4.13 Tornadoes and Severe Wind

Description

FEMA defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." Tornadoes can generate wind speeds greater than 250 miles per hour. Tornado paths can be as large as one mile wide and 50 miles long. Nationally, an average of 800 tornadoes are reported annually across all 50 states.

In general, 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. Supercells, a dangerous type of thunderstorm which form from rotating thunderstorms, can cause the most destructive type of tornado.

Tornado Warnings are issued by the Wilmington, Ohio, Forecast Office when a tornado is indicated by the WSR-88D radar or sighted in person by spotters. The WSR-88D radar is an advanced Weather Surveillance Doppler Radar utilized by the NWS to generate a radar image. Once a warning has been issued, people in the warning area should seek shelter immediately. Warnings will include the location of the tornado, as well as the communities in its path. A tornado warning can be issued without a tornado watch, and they are typically issued for 30 minutes at a time. If the supercell thunderstorm responsible for the formation of the tornado is also producing large volumes of rain, the tornado warning may be combined with a Flash Flood Warning. The NWS Office will follow up any Tornado Warnings with Severe Weather Statements to provide up-to-date information on the tornado and inform the public when the warning is no longer in effect (Source: NWS).

Severe weather events can also create strong winds – often called "straight-line" winds – to differentiate thunderstorm winds from tornadic winds. These winds, which have the potential to cause damage, are caused by an outflow generated by a thunderstorm downdraft.

The NWS can issue various types of wind advisories and warnings. A **Wind Advisory** is issued when sustained winds of 31 to 39 MPH are reached for an hour or more and/or if there are wind gusts of 46 to 57 MPH for any duration. A **High Wind Watch** indicates that sustained, strong winds are possible, and outdoor items should be secured. People should modify plans, so they are not caught outside. Additionally, a **High Wind Warning** indicates that sustained, strong winds (40 MPH or greater) with even stronger gusts (greater than 58 MPH) are happening. People should seek shelter, and those driving should keep both hands on the wheel and slow down. An **Extreme Wind Warning** is issued for surface winds of 115 MPH or greater associated with non-convective, downslope, derecho (not associated with a tornado), or sustained hurricane winds that are expected to occur within one hour.

Location

Severe wind events and tornadoes can occur anywhere in Clinton County. All areas and jurisdictions should be considered at risk for these events.

Extent

Tornadoes are measured by the amount of damage caused by a certain wind speed, assuming greater wind speeds will result in greater damage. The original Fujita Tornado Damage Scale (F-scale) was developed in 1971 without much consideration to a building or structure's integrity or condition as it relates to the wind speed required to damage it. The Enhanced Fujita-scale (EF-Scale) took effect on February 1, 2007. This scale retains with the original F-scale's F0 through F5 wind ratings and classifies tornado damage across 28 different types of damage indicators. These indicators mostly involve building/structure type and are assessed at eight damage levels from 1 through 8. Therefore, construction types and their relative strengths and weaknesses are incorporated into the EF classification given to a particular tornado. The most intense damage along with the type of

construction affected within the tornado path will generally determine the EF scale rating given to the tornado. Table 4.13.1 lists the classifications under the EF- and F-scale. It should be noted that the wind speeds listed in this table are estimates based on damage rather than actual measurements.

Neither NOAA or NWS have re-evaluated the historical tornado data using the enhanced scale; therefore, this assessment and subsequent plans will reference both scales until a complete switchover has occurred.

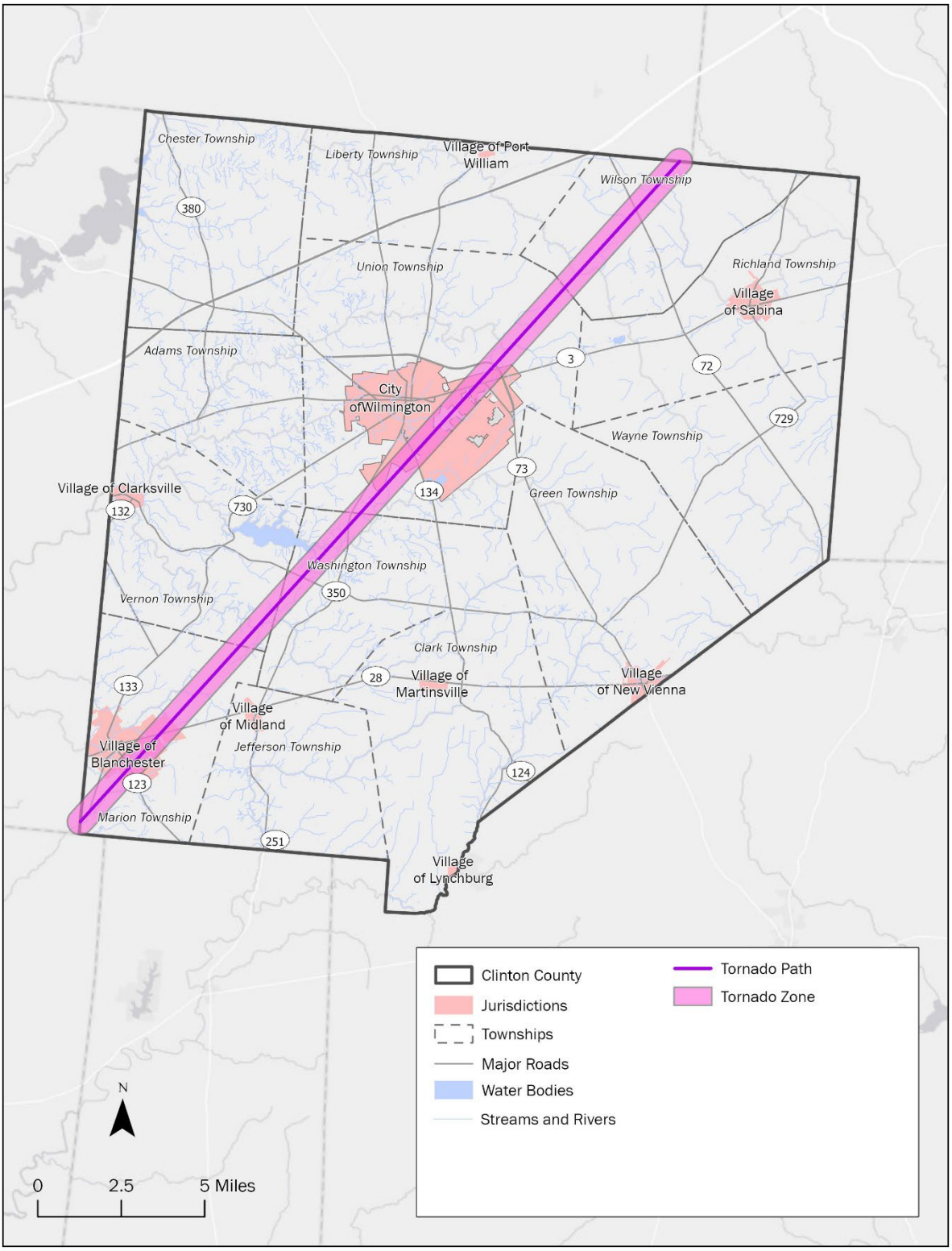
Table 4.13.1: Fujita and Enhanced Fujita Scale Classifications

Fujita Scale 3-Second Wind Gust (MPH)		Damage Levels	Enhanced Fujita Scale 3-Second Wind Gust (MPH)	
F0	45-78	Light Damage: Tree branches down.	EF-0	65-85
F1	79-117	Moderate damage: Roof damage.	EF-1	86-110
F2	118-161	Considerable damage: Houses damaged.	EF-2	111-135
F3	162-209	Severe damage: Buildings damaged.	EF-3	136-165
F4	210-261	Devastating damage: Structures leveled.	EF-4	166-200
F5	262-317	Incredible damage: Whole towns destroyed.	EF-5	Over 200

Source: SOHMP

Figure 4.13.2 simulates an extremely destructive, worst-case scenario EF5 tornado and its impacts on Clinton County assets and infrastructure.

Figure 4.13.2: Worst Case Tornado Scenario



History

There have been 15 tornado events, one event that resulted in four tornadoes, one that resulted in two tornadoes, and the other 13 events resulted in one tornado each in Clinton County between January 1995 and December 2023. There have been 269 High-, Strong-, and Thunderstorm-Wind events in Clinton County between January 1995 and December 2023. Clinton County has had one Major Disaster Declaration for Severe Windstorm Associated with Tropical Depression Ike in 2009. The tornadoes caused an estimated $260,000 in property damage and $16,000 in crop damage. The high-, strong-, and thunderstorm-wind events caused an estimated $7.8 million in property damage and $20,000 in crop damage. No deaths or injuries were reported. Several of the most damaging events, and events with major disaster declarations are described in more detail below.

An EF0 Tornado in Clinton County, March 23, 2012:

An EF0 tornado touched down in Clinton County in the Village of Clarksville on May 23, 2012. The tornado caused minor damage to numerous structures along 2nd Street. Many roofs, trees, fences, and windows were damaged. Winds were estimated at 70 miles per hour (mph). Clinton County reported approximately $50,000 in damage. No deaths or injuries were reported in the County.

An EF0 Tornado in Clinton County, October 26, 2010:

An EF0 tornado touched down in Clinton County on October 26, 2010, and traveled for 3.81 miles into Fayette County before lifting. The tornado was 200 yards wide and had winds of 85 mph. The tornado damaged a portion of a metal roof, four utility poles, several trees, and a horse trailer. Clinton County reported approximately $70,000 in property damage. No deaths or injuries were reported in the County.

A Major Disaster Declaration for Severe Windstorm associated with Tropical Depression Ike, September 14, 2008:

The remnants of Hurricane Ike moved northeast with a frontal boundary across the lower Ohio Valley in September 2008. Wind gusts of up to 70 mph were observed, causing significant damage and widespread power outages. Sustained winds were observed up to 50 mph and lasted for several hours. A Major Disaster Declaration (DR-1805-OH) was declared on October 24, 2008, offering public assistance to 33 counties, including Clinton County. The County reported approximately $5.1 million in property damage. No deaths of injuries were reported in Clinton County.

Thunderstorm Wind Event in Clinton County, April 9, 1999:

A thunderstorm moved through southwest Clinton County near the Village of Clarksville on April 9, 1999. The storm brought severe wind and tornadoes. Twenty properties were damaged and three homes and one business were destroyed. Clinton County reported approximately $1 million in property damage. No deaths or injuries were reported in the County.

Probability

There were 15 tornado events (19 tornadoes) in Clinton County between January 1995 and December 2023 resulting in a total of $260,000 in property damage and $16,000 in crop damage. There were 269 strong-, high-, and thunderstorm-wind events between January 1995 and December 2023, resulting in a total of $7.8 million in property damage and $20,000 in crop damage. On average, which is approximately 0.5 tornado events and nine wind events per year, with an average of $9,517 in property and crop damage for tornadoes and $270,831 in property and crop damage for wind events.

Although it is difficult to predict future tornado activity, a study completed in 2018 on spatial trends of tornadoes saw an eastward shift in tornado frequency. Two other studies (2015 and 2016) showed an increase in tornado frequency in the eastern United States and a decrease in tornado activity in central United States. The study published in 2016 on spatial redistribution of tornado activity stated that there is a documented increase in hazardous conductive weather (HCW) in the lower Ohio valley

regions. The studies do note that the number of tornadoes produced from a single storm are increasing. For instance, in 2020 there were 20 documented tornadoes in Ohio, seven tornadoes from one storm and five tornadoes from another.

Vulnerability Assessment

Infrastructure Impact

Above-ground infrastructure can be damaged by tornadoes. Debris lofted airborne by tornadoes as well as fallen trees can cause damage to buildings and infrastructure and lead to road closures. Above ground utility infrastructure can be damaged or destroyed, which can cause service outages.

Population Impact

Tornadoes are random in nature and have the potential to occur anywhere in the County. Everyone within the County should be prepared for a tornado. Residents in mobile home parks are particularly vulnerable and should have a plan in place.

For social vulnerability, according to the National Risk Index, tornadoes and strong winds have a score of 58.2 ("relatively low") and 61.2 ("relatively moderate") in Clinton County. The index indicates an expected annual loss of $479,000 due to tornadoes and $1.4 million due to strong wind, with 2.2 and 0.2 events occurring per year, respectively.

Property Damage

Tornadoes that have occurred in Clinton County are generally weaker, rated EF-2 or lower; however, even weaker tornadoes can cause significant damage to property. In the last 29 years the property damage in Clinton County has included homes, businesses, mobile homes, roofs, windows, siding, powerlines, and tree damage.

Wind damage in Clinton County has included homes, businesses, roofs, siding, trees, and powerlines. Most of the wind events cause little to no damage, however, one event caused $5.1 million in property damage.

Loss of Life

Loss of life and injuries are always possible during tornadoes and strong wind events. Falling debris is the main cause of death in a tornado, along with becoming airborne.

Economic Losses

Tornadoes and strong wind have the potential to damage infrastructure, resulting in the economic burden of clean up and repairs, as well as the economic loss from deaths and injuries. Expected annual loss (EAL) rates, calculated by FEMA, identify the total value of loss expected each year for a particular community, in this case Clinton County census tracts. Expected losses for buildings, population ($11.6 million for each fatality or 10 injuries), and agriculture per census tract from tornadoes and strong wind are recorded in **Tables 4.13.3 and Table 4.13.4** below. The tables show the census tracts for Clinton County, listing them from highest total EAL to lowest.

Table 4.13.3: Structure and Population Vulnerability from Tornadoes

Census Tract	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Agriculture)	Expected Annual Loss (Total)
39027964400	$195,102	$42,434	$261	$237,797
39027964700	$190,779	$43,408	$37	$234,224
39027965100	$121,967	$32,075	$256	$154,298
39027964900	$105,212	$44,102	$35	$149,349

Census Tract	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Agriculture)	Expected Annual Loss (Total)
39027964800	$101,935	$41,070	$107	$143,112
39027965000	$87,610	$29,731	$174	$117,515
39027964300	$73,374	$27,727	$125	$101,226
39027964502	$70,570	$22,417	$15	$93,002
39027964501	$59,598	$25,236	$14	$84,848
39027964600	$54,966	$21,722	$0	$76,688
Grand Total	**$1,061,113**	**$329,922**	**$1,024**	**$1,392,059**

Source: FEMA National Risk Index

Table 4.13.4: Structure and Population Vulnerability from Strong Winds

Census Tract	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Agriculture)	Expected Annual Loss (Total)
39027964700	$73,524	$10,897	$136	$84,557
39027964400	$70,606	$9,751	$1,103	$81,460
39027965100	$47,055	$8,072	$1,181	$56,308
39027964800	$35,834	$9,152	$393	$45,379
39027964900	$35,359	$9,429	$140	$44,928
39027965000	$33,623	$7,429	$776	$41,828
39027964300	$28,316	$6,979	$584	$35,879
39027964502	$27,198	$5,642	$65	$32,905
39027964501	$22,992	$6,351	$52	$29,395
39027964600	$21,213	$5,468	$0	$26,681
Grand Total	**$395,720**	**$79,170**	**$4,430**	**$479,320**

Source: FEMA National Risk Index

Future Trends

Land Use and Development Trends

Tornadoes can occur anywhere. Any development that has occurred since the previous plan and any future development has the potential to be impacted by tornadoes. While the location of development will not be impacted by tornadoes, shelters should be installed in high occupancy buildings, parks, fairs and festivals, mobile home parks, and similar developments.

In 2023, Clinton County authorized 101 new residential units at a total value of $25,454,000. Though there are more buildings slated for construction, Clinton County's population has decreased 80 individuals from 2020 to 2023. The decline is set to continue such that by 2030 the population will lose an additional 1,343 people (3.2 percent). More buildings but less people may potentially mean more property loss but less population vulnerability. However, with state-of-the-art engineering there is very little potential damage.

The vulnerability of structures and populations to tornado damage is related to the number and age of buildings and population density, such that older buildings with more people increases vulnerability, and fewer buildings and people reduces vulnerability. Much of Clinton County is nonresidential including rangeland, forest, cropland and pasture, with only eight percent either residential or industrial / commercial, reducing the risk of much of the County to tornado damage.