. ALTON MIDDLE SCHOOL	HARDIN	SCHOOL
229	VINE GROVE ELEMENTARY SCHOOL	HARDIN	SCHOOL
230	JOHN HARDIN HIGH SCHOOL	HARDIN	SCHOOL
231	BLUEGRASS MIDDLE SCHOOL	HARDIN	SCHOOL
232	NEW HIGHLAND ELEMENTARY SCHOOL	HARDIN	SCHOOL
233	RINEYVILLE ELEMENTARY SCHOOL	HARDIN	SCHOOL
234	LAKEWOOD ELEMENTARY SCHOOL	HARDIN	SCHOOL
235	WEST HARDIN MIDDLE SCHOOL	HARDIN	SCHOOL
236	LINCOLN TRAIL ELEMENTARY SCHOOL	HARDIN	SCHOOL
237	WOODLAND ELEMENTARY SCHOOL	HARDIN	SCHOOL
238	HOWEVALLEY ELEMENTARY SCHOOL	HARDIN	SCHOOL
239	HARDIN ALTERNATIVE SCHOOL	HARDIN	SCHOOL
240	BROWN STREET CENTER	HARDIN	SCHOOL
241	CENTRAL HARDIN HIGH SCHOOL	HARDIN	SCHOOL
242	LINCOLN TRAIL DISTRICT HEALTH DEPARTMENT	HARDIN	MEDICAL RESPONSE
246	RADCLIFF FD #2	HARDIN	FIRE RESPONSE
252	SCOTT MIDDLE SCHOOL	HARDIN	SCHOOL
254	MACDONALD INTERMEDIATE SCHOOL	HARDIN	SCHOOL
255	FORT KNOX HIGH SCHOOL	HARDIN	SCHOOL
258	ELIZABETHTOWN CHRISTIAN ACADEMY	HARDIN	SCHOOL
262	ST. CHRISTOPHER ELEMENTARY SCHOOL	HARDIN	SCHOOL
267	HELMWOOD HEALTHCARE CENTER	HARDIN	SENIOR GROUP HOUSING
268	KENNSINGTON MANOR	HARDIN	SENIOR GROUP HOUSING
269	NORTH HARDIN HEALTH & REHAB CENTER	HARDIN	SENIOR GROUP HOUSING

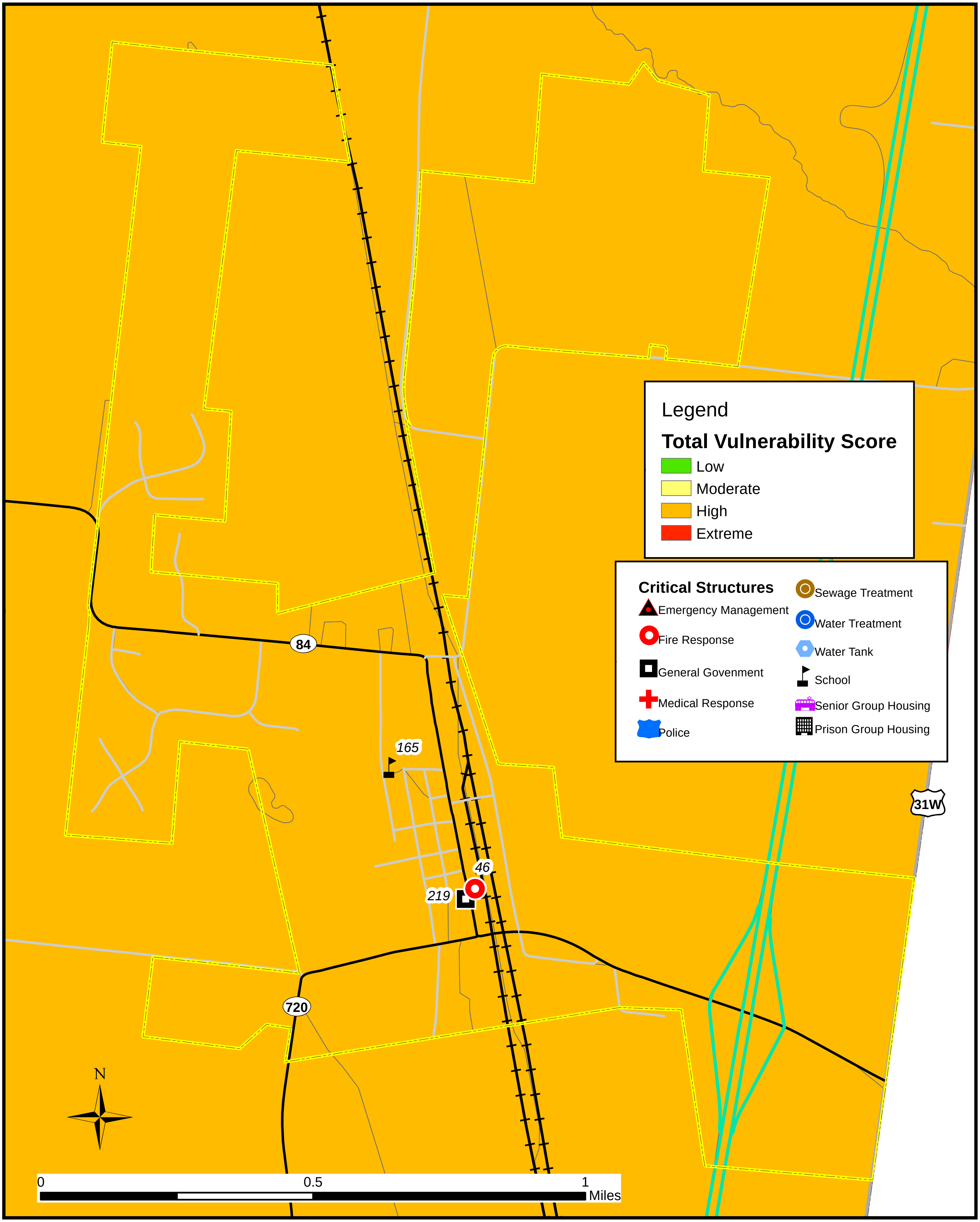
Hardin County (cont.)

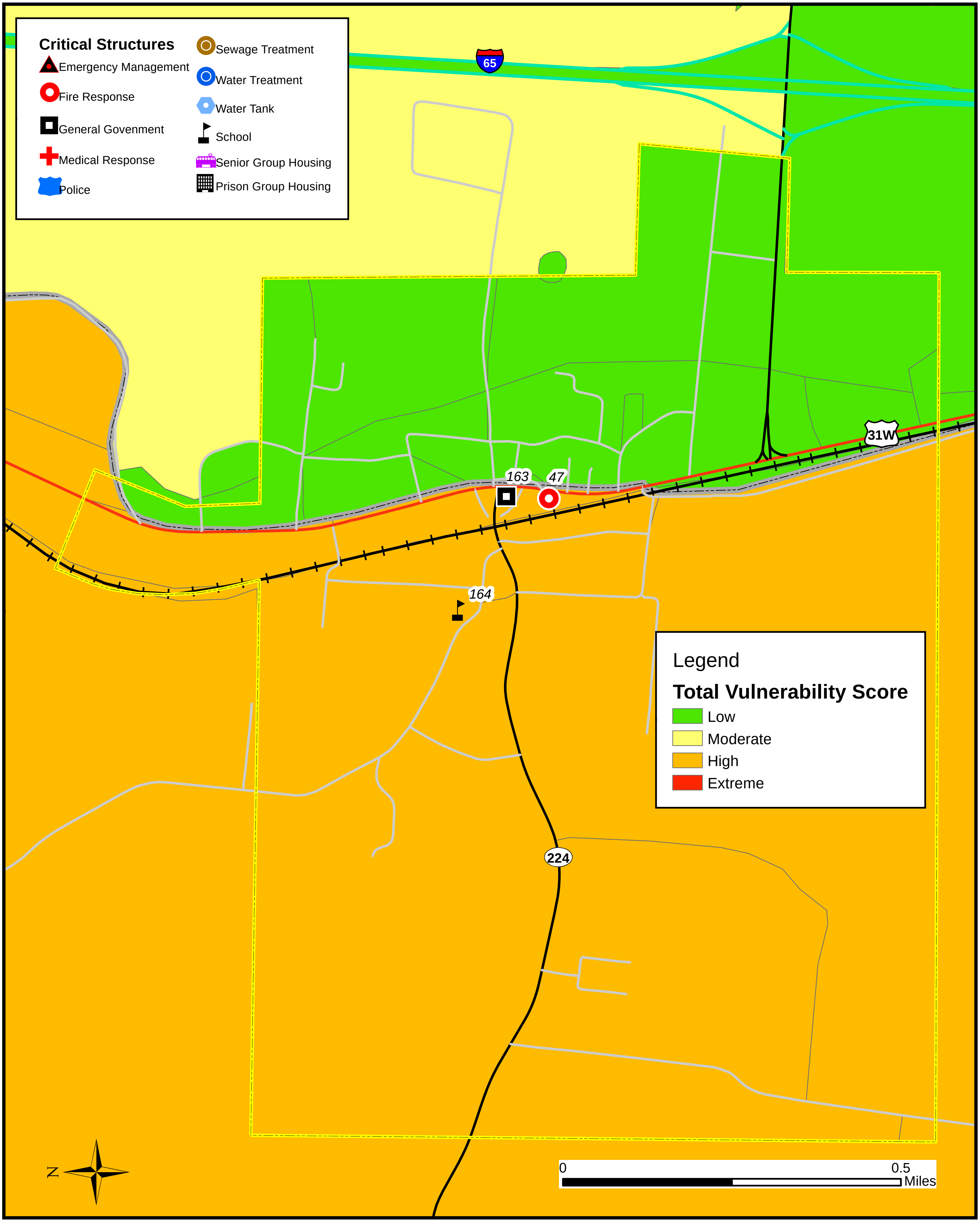
271	HEALTHSOUTH REHAB CENTER	HARDIN	SENIOR GROUP HOUSING
272	ATRIA ASSISTED LIVING	HARDIN	SENIOR GROUP HOUSING
273	MORNINGSIDE GARDENS ASSISTED LIVING	HARDIN	SENIOR GROUP HOUSING
274	TAYLOR MADE ASSISTED LIVING	HARDIN	SENIOR GROUP HOUSING
275	HARDIN CO. HEALTH CENTER	HARDIN	MEDICAL RESPONSE
277	WEST POINT ELEMENTARY SCHOOL	HARDIN	SCHOOL
284	HARDIN COUNTY HEALTH DEPARTMENT	HARDIN	MEDICAL RESPONSE
286	HEARTLAND ELEMENTARY	HARDIN	SCHOOL
288	WOODLAND ES	HARDIN	SCHOOL
289	NORTH HARDIN CHRISTIAN	HARDIN	SCHOOL
291	CENTRAL KENTUCK FIRE TRAINING CENTER	HARDIN	FIRE RESPONSE
293	G C BURKHEAD ELEMENTARY SCHOOL	HARDIN	SCHOOL
295	ST JAMES ELEMENTARY SCHOOL	HARDIN	SCHOOL
296	HARDIN COUNTY EMERGENCY MANAGEMENT	HARDIN	EMERGENCY MANAGEMENT
297	HARDIN COUNTY GOVERNMENT CENTER	HARDIN	GENERAL GOVENMENT
298	ELIZABETHTOWN POLICE DEPT	HARDIN	POLICE
299	COMMUNICARE	HARDIN	SENIOR GROUP HOUSING
300	ELIZABETHTOWN COMMUNITY & TECHNICAL COLLEGE	HARDIN	SCHOOL
301	HARDIN COUNTY EARLY COLEGE & CAREER CENTER	HARDIN	SCHOOL
306	PETERSON DRIVE TOWER	HARDIN	WT
307	ELEVATED TANK	HARDIN	WT
312	PEAR ORCHARD TANK	HARDIN	WT
314	RINEYVILLE TANK	HARDIN	WT
319	PIRTLE SPRINGS CLEAR WELL	HARDIN	WT
326	LONESTAR TANK	HARDIN	WT
327	MULBERRY	HARDIN	WT
336	FREEMAN LAKE WTP	HARDIN	WT
338	OAKLAWN	HARDIN	WT
342	WHISPERING HILLS	HARDIN	WT
348	CITY SPRINGS WATER PLANT CLEARWELL	HARDIN	WT
349	WEST POINT WATER STORAGE TANK	HARDIN	WT
353	VALLEY CREEK TANK	HARDIN	WT
358	VALLEY CREEK TANK	HARDIN	WT
361	BRIZENDINE	HARDIN	WT
364	SOUTH END TANK	HARDIN	WT
369	CLEARWELL #1	HARDIN	WT
375	PRITCHARD	HARDIN	WT
377	STANDPIPE TANK	HARDIN	WT
381	HELMWOOD	HARDIN	WT
386	EASTVIEW TANK	HARDIN	WT
389	LINCOLN TRAIL	HARDIN	WT
397	GLENDALE TANK	HARDIN	WT
400	SONORA TANK	HARDIN	WT
409	PEAR ORCHARD	HARDIN	WT
410	CECILIA TANK	HARDIN	WT
413	CLEARWELL #2	HARDIN	WT
414	LONGVIEW	HARDIN	WT
415	DOW CORNING TANK	HARDIN	WT
426	CITY SPRINGS	HARDIN	WTP
427	WHITE MILLS	HARDIN	WTP
428	PIRTLE SPRINGS	HARDIN	WTP
429	WEST POINT	HARDIN	WTP
430	MULDRAUGH PLANT	HARDIN	WTP
436	FREEMAN LAKE	HARDIN	WTP
437	FORT KNOX/CENTRAL WTP	HARDIN	WTP
441	VALLEY CREEK WWTP	HARDIN	STP
442	WEST POINT WWTP	HARDIN	STP
443	FT KNOX WWTP	HARDIN	STP
444	RADCLIFF WWTF	HARDIN	STP
446	VINE GROVE WWTP	HARDIN	STP

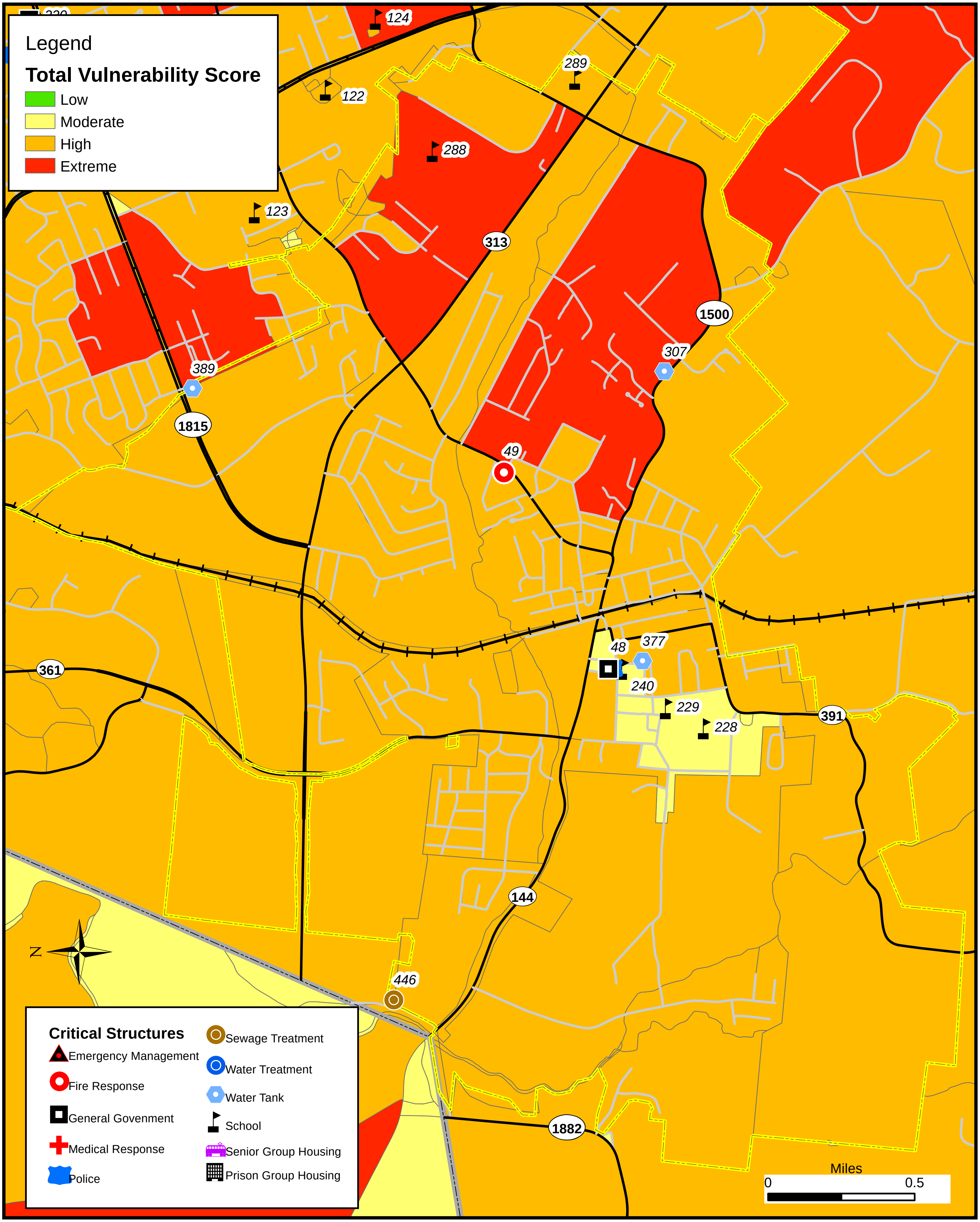

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Fort Knox
N
0
5
Miles

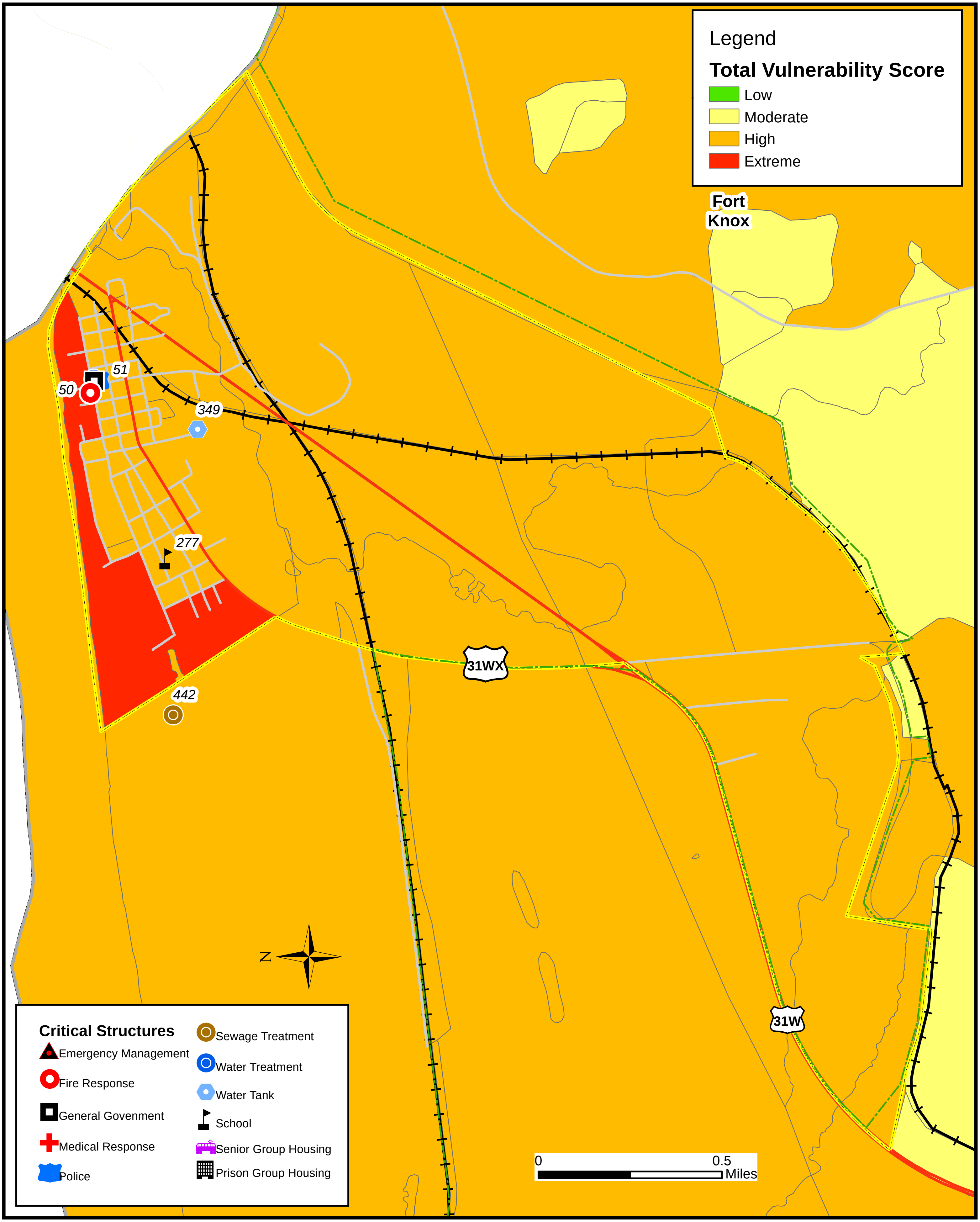

Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
N
0
0.5
1
Miles


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Fort Knox
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
0
0.5
1
Miles
361
1646
1815
313
144
1500
391
377
31W
434
447
284
444
42
220
389
34
123
121
43
122
262
124
288
269
49
48
229
228
307
289
342
237
53
414
246
232
230
231
N


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
84
165
46
219
720
31W
N
0
0.5
1
Miles

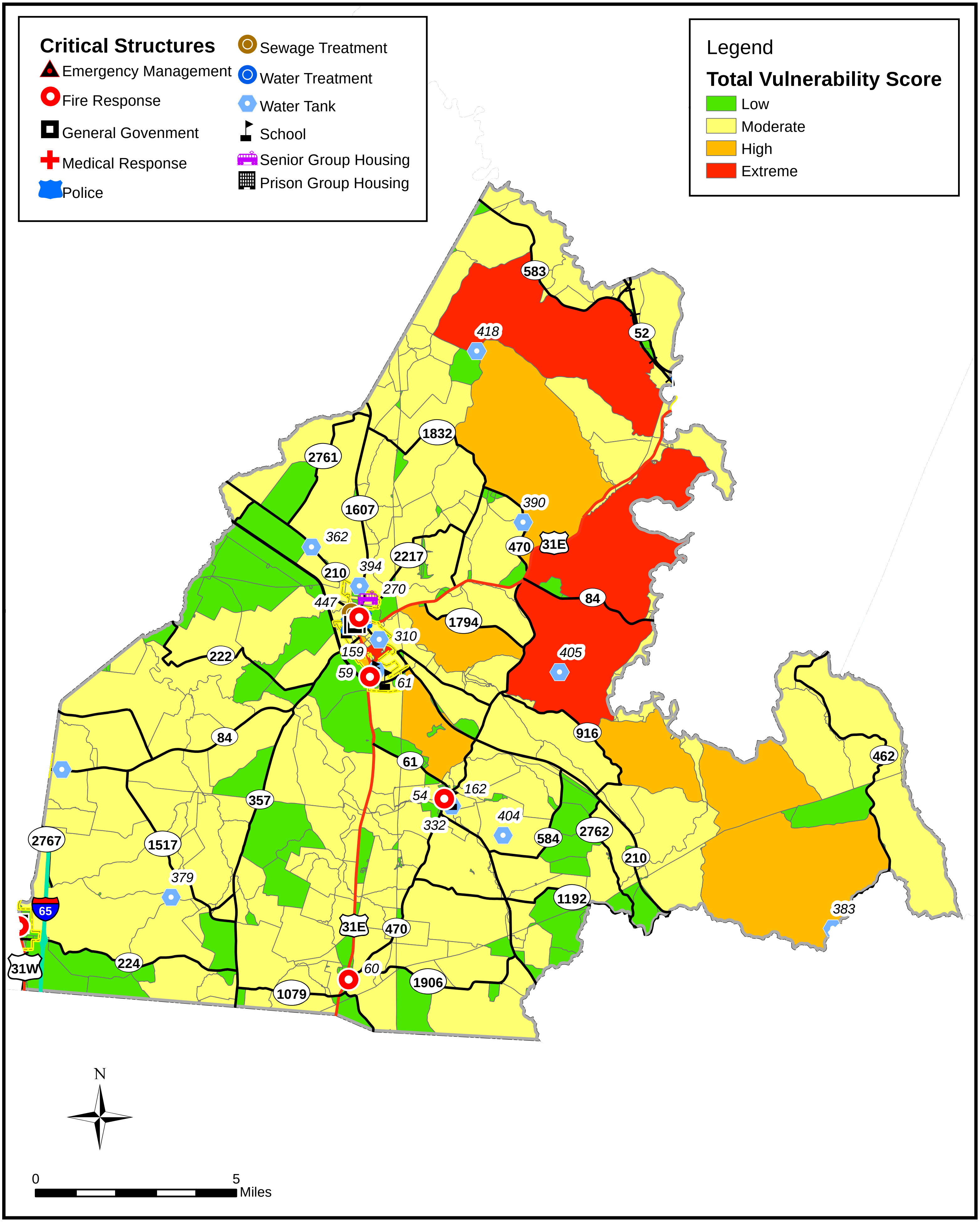

Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
65
31W
163
47
164
224
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
N
0
0.5
Miles

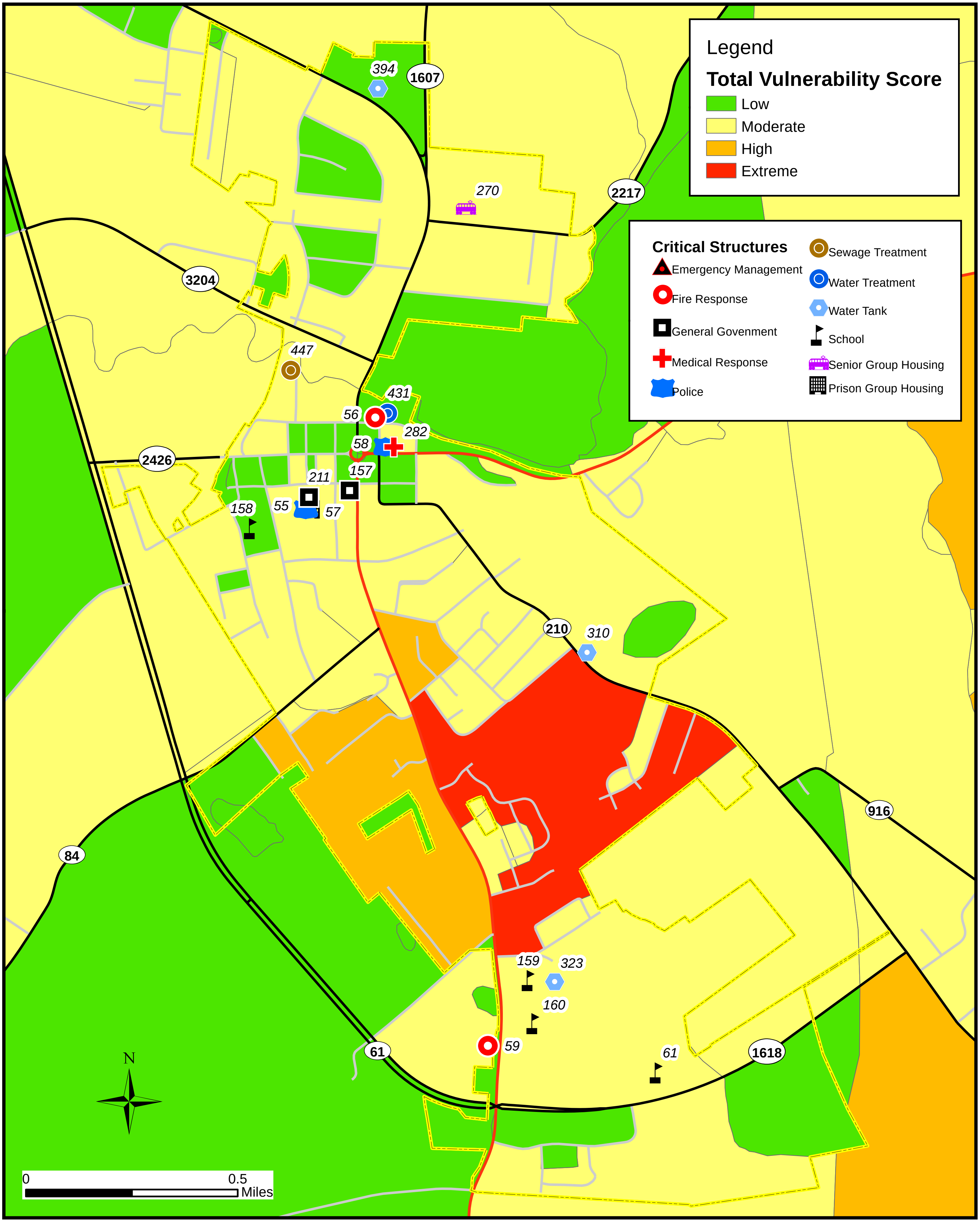

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Miles
0
0.5
N
124
122
289
288
123
313
1500
307
389
1815
49
48
377
240
229
228
391
361
144
446
1882


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Fort Knox
51
50
349
277
442
31WX
31W
N
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
0
0.5
Miles

LaRue County

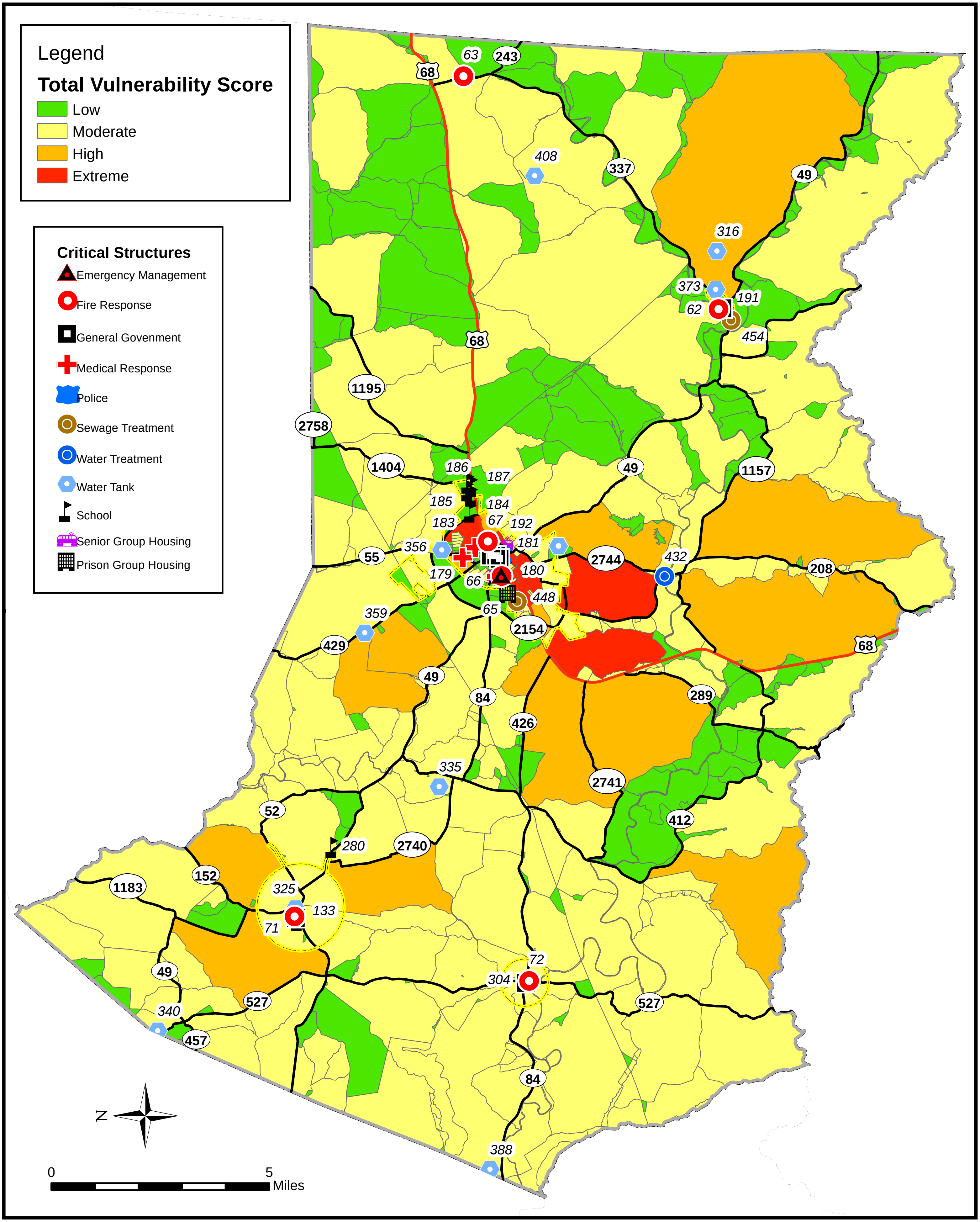
54	BUFFALO FIRE DEPT	LARUE	FIRE RESPONSE
55	LARUE COUNTY SHERIFF	LARUE	POLICE
56	HODGENVILLE FIRE DEPT	LARUE	FIRE RESPONSE
57	LARUE COUNTY JAIL	LARUE	PRISON GROUP HOUSING
58	HODGENVILLE POLICE	LARUE	POLICE
59	LARUE COUNTY FIRE DEPT	LARUE	FIRE RESPONSE
60	MAGNOLIA FIRE DEPT	LARUE	FIRE RESPONSE
61	LARUE COUNTY EMS	LARUE	SCHOOL
157	HODGENVILLE CITY HALL	LARUE	GENERAL GOVENMENT
158	HODGENVILLE ELEMENTARY SCHOOL	LARUE	SCHOOL
159	LARUE COUNTY MIDDLE SCHOOL	LARUE	SCHOOL
160	LARUE COUNTY HIGH SCHOOL	LARUE	SCHOOL
161	MAGNOLIA ELEMENTARY SCHOOL	LARUE	SCHOOL
162	BUFFALO ELEMENTARY SCHOOL	LARUE	SCHOOL
211	LARUE COUNTY COURTHOUSE	LARUE	GENERAL GOVENMENT
270	SUNRISE MANOR	LARUE	SENIOR GROUP HOUSING
282	LARUE COUNTY HEALTH DEPARTMENT	LARUE	MEDICAL RESPONSE
310	FAIRGROUNDS TANK	LARUE	WT
318	NAT RODGERS	LARUE	WT
323	HIGH SCHOOL TANK	LARUE	WT
332	BUFFALO WATER TOWER	LARUE	WT
362	INDUSTRIAL TANK	LARUE	WT
379	WONDERLAND WATER TOWER	LARUE	WT
383	ATTILLA TANK	LARUE	WT
390	WHITE CITY WATER TOWER	LARUE	WT
394	NORTH TANK	LARUE	WT
404	TENNISON RD TANK	LARUE	WT
405	EAST LEAFDALE	LARUE	WT
418	ROANOKE WATER TOWER	LARUE	WT
431	HODGENVILLE	LARUE	WTP
447	HODGENVILLE WWTP	LARUE	STP

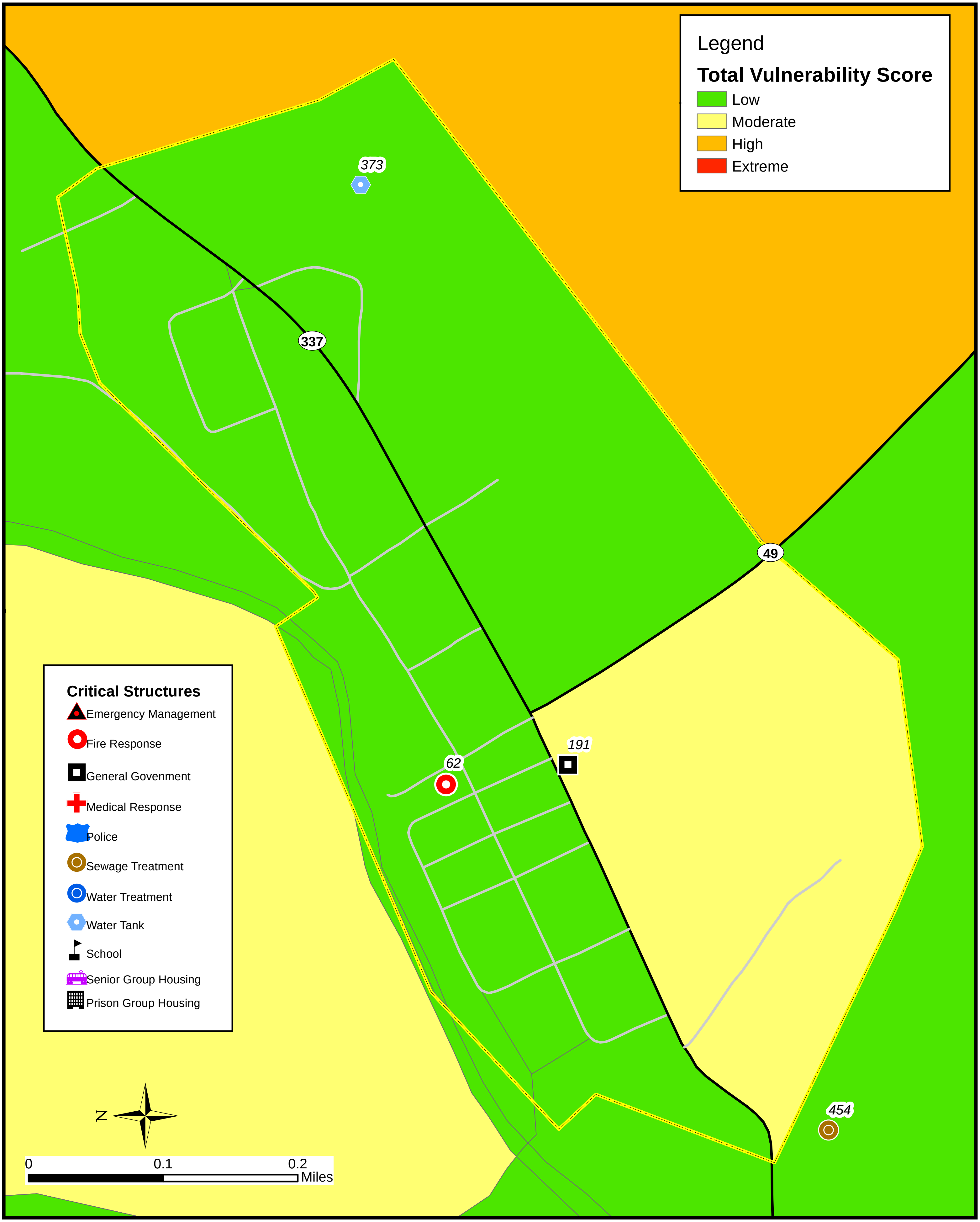

Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
583
52
418
1832
2761
1607
390
470
31E
362
2217
394
210
84
270
447
1794
310
405
159
222
59
61
916
84
462
61
54
162
357
332
404
584
2762
2767
1517
210
379
1192
65
383
31E
470
31W
224
60
1906
1079
N
0
5
Miles

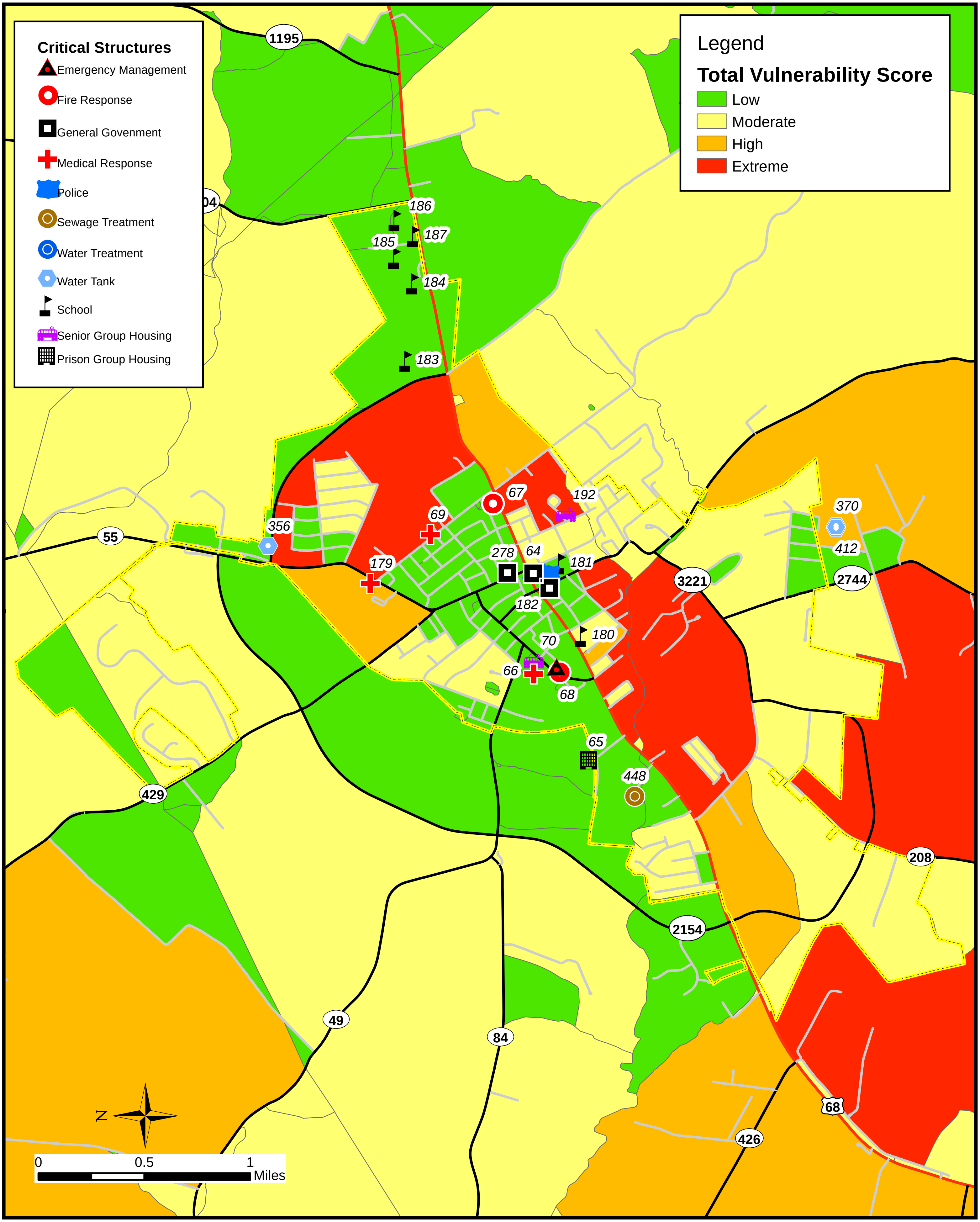

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
394
1607
270
2217
3204
447
431
56
282
58
2426
157
211
158
55
57
210
310
916
84
159
323
160
59
61
61
1618
N
0
0.5
Miles

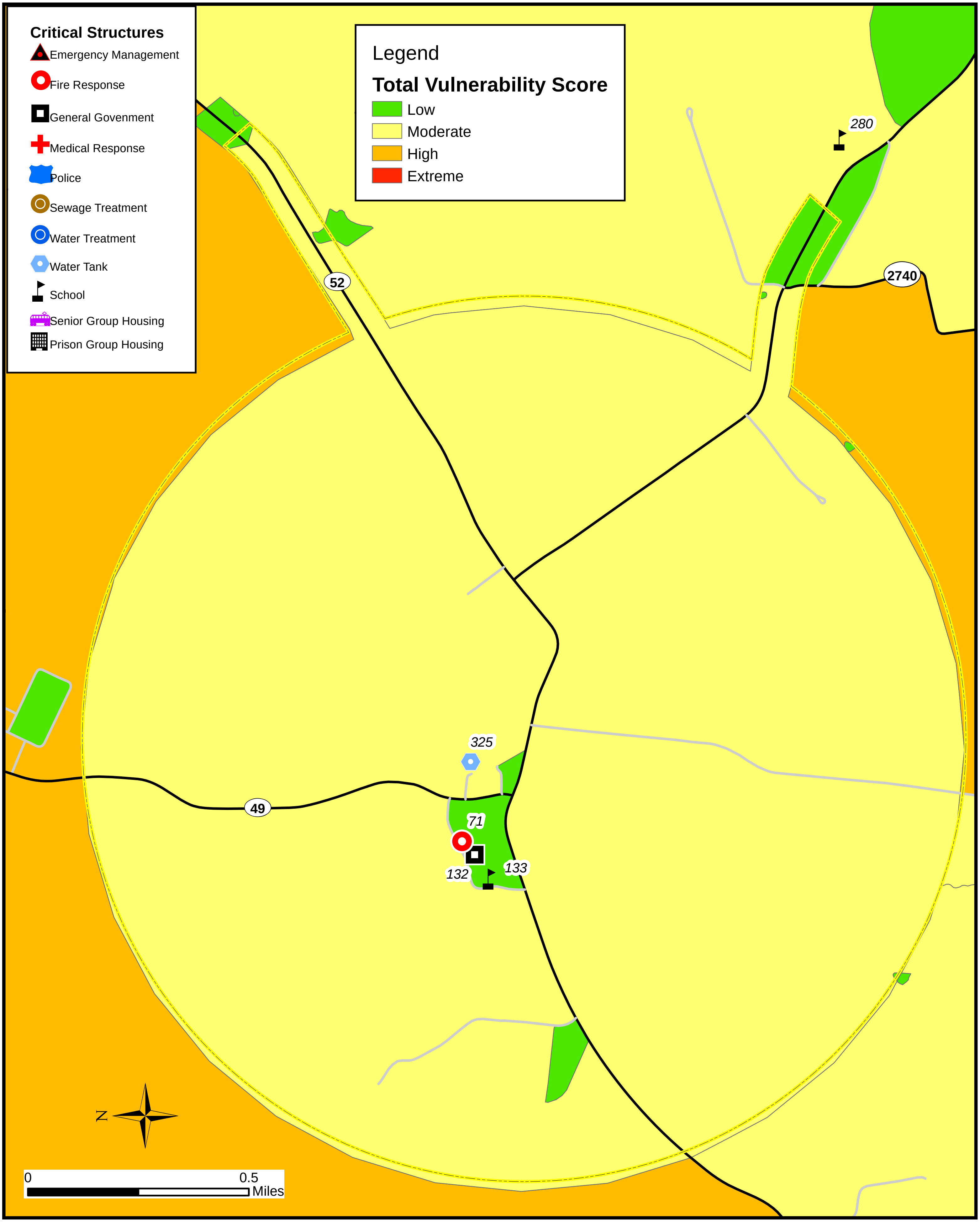
Marion County

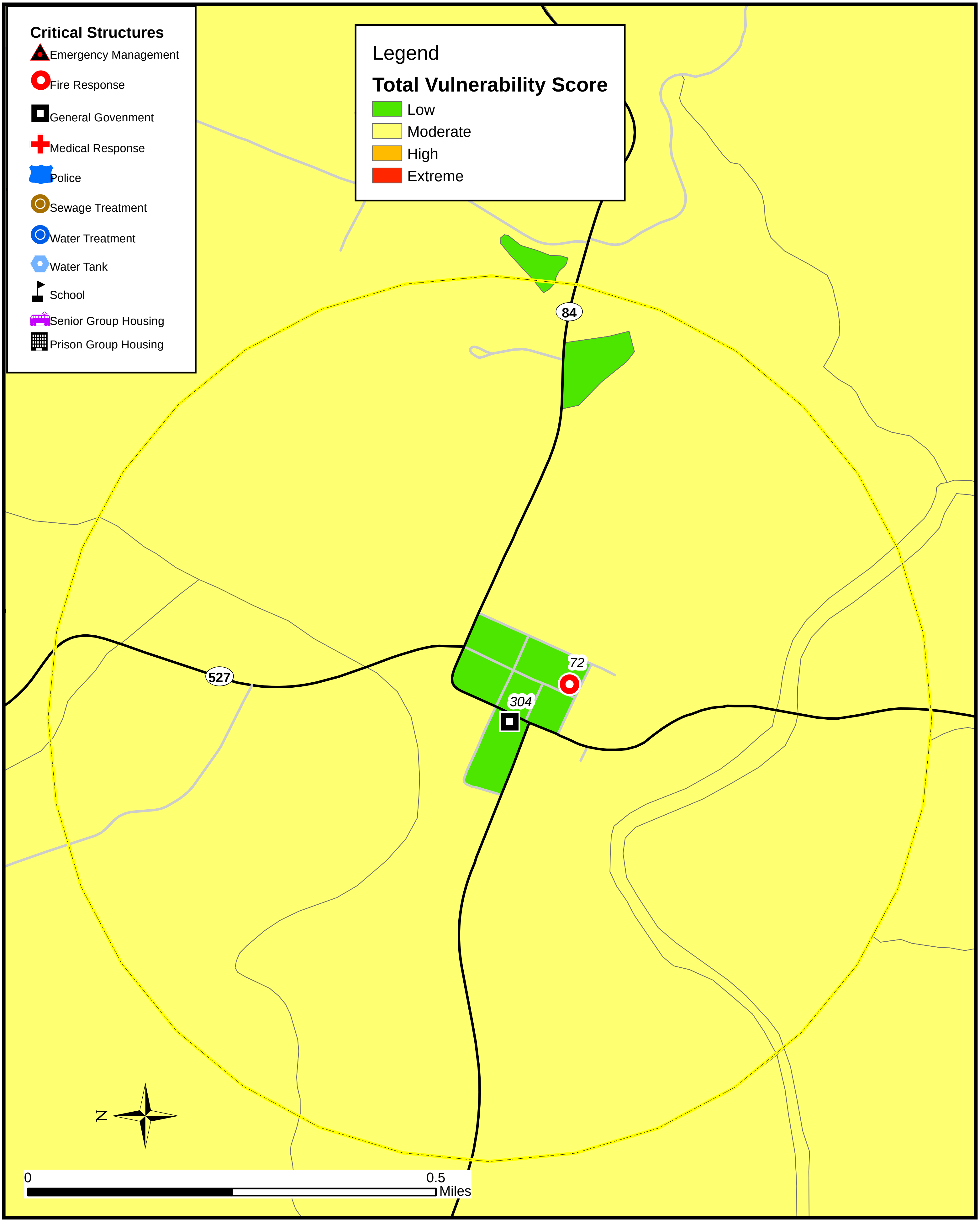
62	BRADFORDSVILLE FIRE DEPT	MARION	FIRE RESPONSE
63	GRAVEL SWITCH FIRE DEPT	MARION	FIRE RESPONSE
64	MARION COUNTY SHERIFF	MARION	POLICE
65	MARION COUNTY JAIL	MARION	PRISON GROUP HOUSING
66	NORTON SPRING VIEW HOSPITAL	MARION	MEDICAL RESPONSE
67	LEBANON FIRE DEPT	MARION	FIRE RESPONSE
68	MARION COUNTY FIRE & RESCUE	MARION	FIRE RESPONSE
69	LIFE FIRST EMERGENCY SERVICE	MARION	MEDICAL RESPONSE
70	NORTON RESTHOME	MARION	SENIOR GROUP HOUSING
71	LORETTO FIRE DEPT	MARION	FIRE RESPONSE
72	RAYWICK FIRE DEPT	MARION	FIRE RESPONSE
132	LORETTO CITY HALL	MARION	GENERAL GOVENMENT
133	ST. FRANCIS OF ASSISI ELEMEMTARY SCHOOL	MARION	SCHOOL
176	LEBANON CITY POLICE STATION	MARION	POLICE
177	MARION COUNTY COURT HOUSE	MARION	GENERAL GOVENMENT
178	MARION COUNTY DISASTER & EMERGENCY SERVICES	MARION	EMERGENCY MANAGEMENT
179	MARION COUNTY HEALTH DEPARTMENT	MARION	MEDICAL RESPONSE
180	LEBANON ELEMENTARY SCHOOL	MARION	SCHOOL
181	ST AUGUSTINE ELEMENTARY SCHOOL	MARION	SCHOOL
182	LEBANON CITY HALL	MARION	GENERAL GOVENMENT
183	LEBANON MIDDLE SCHOOL	MARION	SCHOOL
184	MARION COUNTY AREA TECH CENTER	MARION	SCHOOL
185	MARION COUNTY HIGH SCHOOL	MARION	SCHOOL
186	GLASSCOCK ELEMENTARY SCHOOL	MARION	SCHOOL
187	MARION COUNTY BOARD OF EDUCATION	MARION	SCHOOL
191	BRADFORDSVILLE CITY HALL	MARION	GENERAL GOVENMENT
192	CEDARS OF LEBANON NURSING HOME	MARION	SENIOR GROUP HOUSING
278	JUSTICE CENTER	MARION	GENERAL GOVENMENT
280	WEST MARION ES	MARION	SCHOOL
304	RAYWICK CITY HALL	MARION	GENERAL GOVENMENT
316	HWY 49 (NARROWS)	MARION	WT
325	LORETTO	MARION	WT
335	ST. CHARLES	MARION	WT
340	HOLY CROSS	MARION	WT
356	SPRINGFIELD RD	MARION	WT
359	ST. ROSE TANK	MARION	WT
370	OLD CALVARY RD #2	MARION	WT
373	BRADFORDSVILLE	MARION	WT
388	HWY 84 (GAP KNOB)	MARION	WT
408	RILEY	MARION	WT
412	OLD CALVARY RD #1	MARION	WT
432	LEBANON	MARION	WTP
448	LEBANON WWTP	MARION	STP
454	BRADFORDSVILLE WWTP	MARION	STP


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
0
5
Miles
N


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
373
337
49
191
62
454
N
0
0.1
0.2
Miles

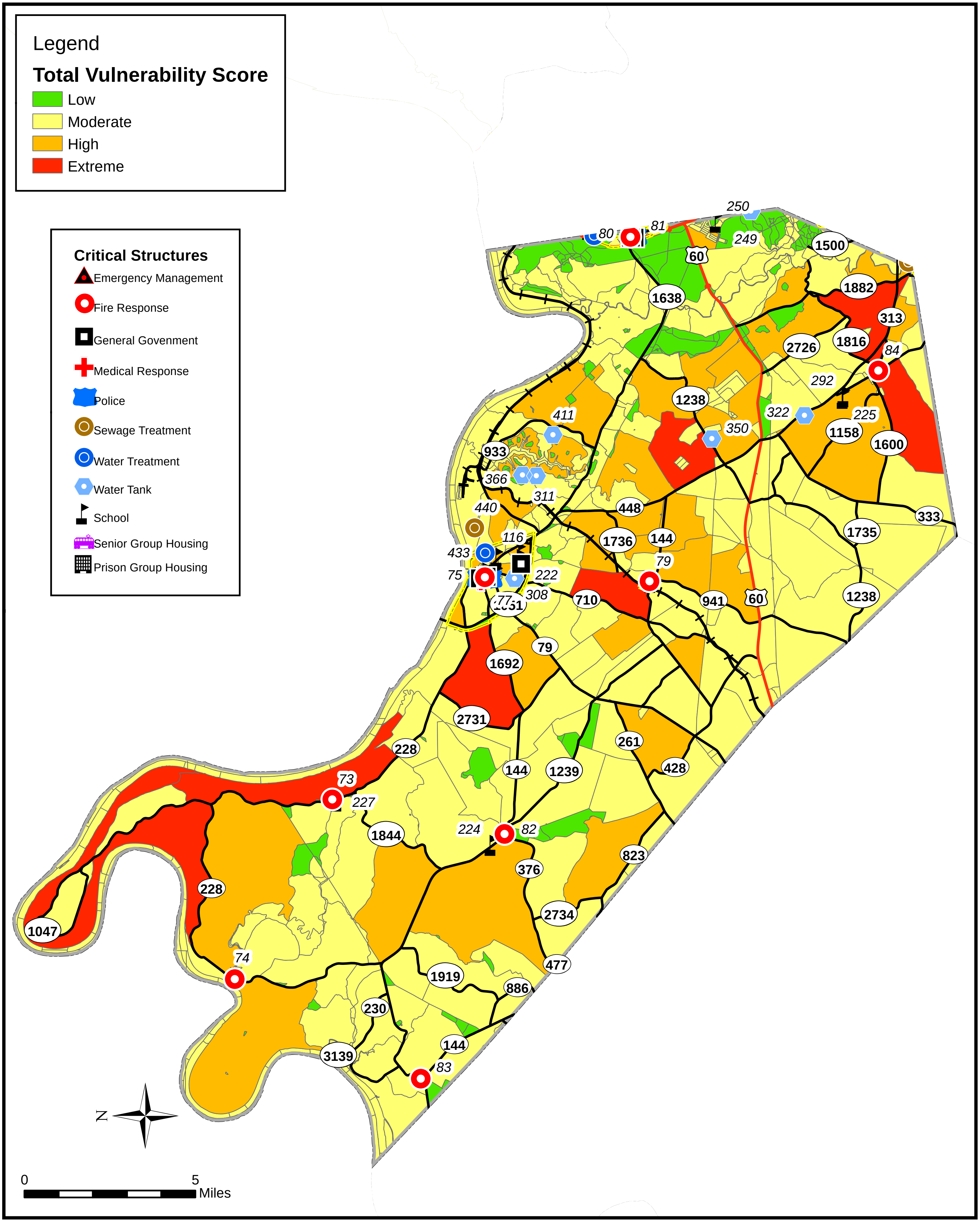

Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
1195
55
429
49
84
2154
3221
2744
208
68
426
186
187
185
184
183
356
69
67
192
179
278
64
181
182
180
70
66
68
65
448
370
412
N
0
0.5
1
Miles

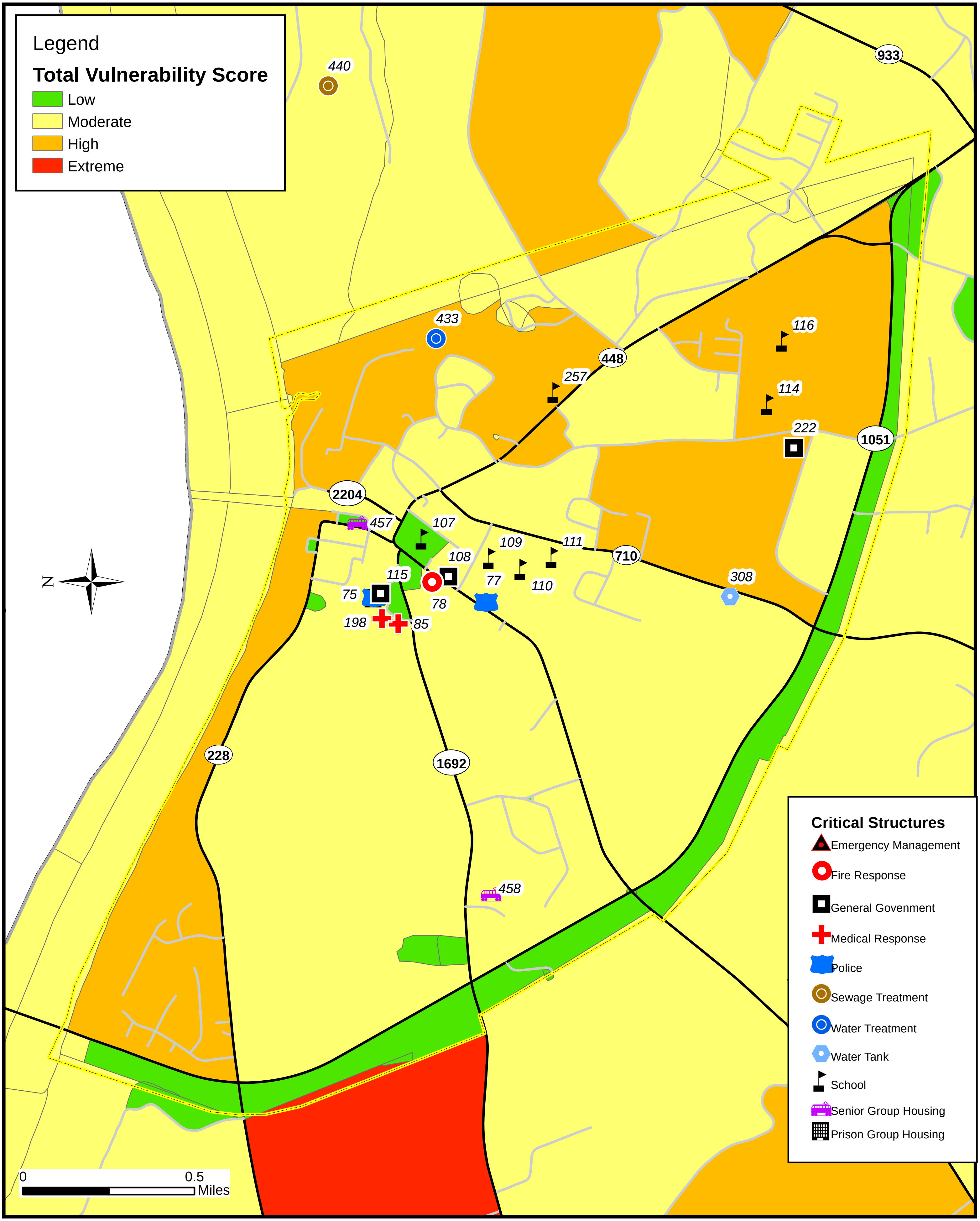

Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
280
2740
52
325
49
71
133
132
N
0
0.5
Miles

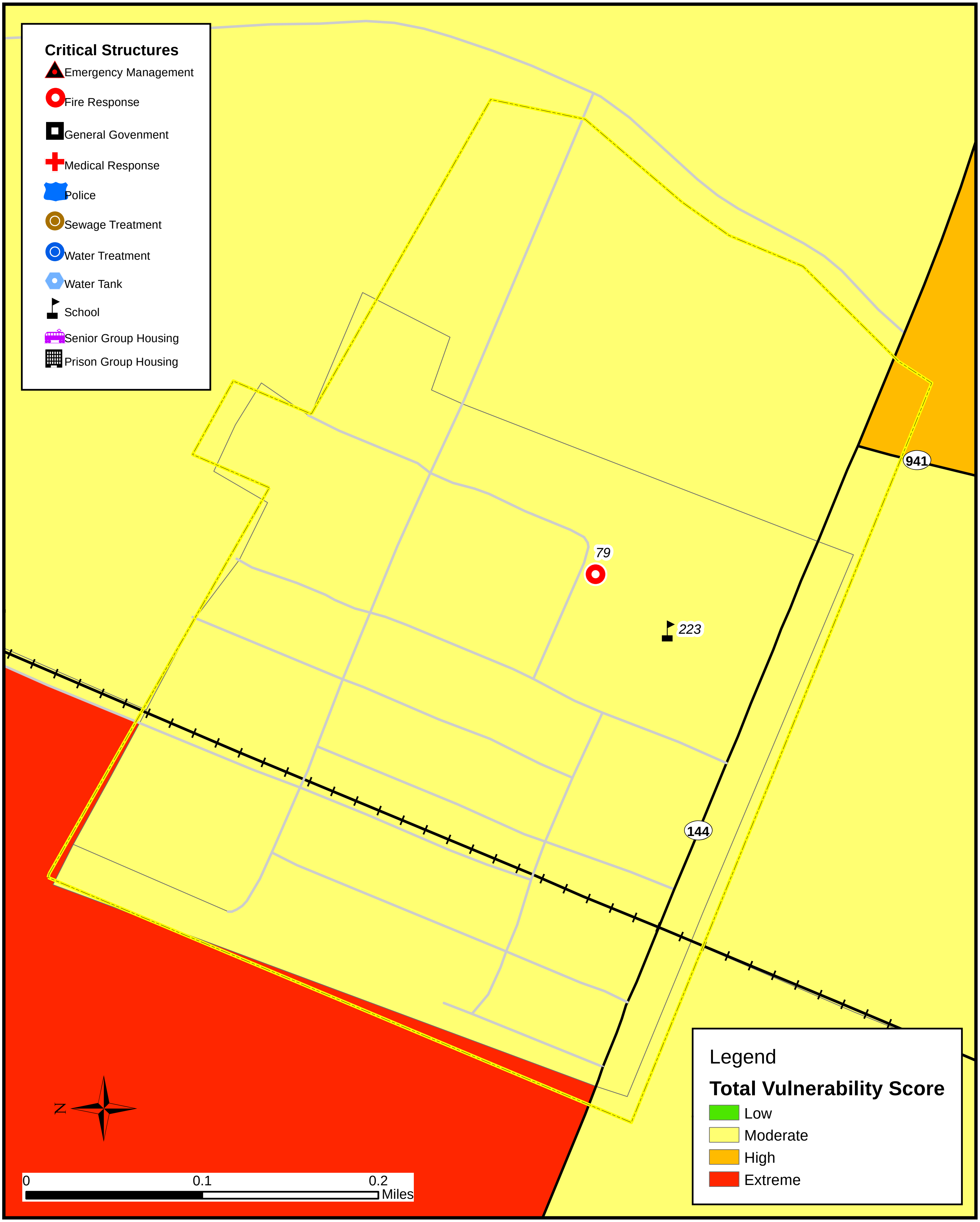

Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
84
527
72
304
N
0
0.5
Miles

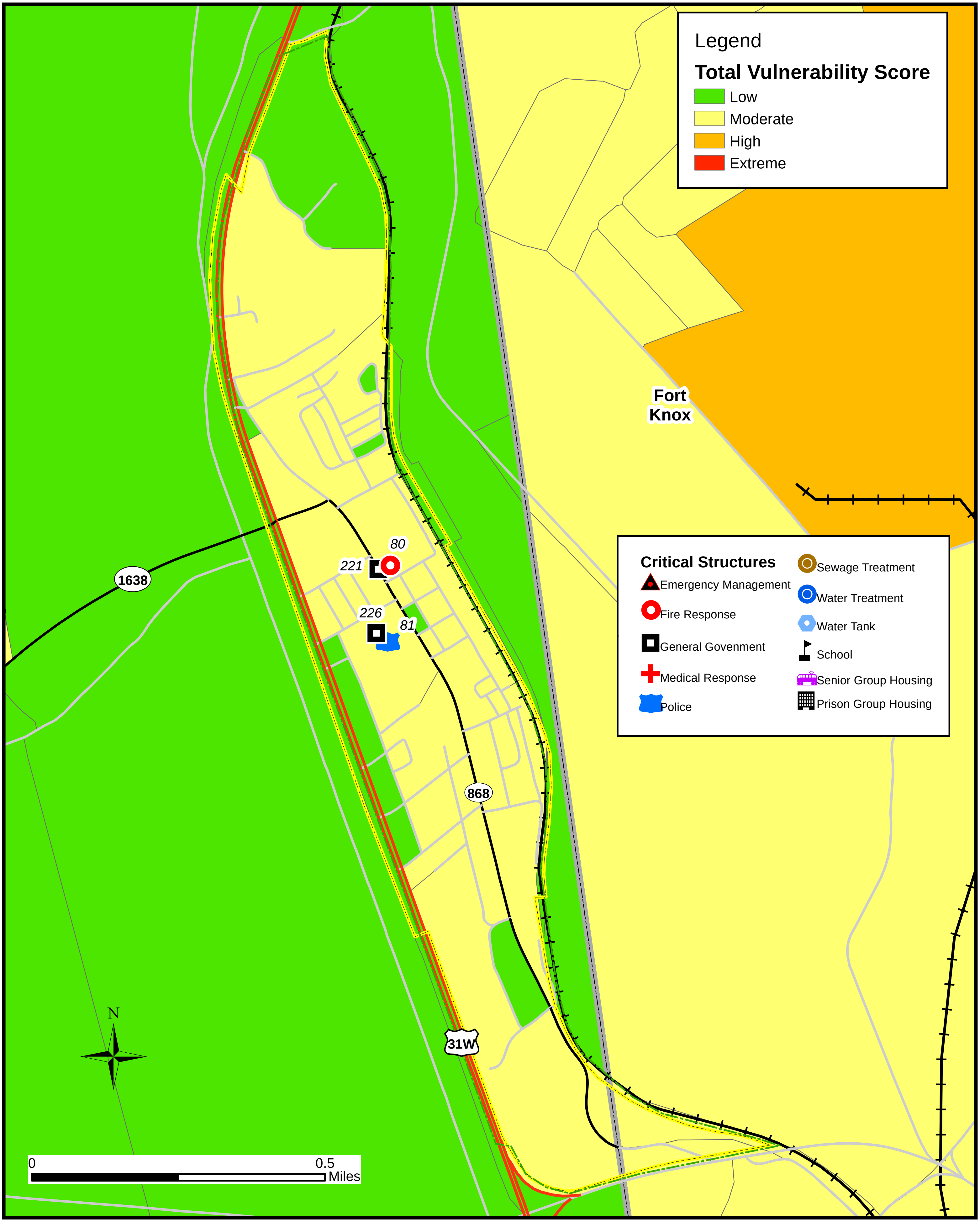
Meade County

73	BATTLETOWN FIRE DEPT	MEADE	FIRE RESPONSE
74	WOLF CREEK FIRE DEPT	MEADE	FIRE RESPONSE
75	MEADE COUNTY SHERIFF	MEADE	POLICE
76	MEADE COUNTY JAIL	MEADE	PRISON GROUP HOUSING
77	BRANDENBURG POLICE	MEADE	POLICE
78	MEADE COUNTY FIRE DEPT	MEADE	FIRE RESPONSE
79	EKRON FIRE DEPT	MEADE	FIRE RESPONSE
80	MULDRAUGH FIRE DEPT	MEADE	FIRE RESPONSE
81	MULDRAUGH POLICE	MEADE	POLICE
82	PAYNEVILLE FIRE DEPT	MEADE	FIRE RESPONSE
83	RHODELIA FIRE DEPT	MEADE	FIRE RESPONSE
84	FLAHERTY FIRE DEPT	MEADE	FIRE RESPONSE
85	MEADE COUNTY EMS	MEADE	MEDICAL RESPONSE
107	BRANDENBURG CENTRAL ELEMENTARY SCHOOL	MEADE	SCHOOL
108	BRANDENBURG CITY HALL	MEADE	GENERAL GOVENMENT
109	MEADE COUNTY VOCATIONAL SCHOOL	MEADE	SCHOOL
110	JAMES R. ALLEN ELEMENTRY SCHOOL	MEADE	SCHOOL
111	MEADE COUNTY HIGH SCHOOL	MEADE	SCHOOL
114	STUART PEPPER MIDDLE SCHOOL	MEADE	SCHOOL
115	MEADE COUNTY COURTHOUSE	MEADE	GENERAL GOVENMENT
116	BRANDENBURG ELEMENTARY SCHOOL	MEADE	SCHOOL
198	MEADE COUNTY HEALTH DEPARTMENT	MEADE	MEDICAL RESPONSE
221	MULDRAUGH STORM SHELTER	MEADE	GENERAL GOVENMENT
222	NATIONAL GUARD ARMORY	MEADE	GENERAL GOVENMENT
223	EKRON ELEMENTARY SCHOOL	MEADE	SCHOOL
224	PAYNEVILLE ELEMENTARY SCHOOL	MEADE	SCHOOL
225	FLAHERTY ELEMENTARY SCHOOL	MEADE	SCHOOL
226	MULDRAUGH CITY HALL	MEADE	GENERAL GOVENMENT
227	BATTLETOWN ELEMENTARY SCHOOL	MEADE	SCHOOL
250	VAN VOORHIS ELEMENTARY	MEADE	SCHOOL
257	ST. JOHN THE APOSTLE ELEMENTARY SCHOOL	MEADE	SCHOOL
292	FLAHERY PRIMARY SCHOOL	MEADE	SCHOOL
308	HIGH PRESSURE TANK	MEADE	WT
311	WATER TANK #1	MEADE	WT
322	FLAHERTY TANK	MEADE	WT
350	GARRETT	MEADE	WT
366	STANDPIPE TANK	MEADE	WT
395	PAYNEVILLE	MEADE	WT
411	WATER TANK #2	MEADE	WT
433	BARNEY JOHNSON	MEADE	WTP
440	BRANDENBURG WWTP	MEADE	STP
457	ALL ABOUT HOME ASSISTED LIVING	MEADE	SENIOR GROUP HOUSING
458	BEEHIVE ASSISTED LIVING	MEADE	SENIOR GROUP HOUSING


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
N
0
5
Miles


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
N
0
0.5
Miles
933
448
2204
1051
710
228
1692
440
433
257
116
114
222
457
107
108
109
111
115
77
110
308
75
78
198
85
458


Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
79
223
941
144
N
0
0.1
0.2
Miles
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme

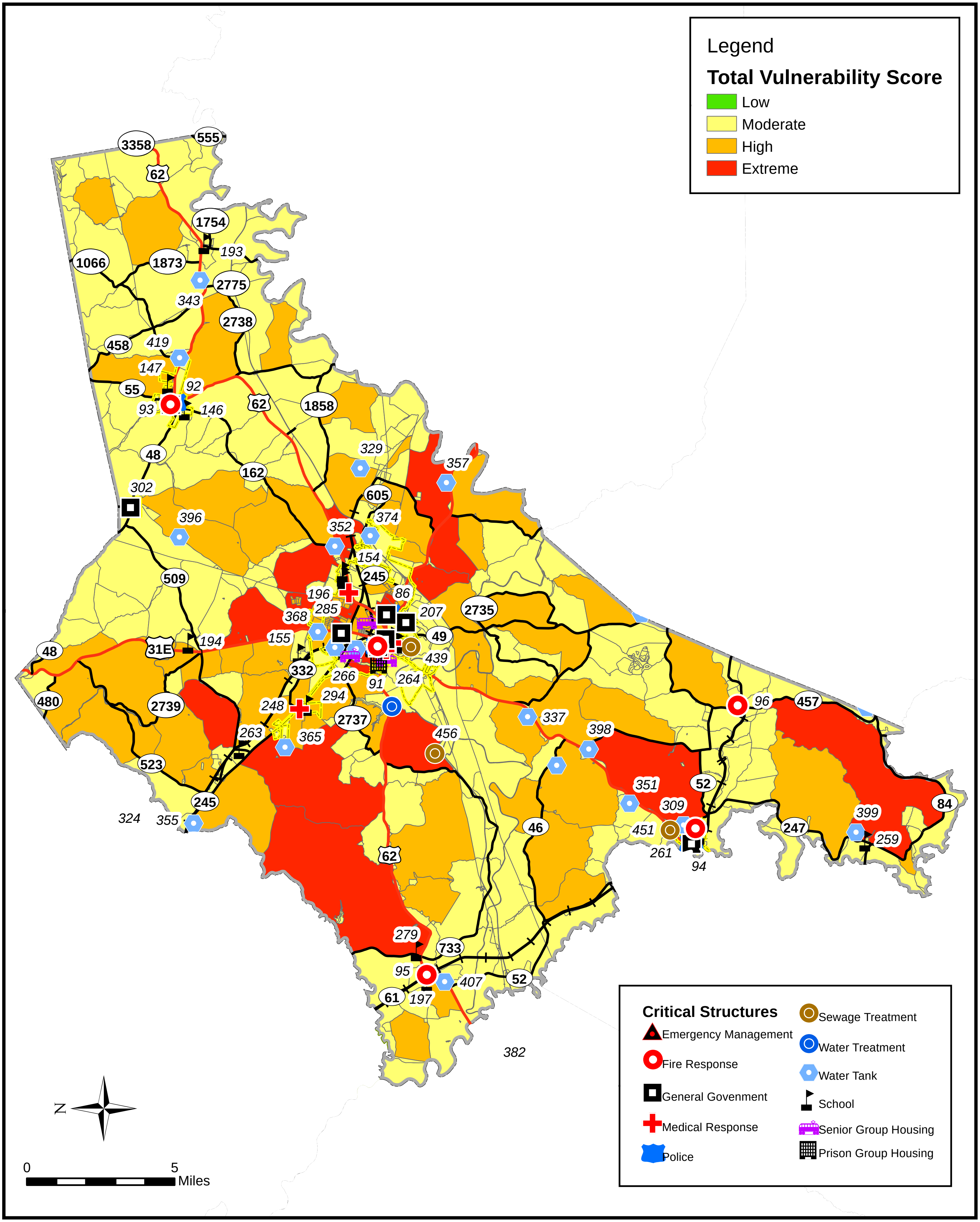

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Fort Knox
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
80
221
226
81
1638
868
31W
N
0
0.5
Miles

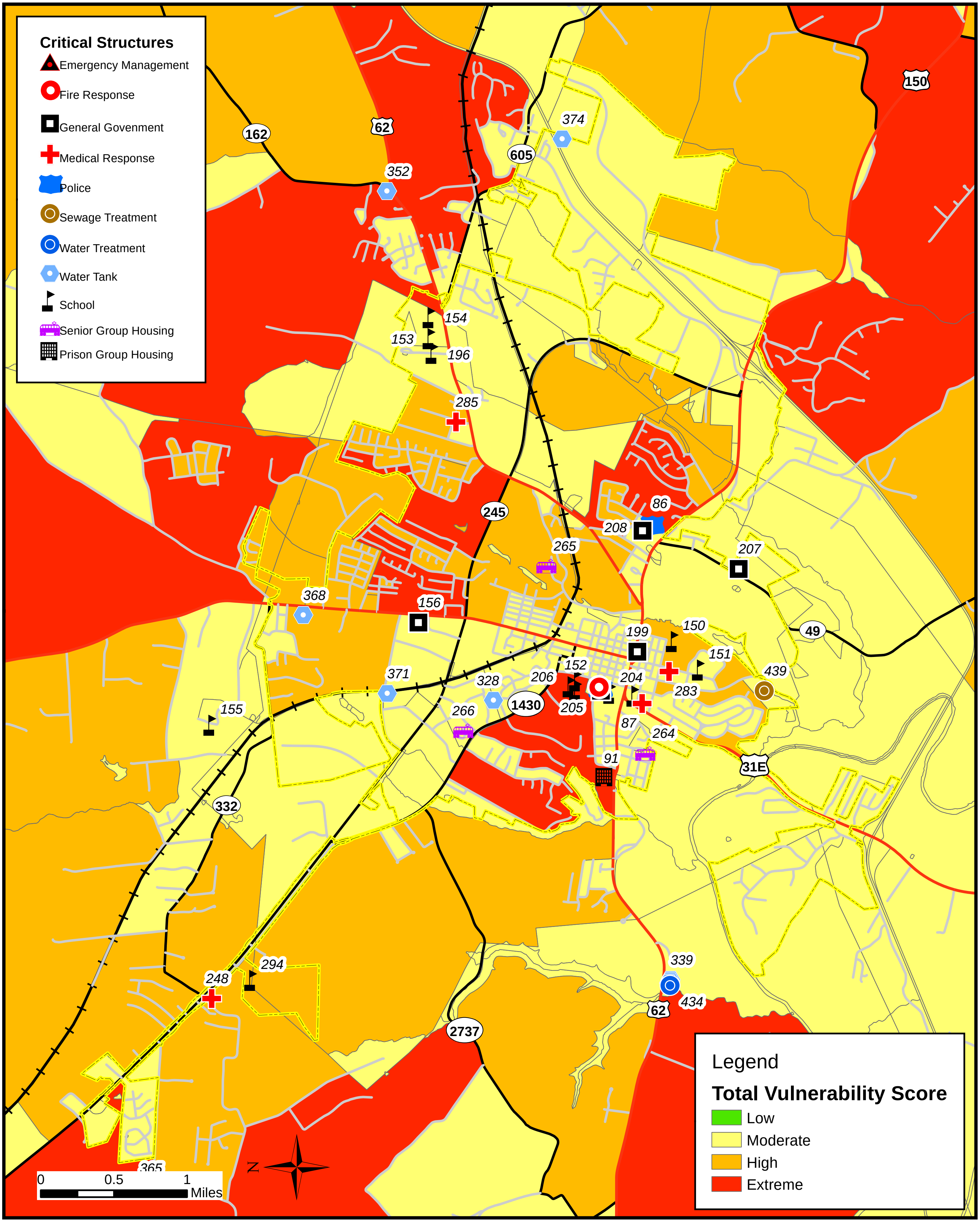
Nelson County

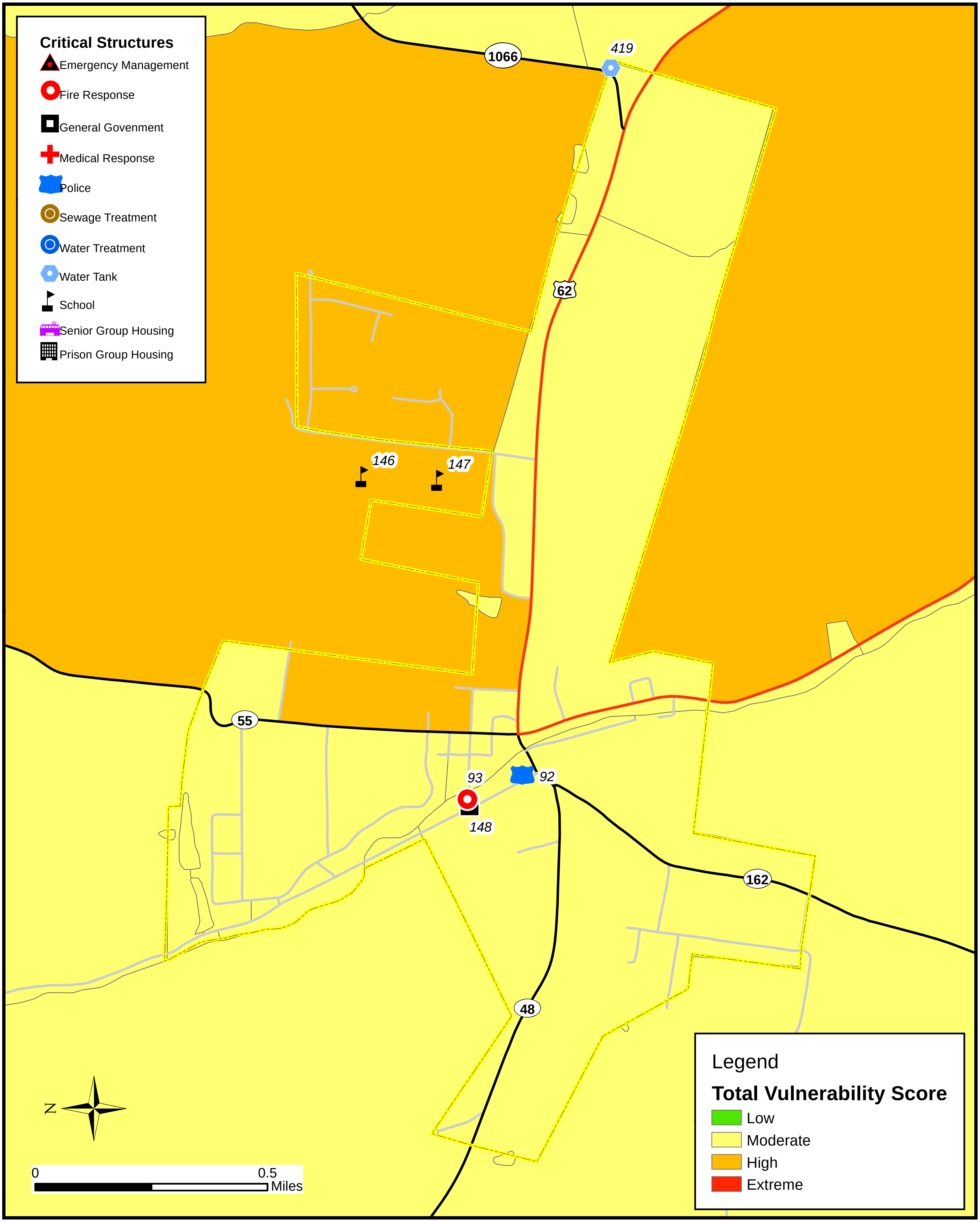
86	NELSON COUNTY SHERIFF	NELSON	POLICE
87	FLAGET MEMORIAL HOSPITAL	NELSON	MEDICAL RESPONSE
88	BARDSTOWN POLICE	NELSON	POLICE
89	BARDSTOWN VFD	NELSON	FIRE RESPONSE
90	BARDSTOWN-NELSON COUNTY FIRE DEPT	NELSON	FIRE RESPONSE
91	NELSON COUNTY JAIL	NELSON	PRISON GROUP HOUSING
92	BLOOMFIELD POLICE	NELSON	POLICE
93	NORTHEAST NELSON VFD	NELSON	FIRE RESPONSE
94	NEW HAVEN POLICE	NELSON	POLICE
95	BOSTON VFD	NELSON	FIRE RESPONSE
96	NEW HOPE FIRE DEPT	NELSON	FIRE RESPONSE
97	ROLLING FORK FIRE DEPT	NELSON	FIRE RESPONSE
134	NEW HAVEN CITY HALL	NELSON	GENERAL GOVENMENT
135	NEW HAVEN MS	NELSON	SCHOOL
146	E. L. BROWN JR. ELEMENTARY SCHOOL	NELSON	SCHOOL
147	BLOOMFIELD MIDDLE SCHOOL	NELSON	SCHOOL
148	BLOOMFIELD CITY HALL	NELSON	GENERAL GOVENMENT
149	BETHLEHEM HIGH SCHOOL	NELSON	SCHOOL
150	FOSTER HEIGHTS ES	NELSON	SCHOOL
151	ST. MONICKS ELEMENTARY SCHOOL	NELSON	SCHOOL
152	BARDSTOWN HIGH SCHOOL	NELSON	SCHOOL
153	NELSON COUNTY VOCATIONAL SCHOOL	NELSON	SCHOOL
154	NELSON COUNTY HIGH SCHOOL	NELSON	SCHOOL
155	SPALDING COLLEGE EXTENSION CENTER	NELSON	SCHOOL
156	NATIONAL GUARD ARMORY	NELSON	GENERAL GOVENMENT
174	BARDSTOWN CITY HALL	NELSON	GENERAL GOVENMENT
175	NEW HAVEN FIRE DEPARTMENT	NELSON	FIRE RESPONSE
193	CHAPLIN ES	NELSON	SCHOOL
194	COX'S CREEK ES	NELSON	SCHOOL
195	NEW HAVEN ES	NELSON	SCHOOL
196	OLD KENTUCKY HOME MS	NELSON	SCHOOL
197	BOSTON ES	NELSON	SCHOOL
199	NELSON COUNTY GOVENMENT	NELSON	GENERAL GOVENMENT
204	SAINT JOSEPH ELEMENTARY SCHOOL	NELSON	SCHOOL
205	BARDSTOWN ELEMENTARY SCHOOL	NELSON	SCHOOL
206	BARDSTOWN MIDDLE SCHOOL	NELSON	SCHOOL
207	NELSON COUNTY NATIONAL GUARD	NELSON	GENERAL GOVENMENT
208	NELSON COUNTY JUSTICE CENTER	NELSON	GENERAL GOVENMENT
248	FLAGET MEMORIAL HOSPITAL	NELSON	MEDICAL RESPONSE
259	ST. ANN ELEMENTARY SCHOOL	NELSON	SCHOOL
261	ST. CATHERINE TRI-PARISH SCHOOL	NELSON	SCHOOL
263	ST. GREGORY ELEMENTARY SCHOOL	NELSON	SCHOOL
264	COLONIAL HOUSE NURSING HOME	NELSON	SENIOR GROUP HOUSING
265	FEDERAL HILL MANOR NURSING HOME	NELSON	SENIOR GROUP HOUSING
266	WINDSOR GARDENS ASSISTED LIVING	NELSON	SENIOR GROUP HOUSING
279	BOSTON ES	NELSON	SCHOOL
283	NELSON COUNTY HEALTH DEPARTMENT	NELSON	MEDICAL RESPONSE
285	NELSON COUNTY EMS	NELSON	MEDICAL RESPONSE
294	THOMAS NELSON HIGH SCHOOL	NELSON	SCHOOL
302	FAIRFIELD CITY HALL	NELSON	GENERAL GOVENMENT
309	INDIAN HILLS	NELSON	WT
317	CLEARWELL TANK	NELSON	WT
324	KY 1604	NELSON	WT
328	245 TANK	NELSON	WT
329	WIRE LN	NELSON	WT
337	BALLTOWN TANK	NELSON	WT
339	CLEARWELL TANK	NELSON	WT
343	CHAPLIN	NELSON	WT
351	VITTITOW	NELSON	WT
352	EAST BARDSTOWN TANK	NELSON	WT
355	WELLER LOOP	NELSON	WT
357	BOTLAND TANK	NELSON	WT
365	LUTHERAN CHURCH RD	NELSON	WT
368	FAIRGROUNDS TANK	NELSON	WT
371	INDUSTRIAL PARK	NELSON	WT
374	WOODLAWN SPRINGS/INDUSTRIAL	NELSON	WT
382	HARDIN COUNTY TANK	NELSON	WT
385	CLEARWELL TANK	NELSON	WT
396	MURRAY'S RUN	NELSON	WT
398	CULVERTOWN	NELSON	WT

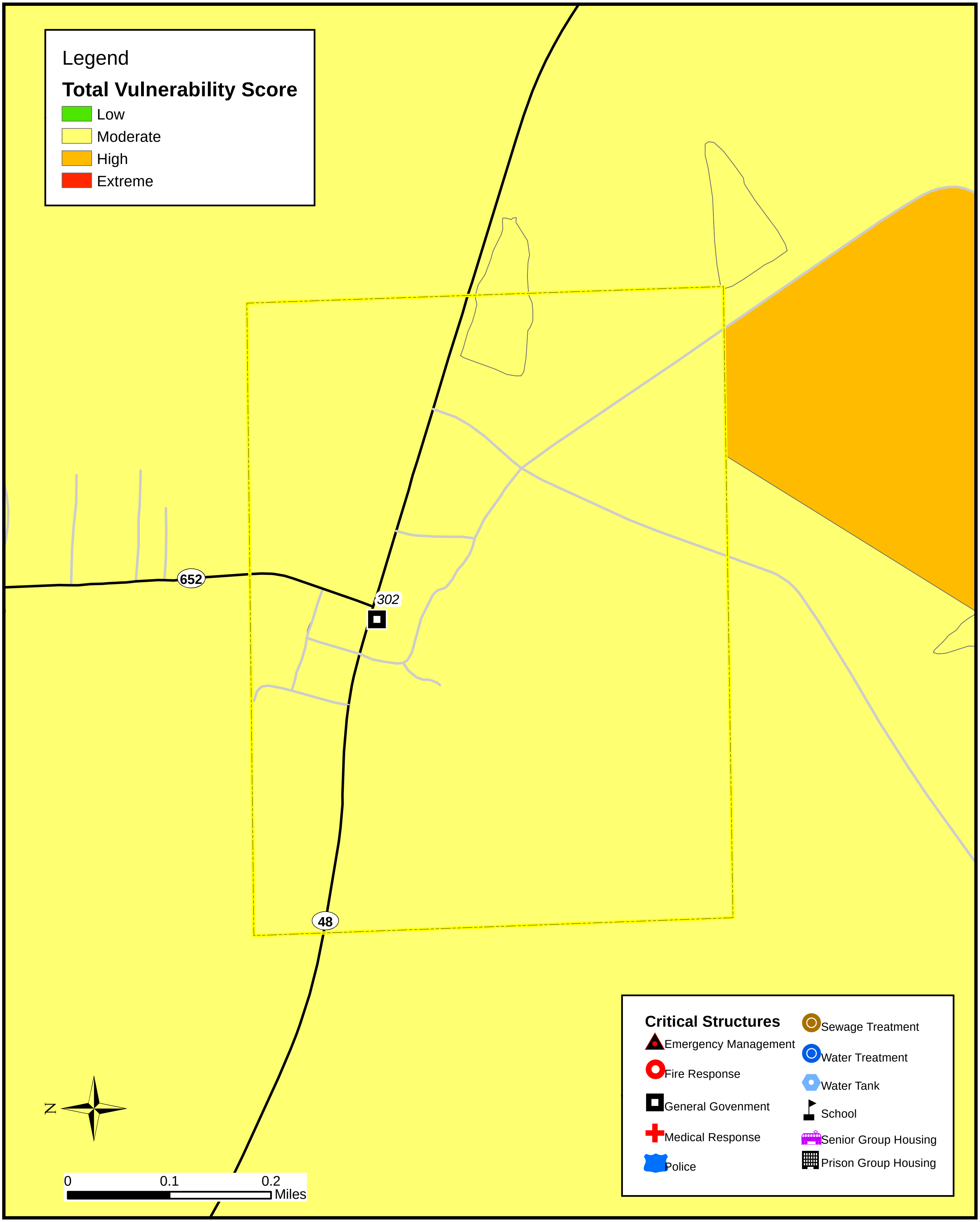
Nelson County (cont.)

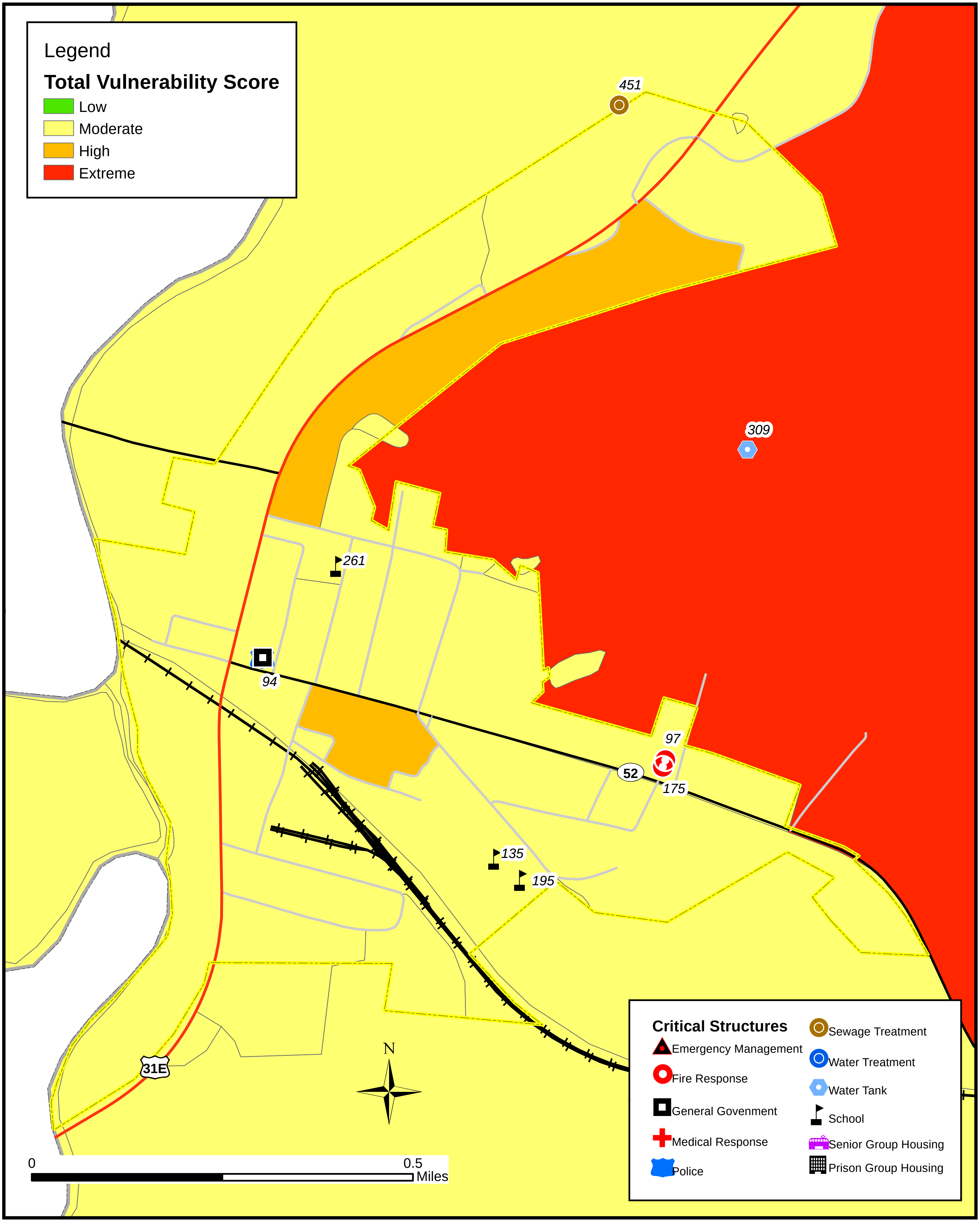
399	HOWARDSTOWN TANK	NELSON	WT
407	BOSTON TANK	NELSON	WT
419	BLOOMFIELD	NELSON	WT
434	SYMPSON LAKE	NELSON	WTP
439	BARDSTOWN WWTP	NELSON	STP
451	NEW HAVEN WWTP	NELSON	STP
456	JERRY L RILEY WWTP	NELSON	STP


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
N
0
5
Miles


Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
0
0.5
1
Miles
N
162
62
605
150
245
49
1430
332
31E
2737
62
374
352
154
153
196
285
86
208
265
207
368
156
199
150
151
439
152
204
283
371
328
206
205
266
155
87
264
91
339
434
294
248
365

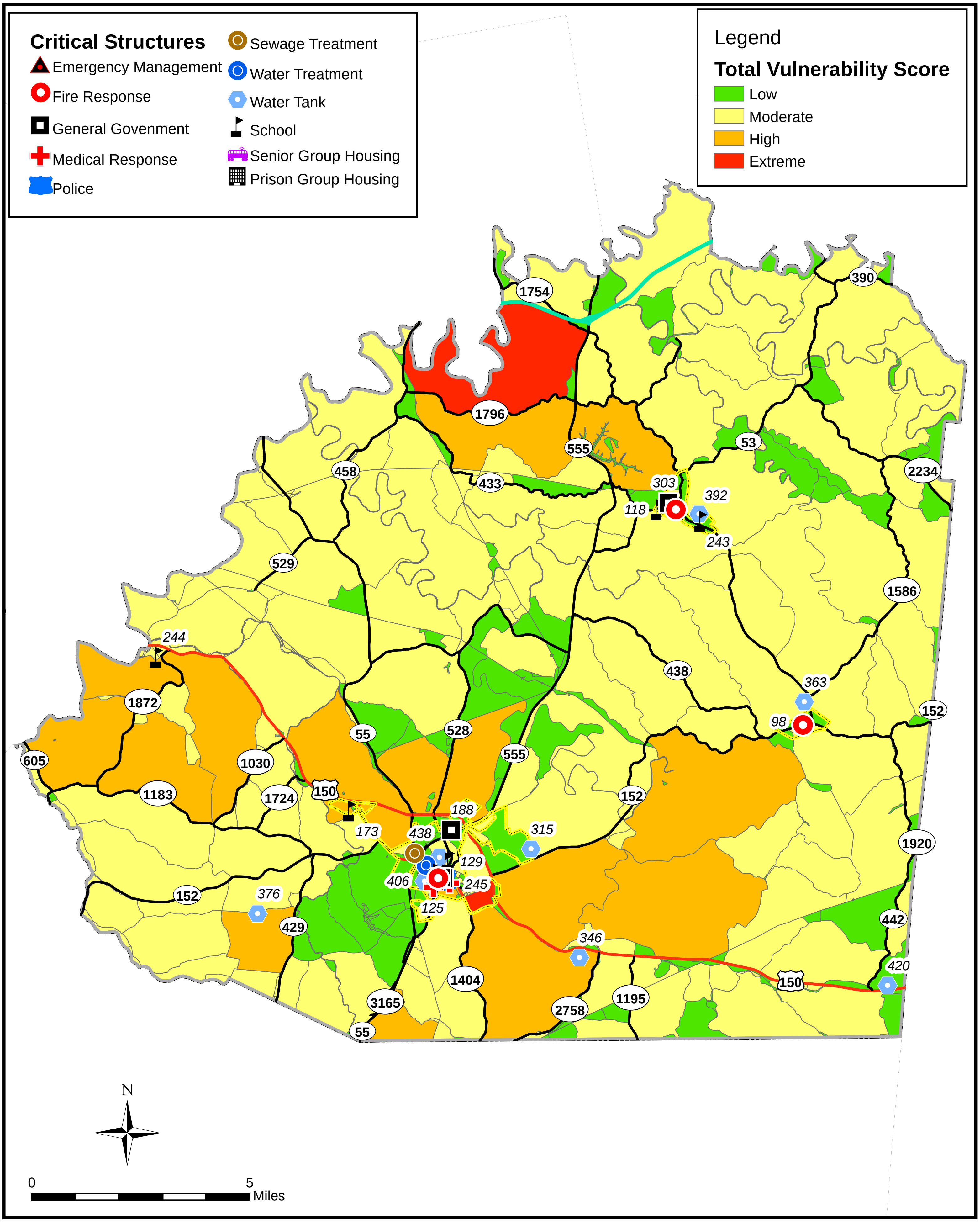

Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
1066
419
62
146
147
55
93
92
148
162
48
N
0
0.5
Miles
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme

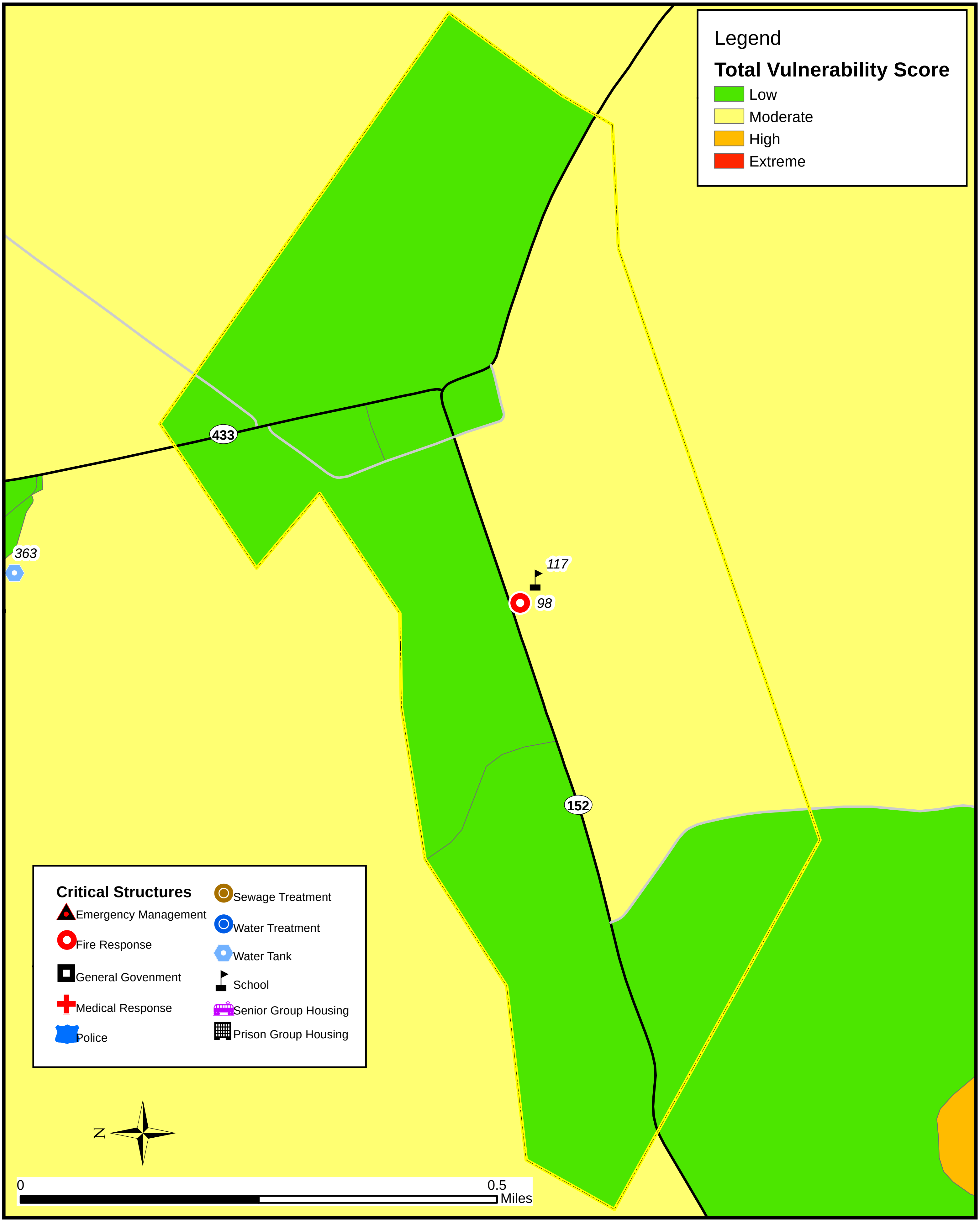

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
652
302
48
N
0
0.1
0.2
Miles
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing

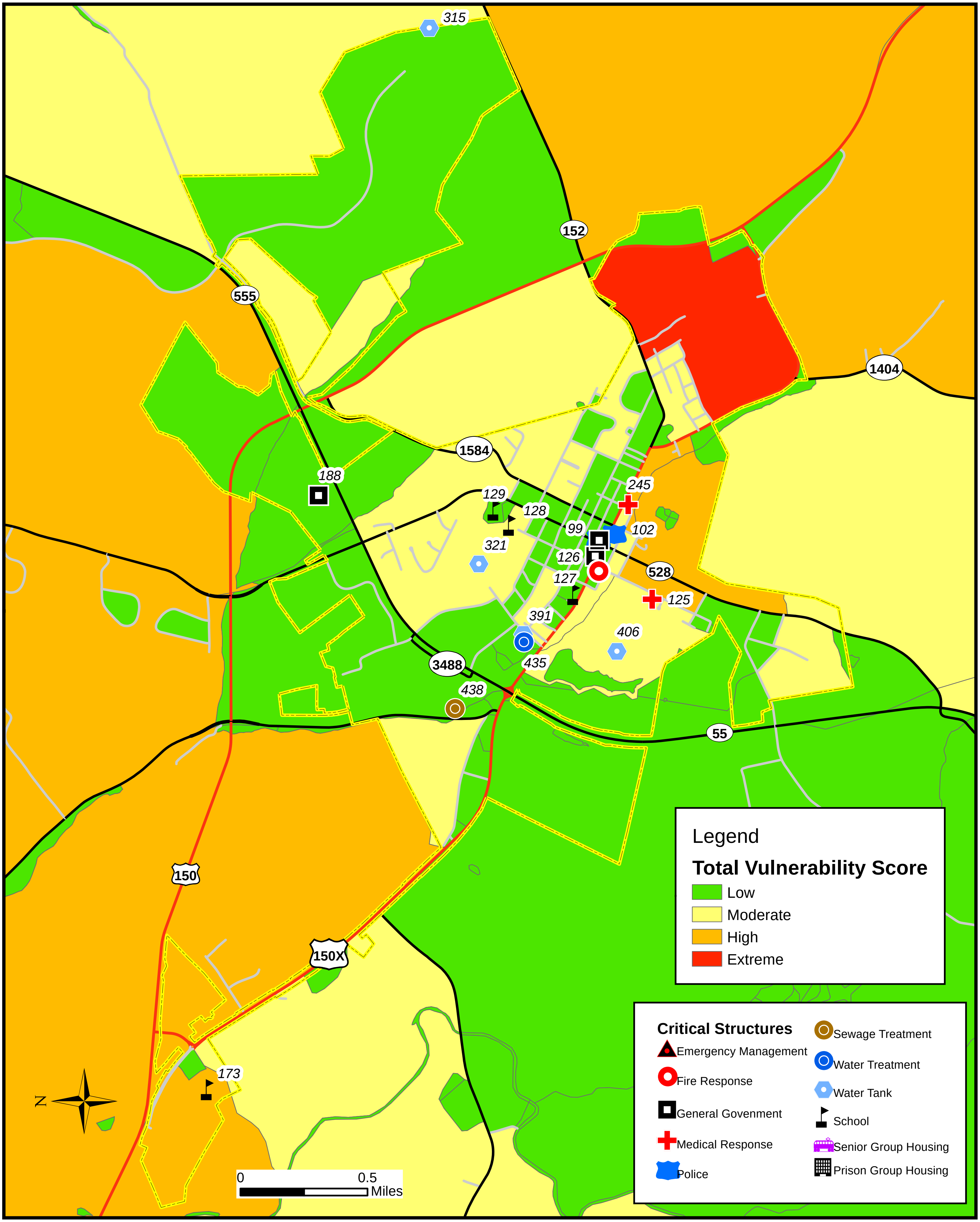

Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
451
309
261
94
97
52
175
135
195
31E
N
0
0.5
Miles
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing

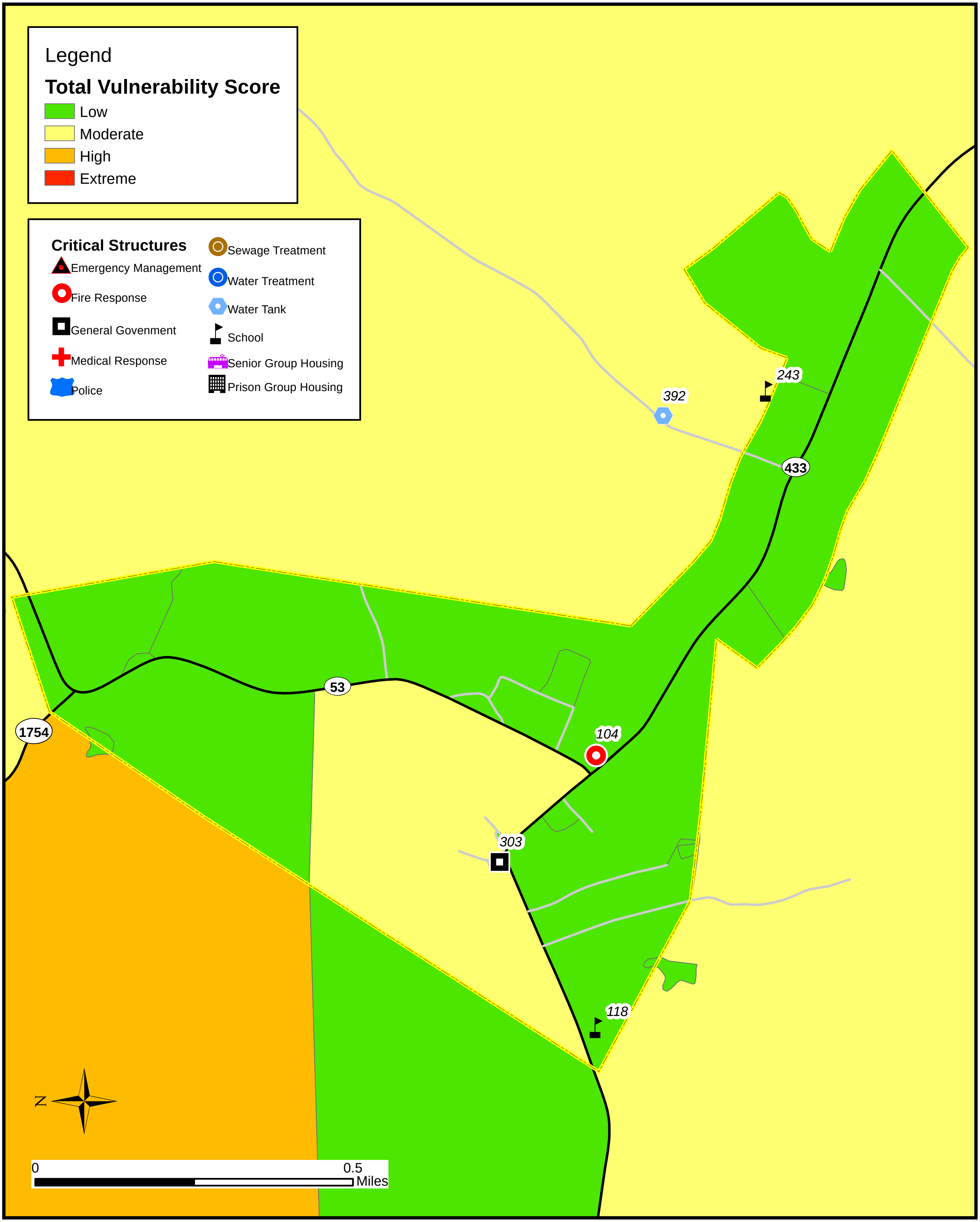
Washington County

98	MACKVILLE FIRE DEPT	WASHINGTON	FIRE RESPONSE
99	WASHINGTON COUNTY SHERIFF	WASHINGTON	POLICE
100	SPRINGFIELD FIRE DEPT	WASHINGTON	FIRE RESPONSE
101	WASHINGTON COUNTY FIRE DEPT	WASHINGTON	FIRE RESPONSE
102	SPRINGFIELD POLICE	WASHINGTON	POLICE
103	WASHINGTON COUNTY JAIL	WASHINGTON	PRISON GROUP HOUSING
104	WILLISBURG FIRE DEPT	WASHINGTON	FIRE RESPONSE
117	MACKVILLE ELEMENTARY SCHOOL	WASHINGTON	SCHOOL
118	CENTRAL KENTUCKY YOUTH ACADEMY	WASHINGTON	SCHOOL
125	WASHINGTON COUNTY EMS	WASHINGTON	MEDICAL RESPONSE
126	SPRINGFIELD CITY HALL	WASHINGTON	GENERAL GOVENMENT
127	ST. DOMINIC SCHOOL	WASHINGTON	SCHOOL
128	SPRINGFIELD ELEMENTARY SCHOOL	WASHINGTON	SCHOOL
129	WASHINGTON COUNTY HIGH SCHOOL	WASHINGTON	SCHOOL
173	ST. CATHERINE COLLEGE	WASHINGTON	SCHOOL
188	NATIONAL GUARD ARMORY	WASHINGTON	GENERAL GOVENMENT
212	WASHINGTON COUNTY COURTHOUSE	WASHINGTON	GENERAL GOVENMENT
243	NORTH WASHINGTON ELEMENTARY SCHOOL	WASHINGTON	SCHOOL
244	FREDERICKTOWN ELEMENTARY SCHOOL	WASHINGTON	SCHOOL
245	WASHINGTON COUNTY HEALTH OFFICE	WASHINGTON	MEDICAL RESPONSE
303	WILLSIBURG CITY HALL	WASHINGTON	GENERAL GOVENMENT
315	INDUSTRIAL PARK	WASHINGTON	WT
321	HIGH SCHOOL	WASHINGTON	WT
346	SIMMSTOWN	WASHINGTON	WT
363	MACKVILLE	WASHINGTON	WT
376	OLD ELIZABETHTOWN RD	WASHINGTON	WT
391	WTP TANK	WASHINGTON	WT
392	WILLISBURG	WASHINGTON	WT
406	ARMORY HILL	WASHINGTON	WT
420	WESLEY CHAPEL	WASHINGTON	WT
435	SPRINGFIELD	WASHINGTON	WTP
438	SPRINGFIELD WATER AND SEWER COMMISSION	WASHINGTON	STP


Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
1754
390
1796
555
53
2234
458
433
303
392
118
243
529
1586
244
438
363
1872
152
98
605
55
528
555
1030
1183
1724
150
152
188
173
438
315
1920
129
406
245
125
152
376
429
442
346
420
150
1404
1195
3165
2758
55
N
0
5
Miles


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
433
363
117
98
152
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
N
0
0.5
Miles


315
152
555
1404
1584
188
129
128
245
99
102
321
126
528
127
125
391
406
435
3488
438
55
150
150X
173
N
0
0.5
Miles
Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing


Legend
Total Vulnerability Score
Low
Moderate
High
Extreme
Critical Structures
Emergency Management
Fire Response
General Govenment
Medical Response
Police
Sewage Treatment
Water Treatment
Water Tank
School
Senior Group Housing
Prison Group Housing
243
392
433
53
1754
104
303
118
N
0
0.5
Miles

II. **Loss Estimation: Potential and Actual Losses**

Losses can be reviewed and evaluated in terms of actual past losses and potential future losses. They can include not only human life, physical structures, crops, etc. but also many other economic factors such as lost rents, wages and production. The overall lack of data pertaining to structures/assets and their values does not allow us to generate a comprehensive loss analysis. In order to evaluate and run scenarios on a "typical" disaster for a specific area and review the data on a micro level, this information would have to be converted into block or zip code level data.

Therefore the loss estimation will be based on past event losses and compiled at a higher level than might be desired. The economic and human costs are given for each of the six primary focus hazards and broken out by county with a regional summary. The averages for any particular event or year are assumed to be the estimated loss. The factor of population and economic growth over time, would cause the loss estimates to continue to rise without implementation of any mitigation measures. A review of the data available is contained in the following tables.

Potential losses takes into account the known values of structures in relation to their vulnerability to type and extent of a specific event.

The data in the tables below is gathered from numerous sources and defined as follows:

The structure sources for each county vary. LTADD maintains a critical structure GIS layer of various facilities including, EOC's, Police & Fire Stations, Government Buildings, Hospitals, Water and Wastewater Utility infrastructure, Schools, Airports, and many other miscellaneous buildings. In addition, LTADD has access to point structure data from many of the individual county's 911 systems. This includes Breckinridge, Hardin (partial), LaRue, Marion, Meade and Washington. The data was collected between 2008 and 2015, depending on the county. The LTADD staff also used GPS to map structures located in floodplains for Grayson, Hardin, Meade and Nelson Counties in 2010. All this data was compared against the landslide and flood plain polygon datasets in a GIS program to generate an approximate count of residences within each of the county's landslide and flood plain hazard areas. This data is used for estimate purposes only and should not be considered definitive or complete counts.

For consistency, Residential and Mobile Home facilities counts are based on US Census, American Community Survey 2013 5-year estimates for Total Housing Units. Data represents the total Housing Unit count minus the percentage figure of Mobile Homes to reach the values for each.

Replacement value for homes is from the US Census "Median value of owner-occupied housing units, 2009-1013" ACS data.

Replacement value for other features was not updated due to the lack of available information.

Table 3.3.4.8 - Current inventory of existing structures and their potential loss estimate by County/City

Jurisdiction	Type of Facility	# of Existing Structures	Estimated Replacement Value Per Unit	Total Potential Loss	# of Existing Structures in Floodplain	Potential Loss in Floodplain	# of Existing Structures in Landslide Prone Area	Potential Loss in Landslide Prone Area
Breckinridge County	Residential	7,610	$82,700	$629,347,000	302	$24,975,400	230	$19,021,000
Cloverport Hardinsburg Irvington	Mobile Homes	2,982	$23,464	$69,969,648	9	$211,176	52	$1,220,128
	Emergency Operations Center	1	$100,000	$100,000	0	$0	0	$0
	Radio Station or Transmitter	2	$98,000	$196,000	0	$0	0	$0
	Fire Station	9	$500,000	$4,500,000	1	$500,000	0	$0
	Police Station	4	$1,372,000	$5,488,000	1	$1,372,000	0	$0
	Government Building[1]	8	$0	$6,900,000	1	$0	0	$0
	Hospital	1	$3,430,000	$3,430,000	0	$0	0	$0
	Sewage Treatment Plant	3	$62,268,000	$186,804,000	0	$0	0	$0
	Water Treatment Plant	1	$32,634,000	$32,634,000	0	$0	0	$0
	Pumping Stations	6	$75,000	$450,000	0	$33,750,000,000	0	$0
	Wells	3	$150,000	$450,000	0	$0	0	$0
	Storage Tanks	12	$750,000	$9,000,000	0	$0	0	$0
	Schools	10	$3,825,000	$38,250,000	0	$0	0	$0
	Air Ports	1	$10,651,000	$10,651,000	0	$0	0	$0
	Natural Gas Facilities	1	$1,068,200	$1,068,200	0	$0	0	$0
	Power Plants/Oil Refineries	0	$0	$0	0	$0	0	$0
County Total		**10,654**	**$117,027,364**	**$999,237,848**	**314**	**$33,777,058,576**	**282**	**$20,241,128**

1 Due to disparity in building sizes unit cost not available

Jurisdiction	Type of Facility	# of Existing Structures	Estimated Replacement Value Per Unit	Total Potential Loss	# of Existing Structures in Floodplain	Potential Loss in Floodplain	# of Existing Structures in Landslide Prone Area	Potential Loss in Landslide Prone Area
Grayson County	Residential[1]	10,380	$87,700	$910,326,000	65	$5,700,500	1	0
Caneyville Clarkson Leitchfield	Mobile Homes	3,126	$14,747	$46,099,122	NA	0	NA	0
	Emergency Operations Center	1	$100,000	$100,000	0	0	0	0
	Radio Station or Transmitter	2	$98,000	$196,000	0	0	0	0
	Fire Station	8	$500,000	$4,000,000	0	0	0	0
	Police Station	4	$1,372,000	$5,488,000	0	0	0	0
	Government Building[2]	7	$0	$6,900,000	0	0	0	0
	Hospital	1	$6,860,000	$6,860,000	0	0	0	0
	Sewage Treatment Plant	3	$62,268,000	$186,804,000	0	0	0	0
	Water Treatment Plant	2	$32,634,000	$65,268,000	0	0	0	0
	Pumping Stations	10	$75,000	$750,000	1	$75,000	0	0
	Wells	0	$150,000	$0	0	0	0	0
	Storage Tanks	15	$750,000	$11,250,000	0	0	0	0
	Schools	8	$7,883,000	$63,064,000	0	0	0	0
	Air Ports	2	$10,651,000	$21,302,000	0	0	0	0
	Natural Gas Facilities	0	$0	$0	0	0	0	0
	Power Plants/Oil Refineries	0	$0	$0	0	0	0	0
County Totals		**13,569**	**$123,443,447**	**$1,328,407,122**	**66**	**$5,775,500**		

1 Limited data. Only Floodplain structures are mapped.

2 Due to disparity in building sizes unit cost not available

Jurisdiction	Type of Facility	# of Existing Structures	Estimated Replacement Value Per Unit	Total Potential Loss	# of Existing Structures in Floodplain	Potential Loss in Floodplain	# of Existing Structures in Landslide Prone Area	Potential Loss in Landslide Prone Area
Hardin County	Residential[1]	39,262	$140,600	$5,520,237,200	863	$121,337,800	22	$3,093,200
Elizabethtown Radcliff Sonora Upton Vine Grove West Point	Mobile Homes[2]	4,949	$17,519	$86,701,531	101	$1,769,419	NA	0
	Emergency Operations Center	3	$100,000	$300,000	0	0	0	0
	Radio Station or Transmitter	8	$98,000	$784,000	0	0	0	0
	Fire Station	19	$500,000	$9,500,000	1	$500,000	0	0
	Police Station	5	$1,372,000	$6,860,000	2	$2,744,000	0	0
	Government Building*	14	$0	$15,100,000	2	$0	0	0
	Hospital	2	$10,290,000	$20,580,000	0	0	0	0
	Sewage Treatment Plant	6	$62,268,000	$373,608,000	2	$124,536,000	0	0
	Water Treatment Plant	4	$32,634,000	$130,536,000	2	$65,268,000	0	0
	Pumping Stations	14	$75,000	$1,050,000	0	$0	0	0
	Wells	2	$150,000	$300,000	2	$300,000	0	0
	Storage Tanks	26	$750,000	$19,500,000	1	$750,000	0	0
	Schools	39	$6,441,000	$251,199,000	0	$0	0	0
	Air Ports	2	$10,651,000	$21,302,000	0	0	0	0
	Natural Gas Facilities	0	$0	$0	0	0	0	0
	Power Plants/Oil Refineries	1	$98,000	$98,000	0	0	0	0
County Total		**44,356**	**$125,585,119**	**$6,457,655,731**	**976**	**$317,205,219**	**22**	**$3,093,200**

1 Residential Structure mapping data for Cities of Elizabethtown & Radcliff not available.

2 Mobile Home in Flood Plain and Landslide Areas is not updated.

Jurisdiction	Type of Facility	# of Existing Structures	Estimated Replacement Value Per Unit	Total Potential Loss	# of Existing Structures in Floodplain	Potential Loss in Floodplain	# of Existing Structures in Landslide Prone Area	Potential Loss in Landslide Prone Area
LaRue County	Residential	5,317	$101,000	$537,017,000	78	$7,878,000	7	$707,000
Hodgenville	Mobile Homes[1]	881	$21,414	$18,865,734	NA	0	NA	0
	Emergency Operations Center	1	$100,000	$100,000	0	0	0	0
	Radio Station or Transmitter	1	$98,000	$98,000	0	0	0	0
	Fire Station	4	$500,000	$2,000,000	1	$500,000	0	0
	Police Station	2	$1,372,000	$2,744,000	0	0	0	0
	Government Building[2]	4	$0	$3,500,000	0	0	0	0
	Hospital	0	$0	$0	0	0	0	0
	Sewage Treatment Plant	1	$62,268,000	$62,268,000	1	$62,268,000	0	0
	Water Treatment Plant	1	$32,634,000	$32,634,000	1	$32,634,000	0	0
	Pumping Stations	7	$75,000	$525,000	0	$0	0	0
	Wells	0	$0	$0	0	0	0	0
	Storage Tanks	11	$750,000	$8,250,000	0	0	0	0
	Schools	6	$4,806,000	$28,836,000	0	0	0	0
	Air Ports	0	$0	$0	0	0	0	0
	Natural Gas Facilities	0	$0	$0	0	0	0	0
	Power Plants/Oil Refineries	1	$107,800,000	$107,800,000	0	0	0	0
County Totals		**6,236**	**$210,525,414**	**$804,637,734**	**81**	**$103,280,000**	**7**	**$707,000**

1 Mobile Home in Flood Plain and Landslide Areas is not updated.

2 Due to disparity in building sizes unit cost not available

Jurisdiction	Type of Facility	# of Existing Structures	Estimated Replacement Value	Total Potential Loss	# of Existing Structures in Floodplain	Potential Loss in Floodplain	# of Existing Structures in Landslide Prone Area	Potential Loss in Landslide Prone Area
Marion County	Residential	7,141	$100,200	$715,528,200	185	0	19	0
Bradfordsville Lebanon Loretto Raywick	Mobile Homes	1,023	$13,827	$14,145,021	NA	0	1	0
	Emergency Operations Center	1	$100,000	$100,000	0	0	0	0
	Radio Station or Transmitter	2	$98,000	$196,000	0	0	0	0
	Fire Station	6	$500,000	$3,000,000	0	0	0	0
	Police Station	2	$1,372,000	$2,744,000	0	0	0	0
	Government Building[2]	12	$0	$12,100,000	0	0	0	0
	Hospital	1	$6,860,000	$6,860,000	0	0	0	0
	Sewage Treatment Plant	2	$62,268,000	$124,536,000	1	$62,268,000	0	0
	Water Treatment Plant	1	$32,634,000	$32,634,000	1	$32,634,000	0	0
	Pumping Stations	4	$75,000	$300,000	0	$0	0	0
	Wells	0	$0	$0	0	0	0	0
	Storage Tanks	11	$750,000	$8,250,000	0	0	0	0
	Schools	9	$5,706,000	$51,354,000	0	0	0	0
	Air Ports	0	$0	$0	0	0	0	0
	Natural Gas Facilities	0	$0	$0	0	0	0	0
	Power Plants/Oil Refineries	0	$0	$0	0	0	0	0
County Total		**8,215**	**$110,477,027**	**$971,747,221**	**187**	**$94,902,000**	**0**	0

1 Mobile Home in Flood Plain is not updated.

2 Due to disparity in building sizes unit cost not available

Jurisdiction	Type of Facility	# of Existing Structures	Estimated Replacement Value Per Unit	Total Potential Loss	# of Existing Structures in Floodplain	Potential Loss in Floodplain	# of Existing Structures in Landslide Prone Area	Potential Loss in Landslide Prone Area
Meade County	Residential	9,714	$120,500	$1,170,537,000	141	$16,990,500	39	0
Brandenburg Ekron Muldraugh	Mobile Homes	2,177	$11,776	$25,636,352	3	0	1	0
	Emergency Operations Center	1	$100,000	$100,000	0	0	0	0
	Radio Station or Transmitter	2	$98,000	$196,000	0	0	0	0
	Fire Station	8	$500,000	$4,000,000	1	0	0	0
	Police Station	3	$1,372,000	$4,116,000	0	0	0	0
	Government Building[1]	7	$0	$6,900,000	0	0	0	0
	Hospital	0	$0	$0	0	0	0	0
	Sewage Treatment Plant	3	$62,268,000	$186,804,000	0	0	0	0
	Water Treatment Plant	1	$32,634,000	$32,634,000	0	$0	0	0
	Pumping Stations	7	$75,000	$525,000	0	$0	0	$0
	Wells	3	$150,000	$450,000	3	$450,000	0	0
	Storage Tanks	8	$750,000	$6,000,000	0	0	0	$0
	Schools	9	$7,409,000	$66,681,000	0	0	0	0
	Air Ports	0	$0	$0	0	0	0	0
	Natural Gas Facilities	0	$0	$0	0	0	0	0
	Power Plants/Oil Refineries	1	$107,800,000	$107,800,000	0	0	0	0
County Total		**11,944**	**$213,288,276**	**$1,612,379,352**	**148**	**$17,440,500**	**40**	**$0**

1 Due to disparity in building sizes unit cost not available

Jurisdiction	Type of Facility	# of Existing Structures	Estimated Replacement Value Per Unit	Total Potential Loss	# of Existing Structures in Floodplain	Potential Loss in Floodplain	# of Existing Structures in Landslide Prone Area	Potential Loss in Landslide Prone Area
Nelson County	Residential[1]	16,627	$124,500	$2,070,061,500	92	$11,454,000	0	0
Bardstown Bloomfield Fairfield New Haven	Mobile Homes	1,562	$17,519	$27,364,678	NA	0	NA	0
	Emergency Operations Center	1	$100,000	$100,000	0	0	0	0
	Radio Station or Transmitter	1	$98,000	$98,000	0	0	0	0
	Fire Station	7	$500,000	$3,500,000	1	0	0	0
	Police Station	4	$1,372,000	$5,488,000	2	0	0	0
	Government Building[2]	11	$0	$15,300,000	1	$0	0	0
	Hospital	1	$6,860,000	$6,860,000	0	0	0	0
	Sewage Treatment Plant	4	$62,268,000	$249,072,000	1	$62,268,000	0	0
	Water Treatment Plant	1	$32,634,000	$32,634,000	0	0	0	0
	Pumping Stations	13	$75,000	$975,000	1	$75,000	0	$0
	Wells	0	$150,000	$0	0	0	0	0
	Storage Tanks	22	$750,000	$16,500,000	0	0	2	$1,500,000
	Schools	19	$5,674,000	$107,806,000	0	0	0	0
	Air Ports	1	$10,651,000	$10,651,000	0	0	0	0
	Natural Gas Facilities	0	$0	$0	0	0	0	0
	Power Plants/Oil Refineries	0	$0	$0	0	0	0	0
County Total		**18,274**	**$121,274,019**	**$2,546,410,178**	**98**	**$73,797,000**	**2**	**$1,500,000**

1 Limited data. Only Floodplain structures are mapped.

2 Due to disparity in building sizes unit cost not available

Jurisdiction	Type of Facility	# of Existing Structures	Estimated Replacement Value Per Unit	Total Potential Loss	# of Existing Structures in Floodplain	Potential Loss in Floodplain	# of Existing Structures in Landslide Prone Area	Potential Loss in Landslide Prone Area
Washington County	Residential	4,243	$107,300	$455,273,900	87	$9,335,100	10	$1,073,000
Mackville Springfield Willisburg	Mobile Homes	791	$13,827	$10,937,157	19	$262,713	3	$41,481
	Emergency Operations Center	1	$100,000	$100,000	0	0	0	0
	Radio Station or Transmitter	0	$98,000	$0	0	0	0	0
	Fire Station	4	$500,000	$2,000,000	0	0	0	0
	Police Station	2	$1,372,000	$2,744,000	0	0	0	0
	Government Building[1]	6	$0	$8,500,000	0	0	0	0
	Hospital	0	$0	$0	0	0	0	0
	Sewage Treatment Plant	1	$62,268,000	$62,268,000	0	0	0	0
	Water Treatment Plant	1	$32,634,000	$32,634,000	0	0	0	0
	Pumping Stations	5	$75,000	$375,000	1	$75,000	0	0
	Wells	0	$0	$0	0	0	0	0
	Storage Tanks	9	$750,000	$6,750,000	0	0	0	0
	Schools	7	$4,392,000	$30,744,000	0	0	0	0
	Air Ports	1	$10,651,000	$10,651,000	0	0	0	0
	Natural Gas Facilities	0	$0	$0	0	0	0	0
	Power Plants/Oil Refineries	0	$0	$0	0	0	0	0
County Total		**5,071**	**$112,961,127**	**$622,977,057**	**107**	**$9,672,813**	**13**	**$1,114,481**

1 Due to disparity in building sizes unit cost not available

Table 3.3.4.9 - Actual Losses Based on Past Events

THUNDERSTORMS WINDS	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$1,211,803	206	54.5	0.25	2.21	$22,235	$5,883	0.00	0.00	0.04	0.01
GRAYSON	$1,215,287	196	56.5	0.25	6.62	$21,510	$6,200	0.00	0.00	0.12	0.03
HARDIN	$64,735,949	300	58.5	4.45	133.17	$1,106,597	$215,786	0.08	0.01	2.28	0.44
LARUE	$1,509,787	193	54.5	1.32	11.6	$27,703	$7,823	0.02	0.01	0.21	0.06
MARION	$1,247,735	180	54.5	0.24	1.63	$22,894	$6,932	0.00	0.00	0.03	0.01
MEADE	$1,679,733	208	55.5	3.45	46.26	$30,265	$8,076	0.06	0.02	0.83	0.22
NELSON	$1,404,130	228	54.5	0.3	12.58	$25,764	$6,158	0.01	0.00	0.23	0.06
WASHINGTON	$1,453,572	168	54.5	0.22	3.58	$26,671	$8,652	0.00	0.00	0.07	0.02
LTADD	$74,457,996	1679	58.5	10.48	217.65	$1,272,786	$44,347	0.18	0.01	3.72	0.13

FLOODS	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$7,801,684	53	48.5	2.09	0.11	$160,859	$147,202	0.04	0.04	0.00	0.00
GRAYSON	$8,185,065	46	48.5	0.04	0.11	$168,764	$177,936	0.00	0.00	0.00	0.00
HARDIN	$47,893,889	69	48.5	2.17	0.11	$987,503	$694,114	0.04	0.03	0.00	0.00
LARUE	$8,067,971	37	48.5	0.17	0.11	$166,350	$218,053	0.00	0.00	0.00	0.00
MARION	$9,740,835	44	48.5	0.31	2.54	$200,842	$221,383	0.01	0.01	0.05	0.06
MEADE	$7,284,005	42	48.5	1.14	0.11	$150,186	$173,429	0.02	0.03	0.00	0.00
NELSON	$35,033,005	93	48.5	3.17	2.11	$722,330	$376,699	0.07	0.03	0.04	0.02
WASHINGTON	$8,984,658	39	48.5	0.17	0.11	$185,251	$230,376	0.00	0.00	0.00	0.00
LTADD	$132,991,112	423	48.5	9.26	5.31	$2,742,085	$314,400	0.19	0.02	0.11	0.01

HAIL	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$4,925,750	77	51.5	0.01	0.52	$95,646	$63,971	0.00	0.00	0.01	0.01
GRAYSON	$2,438,935	84	50.5	0.01	0.5	$48,296	$29,035	0.00	0.00	0.01	0.01
HARDIN	$26,768,252	95	51.5	0.01	0.52	$519,772	$281,771	0.00	0.00	0.01	0.01
LARUE	$1,969,355	59	58.5	0.06	0.56	$33,664	$33,379	0.00	0.00	0.01	0.01
MARION	$35,497,179	58	53.5	0.06	2.56	$663,499	$612,020	0.00	0.00	0.05	0.04
MEADE	$25,032,572	68	59.5	0.01	2.52	$420,715	$368,126	0.00	0.00	0.04	0.04
NELSON	$22,857,556	71	53.5	0.06	1.56	$427,244	$321,937	0.00	0.00	0.03	0.02
WASHINGTON	$10,875,034	51	53.5	0.06	3.56	$203,272	$213,236	0.00	0.00	0.07	0.07
LTADD	$130,364,632	563	59.5	0.28	12.3	$2,191,002	$231,554	0.00	0.00	0.21	0.02

Table 3.3.4.9 - Actual Losses Based on Past Events (cont.)

LIGHTNING	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$289,285	25	54.5	0.04	0.36	$5,308	$11,571	0.00	0.00	0.01	0.01
GRAYSON	$423,574	31	54.5	0.04	2.36	$7,772	$13,664	0.00	0.00	0.04	0.08
HARDIN	$869,962	34	54.5	1.11	2.36	$15,963	$25,587	0.02	0.03	0.04	0.07
LARUE	$61,022	33	54.5	0	0	$1,120	$1,849	0.00	0.00	0.00	0.00
MARION	$154,253	35	54.5	0.14	0.39	$2,830	$4,407	0.00	0.00	0.01	0.01
MEADE	$129,715	28	54.5	0	0	$2,380	$4,633	0.00	0.00	0.00	0.00
NELSON	$907,717	41	54.5	2.12	2.34	$16,655	$22,139	0.04	0.05	0.04	0.06
WASHINGTON	$223,179	36	54.5	0.12	0.34	$4,095	$6,199	0.00	0.00	0.01	0.01
LTADD	$3,058,707	263	54.5	3.57	8.15	$56,123	$11,630	0.07	0.01	0.15	0.03

SNOW & ICE	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$1,411,082	40	54.5	0.31	1.83	$25,891	$35,277	0.01	0.01	0.03	0.05
GRAYSON	$1,981,398	42	54.5	0.29	3.41	$36,356	$47,176	0.01	0.01	0.06	0.08
HARDIN	$2,792,155	45	54.5	0.29	3.47	$51,232	$62,048	0.01	0.01	0.06	0.08
LARUE	$1,050,662	38	54.5	0.29	3.36	$19,278	$27,649	0.01	0.01	0.06	0.09
MARION	$2,681,555	32	54.5	0.29	3.36	$49,203	$83,799	0.01	0.01	0.06	0.11
MEADE	$1,420,840	40	54.5	0.29	1.81	$26,070	$35,521	0.01	0.01	0.03	0.05
NELSON	$2,307,155	41	54.5	1.29	3.47	$42,333	$56,272	0.02	0.03	0.06	0.08
WASHINGTON	$2,697,743	42	54.5	0.37	3.48	$49,500	$64,232	0.01	0.01	0.06	0.08
LTADD	$16,342,589	320	54.5	3.42	24.19	$299,864	$51,071	0.06	0.01	0.44	0.08

TORNADOS	Total Cost	Number Events	Number Years	Total Loss of Life	Total Injuries	Average Cost Per Year	Average Cost Per Event	Average Loss of Life Per Year	Average Loss of Life Per Event	Average Injuries Per Year	Average Injuries Per Event
BRECKINRIDGE	$5,185,260	16	54.5	1.09	20.00	$95,142	$324,079	0.02	0.07	0.37	1.25
GRAYSON	$56,483,213	15	55.5	3.00	23.09	$1,017,716	$3,765,548	0.05	0.20	0.42	1.54
HARDIN	$16,118,723	24	54.5	2.00	73.09	$295,756	$671,613	0.04	0.08	1.34	3.05
LARUE	$5,110,111	11	62.5	0.00	19.12	$81,762	$464,556	0.00	0.00	0.31	1.74
MARION	$735,833	11	54.5	0.00	4.15	$13,502	$66,894	0.00	0.00	0.08	0.38
MEADE	$6,142,325	12	54.5	31.00	267.09	$112,703	$511,860	0.57	2.58	4.90	22.26
NELSON	$2,033,978	13	54.5	1.00	28.15	$37,321	$156,460	0.02	0.08	0.52	2.17
WASHINGTON	$1,840,007	11	54.5	0.00	5.15	$33,762	$167,273	0.00	0.00	0.09	0.47
LTADD	$93,649,450	113	56	38.09	439.84	$1,683,586	$828,756	0.68	0.34	7.91	3.89

NOTE: The historic frequency of a hazard event over a given period of time determines the historic recurrence interval. For example: If there have been 10 Thunderstorm events in the County in the past 5 years, statistically you could expect that there will be 2 events a year.

Realize that from a statistical standpoint, there are several variables to consider. 1) Accurate hazard history data and collection are crucial to an accurate recurrence interval and frequency. 2) Data collection and accuracy has been much better in the past 10-20 years (NCDC weather records). 3) It is important to include all significant recorded hazard events which will include periodic updates to this table.

By updating and reviewing this table over time, it may be possible to see if certain types of hazard events are increasing in the past 10-20 years.

These values should be considered low. More events that have occurred than are documented by the sources used in this table.

All data is compiled at the county level due to extremely limited city specific data, therefore all data and analysis represents incorporated and unincorporated areas inclusively.

Compilation of SHELDUS, NCDC & NCEI. 1967- June 30 2015.

Chart 3.3.4.4 - Lincoln Trail Region - Average Cost Per Year by Event

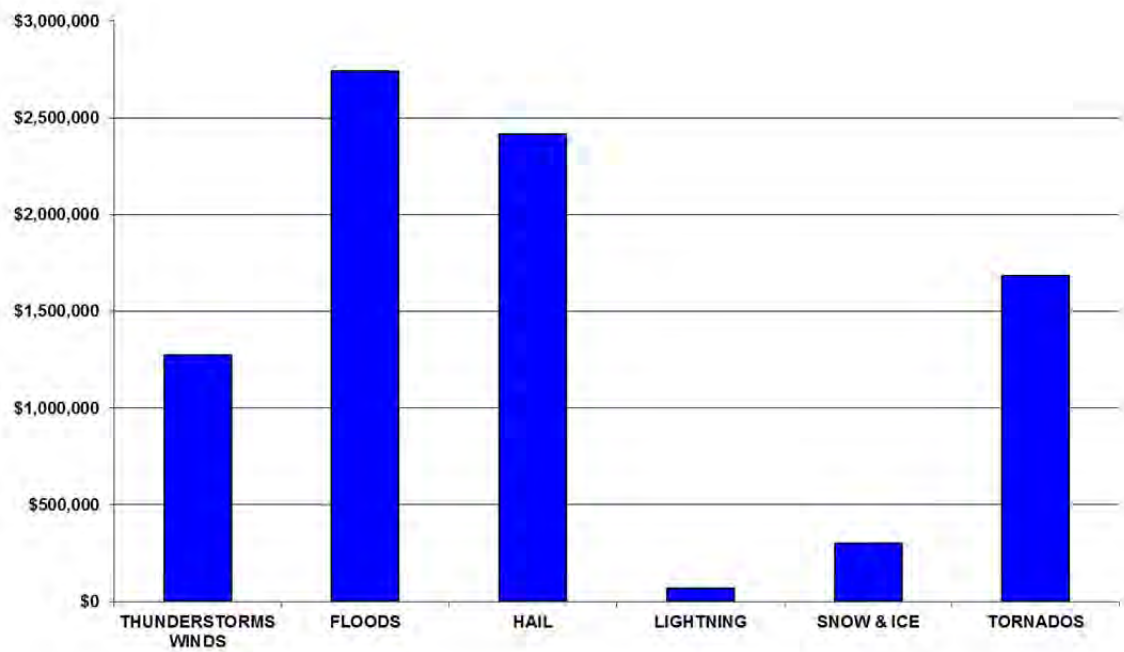


Chart 3.3.4.5 - Lincoln Trail Region - Average Cost Per Event

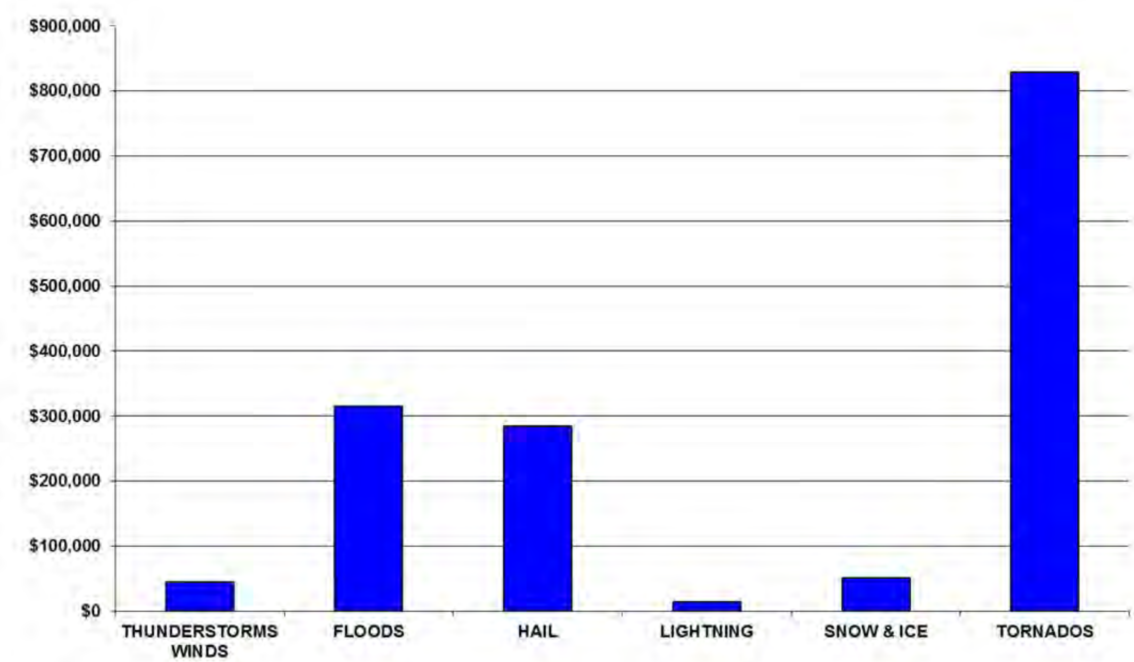


Chart 3.3.4.6 - Lincoln Trail Region - Average Loss of Life Per Year

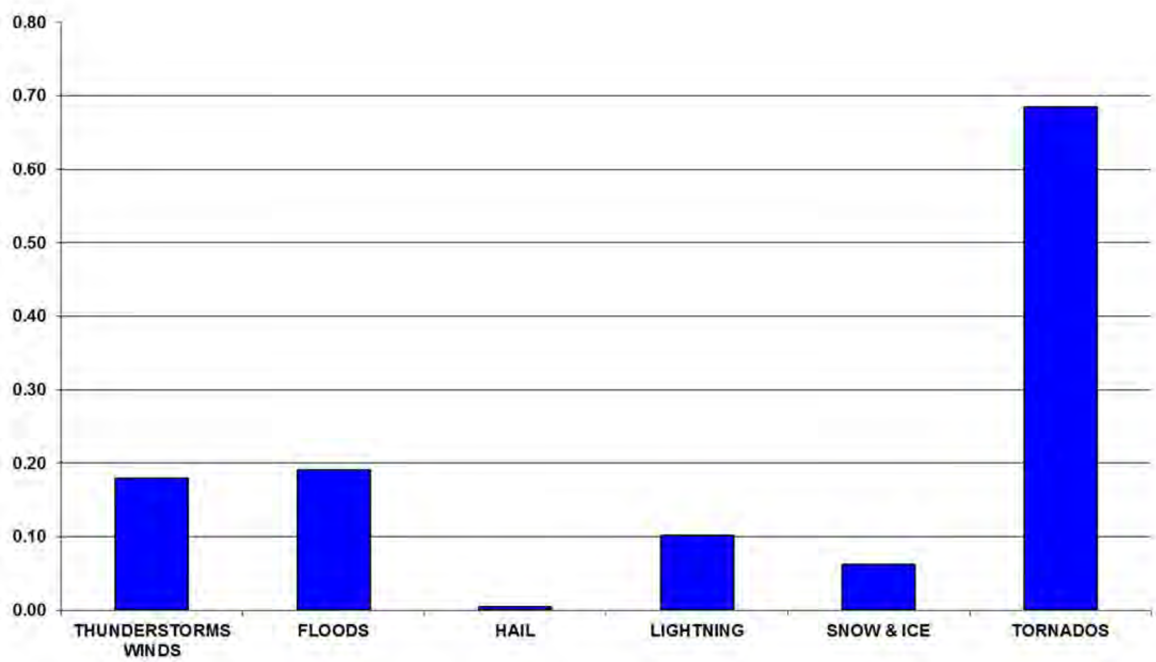


Chart 3.3.4.7 - Lincoln Trail Region - Average Injuries Per Year

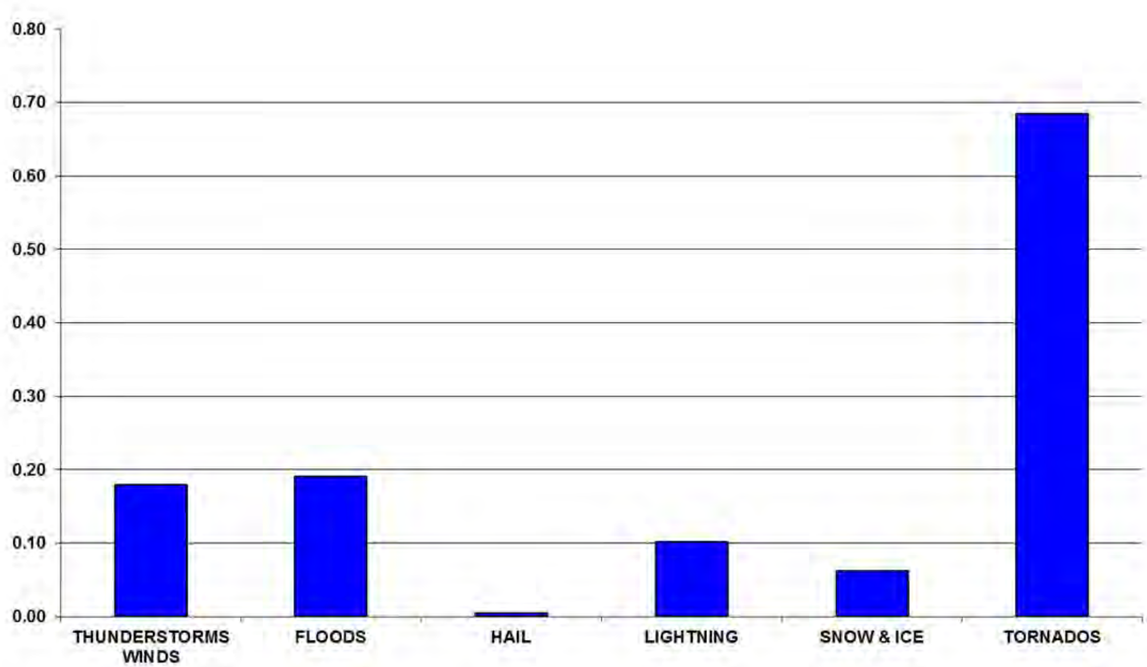


Chart 3.3.4.8 - Lincoln Trail Region – Total Events of Documented Period

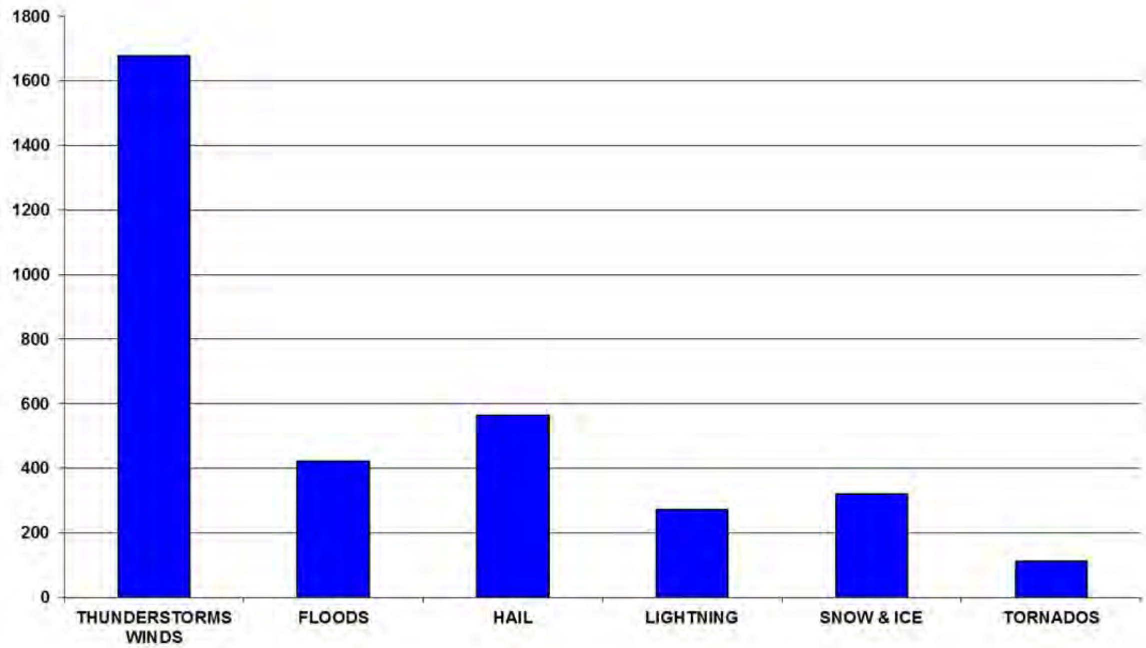
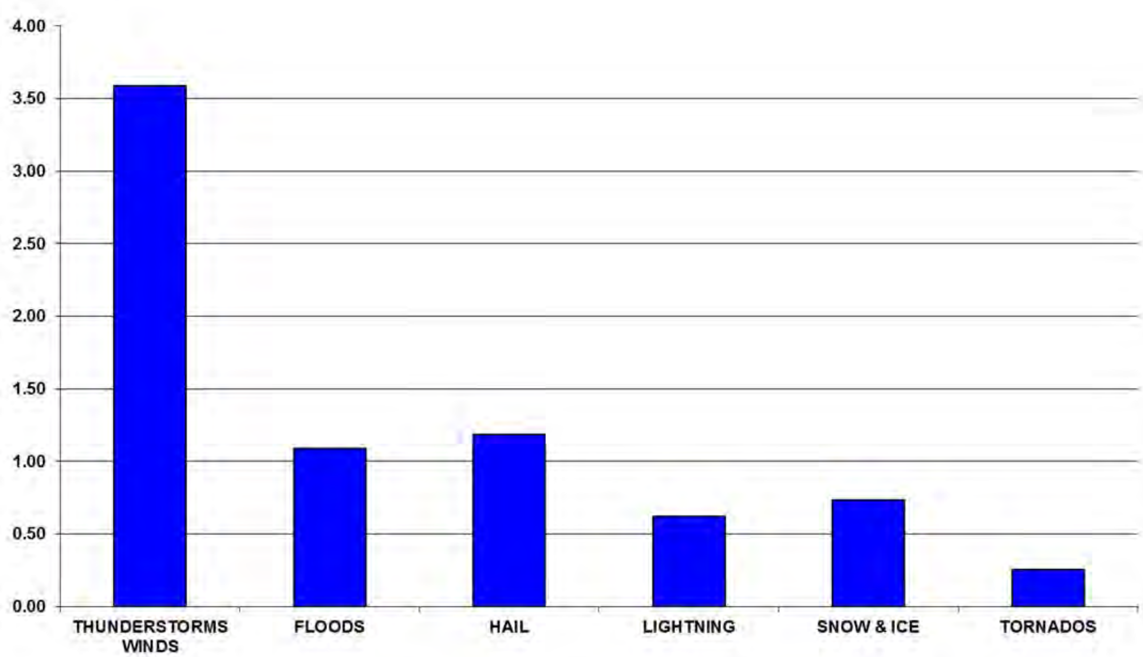


Chart 3.3.4.9 - Lincoln Trail Region – Average Events Per Year



3.3.5 Assessing Vulnerability: Analyzing Develop Trends

Population Growth

The Kentucky State Data Center at the University of Louisville, projects population growth based on the most recent 2010 census data. Table 3.3.5.1 illustrates the population growth for each of the eight counties in the Lincoln Trail Region as well as the entire region. Population figures for 2010 are actual census figures.

Every county within the region is expected to grow over the next fifteen years. Nelson County is expected to see the largest percentage increase of 29.63%, while the entire region sees a population increase of 21.11%.

Tracking population growth offers the region the opportunity to assess how efficiently its first response and preparedness capabilities will effectively serve the population.

Table 3.3.5.1 Population Growth Projections for the Lincoln Trail Region

Jurisdiction	2010 (census)	2015	2020	2025	2030	Projected Gain
Breckinridge Co.	20,059	20,819	21,489	22,065	22,485	12.09%
Grayson Co.	25,746	26,476	27,048	27,465	27,703	07.60%
Hardin Co.	105,543	111,225	116,612	121,541	125,896	19.28%
LaRue Co.	14,193	14,596	14,961	15,265	15,512	09.29%
Marion Co.	19,820	20,637	21,424	22,152	22,757	14.82%
Meade Co.	28,602	29,819	30,901	31,801	32,481	13.56%
Nelson Co.	43,437	46,791	50,119	53,337	56,309	29.63%
Washington Co.	11,717	12,118	12,486	12,813	13,086	11.68%
LTADD Region	261,117	282,481	295,040	306,439	316,231	21.11%

Source: Kentucky State Data Center, University of Louisville, 2011

Housing

In addition to an increase in population, each county in the Lincoln Trail Region has realized an increase in housing units and number of households. With these increases, each county must assess its level of resiliency and preparedness to meet the needs and responsibility of additional residents and property. Table 3.3.5.2 summarizes the population, number of households and number of housing units in each county in 2000. Table 3.3.5.3 immediately below it, shows the number of households and housing units in each county in 2010, and the increase over the 2000 census data.

Table 3.3.5.2 - Households and Housing Units in Lincoln Trail Region - 2000			
County	**Population**	**Housing Units**	**Households**
Breckinridge	18,648	9,890	7,324
Grayson	24,053	12,802	9,596
Hardin	94,174	37,673	34,497
LaRue	13,373	5,860	5,275
Marion	18,212	7,277	6,613
Meade	26,349	10,293	9,470
Nelson	37,477	14,934	13,953
Washington	10,916	4,542	4,121
Source: U.S. Census Bureau – 2000 Census			

Table 3.3.5.3 - Households and Households in the Lincoln Trail Region - 2010				
County	**Housing Units**	**% change from 2000 to 2010**	**Households**	**% change from 2000 to 2010**
Breckinridge	10,592	+7.10%	7,213	-1.52%
Grayson	13,506	+5.50%	9,897	+3.13%
Hardin	44,211	+17.35%	39,401	+14.22%
LaRue	6,198	+5.77%	5,221	-1.02%
Marion	8,164	+12.19%	7,368	+11.42%
Meade	11,891	+15.53%	10,342	+9.21%
Nelson	18,189	+21.80%	16,571	+18.76%
Washington	5,034	+10.90%	4,480	+8.71%
Source: U.S. Census Bureau – 2010 Census				

Housing Growth

Table 3.3.5.4 shows data from the U.S. Census Bureau database concerning new, privately-owned, residential building permits reported by each of the eight counties in the Lincoln Trail Region. Most counties have seen a significant decline in residential construction, due in part, to the decline in the economy and the reduction of troops and programs at Fort Knox.

Table 3.3.5.4 - Residential Building Permits						
Jurisdiction Residence Type	**2004**	**2006**	**2008**	**2010**	**2012**	**2014**
Breckinridge Co.						
Single Family	18	12	10	4	5	2
Two Family	1	0	0	1	0	0
Three/Four Family	0	0	0	0	0	0
Five/More Family	2	0	0	0	0	0
Total	21	12	10	5	5	2

Grayson Co.						
Single Family	0	0	0	4	3	1
Two Family	0	0	0	7	2	0
Three/Four Family	1	0	1	1	1	1
Five/More Family	0	0	0	0	0	0
Total	1	0	1	12	6	2
Hardin Co.						
Single Family	904	804	378	674	248	188
Two Family	14	30	24	12	0	5
Three/Four Family	5	26	18	3	16	0
Five/More Family	13	12	13	25	9	19
Total	936	872	433	714	273	212
LaRue Co.						
Single Family	83	55	25	33	35	29
Two Family	5	1	0	0	3	7
Three/Four Family	0	0	0	0	0	0
Five/More Family	0	0	0	0	0	0
Total	88	56	25	33	38	36
Marion Co.						
Single Family	14	5	7	6	8	9
Two Family	0	1	1	0	1	0
Three/Four Family	0	0	0	1	1	1
Five/More Family	1	0	0	0	0	0
Total	15	6	8	7	10	10
Meade Co.						
Single Family	133	142	100	135	75	75
Two Family	6	2	5	2	3	3
Three/Four Family	1	3	4	4	1	1
Five/More Family	0	0	4	4	0	0
Total	140	147	113	145	79	79
Nelson Co.						
Single Family	406	325	180	146	112	168
Two Family	5	0	0	0	0	3
Three/Four Family	4	3	0	0	0	5
Five/More Family	1	0	3	0	0	0
Total	416	328	183	146	112	176
Washington Co.						
Single Family	5	6	3	2	1	1
Two Family	0	1	0	0	4	5
Three/Four Family	0	0	0	0	0	0
Five/More Family	0	0	0	0	2	2
Total	5	7	3	2	7	8
Source: U.S. Bureau of the Census						

Land Use

There has been no significant change in land use within the Lincoln Trail Region over the last five years. The growth areas of Hardin and Nelson Counties have continued to realize some population growth, and several counties have completed work on highway bypass projects. However, the region still remains largely rural in nature and has a strong agricultural presence. According to the U.S. Department of Agriculture's Natural Agriculture Statistics Services (NASS), there were 1,390,229 acres of farmland in the Region in 2012. Of that acreage, approximately 48.94% was used for cropland, 5.20% for other purposes, 24.06% as pastureland, and 21.46% was woodland.

The economic impact of agricultural activities in the region is significant. In 2012, NASS estimated the value of agricultural products sold was $416.297,000.00. Of that amount, about $216,189,000.00 was in crop sales and $200,108,000.00 in the sale of livestock.

Changes and development in the region are guided and controlled by the comprehensive plans of each jurisdiction, and development in hazard prone areas is restricted.

Table 3.3.5.5 summarizes agricultural land use and data for each of the eight counties in the region. The data illustrates that between 1997 and 2012, on a regional level, there was an approximate 13.44% decrease in the number of farms; a decrease of 7.70% in the number of acres of land used for farmland; and an overall increase of about 62.67% in the estimated market value of farm products sold

Table 3.3.5.5 - Lincoln Trail Region Agricultural Statistics: 1997 to 2012				
Jurisdiction	Year	Number of Farms	Number of Acres in Farmland	Estimated Market Value of Farm Products Sold
Breckinridge County	1997	1501	281,261	$32,712,000
	2002	1443	276,456	$28,714,000
	2007	1509	274,473	$56,081,000
	2012	1304	259,774	$79,537,000
% Change from 1997 to 2012		-13.12%	-7.64%	+143.14%
Grayson County	1997	1568	221,081	$34,860,000
	2002	1650	233,136	$31,642,000
	2007	1530	216,492	$41,192,000
	2012	1357	202,970	$45,663,000
% Change from 1997 to 2012		-13.46%	-8.19%	+30.99%

Hardin County	1997	1854	236,346	$40,418,000
	2002	1732	239,740	$35,898,000
	2007	1588	222,267	$46,907,000
	2012	1357	202,970	$57,949,000
% Change from 1997 to 2012		-26.81%	-14.21%	+43.37%
LaRue County	1997	896	122,658	$25,272,000
	2002	888	134,410	$21,057,000
	2007	811	125,432	$26,579,000
	2012	720	111,975	$41,877,000
% Change from 1997 to 2012		-19.64%	-8.71%	+65.71%
Marion County	1997	1072	172,011	$34,336,000
	2002	1054	171,252	$28,754,000
	2007	1055	160,684	$39,653,000
	2012	1016	166,417	$56,491,000
% Change from 1997 to 2012		-5.22%	-3.25	+64.52%
Meade County	1997	964	129,046	$19,480,000
	2002	955	134,771	$16,171,000
	2007	887	121,448	$28,712,000
	2012	754	119,495	$36,571,000
% Change from 1997 to 2012		-21.18%	-7.40%	+87.74%
Nelson County	1997	1401	185,507	$39,525,000
	2002	1407	189,104	$33,242,000
	2007	1406	196,225	$54,803,000
	2012	1326	187,755	$64,439,000
% Change from 1997 to 2012		-5.35	1.21%	+63.03%
Washington County	1997	1142	162,741	$32,833,000
	2002	1119	149,739	$27,060,000
	2007	1119	162,993	$33,000,000
	2012	1011	140,948	$33,770,000
% Change from 1997 to 2012		-2.71%	-13.39%	+2.85%
Source: U.S. Department of Agriculture, National Agriculture Statistics Service				

Economic and Social Growth

According to the ***Lincoln Trail Occupational Outlook to 2020***, published by the Education and Workforce Development Cabinet, the Department of Workforce Investment and the Kentucky Office of Employment and Training, employment in the Lincoln Trail Region is projected to grow from a 2010 level of 96,368 to 110,015 by 2020. This is a projected gain of 14.2%.

Total annual job openings are expected to be about 3,683, with an annual growth in job openings of approximately 1,445. About 2,238 of the annual job openings are expected to result from separations from the labor force due to retirements or job transfers. Thirty-nine percent of job openings will result from growth, with the remaining 61% resulting from separations from the labor force.

The greatest number of annual job openings is expected to be in Office and Administrative Support Occupations, followed by Sales and Related Occupations and Healthcare Practitioners and Technical Occupations. Two occupations with the greatest number of job openings are Registered Nurses and Combined Food Prep. & Serving Workers, Including Fast Food.

The highest growth rate occupations for the decade are most likely to be:
Healthcare Practitioners and Technical Occupations (61.1%)
Healthcare Support Occupations (58.9%)
Community and Social Service Occupations (34.3%)

Table 3.3.5.6 - Lincoln Trail Region Industrial Sites by County	
Breckinridge County	**Meade County**
Breckinridge County Commerce Park	Bill Corum Commerce Park 163-001 Buttermilk Fall Industrial Site 163-002
Grayson County	**Nelson County**
Judge K.H. Goff Industrial Park 085-001 Leitchfield Industrial Site 085-008	Wilson Industrial Park 179-003 Bardstown Industrial Site 179-007 Bardstown Industrial Site 179-004 Bardstown TEBCO 179-009
Hardin County	**Washington County**
Hughes Center of Commerce & Industry T.J. Patterson Industrial Park 093-003 Millpond Business Center 093-004 Glendale Site 093-005	Springfield Industrial Site 229-005 Springfield-Washington County Commerce Center 229-004
Marion County	
Crossroads Industrial Park 155-004 KY 208 Industrial Park 155-005	
Source: Kentucky Cabinet for Economic Development 2015	

Table 3.3.5.7 – Employment by Type and County (U.S. Census Bureau)

Types of Employment	Breckinridge			Grayson			Hardin			LaRue		
Year	2003	2008	2013	2003	2008	2013	2003	2008	2013	2003	2008	2013
Agriculture, Forestry, Fishing, Hunting	24	11	15	0	0	0	0	49	37	0	44	32
Mining	22	25	23	0	0	0	0	43	61	0	0	NA
Construction	185	277	220	434	386	349	1,557	1,754	1,133	152	234	159
Manufacturing	220	345	304	2,596	2,116	1,669	6,258	5,572	5,662	745	717	496
Trade, Transportation, Utilities	676	663	724	1,563	1,493	1,398	7,275	8,679	8,087	329	340	285
Information	27	33	22	37	45	38	749	1,004	943	0	0	0
Financial Activities	170	174	165	224	257	291	1,669	2,104	1,955	145	148	151
Services	821	386	460	1,719	1,596	1,087	10,594	16,174	17,227	641	776	744
Public Administration	227	222	184	331	347	376	3,962	3,385	5,140	116	102	114
Other	0	0	4	0	8	1	19	46	10	0	0	0
Total	2,372	2,136	2,121	6,904	6,248	5,209	32,083	38,810	40,255	2,734	2,361	1,981

Types of Employment	Marion			Meade			Nelson			Washington		
Year	2003	2008	2013	2003	2008	2013	2003	2008	2013	2003	2008	2013
Agriculture, Forestry, Fishing, Hunting	26	32	0	8	9	17	0	0	0	0	0	0
Mining	0	0	0	76	98	103	0	0	0	0	0	0
Construction	229	221	163	270	448	354	1,222	1,240	1,043	256	310	165
Manufacturing	2,473	3,322	3,130	319	317	327	3,900	3,998	3,814	893	1,029	949
Trade, Transportation, Utilities	753	821	915	892	851	651	2,285	2,705	2,670	552	363	451
Information	31	28	26	0	105	102	116	111	110	13	0	0
Financial Activities	155	162	162	195	262	217	387	458	409	103	92	0
Services	1,774	1,458	1,480	847	257	766	3,336	3,609	4,148	615	157	226
Public Administration	231	9	6	223	228	282	418	422	426	176	158	153
Other	2	2	NA	0	9	NA	3	8	4	0	0	NA
Total	5,763	6,055	5,882	2,830	2,584	2,819	11,667	12,551	12,624	2,608	2,109	1,944

3.3.6 Multi-Jurisdictional Risk Assessment

Overall Summary

As previously stated, most of the natural hazards documented to significantly affect the Lincoln Trail Region, do not adhere to geographic boundaries. The exceptions are floods, landslides and karst. That data enabled the LTHMC to determine that the entire region is at risk for those hazards identified in table 3.3.1.1. On a more definitive level, the tables below summarize the degree or level of risk each hazard poses to the individual counties and the region, as it pertains to the annual frequency chance and economic loss. With limited data at the city level for each hazard, any data that was gathered was merged to create a comprehensive county risk level. For county specific frequency percentages please refer to table 3.3.2.1, or for dollar loses, table 3.3.4.9

Risk Level	Frequency Chance Per year
High Risk Hazard	61%+
Moderate Risk Hazard	31%-60%
Low Risk Hazard	11%-30%
Negligible Risk Hazard	0%-10%

Table 3.3.6.1 - Risk Level based on Historical Frequency Chance Per Year

	THUNDERSTORMS / WINDS	FLOODS	HAIL	LIGHTNING	SNOW & ICE	TORNADOS
BRECKINRIDGE	HIGH	HIGH	HIGH	MODERATE	HIGH	LOW
GRAYSON	HIGH	HIGH	HIGH	MODERATE	HIGH	LOW
HARDIN	HIGH	HIGH	HIGH	HIGH	HIGH	MODERATE
LARUE	HIGH	HIGH	HIGH	HIGH	HIGH	LOW
MARION	HIGH	HIGH	HIGH	HIGH	MODERATE	LOW
MEADE	HIGH	HIGH	HIGH	MODERATE	HIGH	LOW
NELSON	HIGH	HIGH	HIGH	HIGH	HIGH	LOW
WASHINGTON	HIGH	HIGH	HIGH	HIGH	HIGH	LOW
LTADD	**HIGH**	**HIGH**	**HIGH**	**MODERATE**	**HIGH**	**LOW**

Economic Loss: In reviewing the economic loss table below, an annual loss of $100,000 for an entire county may not seem to justify being categorized as "High Risk". For a large metropolitan area, it probably shouldn't be. However, six of the eight Lincoln Trail Region counties have less than 30,000 residents and three of the six have populations less than 20,000. The limited tax base and low-to- moderate-income (LMI) index* in most of these areas further exacerbates their circumstances and it is difficult for them to handle even the "Low Risk" hazards. Only five of the 35 Lincoln Trail jurisdictions have a LMI below 40% while ten have a LMI over 50%. In an area where 40%+ of the families have an income below 80% of the median, local units of government experience immense social and economic responsibilities that are compounded by the damages caused by annual weather events.

*Low to Moderate Income Index: Low or moderate income census tracts are considered to be those in which the median family income is below 80% of the median family income for the Metropolitan Statistical Area (MSA) or Primary Metropolitan Area (PMSA) in which they are located.

Risk Level	Economic Loss Per Year
High Risk Hazard	**$100,000+**
Moderate Risk Hazard	**$50,000-$99,999**
Low Risk Hazard	**$25,000-$49.999**
Negligible Risk Hazard	**0-$24,999**

Table 3.3.6.2 - Risk Level based on Annual Historical Economic Loss

	THUNDERSTORMS / WINDS	FLOODS	HAIL	LIGHTNING	SNOW & ICE	TORNADOS
BRECKINRIDGE	NEGLIGIBLE	HIGH	MODERATE	NEGLIGIBLE	LOW	MODERATE
GRAYSON	NEGLIGIBLE	HIGH	LOW	NEGLIGIBLE	LOW	HIGH
HARDIN	HIGH	HIGH	HIGH	NEGLIGIBLE	MODERATE	HIGH
LARUE	LOW	HIGH	LOW	NEGLIGIBLE	LOW	NEGLIGIBLE
MARION	NEGLIGIBLE	HIGH	HIGH	NEGLIGIBLE	LOW	LOW
MEADE	LOW	HIGH	HIGH	NEGLIGIBLE	LOW	HIGH
NELSON	LOW	HIGH	HIGH	NEGLIGIBLE	LOW	LOW
WASHINGTON	LOW	HIGH	HIGH	NEGLIGIBLE	LOW	LOW
LTADD	**HIGH**	**HIGH**	**HIGH**	**MODERATE**	**HIGH**	**HIGH**

3.4 Mitigation Strategy

The Lincoln Trail Regional Hazard Mitigation Plan includes mitigation strategies intended to reduce or eliminate the impacts of natural hazard events identified through the risk assessment process. The mitigation strategies developed for this plan are the result of gathering pertinent data from every jurisdiction, extensive research and analysis of hazard data and profiles, and careful assessment of regional vulnerability.

Process Summary: Integration of Hazard Mitigation Plan with Other Planning Mechanisms.
The process of gathering hazard data, evaluating local resources and mitigation tools and updating the Lincoln Trail Regional Hazard Mitigation Plan has given all local units of government insight into the importance of incorporation hazard mitigation into local community planning efforts, emergency operations plans, capital improvement plans, local law, and public education outreach efforts whenever practical and applicable. An exhaustive list of these capabilities and planning mechanisms is contained in tables 3.4.1.1.1, 3.4.1.1.2 and 3.4.1.1.3.

This effort is exemplified throughout the migration strategy section of this plan and reflected in the regional goals, jurisdictional legal authorities, mitigation strategies, completed and proposed projects, and public education outreach efforts cited.

3.4.1 - Capabilities Assessment

The success of any mitigation strategy is incumbent on the resources and capabilities of the regional jurisdictions to implement action plans that successfully achieve mitigation goals. Local communities submitted information used to identify regional capabilities. Assessment of these capabilities will enable the region to identify disparities and capitalize on local resources as a means of accomplishing mitigation goals.

Since approval of the Lincoln Trail Regional Hazard Mitigation Plan in 2005, the Plan received dual approval under the multi-hazard and flood mitigation categories. All jurisdictions are now eligible to apply for Flood Mitigation Assistance (FMA) funds in addition to Pre-Disaster and Hazard Mitigation grant assistance.

A capabilities assessment illustrates the resources available to achieve goals, and identifies gaps where improvements can be made to improve regional resiliency and preparedness.

Legal Authority of Local Jurisdictions

Local units of government in Kentucky are empowered to implement mitigation programs, policies and actions. Local governments can utilize their powers of regulation, acquisition, taxation and spending to implement a successful hazard mitigation program within their respective jurisdictions. Utilization of all four is the best approach to formulating a comprehensive program that diminishes the propensity for oversights.

Regulation

Police Power: The Kentucky Revised Statutes bestow general police power to local units of government. This enables them to enact and enforce ordinances that define, prohibit, regulate or abate actions, omissions, or conditions deemed detrimental to the welfare of the public, and to abate nuisances.

Police power is an effective tool that allows local units of government to implement hazard mitigation programs to protect public health, safety and welfare through the use of local ordinances. Local ordinances may also be used to mitigate any circumstance that threatens the general health and safety of the public.

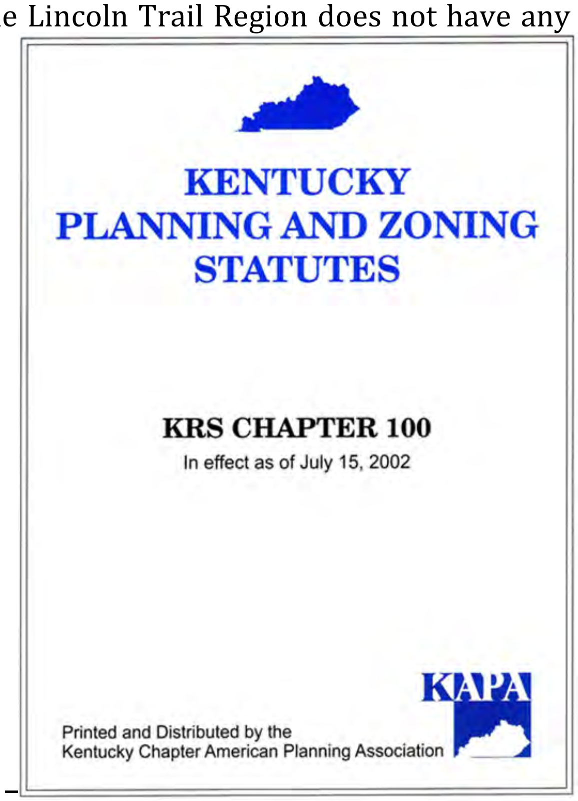
Each jurisdiction within the Lincoln Trail Region has the authority to enact and enforce regulatory ordinances designed to protect the health, safety and general welfare of its citizens.

Building Codes and Building Inspection: Mitigation measures may regulate the standards for the construction and retrofit of structures within a community, in order to make buildings more resilient to the effects of natural hazards. State and Federal building codes and regulations are designed to help meet these standards.

When appropriate, local jurisdictions are encouraged to develop and enforce building codes that exceed the standards provided in State and Federal regulations. The ability of local units of government to develop codes specific to their geography and vulnerabilities is an essential tool to ensure that mitigation strategies are appropriate and successful.

Land Use: KRS 100 enables local units of government to create a comprehensive plan for land use. In counties with populations of 300,000 or more, KRS 100 mandates countywide planning; otherwise, it is an enabling statute. The Lincoln Trail Region does not have any counties with a population of 300,000. KRS 100 allows local governments to utilize a powerful tool for controlling land use within each jurisdiction. Land use controls can determine the amount, timing, density, quality and location of all new development. These land use controls can help to determine the level of vulnerability each jurisdiction will experience as a result of a natural disaster. Land Use Plans become a chapter in each participating jurisdiction's comprehensive plan and can be enforced through planning, zoning ordinances, floodplain ordinances and subdivision regulations.

Planning: KRS 100 establishes three types of planning units: independent, joint and regional. The type of planning unit determines the land area within its purview. The Lincoln Trail

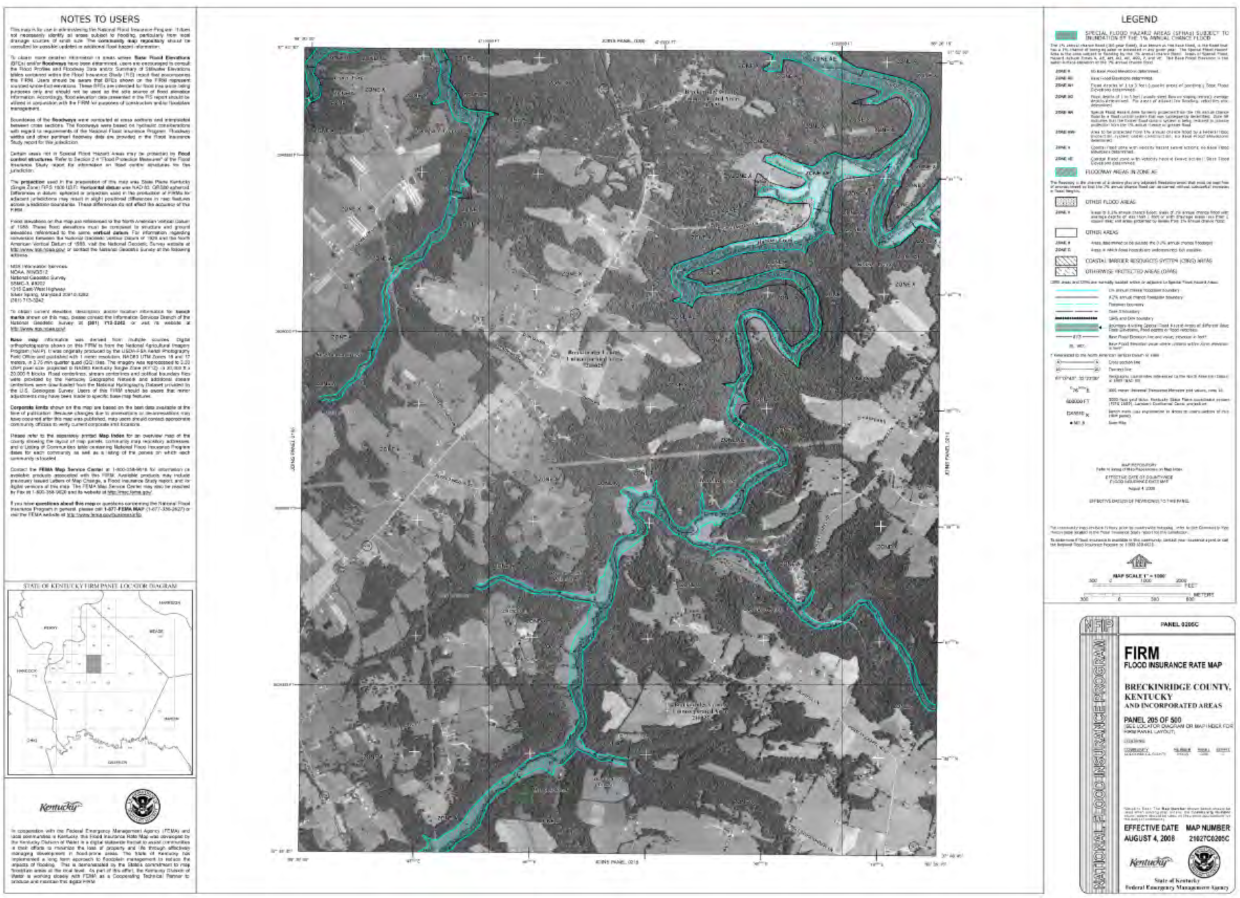


KRS Chapter 100 Cover, *Source: KAPA.*

Region has two joint planning units with the remainder being independent planning units. All planning units have the authority to engage in planning activities such as conducting studies, developing goals and the objectives for attaining those goals, creating policies and ordinances, and implementing administrative means to facilitate plans.

Zoning: When local planning units have adopted all of the required elements of a comprehensive plan, then the legislative bodies and fiscal courts within the planning unit may enact zoning and other growth management regulations to promote public health, safety, morals and general welfare of the planning unit, in accordance with KRS 100.201. Specifically, zoning can be used to protect natural resources, specific areas of the planning unit that need special protection, and to prevent the loss of life, health, or property from fire, flood and other dangers.

Within the Lincoln Trail Region, FEMA has designated Flood Hazard Areas (FHA). Zoning can be effectively used to preclude development within proximity to these areas. Local



FIRM Breckinridge County 21027C0250C, *Source: FEMA.*

Digital Flood Insurance Rate Maps (DFIRM) are used to determine where these areas are. Zoning ordinances should prohibit development within these areas and protect the functional integrity of the floodplains.

Subdivision Regulations: KRS 100 defines subdivision as "the division of a parcel of land into three (3) or more lots or parcels except in a county containing a city of the first, second or third class or in an urban-county government or consolidated local government where a subdivision means the division of a parcel of land into two (2) or more lots or parcels; for the purpose, whether immediate or future, of sale, lease, or building development, or if a new street is involved, any division of a parcel of land; provided that a division of land for agricultural use and not involving a new street shall not be deemed a subdivision." A planning unit may develop subdivision regulations for a number of purposes, to include: the protection and preservation of the value of the land, buildings and improvements upon the land, the protection and provision of public health, safety and general welfare of the jurisdiction, to minimize the pollution of air, streams and ponds, to assure that drainage facilities are adequate, safeguard the water table, preserve the natural features of the area, and to encourage wise use and management of natural resources.

Subdivision regulations, pertaining to flooding, usually require developers to install adequate drainage systems and design water and sewer facilities that minimize flood damage and avoid contamination.

Floodplain Ordinance: State and federal governments can play a significant role in assisting communities to develop and implement floodplain management programs and encourage the effective use of mitigation strategies. However, the final responsibility rests with local units of government. Flood plains are important water resource areas when left in their natural, undisturbed state. They are often very fertile areas for farming as well, and several exist within the Lincoln Trail Region. Flood plains serve three major purposes: as natural water storage and conveyance; water quality maintenance; and as a ground water recharge area. Unsuitable development in, or manipulation of a flood plain can destroy its value and have an adverse environmental impact on the area. An example of adverse impact would be the flooding of previously dry land when fill is added to any area of a flood plain.

All eight counties and eighteen of the twenty-seven cities within the Lincoln Trail Region participate in the National Flood Insurance Program (NFIP), thus making flood insurance available to their citizens. These communities became eligible for participation in NFIP by adopting floodplain management regulations intended to reduce or eliminate future losses due to flooding. Only those property owners who purchase flood insurance are covered for losses due to flooding, since homeowner's insurance does not cover flood damage or losses. Floodplain management regulations, the creation and enforcement of floodplain ordinances and the use of digital floodplain maps are all valuable tools in mitigating damage and losses due to flooding.

Acquisition

KRS 104.030 empowers cities to extend flood control measures outside corporate boundaries through the acquisition of property. For the purpose of protecting property within and beyond their corporate limits, cities of all classes are authorized to extend a municipal flood control system beyond city limits by constructing, enlarging, extending, equipping, maintaining and operating walls or other barriers with necessary appurtenances and equipment, beyond the municipal corporate boundaries.

In 1997, Meade County utilized a FEMA Hazard Mitigation Program Grant to exercise the power of acquisition to buy out a portion of the Concordia Community in Meade County. The land was an area of repetitive flood damage, so the County cleared the land and now keeps it in perpetuity as green space. This action removed twelve homes and several area residents, from an area that was a repetitive hazard and eliminated the potential for future losses there.

Taxation

The Commonwealth of Kentucky empowers local units of government with the ability to levy taxes and impose special assessments. The power of taxation can be used to impact the pattern of development within a community and help fund mitigation programs such as storm water management. As a result of expanding regulations from the Clean Water Act of 1977 and the National Pollutant Discharge Elimination System (NPDES), several of our local units of government have initiated a Storm Water Utility Fee to help fund mitigation projects that reduce losses and infrastructure damage as a result of flooding and pollution caused by storm water.

Spending

The Kentucky General Assembly has empowered local units of government with the ability to make expenditures in the public interest. The economic impact of natural disasters to each jurisdiction plays a role in spending decisions and annual budgets. Money must the allocated to cover the cost of capital improvement projects that mitigate the effects of natural hazards as well as expenses incurred for snow removal, debris pickup and the manpower necessary to respond to any kind of natural disaster.

Political Arena

While most residents of an area are aware of what natural hazards are prevalent in their locale and the potential impact that such events can have, there is a gap in knowledge regarding mitigation measures that can be initiated to mitigate those harmful impacts. Educating the general populace about mitigation measures and strategies that could potentially decrease or eliminate the adverse effects of any disaster, will be a key factor in the planning efforts of our region.

The devastating effects of recent natural hazard events and the profound impact they have had on the region, will certainly affect the political climate and put an emphasis on hazard mitigation planning and strategies.

3.4.1.1 Community Capability Assessment

Each of the thirty-five jurisdictions within the Lincoln Trail Region participated in the process of planning and reviewing the 2015 Lincoln Trail Regional Hazard Mitigation Plan Update. To be as thorough and inclusive as possible, each community was asked to complete a "Capability Assessment Worksheet" that evaluated many aspects of community resiliency and preparedness. The areas covered were planning and regulatory, administrative and technical, financial, and education and outreach. It should be noted that not every category surveyed was applicable to every community. The twenty-seven cities within the region range in size from populations of 113 to 28,531, and have greatly disparate tax bases and amenities. The eight counties range in size from populations of 11,717 to 105,543 and cover areas ranging from 263 square miles to 628 square miles. The table below summarizes the feedback that these 35 communities contributed. Individual jurisdictional responses are on file at the LTADD office.

Table 3.4.1.1.1 - Lincoln Trail Region Capability Assessment Summary		
Planning and Regulatory Assessments		
Plans	Number of Cities	Number of Counties
Comprehensive/Master Plan	15	5
Capital Improvements Plan	2	4
Economic Development Plan	3	4
Local Emergency Operations Plan	27	8
Continuity of Operations Plan	11	7
Transportation Plan	27	8
Storm Water Management Plan	9	4
Community Wildfire Protection Plan	1	2
Other Plans (e.g., brownfields, redevelopment, disaster)	0	0
Building Code, Permitting, and Inspections		
Building Code	9	3
Building Code Effectiveness Grading Schedule Score	2	0
Fire Department ISO Rating	17	4
Site Plan Review Requirements	7	4
Land Use Planning and Ordinances		
Zoning Ordinance	14	4
Subdivision Ordinance	13	4
Floodplain Ordinance	12	4
Natural Hazard (storm water, steep slope, wildfire)	11	2
Flood Insurance Rate Maps (DFIRM)	27	8
Acquisition of Land for Open Space and Public Recreation Areas	7	0
Lincoln Trail Region Capability Assessment Summary		
Administrative and Technical		
Administration	Number of	Number of

	Cities	Counties
Planning Commission	15	5
Mitigation Planning Commission	27	8
Maintenance Programs to Reduce Risk (e.g., tree trimming, clearing drainage systems)	13	7
Mutual Aid Agreements	27	8
Staff		
Chief Building Official	5	4
Floodplain Administrator	10	5
Emergency Manager	27	8
Community Planner	2	2
Civil Engineer	4	1
GIS Coordinator	3	2
Technical		
Warning Systems/Services (Reverse 911, outdoor warning sirens)	27	7
Hazard Data and Information	27	8
Grant Writing	27	8

All of the Lincoln Trail Region cities and counties have access to services provided by the LTADD. ADD staff write and administer grants for any jurisdiction in need of assistance. Every jurisdiction is included in the Regional Hazard Mitigation Plan, and the process and activities necessary to keep it relevant and informative. That includes access to hazard data, information, and risk assessments. There are regional mutual aid agreements in place that include first response personnel and resources from all jurisdictions, as part of NIMS compliance. All jurisdictions have access to DFIRM maps, GIS/GPS assistance, hazard data information, transportation planning, and community planning help, through the Lincoln Trail Area Develop District as well.

Almost the entire region is covered by an outdoor warning system and many have enhanced warning systems such as reverse 911 or Code Red.

The Lincoln Trail Region has two joint planning commissions in LaRue County and Nelson County that provide comprehensive land use plans and regulations for both counties, and the five cities within their respective jurisdictions. Hardin, Meade and Washington Counties have their own planning commissions, as do an additional thirteen cities. All twenty-seven cities are covered by the eight county emergency managers and are included in the EOP of their county. LTADD staff provides land use planning assistance and training on an individual and regional basis. City and County ISO ratings ranged from 4 to 9, with an average of 5.809. The City of West Point is located at the confluence of the Ohio and Salt Rivers and has taken steps to mitigate flood hazards with a *Flood Damage Prevention Plan Ordinance* that requires all new construction to be in compliance with base flood elevations.

Table 3.4.1.1.2 - Lincoln Trail Region Capability Assessment Summary

Financial		
Funding Resource	Number of Cities	Number of Counties
Capital Improvements Project Funding	9	1
Authority to Levy Taxes for Specific Purposes	0	0
Fees for Water, Sewer, Gas, or Electric Service	19	1
Impact Fees for New Development	1	1
Storm Water Utility Fee	3	0
Incur Debt Through Private Activities	4	0
Incur Debt Through General Obligation Bonds	27	8
Community Development Block Grant	27	8
Other Federal Funding Programs	27	8
State Funding Programs	27	8

All of the jurisdictions in the Lincoln Trail Region, with the exception of Elizabethtown, which receives entitlement funding through HUD, are eligible for Community Development Block Grants as well as other State and Federally funded programs. Many communities would like to enhance their storm water management capabilities and are considering a storm water utility fee as a means for funding those activities and projects.

Table 3.4.1.1.3 - Lincoln Trail Region Capability Assessment Summary		
Education and Outreach		
Programs/Organization	Number of Cities	Number of Counties
Local Citizen Groups or Non-profit Organizations Focused on Environmental Protection, Emergency Preparedness, Access and Functional Needs Populations, Etc.	27	8
Ongoing Public Education or Information Program (e.g., Fire Safety, Household Preparedness, Environmental Education)	27	8
Natural Disaster or Safety Related School Programs	All Cities with Schools	8
StormReady Certification		1
Firewise Communities Certification	0	0
Public-private Partnership Initiatives Addressing Disaster Related Issues	2	2

All communities throughout the region have access to local citizens groups or non-profit organizations such as the American Red Cross, the Medical Reserve Corps, Local Emergency Planning Committee (LEPC) groups, Amateur Ham Radio Operators, and the Kentuckiana Volunteer Aviators; these groups are available to assist in emergency situations and in response to a natural hazard event.

Every city and county with a school has a safety education program to inform families about safety and preparedness in the event of a natural disaster or fire. A component of these programs is the dissemination of information about natural disasters and individual and family preparedness. Each of these schools conducts fire and severe weather drills each year. In addition, all communities have access to information through LTADD and from websites such as FEMA's.

Planning to make this eight-county region more resilient and prepared, has been incorporated into many projects and regional trainings over the last five years, and during this update process. All communities have received training and information on the importance of proactive land use planning, and the need to avoid development in hazard prone areas. In addition, every city and county has received information on making their existing infrastructure and critical facilities more resilient to the effects of hazard events.

As part of the Lincoln Trail Region's planning process for updating the Lincoln Trail Regional Hazard Mitigation Plan, each of the eight counties was allocated some regional funding to work toward "StormReady" Certification. Those projects are currently under way and will be completed before the end of 2015. While Hardin County is currently the only "StormReady" certified county, Meade County will be eligible for that certification once their projects are completed. In addition, the National Oceanic and Atmospheric Administration has recognized the Meade County Emergency Management Agency as a "Weather-Ready Nation Ambassador." Over the last 5 years, this region has made great strides in resiliency and preparedness due to the planning efforts of the Lincoln Trail Hazard Mitigation Committee, and the coordinated efforts of the twenty-seven cities and eight counties.

3.4.1.2 Existing Governmental Structures

The table below briefly outlines the jurisdictions that are included in the Lincoln Trail Regional Hazard Mitigation Plan as well as, the characteristics of each governing body.

Table 3.4.1.2.1 - Lincoln Trail Regional Units of Government

Jurisdiction	Population 2010 Census	Type of Government
Breckinridge County encompasses 567.17 square miles with a population density of approximately 35.4 people per square mile. Elevations in the County range from 383 to 920 feet above sea level.		
Breckinridge County	20,059 18,888 (2014 estimate)	One County Judge/Executive & Six Fiscal Court Magistrates
City of Cloverport	1,152	One Mayor & Six City Council Members
City of Hardinsburg	2,343	One Mayor & Six City Council Members
City of Irvington	1,181	One Mayor & Six City Council Members

Grayson County encompasses 496.7 square miles with a population density of approximately 51.8 people per square mile. Elevations in the County range from 395 to 963 feet above sea level.		
Grayson County	25,746 26,194 (2014 estimate)	One County Judge/Executive & Six Fiscal Court Magistrates
City of Caneyville	608	One Mayor & Four City Commissioners
City of Clarkson	875	One Mayor & Four City Commissioners
City of Leitchfield	6,699	One Mayor & Six City Council Members

Hardin County encompasses 623.28 square miles with a population density of approximately 169.3 people per square mile. Elevations in the County range from 383 to 1,017 feet above sea level.		
Hardin County	105,543 108,266 (2014 estimate)	One County Judge/Executive & Eight Fiscal Court Magistrates
City of Elizabethtown	28,531	One Mayor & Six City Council Members
City of Radcliff	21,688	One Mayor & Six City Council Members
City of Sonora	513	One Mayor & Four City Commissioners
City of Upton	683	One Mayor & Four City Commissioners
City of Vine Grove	4,520	One Mayor & Six City Council Members
City of West Point	797	One Mayor & Six City Council Members
LaRue County encompasses 261.52 square miles of land with a population density of approximately 54.3 people per square mile.		
LaRue County	14,193 14,180 (2014 estimate)	One County Judge/Executive & Four Fiscal Court Magistrates
City of Hodgenville	3,206	One Mayor & Six City Council Members
Marion County encompasses 343.01 square miles of land with a population density of approximately 57.8 people per square mile.		
Marion County	19,820 20,007 (2014 estimate)	One County Judge/Executive & Five Fiscal Court Magistrates
City of Bradfordsville	294	One Mayor & Four City Commissioners
City of Lebanon	5,539	One Mayor & Six City Council Members
City of Loretto	713	One Mayor & Four City Commissioners
City of Raywick	134	One Mayor & Four City Commissioners
Meade County encompasses 305.42 square miles of land with a population density of approximately 93.6 people per square mile.		
Meade County	28,602 29,139	One County Judge/Executive & Six Fiscal Court Magistrates

	(2014 estimate)	
City of Brandenburg	2,643	One Mayor & Six City Council Members
City of Ekron	135	One Mayor & Four City Commissioners
City of Muldraugh	947	One Mayor & Six City Council Members

Nelson County encompasses 417.51 square miles of land with a population density of approximately 104.0 people per square mile.		
Nelson County	43,437 44,812 (2014 estimate)	One County Judge/Executive & Five Fiscal Court Magistrates
City of Bardstown	11,700	One Mayor & Six City Council Members
City of Bloomfield	838	One Mayor & Six City Council Members
City of Fairfield	113	One Mayor & Four City Commissioners
City of New Haven	855	One Mayor & Four City Commissioners
Washington County encompasses 297.27 square miles of land with a population density of approximately 39.4 people per square mile.		
Washington County	11,717 11,959 (2014 estimate)	One County Judge/Executive & Six Fiscal Court Magistrates
City of Mackville	222	One Mayor & Four City Commissioners
City of Springfield	2,519	One Mayor & Six City Council Members
City of Willisburg	282	One Mayor & Four City commissioners

3.4.1.3 Local Jurisdiction's "Professional Staff" Assessment

The following table lists the professional staff departments that serve the jurisdictions within the Lincoln Trail Region. It should be noted that police, sheriff and public safety offices are identified in a separate table. Social services in the region are provided by a regional community mental health system. Every county has a presiding county judge/executive and county clerk, and every city has a mayor and city clerk. Every county also has a PVA and a county board of education. Cities with independent boards of education include: Cloverport, Elizabethtown, and West Point.

Table 3.4.1.3.1 - Local Jurisdiction's– Professional Staff

Jurisdiction	PVA (Tax Assessment)	Road Dept.	Health Dept.	Emergency Management	Building Inspections
Breckinridge County	Y	Y	Independent Department	Y	Y
Cloverport	*	PW	*	*	Y
Hardinsburg	*	PW	*	*	Y
Irvington	*	PW	*	*	Y
Grayson County	Y	Y	Y	Y	Y
Caneyville	*	*	*	*	*
Clarkson	*	*	*	*	*
Leitchfield	*	PW	*	*	Y

Hardin County	Y	Y	Y	Y	Y
Elizabethtown	*	PW	*	Y	Y
Radcliff	*	PW	*	Y	*
Sonora	*	*	*	Y	*
Upton	*	*	*	Y	*
Vine Grove	*	PW	*	Y	Y
West Point	*	PW	*	Y	Y
LaRue County	Y	Y	Y	Y	Y
Hodgenville	*	PW	*	*	*
Marion County	Y	Y	Y	Y	State Inspector
Bradfordsville	*	No	*	*	*
Lebanon	*	PW	*	Y	Y
Loretto	*	No	*	*	*
Raywick	*	No	*	*	*
Meade County	Y	Y	Y	Y	Y
Brandenburg	*	PW	*	*	*
Ekron	*	*	*	*	*
Muldraugh	*	PW	*	*	*
Nelson County	Y	Y	Y	Y	Y 2 inspectors
Bardstown	*	PW	*	*	Y
Bloomfield	*	PW	*	*	*
Fairfield	*	*	*	*	*
New Haven	*	PW	*	*	*
Washington County	Y	Y	Y	Y	Y
Mackville	*	*	*	*	*
Springfield	*	PW	*	*	Y
Willisburg	*	*	*	*	*

(NA – Not Applicable), (* - Covered by County), (Y – Yes), (PW – Public Works)

The duties and responsibilities of the professional city and county offices are outlined below.

Boards of Education: The Lincoln Trail Region has eight county boards of education and four independent districts. County boards are responsible for evaluating educational goals; providing financial resources for budgeting purposes; involving the public in the planning process; developing and maintaining a statement of mission, vision and values; and evaluating the effectiveness of school policies and their implementation. All members of a school board are elected to serve by the people of each district.

Building Inspector: A city or county building inspector enforces the State and Local Building Codes, the National Flood Insurance Program, the Community Rating System, and other applicable codes through the process of inspections and permitting.

PVA, City/County Clerk, Sheriff: The Property Valuation Administrator (PVA) is responsible for the valuation of property for tax purposes. A city clerk is hired by the mayor and is responsible for the maintenance and safekeeping of the permanent records of the city, and is the official custodian of records under KRS 61.870 to 61.884. Per KRS 83A.085, the city clerk must submit a list of current city information to the Department for Local Government no later than January 31 of each year. The county clerk is elected by the citizens of the county every four years and performs the clerical duties of fiscal court such as issuing, registering, recording and keeping legal records; registering and purging voter rolls; conducting election duties; and conducting tax duties. A county clerk may serve as clerk of fiscal court. The county sheriff is elected every four years and operates on a budget annually approved by fiscal court. The sheriff is responsible for the collection of real property taxes and enforcement of state and local laws.

City Police: City Police Departments are responsible for the enforcement of local and state laws within their jurisdictions. KRS 95.440 requires cities of the second and third class as well as urban-county government to establish and maintain police and fire departments.

Road Departments: Road Departments are responsible for the repair and maintenance of all public roadways. This responsibility includes snow and debris removal.

Utility Departments: Local utility departments, in conjunction with utility commissions, local units of government and the Kentucky Utility Commission, work in concert to ensure that the entire region has access to safe and reliable water, gas, electric, communication, and sewer services. There could potentially be numerous service providers in any one county.

Emergency Management: Each county emergency management office is responsible for all operations that deal with both natural and man-made disasters. This responsibility extends to mitigation strategies, preparedness, response efforts and recovery operations. Kentucky Revised Statutes mandate that each county establish an emergency management office.

City and County Treasurer: City and County Treasurers are responsible for the oversight and management of either the city or county budget and fiscal programs.

Mayor and County Judge Executive: A mayor or a county judge/executive is elected every four years and is responsible for the oversight of the daily operations of either the city or county government, and the enforcement of city or county policies and regulations. According to the Kentucky Constitution, section 124, and KRS 67.040, a County Judge Executive serves as a member and presiding officer of the fiscal court and acts as the county's chief executive and administrative official.

Health Department/Social Services: In the Lincoln Trail Region, the Lincoln Trail District Health Department and Central Kentucky Community Action agencies provide individuals and communities with programs and services designed to protect public health, provide medical assistance and administer numerous social service programs.

3.4.1.4 First Responder Resources

First responder resources are critical components of the region's level of resiliency and preparedness. Homeland Security grants have enabled many of the Lincoln Trail Region's local jurisdictions to acquire communication and first responder equipment.

Table 3.4.1.4.1 - Lincoln Trail Region First Responder Resources		
Jurisdiction	**Personnel Resources**	**Vehicle & Equipment Resources**
Breckinridge County	Sheriff, 9 officers & 2 staff Trained volunteer firefighters at Stephensport, McQuady, McDaniels, Custer, Webster, Harned County Emergency Mgr.	36 vehicles and 13 portable generators
City of Cloverport	Police Chief Trained volunteer firefighters	4 vehicles
City of Hardinsburg	Police Chief, 4 officers 7 trained volunteer firefighters	36 vehicles and 40 pieces of equipment
City of Irvington	Police Chief, 3 officers, Fire Chief, 22 Trained volunteer firefighters	10 vehicles and 4 pieces of equipment
Grayson County	Sheriff, 9 full-time & 3 part-time officers & 6 staff Trained volunteer firefighters at Anneta Fire District #792, Falls of the Rough Fire & Rescue, Wax Fire & Rescue, East Grayson Fire & Rescue County Emergency Mgr.	31 vehicles and 1 piece of equipment
City of Caneyville	Police Chief Fire Chief, 15 trained volunteers	14 vehicles, utility trailer, 2 generators, firefighter gear, extrication hydraulic tools
City of Clarkson	Police Chief Fire Chief and trained volunteer firefighters	15 vehicles

City of Leitchfield	Police Chief & 14 Officers Fire Chief & 2 trained firefighters, trained volunteer firefighters	20 police vehicles, trailer & generator 15 fire vehicles, boat w/ motor, trailer, 2 generators
Hardin County	Sheriff & 11 officers Trained volunteer firefighters at Stephensburg, White Mills, West 84, Central Hardin, & KY 86 County Emergency Mgr.	8 pumper/tanker vehicles, 3 rescue vehicles, 6 tankers, & 43 other vehicles
City of Elizabethtown	Elizabethtown Police has 49 sworn officers and 18 staff people Paid Fire Dept. has 3 stations & 50 employees	40 police patrol vehicles & SWAT team equipment for police dept. Fire dept. has 4 fire engines, 2 aerial ladder trucks, 3 brush trucks, hazardous material equipment, swift water rescue equipment, a trench equipment trailer
City of Radcliff	Radcliff Police Dept. has chief, 41 officers, 1 public relations officer & 11 staff personnel Fire Dept. has chief, 22 full-time pd. Firefighters & 7 volunteers	Radcliff law enforcement has a fleet of response vehicles. The fire dept. has 8 vehicles, 8 generators, a mobile incident command center, portable lighting and assorted equipment and gear.
City of Sonora	Fire chief and trained volunteer firefighters	Fire dept. has several fire trucks.
City of Upton	Fire chief and volunteer firefighters	6 fire trucks and an emergency generator
City of Vine Grove	Police chief & 7 officers Fire chief, deputy chief, assistant chief and volunteer firefighters	Police patrol vehicles and equipment 6 fire fighting vehicles and fire fighting gear and equipment.

City of West Point	3 police officers Fire chief & 11 trained volunteer firefighters	Police patrol vehicles and equipment 3 fire fighting vehicles and fire fighting gear and equipment
LaRue County	Sheriff & 4 officers Trained volunteer firefighters at 4 county locations	Law enforcement patrol vehicles Firefighting vehicles and equipment
City of Hodgenville	City police dept. with 6 officers Fire chief & 11 trained volunteer firefighters	6 law enforcement vehicles 4 firefighting vehicles, a boat and portable pump
Marion County	Sheriff & 7 officers Marion Co. EMS Marion Co. Rescue	Law enforcement vehicles 5 ambulances EM vehicle EMS director vehicle Firefighting vehicles and equipment
City of Bradfordsville	Fire chief & 15 trained volunteer firefighters	Fire tanker and trucks Emergency generator at community center, sewer plant and fire station
City of Lebanon	Police chief & 16 officers Fire chief & 20 trained volunteer fire fighters	18 law enforcement vehicles Fire fighting vehicles and equipment
City of Loretto	Fire chief & trained volunteer firefighters	4 – class A pumpers 1 – class A pumper/tanker 2 – utility vehicles
City of Raywick	NA	NA
Meade County	Sheriff & 8 officers County-wide fire protection with trained volunteer firefighters at 10 stations throughout the county EMS, EM	Sheriff Dept. vehicles Earth moving equipment Water Dist. Trucks Fire District tankers, brush trucks and assorted firefighting equipment
City of Brandenburg	Police chief & 4 officers	6 police patrol vehicles 3 emergency generators Maintenance and road dept. vehicles
City of Ekron	NA	NA

City of Muldraugh	Police chief & 3 officers Fire chief & 19 trained volunteer firefighters	Law enforcement patrol vehicles (4) 2 pumpers 1 brush truck 1 ladder truck 4 diesel generators 1 decontamination vehicle
Nelson County	Sheriff, 5 command officers, 7 patrol officer, office staff EM EMS Bardstown-Nelson Co. Volunteer Fire Dept.	Law enforcement vehicles Fire fighting vehicles and equipment
City of Bardstown	Police chief & 24 officers Fire chief & 9 trained volunteer firefighters	25 law enforcement vehicles 2 fire truck pumpers and 1 aerial pumper Backup emergency generators at city hall, water treatment plant and wastewater treatment plant
City of Bloomfield	Police chief & 1 officer Fire chief & 5 trained volunteer firefighters	2 law enforcement patrol vehicles 2 fire engines, 1 aerial truck, 2 fire tankers, 2 brush units & 1 support vehicle 2 water trucks, 1 dump truck, 1 portable emergency generator
City of Fairfield	NA	NA
City of New Haven	Police chief Fire chief & 11 trained firefighters	1 law enforcement patrol vehicle 2 fire truck pumpers, 1 boat, 2 emergency generators, mutual aid rescue equipment
Washington County	Sheriff & 3 officers County Emergency Mgmt., County EMS & County Fire Dept.	5 Law enforcement vehicles 4 ambulances 5 rescue trucks 5 fire tankers 6 fire engines 1 command post
City of Mackville	NA	NA
City of Springfield	Police chief & 7 officers Fire chief, 9 officers and 15 trained volunteer firefighters	Law enforcement vehicles Fire Truck, pumper, & assorted fire fighting equipment and gear Dump truck Emergency generators Bobcat w/ bucket
City of Willisburg	Fire chief	NA

3.4.1.5 Utilities and Services

The following chart outline some of the critical utility and service providers in the eight-county, Lincoln Trail Region.

Table 3.4.1.5.1 - Utility and Service Providers

Breckinridge County		
Utility or Service	Utility or Service Provider	Area Served
Electricity	Big Rivers Electric Corp. Kenergy Corporation Meade Co. RECC East Kentucky Power Cooperative Nolin RECC	Breckinridge County
Natural/Propane Gas	Atmos Energy Corp. Valley Gas, Inc.	Breckinridge County
Potable Water	Cloverport Water & Sewer System (distribution only) Hardinsburg Water Dept. Irvington Water System (distribution only)	City of Cloverport City of Hardinsburg and Rural Breckinridge Co. City of Irvington
Sewer Service	Cloverport Sewer System Hardinsburg Sewer System Irvington Sewer System USCOE Rough River Lake	City of Cloverport City of Hardinsburg City of Irvington Local Package Plant
Low-rent/Section 8 Housing	Housing Authority of Irvington Weatherholt Hills Apartments	City of Irvington City of Cloverport
Local Exchange Carriers	Brandenburg Telecom, LLC AT&T Kentucky	Breckinridge County

Grayson County		
Utility or Service	Utility or Service Provider	Area Served
Electricity	Big Rivers Electric Corp. Meade Co. RECC East Kentucky Power Cooperative Farmers RECC Kentucky Utilities (a PPL company) Tennessee Valley Authority Warren RECC	Grayson County
Natural/Propane Gas	Leitchfield Utilities	City of Leitchfield
Potable Water	Caneyville Water & Sewer System (distribution only) Grayson Co. Water District Leitchfield Utilities	City of Caneyville Grayson County City of Leitchfield
Sewer Service	Caneyville Sewer System Clarkson Sewer System Leitchfield Utilities Commission Rough River Dam State Resort Park (pkg. plant)	City of Caneyville City of Clarkson City of Leitchfield Falls of the Rough
Low-rent/Section 8 Housing	NA	
Local Exchange Carriers	Windstream Kentucky East	Grayson County

Hardin County		
Utility or Service	Utility or Service Provider	Area Served
Electricity	Big Rivers Electric Corp. Meade Co. RECC East Kentucky Power Cooperative Nolin RECC Kentucky Utilities (a PPL company) Louisville Gas & Electric (a PPL company)	Hardin County
Natural/Propane Gas	Elizabethtown Water & Gas (distribution only) Louisville Gas & Electric (a PPL company)	City of Elizabethtown Hardin County

Potable Water	Hardin Co. Water Dist. #1 (Fort Knox) Hardin Co. Water Dist. #1 Hardin Co. Water Dist. #2 Vine Grove Water Dept. (distribution only) West Point Water Dept.	Fort Knox City of Radcliff, Northern Hardin County City of Elizabethtown Southern Hardin County City of Vine Grove City of West Point

Sewer Service	Airview Estates Subdivision (pkg. plant) East Hardin Middle School (package plant) Elizabethtown Wastewater System Glendale Auto Truck Plaza (package plant) Hardin Co. Water Dist. #1 Radcliff Sewer System Hardin Co. Water Dist., #2 Heartland Mobile Home Community (pkg. plant) Lincoln Trail Elementary School (pkg. plant) Sonora Auto Truck Plaza (pkg. plant) US Army Hardin Co. Water Dist. #1 Vine Grove Sewer System West Point Sewer System Petro Stopping Centers (pkg. plant)	Airview Estates Subdivision School in Glendale City of Elizabethtown Truck Plaza in Glendale City of Radcliff Hardin County Mobile Home Community in Rineyville Lincoln Trail Elementary School Truck Plaza in Sonora City of Radcliff City of Vine Grove City of West Point Petro in Glendale
Low-rent/Section 8 Housing	Housing Authority of Elizabethtown Housing Authority of Radcliff	City of Elizabethtown City of Radcliff
Local Exchange Carriers	Brandenburg Telecom, LLC AT&T Kentucky	Hardin County

LaRue County		
Utility or Service	Utility or Service Provider	Area Served
Electricity	East Kentucky Power Cooperative Farmers RECC Inter-County Energy Cooperative Nolin RECC Salt River Electric Cooperative Corp. Kentucky Utilities (a PPL company)	LaRue County
Natural/Propane Gas	Louisville Gas & Electric (a PPL company)	LaRue County
Potable Water	Hodgenville Water Works LaRue Co. Water District #1(distribution only)	City of Hodgenville LaRue County
Sewer Service	Hodgenville Sewer System	City of Hodgenville
Low-rent/Section 8 Housing	Housing Authority of Hodgenville	City of Hodgenville
Local Exchange Carriers	Windstream Kentucky East South Central Rural Telephone	LaRue County
Marion County		
Utility or Service	Utility or Service Provider	Area Served
Electricity	East Kentucky Power Cooperative Inter-County Energy Cooperative Salt River Electric Cooperative, Corp. Taylor County RECC Kentucky Utilities (a PPL company)	Marion County
Natural/Propane Gas	Atmos Energy Corporation Louisville Gas & Electric (a PPL company)	Marion County

Potable Water	Lebanon Water Works Co., Inc. Marion County Water Dist. (distribution only)	City of Lebanon Rural Marion County
Sewer Service	Bradfordsville Sewer System Lebanon Sewer System Loretto Wastewater System (collection only)	City of Bradfordsville City of Lebanon City of Loretto
Low-rent/Section 8 Housing	Housing Authority of Lebanon	City of Lebanon
Local Exchange Carriers	Windstream Kentucky East	Marion County
Meade County		
Utility or Service	Utility or Service Provider	Area Served
Electricity	Big Rivers Electric Coop Meade Co. RECC East KY Power Coop Nolin RECC Louisville Gas & Electric (a PPL company)	Meade County
Natural/Propane Gas	Louisville Gas & Electric (a PPL company)	Meade County
Potable Water	Brandenburg Water Works Doe Valley Utilities, Inc. Meade Co. Water District Muldraugh Water Dept. (distribution only)	City of Brandenburg Doe Valley Development Rural Meade County City of Muldruagh
Sewer Service	Brandenburg Sewer System Doe Valley Assoc., Inc. (pkg. plant) Muldraugh Sewer System (collection only)	City of Brandenburg Doe Valley Association City of Muldraugh
Low-rent/Section 8 Housing	NA	NA
Local Exchange Carriers	Brandenburg Telecom, LLC AT&T Kentucky	Meade County

Nelson County		
Utility or Service	Utility or Service Provider	Area Served
Electricity	East KY Power Coop Inter-County Energy Coop Salt River Electric Coop Corp. Kentucky Utilities (a PPL company) Bardstown Municipal Electric & Gas	Nelson County
Natural/Propane Gas	Louisville Gas & Electric (a PPL company)	Nelson County
Potable Water	Bardstown Municipal Water Department Bloomfield Water & Sewer Department (distribution only) New Haven Municipal Water Works (distribution only) North Nelson Water Dist. (distribution only)	Bardstown & adjacent area Bloomfield & Northeastern Nelson Co. City of New Haven & adjacent areas Northern Nelson County
Sewer Service	Abbey of Gethsemani (pkg. plant) Bardstown Sewer System Cox's Creek Elementary School New Haven Sewer System	Abbey at Gethsemani City of Bardstown Cox's Creek City of New Haven
Low-rent/Section 8 Housing	Housing Authority of Bardstown	City of Bardstown
Local Exchange Carriers	Brandenburg Telecom, LLC. AT&T Kentucky	Nelson County
Washington County		
Utility or Service	Utility or Service Provider	Area Served
Electricity	East KY Power Coop Blue Grass Energy Coop Corp. Inter-County Energy Coop Salt River Electric Coop Corp. Kentucky Utilities (a PPL company)	Washington County

Natural/Propane Gas	Atmos Energy Corporation Louisville Gas & Electric (a PPL company)	Washington County
Potable Water	Springfield Water & Sewer Commission	Springfield and Washington County
Sewer Service	Springfield Water & Sewer Commission Washington County Elementary School (pkg. plant)	City of Springfield School in Willisburg
Low-rent/Section 8 Housing	Housing Authority of Springfield	City of Springfield
Local Exchange Carriers	AT&T Kentucky	Washington County

Findings Summary: The mission statement of the Lincoln Trail Hazard Mitigation Committee (LTHMC) is: *To Reduce or Eliminate the Negative Physical and Economic Impacts Natural Hazards have on our Communities*. All jurisdictions desire to accomplish this mission, but disparate resources hinder this effort. The capabilities assessment contained within this document would appear to indicate relative equality across all eight counties. However, each county is unique, with populations that range from more than 105,000 people to less than 12,000, and land mass areas ranging from 300 square miles to 600. Financial disparity is also prevalent due to each county's size and tax base. Many of our counties rely solely on volunteer first responders, while others can afford full-time, paid personnel, in addition to volunteer responders.

Kentucky Emergency Management's goal is to coordinate a system of mitigation, preparedness, response and recovery actions that protect the lives, environment and property of the people of Kentucky. Toward that end, Kentucky Emergency Management requires each county to prepare and update a countywide Emergency Operations Plan (EOP). Each county EOP enumerates policies and provisions for a coordinated local, state and federal emergency response to any natural, technological or manmade emergency or disaster. Each county EOP details preparedness activities for each local government, prior to a disaster. These preparedness actions include, but are not limited to, the selection and training of staff and emergency response personnel, development of operation plans, equipping an emergency operations center (EOC), and the establishment of procedures that will effectively prepare the area to respond to emergencies and disasters. These county plans and the extensive coordination requirements they contain, ensure that the aftermath of any natural or manmade disaster will be minimized. These planning efforts will minimize the length of power outages, expedite efforts to keep roads open, and reduce the amount of time and number of residents who may be displaced from their homes.

In contrast to county emergency operations plans, the Regional Hazard and Flood Mitigation Plan is designed to define activities that local units of government can take to decrease, eliminate or diffuse their vulnerability to disasters prior to an actual disaster event.

The LTHMC has worked with local units of government in the Lincoln Trail Region, during the planning phase of this plan update, to inventory completed mitigation projects, report on current actions and develop future activities that will minimize community vulnerability across the region and decrease adverse impacts that may occur as a result of any future disaster. The Lincoln Trail Hazard and Flood Mitigation Plan Update will contain goals and objectives that pertain to the entire region, are county specific, and address single issues within individual cities. The plan exemplifies a planning effort that is pro-active in addressing actions that will effectively mitigate future natural hazards, as well as a documentation of mitigation initiatives that have solved some past vulnerability issues. To date, the region has accomplished several successful mitigation projects, some are still in progress and others are planned when sufficient funding can be secured.

3.4.1.6 Lincoln Trail Region Community Hazard Mitigation Projects

The hazard mitigation projects in the Lincoln Trail Region, fall into three categories:

1. Projects Completed
2. Projects Presently Underway
3. Future Projects

The Region has planned for projects that will mitigate loss of property and human life and eliminate repetitive losses when possible. The region has used local funds, State funding, FEMA funding, CDBG Funds, and Homeland Security funding to accomplish these projects.

3.4.1.6.1 Completed Projects (1997 through 2014)

Breckinridge County

County

Flood Mitigation: Two bridges in the County located on Marks Ridge Road West (CR-1520) and Shot Pouch Creek Road (CR-1405) were replaced to mitigate flooding issues that previously closed the roads and stranded local residents in their homes, or prevented farmers from reaching their fields and livestock.

Cloverport

Flood Mitigation: Three Ohio Riverfront properties were acquired and relocated to different sites. Land was converted to recreational use in perpetuity.

Slope Stabilization: Bank stabilization measures were taken to prevent damage to a housing complex for the elderly.

West Marks Ridge Rd Bridge, Breckinridge Co. Federal Disaster Declaration 1818 *Source: LTADD Archive.*

Hardinsburg

Disaster Response: The City used grant funding and local funds to improve its emergency response capability by purchasing a mobile command center for use during any kind of disaster response. In addition, a permanent generator was purchased for use in the City Hall and Fire Department so that critical services can be provided during a power outage. The City also purchased a swift water rescue motorized boat for use during flooding incidents.

Irvington

Early Warning System: The City purchased and installed two new early warning sirens to enhance its public warning system.

Grayson County

County

Flood Mitigation: Grayson County built 3 new bridges to mitigate road flooding that stranded county citizens and prevented emergency response efforts from reaching them.

Bloomington Rd Bridge, Grayson Co. Federal Disaster Declaration 1818. *Source: LTADD Archive.*

Caneyville

Early Warning System: The City joined the County's "One Call" service.

Public Safety: Caneyville subscribed to a service that would provide an emergency generator, laptop computer and communication system to the City, in the event of a power outage. This will enable continuity of operations.

Leitchfield

Public Safety: The City purchased an emergency generator for the water treatment plant. Potable water can be supplied to residents even during a power outage.

Hardin County

County

Early Warning System: Hardin County enhanced its public early warning system by purchasing and installing an outdoor siren in the unincorporated community of Stephensburg. The County also implemented a reverse 911 early warning system, countywide.

E. Poplar St. Bridge, Elizabethtown. *Source: City of Elizabethtown.*

Elizabethtown and surrounding area

Early Warning System: Hardin County initiated a study to determine the placement of 16 audible warning sirens in Elizabethtown and the surrounding area. The project provided an early warning system where there had been none. The City also replaced 7 aging, outdoor sirens.

Flood Mitigation: The City purchased 3 repetitive loss properties to eliminate future flooding issues. Land was preserved as green space and a storm water retention basin. The City also mitigated flood issues by replacing a bridge on East Poplar St. to facilitate floodwater flow.

Radcliff generator, 2010 Flooding Declaration, *Source: LTADD Archive.*

Radcliff

Public Safety: Radcliff purchased generators to facilitate power to the community center, which also acts as a shelter, and to power city hall so that critical services can be provided in the event of a power outage.

Early Warning System: The City purchased and installed 3 new outdoor warning sirens and upgraded the current system.

Upton

Early Warning System: Upton purchased and installed an outdoor siren.

Vine Grove

Flood Mitigation: The City repaired the banks of a creek to eliminate road flooding. Vine Grove also replaced sewer lines lying within a waterway to eliminate the potential for sewage to spill into storm water runoff.

West Point

Flood Mitigation: Repetitive loss properties were acquired and their respective structures demolished. Land was preserved as community green space. Four houses, two mobile home parks and three vacant lots were purchased. The City also relocated 5 lift station electrical panels from a floodway to higher points and initiated a local storm water fee to fund future flood mitigation projects.

Public Safety: The City purchased an emergency generator for the wastewater treatment plant so that service could continue in the event of a power outage.

West Point Lift Station. Source: *LTADD Archive.*

LaRue County

County

Public Safety: The County purchased an emergency generator for both the County Courthouse and Hodgenville City Hall to ensure that critical services can be provided in the event of a power outage.

Hodgenville

Public Safety: Emergency generators were purchased for the water plant and sewer plants.

Flood Mitigation: Storm water management improvements completed to address flooding issues on 3 city streets.

Marion County

County

The County built a replacement bridge over Scuffle Creek that frequently flooded and cut off access to 32 residences and farms.

Scuffle Creek Bridge, Marion Co., Federal Disaster Declaration 1818.
Source: LTADD Archive.

Bradfordsville

Public Safety: The City completed a safe room to serve the entire community. Signage was also installed to identify and locate the facility.

Early Warning System: An outdoor siren was installed in the City and weather radios were distributed to the elderly, disabled and rural residents.

Lebanon

Flood Mitigation: A storm water management project was completed to mitigate flooding in the Derring Ct. neighborhood. Three hundred feet of an existing storm drainage channel was relocated, improved and straightened to mitigate repetitive flooding issues. Additional repairs were made to a storm water channel that was causing local flooding.

Loretto

Public Safety: The City purchased and installed an emergency generator for the City Hall/Community Center so that critical services can be provided in the event of a power outage.

Meade County

County
Public Safety: Meade County purchased and equipped a mobile trailer to use wherever a long-term shelter needs to be established for displaced persons. The trailer carries supplies for a 100 person shelter.

Mobile Trailer, Meade Co., 2010 KOHS Grant. *Source: Meade Co EM.*

Concordia Community

Flood Mitigation: Meade County acquired land in the unincorporated community of Concordia to mitigate repetitive flood damage. Ten residential housing units and the land on which they were built was acquired. Structures were demolished and the land preserved as green space in perpetuity.

Muldraugh

Public Safety: Muldraugh built Kentucky's largest, above ground safe room to mitigate loss of life and injury to the community's entire population. The facility can also serve as a long-term shelter for displaced residents.
The City also purchased a used decontamination trailer for use in the event of a hazardous material incident.

Muldraugh Storm Shelter Dedication 24 Oct. 2013.
Source: LTADD Archive.

Nelson County

County

Public Safety: County purchased emergency backup generators for the County EOC, the 911 center and law enforcement facilities.

Flood Mitigation: Improvements made at the county landfill to address flooding issues.

Bardstown

Public Safety: Bardstown relocated and buried power lines in an area that served 120 residences and 10 commercial facilities to eliminate power outages due to severe weather events.

Bloomfield

Public Safety: Bloomfield wired a smaller lift station to accept an emergency portable generator.

Flood Mitigation: The City completed storm drain and sewer improvement projects to mitigate flooding issues.

Washington County

County

Public Safety: Washington County completed an emergency notification system for the County.

Flood Mitigation: The County completed the following bridge projects to mitigate flooding issues: Tick Creek, Walker Lane, Froman Lane, Grundy Home Road, Tatum Ridge Road, Roye Lane, and Willis Lane.

Bank Stabilizations: Washington County completed bank stabilization projects on Sulphur Lick Road, Glenns Creek Road, Coulter Lane, Hardesty Road, Trent Lane, Gregory Lane, and Hardesty Road.

Fredericktown Community

Flood Mitigation: Washington County acquired land in the unincorporated community of Fredericktown to mitigate repetitive flood losses. Twelve structures were either purchased and demolished, or elevated, depending on the preference of owners, to mitigate flood damage.

Mackville

Public Safety: The City has installed an emergency generator at the fire department and has set up a safe room at the local community center. Mackville also installed a siren to notify residents of potential bad weather.

3.4.1.6.2 Projects Presently Underway

Hardin County

Vine Grove

Public Safety: Vine Grove is in the process of constructing a community safe room.

Meade County

Ekron

Public Safety: Ekron is clearing land for the construction of a community safe room.

Regional

Public Safety: All eight, Lincoln Trail Counties, are in the process of enhancing their respective preparedness capabilities. The following list outlines what projects each is undertaking to be better prepared according to the criteria established in the "StormReady" National Weather Service Program.

Breckinridge Co.: Purchasing equipment to establish a County Emergency Operations Center (EOC).

Grayson Co.: Purchasing communication equipment for use among first responders and the County Emergency Operations Center to be used in a disaster response situation. Also purchasing weather radios for distribution to all County critical facilities.

Hardin Co.: Purchasing computer equipment for use in the County's mobile Emergency Operations Center.

LaRue Co.: Purchasing a "Code Red" public warning system.

Marion Co.: Purchasing materials to construct a new mobile Emergency Operations Center.

Meade Co.: Purchasing an emergency generator to power County's Emergency Operations Center. Purchasing equipment to measure weather events.

Nelson Co.: Purchasing a "Code Red" public warning system.

Washington Co.: Purchasing emergency generators to power first responder communication equipment during a power outage.

Regional

All eight Lincoln Trail Counties are in the process of distributing 180 weather radios to critical facilities and to vulnerable citizens such as those who are elderly, disabled, or live in rural areas where outdoor warning systems don't reach**.**

3.4.1.6.3 Future Projects (Pending Funding)

Breckinridge County

County

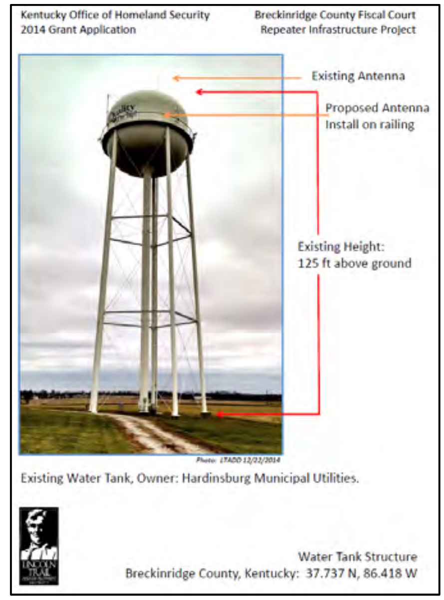
Flood Mitigation: Breckinridge County would like to raise a bridge on Tar Springs Rd. that regularly floods, making six family residences inaccessible during high water. Estimated cost = $400,000

Flood Mitigation: The County would like to raise the roadbed of the Stonehill-Ford Rd. approximately 4 foot on both sides and install new drainage tiles to eliminate reoccurring flooding. This is a moderately traveled, connecting road; it is completely blocked during times of flooding. Estimated cost = $150,000

Public Safety: The County has radio repeaters located on a water tower on Highway 259 in Harned. During a power outage, the repeaters are down and communication capability for EMS, EMA and fire departments is compromised. An on-site generator would resolve this issue. Estimated cost = $8,400

Public Safety: The County needs to purchase a portable emergency generator capable of providing backup electricity to a public housing complex during a power outage. Estimated cost = $30,000

Public Safety: The unincorporated community of Garfield needs an outdoor siren to alert citizens of impending severe weather. Estimated cost = $30,000



HWY 259 Water Tower Repeater Application. *Source: LTADD.*

Landslide Mitigation: The County has a landslide problem on Tar Springs Rd. The road is sliding downhill. The purchase of additional land would enable the County to move the road and eliminate the hazard. Estimated cost = $175,000

Hardinsburg

Public Safety: Hardinsburg would like to construct a community safe room that could also serve as an alternate emergency operations center. Estimated cost = $2 million

The City would like to purchase and install 3 new outdoor warning sirens. Estimated cost = $90,000

Purchase and install permanent generators for the water and sewer plant. Estimated cost = $100,000 each

Flood Mitigation: Hardinsburg wants in install culverts to mitigate flooding issues. Estimated cost = $40,000 each

Grayson County

County

Public Safety: Grayson County would like to construct safe rooms throughout the County. They would also like to install an outdoor siren system and purchase emergency generators to maintain critical public services during a widespread power outage. Estimated cost = $180,500 (generators), $2 million (safe room)

Caneyville

Public Safety: Caneyville would like to construct a FEMA compliant safe room and purchase emergency generators for city facilities such as city hall, fire dept., sewer plant, lift stations and the community center. Estimated cost = $166,500 (generators), $1.2 million (safe room)

Flood Mitigation: Caneyville would like to dredge out the creek that flows through town and often floods the area. Estimated cost = $200,000

Leitchfield

Public Safety: Leitchfield would like to purchase a generator for City Hall so that critical public services can be provided in the event of a power outage. The City would also like to construct a community safe room and install outdoor warning sirens on the south and west sides of town. Estimated cost = $40,000 (generator), $1.2 million (safe room), $6,000 (2 outdoor sirens)

Hardin County

County

Flood Mitigation: Hardin County would like to construct 2 new bridges and culverts to mitigate flooding issues in the County. Estimated cost = $95,000

Public Safety: The County would like to construct 2 tornado safe rooms in the County and upgrade the current outdoor warning siren system with the addition of 4 new sirens. They would also like to purchase 10 emergency generators to power critical facilities in the event of a power outage. It would also like to upgrade its mobile command post with new communication equipment. Estimated cost = $2 million (safe rooms), $80,000 (outdoor warning sirens), $65,000 (generators), $15,000 (mobile command post communications upgrades)

Elizabethtown

Public Safety: Elizabethtown would like to make upgrades to the Pritchard Community Center that serves as the area's long-term shelter for people displaced by local disasters. It would also like to upgrade its current outdoor warning sirens and purchase 6 portable generators for use at critical facilities in the event of a power outage. Estimated cost = $500,000 (Pritchard upgrades), $360,00 (warning sirens), $180,00 (generators)

Radcliff

Public Safety: Radcliff would like to upgrade its emergency outdoor warning sirens with the purchase of 4 new sirens. The City would also like to construct a community safe room and purchase an emergency backup generator for the police dispatch center. Estimated cost = $74,600 (outdoor warning sirens), $1.5 million (safe room), $70,00 (backup emergency generator)

Vine Grove

Public Safety: Vine Grove would like to purchase 4 emergency, backup generators for use at its police dept., sewer plant, public works dept., and fire dept. for provision of critical services during a power outage. The City would also like to install transfer switches for 8 lift stations throughout the City. Estimated cost = $200,000 (generators), $11,000 (switches for lift stations)

West Point

Flood Mitigation: West Point has two flood mitigation projects they wish to complete. The City would like to complete a storm water management project in the Riverview Dr. neighborhood to eliminate flooding issues there. The City would also like to address storm water infiltration issues with its sewer system that causes flooding. Estimated cost = $100,00 (Riverview Dr. project), $500,000 (sewer infiltration project)

LaRue County

Hodgenville
Flood Mitigation: Hodgenville would like to complete a storm water mitigation project on Main St., with the installation of a box culvert drainage system. Estimated cost = $200,000

Marion County

Bradfordsville

Flood Mitigation: Bradfordsville needs to overhaul its storm water management system to eliminate flooding in homes, businesses and civic facilities and to eliminate the need to close roads due to standing water. Estimated cost = $350,000

Bradfordsville Street Flooding, April 2015.
Source: Mayor David Edelen.

Meade County

Brandenburg

Flood Mitigation: Brandenburg would like to complete a project to stabilize the bank of the Ohio River to eliminate flooding issues that affects critical water wells and localized flooding. Estimated cost = $1.2 million

Ekron
Public Safety: Ekron would like to construct a centrally located safe room that would provide all area residents with a safe shelter from any kind of severe weather event. The facility would be within a 5-minute walk for the entire community. Estimated cost = $1 million

Muldraugh

Public Safety: Muldraugh would like to purchase a 200kw natural gas emergency generator to power city hall and the police dept., in the event of a power outage. The City would also like to upgrade its outdoor weather siren system. Estimated cost = $150,000 (generator), $6,800 (sirens)

Flood Mitigation: The City would like to construct 5,200 feet of a storm water management culvert. Estimated cost = $500,000

Nelson County

Bardstown

Public Safety: Bardstown would like to purchase and install an emergency backup generator for the City's sewer pump station. They would also like to construct an emergency road that would allow access to the Town Creek Waste Water Treatment Plant in the event of flooding. Estimated cost = $94,000 (generator), $20,000 (road)

Flood Mitigation: The City wants to construct a watershed detention pond to prevent downstream flooding. Estimated cost = $200,000

Bloomfield

Public Safety: Bloomfield would like to purchase 2 emergency generators to provide backup power to the water dept. and city hall in the event of a power outage. Estimated cost = $60,000

Flood Mitigation: The City would like to raise the Perry Street Bridge and install larger culverts to mitigate flooding that closes the road. Estimated cost = $250,000

Fairfield

Public Safety: Fairfield would like to purchase two emergency backup generators for use at the sites designated by the city to serve as emergency shelters. Estimated cost = $3,500

Washington County

County

Flood Mitigation: Washington County would like to install box culverts along Grundy Home Road to mitigate flooding. In addition, the County needs to replace two bridges; the Ann Osborne Bride and the Mayfield Lane Bridge. Estimated cost = $48,000 (culvert boxes), $140,000 (Mayfield Lane Bridge), $200,000 (Ann Osborne Bridge)

Bank Stabilization: The County needs to stabilize the banks along Cardwell-Tablow Road and on Hardesty Road. Estimated cost = $200,000 each

Springfield

Flood Mitigation: Springfield would like to install approximately 1,800 linear feet of a storm water management system to eliminate flooding issues in the Rizer Ave. neighborhood. Estimated cost = $118,000

The City would also like to complete a 400-foot storm water management project in the Maplewood Ave. neighborhood to address flooding issues. Estimated cost = $8,000

The Lebanon Hill neighborhood needs a storm water management system to address flooding issues. Estimated cost = $90,000

Springfield would also like to completely replace the downtown Main St. storm water management system to improve capacity and eliminate flooding. Estimated cost = $120,000

The Grundy Ave. neighborhood experiences flooding that could be eliminated by a proper storm water management system. Estimated cost = $175,000

Springfield plans to complete a large flood mitigation project within a Zone A flood area in the City. Part of the project would be the construction of a large storm water management system and part of the plan would be the acquisition and demolition of residences that have suffered repetitive flood losses. Estimated cost = $250,000 (Storm water system), $315,000 (acquisition activities)

The City needs to reconstruct a low water bridge that isolates the public works garage due to flooding. Estimated cost = $190,000

Public Safety: Springfield has a plan to purchase a backup generator system that would provide emergency power to its storm shelter, city hall and public works garage. Estimated cost = $75,000

The City would install a "One Call System" as an enhancement of its current 911 program. Estimated cost = $20,000

A plan to bury utility lines in the downtown business district would diminish the propensity for power outages and enable local businesses to continue to serve the community during severe weather events. Estimated cost = $750,000

3.4.2 - Lincoln Trail Regional Hazard Mitigation Goals

The goals and objectives of the Lincoln Trail Regional Hazard Mitigation Plan evolved as a result of serious discussion, planning and careful thought among the eight counties and twenty-seven cities in the region. Local units of government, planning organizations, emergency management teams, concerned residents and first response agencies collected and analyzed hazard data relevant to the region and closely examined local levels of resiliency and preparedness. The planning process included training, review of past efforts, data analysis, and careful consideration of the region's vulnerability. Local funding was utilized to enable each county to improve its level of resiliency and preparedness through criteria established in the National Weather Service "StormReady" program. Projects completed included establishment of county emergency operations centers, "Code Red" early warning systems and the purchase of emergency power generators for emergency management. Funding was also used to improve citizen preparedness; weather radios, designed for use by people with hearing or sight impairments, were distributed to vulnerable populations throughout the eight county region. The following goals and objectives have been part of the region's plan since the plan was first written, but have been edited and expanded to reflect increased awareness of potential hazards.

Representatives from the region developed the mitigation goals and objectives based on the review and evaluation of research data and local vulnerability. While mitigation goals throughout the state and nation closely parallel those of this region, the goals, objectives and action plans in this regional plan are specific to the Lincoln Trail ADD geographic location and population demographics.

Six mitigation strategies have been addressed previously, however, evaluation of those strategies led to consolidation of strategies into four, with emergency services and structural projects incorporated into four main strategies, which were used to develop goals and objectives. The four basic components of the mitigation plan goals are:

1. Prevention: Local governmental, regulatory or planning actions and/or processes that regulate land use, development standards, the integrity of built structures, and allocation of local funds. This strategy controls public and private activity that can reduce or eliminate losses due to regional hazards.
Examples include, but are not limited to:

- Planning and Zoning
- Building Codes
- Land Use Controls
- Medium and Long Range Planning
- Capital Improvement Programs

- Preservation/Protection of Open Spaces, Fragile Ecosystems and Local Geographic Features
- Storm Water Management
- Routine Inspection, Maintenance, and Repair of Infrastructure

2. Protection of Life and Property: Local governmental and agency actions that plan for, fund and execute activities that protect human life and prevent the loss of property. Examples include:
- Acquisition
- Elevation
- Relocation
- Structural Retrofits
- Construction of Mitigation Projects
- Safe Rooms
- Inspection, Repair and Maintenance of All Infrastructure
- Flood Control Projects
- Emergency Power
- Continuity of Operations
- Public Warning Systems
- Emergency Response Services and Facilities
- Evacuation Plans

3. Public Education and Awareness: Local units of government can prepare and plan for hazard mitigation, but, ultimately, personal responsibility plays a key role in hazard mitigation and community resiliency. Educating the public, from a very early age, about disaster preparedness is a key component of this regional plan and an integral part of community resiliency. Information must be disseminated to all citizens on hazard mitigation and include:
- Real Estate Disclosure Statements
- Land Use Information
- Personal Preparedness and Responsibility
- Education on Hazards
- Child and Adult Education Programs and Classes
- Community Outreach Efforts
- National Flood Insurance Program

4. Protection of Natural Resources and Geographic Features: Actions taken to preserve natural resources, systems and geographic features ultimately serve to also mitigate hazards. These actions include:
- Sediment and Erosion control
- Stream and Corridor Restoration
- Protection of Sink Holes and Karst Topography
- Watershed Management
- Forest and Vegetation Management

- Conservation Efforts
- Wetlands Preservation
- Conservation of Riparian Forest Buffers

Regional Problem Statements, Goals and Objectives

In order to identify regional goals and effective action plans in the form of objectives, regional representatives identified problem statements. The problem statements illustrate regional challenges that face all of the local jurisdictions. Without exception, the problems, goals and objectives are generally applicable to the entire Lincoln Trail Region, and could easily address some aspect of all hazards experienced in the area. Potential funding for each action is fluid and includes HMPG, CDBG, Homeland Security, ADF, AFG, and local funds and fees. The people responsible for implementing each action come from each unit of government and its first response agencies, as well as, the Lincoln Trail Area Development District. The Lincoln Trail ADD Board of Directors and Hazard Mitigation Committee is made up of the eight County Judge Executives and Mayors from the counties' respective cities.

Problem Statements and corresponding goals and objectives were identified during the planning, review and research stages of the Regional Hazard Mitigation Plan Update. The goals are basically unchanged, but rapidly improving technology has made data research and gathering more comprehensive.

Problem Statement 1: During the research and review process of the plan update, comprehensive and exact data for the specific Lincoln Trail region was difficult to find. Regional representatives did not believe that the level of hazard data available and the corresponding estimates of damage and losses were accurate.

Goal 1: The Region's first goal and corresponding objectives and action items remain in the plan with some minor modifications. The goal and objectives are generally applicable across the entire region. County specific projects follow the original plan.

<u>Review of Original Plan</u>
Since approval of the original Regional Plan in 2005, advancing technology and local awareness has resulted in additional and more accurate data collection. Mesonet stations have been completed throughout the region and this update includes that information. PDM (Pre-disaster Mitigation) funding allowed LTADD staff to map all structures in floodplains and all critical facilities throughout the region. Losses in floodplains can now be more accurately forecast. All eight counties have now completed the map modernization program and each has had all critical facilities mapped. Additional sources of data have been accessed and Emergency Management Agencies throughout the eight counties have tracked local data and mitigation projects and achievements. All eight counties have received information and funding to become "StormReady", a program

sponsored by the National Weather Service. Each county is aware of weather gauge technology that would enable each county to track localized weather information.

Table 3.4.2.1 - Regional Goal #1			
Goal 1: Gather and Maintain a Comprehensive and Accurate database of jurisdictional specific natural hazard and parcel data.	Category of Action	Estimated Cost to Implement Action	Potential Responsible Entity
Objective 1.1: Establish methodology for gathering natural hazard data			
Action 1.1a: Align criteria and procedures for gathering and reporting natural hazard event data with the National Environmental Information Center.	Prevention	NA	LTADD
Action 1.1b: Identify county contact for collecting natural hazard data.	Prevention	NA	LTHMC, Emergency Manager
Objective 1.2: Collect, store and analyze natural hazard event data			
Action 1.2a: Incorporate GIS into mapping and tracking natural hazard event data	Prevention	$10,000	LTADD, Emergency Manager
Action 1.2b: Encourage updating flood plain and area maps.	Prevention, Awareness	NA	LTHMC, Local Government, Emergency Manager
Action 1.2c: Maintain and update maps of critical facilities	Prevention, Awareness	$3-5,000 per county	LTADD, Emergency Manager, Planning/Zoning

Problem Statement 2: Since the last Lincoln Trail Regional Hazard Mitigation Plan update in 2010, all professionals across the 8-county area have come to better understand the capabilities and resources each brings to the region in response potential. Still, more work is needed to inform each jurisdiction of the power and potential for an effective first response, when mutual aid agreements are in place, professional knowledge is shared, and resources are pooled. A heightened sense of unity and strength will greatly reduce response time, better assist local residents, and decrease any kind of social or economic impact on local communities in the event of natural disaster.

Goal 2: Goal 2 and the corresponding objectives and action steps remain in the plan with some minor modifications. The regional council agrees that the goal and objectives are generally applicable across all jurisdictions. County specific projects follow the original plan.

<u>Review of Original Plan</u>

The Lincoln Trail Region has worked to ensure that all first responders and emergency service agencies have improved their coordinated capabilities. The Region has been participating in the National Incident Management System (NIMS) since its inception in 2005, and supports the NIMS goal for "all response and support agencies to work seamlessly to prevent, protect against, respond to, recover from, and mitigate the effects of incidents, regardless of cause, size, location, or complexity, in order to reduce the loss of life and property and harm to the environment."

Although there is little regional support for Citizen Emergency Response Teams (CERT), the region has a Medical Reserve Corps (MRC) through the local district health department. Volunteers trained in medical and non-medical areas make up the MRC and can be called up in the event of a disaster. The region also has an organization made up of ham radio operators that assists in disaster response, damage assessment and recovery.

Regional emergency response equipment and infrastructure has been acquired and installed throughout the area with funding through Homeland Security, ADF, local funds and other grants. Updated communication equipment, generators, community warning systems and weather tracking technology have been purchased and installed in all 8 counties.

Table 3.4.2.2 - Regional Goal 2

Goal 2: Improve emergency response time, constituent service and education, and regional organizational efficiencies.	Category of Action	Estimated Cost to Implement Action	Potential Responsible Entity
Objective 2.1: Organize regional first responders. Educate the public about personal responsibility, services and available resources, in the event of a natural disaster.			
Action 2.1a: Create a regional inventory of services available to respond to a natural hazard.	Prevention Awareness	NA	Emergency Management LTADD
Action 2.1b: Disseminate information on family preparedness to the public	Prevention Awareness	$200-$500 per county	Local Governments LTADD
Objective 2.2: Organize volunteers to enhance emergency response capabilities.			

Action 2.2a: Organize and train volunteers from agencies across the region	Prevention	NA	Emergency Managers Local Agencies
Objective 2.3: Maintain an inventory of local first response resources and facilities.			
Action 2.3a: Encourage the use of mutual aid agreements that allow the use of first response equipment regionally, when & where needed.	Prevention	NA	Emergency Managers Local units of government
Action 2.3b: Purchase emergency response equipment needed	Prevention	Project Specific	Local Government

Problem Statements 3 & 4: Several natural hazards are prevalent in the nation, but do not affect the Lincoln Trail Region. Analysis of hazard data, identifies the following hazards as most prevalent:

- Floods
- Tornados
- Winter Storms
- Severe Thunderstorms (some with imbedded hail)

Thunderstorms are most frequent, followed by floods and flash flooding. Tornados do not occur as frequently, but have caused more loss of life over the past 50 years, than the other hazards combined. Hailstorms have resulted in the greatest property damage regionally. As of 7-31-2015, the region has received over $8,316,959 in FEMA assistance for flood losses since 01-01-1978.

The following goals and objectives were developed in response to the following criteria:

1. Several jurisdictions have facilities that accommodate vulnerable populations such as children, the elderly, and disabled persons.
2. Regionally, there are an estimated 20 critical facilities and numerous residential structures located in floodplains.
3. Funding opportunities to address natural hazard issues are underutilized.

Eliminating and/or diminishing the physical and economic impact of natural disasters are goals of this plan. The LTHMC recognizes that this must be a regional endeavor that involves all stakeholders from individual citizens to local units of government. Responsible action requires this plan to provide an in-depth knowledge of the scope of natural disasters and the appropriate mitigation actions to protect citizens and property from hazards.

Goals 3 & 4: The following goals and modified objectives and action steps are generally applicable to jurisdictions throughout the region.

Review of Original Plan:

The Lincoln Trail Region has sponsored numerous efforts to promote individual and community preparedness. Efforts, to disseminate educational material to citizens on the importance of individual preparedness to mitigate the effects of hazards on personal safety and property, have increased.

LTADD advises all jurisdictions on the availability of mitigation funding and local applications for assistance have greatly increased over the last five years. Several projects have been completed including flood mitigation projects to address low water fords and bridges. Three applications for safe rooms were approved, and safe rooms have been completed in the Cities of Bradfordsville and Muldraugh. A safe room is currently under construction in Vine Grove. The City of Bardstown completed a project to bury power lines to prevent power outages in areas of residential and commercial development. Regionally, ADF, Homeland Security, Local, and Hazard Mitigation funds have been utilized for the purchase of communication equipment, generators, weather radios, weather gauges, and public alert/warning systems.

Table 3.4.2.3 - Regional Goal 3

Goal 3: Educate all regional stakeholders about natural hazards and the shared responsibility to mitigate impacts on public health, welfare and safety.	Category of Action	Estimated Cost to Implement Action	Potential Responsible Entity
Objective 3.1: Educate entire region on prevalence of natural hazards in this area.			
Action 3.1a: Disseminate information regionally, concerning emergency response and mitigation measures	Prevention Awareness	$500-$1000 per county annually	LTADD Emergency Management
Action 3.1b: Advertise and promote the availability and benefits of the National Flood Insurance Program.	Prevention Awareness	$500-$1000 per county annually	Flood Plain Managers Insurance Agencies
Action 3.1c: Distribute information on personal preparedness and safety	Prevention Awareness	$200-$400 per county annually	LTADD Local Government
Action 3.1d: Provide potential property buyers with hazard data and maps	Prevention Awareness	$1000-$2000 per county	P&Z Insurance Agencies

Action 3.1e: Develop, maintain and publicize evacuation routes	Prevention Awareness	$3000-$5000 per county	Emergency Management Local Government
Action 3.1f: Support the "FAST" program of the Area Agency on Aging to facilitate response to the elderly in coordination with the regional MRC, in the event of a disaster.	Prevention Protection	NA	LTADD Aging Dept. Regional Medical Reserve Corps
Action 3.1g: Provide local units of government with Continuity of Operations Planning (COOP).	Prevention Protection	NA	LTADD Regional Health Dept. State
Objective 3.2: Inform the Public about the damage that results from wind borne debris as a result of a tornado or severe storm.			
Action 3.2a: Educate the public about the advantages of proper tree maintenance.	Prevention Protection	$2000-$3000 per county	Local Government Utility Companies
Objective 3.3: Maximize citizen preparedness for sever weather			
Action 3.3a: Educate the public about public warning systems, shelter locations, and individual preparedness measures.	Prevention Protection Awareness	$500-$2000 per county	Media Local Government Emergency Management
Objective 3.4: Publicize Hazard Mitigation Program Grants and their potential benefits			
Action 3.4a: Post notice of available funding opportunities on the LTADD website	Public Education & Awareness	NA	LTADD

Table 3.4.2.4 - Regional Goal 4	
Goal 4: Develop and implement cost effective policies and measures that aid in mitigating the effects of natural hazards to human safety, infrastructure and natural resources throughout the region.	
Objective 4.1: Decrease losses associated with flooding, landslides, and karst topography/sinkholes.	

Action 4.1a: Train local officials and planning & zoning commissions on the importance of incorporating hazard mitigation into land use planning.	Prevention Education Protection	NA	LTADD FEMA
Action 4.1b: Use acquisition programs to increase green space and recreational opportunities in flood prone areas.	Prevention	Specific to Project	Local Government
Action 4.1c: Protect natural resources and environmentally sensitive areas with regulations and zoning that precludes development in areas such as floodplains, wetlands, steep slopes, and karst topography/sinkholes.	Prevention	NA	Local Government Planning & Zoning Commissions
Objective 4.2: Reduce the vulnerability of critical facilities from effects of all natural hazards			
Action 4.2a: Prioritize mitigation projects that reduce the vulnerability of critical facilities from natural hazards.	Prevention	Project Specific	Local Government
Action 4.2b: Partner with all stakeholders to accomplish proper maintenance on utility easements.	Prevention	Project Specific	Local Government Utilities
Objective 4.3: Develop and implement regulations, ordinances, building codes, or zoning that improve community resiliency.			
Action 4.3a: Require safe rooms in residential developments of manufactured housing or mobile homes.	Prevention	NA	Local Government Planning & Zoning
Action 4.3b: Reduce storm water flooding with systems funded with storm water utility fees. Require such systems in new developments with subdivision regulations.	Prevention	Project Specific	Local Government Planning & Zoning.
Objective 4.4: Create jurisdiction specific hazard mitigation policies that: 1. Increase CRS rating in NFIP communities 2. Decrease disruptions to services and transportation 3. Minimize damage to public infrastructure.			

Action 4.4a: Develop a flood plain management ordinance that does not permit the base flood elevation (BFE) to be raised.	Prevention	NA	Local Government Planning & Zoning
Action 4.4b: Incorporate cumulative substantial damage data or improvement requirements into flood prevention ordinance.	Prevention	NA	Local Government Planning & Zoning
Action 4.4c: Develop maintenance policy to routinely clean debris from waterways.	Prevention	Jurisdiction Specific	Local Government
Action 4.4d: Prioritize cleanup and repair of roads after a natural hazard event.	Prevention	Jurisdiction Specific	Local Government
Action 4.4e: Bury utility lines in areas with repetitive power outages due to natural hazards.	Prevention	Jurisdiction Specific	Local Government Utility Companies
Objective 4.5: Improve severe weather warning systems to serve the population of the region.			
Action 4.5a: Encourage the purchase of weather radios for homes, businesses, and all care giving and educational facilities.	Prevention	$50 per unit	Individuals Emergency Management
Action 4.5b: Track population growth to determine the need for additional outdoor warning systems.	Prevention	Jurisdiction Specific	LTADD Local Government Emergency Management

3.4.3 Implementation of Mitigation Measures

Approximately 60 elected officials and representatives from throughout the 8-county region, along with LTADD staff, prioritized the actions developed from the Regional Plan's goals and objectives. The table below shows the scoring criteria used in the prioritization process and reflects circumstances within each county. It should be noted that any kind of severe weather event could impact the scoring criteria for each jurisdiction. However, the goals and objectives contained in this plan are generally applicable throughout the region.

Implementation of these actions is dependent upon local resources, imminent need, and the availability of grant funds. However, a timetable has been assigned to each of the three ratings. The table lists actions and each county's corresponding score. Review of the scoring criteria helps to illustrate the similarities among the eight counties and underscores the potential for multi-jurisdictional projects and grant applications. As funding opportunities arise, jurisdictions can reference these tables to choose projects.

Timetable and corresponding score.

- High = 1 – 3 years to implement
- Medium = 4 – 6 years to implement
- Low = 7 – 10 years to implement

Table 3.4.3.1 - Prioritization Table	
Parameter	Scoring Criteria
Appropriateness of Action	1 – High: Reduces vulnerability 2 –Medium: Needed, but not linked to vulnerabilities 3 – Low: Inconsistent with identified needs
Consistent with existing plan and capabilities assessment	1 – High: Consistent with plan and priorities 2 – Medium: Somewhat consistent 3 – Low: Conflicts with plans and priorities
Potential to save lives, reduce property damage and loss of services	1 – High: Major impact 2 – Medium: Some impact 3 – Low: Minimal impact
Cost benefit analysis (refer to estimated cost column with actions)	1 – High: Extremely beneficial 2 – Medium: Beneficial 3 – Low: Minimum benefit

Table 3.4.3.2 - 2015 Ratings of Actions for Lincoln Trail Region by County								
Goal 1: Gather and Maintain a Comprehensive and Accurate Database of jurisdiction specific natural hazard and parcel data	Breckinridge	Grayson	Hardin	LaRue	Marion	Meade	Nelson	Washington
Action 1.1a: Align criteria and procedures for gathering and reporting natural hazard event data with the National Environmental Information Center.	H	H	H	M	H	H	H	H
Action 1.1b: Identify county contact for collecting natural hazard event data	M	H	H	H	H	H	H	H
Action 1.2a: Incorporate GIS into mapping and tracking natural hazard event data.	M	H	H	H	H	H	H	H
Action 1.2b: Encourage updating flood plain and area maps.	H	H	H	H	H	H	H	H

Goal 2: Improve emergency response time, constituent service and education, and regional organizational efficiencies.	Breckinridge	Grayson	Hardin	LaRue	Marion	Meade	Nelson	Washington
Action 2.1a: Organize regional first responders. Educate the public about personal responsibility, services and available resources, in the event of a natural disaster.	M	H	M	M	H	H	H	H
Action 2.1b: Disseminate information on family preparedness to the public	H	H	H	H	H	H	H	H
Action 2.2a: Organize and train volunteers from agencies across the region	M	M	M	H	M	H	H	H
Action 2.3a: Encourage the use of mutual aid agreements that allow the use of first response equipment when & where needed.	H	H	H	H	H	H	H	H
Action 2.3b: Purchase emergency response equipment needed.	H	H	H	H	H	H	H	H
Goal 3: Educate all regional stakeholders about natural hazards and the shared responsibility to mitigate impacts on public health, welfare and safety.	Breckinridge	Grayson	Hardin	LaRue	Marion	Meade	Nelson	Washington
Action 3.1a: Disseminate information regionally, concerning emergency response and mitigation measures.	M	H	M	M	M	H	M	H
Action 3.1b: Advertise and promote the availability and benefits of the National Flood Insurance Program.	M	M	H	H	M	H	H	M
Action 3.1c: Distribute information on personal preparedness and safety.	H	H	H	H	H	H	H	H
Action 3.1d: Provide potential property buyers with hazard data and maps.	M	M	L	L	H	H	M	M
Action 3.1e: Develop, maintain and publicize evacuation routes.	M	M	H	H	H	H	M	H

Action 3.1f: Support the "FAST" program of the Area Agency on Aging to facilitate response to the elderly in coordination with the regional MRC, in the event of a disaster.	H	H	H	H	H	H	H	H
Action 3.1g: Provide local government with Coop training.	H	H	H	H	H	H	H	H
Action 3.2a: Educate the public about the advantages of proper tree maintenance.	M	M	L	M	M	H	H	M
Action 3.3a: Educate the public about public warning systems and shelter locations.	H	H	H	H	H	H	H	H
Action 3.4a: Post notice of available funding opportunities on the LTADD website.	M	H	M	M	H	H	H	H
Goal 4: Develop and implement cost effective policies and measures that aid in mitigating the effects of natural hazards to human safety, infrastructure, and natural resources throughout the region.	Breckinridge	Grayson	Hardin	LaRue	Marion	Meade	Nelson	Washington
Action 4.1a: train local officials and planning & zoning people on the importance of incorporating hazard mitigation into land use planning.	M	H	M	M	H	H	H	H
Action 4.1b: Use acquisition programs to increase green space and recreational opportunities in flood prone areas.	M	M	L	M	M	M	H	M
Action 4.1c: Protect natural resources and environmentally sensitive areas with regulations and zoning that precludes development in areas such as floodplains, wetlands, steep slopes, and karst topography/sinkholes.	M	H	M	M	H	H	H	H
Action 4.2a: Prioritize mitigation projects that reduce the vulnerability of critical facilities from natural hazards.	H	H	H	H	H	H	H	H
Action 4.2b: Partner with all stakeholders to accomplish proper maintenance on utility easements.	M	H	L	M	H	H	H	M

Action 4.3a: Require safe rooms in residential development of manufactured housing & mobile homes.	M	H	M	H	H	M	M	M
Action 4.3b: Reduce storm water flooding with systems funded with storm water utility fees. Require such systems in new developments with subdivision regulations.	M	H	H	M	H	H	H	H
Action 4.4a: Develop a flood plain ordinance that does not permit the BFE to be raised.	M	H	H	M	H	H	H	H
Action 4.4b: Incorporate cumulative substantial damage data or improvement requirements into flood prevention ordinances.	M	H	M	M	H	H	H	M
Action 4.4c: Develop maintenance policy to routinely clean debris from waterways	M	H	M	H	H	H	H	H
Action 4.4d: Prioritize cleanup and repair of roads after a natural hazard event.	M	H	H	M	H	H	H	H
Action 4.4e: Bury utility lines in areas with repetitive power outages due to natural hazards	H	H	H	H	H	H	H	H
Action 4.5a: Encourage the purchase of weather radios for homes, businesses, and all care giving and educational facilities.	H	H	H	H	H	H	H	H
Action 4.5b: Track population growth to determine the need for additional outdoor warning systems.	H	H	H	H	H	H	H	H

3.4.4 - Multi-Jurisdictional Strategy

The preceding actions are applicable to all jurisdictions throughout the region and are based on risk assessment (section 3.3). The Lincoln Trail Regional Hazard Mitigation Plan has been adopted by each jurisdiction by resolution. Each local government understands that the implementation of these actions is dependent on several factors, such as available funding and cooperative agreements.

The information contained within the Regional Plan has assisted the eight Lincoln Trail Counties to increase mitigation efforts and complete projects, since the last update in 2010. The vulnerabilities in the plan have guided these efforts and been helpful in completing grant applications. An inventory of projects completed and underway was outlined in this section.

Through review of past successful projects and existing vulnerabilities, each county and city developed a list of future projects that pertain to the specific populations and conditions in each jurisdiction. During October and November of 2015, the elected officials of the Region, had the opportunity to review and discuss this list and add and/or change projects and prioritizations. The prioritization process comes from the original plan and is based on project cost, number of constituents served, and the potential impact on the region if no action is taken. When funds become available, this project list will be referenced to determine what project(s) should be undertaken.

Local partnerships among adjoining cities and counties will remain a priority when projects are chosen. This cooperative effort will be a vital component in the success of this regional plan.

Priority Ranking Reference
1 = High – 1-3 years to implement
2 = Medium – 4-6 years to implement
3 = Low - 7–10 years to implement

Table 3.4.4.1 - Future Mitigation Projects: Breckinridge County

Project	Location/ Population Benefit	Category of Action	Hazard(s) Addressed	Estimated Cost	Priority Ranking
B1: Raise Bridge on Tar Springs Road	County 6 Households	Prevention Protection	Flooding	$400,000	1
B2: Raise Roadbed of Stonehill-Ford Rd.	County 20,059* population	Prevention Protection	Flooding	$150,000	1
B3: Purchase One Generator for Repeater in Harned	County 20,059* population	Prevention Protection	All Identified Weather Hazards	$8,400	1
B4: Purchase One Generator for Public Housing Site	County 25 Households	Prevention Protection	All Identified Weather Hazards	$30,000	2
B5: Install Outdoor Siren System in Garfield	County 45 Households	Prevention Protection	Thunderstorms & Tornados	$30,000	2
B6: Bank Stabilization on Tar Springs Road	County 20,059* population	Prevention	Landslides	$175,000	2

B7: Construct Safe Room in Hardinsburg	Hardinsburg 2,343* population	Protection	Thunderstorms & Tornados	$2 Million	1
B8: Install three new outdoor sirens	Hardinsburg 2,343* population	Protection	Thunderstorms & Tornados	$90,000	1
B9: Install New Generator at Water/Sewer Plant	Hardinsburg Serves Co. of 20,059*	Prevention Protection	All Identified Weather Hazards	$200,000	2
B10: Install Storm Water Culverts	Hardinsburg 2,343* population	Prevention Protection	Flooding	$40,000 Each	2
*All population data is from the 2010 Census					

These Breckinridge County projects will be funded with local money, homeland security, FEMA and hazard mitigation grant funds as they become available. All decisions will be analyzed using cost/benefit analysis to determine that funds are used wisely to benefit the greatest number of people.

Table 3.4.4.2 - Future Mitigation Projects: Grayson County					
Project	**Location/ Population Benefit**	**Category of Action**	**Hazard(s) Addressed**	**Estimated Cost**	**Priority Ranking**
G1: Construct Two Safe Rooms in County	County 25,746* population	Prevention Protection	Thunderstorms & Tornados	$2,000,000	1
G2: Install Outdoor Siren System	County 25,746* population	Prevention Protection	Thunderstorms & Tornados	$90,000	1
G3: Purchase Five Generators to Power Critical Facilities	County 25,746* population	Prevention Protection	All Identified Weather Hazards	$180,500	2
G4: Construct New Community Safe Room	Caneyville 608* population	Prevention Protection	Thunderstorms & Tornados	$1,200,000	1
G5: Purchase Four Generators	Caneyville 608* population	Prevention Protection	All Identified Weather Hazards	$166,500	1
G6: Dredge Creek	Caneyville 608* population	Prevention Protection	Flooding	$200,000	1
G7: Generator for City Hall	Leitchfield 6,699* population	Prevention Protection	All Identified Weather Hazards	$40,000	1

G8: Construct New Community Safe Room	Leitchfield 6,699* population	Prevention Protection	Thunderstorms & Tornados	$1,200,000	2
G9: Purchase and Install Two Outdoor Sirens	Leitchfield 6,699* population	Prevention Protection	Thunderstorms & Tornados	$60,000	1
*All population data is from the 2010 Census					

These Grayson County projects will be funded with local money, homeland security, FEMA and hazard mitigation funds as they become available. All decisions will be analyzed using cost/benefit analysis to determine that funds are used wisely to benefit the greatest number of people.

Table 3.4.4.3 - Future Mitigation Projects: Hardin County					
Project	**Location/ Population Benefit**	**Category of Action**	**Hazard(s) Addressed**	**Estimated Cost**	**Priority Ranking**
H1: Construct Two New Bridges and Culverts	County 105,543* population	Prevention Protection	Flooding	$95,000	1
H2: Construct Two New Safe Rooms	County 105,543* population	Prevention Protection	Thunderstorms & Tornados	$2,000,000	1
H3: Install Four New Outdoor Sirens	County 105,543* population	Prevention Protection	Thunderstorms & Tornados	$80,000	1
H4: Purchase Ten Generators	County 105,543* population	Prevention Protection	All Identified Weather Hazards	$65,000	1
H5: Mobile EOC Communication Upgrades	County 105,543* population	Prevention Protection	All Identified Weather Hazards	$15,000	1
H6: Make Upgrades to Community Shelter	Elizabethtown 28,531* population	Prevention Protection	All Identified Weather Hazards	$500,000	2
H7: Upgrade City's Outdoor Warning System	Elizabethtown 28,531* population	Prevention Protection	Thunderstorms & Tornados	$360,000	1
H8: Purchase 6 Emergency Generators	Elizabethtown 28,531* population	Prevention Protection	All Identified Weather Hazards	$180,000	1

H9: Upgrade City's Outdoor Warning System	Radcliff 21,688* population	Prevention Protection	Thunderstorms & Tornados	$74,600	1
H10: Construct New Community Safe Room	Radcliff 21,688* population	Prevention Protection	Thunderstorms & Tornados	$1,500,000	2
H11: Purchase An Emergency Generator for Police	Radcliff 21,688* population	Prevention Protection	All Identified Weather Hazards	$70,000	2
H12:Purchase Four Emergency Generators	Vine Grove 4,520* population	Prevention Protection	All Identified Weather Hazards	$200,000	1
H13: Install Transfer Switches for 8 Lift Stations	Vine Grove 4,520* population	Prevention Protection	All Identified Weather Hazards	$11,000	2
H14: Install Storm Water System in Riverview Area	West Point 797* population	Prevention Protection	Flooding	$100,000	1
H15: Address I & I Issues with Sewer Plant	West Point 797* population	Prevention Protection	Flooding	$500,000	1
*All population data is from the 2010 Census					

These Hardin, LaRue and Marion County projects will be funded with local money, homeland security, FEMA and hazard mitigation funds as they become available. . All decisions will be analyzed using cost/benefit analysis to determine that funds are used wisely to benefit the greatest number of people.

Table 3.4.4.4 - Future Mitigation Projects: LaRue County					
Project	**Location/ Population Benefit**	**Category of Action**	**Hazard(s) Addressed**	**Estimated Cost**	**Priority Ranking**
L1: Complete Storm Water Mitigation Project Along Main Street	Hodgenville 3,206* population	Prevention Protection	Flooding	$200,000	1
*All population data is from the 2010 Census					

Table 3.4.4.5 - Future Mitigation Projects: Marion County					
Project	**Location/ Population Benefit**	**Category of Action**	**Hazard(s) Addressed**	**Estimated Cost**	**Priority Ranking**
M1: Storm Water System Overhaul for Entire Community	Bradfordsville 294* population	Prevention Protection	Flooding	$500,000	1
*All population data is from the 2010 Census					

Table 3.4.4.6 - Future Mitigation Projects: Meade County					
Project	**Location/ Population Benefit**	**Category of Action**	**Hazard(s) Addressed**	**Estimated Cost**	**Priority Ranking**
Md1: Bank Stabilization on Ohio River Downtown Brandenburg	Brandenburg 2,643* population	Prevention Protection	Flooding	$1,200,000	1
Md2: Construct New Community Safe Room	Ekron 135* population	Prevention Protection	Thunderstorms & Tornados	$1,000,000	1
Md3: Purchase One Emergency Generator to Power City Hall & Police Department	Muldraugh 947* population	Prevention Protection	All Identified Weather Hazards	$150,000	1
Md4: Upgrade City's Outdoor Warning System	Muldraugh 947* population	Prevention Protection	Thunderstorms & Tornados	$6,800	2
Md5: Construct 5,200' of a Storm Water System	Muldraugh 947* population	Prevention Protection	Flooding	$500,000	1
*All population data is from the 2010 Census					

The Meade and Nelson County projects will be funded with local money, homeland security, FEMA, and hazard mitigation grant funds as they become available. All decisions will be analyzed using cost/benefit analysis to determine that funds are used wisely to benefit the greatest number of people.

Table 3.4.4.7 - Future Mitigation Projects: Nelson County					
Project	**Location/ Population Benefit**	**Category of Action**	**Hazard(s) Addressed**	**Estimated Cost**	**Priority Ranking**
N1: Purchase Backup Emergency Generator for City Sewer Pump	Bardstown 11,700* population	Prevention Protection	All Identified Weather Hazards	$94,000	1
N2: Construct Emergency Road to Waste Water Treatment Plant	Bardstown 11,700* population	Prevention Protection	Flooding	$20,000	2
N3: Construct Watershed Detention Pond	Bardstown 11,700* population	Prevention Protection	Flooding	$200,000	1
N4: Purchase Two Emergency Generators	Bloomfield 838* population	Prevention Protection	All Identified Weather Hazards		2
N5: Raise Perry St. Bridge & Install Larger Culverts	Bloomfield 838* population	Prevention Protection	Flooding		1
N6: Purchase Two Emergency Generators	Fairfield 113* population	Prevention Protection	All Identified Weather Hazards	$3,500	1
*All population data is from the 2010 Census					

Table 3.4.4.8 - Future Mitigation Projects: Washington County					
Project	**Location/ Population Benefit**	**Category of Action**	**Hazard(s) Addressed**	**Estimated Cost**	**Priority Ranking**
W1: Install box Culverts on Grundy Home Road	County 11,717* population	Prevention Protection	Flooding	$48,000	2
W2: Replace the Ann Osborne Bridge	County 11,717* population	Prevention Protection	Flooding	$200,000	2
W3: Replace the Mayfield Lane Bridge	County 11,717* population	Prevention Protection	Flooding	$140,000	2
W4: Stabilize Banks of Cardwell-Tablow Rd. & Hardesty Road	County 11,717* population	Prevention Protection	Landslides	$200,000 Each	1

W5: Install 1,800' of Storm Water Mgmt. System	Springfield 2,519* population	Prevention Protection	Flooding	$118,000	1
W6: Install 400' Storm Water Mgmt. System on Maplewood Ave.	Springfield 2,519* population	Prevention Protection	Flooding	$8,000	1
W7: Install Storm Water Mgmt. System in Lebanon Hill Neighborhood	Springfield 2,519* population	Prevention Protection	Flooding	$90,000	1
W8: Replace Main St. Storm Water Mgmt. System	Springfield 2,519* population	Prevention Protection	Flooding	$120,000	1
W9: Install Storm Water Mgmt. System on Grundy Ave.	Springfield 2,519* population	Prevention Protection	Flooding	$175,000	1
W10: Install Storm Water Mgmt. System in Zone A Flood Area	Springfield 2,519* population	Prevention Protection	Flooding	$250,000	1
W11: Relocate 7 Homes on Ballard St. & Eddleman Ct. from Zone A Flood Area	Springfield 7 Households	Prevention Protection	Flooding	$315,000**	1
W12: Reconstruct Low Water Bridge	Springfield 2,519* population	Prevention Protection	Flooding	$190,000	3
W13: Purchase Emergency Backup Generator	Springfield 2,519* population	Prevention Protection	All Identified Weather Hazards	$75,000	2
W14: Install "One Call System" to Enhance 911 Program	Springfield 2,519* population	Prevention Protection	All Identified Weather Hazards	$20,000	2
W15: Bury Utility Lines in Business District	Springfield 2,519* population	Prevention Protection	All Identified Weather Hazards	$750,000	3
*All population data is from the 2010 Census **Based on Repetitive Claims on Properties					

These Washington County projects will be funded with local money, homeland security, FEMA, and hazard mitigation grant funds as they become available. All decisions will be analyzed using cost/benefit analysis to determine that funds are used wisely to benefit the greatest number of people.

Appendix A: Forms

Hazard Mitigation Plan Update Evaluation Worksheet
Public Opinion Survey

LINCOLN TRAIL REGION
PLAN UPDATE EVALUATION WORKSHEET

Jurisdiction: ___________________________

Date of Evaluation: _____/_____/20_____

PLAN SECTION	CONSIDERATIONS	Y/N/NA	COMMENT
Planning Process	Should new jurisdictions and/or districts be invited to participate in future plan updates?		
	Have any internal or external agencies been invaluable to the mitigation strategy?		
	Can any procedures (e.g., meeting announcements, plan updates) be done differently or more ef!ciently?		
	Has the Planning Team undertaken any public outreach activities?		
	How can public participation be improved?		
	Have there been any changes in public support and/or decision- maker priorities related to hazard mitigation?		
Capability Assessment	Have jurisdictions adopted new policies, plans, regulations, or reports that could be incorporated into this plan?		
	Are there different or additional administrative, human, technical, and !nancial resources available for mitigation planning?		
	Are there different or new education and outreach programs and resources available for mitigation activities?		
	Has NFIP participation changed in the participating jurisdictions?		

Risk Assessment	Has a natural and/or technical or human-caused disaster occurred?		
	Should the list of hazards addressed in the plan be modi!ed?		
	Are there new data sources and/or additional maps and studies available? If so, what are they and what have they revealed? Should the information be incorporated into future plan updates?		
	Do any new critical facilities or infrastructure need to be added to the asset lists?		
	Have any changes in development trends occurred that could create additional risks?		
	Are there repetitive losses and/or severe repetitive losses to document?		
Mitigation Strategy	Is the mitigation strategy being implemented as anticipated? Were the cost and timeline estimates accurate?		
	Should new mitigation actions be added to the Action Plan? Should existing mitigation actions be revised or eliminated from the plan?		
	Are there new obstacles that were not anticipated in the plan that will need to be considered in the next plan update?		
	Are there new funding sources to consider?		
	Have elements of the plan been incorporated into other planning mechanisms?		
Plan Maintenance Procedures	Was the plan monitored and evaluated as anticipated?		
	What are needed improvements to the procedures?		

Mitigation Public Opinion Survey

For 2015 Regional Hazard Mitigation Plan Update

LINCOLN TRAIL AREA DEVELOPMENT DISTRICT

Your household has been randomly selected to participate in this survey about public perceptions and opinions regarding natural hazards in your county. In addition, we would like information regarding the methods and techniques you prefer for reducing the risks and losses associated with these hazards. The questionnaire should be completed by an adult, preferably the head of household. The information you provide will be used to help improve public/private coordination, mitigation, and risk reduction efforts in your county. The survey should take less than 30 minutes to complete.

This is a public opinion survey, the results of which will inform local natural hazard mitigation planning in Kentucky. Your returned, completed survey indicates your willingness to take part in the study. Participation in this study is voluntary. The survey is not intended to contribute to "generalizable knowledge" and <u>none of the information you provide will be attributed to you directly</u>. If you have questions regarding your rights as a research participant, please contact the Lincoln Trail Area Development District, PO Box 604, Elizabethtown KY, 42702, Phone 270-769-2393, website www.ltadd.org

NATURAL HAZARD INFORMATION

First we would like to know about your experiences involving natural hazards and your exposure to preparedness information.

1. During the past five years in the county you currently reside in, have you or someone in your household directly experienced a natural disaster such as an earthquake, severe windstorm, flood, wildfire, or other type of natural disaster?
   - ☐ Yes
   - ☐ No (***IF NO Skip to Question 2***)

   If "YES", which of these natural disasters have you or someone in your household experienced in the past five years?
   (***Please check all that apply***)
   - ☐ Drought
   - ☐ Dust Storm
   - ☐ Earthquake
   - ☐ Flood
   - ☐ Landslide / Debris Flow
   - ☐ Wildfire
   - ☐ Windstorm
   - ☐ Volcanic Eruption
   - ☐ Severe Winter Storm
   - ☐ Other (specify): ____________________

2. How concerned are you about the following natural disasters affecting your county?
   (*Check the corresponding box for each hazard)*

Natural Disaster	Very Concerned	Somewhat Concerned	Neutral	Not Very Concerned	Not Concerned
Drought	☐	☐	☐	☐	☐
Dust Storm	☐	☐	☐	☐	☐
Earthquake	☐	☐	☐	☐	☐
Flood	☐	☐	☐	☐	☐
Landslide / Debris Flow	☐	☐	☐	☐	☐
Wildfire	☐	☐	☐	☐	☐
Volcanic Eruption	☐	☐	☐	☐	☐
Wind Storm	☐	☐	☐	☐	☐
Severe Winter Storm	☐	☐	☐	☐	☐
Other: ____________	☐	☐	☐	☐	☐

3. Have you ever received information about how to make members of your household and your home safer from natural disasters?
   - ☐ Yes
   - ☐ No (***IF NO Skip to Question 5***)

   If "YES", how recently?
   - ☐ Within the last 6 months
   - ☐ Between 6 and 12 months
   - ☐ Between 1 and 2 years
   - ☐ Between 2 and 5 years
   - ☐ 5 years or more

4. From whom did you **last** receive information about how to make members of your household and your home safer from natural disasters?
   (***Please check only one***)
   - ☐ News media
   - ☐ Government agency
   - ☐ Insurance agent or company
   - ☐ Utility company
   - ☐ University or research institution
   - ☐ Neighbor / friend / family member
   - ☐ Elected official
   - ☐ American Red Cross
   - ☐ Other non-profit organization
   - ☐ Social media (e.g. Facebook)
   - ☐ Not sure
   - ☐ Other:________________________

5. Whom would you <u>most trust</u> to provide you with information about how to make your household and home safer from natural disasters?
   (*Please check up to three*)
   - ☐ News media
   - ☐ Government agency
   - ☐ Insurance agent or company
   - ☐ Utility company
   - ☐ University or research institution
   - ☐ Neighbor / friend / family member
   - ☐ Elected official
   - ☐ American Red Cross
   - ☐ Other non-profit organization
   - ☐ Social media (e.g. Facebook)
   - ☐ Not sure
   - ☐ Other:______________________

6. What is the <u>most effective</u> way for you to receive information about how to make your household and home safer from natural disasters?
   (*Please check up to three*)

   Newspapers:
   - ☐ Newspaper stories
   - ☐ Newspaper ads

   Television:
   - ☐ Television news
   - ☐ Television ads

   Radio:
   - ☐ Radio news
   - ☐ Radio ads

   Internet:
   - ☐ Email newsletters
   - ☐ Online news outlets
   - ☐ Social media (e.g. Facebook)

   Other methods:
   - ☐ Schools
   - ☐ Outdoor advertisements (billboards, etc.)
   - ☐ Books
   - ☐ Mail
   - ☐ Fire Department/Rescue
   - ☐ Fact sheet/brochure
   - ☐ Chamber of Commerce
   - ☐ Public workshops/meetings
   - ☐ Magazine
   - ☐ University or research institution
   - ☐ Other: ________________________

7. Prior to receiving this survey, were you aware of your county's Natural Hazard Mitigation Plan (NHMP)?
   - ☐ Yes
   - ☐ No

8. Prior to receiving this survey, were you aware that the Federal Emergency Management Agency (FEMA) requires your county to update the NHMP every five years in order for your county to be eligible for federal pre- and post-disaster hazard mitigation funds?
   - ☐ Yes
   - ☐ No

COMMUNITY VULNERABILITIES AND HAZARD MITIGATION STRATEGIES

In order to assess community risk, we need to understand which community assets may be vulnerable to natural hazards in the region. Vulnerable assets are those community features, characteristics, or resources that may be impacted by natural hazards (e.g. populations with functional needs, economic components, environmental resources, etc.). The next set of questions will focus on vulnerable assets in your community and your preferred strategies to mitigate risk to those assets.

9. Community assets are features, characteristics, or resources that either make a community unique or allow the community to function. In your opinion, which of the following *categories* are most susceptible to the impacts caused by natural hazards in your county?
   (Please rank the community assets in order of vulnerability, 1 being most vulnerable and 6 being least vulnerable)

Community Assets	Potential Natural Hazard Impact	Order of Vulnerability
Human	Loss of life and/or injuries	_____
Economic	Business closures and/or job losses	_____
Infrastructure	Damage or loss of bridges, utilities, schools, etc.	_____
Cultural/Historic	Damage or loss of libraries, museums, fairgrounds, etc.	_____
Environmental	Damage or loss of forests, rangeland, waterways, etc.	_____
Governance	Ability to maintain order and/or provide public amenities and services	_____

10. Next we would like to know what specific types of community assets are most important to you.
    (*Check the corresponding box for each asset)*

Community Assets	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Elder-care facilities	☐	☐	☐	☐	☐
Schools (K-12)	☐	☐	☐	☐	☐
Hospitals	☐	☐	☐	☐	☐
Major bridges	☐	☐	☐	☐	☐
Fire/Police Stations	☐	☐	☐	☐	☐
Museums/Historic buildings	☐	☐	☐	☐	☐
Major employers	☐	☐	☐	☐	☐
Small businesses	☐	☐	☐	☐	☐
College / University	☐	☐	☐	☐	☐
City Hall / Courthouse	☐	☐	☐	☐	☐
Parks	☐	☐	☐	☐	☐
Other: __________________	☐	☐	☐	☐	☐
Other: __________________	☐	☐	☐	☐	☐
Other: __________________	☐	☐	☐	☐	☐
Other: __________________	☐	☐	☐	☐	☐
Other: __________________	☐	☐	☐	☐	☐

11. A number of activities can reduce your community's risk from natural hazards. These activities can be both regulatory and non-regulatory. **Please check the box that best represents your opinion of the following strategies to reduce the risk and loss associated with natural disasters.**

Community-wide Strategies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Sure
I support a regulatory approach to reducing risk	☐	☐	☐	☐	☐	☐
I support a non-regulatory approach to reducing risk	☐	☐	☐	☐	☐	☐
I support a mix of both regulatory and non-regulatory approaches to reducing risk	☐	☐	☐	☐	☐	☐
I support policies to prohibit development in areas subject to natural hazards	☐	☐	☐	☐	☐	☐
I support the use of tax dollars (federal and/or local) to compensate land owners for not developing in areas subject to natural hazards	☐	☐	☐	☐	☐	☐
I support the use of local tax dollars to reduce risks and losses from natural disasters	☐	☐	☐	☐	☐	☐
I support protecting historical and cultural structures	☐	☐	☐	☐	☐	☐
I would be willing to make my home more disaster-resistant	☐	☐	☐	☐	☐	☐
I support steps to safeguard the local economy following a disaster event	☐	☐	☐	☐	☐	☐
I support improving the disaster preparedness of local schools	☐	☐	☐	☐	☐	☐
I support a local inventory of at-risk buildings and infrastructure	☐	☐	☐	☐	☐	☐
I support the disclosure of natural hazard risks during real estate transactions	☐	☐	☐	☐	☐	☐

12. Natural hazards can have a significant impact on a community, but planning for these events can help lessen the impacts. The following statements will help determine citizen priorities regarding planning for natural hazards in your county. **Please tell us how important each one is to you.**

Statements	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Protecting private property	☐	☐	☐	☐	☐
Protecting critical facilities (e.g. transportation networks, hospitals, fire stations)	☐	☐	☐	☐	☐
Preventing development in hazard areas	☐	☐	☐	☐	☐
Enhancing the function of natural features (e.g. streams, wetlands)	☐	☐	☐	☐	☐
Protecting historical and cultural landmarks	☐	☐	☐	☐	☐
Protecting and reducing damage to utilities	☐	☐	☐	☐	☐
Strengthening emergency services (e.g.- police, fire, ambulance)	☐	☐	☐	☐	☐
Disclosing natural hazard risks during real estate transactions	☐	☐	☐	☐	☐
Promoting cooperation among public agencies, citizens, non-profit organizations, and businesses	☐	☐	☐	☐	☐

MITIGATION AND PREPAREDNESS ACTIVITIES IN YOUR HOUSEHOLD

Households can mitigate and prepare for natural hazards in order to prevent damage to property, injuries, and loss of life. The precautions you take and training you receive can make a big difference in your ability to recover from a natural disaster or emergency. Access to basic services, such as electricity, gas, water, telephones and emergency care may be cut off temporarily, or you may have to evacuate at a moment's notice. The following questions focus on your household's preparedness for disaster events.

13. In the following list, please check those activities that you have done in your household, plan to do in the near future, have not done, or are unable to do.
    (***Please check one answer for each preparedness activity***)

In your household, have you or someone in your household:	**Have Done**	**Plan To Do**	**Not Done**	**Unable To Do**
Attended meetings or received written information on natural disasters or emergency preparedness?	☐	☐	☐	☐
Talked with members in your household about what to do in case of a natural disaster or emergency?	☐	☐	☐	☐
Developed a "Household/Family Emergency Plan" in order to decide what everyone would do in the event of a disaster?	☐	☐	☐	☐
Prepared a "Disaster Supply Kit" (stored extra food, water, batteries, or other emergency supplies)?	☐	☐	☐	☐
In the last year, has anyone in your household been trained in First Aid or Cardio-Pulmonary Resuscitation (CPR)?	☐	☐	☐	☐
Prepared your home by having smoke detectors on each level of the house	☐	☐	☐	☐
Discussed or created a utility shutoff procedure in the event of a natural disaster?	☐	☐	☐	☐

GENERAL HOUSEHOLD INFORMATION

Finally, we would appreciate any information you are willing to share with us about you and your household. This information will remain confidential and is for survey comparison purposes only.

14. Please indicate your age: _______

15. Gender: ☐ Male ☐ Female

16. Please indicate your level of education:
    - ☐ High school graduate/GED
    - ☐ Some college/trade school
    - ☐ College degree
    - ☐ Postgraduate degree
    - ☐ Other (please specify): ______________________________

17. What is your total household income?
    - ☐ Less than $10,000
    - ☐ $10,000 - $19,999
    - ☐ $20,000 - $29,999
    - ☐ $30,000 - $39,999
    - ☐ $40,000 - $49,999
    - ☐ $50,000 - $59,999
    - ☐ $60,000 - $69,999
    - ☐ $70,000 - $79,999
    - ☐ $80,000 - $89,999
    - ☐ $90,000 - $99,999
    - ☐ $100,000 - $149,999
    - ☐ More than $150,000

18. Zip code *(optional)*: ____________________

19. County:

- ☐ Breckinridge County
- ☐ Grayson County
- ☐ Hardin County
- ☐ LaRue County
- ☐ Marion County
- ☐ Meade County
- ☐ Nelson County
- ☐ Washington County

20. Please specify your race:

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

21. Please specify your ethnicity:

- ☐ Hispanic or Latino
- ☐ Not Hispanic or Latino

22. How long have you lived in Kentucky?

- ☐ Less than one year
- ☐ 1-5 years
- ☐ 5-9 years
- ☐ 10-19 years
- ☐ 20 years or more

23. Do you own or rent your home? ☐ Own ☐ Rent

24. Do you own/rent a:

- ☐ Single-family home
- ☐ Duplex
- ☐ Apartment (3-4 units in structure)
- ☐ Apartment (5 or more units in structure)
- ☐ Condominium / townhouse
- ☐ Manufactured home
- ☐ Other: ____________________

Please feel free to provide any additional comments in the space provided:

THANK YOU VERY MUCH FOR PROVIDING THIS INFORMATION

The Lincoln Trail Area Development District prepared this survey. Implementation of this survey has been made possible by funding from the Federal Emergency Management Agency and Lincoln Trail ADD.

For more information, please contact the Lincoln Trail ADD at:
PO Box 604, Elizabethtown, KY 42702
or phone at 270-769-2393 or visit www.ltadd.org/hazardmitigation

Appendix B: Bibliography

Cutter, Susan L.: "*Vulnerability to Environmental Hazards"* from *Progress in Human Geography*,20, 4 pp. 529-539, Dept. of Geography, University of South Carolina, Columbia, SC, Arnold, 1996.

Cutter, Susan L., Mitchell, Jerry T., and Scott, Michael S.: *Handbook for Conduction a GIS-Based Hazards Assessment at the County Level*, Hazards Research Lab, Dept. of Geography, University of South Carolina, Columbia, SC, 1997.

Odeh, David J.: "*Natural Hazards Vulnerability Assessment for Statewide Mitigation Planning in Rhode Island"* from *Natural Hazards Review,* Vol. 3, Num. 4, pp177-187, American Society of Civil Engineers, 2002.

FEMA: *Local Mitigation Planning Handbook*, Federal Emergency Management Agency, March 2013.

Access to information from the internet was critical to the completion of this plan. The following sites were primary sources of data used in this effort.

Government

Federal Emergency Management Agency (FEMA)
www.fema.gov

Focus: hazard types, mitigation strategies and hazard planning.

United States Census Bureau
www.census.gov

Focus: demographic data on populations, TIGER GIS data.

National Oceanic and Atmospheric Agency (NOAA)
www.noaa.gov

Focus: historic climatic data, events, costs.

National Center for Environmental Information(NCEI), NOAA & National Weather Service
http://www.ncdc.noaa.gov/oa/ncdc.html

Focus: Weather Event data, 1950-Sept. 2015.

United States Geologic Survey (USGS)
http://usgs.gov/

http://earthquake.usgs.gov/activity/past.html

Focus: National Earthquake Information Center (NEIC) Databases, "USGS/NEIC 1973-2015" & "Eastern, Central and Mountain States of U.S., 1534 - 1986".

Disaster Help
www.disasterhelp.gov

Focus: Public information about disasters and response issues.

USDA Risk Management Agency
http://www.rma.usda.gov/other/

Focus: Agricultural loss statistics.

Educational

University of South Carolina, Hazard Research Lab
http://www.cas.sc.edu/geog/hrl/index.htm

Focus: SHELDUS Data Base, July 2003.

University of Nebraska – Lincoln, National Drought Mitigation Center
http://www.drought.unl.edu/index.htm

Focus: Drought issues and statistics.

University of Colorado, Natural Hazards Center
http://www.colorado.edu/hazards/

Focus: Numerous links and data about natural hazards.

Stanford University, National Performance of Dams Program

http://npdp-devserv.stanford.edu/front.html

Focus: Information about dams and failure issues.

Cornell University, USDA Economics, Statistics and Market Information System
http://usda.mannlib.cornell.edu/

Focus: Agricultural Census data and miscellaneous economic factors.

Private

Natural Hazards.org
http://www.naturalhazards.org/

Focus: Numerous links and data about natural hazards.

National Crop Insurance Services
http://www.ag-risk.org/

Focus: Crop disaster issues and data.

Appendix C: Notices, Resolutions

County Participation Resolutions
Sample shown - Breckinridge County

Public Hearing Notice for comment Jan 7^{th}, 2016

County Adoption Resolution
Sample shown – Hardin County

RESOLUTION NO. 2015-0309
Resolution to Participate in the Planning Process for The Lincoln Trail Regional Hazard Mitigation and Flood Mitigation 2015 Plan Update

Breckinridge County, Kentucky

WHEREAS, the County recognized the threat that natural hazards pose to people and property within Breckinridge County; and

WHEREAS, the County has prepared a multi-hazard and flood mitigation plan, hereby known as the Lincoln Trail Regional Hazard Mitigation and Flood Mitigation Plan in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS, the Lincoln Trail Regional Hazard Mitigation and Flood Mitigation Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in Breckinridge County from the impacts of future hazards and disasters; and

WHEREAS, participation in the planning process by the County demonstrates their commitment to the hazard and flood mitigation plan and updating data, goals and actions in the 2015 Lincoln Trail Regional Hazard and Flood Mitigation Plan Update.

NOW THEREFORE, BE IT RESOLVED BY BRECKINRIDGE COUNTY, KENTUCKY, THAT, the local governing body will participate in planning for the 2015 Lincoln Trail Regional Hazard Mitigation and Flood Mitigation Plan Update.

Done this 9th Day of March 2015.

Maurice Lucas
Maurice Lucas
County Judge-Executive

Date 3/9/2015

ATTEST

Kathina Bell
Kathina Bell
Breckinridge County Fiscal Court Clerk

Date 3/9/2015

Public Hearing Notice

To all interested citizens of the Kentucky Counties of Breckinridge, Grayson, Hardin, LaRue, Marion, Meade, Nelson and Washington:
The *Lincoln Trail Regional Hazard Mitigation Plan* has been rewritten and updated and is available for review and comments. A regional public hearing will be held Thursday, January 7, 2016 4:00 to 7:00 p.m. EST, with an alternate date of January 12, 2016 in the event of inclement weather. The purpose of this hearing is to obtain views on the plan, review proposed activities, goals and proposed mitigation projects, and solicit public comment. The meeting will be held at the office of Lincoln Trail Area Development District, 613 College St. Rd., Elizabethtown, KY. 42701.

Participation in the Lincoln Trail Hazard Mitigation Plan, by the 35 jurisdictions it represents, is a federal requirement by the Federal Emergency Management Agency:

A. Per Title 44 Code of Federal Regulations (CFR) Part 201, for FEMA assistance in the event of a disaster.
B. To participate in the Emergency Management Activities of mitigation, prevention, protection, preparedness, response and recovery.
C. To increase regional resiliency and preparedness.

Comments on The Lincoln Trail Regional Hazard Mitigation Plan

A draft copy of the Plan is available for citizens' review and comment at the Lincoln Trail ADD website (ltadd.org). Comments on the proposed application may be submitted to the attention of Janice Rawson at the above address, until the close of business on Tuesday, January 12, 2016.

Discrimination Clause

Lincoln Trail ADD does not discriminate on the basis of race, color, national origin, sex, age, religion or disability, and provides, upon request, reasonable accommodation, including auxiliary aids and services, to afford an individual with a disability an equal opportunity to participate in all services, programs and activities. Any persons requiring special needs assistance should contact Janice Rawson at 877.255.8233 at least five days prior to the meeting. The TDD number for the hearing impaired is 800.648.6057.

NOTE: ADA Contacts

Department for the Blind	800.877.KYBLIND	www.apps.blind.ky.gov
American Printing House	800.223.1839	www.aph.org
Commission for the Deaf and Hard of Hearing	800.372.2907	www.kcdhh.org
For Interpreter Director		www.hcdhh.org/access/interpdir.html
State Relay TTY Number	800.648.6057	

Resolution To Adopt The Lincoln Trail Regional Hazard Mitigation and Flood Mitigation 2015 Plan Update
Resolution Number __________________

Hardin County, Kentucky

WHEREAS the County recognizes the threat that natural hazards pose to people and property within Hardin County; and

WHEREAS the County has prepared a multi-hazard and flood mitigation plan, hereby known as the Lincoln Trail Regional Hazard Mitigation and Flood Mitigation Plan in accordance with the Disaster Mitigation Act of 2000; and

WHEREAS the Lincoln Trail Regional Hazard Mitigation and Flood Mitigation Plan identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in Hardin County from the impacts of future hazards and disasters; and

WHEREAS adoption by the County demonstrates their commitment to hazard and flood mitigation and achieving goals outlined in the 2015 Lincoln Trail Regional Hazard and Flood Mitigation Plan.

NOW THEREFORE, BE IT RESOLVED BY HARDIN COUNTY, KENTUCKY, THAT:
1. Hardin County adopts the Lincoln Trail Hazard and Flood Mitigation Plan; and
2. Vests the Lincoln Trail Area Development District with the responsibility, authority and means to inform all concerned parties of this action; and
3. Agrees to review the document on a regular basis according to the Plan Maintenance Procedures; and
4. Agrees to carry out plan actions to achieve objectives of the Lincoln Trail Regional Hazard and Flood Mitigation Plan.

Adopted this _______________ day of _________________________________, 2015.

____
County Judge/Executive

____
Date

Attest:

____

____
Date

Appendix D: Meeting Notification and Attendance

Hazard Mitigation Kick-off Meeting. Jan. 29, 2015

Integrating Hazard Mitigation into Local Planning Meeting. Sept. 17, 2015

Hazard Mitigation Public Hearing. Jan. 12, 2016

LINCOLN TRAIL AREA DEVELOPMENT DISTRICT

613 College St. Rd.
P.O. Box 604
Elizabethtown, KY 42702
Phone: 270-769-2393
Fax: 270-769-2993
TDD: 800-247-2510
Equal opportunity employer M/F/D

MEMORANDUM

To: All County Judge/Executives, City Mayors, County Emergency Managers

From: Wendell Lawrence WL/kp
Executive Director

Date: January 5, 2015

Subject: 2015 Lincoln Trail Regional Hazard Mitigation Plan Update

The Lincoln Trail Area Development District has received funding from a FEMA Pre-disaster Mitigation grant to accomplish the mandatory update of the Lincoln Trail Regional Hazard Mitigation Plan. Every City and County in our region ***must*** participate in this planning process in order to be eligible for any FEMA Hazard Mitigation assistance in the event of a declared disaster such as an ice storm or tornado.

To kick off this effort, LTADD will host a training meeting on January 29, 2015 from 10:30 a.m. to 3:00 p.m. (EST). The training will be held at the Muldraugh Safe Room in Muldraugh. Several state and local officials will provide training and information on the elements of community preparedness and resiliency. The agenda is included in this mailing as is a map showing the location of the Muldraugh Safe Room. The Safe Room was a Hazard Mitigation Grant Program project. Many thanks to Mayor Noon for his hospitality.

Lunch will be provided as well as a customized planning packet for each jurisdiction within the Lincoln Trail ADD. Elected officials training hours credit is pending. Please plan to attend, or designate someone from your jurisdiction to attend on your behalf. Please **R.S.V.P.** to Karen Weaver at 270-769-2393 or at Karen@ltadd.org. Do not hesitate to contact us if you have questions.

AGENDA

HAZARD MITIGATION TRAINING
THURSDAY, JANUARY 29, 2015
10:30 to 3:00 p.m.

At Muldraugh Safe Room
Main Street
Muldraugh, KY

Sponsored by
Lincoln Trail Area Development District

Workshop Agenda:

COOP Training (Continuity of Operations Planning)
Presented by Ms. Eva Wilson, NFG NG KYARNC

Citizen Preparedness
Presented by Ron Dodson & Angel Gates, Meade Co. Emergency Management

Community Resiliency
Presented by Joe Sullivan, Warning Coordination Meteorologist, National Weather Service
And Doug Finlay, Hardin Co. Emergency Management

Mitigation Actions for Land Use Planning
Presented by Lincoln Trail ADD Planners

Question/Discussion Period

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	FMA-2013-0014	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
1.	Ron Dodson	Director	Meade Co EMA	Ron Dodson	meadeema@bbtel.com
2.	Joseph E Noon	Mayor	Muldraugh Ky	[illegible]	muldraugh@bbtel.com
3.	Ouita Berry	EM Coordinator	Hardin Co EM	OBerry	emcoordinator@hardin.co
4.	Doug Finlay	Director	Hardin Co EM	Doug Finlay	emdirector@hardin.co
5.	Mike Robinson	GIS Specialist	LTADD	Mike Robinson	mrobinson@ltadd.org
6.	Angel Gates	Deputy Director	Meade Co EMA	Angel Gates	angel_gates@yahoo.com
7.	Holly Fowler	City Clerk	Hardinsburg	Holly Fowler	clerk@hardinsburg.org
8.	Michele Walters	GIS Tech	LTADD	Michele Walters	
9.	Janice Rawson	PAS	LTADD	Janice Rawson	
10.	Ashley Willoughby	Comm Devel. Spec.	LTADD	Ashley Willoughby	
11.	Joe Sullivan	Warning Coord Met	NWS	[illegible]	Joe.Sullivan@noaa.gov
12.	Sheila Puckett	Pw. Director	City of Leitchfield	Sheila Puckett	sheila.puckett@leitchfield.org
13.	Tim Bartley	P.W. Director	City of New Haven	Tim Bartley	bartley8974@gmail.com

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	FMA-2013-0014	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
14.	Rebecca Hayse	Treasurer	Grayson Co. Fiscal Ct.	Rebecca Hayse	gctreasurer@bgtelco.com
15.	Toni Burton	City Clerk/Treasurer	City of Hodgenville	Toni Burton	hodgenvilleclerk@windstream.net
16.	Steven Johnson	Police officer	Hodgenville Police	[illegible]	steve173@windstream.net
17.	Nick Grinstead	Planning Grants Manager	University of KY KYEM	[illegible]	nick.grinstead@uky.edu
18.	Mark Malone	Admin Chief	Elizabethtown Fire	Mark Malone	mark.malone@elizabethtownky.gov
19.	Greg Ashworth	Risk Manager	City of Bardstown	[illegible]	gashworth@bardstowncable.net
20.	Eva Wilson	Recovery Planning Coordinator	KYEM	Eva Kwilson	eva.k.wilson.nfg@mail.mil
21.	Chandra Coleman	Admin Asst	Grayson Co. Fiscal Ct.	[illegible]	[illegible]@bgtelco.com
22.	Missy Goodwin	City Clerk-Treasurer	City of West Point	[illegible]	missy@westpointky.org
23.	Marty Moore	EMA Director	Breck Co EMA	Marty Moore	MMoore@BBTel.com
24.	Anthony Lee	Public Works Dir	City of Muldraugh	[illegible]	muldpublicworks@gmail.com
25.	David Edelen	mayor	City Bradfordsville	David Edelen	dedelen@hotmail.com
26.	David Daugherty	county judge marion Co		David Daugherty	marioncountyjudge@[illegible]

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	FMA-2013-0014	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
27.	James P. Embry	Mayor	City of Caneyville	James P. Embry	
28.	Anthony Clark	Police Chief/ Fire Chief	City of Caneyville	Anthony Clark	cpdclark122@yahoo.com
29.	Ashley Russo	City Clerk / Applicant's Agent	City of Radcliff	Ashley Russo	arusso@radcliff.org
30.	Jackie Johnson	City Clerk/Treasurer	City of Vine Grove	Jackie Johnson	Jackie@vinegrove.org
31.	Steven New	Fire Chief/em	City of Vine Grove	Steven New	VGFD600@Aol.com
32.	Johnathan Hendricks	EM Deputy Director	Nelson Co	[illegible]	NCEMSJohn@aol.com
33.	Todd C. Neal	KYEM HMGP	KYEM	Todd Neal	todd.c.neal@us.army.mil
34.	Kevin Devine	EM Director	Washington Co Springfield	[illegible]	wcuen@bellsouth.net
35.	Bonnie Henderson	Mayor	City of Clarkson	Bonnie H. Henderson	mayor@clarksonky.com
36.	Alicia Hayes	City Clerk	City of Clarkson	Alicia Hayes	clerk@clarksonky.com
37.	Molly Jones	City Clerk	City of Brandenburg	Molly Jones	molly@bbtel.com
38.	Nikki Wheatley	City Clerk	City of Lebanon	[illegible] Wheatley	nblack@lebanonky.org
39.	William Ash	Mayor	City of West Point	William P. Ash	mayor@westpointky.org

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	FMA-2013-0014	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
40.	WENDELL LAWRENCE	EX. DIR	LTADD	[illegible]	wendell@ltadd.org
41.	MIKE BURRESS	DEPUTY DIR	LTADD	Mike Burress	MIKE@LTADD.ORG
42.	MAURICE LUCAS	Judge Exec	Breck. Co.	Maurice Lucas	MAURICELUCAS@bbtel.com
43.	Eric Vertrees	Em. Mgmt.	Breck Co	Eric Vertrees	
44.	Rhonda Hagan	Mayor	City of Bloomfield	Rhonda Hagan	rhagan@bardstowncable.net
45.	Janet Graves			Janet Graves	
46.	JIM GLISSON	COUNCIL	CITY OF BLOOMFIELD	J Glisson	
47.	Sue Case	Council	Bloomfield	Sue Case	
48.	LISA BALLMAN	City Clerk	Irvington	Lisa Ballman	lisa@irvingtonky.org
49.	Yvonne Kennedy	Mayor	Irvington	Yvonne Kennedy	mayor@irvingtonky.org
50.	Scott Thompson	Maint. tech	city of Bloomfield	[illegible]	sthompson@nenfd.org
51.	Deedee Whitely	Em. Mgmt Applic. Agt.	Grayson Co. EM	Deedee Whitely	deedeewhitely@gmail.com
52.	Ernie Perkins	Grayson Co. E.M. Director	Grayson Co EM	[illegible]	ernieperkins375@yahoo.c

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	FMA-2013-0014	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
53.	Jamie Henderson	Fire Chief	Radcliff Fire		jhenderson@radcliff.org
54.	Dennis Wells	Director	Larue Co Em		dwells@laruecounty.org
55.	Nathaniel Hall	911 Director Deputy EM	LaRue Co. EM		nhall@laruecounty.org
56.	Joe Prewitt	Director EM	Nelson Co		NCEMSJoe@aol.com
57.	James Bartley	water & sewer	city of New Haven	James Bartley	
58.	Caroline Cline	City Clerk/Treas.	Muldraugh	Caroline J. Cline	muldraugh@bbtel.com
59.	Murray Wanner	Planning Official	City of Radcliff		mwanner@radcliff.org
60.	Charlie Ashbaugh	Police Chief	Muldraugh		charlie.ashbaugh@yahoo.com
61.	Joshua Cook	Regional Senior Planner	BGADD		Jcook@bgadd.org
62.	Leann Lacy	comm. Dev. Spec	"	Leann Lacy	llacy@bgadd.org
63.					
64.					
65.					

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	PDM-2013-0005	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
1.	Joseph E Noon Sr.	mayor	Muldraugh, Ky	[signature]	muldraugh@bbtel.com
2.	Olivia R. Berry	EM Coordinator	Hardin Co EM	O Berry	emcoordinator@hardin.co
3.	Doug Finlay	Director	Hardin Co EM	Doug Finlay	emdirector@hardin.co
4.	Ron Dodson	Director	Meade Co EMA	[signature]	meadeema@bbtel.com
5.	Michael Robinson	GIS LTADD	LTADD	[signature]	mrobinson@LTADD.org
6.	Angel Gates	Deputy Director EMA	Meade Co EMA	Angel Gates	angel_gates@yahoo.com
7.	Holly Fowler	City Clerk	Hardinsburg	Holly Fowler	clerk@hardinsburg.org
8.	Janice Rawson	LTADD	LTADD	Janice Rawson	
9.	Michele Walters	GIS Tech	LTADD	Michele Walters	
10.	Ashley Willoughby	Comm. Dev. LTADD	LTADD	Ashley Willoughby	awilloughby@ltadd.org
11.	Sheila Puckett	PW Director	City of Leitchfield	Sheila Puckett	sheila.puckett@leitchfield.org
12.	JOE SULLIVAN	WARNING COORD. METEOROLOGIST	NWS	[signature]	Joe.Sullivan@noaa.gov
13.	James Bartley		City of New Haven	James Bartley	

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	PDM-2013-0005	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
14.	Chandra Glenn	Admin. Asst.	Grayson Co. Fiscal Ct.	Chandra Glenn	Punkinatbgtelco.com
15.	Rebecca Hayse	Treasurer	GraysonCo Fiscal Ct	Rebecca Hayse	gctreasurer@bgtelco.com
16.	Jori Burton	Clerk/Treasurer	City of Hodgenville	Lori Burton	hodgenvilleclerk@windstream.net
17.	Steven Johnson	Police officer	Hodgenville Police	St Johnson	sfex173@windstream.net
18.	Eva Wilson	Recovery Planning Coordinator	KYEM	Eva Kat Wilson	eva.k.wilson.nfg@mail.mil
19.	Nick Grinstead	Planning Grants Manager	University of KY/ KYEM	Nick Grinstead	nick.grinstead@uky.edu
20.	Greg Ashworth	Risk Manager	City of Bardstown		gashworth@bardstowncable.net
21.	Marty Moore	EMA Director	Breck Co EMA	Marty Moore	MMoore@BBTel.Com
22.	Melissa Goodwin	City Clerk/Treasurer	City of West Point	Melissa	missy@westpointky.org
23.	Anthony Lee	Public Works Dir	City of Muldraugh		muldpublicworks@gmail.com
24.	David Edelen	Mayor	City of Bradfordsville	David Edelen	dedelen@hotmail.com
25.	David Daugherty	County Judge	Marion County Judge	David Daugherty	marioncountyjudge@windstream.net
26.	James P. Embry	Mayor	City of Caneyville	James P. Embry	

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	PDM-2013-0005	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
27.	Anthony Clark	Police Chief Fire Chief	City of Caneyville	Anthony Clark	cpdclark122@yahoo.com
28.	Ashley Russo	City Clerk / Fema Applicant's Agent	City of Radcliff	Ashley Russo	arusso@radcliff.org
29.	Jackie Johnson	City Clerk/Treasurer	City of Vine Grove	Jackie Johnson	jackie@vinegrove.org
30.	Steven R New	Fire Chief E/M	City of Vine Grove	Steve R New	VGFD1600@Aol.com
31.	Kevin Devine	EM Director	Washington Co Springfield	[illegible]	kcven@bellsouth.net
32.	Johnathan Hendricks	EM Deputy Director	Nelson Co.	Johnathan Hendricks	NCEMSJohn@Aol.com
33.	Todd C. Neal	Grants Mgr	KYEM	Todd C Neal	todd.neal@us.army.mil
34.	Bonnie Henderson	Mayor	City of Clarkson	Bonnie G. Henderson	mayor@clarksonky.com
35.	Alicia Hayes	City Clerk	City of Clarkson	Alicia Hayes	clerk@clarksonky.com
36.	Molly James	City Clerk	City of Brandenburg	Molly James	molly@bbtel.com
37.	Nikki Wheatley	City Clerk	City of Lebanon	[illegible] Wheatley	nblack@lebanonky.org
38.	William Ash	Mayor	City of West Point	William Ash	mayor@westpointky.org
39.	Wendell Lawrence	Ex. Dir.	LTADD	Wendell	wendell@ltadd.org

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	PDM-2013-0005	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
40.	Mike Burgess	Deputy Dir.	LTADD	Mike Burgess	mike@ltadd.org
41.	Maurice Lucas	Judge-Exec	Breck Co	Maurice Lucas	mauricelucas@bbtel.com
42.	Eric Vertrees	Em. Mgmt.	Breck Co.	Eric Vertrees	
43.	Rhonda Hagan	Mayor	City of Bloomfield	Rhonda Hagan	rhagan@bardstowncable.net
44.	Janet Graves		City of Bloomfield	Janet Graves	
45.	Jim Glisson	Council	" " "	Jim Glisson	jmglisson@aol.com
46.	Sue Case	Council	City of Bloomfield	Sue Case	
47.	Lisa Ballman	City Clerk	Irvington	Lisa Ballman	lisa@irvingtonky.org
48.	Yvonne Kennedy	Mayor	Irvington	Yvonne Kennedy	mayor@irvingtonky.org
49.	Scott Thompson	maint. tech	City of Bloomfield		sthompson@nenfcl.org
50.	Deedee Whitely	Emerg. Mgmt Applic. Asst.	Grayson Co. EM	Deedee Whitely	deedeewhitely@gmail.com
51.	Ernie Perkins	E.M. Director	Grayson Co EM		ernieperkins375@yahoo.com
52.	Jamie Henderson	Fire Chief	Radcliff Fire		jhenderson@radcliff.org

MEETING SIGN-IN SHEET: LINCOLN TRAIL AREA DEVELOPMENT DISTRICT (LTADD) HAZARD MITIGATION TRAINING

Projects:	PDM-2013-0005	**Meeting Date:**	January 29, 2015
Facilitator:	Lincoln Trail Area Development District (LTADD): Janice Rawson, Mike Robinson, Wendell Lawrence	**Place/Room:**	Muldraugh Safe Room, Muldraugh, KY

	PRINT Name	Title	Agency	Signature	E-Mail
53.	Dennis Wells	Director EM	Larue Co. EM	[signature]	dwells@laruecounty.org
54.	Nathaniel Hall	911 Director Deputy EM	LaRue Co. EM	[signature]	nhall@laruecounty.org
55.	Joe Prewitt	Director EM	Nelson Co.	[signature]	NCEMSJoe@Aol.com
56.	Tim Bartley	P.W. Director	City of New Haven	[signature]	bartley8974@gmail.com
57.	Caroline Cline	City Clerk/Treas.	Muldraugh	[signature]	muldraugh@bbtel.com
58.	Mark Malone	Admin. Chief	Elizabethtown F.D.	[signature]	mark.malone@elizabethtownky.gov
59.	Murray Wanner	Planning Official	City of Radcliff	[signature]	mwanner@radcliff.org
60.	Charlie Ashbaugh	Police Chief	Muldraugh	[signature]	charlie.ashbaugh@yahoo.com
61.	Joshua Cook	Regional Senior Planner	BGADD	[signature]	JCook@bgadd.org
62.	Leann Lacy	Comm. Dev. Spec.	"	[signature]	llacy@bgadd.org
63.					
64.					
65.					

LINCOLN TRAIL
AREA DEVELOPMENT DISTRICT

613 College St. Rd.
P.O. Box 604
Elizabethtown, KY 42702
Phone: 270-769-2393
Fax: 270-769-2993
TDD: 800-247-2510
Equal opportunity employer M/F/D

MEMORANDUM

To: All County Judge/Executives, Mayors, Planning and Zoning Commissions, Boards of Adjustment, and Interested Parties.

From: Janice Rawson, Public Administration Specialist

Date: August 20, 2015

Subject: HB 55 Training for all persons concerned with and/or interested in Planning & Zoning (REGISTRATION REQUIRED)

The Lincoln Trail Area Development District will host a HB 55 training workshop for locally elected officials, planning and zoning officials and members of any Boards of Adjustment. The session will be held at the Lincoln Trail Area Development District Office in Elizabethtown at 5 p.m. (EDT), Thursday, September 17, 2015. Registration will begin at 4:30 p.m. The cost is $5.00 per person and includes the cost of training materials, a training certificate and a boxed dinner. This session will count as three (3) hours of training and should be over by 8:00 p.m.

The Lincoln Trail Community and Economic Development Department will present *Integrating Hazard Mitigation Into Local Planning*. This session will give local planners and decision makers an opportunity to review strategies. There will be ample opportunity for questions and discussion.

Because we must pay for food in advance, all who register will be charged if they do not cancel by 4:30 p.m., September 11, 2015. Please **RSVP** with Karen Weaver at 270-769-2393 by close of business, **September 11, 2015**. If you would rather email your registration, you may contact Karen at Karen@ltadd.org. Please note that the spelling of names on your registration will appear on the training certificate.

Note: Local units of government with planning and zoning commissions are responsible for monitoring the meeting and training requirements of KRS 100.

If you have questions or need more information, do not hesitate to call.

AGENDA

HB 55 Training – Integrating Hazard Mitigation Into Local Planning

THURSDAY, September 17, 2015

5:00 to 8p.m.

At Lincoln Trail Area Development District office
613 College Street Road
Elizabethtown, KY 42701

Sponsored by
Lincoln Trail Area Development District

Workshop Agenda:
Introductions
Mapping
Transportation
Water/Wastewater Infrastructure
General Planning

Presented by:
LTADD Community and Economic Development Department

Mike Burress	Deputy Director
Mike Robinson	GIS Specialist
Mike Skaggs	MPO Planner
Aaron Hawkins	Transportation Planner
Ashley Willoughby	Water Coordinator
Janice Rawson	Public Administration Specialist

HB55 TRAINING
September 17, 2015

Name (PLEASE PRINT)	Representing	Phone No.	Email Address	SIGNATURE
✓ Kenny Devore	City of Hodgenville cancelled	Toni	hodgenvilleclerk@windstream.net	see Mary Locke below
✓ Mitchell Key	↓		↓	Mitchell Key
✓ Donald Costello	↓		↓	Donald Costello
✓ Toni Burton	↓	pd w/ ✓ for 7 for $135 attendees	↓	Toni Burton
✓ Bonnie Clark	↓		↓	Bonnie Clark
✓ Sharon Hornback	↓		↓	x Sharon Hornback
✓ Larry Davis	Hodgenville Council	Toni	↓	Larry Davis
✓ Roger Ledridge	City of Hardinsburg cancelled		holly@hardinsburg.org	cancelled
✓ Brenda Edge	↓		↓	x Brenda Edge
✓ David Hayes	↓		↓	+ [illegible]
✓ Buddy Parker	Washington Co. Planning Administr	(859) 336-5415	Bparker28@yahoo.com	Buddy Parker
✓ Charlie Allgeier	Meade Co. Planning & Zoning	Timmi	accountspayable@meadeky.gov	x Charlie Allgeier
✓ Chuck Hansbrough	↓		↓	Chuck Hansbrough
✓ Rob Pack	↓		↓	

Mary Locke Hodgenville x [illegible]

HB55 TRAINING

September 17, 2015

Name (PLEASE PRINT)	County	Phone No.	Email Address	SIGNATURE
√ David Masterson	↓		↓	
√ Randall Hardesty	↓		↓	Randall Hardesty
√ Jeff Embrey	City of Brandenburg		molly@bbtel.com	x [illegible] Embrey
√ Sheila Puckett	Leitchfield-Public Works & Zoning		Sheila.puckett@leitchfield.org	x Sheila Puckett
√ Charles McCreary	City of West Point P&Z		Gaye Moore asstclerk@westpointky.org	x [illegible]
√ Donna McCreary	↓		↓	+ Donna McCreary
√ Chris Mayhew	Vine Grove P&Z Admin 1		chris@vinegrove.org	see Thomas Billing.
√ Sandra White	Planning Comm 2		↓	x Sandra White
√ Gary Ford	Planning Comm 3		↓	+ Gary Ford
→ √ Ivy Mitchell	Bd of Adjustments 4		↓	Ivy E. Mitchell
√ Sam Pearson	↓ 5		↓	x [illegible]
√ Robert Thompson	↓ 6		↓	[illegible]
→ √ Phyllis Mitchell	↓ 7		↓	Phyllis Mitchell
√ Dagmar Rennaker	↓ 8		↓	x [illegible]
Thomas Billing	9			x [illegible]

HB55 TRAINING

September 17, 2015

Name (PLEASE PRINT)	County	Phone No.	Email Address	SIGNATURE
√Kathy Sisco	Vine Grove City Council	10	↓	Kathy Sisco
√ Steve Wardrip	Meade County P&Z	Timmi	accountspayable@meadeky.gov	x Steve Wardrip
√ Tom Goddard	↓		↓	x T Goddard
√ Eli Dix	↓	Cancelled	↓	
√ Gary Chapman	↓	Cancelled	↓	
√ Gerry Lynn	↓		↓	Gerry Lynn
√ Dodie Maier	Racliff Planning Commission	Denise	dhaynes@radcliff.org	x Dodie Maier
Archie A. Mack	Radcliff BOA	270-351-6159	AF4EBHAM@TWC.COM	Archie A Mack Sr.
Randy Newberry	LaRue BOA			x R. Newberry
Rita Williams	LaRue BOA			x Rita T Williams
* BILL BETSON	VINE GROVE P+Z	(270) 319-3430	betsonwr@me.com	William Betson
* STEPHEN BLAKE DURRETT	LARUE	270-405-1457	blakedurrett@gmail.com	Stephen Blake Durrett

Public Hearing Notice

To all interested citizens of the Kentucky Counties of Breckinridge, Grayson, Hardin, LaRue, Marion, Meade, Nelson and Washington:
The *Lincoln Trail Regional Hazard Mitigation Plan* has been rewritten and updated and is available for review and comments. A regional public hearing will be held Thursday, January 7, 2016 4:00 to 7:00 p.m. EST, with an alternate date of January 12, 2016 in the event of inclement weather. The purpose of this hearing is to obtain views on the plan, review proposed activities, goals and proposed mitigation projects, and solicit public comment. The meeting will be held at the office of Lincoln Trail Area Development District, 613 College St. Rd., Elizabethtown, KY. 42701.

Participation in the Lincoln Trail Hazard Mitigation Plan, by the 35 jurisdictions it represents, is a federal requirement by the Federal Emergency Management Agency:

A. Per Title 44 Code of Federal Regulations (CFR) Part 201, for FEMA assistance in the event of a disaster.
B. To participate in the Emergency Management Activities of mitigation, prevention, protection, preparedness, response and recovery.
C. To increase regional resiliency and preparedness.

Comments on The Lincoln Trail Regional Hazard Mitigation Plan

A draft copy of the Plan is available for citizens' review and comment at the Lincoln Trail ADD website (ltadd.org). Comments on the proposed application may be submitted to the attention of Janice Rawson at the above address, until the close of business on Tuesday, January 12, 2016.

Discrimination Clause

Lincoln Trail ADD does not discriminate on the basis of race, color, national origin, sex, age, religion or disability, and provides, upon request, reasonable accommodation, including auxiliary aids and services, to afford an individual with a disability an equal opportunity to participate in all services, programs and activities. Any persons requiring special needs assistance should contact Janice Rawson at 877.255.8233 at least five days prior to the meeting. The TDD number for the hearing impaired is 800.648.6057.

NOTE: ADA Contacts

Department for the Blind	800.877.KYBLIND	www.apps.blind.ky.gov
American Printing House	800.223.1839	www.aph.org
Commission for the Deaf and Hard of Hearing	800.372.2907	www.kcdhh.org
For Interpreter Director		www.hcdhh.org/access/interpdir.html
State Relay TTY Number	800.648.6057	

LINCOLN TRAIL
AREA DEVELOPMENT DISTRICT

613 College St. Rd.
P.O. Box 604
Elizabethtown, KY 42702
Phone: 270-769-2393
Fax: 270-769-2993
TDD: 800-247-2510
Equal opportunity employer M/F/D

MEMORANDUM

To: All County Judge/Executives, City Mayors, County Emergency Managers

From: Wendell Lawrence
Executive Director

Date: December 22, 2015

Subject: 2015 Lincoln Trail Regional Hazard Mitigation Plan Update

As you know, the Lincoln Trail Area Development District received funding from a FEMA Pre-disaster Mitigation grant to accomplish the mandatory update of the Lincoln Trail Regional Hazard Mitigation Plan. Every City and County in our region ***was required*** to participate in this planning process in order to be eligible for any FEMA Hazard Mitigation assistance in the event of a declared disaster such as an ice storm or tornado. That requirement extends to the adoption of the plan by every jurisdiction. An adoption resolution will be provided to you once the plan is approved by FEMA.

To date, the plan has been rewritten and sent to the FEMA offices on the State and Federal level for approval. The rewritten Lincoln Trail Regional Hazard Mitigation plan is now available for your review on our website, ltadd.org. Please review the plan. LTADD will host a public meeting on January 7, 2016 from 4:00 p.m. to 7:00 p.m. (EST). The meeting will be held at LTADD office in Elizabethtown. A public hearing notice was placed in the newspaper of greatest circulation in each county. Please plan to attend or to have representatives from your jurisdiction attend. All comments, revisions and/or corrections should be forwarded to us as soon as possible. This meeting will be in an "open house" format, and you may attend at any point during that 3-hour period.

Lincoln Trail Regional Multi-Hazard Mitigation Plan Review Meeting
Review Public Hearing
January 7, 2016 - 4:00 p.m. (EST)

NAME	Organization	Contact Information
Julie Masters	Nelson County	
Britney Lucas	Buck Co.	
Tabitha French	Larue Co.	
Jackie Johnson	City of Vine Grove	Jackie@vinegrove.org.
Ashley Russo	City of Radcliff	arusso@radcliff.org
William Ash	City of WEST Point	mayor@westpointky.org
Joseph E Noon.	City of Muldraugh	
GREG ASHWORTH	CITY of Bardstown	gashworth@bardstowncable.net
Kim Sowders	City of Leitchfield	Kim.sowders@leitchfield.org
DENNIS WELLS	LARUE CO. EM	dwells@laruecounty.org
Nathan Hall	LaRue Co. E-911/Deputy E.M.	nhall@laruecounty.org
Eric Vertrees	Breckinridge Co. EMA	ericvertrees@bbtel.com
Darlene Bozza	Meade Co.	
Rory Finley	Hardin Co. EM	emdirector@hardin.co
Yvonne Kennedy	City of Irvington	~~YvonneKennedy@~~ mayor@irvingtonky.org
Lise Ballman	City of Irvington	lisa@irvingtonky.org
Michael Robinson	LTADD	mrobinson@ltadd.org

Andy Willoughby	LTADD	awilloughby@ltadd.org
Aaron Hawkins	LTADD	aaron@ltadd.org