4.4 Assessing Vulnerability: Estimating Potential Losses

This section presents exposure, damage, and loss estimates, for each of the 8 hazards evaluated. The findings support planning efforts based on a better understanding of the potential impacts associated with each hazard and provide a foundation for the mitigation strategy presented in Section 5. For each hazard, quantifiable loss estimates are presented, if feasible. For all hazards, available loss or risk information is presented based on current knowledge of the study area relative to each hazard and a qualitative vulnerability assessment of each hazard. Future efforts will include the development of additional data so that quantitative loss estimates may be refined over time. In accordance with DMA 2000, a data collection plan addressing current data needs is included in the mitigation strategy section of this plan (Section 5).

For this portion of the risk assessment, available data, methodologies, and assumptions were used to select and apply a risk assessment methodology for each hazard. Table 4-4-1 shows the risk assessment methodology selected for each hazard.

Table 4-4-1. Summary of Risk Assessment Methodology Selection

Hazard	Comments	Output
HAZUS-MH Methodology		
Flood	HAZUS-MH-provided data were used and supplemented with local data for critical facilities. The HAZUS-MH models were used to obtain exposure and loss estimates.	HAZUS-MH Exposure and Loss Estimate Maps, Tables and Text
Hurricane (Part of Severe Storm)		
HAZUS-MH Supported Methodology		
Severe Storm (Non-Hurricane Portion)	For these hazards, available historic data and professional expertise regarding areas at risk for each hazard was compiled from a variety of sources. Professional judgment and available data were then used to evaluate past and potential events, and assess risks in a qualitative manner. HAZUS-MH was used to support inventory evaluations and graphical presentations of areas at risk. Data needs to support quantitative risk assessment were identified for the data collection plan.	HAZUS-MH Supported Exposure Estimates and Input to Data Needs Portion of Mitigation Strategy (Section 5)
Severe Winter Storm		
Ice Storm		
Extreme Temperatures		
Fire (urban and wild)		
Infestation (primarily disease-carrying mosquitoes)		
Hazardous Materials (fixed facility)		

Two methodologies were used to assess potential exposure and losses associated with priority hazards of greatest concern to the Town of Clay, as summarized below:

- **HAZUS-MH** is a parametric model in that distinct hazard and inventory parameters (for example, wind speed and building types) are considered quantitatively to determine the potential impact (damages and losses) on humans, buildings, roads, and other assets. The HAZUS-MH risk assessment methodology was applied using HAZUS-MH software to estimate losses associated with the flood and hurricane (portion of the severe storm) hazards. HAZUS-MH loss estimate data can include the three areas summarized below:

    1. The replacement values for general building stock; this includes the cost of full repair or replacement to the building stock based on damage associated with a hazard event. For buildings, replacement value addresses building structure and content replacement.

2. Impact to critical facilities and lifelines, where feasible. For this assessment, the percent of building damage or the range of damage (from none to severe) is evaluated using HAZUS-MH for flood and hurricane. This also can be used to estimate the annual loss, where value data for critical facilities is available. However, for critical facilities, the functionality of facilities after a hazard event is generally the primary focus.

3. Population at risk or impacted. Using the inventory data in HAZUS-MH, population related data are analyzed to assess the potential population that could be impacted by the hazard.

- **HAZUS-MH support** was used to assist the evaluation of the other hazards, for which hazard models do not yet exist in HAZUS-MH [severe winter storm, ice storm, extreme temperatures, fire (urban and wild), infestation, and Haz Mat (fixed facility) incidents]. HAZUS-MH was used to map hazard areas, where applicable, and calculate exposure based on geographic hazard areas. For most of the hazards evaluated in this risk assessment, historic data are not adequate to model future losses. For a number of hazards, such as the severe winter storm (snow) hazard, the entire study area is at risk, or exposed, to the hazard. For these hazards, available data, professional knowledge, and evaluation of local data were applied to evaluate the qualitative risk, exposure and loss associated with each hazard. This evaluation provides a sound basis for, mitigation strategies developed in Section 5.

For the HAZUS-MH supported analysis, data from HAZUS-MH augmented with local data were used to assess the inventory and affected populations at risk based on the designated hazard areas identified in Section 4.2 of this plan for each hazard. In some cases loss estimates were feasible using HAZUS-MH. In other cases, the area of inventory vulnerable to each hazard was evaluated based on historic information and best professional judgment using the best, readily-available data. In these cases, assumptions regarding the potential percentage of inventory that could be lost were used to develop estimates of potential losses. These percentages are considered conservative estimates based on available loss data. With time, additional data collection and research will support further refinement of the exposure and loss estimate results.

All of the exposure assessments and loss estimations are based on the best readily available data. Where information limitations exist, the following are described under Additional Data Needs and Next Steps:

1) An explanation of why a detailed loss estimate could not be completed;
2) A summary of additional data needs for further analysis; and
3) Measures that will be undertaken to gather data to complete the analysis over time.

Additional data that would be useful to estimate losses or exposure for the hazards of concern are also summarized in Table 4-4-19 at the end of this section. This data supplementation effort is included as a mitigation action in the mitigation strategy portion of this plan. The planning group adopted this methodology based on FEMA's How To Guide, which states "in cases where loss estimation tables are not currently available, base your assumptions on your past experience with those hazards in your planning area." Also, DMA regulations state that the best, readily-available data is acceptable and plans to supplement data over time should be addressed. Therefore, when the extent of damage cannot be identified, the vulnerable asset data values and qualitative assessment of risk suffice for this mitigation plan. Future updates to this plan will improve and refine the analyses presented in this plan.

As discussed in Section 4.1, hazards are presented by category in the following order:

Natural Hazards

1) Severe storm (wind, including hurricanes and tornadoes)
2) Severe winter storm (snow)
3) Ice storm
4) Flood
5) Extreme temperatures
6) Fire (urban and wild)
7) Infestation (primarily disease-carrying mosquitoes)

Human-Caused Hazards

1) Hazardous Materials (fixed facility)

Major data sources used to derive the inventory exposure and loss estimates presented in this section are included in Appendix C and listed in the references section of this document.

4.4.1 Natural Hazards

Natural hazards summarized in this section include: severe storm (wind, including hurricanes and tornados), severe winter storm (snow), ice storm, flood, extreme temperatures, fire (urban and wild), and infestation (primarily disease-carrying mosquitoes).

4.4.1.1 Severe Storm (including Hurricanes and Tornadoes)

Severe storms, including hurricanes, thunderstorms, hailstorms, and tornadoes, include high winds and air speeds that result in power outages, disruptions to transportation corridors and equipment, loss of workplace access, significant property damage, injuries and loss of life, and the need to shelter and care for individuals impacted by the events. A large amount of damage can be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, vehicles, and, in some cases, people.

Data Collected and Used

Data used to assess this hazard include data available for hurricanes in HAZUS-MH, NOAA NCDC data, professional knowledge, information provided by the Town of Clay, and data available from FEMA.

According to NOAA's NCDC database, no hurricane or tropical storm events have been recorded as direct events in Onondaga County since 1950. However, high winds and flooding associated with hurricanes and tropical storms have impacted the Town of Clay (for example, flooding associated with Tropical Storm Agnes in 1972). HAZUS-MH contains data on historic hurricane events. It also includes surface roughness and vegetation (tree coverage) maps for the area. For this risk assessment HAZUS-MH was used to estimate losses for a high-wind event that could be associated with a coastal hurricane or other wind-related event.

A loss estimate was conducted for the severe storm using the hurricane module of HAZUS-MH, which estimates the wind-related losses associated with such an event. This is appropriate because full-force hurricanes are not likely to occur in the Town of Clay due to the distance of the county from the Atlantic Ocean, as well as latitude. Flood related damages are discussed in Section 4.4.1.4.

Exposure and Loss Estimation

Due to the Town of Clay's inland location, the loss associated with hurricane is primarily associated with hurricane-related winds and rains (flooding is presented in Section 4.4.1.4). Wind associated with a hurricane event in this area is more similar to a severe windstorm and therefore, can support analysis of the severe storm event (wind) for this area. The damage from hurricane-related winds is considered representative of a severe windstorm and representative of winds that may be anticipated in this area.

Secondary flooding associated with the torrential downpours during hurricanes is also a concern in the Town of Clay. The Town of Clay has experienced flooding in association with hurricanes and tropical storms in the past. The flood hazard is described in Section 4.4.1.4.

Limited damage information is available for high wind events, but available data indicates that the study area can suffer hurricane-related winds, tornado, and other high wind severe storms. Table 4-4-2 identifies severe storm events, including those that resulted in Presidential or Other Disaster Declarations in the vicinity of, or for, the study area (based on Town of Clay and NCDC NOAA data). This documentation records a total of:

- 159 thunderstorm and high wind events between 1956 and 2004, including winds from 0 to 57 knots, 5 deaths, 27 injuries, and $98 million in property damage in Onondaga and surrounding counties.
- Eighteen lightning events recorded between 1994 and 2004, with one death, eight injuries, and $275,000 in property damage recorded for the Town of Clay and surrounding areas.
- Seven tornado events between 1963 and 2002, ranging in severity from F0 to F3, with 5 injuries and $5.3 million in damage in the county and surrounding area (including $500,000 of damage in Syracuse associated with a tornado (F1) in Syracuse in 1993.
- No tropical storms or hurricanes, directly impacting the county, but a number of wind and rain-related events associated with coastal events (for example, flooding associated with Hurricane Agnes in 1972).

Table 4-4-2. Severe Storm Events in Town of Clay and Surrounding Area

Storm Events	Years	Recorded Damages (Property)	Comments
Tornado – NA Thunderstorm/Wind – 2 Lightning – ND	1950 to 1959	$0	Events are noted in August 1956 and July 1959 but no specific data is provided. The events are noted specifically for Onondaga County.
Tornado – 1 Thunderstorm/Wind – 10 Lightning – ND	1960 to 1969	$3,000	Tornado - A tornado of F0 magnitude occurred in June and impacted Onondaga County. The tornado path was about 5 miles long by 100 yards wide. Thunderstorm/Wind – Ten events are noted with winds up to 55 knots; no injuries, deaths, or property damage values are included with the data.
Tornado – 0 Thunderstorm/Wind – 11 1Lightning – ND	1970 to 1979	$650,000	Thunderstorm/Wind – Eleven events are noted with winds up to 57 knots. Little additional information is provided. The Town of Clay disaster data also note hurricane-related flooding associated with the aftermath of Hurricane Agnes in 1972 (not included in this list of recorded damages).
Tornado – 2 Thunderstorm/Wind – 36 Lightning – 4	1980 to 1989	$525,000	Tornado – Two events are recorded in the 1980s; one F3 event May 1983, resulting in $2.5 million in damage and one F1 event in July 1986 that resulted in $250,000 and five injuries. Thunderstorm/wind – 36 are noted with no specific data on damage, death or injury (no losses are recorded for the events).

Storm Events	Years	Recorded Damages (Property)	Comments
Tornado – 2 Thunderstorm/Wind – 74 Lightning – 4	1990 to 1999	$95,005,000	Tornado – Two events are recorded in the 1990s; one F0 event August 1990 with $25,000 in damage and one F1 event in August 1993 with $500,000 in damage. Thunderstorm/wind – 74 events are documented including 69 thunderstorm/wind and 5 high wind events. Total damages for these events included: $92,981,000, with $90 million recorded for a single event in 1998. Impacts noted include tree falls, building damage, and downed power lines. Lightning – 4 events including 1 1 injury in Syracuse in 1994, 5 injuries in Syracuse in Manlius in 1996, and 1 more injury I Syracuse in 1999. Total damages for these events is reported as $23,000. Note: The Town of Clay notes an event in 1992 or 1993, but no specific data is available.
Tornado – 2 Thunderstorm/Wind – 24 Lightning – 14	2000 to 2004	$95,005,000	Tornado - Two tornado events are recorded (one in September 2001 and one in July 2002), with the first being a F0 tornado causing $1,000 in damage and the second being an F1 tornado causing $2 million in damage. No injuries or deaths are reported for events. Thunderstorm/wind – 24 events, including a storm wind event, 8 high wind events, and 15 thunderstorm wind events resulting in 1 injury, no deaths, and $5,138,000 in property damage. Lightning – 14 events, including one in Clay that injured a person. A total of 1 injury, 1 death, and $282,000 in damage. Note: The Town of Clay specifically notes the windstorm / flood in May 2000, which resulted in FEMA 1335 DR NY with a reimbursement of $19,748.81 (not included with NOAA NCDC total in column to left).

Notes: Recorded losses indicate the dollar value of loss made available through public records reviewed and generally indicate the reimbursement received, rather than the total loss that may have been incurred. Source: Primary Source for events and losses is NOAA NCDC, with notes from Town of Clay, 2005 (Documented Disasters).

General information on severe storm events is discussed in Section 4.2 and indicates that 132 thunderstorm wind/wind events, lightning events, and tornados have been recorded in Onondaga County since 1980 (about 5.5 events per year) (NCDC). Three of these events are indicated as impacting Clay directly. According to NWS statistics, Onondaga County experiences low to moderate force tornadoes (F0 to F1) about once every 3 years on average and severe tornadoes (F2 or greater) about once every 20 years (NWS). In addition to available historic data, the HAZUS-MH methodology and model were used to analyze the hurricane hazard associated with the 100-year and 500-year Mean Return Period (MRP) hurricane events in the Town of Clay. For the 100-year event, wind speeds were estimated to be less than 50 miles per hour (mph) and no losses occurred.

Damage to General Building Stock - For the 500-year hurricane event, wind speeds are estimated at about 70 mph. Losses associated with such an event are summarized in the following paragraphs. The HAZUS-MH probabilistic model for the 500-year event estimates that 1 building would be at least moderately damaged. No buildings would be completely destroyed. Table 4-4-3 shows the expected building damage by occupancy class. This shows that 47 buildings would suffer minor damage, while 1 building would suffer moderate damage. No buildings are estimated to suffer severe damage or total destruction.

Table 4-4-3. Buildings Experiencing Minor or Moderate Damage from 500-year Hurricane Event (Wind)

Building Occupancy Class	Number of Buildings	Number Experiencing Minor Damage (3)	Number Experiencing Moderate Damage (3)
Residential	17,162 (1)	46	1
Commercial	215	1	0
Industrial	27	0	0
Agricultural	75 (2)	0	0
Religious	34 (2)	0	0
Government	14 (2)	0	0
Educational	12 (2)	0	0

Sources: (1) FEMA HAZUS-MH default data, (2) Town of Clay Planning and Development, (3) HAZUS-MH Hurricane Probabilistic Modeling for 500-year Event.

Of the total buildings included in the building stock, 13,859 are wood construction; these experience 29 buildings with moderate damage. Masonry accounts for 2,377 buildings and 13 minor and 1 moderately damaged building. Concrete, steel, and other construction account for 1,017 buildings; two of these buildings experiencing minor damage. Based on the damage estimated, no persons are estimated to require temporary housing due to hurricane damage. Table 4-4-4 shows the estimated replacement (damage) in terms of dollars for buildings for a 500-Year hurricane event.

Table 4-4-4. Estimated Damage to Building Stock Associated with 500-year Hurricane Event in Town of Clay

Category of Building	500-Year Event		
	Building Structure Damage	Building Content Damage	Total Building Damage
Residential Exposure (Single and Multi-Family Dwellings)	$2,334,460	$7,040	$2,3512,640
Commercial	$53,250	$0	$53,250
Industrial	$12,590	$0	$12,590
Others (Agricultural, Religious, Government, Education)	$5,460	$0	$5,460
TOTAL DAMAGE	$2,405,760	7,040	$2,412,810

Note: Source is FEMA HAZUS-MH Hurricane Probabilistic Modeling for 500-year Event

The hurricane model also estimates business interruption loss which can be associated with damaged buildings that can no longer function for their intended purposes, relocation damage associated with rental or other properties, and wage losses due to a hurricane event. No income or wage losses are estimated to occur for the 500-year hurricane event. Relocation and rental loss costs are estimated to total $10,400 and are considered a minor impact.

Finally, the hurricane model estimates debris that would be generated associated with building damage, tree debris, downed power lines, etc. The model estimates that 134,260 tons of debris would be generated, with all of that being associated with tree debris. This would require about 8, 25-ton trucks to support removal.

Figure 4-4-1 shows the total estimated residential losses associated with a 500-year hurricane event. Industrial and commercial loss maps are not shown due to the low level of impact anticipated. It is noted that this figure depicts the total dollar value of losses within each census block, and not loss densities. Failure to make this distinction may lead one to suspect anomalies in the data, particularly in locations such as the Clay Marsh. In this instance, the census block that includes Clay Marsh also includes residential properties along the east side of Wildcreek Way resulting in significant residential exposure.

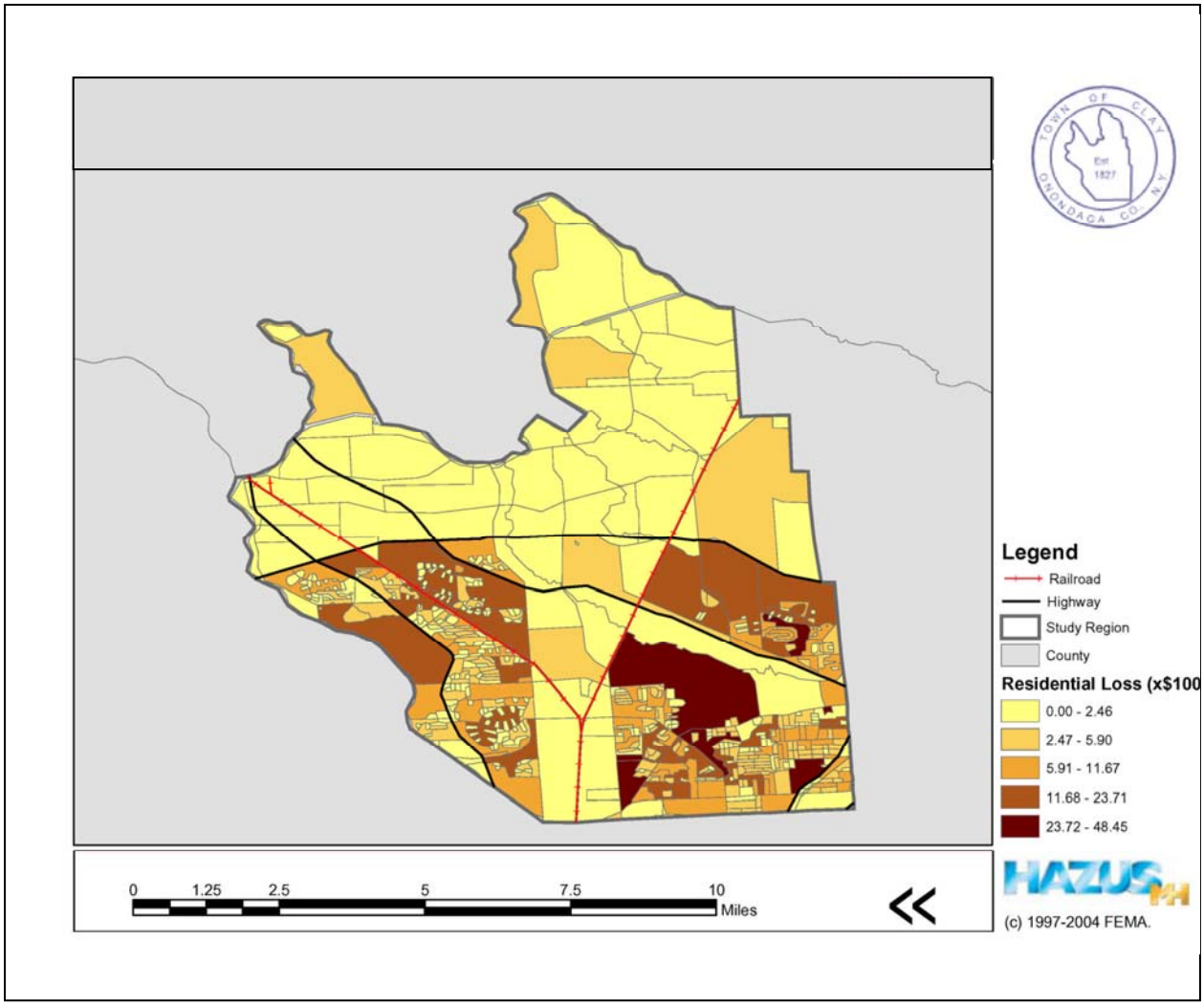
Damage to Critical Building Stock – The hurricane model also estimates damages to critical building stock (schools, emergency care facilities, etc.). For the 500-year wind-related hurricane event, it is estimated that no fire stations, hospitals, schools, or police stations would be damaged significantly and none would lose operational capabilities. Also, no hospital beds are estimated to be required to address injuries that could be incurred.

Additional Data and Next Steps

Over time, the town will obtain additional value data to support the analysis of this hazard. Data that will support the analysis would include additional detail on past hazard events and impacts, additional information on estimated frequency of these events, and future data regarding events and damages as they occur. In addition, information on particular buildings or infrastructure and their value will support

updates regarding the particular assets in the Town of Clay that are most vulnerable to severe storm (wind-related) events.

Figure 4-4-1. Estimated Damage Density for Residential Building Stock for 500-year Hurricane Event



For the severe storm events that cannot currently be modeled in HAZUS-MH (tornado, thunderstorm, windstorm, etc.), additional detailed loss data from past and future events will assist in assessing potential future losses. Based on these values and a sufficient number of data points, future losses could be modeled. Alternately, percent of damage estimates could be made and multiplied by the inventory value to estimate potential losses. This methodology is based on FEMA's How To Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA 2004). Finally, with time, HAZUS-MH will be released with modules that address hurricane wind and associated flooding as one model and will include a tornado module. As this version of HAZUS-MH is released, the study area can run analyses for the tornado hazard and re-run an analysis for an overall picture of the hurricane-associated wind and flood damages.

Overall Vulnerability Assessment

Severe storms are common in the study area, often causing impacts and losses to the Town of Clay and the municipalities' roads, structures, facilities, utilities, and population. Existing and future mitigation efforts should continue to be developed and employed that will enable the study area to be prepared for these events when they occur.

4.4.1.2 Severe Winter Storm (Snow)

Severe winter storms are of significant concern to the Town of Clay due to the frequency and magnitude of these events in the region, the direct and indirect costs, delays, and impacts on the people and facilities of the region related to snow and ice removal, health problems, cascade effects such as utility failure, flooding from ice jams, and stress on community resources.

Data Collected and Used

National weather databases, Town of Clay, and jurisdictional data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Onondaga County from NOAA's NCDC website and data provided directly by the Town of Clay. This data was used to support an evaluation of exposure and potential impacts associated with this hazard. Available historic data are presented in Section 4.2.

Exposure and Loss Estimation

Heavy snowfall, coupled with low temperatures, often results in increases in traffic accidents; disruptions in transportation, commerce, government, and education; utility outages due to falling trees, branches, and other objects; personal injuries associated with slippery surfaces and freezing temperatures; and numerous other problems. Specific damages associated with severe winter storm (snow) events in the study area include the following primary concerns:

- Injuries, including fatalities, associated with accidents, low temperatures, power loss, falling objects and accidents associated with frozen and slippery surfaces and snow accumulation
- Increases in the frequency and impact of traffic accidents, which result in personal injuries
- Ice-related damage to trees, building and infrastructure inventory, and utilities (power lines, bridges, substations, etc.)
- Roads damaged through freeze and thaw processes
- Stress on the local shelters and emergency response infrastructure
- Lost productivity that occurs when people cannot go to work, school, or stores due to inclement conditions

The climate of the Town of Clay is such that no areas are immune to the potential damaging effects of severe winter storms. Some minimum damage is anticipated annually, with potential extensive damage occurring about once every 10 years.

Property Damage - As presented in Figure 4-2-2 in Section 4.2, historic data for severe winter storm (heavy snow) events indicate that between 1993 and 2005, 84 heavy snow events were recorded (with 69 through the end of 2004). This indicates that an average of 6.5 such events occur each year. Damage data for these storms is provided in Table 4-4-5, as available.

Events include lake effect snows (from the Great Lakes), Artic Clippers, and snow that moves from North Carolina and up along the east coast. In many cases, Northern Onondaga is noted as being impacted (includes Town of Clay). Accidents, power outages, school closures, the need for shelters, and roof

collapses are associated with some of the events. The number of accidents is significantly impacted by the timing of the snow storm (during commuter hours, on a holiday, etc.) and the timing of the event in the season (with more accidents earlier in the season and later accidents reduced as people remain at home). The number of events and dollar events report for Onondaga and surrounding counties are significant. Based on the number of events of significance in some years where the reported damages are $0, it appears that actual damage costs may be reported in an unsystematic, manner and that losses to property are potentially higher than shown.

Table 4-4-5. Severe Winter Storm (Snow) Events in Onondaga County and Surrounding Areas

Heavy Snow Events	Year	Recorded Damages (Property)	Comments
10	1993	$7,100,000	Events ranged from November through April with April event causing $5 million in property damage (including a Blizzard in March that resulted in a disaster declaration based on up to 43-inches of snow). Snow events included impacts such as accidents and power outages.
4	1994	$650,000	Events included two in January, one in February, and one in March. Little descriptive information provided.
2	1995	$30,000	Two events were noted for November; one was a snow squall caused by lake effect snow; the second was an intense coastal storm that brought up to 21 inches of snow to the Central New York region and caused major road closures.
7	1966	$86,000	Events ranged from November through March and included one event that caused 4,000 people to lose power in Onondaga County and poor visibility that resulted in 10 injuries and 3 deaths for an event in March. The March event included two injuries and one death in Marcellus (Onondaga County) due to a traffic accident.
7	1997	$0	Seven events ranging from November through February are noted; in one event, 20 to 30 inches of snow occurred in Syracuse and along the I-81 corridor. In the November event, wet snow resulted in downed power lines and isolated roof collapses in Onondaga and Oneida Counties (but no damage value recorded).
4	1998	$0	Events included one in January, one in February and two in March. One March event included freezing rain; little other information recorded.
4	1999	$0	Events ranged from November through March; the March event included heavy, wet snow. The December event included 12 inches; a November event showed strong variability in impact (from 3 to 7 inches in Syracuse).
12	2000	$0	Events included one in November, seven in December, two in January, and two in February; no injuries or fatalities reported although roadway accidents noted.
7	2001	$0	Events included two in January, two in February, and three in February; heaviest snowfalls occurred in March with 10 to 30 inches during one event. January event included thunder. Numerous lake effect snowfalls.
3	2002	$0	Events included one in November and two in December. The second December event included 8 to 14 inches of snow along I-81 and caused closure of part of the New York State Thruway; power outages were noted in the Catskills and many counties declared states of emergencies.
5	2003	$9,540,000	Events included one in January, two in February, one in April and two in December; impacts included accidents, a need for emergency shelters, accidents, and roof collapses (Oneida County reported barn, fire station and mobile home impacts for a February storm).
4	2004	$600,000	Events included two in January, one in February and one in March, impacting Northern Onondaga County and including accidents during periods of commuting.
69	11 yrs.	$1,600,000/yr.	Reflects the average loss per year based on the reported damages listed in the table.

Notes: Recorded losses indicate the values shown on the web site for Onondaga and other surrounding counties impacted. The reported damages are shown but may not represent total losses. Source: NOAA NCDC Storm Event Database (accessed on May 13, 2005).

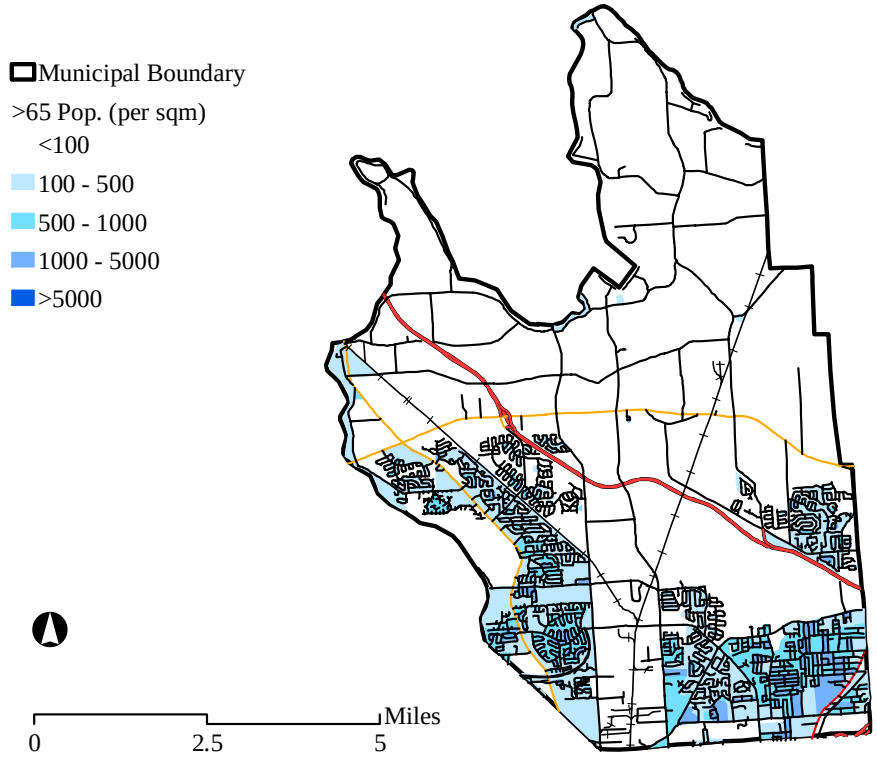
Population Impacts – As discussed above, some traffic accidents associated with storm events include injuries and in limited cases, deaths. However, the number of injuries and deaths reported for accidents is generally low.

Populations considered most vulnerable to severe winter storm impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 4-4-6 summarizes the population over the age of 65 and living in households with an income below $20,000 per year. Figures 4-4-2 and 4-4-3 show the distribution of these populations in the Town of Clay.

Table 4-4-6. Population in Study Area Exposed to Severe Winter Storm (Snow) Events

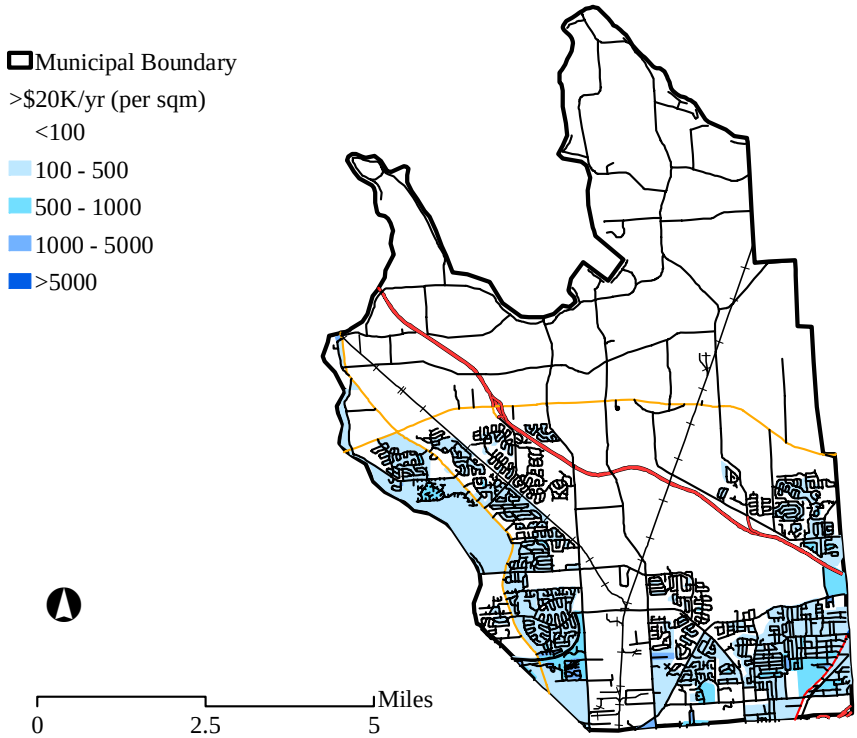
Population Category	Number of Persons Exposed
Elderly (Over 65 years of age)	5,472 (9.3 % of total population)
Low Income (Persons living in households with annual incomes less than $20,000)	2,885 (4.9% of total population)
Total Population (includes categories above)	58,000

Figure 4-4-2. Distribution of Elderly Population for Study Area



Source: HAZUS-MH (FEMA 2004)

Figure 4-4-3. Distribution of Populations with Income Less Than $20K/year for Town of Clay



Source: HAZUS-MH (FEMA 2004)

The entire inventory in the Town of Clay is vulnerable to a severe winter storm. Table 4-4-7 identifies the building count and valuation of this inventory as well as the losses that would result from 1, 5, and 10 percent damage to this inventory as a result of a severe winter storm.

Table 4-4-7. Inventory of General Building Stock Exposure for Town of Clay

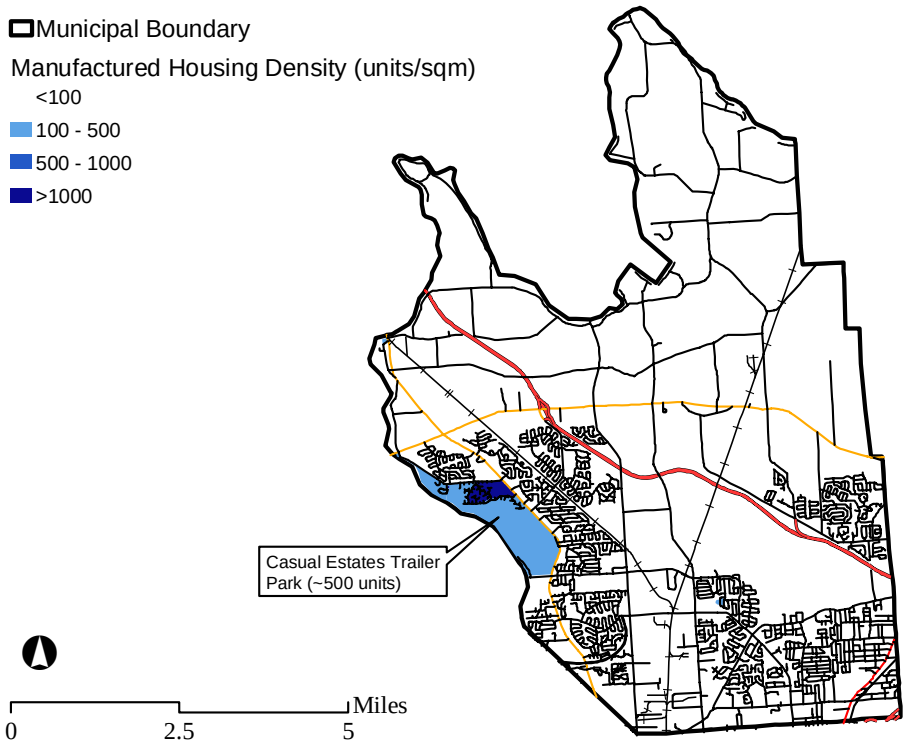
Building Occupancy Class	Number of Buildings	Total Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	17,162	$2.92B	$29.2M	$146M	$292M
Commercial	215	$0.45B	$4.5M	$22.5M	$45M
Industrial	27	$80.2M	$0.8M	$4.0M	$8.0M
Agricultural	75	$4.2M	$0.04M	$0.2M	$0.4M
Religious	34	$22.4M	$0.2M	$1.1M	$2.2M
Government	14	$1.7M	$0.01M	$0.08M	$0.17M
Educational	12	$14.8M	$0.01M	$0.7M	$1.48M
Total					

Note: The building values shown do not include building contents; for the severe storm hazard, damage will generally impact structures such as the roof and building frame.

Based on the data indicated in Table 4-4-7, historic data indicates losses of approximately $1.6 million dollars per year have occurred in the past; this equals less than 0.05 percent of the total value of residential, commercial, and industrial building stock structural value. Therefore, the loss estimates of 1, 5 and 10 percent can be considered conservative estimates of anticipated future damage. An assessment on damage to critical infrastructure cannot be made due to the lack of readily available data on the valuation of this infrastructure. However, historical data such as the damage and repair to roadways is discussed above, as available.

Manufactured homes are particularly vulnerable to severe winter storms. Figure 4-4-4 shows the distribution of these types of homes in the Town of Clay.

Figure 4-4-4. Manufactured Homes in Study Area



Source: HAZUS-MH (FEMA, 2004); and Town of Clay Planning and Development (2005)

HAZUS-MH data indicates that there are approximately 831 manufactured homes in the Town of Clay, distributed as shown on Figure 4-4-4. Town of Clay Planning and Development indicates that there are nearly 500 manufactured homes located in the Casual Estates mobile home park along the Seneca River, with plans for this to increase to 735 units. The value of these homes is estimated at $33,000 each based on HAZUS-MH data; this equals a total exposed value of $27,390,000. One, 5, and 10 percent losses would equal: (1) $$273,900 (1 percent); (2) $$1,369,500 (5 percent); and (3) $2,739,000 (10 percent).

Another area that is vulnerable to a severe winter storm is the flood plain. At risk residential infrastructure are summarized in Section 4.4.1.4. Generally, losses resulting from flooding associated with severe winter storms should be less than that associated with a 100-year or 500-year flood. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time.

Additional Data and Next Steps

Although event data is available for a period of 10 years, location-specific data regarding damage has not been tracked and correlation to specific infrastructure and inventory areas is not possible because winter storms can impact any portion of the study area. Based on currently available data, modeling of future losses would only be possible for total losses and would have a large margin of uncertainty given the currently available data. However, the exposure assessment discussed above identifies vulnerable populations and infrastructure of particular concern for this hazard. Conservative estimates of potential

losses based on "percent of damage" assumptions also are provided in the tables in this section as a guide for planning mitigation options.

As additional valuation data for critical infrastructure and area of impact is obtained, the data in HAZUS-MH can be modified to include the valuation data. This would support estimates of potential exposure and damage for critical facilities.

Additional data could include the collection of cost data from federal and state agencies on the valuation of roadways, bridges and other critical infrastructure. Standard valuation data is available from a variety of public and private sources. For example, if the average cost of a roadway mile, railway segments, and categories of schools, nursing homes, or potable water treatment piping were identified, the assets value could be calculated based on this information. Resources for obtaining this information include but are not limited to the Federal Highway Administration, RS Means, DOT, GSA, and NYSDEC. Also, the study area representatives will track more specific event and loss data to support the identification of particular assets of concern.

Because historic data on losses will not be adequate to predict specific losses to inventory, the percent of damage assumption methodology employed for general buildings and mobile homes in this section can be applied to infrastructure and critical facilities, when valuation data is available. This methodology is based on FEMA's How To Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA 2004).

Overall Vulnerability Assessment

Severe winter storms are common in the study area, often causing significant impacts and losses to the Town of Clay and the town's roads, structures, facilities, utilities, and population. Existing and future mitigation efforts should continue to be developed and employed that will enable the study area to be prepared for these events when they occur. The cascade effects of severe winter storms include utility losses and transportation accidents and flooding. Losses associated with the flood hazard are discussed earlier in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding related to ice jams or rapid snow melt.

4.4.1.3 Ice Storm

Ice storms are of significant concern to the Town of Clay due to the frequency and magnitude of these events in the region, the direct and indirect costs, delays, and impacts on the people and facilities of the region related to snow and ice removal, health problems, cascade effects such as utility failure, flooding from ice build up, and stress on community resources.

Data Collected and Used

National weather databases, the Town of Clay, and jurisdictional data were collected and analyzed. Data on property damage and loss, and injuries and deaths, was collected for Onondaga County from NOAA's NCDC website. This data was used to support an evaluation of past losses and potential future exposure to this hazard.

Exposure and Loss Estimation

Ice storms often results in increases in traffic accidents; disruptions in transportation, commerce, government, and education; utility outages due to falling trees, branches, and other objects; personal

injuries associated with slippery surfaces and freezing temperatures; and numerous other problems. Specific damages associated with ice storms in the study area include the following primary concerns:

- Injuries, including fatalities, associated with accidents, low temperatures, power loss, falling objects, and frozen and slippery surfaces
- Increases in the frequency and impact of traffic accidents, which result in personal injuries
- Ice-related damage to trees, building and infrastructure inventory, and utilities (power lines, bridges, substations, etc.)
- Ice build ups that cause localized flooding and resultant traffic problems
- Roads damaged through freeze and thaw processes
- Stress on the local shelters and emergency response infrastructure
- Lost productivity that occurs when people cannot go to work, school, or stores due to inclement conditions

The climate of the Town of Clay is such that no areas are immune to the potential damaging effects of severe winter storms and ice storms. Although ice storms are known to occur independently, they often occur concurrently with the severe winter storm (snow) hazard events (for example, freezing rain and ice, combined with snow) and data specifically recorded for "ice storms" does not represent all winter storms that include ice (rather it represents storms that are primarily ice-related). Also, limited damage data is available for the ice storm hazards, where they are recorded.

Historic information is sufficient from the NCDC to perform rather crude statistical modeling of the frequency of ice storms in the Town of Clay. Data on ice storm events is only readily available from NCDC for the years since 1993. Only a few ice storms of note have occurred during that period. Based on this limited data, the statistical power of a test to predict storm occurrence and associated losses would be low. In addition, data acquired to this point is insufficient to predict the vulnerable areas and future losses at this time. Based on the available data, it is reasonable to assume that several ice storm events of varying severity will occur within each 10-year period in the Town of Clay. The entire Town of Clay is vulnerable to this hazard.

Property Damage - As presented in Figure 4-2-2 in Section 4.2, historic data for ice storm events indicate that between 1993 and 2004, 20 ice storm events were recorded. This indicates that an average of 2 such events occur each year. Damage data for these storms is provided in Table 4-4-8, as available.

Accidents, power outages, school closures, the need for shelters, and roof collapses may be associated with some of the events. The number of accidents is significantly impacted by the timing of the ice storm (during commuter hours, on a holiday, etc.) and the timing of the event in the season (with more accidents earlier in the season and later accidents reduced as people remain at home). The number of events and dollar events report for Onondaga and surrounding counties are significant. Based on the number of events of significance in some years were the reported damages are $0, it appears that actual damage costs may be reported in an unsystematic, manner and that losses to property are potentially higher than shown.

Population Impacts – As discussed above, some traffic accidents, shelter needs, and power outages have impacted the Town of Clay in the past 11 years. No reported injuries or deaths have been recorded in the materials available for review.

Populations considered most vulnerable to ice storm impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 4-4-9 summarizes the population over the age of 65 and living in households with an income below $20,000 per year. Figures 4-4-5 and 4-4-6 show the distribution of these populations.

Table 4-4-8. Ice Storm Events in Onondaga County and Surrounding Areas

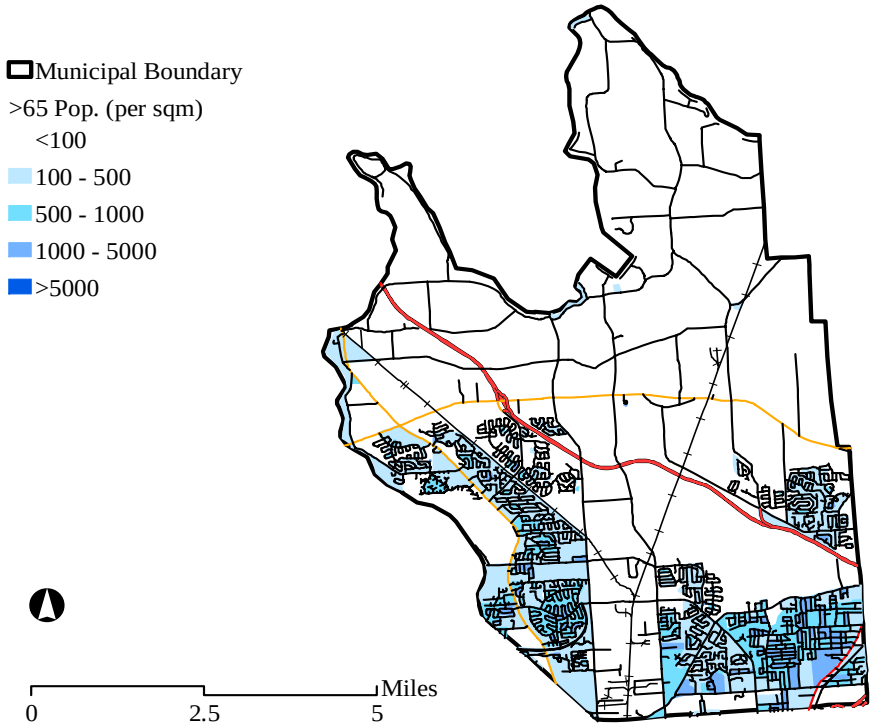
Heavy Snow Events	Year	Recorded Damages (Property)	Comments
0	1993 to 1998	$0	No specific events recorded in NCDC NOAA database of storm events (ice events or winter storm events). Some freezing rain included with earlier winter storm events (snow) (see Section 4.4.1.2).
3	1999	$0	One ice storm and two "winter storm" events occurred in January started with a mixture of snow, sleet and freezing rain. Snow accumulation was relatively minor but the freezing rain resulted in significant icing. Ice accumulations to nearly one inch occurred over parts of the area, downing trees and power lines. Some power outages occurred in other counties and driving conditions were treacherous for the first January event. The second included snow, followed by ice, followed by snow and also included dangerous travel conditions. The third event included ice, 1o to 13 inches of show (Syracuse Airport), and low temperatures (below zero in the area).
2	2000	$0	One ice storm is reported for February and included a storm from the Ohio Valley with significant Gulf moisture. Ice accumulations of about 0.25 inches were observed in the area. Numerous automobile accidents occurred but no major injuries were reported. Many area schools were closed or delayed. One winter storm and one ice storm occurred in December, with both including some snow and ice.
0	2001	$0	No specific events recorded in NCDC NOAA database of storm events (ice events or winter storm events). Some freezing rain included with earlier winter storm events (snow) (see Section 4.4.1.2).
1	2002	$0	One winter storm in February 2002 included a mixture of rain, freezing rain, snow, and sleet. Ice accumulations of up to 0.5 inches were reported. No accidents or injuries reported.
4	2003	$155,660 (Clay), $28.5 million (area)	The NCDC NOAA database and Town of Clay documentation record an event in April 2003 that included accumulation of ice in the area up to 0.25-1 inch and snow in some areas. In the Town of Clay, impacts were significant and included: opening of the Elmcrest School Shelter, power outages for up to 6 days, and a disaster declaration (NYS Disaster Declaration for 13 counties, and Presidential Declaration for 5 counties, including Onondaga). The property reimbursement received by the Town of Clay is indicated though total damages may be higher than the reimbursed amount.
0	2004	$0	No specific events recorded in NCDC NOAA database of storm events (ice events or winter storm events). Some freezing rain included with earlier winter storm events (snow) (see Section 4.4.1.2).
10	11 yrs.	$2.6 million/yr.	Reflects the average loss per year for a large-scale area, including the Town of Clay, based on the reported damages listed in the table and one major event in 2003.

Notes: Recorded losses indicate the values shown on the web site for Onondaga and other surrounding counties impacted. Some freezing rain and ice impacts also are captured by the heavy snow event data presented in 4.4.1.2 as these events often occur concurrently. Winter storms and ice storms are shown above. The reported damages are shown but may not represent total losses. Source: NOAA NCDC Storm Event Database (accessed on May 13, 2005) and Town of Clay Documented Disasters (provided to Tetra Tech)).

Table 4-4-9. Population in Town of Clay Exposed to Ice Storm Events

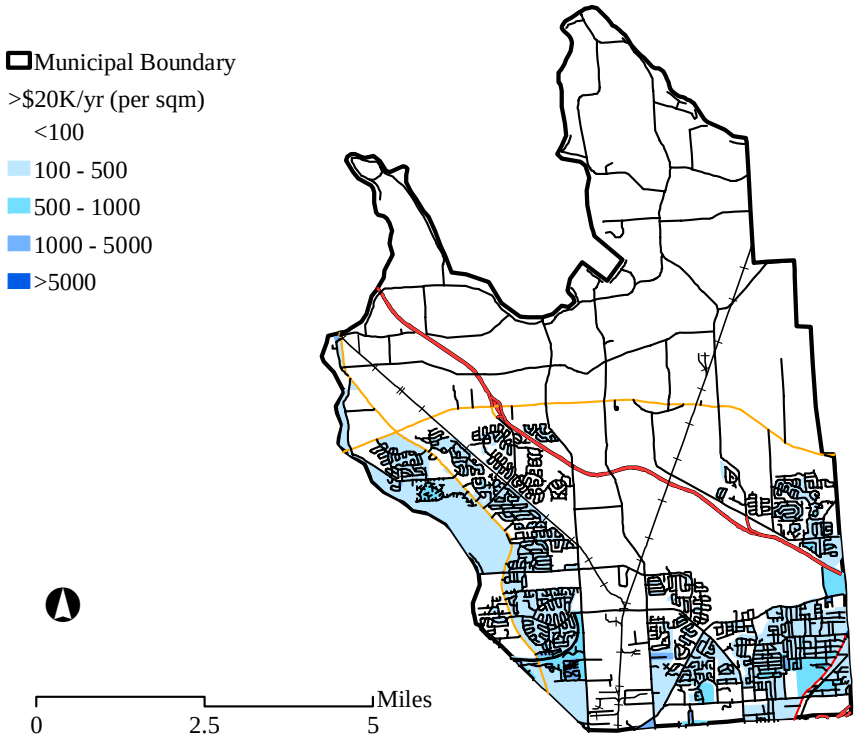
Population Category	Number of Persons Exposed
Elderly (Over 65 years of Age)	5,472 (9.3 % of total population)
Low Income (Persons living in households with annual incomes less than $20,000)	2,885 (4.9% of total population)
Total Population (includes categories above)	58,000

Figure 4-4-5. Distribution of Elderly Population for Study Area



Source: HAZUS-MH (FEMA 2004)

Figure 4-4-6. Distribution of Populations with Income Less Than $20K/year for Town of Clay



Source: HAZUS-MH (FEMA 2004)

The entire inventory in the Town of Clay study area is vulnerable to an ice storm. Table 4-4-10 identifies the building count and valuation of this inventory as well as the losses that would result from 1, 5, and 10 percent damage to this inventory as a result of a severe winter storm.

Table 4-4-10. Inventory of General Building Stock and Potential Damage Associated with Ice Storm Events

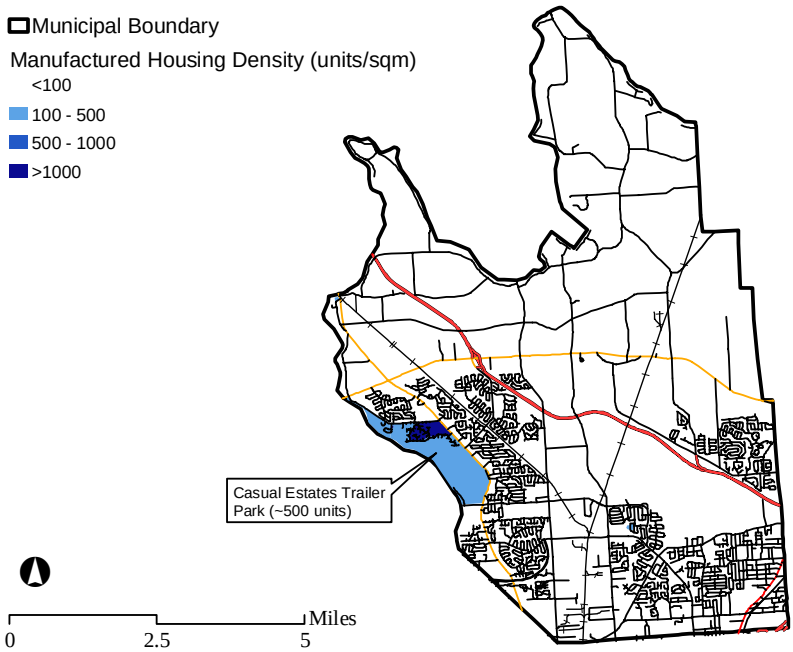
Building Occupancy Class	Number of Buildings	Total Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	17,162	$2.92B	$29.2M	$146M	$292M
Commercial	215	$0.45B	$4.5M	$22.5M	$45M
Industrial	27	$80.2M	$0.8M	$4.0M	$8.0M
Agricultural	TBD	$4.2M	$0.04M	$0.2M	$0.4M
Religious	34	$22.4M	$0.2M	$1.1M	$2.2M
Government	1	$1.7M	$0.01M	$0.08M	$0.17M
Educational	16	$14.8M	$0.01M	$0.7M	$1.48M
Total					

Note: The building values shown do not include building contents.

Based on the data indicated in Table 4-4-10, historic data indicates losses of approximately $2.6 million dollars per year for a large (up to 13 county area) have occurred in the past; the only documentation of actual damage for the Town of Clay is the recorded reimbursement of $155,659 in 2003, when a state and presidential disaster declaration resulted in Onondaga County. This equals a non-significant percentage of the total residential, commercial, and industrial building stock structural value. Therefore, the loss estimates of 1, 5 and 10 percent can be considered conservative estimates of anticipated future damage. An assessment on damage to critical infrastructure cannot be made due to the lack of readily available data on the valuation of this infrastructure. However, historical data such as the damage and repair to roadways is discussed above, as available.

Manufactured homes are particularly vulnerable to ice storms. Figure 4-4-7 shows the distribution of these types of homes in the Town of Clay.

Figure 4-4-7. Manufactured Homes in Study Area



Source: HAZUS-MH (FEMA, 2004); and Town of Clay Planning and Development (2005)

HAZUS-MH data indicates that there are approximately 831 manufactured homes in the Town of Clay, distributed as shown on Figure 4-4-7. Town of Clay Planning and Development indicate that there are nearly 500 manufactured homes located in the Casual Estates mobile home park along the Seneca River, with plans for up to 735 units. The value of these homes is estimated at $33,000 each based on HAZUS-MH data; this equals a total exposed value of $27,390,000. One, 5, and 10 percent losses would equal: (1) $$273,900 (1 percent); (2) $$1,369,500 (5 percent); and (3) $2,739,000 (10 percent).

Additional Data and Next Steps

Although event data is available for a period of 10 years, location-specific data regarding damage has not been tracked and correlation to specific infrastructure and inventory areas is not possible because ice storms can impact any portion of the study area. Based on currently available data, modeling of future losses would only be possible for total losses and would have a large margin of uncertainty given the currently available data. However, the exposure assessment discussed above identifies vulnerable populations and infrastructure of particular concern for this hazard. Conservative estimates of potential losses based on "percent of damage" assumptions also are provided in the tables in this section as a guide for planning mitigation options.

As additional valuation data for critical infrastructure and area of impact is obtained, the data in HAZUS-MH can be modified to include the valuation data. This would support estimates of potential exposure and damage for critical facilities.

Additional data could include the collection of cost data from federal and state agencies on the valuation of roadways, bridges and other critical infrastructure. Standard valuation data is available from a variety of public and private sources. For example, if the average cost of a roadway mile, railway segments, and categories of schools, nursing homes, or potable water treatment piping were identified, the assets value could be calculated based on this information. Resources for obtaining this information include but are not limited to the Federal Highway Administration, RS Means, DOT, GSA, and NYSDEC. Also, the study area representatives will track more specific event and loss data to support the identification of particular assets of concern.

Because historic data on losses will not be adequate to predict specific losses to inventory, the percent of damage assumption methodology employed for general buildings and mobile homes in this section can be applied to infrastructure and critical facilities, when valuation data is available. This methodology is based on FEMA's How To Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA 2004).

Overall Vulnerability Assessment

Ice storms are common in the study area, and may cause significant impacts and losses to the Town of Clay and the municipalities' roads, structures, facilities, utilities, and population. Existing and future mitigation efforts should continue to be developed and employed that will enable the study area to be prepared for these events when they occur. The cascade effects of severe winter storms include utility losses and transportation accidents. Losses associated with these hazards are discussed later in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms.

4.4.1.4 Flood

Flood is a significant concern for the Town of Clay, which has experienced significant flood events in the past and can be expected to experience additional floods in the future. The flood hazard exposure and loss estimate analysis is presented below.

A *flood polygon* is a GIS vector file outlining the area exposed to the flood hazard. HAZUS-MH generates this polygon at the end of the flood computations in order to analyze the at-risk inventory.

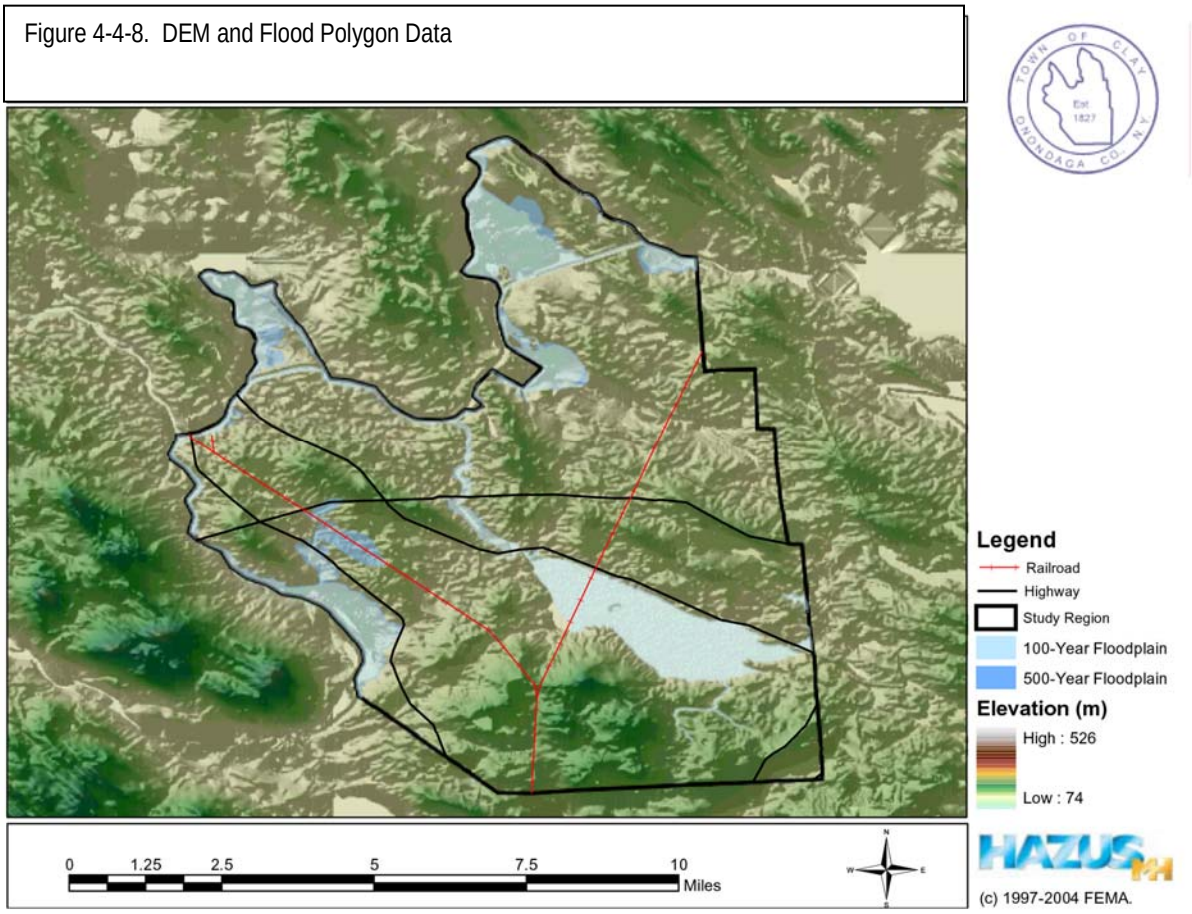
A *GIS shape file* is a type of GIS vector file that was developed by ESRI for its ArcView software. This type of file contains a table and a graphic. The records in the table are linked to corresponding objects in the graphic.

Data Collected and Used

Input data collected and reviewed for the flood hazard includes local damage data from historical flood events and FEMA Q3 flood polygon data, which delineate the 100- and 500-year flood plain boundaries. Population data were taken from HAZUS-MH and are based on the most recent census conducted in 2000 (FEMA 2004). General building stock data was used as provided in HAZUS-MH, supplemented by local data regarding critical facilities and lifelines.

The modeling approach used Q3 flood zone flood polygon data and U.S. Geologic Survey (USGS) Digital Elevation Model (DEM) data to estimate the base elevation. Given the size of the area of interest, a third-party tool, the HAZUS-MH flood macro was used to support analysis of the entire study area. Figure 4-4-8 shows the DEM and flood polygon data used to model the flood event.

Figure 4-4-8. DEM and Flood Polygon Data



The HAZUS-MH methodology was customized to analyze the flood hazard for the Town of Clay. Losses were estimated for a 100- and a 500-year mean return period (MRP) flood event. The 11 residential and 10 commercial occupancy classes available in HAZUS-MH were condensed into the following occupancy classes (residential, commercial, industrial, agricultural, religious, government, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single family dwellings. A FEMA third-party tool provided with HAZUS-MH, the flood wizard was then used to model the potential exposure and losses associated with the 100-year and 500-year flood events. In addition, impacts to critical facilities were evaluated for the 100-year and 500-year MRP flood events.

Exposure and Loss Estimation

The flood risk assessment was run using the HAZUS-MH Flood Macro, using FEMA Quality 3 (Q3) data. The following table presents the building stock exposure and estimated losses for the 100- and 500-year flood events are summarized in Table 4-4-11 below.

Table 4-4-11. Population in Study Area Exposed to the Flood Event

Population Exposed to 100-year Flood Event	Population Exposed to 500-year Flood Event
2,440	3,900

This indicates that 4 percent of the total population of 58,000 is exposed to the 100-year flood event and that 7 percent of the total population is exposed to the 500-year flood event. Exposure represents the population living in or near flood plain areas that could be impacted should a flood event occur.

Table 4-4-12 shows the number of buildings exposed to the 100- and 500-year flood events

Table 4-4-12. Estimated Exposure Number of Buildings Exposed to Flood Events in Town of Clay

Category of Building	100-year Flood	500-year Flood
	Number of Buildings Exposed	Number of Buildings Exposed
Residential Exposure (Single and Multi-Family Dwellings)	902	1,316
Commercial	14	16
Industrial	0	0
Agricultural	0	0
Religious	1	1
Government	0	0
Education	0	0
TOTAL AT-RISK	917	1,333

Table 4-4-13 shows the dollar value exposed in millions of dollars (M) for building structure, building content and total (structure and content) for the 100- and 500 year flood events.

Table 4-4-13. Estimated Value of General Building Stock Exposed to Flood Events for Town of Clay

Category of Building	100-year Flood			500-year Flood		
	Building Structure Value Exposed	Building Content Value Exposed	Total Building Value Exposed	Building Structure Value Exposed	Building Content Value Exposed	Total Building Value Exposed
Residential Exposure (Single and Multi-Family Dwellings)	$109.1M	$54.6M	$163.7M	$174.7M	$87.3M	$262.0M
Commercial	$20.4M	$21.5M	$41.9M	$23.6M	$24.8M	$48.4M
Industrial	$0.3M	$0.3M	$0.6M	$0.4M	$0.4M	$0.8M
Agricultural	$0.2M	$0.2M	$0.4M	$0.3M	$0.3M	$0.6M
Religious	$1.7M	$1.7M	$3.4M	$2.1M	$2.1M	$4.2M
Government	$0	$0	$0	$0	$0	$0
Education	$0.3M	$0.3M	$0.6M	$0.8M	$0.9M	$1.7M
TOTAL AT-RISK	$132M	$78.6M	$210.6M	$201.9M	$115.8M	$317.7M

Notes: M - Million. Dollars rounded to the nearest million (M). Estimate includes building and building content exposure.

Table 4-4-14 shows the dollar value estimated to be lost through floods in dollars for building structure, building content and total (structure and content) for the 100- and 500 year flood events.

Table 4-4-14. Estimated Damage to Building Stock Associated with Flood Events for Town of Clay

Category of Building	100-year Flood			500-year Flood		
	Building Structure Damage	Building Content Damage	Total Building Damage	Building Structure Damage	Building Content Damage	Total Building Damage
Residential Exposure (Single and Multi-Family Dwellings)	$726,300	$1,553,700	$2,280,000	$1,676,800	$3,581,000	$5,257,800
Commercial	$850,300	$611,100	$1,461,400	$2,327,600	$1,736,300	$4,063,900
Industrial	$4,700	$4,500	$9,200	$11,800	$11,500	$23,300
Agricultural	$5,600	$3,600	$9,200	$24,700	$18,800	$43,500
Religious	$17,700	$16,700	$34,400	$61,500	$56,900	$118,400
Government	$0	$0	$0	$0	$0	$0
Education	$26,000	$12,200	$38,200	$69,600	$35,200	$104,800
TOTAL DAMAGE	$1,630,600	$2,201,800	$3,832,400	$4,172,000	$5,439,700	$9,611,700

The total loss for the 100-year flood indicates that 1.8 percent of the total exposed building value could be impacted by the 100-year flood. Three percent of the total exposed building value could be impacted by the 500-year flood. Areas within the flood zone include Horseshoe Island, Wetzel Road, Foster Road, Riverview Road, Ethel Road and Riveria Drive where some properties are considered repetitive loss houses. These houses are at particular risk for a flood event. The two industrial parks are not located in the 500-year or 100-year flood zone which limits the industrial exposure and damage reflected above for the industrial category.

With respect to critical facilities in the Town of Clay, the only critical facilities within the floodplain are four wastewater facilities (one treatment plant (TP) and three pump stations (PS)). The calculated losses, by percent, were estimated as follows:

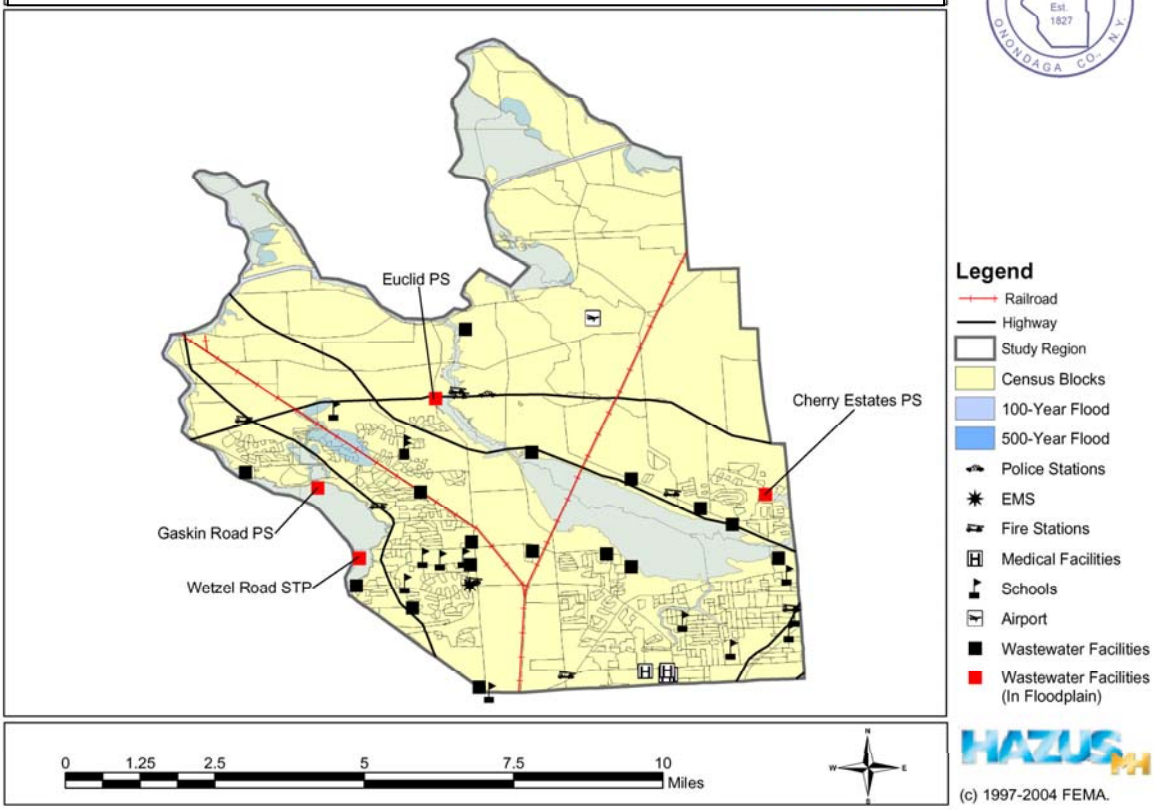
- The Gaskin Road PS is the most impacted station. The 100-year flood is estimated to cause 15% damage and the 500-year flood is estimated to cause about 25% damage.
- The Wetzel Road STP also is impacted with the 100-year flood causing about 9% damage and the 500-year flood causing about 11% damage.*
- The Cherry Estates PS and the Euclid PS were each damaged by the 100-year and 500-year flood (5% damage for 100-year flood and 8% damage for the 500-year flood event).

*It is noted that severe flooding in 1998 did not result in any damages to the Wetzel Road Treatment Plant. The Planning Group notes that the Wetzel Road plant is actually located on the only high ground within this portion of the flood plain.

The dollar value loss could be calculated using the actual value of these facilities and the estimated damage. However, for critical facilities such as PSs and TPs, the impact on function is the primary concern for a flood event.

The results of the flood estimate that other critical facilities and educational buildings are not exposed. Figure 4-4-9 shows the location of the flood zones in the Town of Clay relative to critical facilities.

Figure 4-4-9. Critical Facilities and Flood Zones



Over time, the Town of Clay will continue to work together to learn more about the flood hazard, enhance participation in FEMA's NFIP, and support further mitigation efforts as discussed in Section 5 to reduce the losses should future flood events occur. Refinement of floodplain maps and improvement of local

inventory data will support refined analyses using the flood model over time. Future evaluations may apply the HAZUS-MH model to study particular reaches of concern in greater detail. Also, the model may be used to estimate the impact of particular mitigation activities that could be implemented to reduce flood risk. Also, as new or refined flood maps are created and development and mitigation efforts occur, future evaluations will consider any changes to the flood loss estimates presented in this plan.

Overall Vulnerability Assessment

The flood hazard is evaluated as a significant threat, which can be managed and planned for through the mitigation strategy and specific activities outlined in Section 5.

4.4.1.5 Extreme Temperatures

Extreme temperatures generally occur for a short-term period and in the Town of Clay, tend toward extreme cold/wind chill events, rather than extreme heat events.

Data Collected and Used

Data used to assess the extreme temperature hazard include data available from NOAA NCDC, professional knowledge, data provided by the town of Clay, and available data from FEMA.

Exposure and Loss Estimation

Records from 1996 through 2004 included extreme weather events as summarized in Table 4-4-15.

Table 4-4-15. Extreme Temperature Events in Town of Clay and Surrounding Area (1996 to 2004)

Extreme Temp. Events	Year	Recorded Damages (Property)	Comments
3	1996	$0	Three events were recorded in 1996 for Onondaga County and surrounding areas. These occurred in January, May and October, and all were extreme cold events with no property damage, injuries or deaths noted. For one event, the temperature reached negative 15 degrees Fahrenheit.
0	1997 to 1999	$0	No events are documented in Town of Clay records or the NCDC database for this period.
1	2000	$0	One event was noted in September. A killing freeze occurred with temperatures below 30 degrees Fahrenheit.
1	2001	$0	One extreme heat event was noted for August, with days of high heat and temperatures at around 100 degrees Fahrenheit.
0	2002	$0	No events are documented in Town of Clay records or the NCDC database for this period.
1	2003	$0	One extreme cold/wind chill event was noted in March.
2	2004	$400,000	The NCDC NOAA database lists two extreme cold/wind chill events with high winds including winds up to 25 miles per hour. These occurred Wind chill temperatures reached 20 to 40 below 0 Fahrenheit. Scattered pipe freezing was noted at residences and businesses.
8	9 yrs.	$44,444/yr.	Reflects the average loss per year for a large-scale area, including the Town of Clay, based on the reported damages listed in the table.

Notes: Recorded losses indicate the values shown on the web site for Onondaga and other surrounding counties impacted.
Source: NOAA NCDC Storm Event Database (accessed on May 13, 2005) and Town of Clay Documented Disaster (provided to Tetra Tech).

The table above illustrates that extreme cold events are more common than extreme heat events in the period for which data are available. Through May 2005, 5 additional events are noted (all extreme cold/wind chill) with no property damage noted.

According to available data, the highest temperature recorded for the area (Syracuse) occurred in 1936, with a temperature of 102 degrees Fahrenheit. The lowest temperature recorded is noted in 1966 and was negative 26 degrees Fahrenheit.

The entire area of the Town of Clay is exposed to this hazard. Populations at particular risk to extreme cold and heat events can include the elderly, who are less able to withstand temperature extremes, and low-income persons, which can not afford proper heating or cooling. Table 4-4-16 summarizes the population over the age of 65 and living in households with an income below $20,000 per year. Figures showing the distribution of these populations have been included with the winter storm (snow) and ice storm event hazards.

Table 4-4-16. Population in Town of Clay Exposed to Extreme Temperature Events

Population Category	Number of Persons Exposed
Elderly (Over 65 years of Age)	5,472 (9.3 % of total population)
Low Income (Persons living in households with annual incomes less than $20,000)	2,885 (4.9% of total population)
Total Population (includes categories above)	58,000

All of the building stock in the Town of Clay is exposed to the extreme temperature hazard. Based on available data it appears that extreme cold and extreme cold/wind chill events are more common than extreme heat events. Extreme cold events can damage buildings through freezing/bursting pipes and freeze/thaw cycles. Approximately $400,000 of damage from extreme cold/wind chill events are recorded for the Town of Clay and the surrounding area between 1996 and 2004. Due to a lack of data regarding past losses and the limited period for which data are available (1996 through 2004), it not possible to model or estimate potential future losses related to extreme low temperatures in a quantitative manner at this time.

Extreme heat events can result in drought and dry conditions that are conducive to fires if they occur over a prolonged period of time. However, such conditions are not anticipated to occur frequently in the Town of Clay based on its northern location and the data available to date. Due to a lack of data regarding past losses and the limited period for which data are available (1996 through 2004), it not possible to model or estimate potential future losses related to extreme high temperature events in a quantitative manner at this time.

Additional Data and Next Steps

Extreme temperature data appears to be somewhat limited for the Town of Clay and surrounding area. Although daily high and low temperatures are tracked by NOAA and other agencies, it appears that events qualifying as extreme are relatively rare in the area and when they do occur they do not extend for periods of time that would cause droughts or other major impacts.

The Town of Clay will track data on future events and obtain any additional information it can on past events, particularly in terms of any injuries, deaths, shelter needs, pipe freeze or other building damage

Overall Vulnerability Assessment

Overall, this hazard is considered to have potential impacts including injury, death and property damage. Such events appear to be relatively rare (extreme high temperature) to frequent (extreme cold events), with the planning group finding an overall “frequent” event rating (at least one event per year). The overall ranking for this hazard, tied to the vulnerability of the town to this hazard is moderately low.

4.4.1.6 Fire (Urban and Wild)

Urban fire is a concern wherever concentrations of population and buildings are present. The effects of urban fire can be significant, but are generally localized to one or two city blocks. Wildfires can impact a greater area, but in the Town of Clay, seasonal rainfall is generally adequate to prevent wildfire and areas of development in the Town of Clay generally are not located in wildfire hazard areas. However, increasing and planned development may increase the wildfire and urban hazards in particular towns within the study area.

Data Collected and Used

Data available regarding the fire hazard included input from town and county officials, the NOAA's NCDC database, Moyers Corner Fire Department, Town of Clay disaster data, and the HAZNY documentation for this area.

Exposure and Loss Estimation

NOAA's NCDC maintains records of wildfires in Onondaga County for the period since 1950. According to the NCDC website, no significant wildfires were reported for this period. The climate of Onondaga County is not conducive to large-scale drought and dry climate vegetation that are primary causes of the massive and highly destructive wildfires that occur periodically in the Western United States. No droughts are noted for Onondaga in the NOAA NCDC database.

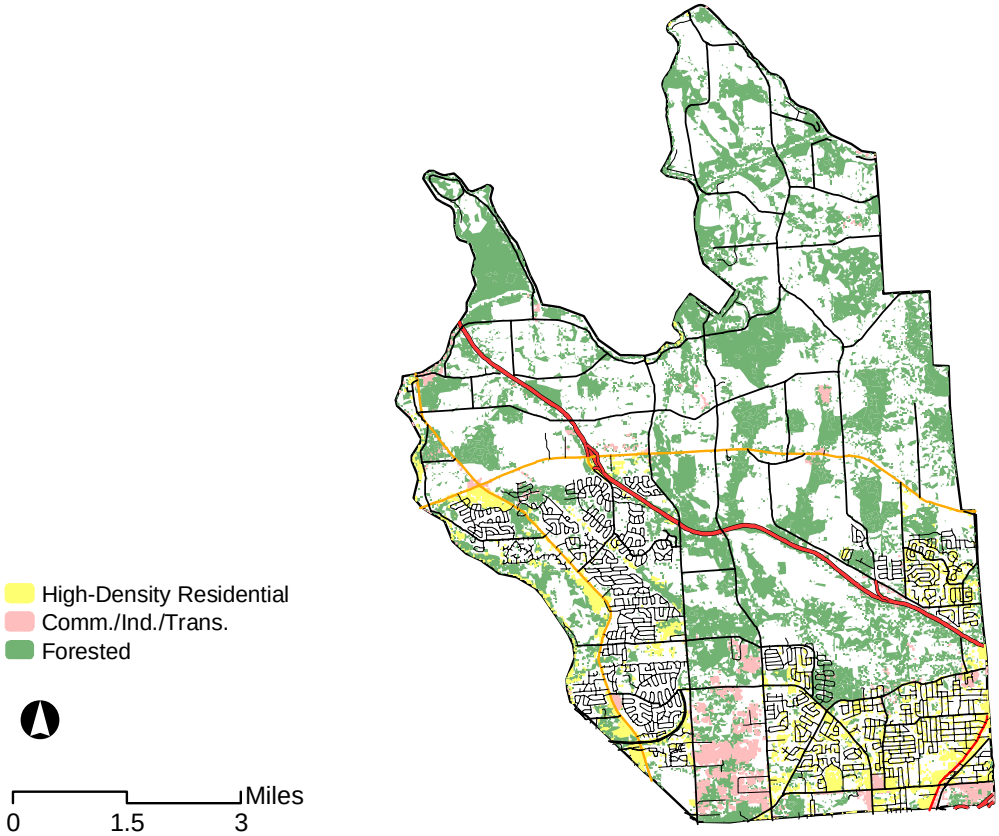
However, urban fires in developed areas of the Town of Clay do occur. Fire service is provided by the Moyers Corners Fire Departments, which serves approximately 80% of the town. Contracts with the Brewerton, Caughdenoy and North Syracuse Fire Departments provide fire protection service for the remaining 20% of the town. A vast majority of the town is serviced by the municipal water system, capable of meeting the water demands of fire-fighting. Fire department apparatus is current and meets ISO standards. Training is provided weekly by fire department instructors certified by the NY State Office of Fire Prevention and Control, and meets Public Employees Safety and Health Standards (PESH OSHA). The Onondaga County Fire Investigation Unit and the Town of Clay Police investigate all structure fires.

Data regarding how fire events are tracked, estimated damages that occur, and particular areas of vulnerability based on current water provision, fire response resources, and other factors have been requested from the local fire department representatives and will be included in revisions to this plan as they become available.

Urban areas have the potential for significant damage to infrastructure, loss of life, and strain on existing healthcare facilities and emergency responders based on high structural and population densities. Structural fires typically impact individual or closely clustered buildings. Building densities are included in Section 4.3 of this plan.

Wide-reaching woodland fires, though uncommon in the region, would be more likely to strike heavily forested areas during dry periods. Figure 4-4-10 shows areas exposed to potential fire, which included forested areas (more susceptible to wildfire) and commercial and residential development (more susceptible to urban fire.

Figure 4-4-10. Areas of Forested and Urban Land in Town of Clay



Source: NLDC, 2004

Urban fires occur occasionally in the study area; the effects are local (that is, generally constrained to a limited geographic area), but can be acute within the localized area (resulting in major or complete destruction of building structure or content). Losses and impacts to the structures, critical facilities, and utilities would be local and short in duration, though potentially could have a high impact on individual structures and facilities. Such fires also can result in injury and death. Existing and future mitigation efforts such as those presented in Section 5 should continue to be developed and employed so that the study area is prepared for these events when they occur.

Table 4-4-17 identifies the building value for the various occupancy classes in the Town of Clay, The average value for each type of building is also shown. Based on past experience, one to several buildings may be damaged in a fire event (urban), but more than 3 buildings are generally not impacted by a single urban fire event.

Table 4-4-17. Building Count and Total and Average Building Value (Content and Structure) Exposed to Urban Fire

Category of Building	Number of Buildings	Building Structure Value Exposed (Total)	Average Value or Each Building Exposed (Structure)
Residential	17,162	$2,920M	$170,143
Commercial	215	$450M	$2,093,023
Industrial	27	$80.2M	$2,970370
Agricultural	75	$4.2M	
Religious	34	$22.4M	$658,823
Government	14	$1.7M	$1,700,000
Educational	12	$14.8M	
Total	17,439	$3,493.3M	NA

Notes: M - Million. Dollars rounded to the nearest million (M). Estimate includes building and building content exposure.

Additional Data and Next Steps

Data regarding the construction characteristics of structures in the study area, such as primary building materials used (e.g., wood vs. brick, fire detection equipment, age, etc.), proximity to forested areas, and availability of fire suppression infrastructure should be identified for further evaluation. Due to insufficient data, a full loss estimate was not completed for the fire hazard. Based on all of the readily available information, all structures in the Town of Clay are at some risk of being destroyed or seriously damaged by a fire.

The percentage exposure estimate presented on the previous page is based on a methodology presented in FEMA's How To Series (FEMA 386-2), Understanding Your Risk, Identifying and Estimating Losses (FEMA 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA 2004). For the urban fire hazard it provides a conservative estimate. Another means to analyze this fire risk is to estimate the value of property on one city block. For example, a highly developed block would present a conservative, yet more realistic estimate of impact from an urban fire event (see Additional Data and Next Steps).

Once additional valuation data for critical infrastructures is obtained, including data for schools, nursing homes, and other infrastructure that may be located in the more densely populated areas of the multi-jurisdictional study area, the data in HAZUS-MH can be modified to include accurate local valuation data and can be used to estimate exposure for these assets.

The FEMA fuel model maps do not provide sufficient information to identify specific wildfire hazard areas to perform an exposure assessment for the urban-wildfire interface areas. Wildfire hazard maps were not readily available and will be required to identify the geographic locations where wildfires have taken place in the past and areas prone to wildfires. With increasing development near forest lands, a greater focus on the wildfire hazard may be warranted.

Overall Assessment

Buildings constructed of wood are generally more likely to be impacted by fire than buildings constructed with bricks or concrete. While it is not possible to predict when and where a fire will start, the Town of Clay fire departments are well-equipped and prepared to respond to fires as they arise. Large-scale wildfires are considered unlikely to occur in the area due to the amount of moisture stored in the vegetation, topography, and the amount of precipitation that the area receives annually. The status of fire risk in the county and municipalities will continue to be monitored and ongoing and new mitigation efforts to prevent fires and control them when they arise will continue to be developed. The overall ranking for this hazard, tied to the vulnerability of the town to this hazard is moderately low.

4.4.1.7 Infestation (primarily West Nile Virus-carrying mosquitoes)

Data Collected and Used

Hazard data was obtained from the planning group, HAZNY effort, and New York State Department of Health (NYSDOH) and Federal Centers for Disease Control (CDC) web sites. These sites indicate that the West Nile Virus is present in the area of the Town of Clay (see Section 4.2).

Exposure and Loss Estimation

Available information on areas at risk and past occurrences of WNV incidents are presented below. Table 4-4-18 presents documentation from state web sites for the years 2004 for Onondaga County in relation to the west Nile Virus.

Table 4-4-18. WNV Documentation for New York State and Onondaga County (2000 to 2004)

Year	WNV Positive Results for New York (State/ Onondaga County)				
	Live and Dead Birds	Horses	Mosquito Pools	Humans	Others
2004	207/7	5/0	238/0	10(0)/0	1/0
2003	1,368/36	32/0	471/10	71(1)/1(0)	3/0
2002	1,455/64	36/1	445/16	83(5)/5(0)	2/0
2001	803/28	22/0	316/0	15(2)/0	0/0
2000	1,277/0	28/0	400/0	14(Not listed)/0	23/Not listed

Notes: Data obtained from http://www.health.state.ny.us/nysdoh/westnile/ on the NYDOH web site. Data available for the years 200 through 2004. Data indicate the presence of the virus in specimens analyzed; they do not necessarily indicate ill or symptomatic specifies. Numbers in parentheses for humans indicate deaths.

Areas at risk include those areas including, and around swamps and ponds, as shown in Figure 4-4-11. Persons at risk could include those with lower resistance to diseases, including the elderly and children.

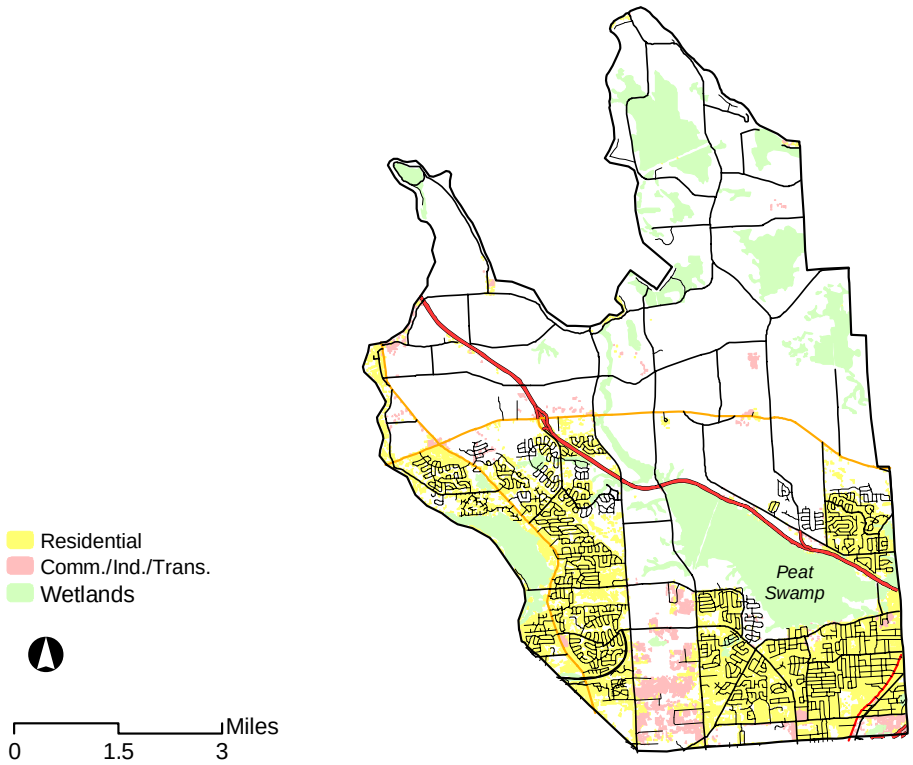
Additional Data and Next Steps

See text above for requested information. In addition, the Town of Clay will work with County, State, and Federal health officials to track statistics on future occurrences of disease and mitigation the potential for future infestations and impacts.

Overall Vulnerability Assessment

The overall vulnerability assessment will be presented after the risk assessment for this hazard is complete.

Figure 4-4-11. Mosquito Hazard Areas in the Town of Clay



4.4.2 Human-Caused Hazards

This section addresses hazardous materials at fixed facilities, the only human-caused hazards evaluated.

4.4.2.1 Hazardous Materials (fixed facility)

Hazardous materials (fixed facilities) include public, commercial, and industrial facilities that use hazardous materials to support operations. Examples can include: pools (chlorine), industrial facilities (a range of chemicals could be used), and other facilities. When events such as fires, flood, or spills occur, humans and the environment are at risk.

Data Collected and Used

For this hazard, data was obtained from the county and local town officials. These representatives work with the state and other agencies to track and report transportation incidents in the study area. New York Department of Motor Vehicle data and U.S. Coast Guard data also was obtained and reviewed. Data collected to date indicate that several HazMat facilities are located in the Town of Clay (see Section 4.3). This data and data from local fire departments and other emergency representatives will be used to further develop the exposure and loss estimation for this hazard.

Exposure and Loss Estimation

According to data collected to date, no local HazMat fixed facility incidents have occurred. Local data that would be useful would include:

- Local planning efforts
- HazMat facilities of particular concern
- Traffic routes at risk
- Impact of potential floods near HazMat facilities
- Other concerns (pipeline fixed locations) and others.

Additional Data and Next Steps

Tetra Tech is still compiling data to support risk assessment for this hazard.

Overall Vulnerability Assessment

Tetra Tech is still compiling data to support risk assessment for this hazard.

4.4.3 Additional Data Needs and Next Steps

Several areas were identified in the preceding sections for which additional data would be useful to model risk, vulnerability, and losses. These data and their potential sources and usefulness relative to specific hazards are presented in Table 4-4-19.

Table 4-4-19. Data Needs to Support Future Refinement of Loss and Exposure Estimates

Data Needed	Potential Source	Potential Usefulness	Hazard Evaluations Supported
Spatial and attribute information for overhead and underground utilities (age, type of equipment, past problems, proximity to facilities, etc.)	Private and public utilities, County and Town Public Works Departments	Evaluation of areas prone to power outages	Flood; Severe Storm (Including Hurricane); Severe Winter Storm; Ice Storm; Fire (Urban and Wild)
Cost and loss information pertaining to utility failure and blackouts	Private and public utilities, County and Town Public Works Departments	Modeling and estimation of future losses	Flood; Severe Storm (Including Hurricane); Severe Winter Storm; Ice Storm
Outage, replacement, and maintenance records for utilities (e.g., power lines, sewers, WTPs, etc.) infrastructure	Private and public utilities, County and Town Public Works Departments; County, State, and Federal Transportation Departments	Modeling and prediction of future utility failure events	Flood; Severe Storm (Including Hurricane); Severe Winter Storm; Ice Storm
Data on the location, severity (property losses, injuries, fatalities, etc.), frequency, and causes of traffic accidents	Transportation Departments, Public Safety Agencies (Police, Fire and Rescue, other); Insurance Companies	Modeling and prediction of future accident hazard areas, events, and losses	Severe Storm (Including Hurricane); Severe Winter Storm; Ice Storm;
Replacement value, expenditure, spatial, and maintenance records for transportation infrastructure (roads, bridges, rail lines, airports, etc.) and other critical inventory	Transportation Departments, County and Town Clerk and Treasurers, Public Works Departments	Modeling and prediction of future accident hazard areas, events, and losses	Severe Storm (Including Hurricane); Severe Winter Storm; Ice Storm;

Data Needed	Potential Source	Potential Usefulness	Hazard Evaluations Supported
Vegetation cover and attribute information for critical structures (locations, proximity to roads, homes, facilities, age, maintenance, etc.)	County, State, and Federal Environmental and Planning Departments; Land Use Departments	Modeling of potential power outages, problems, and disruptions due to falling trees and branches and better estimates of wind impacts	Flood; Severe Storm (Including Hurricane); Severe Winter Storm; Ice Storm; Fire (Urban and Wild)
Information regarding disease outbreaks and prevention measures (e.g., type and severity of disease, number of people affected, locations, international travel, response and controls, immunizations, cancer registries, losses, etc.)	County, State, and Federal Public Health Departments (e.g., Onondaga County Public Health Department, NYSDH, CDC, etc.)	Prediction of events and losses associated with future outbreaks and response	Infestation
Attribute and spatial information regarding critical facilities and vulnerable infrastructure (e.g., construction materials, security, number of people typically present, "importance" of resource, structural considerations, proximity to residential and economic centers, etc.)	County Assessor, Recorder, Treasurer, HAZUS-MH, land use planning agencies, etc.	Assessment of vulnerability to terrorism and other hazards not currently evaluated by HAZUS-MH	Fire (Urban and Wild);
Information regarding fires, emergency response, and Hazmat responses (e.g., type and severity of event, number of people and structures, affected, locations, response and controls, causes, losses, etc.)	County and Town Fire Marshall; Hazmat Teams; County, State, and Federal Environmental Departments	Assessment of vulnerability to fire and chemical release	Fire (Urban and Wild); HazMat (fixed facility)
Mapping and refined data on hazard areas and hazard factors (topography, landslide potential, aquifer characteristics, etc.)	County and Town Officials, State and Federal Agencies	Assessment of areas for mitigation and of areas of high exposure	Flood; Severe Storm (Including Hurricane); Severe Winter Storm; Ice Storm; Fire (Urban and Wild); Infestation