

## **2.3 TORNADO**

Tornadoes are rapidly rotating funnels of wind extending from storm clouds to the ground. They are created during severe thunderstorms when cold air overrides a layer of warm air, causing the warm air to rise rapidly. The midsection of the United States experiences a higher rate of tornadoes than other parts of the country because of the recurrent collision of moist, warm air moving north from the Gulf of Mexico with colder fronts moving east from the Rocky Mountains (FEMA, MHIRA 40).

Tornadoes are the most hazardous when they occur in populated areas. Tornadoes can topple mobile homes, lift cars, snap trees, and turn objects into destructive missiles. Among the most unpredictable of weather phenomena, tornadoes can occur at any time of day, in any state in the union, and in any season. While the majority of tornadoes cause little or no damage, some are capable of tremendous destruction, reaching wind speeds of 200 mph or more.

Tornadoes are not spatial hazards. As a result, it is often difficult to profile tornadoes and determine the exact risk. However, estimations can be developed by analyzing historic occurrences and past declarations. While Ohio does not rank among the top states for the number of tornado events, it does rank within the top 20 states in the nation for fatalities, injuries, and dollar losses, indicating that it has a relatively high likelihood for damages resulting from tornado.

### **RISK ASSESSMENT**

#### **Location**

Ohio has a significant history of past tornado events. Map 2.3.a depicts the paths of 731 tornadoes that have struck the State of Ohio between 1950 and 2000. In Ohio, tornadoes have higher frequency in the spring and summer months of April, May, June, and July (see Chart 2.3.a). These storms caused over 200 deaths and over 4,000 injuries in the State. Between 1964 and 2004 10 tornadoes created damage that resulted in a federal disaster declaration (see Table 2.3.a). All regions in the state have had tornado declarations. However, Region 2 and Region 3 have the most counties that have received the most repetitive damage from historic occurrences and have had the largest estimated losses due to tornadoes.

#### **LHMP Data**

Although tornadoes can occur throughout the state, the City of Xenia appears to be especially tornado prone. According to the Greene County LHMP, "Nineteen tornadoes were reported in Greene County, Ohio since 1884. These tornadoes caused 43 deaths, 1,377 injuries and over \$1 billion dollars of damage. Xenia was the location of seven tornadoes, responsible for the majority of the fatalities and caused the highest amount of damage." Greene County considers tornados a major event with the potential of high damage, personal injury, and loss of life. They have conducted a number of studies involving tornados and have incorporated those studies into their LHMP.

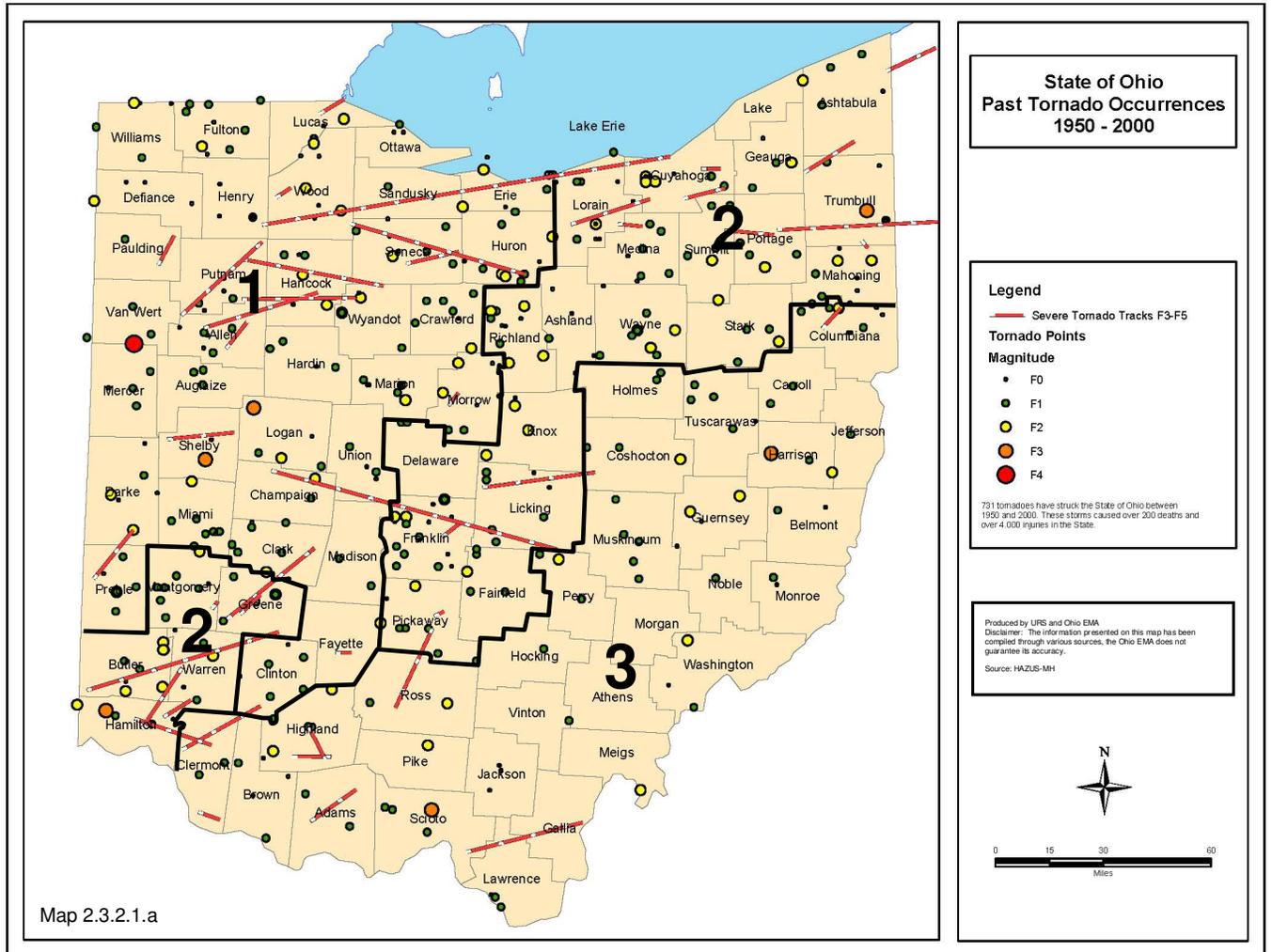
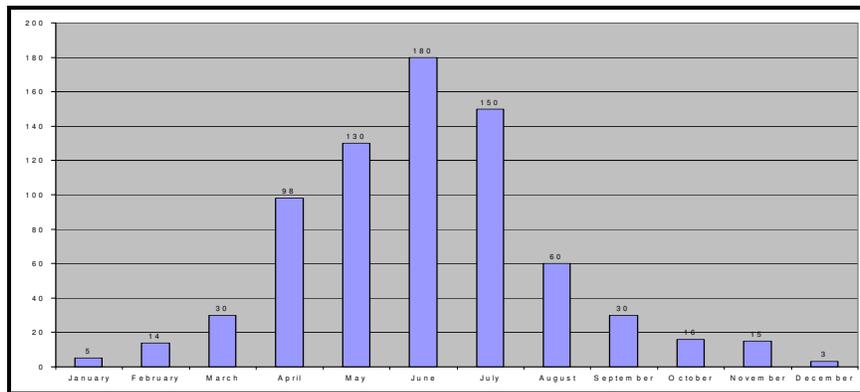


Chart 2.3.a

Frequency of Ohio Tornadoes by Month, 1950 to 2000



Source: SeverePlot Software, NOAA, <http://spc.noaa.gov/software/svrplot2/>

Table 2.3.a

| Tornado Disaster Declarations by Region |        |        |        |        |          |        |         |         |         |          |            |        |        |        |        |        |        |         |         |         |         |        |            |        |        |        |        |        |         |         |         |         |   |  |
|---|--------|--------|--------|--------|----------|--------|---------|---------|---------|----------|------------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|--------|------------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---|--|
| Region 1                                |        |        |        |        | Region 2 |        |         |         |         | Region 3 |            |        |        |        |        |        |        |         |         |         |         |        |            |        |        |        |        |        |         |         |         |         |   |  |
| County                                  | DR-191 | DR-238 | DR-421 | DR-642 | DR-738   | DR-870 | DR-1227 | DR-1343 | DR-1444 | DR-1484  | County     | DR-191 | DR-238 | DR-421 | DR-642 | DR-738 | DR-870 | DR-1227 | DR-1343 | DR-1444 | DR-1484 | County | DR-191     | DR-238 | DR-421 | DR-642 | DR-738 | DR-870 | DR-1227 | DR-1343 | DR-1444 | DR-1484 |   |  |
| Allen                                   | X      |        |        |        |          |        |         |         |         |          | Ashland    |        |        |        |        |        |        |         |         |         |         | X      | Adams      |        |        | X      |        |        |         |         |         |         | X |  |
| Auglaize                                |        |        |        |        |          |        |         |         | X       |          | Ashtabula  |        |        |        | X      |        |        |         |         |         |         |        | Athens     |        |        |        |        | X      | X       |         |         |         |   |  |
| Champaign                               |        |        |        |        |          |        |         |         |         |          | Butler     |        |        | X      |        |        | X      |         |         |         |         |        | Belmont    |        |        |        |        | X      | X       |         |         |         |   |  |
| Clark                                   |        |        | X      |        |          |        |         |         |         |          | Cuyahoga   | X      |        |        |        |        |        |         |         |         | X       | X      | Brown      |        | X      |        |        |        |         |         |         |         |   |  |
| Clinton                                 |        |        |        |        |          |        |         |         |         |          | Delaware   | X      |        | X      |        |        |        |         |         |         |         |        | Carroll    |        |        |        |        |        |         |         |         |         | X |  |
| Crawford                                |        |        |        |        |          |        |         |         |         |          | Fairfield  |        |        |        |        |        | X      |         |         |         |         |        | Clermont   |        | X      |        |        | X      |         |         |         |         |   |  |
| Defiance                                |        |        |        |        |          |        |         |         |         |          | Franklin   |        |        | X      |        |        | X      | X       |         |         | X       | X      | Columbiana |        |        |        | X      | X      |         |         |         |         | X |  |
| Darke                                   |        |        |        |        |          |        |         |         |         |          | Geauga     |        |        |        |        |        | X      |         |         |         |         |        | Coshocton  |        |        |        | X      |        | X       |         |         | X       |   |  |
| Erie                                    |        |        |        |        |          |        |         |         |         |          | Greene     |        |        | X      |        |        |        |         | X       |         |         |        | Gallia     |        | X      |        |        |        |         |         |         |         |   |  |
| Fayette                                 |        |        | X      |        |          |        |         |         |         |          | Hamilton   |        |        | X      |        |        |        |         |         |         |         |        | Guernsey   |        |        |        |        |        | X       |         |         |         |   |  |
| Fulton                                  |        |        |        |        |          |        |         |         |         |          | Knox       |        |        |        |        |        |        | X       |         |         |         |        | Harrison   | X      |        |        |        | X      | X       |         |         |         |   |  |
| Hancock                                 | X      |        |        | X      |          |        |         |         | X       |          | Lake       |        |        |        |        |        |        |         |         |         |         |        | Highland   | X      |        |        |        |        |         |         |         |         |   |  |
| Hardin                                  |        |        |        |        |          |        |         |         |         |          | Licking    |        |        |        |        | X      |        |         |         |         |         |        | Hocking    |        |        |        |        | X      |         |         |         |         |   |  |
| Henry                                   |        |        |        |        |          |        |         |         | X       |          | Lorain     | X      |        |        |        |        | X      |         |         |         | X       |        | Holmes     |        |        |        |        |        |         |         |         |         |   |  |
| Huron                                   |        |        |        |        |          |        |         |         | X       |          | Mahoning   |        |        |        |        |        | X      |         |         |         | X       |        | Jackson    |        |        |        |        | X      | X       |         |         |         |   |  |
| Logan                                   |        |        |        |        |          |        |         |         |         |          | Medina     | X      |        |        |        |        | X      |         |         |         | X       | X      | Jefferson  |        |        |        |        | X      | X       |         |         |         | X |  |
| Lucas                                   | X      |        |        |        |          |        |         |         |         |          | Montgomery |        |        |        |        |        |        |         |         |         |         |        | Lawrence   |        |        |        |        | X      |         |         |         |         |   |  |
| Madison                                 |        |        | X      |        |          |        |         |         |         |          | Pickaway   | X      |        | X      |        |        |        |         | X       |         |         |        | Meigs      |        |        |        |        |        | X       |         |         |         |   |  |
| Marion                                  |        |        |        |        |          |        |         |         |         |          | Portage    |        |        |        |        | X      | X      |         |         |         |         |        | Monroe     |        |        |        |        | X      | X       |         |         |         |   |  |
| Morrow                                  | X      |        |        | X      |          |        | X       |         |         |          | Richland   |        |        |        |        |        |        |         | X       |         |         |        | Morgan     |        |        |        |        |        | X       |         |         |         |   |  |
| Mercer                                  | X      |        |        |        |          |        |         |         |         |          | Stark      |        |        |        |        |        |        |         |         |         |         |        | Muskingum  |        |        |        |        | X      | X       |         |         |         |   |  |
| Miami                                   |        |        |        |        |          |        |         |         |         |          | Summit     |        |        | X      |        |        | X      |         |         |         | X       | X      | Noble      |        |        |        |        |        | X       |         |         |         |   |  |
| Ottawa                                  |        |        |        |        |          |        | X       | X       |         |          | Trumbull   |        |        |        | X      | X      |        |         |         |         |         |        | Perry      |        |        |        |        | X      | X       |         |         |         |   |  |
| Paulding                                |        |        | X      |        |          |        |         |         | X       |          | Warren     |        |        | X      |        |        |        |         |         |         |         |        | Pike       |        |        |        |        | X      |         |         |         |         |   |  |
| Preble                                  |        |        |        |        |          |        |         |         |         |          | Wayne      |        |        |        |        |        |        |         |         |         |         |        | Ross       |        |        |        |        | X      |         |         |         |         |   |  |
| Putnam                                  |        |        | X      | X      |          |        |         |         | X       |          |            |        |        |        |        |        |        |         |         |         |         |        | Scioto     |        | X      |        |        |        |         |         |         |         |   |  |
| Sandusky                                |        |        |        |        |          |        | X       | X       |         |          |            |        |        |        |        |        |        |         |         |         |         |        | Tuscarawas |        |        |        |        |        | X       |         |         |         |   |  |
| Seneca                                  | X      |        |        |        |          |        |         |         | X       |          |            |        |        |        |        |        |        |         |         |         |         |        | Vinton     |        |        |        |        | X      |         |         |         |         | X |  |
| Shelby                                  | X      |        |        |        |          |        |         |         |         |          |            |        |        |        |        |        |        |         |         |         |         |        | Washington |        |        |        |        |        | X       |         |         |         |   |  |
| Union                                   |        |        |        |        |          |        |         |         |         |          |            |        |        |        |        |        |        |         |         |         |         |        |            |        |        |        |        |        |         |         |         |         |   |  |
| Van Wert                                | X      |        |        |        |          |        |         |         |         |          |            |        |        |        |        |        |        |         |         |         |         |        |            |        |        |        |        |        |         |         |         |         |   |  |
| Williams                                |        |        |        |        |          |        |         |         |         |          |            |        |        |        |        |        |        |         |         |         |         |        |            |        |        |        |        |        |         |         |         |         |   |  |
| Wood                                    |        |        |        |        |          |        |         |         |         |          |            |        |        |        |        |        |        |         |         |         |         |        |            |        |        |        |        |        |         |         |         |         |   |  |
| Wyandot                                 |        |        |        | X      |          |        |         |         |         |          |            |        |        |        |        |        |        |         |         |         |         |        |            |        |        |        |        |        |         |         |         |         |   |  |

## **Past Occurrences**

One of the most significant storms is the April 1974 storm known as the Super-outbreak. One-hundred forty-eight tornadoes charged across Alabama, Georgia, Illinois, Indiana, Kentucky, Michigan, Mississippi, North Carolina, Ohio, South Carolina, Tennessee, Virginia, and West Virginia, killing 330 people and injuring 5,484 others. Within Ohio, the storm particularly affected Xenia, a municipality in Greene County within Region 1, where 37 tornadoes left 30 people dead, 1,100 injured, and more than 1,000 homes destroyed (NOAA, <http://www.publicaffairs.noaa.gov/storms/>). In September 2000, Xenia was again struck by an F4 tornado, damaging or destroying 300 homes and businesses, killing one person, and injuring 115 (Xenia 3-3).

Another notable storm occurred on April 1999, in Region 1 and Region 2 affecting the counties of Clinton, Hamilton, and Warren. The tornadoes killed four people, injured 42, and damaged or destroyed 400 structures, causing about \$82 million in losses (Ohio EMA 16).

In more recent years there have been two disaster declarations DR-1444, which was specifically for tornado, related damage and DR-1484, which covered tornado and flood, related damage. DR-1444 was in November 2002 and affected several counties in Region 1 and Region 2 and caused damage in Coshocton County, which is located in Region 3. The damage from this disaster was relative to a tornado that registers a F-4 on the Fujita Scale. Many of the residents of the impacted counties were left homeless, many were trapped in debris, damage to commercial structures created localized unemployment, hundreds of injuries were reported, and multiple lives were lost.

DR-1484 was in August 2003 and was the most recent declaration that included tornadic damage. The primary damage from this disaster was flood related, and a more thorough discussion of those issues can be found in the flood section of the Risk Assessment. However, Mahoning County in the eastern portion of Region 2 was left damaged by a tornado that spawned from the storm. The tornado confirmed as an F-1 and affected part of the City of Youngstown and parts of the unincorporated areas of the County. The tornado was 50-100 yards wide and 8 miles long. Sixty homes received major damage and 20 received minor damage. The estimated loss from this tornado was \$900,000 and approximately 33% of the structures were insured.

## **Probability of Future Events**

Between 1950 and 2000, Ohio experienced 731 tornadoes, an average of 14.6 storms annually. Statewide, there is a statistical chance of 4% on any given day of having a tornado of any size (this represents a statistical probability calculated mathematically based on the occurrence of past tornado events: 14.6 tornadoes divided by 365 days = 0.04 occurrences per day. Of course the likelihood of a tornado is normally lower during the winter and higher during the summer). While tornado occurrences are generally considered to be unpredictable, past occurrences

show that there is a 0.29% chance statewide of having a EF3, EF4, or EF5 tornado with wind speeds of at least 136 mph. Based on historic occurrences the counties with the highest probability of occurrence, include Huron, Medina, Richland (0.09%), Franklin (0.11%), and Lorain (0.12%). Portage, Greene, and Scioto have the highest chance, 0.01%, of having an EF5 tornado.

The Enhanced Fujita Tornado Scale measures tornado intensity. The Enhanced Fujita Tornado Measurement Scale, shown in Table 2.3.2.3.a, determines likely wind speeds based on the severity of tornado damage and assigns a scale category, EF0 through EF5. The table below shows the tornado category, corresponding wind speed, types of damage possible, and the number of tornadoes per category that Ohio has experienced between 1950 and 2000. Tornado occurrence and intensities by county can be found in Appendix E, Additional Tornado Information.

Table 2.3.b shows that the majority of tornadoes in Ohio, about 70%, fall in the gale to moderate categories (EF0 to EF1) causing light to moderate damage, such as breaking tree limbs or overturning mobile homes. Fifteen or 2% of past tornadoes have been EF4 or EF5 with wind speeds similar to those that affected Xenia in the 1974 Superoutbreak.

**Table 2.3.b**

| <b>Enhanced Fujita Tornado Measurement Scale and Frequencies in Ohio</b> |                              |   |                        |                           |
|--|------------------------------|---|------------------------|---------------------------|
| <b>Category</b>  | <b>Wind Speed</b>            | <b>Examples of Possible Damage</b>  | <b>Number in Ohio*</b> | <b>% of OH Tornadoes*</b> |
| <b>EF0</b>   | Gale<br>(65-85 mph)          | Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.   | 185                    | 25.31%                    |
| <b>EF1</b>   | Moderate<br>(86-110 mph)     | Moderate damage. Surface peeled off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.  | 330                    | 45.14%                    |
| <b>EF2</b>   | Significant<br>(111-135 mph) | Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.   | 163                    | 22.30%                    |
| <b>EF3</b>   | Severe<br>(136-165 mph)      | Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.  | 38                     | 5.20%                     |
| <b>EF4</b>   | Devastating<br>(166-200 mph) | Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.  | 12                     | 1.64%                     |
| <b>EF5</b>   | Incredible<br>(Over 200 mph) | Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 100-yards; trees debarked; incredible phenomena will occur. | 3                      | 0.41%                     |
| <b>Total tornadoes in Ohio, 1950-2000</b>                                |                              |   | <b>731</b>             | <b>--</b>                 |

\*The number and % of tornados was based off of the Fijuita scale and not the Enhanced-Fujita scale, implemented on February 1, 2007.

Source: SeverePlot Software, Storm Prediction Center, NOAA; FEMA Understanding Your Risks

For a more detailed understanding of the probability of future occurrence for the state Tables 2.3.c, 2.3.d, and 2.3.e determine the probability of future occurrence based on past occurrences by region for each county. In Region 1, Huron, Wood, and Seneca counties have the highest probability of future occurrence all having a probability of 28% or more. Most of the counties within this region have a probability of 8% to 15% probability.

**Table 2.3c**

| <b>Number and Statistical Probability of Tornadoes for Region 1</b> |           |           |            |           |           |           |           |           |           |           |           |           |                    |
|---|-----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|
|   | <b>F0</b> |           | <b>F1</b>  |           | <b>F2</b> |           | <b>F3</b> |           | <b>F4</b> |           | <b>F5</b> |           | <b>Grand Total</b> |
|   | <b>#</b>  | <b>F0</b> | <b>#</b>   | <b>F1</b> | <b>#</b>  | <b>F2</b> | <b>#</b>  | <b>F3</b> | <b>#</b>  | <b>F4</b> | <b>#</b>  | <b>F5</b> |                    |
| Allen   | 4         | 8%        | 3          | 6%        |           | 0%        | 2         | 4%        | 1         | 2%        |           | 0%        | 20%                |
| Auglaize  | 1         | 2%        | 4          | 8%        |           | 0%        |           | 0%        |           | 0%        |           | 0%        | 10%                |
| Champaign   |           | 0%        | 2          | 4%        | 2         | 4%        |           | 0%        |           | 0%        |           | 0%        | 8%                 |
| Clark   | 3         | 6%        | 7          | 14%       | 1         | 2%        |           | 0%        |           | 0%        |           | 0%        | 22%                |
| Clinton   | 4         | 8%        | 6          | 12%       | 2         | 4%        |           | 0%        |           | 0%        |           | 0%        | 24%                |
| Crawford  | 1         | 2%        | 7          | 14%       | 1         | 2%        |           | 0%        |           | 0%        |           | 0%        | 18%                |
| Darke   | 5         | 10%       | 2          | 4%        | 4         | 8%        | 1         | 2%        |           | 0%        |           | 0%        | 24%                |
| Defiance  | 4         | 8%        |            | 0%        | 2         | 4%        |           | 0%        |           | 0%        |           | 0%        | 12%                |
| Erie  | 5         | 10%       | 3          | 6%        | 2         | 4%        |           | 0%        |           | 0%        |           | 0%        | 20%                |
| Fayette   | 1         | 2%        | 2          | 4%        | 2         | 4%        | 1         | 2%        |           | 0%        |           | 0%        | 12%                |
| Fulton  | 4         | 8%        | 6          | 12%       | 1         | 2%        |           | 0%        |           | 0%        |           | 0%        | 22%                |
| Hancock   | 1         | 2%        | 4          | 8%        | 3         | 6%        |           | 0%        |           | 0%        |           | 0%        | 16%                |
| Hardin  | 1         | 2%        | 4          | 8%        |           | 0%        |           | 0%        |           | 0%        |           | 0%        | 10%                |
| Henry   | 3         | 6%        | 2          | 4%        | 2         | 4%        |           | 0%        |           | 0%        |           | 0%        | 14%                |
| Huron   | 4         | 8%        | 6          | 12%       | 6         | 12%       |           | 0%        |           | 0%        |           | 0%        | 32%                |
| Logan   | 1         | 2%        | 2          | 4%        | 1         | 2%        | 1         | 2%        |           | 0%        |           | 0%        | 10%                |
| Lucas   | 1         | 2%        | 1          | 2%        | 2         | 4%        |           | 0%        | 1         | 2%        |           | 0%        | 10%                |
| Madison   |           | 0%        | 5          | 10%       |           | 0%        |           | 0%        |           | 0%        |           | 0%        | 10%                |
| Marion  | 4         | 8%        | 5          | 10%       | 4         | 8%        |           | 0%        |           | 0%        |           | 0%        | 26%                |
| Mercer  | 3         | 6%        | 7          | 14%       | 1         | 2%        |           | 0%        |           | 0%        |           | 0%        | 22%                |
| Miami   | 2         | 4%        | 9          | 18%       | 2         | 4%        |           | 0%        |           | 0%        |           | 0%        | 26%                |
| Morrow  | 3         | 6%        | 2          | 4%        | 5         | 10%       | 1         | 2%        |           | 0%        |           | 0%        | 22%                |
| Ottawa  | 2         | 4%        | 2          | 4%        | 2         | 4%        |           | 0%        |           | 0%        |           | 0%        | 12%                |
| Paulding  |           | 0%        | 5          | 10%       | 1         | 2%        | 1         | 2%        |           | 0%        |           | 0%        | 14%                |
| Preble  | 1         | 2%        | 4          | 8%        | 2         | 4%        | 1         | 2%        |           | 0%        |           | 0%        | 16%                |
| Putnam  | 4         | 8%        | 6          | 12%       | 1         | 2%        | 1         | 2%        |           | 0%        |           | 0%        | 24%                |
| Sandusky  |           | 0%        | 3          | 6%        |           | 0%        |           | 0%        |           | 0%        |           | 0%        | 6%                 |
| Seneca  | 3         | 6%        | 6          | 12%       | 3         | 6%        | 2         | 4%        |           | 0%        |           | 0%        | 28%                |
| Shelby  | 2         | 4%        |            | 0%        | 1         | 2%        | 1         | 2%        | 1         | 2%        |           | 0%        | 10%                |
| Union   | 2         | 4%        | 3          | 6%        | 1         | 2%        |           | 0%        |           | 0%        |           | 0%        | 12%                |
| Van Wert  | 1         | 2%        | 6          | 12%       | 1         | 2%        | 1         | 2%        | 1         | 2%        |           | 0%        | 20%                |
| Williams  | 1         | 2%        | 2          | 4%        | 3         | 6%        |           | 0%        |           | 0%        |           | 0%        | 12%                |
| Wood  | 8         | 16%       | 2          | 4%        | 4         | 8%        | 1         | 2%        |           | 0%        |           | 0%        | 30%                |
| Wyandot   | 1         | 2%        | 4          | 8%        | 3         | 6%        |           | 0%        |           | 0%        |           | 0%        | 16%                |
| <b>Total</b>  | <b>80</b> |           | <b>132</b> |           | <b>65</b> |           | <b>1</b>  |           | <b>4</b>  |           | <b>0</b>  |           |                    |

**Table 2.3.d**

| <b>Number and Statistical Probability of Tornadoes for Region 2</b> |           |           |            |           |           |           |           |           |           |           |           |           |                    |
|---|-----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|
|   | <b>F0</b> |           | <b>F1</b>  |           | <b>F2</b> |           | <b>F3</b> |           | <b>F4</b> |           | <b>F5</b> |           |                    |
|   | <b>#</b>  | <b>F0</b> | <b>#</b>   | <b>F1</b> | <b>#</b>  | <b>F2</b> | <b>#</b>  | <b>F3</b> | <b>#</b>  | <b>F4</b> | <b>#</b>  | <b>F5</b> | <b>Grand Total</b> |
| Ashland   | 6         | 12%       | 3          | 6%        | 1         | 2%        |           | 0%        |           | 0%        |           | 0%        | 20%                |
| Ashtabula   | 1         | 2%        | 4          | 8%        | 4         | 8%        |           | 0%        | 1         | 2%        |           | 0%        | 20%                |
| Butler  | 2         | 4%        | 5          | 10%       | 4         | 8%        | 1         | 2%        |           | 0%        |           | 0%        | 24%                |
| Cuyahoga  | 3         | 6%        | 3          | 6%        | 3         | 6%        | 2         | 4%        |           | 0%        |           | 0%        | 22%                |
| Delaware  | 1         | 2%        | 1          | 2%        | 1         | 2%        |           | 0%        |           | 0%        |           | 0%        | 6%                 |
| Fairfield   | 2         | 4%        | 7          | 14%       | 1         | 2%        | 1         | 2%        |           | 0%        |           | 0%        | 22%                |
| Franklin  | 8         | 16%       | 7          | 14%       | 5         | 10%       | 1         | 2%        |           | 0%        |           | 0%        | 42%                |
| Geauga  | 2         | 4%        | 3          | 6%        | 3         | 6%        |           | 0%        |           | 0%        |           | 0%        | 16%                |
| Greene  | 1         | 2%        | 4          | 8%        | 5         | 10%       |           | 0%        | 1         | 2%        | 1         | 2%        | 24%                |
| Hamilton  |           | 0%        | 5          | 10%       | 2         | 4%        | 2         | 4%        | 2         | 4%        |           | 0%        | 22%                |
| Knox  | 4         | 8%        | 1          | 2%        | 5         | 10%       |           | 0%        |           | 0%        |           | 0%        | 20%                |
| Lake  | 1         | 2%        |            | 0%        | 1         | 2%        |           | 0%        |           | 0%        |           | 0%        | 4%                 |
| Licking   | 2         | 4%        | 8          | 16%       | 3         | 6%        | 1         | 2%        |           | 0%        |           | 0%        | 28%                |
| Lorain  | 9         | 18%       | 8          | 16%       | 3         | 6%        |           | 0%        | 2         | 4%        |           | 0%        | 44%                |
| Mahoning  | 5         | 10%       | 4          | 8%        | 4         | 8%        | 1         | 2%        |           | 0%        |           | 0%        | 28%                |
| Medina  | 6         | 12%       | 9          | 18%       | 1         | 2%        | 1         | 2%        |           | 0%        |           | 0%        | 34%                |
| Montgomery  | 1         | 2%        | 5          | 10%       |           | 0%        | 1         | 2%        |           | 0%        |           | 0%        | 14%                |
| Pickaway  | 3         | 6%        | 5          | 10%       | 2         | 4%        | 2         | 4%        |           | 0%        |           | 0%        | 24%                |
| Portage   | 1         | 2%        | 5          | 10%       | 1         | 2%        |           | 0%        |           | 0%        | 1         | 2%        | 16%                |
| Richland  | 5         | 10%       | 7          | 14%       | 4         | 8%        |           | 0%        |           | 0%        |           | 0%        | 32%                |
| Stark   |           | 0%        | 3          | 6%        | 2         | 4%        |           | 0%        |           | 0%        |           | 0%        | 10%                |
| Summit  | 1         | 2%        | 5          | 10%       | 1         | 2%        | 2         | 4%        |           | 0%        |           | 0%        | 18%                |
| Trumbull  | 5         | 10%       | 3          | 6%        | 1         | 2%        | 2         | 4%        | 1         | 2%        |           | 0%        | 24%                |
| Warren  | 3         | 6%        | 3          | 6%        | 4         | 8%        |           | 0%        |           | 0%        |           | 0%        | 20%                |
| Wayne   | 1         | 2%        | 9          | 18%       | 3         | 6%        |           | 0%        |           | 0%        |           | 0%        | 26%                |
| <b>Total</b>  | <b>73</b> |           | <b>117</b> |           | <b>64</b> |           | <b>17</b> |           | <b>7</b>  |           | <b>2</b>  |           |                    |

**Table 2.3.e**

| Number and Statistical Probability of Tornadoes for Region 3 |           |     |           |     |           |     |          |    |          |    |          |    |             |
|--|-----------|-----|-----------|-----|-----------|-----|----------|----|----------|----|----------|----|-------------|
|  | F0        |     | F1        |     | F2        |     | F3       |    | F4       |    | F5       |    |             |
|  | #         | F0  | #         | F1  | #         | F2  | #        | F3 | #        | F4 | #        | F5 | Grand Total |
| Adams  | 1         | 2%  | 6         | 12% |           | 0%  | 1        | 2% |          | 0% |          | 0% | 16%         |
| Athens   |           | 0%  | 1         | 2%  |           | 0%  |          | 0% |          | 0% |          | 0% | 2%          |
| Belmont  | 2         | 4%  | 1         | 2%  |           | 0%  |          | 0% |          | 0% |          | 0% | 6%          |
| Brown  | 3         | 6%  | 4         | 8%  | 1         | 2%  |          | 0% |          | 0% |          | 0% | 16%         |
| Carroll  |           | 0%  | 2         | 4%  | 1         | 2%  |          | 0% |          | 0% |          | 0% | 6%          |
| Clermont   | 4         | 8%  | 3         | 6%  | 1         | 2%  | 1        | 2% | 1        | 2% |          | 0% | 20%         |
| Columbiana   | 6         | 12% | 5         | 10% | 3         | 6%  | 1        | 2% |          | 0% |          | 0% | 30%         |
| Coshocton  |           | 0%  | 2         | 4%  | 1         | 2%  |          | 0% |          | 0% |          | 0% | 6%          |
| Gallia   | 1         | 2%  | 2         | 4%  | 1         | 2%  |          | 0% |          | 0% |          | 0% | 8%          |
| Guernsey   | 3         | 6%  | 2         | 4%  | 2         | 4%  |          | 0% |          | 0% |          | 0% | 14%         |
| Harrison   |           | 0%  | 1         | 2%  | 1         | 2%  | 1        | 2% |          | 0% |          | 0% | 6%          |
| Highland   | 1         | 2%  | 4         | 8%  | 3         | 6%  | 2        | 4% |          | 0% |          | 0% | 20%         |
| Hocking  |           | 0%  | 2         | 4%  |           | 0%  |          | 0% |          | 0% |          | 0% | 4%          |
| Holmes   |           | 0%  | 4         | 8%  | 2         | 4%  |          | 0% |          | 0% |          | 0% | 12%         |
| Jackson  | 3         | 6%  | 1         | 2%  |           | 0%  |          | 0% |          | 0% |          | 0% | 8%          |
| Jefferson  | 1         | 2%  | 1         | 2%  | 1         | 2%  |          | 0% |          | 0% |          | 0% | 6%          |
| Lawrence   | 1         | 2%  | 2         | 4%  |           | 0%  |          | 0% |          | 0% |          | 0% | 6%          |
| Meigs  |           | 0%  | 2         | 4%  | 1         | 2%  |          | 0% |          | 0% |          | 0% | 6%          |
| Monroe   | 1         | 2%  | 1         | 2%  |           | 0%  |          | 0% |          | 0% |          | 0% | 4%          |
| Morgan   |           | 0%  |           | 0%  |           | 0%  |          | 0% |          | 0% |          | 0% | 0%          |
| Muskingum  |           | 0%  | 9         | 18% | 6         | 12% |          | 0% |          | 0% |          | 0% | 30%         |
| Noble  |           | 0%  | 1         | 2%  | 1         | 2%  |          | 0% |          | 0% |          | 0% | 4%          |
| Perry  |           | 0%  | 4         | 8%  | 1         | 2%  |          | 0% |          | 0% |          | 0% | 10%         |
| Pike   |           | 0%  | 1         | 2%  | 2         | 4%  |          | 0% |          | 0% |          | 0% | 6%          |
| Ross   |           | 0%  | 6         | 12% | 1         | 2%  |          | 0% |          | 0% |          | 0% | 14%         |
| Scioto   | 1         | 2%  | 8         | 16% | 1         | 2%  | 1        | 2% |          | 0% | 1        | 2% | 24%         |
| Tuscarawas   | 2         | 4%  | 4         | 8%  | 2         | 4%  |          | 0% |          | 0% |          | 0% | 16%         |
| Vinton   |           | 0%  |           | 0%  |           | 0%  |          | 0% |          | 0% |          | 0% | 0%          |
| Washington   | 2         | 4%  | 2         | 4%  | 2         | 4%  |          | 0% |          | 0% |          | 0% | 12%         |
| <b>Total</b>   | <b>32</b> |     | <b>81</b> |     | <b>34</b> |     | <b>7</b> |    | <b>1</b> |    | <b>1</b> |    |             |

In Region 2, Lorain, Franklin, Medina, and Richland have the highest probability of future occurrence all having a probability of more than 32%. The largest number of counties in this region has a probability of 20% or more.

Muskingum and Columbiana Counties have the highest probability of future occurrence in Region 3, both having 30% probabilities. Unlike other regions, Region 3 has two counties that have a 0% probability (Morgan and Vinton) as they have had no past occurrences. However, it does not mean tornadoes cannot occur in these areas, it simply means there is a less likelihood based on past occurrences.

## **Environmental Impacts**

Tornados themselves have little direct impact on the environment. The path of a tornado is normally relatively small compared to other disasters such as a flood, forest fire, or hurricane. Tornados directly effect the environment by damaging vegetation, spreading lead and asbestos particulate from older structures damaged, or by transporting invasive plants or small animals not native to the area which could alter the ecosystem.

The most devastating effect a tornado can have on the environment is through damaging a facility that houses or manufactures large amounts of hazardous materials, either chemical or petroleum based. The impact would be determined by the amount and type of material released. Bhopal, India is only one example of what could happen if a tornado struck a chemical facility. On December 3, 1984, the Union Carbide plant in Bhopal, India released a toxic gas cloud of methyl isocyanate gas, which killed thousands of cats, dogs, cows, and birds, in addition to the civilian casualties.

## **VULNERABILITY ANALYSIS & LOSS ESTIMATION**

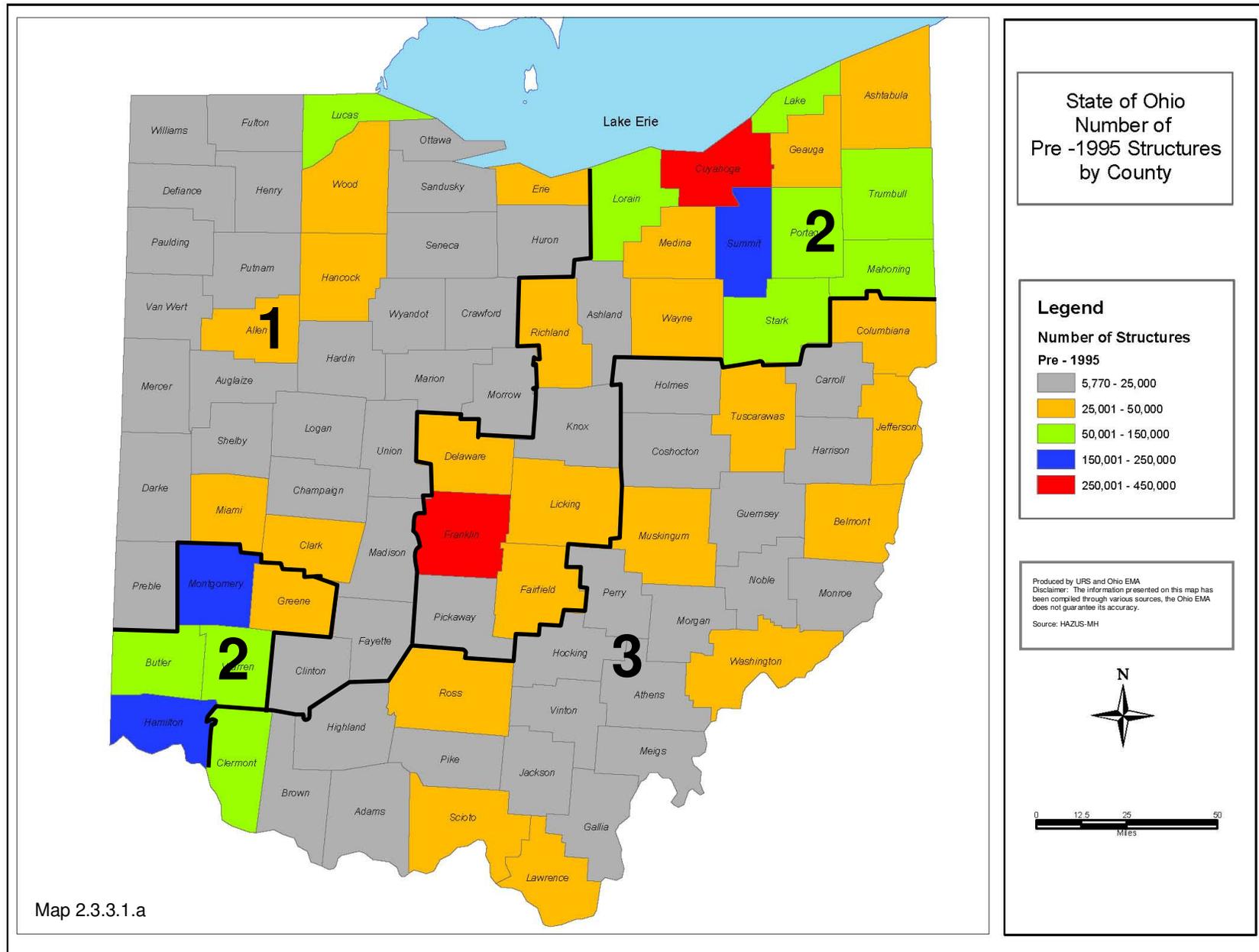
### **Methodology**

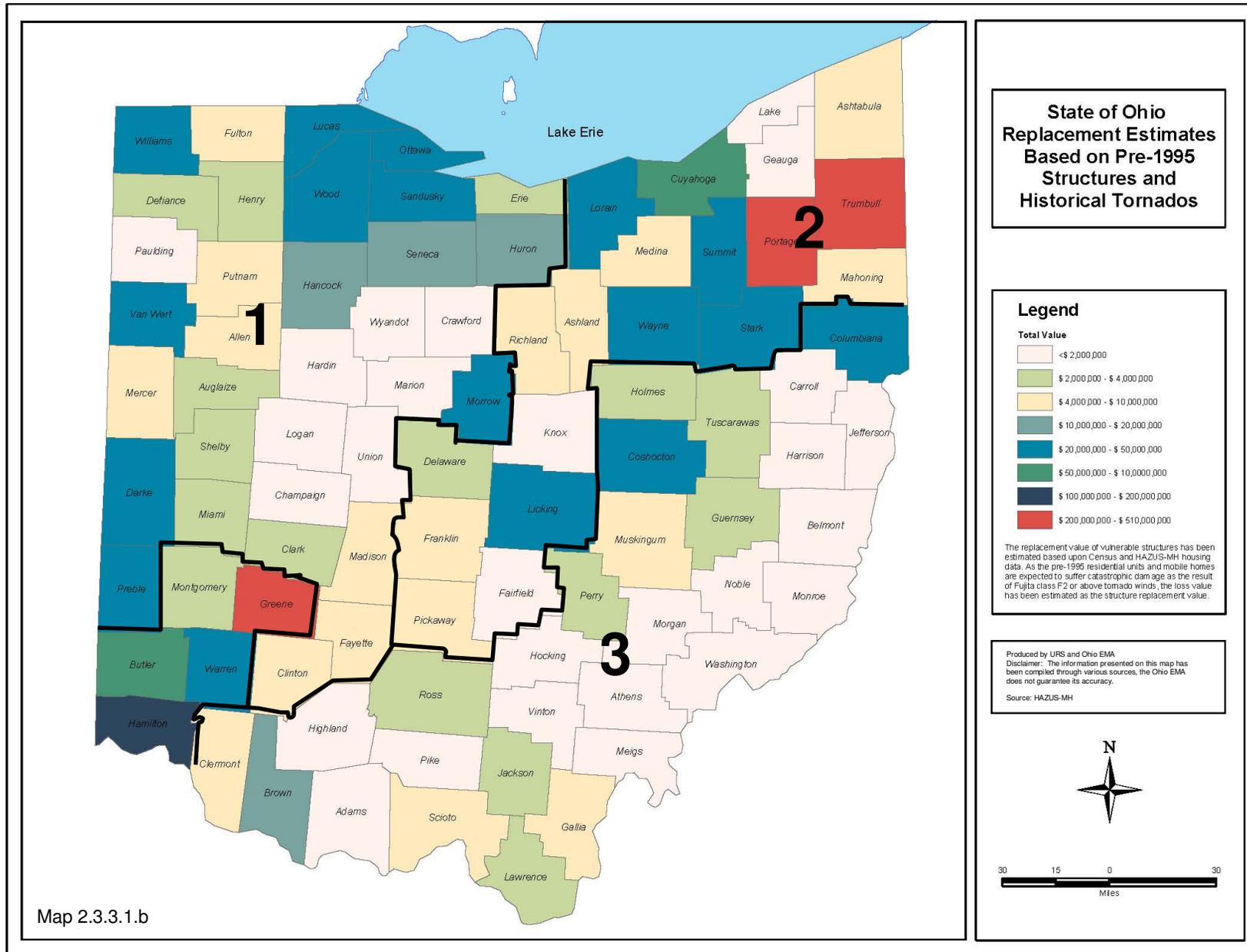
The Tornado Relative Risk column indicates the relative likelihood of the occurrence of a strong tornado (EF2 or above). These relative ratings were determined by review of actual tornado occurrences over a 50-year period. Based on the frequency of occurrence, each county has been assigned into a high, medium, or low *relative* risk categories.

There is a high probability that mobile homes and residential units built without wind-resistant construction standards would suffer catastrophic destruction as the result of a strike by an EF2 or stronger tornado. On a statewide basis, Ohio does not have building codes that address wind resistance for most types of residential dwellings. However, since 1995 many local codes that address wind resistance have been adopted. Therefore, structures constructed prior to 1995 are potentially more susceptible to catastrophic destruction as the result of a tornado strike than those constructed after 1995.

By using U.S. Bureau of the Census housing data, the age of structures can be assessed on a countywide basis and the year 1995 was used as a benchmark to separate the most vulnerable pre-1995 housing stock from later construction. In addition, mobile homes are considered highly vulnerable to catastrophic damage from tornadoes and high wind regardless of construction date. Census housing data also include information on the number of mobile or manufactured homes for each county. The actual numbers of vulnerable residential housing units in each county was determined based on adding the resulting totals for residential structures built before 1995 and mobile homes. Vulnerable structures represent a percentage of the residential and total building units, indicating the relative exposure of the county to tornado damage.

The average residential home value of vulnerable structures has been estimated based upon Census and HAZUS-MH housing data. As the pre-1995 residential units and mobile homes are expected to suffer catastrophic damage as the result of an Enhanced Fujita class EF2 or above tornado winds, the loss value has been estimated as the structure replacement value. Map 2.3.3.1.a shows the number of pre-1995 structures by county. Map 2.3.3.1.b shows replacement estimates based on Pre-1995 structures and historical tornadoes. The ratio of personal income to potential loss, expressed as a percentage, represents a relative measure of county economic vulnerability.





County commercial and governmental unit counts have been calculated from the number of structures per census block according to HAZUS-MH level one data. Average values for commercial and governmental units have been based on HAZUS-MH residential average value. Commercial unit average value equals three times HAZUS-MH residential census block average value. Governmental unit average value equals four times HAZUS-MH residential census block average value. Commercial and governmental Pre-95 structures have been based on HAZUS-MH census block residential year built ranges. Historical damages are 50-year tornado damage totals for each county provided by NCDC / NOAA storm event database. At risk totals have been calculated by multiplying pre-95 structures by their respective average values.

### **2.3.3.2 Results**

Tables 2.3.f, 2.3.g, and 2.3.h provide information on the number of residential structures and the estimate of potential residential loss based on the number of structures, date of construction and average value for each region by county.

**Table 2.3.f**

| <b>EF-2 Vulnerability and Estimate of Potential Residential Losses for Region 1</b> |                              |  |                             |  |                     |                                     |  |  |  |   |
|---|------------------------------|--|-----------------------------|--|---------------------|-------------------------------------|--|--|--|---|
| <b>County</b>   | <b>Tornado Relative Risk</b> | <b>Res. Units (Incl. Mobile Homes)</b> | <b>Avg. Res. Home Value</b> | <b>Non Mobile Home Res. Units Pre-1995</b> | <b>Mobile Homes</b> | <b>Pre-1995 Res. + Mobile Homes</b> | <b>% Res. Pre-1995 &amp; MH (At Risk Pop.)</b> | <b>\$ Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Res. + All Mobile Homes) x1,000</b> | <b>Personal Income by Risk Value to (%)</b> |
| Allen   | MEDIUM                       | 35,116                                 | \$68,837                    | 28,643                                     | 2,264               | 30,907                              | 88%  | \$5,879,000  | \$2,128,000  | 89%   |
| Auglaize  | MEDIUM                       | 15,483                                 | \$92,359                    | 9,557                                      | 856                 | 10,413                              | 67%  | \$3,275,000  | \$962,000  | 95%   |
| Champaign   | HIGH                         | 14,029                                 | \$87,183                    | 7,477                                      | 1,401               | 8,878                               | 63%  | \$578,000  | \$774,000  | 98%   |
| Clark   | HIGH                         | 49,099                                 | \$82,218                    | 39,807                                     | 3,056               | 42,863                              | 87%  | \$3,118,000  | \$3,524,000  | 80%   |
| Clinton   | HIGH                         | 14,211                                 | \$89,214                    | 8,344                                      | 1,561               | 9,905                               | 70%  | \$8,120,000  | \$ 884,000   | 85%   |
| Crawford  | MEDIUM                       | 16,401                                 | \$75,545                    | 11,384                                     | 1,287               | 12,671                              | 77%  | \$1,780,000  | \$957,000  | 86%   |
| Darke   | MEDIUM                       | 17,992                                 | \$87,458                    | 10,674                                     | 910                 | 11,584                              | 64%  | \$30,713,000   | \$1,013,000  | 98%   |
| Defiance  | MEDIUM                       | 14,471                                 | \$79,561                    | 9,253                                      | 1,415               | 10,668                              | 74%  | \$2,578,000  | \$849,000  | 92%   |
| Erie  | LOW                          | 28,326                                 | \$103,990                   | 22,023                                     | 1,606               | 23,629                              | 83%  | \$3,495,000  | \$2,457,000  | 70%   |
| Fayette   | HIGH                         | 9,633                                  | \$82,187                    | 6,633                                      | 673                 | 7,306                               | 76%  | \$5,585,000  | \$600,000  | 86%   |
| Fulton  | MEDIUM                       | 14,738                                 | \$99,753                    | 8,001                                      | 1,517               | 9,518                               | 65%  | \$5,353,000  | \$949,000  | 84%   |
| Hancock   | HIGH                         | 24,756                                 | \$98,415                    | 16,115                                     | 2,084               | 18,199                              | 74%  | \$14,553,000   | \$1,791,000  | 84%   |
| Hardin  | HIGH                         | 11,048                                 | \$67,522                    | 6,062                                      | 1,236               | 7,298                               | 66%  | \$553,000  | \$493,000  | 105%  |
| Henry   | HIGH                         | 10,624                                 | \$79,781                    | 5,498                                      | 1,042               | 6,540                               | 62%  | \$2,578,000  | \$522,000  | 104%  |
| Huron   | MEDIUM                       | 19,854                                 | \$89,372                    | 11,682                                     | 1,881               | 13,563                              | 68%  | \$5,879,000  | \$1,212,000  | 89%   |
| Logan   | HIGH                         | 19,872                                 | \$77,790                    | 11,161                                     | 2,599               | 13,760                              | 69%  | \$60,808,000   | \$1,070,000  | 82%   |
| Lucas   | HIGH                         | 140,239                                | \$85,349                    | 128,931                                    | 5,331               | 134,262                             | 96%  | \$578,000  | \$11,459,000   | 81%   |
| Madison   | HIGH                         | 12,605                                 | \$102,672                   | 8,184                                      | 1,255               | 9,439                               | 75%  | \$3,118,000  | \$969,000  | 78%   |
| Marion  | MEDIUM                       | 21,697                                 | \$70,649                    | 15,167                                     | 1,471               | 16,638                              | 77%  | \$8,120,000  | \$1,175,000  | 103%  |
| Mercer  | MEDIUM                       | 14,029                                 | \$90,338                    | 8,849                                      | 1,197               | 10,046                              | 72%  | \$1,780,000  | \$908,000  | 84%   |
| Miami   | MEDIUM                       | 32,203                                 | \$110,134                   | 23,185                                     | 782                 | 23,967                              | 74%  | \$67,753,000   | \$2,640,000  | 81%   |
| Morrow  | HIGH                         | 12,198                                 | \$83,621                    | 5,695                                      | 1,972               | 7,667                               | 63%  | \$3,495,000  | \$641,000  | 88%   |
| Ottawa  | MEDIUM                       | 24,635                                 | \$105,435                   | 15,163                                     | 4,002               | 19,165                              | 78%  | \$6,718,000  | \$2,021,000  | 45%   |
| Paulding  | MEDIUM                       | 8,215                                  | \$63,258                    | 4,740                                      | 1,142               | 5,882                               | 72%  | \$5,353,000  | \$372,000  | 99%   |
| Preble  | MEDIUM                       | 14,663                                 | \$91,528                    | 8,904                                      | 807                 | 9,711                               | 66%  | \$138,450,000  | \$889,000  | 88%   |
| Putnam  | HIGH                         | 11,430                                 | \$86,129                    | 6,447                                      | 982                 | 7,429                               | 65%  | \$14,553,000   | \$640,000  | 101%  |
| Sandusky  | MEDIUM                       | 21,184                                 | \$86,086                    | 12,670                                     | 1,620               | 14,290                              | 67%  | \$2,578,000  | \$1,230,000  | 97%   |
| Seneca  | MEDIUM                       | 19,897                                 | \$77,134                    | 11,286                                     | 1,559               | 12,845                              | 65%  | \$28,000   | \$991,000  | 101%  |
| Shelby  | HIGH                         | 15,723                                 | \$95,786                    | 10,050                                     | 971                 | 11,021                              | 70%  | \$3,103,000  | \$1,056,000  | 92%   |
| Union   | LOW                          | 13,271                                 | \$112,133                   | 6,806                                      | 1118                | 7,924                               | 60%  | \$275,000  | \$889,000  | 95%   |
| Van Wert  | MEDIUM                       | 10,949                                 | \$68,697                    | 5,886                                      | 937                 | 6,823                               | 62%  | \$2,750,000  | \$469,000  | 116%  |
| Williams  | LOW                          | 14,386                                 | \$79,873                    | 8,156                                      | 1,473               | 9,629                               | 67%  | \$5,778,000  | \$769,000  | 94%   |
| Wood  | HIGH                         | 40,100                                 | \$105,421                   | 28,775                                     | 4,970               | 33,745                              | 84%  | \$5,195,000  | \$3,557,000  | 72%   |
| Wyandot   | MEDIUM                       | 8,041                                  | \$76,954                    | 4,100                                      | 731                 | 4,831                               | 60%  | \$1,440,000  | \$372,000  | 60%   |
| <b>REGIONAL TOTALS</b>  |                              | 751,118                                | \$2,952,382                 | 525,308                                    | 57,708              | 583,016                             |  | \$425,910,000  | \$50,348,000   |   |

**Table 2.3.g**

| <b>EF-2 Vulnerability and Estimate of Potential Residential Losses for Region 2</b> |                              |  |                             |  |                     |                                     |  |  |  |   |
|---|------------------------------|--|-----------------------------|--|---------------------|-------------------------------------|--|--|--|---|
| <b>County</b>   | <b>Tornado Relative Risk</b> | <b>Res. Units (Incl. Mobile Homes)</b> | <b>Avg. Res. Home Value</b> | <b>Non Mobile Home Res. Units Pre-1995</b> | <b>Mobile Homes</b> | <b>Pre-1995 Res. + Mobile Homes</b> | <b>% Res. Pre-1995 &amp; MH (At Risk Pop.)</b> | <b>\$ Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Res. + All Mobile Homes) x1,000</b> | <b>Personal Income by Risk Value to (%)</b> |
| Ashland   | LOW                          | 17,620                                 | \$90,561                    | 10,622                                     | 1,417               | 12,039                              | 68%  | \$7,203,000  | \$1,090,000  | 83%   |
| Ashtabula   | HIGH                         | 37,671                                 | \$75,642                    | 24,788                                     | 3,912               | 28,700                              | 76%  | \$6,353,000  | \$2,171,000  | 80%   |
| Butler  | HIGH                         | 102,651                                | \$107,639                   | 85,029                                     | 4,956               | 89,985                              | 88%  | \$60,808,000   | \$9,686,000  | 76%   |
| Cuyahoga  | HIGH                         | 399,032                                | \$108,816                   | 303,202                                    | 3,214               | 306,416                             | 77%  | \$67,753,000   | \$33,343,000   | 93%   |
| Delaware  | MEDIUM                       | 39,474                                 | \$194,198                   | 16,580                                     | 1,319               | 17,899                              | 45%  | \$3,800,000  | \$3,476,000  | 100%  |
| Fairfield   | MEDIUM                       | 40,497                                 | \$120,319                   | 25,943                                     | 1,549               | 27,492                              | 68%  | \$1,538,000  | \$3,308,000  | 80%   |
| Franklin  | MEDIUM                       | 302,592                                | \$111,630                   | 226,183                                    | 4,953               | 231,136                             | 76%  | \$6,718,000  | \$25,802,000   | 96%   |
| Geauga  | HIGH                         | 31,135                                 | \$165,026                   | 21,468                                     | 1,368               | 22,836                              | 73%  | \$1,853,000  | \$3,769,000  | 67%   |
| Greene  | HIGH                         | 45,416                                 | \$122,301                   | 42,040                                     | 835                 | 42,875                              | 94%  | \$268,860,000  | \$5,244,000  | 65%   |
| Hamilton  | HIGH                         | 234,751                                | \$114,903                   | 147,443                                    | 3,302               | 150,745                             | 64%  | \$138,450,000  | \$17,321,000   | 117%  |
| Knox  | MEDIUM                       | 18,318                                 | \$88,612                    | 10,996                                     | 1,254               | 12,250                              | 67%  | \$250,000  | \$1,085,000  | 89%   |
| Lake  | HIGH                         | 73,399                                 | \$136,994                   | 70,356                                     | 2,329               | 72,685                              | 99%  | \$3,275,000  | \$9,957,000  | 53%   |
| Licking   | HIGH                         | 49,158                                 | \$101,874                   | 34,008                                     | 3,509               | 37,517                              | 76%  | \$10,078,000   | \$3,822,000  | 78%   |
| Lorain  | LOW                          | 89,269                                 | \$110,349                   | 76,386                                     | 3,470               | 79,856                              | 89%  | \$300,000  | \$8,812,000  | 68%   |
| Mahoning  | MEDIUM                       | 81,767                                 | \$62,176                    | 76,558                                     | 1,980               | 78,538                              | 96%  | \$5,660,000  | \$4,883,000  | 99%   |
| Medina  | MEDIUM                       | 46,980                                 | \$148,399                   | 34,362                                     | 703                 | 35,065                              | 75%  | \$28,860,000   | \$5,204,000  | 70%   |
| Montgomery  | MEDIUM                       | 173,462                                | \$95,186                    | 108,276                                    | 3,811               | 112,087                             | 65%  | \$2,578,000  | \$10,669,000   | 114%  |
| Pickaway  | MEDIUM                       | 17,324                                 | \$92,297                    | 10,453                                     | 2,291               | 12,744                              | 74%  | \$1,853,000  | \$1,176,000  | 78%   |
| Portage   | HIGH                         | 49,739                                 | \$108,343                   | 39,249                                     | 5,514               | 44,763                              | 90%  | \$3,353,000  | \$4,850,000  | 64%   |
| Richland  | MEDIUM                       | 41,696                                 | \$77,608                    | 34,861                                     | 2,523               | 37,384                              | 90%  | \$553,000  | \$2,901,000  | 83%   |
| Stark   | HIGH                         | 119,039                                | \$92,407                    | 102,110                                    | 3,825               | 105,935                             | 89%  | \$10,208,000   | \$9,789,000  | 79%   |
| Summit  | HIGH                         | 171,766                                | \$107,341                   | 151,050                                    | 2,525               | 153,575                             | 89%  | \$2,800,000  | \$16,485,000   | 75%   |
| Trumbull  | HIGH                         | 77,034                                 | \$79,154                    | 66,361                                     | 5,301               | 71,662                              | 93%  | \$285,000  | \$5,672,000  | 76%   |
| Warren  | HIGH                         | 49,723                                 | \$138,478                   | 33,288                                     | 1,012               | 34,300                              | 69%  | \$380,000  | \$4,750,000  | 85%   |
| Wayne   | LOW                          | 36,561                                 | \$96,691                    | 24,042                                     | 3,959               | 28,001                              | 77%  | \$30,175,000   | \$2,707,000  | 76%   |
| <b>REGIONAL TOTALS</b>  |                              | 2,346,074                              | \$2,746,944                 | 1,775,654                                  | 70,831              | 1,846,485                           |  | \$663,944,000  | \$197,972,000  |   |

**Table 2.3.h**

| <b>EF-2 Vulnerability and Estimate of Potential Residential Losses for Region 3</b> |                              |  |                             |  |                     |                                     |  |  |  |   |
|---|------------------------------|--|-----------------------------|--|---------------------|-------------------------------------|--|--|--|---|
| <b>County</b>   | <b>Tornado Relative Risk</b> | <b>Res. Units (Incl. Mobile Homes)</b> | <b>Avg. Res. Home Value</b> | <b>Non Mobile Home Res. Units Pre-1995</b> | <b>Mobile Homes</b> | <b>Pre-1995 Res. + Mobile Homes</b> | <b>% Res. Pre-1995 &amp; MH (At Risk Pop.)</b> | <b>\$ Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Res. + All Mobile Homes) x1,000</b> | <b>Personal Income by Risk Value to (%)</b> |
| Adams   | MEDIUM                       | 12,853                                 | \$49,195                    | 6,636                                      | 3,162               | 9,798                               | 76%  | \$505,000  | \$482,000  | 82%   |
| Athens  | LOW                          | 22,548                                 | \$68,278                    | 13,430                                     | 4,709               | 18,139                              | 80%  | \$250,000  | \$1,238,000  | 71%   |
| Belmont   | LOW                          | 25,839                                 | \$58,405                    | 17,275                                     | 2,732               | 20,007                              | 77%  | \$50,000   | \$1,169,000  | 97%   |
| Brown   | MEDIUM                       | 18,186                                 | \$69,872                    | 9,044                                      | 3,820               | 12,864                              | 71%  | \$10,078,000   | \$899,000  | 80%   |
| Carroll   | MEDIUM                       | 13,079                                 | \$74,100                    | 7,032                                      | 2,250               | 9,282                               | 71%  | \$300,000  | \$688,000  | 70%   |
| Clermont  | HIGH                         | 59,058                                 | \$109,471                   | 45,576                                     | 6,110               | 51,686                              | 88%  | \$5,660,000  | \$5,658,000  | 70%   |
| Columbiana  | MEDIUM                       | 40,719                                 | \$67,917                    | 25,599                                     | 4,829               | 30,428                              | 75%  | \$28,860,000   | \$2,067,000  | 90%   |
| Coshocton   | HIGH                         | 15,607                                 | \$68,418                    | 8,731                                      | 2,625               | 11,356                              | 73%  | \$27,530,000   | \$777,000  | 77%   |
| Gallia  | MEDIUM                       | 14,508                                 | \$58,048                    | 8,111                                      | 3,489               | 11,600                              | 80%  | \$9,150,000  | \$673,000  | 70%   |
| Guernsey  | MEDIUM                       | 17,318                                 | \$56,318                    | 9,960                                      | 2,969               | 12,929                              | 75%  | \$3,353,000  | \$728,000  | 87%   |
| Harrison  | LOW                          | 7,433                                  | \$48,630                    | 3,823                                      | 1,289               | 5,112                               | 69%  | \$353,000  | \$249,000  | 105%  |
| Highland  | HIGH                         | 17,438                                 | \$67,372                    | 8,934                                      | 3,244               | 12,178                              | 70%  | \$1,100,000  | \$820,000  | 82%   |
| Hocking   | LOW                          | 12,097                                 | \$68,437                    | 6,602                                      | 2,136               | 8,738                               | 72%  | \$28,000   | \$598,000  | 76%   |
| Holmes  | LOW                          | 11,757                                 | \$91,042                    | 6,075                                      | 1,610               | 7,685                               | 65%  | \$505,000  | \$700,000  | 79%   |
| Jackson   | MEDIUM                       | 13,570                                 | \$56,309                    | 7,882                                      | 2,676               | 10,558                              | 78%  | \$7,203,000  | \$595,000  | 81%   |
| Jefferson   | LOW                          | 27,889                                 | \$54,788                    | 21,717                                     | 2,802               | 24,519                              | 88%  | \$6,353,000  | \$1,343,000  | 91%   |
| Lawrence  | HIGH                         | 25,923                                 | \$54,973                    | 17,960                                     | 4,576               | 22,536                              | 87%  | \$50,000   | \$1,239,000  | 74%   |
| Meigs   | MEDIUM                       | 11,733                                 | \$45,300                    | 5,785                                      | 2,862               | 8,647                               | 74%  | \$27,530,000   | \$392,000  | 82%   |
| Monroe  | LOW                          | 7,387                                  | \$51,237                    | 3,501                                      | 1,393               | 4,894                               | 66%  | \$30,713,000   | \$251,000  | 91%   |
| Morgan  | LOW                          | 8,124                                  | \$51,759                    | 4,113                                      | 1,853               | 5,966                               | 73%  | \$3,800,000  | \$309,000  | 67%   |
| Muskingum   | HIGH                         | 30,350                                 | \$71,016                    | 20,764                                     | 3,647               | 24,411                              | 80%  | \$1,538,000  | \$1,734,000  | 86%   |
| Noble   | LOW                          | 5,763                                  | \$51,408                    | 2,458                                      | 1,141               | 3,599                               | 62%  | \$5,585,000  | \$185,000  | 107%  |
| Perry   | MEDIUM                       | 13,659                                 | \$62,872                    | 6,507                                      | 2,433               | 8,940                               | 65%  | \$9,150,000  | \$562,000  | 95%   |
| Pike  | HIGH                         | 12,809                                 | \$58,139                    | 7,412                                      | 3,295               | 10,707                              | 84%  | \$268,860,000  | \$622,000  | 72%   |
| Ross  | HIGH                         | 28,884                                 | \$72,480                    | 16,684                                     | 5,284               | 21,968                              | 76%  | \$353,000  | \$1,592,000  | 81%   |
| Scioto  | MEDIUM                       | 30,362                                 | \$52,115                    | 20,984                                     | 4,640               | 25,624                              | 84%  | \$1,100,000  | \$1,335,000  | 91%   |
| Tuscarawas  | MEDIUM                       | 33,769                                 | \$80,508                    | 18,564                                     | 4,080               | 22,644                              | 67%  | \$1,250,000  | \$1,823,000  | 86%   |
| Vinton  | LOW                          | 6,643                                  | \$45,723                    | 3,160                                      | 1,901               | 5,061                               | 76%  | \$30,473,000   | \$231,000  | 76%   |
| Washington  | LOW                          | 25,972                                 | \$67,097                    | 16,894                                     | 4,117               | 21,011                              | 81%  | \$36,273,000   | \$1,410,000  | 81%   |
| <b>REGIONAL TOTALS</b>  |                              | 571,277                                | \$1,831,227                 | 351,213                                    | 91,674              | 442,887                             |  | \$517,953,000  | \$30,369,000   |   |

Tables 2.3.i, 2.3.j, and 2.3.k provide information on the number of commercial structures and the estimate of potential commercial structure loss based on the number of structures, date of construction and average value for each region by county.

**Table 2.3.i**

| <b>EF-2 Vulnerability and Estimate of Potential Commercial Losses for Region 1</b> |                              |                         |  |                                  |                         |  |  |
|--|------------------------------|-------------------------|--|----------------------------------|-------------------------|--|--|
| <b>County</b>  | <b>Tornado Relative Risk</b> | <b>Commercial Units</b> | <b>Average Commercial Value (3x Res. Ave. Value)</b> | <b>Commercial Units Pre-1995</b> | <b>% Comm. Pre-1995</b> | <b>Dollar Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Commercial)</b> |
| Allen  | MEDIUM                       | 466                     | \$216,735  | 386                              | 83%                     | \$5,879,000  | \$83,659,710                                     |
| Auglaize   | MEDIUM                       | 112                     | \$297,135  | 97                               | 87%                     | \$3,275,000  | \$28,822,095                                     |
| Champaign  | HIGH                         | 84                      | \$286,329  | 72                               | 86%                     | \$578,000  | \$20,615,688                                     |
| Clark  | HIGH                         | 385                     | \$261,177  | 306                              | 79%                     | \$3,118,000  | \$79,920,162                                     |
| Clinton  | HIGH                         | 108                     | \$293,388  | 89                               | 82%                     | \$8,120,000  | \$26,111,532                                     |
| Crawford   | MEDIUM                       | 80                      | \$244,326  | 67                               | 84%                     | \$1,780,000  | \$16,369,842                                     |
| Darke  | MEDIUM                       | 107                     | \$276,537  | 91                               | 85%                     | \$30,713,000   | \$25,164,867                                     |
| Defiance   | MEDIUM                       | 108                     | \$259,167  | 90                               | 83%                     | \$2,578,000  | \$23,325,030                                     |
| Erie   | LOW                          | 332                     | \$349,257  | 267                              | 80%                     | \$3,495,000  | \$93,251,619                                     |
| Fayette  | HIGH                         | 71                      | \$257,247  | 60                               | 85%                     | \$5,585,000  | \$15,434,820                                     |
| Fulton   | MEDIUM                       | 110                     | \$331,698  | 94                               | 85%                     | \$5,353,000  | \$31,179,612                                     |
| Hancock  | HIGH                         | 279                     | \$317,820  | 226                              | 81%                     | \$14,553,000   | \$71,827,320                                     |
| Hardin   | HIGH                         | 62                      | \$227,661  | 52                               | 84%                     | \$553,000  | \$11,838,372                                     |
| Henry  | HIGH                         | 61                      | \$263,655  | 53                               | 87%                     | \$2,578,000  | \$13,973,715                                     |
| Huron  | MEDIUM                       | 160                     | \$300,087  | 136                              | 85%                     | \$5,879,000  | \$40,811,832                                     |
| Logan  | HIGH                         | 114                     | \$266,022  | 96                               | 84%                     | \$60,808,000   | \$25,538,112                                     |
| Lucas  | HIGH                         | 2,027                   | \$262,665  | 1703                             | 84%                     | \$578,000  | \$447,318,495                                    |
| Madison  | HIGH                         | 59                      | \$340,014  | 49                               | 83%                     | \$3,118,000  | \$16,660,686                                     |
| Marion   | MEDIUM                       | 224                     | \$224,808  | 185                              | 83%                     | \$8,120,000  | \$41,589,480                                     |
| Mercer   | MEDIUM                       | 86                      | \$289,254  | 72                               | 84%                     | \$1,780,000  | \$20,826,288                                     |
| Miami  | MEDIUM                       | 305                     | \$336,726  | 247                              | 81%                     | \$67,753,000   | \$83,171,322                                     |
| Morrow   | HIGH                         | 30                      | \$297,954  | 25                               | 83%                     | \$3,495,000  | \$7,448,850                                      |
| Ottawa   | MEDIUM                       | 147                     | \$375,780  | 121                              | 82%                     | \$6,718,000  | \$45,469,380                                     |
| Paulding   | MEDIUM                       | 24                      | \$222,180  | 19                               | 79%                     | \$5,353,000  | \$4,221,420                                      |
| Preble   | MEDIUM                       | 72                      | \$292,035  | 62                               | 86%                     | \$138,450,000  | \$18,106,170                                     |
| Putnam   | HIGH                         | 101                     | \$282,102  | 86                               | 85%                     | \$14,553,000   | \$24,260,772                                     |
| Sandusky   | MEDIUM                       | 142                     | \$276,498  | 125                              | 88%                     | \$2,578,000  | \$34,562,250                                     |
| Seneca   | MEDIUM                       | 147                     | \$250,818  | 129                              | 88%                     | \$28,000   | \$32,355,522                                     |
| Shelby   | HIGH                         | 96                      | \$303,744  | 80                               | 83%                     | \$3,103,000  | \$24,299,520                                     |
| Union  | LOW                          | 86                      | \$366,747  | 71                               | 83%                     | \$275,000  | \$26,039,037                                     |
| Van Wert   | MEDIUM                       | 79                      | \$224,376  | 70                               | 89%                     | \$2,750,000  | \$15,706,320                                     |
| Williams   | LOW                          | 93                      | \$266,754  | 78                               | 84%                     | \$5,778,000  | \$20,806,812                                     |
| Wood   | HIGH                         | 501                     | \$361,752  | 416                              | 83%                     | \$5,195,000  | \$150,488,832                                    |
| Wyandot  | MEDIUM                       | 62                      | \$257,331  | 55                               | 89%                     | \$1,440,000  | \$14,153,205                                     |
| <b>REGIONAL TOTALS</b>   |                              | 6,920                   | \$9,679,779  | 5,775                            |                         | \$425,910,000  | \$1,635,328,689                                  |

**Table 2.3.j**

| <b>EF-2 Vulnerability and Estimate of Potential Commercial Losses for Region 2</b> |                              |                         |  |                                  |                         |  |  |
|--|------------------------------|-------------------------|--|----------------------------------|-------------------------|--|--|
| <b>County</b>  | <b>Tornado Relative Risk</b> | <b>Commercial Units</b> | <b>Average Commercial Value (3x Res. Ave. Value)</b> | <b>Commercial Units Pre-1995</b> | <b>% Comm. Pre-1995</b> | <b>Dollar Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Commercial)</b> |
| Ashland  | LOW                          | 96                      | \$297,678  | 82                               | 85%                     | \$7,203,000  | \$24,409,596                                     |
| Ashtabula  | HIGH                         | 224                     | \$250,800  | 193                              | 86%                     | \$6,353,000  | \$48,404,400                                     |
| Butler   | HIGH                         | 1,304                   | \$334,416  | 1052                             | 81%                     | \$60,808,000   | \$351,805,632                                    |
| Cuyahoga   | HIGH                         | 7,165                   | \$326,907  | 5600                             | 78%                     | \$67,753,000   | \$1,830,679,200                                  |
| Delaware   | MEDIUM                       | 383                     | \$597,747  | 284                              | 74%                     | \$3,800,000  | \$169,760,148                                    |
| Fairfield  | MEDIUM                       | 319                     | \$369,438  | 263                              | 82%                     | \$1,538,000  | \$97,162,194                                     |
| Franklin   | MEDIUM                       | 5,004                   | \$337,038  | 3855                             | 77%                     | \$6,718,000  | \$1,299,281,490                                  |
| Geauga   | HIGH                         | 299                     | \$512,148  | 240                              | 80%                     | \$1,853,000  | \$122,915,520                                    |
| Greene   | HIGH                         | 431                     | \$372,669  | 326                              | 76%                     | \$268,860,000  | \$121,490,094                                    |
| Hamilton   | HIGH                         | 4,606                   | \$346,338  | 3716                             | 81%                     | \$138,450,000  | \$1,286,992,008                                  |
| Knox   | MEDIUM                       | 95                      | \$282,414  | 80                               | 84%                     | \$250,000  | \$22,593,120                                     |
| Lake   | HIGH                         | 1,005                   | \$422,865  | 792                              | 79%                     | \$3,275,000  | \$334,909,080                                    |
| Licking  | HIGH                         | 481                     | \$325,863  | 382                              | 79%                     | \$10,078,000   | \$124,479,666                                    |
| Lorain   | LOW                          | 1,144                   | \$343,434  | 900                              | 79%                     | \$300,000  | \$309,090,600                                    |
| Mahoning   | MEDIUM                       | 1,097                   | \$188,598  | 900                              | 82%                     | \$5,660,000  | \$169,738,200                                    |
| Medina   | MEDIUM                       | 698                     | \$446,247  | 563                              | 81%                     | \$28,860,000   | \$251,237,061                                    |
| Montgomery   | MEDIUM                       | 2,393                   | \$287,112  | 1857                             | 78%                     | \$2,578,000  | \$533,166,984                                    |
| Pickaway   | MEDIUM                       | 88                      | \$313,020  | 71                               | 81%                     | \$1,853,000  | \$22,224,420                                     |
| Portage  | HIGH                         | 432                     | \$362,688  | 334                              | 77%                     | \$3,353,000  | \$121,137,792                                    |
| Richland   | MEDIUM                       | 443                     | \$246,243  | 358                              | 81%                     | \$553,000  | \$88,154,994                                     |
| Stark  | HIGH                         | 1,453                   | \$282,630  | 1196                             | 82%                     | \$10,208,000   | \$338,025,480                                    |
| Summit   | HIGH                         | 2,412                   | \$321,444  | 1946                             | 81%                     | \$2,800,000  | \$625,530,024                                    |
| Trumbull   | HIGH                         | 759                     | \$252,069  | 618                              | 81%                     | \$285,000  | \$155,778,642                                    |
| Warren   | HIGH                         | 457                     | \$423,396  | 345                              | 75%                     | \$380,000  | \$146,071,620                                    |
| Wayne  | LOW                          | 272                     | \$321,486  | 224                              | 82%                     | \$30,175,000   | \$72,012,864                                     |
| <b>REGIONAL TOTALS</b>   |                              | 33,060                  | \$8,564,688  | 26,177                           |                         | \$663,944,000  | \$8,667,050,829                                  |

**Table 2.3.k**

| <b>EF-2 Vulnerability and Estimate of Potential Commercial Losses for Region 3</b> |                              |                         |  |                                  |                         |  |  |
|--|------------------------------|-------------------------|--|----------------------------------|-------------------------|--|--|
| <b>County</b>  | <b>Tornado Relative Risk</b> | <b>Commercial Units</b> | <b>Average Commercial Value (3x Res. Ave. Value)</b> | <b>Commercial Units Pre-1995</b> | <b>% Comm. Pre-1995</b> | <b>Dollar Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Commercial)</b> |
| Adams  | MEDIUM                       | 38                      | \$197,322  | 32                               | 84%                     | \$505,000  | \$6,314,304                                      |
| Athens   | LOW                          | 159                     | \$239,247  | 130                              | 82%                     | \$250,000  | \$31,102,110                                     |
| Belmont  | LOW                          | 236                     | \$195,318  | 207                              | 88%                     | \$50,000   | \$40,430,826                                     |
| Brown  | MEDIUM                       | 56                      | \$263,715  | 46                               | 82%                     | \$10,078,000   | \$12,130,890                                     |
| Carroll  | MEDIUM                       | 43                      | \$265,317  | 36                               | 84%                     | \$300,000  | \$9,551,412                                      |
| Clermont   | HIGH                         | 594                     | \$362,706  | 484                              | 81%                     | \$5,660,000  | \$175,549,704                                    |
| Columbiana   | MEDIUM                       | 257                     | \$225,315  | 220                              | 86%                     | \$28,860,000   | \$49,569,300                                     |
| Coshocton  | HIGH                         | 87                      | \$245,946  | 73                               | 84%                     | \$27,530,000   | \$17,954,058                                     |
| Gallia   | MEDIUM                       | 102                     | \$229,071  | 83                               | 81%                     | \$9,150,000  | \$19,012,893                                     |
| Guernsey   | MEDIUM                       | 113                     | \$195,489  | 96                               | 85%                     | \$3,353,000  | \$18,766,944                                     |
| Harrison   | LOW                          | 23                      | \$177,066  | 20                               | 87%                     | \$353,000  | \$3,541,320                                      |
| Highland   | HIGH                         | 84                      | \$248,493  | 69                               | 82%                     | \$1,100,000  | \$17,146,017                                     |
| Hocking  | LOW                          | 48                      | \$246,438  | 40                               | 83%                     | \$28,000   | \$9,857,520                                      |
| Holmes   | LOW                          | 182                     | \$313,155  | 154                              | 85%                     | \$505,000  | \$48,225,870                                     |
| Jackson  | MEDIUM                       | 61                      | \$211,704  | 51                               | 84%                     | \$7,203,000  | \$10,796,904                                     |
| Jefferson  | LOW                          | 216                     | \$179,535  | 178                              | 82%                     | \$6,353,000  | \$31,957,230                                     |
| Lawrence   | HIGH                         | 78                      | \$197,988  | 62                               | 79%                     | \$50,000   | \$12,275,256                                     |
| Meigs  | MEDIUM                       | 38                      | \$182,805  | 32                               | 84%                     | \$27,530,000   | \$5,849,760                                      |
| Monroe   | LOW                          | 38                      | \$185,421  | 33                               | 87%                     | \$30,713,000   | \$6,118,893                                      |
| Morgan   | LOW                          | 30                      | \$202,092  | 25                               | 83%                     | \$3,800,000  | \$5,052,300                                      |
| Muskingum  | HIGH                         | 286                     | \$235,728  | 238                              | 83%                     | \$1,538,000  | \$56,103,264                                     |
| Noble  | LOW                          | 25                      | \$192,033  | 22                               | 88%                     | \$5,585,000  | \$4,224,726                                      |
| Perry  | MEDIUM                       | 37                      | \$225,798  | 32                               | 86%                     | \$9,150,000  | \$7,225,536                                      |
| Pike   | HIGH                         | 60                      | \$236,715  | 49                               | 82%                     | \$268,860,000  | \$11,599,035                                     |
| Ross   | HIGH                         | 185                     | \$259,434  | 152                              | 82%                     | \$353,000  | \$39,433,968                                     |
| Scioto   | MEDIUM                       | 188                     | \$180,240  | 158                              | 84%                     | \$1,100,000  | \$28,477,920                                     |
| Tuscarawas   | MEDIUM                       | 223                     | \$269,772  | 192                              | 86%                     | \$1,250,000  | \$51,796,224                                     |
| Vinton   | LOW                          | 15                      | \$193,548  | 13                               | 87%                     | \$30,473,000   | \$2,516,124                                      |
| Washington   | LOW                          | 183                     | \$235,107  | 153                              | 84%                     | \$36,273,000   | \$35,971,371                                     |
| <b>REGIONAL TOTAL</b>  |                              | <b>3,685</b>            | <b>\$6,592,518</b>                                   | <b>3,080</b>                     |                         | <b>\$517,953,000</b>   | <b>\$768,551,679</b>                             |

Tables 2.3.l, 2.3.m, and 2.3.n provide information on the number of local governmental structures and the estimate of potential local governmental structure loss based on the number of structures, date of construction and average value for each region by county.

**Table 2.3.1**

| <b>EF-2 Vulnerability and Estimate of Potential Governmental Structure Losses for Region 1</b> |                              |                   |  |                                    |                        |  |  |
|--|------------------------------|-------------------|--|------------------------------------|------------------------|--|--|
| <b>County</b>  | <b>Tornado Relative Risk</b> | <b>Gov. Units</b> | <b>Average Governmental Value (4x Res. Ave. Value)</b> | <b>Governmental Units Pre-1995</b> | <b>% Gov. Pre-1995</b> | <b>Dollar Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Governmental)</b> |
| Allen  | MEDIUM                       | 27                | \$288,980  | 22                                 | 83%                    | \$5,879,000  | \$6,459,804  |
| Auglaize   | MEDIUM                       | 5                 | \$396,180  | 4                                  | 87%                    | \$3,275,000  | \$1,719,344  |
| Champaign  | HIGH                         | 4                 | \$381,772  | 3                                  | 86%                    | \$578,000  | \$1,307,190  |
| Clark  | HIGH                         | 6                 | \$348,236  | 5                                  | 79%                    | \$3,118,000  | \$1,658,074  |
| Clinton  | HIGH                         | 15                | \$391,184  | 12                                 | 83%                    | \$8,120,000  | \$4,861,529  |
| Crawford   | MEDIUM                       | 6                 | \$325,768  | 5                                  | 84%                    | \$1,780,000  | \$1,634,505  |
| Darke  | MEDIUM                       | 4                 | \$368,716  | 3                                  | 85%                    | \$30,713,000   | \$1,249,474  |
| Defiance   | MEDIUM                       | 5                 | \$345,556  | 4                                  | 83%                    | \$2,578,000  | \$1,439,529  |
| Erie   | LOW                          | 16                | \$465,676  | 13                                 | 80%                    | \$3,495,000  | \$5,992,498  |
| Fayette  | HIGH                         | 4                 | \$342,996  | 3                                  | 85%                    | \$5,585,000  | \$1,161,886  |
| Fulton   | MEDIUM                       | 6                 | \$442,264  | 5                                  | 86%                    | \$5,353,000  | \$2,276,487  |
| Hancock  | HIGH                         | 6                 | \$423,760  | 5                                  | 81%                    | \$14,553,000   | \$2,058,992  |
| Hardin   | HIGH                         | 3                 | \$303,548  | 3                                  | 84%                    | \$553,000  | \$769,190  |
| Henry  | HIGH                         | 4                 | \$351,540  | 3                                  | 86%                    | \$2,578,000  | \$1,212,697  |
| Huron  | MEDIUM                       | 8                 | \$400,116  | 7                                  | 85%                    | \$5,879,000  | \$2,720,775  |
| Logan  | HIGH                         | 3                 | \$354,696  | 3                                  | 84%                    | \$60,808,000   | \$892,083  |
| Lucas  | HIGH                         | 27                | \$350,220  | 23                                 | 84%                    | \$578,000  | \$7,945,224  |
| Madison  | HIGH                         | 10                | \$453,352  | 8                                  | 83%                    | \$3,118,000  | \$3,759,820  |
| Marion   | MEDIUM                       | 11                | \$299,744  | 9                                  | 83%                    | \$8,120,000  | \$2,730,318  |
| Mercer   | MEDIUM                       | 3                 | \$385,672  | 3                                  | 84%                    | \$1,780,000  | \$966,174  |
| Miami  | MEDIUM                       | 10                | \$448,968  | 8                                  | 81%                    | \$67,753,000   | \$3,635,354  |
| Morrow   | HIGH                         | 3                 | \$397,272  | 2                                  | 83%                    | \$3,495,000  | \$989,162  |
| Ottawa   | MEDIUM                       | 4                 | \$501,040  | 3                                  | 82%                    | \$6,718,000  | \$1,652,072  |
| Paulding   | MEDIUM                       | 3                 | \$296,240  | 2                                  | 78%                    | \$5,353,000  | \$693,404  |
| Preble   | MEDIUM                       | 9                 | \$389,380  | 8                                  | 86%                    | \$138,450,000  | \$3,002,948  |
| Putnam   | HIGH                         | 3                 | \$376,136  | 3                                  | 85%                    | \$14,553,000   | \$963,412  |
| Sandusky   | MEDIUM                       | 4                 | \$368,664  | 4                                  | 88%                    | \$2,578,000  | \$1,295,569  |
| Seneca   | MEDIUM                       | 5                 | \$334,424  | 4                                  | 88%                    | \$28,000   | \$1,465,176  |
| Shelby   | HIGH                         | 4                 | \$404,992  | 3                                  | 83%                    | \$3,103,000  | \$1,343,172  |
| Union  | LOW                          | 1                 | \$488,996  | 1                                  | 82%                    | \$275,000  | \$403,079  |
| Van Wert   | MEDIUM                       | 2                 | \$299,168  | 2                                  | 89%                    | \$2,750,000  | \$529,976  |
| Williams   | LOW                          | 3                 | \$355,672  | 3                                  | 84%                    | \$5,778,000  | \$897,780  |
| Wood   | HIGH                         | 13                | \$482,336  | 11                                 | 83%                    | \$5,195,000  | \$5,202,727  |
| Wyandot  | MEDIUM                       | 6                 | \$343,108  | 5                                  | 88%                    | \$1,440,000  | \$1,814,198  |
| <b>REGIONAL TOTALS</b>   |                              | 243               | \$12,906,372   | 202                                |                        | \$425,910,000  | \$76,703,622                                       |

**Table 2.3.m**

| <b>EF-2 Vulnerability and Estimate of Potential Governmental Structure Losses for Region 2</b> |                              |                   |  |                                    |                        |  |  |
|--|------------------------------|-------------------|--|------------------------------------|------------------------|--|--|
| <b>County</b>  | <b>Tornado Relative Risk</b> | <b>Gov. Units</b> | <b>Average Governmental Value (4x Res. Ave. Value)</b> | <b>Governmental Units Pre-1995</b> | <b>% Gov. Pre-1995</b> | <b>Dollar Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Governmental)</b> |
| Ashland  | LOW                          | 7                 | \$396,904  | 6                                  | 85%                    | \$7,203,000  | \$2,365,521  |
| Ashtabula  | HIGH                         | 18                | \$334,400  | 16                                 | 86%                    | \$6,353,000  | \$5,195,239  |
| Butler   | HIGH                         | 45                | \$445,888  | 36                                 | 81%                    | \$60,808,000   | \$16,184,895                                       |
| Cuyahoga   | HIGH                         | 267               | \$435,876  | 209                                | 78%                    | \$67,753,000   | \$90,961,945                                       |
| Delaware   | MEDIUM                       | 7                 | \$796,996  | 5                                  | 74%                    | \$3,800,000  | \$4,141,998  |
| Fairfield  | MEDIUM                       | 12                | \$492,584  | 10                                 | 83%                    | \$1,538,000  | \$4,879,133  |
| Franklin   | MEDIUM                       | 562               | \$449,384  | 433                                | 77%                    | \$6,718,000  | \$194,587,399                                      |
| Geauga   | HIGH                         | 10                | \$682,864  | 8                                  | 80%                    | \$1,853,000  | \$5,477,821  |
| Greene   | HIGH                         | 31                | \$496,892  | 23                                 | 76%                    | \$268,860,000  | \$11,633,883                                       |
| Hamilton   | HIGH                         | 136               | \$461,784  | 110                                | 81%                    | \$138,450,000  | \$50,663,053                                       |
| Knox   | MEDIUM                       | 7                 | \$376,552  | 6                                  | 85%                    | \$250,000  | \$2,230,822  |
| Lake   | HIGH                         | 37                | \$563,820  | 29                                 | 79%                    | \$3,275,000  | \$16,445,815                                       |
| Licking  | HIGH                         | 26                | \$434,484  | 21                                 | 80%                    | \$10,078,000   | \$8,981,185  |
| Lorain   | LOW                          | 28                | \$457,912  | 22                                 | 79%                    | \$300,000  | \$10,092,371                                       |
| Mahoning   | MEDIUM                       | 44                | \$251,464  | 36                                 | 82%                    | \$5,660,000  | \$9,075,821  |
| Medina   | MEDIUM                       | 24                | \$594,996  | 19                                 | 81%                    | \$28,860,000   | \$11,527,300                                       |
| Montgomery   | MEDIUM                       | 90                | \$382,816  | 70                                 | 78%                    | \$2,578,000  | \$26,729,689                                       |
| Pickaway   | MEDIUM                       | 16                | \$417,360  | 13                                 | 81%                    | \$1,853,000  | \$5,417,978  |
| Portage  | HIGH                         | 11                | \$483,584  | 8                                  | 77%                    | \$3,353,000  | \$4,109,131  |
| Richland   | MEDIUM                       | 8                 | \$328,324  | 6                                  | 81%                    | \$553,000  | \$2,122,293  |
| Stark  | HIGH                         | 23                | \$376,840  | 19                                 | 82%                    | \$10,208,000   | \$7,133,031  |
| Summit   | HIGH                         | 69                | \$428,592  | 56                                 | 81%                    | \$2,800,000  | \$23,853,417                                       |
| Trumbull   | HIGH                         | 24                | \$336,092  | 20                                 | 81%                    | \$285,000  | \$6,564,124  |
| Warren   | HIGH                         | 7                 | \$564,528  | 5                                  | 75%                    | \$380,000  | \$2,982,186  |
| Wayne  | LOW                          | 9                 | \$428,648  | 7                                  | 82%                    | \$30,175,000   | \$3,170,876  |
| <b>REGIONAL TOTALS</b>   |                              | 1,518             | \$11,419,584   | 1,193                              |                        | \$663,944,000  | \$526,526,926                                      |

**Table 2.3.n**

| <b>EF-2 Vulnerability and Estimate of Potential Governmental Structure Losses for Region 3</b> |                              |                   |  |                                    |                        |  |  |
|--|------------------------------|-------------------|--|------------------------------------|------------------------|--|--|
| <b>County</b>  | <b>Tornado Relative Risk</b> | <b>Gov. Units</b> | <b>Average Governmental Value (4x Res. Ave. Value)</b> | <b>Governmental Units Pre-1995</b> | <b>% Gov. Pre-1995</b> | <b>Dollar Value of Historic Tornado Damages (50 yrs. NOAA)</b> | <b>At Risk Total Value (Pre-1995 Governmental)</b> |
| Adams  | MEDIUM                       | 4                 | \$263,096  | 3                                  | 84%                    | \$505,000  | \$884,558  |
| Athens   | LOW                          | 12                | \$318,996  | 10                                 | 82%                    | \$250,000  | \$3,136,481  |
| Belmont  | LOW                          | 13                | \$260,424  | 11                                 | 88%                    | \$50,000   | \$2,972,247  |
| Brown  | MEDIUM                       | 3                 | \$351,620  | 2                                  | 83%                    | \$10,078,000   | \$871,420  |
| Carroll  | MEDIUM                       | 6                 | \$353,756  | 5                                  | 83%                    | \$300,000  | \$1,761,556  |
| Clermont   | HIGH                         | 16                | \$483,608  | 13                                 | 81%                    | \$5,660,000  | \$6,300,291  |
| Columbiana   | MEDIUM                       | 9                 | \$300,420  | 8                                  | 85%                    | \$28,860,000   | \$2,309,738  |
| Coshocton  | HIGH                         | 3                 | \$327,928  | 3                                  | 84%                    | \$27,530,000   | \$830,810  |
| Gallia   | MEDIUM                       | 2                 | \$305,428  | 2                                  | 81%                    | \$9,150,000  | \$496,603  |
| Guernsey   | MEDIUM                       | 3                 | \$260,652  | 3                                  | 85%                    | \$3,353,000  | \$662,344  |
| Harrison   | LOW                          | 3                 | \$236,088  | 3                                  | 86%                    | \$353,000  | \$612,292  |
| Highland   | HIGH                         | 6                 | \$331,324  | 5                                  | 82%                    | \$1,100,000  | \$1,637,010  |
| Hocking  | LOW                          | 8                 | \$328,584  | 7                                  | 84%                    | \$28,000   | \$2,196,339  |
| Holmes   | LOW                          | 5                 | \$417,540  | 4                                  | 85%                    | \$505,000  | \$1,766,825  |
| Jackson  | MEDIUM                       | 5                 | \$282,272  | 4                                  | 84%                    | \$7,203,000  | \$1,190,595  |
| Jefferson  | LOW                          | 7                 | \$239,380  | 6                                  | 82%                    | \$6,353,000  | \$1,381,258  |
| Lawrence   | HIGH                         | 6                 | \$263,984  | 5                                  | 79%                    | \$50,000   | \$1,251,722  |
| Meigs  | MEDIUM                       | 2                 | \$243,740  | 2                                  | 86%                    | \$27,530,000   | \$416,848  |
| Monroe   | LOW                          | 4                 | \$247,228  | 3                                  | 86%                    | \$30,713,000   | \$854,476  |
| Morgan   | LOW                          | 2                 | \$269,456  | 2                                  | 85%                    | \$3,800,000  | \$457,271  |
| Muskingum  | HIGH                         | 10                | \$314,304  | 8                                  | 83%                    | \$1,538,000  | \$2,616,304  |
| Noble  | LOW                          | 2                 | \$256,044  | 2                                  | 88%                    | \$5,585,000  | \$448,537  |
| Perry  | MEDIUM                       | 5                 | \$301,064  | 4                                  | 86%                    | \$9,150,000  | \$1,296,251  |
| Pike   | HIGH                         | 4                 | \$315,620  | 3                                  | 82%                    | \$268,860,000  | \$1,033,061  |
| Ross   | HIGH                         | 6                 | \$345,912  | 5                                  | 82%                    | \$353,000  | \$1,707,555  |
| Scioto   | MEDIUM                       | 8                 | \$240,320  | 7                                  | 84%                    | \$1,100,000  | \$1,616,383  |
| Tuscarawas   | MEDIUM                       | 6                 | \$359,696  | 5                                  | 86%                    | \$1,250,000  | \$1,853,774  |
| Vinton   | LOW                          | 3                 | \$258,064  | 3                                  | 84%                    | \$30,473,000   | \$653,860  |
| Washington   | LOW                          | 5                 | \$313,476  | 4                                  | 84%                    | \$36,273,000   | \$1,310,289  |
| <b>REGIONAL TOTALS</b>   |                              | 168               | \$8,790,024  | 142                                |                        | \$517,953,000  | \$44,526,698                                       |

Region 1 has the second highest number (751,118) total at risk residential structures with an estimate of potential loss of \$50,348,000. Within Region 1, Lucas County has the largest number of residential structures that are pre-1995. As a result, Lucas has the highest estimate of estimate of potential residential loss in the region (\$11,459,000). Wyandot County has the lowest number of pre-1995 residential structures within the region (4,831). In addition, they have the lowest estimate of potential residential loss in the region (\$372,000).

Additionally, Region 1 has the second highest number (6,920) of commercial structures at risk to tornadoes with approximately 5,775 commercial units being constructed prior to 1995. The total at risk value of the pre-1995 at risk structures is \$1,635,328,689. Within Region 1, Lucas County has the largest number of

commercial structures at risk with a total estimate potential loss of \$447,318,495. Paulding County has the least amount of commercial structures at risk with a total estimated potential loss of \$4,221,420.

Region 1 also has the second highest number of local governmental structures at risk to tornadoes (243) with a total estimated value of \$76,703,622. Again Lucas County has the highest vulnerability within the region with a total of 27 local governmental structures at risk. Of those structures 23 were constructed pre-1995 with a total estimated value of \$7,945,224.

Region 2 has the largest number of structures at risk to tornadoes and the greatest estimate of potential losses (2,346,074 with an estimate of potential residential loss of \$197,972,000). Within Region 2, Cuyahoga County has the largest number of pre-1995 residential structures with a total estimate of potential loss of \$33,343,000. Franklin County has the second largest with a total of 226,183 pre-1995 residential structures and an estimate of potential loss of \$25,802,000. Ashland County has the lowest number of pre-1995 structures (12,039), as well as the lowest estimate of potential residential loss in the region (\$1,090,000).

Region 2 greatly supersedes Region 1 and 3 in the number (33,060) of commercial structures at risk to tornadoes with approximately 79% (26,177) of those structures being constructed pre-1995. The total at risk value for the pre-1995 constructed structures is \$8,667,050,829. Within Region 2, Cuyahoga County has the largest number of commercial structures (7,165) at risk with a total estimated value of \$1,830,679,200. Pickaway County has the lowest number of at risk commercial structures (88) with the lowest estimated value of \$22,224,420.

As with residential and commercial vulnerability, Region 2 has the highest vulnerability to tornadoes for local governmental structures with a total of 1,518 structures at risk. Of those structures, 1,193 were constructed prior to 1995 with a total at risk value of \$526,526,926. Franklin County has the highest number of local governmental structures at risk (562) with 443 of those structures being constructed prior to 1995. The total estimated value of the pre-1995 structures at risk is \$194,587,399.

Region 3 has the lowest number of total residential structures at risk (571,277) with an estimate of potential residential loss of \$30,369,000. Within the region, Clermont County has the largest number of pre-1995 residential structures (51,686), which results in an estimate of potential loss of \$5,658,000. Noble County has the least number of pre-1995 residential structures (1,141), which results in the lowest estimate of potential residential loss in the region (\$185,000).

In addition to the lowest number of residential structures at risk to tornadoes, Region 3 also has the lowest number of commercial structures at risk to tornadoes. In all, the region has 3,685 commercial structures at risk with approximately 83% constructed pre-1995. The total estimate risk for the pre-1995 commercial structures is \$768,551,679. Within the region Clermont County has the largest number (594) of commercial structures at risk with a total estimated risk of \$175,549,704.

Again, Region 3 has the least vulnerability to tornadoes. The region as a whole has 168 local governmental structures at risk to tornadoes with 142 of those structures being constructed prior to 1995. The total at risk value of the pre-1995 structures is \$44,526,698. Within the region Clermont County has the highest vulnerability with 16 local governmental structures at risk. Of those structures, 13 were constructed prior to 1995 with a total at risk value of \$6,300,291.

### **VULNERABILITY ANALYSIS & LOSS ESTIMATE OF STATE OWNED CRITICAL FACILITIES**

The methodology to determine the vulnerability of state-owned structures and critical facilities to tornadoes were identified in section 2.1. Since tornadoes are non-spatial hazards and have the potential to affect all state-owned structures and critical facilities in the state, this section defaults to the overall discussion of state-owned structures and critical facilities identified in section 2.1, Table 2.1.a, and Appendix C.