3.3 Vulnerability Assessment

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

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

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

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

3.3.1 Methodology

The vulnerability assessment defines and quantifies populations, buildings, critical facilities, and other community assets at risk to natural hazards. The vulnerability assessment for this plan followed the methodology described in the FEMA publication *Understanding Your Risks—Identifying Hazards and Estimating Losses* (2002).

The Vulnerability Assessment is divided into four parts:

- **Section 3.3.2 Community Assets** identifies the structures and critical facilities for Warren County.
- **Section 3.3.3 Vulnerability by Hazard** describes the vulnerability to damage from natural and manmade hazards. The vulnerability assessments divide each county by building damage by each category, which includes the following types of property:
    - Residential
    - Commercial
    - Industrial
    - Agriculture
    - Religious
    - Government
    - Education
- **Section 3.3.4 Future Land Use and Development** discusses development trends, including population growth, housing demand, and future projects.
- **Section 3.3.5 National Flood Insurance Program (NFIP)** addresses insured structures that have been repetitively damaged floods.

3.3.2 Community Assets

Table 3.3.1 below lists the total valuations for the seven categories of building stock in Warren County. The information in the table is taken from HAZUS_MH runs conducted by SEMA.

Table 3.3.1 Building stock exposure (all values thousands of $'s)

Type of building	Building count
Residential	1,284,129
Commercial	208,579
Industrial	123,392
Agriculture	11,712
Religion	30,676
Government	8,794
Education	14,912
Total	**1,682,194**

Source: HAZUS_MH, SEMA

Critical Facilities and Infrastructure

A critical facility may be defined as one that provides essential public safety or mitigation functions during response or recovery operations. Table below provides an inventory of critical facilities and infrastructure (based on available data from the county and State of Missouri) in Warren County.

Table 3.3.2 Inventory of Critical Infrastructure in Warren County

Type	Innsbrook	Marthasville	Pendleton	Warrenton	Wright City	Truesdale	Total
Airports	--	--	--	--	--	--	--
Elder Care Facility/ Long Term Care	--	1	--	5	--	--	6
Health Care Facility	--	--	--	--	--	--	--
Fire Stations	1	1	--	2	2	--	6
Schools	--	1	--	6	3	--	10
Police stations	1	1	1	1	1	1	8

Tables below provides specific information on the Elder Care Facilities, Long Term Care Facilities, and government-owned structures in Warren County. Citizens that reside in these facilities are considered special needs and may require additional assistance in the event of a natural hazard or emergency event.

Table 3.3.3 Warren County facilities requiring special consideration

Facility Name	Address	City	Occupants
Schools:			
Marthasville Elementary School	800 E. Main	Marthasville	205
St. Ignatius Loyola School, K-8	701 Mill Rd	Concord Hill	59
St. Vincent School, K-8	7600 S. Hwy. 94	Dutzow	131
Daniel Boone School, PreK-3	302 Kuhl Ave	Warrenton	881
Rebecca Boone School	301 Pinkney	Warrenton	452
Black Hawk Middle School	302 Kuhl Ave	Warrenton	750
Warrior Ridge Elementary	302 Kuhl Ave	Warrenton	
Warren County High School	803 Pinkney	Warrenton	950
Holy Rosary Catholic School	716 E. Main	Warrenton	186
Wright City Elementary School	100 Wildcat Dr	Wright City	635
Wright City Middle School	402 N. Service Rd	Wright City	350
Wright City High School	500 Westwoods Rd	Wright City	450
Warrenton Christian School	806 S. Hwy. 47	Warrenton	156
Liberty Christian School	402 N Service Road	Warrenton	
Child/Adult Day Care Facilities:			
Sassafras & Scissors Preschool	203 East South Steer	Marthasville	20
Jolly Tots	1140 Columbus Circle	Warrenton	16
Reach Out Adult Day Care	107 S. Hwy. 47	Warrenton	5
Good Shepherd Lutheran Day Care	101 S. Elm St.	Wright City	35
Open Hearts Child Care Center	70 Bell Road	Wright City	
Warrenton Area Child Care Center	1022 Steinhagen	Warrenton	72
Youth in need	1022 Steinhagen	Warrenton	105
Whitegate Child Care Center	Hwy. 94 & TT	Dutzow	45
Emmaus Homes, Inc.	2200 Hwy. D	Marthasville	225
Kindercare		Wright City	
Preschools:			
Wesleyan Kiddie Kollege	806 South Hwy 47	Warrenton	193
Kiddie Kampus	701 E. Main	Warrenton	38
Little Lambs Lutheran Preschool	950 S. Hwy. 47	Warrenton	22
Nursing/Residential Facilities:			
Warrenton Manor	65 Hwy. AA	Warrenton	120
Bristol Manor	815 Woolf Rd	Warrenton	12
Country Cove West	707 E. Booneslick	Warrenton	34
Whispering Pines Assisted Living	700 Forest Ave.	Warrenton	52
		TOTAL	4,741

Table 3.3.4 Government-owned structures within Warren County

Location	Structure
Marthasville	City Hall
Marthasville	Police Department
Marthasville	Ambulance District

Location	Structure
Marthasville	Fire Station No. 1, Rt. D & 4th
Marthasville	U.S. Post Office
Pendleton	Fire Station No. 3
Truesdale	City Hall & Police Department
Warrenton	Warren County Courthouse and Annex
Warrenton	Warren County Ambulance District, Fairgrounds
Warrenton	Warren County Ambulance District, Helipad, Fairgrounds
Warrenton	Warren County Road and Bridge Facility
Warrenton	City Hall, Police Station & Annexes
Warrenton	Fire Station No. 1, Hwy. 47 & Fairgrounds
Warrenton	Fire Station No. 2, Hwy. 47 & Lakeview
Warrenton	Emergency Operations Center, 911
Warrenton	Missouri National Guard Armory
Warrenton	National Weather Service Office
Warrenton	U.S. Natural Resources Service Office & Farm Service Agency
Warrenton	U.S. Post Office
Warrenton	Warren County Scenic Regional Library
Wright City	City Hall & Police Department
Wright City	Warren County Ambulance District, 111 SW 2nd
Wright City	Fire Station No. 1, N. 2nd & N. 1st
Wright City, north	Fire Station No. 2, Hwy. J & WW
Wright City, south	Fire Station No. 3, Stracks Church Rd.
Wright City	U.S. Post Office

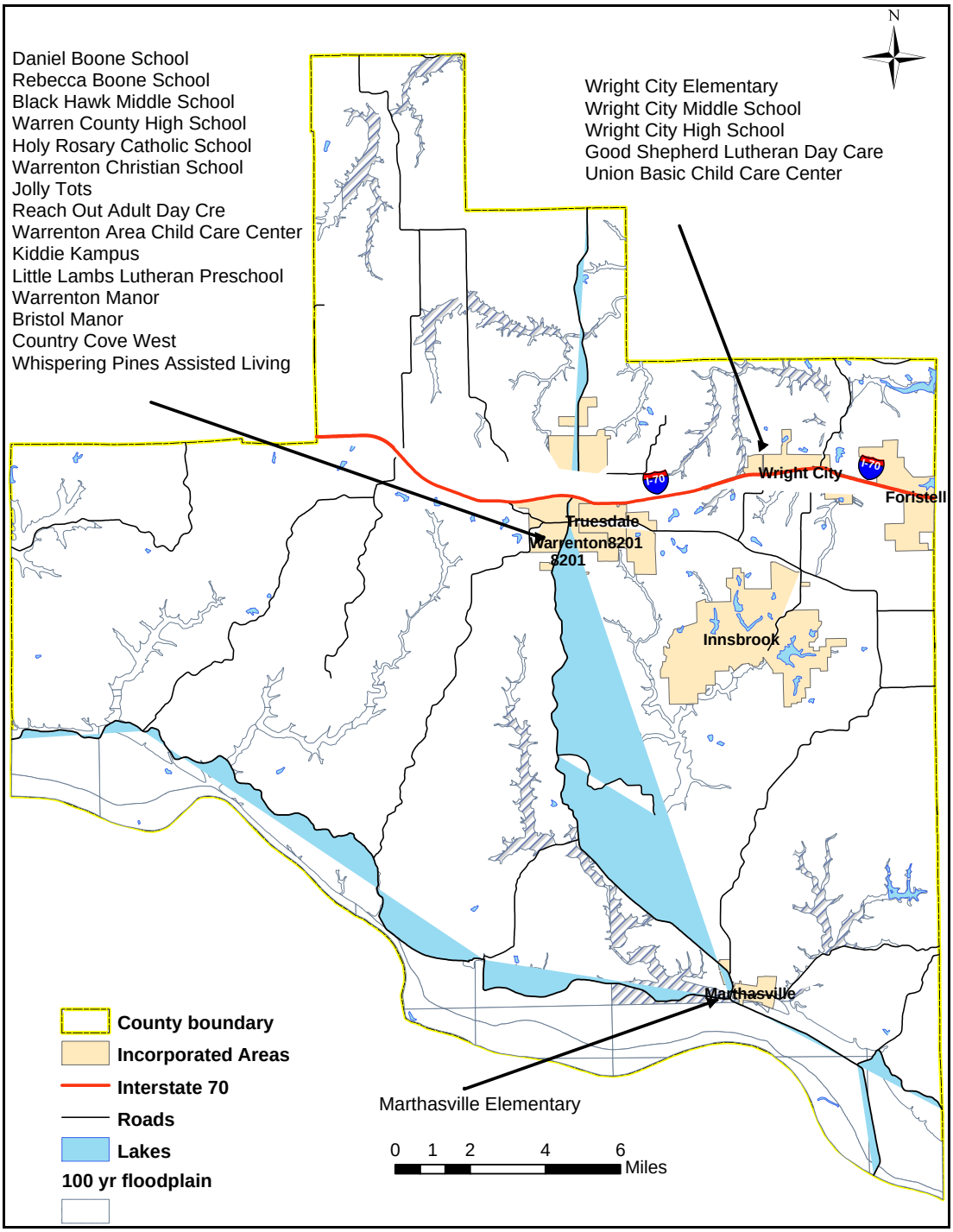
Other Assets

Assessing the vulnerability of Warren County to disaster also involves an inventory of natural, historic, cultural, and economic assets located in the planning area. In Warren County, specific assets include the following:

- Endangered and threatened species within Warren County include the bald eagle, Indiana bat, and western fox snake as well as paddlefish, pallid sturgeon, sickle fin club, and sturgeon chub. No plant species currently are listed for the county.
- The National Registry of Historic Places includes five places in Warren County. The Marthasville area includes Borgmann Mill (5 miles east off Hwy. D), the Callaway Flanders House (1 mile south off Hwy. 94), and the Starke-Meinershagen-Boeke Rural Historic District (5 miles west on Hwy. 94). Also on the registry is Warrenton's Schowengerdt Ernst House. Additional buildings of cultural importance include the Warren County Museum and Historical Library, the Warren County Scenic Regional Library, and the University of Missouri Extension Center.

- The Archaeological Society of Missouri has recorded 130 archaeological sites in Warren County. The exact locations cannot be shown in order to protect the individual resources.

Map 3.3.1 below shows the critical facilities in Warren County



Data Limitations

Several data limitations were encountered during development of this plan update. Estimating potential losses that may occur as a result of hazard events requires a full range of information and accurate data. Inadequate information posed a problem for developing loss estimates for most of the identified hazards.

Throughout the risk and vulnerability assessment included in Section 3, descriptions of limited data indicate some areas in which the County and municipalities can improve their ability to identify vulnerable structures and improve loss estimates. As the County and municipal governments work to increase their overall technical capacity and implement comprehensive planning goals, they should also attempt to improve their ability to identify areas of increased vulnerability.

The hazard profiles, vulnerability assessments, population and inventories of critical facilities of this current plan were based on best available data. Improvements to the best available data can be made to better assess the risks and target mitigation strategies that best respond to the hazard issues within the County. In order to accomplish this, mitigation strategies pertaining to the data limitations have been included in the mitigation section.

The table below discusses the available sources of information for each of the hazards and the recommended future efforts for finding the missing data.

Table 3.3.5 discusses the available data and the data limitations followed by recommendation for each of the hazard

Hazard	Available data	Data limitations & Recommendations
Dam failure	DNR dam safety program; Missouri Spatial Data Information Services; newspaper articles; existing plans and reports	Missouri DNR's Division of Dam Safety completed the dam inundation maps for the high hazard dams in Warren County. DNR employed LiDAR data extracted from ArcView using HEC-GeoRAS, hydraulic analysis using HEC-RAS, and mapping using ArcView. DNR conducted the analysis using the Rapid Assessment Method, and the Detailed Method. Both these methods employ several standard assumptions about the nature of the breach and flow conditions. Currently, the Warren County EMD and the County 911 are working to put together a list of the structures that would be inundated by the high-hazard dams. When these maps are available, a more accurate analysis of Dam failure and its effects on the jurisdictions represented in the plan will be possible.

Table 3.3.5 discusses the available data and the data limitations followed by recommendation for each of the hazard		
Hazard	**Available data**	**Data limitations & Recommendations**
Hazardous materials	Missouri State Highway Patrol crash report; Department of Health and Senior Services; newspaper articles; existing plans and reports	Apart from the GIS mapping, detailed analysis on each and every hazardous material event from the County emergency operations plan; developing buffer maps for each of the hazard location; and estimated cost calculated for fixing the clean-ups per incident hazard would help in calculating the estimated losses for the future plan updates.
Utility interruptions/power failure	Existing plans and reports; newspaper articles;	Apart from GIS mapping of the hazard location, loss estimates from the electric companies; engineering studies and plans on the water & wastewater system would help in calculating the estimated losses for the future plan updates.
Hailstorms	National climatic data center; newspaper articles; existing plans and reports	Apart from GIS mapping, the dollar values of estimated property loss; any crop insurance paid for the damages from USDA's Risk Management Agency would help in calculating the estimated losses for the future plan updates.
Thunderstorms & high winds	National climatic data center; existing plans and reports; newspaper articles;	USDA's Census for Agriculture, Claims data from USDA's Risk Management Agency along with the 2010 U.S. Census; HAZUS-MH data would help in calculating the estimated losses for the future plan updates.
Tornadoes	National weather service; National climatic data center; newspaper articles; existing plans and reports;	Apart from GIS mapping, the dollar values of estimated property loss values with the help of an engineer; loss estimates from the electric companies; and any other updates from the County emergency operations plan; and HAZUS-MH data would help in calculating the estimated losses for the future plan updates.
Severe winter weather	National Center for Health Statistics; National climatic data center; newspaper articles; existing plans and reports;	USDA's Census for Agriculture, Claims data from USDA's Risk Management Agency along with the 2010 U.S. Census; HAZUS-MH data would help in calculating the estimated losses for the future plan updates.
Transportation	State Hazard Mitigation Plan; newspaper articles; existing plans and reports.	As there no transportation studies conducted, any estimated costs of traffic crashes, cost per injury based on the severity can be used in calculating the estimated losses for the future plan updates.
Floods	National climatic data center; Flood insurance rate maps; newspaper articles; HAZUS-MH maps developed by SEMA; newspaper articles. 2008 flood hazard information (p.53) was used to determine the vulnerability for flood hazards.	The information on the repetitive loss properties was the only information available for calculating the loss estimates. The HAZUS maps shared by SEMA and the locally available data was used to calculate the loss estimates. HAZUS-MH would help in modeling flood vulnerability and flood loss. As mentioned in the State Hazard Mitigation Plan 2010, by integrating the Digital Flood Insurance Rate Map (DFIRM) depth grids also might provide some enhanced flood vulnerability/loss estimate capability. The analysis would provide the number of buildings impacted, estimates of the building repair costs,

Table 3.3.5 discusses the available data and the data limitations followed by recommendation for each of the hazard		
Hazard	**Available data**	**Data limitations & Recommendations**
		and the associated loss of building contents and business inventory. These loss estimates along with the knowledge shared by the local planning and engineering staff would provide a detailed loss estimates for the flood hazard. Boonslick Regional Planning Commission recently received CDBG land use planning grant funding which will analyze the floodplain maps; levee boundaries; and other related hazards. This information would be helpful in the future updates of the plan.
Levee failure	National climatic data center; newspaper articles; Army Corp of Engineers; Local available data;	There are several non-certified levees in the County apart from the levees located along the Missouri River The State of Missouri does not have a single comprehensive inventory of levee systems. HAZUS-MH would help in determining a detailed loss estimate for levee failures provided if all the levees can be detected on the computer terrain models.
Earthquake	U.S. Geological Survey; Center for Earthquake Research and Information at the University of Memphis; newspaper articles;	Apart from GIS mapping, HAZUS-MH generated losses and the estimated dollar values of losses with the help of an engineer would provide the vulnerability and estimated losses to earthquakes.
Terrorism	Newspaper articles	Information from the Regional Homeland Security Advisory Council's database on the past events.
Wildfire	Newspaper articles; Emergency operations plan.	The structures information needs to be overlayed along the Wildland Urban Interface maps to look at the potential impacts.

Section 3.3.3 Vulnerability by Hazard

3.3.3.1 Vulnerability by hazard

Tables 3.3.3.2 A & B show the overall vulnerability assessment for Warren County and the participating jurisdictions. Overall risk was calculated by summing the values for probability and severity. These overall rankings are further defined based on the percentage of damage for a specific hazard.

On an individual jurisdiction level, the overall vulnerability ranking is best characterized as a damage estimate for potential loss to structures in the hazard area and defined as follows:

- **3** = less than 5 percent of the jurisdiction impacted.
- **4** = 5-10 percent of the jurisdiction impacted.
- **5** = 10-15 percent of the jurisdiction impacted.
- **6** = 15-25 percent of the jurisdiction impacted.
- **7** = 25-30 percent of the jurisdiction impacted.

For example, if tornado has a probability of “highly likely-4” and the severity is “limited-2”, the total value of both is 6, therefore, the overall ranking is 6.

Table 3.3.3.1 defines the levels for probability and magnitude/severity

Element/ Level	**Characteristics**
Probability	The likelihood that the hazard will occur.
4- Highly Likely	Event is probable within the calendar year. Event has up to 1 in 1 year chance of occurring (1/1=100%) History of events is greater than 33% likely per year. Event is "Highly Likely" to occur
3- Likely	Event is probable within the next three years. Event has up to 1 in 3 years chance of occurring (1/3=33%) History of events is greater than 20% but less than or equal to 33% likely per year Event is "Likely" to occur
2- Occasional	Event is probable within the next five years. Event has up to 1 in 5 years chance of occurring (1/5=20%) History of events is greater than 10% but less than or equal to 20% likely per year Event could "Possibly" occur
1-Unlikely	Event is possible within the next 10 years Event has up to 1 in 10 years chance of occurring (1/10=10%) History of events is less than or equal to 10% likely per year Event is "Unlikely" but is possible of occurring
Magnitude / Severity	The deaths, injuries, or damage (property or environmental) that could result from the hazard.
4- Catastrophic	Multiple deaths Complete shutdown of facilities for 30 or more days

Element/ Level	Characteristics
	More than 50 percent of property is severely damaged
3- Critical	Injuries and/or illnesses result in permanent disability Complete shutdown of critical facilities for at least two weeks 25–50 percent of property is severely damaged
2- Limited	Injuries and/or illnesses do not result in permanent disability Complete shutdown of critical facilities for more than one week 10–25 percent of property is severely damaged
1-Negligible	Injuries and/or illnesses are treatable with first aid Minor quality of life lost Shutdown of critical facilities and services for 24 hours or less Less than 10 percent of property is severely damaged

Table 3.3.3.2 A shows the overall vulnerability assessment for Warren County and the participating jurisdictions for the countywide hazards.

Hazard	Unincorporated area	Innsbrook	Marthasville	Pendleton	Warrenton	Wright City	Truesdale	Warren school	Wright City school	Washington school	Gasconade school
Drought	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3
Earthquake	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3
Extreme Heat	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3
Hailstorms	3+2	3+2	3+2	3+2	3+2	3+2	3+2	3+2	3+3	3+2	3+2
Severe winter weather	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3
Thunderstorms & High Winds	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2
Tornadoes	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2
Hazardous Materials	3+2	3+2	3+2	3+2	3+2	3+2	3+2	3+2	3+2	3+2	3+2
Terrorism	1+2	1+2	1+2	1+2	1+2	1+2	1+2	1+2	1+2	1+2	1+2
Transportation	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3	3+3
Utility interruptions/power failure	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2	4+2

Table 3.3.3.2 B shows overall vulnerability assessment for the jurisdiction specific hazards.

Hazard	Unincorporated area	Innsbrook	Marthasville	Pendleton	Warrenton	Wright City	Truesdale	Warren school	Wright City school	Washington school	Gasconade school
Dam	2+2	2+2	2+3	NA	NA	NA	NA	NA	NA	2+3	NA
Floods	3+2	3+2	3+3	NA	3+2	3+2	3+2	3+2	3+2	3+3	NA
Levee	NA	NA	3+3	NA	NA	NA	NA	NA	NA	NA	NA
Wild Fire	NA	NA	2+3	NA	2+3	NA	2+2	2+3	NA	NA	NA

Potential Loss Estimates

HAZUS-MH (Hazards US- Multi-Hazard) data has been utilized to assist in developing a raw building count for each participating jurisdiction within Warren County. The total building count for all the jurisdictions by building type is shown below.

Table 3.3.3.3 Total building count for Warren County

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	74	257	4	5	81	21	7161	18592
Innsbrook	0	6	0	0	4	0	1056	562
Marthasville	2	13	1	2	2	2	363	859
Warrenton	8	130	1	6	33	12	2215	7155
Wright City	3	63	3	3	30	6	719	2797
Truesdale	1	8	1	1	5	0	183	630

Source: HAZUS counts developed by State Emergency Management Agency.

The HAZUS-MH software didn't include the boundary files for the Village of Pendleton which was incorporated after the 2000 Census. Therefore, the building count data for Pendleton is unavailable during this plan update and an action plan has been proposed concerning this data limitation.

The total building damage count for the seven categories of building stock for the county and the overall vulnerability assessment for each hazard (Tables 3.3.2.2 A & B) were used to calculate the potential loss estimates for each hazard. Also, the population impacted (2000 Census) is assessed for each hazard with the help of the information found in Section 2, Table 2.3. The enrollments for the school districts (Section 2, Table 2.4) have been used to develop the population impacted for school districts.

The loss estimates are divided into two parts. The first part deals with the jurisdiction wide hazards (3.3.2.2 3.3.2.13) and the second part deals with the jurisdiction specific hazards (3.3.2.14- 3.3.2.18).

The overall vulnerability considered includes:

- **3** = less than 5 percent of the jurisdiction impacted.
- **4** = 5-10 percent of the jurisdiction impacted.
- **5** = 10-15 percent of the jurisdiction impacted.
- **6** = 15-25 percent of the jurisdiction impacted.
- **7** = 25-30 percent of the jurisdiction impacted.

Overall methodology: During this plan update process, lack of information concerning the specific location of the structures within the county and participating jurisdictions was identified. Due to this lack of data, no direct comparison to the known hazard areas, such as SFHAs could be completed. In order to resolve this lack of data during future update processes, an action has been included as a recommended item under the plan maintenance process. If location data for structures becomes available prior to the next five year update of the Warren County Hazard Mitigation plan, it will be integrated into the plan.

Since, a direct comparison of structure locations and known hazard areas could not be completed it was necessary to rely on the experience of the planning committee and the documented past damages as the basis for calculating the impact in terms of structural vulnerability/damages. The committee also considered the potential damage to lives, crop, and property in assuming the values for calculating the impact. Further, similarities between impacts associated with different types of events, such as hail events and thunderstorms or snow storm and utility interruptions/power failure, was also considered as a component of the strategy for calculating the percentage values.

Methodology followed: Along with the committee's experiences and capabilities, the methodology was based on considering the likelihood of occurrence (# of events/ yrs. of data), hazard prioritization, overall vulnerability, and the specific information on past events and damages.

Likelihood of occurrence (# of events/yrs. of data) - information from the NCDC on the number of events was used to calculate the number of events. These are rated by the committee as follows:

a) <0 events or No significant events or None= 1
b) 1-1.5 events= 2
c) 1.6-3 events=3
d) 3-10events=4

The hazard ratings from the prioritization process include:

a) Low=1
b) Medium=2
c) High=3

The overall vulnerability ratings for each hazard are utilized as a basis in arriving with the values for calculating the impact. These ratings are shown in the specific hazard tables.

The methodology followed for calculating the impact for each hazard is explained in detail below followed by the specific hazard tables.

For the hazards, *terrorism, dam failure,* there is lack of information on the affected areas from the past events and the specific jurisdictional damages to property and lives. Therefore, the hazard priority ranking, overall vulnerability, and the committee's experiences were used to arrive with a value for calculating the impact for these hazards. The detailed hazard tables are provided below.

Hazard	Likelihood of occurrence (# of events / yrs. of data) <0 events or No significant events or None= 1 1-1.5 events= 2 1.6-3 events=3 3-10events=4	Overall vulnerability	Calculated impact
Terrorism	None= 1	3=<5%	The committee considered the factors - there have been no past events, the event is unlikely to occur and the hazard priority for calculating the impact for this hazard. The overall vulnerability is less than 5%. The committee decided to select 2% on the basis that the hazard was prioritized as medium.

Hazard	Likelihood of occurrence (# of events / yrs. of data) <0 events or No significant events or None= 1 1-1.5 events= 2 1.6-3 events=3 3-10events=4	Overall vulnerability	Total (Likelihood of occurrence +overall vulnerability)	Calculated impact
Dam failure	No significant events=1	4=5-10% 5=10-15%	Dam= 1+4=5	The total sum of the likelihood of occurrence and the overall vulnerability are used in selecting the percentage values for calculating the impact for the hazard. The total sum is 5, therefore, the committee decided to use 5% for calculating the impact. There are dams in the county; however, there are no major hazard events identified. Therefore, 5% is used as the calculated impact for the county and the jurisdictions except for the City of

Hazard	Likelihood of occurrence (# of events / yrs. of data) <0 events or No significant events or None= 1 1-1.5 events= 2 1.6-3 events=3 3-10events=4	Overall vulnerability	Total (Likelihood of occurrence +overall vulnerability)	Calculated impact
				Marthasville. The dam inundation map for Marthasville and the information gathered from local experiences helped in selecting a percentage value for the calculated impact. Considering that the City is more susceptible to loss of property and life, 10% is used to calculate the impact.

Hazard	Likelihood of occurrence (# of events / yrs. of data) <0 events or No significant events or None= 1 1-1.5 events= 2 1.6-3 events=3 3-10events=4	Hazard Prioritization (Low=1, Medium=2, High=3)	Overall vulnerability	Total (Likelihood of occurrence +prioritization+ overall vulnerability)	Calculated impact
Hazardous Materials	Hazardous Materials- 1.2 events=2	Hazardous Materials= 3	5=10-15%	Hazardous Materials- 2+3+5= 10	The total sum of the likelihood of occurrence and the overall vulnerability are used in selecting the percentage values for calculating the impact for the hazard (2+3+5=10). The committee decided to use 10% for calculating the impact.

Hazard	Hazard Prioritization (Low=1, Medium=2, High=3)	Overall vulnerability	Total (Likelihood of occurrence +prioritization+ overall vulnerability+	Calculated impact
Utility interruptions/power failure	Utility interruptions/power failure= 3	6=15-25%	Utility interruptions/power failure= 3+6=9	For utility interruptions/power failure, the sum is 9, but the overall vulnerability is between 15-25%. Considering that it is a high priority, the committee selected 20% for calculating the impact.

For the hazards- *hailstorms, and thunderstorms & high winds*, along with the committee's experiences and capabilities, the information provided in the NCDC website on the specific hazard events, past damages to lives, property & crops, and overall vulnerability formed as a basis for selecting a value for calculating the impact. The detailed hazard tables are provided below.

Hazard	Likelihood of occurrence (# of events / yrs. of data) <0 events or No significant events or None= 1 1-1.5 events= 2 1.6-3 events=3 3-10events=4	Hazard Prioritization (Low=1, Medium=2, High=3)	Overall vulnerability	Total	Calculated impact
Hailstorms	Hailstorms-1.5 events=2	Hailstorms=1	5=10-15%	Hailstorms= 2+1+5=8	As per NCDC, there are 5 recorded events that have a hail size of 1.75 inches of diameter. As per the intensity category defined by the tornado and storm research organization, hail events with diameter more than 0.8 inches are considered to be "severe" or "destructive". The committee decided to select 10 % (sum of likelihood of occurrence, hazard priority, and overall vulnerability = 2+1+5=8) for calculating the impact for this hazard.

Hazard	Likelihood of occurrence (# of events / yrs. of data) <0 events or No significant events or None= 1 1-1.5 events= 2 1.6-3 events=3 3-10events=4	Overall vulnerability	Total	Calculated impact
Thunderstorms & High Winds	Thunderstorms & High Winds- 4 events=4	6=15-25%	Thunderstorms & High Winds=4 +6=10	Although there are no recorded events that affected life and property, considering that there are chances of having storms and most of the hail events turned into thunderstorms, the committee decided to select 20 % (sum of likelihood of occurrence and overall vulnerability *2)= (4+6)*2=20%) for calculating the impact for this hazard.

For the hazards- *tornadoes, severe winter weather, transportation, and floods/levee failure*- overall vulnerability, specific hazard damages such as building stock, crops, lives etc., from the NCDC website, and committee experiences were used in selecting the percentage for calculating the impact.

The damages from the past events such as property damage, damage to lives, crops, injuries, and the total building stock were used in calculating the damages to the building stock. The detailed hazard tables are provided below.

Hazard	Hazard prioritization (Low=1, Medium=2, High=3)	Overall vulnerability	Calculated impact
Tornadoes	Tornadoes=3	6=15-25%	Sum of the hazard priority and the overall vulnerability is 3+6=9. Since, the overall vulnerability has a percentage of 15-25%, the committee decided to select 20% for calculating the impact.

Hazard	Hazard prioritization (Low=1, Medium=2, High=3)	Overall vulnerability	Calculated impact
Severe winter weather	Severe winter weather=3	6=15-25%	Warren County received 5 presidential major disaster declarations, and 4 USDA declarations

Hazard	Hazard prioritization (Low=1, Medium=2, High=3)	Overall vulnerability	Calculated impact
			for this hazard. Sum of the hazard priority and the overall vulnerability is 3+6=9. Since, the overall vulnerability has a percentage of 15-25%, the committee decided to select 20% for calculating the impact.

Hazard	Overall vulnerability	Calculated impact
Transportation	6=15-25%	The transportation incidents could be associated with other hazards- thunderstorms & high winds, severe winter weather, hail storms, tornadoes, and floods. For these hazards, 20% was used for calculating the impact. Therefore, the committee decided to use the same number for calculating the impact for this hazard.

Hazard	Hazard prioritization (Low=1, Medium=2, High=3)	Overall vulnerability	Calculated impact
a) Floods b) Levee failure	Floods- 2	5=10-15% 6=15-25%	Areas hardest hit by the flooding were along the Missouri River in southern Warren County. There was crop damage worth $5 million reported. There was no recorded damage to lives. For the unincorporated area, Innsbrook, Warrenton, Wright City, and Truesdale- the severity is rated as "limited-2". Hazard priority rating times the overall vulnerability i.e. 2*5= 10 is used for calculating the impact for these jurisdictions. For Marthasville, the severity is rated as "critical-3". Considering the severity rating and that this jurisdiction is located along the Missouri river, the committee decided to select 20% for calculating the impact. Levee failures are associated with flooding events. Looking at the hazard profiles and history, the City of Marthasville is the only jurisdiction that would have a considerable impact from levee failures. Therefore, 20% was selected to calculate the impact for the jurisdiction.

There are no past recorded events for earthquake hazard. Therefore, the percentage of magnitude /severity is adjusted based on the committee's expertise to arrive with a value for calculating the impact. The hazard table for earthquake is provided below.

Hazard	Overall vulnerability	Calculated impact
Earthquake	6=15-25%	According to SEMA, a major earthquake affecting Warren County definitely is expected with a Level VI impact on the Modified Mercalli Intensity Scale from a 6.7 earthquake, Level VII from a 7.6 earthquake and Level VIII from a 8.6 earthquake. According to USGS and CERI, Warren County stands a good chance of experiencing an earthquake of magnitude 6.0 or greater within the next 50 years. The committee selected 20% for calculating the impact.

Hazard	Overall vulnerability	Calculated impact
Wildfire	4=5-10%=5% 5=10-15%=10%	Truesdale has medium density wildland-urban interface. Considering that a wildfire event would have a limited impact and that there are no past events, since there is a considerable amount of median density wildland-urban interface, the committee selected 5% for calculating the impact. Both the City of Marthasville and City of Warrenton has a mix of high density and medium density wildland-urban interface. Therefore, 10% was selected for calculating the impact.

Jurisdiction wide hazards

3.3.3.2 Drought risk assessment

Even though, drought had an overall ranking of '6', drought is not anticipated to damage structures.

3.3.3.3 Earthquake risk assessment

Overall vulnerability= 6= 15-25 %of the jurisdiction impacted

Maximum calculated impact = 20 %

Table 3.3.3.4 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	14.8	51.4	0.8	1	16.2	4.2	1432.2	3718
Innsbrook	0	1.2	0	0	0.8	0	211.2	112
Marthasville	0.4	2.6	0.2	0.4	0.4	0.4	72.6	172
Warrenton	1.6	26	0.2	1.2	6.6	2.4	443	1431
Wright City	0.6	12.6	0.6	0.6	6	1.2	143.8	559
Truesdale	0.2	1.6	0.2	0.2	1	0	36.6	126

Table 3.3.3.4 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	608
Wright City R-II School District	250
Washington School (Elementary School)	44
Gasconade County R-I School	216

3.3.3.4 Extreme Heat assessment

Even though, the overall vulnerability for extreme heat is "6", it is not expected to have an impact on the buildings. Therefore, the vulnerability assessment has not been included for the hazard extreme heat.

3.3.3.5 Hailstorms assessment

Overall vulnerability= 5= 10-15 %of the jurisdiction impacted

Maximum calculated impact = 10 %

Table 3.3.3.5 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	7.4	25.7	0.4	0.5	8.1	2.1	716.1	1859
Innsbrook	0	0.6	0	0	0.4	0	105.6	56
Marthasville	0.2	1.3	0.1	0.2	0.2	0.2	36.3	86
Warrenton	0.8	13	0.1	0.6	3.3	1.2	221.5	715
Wright City	0.3	6.3	0.3	0.3	3	0.6	71.9	279
Truesdale	0.1	0.8	0.1	0.1	0.5	0	18.3	63

Table 3.3.3.5 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	304
Wright City R-II School District	125
Washington School (Elementary School)	22
Gasconade County R-I School	108

3.3.3.6 Severe Winter Weather assessment

Overall vulnerability= 6= 15-25 %of the jurisdiction impacted

Maximum calculated impact = 20 %

Table 3.3.3.6 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	14.8	51.4	0.8	1	16.2	4.2	1432.2	3718
Innsbrook	0	1.2	0	0	0.8	0	211.2	112
Marthasville	0.4	2.6	0.2	0.4	0.4	0.4	72.6	172
Warrenton	1.6	26	0.2	1.2	6.6	2.4	443	1431
Wright City	0.6	12.6	0.6	0.6	6	1.2	143.8	559
Truesdale	0.2	1.6	0.2	0.2	1	0	36.6	126

Table 3.3.3.6 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	608
Wright City R-II School District	250
Washington School (Elementary School)	44
Gasconade County R-I School	216

3.3.3.7 Thunderstorms & high winds assessment

Overall vulnerability= 6= 15-25 %of the jurisdiction impacted

Maximum calculated impact = 20 %

Table 3.3.3.7 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	14.8	51.4	0.8	1	16.2	4.2	1432.2	3718
Innsbrook	0	1.2	0	0	0.8	0	211.2	112
Marthasville	0.4	2.6	0.2	0.4	0.4	0.4	72.6	172
Warrenton	1.6	26	0.2	1.2	6.6	2.4	443	1431
Wright City	0.6	12.6	0.6	0.6	6	1.2	143.8	559
Truesdale	0.2	1.6	0.2	0.2	1	0	36.6	126

Table 3.3.3.7 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	608
Wright City R-II School District	250
Washington School (Elementary School)	44
Gasconade County R-I School	216

3.3.3.8 Tornadoes assessment

Overall vulnerability= 6= 15-25 %of the jurisdiction impacted

Maximum calculated impact = 20 %

Table 3.3.3.8 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	14.8	51.4	0.8	1	16.2	4.2	1432.2	3718
Innsbrook	0	1.2	0	0	0.8	0	211.2	112
Marthasville	0.4	2.6	0.2	0.4	0.4	0.4	72.6	172
Warrenton	1.6	26	0.2	1.2	6.6	2.4	443	1431
Wright City	0.6	12.6	0.6	0.6	6	1.2	143.8	559
Truesdale	0.2	1.6	0.2	0.2	1	0	36.6	126

Table 3.3.3.8 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	608
Wright City R-II School District	250
Washington School (Elementary School)	44
Gasconade County R-I School	216

3.3.3.9 Hazardous materials assessment

Overall vulnerability= 5= 10-15 %of the jurisdiction impacted

Maximum calculated impact = 10 %

Table 3.3.3.9 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	7.4	25.7	0.4	0.5	8.1	2.1	716.1	1860
Innsbrook	0	0.6	0	0	0.4	0	105.6	56
Marthasville	0.2	1.3	0.1	0.2	0.2	0.2	36.3	86
Warrenton	0.8	13	0.1	0.6	3.3	1.2	221.5	715
Wright City	0.3	6.3	0.3	0.3	3	0.6	71.9	279
Truesdale	0.1	0.8	0.1	0.1	0.5	0	18.3	63

Table 3.3.3.9 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	304
Wright City R-II School District	125

School District	Population impacted ('08-'09 enrollment)
Washington School (Elementary School)	22
Gasconade County R-I School	108

3.3.3.10 Terrorism Hazard Assessment

Overall vulnerability= 3 = less than 5 percent of the jurisdiction impacted.

Maximum calculated impact = 2 %

Table 3.3.3.10 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	1.4	5.14	0.08	0.1	1.62	0.42	143.2	371
Innsbrook	0	0.12	0	0	0.08	0	21.1	11
Marthasville	0.04	0.26	0.02	0.04	0.04	0.04	7.2	17
Warrenton	0.16	2.6	0.02	0.12	0.6	0.24	44.3	143
Wright City	0.06	1.26	0.06	0.06	0.6	0.12	14.3	56
Truesdale	0.02	0.16	0.02	0.02	0.1	0	3.6	13

Table 3.3.3.10 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	61
Wright City R-II School District	25
Washington School (Elementary School)	5
Gasconade County R-I School	22

3.3.3.11 Transportation Hazard Assessment

Overall vulnerability= 6= 15-25 %of the jurisdiction impacted

Maximum calculated impact = 20 %

Table 3.3.3.11 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	14.8	51.4	0.8	1	16.2	4.2	1432.2	2920
Innsbrook	0	1.2	0	0	0.8	0	211.2	102
Marthasville	0.4	2.6	0.2	0.4	0.4	0.4	72.6	172
Warrenton	1.6	26	0.2	1.2	6.6	2.4	443	1431
Wright City	0.6	12.6	0.6	0.6	6	1.2	143.8	556
Truesdale	0.2	1.6	0.2	0.2	1	0	36.6	126

Table 3.3.3.11 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	608
Wright City R-II School District	250
Washington School (Elementary School)	44
Gasconade County R-I School	216

3.3.3.12 Utility interruptions Hazard Assessment

Overall vulnerability= 6= 15-25 %of the jurisdiction impacted

Maximum calculated impact = 20 %

Table 3.3.3.12 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	14.8	51.4	0.8	1	16.2	4.2	1432.2	2920
Innsbrook	0	1.2	0	0	0.8	0	211.2	102
Marthasville	0.4	2.6	0.2	0.4	0.4	0.4	72.6	172
Warrenton	1.6	26	0.2	1.2	6.6	2.4	443	1431
Wright City	0.6	12.6	0.6	0.6	6	1.2	143.8	556
Truesdale	0.2	1.6	0.2	0.2	1	0	36.6	126

Table 3.3.3.12 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	608
Wright City R-II School District	250
Washington School (Elementary School)	44
Gasconade County R-I School	216

Jurisdiction specific hazards

3.3.3.13 Dam failure assessment

Overall vulnerability=4= 5-10 % of the jurisdiction impacted.

Maximum calculated impact = 5%

Overall vulnerability= 5= 10-15 %of the jurisdiction impacted

Maximum calculated impact = 10 %

Table 3.3.3.13 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	3.7	12.85	0.2	0.25	4.05	1.05	358.05	930
Innsbrook	0	0.3	0	0	0.2	0	52.8	28
Marthasville	0.2	1.3	0.1	0.2	0.2	0.2	36.3	86
Warrenton	NA	NA	NA	NA	NA	NA	NA	NA
Wright City	NA	NA	NA	NA	NA	NA	NA	NA
Truesdale	NA	NA	NA	NA	NA	NA	NA	NA

Table 3.3.3.13 B

School District	Population impacted ('08-'09 enrollment)
Washington School (Elementary School)	11

3.3.3.14 Floods damage assessment

Overall vulnerability= 5= 10-15 %of the jurisdiction impacted

Maximum calculated impact = 10 %

Overall vulnerability= 6= 15-25 %of the jurisdiction impacted

Maximum calculated impact = 20 %

Table 3.3.3.14 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	7.4	25.7	0.4	0.5	8.1	2.1	716.1	1860
Innsbrook	0	0.6	0	0	0.4	0	105.6	56
Marthasville	0.4	2.6	0.2	0.4	0.4	0.4	72.6	172
Warrenton	0.8	13	0.1	0.6	3.3	1.2	221.5	715
Wright City	0.3	6.3	0.3	0.3	3	0.6	71.9	278
Truesdale	0.1	0.8	0.1	0.1	0.5	0	18.3	63

Table 3.3.3.14 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	304
Wright City R-II School District	125
Washington School (Elementary School)	44

3.3.3.15 Levee failure assessment

Overall vulnerability= 6= 15-25 %of the jurisdiction impacted

Maximum calculated impact = 20 %

Table 3.3.2.15 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Marthasville	0.4	2.6	0.2	0.4	0.4	0.4	72.6	172

Table 3.3.3.15 B

School District	Population impacted ('08-'09 enrollment)
Washington School (Elementary School)	44

3.3.3.16 Wildfire damage assessment

Overall vulnerability= 5= 10-15 %of the jurisdiction impacted

Maximum calculated impact = 10 %

Overall vulnerability=4= 5-10 % of the jurisdiction impacted.

Maximum calculated impact = 5%

Table 3.3.3.16 A

Jurisdiction	Agriculture	Commercial	Education	Government	Industrial	Religious	Residential	Population
Unincorporated area	NA	NA	NA	NA	NA	NA	NA	NA
Innsbrook	NA	NA	NA	NA	NA	NA	NA	NA
Marthasville	0.2	1.3	0.1	0.2	0.2	0.2	36.3	86
Warrenton	0.8	13	0.1	0.6	3.3	1.2	221.5	715
Wright City	NA	NA	NA	NA	NA	NA	NA	NA
Truesdale	0.05	0.4	0.05	0.05	0.25	0	9.15	31.5

Table 3.3.3.16 B

School District	Population impacted ('08-'09 enrollment)
Warren County R-III School District	304

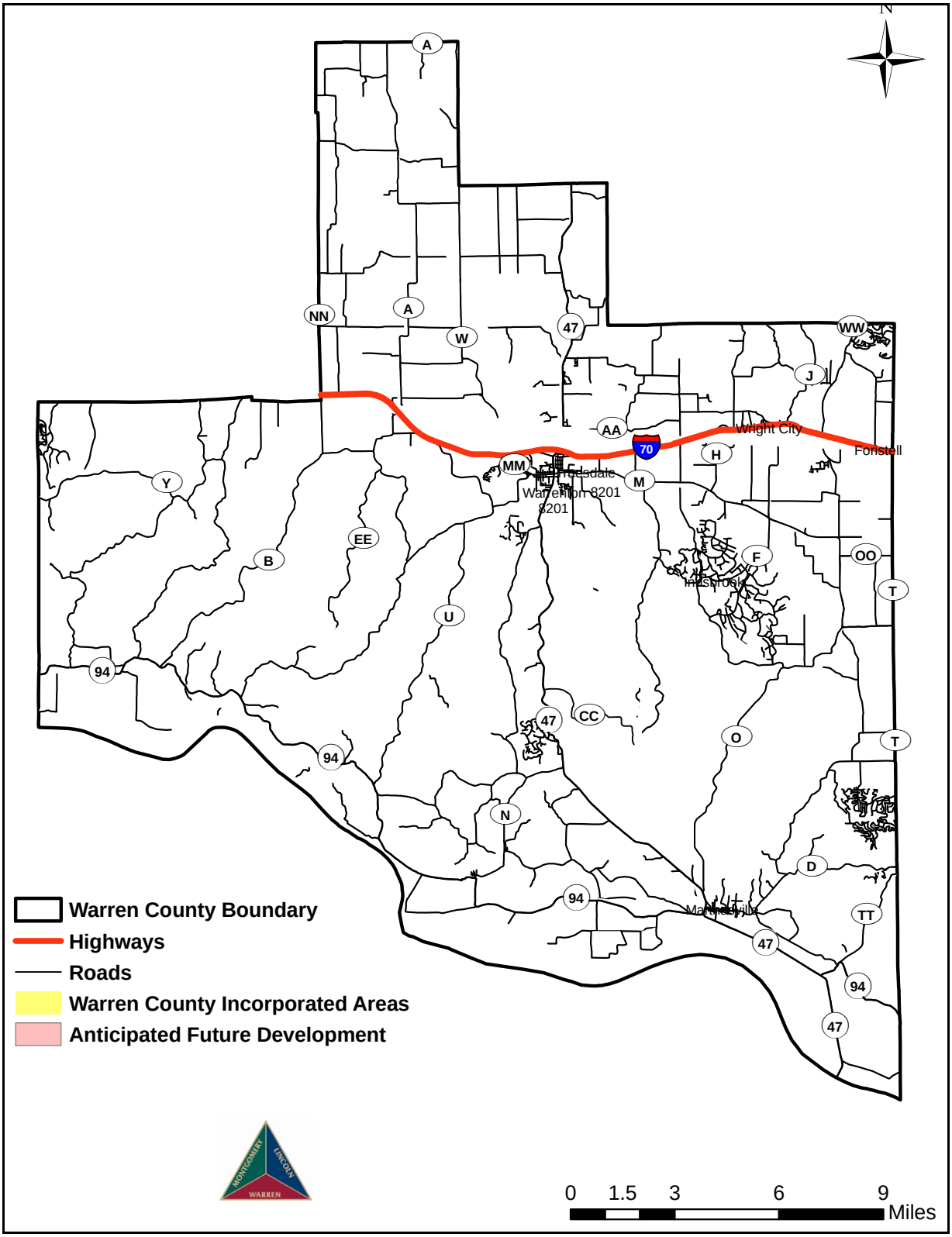
3.3.4 Natural Hazards Composite and Future Development Trends

As per the current trend, it was estimated that future development would occur along I-70, Hwy 94(East -West along the Missouri River), and Hwy 47 North/South. Further, it was estimated that the cities along I-70 tend to grow at an accelerated rate compared to other areas in the county.

The current estimated population in Warren County is 30,467. It was projected to increase to 40,174 by 2020. This represents a growth of 32 percent within a span of 12 years which shows that there would be a little growth in the county.

Keeping in mind the current trend of occurrence of natural hazards, it can be estimated that the major flood hazard would likely occur along the Missouri river floodplain. The anticipated growth areas are less likely to be impacted by riverine flooding, though localized flooding is possible if storm drainage systems are not developed in densely populated areas. The other major hazard tornadoes and thunderstorms are likely to occur throughout the county.Therefore, future development should anticipate these hazards and provide adequate safegaurds.

Map 3.3.3.1 shows the future development trends for Warren County



3.3.5 National Flood Insurance Program (NFIP)

Warren County has development policies in place to discourage development in the floodplain. FEMA defines a repetitive loss property as:

> "any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. At least two of the claims must be more than 10-days apart but, within ten-years of each other. A repetitive loss property may or may not be currently insured by the NFIP."

The information provided in the table below is current from FEMA's database as of August 31st, 2009.

Table 3.3.5.1Dollar values of Repetitive losses as of 08/31/2009

Repetitive Loss	Warren County (290443*)	City of Marthasville (290444*)
Building Payments ($'s)	351,806.31	203,224.59
Contents Payments ($'s)	14,132.55	31,816.88
Total Payments ($'s)	369,938.86	235,041.47
Average Payment ($'s)	19,259.94	21,367.41
Losses	19	11
Properties	9	4

*Community number Source: SEMA

Table 3.3.5.2 shows the list of properties included in the National Flood Insurance Program (NFIP) Repetitive Loss Database

Community Name	Mitigated?	Insured?	Occupancy	Losses	Data Type	As of Date
MARTHASVILLE, CITY OF	NO	YES	NON RESIDNT	2	Non-mitigated Data	08/31/2009
MARTHASVILLE, CITY OF	NO	NO	NON RESIDNT	3	Non-mitigated Data	08/31/2009
MARTHASVILLE, CITY OF	NO	SDF	SINGLE FMLY	4	Non-mitigated Data	08/31/2009
MARTHASVILLE, CITY OF	NO	YES	NON RESIDNT	2	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	NO	SINGLE FMLY	2	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	NO	SINGLE FMLY	3	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	NO	NON RESIDNT	2	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	YES	NON RESIDNT	2	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	NO	NON RESIDNT	2	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	NO	SINGLE FMLY	2	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	NO	SINGLE FMLY	2	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	NO	SINGLE FMLY	2	Non-mitigated Data	08/31/2009
WARREN COUNTY*	NO	NO	SINGLE FMLY	2	Non-mitigated Data	08/31/2009

Source: SEMA