

Hamilton County, Tennessee
Multijurisdictional Natural Hazards Mitigation Plan
2019



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Chapter 1 Introduction and Background

Purpose

This plan seeks to develop a comprehensive strategy to reduce the impacts of natural hazards in Hamilton County. The rising costs and apparent increase in the rate of occurrence of natural disasters has led to the need to identify additional ways to reduce the County's vulnerability to natural hazards—before the next disaster actually occurs.

Disasters can exact a heavy toll. In the past, natural hazards in Hamilton County have caused injury and loss of life, severe property damage, interruption of the delivery of vital goods and services, disruption of local economies, and harm to the natural environment. Natural hazards are an inevitable fact. Human ingenuity can do nothing to stop a tornado or winter storm from occurring. Planning for natural hazards and implementing mitigation measures, however, can reduce the impact of such events when they do occur. Monetary losses, personal injury, loss of life, as well as economic, social, and environmental impact on the community can be reduced. The purpose of this plan, therefore, is to outline a strategy with specific programs and policies that can be implemented by Hamilton County and local units of government within Hamilton County to reduce the impact of natural hazards on people, structures, and the natural environment. Chattanooga, Collegedale, East Ridge, Lookout Mountain, Hamilton County, Red Bank, Signal Mountain, Soddy-Daisy, Walden, the University of Tennessee at Chattanooga (UTC) and the Hamilton County Department of Education (HCDE) are continuing plan participants.

Background

Hamilton County is the fourth largest County in Tennessee with 2017 population of 361,613. The City of Chattanooga is the fourth largest city in the state with a 2017 population of 179,136. Principal towns, in addition to Chattanooga, are Red Bank, Soddy-Daisy, Collegedale, East Ridge, Lookout Mountain, Walden, Ridgeside, Lakesite, and Signal Mountain (Map 1).

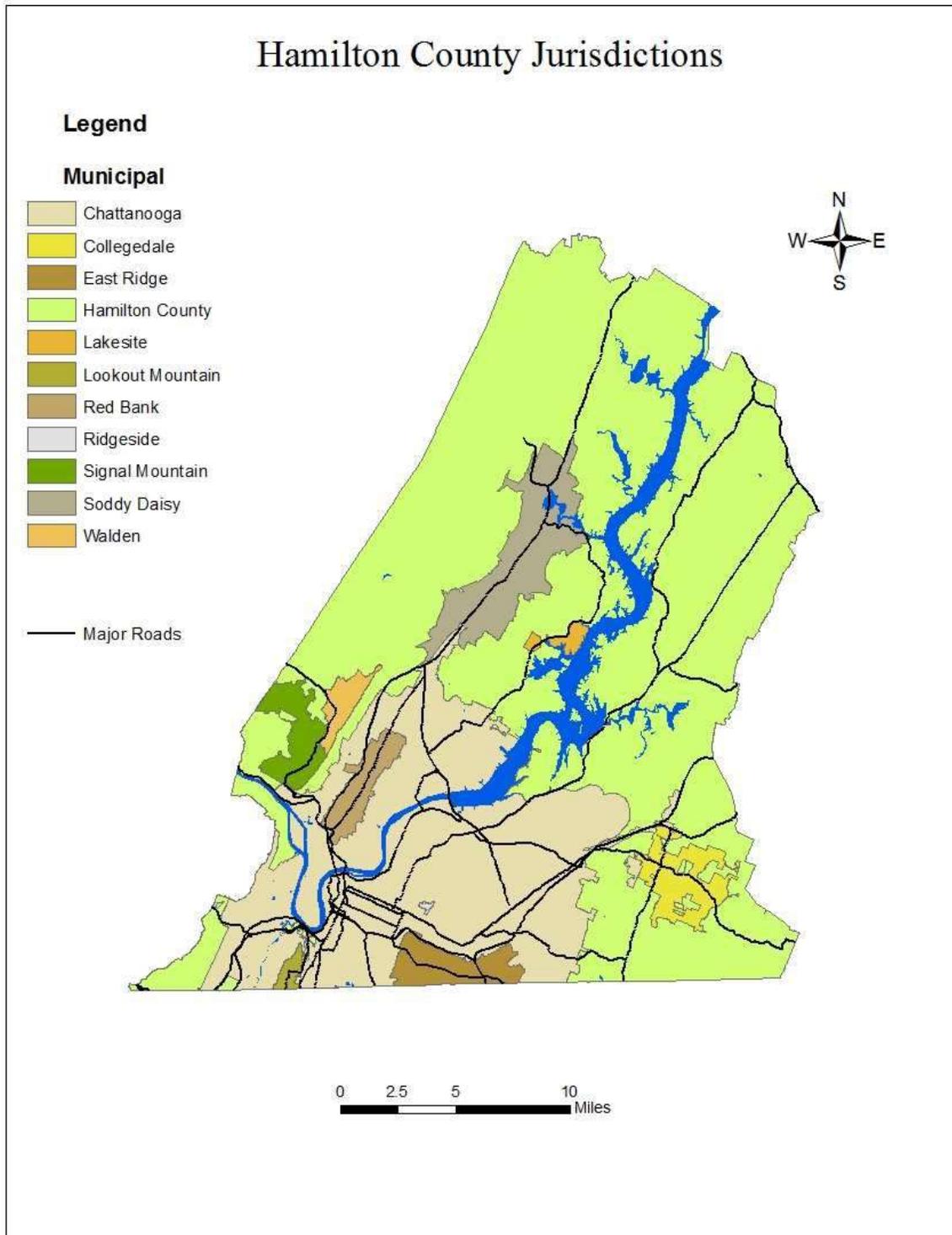
Hamilton County is located in southeastern Tennessee and is bordered on the north by Rhea and Meigs counties, Tennessee; on the east by Bradley County, Tennessee; on the west by Bledsoe, Marion, and Sequatchie Counties, Tennessee; and on the south by Dade, Walker, and Catoosa Counties, Georgia. The major city in the county is Chattanooga, which serves as a major trade and industrial center in the southeast.

The county covers approximately 575 square miles or 368,479 acres. Hamilton County is divided from north to south by the Tennessee River and the Chickamauga and Nickajack Reservoirs.

Hamilton County includes two distinct geographic areas, the Cumberland Plateau and Mountains and the Southern Appalachian Ridges and Valleys. In winter, valleys in Hamilton County are very cool with occasional cold and warm spells. Upper slopes and Mountaintops are generally cold. In summer, the valleys are very warm and frequently hot, and mountains that are warm during the day become cool at night. Precipitation is heavy and evenly distributed throughout the year. Summer precipitation falls mainly as thunderstorms.

Major transportation corridors include Interstates 24 and 75; U.S. Routes 11, 27, 41, 54, 72,

and 127; State Routes 27, 29, and 58; and the CSX and Norfolk Southern Railway. Colleges and universities in Hamilton County include the University of Tennessee at Chattanooga, Chattanooga State Technical Community College, and Southern Adventist University.



History

Hamilton County

As early as 200 BC the Cherokee nation inhabited the area around Lookout Mountain and the Chattanooga Valley and called it Chatanuga, or "rock rising to a point." Creek, Choctaw, and Shawnee tribes also inhabited the land, but the overwhelming majority of the population was the Cherokee people.

The Tennessee General Assembly created Hamilton County on October 25, 1819. Rhea, Marion, and Bledsoe Counties bounded the new county, and it extended south to the state line. The creation of the new county on the southwestern frontier was brought about by a treaty with the Cherokees in 1817. By the terms of the Hiwassee Purchase, the Indians yielded large sections of Alabama and Georgia, as well as the Sequatchie Valley and the area that became Hamilton County. Initially, Hamilton County did not extend south of the Tennessee River. This area, including the site of Cherokee Chief John Ross's landing in present-day Chattanooga, did not become a part of the county until the disputed Treaty of 1835 that led to Indian removal and the "Trail of Tears." The county was named in honor of Alexander Hamilton, secretary of the treasury in George Washington's administration. Hamilton was the name of the district of which this section had formerly been a part.

At the time of the 1820 census, Hamilton County counted 821 residents, including 16 free blacks and 39 slaves. Approximately 100 Cherokees lived on six private family reserves. The settlers were clustered mainly at Sale Creek, at Poe's Crossroads (Daisy) and at the farm of Asahel Rawlings (Dallas). The courts were later moved nearby to the farm of John Mitchell before a log courthouse was built at Dallas on the Tennessee River. The county seat was shifted across the river to the new town of Harrison in 1840. Chattanooga, whose growth far outstripped that of Harrison, became the seat of government in 1870.

Chattanooga

Chattanooga's future as a railroad center was assured when the Western and Atlantic Railroad selected it as its northern terminus. This line reached the city in 1849, and the Nashville and Chattanooga Railroad was completed in 1854. The East Tennessee, Virginia and Georgia Railroad, the Cincinnati Southern, and other rail lines later were extended to the growing city.

A rail center and the "Gateway to the South," Chattanooga became a focal point in the Civil War, especially in the summer and fall of 1863. The Army of Tennessee under General Braxton Bragg fell back from the city and fought a bloody battle at nearby Chickamauga, Georgia, on September 19 and 20, 1863. From the surrounding mountains, the Confederate forces besieged Chattanooga until the arrival of Union forces under General Ulysses S. Grant and General William T. Sherman. The Union won victories at Wauhatchie and Lookout Mountain prior to the famous charge up Missionary Ridge on November 25, 1863.

After the Civil War, Chattanooga experienced a cholera epidemic in 1873 and a yellow fever scourge five years later. There were also devastating floods in 1867 and 1886. The city still managed to develop as a manufacturing center and underwent a real estate boom in the late

1880s. Later, it became the site of the first Coca-Cola bottling franchise and the headquarters for several major insurance companies. The Krystal hamburger, the Moon Pie, and the Double-Cola soft drink originated and have their corporate headquarters in Chattanooga.

The development of the downtown riverfront, including erection of the Tennessee Aquarium, the Children's Discovery Museum, the IMAX Theater, and the Chattanooga Visitors Center has made the area a popular tourist destination. The Walnut Street Bridge was restored as a popular pedestrian walkway, and the Tennessee Riverwalk was built along the river. Chattanooga, which had a remarkable cleanup of its polluted air, has developed a reputation as "the environmental city," featuring electric buses, greenways, and an expanded convention center with an environmental design.

Collegedale

Collegedale was incorporated in 1968. The name was derived from the presence of Southern College, which has now gained University status. O.D McKee, founder of McKee Foods, which produces Little Debbie Snack Foods, is one of the areas prominent residents. McKee Foods is the area's largest employer.

East Ridge

The Town of East Ridge was incorporated under Private Acts 1921, Chapter 569 on January 12, 1954. The citizens of the town voted to become a home rule municipality on November 3, 1970. Voters elected to change the name from the Town of East Ridge to the City of East Ridge. East Ridge was named for the area "East of Missionary Ridge," the site of a major Civil War Battle.

Lookout Mountain

Lookout Mountain was the site of the Civil War "Battle above the Clouds" on November 25, 1863. A National Military Park was dedicated to commemorate the event in 1934. Lookout Mountain was incorporated as a town in 1890. The Incline Railway (1896) and National Military Park make Lookout Mountain a popular tourist destination.

Red Bank

Red Bank began as an early rural suburb of Chattanooga running along the Dayton Pike from Stringer's Ridge to Daisy, TN. Its growth began by a housing boom following World War I. Early settlements sprang up along the stops of the Chattanooga Traction Company trolley line. By 1945, the population in the area of Red Bank had grown to over 4,000 and thoughts of becoming a new city began to arise as an option that was seriously being considered by many of its residents. Red Bank-White Oak was chartered in 1955. On January 7, 1967, the city of Red Bank-White Oak officially became Red Bank.

Signal Mountain

During the Civil War Battle of Chattanooga in the fall of 1863, the Union Army used Signal Point as a communications station to signal various locations in the Chattanooga area.

Development of the area began in 1878 when Charles E. James bought 4,400 acres of land in the signal point area. He constructed a streetcar track up the mountain and built Signal Mountain Inn, which opened in 1913. By 1925, two hundred houses had been built within a few blocks of the Inn. The Town of Signal Mountain received its charter from the State of Tennessee on April 4, 1919. The town's charter was changed in 1990 to convert to a Council/manager form of government.

Soddy-Daisy

William Sodder established a trading post at Soddy around 1770. This post spawned an enclave in the wilderness in which continental soldiers settled in 1789. Perhaps the biggest boon to development in the area was the discovery of coal in the ridges.

For years, mining was the primary economic activity in the northern part of Hamilton County. In 1867, the Soddy Coal Company began operation. With the establishment of the mining industry, the town of Soddy began to grow. The majority of housing and business in the developing town was company-owned.

The Daisy Community was also involved in mining operations, but on a somewhat smaller scale. While both Soddy and Daisy were successful coal mining communities, the decline and eventual closing of the mines in the 1930's forced businesses to close and some people to move elsewhere in search of employment. To make things worse for Soddy was the 1947 construction of US 27, which by-passed the business district of the town. However, the road went through the Daisy Community. Because of the highway, a hosiery mill, and a turpentine plant Daisy held onto some of its population. In April of 1969, the communities of Soddy and Daisy incorporated to form the city of Soddy-Daisy. Since then, several occurrences have shaped the physical character of the City. Among these are the construction of US 27 / State 29, which bisects the city east, and west. The Sequoyah Nuclear Power Plant has spawned development in the eastern portion of the City.

Walden

Walden received its Charter from the State of Tennessee on August 11, 1975 with an initial population of 1,118 residents. Walden is located on Walden's ridge at an altitude of approximately 2,080 feet. It is primarily a rural residential area with several small businesses and churches.

University of Tennessee at Chattanooga (UTC)

Located near downtown Chattanooga, UTC had been a private institution for 83 years when it joined the University of Tennessee's system of statewide campuses in 1969. Total enrollment in 2018 was 11,638 with 3,432 students residing in campus housing. The UTC physical plant consists of 92 buildings encompassing 3,492,074 square feet. The university has 1,216 budgeted positions.

Hamilton County Department of Education

The Hamilton County Department of Education (HCDE) is the fifth largest school system in the state of Tennessee, covering the county's entire geographic area. The district's 79 schools consist of Pre-K through grade twelve with nearly 2,800 full-time teachers responsible for educating over 44,500 students.

Natural Hazard Overview

A review of past natural disasters in Hamilton County, and across the State of Tennessee highlights 8 primary hazards as presenting potential risk to the communities of Hamilton County. These hazards include flood, winter storms, severe storms, tornado, geologic hazards (landslide, erosion, and sinkholes), earthquake, drought, and wildfire. Fog is a minor hazard for severely limiting visibility and creating dangerous driving conditions.

Flooding is a serious problem in Hamilton County. Since 1936, TVA regulation of the Tennessee River has substantially reduced the frequency and magnitude of Tennessee River floods and backwater flooding of local tributaries. However, flooding remains a serious concern. Since 2000, the National Climatic Data Center (NCDC) has documented 34 flood events in Hamilton County producing an annual average of 1.3 million dollars of property damage.

Severe storms with related hail, lightning, and high winds are the most frequent natural hazard to affect Hamilton County. Tornadoes are a less frequent natural hazard associated with thunderstorms, but a far more devastating and costly one. The National Weather Service Forecast Office in Morristown, Tennessee provided documentation of 25 tornadoes that have affected the County since 1970. A severe tornado outbreak occurred on April 27, 2011 with ten documented tornados raging through the county. The most serious was an EF-4 that ravaged the Apison area in the southeast portion of the county killing 8 residents and causing massive property damage. The following year an early March EF3 tornado struck near Harrison injuring 30 people and causing approximately 28 million dollars in property damage.

Although infrequent, winter storms, particularly ice storms, are a serious hazard. Damage associated with winter weather events occurs mainly as traffic accidents, downed utility lines, and fallen trees. The Ice Storm of March 1960 caused approximately 30 million dollars of property damage and shut down the towns of Walden, Signal Mountain, and Lookout Mountain for up to seven days. The “Blizzard of March 1993” dropped up to 3 feet of snow in the upper elevations and caused approximately fifty thousand dollars in property damage.

The many hillsides and steep slopes in Hamilton County present areas potentially susceptible to landslide and erosion. Past landslide events have been associated with heavy rain, denuding slopes of vegetation or roadway construction. Area stream banks are also susceptible to severe erosion following heavy rains. In addition, karst topography in Hamilton County can result in the development of sinkholes.

Historic records for earthquake events are very limited in comparison to the geologic time scale. Hamilton County is in the East Tennessee Seismic Zone, the second most active seismic zone east of the Rocky Mountains. On April 29, 2003 a 4.9 magnitude earthquake with an epicenter located in Fort Payne, Alabama was felt in Hamilton County. Most recently, on December 12, 2018 a magnitude 4.4 quake struck around 4:14 a.m. EST. The quake was centered about 7 miles north-northeast of Decatur, Tennessee, in Meigs County, about 50 miles north-northeast of Chattanooga. There is a small but potentially serious risk from earthquake events.

Finally, the impacts of drought are considered because of the increased potential for wildfire in the forested areas of Hamilton County and impacts on agriculture. Forested steep slopes and bluff lines are particularly vulnerable to wildfire because of the difficulty of controlling once ignited.

What is Hazard Mitigation?

Mitigation refers to the policies and activities that will reduce the area's vulnerability to damage from future disasters. Generally, these measures are ones that can be put in place before a disaster occurs. There are a multitude of different types of mitigation programs that can be put in place. In general, mitigation activities can be broken into two categories, structural and non-structural.

Structural mitigation measures try to minimize the effect of hazards on people, buildings, and infrastructure. This includes actions such as building dams and levees, flood-proofing homes, constructing tornado shelters, and instituting building codes that require wind resistant construction.

Non-structural mitigation measures typically concentrate on identifying hazard-prone areas and limiting their use. Examples include land use zoning, the selection of building sites, tax incentives, insurance programs, relocation of residents to remove them from the path of a hazard, the establishment of warning systems, and planning for at-risk populations.

Plan Requirements

This plan is designed to meet the requirements of the Federal Disaster Mitigation Act of 2000 (DMA 2000). The DMA 2000 established new hazard mitigation project funding mechanisms and new state and local planning requirements as conditions of project funding eligibility. The DMA 2000 also provides specific criteria for the preparation and adoption of multi-jurisdictional, "all-hazards" mitigation plans by local governments to meet these requirements. The Hamilton County Natural Hazard Mitigation Plan was prepared to support the requirements of a mitigation plan for all participating local governments in the County. DMA requirements specify that the following elements must be included in the plan:

- > Adoption by the local governing body. The plan must include documentation that the local governing body has formally adopted the plan. In a multi-jurisdictional plan, all participating local units of government seeking plan approval must individually adopt the plan.
- > All local units of government included in the plan must participate in the planning process.
- > The plan must document how the plan was prepared and who was involved in the planning process. Public involvement is essential.
- > A risk assessment section should include:
 - Identification of the hazards likely to affect the area, noting data limitations and providing an explanation for eliminating hazards from further consideration.
 - A discussion of past events and description of their severity and resulting effects.
 - A description of the local vulnerability to the described hazards in terms of the types and numbers of buildings, infrastructure, and critical facilities located in the potentially affected areas.
 - A description of the potential dollar losses to the vulnerable structures identified and a description of the methods used to calculate the estimate.
 - A description of the vulnerability in terms of land use and development so that

mitigation options can be considered in future land-use decisions.

>" The plan must include a hazard mitigation strategy describing:

- Goals to reduce or avoid long-term vulnerabilities to the identified hazards.
- A range of specific mitigation actions and projects to be considered, with particular emphasis on new and existing buildings and infrastructure.
- An action plan identifying how the actions will be prioritized, implemented, and administered by the local jurisdiction. Prioritization must include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.
- For multi-jurisdictional plans, there must be identifiable actions items specific to the jurisdiction requesting FEMA approval of the plan.
- Provisions for reviewing, monitoring, and evaluating progress of the plan's implementation. The plan must also be updated at least every five years and re-approved.

FEMA Hazard Mitigation Project Funding

After November 1, 2004 cities, towns, and counties not having a FEMA approved hazard mitigation plan will be ineligible for certain types of disaster assistance. Under the terms of the DMA, local governments affected by a federally declared disaster are still eligible for emergency aid without having a plan in place. However, those local units would be ineligible for FEMA funds to support hazard mitigation projects that are a part of the normal rebuilding and recovery process.

In addition to post-disaster mitigation funding, local preparation and FEMA approval of a mitigation plan provides participants the opportunity to apply for FEMA administered pre-disaster mitigation project funding. This is a competitive, national grant program designed to reduce over-all risks to the population and structures, as well as reducing the future reliance on federal funding for recovery after a disaster.

In addition to simply identifying and describing natural hazards, the plan also analyzes vulnerability to each hazard. The vulnerability assessment describes not only the physical characteristics of each hazard, but also the potential impact of each hazard on people, buildings, and the social and economic infrastructure of the communities of the County.

Using the vulnerability assessment as the basis for planning, and with the involvement of local units of government and community partners, Hamilton County has prepared this multi-jurisdictional natural hazard mitigation plan. The plan identifies goals, information, and measures for hazard mitigation and risk reduction to make communities more disaster resistant and sustainable. In addition, mitigation actions can protect critical community facilities, reduce exposure to liability, and minimize community disruption. Information in the plan can also be used to help guide and coordinate mitigation activities and local policy decisions for future land use decisions within communities.

Chapter 2- Natural Hazards Mitigation Planning Process

Planning Process

In the fall of 2017, the Hamilton County Office of Emergency Management (HCOEM) began contact with past plan participants to notify them of the pending update of the Mitigation Plan and to schedule an initial meeting. The first meeting was held on January 25, 2018 to begin the update process and also wrap up the final details on a debris management plan. The sign in sheet and meeting agenda are included in the appendix. At the meeting it was agreed that HCOEM would meet individually each participating jurisdiction to assist in the update process and review elements of the draft plan. Each member of the planning group was provided a copy of *the existing Hamilton County Natural Hazards Mitigation Plan, Hazard Mitigation Assistance Guidance, and Mitigation Ideas: Possible Mitigation Measures by Hazard Type*. Greg Helms, Lead Emergency Management Planner for Hamilton County, led the development of the plan update.

The major focus of the plan update is concentrated on Chapters 2 *Planning Process*, Chapter 3 *Hazard Analysis*, and Chapter 4 *Mitigation Strategy, Actions, and Implementation*. Minor revisions were recorded in Chapter 1 *Introduction and Background* in the Natural Hazard Overview section to reflect results of the updated Hazard Analysis.

A continuing effort to include community partners in the mitigation process included assisting local health facilities with their hazard and vulnerability assessments, briefing the Hamilton County LEPC on the county plan and actions they can take to mitigate natural hazards at their facilities, and engaging with the University of Tennessee at Chattanooga Department of Geology to improve knowledge of geologic hazards in the county. The sign in sheet and briefing slides for the LEPC meeting is located in the appendix.

The Mitigation Planning Group with support from a Mitigation Planning Support Group followed a mitigation planning process developed from materials provided by the Federal Emergency Management Agency (FEMA). This process involved the following steps:

1. Review and confirm consensus on potential hazards
All participants reviewed Chapter 3 Hazard Analysis to determine whether new hazards should be considered or previously identified hazards should be removed from the plan.
2. Update information concerning each hazard
All participants provided information specific to their jurisdiction to HCOEM. HCOEM incorporated the new information provided by plan participants as well as information provided by the planning support group to update the hazard analysis in Chapter 3.
3. Review and update prioritization of hazards
All participants reviewed hazard prioritization. Flooding, severe storms, and tornados remain the primary threats. After the wildfires in October of 2016, priority was increased for heavily forested areas in Signal Mountain, Lookout Mountain, Walden, and the unincorporated parts of Hamilton County. Most recently, heavy rain events in September of 2018 and February of 2019 have highlighted the threat from erosion and landslides.

4. Review plan goals and objectives

All participants reviewed the problem statements and goals in Chapter 2. Geologic hazards were separated instead of addressing them as a group.

5. Update the status of current mitigation actions. Develop and prioritize new mitigation actions as needed.

All participants reviewed Chapter 4 and updated the status of mitigation actions specific to their jurisdiction. Mitigation actions were identified as completed, ongoing, deferred, or deleted. New mitigation actions were prioritized and included in the plan update.

Participants also reviewed the implementation strategies in Chapter 4 and provided recommendations to strengthen implementation of the plan.

6. Prepare draft update of the Mitigation Plan

Hamilton County Emergency Management prepared the written draft plan.

8. Review the draft plan within the Planning Group

All participants reviewed the draft plan before submittal to the state for review.

9. Provide the opportunity for the public and other local groups to review the draft and provide comment

The Hamilton County Office of Emergency Management posted public notice in the Chattanooga Times Free Press legal announcements. The public was provided the opportunity to comment at a public meeting on March 7, 2019 or through a notice and posting of the draft plan on the county emergency management website. Social media was also used to publicize the plan update. The Chattanooga Times Free Press published an article concerning the plan update on March 21, 2019 that also included a link to the draft on the HCOEM website and contact information for Greg Helms. A copy of the article is included in the appendix. No members of the public attended the March 7 meeting, however HCOEM received one inquiry concerning flooding issues north of the Hamilton Place Mall after the homeowner read the draft plan online.

As a result of the inquiry a new area was added to the problem flash flood inventory located on page 106.

10. Submit plan to the State of Tennessee

HCOEM submitted the draft update to the State Mitigation Office for review.

11. Revise the plan based on State recommendations in preparation for review by FEMA.

The Hamilton County Office of Emergency Management will revise the plan based on State recommendations and participants will review and approve the revised plan for final submittal. The planning group met on April 3, 2019 to review the updated draft plan. The sign in sheet for the meeting is included in the appendix.

12. Final plan approval and the opportunity for public comment

After FEMA approves the plan “pending adoption” each jurisdiction or participant in the plan will be required to formally adopt the plan to obtain FEMA approval. The adoption process will serve as another opportunity for public participation and comment. The plan will also remain posted on the HCOEM website for continued review and comment by interested parties.

The following tables list the Mitigation Planning Group participants as well as the Mitigation Planning Support Group members.

Hamilton County Natural Hazards Mitigation Planning Group		
Greg Helms	Lead Emergency Management Planner	Hamilton County
Charlie Hall	District Coordinator	TEMA
Ben Wilson	Director Highway Department	Hamilton County
Gene Quinn	Maintenance Superintendent	Hamilton County
Maria Price	Engineering Manager	City of Chattanooga
Marty Hawkins	Senior Engineer	City of Chattanooga
Randall G Smith	Red Bank City Manager	City of Red Bank
Tim Thornbury	City Manager	City of Red Bank
Greg Tate	Public Works Supervisor	City of Red Bank
Amanda Bowers	Community Involvement Coordinator	City of East Ridge
Kenny Custer	Director of Community Services	City of East Ridge
Mike Williams	Fire Chief	City of East Ridge
Eric Mitchell	Fire Chief	Town of Signal Mountain
Chuck Martin	Code Enforcement/Floodplain Manager	Town of Signal Mountain
Andrew Morkert	Building, Codes, and Safety Director	City of Collegedale
Eric Sines	Public Work Director	City of Collegedale
Steve Grant	Public Work Director	Soddy Daisy
Janice Cagle	City Manager	Soddy Daisy
Mike Guffey	Fire Chief	Soddy Daisy
Burt Johnson	Finance Director	Soddy Daisy
Tim Harper	Safety Director	HCDE
Justin Witt	Director Maintenance and Operations	HCDE
Bill Travis	Building Maintenance	HCDE
Tim Pridemore	Emergency Management Specialist	University of Tennessee Chattanooga
Bob Jackson	Director Safety and Risk Management	University of Tennessee Chattanooga
Chuck Wells	Police/Fire Chief	Town of Lookout Mountain
Jody Clift	WRES Captain	Town of Walden

Mitigation Planning Support Group	
	Role
University of Tennessee Chattanooga Geology Department	Geologic hazards research, sinkhole mapping, landslide susceptibility research
TVA	Flood Maps and data ; dam safety, flood modeling, flood preparedness, building elevation data
Regional Planning Agency	Public Information, Development and Demographic Data and Analysis
Hamilton County GIS	Geographic Data, Analysis, and Maps
Electric Power Board	Vulnerability Analysis/Damage Assessment
Chattanooga-Hamilton County Health Department	Coordinate review of hazard identification and vulnerability assessment with local hospital emergency preparedness coordinators
Chattanooga-Hamilton County Stormwater Management	Identify local non flood zone areas subject to flash flooding
National Weather Service Morristown	Provide historical weather data, significant event cost data, briefings for significant forecasted weather events-Flood preparedness
USGS, USACE	Flood prediction for Hamilton County. Advised on additional stream gauges-Flood preparedness

Neighboring Communities, Commercial, Academic, and Nonprofit outreach

A notification letter was sent to adjoining counties on November 7, 2017 stating that Hamilton County had begun the process of preparing a Natural Hazards Mitigation Plan. The letter invited the participation of interested parties. A copy of the letters is included in the appendix.

The Hamilton County Office of Emergency Management (HCOEM) maintains an extensive network of contacts within the community. In an ongoing effort to raise awareness of the benefits of hazard mitigation and to increase community involvement, HCOEM strives to maintain community awareness of mitigation actions within Hamilton County. Emergency Management maintains a website at www.hamiltonready.org where the mitigation plan is posted as a public resource. HCOEM also advocates a whole community approach to emergency management. Outreach to partners in healthcare, education, business, religion, government, and nonprofits plays a crucial role in strengthening community resilience. HCOEM has worked to educate the Local Emergency Planning Committee (LEPC) about area hazards and possible mitigation actions. In, addition the office assists community partners in developing facility specific vulnerability assessments.

Problem Statements and Goals

The community hazard survey, originally conducted for the 2005 plan and updated in the 2012 plan was revisited and updated in 2018. Problem statements and planning goals were also revisited and updated by the planning group to reflect new information or changes in priorities.

Hamilton County, Tennessee Natural Hazard Risk Assessment												
	Unincorporated County	Chattanooga	East Ridge	Red Bank	Soddy-Daisy	Collegedale	Signal Mountain	Lookout Mountain	Walden	HCDE	UTC	Hazard Score
Flood	3	3	3	2	3	2	2	1	1	2	1	23
Winter storm	2	2	2	2	2	2	2	2	2	2	2	22
Severe Storm	2	2	2	2	2	2	2	2	2	2	2	22
Tornado	3	3	3	3	3	3	3	3	3	3	3	33
Drought	1	1	1	1	1	1	1	1	1	1	1	11
Wildfire	3	2	2	2	2	2	3	3	3	1	1	24
Geologic Hazard												
Sinkhole	1	1	1	1	1	1	1	1	1	1	1	11
Erosion	3	2	2	2	3	1	2	1	2	1	1	20
Landslide	2	2	2	2	1	1	2	1	2	1	0	16
Earthquake	3	3	3	3	3	3	3	3	3	3	3	33
Total	23	21	21	20	21	18	21	18	20	17	15	215

Risk Scale: Severe=3, Moderate=2, Low=1, None=0

The following table illustrates the number and estimated cost of severe weather events that occurred in Hamilton County between 2000 and 2018. Thunderstorm wind is by far the most frequent hazard, while tornados followed by flooding are the most costly.

Severe weather events in Hamilton County 2000 to 2018																					
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Grand Total Count	Total Estimated Cost
Cold/Wind Chill																1				1	\$0
Excessive Heat								1												1	\$0
Flash Flood	3	1	1	3		1				3	1	2	1		1		1			18	\$23,431,000
Flood				2						2	1		2	3		5			1	16	\$912,000
Hail	7	7	2	6	4	5	18	2	6	3	2	9	6		1		3			81	\$0
Heavy Snow				2							4	2			2	16				26	\$0
High Wind																		1		1	\$0
Ice Storm						1										1				2	\$0
Lightning					2		1				1									4	\$615,000
Strong Wind				1			1			1		1								4	\$33,000
Thunderstorm Wind	11	16	10	23	11	13	23	13	19	16	20	21	12	12	8	10	12	13	10	273	\$2,519,500
Tornado										1	2	14	1							18	\$55,900,000
Tropical Storm					2															2	\$30,000
Winter Storm	3	2	1	1	1											1				9	\$0
Grand Total	24	26	14	38	20	20	43	16	25	27	31	51	22	15	11	35	13	17	11	459	\$106,690,500

Source: National Climatic Data Center at <https://www.ncdc.noaa.gov/stormevents/>

Flooding:

Flooding causes a significant amount of reoccurring damage in Hamilton County. Flooding primarily affects properties located in the Tennessee Valley, although mountaintop communities are susceptible to flash flood events. Tributaries of the Tennessee River are prone to backwater flooding.

- Flooding continues to damage properties both inside and outside of the 100-year floodplain.
- Residents often drive through standing floodwater.
- Flooding repeatedly damages some structures in the 100-year floodplain.
- Inadequate infrastructure is unable to handle stormwater in some areas of Hamilton County.
- There is a lack of comprehensive area rain gauging and stream flow monitoring capabilities.
- Flood and flash flood events exacerbate stream bank erosion.
- There is no requirement for stream buffers in local ordinances. The Regional Planning Agency does include riparian buffers in its land use plans where appropriate. However, land use plans are advisory documents only.

GOAL: Protect lives and property by reducing the exposure of persons and property to flood events in Hamilton County.

Winter Storms: Hamilton County is vulnerable to ice storms, snowstorms, and extreme weather change in the winter.

The most common effects of winter storms are power and communication outages, and traffic accidents.

Mountainous areas experience yearly difficulty with winter weather.

Winter storms cause some areas to become inaccessible for extended periods of time.

GOAL: Mitigate impact of winter weather on people and property.

Severe Storms: Severe storms with high winds, lightening, hail, and heavy rain are possible throughout the year in Hamilton County.

- High winds cause falling limbs and trees that damage power lines and public utilities.
- Heavy rain overwhelms stormwater drainage capacity and leads to flooding of problem areas.
- Lightening has destroyed or damaged buildings by igniting fires.

GOAL: Minimize the impact of severe storms on area property and lives.

Tornadoes: Tornadoes are associated with severe thunderstorms and although infrequent, may cause substantial property damage and loss of life.

- From 1974 to 2018, 25 tornados have hit Hamilton County.
- From 2000 to 2018, tornados were the costliest hazard and caused the greatest loss of life.
- There are no identified public tornado shelters within Hamilton County.
- There is a substantial risk of property damage and loss of life for residents of mobile homes.

GOAL: Save lives, reduce property damage, and increase awareness of the danger of tornadoes.

Drought/Wildfire- Wildfire is the main threat associated with drought conditions.

- Agriculture is vulnerable to drought conditions
- Water conservation measures may be necessary during an exceptional drought
- Increased outreach is needed to educate the public on how to minimize fire risk to property located in the wildland/urban interface.
- Fire suppression on steep slopes and bluff lines is especially difficult.

GOAL: Reduce the threat of wildfire

Landslide/Erosion: Stream banks, steep slopes, and slopes cut for roads have the potential for failure.

- Removal of vegetation in hazard areas increases the potential for landslides.
- Heavy rain increases the probability of slope failure.
- Residents may be unaware of the potential hazard of landslides.
- Severe stream bank erosion in several areas, particularly along North Chickamauga Creek and northern Hamilton County, is threatening property and structures.

GOAL: Identify and map high hazard areas and identify techniques to minimize risk.

Subsidence/Sinkholes (Dolines): Karst topography in Hamilton County can lead to the development of sinkholes. Near surface carbonate rocks (limestone and dolomite) are susceptible to dissolution by surface water or ground water.

- Development of sinkholes can occur rapidly and can lead to property damage and loss of life.
- The public may be unaware of the hazard.
- Improved mapping and assessment of risk is needed.

Goal: Protect property and life by identifying high hazard areas and educating the public of the risk.

Earthquakes: Earthquakes are common in the East Tennessee Seismic Zone, but rarely noticeable. A major earthquake could result in significant loss of property and life.

- Because a major earthquake has not occurred in the area in the historical record, the

threat may be under-estimated.

- Older buildings and infrastructure may be severely damaged in the event of a significant earthquake.
- Hamilton County contains several critical facilities that increase the potential danger of a major earthquake.
- Steep slopes and hillsides could become unstable in the event of a major earthquake.

GOAL: Save lives, reduce potential property damage and increase public awareness.

Development of Mitigation Alternatives

The Planning Group reviewed mitigation alternatives in response to problem statements. The following mitigation alternatives form the basis for preferred actions discussed in Chapter 4.

All Hazards

- Promote Continuity of Operations/Business Continuity to business, education, medical, and government interests in the county.
- Continue public education on local hazards and encourage personal, family, and community mitigation and preparedness.
- Adopt and enforce current building codes
- Increase the availability of hazard maps for public use and education
- Continue to improve assessment of community risk and vulnerability
- Continue work to identify critical facilities at risk and identify potential mitigation actions
- Incorporate risk assessment and hazard mitigation principles into comprehensive and capital improvement planning efforts.
- Identify facilities to serve as public shelters
- Install quick connect emergency generator hook-ups for critical facilities
- Establish a hazard awareness week in coordination with local media to promote awareness of all local hazards
- Form a plan implementation steering committee to monitor progress on local mitigation actions
- Continue to promote the purchase of NOAA weather alert radios or use of weather alert smartphone apps by residents

Flooding

Emphasis will be to seek Federal Mitigation Grants and/or other funding sources to:

- Purchase severe repetitive loss structures and then repetitive loss structures
- Educate residents in high-risk areas
- Educate property owners of responsibility for stream maintenance
- Continue to implement new stream gauging systems and refine flood prediction capabilities
- Identify and evaluate flood control and maintenance measures for problem areas and waterways.
- Continue to develop basin modeling
- Apply basin modeling and flood mapping to evaluate the impact of new development projects
- Improve GIS capabilities to include real time modeling and projections of flood areas
- Increase capacity of stormwater drainage system in problem areas
- Adopt best management practices for stormwater quantity and quality management
- Continue public/private collaboration to expand greenway system countywide

Winter Storm

- Evaluate feasibility of underground utilities for problem areas and new developments
- Utilities to prune trees near power lines
- Continue planning for road treatment and debris clearance
- Public information
- Continue preparedness activities including providing shelters for residents that experience power outages and identifying vulnerable populations that may need additional assistance.

Severe Storm

- Early warning system
- Evaluate feasibility of underground utilities for problem areas and new developments
- Place weather alert radios in each school and day care center as well as government agencies

Tornado

- Identify public buildings for use as tornado shelters
- Support severe weather awareness week
- Promote the use of NOAA weather radios and weather warning apps
- Public education
- Include safe room guidance from FEMA P-320 on the emergency management website

Drought/Wildfire

- Map urban/wildland interface and conduct a vulnerability assessment
- Develop wildland-urban interface code for vulnerable areas
- Public education on responsible water use during severe drought
- Update and maintain local drought emergency plans
- Public education on landscaping and building techniques to reduce property vulnerability to wildfire (Firewise Program)

Geologic Hazards

- Subsidence/Sinkholes
 - Develop a countywide map of high risk areas
 - Development restrictions in susceptible areas
 - Public education about the hazard
- Landslide
 - Regulation of vegetation removal and development on steep slopes
 - Identify and map high risk areas
- Erosion
 - Identify resources to assist with streambank erosion on private property
 - Continue public/private collaboration for greenway system land acquisition
 - Adopt best management practices for stormwater quantity and quality management
- Earthquake
 - Adopt and enforce current building codes
 - Evaluate vulnerability of critical infrastructure
 - Public education of the hazard including preparedness and mitigation actions
 - Use HAZUS to estimate potential losses from and earthquake

Previous Plans and Studies

In preparing this plan, information from the following plans, policies, and studies was reviewed and incorporated where appropriate.

Comprehensive Plan 2030 (2005): This plan is an advisory document meant to guide future development in the county. The plan seeks to preserve sensitive areas such as floodways and steep slopes for appropriate uses that decrease vulnerability.

Renewing Our Vision: Comprehensive Plan Update 2030 Phase 1 of Growing Forward (2016) One goal of the plan is to “create healthy communities” that identifies the value of natural systems including “wetlands, large forested and wooded areas, water sources, hillsides, and floodplains.” The plan notes that “most of Hamilton County’s natural systems...are largely unprotected from development practices that would impact these resources”. The plan is also used as a resource to update development patterns and trends.

Mountain Creek Greenway Plan 2003: This plan supports the development of greenways as a means to promote suitable use of areas subject to flood hazards.

Wolftever Creek Area Plan 2007: This plan supports the retention and expansion of riparian buffers along Wolftever Creek and its tributaries, as well as protection of steep slopes.

Hamilton County Basic Emergency Operations Plan (BEOP):

The Hamilton County BEOP includes the following Hazard Mitigation Measures.

Emergency Support Function	Responsible Agency	Mitigation Measures
ESF 3 - Infrastructure	Hamilton County/Municipal Building Inspector	Require structural mitigation measures be built into all new construction of county-owned/operated facilities
ESF 3 - Infrastructure	Hamilton County Schools	Develop structural and non-structural guidance for educational facilities to reduce the chances of student/faculty injury during all types of emergencies
ESF 3 - Infrastructure	Public Water Utility Districts and Private Water Companies	Develop emergency plans, develop back-up power capabilities, and take other preparedness measures to reduce the potential for system failures
ESF 3 - Infrastructure	Hamilton County/Municipal Wastewater Collection Systems and Treatment Facilities	Develop emergency plans, develop back-up power capabilities, and take other preparedness measures to reduce the potential for system failures

ESF 3 - Infrastructure	Chattanooga Hamilton County Health Department	Develop plans for assessing the public health consequences of malfunctioning potable water and sanitary sewer systems
ESF 12 - Energy	Electric Power Board / Volunteer Electric	Institute mitigation practices at utility distribution facilities to reduce the potential effects of hazards on the utility's ability to deliver electricity to local users.
ESF 12 - Energy	Chattanooga Gas Company	Institute mitigation practices at utility distribution facilities to reduce the potential effects of hazards on the utility's ability to deliver natural gas to local users
ESF 12 - Energy	Hamilton County Emergency Management	Develop database listing of generators and develop procedures for acquiring and deploying it with personnel to critical facilities during power failures
ESF 15 - Recovery	Hamilton County Emergency Management	Develop Local Hazard Mitigation Plans
ESF 15 – Recovery, Subfunction 15.2	Concept of Operations	The state task force will also assist the local task force in developing plans for reconstructing areas damaged by the disaster, taking into account prudent mitigation measures as identified by the State Mitigation Officer

State of Tennessee Hazard Mitigation Plan (2018): The state hazard mitigation plan was used to update hazard profiles and also to incorporate information related to Hamilton County's vulnerability to specific hazards.

Flood Insurance Study for Hamilton County, Tennessee (FEMA 2016): This study was used to determine historic flood events and principal flooding problems that exist in the county. The study contains flood profiles and elevation data for area streams that will be used in future modeling of flood events.

Development Trends 2010, Hamilton County: This study conducted by the Information and Research Division of the CHCRPA was incorporated into the discussion of development trends in Hamilton County in the 2012 plan.

Hamilton County Urban Growth Plan (1999): This plan was reviewed to determine county development goals and policies relevant to Natural Hazard Mitigation.

Reconnaissance Study - Section 905(b) (WRDA 86) Preliminary Analysis - Ecosystem Restoration and Flood Damage Reduction Study - North Chickamauga Creek Watershed - Hamilton and Sequatchie Counties, TN (Army Corps of Engineers (1998)): This study was requested by the city of Soddy Daisy and Hamilton County to determine mitigation alternatives for severe stream bank erosion and flooding problems on North Chickamauga Creek. Information from this study was used to document the history and probable causes of streambank erosion in the North Chickamauga Creek Watershed.

Moore, Harry, and Drumm, Eric C., *Karst Geology in Tennessee*: Describes geologic conditions in Tennessee that lead to karst features and describes common problems related to karst.

Weary, D.J., *An Appalachian Regional Karst Map and Progress Towards a New National Map, U.S. Geological Survey*: Discussion of the development of a national karst map with Appalachia serving as the initial data compilation area.

Weary, D.J., and Doctor, D.H., *Karst in the United States of America: a digital map compilation and database: U.S. Geological Survey Open-file Report 2014-1156*.GIS data to map karst geology

Floods on North Chickamauga, Mountain, and Lookout Creeks (TVA 1961); Floods on the Tennessee River, Chattanooga & Dry Creeks, and Stringers Branch (TVA 1959); Floods on the South Chickamauga, West Chickamauga, and Spring Creeks (TVA 1958): TVA studies of flooding on area creeks contributed historic documentation of flood events in Hamilton County. Data contained in the study may be useful to determine the effects of urbanization on area watersheds.

Plan Adoption

All participating jurisdictions (Chattanooga, Collegedale, East Ridge, Lookout Mountain, Hamilton County, Red Bank, Signal Mountain, Soddy-Daisy, Walden, UTC, and HCDE) will be required to adopt the updated plan after FEMA approval “pending adoption”. The public will be given the opportunity to review and comment on the final plan prior to adoption. This opportunity will take place at a local legislative meeting for each jurisdiction before the plan adoption decision takes place. The opportunity for final public comment will therefore be documented through the receipt of a signed adoption resolution.

Chapter 3 - Hazard Analysis

The Impacts of Natural Disasters

Images of the destructive impacts of natural disasters have become commonplace in the newspapers and evening newscasts across the country. These images often portray the direct impacts of a disaster, people are killed, many others are injured, and homes, office buildings, shopping centers, and other physical structures are destroyed. In large-scale disasters, the destruction can severely interrupt work, traffic, and the daily routine of the area for months and in some cases years after the event.

Natural hazards addressed in this plan include flood, winter storms, severe storms hail, lightning, and high wind, as well as tornadoes, earthquakes, landslide/erosion, and drought/wildfire. Natural hazards were determined through review of past events and discussion within the Planning Group. Although hurricanes affect Hamilton County, they are not addressed as a separate hazard in this plan. The Planning Group agreed that hazards that will be addressed in the plan such as severe storms, erosion, and flooding incorporate the effects of hurricane remnants that may reach our area.

Terminology

The terminology of hazard analysis is often confused by inconsistent usage of key terms. Hazard, vulnerability, and risk in many cases are used almost interchangeably; however these terms all have distinct meanings. *Hazard* refers to the occurrence of the actual event that threatens human development. *Vulnerability* refers to the susceptibility of human development to harmful impacts of that hazard. *Risk* refers to the likelihood of suffering harm from the hazard in question.

An assessment can be conducted at three levels of sophistication:

1. *Hazard identification*: Define the severity and likelihood of the natural hazards that may occur in the County.
2. *Vulnerability assessment*: Evaluate the people and property exposed to the hazard and the extent of injury and damage that may result from a hazardous event of a given intensity occurring over a certain geographic area.
3. *Risk analysis*: Incorporate the estimation of probability of a hazard occurring with the vulnerability to damage and injury.

Experts in the field of disaster management often use an array of terms with fine distinctions to describe the impacts of natural hazards. Where appropriate this plan will use terms as defined by the National Research Council in its 1999 publication entitled, "The Impacts of Natural Disasters: A Framework for Loss Estimation."

- The *impact of a disaster* is the broadest term, and includes both market based and non-market effects. For example, market-based impacts include destruction to property and a reduction in income and sales. Non-market effects include environmental consequences and psychological effects suffered by individuals involved in a disaster. In principle, individual impacts can be either negative or positive, though obviously the impacts of disasters are predominantly undesirable.
- The *losses* of a disaster represent market-based negative economic impacts. These

consist of direct losses that result from the physical destruction of buildings, crops, and natural resources and indirect losses that represent the consequences of that destruction, such as temporary unemployment and business interruption.

- The *costs* of a disaster, as the term is conventionally used, typically refer to cash payouts by insurers and governments to reimburse some (and in certain cases all) of the losses suffered by individuals and businesses.
- The *damages* caused by a disaster refer to physical destruction, measured by physical indicators, such as the numbers of deaths and injuries or the number of buildings destroyed. When valued in monetary terms, damages become direct losses.

Methodology

This plan represents the effort of Hamilton County and participating jurisdictions to collaborate in the process of developing a Natural Hazards Mitigation Plan. The plan is not a static document, but one that represents the beginning of a continuing process. The following methodology is designed to serve as a framework to guide the continuing assessment of vulnerability. As capabilities are enhanced and new information is obtained, vulnerabilities can be analyzed in greater detail.

The vulnerability assessment is the basis of the County's hazard mitigation strategy. As used here, *vulnerability assessment* means the evaluation of the impact of natural hazards on the human-built environment. FEMA recommends an analysis based on critical facilities and the potential for future economic losses.

The vulnerability assessment is essential so that the County and communities within the County can develop targeted strategies to reduce their exposure and potential for loss. In general, the following methodology for assessing vulnerability was used:

1. *Assess the hazards.* This assessment includes a profile of the hazard and a discussion of past history, frequency of occurrence, severity, geographic areas that could be affected and time factors such as predictability and speed of onset.
2. *Assess vulnerabilities.* Based on the potential impacts, the vulnerability of exposed structures, infrastructure, and people are described and mapped.
3. *Determine potential for future losses.* The particular method for determining the future loss potential varies from hazard to hazard. In general, however, the potential for future losses is an estimate of possible monetary losses based on a most probable case scenario and the impact analysis and vulnerability assessment for each hazard.

4. *Rank the hazard vulnerabilities.* Based on the information compiled in the vulnerability assessment, the planning group ranked the hazards to allow for quantitative comparison. This ranking was then used to assign priorities to the general mitigation goals and objectives.

Note: The improved value of property was used to calculate the potential for damages to structures that might be impacted. Improved value represents an assessor's estimate in a point in time of the price a seller could receive for the structure in a fair market transaction. From the perspective of a local unit of government, improved value represents the tax base. If a building is destroyed, the tax base decreases. Improved value is not an estimate of the replacement value of the structure.

When assessing vulnerability and designing mitigation programs, it is also useful to distinguish between the physical destruction caused by the disaster and the consequences of that destruction. There are other ways to break this down even further:

- >" *Primary direct losses* are those resulting from the immediate destruction of the event itself, such as water damage from a flood or structural damage from high winds.
- >" *Secondary direct losses* are those additional impacts that occur as a result of the primary damage, such as tornado damage resulting in a hazardous materials release or downed overhead power lines as a result of falling tree limbs after an ice storm.
- >" *Indirect losses* are those losses that result from the consequences of the actual physical destruction. Indirect losses include business losses due to direct physical damage to commercial structures or loss of infrastructure, loss of wages to employees, rippling effects due to the loss of wages as employees reduce their spending on other consumer products and services, the loss of function of critical facilities such as schools or health care facilities, and environmental damages.

Loss estimates from past events and projections for future losses serve as the basis for hazard mitigation efforts. Because mitigation can be costly, it is important for policymakers at all levels of government to be aware of the total *losses* of disasters—and ideally of the extent to which those losses can be reduced by various mitigation strategies—so cost-effective mitigation strategies can be designed and implemented.

Plan Update Statement: The Hazard Analysis section of the plan has been updated to include new demographic information. Each hazard was reviewed by the planning group and was updated to reflect incidents that have occurred since the 2012 plan. Vulnerability analysis was updated to reflect changes in development and property values.

Existing and Emerging Conditions

Population

Population increased in all jurisdictions between 2010 and 2017. Collegedale continues rapid growth with a 40.8 percent rate of growth during this period.

The following table illustrates population growth by jurisdiction from 2000 to 2017.

Hamilton County Population										
Jurisdiction	Census 2000	% of County	Census 2010	% of County	Census 2017	% of County	Growth 2000-2010		Growth 2010-2017	
							Number	% Change	Number	% Change
Chattanooga	155,554	53.4%	167,674	50.5%	179,136	49.5%	12,120	7.8%	11,462	6.8%
Collegedale	6,514	1.8%	8,282	2.1%	11,659	3.2%	1,768	27.1%	3,377	40.8%
East Ridge	20,640	7.4%	20,979	6.7%	21,118	5.8%	339	1.6%	139	0.7%
Lakesite	1,845	0.3%	1,826	0.6%	1,865	0.5%	-19	-1.0%	39	2.1%
Lookout Mountain	2,000	0.7%	1,832	0.6%	1,872	0.5%	-168	-8.4%	40	2.2%
Red Bank	12,418	4.3%	11,651	4.0%	11,754	3.3%	-767	-6.2%	103	0.9%
Ridgeside	389	0.1%	390	0.1%	429	0.1%	1	0.3%	39	10.0%
Signal Mountain	7,429	2.5%	7,554	2.4%	8,560	2.4%	125	1.7%	1,006	13.3%
Soddy Daisy	11,530	2.9%	12,714	3.7%	13,693	3.8%	1,184	10.3%	979	7.7%
Walden	1,960	0.5%	1,898	0.6%	2,118	0.6%	-62	-3.2%	220	11.6%
Unincorporated	87,617	26.2%	101,663	28.5%	109,409	30.3%	14,046	16.0%	7,746	7.6%
County Total	307,896	100.0%	336,463	100.0%	361,613	100.0%	28,567	9.3%	25,150	7.5%

Source: U.S. Census 2000, U.S. Census 2010, U.S. Census 2017 Population Estimate

Analyses of the Census indicated population increased generally in a crescent shape from East Brainerd, Ooltewah, Hunter Road, Wolftever Creek areas, and crossed the Tennessee River to the Middle Valley and Sequoyah areas in the last decade. The analysis also showed continued growth in the downtown Chattanooga and UTC areas.

According to the University of Tennessee at Knoxville Boyd Center for Business and Economic Research the total projected 2030 population for Hamilton County is 396,019. This represents an increase of 59,556 people, or 15% over the 2010 base year population from the U. S. Census. A detailed explanation of the population projection methodology is available at

<http://tndata.utk.edu/sdcpopulationprojections.htm>

Density is important in determining an areas vulnerability to certain hazards. For example, a tornado that occurs in the unincorporated county will affect fewer people and structures than if the same tornado occurs in the more densely populated city of East Ridge. Table 5 presents a summary of the density of area population and housing units. Population density is based on 2017 census estimates. Housing unit density is based on the 2010 decennial census with the exception of the total for Hamilton County, which is based on 2017 census estimates. Housing unit density for all of Hamilton County in 2010 was 278.6 units per square mile compared to 293.2 estimated for 2017.

Hamilton County Area and Density							
			Square Miles			Density/Sq. Mile of Land Area	
Area	Population	Housing Units	Total Area	Water Area	Land Area	Population 2017	Housing Units
Hamilton County	361,613	159,040	575.72	33.28	542.44	666.64	293.2
Unincorporated	109,409	51,702	372.24	24.53	347.71	314.66	148.7
Chattanooga	179,136	79,607	143.17	7.96	135.21	1,324.87	588.8
Collegedale	11,659	3,051	8.33	0	8.33	1,399.64	366.3
East Ridge	21,118	10,384	8.26	0	8.26	2,556.66	1,257.10
Lakesite	1,865	764	1.72	0	1.72	1,084.30	444.2
Lookout Mtn	1,872	800	1.26	0	1.26	1,485.71	634.9
Red Bank	11,754	6,179	6.44	0	6.44	1,825.16	959.5
Ridgeside	429	160	0.17	0	0.17	2,523.53	941.2
Signal Mtn	8,560	3,168	6.68	0	6.68	1,281.44	474.3
Soddy-Daisy	13,693	5,507	23.82	0.79	23.03	594.57	239.1
Walden	2,118	799	3.63	0	3.63	583.47	220.1

Source: <https://www.census.gov/quickfacts/fact/table/hamiltoncountytennessee,US/HSG010217> Housing units, July 1, 2017, (V2017), 2010 Decennial Census, (Note *2017 information)

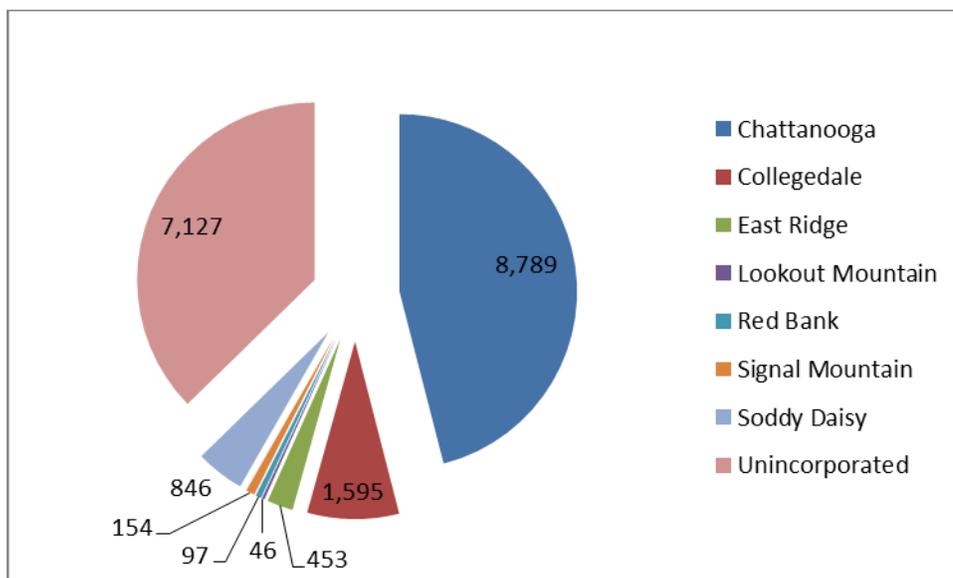
Land Use and Development Trends

Building permit information from 2001 to 2014 shows that residential growth has rebounded following a downturn from 2007 to 2012 as a result of the Great Recession. According to the 2016 Comprehensive Plan, “over 70% of Hamilton County’s land area is zoned for low intensity development patterns (agricultural and low-density residential) that promote suburban single-family subdivision development.” Development can be expected to continue in unincorporated areas in the northern and eastern parts of Hamilton County. Major areas likely to continue growing are:

- Soddy Daisy and areas farther to the north
- Middle Valley and Sequoyah area
- Areas north and northeast of the VAAP property (Enterprise South)
- Areas around Wolftever and Savannah Creeks
- East Brainerd, Collegedale, and Ooltewah areas
- Lookout Valley
- Chattanooga Downtown and Southside

Residential building permits 2001-2014															
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Grand Total
Hamilton Total	1,573	1,515	1,706	1,882	1,972	2,000	1,414	835	710	705	744	984	1,031	2,036	19,107
Chattanooga	893	708	753	819	862	932	640	418	269	273	285	375	435	1,127	8,789
Collegedale	52	39	53	54	61	73	234	49	53	63	319	41	483	21	1,595
East Ridge	2	10	170	42	71	26	31	24	7	14	10	20	14	12	453
Lookout Mountain	26	3		2	4	1	2	2		1		1		4	46
Red Bank		9	11	11	11	11	9	7	5	5			1	17	97
Signal Mountain	8	13	12	15	12	9	7	5	3	10	10	16	18	16	154
Soddy Daisy	82	100	66	81	72	150	138	45	17	20	11	21	23	20	846
Unincorporated	510	633	641	858	879	798	353	285	356	319	109	510	57	819	7,127

Total residential building permits 2001-2014

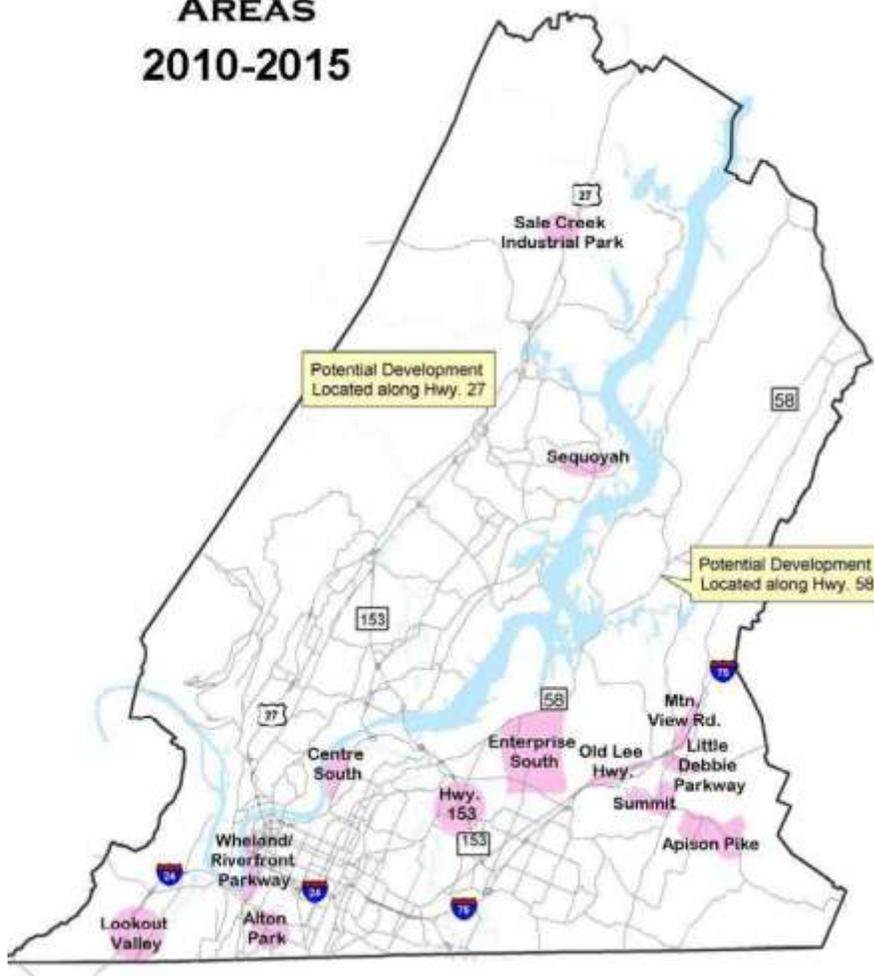


Commercial development, particularly retail and services, tends to occur along the major corridors in residential growth areas. The same areas cited above as residential growth areas are likely candidates for further commercial development/expansion.

The principal areas for continued industrial and business development/expansion are:

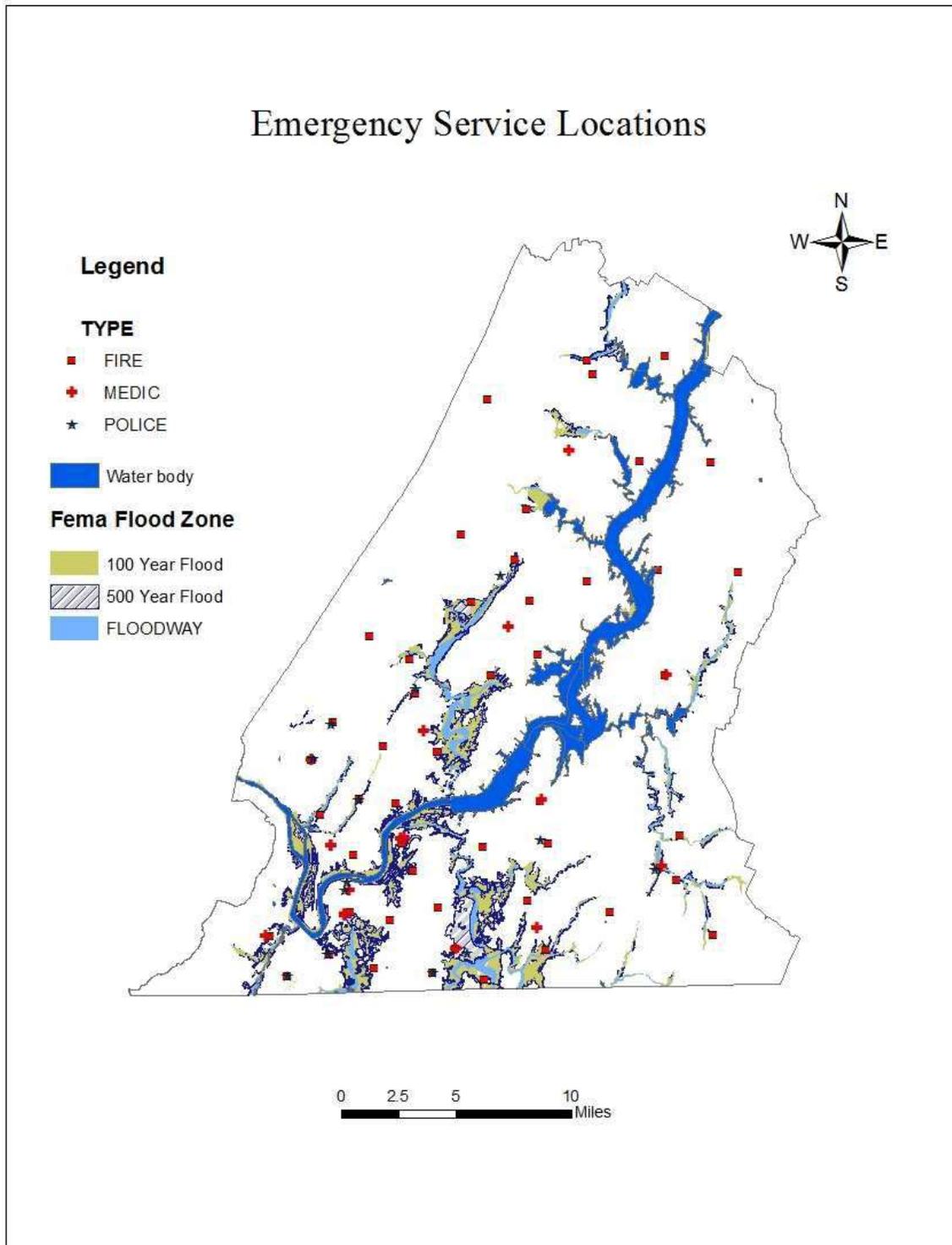
- Lookout Valley
- Alton Park
- Wheland property/Riverfront Parkway
- Centre South
- Highway 153/Shallowford Industrial Park area
- Enterprise South
- Area adjacent to Sequoyah Nuclear Plant Areas along Highways 58 and 27, and
- Sale Creek Industrial Park
- Summit area along Old Lee Highway and Little Debbie Parkway

POTENTIAL INDUSTRIAL GROWTH AREAS 2010-2015

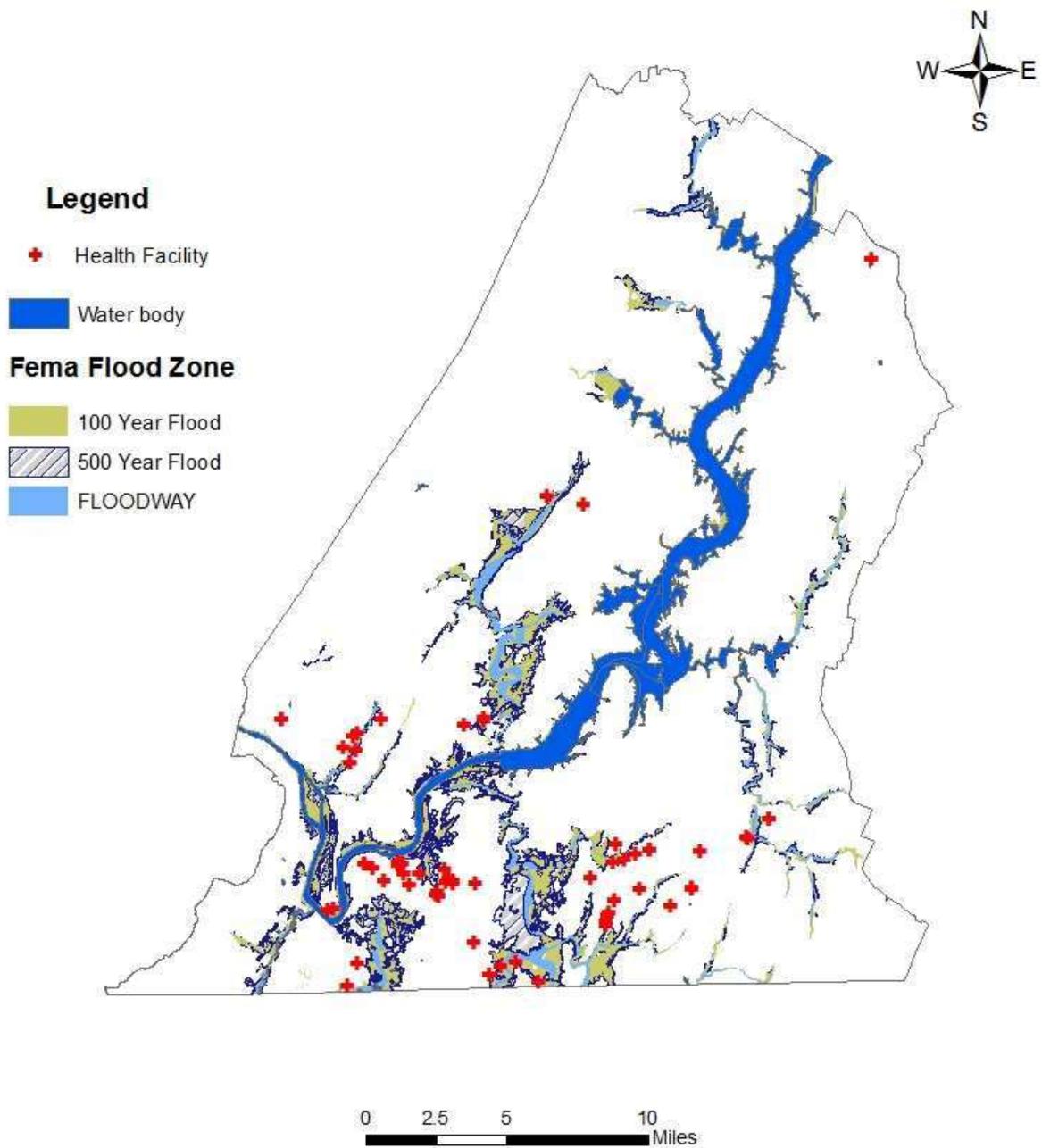


Critical Facilities

The following maps show the location of critical facilities, including fire stations, police stations, emergency medical service (EMS) stations, schools, and city halls. All critical facilities are vulnerable to non-site specific hazards such as severe storms.



Health Care Facilities



Hamilton County Government Facilities

Legend

Government_Facilities

-  CITY HALL
-  COUNTY COURTHOUSE
-  POST OFFICE

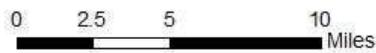
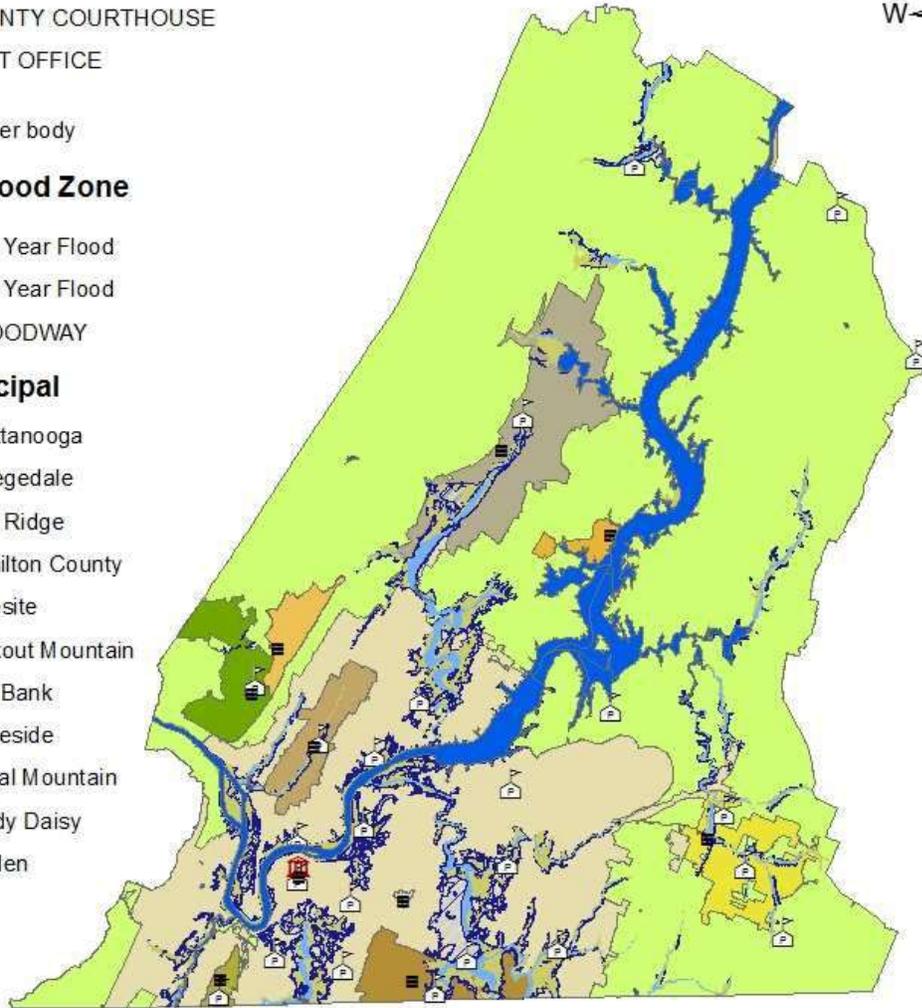
-  Water body

Fema Flood Zone

-  100 Year Flood
-  500 Year Flood
-  FLOODWAY

Municipal

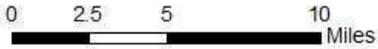
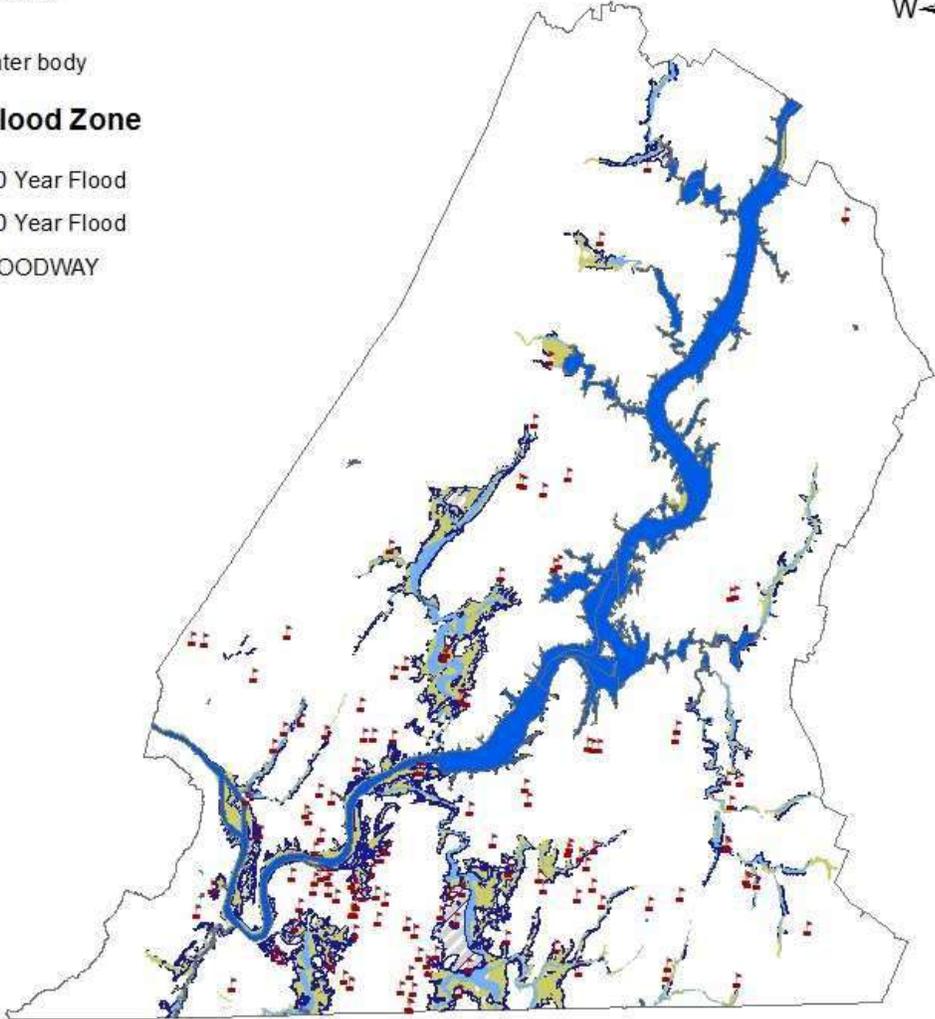
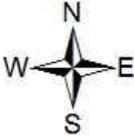
-  Chattanooga
-  Collegedale
-  East Ridge
-  Hamilton County
-  Lakesite
-  Lookout Mountain
-  Red Bank
-  Ridgeside
-  Signal Mountain
-  Soddy Daisy
-  Walden



Hamilton County Schools

Legend

-  Schools
-  Water body
- Fema Flood Zone**
 -  100 Year Flood
 -  500 Year Flood
 -  FLOODWAY



Hazards, Vulnerability, and Risk

The evaluation of natural hazards must consider the differential probability, historic occurrence, and likely impact of each hazard by jurisdiction.

The **Probability of Occurrence** is based on available historic data as well assumptions derived from available hazards literature.

Probability of Occurrence

- ◆ **High:** Greater than 20 percent probability each year, or at least one chance in the next 5 years
- ◆ **Moderate:** Between a 5 and 10 percent probability in the next year, or at least one chance in the next 10 years
- ◆ **Low:** Between a 1 and 5 percent probability in the next year, or at least one chance in the next 20 to 100 years

Historic Occurrence is based on documentation of past events.

Historic Occurrence

- ◆ **High:** At least once every five years
- ◆ **Moderate:** At least once every 10 years
- ◆ **Low:** At least once in the last 20 to 100 years
- ◆ **Unknown:** Historic data was not available for evaluation

The **Likely Extent/Magnitude** of each hazard is inferred from past events or surmised from a worst-case scenario.

Likely Extent/Magnitude (one or more criteria may be met)

- ◆ **Serious:** Severe injuries, loss of life, significant property damage, evacuations and provision of emergency shelter.
- ◆ **Moderate:** Some injuries, property damage; disruption of area for more than 24 hours.
- ◆ **Minimal:** Minor injuries, disruption of the area for less than 24 hours, minor property damage.

Hazard	Jurisdiction	Probability of Occurrence	Historic Occurrence	Likely Extent/Magnitude
Flood	Unincorporated County	High (Valley) Moderate (Plateau)	High (Valley) Moderate (Plateau)	Moderate (Valley) Minimal (Plateau)
	Collegedale	High	High	Moderate
	Chattanooga	High	High	Serious
	East Ridge	High	High	Serious
	Lookout Mountain	Low	Low	Minimal
	Red Bank	High	High	Moderate
	Soddy-Daisy	High	High	Serious
	Signal Mountain	High	High	Minimal
	Walden	Low	Low	Minimal
	UTC	High	High	Minimal
	HCDE	High	High	Moderate
Severe Storms	Unincorporated County	High	High	Moderate
	Collegedale	High	High	Moderate
	Chattanooga	High	High	Moderate
	East Ridge	High	High	Moderate
	Lookout Mountain	High	High	Moderate
	Red Bank	High	High	Moderate
	Soddy-Daisy	High	High	Moderate
	Signal Mountain	High	High	Moderate
	Walden	High	High	Moderate
	UTC	High	High	Moderate
	HCDE	High	High	Moderate
Winter Storms	Unincorporated County	High (Plateau) High (Valley)	High (Plateau) Moderate (Valley)	Moderate (Plateau) Moderate (Valley)
	Collegedale	High	High	Moderate
	Chattanooga	High	High	Moderate
	East Ridge	High	High	Moderate
	Lookout Mountain	High	High	Moderate
	Red Bank	High	High	Moderate
	Soddy-Daisy	High	High	Moderate
	Signal Mountain	High	High	Moderate
	Walden	High	High	Moderate
	UTC	High	High	Moderate
	HCDE	High	High	Moderate

Hazard	Jurisdiction	Probability of Occurrence	Historic Occurrence	Likely Extent/Magnitude
Tornado	Unincorporated County	High	Moderate	Serious
	Collegedale	High	Moderate	Serious
	Chattanooga	High	Moderate	Serious
	East Ridge	High	Moderate	Serious
	Lookout Mountain	High	Moderate	Serious
	Red Bank	High	Moderate	Serious
	Soddy-Daisy	High	Moderate	Serious
	Signal Mountain	High	Moderate	Serious
	Walden	High	Moderate	Serious
	UTC	High	Moderate	Serious
	HCDE	High	Moderate	Serious
Drought	Unincorporated County	High	High	Minimal
	Collegedale	High	High	Minimal
	Chattanooga	High	High	Minimal
	East Ridge	High	High	Minimal
	Lookout Mountain	High	High	Minimal
	Red Bank	High	High	Minimal
	Soddy-Daisy	High	High	Minimal
	Signal Mountain	High	High	Minimal
	Walden	High	High	Minimal
	UTC	High	High	Minimal
	HCDE	High	High	Minimal
Wildfire	Unincorporated County	High	High	Moderate
	Collegedale	Low	Low	Minimal
	Chattanooga	Low	Low	Minimal
	East Ridge	Moderate	Moderate	Moderate
	Lookout Mountain	High	High	Moderate
	Red Bank	Low	Low	Minimal
	Soddy-Daisy	Low	Low	Minimal
	Signal Mountain	High	High	Moderate
	Walden	High	High	Moderate
	UTC	Low	Low	Minimal
	HCDE	Low	Low	Minimal

Hazard	Jurisdiction	Probability of Occurrence	Historic Occurrence	Likely Extent/Magnitude
Earthquake (4.0 <=)	Unincorporated County	Low	Low	Moderate
	Collegedale	Low	Low	Moderate
	Chattanooga	Low	Low	Moderate
	East Ridge	Low	Low	Moderate
	Lookout Mountain	Low	Low	Moderate
	Red Bank	Low	Low	Moderate
	Soddy-Daisy	Low	Low	Moderate
	Signal Mountain	Low	Low	Moderate
	Walden	Low	Low	Moderate
	UTC	Low	Low	Moderate
	HCDE	Low	Low	Moderate
Erosion	Unincorporated County	High	High	Moderate
	Collegedale	Moderate	Moderate	Moderate
	Chattanooga	Moderate	Moderate	Moderate
	East Ridge	Moderate	Moderate	Minimal
	Lookout Mountain	Moderate	Moderate	Minimal
	Red Bank	Moderate	Moderate	Minimal
	Soddy-Daisy	Moderate	High	Moderate
	Signal Mountain	Moderate	Moderate	Moderate
	Walden	High	High	Moderate
	UTC	Low	Low	Minimal
	HCDE	Moderate	Moderate	Minimal
Subsidence/Sinkholes	Unincorporated County	Moderate	Unknown	Moderate
	Collegedale	Moderate	Unknown	Moderate
	Chattanooga	Moderate	Low	Moderate
	East Ridge	Moderate	Unknown	Moderate
	Lookout Mountain	Moderate	Unknown	Moderate
	Red Bank	Moderate	Unknown	Moderate
	Soddy-Daisy	Moderate	Unknown	Moderate
	Signal Mountain	Moderate	Low	Moderate
	Walden	Moderate	Unknown	Moderate
	UTC	Low	Low	Moderate
	HCDE	Moderate	Moderate	Moderate
Landslide	Unincorporated County	Moderate	Moderate	Moderate
	Collegedale	Low	Unknown	Moderate
	Chattanooga	Moderate	Moderate	Moderate
	East Ridge	Moderate	Moderate	Minimal
	Lookout Mountain	Moderate	Low	Minimal
	Red Bank	Moderate	Moderate	Moderate
	Soddy-Daisy	Low	Low	Moderate
	Signal Mountain	Moderate	Moderate	Moderate
	Walden	Moderate	Moderate	Moderate
	UTC	Low	Low	Minimal
	HCDE	Low	Low	Low

Flood



Panoramic view of Chattanooga during the flood of 1917. Source: Hamilton County Public Library, Paul A. Hiener Collection

A flood is a natural event for rivers and streams. Excess water from snowmelt and rainfall accumulates and overflows onto the banks and adjacent floodplains. Floodplains are lowlands, adjacent to rivers and lakes that are subject to recurring floods (Map 5). Flooding is the most common and costly hazard in Hamilton County, and thousands of households are located within floodplains. Floods can occur at any time of the year, and at any time of day or night. Most injuries and deaths occur when people are swept away by flood currents, often when attempting to traverse floodwaters in a vehicle. Most property damage results from inundation by sediment-filled water, or by debris in floodwaters that acts as “battering rams.”

Floods generally fall into two categories: *flash floods*, the product of heavy localized precipitation in a short period over a given location, or caused by a dam break or levee failure; and *general floods*, which can occur in riverine and urban settings.

Flash Flooding: Flash floods occur within a few minutes or hours of heavy amounts of rainfall or from a dam or levee failure. In Hamilton County, most flash flooding is caused by slow-moving thunderstorms or repeated thunderstorms in a local area. Areas subject to rapid floodwater inundation pose special threats to life and property because there is insufficient time for warning, evacuation, emergency flood proofing, or other protective measures. Flash floods can destroy buildings and bridges, uproot trees, and scour out new drainage channels. Heavy rains that produce flash floods can also trigger mudslides. Suddenness is a serious problem in the following areas:

- Steep rivers and streams in mountainous or hilly areas subject to sudden rainfall and rapid runoff;
- Areas with steep slopes and little or no vegetative ground cover;
- Areas behind dams or levees subject to failure or overtopping;
- Urban areas where much of the ground is covered by impervious surfaces, or where fixed drainage channels may be unable to contain the runoff that is generated by intense rainfall events.

Riverine Flooding: Riverine flooding occurs when stream flow exceeds the capacity of the normal watercourse, and is a function of precipitation levels and water runoff volumes within the watershed of the stream or river. The severity of a flooding event is determined by a combination of river basin physiography, local thunderstorm movement, past soil moisture conditions, and the degree of vegetative clearing. Abnormal weather patterns may also contribute to flooding of a local area.

Urban Flooding: Urban flooding occurs where there has been development within stream floodplains. Floodplains are often considered attractive for development since they provide flat areas for building. The price of this accessibility and convenience has been increased flooding of the ensuing urban areas. Urbanization increases the magnitude and frequency of floods by increasing impermeable surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land, and occasionally, overwhelming sanitary sewer systems.

High Risk Factors:

The following conditions may exacerbate the effects of floods: impermeable surfaces, steeply sloped watersheds, constrictions, obstructions, debris, contamination, soil saturation, and velocity.

Impermeable surfaces: Excessive amounts of paved areas or other surfaces upstream or in the community can increase the amount and rate of water runoff. Development affects the runoff of stormwater when buildings and parking lots replace the natural vegetation, which normally would absorb water. When rain falls in an undeveloped area, as much as 90 percent of it will infiltrate the ground; in a highly developed area, as much as 90 percent of rainfall will run off.

Steeply sloped watersheds: In hilly and mountainous areas, a flood may occur minutes after a heavy rain. These flash floods allow little or no warning time, and are characterized by high velocities.

Constrictions: Re-grading or filling within or on the edge of floodplains obstructs flood flows, backing up floodwaters onto upstream and adjacent properties. It also reduces the floodplain's ability to store excess water, sending more water downstream and causing floods to rise to higher levels. This also increases floodwater's velocity downstream of the constriction.

Obstructions: Bridges, culverts and other obstructions can block flood flow and trap debris, causing increased flooding upstream and increased velocity downstream.

Debris: Debris from the watershed, such as trees, rocks, and parts of damaged buildings, increases the hazard posed by moving water. Moving water will float, drag or roll objects, which then act as battering rams that can knock holes in walls and further exacerbate the effects of debris.

Contamination: Few floods have clear floodwater, and the water will pick up whatever was on the ground within the floodplain, such as soil, road oil, farm and lawn chemicals, and animal waste. In addition, if a wastewater treatment plant was inundated, the floodwaters will likely include untreated sewage. Contamination is also caused by the presence of hazardous material storage in the floodplain and in the community, as well as upstream from the community.

Soil saturation: Rainfall in areas already saturated with water will increase the runoff.

Velocity: Flood velocity is the speed of moving water, measured in feet per second. Velocity is determined by slope, waves, and several other factors. The damage potential of flood waters increases dramatically, sometimes exponentially, with velocity. High velocities (greater than 5 feet per second) can erode stream banks, lift buildings off their foundations, and scour away soils around bridge supports and buildings.

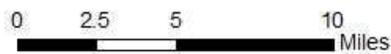
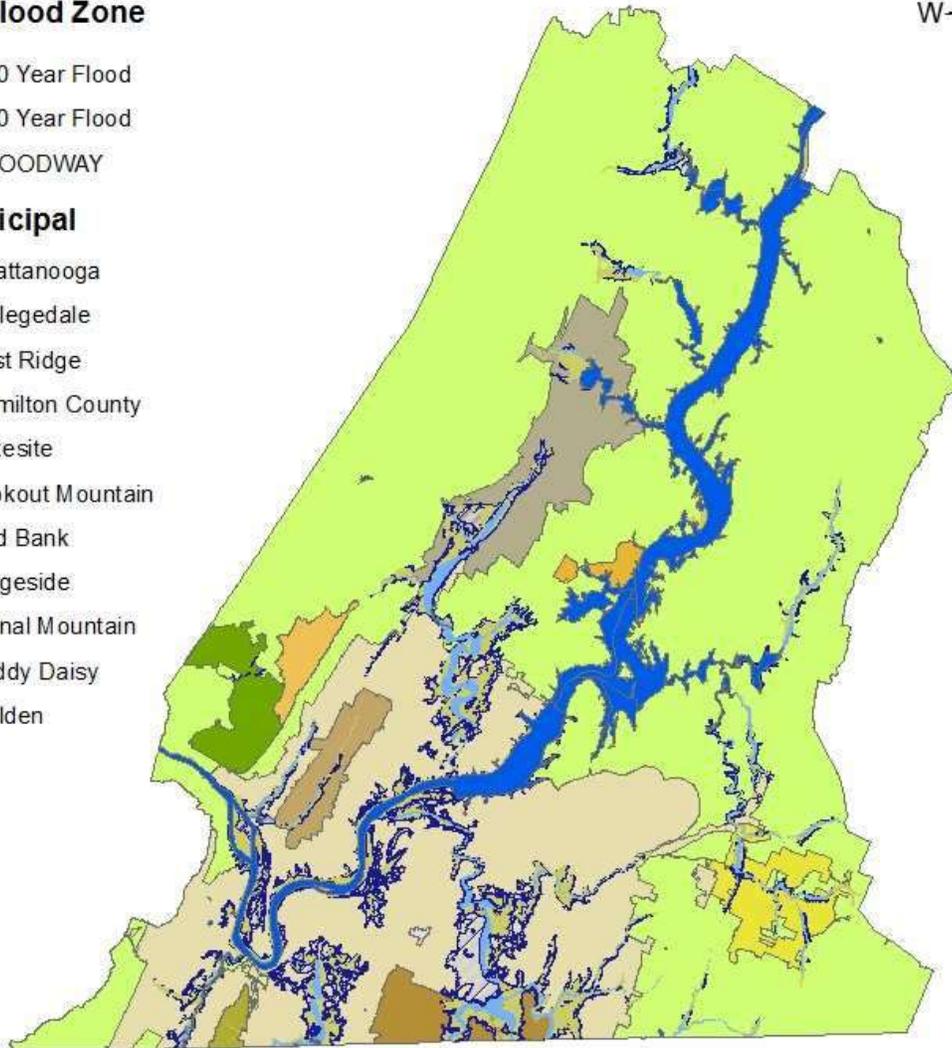
Hamilton County Flood Zones

Legend

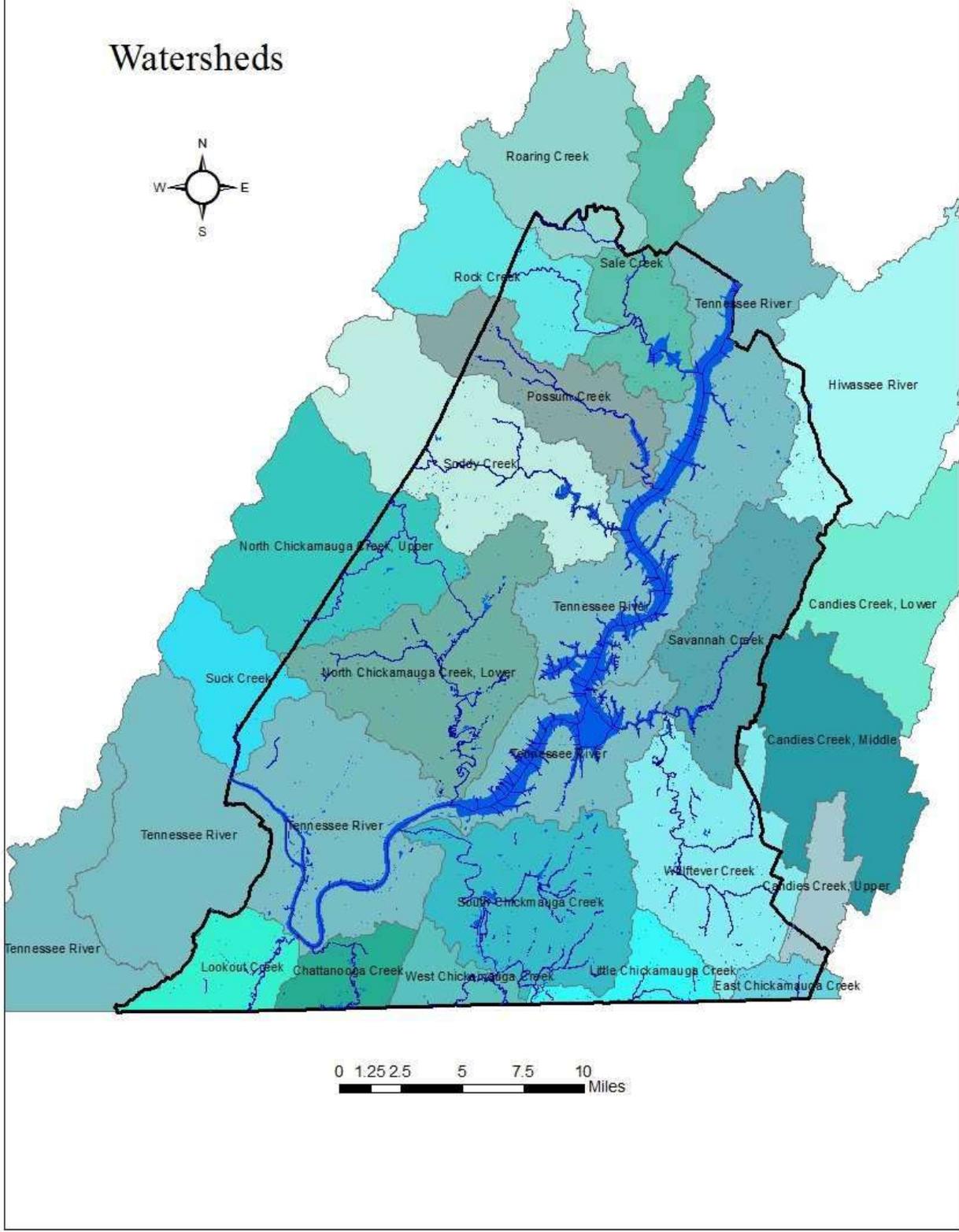
-  Water body
- Fema Flood Zone**
-  100 Year Flood
-  500 Year Flood
-  FLOODWAY

Municipal

-  Chattanooga
-  Collegedale
-  East Ridge
-  Hamilton County
-  Lakesite
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-  Ridgeside
-  Signal Mountain
-  Soddy Daisy
-  Walden



Watersheds



Significant Events

Major flood events in 1973 and 2003 affected floodplain properties along the Tennessee River, all creeks, and unnamed tributaries.

Flash flooding in 1996 and 2001 occurred along Gadd Road from the base of the ridge to North Chickamauga Creek. The Forest Plaza area from Ely and Delashmitt Roads to Hixson Pike was also affected.

March 20 1973

700 homes, 200 business and 12 factories were damaged by Tennessee River floodwaters.



Entrance to Brainerd Village shopping center (5786 Brainerd Road) during 1973 flood. Source: Daniel, Michael L.

October 5 1995

Rains from the remnants of Hurricane Opal caused widespread flooding countywide. A circus was left stranded at a campground and had to be evacuated. A number of residences and businesses were also surrounded by water and occupants had to be evacuated. There was significant flooding of the Lookout Valley/Tiftonia section of Chattanooga.

August 11 1996

Heavy rain fell within a few hours on ground already saturated from previous rains. Seventy-six homes, twenty-six businesses, four public buildings, and three churches were heavily damaged in Red Bank and Hixson. Many people were evacuated to emergency shelters. Numerous streets were flooded stranding cars and motorists.

May 6 2003

Record flooding on the South Chickamauga Creek, near record flooding on the Tennessee River, wide spread flooding, road closures, damage, and evacuations.



May 2003 View of Lee Highway looking northeast near South Chickamauga Creek and Lovell Field.

September 16-18 2004

Remnants of Hurricane Ivan moved through the area bringing heavy rain and high winds. High winds caused downed trees and limbs that led to widespread power outages. The Electric Power Board (EPB) reported approximately \$900,000 in damage to power lines and public utilities in the Tennessee Valley.

There was minor and moderate flooding throughout the county. In Soddy-Daisy, a 50-foot section of Back Valley road was washed out by overflow from Possum Creek. Hamilton County road officials estimated around \$500,000 in damage to area roads and bridges. The South Chickamauga reached a maximum stage of 25.1 feet, 7.1 feet above flood stage, causing evacuations and road closures in some of the low-lying areas around Spring Creek in East Ridge. There was extensive flooding of the north end of the airport. Several area creeks sustained major bank erosion that threatened homes and roadways.



September 17, 2004, Rossville Boulevard: Photograph by Blaine Headrick

September 17-24 2009

Widespread minor street flooding began, and eventually escalated into areal and river flooding. The South Chickamauga Creek exceeded its banks and flooded surrounding areas of Chattanooga and East Ridge. The West Chickamauga Creek also contributed to flooding along the South Chickamauga, and areas of East Ridge. The South Chickamauga stage reached 28.54', which is the second highest recorded stage on that river. Numerous businesses and roads were affected by the high waters, with several drivers having to be rescued after driving into flooded streets. Creeks flowing off the Cumberland Plateau in northern Hamilton County also caused flooding in the Soddy Daisy areas, closing roads. One fatality occurred on 9/20/2009, when a 46 year old man, on a wager, tried to swim across a drainage ditch full of rushing water, and was swept into the aqueduct system.



Widespread flooding in East Ridge- Photo by Amy Maxwell, Hamilton County Emergency Services 9-2009

September 26, 2018

The NWS estimated that up to 12 inches of rain fell in northern Hamilton County. Heavy rain and saturated soil led to widespread flash flooding in Soddy Daisy. The Little Soddy Creek broke out of its bank leading to one fatality. Flash flooding damaged 85 properties in the area with losses estimated at 1.3 million dollars.



Flooding in Soddy Daisy 9/26/2018

Mitigation efforts

Hamilton County and all local jurisdictions with the exceptions of the town of Walden, and Ridgeside are participants in the National Flood Insurance Program (NFIP).

The following section documents specific actions undertaken by local governments.

All Jurisdictions:

1. Maintenance of stormwater drainage system by keeping clear of debris
2. Stormwater management best practices to reduce quantity of water runoff
3. Documentation of areas subject to flash flooding during heavy rainfall events

East Ridge:

1. The City requested the Corps of Engineers undertake Planning, Engineering, and Design of flood control measures along Spring Creek. The locally preferred plan was “residential nonstructural” corrective measures which would include raising structures in place or removing them completely from hazard areas. There was a 25 percent local cost-sharing requirement.(past action)
2. The City also was involved with an acquisition project to purchase land and 13 repetitive loss structures from the current owners and clear the land to be held as open space at a cost of approximately \$800,000.(past action)
3. The City has applied for and received several Community Development Block Grants to purchase blighted homes in flood prone areas of East Ridge. Since 2012, the City has received 1 CDBGs totaling \$300,000 in grant funds, which purchased 6 homes. Currently, the City has an application submitted for blight removal of homes in the floodway in the most recent round of CDBG funds, requesting \$315,000 to purchase 7 homes.(new item)

Chattanooga:

1. Flood Control Gate – Spring Creek and N. Terrace Road
2. North Terrace Pump Station and detention pond– 314 S. Howell Avenue at N. Terrace Road
3. Earl Lane Pump Station and underground storage – 808 Lower Mill Road in the unopened ROW of Marsh Road
4. Valleybrook Pump Station and levee – 113 Valleybrook Circle
5. Brainerd Levee – Along S. Chickamauga Creek from N. Moore Road to I-75.
6. McCutcheon Road Detention Pond – 2444 Hickory Valley Road
7. Lookout Valley Detention Pond – 301 Labeling Way
8. Implementation of Routine Maintenance Practices to keep the drainage system open and flowing.
9. Require new and re-development projects to install detention measures to prevent increases in stormwater runoff from the site.
10. Buy out of repetitive loss properties along Aster Avenue. (completed action)
11. Basin modeling and creation of new flood mapping techniques (ongoing)
12. Adopted stormwater and floodplain ordinances (completed, updates ongoing)
13. Installed rain gauges and flow meters at key locations in the drainage system.
14. Capital planning program

15. Dual power sources for the Moccasin Bend Waste Water Treatment Plant
16. Moccasin Bend Waste Water Treatment Plant and system wide pump station infrastructure built above 100-year flood elevation.
17. All Plant, pump station controls, and CSO facilities controls now located above 100-year flood elevation.
18. Flood Preparedness Program-Ongoing project between the City of Chattanooga, USACE, TVA, USGS, and NWS to provide updated modeling, mapping, and predictive capabilities regarding streams within the city. (near completion)

Development Trends

Population projections and subdivision trends indicate that growth will occur primarily in unincorporated portions of the county, downtown Chattanooga, the area around the University of Tennessee at Chattanooga, Collegedale, and in Soddy-Daisy. New development has the potential to alter drainage characteristics of watersheds (Map 12) possibly increasing the frequency and magnitude of flood events. Floodplain ordinances regulate but do not prohibit development within the 100-year floodplains.

Vulnerability

The county and all of its jurisdictions are affected by flooding. However, the most frequently and severely affected jurisdictions include East Ridge, Chattanooga, and Unincorporated Hamilton County.

Repetitive Loss Properties

Hamilton County has 185 repetitive loss (RL) and 33 severe repetitive loss (SRL) structures, according to FEMA Region IV records provided by TEMA in 2018. Repetitive loss is a term associated with the National Flood Insurance Program (NFIP). Chattanooga and East Ridge have the largest number of repetitive loss structures and associated payments. For Flood Mitigation Assistance (FMA) program purposes, a repetitive loss structure is one that is covered by a flood insurance contract under the NFIP, that has suffered flood damage on two or more occasions over a 10-year period, ending on the date when a second claim is made, in which the cost to repair the flood damage, on average, equals or exceeds 25% of the market-value of the structure at the time of each flood loss event. A repetitive loss structure is important to the NFIP, since structures that flood frequently put a strain on the flood insurance fund. It should also be important to a community because of the disruption and threat to residents’ lives by the continual flooding. The following table contains the number of repetitive loss properties by jurisdiction.

Repetitive Loss Properties		
Jurisdiction	Number	Sum of Total Paid
CHATTANOOGA, CITY OF	87	\$5,739,568
EAST RIDGE, CITY OF	75	\$2,531,700
HAMILTON COUNTY *	15	\$1,602,966
RED BANK, CITY OF	4	\$277,620
SODDY-DAISY, CITY OF	4	\$108,466
Grand Total	185	\$10,260,321

Source: TEMA November 2018

Severe Repetitive Loss Properties		
Row Labels	Number	Sum of Total Paid
CHATTANOOGA, CITY OF	11	\$1,774,637
EAST RIDGE, CITY OF	15	\$2,072,772
HAMILTON COUNTY *	6	\$819,914
RED BANK, CITY OF	1	\$219,399
Grand Total	33	\$4,886,722

Source: TEMA November 2018

In order for a property to meet the SRL designation, it must be insured under the NFIP and have incurred flood losses that resulted in either:

- four or more flood insurance claims payments that each exceeded \$5,000, with at least two of those payments occurring in a 10-year period, and with the total claims paid exceeding \$20,000; or
- two or more flood insurance claims payments that together exceeded the value of the property.

The following table, prepared with GIS analysis, illustrates the appraised value of buildings by jurisdiction within the 100-year and 500-year floodplains of Hamilton County by property type. This provides a general estimate of total exposure to flood hazards. Without building elevation data, it is difficult to estimate exact losses. Past events provide the best estimate of damage and losses that may occur as the result of future flood events. A major event such as the May 2003 floods could be expected to cause upwards of twenty million dollars in direct losses.

Appraised building value by jurisdiction and flood hazard area					
		100 Year	500 Year	Floodway	Grand Total
Chattanooga		\$ 567,391,400	\$ 1,243,311,700	\$ 19,675,900	\$ 1,830,379,000
	City	\$ 116,700	\$ 3,365,700		\$ 3,482,400
	Commercial	\$ 215,529,600	\$ 421,842,300	\$ 660,700	\$ 638,032,600
	County		\$ 4,425,700	\$ 2,193,800	\$ 6,619,500
	Fraternal		\$ 840,100		\$ 840,100
	Industrial	\$ 115,222,000	\$ 227,676,100		\$ 342,898,100
	Mobile Home	\$ 114,800	\$ 12,600		\$ 127,400
	Multi Family	\$ 100,724,500	\$ 182,633,700	\$ 5,056,100	\$ 288,414,300
	Public Housing		\$ 130,000		\$ 130,000
	Religious	\$ 6,409,900	\$ 16,822,300	\$ 4,063,200	\$ 27,295,400
	Single Family	\$ 120,355,100	\$ 385,563,200	\$ 7,702,100	\$ 513,620,400
	State	\$ 8,918,800			\$ 8,918,800
Collegedale		\$ 14,089,900	\$ 48,544,900	\$ 24,330,800	\$ 86,965,600
	Commercial	\$ 11,814,800	\$ 15,302,200	\$ 1,165,300	\$ 28,282,300
	Industrial	\$ 1,602,200	\$ 22,140,300	\$ 22,999,100	\$ 46,741,600

	Multi Family	\$ 216,600	\$ 8,556,100	\$ 88,600	\$ 8,861,300
	Religious	\$ 137,800	\$ 208,700		\$ 346,500
	Single Family	\$ 318,500	\$ 2,337,600	\$ 77,800	\$ 2,733,900
East Ridge		\$ 142,296,900	\$ 50,945,700	\$ 3,805,700	\$ 197,048,300
	Commercial	\$ 73,068,200	\$ 15,769,500	\$ 2,622,300	\$ 91,460,000
	Industrial	\$ 489,900	\$ 1,113,300		\$ 1,603,200
	Multi Family	\$ 23,608,300	\$ 8,257,400	\$ 61,900	\$ 31,927,600
	Religious	\$ 918,200	\$ 665,000		\$ 1,583,200
	Single Family	\$ 44,212,300	\$ 25,140,500	\$ 1,121,500	\$ 70,474,300
Hamilton County		\$ 101,090,000	\$ 49,486,000	\$ 2,176,800	\$ 152,752,800
	Commercial	\$ 11,557,300	\$ 897,600	\$ 322,800	\$ 12,777,700
	Multi Family	\$ 5,205,200	\$ 11,250,000		\$ 16,455,200
	Religious	\$ 86,500			\$ 86,500
	Single Family	\$ 84,241,000	\$ 37,338,400	\$ 1,854,000	\$ 123,433,400
Lakesite		\$ 4,697,500			\$ 4,697,500
	Commercial	\$ 1,126,100			\$ 1,126,100
	Single Family	\$ 3,571,400			\$ 3,571,400
Lookout Mountain		\$ 4,062,900			\$ 4,062,900
	Single Family	\$ 4,062,900			\$ 4,062,900
Red Bank		\$ 37,817,700	\$ 5,277,200	\$ 4,424,600	\$ 47,519,500
	Commercial	\$ 12,550,700	\$ 1,417,500	\$ 1,652,200	\$ 15,620,400
	Fraternal	\$ 208,200			\$ 208,200
	Industrial	\$ 1,163,000		\$ 170,500	\$ 1,333,500
	Multi Family	\$ 12,254,500	\$ 1,073,600	\$ 62,200	\$ 13,390,300
	Religious	\$ 681,500			\$ 681,500
	Single Family	\$ 10,959,800	\$ 2,786,100	\$ 2,539,700	\$ 16,285,600
Signal Mountain		\$ 540,700	\$ 783,700		\$ 1,324,400
	Single Family	\$ 540,700	\$ 783,700		\$ 1,324,400
Soddy Daisy		\$ 62,886,600	\$ 69,601,500	\$ 2,911,900	\$ 135,400,000
	Commercial	\$ 13,218,100	\$ 16,101,100	\$ 1,225,400	\$ 30,544,600
	Industrial	\$ 5,427,600	\$ 5,672,100	\$ 183,600	\$ 11,283,300
	Mobile Home		\$ 442,000	\$ 89,500	\$ 531,500
	Multi Family	\$ 1,975,900	\$ 10,910,200		\$ 12,886,100
	Religious	\$ 390,500	\$ 617,900	\$ 143,500	\$ 1,151,900
	Single Family	\$ 41,874,500	\$ 35,858,200	\$ 1,269,900	\$ 79,002,600
Grand Total		\$ 934,873,600	\$ 1,467,950,700	\$ 57,346,600	\$ 2,460,170,900

Plan update note: this table has been updated using current appraisal information. Also building footprints were used to eliminate parcel information with no structure within a flood hazard area.

Severe Storms/Thunderstorms

Thunderstorms are the result of convection in the atmosphere. They are typically the by-product of atmospheric instability, which promotes the vigorous rising of air parcels that form cumulus and, eventually, the cumulonimbus (thunderstorm) cloud.

These storms can become severe, producing strong winds, frequent lightning, hail, downbursts, and even tornadoes. A typical thunderstorm may be three miles wide at its base, rise to between 40,000 to 60,000 feet in the troposphere, and contain half a million tons of condensed water. Conglomerations of thunderstorms along cold fronts (with squall lines) can extend for hundreds of miles.

According to the National Weather service, a severe thunderstorm is one that produces tornadoes, hail 0.75 inches or more in diameter, or winds of 50 knots (58 mph) or more. Structural wind damage may imply the occurrence of a severe thunderstorm. Hail, formed by the accretion of super cooled liquid water on ice particles in a thunderstorm updraft, can pose a serious threat to agriculture and exposed objects. Likewise, strong winds can potentially wreak havoc on fragile or flimsy structures, or yield secondary damage through the downing of trees. Lightning associated with thunderstorms poses a threat to people and animals in unsheltered areas. The tornado, however, is by far the greatest natural hazard threat associated with severe thunderstorms.

Mitigation efforts

- There is countywide tree trimming in utility right of ways.
- Countywide enforcement of building codes
- Hamilton County participates in NWS severe weather awareness programs.
- EPB smart grid can redirect power service to minimize power outages
- The National Weather Service issues watches and warnings to the public and government agencies.

Development Trends

Severe storms are a non-site specific hazard; therefore, current development trends have no effect. However, population growth and new development increase the number of persons and property that could be impacted by storm events.

Vulnerability

Thunderstorms are a random occurrence. The county and all of its jurisdictions are affected by severe storms. Historic events documented by the National Climatic Data Center (NCDC) were examined to determine past damages. From 2000 to 2018, the NCDC has documented 277 significant thunderstorm related wind and lightening events causing an average of \$165,000 in annual property damage.

Winter Storms

Hamilton County is vulnerable to ice storms, snowstorms, and extremely cold weather. The most common effects of winter storms are power failure and traffic accidents. In 1993, Tennessee experienced a winter storm killing 18 people and causing \$22 million in damage. The Hamilton County area experienced serious damage to the power grid causing many residents to be without power for up to three weeks. Ice storms in 1994 and 1995 caused power outages in mountainous areas and left many residents isolated for up to ten days. Lookout Mountain, Signal Mountain, and Walden experience some difficulty with winter storms every year. Icing of roadways limits access to residences and services. Power and communication outages and debris caused by fallen trees and limbs are common occurrences.

Between 2000 and 2018, data records show Hamilton County to have had 2 minor ice storm events and 9 winter storm events. The severity of winter storms is commonly measured by inches of snowfall. Based on previous occurrences, it is possible for snowfall to accumulate over 6 inches in Hamilton County.



March 3, 1960 Ice storm on Walden's Ridge, Signal Mountain, Tennessee. Paul A. Hiener Collection

Mitigation efforts

All local jurisdictions stockpile sand and salt for use in winter storm events. There is also countywide tree trimming in utility right of ways to reduce the potential for damage to utilities.

Development Trends

Winter storms are a non-site-specific hazard; therefore, current development trends have no effect. However, population growth and new development increase the number of persons and property that could be impacted by storm events.

Vulnerability

Winter storms are a random event that can affect any or all parts of the County. However, Lookout Mountain, Signal Mountain, Walden, and unincorporated areas located in mountain areas are at increased risk.

Tornadoes

A tornado is a violently rotating column of air extending to the ground. The following wind map of the United States shows that Hamilton County is in Zone IV, with potential wind speeds of 250 mph or more. Damage paths can be in excess of 1 mile wide and 50 miles long. Tornadoes are among the most unpredictable of weather phenomena. Tornado season runs ordinarily from March through August; however, tornadoes can strike at any time of the year if the essential conditions are present.

Map 11



Cause of Tornadoes:

Thunderstorms and hurricanes spawn tornadoes when cold air overrides a layer of warm air, causing the warm air to rise rapidly. The winds produced from wildfires have also been known to produce tornadoes. The nature of tornadoes is that they strike at random. Predicting exactly what parts of Hamilton County have a greater chance of being struck by a tornado is difficult if not impossible.

Analysis of historical events documented by the National Weather Service in Morristown, TN, indicates a 14 percent yearly probability for a tornado event in Hamilton County.

The following table summarizes the historical record of tornadoes that have occurred in Hamilton County.

Documented Tornadoes in Hamilton County TN						
Date	Time (LST)	Dead	Injured	Path Length (miles)	Rating	Location
4/22/1883	11:00 PM	0	0	1	F2	Chattanooga
5/20/1883	4:00 PM	0	0	?	F2	Soddy-Daisy
4/30/1909	2:00 PM	0	8	?	F2	Red Bank
3/25/1935	9:00 PM	0	4	4	F2	Soddy
4/3/1974	3:50 PM	0	2	5.9	F1	near New Point
8/12/1977	7:30 PM	0	0	0.1	F0	Chattanooga
6/24/1980	4:20 PM	0	0	?	F0	East Brainerd
10/4/1990	8:15 AM	0	0	1.8	F1	Chattanooga
4/15/1994	11:30 AM	1	2	2	F3	Birchwood
4/21/1995	1:20 AM	0	0	0.1	F0	Red Bank
4/21/1995	1:25 AM	0	0	5	F2	Chattanooga to Hixson
4/21/1995	1:30 AM	0	0	1	F1	Chattanooga
3/29/1997	1:10 AM	0	44	8	F3	Chattanooga
4/10/2009	3:23 PM	0	0	0.5	EF1	Sale Creek
10/25/2010	5:00 AM	0	0	0.1	EF0	Harrison
10/26/2010	5:50 PM	0	6	1.2	EF2	Chattanooga (Chickamauga Dam)
2/28/2011	2:25 PM	0	0	2.2	EF1	Signal Mountain
2/28/2011	2:30 PM	0	0	2.6	EF1	near Red Bank
4/27/2011	7:55 AM	1	0	1.5	EF2	Lookout Valley
4/27/2011	8:04 AM	0	0	2	EF1	near Red Bank
4/27/2011	8:04 AM	0	0	2.2	EF1	near East Ridge
4/27/2011	8:08 AM	0	0	0.5	EF1	near Harrison
4/27/2011	9:00 AM	0	0	0.6	EF1	near Birchwood
4/27/2011	2:08 PM	0	0	7	EF1	near Ooltewah to near Georgetown
4/27/2011	5:03 PM	0	0	3.8	EF1	near Ridgeside
4/27/2011	5:14 PM	0	0	3.6	EF1	near Ooltewah
4/27/2011	5:15 PM	0	0	4	EF1	near East Ridge
4/27/2011	7:27 PM	8	100	4	EF4	near Apison
3/2/2012	12:41 AM	0	30	9.3	EF3	near Harrison

Source: NOAA National Climatic Data Center

Significant Events

April 21 1995

A tornado touched down over parts of suburban Chattanooga. The tornado caused most of its damage in a 16-block area. Overall 80 buildings were damaged. Of the 80 buildings damaged, 50 of them were homes and 30 of the buildings were businesses. Several apartments suffered roof damage and 43 persons were evacuated.

February 29 1997

An F3 tornado first touched down in the Tiftonia area just west of downtown Chattanooga. As the tornado moved due east across the southern part of Hamilton county, 50 homes were completely destroyed. Another 600 homes and 1 business were heavily damaged. Forty-four people were injured and property damage was estimated at 45 million dollars. Most of the damage area was concentrated in the East Brainerd area. Approximately 200,000 homes were without power after the storm.

October 26, 2010

A tornado hit near south Chickamauga dam with damage to a cement plant, homes, and multiple vehicles. Numerous trees and power lines were down.

February 28, 2011

Two tornados struck Hamilton County. One cut a path through Signal Mountain, while the second crossed through North Chattanooga and Red Bank. No fatalities were recorded but there was widespread damage with numerous trees and power lines down.

April 27, 2011

Ten tornados devastated Hamilton County on April 27, 2011. An EF 2 tornado struck Lookout Valley at 7:55 am and caused extensive damage. Tornados continued to track through the county throughout the day. The last tornado was an EF 4 that struck the Apison community in the southeastern part of the county causing 8 fatalities. Emergency Management estimated almost 30 million dollars in residential property damage throughout the county. The cost to local governments and utilities totaled more than 27 million dollars.

March 2, 2012

On March 2, an EF-3 tornado hit near Harrison injuring 30 people and causing an estimated 28 million dollars in property damage.

Mitigation efforts

- Hamilton County Office of Emergency Services has the capability to monitor weather systems, as well as the potential intensity of the storms, via NWS and other electronic means.
- The National Weather Service issues watches and warnings to the public and government agencies.
- Hamilton County participates in Severe Weather Awareness week in collaboration with the NWS and local media to educate the public.

Development Trends

Tornadoes are not a site-specific hazard; therefore, current development trends have no effect. However, population growth and new development increase the number of persons and property that could be impacted by a tornado.

Vulnerability

Recent weather trends point to the likelihood of an increased frequency of tornadic activity in the southeast. Hamilton County and all of its jurisdictions are equally vulnerable to the devastating effects of tornados.

Drought/Wildfire

Both urban and rural areas of Hamilton County are vulnerable to drought or prolonged periods without rainfall. Drought affects agriculture, urban water supply, and causes dry conditions in forested areas, which increases the risk of wildfires. The entire state of Tennessee, including Hamilton County, has the potential for a significant drought every 15 years.

The severity of a drought is commonly measured using the Palmer Drought Severity Index (see following chart). Based on previous occurrences, it is possible for the extent of drought to exceed -4.0 (moderate drought) in Hamilton County as seen between August 2007 and January 2008.

Source: <http://drought.unl.edu/>

Palmer Drought Severity Index	
Rating	Classification
4.0 or higher	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 lower	extreme drought

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the air for miles around. Naturally occurring and non- native species of grasses, brush, and trees fuel wildfires. On average, local fire departments respond to five wildfires a month during the summer months. The fires are normally contained within a four-hour period.

A wildland fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines, and similar facilities.

An Urban-Wildland Interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels.

The severity of wildland fires can be measured by the potential of burnable acres. In a worse cause scenario it is possible for several thousand acres to burn from a wildland fire in Hamilton County.

Causes of Wildfires

People start more than four out of every five wildfires, usually as debris burns, arson, or carelessness. Lightning strikes are the next leading cause of wildfires.

Factors Affecting Wildfire Behavior

Wildfire behavior is based on three primary factors: fuel, topography, and weather.

Fuel: The type and amount of fuel, as well as its burning qualities and level of moisture affect wildfire potential and behavior. The continuity of fuels, expressed in both horizontal and vertical components is also a factor, in that it expresses the pattern of vegetative growth and open areas.

Topography (slope) is important because it affects the movement of air (and thus the fire) over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels. In general terms, the steeper the slope of the land, the faster a fire can spread up the slope.

Weather affects the probability of wildfire and has a significant effect on its behavior. Temperature, humidity, and wind (both short and long term) affect the severity and duration of wildfires.

Significant Events

During the drought of 1987, wildfires destroyed over 10,000 acres in Hamilton County. Drought conditions caused the Chattanooga Tennessee American Water Company to set up a number of public water distribution points.

In October 2010 multiple agencies fought three separate wildfires along the Cumberland Trail in the span of a few weeks. No homes were reportedly damaged from these events and no one had to be evacuated. The first fire impacted approximately 50 acres near Soddy Daisy, the second burned nearly 200 acres in Sale Creek, and the third occurred near Montlake Road. Because of the elevated levels for fire outbreaks during this timeframe, Tennessee State Parks put a temporary ban on backcountry campfires.

October 8th - November 25, 2016: Kimball Complex: Mowbray, Poe Road and Flippers Bend Forest Fire

This incident was a woods/brush/forest fire that at its peak involved over 2000 acres at three different geographical locations. During the duration of this event structural endangerment issues were an issue along with evacuation and relocation of residents, pets and livestock.

During the extreme drought of August 2007 to January 2008, Hamilton County was a part of a Statewide Drought Task Force. In October of 2016, the county entered a severe drought that reached extreme drought conditions in November. The drought continued as severe in December of 2016 through March of 2017.

Historical Drought in Hamilton County 2010 to 2018		
Year	Month	Drought Severity
2012	June	Moderate
2016	July	Moderate
2016	August	Moderate
2016	September	Moderate
2016	October	Severe
2016	November	Exceptional
2016	December	Severe
2017	January	Moderate
2017	February	Severe
2017	March	Severe

Source: <https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/>

Hamilton County Wildfire 2007 to 2016						
Year	# of Fires Forested	# of Fires Non-Forested	Total	# of Acres Forested	# of Acres Non-Forested	Total
2016	17	0	17	2,407.60	2	2,409.60
2015	6	0	6	71	0	71
2014	14	5	19	127.4	32.8	160.2
2013	8	1	9	85.4	0.2	85.6
2012	19	0	19	169.6	0.6	170.2
2011	15	5	20	134.5	21.6	156.1
2010	28	5	33	690.8	13.7	704.5
2009	11	2	13	55.2	14.6	69.8
2008	29	5	34	552.8	81.7	634.5
2007	40	9	49	1,190.10	57.8	1,247.90

Source: Tennessee Emergency Management Agency

Mitigation efforts

As a result of the drought of 1987, local drought preparedness procedures and plans were developed. Water utility provider inter-connect agreements developed by local governments provide a means of supplying potable water to utility districts that exhaust their supply. Signal Mountain has an “Emergency Plan for Water System,” which includes a *water shortage ordinance* with procedures for drought or interruption of water distribution. Wildfire mitigation has focused on public education, burn bans, and work to develop wildland/urban interface codes.

Current Development Trends

Development in rural areas is increasing the urban/wildland interface. Population projections indicate substantial growth will occur in the unincorporated portions of Hamilton County, possibly increasing the urban/wildland interface. Economic development and population growth will also increase the demand for water, increasing the impact of drought conditions.

Vulnerability

The county and all of its jurisdictions may be affected by a drought conditions. Agriculture is especially vulnerable. The most serious consequence of drought conditions is the increased risk of wildfire. Lookout Mountain, Mowbray Mountain, Signal Mountain, and Walden are located in areas where steep slopes and heavily forested areas are vulnerable to the risk of wildfire. Drought conditions, wildfire, and high winds could increase the vulnerability of urban areas of the county.

Geologic Hazards

Landslide

Common throughout the mountainous Appalachian region, landslides are described as downward movement of a slope and materials under the force of gravity. The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Landslides are influenced by human activity (mining and construction of buildings, railroads, and highways), and natural factors (geology, precipitation, and topography).

Causes of Landslides:

Landslides occur when masses of rock, earth, or debris move down a slope. Therefore, gravity acting on an overly steep slope is the primary cause of a landslide. They are activated by storms, fires, and by human modifications to the land. New landslides occur as a result of rainstorms,

earthquakes, and various human activities such as clear-cutting.

Predicting Landslides:

The best predictor of future landslides is past landslides because they tend to occur in the same places. Existing or old landslides may be found in the following areas:

- On or at the base 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
- Developed hillsides where leach field septic systems are used

High Risk Factors:

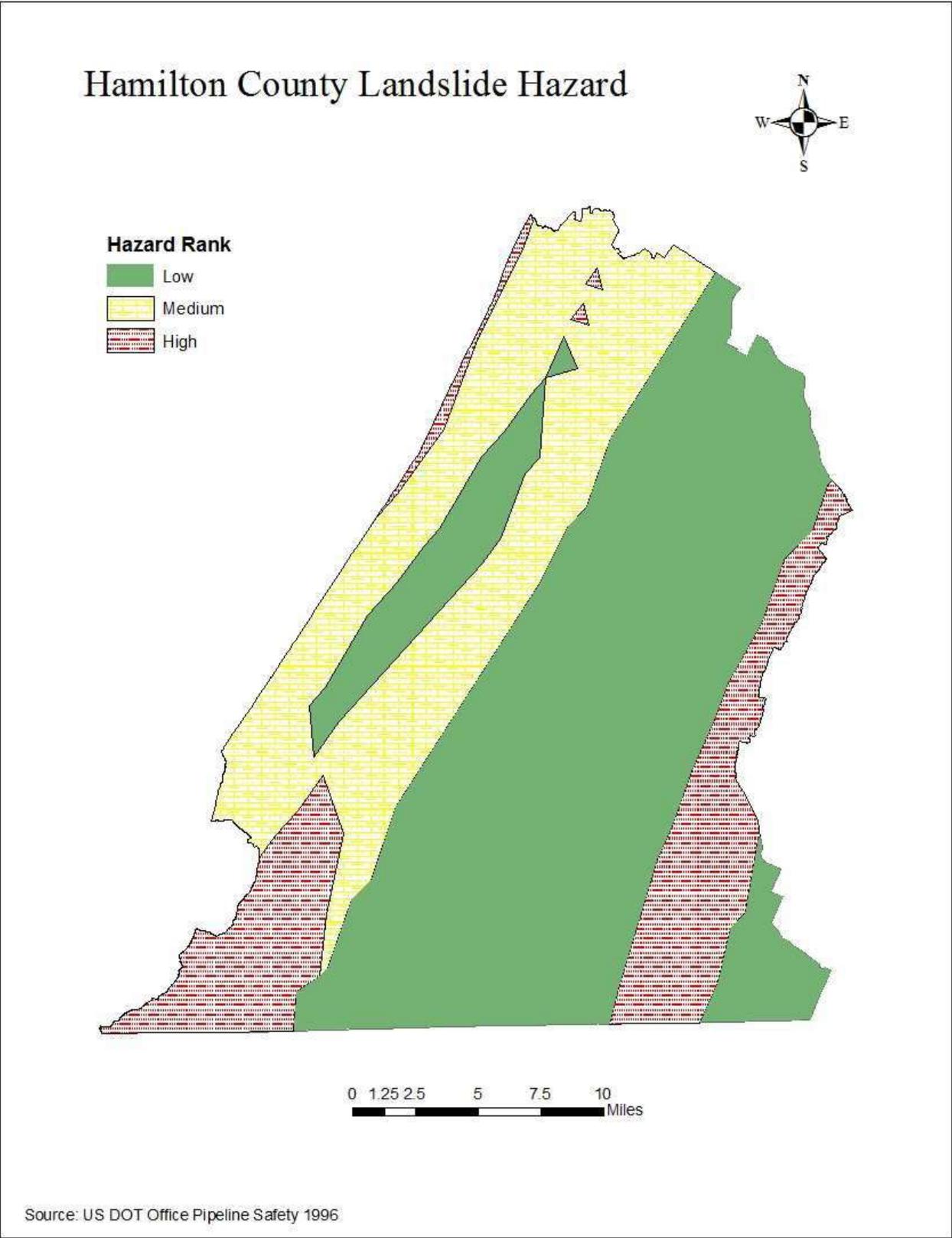
The following conditions may exacerbate the effects of landslides:

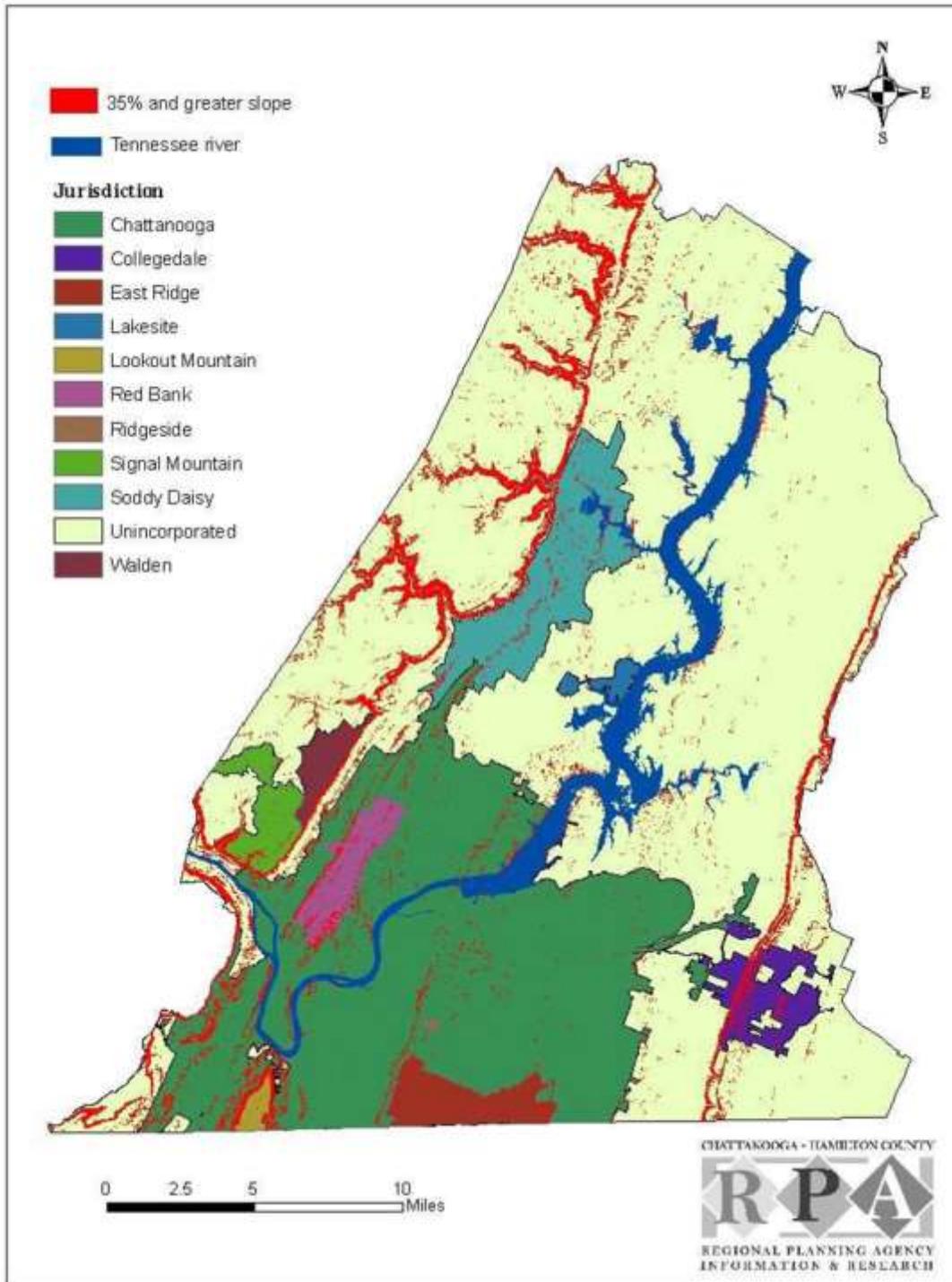
- Erosion: Erosion caused by rivers create overly steep slopes.
- Unstable Slopes: Rock and soil slopes are weakened through saturation by snowmelt or heavy rains.
- Earthquakes: The shaking from earthquakes creates stress that makes weak slopes fail.
- Vibrations: Machinery, traffic, blasting, and even thunder may cause vibrations that trigger failure of weak slopes.
- Increase of Load: Weight of rain/snow, fills, vegetation, stockpiling of rock or ore from waste piles, or from man-made structures may cause weak slopes to fail.
- Hydrologic Factors: Rain, high water tables, little or no ground cover, numerous freeze/thaw cycles may cause weak slopes to fail.
- Human Activity: These include development activities such as cutting and filling along roads and removal of forest vegetation. Such activities are capable of greatly altering slope form and ground water conditions, which can cause weak slopes to fail.
- Removal of Lateral and Underlying Support: Erosion, previous slides, road cuts and quarries can trigger failure of weak slopes.
- Increase of Lateral Pressures: Hydraulic pressures, tree roots, crystallization, swelling of clay soil may cause weak slopes to fail.
- Regional Tilting: Geologic movements can trigger weak slopes to fail.

The following map based on the Landslide Hazard Rank –LSHR dataset illustrates areas in Hamilton County that are susceptible to landslides. The map is based on an Arc/Info grid created from information pertaining to swelling clays, landslide incidence and susceptibility and land subsidence in soils.

Each layer represents a ranking normalized to a scale of 0-100, of the level of exposure to natural hazards where 100 represent the highest ground failure hazard and zero represents the lowest ground failure hazard.

Areas of the Hamilton County with slopes of 35 percent and greater are potentially vulnerable to landslide.





Areas of the Hamilton County with slopes of 35 percent and greater are potentially vulnerable to landslide.

Significant Events

August 17 1982

Signal Mountain Road was closed due to a mudslide.

February 16 2003

Twenty-two roads closed due to high water with mudslides on Signal Mountain

November 12, 2009

A small rockslide toppled onto the W Road on the side of Signal Mountain, closing the road.

December 12, 2009

A rockslide closed one of the two main routes up Lookout Mountain. Two large boulders came down by Scenic Highway near the Winterview condominiums. According to examining officials, two boulders fell to the road's edge but are not across the roadway.

January 28, 2012

A muddy rockslide shut down Signal Mountain's W Road, blocking one of the mountain's main thoroughfares.

February 2019

Long duration heavy rain led to numerous slope failures in the county. A subway restaurant and one home were completely destroyed.

Current Development Trends

Residential development occurring on steep slopes may increase the potential for slope destabilization and landslides.

Vulnerability

Areas of the Hamilton County with slopes of 35 percent and greater are especially vulnerable to landslide. HCOEM is working with the UTC Department of Geology to develop a project to research areas susceptible to landslide.

Erosion

All natural stream channels shift the location of their channels to some degree over time. In a channel migration hazard area, a stream is likely to move laterally which can result in property being damaged or destroyed. A house may be on a high bank above the 100-year flood elevation, yet it can still be endangered when the river erodes the ground and undercuts the bank beneath the house.

Streambank erosion has been identified as a serious problem on North Chickamauga Creek, Falling Water Creek, Rock Creek, and Big Soddy Creek, and Little Soddy Creek. These creeks are located on highly erodible alluvial deposits consisting of a mixture of silt, sand, gravel, and cobble (a rock fragment between 64 and 256 millimeters in diameter, especially one that has been naturally rounded).

North Chickamauga Creek serves as the most striking example of the problem. The area near the Dayton Pike Bridge has been especially problematic. The U.S. Army Corps of Engineers (USACE) has documented, through analysis of aerial photography, the extent, and progress of erosion occurring above and below the bridge since 1953 (see table). The USACE study (1998) documented the following structures and areas at risk: the Dayton Pike bridge

abutment and approach, two TVA transmission towers, the Soddy-Daisy Industrial Park, and several homes in the Willow Creek subdivision. Since this study was conducted, two homes in the Willow Creek subdivision have been abandoned due to undermining and the threat of imminent collapse.

Streambank Erosion on North Chickamauga Creek					
Date of Aerial Photo	Extent of Erosion Upstream of the Dayton Pike Bridge (feet)	Channel Widths at Selected Locations Upstream and Downstream of the Dayton Pike Bridge (feet)			
		2000 feet above	1000 feet above	At bridge	1000 feet below
1953	500	60	190	190	150
1968	2340	120	240	240	200
1976	2550	215	260	260	220
1985	2680	160	260	260	220
1996	*	*	250	250	220

Source: USACE 1998 *no photo available

Probable causes of stream channel instability cited in the 1998 USACE study include catastrophic flooding, construction of the Dayton Pike Bridge, or past mining of cobble from the streambed.

North Chickamauga Creek, Falling Water Creek, Big Soddy Creek, Little Soddy Creek, and Rock Creek have been identified as area streams that are or have experienced significant channel migration due to the rapid rise and flow of water during heavy rains in conjunction with the geologic composition of stream banks and surrounding land.

Significant Events

September 16-18 2003

Erosion associated with flooding from the remnants of Hurricane Ivan damaged area roads. Back Valley Road in Soddy-Daisy was washed out. Several homes in the Willow Creek subdivision lost as up to 50 feet of property as the stream bank eroded and undercut foundations. The appraised value of the homes that are now unlivable is approximately \$256,000. Area road damage from floodwater erosion was estimated in excess of \$500,000.

September 26, 2018

The NWS estimated that up to 12 inches of rain fell in northern Hamilton County. Heavy rain and saturated soil led to widespread flash flooding in Soddy Daisy and the surrounding area. As a result, streambank erosion occurred on the Little Soddy Creek. Flash flooding damaged 85 properties in the area with losses estimated at 1.3 million dollars.

February 2019

Long duration heavy rain caused severe erosion problems throughout the county. Numerous roads were damaged and streambank erosion was severe.



Back Valley Road at Sale Creek 9/17/2004, Photograph by Amy Maxwell



Streambank erosion in Willow Creek Subdivision on North Chickamauga Creek

Mitigation efforts

Soddy Daisy received a grant from FEMA in the amount of \$1,300,000 to stabilize the creek banks and re-channel over 2,000 feet of the creek. Gabion baskets were installed on the North West side of the creek (adjacent to the Willow Creek Subdivision) for 700 feet and on the northeast side of Dayton Pike Bridge adjacent to the Industrial Park for 325 feet. Total cost of project to include in-kind services is estimated to be \$1,600,000.

The City also was the recipient of a USDA, NFC grant in the amount of \$180,000 that was used to purchase and remove a residence that was in immediate danger of falling into the Creek.

Erosion on Roberts Mill Road caused by Falling Water Creek was mitigated with a \$428,000 project awarded in 2002.

Soil stabilization projects have been completed on the W road, Hotwater Road, and Montlake Road.

In 2005, the NRCS Emergency Watershed Protection program was used to complete a bank stabilization project on Rock Creek to mitigate erosion that washed out Rock Creek Road and threatened two homes on Leggett Road.

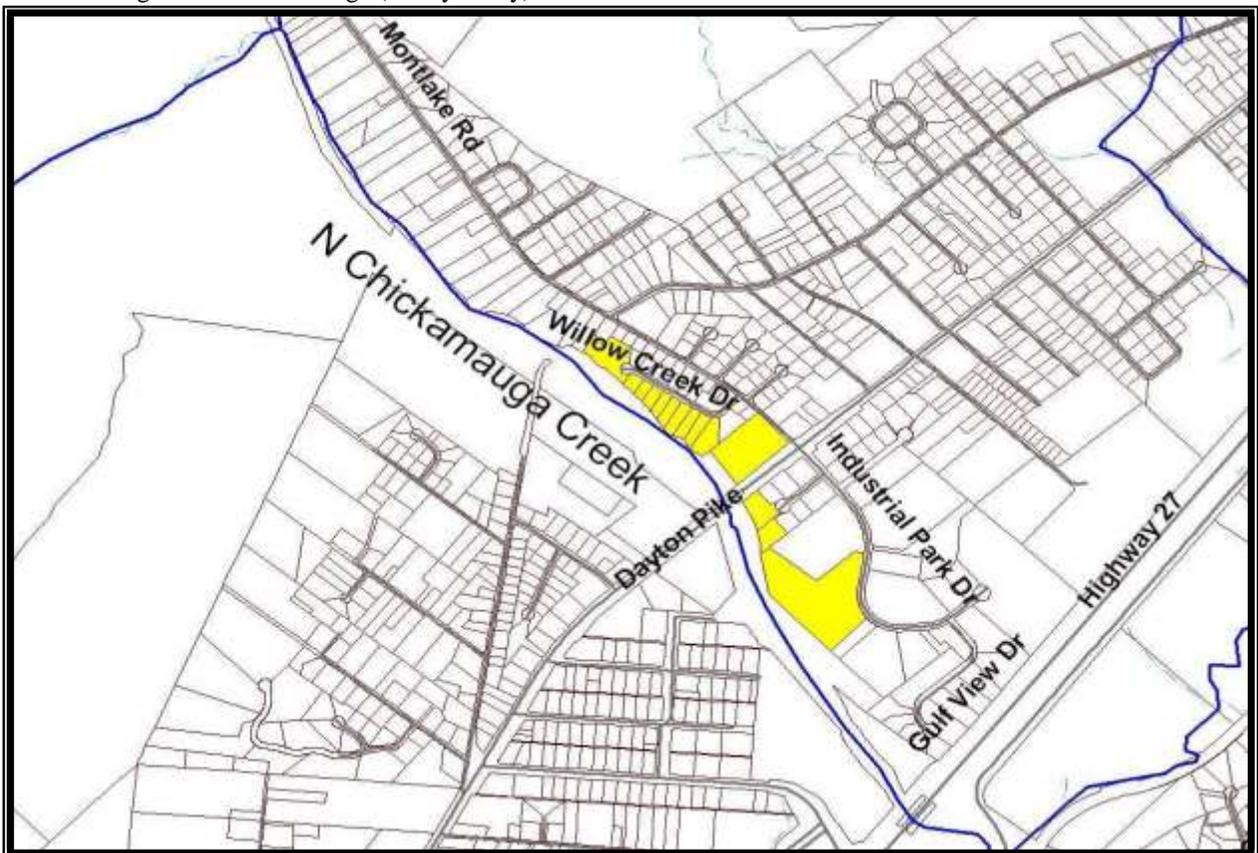
Current Development Trends

Population projections indicate growth will occur in the unincorporated portions of Hamilton County. Residential development occurring on steep slopes may increase the potential for slope destabilization and landslides. Continuing development of property near area streams with highly erodible banks could increase the number of vulnerable structures.

Vulnerability

The appraised value of vulnerable property near Dayton Pike in Soddy Daisy is 2.65 million dollars. The shaded area on Map 13 indicates property identified in the USACE 1998 study. This area has been mitigated with the use of Gabion Baskets.

Existing North Chickamauga (Soddy Daisy) Erosion Hazard Area



Sinkholes/Subsidence

Karst topography in Hamilton County can lead to the development of sinkholes. Near surface carbonate rocks (limestone and dolomite) are susceptible to dissolution by surface water or ground water.

Significant Events

March 9 2016

Airport Road was closed between Shallowford Road and Airport Connector Road/Shepherd Road as the result of a sinkhole.

May 27, 2016

A water main break inside a Chattanooga apartment complex caused a sinkhole that devoured a car with the owner inside. The driver was able to exit the vehicle unharmed

June 28, 2018

An 18 foot wide 17 foot deep sinkhole developed in the parking lot of a Walgreens on Tennessee Avenue. A leaking pipe was suspected of eroding the subsurface material.

August 18, 2018

A sinkhole opened in the parking lot of Firehouse Subs on Highway 153. The collapse occurred under the driver's side rear of a small car.

Mitigation Efforts

The Hamilton County OEM is working with the University of Tennessee (UTC) Geology Department to support research and improved mapping of existing sinkholes as well as areas vulnerable to the hazard. In addition, HCOEM is monitoring local news to improve documentation of sinkhole events.

Development Trends

As the county continues to grow more infrastructure and property could be vulnerable to the hazard.

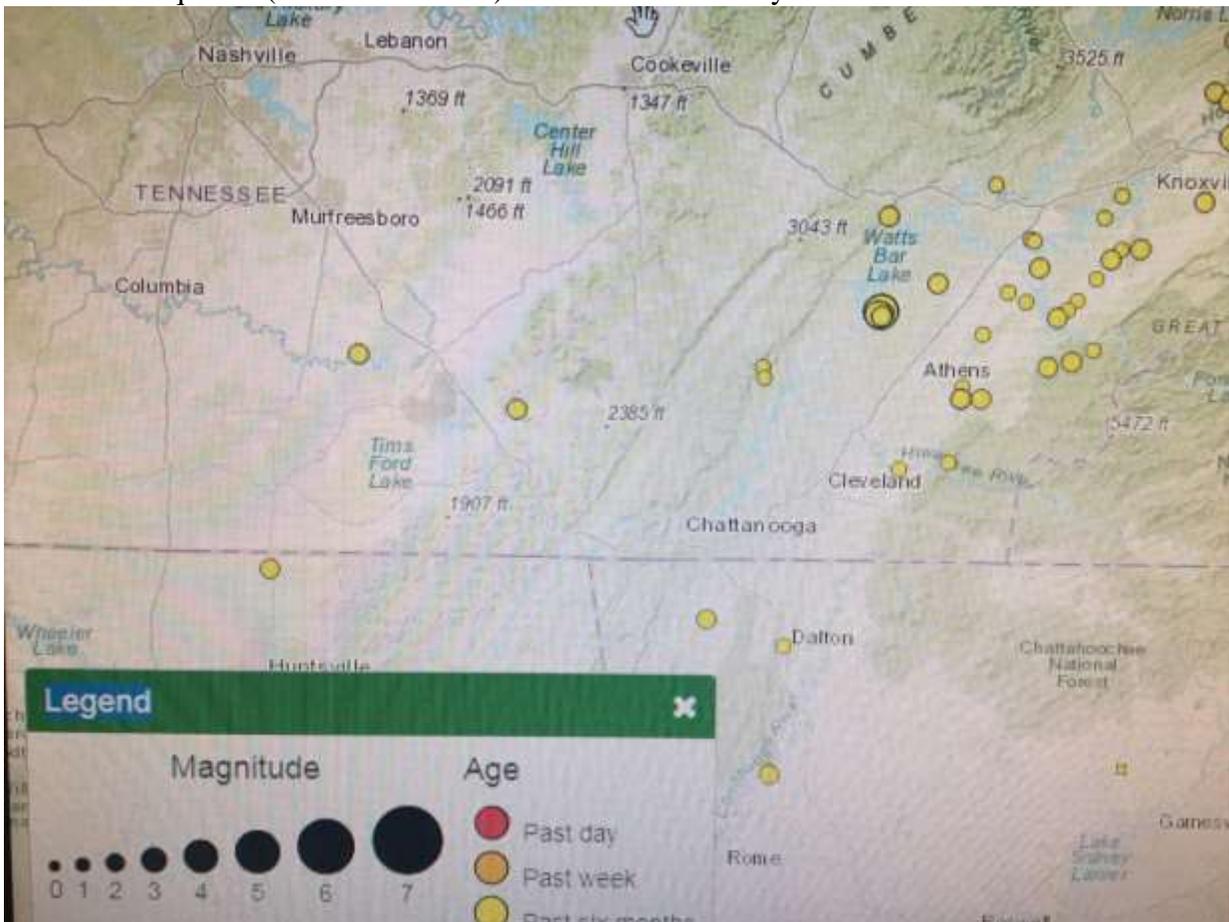
Vulnerability

Improved mapping and research will assist in developing a model to predict vulnerability. As Karst geology is widespread in the county so there is the potential for widespread vulnerability.

Earthquakes

Hamilton County is in the East Tennessee Seismic Zone (ETSZ), the second most active seismic zone east of the Rocky Mountains. The greatest danger from earthquakes comes from structural failures, disruption of utilities, and falling objects. Secondary effects include fires and dam failures. In 1993, a fault zone was identified in East Tennessee running roughly parallel to Interstate 75 between Chattanooga and Bristol.

The Center for Earthquake Research and Information (CERI) at the University of Memphis, maintains a database of earthquake events in the Central United States. The following map of recent earthquakes (8/2018 to 2/2019) illustrates the activity in the ETSZ.



Source: <https://www.memphis.edu/ceri/seismic/index.php>

Significant Events

April 29, 2003

A 4.9 magnitude earthquake with an epicenter located in Fort Payne, Alabama was felt in Hamilton County.

December 12, 2018

A 4.4 magnitude earthquake hit centered between Chattanooga and Knoxville hit at 4:15 a.m. It was followed about 12 minutes later by a magnitude 3.3 aftershock.

Mitigation efforts

There is countywide application of International Building Code 2012.

Hamilton County OEM provides public information during speaking opportunities and on its website to help educate the public.

Current Development Trends

Earthquakes are a non-site-specific hazard; therefore, population growth and new development increase the number of persons and property that could be impacted by an earthquake.

Vulnerability

The entire county would be affected by a major earthquake. Critical infrastructure, including Chickamauga Dam and the Sequoyah Nuclear Power Plant are of particular concern. The Tennessee Valley Authority (TVA) maintains rigorous design and inspection requirements for its facilities. TVA also regularly conducts emergency drills to prepare for such events.

Downtown Chattanooga has a large number of multistory buildings. Many of these buildings were constructed prior to the enforcement of seismic building code requirements.

The Tennessee Emergency Management Agency provided FEMA software (HAZUS) analysis to estimate the effect of a historical 5.5 magnitude earthquake with an epicenter at longitude -83.55, latitude 35.62.

HAZUS estimates a very minor impact from the earthquake. HAZUS estimates that about 39 buildings will be at least moderately damaged. No buildings will be damaged beyond repair according to HAZUS. The total economic loss estimated for the earthquake is 1.6 million dollars, which includes building and lifeline related losses.

The probability of a major earthquake is assumed to be small. However because the underlying fault lines and geology of the ETSZ are not fully understood, the potential for a major earthquake should be taken seriously.

Capability Assessment

Local departments, agencies, and organizations have a direct impact through specifically delegated responsibility to carry out mitigation activities or hazard control tasks. Chattanooga has the following government divisions that have responsibilities for hazard mitigation. These responsibilities are also carried out through departments of public works in other jurisdictions.

Chattanooga Divisions

Citywide Services are responsible for providing daily logistical planning, resource and personnel management services, and oversight of the implementation of various services. These include sewer construction and maintenance, street construction and maintenance, emergency response, solid waste and sanitation, brush collection, recycling, street cleaning and urban forestry.

Codes and Inspection is responsible for enforcing the regulatory building codes and ordinances adopted by the City. The Office of Inspection issues permits governing building, construction, electrical, plumbing, mechanical, gas and sign installation. This office is also

responsible for enforcing zoning regulations.

Engineering / Storm Water / Technical Information Center is responsible for maintaining records on and overseeing city projects. Records are kept on the location of sanitary and storm sewers, right-of-ways, construction schedule, topographic and flood maps, subdivision plats, street, utility, and property information.

Waste Resources is responsible for the operation and maintenance of sanitary sewer systems and the Wastewater Treatment Plant, responds to sewer stoppages, operates the Birchwood Landfill, and the operational maintenance of storm water pumping stations at the Brainerd Levee and orchard Knob area.

Legal Authority

Enabling legislation in Tennessee delegates legal authority to local governments to implement regulatory measures. The basis for much of this authority is the police power designed to protect public health, safety, and welfare. This authority enables local officials to enact and enforce ordinances and to define and abate nuisances. As hazard mitigation is a form of protecting public health, safety, and welfare, it falls under the general regulatory powers of local governments. Enabling legislation also extends to building codes and inspections, land use, acquisition, and floodway regulation.

Building Codes and Inspections

Building codes and inspections provide local governments with the means to maintain structures that are resilient to natural hazards. The 2012 International Building Codes, applied countywide, prescribe minimum standards for building construction that ensures structures are built to standards that have a high wind resistance and flood-proofing measures. Local governments are permitted to adopt additional codes as long as the regulations are at least as stringent as the state standards. State-enabling legislation authorizes local governments to carry out building inspections to ensure local structures adhere to the minimum state building standards.

Adopted Codes

- International Building Code - 2012 Edition
- International Residential Code - 2012 Edition
- International Plumbing Code - 2012 Edition
- International Mechanical Code - 2012 Edition
- International Fuel Gas Code - 2012 Edition
- International Fire Code - 2012 Edition

Land Use Planning

Through land use regulatory powers granted by the state, local governments can control the location, density, type and timing of land use and development in the community. The CHCRPA prepares land use plans for local jurisdictions recently updated the Comprehensive Plan for Hamilton County. The staff of the CHCRPA prepares recommendations on zoning cases and subdivision requests for the Chattanooga-Hamilton County Regional Planning Commission (CHCRPC).

The CHCRPC is a voluntary body of 15 members largely appointed by the Mayor of the City of Chattanooga and the County Executive for staggered three-year terms. Its role is to make zoning and land use recommendations to the local legislative bodies and to make final

decisions on subdivision requests for Hamilton County and all municipal governments, except Collegedale, Red Bank, Signal Mountain, and Soddy-Daisy.

Zoning and Subdivision Regulations

Zoning and Subdivision Regulations are the two most common legal devices used to implement the policies of the Comprehensive Plan. The zoning ordinance divides jurisdictions into zones in which land use is regulated by specifying the permitted use of buildings and land, the density of development, and the size and location of buildings on the land. Local governments are authorized under the Tennessee Code Section 13 to regulate the subdivision of land within their jurisdiction. Subdivision regulates the division of land as well as the location, design, and installation of supporting infrastructure. Zoning and Subdivision Regulation provide a powerful tool for local government to direct development away from environmentally sensitive/hazardous areas such as floodplains and steep slopes.

Incorporation into existing Planning Mechanisms

Incorporation of the Plan into other planning mechanisms, by either content or reference, enhances a community's ability to perform natural hazard mitigation by expanding the scope of the Plan's influence. Over the past planning cycle, the success of incorporating Plan elements into other planning programs has varied from jurisdiction to jurisdiction.

Typical ways of incorporation included:

- Use of, or reference to, Plan elements in updates to general and comprehensive planning documents.
- Addition of defined mitigation actions to capital improvement programming.
- Inclusion of Plan elements into development planning and practices.
- Resource for developing and/or updating emergency operations plans.

The Plan will continue to function as a standalone document subject to its own review and revision schedule. The Plan will also serve as a reference for other mitigation and land planning needs of the participating jurisdictions. Whenever possible, each jurisdiction will endeavor to incorporate mitigation actions and projects identified in the Plan into existing planning mechanisms and documents. This process may include adding or revising building codes, adding or changing zoning and subdivision ordinances, incorporating mitigation goals and strategies into general and/or comprehensive plans, and incorporating the risk assessment results into development review processes to ensure proper hazard mitigation for future development.

Chapter 4 – Mitigation Strategy, Actions, and Implementation

The Federal emphasis for hazard mitigation is on reducing payouts from disaster declarations. Disaster payments are projected to increase to a point where they can no longer be sustained so it only makes sense to develop programs to bring those costs back under control. A key feature of FEMA’s strategy for achieving this goal is to provide technical and financial assistance to local units of government for planning and projects to reduce overall risks to the local community. FEMA encourages local governments to use a variety of techniques to influence the location, type, intensity, design, quality, and timing of development. Many of these tools can be used to mitigate natural hazards and enhance the community’s resilience and ability to recover from hazards. FEMA recommends that the following tools be used in a local mitigation strategy:

Hazard Mitigation Tools

Building standards specify how buildings are constructed. In addition to traditional building codes, building standards can include flood-proofing requirements, seismic design standards, and wind-bracing and anchoring requirements for new construction and similar requirements for retrofitting existing buildings.

Development regulations, which may include separate zoning and subdivision ordinances, regulate the location, type, and intensity of new development. Development regulations can include flood-zone regulations; setbacks from faults, steep slopes, and coastal erosion areas; and overlay zoning districts that apply additional development standards for sensitive lands, such as wetlands, dunes, and hillsides.

Capital improvement programs can be an effective way to implement mitigation throughout a community. Local public policies supporting hazard mitigation should be incorporated into these programs. Locating schools, fire stations, and other public buildings, streets, storm sewers, and other utilities outside of high hazard areas is an obvious policy. When siting public facilities in hazardous locations is necessary, communities can incorporate hazard reduction measures into the design or require retrofits where economically feasible. Public facility siting is a key determinant of the location of new privately financed growth in a community. As such, facilities, particularly roads and utilities, should not be sited where they have the potential to encourage growth in high hazard zones.

Land and property acquisition means purchasing properties in hazard-prone areas with public funds, and restricting development to uses that are less vulnerable to disaster-related damages. This can be accomplished through acquisition of undeveloped lands, acquisition of development rights, transfer of development rights to lower-risk areas, relocation of buildings, and acquisition of damaged buildings.

Taxation and fiscal policies can be used to distribute the public costs of private development of high hazard areas more equitably, specifically shifting more of the cost burden directly onto owners of such properties. Employing impact taxes to cover the public costs of development in areas of high hazards or providing tax breaks for reducing land use intensities in hazardous areas are two options.

Public awareness through information dissemination on natural hazards, and providing educational materials to the construction industry, homeowners, tenants, and businesses are also important. Included in this category are hazard disclosure requirements for the real estate industry and public information campaigns to increase awareness in all sectors of the community.

Implementation of National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) is a federal program to identify flood prone areas and make flood insurance available to the owners and leasers of property. This insurance provides an insurance alternative to disaster assistance for meeting escalating costs of repairing damaged buildings and their contents from floods. Participation in the NFIP by Hamilton County, Chattanooga, Collegedale, East Ridge, Lakesite, Lookout Mountain, Red Bank, Signal Mountain, and Soddy Daisy is by agreement with the federal government predicated on the adoption and enforcement of floodplain ordinances that ensure new buildings will be free from flood damage and prevent new developments from increasing flood damages on existing properties.

There are currently 2,414 flood insurance policies in effect in Hamilton County. The county and participating jurisdictions currently do not participate in the Community Rating System, but enrollment in the program is a long-term priority. The Town of Walden has been informed about the NFIP program but has decided not to participate at this current time largely because they are situated on elevated land that diminishes their chances of receiving a major flood.

NFIP Policy Information			
Community Name	Policies in force	Insurance in force whole \$	Written Premium in force
Chattanooga	1400	\$ 389,635,300.00	\$ 1,351,504.00
Collegedale	28	\$ 9,289,100.00	\$ 27,743.00
East Ridge	365	\$ 60,400,800.00	\$ 434,542.00
Hamilton County*	265	\$ 64,136,100.00	\$ 176,993.00
Lakesite	2	\$ 600,000.00	\$ 660.00
Lookout Mountain	4	\$ 1,300,000.00	\$ 5,063.00
Red Bank	116	\$ 20,116,100.00	\$ 191,384.00
Signal Mountain	3	\$ 910,000.00	\$ 1,103.00
Soddy Daisy	231	\$ 37,259,300.00	\$ 208,268.00
Total	2,414	\$ 583,646,700.00	\$ 2,397,260.00
<i>*Unincorporated</i>			
Source: https://www.fema.gov/policy-claim-statistics-flood-insurance (as of 9/30/2018)			

In October of 2009, NFIP communities in Hamilton County began a Flood Map Project with FEMA to update local flood maps through the Risk Map (Risk Mapping, Assessment, and Planning). New studies under Risk Map are based on need. Local communities have the responsibility to identify needs and priorities. Risk Map creates a partnership between FEMA and local communities to address local needs. (New maps were released in April of 2015)

The goals of the program are to:

- Address gaps in flood hazard data
- Increase public awareness and understanding of risk
- Assist and support local entities engaging in risk-based mitigation planning

- Provide an enhanced digital platform
- Align Risk Analysis programs and develop synergies

Plan Goals

Flood:

Protect lives and property by reducing vulnerability to flood events in Hamilton County.

Severe Storms:

Reduce potential damages to new and existing buildings and infrastructure and increase public preparedness.

Tornadoes:

Save lives, reduce property damage, and increase awareness of the danger of tornadoes.

Landslide

Identify high hazard areas and identify techniques to minimize risk.

Erosion:

Identify high hazard areas and identify techniques to minimize risk.

Sinkholes

Identify high hazard areas and identify techniques to minimize risk.

Earthquakes:

Save lives, reduce potential property damage and increase public awareness.

Drought

Minimize the impacts of drought in Hamilton County.

Wildfire:

Protect lives and property from vulnerability to wildfire.

Objectives and Actions

Each participating jurisdiction has developed and prioritized objectives and preferred actions to mitigate natural hazards in its locality. Objectives represent measurable steps towards achievement of overall plan goals. Preferred actions are specific measures implemented to achieve the objectives of the plan. Preferred actions are prioritized at the jurisdiction level. Mitigation action priority is based on the local government capability, likelihood of implementation, and qualitative discussion of costs and benefits. The achievement of objectives and implementation of specific actions in some instances may be contingent upon the future availability of local, state, and federal resources and funding.

Plan Update Statement: Mitigation goals have been updated to align with identified hazards. Mitigation actions for each jurisdiction have been updated to reflect items that have been completed, are ongoing, or have been deleted.

Process for Setting Priorities for Mitigation Actions

The decisions on mitigation action priorities were made by each plan participant. Priority setting was based on the following factors:

The Hazard Analysis in chapter three as well as local knowledge of the impacts of past hazard events, the extent of the area impacted, and the relation of a given mitigation action to the jurisdiction’s objectives. Within the context of these factors, participants considered the following criteria to prioritize their mitigation actions.

1. Protection of life and property
 - The effectiveness of each mitigation action in protecting life and preventing injuries.
 - Eliminating or reducing damage to structures and infrastructure
2. Technical feasibility and administrative capability
 - Is the mitigation action technically feasible and does the participant have the personnel to implement successfully
3. Legal authority
 - Does the legal authority to implement the mitigation action exist
4. Cost and benefit
 - Participants considered the benefits that would result from a mitigation action versus the cost, and whether the costs are reasonable compared to the probable benefits. Benefits include losses avoided, such as the number and value of structures and infrastructure protected by the action and the population protected from injury and loss of life.
5. Environmental impact and constraints
 - Consideration of potential environmental impacts, including benefits, as well as regulatory compliance

Plan participants assigned a high, medium, or low priority designation for each mitigation action selected for their jurisdiction.

Priority	Considerations
High	High reduction in loss of life and property
	Greatest benefit related to cost
	Legal authority is established
	Technical feasibility established and can be implemented with existing personnel
	Provides greatest environmental benefit
Medium	High/Moderate reduction in loss of life and property
	Benefit exceeds cost
	Legal authority is or can be established
	Technically feasible and existing personnel can implement with minimal support
	Positive environmental impact
Low	High/Moderate reduction in loss of life and property for lower ranked risk
	Benefit exceeds or equals cost
	Legal authority is or can be established
	Most likely requires feasibility study and outside support for implementation
	Positive or neutral environmental impact

Mitigation Actions Countywide (all plan participants)

1. *Implementation of Integrated Public Alert and Warning System (IPAWS)
(Replaced: Installation of early warning system, (Reverse 911) to notify residents of imminent danger)*

Responsible Agency: Hamilton County OEM, 911 Communications

Priority: High

Cost Estimate: \$4,000 per year for launching software license

Hazard addressed: All hazards

Benefit: Ability to target specific areas countywide for notification of imminent danger from all hazards.

Potential funding source: Existing budget

Schedule: Completed

Status: Implemented and tested monthly

2. *Increase and reinforce public awareness of natural hazards including information on mitigation and preparedness.*

Responsible Agency: Hamilton County OEM in coordination with local media

Priority: High

Cost Estimate: Existing staff and local resources

Hazard addressed: All hazards

Benefit: Low cost and significant benefit in culturing an informed and prepared citizenry

Potential funding source: Existing budget

Schedule: Continuous and timely to address seasonal weather hazards. Yearly to address low probability hazards such as earthquakes.

Status: Ongoing

3. *Locate all new essential and emergency service facilities outside of flood hazard areas.*

Responsible Agency: Hamilton County/Jurisdiction

Priority: High

Cost Estimate: NA

Hazard addressed: Flooding

Benefit: Protects new emergency service facilities (critical infrastructure) from known flood hazards.

Potential funding source: Existing local budget

Schedule: Continuous as needed

Status: Ongoing: This action continues.

4. *Establish a mitigation working group to meet annually to review mitigation actions, strategies, and implementation.*

Responsible Agency: Hamilton County/Jurisdictions/Community Partners

Priority: High

Cost Estimate: existing budget

Hazard addressed: All hazards

Benefit: The mitigation working group will facilitate the mitigation planning process,

work with local jurisdictions to strengthen hazard risk and vulnerability assessment, assist local jurisdictions with development of mitigation alternatives and actions, assist with the identification of funding resources, conduct cost benefit analysis of mitigation alternatives, monitor plan implementation, and coordinate and write grant applications.

Potential funding source: Existing local budget

Schedule: 2019

Status: New action

5. *Evaluate structural vulnerability of pre- seismic construction standards buildings to earthquake; continue enforcement of seismic standards for new construction.*

Responsible Agency: Hamilton County/Jurisdiction Building Code Enforcement

Priority: Medium

Cost Estimate: Existing staff and local resources

Hazard addressed: Earthquake

Benefit: Information to prioritize structures for seismic retrofit, protect lives and property

Potential funding source: Existing local budget/ Pre Disaster Mitigation Grant

Schedule: Continuous as local resources allow

Status: This action will continue

6. *Adopt and enforce International Building Codes*

Responsible Agency: Hamilton County/Jurisdiction

Priority: High

Cost Estimate: Existing staff and local resources

Hazard addressed: All hazards

Benefit: Increased resilience of built environment to hazards

Potential funding source: Existing local budget

Schedule: Ongoing

Status: This action continues

7. *UTC Department of Geology research of Geologic Hazards*

Responsible Agency: UTC Department of Geology and Hamilton County OEM

Priority: High

Cost Estimate: \$20,000

Hazard addressed: Geologic Hazards (landslide and sinkholes)

Benefit: Identification of the location, distribution, and extent of geologic hazards to determine vulnerability

Potential funding source: HMGP

Schedule: As funding and resources become available

Status: New Action

8. *Mitigate streambank erosion by assessing vulnerability and identifying appropriate actions*

Responsible Agency: HCOEM, Jurisdictions, NRCS Emergency Watershed Protection, TDEC

Priority: High

Cost Estimate: based on need and grant resources

Hazard addressed: Erosion

Benefit: Identification of the location, distribution, and extent of streambank erosion to determine vulnerability and measures to protect property and the environment

Potential funding source: NRCS EWP

Schedule: As funding and resources become available

Status: New Action

9. Develop a map of the wildland urban interface (continuum)

Responsible Agency: Hamilton County Office of Emergency Management, Hamilton County GIS

Priority: High

Cost Estimate: existing staff time

Hazard addressed: Wildfire

Benefit: Identify the vulnerability of specific areas countywide for participation in the Firewise program and for increased monitoring during enhanced fire conditions

Potential funding source: Existing budget

Schedule: 2021 for update based on 2020 Census

Status: New Action- completed based on 2010 Census information, but will be updated with 2020 Census information

Chattanooga

Objectives

1. Continually review existing ordinances and/or create ordinances to support mitigation plan goals.
2. Increase the capability to monitor rainfall and stream flow.
3. Increase basin modeling and flood mapping capabilities.
4. Protect area streams from the effects of urban development.
5. Decrease the number of repetitive loss structures.
6. Increase scrutiny of proposed developments and monitor development in floodplains and floodways.
7. Reduce flooding of the Rossville Boulevard commercial district.
8. Increase capabilities to warn flood zone residents of imminent flooding due to headwater rainfall.
9. Reduce the impact of power outages on crucial infrastructure.
10. Upgrade inadequate infrastructure.

Preferred Actions

- 1. Review and revise ordinances necessary to strengthen mitigation efforts.*

Responsible Agency: CHCRPA, Public Works: Division of Codes and Inspection, Engineering/Stormwater

Priority: High

Cost Estimate: Three months of staff time

Hazard addressed: All hazards

Benefit: Reduce vulnerability, encourage responsible and sustainable development

Potential funding source: Existing budget

Schedule: Continuous as necessary

Status: Chattanooga has updated its zoning ordinance to reflect changes to coincide with recommendations from the State of Tennessee planning office, and FEMA. The city is currently developing an ordinance to strengthen development standards for steep slopes and floodplain areas.

2. *Establish incentive for establishing and maintaining stream buffers.*

Responsible Agency: Public Works: Stormwater Management

Priority: High

Cost Estimate: Six months of staff time

Hazard addressed: Flooding/Erosion

Benefit: Improve regulatory authority, reduce vulnerability, and improve water quality, decrease rate and volume of rainfall runoff.

Potential funding source: Existing budget

Schedule: Complete

Status: This action is addressed in the Chattanooga Stormwater Management Ordinance

3. Increase scrutiny of proposed developments and monitor development in floodplains and floodways.

Responsible Agency: Public Works: Land Development Office, Zoning, Stormwater Management

Priority: High

Cost Estimate: Six months of staff time

Hazard addressed: Flooding

Benefit: Increase ability to guide responsible development in sensitive areas. Improve public information

Potential funding source: Existing budget

Schedule: Continuous

Status: Ongoing-All personnel in the City of Chattanooga, Land Development Office, Zoning Division, have attended training in Managing Floodplain Development at the FEMA national training center in Emmitsburg, Maryland. All plans submitted for development in the floodplain are reviewed by these trained personnel. This includes both commercial and residential. This department also maintains the elevation certificates and other data, such as LOMR-F's (**Letter of Map Revision Based on Fill**) to comply with NFIP requirements and also to be readily able to provide this information to the public, insurance companies, and banking institutions. Additionally, new LOMR-F's and other map revisions are reported to the GIS department to assure that these changes are available on the official mapping of the City of Chattanooga. This information is then available on-line, free of charge.

4. *Implement flood control measures for Dobbs Branch Watershed*

Responsible Agency: Public Works: Engineering/Stormwater

Priority: High

Cost Estimate: Based on feasibility study

Hazard Addressed: Flooding

Benefit: Reduce impact of repeated flooding in the area

Potential funding source: USACE, Existing budget

Schedule: Within 5 years (2013)

Status: Deleted

5. *Installation of additional stream flow gauges on Lookout, Mountain, and Wolfcreek Creeks.*

Responsible Agency: Public Works: Stormwater Management, Hamilton County OEM

Priority: Medium

Cost Estimate: \$17,000 per gauge

Hazard addressed: Flooding

Benefit: Improve prediction capabilities, increase warning time, and reduce loss of property and life

Potential funding source: Local, USGS

Schedule: Continuous as funding becomes available

Status: Stream gauges have been added on the Chattanooga, West Chickamauga, and South Chickamauga creeks in North Georgia. The stream gauge on the North Chickamauga has been reactivated. Chattanooga will continue efforts to add stream gauges.

6. *Implement automatic notification from rain gauges and flow meters to Stormwater Management staff.*

Responsible Agency: Public Works: Stormwater Management

Priority: Medium

Cost Estimate: \$150,000 a year

Hazard Addressed: Flooding

Benefit: Improve prediction capabilities, increase warning time, and reduce loss of property and life

Potential funding source: Existing budget

Schedule: Continuous/ongoing

Status: Chattanooga will continue efforts to complete this action.

7. *Continue development of basin modeling and creation of flood mapping in mapped, unmapped, and developing areas.*

Responsible Agency: Public Works: Stormwater Management

Priority: Medium

Cost Estimate: \$1,500 per river mile for approximate A zone studies; \$15,000 per river mile for detailed studies

Hazard Addressed: Flooding

Benefit: Improve land use planning and regulation, reduce vulnerability of new development

Potential funding source: USACE, existing budget

Schedule: continuous/ongoing

Status: Chattanooga will continue efforts to complete this action.

8. *Decrease the number of severe repetitive and repetitive loss structures*

Responsible Agency: Public Works: Engineering/Stormwater

Priority: High (SRL priority)

Cost Estimate: to be determined

Hazard Addressed: Flooding

Benefit: Relocation/Removal is more cost effective than repeated losses

Potential funding source: PDM, HMGP, FMA, CDBG

Schedule: Continuing

Status: In 2006 the City of Chattanooga, Land Development Office applied for and received a grant for Hazard Mitigation of repetitive loss structures. Seven homes were purchased and the land returned to open green space. Chattanooga will continue to seek funding when available to continue this process with severe repetitive loss properties as the first priority. Also, building applications, are reviewed for previously flood damaged properties, or applicants seeking additions to structures in the floodplain before allowing substantial repair or improvement to properties without proper mitigation measures.

9. *Improve GIS capabilities to include real-time modeling and better projections of flood areas.*

Responsible Agency: Public Works: Engineering/Stormwater

Priority: Medium

Cost Estimate: Existing staff

Hazard Addressed: Flooding

Benefit: Improve warning of flood potential, improve land use planning and regulation, and avoid development of flood prone areas

Potential funding source: USACE, PDM, existing budget

Schedule: Continuous

Status: Ongoing

10. *Mountain Creek flood zone restoration.*

Responsible Agency: Public Works: Engineering/Stormwater

Priority: Low

Cost Estimate: \$500,000

Hazard Addressed: Flooding

Benefit: Flood protection, improved water quality

Potential funding source: TDEC Mitigation Banking

Schedule: Continuous

Status: Chattanooga will continue efforts to complete this action.

11. *Citico Creek WPA channel removal and natural stream restoration.*

Responsible Agency: Public Works: Engineering/Stormwater

Priority: Low

Cost Estimate: Based on feasibility study

Hazard Addressed: Flooding, erosion

Benefit: Improved flood control, improved water quality

Potential funding source: PDM, HMGP, USACE, NRCS

Schedule: Ongoing

Status: Chattanooga will continue efforts to complete this action.

12. *Reduce impact of power outages on critical infrastructure*

Responsible Agency: Waste Resources/Public Works

Priority: Low

Cost Estimate: Based on site specific needs assessment

Hazard Addressed: Flooding

Benefit: water quality improvement, flood protection

Potential funding source: existing budgets

Schedule: Ongoing

Status: The Waste Resources Division of the Public Works Department has met with the Electric Power Board and where possible identified multiple sources of power feeds for their large sewage pump stations. Seven (7) of the smaller stations have on-site generators and automatic transfer switches. Five (5) of the CSO facilities have on-site generators. They are planning to add more generators as funds permit to pump stations in the near future. The Moccasin Bend Treatment Plant has two distinct electrical feeds available at the plant switchyard. The control center for the treatment plant has a backup generator and automatic transfer switch. They have three portable generators available for use, capable of operating the smaller stations, with an SOP in place for deployment. These stations are equipped with generator connections and transfer switches.

The Paul Clark Building, the dispatch center for brush, trash, and street clearing crews also has an onsite generator.

13. Acquire property for greenway system.

Responsible Agency: Trust for Public Land, Parks and Recreation, Public Works: Engineering

Priority: Low

Cost Estimate: 2.65 million for the current South Chickamauga extension

Hazard Addressed: Flooding

Benefit: Flood protection, Stormwater Management, utilize potential flood hazard areas for public recreation

Funding source: 1.6 million in federal transportation funds for alternative transportation, 400,000 federal stimulus funds, 400,000 from the Lyndhurst foundation, and 250,000 from the Benwood Foundation

Schedule: Continuous as funding becomes available

Status: Work is complete on miles 0-4 and 7-12 of the South Chickamauga Greenway

Collegedale

Objectives

1. Maintain flow capacity at the Wolftever Creek/Tallant Road Bridge.
2. Reduce flooding on Apison Pike at Wolftever Creek.
3. Reduce collector street flooding.
4. Reduce possible Sanitary Sewer Overflows.
5. ROW tree removal.
6. Reduce impact of power outages on critical city operations

Preferred Actions

1. *Routinely clean debris from support bracings under bridges.*

Responsible Agency: Public Works

Priority: High

Cost Estimate: Existing staff
Hazard Addressed: Flooding
Benefit: Reduce backup flooding on Apison Pike and Tallant Road
Potential funding source: Existing budget
Schedule: Continuous
Status: Ongoing cleanup of debris has mitigated flooding on Apison Pike and Tallant Road

- 2. Raise State Route 317 at McKee Plant #2 to alleviate roadway flooding.*

Responsible Agency: Public Works, TDOT
Priority: Medium
Cost Estimate: Based on feasibility study
Hazard Addressed: Flooding
Benefit: Eliminate chronic flooding problem on State Route 317
Potential funding source: TDOT, existing budget
Schedule: Project completion date = 2021
Status: Updated schedule to align with TDOT timeline

- 3. Maintain and Clear all driveway culverts and ROW ditches.*

Responsible Agency: Public Works, TDOT
Priority: Medium
Cost Estimate: Existing Staff
Hazard Addressed: Flooding
Benefit: Reduce potential flash flooding of collector streets
Potential funding source: existing budget
Schedule: routine 2 times a year
Status: New action

- 4. Reduce SSO potential by removing I/I in sewer system.*

Responsible Agency: Public Works Sewer Department
Priority: High
Cost Estimate: \$2.5 million
Hazard Addressed: Flooding
Benefit: Eliminate potential public health hazards, regulation compliance
Potential funding source: Existing budget, SRF
Schedule: Started 2011-2021
Status: New action

- 5. ROW tree removal.*

Responsible Agency: Public Works
Priority: Medium
Cost Estimate: existing budget
Hazard Addressed: Severe storm, winter storm
Benefit: Reduce roadway closure, and storm debris potential
Potential funding source: existing budget
Schedule: four times a year

Status: New action

6. Install backup diesel generator at Collegedale Economic Development Center

Responsible Agency: Building & Codes Department

Priority: High

Cost Estimate: \$40,000

Hazard Addressed: All hazards

Benefit: The City of Collegedale Municipal and Public Works Buildings have back-up diesel generators; however, adding a back-up diesel generator at Collegedale Economic Development Center will enable Collegedale to continue performing critical operations in the event that Collegedale Municipal Building experiences loss of building power and/or extreme damage to Municipal Building

Potential funding source: existing budget

Schedule: Within 3 years

Status: New action

East Ridge

Objectives

1. Reduce flood damage in the Spring Creek and South and West Chickamauga Creek flood zones.
2. Reduce the amount of property damage due to both stream bank erosion and outdated stormwater management systems during flash flooding and/or flood events.
3. Increase early warning and accurate flood level assessment tools for better awareness and emergency preparedness.
4. Improve water quality and general management of the City's stormwater management system by treating the 1st ½ inch of rain water during storm events.

Preferred Actions

1. *Acquire funds to purchase existing repetitive loss structures in the floodplain and clear the land to be held as open space (updated to remove in place elevation and flood proofing)*

Responsible Agency: Public Works and Codes Enforcement

Priority: High

Cost Estimate: Based on feasibility study and funding source

Hazard Addressed: Flooding

Benefit: Mitigation of repetitive loss structures is more cost effective than no action

Potential funding source: FMA, PDM, HMGP, CDBG

Schedule: Continuous as funding becomes available

2. *Evaluate alternatives to do the following (A.) reduce rate and volume of rainfall runoff into area creeks to reduce flooding potential; and (B.) reduce amount of property damage due to outdated stormwater management system during all large flood events.*

Responsible Agency: Public Works, CHCRPA and Building Official

Priority: High

Cost Estimate: Existing staff

Hazard Addressed: Flooding, severe storm

Benefit: Flood control, storm water management, improve water quality

Potential funding source: PDM, existing budget

Schedule: Ongoing

- 3. Redirect or intercept the high flow of Spring Creek at the Anderson Avenue outlet and divert into South Chickamauga Creek.*

Responsible Agency: Public Works and Codes Enforcement

Priority: Medium

Cost Estimate: Based on feasibility study

Hazard Addressed: Flooding, severe storm

Benefit: Flood control, stormwater management

Potential funding source: PDM, HMGP, USACE, existing budget

Schedule: Ongoing

- 4. Improve current stormwater infrastructure to handle 2, 5, and 10-year events while minimizing erosion (especially along the John Ross/Bennett/Laredo and Marlboro Drainage System).*

Responsible Agency: Public Works and Codes Enforcement

Priority: High

Cost Estimate: Based on feasibility study

Hazard Addressed: Flooding, severe storms

Benefit: Flood control, stormwater management, improve water quality

Potential funding source: PDM, HMGP, USACE, existing budget

Schedule: 5 years plus (2019+)

- 5. Add water level gauging tools to include monitoring and software in Spring Creek to provide accurate flood level measurements.*

Agency: Codes Enforcement and USACE, USGS

Priority: Low

Cost Estimate: \$15,000 annual cost share

Hazard Addressed: Flooding

Benefit: Accurate warning of flood events, improve flood models

Potential Funding source: USGS/USACE/East Ridge/

Schedule: as funding becomes available

- 6. Dredge or clean-out excess debris and silt in portions of Spring Creek and Chickamauga Creek.*

Agency: USACE and TDEC.

Priority: High

Cost Estimate: Based on feasibility study

Hazard Addressed: Flooding

Benefit: Allow decrease property damage during floods

Funding source: TBD

Schedule: as funding becomes available

- 7. Create a City initiative to produce an ongoing public education marketing campaign advising homeowners and businesses about floods and encouraging them to obtain flood*

insurance.

Agency: City Manager's Office and Building Official

Priority: Medium

Cost Estimate: Based on marketing materials

Hazard Addressed: Flooding

Benefit: Inform the public about floods and available flood insurance.

Funding source: TBD

Schedule: Ongoing

8. Review/revisions of local building codes (improve structural ability to withstand high winds/snow load, earthquakes.)

Agency: Building Official

Priority: Low

Cost Estimate: TBD

Hazard Addressed: Flooding, severe storm, winter storm, earthquake

Benefit: decrease property damage during earthquakes, storm events

Funding source: East Ridge

Schedule: Within 2 years 2021

9. Create a comprehensive stormwater management plan

Agency: City Manager's Office, TDEC Code Enforcement, Hamilton County Water Quality

Priority: High

Cost: TBD **Hazard Addressed:** Flooding, severe storm

Benefit: To assist in evaluating the City's stormwater system and develop/implement various alternatives to update the current stormwater management system to prevent flooding of new and existing buildings and infrastructure.

Funding Source: TEMA, TDEC, and City of East Ridge

Schedule: Ongoing

Lookout Mountain:

Objectives

1. Increase the capability to mitigate the effects of drought, wildfire, and severe weather events.
2. Increase the capacity to support vulnerable population in the event of natural disasters and /or utility service disruption

Preferred Actions

- 1. Acquire backup source of electricity for water pumps to supply storage tanks.*

Responsible Agency: Public Works

Priority: High

Cost Estimate: Based on feasibility study

Hazard Addressed: All Hazards

Benefit: Maintain supply of water during power outages

Potential funding source: HGMP, existing budget

Schedule: Continuing maintenance of generators

Status: Completed/Ongoing maintenance: A backup source of electricity is in place for water pumps supplying water to the two storage tanks at Fort Circle on Lookout Mountain. A diesel generator is installed at the pump station to be placed in use in case of power outages. A second backup system can be placed in service within 24 hours. The large tanks capacity is 1.2 million gallons and the small tank has a capacity of 475,000 gallons. The Towns' water system is owned and operated by the Tennessee American Water Company. The company plans to begin construction of a larger supply line up the eastern bluffs below East Brow Rd. in January 2010.

- 2. Identify vulnerable population and establish procedures and locations for emergency shelter in the event of natural disaster and/or utility service disruption.*

Responsible Agency: Hamilton County Office of Emergency Services, Town of Lookout Mountain

Priority: High

Cost Estimate: Existing staff time

Hazard Addressed: All hazards

Benefit: Increase capacity, utilization, and coordination of local resources in support of vulnerable population, protect health and safety of local residents.

Potential funding source: PDM, existing budget

Schedule: Continuous

Status: Completed/Ongoing: The Fire and Police Department currently has a list and access keys of elderly residents that enables the Town to maintain contact with them for health reasons. The department is called upon by these residents to give assistance periodically. The Town Commission will establish a written procedure to provide this emergency shelter by February 1, 2010. Research has revealed that only one location exists that can provide a diesel electric power generator in the event of a power outage and this is Lookout Mountain Elementary School.

- 3. Establish a fireplug and hose drop for wildfire suppression on the mountainside.*

Responsible Agency: Town Fire Department

Priority: Medium

Cost Estimate: Based on feasibility study

Hazard Addressed: Wildfire

Benefit: Enhance ability to quickly control and suppress wildfire on steep forested slopes.

Potential funding source: HGMP, existing budget

Schedule: Completed

Status: Completed: Fireplugs are located on each block of East Brow and West Brow Roads. The apparatus and personnel responding to the scene by the Lookout Mountain Fire Department will supply a Hose Drop and Perimeter control. Backup Hose Drop will be supplied by the Lookout Mountain Georgia Fire Department.

- 4. Coordinate wildfire control on steep slopes with the City of Chattanooga, the National Park Service, the Tennessee Division of Forestry, and the Town Fire Department.*

Responsible Agency: Town Fire Department, Hamilton County Office of Emergency Services

Priority: Medium

Cost Estimate: Existing staff

Hazard Addressed: Wildfire

Benefit: Enhance interagency coordination and response to wildfire on steep forested slopes.

Potential funding source: PDM, existing budget

Schedule: Continuous

Status: In the event of mountainside wildfire, Hamilton County OEM, Tennessee Division of Forestry, the National Park Service, city of Chattanooga, Town of Lookout Mountain Tennessee Fire Department, Lookout Mountain Georgia Fire Department, and Tri-State Mutual Aid will utilize a combined agency effort. All contact numbers are on file at Lookout Mountain Tennessee Fire/Police Dispatch.

5. *Provide for Medical and subsistence needs if periods of extended blockage of state highway access to Lookout Mountain is caused by storm debris and, land or rock slides.*

Responsible Agency: Town of Lookout Mountain, CARTA

Priority: High

Cost Estimate: NA

Hazard Addressed: All hazards

Benefit: Maintain freedom of movement of services, persons, and supplies in the event of extended road closure.

Potential funding source: TDOT, existing budget

Schedule: Complete

Status: Completed: An agreement has been established between the Town of Lookout Mountain and the Chattanooga Area Regional Transportation Authority to utilize the service of the Lookout Mountain Incline for medical and subsistence needs. The agreement between the Town and CARTA is located in the appendix

6. *Participate in Firewise program*

Responsible Agency: Lookout Mountain Fire Department, HCOEM

Priority: High

Cost Estimate: Existing staff time

Hazard Addressed: Wildfire

Benefit: Protect property and life from the wildfire

Potential funding source: NFPA grant, existing budget

Schedule: 2019 to continuous

Status: New action

Red Bank

Objectives

1. Reduce flood damage associated with Stringers Branch and tributaries
2. Reduce flooding on Lyndon Avenue and Memorial Drive
3. Increase scrutiny of proposed development in or near floodplains
4. Improve stormwater drainage and collection capacity

Preferred Action

1. *Buy out repetitive loss properties*

Responsible Agency: Public Works: Administration and Engineering

Priority: High

Cost Estimate: Based on property owner participation

Hazard Addressed: Flooding

Benefit: Eliminate repetitive cost of flood damage to existing buildings

Potential funding source: FMA, PDM, HMGP, and existing budget

Schedule: Continuous as funding becomes available

Status: Ongoing: Red Bank will continue to pursue this preferred action as resources allow.

2. *Routinely clean debris from support bracing under bridges*

Responsible Agency: Public Works: Storm Water Specialist

Priority: High

Cost Estimate: Existing staff

Hazard Addressed: Flooding

Benefit: Reduce backup flooding on the north east portion of Stringer's Branch

Potential funding source: existing budget

Schedule: Continuous

Status: New action-Ongoing cleanup of debris has mitigated flooding in and around Forsythe St, Brentwood Dr., Orlando Dr., East Daytona Dr., Ormand Dr., Paulmar Dr., and Barker Rd.

3. *Increase scrutiny of proposed development of floodplain areas*

Responsible Agency: Public Works: City Building Official

Priority: High

Cost Estimate: existing staff

Hazard Addressed: Flooding

Benefit: Increase ability to guide responsible development in sensitive areas. Improve public information

Potential funding source: existing budget

Schedule: New action

4. *Reduce impact of sanitary sewer system overflow along Lyndon Avenue during periods of heavy and prolonged rainfall*

Responsible Agency: Hamilton County WWTa/City of Red Bank Public Works

Priority: High

Cost Estimate: based on site specific needs assessment

Hazard Addressed: Flooding, severe storm

Benefit: water quality improvement, flood protection

Potential funding source: existing budgets

Schedule: under development

Status: New action-The Public Works Department has met with the Hamilton County WWTa and identified sources of storm water intrusion into the sanitary sewer system which causes manhole overflow during heavy rains. This is due to the reduction of pipe sizes along Lyndon Avenue. A plan has been developed to mitigate the problem.

Signal Mountain:

Objectives

1. Reduce the occurrence of power and communication outages, and traffic disruptions due to severe winds. (Due to fallen trees and utility lines.)
2. Increase the capacity to support vulnerable population in the event of natural disasters and /or utility service disruption
3. Reduce the occurrence of mudslides and erosion.
4. Implement Fire Adapted Communities Standards for reduction in wildland fire risk.

Preferred Actions

1. *Evaluate the feasibility of underground utilities, scheduled tree trimming and removal of dead trees in ROW.*

Responsible Agency: Individual Utility Companies, Town of Signal Mountain

Priority: High

Cost Estimate: Based on work identified

Hazard Addressed: Severe storm, winter storm

Benefit: Eliminate the cost of repetitive repair of new utility infrastructure and traffic disruptions caused by frequent weather related events.

Potential funding source: PDM, HGMP, utility companies, existing budget

Schedule: Within 2 years (2021)

Status: Ongoing: Signal Mountain has implemented an annual tree removal plan for trees in the ROW that cause a risk. Signal Mountain has chosen to continue efforts to complete this action.

2. *Identify vulnerable population and establish procedures and locations for emergency shelter in the event of natural disaster and/or utility service disruption.
Example: Alexian Village and campus*

Responsible Agency: Hamilton County Office of Emergency Services, Town of Signal Mountain, American Red Cross

Priority: High

Cost Estimate: Existing staff time

Hazard Addressed: All hazards

Benefit: Increase capacity, utilization, and coordination of local resources in support of

vulnerable population, protect health and safety of local residents.

Potential funding source: PDM, existing budget

Schedule: Within 2 years (2020)

Status: Ongoing-Signal Mountain is working with the American Red Cross to identify shelter locations. Signal Mountain will continue efforts to complete this action.

3. *Identify and map areas susceptible to landslide and erosion and prevent runoff into area streams.*

Responsible Agency: Stormwater Utility, Hamilton County GIS, NRCS, UTC Department of Geology

Priority: Medium

Cost Estimate: Create Stormwater Manager Position

Hazard Addressed: Landslide, erosion, severe storm

Benefit: Identify hazard for existing and future development

Potential funding source: PDM, existing budget

Schedule: Within 2 years (2020)

Status: Ongoing: Signal Mountain has created and filled the stormwater manager position. The town is continuing efforts to address the erosion and stormwater issues.

4. *Introduce and Implement Fire Adaptive Communities Standard*

Responsible Agency: Town of Signal Mountain Fire and Public Works Departments TN Division of Forestry

Priority: High

Hazard Addressed: Wildfire

Cost Estimate: Based program needs

Benefit: Prepare homeowners and business owners to reduce the wildfire threat

Potential funding source: TN Dept. of Forestry, existing town budget

Schedule: Within 3 years (2022)

Status: New action: Adopting a Wildland Urban Interface ordinance, working jointly with TN Div. of Forestry on public awareness and education. Identifying wildfire prone areas of community

Soddy-Daisy

Objectives:

1. Reduce and mitigate erosion
2. Mitigate repetitive loss properties
3. Mitigate areas that flood

1. Little Soddy Creek (from railroad creek bridge west of Back Valley Road to Soddy Embayment)

Restore shoreline to stop erosion, clean out and re-channel to improve capacity due to buildup of silt and debris

Responsible Agency: TDEC, TVA, Army of Corps of Engineers, City of Soddy-Daisy

Priority - High

Cost Estimate - Based on feasibility study

Hazard Addressed: Flooding, erosion

Benefit - To stop erosion of present roadway that is in immediate danger of being washed away, reduce possibility of flooding new and existing buildings and infrastructure, and to reduce the possibility of flooding of business district.

Potential Funding Source – USDA Emergency Watershed Protection Program

Schedule: complete by 2021

Status: The area for mitigation was extended from the Masonic Lodge to the railroad creek bridge just west of Back Valley Road. The U.S. Department of Agriculture has approved grant funding for an Emergency Watershed Protection Program (EWPP) project to repair watershed damages and impairments along Little Soddy Creek due to the massive flooding in 2018.

2. **Soddy Lake Embayment**

Dredge excessive siltation from storm or heavy rain runoff; remove garbage, trees and brush from Soddy Lake between Dayton Pike and Highway 27

Responsible Agency - TVA, TDEC, City of Soddy-Daisy

Priority - High

Cost Estimate - Based on feasibility and engineering studies

Hazard Addressed: Flooding, erosion

Benefit - To eliminate continued flooding of business district due to silting and debris which impedes effluent from Little Soddy Creek

Potential Funding Source - FEMA, Federal and State Mitigation funds, and local taxes

Schedule: determined by project approval from the Tennessee Department of Environment and Conservation (TDEC)

Status: Ongoing

3. **Poe Branch**

Clean out garbage and brush to alleviate flooding of Daisy Dallas Road, distance being from Bean Street to Harrison Lane. Updated to “Remove garbage, brush, beaver dams and excessive silt to alleviate flooding from North Card Road to the North Chickamauga Creek”

Hazard Addressed: Flooding

Responsibility Agency – TDEC, TDOT, and the City of Soddy-Daisy,

Priority - High

Cost Estimate - Existing Staff

Benefit - To alleviate flooding of Maple Street, Card Road, Rock Quarry Road, Vine Street, Daisy Dallas Road and new and existing buildings and infrastructure around Pottery Lane, Church Street and Kingsboro Street

Potential Funding Source - Existing local budget

Schedule: determined by project approval from the Tennessee Department of Environment and Conservation (TDEC)

Status: Revised area for mitigation/ongoing

4. **Big Soddy Creek**

Re-channel and dredge Creek west of Dayton Pike

Updated to “Dredge creek, remove garbage and brush from Soddy Embayment to Back Valley Road”

Responsible Agency - TDEC, TVA, Army Corps of Engineers, City of Soddy-Daisy

Priority - High

Cost Estimate - Based on engineering design and study

Hazard Addressed: Flooding, erosion

Benefit - To protect two bridges and roadway that are in immediate danger of being washed away and to alleviate flooding upstream

Potential Funding Source - FEMA, Federal and State Mitigation funds, and local taxes

Schedule: determined by project approval from the Tennessee Department of Environment and Conservation (TDEC)

Status: Ongoing

5. Big Soddy Creek

Seek grant to purchase residential structure

Responsible Agency - FEMA, TDEC, Army Corps of Engineers, City of Soddy-Daisy

Priority - Medium

Cost Estimate - \$150,000 to \$200,000

Hazard Addressed: Flooding, erosion

Benefit - Stabilization of the shoreline or embankment would be more costly than the purchase of the residence.

Potential Funding Source - FEMA, Federal and State Mitigation funds, and local taxes

Schedule: 2022

Status: Ongoing

6. Lake Carolyn and Echo Lane

Remove garbage, brush, beaver dams, and excessive silt to alleviate flooding on Lake Carolyn Lane and Echo Lane

Responsible Agency - FEMA, TDEC, Army Corps of Engineers, City of Soddy-Daisy

Priority - High

Cost Estimate – based on engineering study

Hazard Addressed: Flooding

Benefit – Alleviate flooding of existing buildings and infrastructure

Potential Funding Source - FEMA, Federal and State Mitigation funds, and local taxes

Schedule: as funding becomes available

Status: New action

7. North Chickamauga Creek

Seek grant to purchase residential structure along with creek bank stabilization using gabion baskets

Responsible Agency - FEMA, TDEC, Army Corps of Engineers, City of Soddy-Daisy

Priority - High

Cost Estimate - \$150,000 to \$200,000 for the structure/bank stabilization based on

engineering study

Hazard Addressed: Flooding, erosion

Benefit – Control streambank erosion to protect existing structures and roadway

Potential Funding Source - FEMA, Federal and State Mitigation funds, and local taxes

Schedule: 2022

Status: Added creek stabilization to the action/ongoing

Soddy-Daisy - Completed Actions

Objectives

1. Protect stream banks from erosion; minimize future damage to North Chickamauga Creek banks and bridges.

The City received a grant from FEMA in the amount of \$1,300,000 to stabilize the creek banks and re-channel over 2,000 feet of the creek. Gabion baskets were installed on the North West side of the creek (adjacent to the Willow Creek Subdivision) for 700 feet and on the northeast side of Dayton Pike Bridge adjacent to the Industrial Park for 325 feet. Total cost of project to include in-kind services is estimated to be \$1,600,000.

The City also was the recipient of a USDA, NFC grant in the amount of \$180,000 that was used to purchase and remove a residence that was in immediate danger of falling into the Creek.

Continuation of bank stabilization is needed and the re-channeling of the creek bed for approximately 2,000 feet on both side of the stream bank using gabion baskets and natural plantings.

Walden

Objectives

1. Reduce the occurrence of power and communication outages.
2. Increase resilience to wildfire
3. Reduce the occurrence of mudslides and erosion.

Preferred Actions

1. *Evaluate the feasibility of underground utilities*

Responsible Agency: To be determined, EPB, South Central Bell

Priority: High

Cost Estimate: Based on feasibility study

Hazard Addressed: Severe storm, winter storm

Benefit: Eliminate the cost of repetitive repair to new and existing utility infrastructure caused by frequent weather related events.

Potential funding source: PDM, HGMP, EPB, South Central Bell existing budget

Schedule: Ongoing with new development

Status: Deferred: Walden has chosen to continue efforts to complete this action.

2. *Identify vulnerable population and establish procedures and locations for emergency shelter in the event of natural disaster and/or utility service disruption.*

Responsible Agency: Hamilton County Office of Emergency Management, Town of Walden

Priority: High

Cost Estimate: Existing staff time

Hazard Addressed: All hazards

Benefit: Increase capacity, utilization, and coordination of local resources in support of vulnerable population, protect health and safety of local residents.

Potential funding source: PDM, existing budget

Schedule:

Status: Complete in coordination with HCOEM and the Red Cross

3. *Identify and map areas susceptible to erosion/landslide.*

Responsible Agency: Hamilton County GIS, NRCS, CHCRPA, UTC Department of Geology

Priority: Medium

Cost Estimate: Existing staff

Hazard Addressed: Landslide, erosion

Benefit: Avoid development of new buildings and infrastructure in hazardous areas; notify residents in potentially hazardous areas

Potential funding source: Existing budget

Schedule: Continuous

Status: Walden has chosen to continue efforts to complete this action

4. *Participate in Firewise program*

Responsible Agency: Walden's Ridge Volunteer Fire, HCOEM

Priority: High

Cost Estimate: Existing staff time

Hazard Addressed: Wildfire

Benefit: Protect property and life from the wildfire

Potential funding source: NFPA grant, existing budget

Schedule: 2019 to continuous

Status: New action

Unincorporated County

Objectives

1. Remediate areas and structures that experience repeated flooding
2. Encourage conservation and/or responsible development of flood and erosion hazard areas to protect new and existing buildings and infrastructure
3. Erosion protection along sections of several creeks in the northern area of Hamilton County.

4. Implement Fire Adapted Communities Standards for reduction in wildland fire risk.

Preferred Actions

1. *Acquire funds to acquire and demolish severe repetitive and repetitive loss properties*

Responsible Agency: Hamilton County Public Works: Engineering, HCOEM

Priority: High (SRL priority)

Cost Estimate: Based on property owner participation

Hazard Addressed: Flooding, erosion

Benefit: Relocation/Removal is more cost effective than repeated losses

Potential funding source: FMA, PDM, HMGP, existing budget

Schedule: Continuous as funding becomes available

Status: Ongoing

2. *Map channel migration hazard areas and implement development restrictions in susceptible areas.*

Responsible Agency: Hamilton County GIS, NRCS

Priority: High

Cost Estimate: Existing staff time

Hazard Addressed: Flooding, erosion

Benefit: Improve water quality; reduce exposure of new and existing development to erosion hazard

Potential funding source: PDM, existing budget

Schedule: Continuous

Status: Ongoing

3. *Strengthen stormwater management ordinance and adopt best practices*

Responsible Agency: Public Works: Stormwater Management

Priority: High

Cost Estimate: existing staff time

Hazard Addressed: Flooding, erosion

Benefit: Improve regulatory authority, reduce vulnerability of new buildings and infrastructure, and improve water quality, decrease rate and volume of rainfall runoff.

Potential funding source: Existing budget

Schedule: Continuous

Status: Ongoing

4. *Address erosion and landslide Roberts Mill Road from Levi Road east to the Bens in Falling Water Creek*

Responsible Agency: Hamilton County Public Works: Engineering

Priority: Medium

Cost Estimate: \$428,000

Hazard Addressed: Flooding, erosion

Benefit: Remedy chronic flooding of this area

Potential funding source: Existing budget

Schedule: Within 5 years (2016)

Status: Completed. Landslide and erosion hazard mitigated with repairs (resolution #602-38)

5. *Raise Hunter Road in the 5800 address area.*

Responsible Agency:

Priority: Medium

Cost Estimate: Based on feasibility study

Hazard Addressed: Flooding

Benefit: Remedy chronic flooding of this area

Potential funding source: PDM, existing budget

Schedule: Within 3 years (2022)

Status: Ongoing

7. *Participate in Firewise program*

Responsible Agency: Volunteer Fire Department, HCOEM

Priority: High

Cost Estimate: Existing staff time

Hazard Addressed: Wildfire

Benefit: Protect property and life from the wildfire

Potential funding source: NFPA grant, existing budget

Schedule: 2019 (continuous)

Status: New action

Hamilton County Department of Education

Objectives:

1. Prepare the school population and surrounding community residents to survive a tornado.
2. Reduce the need to draw on critical services during a tornado emergency.
3. Mitigate flooding at Soddy Daisy Elementary
4. Prepare Vulnerability Assessment for each school campus

1. *Construct safe community rooms or corridors in new and/or existing schools to provide students and community residents protection from tornado force winds*

Responsible Agency: Hamilton County Department of Education

Priority: High

Cost Estimate: based on existing facility needs, included in the budget for new construction

Hazard Addressed: Tornado, severe storm

Benefit: Provide protection for school populations and community members during a tornado event.

Potential funding source: Existing budget for new construction, PDM, HMGP, for retrofit of existing facilities

Schedule: Ongoing

Status: Ongoing-Middle Valley Elementary was built in 2015-2016. A tornado/severe storm

shelter area was constructed on the first floor in the central part of the building.

2. *Improve stormwater infrastructure at Soddy Daisy Elementary*

Responsible Agency: HCDE, City of Soddy Daisy

Priority: High

Cost Estimate: \$20,000

Hazard Addressed: Flooding

Benefit: Provide protection of the school population and property from a heavy rain event.

Potential funding source: Existing budget for new construction,

Schedule: complete by 2021

Status: New action- HCDE has met with Soddy Daisy to install curbing along North Oak Street to direct runoff away from the school. Also planned is replacement of a 12 inch culvert with a 36 inch culvert to prevent backup of stormwater.

3. *Prepare a vulnerability assessment for each school campus*

Responsible Agency: HCDE, HCOEM

Priority: High

Cost Estimate: Existing staff time

Hazard Addressed: All hazards

Benefit: Development of appropriate and effective mitigation actions

Potential funding source: Existing budget

Schedule: complete by 2021

Status: New action

University of Tennessee at Chattanooga

Goal: Align mitigation efforts to address the top concerns identified in our Hazard Identification, Risk Assessment and Consequence Analysis (January 11, 2018)

1. *Upgrades to campus-wide alerting system*

Responsible Agency: UTC Emergency Services

Priority: High

Cost Estimate: \$40,000 annually

Benefit: Improve the ability to alert the campus population about potentially dangerous situations.

Potential funding source: University of Tennessee System

Schedule: Upgrade two buildings each year; complete campus by July 2035.

Status: Ongoing-Current system, built in 2011 with funds from the U.S. Department of Education, can send SMS text messaging, email, social media updates and visual text to wall-mounted units in select locations. Upgrades will include increased coverage of alert beacons, scrolling message boards, and desktop alert software. The most costly improvements will include changing out fire system devices to meet NFPA 72-2013 code.

2. *Construct safe rooms for protection from tornado force winds*

Responsible Agency: Safety and Risk Management/Emergency Management

Priority: Medium

Cost Estimate: \$5,000,000

Benefit: Provide protection for campus populations and community members during a tornado emergency.

Potential funding source: Federal Emergency Management Agency

Schedule:

Status: Deleted

3. Develop comprehensive Emergency Management Plans, including Hazard and Risk Assessment, Mitigation, Response and Recovery

Responsible Agency: Safety and Risk Management/Emergency Management

Priority: Medium

Cost Estimate: \$ No cost assigned

Benefit: Improving the workflow between campus and local emergency management officials allowing the campus to serve as a partner and a resource in local response.

Potential funding source: University of Tennessee

Schedule: 31 December 2012

Status: Complete

4. Improve evacuation and shelter signage.

Responsible Agency: UTC Emergency Services

Priority: High

Cost Estimate: \$30,000

Benefit: Improve awareness of evacuation routes, safety devices, and access to shelter areas.

Potential funding source: University of Tennessee at Chattanooga

Schedule: Complete by July 2022

Status: New action- Funding has not been allocated for this project.

5. Create and deploy SafeMOCS Training program.

Responsible Agency: UTC Emergency Services

Priority: High

Cost Estimate: \$20,000

Benefit: Provide education, training, and planning to campus students, faculty, and staff regarding our top hazards.

Potential funding source: University of Tennessee at Chattanooga

Schedule: As an outreach effort, we do not intend to cease these efforts.

Status: New action-Complete are branding, giveaways, and a schedule for education. Future efforts will improve training and outreach to large and vulnerable populations.

6. Develop and implement Continuity of Operation Plans (COOPs) with campus departments

Responsible Agency: UTC Emergency Services

Priority: Medium

Cost Estimate: Cost not assigned

Benefit: Improved ability to continue providing mission essential functions during the time of emergency preparations, response, and/or recovery.

Potential funding source: University of Tennessee at Chattanooga

Schedule: Began 2018.

Status: Ongoing-The goal is to assist two departments each year to complete their COOP.

7. Improve response communications by migrating the campus to the TVRS Public Safety Communications System

Responsible Agency: UTC Emergency Services

Priority: High

Cost Estimate: \$150,000

Benefit: Improved communications during the run-up to any forecasted emergency as well as during the response and recovery phase.

Potential funding source: Stimulus funds

Schedule: Project completed

Status: The campus has a cache of 170 radios that are equipped with interoperability talk groups. All legacy radio systems have been discontinued, with the exception of UTC Athletics, which remains for operational reasons related to team travel.

8. Development of Threat, Risk and Vulnerability Assessments with associated data gathering and upgrades to tactical emergency response plans.

Responsible Agency: Safety and Risk Management/Emergency Management

Priority: High

Cost Estimate: \$10,000

Benefit: Provide responders with information needed to quickly and accurately assess campus incidents resulting from natural or man-made events.

Potential funding source: US Department of Education

Schedule: 1 July 2012

Status: Completed

Chapter 5 – Monitoring, Evaluation, Updating the Plan, and Public Involvement

The Hamilton County Office of Emergency Management Agency (HCOEM) will chair a Mitigation Working Group (MWG) to monitor plan implementation for all participating jurisdictions. The MWG will meet annually to review new information, share success stories, and to continue development of new mitigation actions.

The HCOEM will work to facilitate expansion of the MWG to include representatives of local businesses and commercial interests, the academic community, citizen groups, and relevant government agencies. Updates to the plan will be posted on the HCOEM website for public review and comment. A notice of updates to the Plan, including a summary of the proposed update, will be provided to the local media for publication and to participating local governments. Comments from the public and participating governments will be solicited and the proposed update modified, as appropriate, to respond to these comments. Administrative changes, wording corrections, hazard analysis, or other such portions of the Mitigation Plan, should not require additional action by local elected bodies. However, changes that may have a significant impact or significant expenditure of non-budgeted funds may require action by respective elected bodies.

Thereafter, the plan will be updated every five (5) years or as necessary if new actions are developed by MWG. Plan updates will be submitted to the Tennessee State Hazard Mitigation Officer and FEMA for approval.

Changes in development, technology or the capability of local jurisdictions to implement the actions adopted in the plan could necessitate the need for revisions in the plan. There are many issues that the monitoring and evaluation process should include:

- The adequacy of jurisdiction resources to implement the strategies as adopted
- Any redundancy among strategies that can be eliminated to free-up resources
- Whether adequate funding is available for implementation of the strategies as adopted
- Any technical, legal or coordination problems associated with implementation
- Whether mitigation actions are being implemented according to the prioritization scope

However, the primary issue that monitoring and evaluation should address is whether vulnerability has decreased as a result of the actions adopted in the plan. Where vulnerability has decreased, the MWG will determine why and consider implementing successful mitigation actions in other locations. Where vulnerability has remained constant or increased, the MWG will identify whether additional measures might be more successful or whether revisions should be made to existing measures.

As previously noted, changes in development, technology or the capability of the planning area to implement the strategies adopted in the plan could alter the ability of the planning area to implement the mitigation strategies identified and adopted in their plan or could necessitate the need for new strategies to be identified. As a result, update and revision is a necessary part of the hazard mitigation planning process. While monitoring and evaluation are ongoing processes, update and revision will occur at regularly scheduled intervals.

Implementation through Existing Programs

Hamilton County and local jurisdictions address planning goals and legislative requirements through its Land Use Plans, Flood Hazard Ordinances, Stormwater Management Plans, Zoning Ordinances, Building Codes, and Capital Improvement Plans. The Hamilton County Natural Hazards Mitigation Plan provides a series of goals, objectives, and actions that are closely related to the goals and objectives of these existing planning programs. Hamilton County and local jurisdictions will have the opportunity to implement adopted mitigation strategies through existing programs, procedures and land use plan updates.

Land Use Plans are updated on a cyclical basis and will incorporate information from the NHMP as appropriate. As an example, the Comprehensive Plan 2030 prepared in 2006, incorporated information from the NHMP (2005) and development trend reports prepared by the agency incorporated information from the plan to highlight areas that may have special considerations to address in the process of development.

Plans currently maintained by the CHCRPA include: Avondale (2004), Alton Park (2000), Brainerd Hills Plan (2002), Brainerd Road / Lee Highway Revitalization Plan (1994), Brainerd Town Center (1998), Bush town (2000), Comprehensive Plan 2030 (in progress), Downtown (2004), East Brainerd (1990), East Brainerd Corridor Community Plan (2003), East Chattanooga Area Plan (2004), Eastdale (1998), Glenwood / Churchville / Orchard Knob Neighborhood Plan (2002), Hamilton Place Community Plan (2000), Highland Park (2000), Highway 58 Community Plan (2002), Hill City - Northside (2003), Hixson - North River Community Plan (2004), Lookout Valley (2003), Mountain Creek Greenway Plan (2003), North Brainerd Area Plan (2004), North Suburban Area (1991), Oak Grove Neighborhood Plan (2004), Ridgedale (1998), Rossville Boulevard Community Plan (2004), Shallowford Road - Lee Highway Area Plan (2005), Soddy-Daisy Comprehensive Plan 2020, Southside (1997), St. Elmo (2001) 2020 Plan (2001), TransPlan 2030, Comp Plan 2030.

Enhancing Public Involvement

Traditional media, such as newspaper will still be used to notify the public of significant events related to the plan. However the rise of social media presents a unique opportunity to engage the public in the planning process. HCOEM has developed an enhanced website that will include the ability to provide valuable mitigation information, as well as to solicit public involvement in the planning process. HCOEM social media accounts can also be used to disseminate information. The public will be kept informed of proposed changes, modifications, reviews, and updates to the plan by advertising that such updates, modifications, and reviews are being considered.

Appendix

Definitions

(Not all terms are used in the current version of the plan, but are included for future reference)

Annual Flood:

The maximum discharge peak during a given water year (October 1 - September 30).

Attenuation:

The process where the flood crest is reduced as it progresses downs

Backflow:

The backing up of water through a conduit or channel in the direction opposite to normal flow.

Backwater Flooding:

Upstream flooding caused by downstream conditions such as channel restriction and/or high flow in a downstream confluence stream.

Bankfull Stage/Elevation:

An established river stage/water surface elevation at a given location along a river that is intended to represent the maximum water level that will not overflow the riverbanks or cause any significant damages from flooding.

Base Flood:

The national standard for floodplain management is the base, or one percent chance flood. This flood has at least one chance in 100 of occurring in any given year. It is also called a 100-year flood.

Daily Flood Peak:

The maximum mean daily discharge occurring in a stream during a given flood event.

Detention Basins:

Structures that are built upstream from a populated area so that precipitation flows do not flood and cause the loss of life or property. They are normally dry, but are designed to detain surface water temporarily during, and immediately after a runoff event. Their primary function is to attenuate the storm flows by releasing flows at a lower flow rate. There are no gates or valves allowed on the outlet so that water can never be stored on a long-term basis. Typical detention times in such a basin would be on the order of 24 to 72 hours although some are as long as 5 to 10 days.

Drought:

A period of abnormally dry weather sufficiently prolonged from the lack of precipitation to cause a serious hydrologic imbalance.

Drought Index:

Computed value that is related to some of the cumulative effects of a prolonged and abnormal moisture deficiency. (An index of hydrological drought corresponding to levels below the mean in streams, lakes, and reservoirs.)

Dry Floodproofing:

A dry flood proofed building is sealed against floodwaters. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings like doors windows, sewer lines and vents are closed, whether permanently, with removable shields, or with sandbags. The flood protection level should be no more than 2 or 3 feet above the top of the foundation because the buildings walls and floors cannot withstand the pressure of deeper water.

Wet Floodproofing:

An approach to flood proofing that usually is a last resort. Floodwaters are intentionally allowed into the building to minimize water pressure on the structure. Wet Floodproofing can include moving a few valuable items to a higher place or completely rebuilding the floodable area. Wet flood proofing has an advantage over other approaches: no matter how little is done, flood damage will be reduced. Thousands of dollars in damage can be avoided just by moving furniture and appliances out of the flood-prone area.

Flash Flood:

A flood which follows within a few hours (usually less than 6 hours) of heavy or excessive rainfall, dam or levee failure, or the sudden release of water impounded by an ice jam.

Flash Flood Guidance (FFG):

An internal product produced by the RFC's containing rainfall threshold values that must be exceeded in order to produce a flash flood.

Flash Flood Statement (FFS):

A statement by the NWS, which provides follow-up information on flash flood watches and warnings.

Flash Flood Table:

A table of pre-computed forecast crest stage values for small streams for a variety of antecedent moisture conditions and rain amounts. Soil moisture conditions are often represented by flash flood guidance values. In lieu of crest stages, categorical representations of flooding, e.g., minor, moderate, etc. may be used on the tables.

Flash Flood Warning (FFW):

A warning by the NWS issued to warn of flash flooding that is imminent or occurring.

Flash Flood Watch (FFA):

A statement by the NWS that alerts communities to the possibility of flash flooding in specified areas

Flood:

The inundation of a normally dry area caused by high flow, or overflow of water in an established watercourse, such as a river, stream, or drainage ditch; or ponding of water at or near the point where the rain fell. This is a duration type event with a slower onset than flash flooding, normally greater than 6 hours.

Flood Control Storage:

Storage of water in reservoirs to abate flood damage.

Flood Crest:

The Maximum height of a flood wave as it passes a location.

Flood Frequency Curve:

(1) A graph showing the number of times per year on the average, plotted as abscissa, that floods of magnitude, indicated by the ordinate, are equaled or exceeded. (2) A similar graph but with recurrence intervals of floods plotted as abscissa.

Flood Loss Reduction Measures:

The strategy for reducing flood losses. There are four basic strategies. They are prevention, property protection, emergency services, and structural projects. Each strategy incorporates different measures that are appropriate for different conditions. In many communities, a different person may be responsible for each strategy.

Flood of Record:

The highest observed river stage or discharge at a given location during the period of record keeping. (Not necessarily the highest known stage.)

Flood Plain:

The portion of a river valley that has been inundated by the river during historic floods.

Flood Plain Information Studies:

Reports usually prepared by the U.S. Army Corps of Engineers (USACE) following a survey of a flood-impacted community.

Flood Potential Outlook (ESF on AFOS) (FPO for Acronym):

An NWS outlook that is issued to alert the public of potentially heavy rainfall that could send area rivers and streams into flood or aggravate an existing flood.

Flood Prevention:

Measures that are taken in order to keep flood problems from getting worse. Planning, land acquisition, river channel maintenance, wetlands protection, and other regulations all help modify development on floodplains and watersheds to reduce their susceptibility to flood damage. Preventive measures are usually administered by the building, zoning, planning and/ or code enforcement offices of the local government.

Flood Problems:

Problems and damages that occur during a flood as a result of human development and actions. Flood problems are a result from: **1)** Inappropriate development in the floodplain (e.g., building too low, too close to the channel, or blocking flood flows); **2)** Development in the watershed that increases flood flows and creates a larger floodplain or; **3)** A combination of the previous two.

Flood Profile:

A graph of elevation of the water surface of a river in flood, plotted as ordinate, against distance, measured in the downstream direction, plotted as abscissa. A flood profile may be drawn to show elevation at a given time, crests during a particular flood, or to show stages of concordant flows.

Flood Routing:

Process of determining progressively the timing, shape, and amplitude of a flood wave as it moves downstream to successive points along the river.

Flood Stage:

A gage height at which a watercourse overtops its banks and begins to cause damage to any portion of the defined reach. Flood stage is usually higher than or equal to bankful stage.

Flood Statement (FLS):

A statement issued by the NWS to inform the public of flooding along major streams in which there is not a serious threat to life or property. It may also follow a flood warning to give later information.

Flood Warning (FLW):

A release by the NWS to inform the public of flooding along larger streams in which there is a serious threat to life or property. A flood warning will usually contain river stage (level) forecasts.

Flood Wave:

A rise in streamflow to a crest and its subsequent recession caused by precipitation, snowmelt, dam failure, or reservoir releases.

Floodproofing:

The process of protecting a building from flood damage on site. Floodproofing can be divided into wet and dry flood proofing. In areas subject to slow-moving, shallow flooding, buildings can be elevated, or barriers can be constructed to block the water's approach to the building. These techniques have the advantage of being less disruptive to the neighborhood. It must be noted that during a flood, a flood proofed building may be isolated and without utilities and therefore unusable, even though it has not been damaged.

Floodwall:

A long, narrow concrete or masonry embankment usually built to protect land from flooding. If built of earth the structure is usually referred to as a levee. Floodwalls and levees confine streamflow within a specified area to prevent flooding. The term "dike" is used to describe an embankment that blocks an area on a reservoir or lake rim that is lower than the top of the dam.

Floodway:

- (1) A part of the flood plain, otherwise leveed, reserved for emergency diversion of water during floods. A part of the flood plain which, to facilitate the passage of floodwater, is kept clear of encumbrances.
- (2) The channel of a river or stream and those parts of the flood plains adjoining the channel, which are reasonably required to carry and discharge the floodwater or flood flow of any river or stream.

Major Flooding:

A general term including extensive inundation and property damage. (Usually characterized by the evacuation of people and livestock and the closure of both primary and secondary roads.)

Moderate Flooding:

The inundation of secondary roads; transfer to higher elevation necessary to save property -- some evacuation may be required.

Minor Flooding:

A general term indicating minimal or no property damage but possibly some public inconvenience.

One Percent Chance Flood (One Hundred Year Flood):

flood magnitude that has one chance in 100 of being exceeded in any future 1-year period. The occurrence of floods is assumed to be random in time, or regularity of occurrence is implied. The exceeding of a 1-percent chance is no guarantee, therefore, that a similar size flood will not occur next week. The risk of experiencing a large flood within time periods longer than 1 year increases in a nonadditive fashion. For example, the risk of exceeding a 1-percent chance flood one or more times during a 30-year period is 25 percent and during a 70-year period is 50 percent.

Palmer Drought Severity Index:

An index whereby excesses or deficiencies of precipitation are determined in relation to average climate values. The index takes into account precipitation, potential and actual evapotranspiration, infiltration of water into the soil, and runoff.

Upstream Slope:

The part of the dam that is in contact with the reservoir water. On earthen dams, this slope must be protected from the erosive action of waves by rock riprap or concrete.

Urban Flash Flood Guidance:

A specific type of flash flood guidance, which estimates the average amount of rain needed over an urban area during a specified period of time to initiate flooding on small, ungaged streams in the urban area.

Urban Flooding:

Flooding of streets, underpasses, low lying areas, or storm drains. This type of flooding is mainly an inconvenience and is generally not life threatening.

Storm Hydrograph:

A hydrograph representing the total flow or discharge past a point.

Stormwater Discharge:

Precipitation that does not infiltrate into the ground or evaporate due to impervious land surfaces but instead flows onto adjacent land or water areas and is routed into drain/sewer systems.

Regulatory Floodway:

Some maps show an area where construction regulations require special provisions to account for this extra hazard. This is a regulatory floodway

Recurrence Interval:

The average amount of time between events of a given magnitude. For example, there is a 1% chance that a 100- year flood will occur in any given year.

Reach:

The distance between two specific points outlining that portion of the stream, or river for which the forecast applies. This generally applies to the distance above and below the forecast point for which the forecast is valid.

Problem Flood Areas (Flash Flood)

Chattanooga

Stormwater

1. Brown's Ferry Road @ Parker Lane
2. Astor Avenue near pump station
3. Wauhatchie Pike @ Cummings Road
4. North Moss Avenue @ Center Street
5. Manning Street @ Stringer Street
6. Mountain Creek Road @ Cross Street (private)
7. Brown's Ferry Road @ Waterfront Drive
8. Dayton Boulevard and Old Dayton Pike
9. 680 Signal Mountain Road
10. Cummings Highway (Broad Street to Church Street)
11. Church Street (Cummings Highway to West 38th Street)
12. West 38th Street (St. Elmo Avenue to Dead End)
13. Main Street @ Railroad Underpass
14. Vine Street (Georgia Avenue to Douglas Street)
15. Market Street (4th Street to 8th Street)
16. 10th and 11th Streets (Park Avenue to Douglas Street)
17. West 33rd Street (Between Broad Street and Alton Park Blvd.)
18. 20th Street @ Washington Street
19. 800 Hooker Road
20. Workman Road
21. 900 East 11th Street
22. 1500 East 23rd Street
23. Rossville Boulevard (Interstate 24 area)
24. 23rd Street @ 4th Avenue
25. Forest Plaza Subdivision
26. Birmingham Drive
27. Atlanta Drive
28. Memphis Drive
29. 109 Valleybrook Road
30. Valleybrook Subdivision
31. 409 Valleybrook Road
32. Gadd Road @ Hixson Recreation Center
33. Adams Road @ Crescent Club Drive
34. Grubb Road @ School Drive
35. Boy Scout Road
36. Austin Road @ Orchard Business Park
37. 1499 Lower Mill Road
38. 1244 Village Green Drive
39. 5613 Winding Lane
40. 1317 Windbrook Lane
41. 4121 Hixson Pike
42. Highway 153 and Hamil road

43. Ely Road and Delashmitt Road
44. Taylor Street and Dodson Avenue
45. Amnicola Highway and Crotchfield Street
46. Shallowford Road and Wilcox Boulevard
47. Lyerly Street @ Ivy Street
48. 3510 and 3515 Taylor Street
49. Brainerd Road @ Brainerd Village
50. Brainerd Road @ East Brainerd Road
51. Chickamauga Road
52. Brainerd Road @ Provence Street
53. Dodson Avenue and 3rd Street
54. Brainerd section of town bounded by the Brainerd Levee on the east, Kenwood on the west, Interstate 24 on the south, to Brainerd High School on the north
55. Lee Highway and Shallowford Road (between Robinson Drive and Jordan Drive)
56. Hickory Valley Road @ Hickory Brook Drive
57. Davidson Road @ Mackey Road
58. East Brainerd Road @ Mackey Avenue
59. 7000 block of Lee Highway
60. 520 and 900 Airport Road
61. 7300 Standifer Gap Road
62. 7200 Noah Reid Road
63. Bonny Oaks Drive @ Redlands Drive
64. Bonny Oaks Drive @ Jersey Pike
65. Hickory Brook Road
66. Noah Reid Road @ Shallowford Road
67. Oakwood Drive @ Highway 58
68. Oakwood Drive @ Jersey Pike
69. Standifer Gap @ Friars Branch
70. 2330 Hickory Valley Road
71. Alton Park Area (Polk, Fagan, and Dorris Streets)
72. Preston Circle

Waste Resources

1. Combined Sewer System and related CSO Facilities
2. South Chickamauga Creek Interceptor Sewer and related collection sewers
3. North Chickamauga Creek Interceptor Sewer and related collection sewers
4. Mountain Creek Interceptor Sewer and related collection sewers
5. Chattanooga Creek Interceptor Sewer and related collection sewers
6. Riverview sewers through Chattanooga Golf and Country Club
7. Engle Stadium area
8. Vine Street and Lindsey
9. 23rd Street
10. City Yards

Parks and Recreation

1. Culvert @ N. Chickamauga Creek Greenway ¼ mile north of Hamill Rd.
2. Culvert @ Rivermont Park @ driveway to Champions Club

3. Parking area @ Heritage Park
4. Tennis Courts, Fieldhouse @ Warner Park
5. Landscaping @ Coolidge Park
6. Structure & Playing Field @ Engel Stadium

Soddy-Daisy

1. Chickamauga Creek Bridge
2. Dayton Pike
3. Daisy Dallas Road
4. O'Sage Drive

East Ridge

1. Severe over bank flooding of Spring Creek
2. Upstream of Ringgold Rd along Springvale Rd
3. Upstream of Spring Creek Rd along Graston Ave, Wentworth Avenue, and Wellworth Avenue.
4. Downstream of Ringgold Rd along Swope Drive, Oakdale Avenue, West End Avenue, Marion Avenue, Pleasant Street, Connell Street, and Merida Street.

Collegedale

1. 4-Corners Intersection
2. Tucker Road
3. Old Camp Road
4. Sunrise Meadows Subdivision
5. Landrum Subdivision
6. Tallent and Edgmon Road

Red Bank

1. Memorial Drive Bridge at Dayton Boulevard/Lyndon Avenue

Signal Mountain

1. Headwater flooding across US 127
- 2.

Unincorporated County

1. Middle Valley Road between Eagle Drive and Thrasher Pike
2. Roberts Mill Road from Levi Road east to the bend in Falling Water Creek
3. Mackey Branch from Standifer Gap Road to Shallowford Road
4. Hunter Road in the 5800 address area
5. Erosion along Rock Creek and Falling Water Creek

Natural Hazards Internet Resources: A Guide for Hamilton County Communities

With the rapid expansion of information available on the Internet, the search for information on a specific topic is often laborious and frustrating. This guide provides a listing of pertinent natural hazards web pages in an effort to make the search for hazards information easier. Web pages are included with the potential use of local government officials and community leaders in mind. Web page citations include the title, web page address, and a brief description. Web pages are grouped into the following categories:

- **Natural Hazards Preparedness:** Includes web pages dedicated to disaster planning, safety tips and contingency planning.
- **Natural Hazards Response:** Includes web pages of organizations dedicated to immediate response in the wake of a natural disaster.
- **Natural Hazards Mitigation:** Includes web pages dedicated to reducing the vulnerability of properties and lives to repetitive loss due to successive natural hazards events.
- **Natural Hazards Information:** Includes web pages that generally describe natural hazards.
- **Natural Hazards Literature:** Includes web pages that provide information on natural hazards publications, databases, networks, and other relevant links on the Internet.
- **Natural Hazards Research Tools:** Includes web pages that offer technical tools used for understanding the spatial and temporal characteristics of natural hazards and their impacts.
- **Specific Natural Hazards Categories:** Includes web pages dedicated to providing information and resources related to the following specific natural hazards: earthquakes, floods, weather hazards (with climate resources), and wildfire.

Natural Hazards Preparedness:

Tennessee Emergency Management Agency

<https://www.tn.gov/tema.html>

Hazard information for the state of Tennessee

Hamilton County Office of Emergency Management

www.hamiltonready.org

USA Today: Natural Disaster Safety Tips

<http://www.usatoday.com/weather/wsaf0.htm>

General information about natural hazard event preparedness, including links to key state/federal web sites.

DERA: Disaster Preparedness and Emergency Response Association

<http://www.disasters.org/>

Disaster preparedness information in several languages.

Institute for Business and Home Safety

<http://www.ibhs.org/>

Resource for insurers and reinsurers to reduce harm caused by natural disasters.

Southern Building Code Congress International

<http://www.sbcci.org/>

Building Code technical, educational, and administrative support for government agencies.

FEMA

<http://www.fema.gov/plan/prevent/property.shtm>

Small Business Administration: Disaster Information

<https://www.sba.gov/funding-programs/disaster-assistance>

Disaster preparedness and recovery information focused on small businesses, including disaster loan program.

Natural Hazards: Response:

American Red Cross

<http://www.redcross.org/>

National relief agency for victims of natural and man-made disasters in the United States.

Salvation Army: Southern Region

http://www.uss.salvationarmy.org/uss/www_uss.nsf

National relief agency for victims of natural and man-made disasters in the United States.

US FEMA: Federal Emergency Management Agency

<http://www.fema.gov/>

Homepage for the Federal Emergency Management Agency: Current information and links.

Natural Hazards Information:

USGS: Natural Hazards Gateway

<http://www.usgs.gov/hazards/>

Natural Hazards Research and Information Center: Natural Hazards Observer

<http://www.colorado.edu/hazards/o/>

Newsletter of the Natural Hazards Research and Applications Information Center.

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Natural Hazards Literature:

National Hazards Research and Applications Information Center:

Bibliography

<http://www.colorado.edu/hazards/library/>

Bibliography of social science literature focusing on natural disaster preparation, recovery and mitigation.

FEMA: US Fire Administration

<https://www.usfa.fema.gov/>

Bibliography and on-line report access to technical issues related to fire.

Natural Hazards Research Tools:

Tennessee Geographic Information Resources

<http://www.tngis.org/>

Geographic information for Tennessee.

Geologic Hazards

Center for Earthquake Education and Research

<http://www.ceri.memphis.edu/>

Public information, seismic data, and links from the University of Memphis.

American Red Cross: Earthquake Preparedness

<http://www.crossnet.org/disaster/safety/earth.html>

Earthquake preparedness information.

Building Seismic Safety Council

<https://www.nibs.org/page/bssc>

Organization responsible for developing and promoting building earthquake risk mitigation regulatory provisions.

USGS: Earthquake Hazards and Preparedness

<http://quake.wr.usgs.gov/hazprep/index.html>

Information on earthquake hazards, preparedness and fact sheets on scientific research.

USGS: Natural Hazards

https://www2.usgs.gov/natural_hazards/

USGS information on geologic hazards, including earthquakes and landslides.

USGS: Geologic Hazards: Landslides

<http://landslides.usgs.gov/landslide.html>

Landslide publications, research, and recent events.

Tennessee Stream Mitigation Project

<https://tsmp.us/>

Non-Profit that funds mitigation projects on degraded streams in Tennessee. Projects include stream restoration, bank stabilization, and riparian restoration.

Floods

Association of State Floodplain Managers

<http://www.floods.org/>

Organization interested in floodplain management, flood hazard mitigation, NFIP, and flood preparedness, warning and recovery.

Floodplain Management Association

<http://www.floodplain.org/>

Information on floodplains and general information on floods.

National Association of Flood and Stormwater Management Agencies

<http://www.nafmsma.org/>

Current information on legislative activity related to public policy on stormwater, flood control, watersheds and floodplains.

US Army Corps of Engineers

<http://www.usace.army.mil/>

Homepage for the U.S. Army Corps of Engineers: Current information and links.

FEMA: National Flood Insurance Program (NFIP)

<http://www.fema.gov/nfip/>

Homepage for FEMA's National Flood Insurance Program.

FEMA: National Flood Hazard Layer

<https://www.fema.gov/national-flood-hazard-layer-nfhl>

The National Flood Hazard Layer (NFHL) is a geospatial database that contains current effective flood hazard data. FEMA provides the flood hazard data to support the National Flood Insurance Program. You can use the information to better understand your level of flood risk and type of flooding. The simplest way for you to access the flood hazard data, including the NFHL, is through [FEMAs Map Service Center \(MSC\)](#).

USDA National Resource Conservation Service

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/>

Watershed protection and flood prevention resources

Weather Hazards/Climate Resources

Tornado Project

<http://www.tornadoproject.com/>

Comprehensive collection of tornado statistics and resources for meteorological interests and emergency managers.

NOAA: National Climatic Data Center

<http://www.ncdc.noaa.gov/>

Access to Climate data for the U.S., including surface data, radar and satellite data, plus climate extremes/weather event summaries.

NOAA: Southern Regional Climate Center

<http://www.sccc.lsu.edu/>

Climate services and data for the Southern U.S.

NOAA: National Hurricane Center: Tropical Prediction Center

<http://www.nhc.noaa.gov/>

Hurricane forecasts, as well as historical and general information, including a glossary of terms.

NOAA: Tornadoes: Nature's Most Violent Storms

<http://www.nssl.noaa.gov/NWSTornado/>

Background information on tornadoes, plus preparedness information.

NOAA: Weather Radio

https://www.nws.noaa.gov/nwr/coverage/station_listing.html

NOAA weather radio transmitter information for all fifty states and U.S. territories.

Wildfires/Drought

NFPA Firewise Program

<https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA>

Information for communities and property owners to mitigate wildfire

US National Interagency Fire Center

<http://www.nifc.gov/>

Current information on wildland fire, fire safety, and science/technology applications to fire fighting.

U.S. Fire Administration

<http://www.usfa.fema.gov/>

Response and mitigation agency for fire provides fire safety information related to hurricanes and floods.

NOAA Historical Palmer Drought Indices

<https://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers/>

National Integrated Drought Information System

<https://www.drought.gov/drought/states/tennessee>

Planning Process

January 25, 2018 sign in sheet and agenda

Name	Agency/Jurisdiction	e-mail
Thomas Hayes	Public Works	thayes@chattanooga.gov
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Gene Quinn	"	geneq@hamilton.gov
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Rudolf Sill	City of Red Bank	rsill@redbank.gov
Greg Smith	HCMA	gsmith@hamilton.gov
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Bert Johnson	City of Soddy-Daisy	Bert.johnson@soddy-daisy.org
Eric Nitchel	Signal Man	nitchel@chattanooga.gov

Agenda
Mitigation Plan Update/Debris Management Plan
1- 25-2018

1. Mitigation Plan Update

- Discuss Flooding/ Repetitive Loss Properties as a priority, Wildfire Mitigation post 2016, Sinkholes –need better information
- Provide contact to OEM to coordinate update process
- Review hazards and update risk assessment/priority/hazard profiles
- Review goals and objectives
- Update mitigation strategy and actions specific to each jurisdiction (current status) –new actions
- Draft Plan Complete/Public Meeting
- Final Draft review after public meeting/outreach

2. Debris Management Plan

- Hamilton County will submit the plan for FEMA approval.
- Review of FEMA Debris Management Plan Checklist/Tasks to complete
 - Debris quantity estimate for 2 events
 - -OEM has HAZUS debris estimate for flood
 - Tornado-Actual (2011/2012) or estimate based on USACE formula
 - Collection Methods-curb-side, collection points, etc.
 - Temporary Debris Management Collection Sites and Disposal Locations
 - Identify TDMS Locations
 - Traffic Circulation Plan
 - Capacity
 - Required permits-TDEC
 - Management of Debris if lack of landfill capacity
 - Identify final destination for disposal/recycle

 - Force Account/Contract Resources/Procurement
 - Definition of types of work performed by force account labor
 - Types of work performed by contractors
 - Contactor types and required qualifications
 - RFQ

Complete by March 1 2018 (5weeks)

LEPC Meeting sign in sheet and presentation (9-12-2018)

Hamilton County Local Emergency Planning Committee

Contact Info Changed	Name	Company/Agency	Email
✓	Amy Maxwell	HCOEM	amyjmc@hamiltontn.gov
	Daniel Hague	CEO	
	Tim Hawkins	DHS	Timothy.Hawkins@HQ.DHS.GOV
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	Sean Reynolds	Sofix	kelvin@sofix.net
	Jake Cooper	EPB	CooperWJ@epb.net
	Jack Gray	LAMBERT	jack.gray@lambert.com
	Sabrina Novak	Health	Sabrina.n@hamiltontn.gov
	Joshua Fraker	Southern University Safety	jfraker@southern.edu
	Maria Salend	Atty General	same

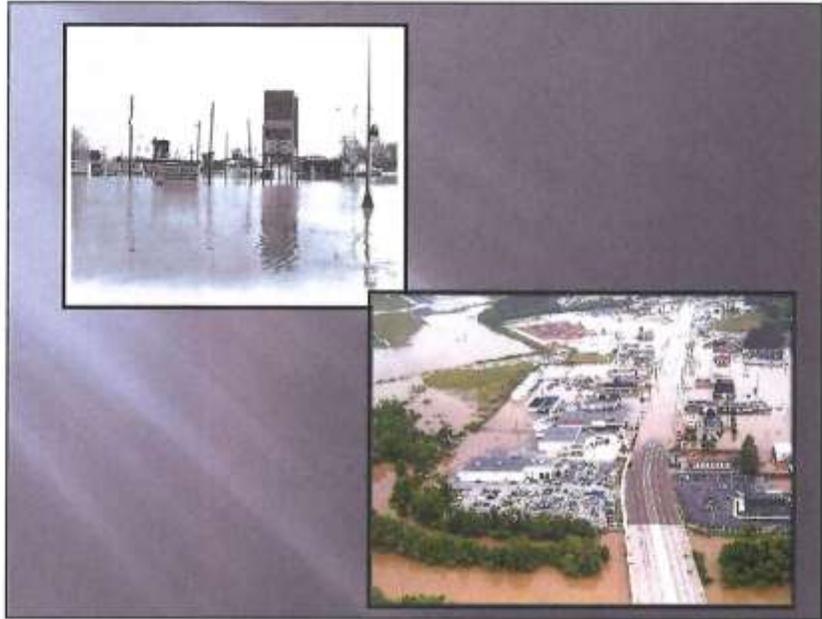
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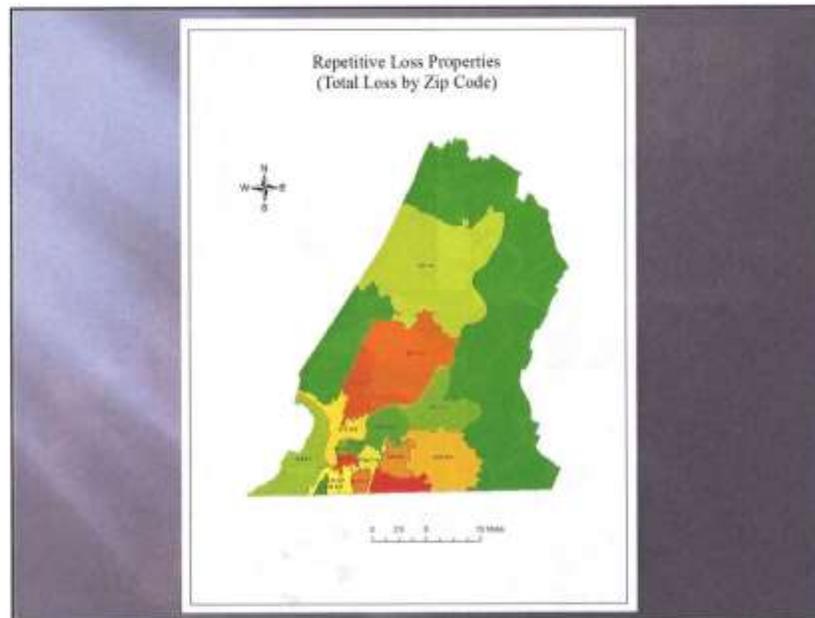
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Mitigation

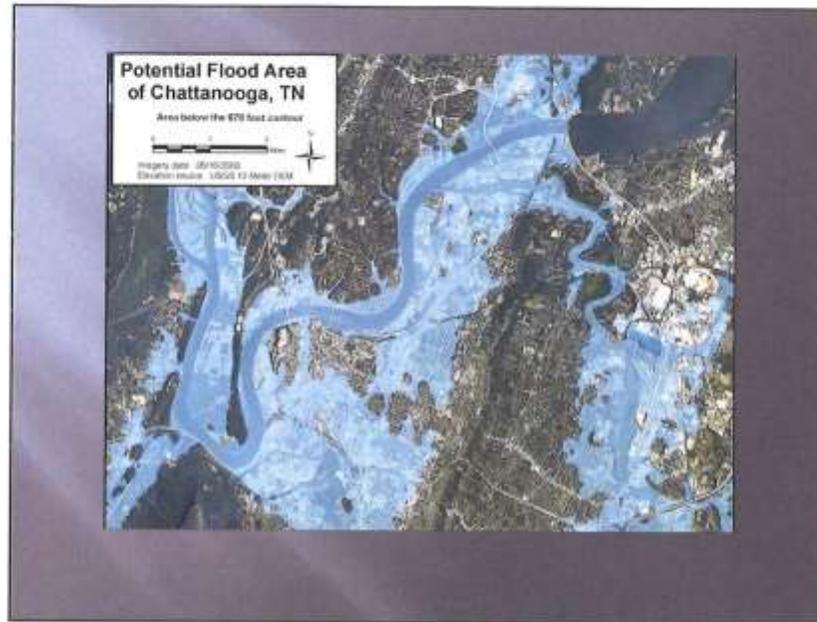


What is Mitigation?





1. Flood Control Gate – Spring Creek and N. Terrace Road
2. North Terrace Pump Station and detention pond – 314 S. Howell Avenue at N. Terrace Road
3. Earl Lime Pump Station and underground storage – 808 Lower Mill Road in the unopened ROW of Marsh Road
4. Valleybrook Pump Station and levee – 113 Valleybrook Circle
5. Brainerd Levee – Along S. Chickamauga Creek from N. Moore Road to I-75.
6. McCutcheon Road Detention Pond – 2444 Hickory Valley Road
7. Lookout Valley Detention Pond – 301 Labeling Way
8. Implementation of Routine Maintenance Practices to keep the drainage system open and flowing.
9. Require new and re-development projects to install detention measures to prevent increases in stormwater runoff from the site.
10. Buy out of repetitive loss properties along Aster Avenue.
11. Basin modeling and creation of new flood mapping techniques
12. Adopted stormwater and floodplain ordinances
13. Installed rain gauges and flow meters at key locations in the drainage system.
14. Capital planning program
15. Dual power sources for the Moccasin Bend Waste Water Treatment Plant
16. Moccasin Bend Waste Water Treatment Plant and system wide pump station infrastructure built above 100-year flood elevation.
17. All Plant, pump station controls, and CSO facilities controls now located above 100-year flood elevation.



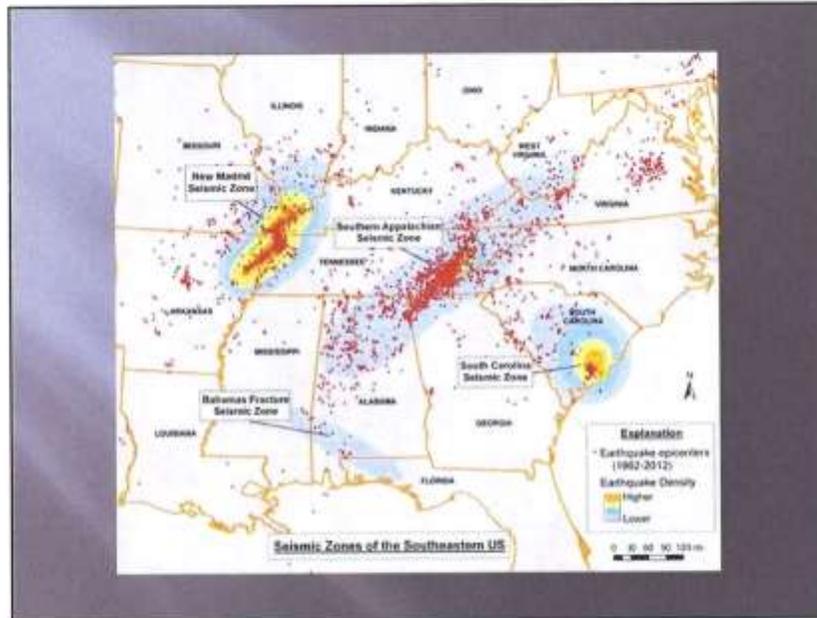
What else is there?

Wildfire

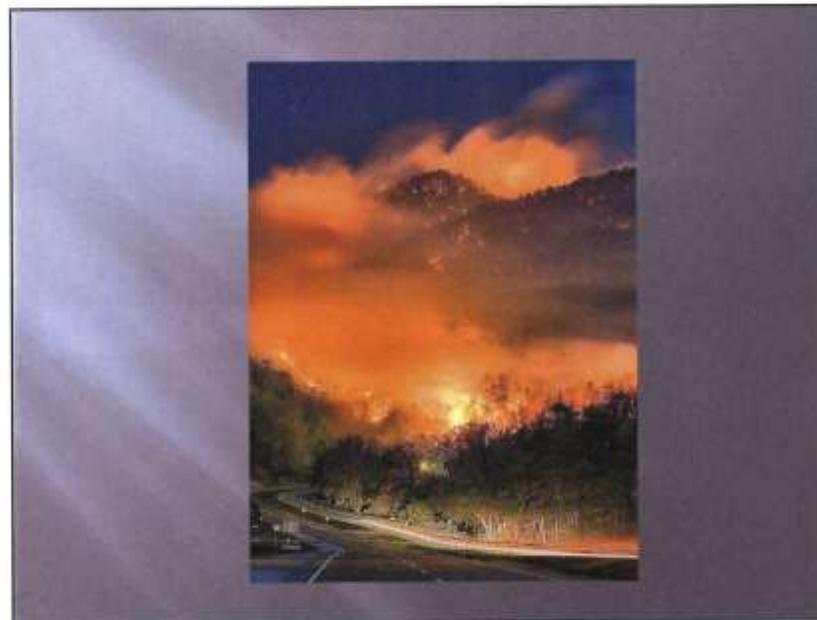
Earthquake

Ice Storm

Tornado









Arkema officials charged with "recklessly" releasing chemicals amid Harvey flooding

<https://www.texastribune.org/2018/08/03/arkema-its-tinorl-chemical-fire-hurricane-harvey/>

"Considering that extreme weather events are likely to increase in number and severity, the chemical industry must be prepared for worst case scenarios at their facilities," Chemical Safety Board Chairperson Vanessa Allen Sutherland said Thursday in a [statement](#). "We cannot stop the storms, but working together, we can mitigate the damage and avoid a future catastrophic incident."
May 2018

In its final report, the CSB called for more robust industry guidance to help hazardous chemical facilities better prepare for extreme weather events, like flooding, so that similar incidents can be avoided. The key lessons for companies within areas that are susceptible to extreme weather include:

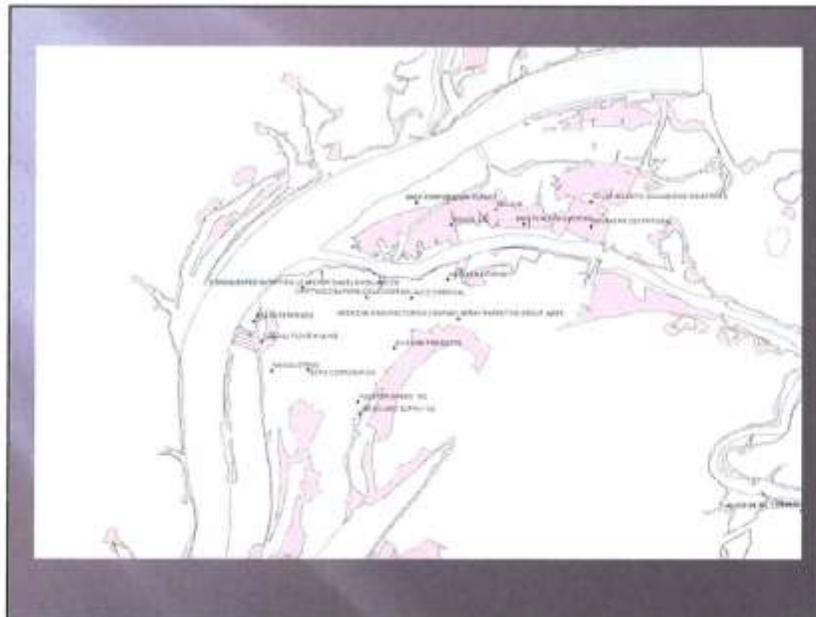
- Facilities should perform an analysis to determine susceptibility to potential extreme natural events— such as flooding, earthquakes, and high winds

- When conducting analyses of process hazards, or facility siting, companies should evaluate the potential risk of extreme weather events and the adequacy of safeguards.

- When evaluating and mitigating the risk from extreme weather events, facilities should strive to apply a sufficiently conservative risk management approach.

- If flooding is the risk, facilities must ensure that critical safeguards and equipment are not susceptible to failure by a common cause and that independent layers of protection are available in the event of high-water levels.

•<https://www.csb.gov/csb-releases-arkema-final-report/>



HAMILTON COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN Planning Group Meeting			
Purpose:	Plan review/Implementation and Monitoring next steps	Meeting Date:	April 3, 2019
Facilitator:	Greg Helms, Lead OEM Planner	Location:	Emergency Operations Center
Name	Title	Jurisdiction/Agency	
H. Tim Pridemore	E.M. Coordinator	U.T. Chilton Co. GA	
Greg Helms	Lead Planner	Hamilton OEM	
CHARLIE HALL	D. C.	TEMA	
Cone Quinn	HCHD Superintendent	Highway Dept.	
Mike P. Flynn SR	Deputy Fire Chief	East Ridge F.D.	
Mike P. Flynn Jr	Fire Marshal	East Ridge F.D.	
Mike Williams	Fire Chief	East Ridge Fire Rescue	
Mania Price	Engr Mgr	City of Chattanooga	
Burt Johnson	Finance Director	City of Soddy-Daisy	
Greg Tate	Public Works Supervisor	City of Red Bank	
ERIC MITCHELL	Fire Chief	TOWN of Signal MTN	
Marty Hawkins	Senior Engineer	City of Chattanooga	
JODY CLIFT	WRFS CAPTAIN	LAURENS R206	
Mike Guffey	Soddy-Daisy Fire Dept	City of Soddy-Daisy	
Tim Harper	Mgr. Safety/Compliance	Hamilton Co Dept. of Education	
WALKER JONES	MAYOR	AKT MTN, TN	

Public Notice



Account #: 27759
Company: HCEOM
Client:
Ad number: 136799
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Note:

AFFIDAVIT • STATE OF TENNESSEE • HAMILTON COUNTY

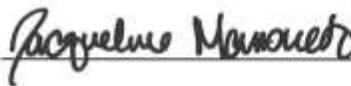
Before me personally appeared Jim Stevens, who being duly sworn that he is the Legal Sales Representative of the CHATTANOOGA TIMES FREE PRESS, and that the Legal Ad of which the attached is a true copy, has been published in the above named newspaper and on the corresponding newspaper website on the following dates, to-wit:

Chattanooga Times Free Press: 03/03/19; TimesFreePress.com: 03/03/19.

And that there is due or has been paid the CHATTANOOGA TIMES FREE PRESS for publication the sum of \$93.50. (Includes \$10.00 Affidavit Charge).



Sworn to and subscribed before me this date: 03/04/2019



My Commission Expires 03/07/2021



Chattanooga
Times Free Press

400 EAST 11TH ST
CHATTANOOGA, TN 37403

PUBLIC NOTICE

The public is invited to review and comment on a draft of the 2019 update of the Hamilton County Multijurisdictional Natural Hazards Mitigation Plan. The purpose of the Plan is to develop strategies and specific actions that can be implemented by Hamilton County and jurisdictions within Hamilton County to mitigate the impact of natural hazards on people, property, and the environment. The Hamilton County Office of Emergency Management (HCEOM) will host a public meeting on Thursday March 7, 2019 at the 911 Communications Center at 3404 Arescota Highway from 4:30 p.m. to 7:00 p.m. Copies of the plan will be available for review and comment. The plan will also be posted on the HCEOM website at www.hamiltonready.org for review. Comments, questions, and suggestions can be e-mailed to Greg Helm at gregoryh@hamiltontn.gov

Screen shot of link to the draft plan on the HCOEM website:



Hamilton County hazards mitigation plan released



STAFF PHOTO BY DODG STRICKLAND

Emergency workers survey damage after an overnight mudslide destroyed a Subway restaurant on Signal Mountain Road on Feb. 23.

BY MARK PACE
STAFF WRITER

An updated hazards mitigation plan for Hamilton County focuses on flooding, landslides and sinkholes following record rainfall in the Tennessee Valley for more than a year.

The Federal Emergency Management Agency mandated-plan develops a county-wide strategy to reduce the effects of natural events with input from jurisdictions, government agencies, university researchers and the public.

"Natural hazards are an inevitable fact. Human ingenuity can do nothing to stop a tornado or winter storm from occurring," according to the plan. "Planning for nat-

ural hazards and implementing mitigation measures, however, can reduce the impact of such events when they do occur."

Since 2000, there have been 34 documented flood events in



View the full report at timesfreepress.com

Hamilton County, causing an annual average of \$1.3 million in property damage. Last year was the wettest year on record for the Tennessee Valley, with more than 67 inches of rain, and one of the wet-

test years in the history of Chattanooga. The rain highlighted the geological dangers in the Chattanooga area as steep slopes slid into roadways and holes opened in parking lots of local businesses.

See HAZARDS • B5

The hillside beneath a Mapco station slid away in late February. Later that week, a mudslide crushed a Subway restaurant on Signal Mountain Road, followed by a later landslide in the parking lot of AwardCountry.com off nearby Dayton Boulevard.

Several small sinkholes have caused problems for local businesses in the past year. A 15-foot deep sinkhole opened in a Soddy-Daisy soccer field last year, and the previous year a sinkhole at Mountain Brook Apartments, now Rise at Signal Mountain, engulfed a resident's car.

The county's office of emergency management and homeland security has updated its plan to continue reducing risk in such areas. It has partnered with the University of Tennessee at Chattanooga Department of Geology to look at the history of sinkholes and landslides in the area as well as soil types to see what areas would be susceptible in the future.

From there, they'll work to help ensure development projects consider such factors, and they hope the information can be used to help jurisdictions work to make smart decisions to limit risk.

The office of emer-



STAFF PHOTO BY DODG STRICKLAND

Kenny Kinnaman with Chattanooga Public Works, left, and an individual who did not want to give his name survey floodwaters covering Aster Road on Feb. 20 in Lookout Valley.

gency management and homeland security plans to use the study to try to get grants to continue the UTC research. It also plans to help local communities apply for grants to purchase property from people living in homes that are regularly flooded. Chattanooga has done so already in areas such as Aster Road. The city buys the property from the owners, allowing them to move, and then tears down the homes to create an open flood plain.

"This is one of the hardest plans that we work on because it's multiple jurisdictions, and you have to get everybody to update their projects and look at their long-range [efforts], what they're going to try to do to mitigate certain things," project lead planner Gregory Helms said.

The county began implementing the FEMA-mandated mitigation plans shortly after the turn of the 21st century. By 2004, all municipalities without an approved plan would be ineligible for certain types of disaster assistance. The plans are required to be updated every five years.

It has been sent to the state for review and then will go to FEMA for final approval or to find out if anything needs to be fixed.

The hazard mitigation plan is always open for public comment. Comments may be sent to gregoryh@hamiltontn.gov.

Contact staff writer Mark Pace at mpace@timesfreepress.com or 423-757-6659. Follow him on Twitter @themarkpace and on Facebook at ChattanoogaOutdoorsTFP.

Regional Notice

November 7, 2017

Mr. Gregg Ridley
P.O. Box 149
Pikeville, TN 37367
BLEDSOE

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. Ridley,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

If you have any questions or would like to review and comment on a draft of the plan update, please contact Gregory Helms at 423-209-6917 or gregoryh@hamiltontn.gov

Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security

November 7, 2017

Mr. Gary Davis
P.O. Box 1167
Cleveland, TN 37364
BRADLEY

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. Davis,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

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Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security

November 7, 2017

Mr. George Jackson Jr.
P.O. Box 789
Jasper, TN 37347
MARION

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. Jackson,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

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Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security

November 7, 2017

Mr. William L. James
P.O. Box 156
Decatur, TN 37322
MEIGS

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. James,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

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Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security

November 7, 2017

Mr. George Thacker
375 Church Street, Suite 215
Dayton, TN 37321

RHEA

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. Thacker,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

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Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security

November 7, 2017

Mr. D. Keith Cartwright
P.O. Box 595
Dunlap, TN 37347
SEQUATCHIE

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. Cartwright,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

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Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security

November 7, 2017

Mr. Jim Walker
800 Lafayette Street
Ringgold, GA 30736
CATOOSA

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. Walker,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

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Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security

November 7, 2017

Mr. Ted Rumley
71 Case Avenue
Trenton, GA 30752
DADE

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. Rumley,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

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Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security

November 7, 2017

Mr. Shannon Whitfield
P.O. Box 445
101 South Duke Street
LaFayette, GA 30728
WALKER

Re: Hamilton County Natural Hazards Mitigation Plan

Dear Mr. Whitfield,

The purpose of this letter is to notify adjacent county governments that Hamilton County, Tennessee is in the process of updating our Natural Hazards Mitigation Plan. The current plan was approved by the Federal Emergency Management Agency in 2013. The plan must be updated every five years. The revised plan will update local demographics, development trends, risk and vulnerability to natural hazards, hazard related events, and the status of past mitigation actions. Participating local jurisdictions will also revise their mitigation actions to reflect local concerns, as well as capability for implementation.

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Respectfully,

Gregory Helms
Lead Emergency Management Planner
Hamilton County Office of Emergency Management and Homeland Security