III. Hazard/Threat Profiles

St. Clair County

This chapter describes the potential hazards that could affect St. Clair County. It is important to note that the hazard rankings, describe the impacts a disaster could have during the planning, mitigation, response, and recovery cycle. In addition, probability of hazards as defined from past experiences is measured.

Boston Marathon Bombing on April 15, 2013. Source: International Business Times

Terrorism/Sabotage

Description

Terrorism is the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives. The threat of terrorism continues to receive significant media attention during the last few years. The September 11, 2001 terrorist attacks, along with Fort Hood shooting, and the Boston Marathon bombing in New York City, Washington DC, Texas and Boston, have heightened public concern and awareness about terrorism. On November 5, 2009, at Fort Hood near Killeen Texas, a shooting occurred killing 13 people and injuring over 30 people. On April 15, 2013, during the Boston Marathon, two pressure cooker bombs exploded at 2:49 pm, killing 3 people and injuring 264 others. The bombs exploded about 13 seconds and 210 yards apart, near the finish line on Boylston Street.

September 11, 2001 – Terrorists attack on the World Trade Center in New York City. Source: www.wordpress.com/2011/09/september-11-2001-world-trade-center.jpg

The effects of terrorism can vary significantly, from loss of life and injuries to property damage and disruptions in services such as electricity, water supply, public transportation, and communications. Terrorist attacks can take a wide variety of forms, and can affect a small area (e.g. a building), or a large area (e.g. disrupted services for an entire city). Historically, bombings have been the most frequently used terrorist method in the United States.

In NYC there have been many plot disruptions, including one in 2006, where eight suspects had hoped to pull off the attack in October or November, using suicide bombers who would attack train tunnels used by tens of thousands of commuters in an effort to bring death and flooding to lower Manhattan. Federal investigators intervened before the suspects could travel to the United States and become a more serious threat.

In May of 2009, four men placed what they believed were functioning bombs outside of Jewish targets in the Bronx neighborhood of Riverdale and additionally constructed plans to fire missiles at military transport planes at Stewart International Airport near Newburgh NY. The group was arrested and sentenced to a 25 year term. On May 1, 2010, a Pakistan-American residing in Connecticut, attempted to detonate a car bomb in Times Square. In October 2011, Umar Farouk Abdulmutallab, the so-called "underwear bomber" plead guilty in federal court in Detroit for trying to blow up an airplane carrying 290 passengers and crew on behalf of Al Qaeda. Since the 9/11 attacks, the FBI has worked hard to become an intelligence-driven organization capable of preventing the next terror attack. The FBI is using their growing suite of investigative and intelligence capabilities to neutralize terrorist cells and operatives here in the U.S.

The destruction left on the street after the Boston Marathon Bombing where 3 died and 264 were injured. Source: http://static.infowars.com/2013/4/i/general/bostonmar3.jpg

A terrorists attack in St. Clair County remains a possibility. The ability to identify and adapt to emerging threats is a critical component of the U.S. Homeland Security Strategy.

The FBI had defined domestic terrorism as "the unlawful use, or threatened use, of force or violence by a group or individual based and operating entirely within the United States or its territories without foreign direction committed against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." An estimated 10,000 to 100,000 people belong to right wing militia groups in the United States, but their level of involvement varies, and the extremist core of this movement is smaller.

Terrorism is difficult to rank due to the uncertainly of the type of attack, location(s), and lack of warning. One assumption is that such attacks would be targeted at population centers or specific government, transportation, or industrial facilities. Terrorism received a high hazard priority ranking because of its potential to affect a large population, its potential for causing casualties, its impact on the environment, and the potential for causing corollary effects or other hazards.

Frequency

It is difficult to establish a frequency for terrorist activity in St. Clair County based on historical events. Acts of domestic terrorism and/or sabotage in St. Clair County history include a mail bombing; a foiled plot for a large-scale, premeditated school massacre; and a series of pipe-bombings in the southern part of the county. Despite a lack of established frequency for this hazard, it is somewhat likely to occur in the future.

"These terrorists kill not merely to end lives, but to disrupt and end a way of life. With every atrocity, they hope that America grows fearful, retreating from the world and forsaking our friends. They stand against us, because we stand in their way."

President George W. Bush, speaking on al-Qaeda, during his presidential address on September 11, 2001.

Health and Safety

Due to the nature of terrorist attacks, it is difficult to establish a death or injury rate from historical events. In considering the hazard's severity and magnitude, the attacker's choice of weapon is an obvious consideration. Even if weapons are not actually used, the threat of using weapons can create a state of anxiety that can lead to disorder.

Affected Areas

Possible attack targets are broadly characterized as including bridges, tunnels, freeways, airports, utilities, and chemical/industrial plants in St. Clair County area. Pipelines, water treatment facilities, sewer treatment facilities, and other public facilities also are potential targets. St. Clair County should also be cognizant of potential targets across the St. Clair River in Lambton County, Ontario, especially areas in and around the area known as "Chemical Valley."

Detailed information on this matter is law enforcement sensitive and homeland security sensitive and, therefore, is not available to the general public.

Economic Impact

It is difficult to determine the economic impact of terrorist acts. Given that terrorism can take many forms and have widely different consequences, there is potential for terrorist acts to cause great economic damage.

Critical Facilities/Services

Terrorist acts carried out on public infrastructure can directly impact the county's ability to operate essential facilities and provide services. Significant terrorist acts would require large-scale response from all levels of government.

Significant Past Occurrences

While no international terrorist attacks have occurred in St. Clair County, there have been a small number of domestic events or pre-events.

St. Clair Power Plant along the St. Clair River. Photo Source: St. Clair County Metropolitan Planning Commission.

- **August 22, 2013**: A man fishing in the Black River found a pipe bomb near the 6800 block of Norman Rd. in Grant Township. The object appeared to be a PVC pipe wrapped in a plastic bottle and taped with duct tape. The Michigan State Police bomb squad was called. They disarmed the bomb, which did contain explosive material. The incident remains under investigation.
- **In December of 2009**, Umar Abdul Mutallab, a Nigerian man attempted to detonate plastic explosives hidden in his underwear while on board Northwest Airlines flight 253, which was en route from Amsterdam to Detroit, Michigan. The 23 year old man pled guilty and was convicted in a U.S. Federal court. Umar Abdul Mutallab was sentenced to life in prison.
- **In December 2003**, the U.S. Coast Guard was called to investigate a floating barge near DTE Energy St. Clair County Power Plant in East China Township
- **In November 2001**, the St. Clair County Hazardous Operation Team became the only team ever directed by the state to respond to a Weapons of Mass Destruction (WMD) threat. This particular event was an anthrax scare in the Flint area that turned out to be a false alarm.

Infrastructure/Utility Failure

Description

Infrastructure failures are defined as loss of public or private utility infrastructure that causes temporary cessation of essential functions and/or services. The most recent example of this hazard was the electrical power outage that occurred on April 25, 2009, where at least 120,000 DTE Energy customers were without power due to some storms that knocked out a bunch of power lines. The outage lasted a couple of days for the area and the damage was extensive.

Public and private utility infrastructure provides essential life supporting services such as electric power, heating and air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation. When one or more of these independent, yet inter-related systems fails due to disaster or other cause – even for a short period of time – it can have devastating consequences. For example, when power is lost during periods of extreme heat or cold, people can die in their homes. When the water or wastewater treatment systems in a community are inoperable, serious public health problems arise that must be addressed immediately to prevent outbreaks of disease. When storm drainage systems fail due to damage or an overload of capacity, serious

flooding can occur. All of these situations can lead to disastrous public health and safety consequences if immediate mitigation steps are not taken.

St. Clair County's first responders and emergency management staff are trained to manage such events, by coordinating resources, response organization and assets, by collaborating with Federal and State officials, and communicating with the public through broadcast and print media.

Frequency

Although severe weather plays a vital role in causing electrical power and communication failures on a regular basis throughout the county, these failures are usually short in duration and limited to a specific area. Prompt response by the local utility companies to repair downed lines and broken poles as well as safety mechanisms in place at the generating and transmission stations help limit widespread disaster.

Health and Safety

Many types of infrastructure failure can lead to disastrous public health and safety consequences if immediate actions are not taken. Typically, it is the most vulnerable members of society, such as the elderly, very young, impoverished, and people in poor health, that are the most heavily impacted by an infrastructure failure. The availability of clean drinking water is crucial to the health and safety of the public. Water service interruptions can cause untreated or poorly treated drinking water to enter the water supply, resulting in boil water advisories. Power outages can be particularly dangerous during times of extreme heat or cold, especially since people rely on electricity to cool or heat homes.

Affected Areas

If the failure involves more than one system, or is large enough in scope and magnitude, whole communities and possibly even regions can be severely impacted.

Economic Impact

Economic impacts have the potential to be extremely devastating to businesses, local governments and the general public, and will depend greatly on the type and extent of the infrastructure failure.

Critical Facilities/Services

Infrastructure failures have great potential to result in damages, especially to critical facilities that provide essential services such as electricity and water and sewage treatment. Damages will depend on the type and extent of the failure. Loss of water or power services can make it difficult to operate other critical facilities such as schools, hospitals, government buildings, and businesses.

Significant Past Occurrences

- **June 29, 2013, Power Outage:** DTE is reporting 68,000 customers are without power after storms swept through metro Detroit. The hardest high areas are Northern Oakland County, Pontiac and the Thumb area.
- **June 25, 2012, Power Outage due to Utility Pole Fire:** Port Huron Township responded to a call for a utility pole fire in the 1600 block of Yeager Street causing power outages for the area. The fire department controlled the flames with an extinguisher until Detroit Edison Energy shut off power to the pole
- **February 20, 2011:** The Detroit Edison power plant in St. Clair observed sheen at an outfall, which resulted in a release of oil into the St. Clair River. The amount was unknown.
- **April 25, 2009, Power outage for St. Clair and Oakland County:** On April 25, 2009 Oakland and St. Clair County were without power due to a storm that knocked out a

During the Blackout of 2003, three major hub airports – New York's La Guardia and Kennedy airports, as well as Detroit International Airport – had only sporadic power through midday Friday, August 14th. About 400 flights were expected to be canceled, which created a jam that affected virtually all major airlines.

--CNN.com, August 15, 2003.

number of power lines. There were at least 120,000 DTE Energy customers without electricity in southeastern Michigan. The utility which has 2.2 million electricity customers in the state called in a repair crew to restore the power. The outage lasted a couple of days for the area and damage was extensive.

- **The 2003 blackout:** St. Clair County experienced a massive electrical power failure on Thursday August 14, 2003 at approximately 4:15 pm, along with much of the eastern United States, that lasted anywhere from 3-36 hours, depending on location. Some areas of the county experienced only periodic blackouts. A local State of Emergency was declared and much of the community had to significantly reduce or cancel all business activities.
- In recent years, there have been periodic blackouts in confirmed geographic areas of the county. There have also been occasional short-term shutdowns of water treatment plants due to hazardous materials incidents impacting St. Clair River, as well as intermittent sewer backups, water admin breaks, and telephone service interruption.

Hazardous Materials Transportation Incident

Description

Hazardous materials transportation incidents refer to uncontrollable releases of hazardous materials during transport, which pose a risk to the health, safety, property, and the environment (MSP/HSEMD). Hazardous materials are chemical substances that, if released or misused, can pose a threat to health or the environment. These materials come in many forms, such as explosives, flammable and combustible substances, poisons, and radioactive materials. Since their chemical properties vary significantly, an incident could be obvious (e.g., airborne plume, spill on the ground, bad smell) or not readily apparent (e.g., beneath the surface of the ground, no odor or color).

All uncontrolled release of hazardous materials during transport is capable of posing a risk to health, safety, property or the environment. All modes of transportation – highway, railroad, seaway, airway, and pipeline – are carrying thousands of hazardous material shipments on a daily basis through local communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency affecting many people. The U.S. Department of Transportation regulates the transportation and shipping of over 18,000 different materials. Areas most at risk are within a 1-5 mile radius of a major transportation route along which hazardous material shipments move.

Approximately 31,456 St. Clair County Residents live within a 200 feet buffer of an interstate highway or rail corridor. (2010 Census)

- 14,827 people live within a 200 foot radius of a railroad track.
- 6,582 houses are within a 200 foot radius of a rail road track.
- 7,139 people live within a 200 foot radius of a major interstate.
- 2,908 houses are within a 200 foot radius of a major interstate.

St. Clair County is particularly vulnerable due a hazardous material incident during transport due to its proximity to interstate transportation routes, its function as an international border crossing, its multiple shipping ports, and the large number of hazardous material shipments that occur on a daily basis.

Frequency

Approximately 46 ½ million pounds of chemicals move through the county each day by truck or rail. According to the U.S. Coast Guard National Response Center, there have been 11 vessel incidents and 5 mobile incidents affecting water since 2007. In addition, there have been 10 mobile hazardous material incidents that caused freeway shutdowns for longer than 3 hours, but less than 18 hours. As the county continues to develop and attract new business and industry, it is anticipated that the probability of occurrence for this hazard will increase.

An average of 200 garbage trucks from Ontario, Canada crosses the Blue Water Bridge each day and travel through St. Clair County on their way to landfills in Wayne County and Macomb County. These landfills take trash from Toronto, Ontario, as well as small amounts of sewage sludge. United States Customs inspectors have found medical waste and illegal narcotics in some of the trash shipments.

In early 2004, the federal government warned that more than half of the nation's 60,000 pressurized rail tank cars did not meet industry standard's, and they raised questions about the safety of the rest of the fleet as well.

HazMat Exercise in 2013. Source: St. Clair County Emergency Management

Health and Safety

Compared to fixed site hazardous material incidents in St. Clair County, transportation related incidents are more likely to result in death or injury. Drivers traveling behind trucks carrying hazardous materials or other waste products are subject to any materials that may be released or spilled from a truck. In addition, hazardous materials could potentially enter the air intake of other vehicles, which could cause serious or even fatal injuries.

Affected Areas

As mentioned in the Community Profile section of this plan, St. Clair County has 495 miles of county primary roads, 1,057 miles of county local roads, 260 miles of city streets and over 180 miles of state trunk lines. Major freight routes include interstate Highways 69 and 94, which traverse the county from the west and south merging in Port Huron before joining Canada's Highway 402. Although large scales off site impacts are not common with hazmat transportation incidents they are certainly possible within St. Clair County. Off-site impacts can include evacuation, closure or roadways, and environmental contamination.

There are also eleven commercial port facilities within the county along the St. Clair River, facilitating the transporting of goods within the greater St. Lawrence Seaway, and six crossings locations for the Blue Water Area.

Table 3.1: Crossings for the St. Clair River and Blue Water Area

Blue Water Crossings	Carries	Location
Harsens Island Ferry	M-154	Algonac, Michigan and Harsens Island, Michigan (crosses the North Channel of the St. Clair)
Russell Island Ferry	Passengers Only	Algonac, Michigan and Russell Island, Michigan
Walpole-Algonac Ferry	Cars and Passengers	Algonac, Michigan and Walpole Island, Ontario
Sombra-Marine City (Blue water) Ferry	M-29 and St. Clair Parkway	Marine City, Michigan and Walpole Island, Ontario
St. Clair Tunnel	Canadian National Railway	Port Huron, Michigan and Sarnia, Ontario
Blue Water Bridge	I-69, I-94, Highway 402	

Source: The Blueways of St. Clair www.bluewayofstclair.org

Economic Impact

The economic impact due to this hazard can be highly variable, especially when including in the costs of environmental remediation. According to the U.S. EPA Hazmat Response Team, costs for responding to a Hazmat incident can range from $1000 to $100,000. Costs to the public can include response efforts, commuter delays, and damage to transportation infrastructure. On July 19, 2012, a 110 foot dredge carrying between 1,500 and 2,000 gallons of diesel fuel capsized early in the morning, spilling many gallons into the lake. Refer to table 3-2, which depict the breakdown of costs from the incident.

Table 3.2: Breakdown of Cost for the "Arthur J." Dredge Sinking in Lake Huron

Jurisdiction	Date	Total Amount	Reason for Costs	Total
Burtchville Twp.				
Burtchville Twp.	7/19/2012	$2,106.67	Personnel Cost	$2,566.83
Burtchville Twp.	7/19/2012	$1,365.98	Other Costs	$1,365.98
Burtchville Twp.	7/19-31/2012	$10,125.00	Equipment Costs	$10,125.00
Total overall cost for Burtchville Twp.				**$14,057.81**
Fort Gratiot Twp.				
Fort Gratiot Twp.	7/19-31/2012	$2,562.32	Personnel Cost	$2,562.32
Fort Gratiot Twp.	7/19-31/2012	$4,200.00	Equipment Costs	$4,200.00
Total overall cost for Fort Gratiot				**$6,762.32**
Port Huron				
Port Huron	7/19-30/2012	$720.00	Equipment Costs	$720.00
Port Huron & Port Huron DPW	7/19-30/2012	$1,578.12	Personnel Costs	$1,578.12
Port Huron	7/19/2012	$1,074.15	Other Costs	$1,074.15
Port Huron DPW	7/19-23/2012	$101.93	Equipment Costs	$101.93
Total overall cost for Port Huron				**$3,474.20**
Marysville				
Marysville	7/19-8/11/2012	$2,611.12	Personnel Cost	$2,611.12
Total overall cost for Marysville				**$2,611.12**
St. Clair County Homeland Security Emergency Management				
SCC HSEM	7/19-8/23/2012	$6,649.76	Personnel Costs	$6,649.76
Total of overall costs for SCC HSEM				**$6,649.76**
St. Clair County Information Technology				
SCC IT	7/25/2012	$640.00	Equipment Cost	$640.00
Total of overall costs for SCC IT				**$640.00**
St. Clair County Administration				
SCC Admin	7/19/2012	$181.83	Personnel Cost	$181.83
SCC Admin	7/20/2012	$109.10	Personnel Cost	$109.10
Total of overall costs for SCC Admin				**$290.93**
St. Clair County Health Department				
SCC Health	7/19-8/7/2012	$5,440.17	Personnel Cost	$5,440.17
Total of overall costs for SCC Health Department				**$5,440.17**
St. Clair County Communication Support Vehicle				

SCC CSV	7/19/2012	$4,000.00	Equipment Cost	$4,000.00
SCC CSV	7/20/2012	$1,200.00	Equipment Cost	$1,200.00
Total of overall costs for SCC Communications Support Vehicle				**$5,200.00**
St. Clair County Hazmat				
SCC HazMat	7/19-21/2012	$11,992.00	Equipment Cost	$11,992.00
SCC HazMat	7/19-21/2012	$4,343.12	Personnel Costs	$4,343.12
SCC HazMat	7/19-21/2012	$1,642.32	Other Costs	$1,642.32
Total of overall costs for SCC Hazmat				**$17,977.44**
St. Clair County Marine Division				
SCC Marine Division	7/19-21/2012	$1,488.57	Personnel Costs	$1,488.57
SCC Marine Division	7/19-20/2012	$4,817.90	Equipment/Fuel Cost	$4,817.90
Total of overall costs for SCC Marine Division				**$6,306.47**
Total overall costs of Incident				**$69,410.22**

Breakdown of cost for the "Arthur J." sinking, Lake Huron, July 2012. Source: St. Clair County Emergency Management.

Critical Facilities/Services

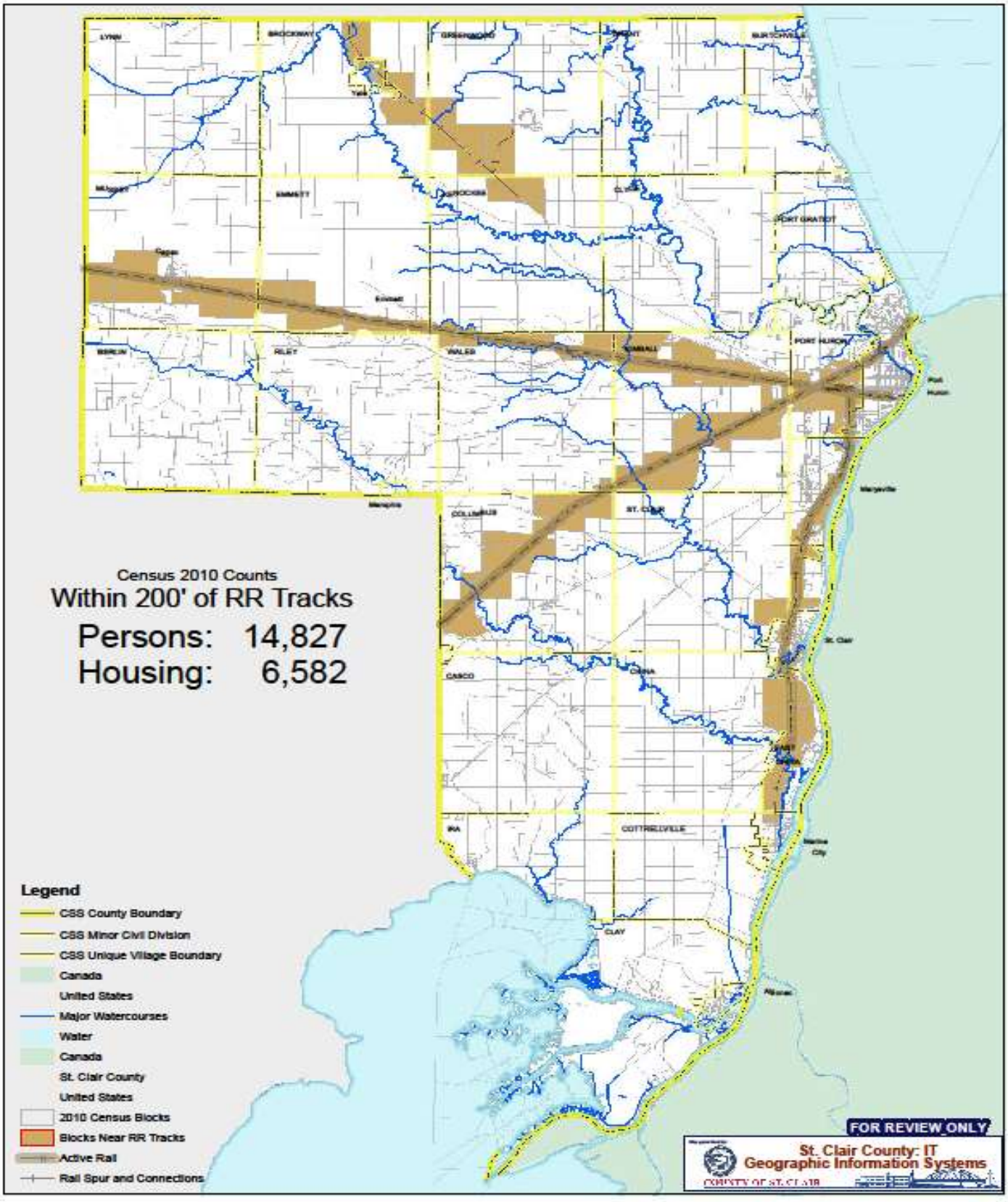
A significant hazardous material transportation incident can involve response efforts from a multitude of local agencies and county departments. Additional service outputs may be required for environmental remediation and restoring public confidence in the environmental health of the county.

Significant Past Occurrences

Notable hazardous material transportation incidents in St. Clair County include:

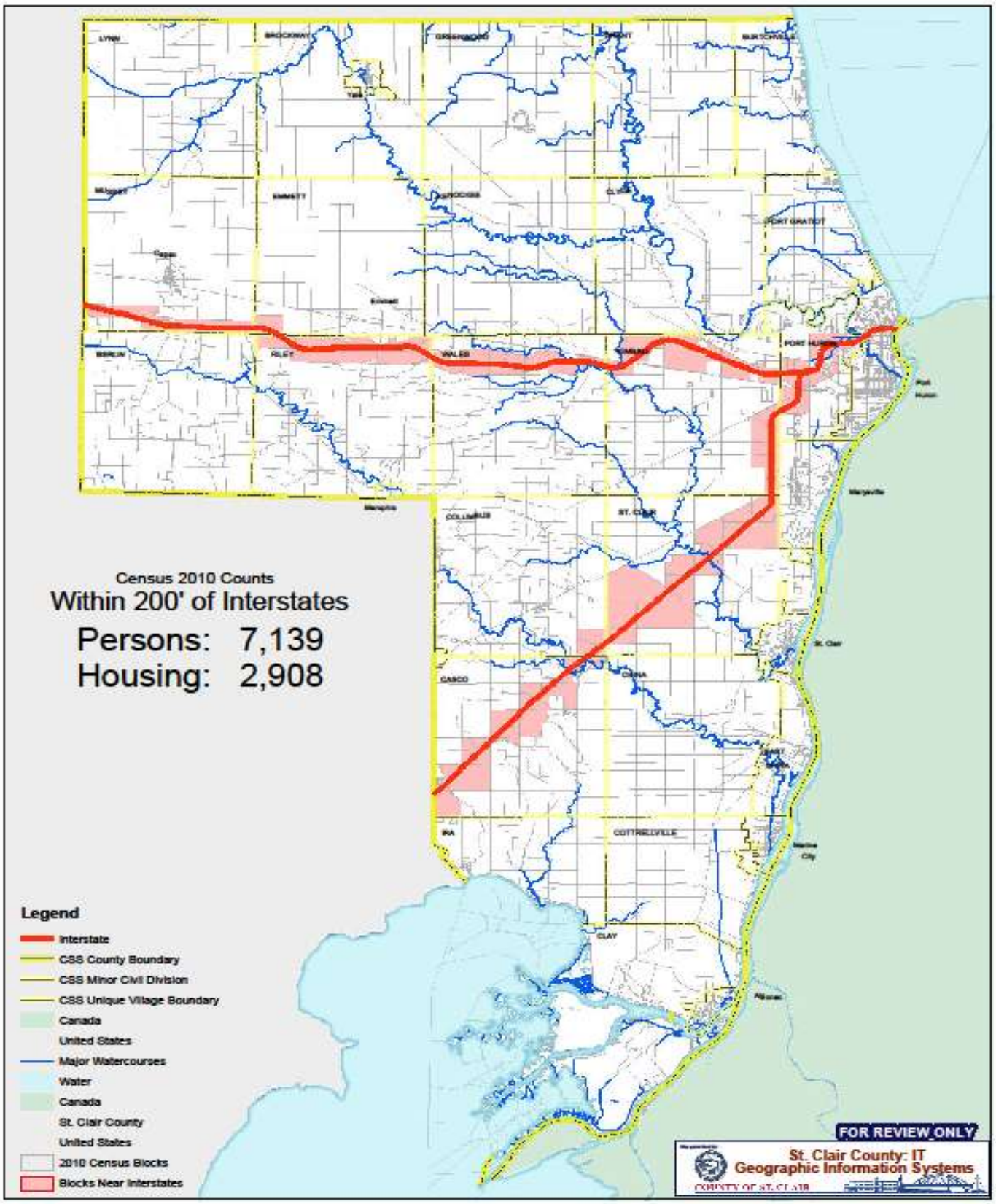
- **March 9, 2009:** Around 6:45 pm, a sunken vessel in the black river was reported; the vessel was leaking fuel and oil into the river. Sheen was reported seen on top of the water, 500 gallons of fuel and oil was aboard the vessel. The amount released into the river was unknown, and the local fire department responded and set a boom out to absorb the fuel and oil.
- **November 13, 2010:** A call was reported to the MDEQ about a sinking vessel in Black River. The vessel had approximately 10 gallons of fuel on board, which was released into the River. Sheen was seen on top of the river, booms were set out in the river to soak up the oil.
- **July 19, 2012:** A 110-foot dredge carrying between 1,500 and 2,000 gallons of diesel fuel capsized early in the morning, spilling many gallons of the fuel into the lake. The sinking took place about two miles off shore near Lakeport north of Port Huron. St. Clair County Emergency Management, St. Clair County Hazmat Team, St. Clair County Dive Team, the Burtchville Township Fire Department, U.S. Coast Guard and U.S. Army Corps of Engineers were on scene by mid-morning. By Friday July 20, 2012 the U.S. Coast Guard issued a press release saying all the fuel valves and vents connected to the fuel tank have been plugged. Refer to table above to show breakdown of costs in each Township.

Population near Active Railroads



Population of person's and housing near Rail Road's. Source: St. Clair County Geographic Information Systems.

Population near Interstate Highways



Population of people and housing within a 200 foot radius of a major interstate. Source: St. Clair County Geographic Information Systems.

Hazardous Materials Facility Incident

Description

Hazardous material incidents at fixed site facilities refer to uncontrollable releases of hazardous materials at a facility, which poses a risk to the health, safety, property, and the environment (MSP/EMHSD). The most well-known example of a large-scale fixed-site hazardous materials incident is that which occurred at the Union Carbide plant in Bhopal, India, 1984; this incident caused 2,500 deaths and injuries to many others.

Welding Fire in South Park, Source: St. Clair County Emergency Management

Hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other community facilities. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases. Hazardous materials are highly regulated by the government to reduce risk to the general public, property and the environment. Despite precautions taken to ensure careful handling during the manufacture, transport storage, use and disposal of these materials, accidental releases are bound to occur. Areas at most risk are within a 1-5 mile radius of identified hazardous material sites.

Frequency

According to the Michigan Department of Environmental Quality, there have been 61 incidents at fixed site facilities affecting water, 20 incidents affecting land, and 17 affecting air quality, since 2008. In addition, there have been 19 pipeline incidents and two storage tank incidents affecting water, land, or air. Between 2008 and 2013, there were 50 releases of toxic chemicals at St. Clair County facilities. However, between the years of 2008 to 2013, the number of releases has increased since 2000. The large number of chemical companies located across the St. Clair River in Sarnia, Ontario makes the county even more susceptible to hazardous material incidents. In addition, there are 29 pipelines traversing the county. In addition to toxic chemicals, Michigan Department of Environmental Quality also reported 5 incidents of Natural Occurrence Phenomena. A Natural Occurrence Phenomena is an occurrence of material, or foam on the water with no explanation or source.

Health and Safety

Hazardous material releases can cause severe harm to people or the environment if proper mitigation action is not immediately taken.

Affected Areas

Hazardous material incidents typically involve an uncontrolled release of material into the surrounding community and environment that may necessitate evacuations or in-place sheltering of the affected population. The impacts from industrial accidents are often confined to the site or facility itself with minimal physical outside impacts.

Given the diverse economy of St. Clair County, the potential for various types of hazardous material accidents exists in both urban and rural settings. The magnitude and severity of this hazard in urban settings can range from accidental industrial releases at large-scale manufacturing plants to localized incidents at retail business such as dry cleaners, gas stations, laboratories, etc. A similar potential for hazards exist in rural setting from accidents with agricultural chemicals.

Economic Impact

Industrial accidents can cause severe economic disruption to the facility and surrounding community, as well as significant, long-term impacts on the families of the workers injured or killed. The economic impact due to

fixed-site hazardous materials incidents can be highly inconsistent, especially when including the costs of environmental remediation. Some property damage from this type of event can be expected, especially if the release results in a fire or explosion. Additional impact, in the form of lost business revenue, can result if the incident causes a business to close.

Critical Facilities/Services

A significant fixed-site hazardous materials incident can involve response efforts from a multitude of organizations and county departments. Additional service outputs may be required for environmental remediation and restoring public confidence in the environmental health of the county.

Significant Past Occurrences

The deadliest industrial accident in Michigan history occurred on December 11, 1971 when an explosion tore through a tunnel being built in Fort Gratiot to carry cold, clear water from Lake Huron to Detroit and Flint. During the drilling process, methane gas had built up due to extensive drilling and poor ventilation and a massive explosion killed 22 men. The force of the blast shot debris up the 238-foot elevator shaft and another 150 to 200 feet into the air.

Notable fixed-site hazardous material releases into the St. Clair River include:

- **July 9, 2013:** Domtar Paper Company reported a leak of high PH waste water, leaking into the St. Clair River.
- **July 19, 2012:** The Smith Creek Landfill reported 100 gallons of partially treated leachate that was released into the Pine River. The leachate contained approximately 800 ppm NH3 and pH9. Cleanup was initiated the same day.
- **July 30, 2011:** Dunn Paper, which is located on the St. Clair River, reported 300 lbs. of paper released into the St. Clair River. The release happened due to a paper fiber that broke inside the mill. The Michigan Department of Environmental Quality received many complaints of large chunks of paper floating down the St. Clair River. Dunn Paper initiated the cleanup.
- **June 6, 2010:** The Sarnia Waste Water Treatment Plant reported an overflow of Hydro Carbon, the overflow was released into the St. Clair River on Canada's side. The overflow was 220 meters cubed in 7 minutes and was ongoing for 2 days at 43,000 cubed meters per day.
- **July 26, 2009:** the Sarnia Waste Water Treatment Plant reported a waste water leak into the St. Clair River. Primary and Treated UV waste water was leaking into the St. Clair River on Canada's side, due to a broken pipe. The cleanup was initiated by the Sarnia WWTP.

Sarnia, Ontario industrial park also known as Chemical Valley. Source: http://greatlakesenvironmentaljustice.wordpress.com/sarnia/corporate-presence/

Hazardous Material Water Incidents

"Arthur J." Barge, leaking over 1500 gallons of fuel into Lake Huron. Source: St. Clair County Emergency Management

Description

Hazardous material incidents related to water refer to the uncontrollable release of hazardous material that affects the bodies of water surrounding St. Clair County, which poses a risk to the health, safety, environment, along with marine life that lives in the surrounding water. St. Clair County's water resources are one of the most important assets to the community. Creeks, streams, drains and ditches stretch across St. Clair County and carry water to the Black River, Pine River, Belle River, Clinton River, St. Clair River, Lake Huron and Anchor Bay. Protection of these water resources is essential to quality of life especially as the county's population continues to grow. Development of land and the resulting increase in quantity and velocity of storm water can have degrading effects on water resources if measures are not taken to protect them.

The large number of chemical companies located across the St. Clair River in Sarnia, Ontario as well as St. Clair Counties own industrial park makes the county even more susceptible to hazardous material incidents that can have an effect on the county and residents. In addition, there are 29 pipelines traversing the county. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases.

In 2003, the United States Environmental Protection Agency implemented the Phase II Storm Water Rule which requires certain communities to regulate point sources that discharge pollutants into waters of the state. Individual homes do not need a permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface water.

A fundamental concept of watershed protection is cooperation across political jurisdictions in protection of land and water resources to achieve water quality goals. There is a growing emphasis in St. Clair County to manage our surface waters on a watershed basis; this shift in approach is referred to as Watershed Management and recognizes that working with the natural structure and function of resources will provide more successful results, as opposed to strictly political boundaries. St. Clair County is made up of six major watersheds: Anchor Bay, Northeastern Watershed, North Branch Clinton River, Belle River, Pine River, and Mill Creek, all of which are important water resources. St. Clair County is responsible for 20 public beaches and 9 private beaches, all of which are maintained by the Michigan Department of Environmental Quality.

"Arthur J." Dredge sinking, Lake Huron. Source: St. Clair County Emergency Management

To preserve the most valuable and primary resource, St. Clair County has determined goals to help protect the waters, these consist of:

- Improving the water quality of rivers, streams, and lakes while remembering that what we do in St. Clair County affects water resources downstream.
- Carefully manage storm water runoff and wastewater disposal in both urban and rural areas. Design storm drain systems to accommodate water quality control techniques, such as street sweeping, filtration, and siltation control mechanisms. Maintain storm water systems so they can handle maximum input and flow.

- Develop model storm water management ordinance and encourage local communities to also adopt it.
- Develop a groundwater model to increase awareness of groundwater characteristics and potential threats. Keep an up-to-date well log.
- Develop model groundwater protection ordinances and encourage local communities to also adopt them.
- Learn more about nonpoint source pollution. Remember that water runs downhill and everything applied to a lawn or property eventually flows or leaches into the groundwater or nearest surface water.

Frequency

According to the Michigan Department of Environmental Quality, there have been over 200 incidents with chemicals between the years of 2008 and 2013. Of which, 22 were related to pipelines, 35 directly related to fixed site incidents, 32 vessel incidents and 12_naturally occurring phenomena's of discharge into the lakes, rivers and streams. That is an average of a little over 60 chemical release incidents per year into the fresh waters of Michigan.

Health and Safety

Water is essential to our survival, without water, these and other resources will not exist as we know them. Water purifies air, moistens land, nurtures food – both plants and animals – and grows trees form which we attain principal building materials. Hazardous material releases can cause severe harm to people or the environment if proper mitigation action is not immediately taken.

Affected Areas

Hazardous material incidents typically involve an uncontrolled release of material into the surrounding community and environment that may necessitate evacuations or in-place sheltering of the affected population. The impacts from hazardous material into the waters can affect the community and population of St. Clair County.

Given the diverse economy of St. Clair County, the potential for various types of hazardous material accidents exists in both urban and rural settings. The magnitude and severity of this hazard in urban settings can range from accidental industrial releases at large-scale manufacturing plants to localized incidents at retail business such as dry cleaners, gas stations, laboratories, vessels, farms, etc. A similar potential for hazards exist in rural setting from accidents with agricultural chemicals.

Economic Impact

Chemical releases into the water can have severe economic effects on the community, environment and life within St. Clair County. The economic impact due to chemical releases into the water can be highly inconsistent, especially when including the costs of environmental remediation.

Critical Facilities/Services

A significant Hazardous Material Water incident can involve response efforts from a multitude of organizations and county departments. Additional service outputs may be required for environmental remediation and restoring public confidence in the environmental health of the county.

Table 3.3: Chemical Releases for 2012 and 2013

County	City	Date	Time	Chemical	Amount Released	Waterbody Affected
St. Clair County	Jeddo	2/18/2012	5:00 PM	Home Heating Fuel	200-300 Gallons	Birch Creek
St. Clair County	Port Huron	2/22/2012	7:00 AM	Paper Mill Chemicals	Unknown	Black River
St. Clair County	Port Huron	2/23/2012	4:25 AM	Hydraulic Oil	300 Gallons	Black River
St. Clair County	Port Huron	3/11/2012	4:22 PM	Wastewater	500 Gallons	Black River
St. Clair County	Marysville	4/16/2012	4:04 PM	Unknown (dark black)	Unknown	St. Clair River
St. Clair County	Port Huron	5/21/2012	10:40 AM	Paper Waste	Unknown	St. Clair River
St. Clair County	Marysville	6/7/2012	10:05 AM	Unknown (sheen on water)	Small amount	St. Clair River
St. Clair County	Port Huron	6/9/2012	10:15 AM	Gas & Oil	Unknown	Black River
St. Clair County	Port Huron	6/11/2012	5:00 PM	Chlorine	Range 100 Gallons	Lake Huron
St. Clair County	Port Huron	6/17/2012	5:36 PM	CSO-treated/UV Stabilized	Unknown	St. Clair River
St. Clair County	Marine City	6/15/2012	10:33 AM	Composite Leachate	Unknown	Marsac Creek
St. Clair County	Clay Twp.	6/22/2012	8:26 PM	JP-5 Jet Fuel	400 Pounds	St. Clair River
St. Clair County	Lakeport	7/19/2012	7:51 AM	Diesel Fuel	1,500 Gallons	Lower Lake Huron
St. Clair County	Smith's Creek	7/19/2012	4:50 PM	Treated Leachate	100 Gallons	Pine River
St. Clair County	Sarnia	8/18/2012	12:13 PM	Ethyl benzene	Unknown	St. Clair River
St. Clair County	East China	11/9/2012	8:47 AM	Oil Sheen	less than gallon	St. Clair River
St. Clair County	Port Huron	11/20/2012	8:50 AM	Wastewater	10,320 Gallons	St. Clair River
St. Clair County	Port Huron	1/30/2013	4:02 AM	Wastewater	300-350 Gallons	St. Clair River
St. Clair County	St. Clair	4/12/2013	9:20 AM	Oil	Unknown	St. Clair River
St. Clair County	Port Huron	5/28/2013	10:00 AM	Unknown Sheen	Unknown	Black River
St. Clair County	St. Clair	6/19/2013	9:00 AM	Dark Colored Muck	Unknown	St. Clair River
St. Clair County	Port Huron	7/9/2013	6:10 AM	High PH Wastewater	Unknown	St. Clair River
St. Clair County	Port Huron	7/18/2013	9:00 AM	Treated Effluent	Unknown	Black River

St. Clair County	Cottrellville	7/23/2013	6:10 PM	Unknown	55 Gallons	St. Clair River
St. Clair County Total Gallons of Chemicals					13,925 Gallons	

Chemical releases between the years of 2012 and 2013. Source: Michigan Department of Environmental Quality

Significant Past Occurrences

- **March 11, 2010:** Roadside ditch was reported for a leak into Mill Creek. It was found that 55 gallons of green liquid were dumped into the ditch connected to Mill Creek. St. Clair County Emergency Management was contacted and a Hazmat inspector was sent to the scene. It was found that 10-15 gallons of hydraulic oil were released into the ditch which then flowed into Mill Creek. Cleanup was initiated.
- **March 27, 2010:** Compass Pointe Marina it was reported that oil or fuel was released into the Swan Creek. After investigation it was found that it was left over from past incident, and it was released when the ice broke apart. Cleanup was initiated.
- **March 28, 2010:** A floating barrel was reported in the south channel of Harsens Island. The USCG dispatched pollution investigators and also contacted the Clay Township Fire Department who was the first on scene to investigate. Upon further investigation it was determined that the floating barrel was actually a piece of a depth gauge meter that had broken off and was floating downriver. It was likely a depth gauge that was placed into Lake Huron. It is unknown what type of product was in the gauge to cause sheen. The Fire Department was able to remove the gauge from the water and absorb the sheen.
- **October 9, 2010:** A natural occurrence phenomena was reported. Green foam along the shoreline of Lake Huron, however there was no known sources, and no explanation of the foam.
- **November 11, 2010:** A sinking vessel in the Black River was reported. The vessel was leaking gasoline into the river upon sinking. It was reported that approximately 10 gallons of gasoline were on board. Services were called for cleanup.
- **March 21, 2011:** It was reported that there was 100+ dead fish at the Kettlewell Pond. The cause was unknown and there was no sheen on water. I thought it to be a natural kill however the pond smelled like kerosene.
- **October 20, 2011:** Sheen on the Black River was reported. The sheen was approximately 1 mile in length, and had a rainbow color. The sheen was tested and it tested positive for oil. The quantity was unknown.
- **June 22, 2012:** At 8:10 pm, a U.S. Coast Guard helicopter was performing a search and rescue (SAR). The helicopter had to hover to perform the SAR and had to drop 400 pounds of JP – 5 Jet Fuel in order to hover at the required elevation due to the weight of the helicopter. Approximately 60 gallons of Jet Fuel was released into St. Clair River. Booms were set out to absorb the fuel.
- **July 18, 2013:** An Effluent pipe broke near 12th street and Kearny in Port Huron. The Mill shutdown around 10 AM, and personnel are digging up the street to find source of line break. Material released into water was treated effluent to Black River, not St. Clair River as authorized. The responsible party was Domtar Paper Mill located in Port Huron, who also initiated the cleanup and fixing the pipe.

Radiological Accident

Description

A radiological accident is an event that involves the release of potentially dangerous radioactive materials into the environment. This release is usually in the form of a cloud or "plume" and could affect the health and safety of anyone in its path. Radiological accidents can occur anywhere that radioactive materials are used, stored, or transported. A nuclear power plant, hospital, university, research laboratory, industrial plant, major highway, railroad line, or shipping yard could be the site of a radiological emergency. However, operations of facilities and the transport and disposal of radioactive waste are closely regulated by a variety of federal and local organizations, so the likelihood of an incident is remote. St. Clair County has two major highways running through it, as well as numerous freighters accessing ports along the St. Clair River.

Frequency

Medical facilities within St. Clair County have low levels of radiological materials located within their facilities. Truck transportation of low-level radioactive materials occurs on a frequent basis due to the county sharing an international border and being traversed by two major interstate freeways. However, no radiological accidents have occurred in St. Clair County. The Blue Water Bridge had radiation detectors installed in 2003. U.S. Customs officials turn away two to three Canadian trash haulers per week because of radioactive medical waste.

Health and Safety

This hazard ranked high because of the potential devastating effects to the population if there was an accident with a release. A radiological accident could result in radioactive materials becoming airborne. The severity of radiological contamination from such an event is directly proportionate to the type and amount of radioactive material released, weather conditions at the time of the release, and the location relative to wind direction following the release.

In 2012 a plan proposed to build a nuclear waste site on Lake Huron concerns many Michigan and Sarnia residents. Lake Huron sits to the north of Lakes St. Clair, Erie and Ontario and water of this lake flows southward and eastward, eventually connecting to the Atlantic Ocean through the St. Lawrence Seaway. The Great Lakes account for 21% of the world's fresh water resources, or a little over one fifth. The proposed site is to store nuclear waste almost a half mile underground which would be one and a half miles from Lake Huron. Many are concerned that the nuclear waste will leak into the Great Lakes which could cause many health and environment problems for the citizens of Michigan and Canada.

Affected Areas

State and local government implementation of protective actions, and other preparedness and response activities, are based on the Nuclear Accident Emergency Action Level Classification System. In most cases, the Primary Emergency Planning Zone (EPZ) around a nuclear power plant is 10 miles. Within this zone, plans are developed to protect the public through in-place sheltering and evacuation in the event of an accident. The area within the Primary EPZ for which protective actions are implemented will depend on the type and amount of radioactive material released and current weather factors. The secondary EPZ, consisting of a 50-mile radius around most nuclear plants, exists for planning considerations that prevent the introduction of radioactive contamination into the food chain. St. Clair County does not lie with a Primary EPZ or Secondary EPZ.

Economic Impact

Because the frequency of this event is low in the United States, it is not easy to ascertain the economic impacts. It is estimated that the impact could be very high, depending on the severity of the event.

Critical Facilities/Services

Response to radioactive release would likely involve multiple agencies and departments from all levels of government.

Public Health Emergencies

Description

Public Health Emergencies are defined as those that involve a widespread and/or severe epidemic, incident of contamination, or other situation that presents a danger to or otherwise negatively impacts the general health and well-being of the public. SARS, West Nile, pandemic Flu, and septic system failures are examples of public health emergencies that are of concern for county residents. Public health emergencies can occur as primary events by themselves, or they may be secondary events caused by another disaster of emergency, such as flood, tornado, or hazardous material incident. The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact a large number of people. Public health emergencies can be statewide, regional, or localized in scope and magnitude.

In particular the St. Clair County Public Health Areas of Concern include, but are not limited to:

- Threat of invasive species of pests, vermin, or disease.
- FDA/MDA Food Product Recalls that affect St. Clair County.
- Closure or disruption of basic critical public health infrastructure such as water treatment plants and power plants.
- Contamination of community and/or private water well systems due to flooding, system failures, or intentional acts.
- Foodborne outbreaks growing in size and scope due to mega food production, antibiotics resistance, global travel, and intentional acts.
- Incidents of vaccine preventable disease growing due to decline of participation in vaccination programs.
- Shortage of vaccines.
- Issues surrounding garbage trucks of unknown types of wastes and thousands of chemical transport vehicles.
- Residential exposure to chemical and air releases and no formal communication structure to assure effective and efficient to public health officials for public health surveillance purposes.
- Biological exposures have incubation period anywhere from six hours to six weeks depending on the pathogen. Thus, a ripple effect or scope of an infectious disease outbreak could affect dozens, hundred, or thousands of people.

The St. Clair County Health Department is ready for all potential disease threats and monitors unusual or suspect symptoms. The health department evaluates many factors in its response to a disease threat, including the mode of transmission, the route of entry, and the commonality of victims. Indicators of unusual disease activity include:

- Rapidly increasing disease incidence.
- Unusual increase in the number of people seeking care, especially with neurological, respiratory, dermal, and/or gastrointestinal symptoms.
- Higher attack rate among persons who had attendance at similar activities or events.
- Clusters of patients arriving from a single locale.
- Large numbers of rapidly fatal cases.
- Any patient presenting with symptoms and/or signs that suggest inhalation, ingestion, or dermal exposure to a toxic chemical agent.
- Increase utilization of hotlines, such as “Ask a Nurse” or “Poison Control.”
- Unusual age distribution for common diseases.
- Unexplained clusters of diseased or dead animals.
- Unexplained evidence of disease or toxic exposure to the general environment, such as trees or plants.

In terms of biological incidents, general objectives of the public health responder include alerting and educating the public; monitoring active and passive surveillance systems; determining whether more than one

agent is involved; isolating the "ring of exposure" as necessary; lab analysis; mass prophylaxis, vaccinations, antibiotics, acute care facilities; and coordination with enforcement and investigative authorities.

Biological agents of the highest concern include:

- **Smallpox (worst case scenario):** Smallpox is a serious contagious and sometimes fatal infectious disease. In the aftermath of the events of September 11, 2001, there is heightened concern that smallpox might be used as an agent of bioterrorism. For this reason, the U.S. government is taking precautions for dealing with a smallpox outbreak.
- **Anthrax:** Anthrax is an acute infectious disease caused by the spore-forming bacterium *Bacillus anthracis*. Humans can become infected with anthrax by handling products from infected animals or by inhaling anthrax spores from contaminated animal products.
- **Plague:** People usually get plague from being bitten by a rodent flea that is carrying the plague bacterium or by handling an infected animal. It is an infectious disease of animals and humans caused by a bacterium named *Yersinia pestis*.
- **Tularemia:** Tularemia is a potentially serious illness that occurs naturally in the United States. It is caused by the bacterium *Francisella tularensis* found in animals, especially rodents and rabbits.
- **Botulism:** Botulism is a rare but serious paralytic illness caused by a nerve toxin that is produced by the bacterium *Clostridium botulinum.* All forms of botulism can be fatal and are considered medical emergencies. Foodborne botulism can be especially dangerous because many people can be poisoned by eating a contaminated food.
- **Viral Hemorrhagic Fevers:** Viral hemorrhagic fevers (VHFs) refer to a group of illnesses that are caused by several distinct families of viruses. Generally, the entire vascular system is damaged, and the body's ability to regulate itself is impaired. These symptoms are often accompanied by hemorrhage (bleeding).
- Other new concoction, mutation, or combination of agents.

Frequency

In St. Clair County, there are as many as 50 to 100 FDA/MDA Food Product Recalls annually. Between 2006 and 2013, there has been an annual average of 650 cases of sexually transmitted diseases, an average of 60 cases of hepatitis, an average of 5,500 cases of influenza-like diseases, and an average of 112 suspected foodborne/waterborne diseases per year. Tables 3 and 4 depict a five-year trend of public health incidents in St. Clair County.

Table 3.4: Nursing Division, Average Confirmed Cases 2006-2012

Disease	2011
Aids/HIV Case Management Clients	60
Foodborne/Waterborne Diseases	112
Meningitis	15
Sexually Transmitted Disease Diagnosis and Treatment	650
Tuberculosis	0
Vaccine Preventable Diseases (VPD)	8410
Hepatitis (A, B, C, D, E)	60
Animal Bites	15
Pneumonia/Influenza	14
Other Diseases	12
Unusual Suspects	3

Table 3.5: Environmental Health Division Annual Averages, 2006-2012

Food Program	
Facility Inspections (routine)	1299
Follow-up Inspections (Compliance)	248
Plan Reviews (Compliance)	22
Phone Consultation (food safety)	155
Temporary Unit Inspections	230
Food Safety Training (in-service/classes)	70
Food Related Complaint Investigations	110
Foodborne/Waterborne Illness Complaint Investigations	112
Sewage/Wastewater Program	
Sewage Permits Issued	650
Sewage Site Inspections	1,500
Failed System Evacuated/Corrected	33
Complaint Investigations	222
Phone Consultations	30
County Landfill Inspections	
Landfill Inspections	15
Water Well/Drinking Water	
Well Permits Issued	360
Well Final Inspections	78
Abandoned Wells (Plugged)	22
Phone Consultations	25
Suspect Disease Exposure - Animals	
Dead Bird/site visit and pick-up	12
Phone Consultations (all types)	88
Water Treating (bacterial) # of Samples	
Water Wells and Pools	360
Enforcement or Warnings	125
Surface Water/Recreational Water	1,500
Enforcement or Warnings	25
Phone Consultations	134

Source: St. Clair County Health Department, 2011

Mass Casualty

Description

Mass casualty situations occur when the number of casualties exceeds the available medical capability to rapidly treat and evacuate them. In disaster relief operations and in the aftermath of terrorist incidents, mass casualty situations frequently occur. For example, a disaster that destroys a significant amount of property may result in a mass casualty situation even though the number of injured is relatively low. By destroying a significant number of the medical assets within the community, those injured cannot obtain care locally and, therefore, overwhelm the remaining medical assets. Mass casualty incidents are rare but are most likely to occur in transportation accidents. While mass casualty incidents are possible in severe weather, they are also rare.

Frequency

It is difficult to establish a frequency for mass casualty incidents in St. Clair County based on historical events since there have few occurrences to date. In July 1999, a beach 65-A90 aircraft crashed at the end of the runway at Marine City Airport, killing all ten people on board.

Health and Safety

Mass casualty situations are normally chaotic. Victims are in various stages of pain and distress. Casualties will range in age from infants to geriatric patients. Parents and loved ones may not want to be separated from the victim, even to permit the provision of medical care. Severity of medical conditions will vary relatively minor injuries to severe life-threatening trauma. Medical care provided may be complicated due to pre-existing medical conditions (disease, injury, or disability). New casualties will be arriving at hospitals or treatment facilities before the patients already on hand are treated. There may be uninjured persons looking for a family member, friend, or coworker; their search may be disruptive to the ongoing medical operation.

Affected Areas

Depending on the situation, a mass casualty event could impact a confined area of the county or the entire community. Even though an event takes place in one area of the county, other areas of the county may be utilized as treatment centers, transport stations, or in other capacities.

The county is home to numerous stadiums, especially near high schools, that can hold up to 11,000 people. In addition, there are cruise vessels that traverse county waterways often holding up to 600 people. Many of the communities within St. Clair County also hold fairs and festivals throughout the year.

Economic Impact

Mass casualty events could bring with them significant economic impacts. Roads and businesses could close. Numerous organizations may be required to provide facilities to serve as neighborhood emergency help centers, and public transportation services may be needed to transport patients and/or victims. Many volunteers may be needed which would take people away from their normal jobs.

Critical Facilities/Services

Mass casualty events would require a substantial amount of resources and assistance from multiple county agencies and departments as well as community partners such as the American Red Cross, transportation facilities, school districts, mental health agencies, pharmacies, animal health, stand-alone health and medical facilities and private practices.

Significant Past Occurrences

- **June 24, 1999:** Two 14 year old teenagers stood trial as adults for plotting to murder fellow students at Holland Woods Middle School. The teenagers planned to rob a gun store, then seize the school office, assemble students in the gym and massacre them. The pair was planning to massacre more people than the Columbine shooting. The father of a friend of one of the teenager boys secretly taped a phone conversation in which the boys were talking about their plan. After the boys were taken into custody a pipe bomb was found behind the Middle School, causing the school to close down for the day.

Damage from an EF-1 tornado, Fort Trodd Campground, Source: St. Clair County Emergency Management

Tornado

Description

A tornado is a violently rotating column of air extending from a thunderstorm to the ground. Tornadoes in the winter and early spring are often associated with strong, frontal systems that form in the central states and move east. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be excess of one mile wide and 50 miles long. Table 3 depicts the Enhanced Fujita scale for measuring tornadoes. In an average year, about 1,000 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries.

Property damage from tornadoes is in the hundreds of millions of dollars every year. Michigan averages approximately 18 tornadoes per year, most occurring in the southern Lower Peninsula.

Frequency

Twenty one tornadoes have been reported in St. Clair County since 1950, including two F-4's, two F-3's, and two F-2's tornadoes. The strongest tornadoes in St. Clair County since 1950 occurred in 1953. Both tornadoes reported during that year were categorized as EF4 (out of 5) on the Fujita scale. The first, on 5/21/53, developed near Smith's Creek and moved just south of Port Huron before it passed into Ontario. In St. Clair County, 2 persons were killed and 68 injured as 90 houses and 83 other buildings were destroyed. 300 houses and 124 other buildings were damaged. At its widest, the tornado was nearly a mile wide.

The second EF4 occurred on 6/8/53, from the same storm system as the well-known Flint-Beecher tornado. The tornado developed near Kings Mill in Lapeer County and moved east-northeast into St. Clair County, passing north of Yale, south of Jeddo, and north of Lakeport. Though no deaths were reported with this tornado in St. Clair County, one person was killed in Lapeer County. In St. Clair County, 23 injuries were reported. This tornado had a mean width of nearly 1/2-mile.

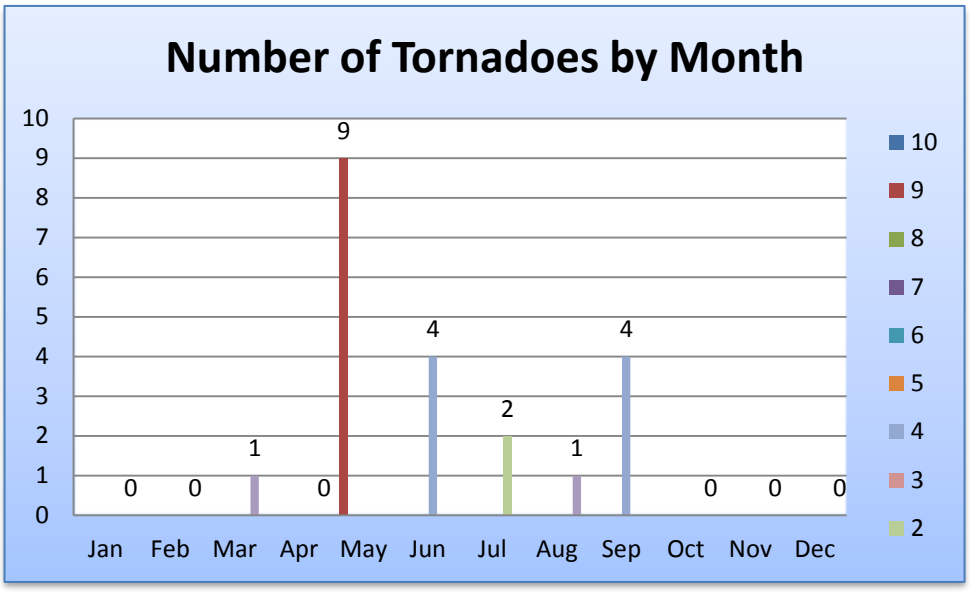
The most damaging tornado in St. Clair County since 1950 occurred on 5/2/83. This tornado was an EF3, and tracked from East Detroit across Lake St. Clair and Harsens Island. On Harsens Island, the tornado destroyed an aircraft hangar and another large building, and damaged or demolished 25 to 30 homes. 3 injuries resulted from flying glass. Total damage was estimated at over $5 million.

An EF3 on 9/2/84 moved from near Roseburg in Sanilac County to Lakeport, with an injury and most of the damage occurring in Sanilac County.

On June 27, 2010 an EF-1 tornado hit Fort Trodd Campground where several recreational vehicles were overturned and two were thrown into a nearby pond. One was reported dead and four were injured. A total of $700,000 was reported in damages.

All other tornadoes in St. Clair County have either been categorized as EF1 or EF2. Tornadoes in Michigan are most frequent in spring and early summer (April – June) when warm, moist air from the Gulf of Mexico collides with cold air from the polar region to generate severe thunderstorms. These thunderstorms often produce tornados. Refer to Table 3-5 for Number of Tornadoes per month and Table 3-6 for the Enhances Fujita Scale.

Table 3.6: Number of Tornadoes by Month for St. Clair County



Health and Safety

There have been at least three deaths and 99 injuries reported in St. Clair County from tornadoes between 1950 and 2013. A tornado that occurred on June 27, 2010 at Fort Trodd campground located in Clyde Township, accounted for 4 injuries and 1 death. Another tornado that occurred on May 21, 1953 in Port Huron accounted for two deaths and 68 injuries, the worst tornado with the most injured and damages that Michigan has seen.

Picture of tornado in St. Clair County, Michigan June 2010 Source: www.examiner.com

Table 3.7: Enhanced Fujita Scale

EF-Scale	Wind Speed MPH	Type of Damage	Frequency
EF0	65-85	Light Damage - some damage to chimneys; branches broken off trees; shallow-rooted tress pushed over; sign boards damaged	53.5%
EF1	86-110	Moderate Damage - Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads	31.6%
EF2	111-135	Considerable Damage - Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground	10.7%
EF3	136-165	Severe Damage - Roofs and some walls torn off well-constructed houses; trains overturned; most tress in forest uprooted; heavy cars lifted off the ground and thrown	3.4%
EF4	166-200	Devastating Damage - Well-constructed housed leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated	0.7%
EF5	Over 200	Incredible Damage - Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meter (109 yards); trees debarked; incredible phenomena will occur	less than .1%

Source: National Oceanic and Atmospheric Administration, St. Clair County Tornado Statistics http://www.crh.noaa.gov/dtx/torstats/county.php?co=stc

Affected Areas

A tornado would affect an entire population in the tornado path. While all types of buildings can potentially be damaged in a tornado, three types of structures are more susceptible to extreme damage: 1) Mobile homes, 2) buildings with large spans, such as airplane hangars, gymnasiums, and 3) Homes on crawl spaces. The most vulnerable population would be residents living in mobile home parks. There are 32 mobile home parks in St. Clair County.

Economic Impact

Property damage is the greatest contributor to economic loss. The amount of damage varies greatly with the severity of the tornado. The major impact of a tornado on the local economy is damage to businesses and infrastructure. A heavily damaged business, especially one that was barely making a profit, often has to be closed. Infrastructure damage is usually limited to above ground utilities, such as power lines. Damage to utility lines can usually be repaired or replaced relatively quickly. Also, damage or destruction to utility lines (primarily overhead) can result in the loss of power and other utilities anywhere from a few moments to several days. Tornadoes can also destroy or damage agricultural fields, disrupt transportation services due to debris and/or downed power lines, and destroy trees and other flora.

Michigan has a history of deadly tornadoes going back to the late 19th century. Since 1882, at least 343 people have been killed in Michigan by tornadoes. That is an average of 38 deaths per year from tornadoes all across the state of Michigan.

Over $31.32 million in property damage was reported for the 21 tornado events reported in St. Clair County between 1950 and 2013. This is an average of $1,491,571.43 per year.

Critical Facilities/Services

Tornadoes can require a substantial amount of resources and assistance from multiple agencies and departments including local emergency response departments, as well as state and federal departments including FEMA and The American Red Cross. Because a tornado can hit anywhere in the county, all critical

facilities are susceptible to being hit. Schools are a particular concern though for two reasons: 1) They have large numbers of people present, either during school or as a storm shelter, and 2) they have large span areas, such as gyms and theaters.

Significant Past Occurrences

- **June 27, 2010:** A tornado occurred at 7:06 pm in Clyde Township in St. Clair County. One fatality and 4 injuries resulted from this tornado as it hit a campground just north of I-69 and west of Wadhams. The tornado touched down north of Lapeer Rd. along Rabidue Rd. and continued eastward for 2.9 miles before lifting between Lapeer Rd. and the Black River just east of Abbottsford Rd. This tornado was rated EF1 with maximum winds around 95 mph, which occurred at and just east of the Fort Trodd Campground. About 10 campers were damaged or destroyed.
- **May 23, 2004:** An EF-1 tornado touched down 3 miles east of Yale, damaging roofing and numerous trees, causing $5,000 in property damage in the immediate vicinity.
- **May 31, 2004:** An EF-1 tornado hit a strip mall on Kraft Rd. and 24th Avenue in Fort Gratiot. Nearby homes were damaged, as were cars parked at the shopping center. Property damage totaled $50,000.

Table 3.8: Past Tornados that have affected St. Clair County:

Date	Time	Type	EF-Scale	Deaths	Injuries	$$ Total in Damages
5/21/1953	4:21 PM	Tornado	4	2	68	$2,500,000
6/8/1953	10:50 PM	Tornado	4	0	23	$250,000
5/21/1975	2:45pm	Tornado	2	0	0	$25,000
6/4/1975	6:50 PM	Tornado	1	0	0	$25,000
9/17/1977	12:25 AM	Tornado	1	0	0	$25,000
8/19/1978	2:15 PM	Tornado	1	0	0	$25,000
5/2/1983	11:20 AM	Tornado	3	0	3	$25,000,000
5/22/1984	8:20 PM	Tornado	1	0	1	$25,000
7/10/1984	11:25 PM	Tornado	1	0	0	$0
9/2/1984	4:54 PM	Tornado	3	0	0	$2,500,000
9/6/1990	3:20 PM	Tornado	1	0	0	$3,000
9/14/1990	12:55 PM	Tornado	1	0	0	$25,000
3/27/1991	8:53 PM	Tornado	1	0	0	25,000
5/28/1995	6:14 PM	Tornado	1	0	0	$0
6/21/1996	11:50 PM	Tornado	1	0	0	$40,000
6/22/1996	12:00 AM	Tornado	2	0	0	$25,000
7/28/1999	4:00 PM	Tornado	1	0	0	$60,000
5/14/2004	5:11 PM	Tornado	0	0	0	$15,000
5/23/2004	7:30 PM	Tornado	1	0	0	$5,000
5/31/2004	4:20 PM	Tornado	1	0	0	$50,000
6/27/2010	6:06 PM	Tornado	1	1	4	$700,000
Total in Damages						**$31,323,000.00**

Tornadoes that have occurred in St. Clair County Source: National Oceanic and Atmospheric Administration

Extreme Heat Temperatures Mid-July 2013. Source: National Weather Service

Extreme Temperatures

Description

Extreme temperatures can take form of extreme heat or extreme cold. Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks are defined as extreme heat. Humid or muggy conditions add to the discomfort of high temperatures and occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground.

Extreme cold temperature events are characterized by prolonged periods of very low temperatures, often accompanied by exacerbating conditions such as heavy snowfall and high winds.

Frequency

There have been fifteen extreme temperature events reported in St. Clair County since 1950. Of the fifteen extreme temperature events, seven have been extreme cold events and eight have been either record warmth or excessive heat.

Health and Safety

When temperatures reach excessive highs and lows, they are primarily affecting the most sensitive populations such as the elderly, children, impoverished individuals, and people in poor health. The major of extreme heat are heatstroke, which is a major medical emergency, and heat exhaustion. Most heat disorders occur because the victim has been overexposed to heat or has over-exercised for his or her age and physical condition. Other settings that can stimulate heat-related illnesses include dormant atmospheric conditions and poor air quality. Extreme heat can be fatal when it pushes the human body beyond its limits. Under normal conditions, the body's internal thermostat generates perspiration that evaporates and cools the body. However, in extreme heat and high humidity, evaporation is slowed and the body must exert more effort to sustain a normal temperature.

The major threats of extreme cold are hypothermia and frostbite. The best thing people can during periods of extremely cold temperatures is stay indoors. However, there are certain risks associated with staying indoors as well. Extremely cold temperatures could potentially cause power failures and wreak havoc on home heating systems. When people must use space heaters and fireplaces to stay warm, there is heightened risk of household fires and carbon monoxide poisoning.

Extreme temperatures can also negatively impact livestock, crops, and wildlife.

Affected Areas

Extremely cold or hot temperatures would impact all of St. Clair County and its regional neighbors. Since meteorological conditions are regionally-based, such severe conditions would likely impact all of the southeast Michigan, the entire state of Michigan, or even neighboring states.

Economic Impact

Extremely cold temperatures occurring during the agriculture growing season can cause crops to fail and threaten yields. Extremely high temperatures could also devastate sensitive crops and generate drought conditions. Both situations could create economic hardships for local farmers and the communities in St. Clair County.

Critical Facilities/Services

Extreme cold temperatures can weaken infrastructure essentials as power lines and gas and water lines become frail and more susceptible to damage. Pipes can potentially freeze and burst in homes that are poorly insulated or devoid of heat. If associated with another hazard, such as a pervasive power outage, extreme cold

temperatures can be devastating, since large numbers of people would lose capability to heat their homes. Extremely cold conditions may also cause ice jams on local rivers and streams, which could cause flooding during the spring thaw.

Extremely high temperatures can lead to power grid failures, periodic blackouts, and drought conditions.

Significant Past Occurrences

Significant periods of extreme temperatures in St. Clair County include:

- **July 15-19, 2013:** Extreme heat warning was in effect for 4 days, temperatures topped out in the mid 90's with heat index values that reached the low 100's. The conditions caused concern for the elderly and people with health conditions as heat indices reached 103 degrees. Cooling stations opened during this period, these cooling stations included Fort Gratiot's 3720 Keewahdin Road Offices which opened from 8 am to 4:30 pm, the American Legion Hall at 7150 Smiths Creek Road which was open till midnight, and the hall at 2160 Wadhams Road at the Kimball Township Office, these places offered air conditioning for people to get relief from the heat.

- **July 1-7, 2012:** An extended heat wave gripped southeast Michigan during the first week of July, with temperatures topping out around 100 degrees on multiple days. In fact, Detroit set a record high on July 4th, reaching 102 degrees. Heat indices peaked out around 110 degrees on July 4th and 6th. Although no known heat deaths were reported, over 700 heat related emergency room visits were reported statewide.

- **June 28, 2012:** High temperatures climbed to around 100 degrees across much of southeast Michigan during the afternoon hours of June 28th, with heat indices climbing between 100 and 110 degrees. This lead to an increase in heat related hospitalizations. Temperatures slowly came down during evening hours, with drier air slowly filtering in. Although Friday June 29th ended up being hot with high temperatures in the low to mid 90's, the dry air helped to keep heat indices short of 100 degrees.

- **July 17-22, 2011:** a mid-July heat wave helped cap off the warmest month on record at Detroit. Three direct deaths were reported due to the heat wave, as heat indices were above 100 degrees. Here are the high temperatures recorded for Detroit and Flint during the period of July 17th-22nd.

Flint	95, 94, 94, 95, 99, 84
Detroit	92, 96, 94, 96, 100, 95

- **January 14-18, 2009:** An arctic air mass became firmly established over the Great Lakes region on January 14th and persisted through the 18th. Temperatures fell below zero all four days, with wind chill values in the 5 to 30 below range during the majority of the time. Detroit's low temperatures for January 14-18 were as follows: -3, -3, -15, and -11.
- **February 3-6, 2007:** A bitter cold air mass blasted into the region on Saturday, February the 3rd and persisted through Tuesday, February the 6th. Temperatures through this period were 20-25 degrees below normal. Daytime temps struggled to reach 10 degrees while subzero temperatures occurred all 3 nights. After factoring in the winds, apparent temperatures ranged from 15 below to 25 below through nearly the entire event. Almost every school district in Southeast Michigan canceled school on Monday and most did the same on Tuesday, citing conditions too dangerous for the kids either walking to school or waiting outside for the bus. Area hospitals reported numerous cases of patients suffering from cold related illnesses. Most of the cases involved frostbite. At least one fatality was blamed on the cold weather. Frozen pipes and water main breaks occurred throughout all of Southeast Michigan, leaving many residents and business owners out in the cold. Area homeless shelters were filled to capacity. There were also many cases of fire sprinkler lines freezing and breaking, leading to flooding. AAA Michigan reported 20,000 vehicle service calls due to the cold air, the most in nearly 10 years. Total

damages were roughly estimated at $425 Thousand, including electrical and mechanical damages to vehicles and property damages caused by flooding.

Transportation Disruption Accident

Description

Transportation accidents involve crashes or accidents involving air, water, and land transportation. A transportation accident involving an air, land or water based commercial passenger carrier could result in fatalities or serious injuries. Vulnerable areas would include: 1) communities with, or near, and airport offering commercial passenger service; 2) communities with railroad tracks on which commercial rail passenger service is provided; 3) communities in which commercial intercity passenger bus or local transit bus service is provided; 4) communities with school bus service; and 5) communities in which commercial marine passenger ferry service is provided. A serious accident involving any of the above modes of passenger transportation could result in a mass casualty incident, requiring immediate life-saving community response. In addition, a marine transportation accident would require a water rescue operation possibly under dangerous conditions on the Great Lakes. Ground, air, and water transportation issues can pose risks to transportation users and to the general public.

Frequency

There have been approximately 1,245 total transportation disruption/accidents and structure failures in St. Clair County since 2006, an average of 103 incidents per year.

Since 1970, there have been 52 air incidents and 7 fatalities in St. Clair County. Nearly 54% of all air incidents have occurred in Port Huron and another 35% have occurred in Marine City, both communities with airports. In the seven fatal crashes, a total of 21 people were killed.

Health and Safety

Passenger train accidents usually involve a collision with a vehicle attempting to cross the railroad tracks as a train is approaching the crossing. Serious injuries are usually kept to a minimum – unless the train accident results in a major derailment. Bus accidents, on the other hand, can be quite serious, especially if the bus has tipped over. Numerous injuries are a very real possibility in those types of situations.

A water transportation accident involving one of the three marine car/passenger ferries operating in St. Clair River communities could have significantly safety consequences.

Affected Areas

The potential for vehicular accidents is greatest at major intersections during peak travel times. High crash intersections are derailed in the Community Profile section of this plan. There are also a number of limited access highways and arterial routes in the county that experience speeds and traffic volumes that may contribute to multiple vehicle accidents.

Due to the fact that the majority of aircraft accidents occur during landing or takeoff, the area most at risk for impact is the airport (or heliport) and immediately adjacent areas. The risk at any point in time is dependent on the number of over flights, weather conditions, type of aircraft, and characteristics of the crash site.

For rail incidents, areas adjacent to a railroad are most at risk for impact from this hazard due to the potential for derailment.

Economic Impact

When roads are closed, access to trade or employment centers can potentially be blocked or altered, which can negatively impact businesses and productivity. Major air or rail travel accidents or disruptions can create negative perceptions of those particular modes of travel, which may negatively impact the economic well-being of those industries in the future. Some people may be more reluctant to use a particular mode after a major accident or disruption.

Critical Facilities/Services

Respond to air and vehicular transportation accidents are provided by local fire and police departments. Marine transportation accidents are handled by local fire and police departments and the United States Coast Guard.

Vehicular traffic accidents can potentially cause prolonged periods of congestion, especially if a road needs to be temporarily closed down. These delays could hinder the efforts of emergency responders to reach an incident. Transportation accidents would likely have corollary effects such as site cleanup, possible Hazmat remediation, mass casualty, and injury management.

Significant Past Occurrences

Major transportation disruptions in St. Clair County in recent years include:

- **October 29, 2005**: A small plane crashed at the St. Clair County Airport, when attempting to land, the left wing touched the ground, causing the plane to roll several times. The plane then exploded into flames on the main runway, about 100 feet from the airport's main terminal building. The plane was occupied with one man, who was badly burned, and no one on the ground was injured.
- **June 6, 2013**: At 6 pm on a Wednesday evening, 2 tractor trailers collided on the south span of the bridge heading toward the Canadian Inspection area. Point Edward Fire, OPP, Sarnia Fire & Rescue, and a local HAZMAT team were called to the scene. Traffic still flowed over the bridge with Canadian – bound cars diverted to the north span. Cleanup included the removal of residual potassium hydroxide solution, a small amount of which was released from one of the vehicles involved in the incident.

Flooding

Description

Belle River Flood, April 2012.
Source: St. Clair County Emergency Management

When rainfall runoff collects in rivers, creeks, and streams and exceeds the capacity of channels, floodwaters overflow onto adjacent lands. Floods result from rain events, whether short and intense or long and gentle. Flood hazards are categorized as follows:

- **Riverine Floods** are a function of precipitation levels and water runoff volumes, and occur when water rises out of the banks of the waterway. Riverine floods are generally caused by prolonged, intense rainfall, snowmelt, ice jams, dam failures, or any combination of these factors. Such overbank flows are natural events that may occur on a regular basis. Riverine floods occur on river systems whose tributaries may drain large geographic areas and encompass many independent river basins. Flooding along waterways that drain larger watersheds often can be predicted in advance, especially where it takes 24 hours or more for the flood crest (maximum depth of flooding) to pass.
- **Flash Floods** not only occur suddenly, but also involve forceful flows that can destroy buildings and bridges, uproot trees, and scour out new channels. Most flash flooding is caused by slow-moving thunderstorms, repeated thunderstorms in a local area, or heavy rains from tornadoes. Flash flooding is common in urban areas, where much of the ground is covered by impervious surfaces and drainage ways are designed for smaller flows. Flash floods are typically characterized by high velocity water, often carrying large amounts of debris.
- **Urban drainage flooding** occurs where development has altered hydrology through changes in the ground surface and modification of natural drainage ways. Urbanization increases the magnitude and frequency of floods by increasing impervious surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land, and, occasionally, overwhelming sewer systems. Urban

flooding involves the overflow of storm sewer systems and is usually caused by inadequate drainage following heavy rainfall or rapid snowmelt.

- **Shoreline Flooding and Erosion** is typically caused by high Great Lakes water levels, storm surges, or high winds. Shoreline flooding and erosion are natural processes that occur at normal and even low Great Lakes water levels. During periods of high water, however, flooding and erosion are more frequent and serious, causing damage to homes, businesses, roads, water distribution and wastewater treatment facilities, and other structures in coastal communities. Windstorms and differences in barometric pressure can temporarily tilt the surface of lake up at one end as much as eight feet. This phenomenon is called a storm surge and can drive lake water inland over large areas.

Frequency

There have been eight major flood events in St. Clair County since 1980. Between 2008 and 2013 there have been 5 major flood events, resulting in $65,050,000 million in damages. About 32% of those properties have been mitigated.

Health and Safety

Possible loss of life would be primarily from drowning incidents. Other potential health-related problems could be from sewer back-ups and increased pollutant concentrations. Floods may leave people stranded in their homes for several days without power or heat, or they may be unable to reach their homes at all. There is the potential for safety issues if a shoreline bank were to collapse unexpectedly or a storm surge caused flooding of a structure with inhabitants.

Long-term collateral dangers include the outbreak of disease, widespread animal death, and broken sewer lines causing water supply pollution, downed power lines, broken gas lines, fires, and the release of hazardous materials.

Affected Areas

Areas in and around floodplains are most susceptible to flood damage. Because of the higher density of people and structures, urban floods are typically more of a concern than those that occur in rural areas. Flooding in St. Clair County would primarily affect streets and infrastructure located near the floodplains and in areas with inadequate drainage.

Economic Impact

Property loss and content loss can be very high as a result of a flood event. In the eight major flood events the county has experienced since 1980, more than $154.55 million in property damage has been incurred. Flooding is a natural occurrence and does not become a disaster until people put themselves and objects of value into harm's way of this natural process. When left undisturbed, the land that surrounds a waterway serves as a natural flood and erosion control system by providing temporary storage of floodwaters, reducing the velocity of the water, and minimizing the amount of sediment that can accumulate downstream. Floodplains also help maintain water quality by filtering nutrients and impurities from storm water runoff.

Critical Facilities/Services

Flooding events can require a substantial amount of resources and assistance from multiple agencies and departments including local emergency response departments, as well as state and federal departments including FEMA and The American Red Cross.

Flood-Prone Tax Parcels in St. Clair County

There are 16,058 flood-prone tax parcels in St. Clair County – roughly 22% of all the parcels in the county. Of all the flood-prone tax parcels in the county, 41% are located in Clay Township, 5.3% are located in Ira Township, 4.7% are located in East China Township, and 4.5% are located in St. Clair Township. See Tables 3.8a, 3.8b, and 3.8c. Of the total flood-prone properties within the county, 10,280 are homestead properties.

The total property value of flood-prone parcels within the county is approximately $5.08 million, according to figures based on the assessment role maintained by St. Clair County Equalization. This amount represents about 40% of the total property value in the county. The countywide average value of flood-prone parcels is $316,783.

Table 3.9a: Flood-Prone Tax Parcel Statistics in St. Clair County – All Properties

Municipality	Total Count in Flood-Prone Areas	Flood-Prone Count Where Property Value = 0**	Flood-Prone Count Where No Data Available	Total Property Value of Flood-Prone Area*	Average Property Value of Flood-Prone Area*	Median Housing Value of Entire Municipality
Algonac	1002	64	15	$130,772,900	$208,989	$172,853
Marine City	345	17	10	$57,513,970	$251,328	$188,122
Marysville	130	17	1	$73,845,536	$568,043	$283,189
Memphis	50	4	0	$6,649,772	$132,995	$119,200
St. Clair	212	32	11	$79,173,594	$373,460	$227,182
Yale	95	12	1	$13,069,730	$137,576	$88,800
Berlin Twp.	568	18	1	$4	$195,451	$169,031
Brockway Twp.	213	9	1	$32,954,700	$154,717	$140,155
Burtchville Twp.	248	11	1	$52,406,806	$211,318	$119,548
Casco Twp.	317	8	0	$74,330,362	$234,481	$149,100
China Twp.	364	11	0	$885,885,700	$2,433,752	$320,650
Clay Twp.	6547	426	510	$1,007,828,970	$15,393,752	$247,575
Clyde Twp.	317	14	0	$71,068,956	$224,192	$194,368
Columbus Twp.	445	6	2	$93,942,900	$211,108	$166,950
Cottrellville Twp.	308	9	4	$70,460,730	$228,769	$175,542
East China Twp.	759	17	13	$1,537,995,200	$2,026,344	$160,493
Emmett Twp.	74	0	0	$12,429,838	$167,971	$142,300
Fort Gratiot Twp.	509	20	14	$143,314,200	$281,560	$161,702
Grant Twp.	185	7	11	$28,062,400	$151,689	$125,600
Greenwood Twp.	25	1	0	$4,684,138	$187,366	$117,600
Ira Twp.	860	15	26	$157,947,744	$183,660	$176,013
Kenockee Twp.	252	6	2	$42,989,292	$170,592	$139,773
Kimball Twp.	432	18	2	$57,247,700	$132,518	$100,942
Lynn Twp.	260	1	0	$47,492,874	$182,665	$132,928
Mussey Twp.	203	10	0	$32,226,802	$158,753	$116,358
Port Huron Twp.	244	16	6	$48,015,900	$196,786	$124,666
Riley Twp.	159	2	3	$29,581,914	$186,050	$163,043
St. Clair Twp.	680	24	7	$149,243,674	$219,476	$155,226
Wales Twp.	255	10	0	$34,749,268	$136,272	$134,500
Flood Prone Parcels Totals	16,058	805	641	$5,086,901,740	$316,783	
% of Total County	22%	1.1%	1%	40%		

Table 3.9b: Flood-Prone Tax Parcel Statistics in St. Clair County - Homestead Properties

Municipality	Flood-Prone Count	Total Property Value Homestead Properties	Average Property Value
Algonac	711	$96,178,700	$135,272
Marine City	216	$39,719,890	$183,888
Marysville	77	$18,764,458	$243,694
Memphis	32	$3,836,352	$119,886
St. Clair	209	$40,831,940	$195,368
Yale	61	$7,821,794	$128,226
Berlin Twp.	455	$100,241,178	$220,310
Brockway Twp.	124	$24,070,500	$194,117
Burtchville Twp.	154	$41,148,950	$267,200.97
Casco Twp.	250	$58,180,852	$232,723.41
China Twp.	290	$61,694,400	$212,739.31
Clay Twp.	3,327	$696,108,856	$209,230.19
Clyde Twp.	237	$233,900	$986.92
Columbus Twp.	324	$70,568,900	$217,805.25
Cottrellville Twp.	233	$55,548,154	$238,404.09
East China Twp.	555	$121,068,000	$218,140.54
Emmett Twp.	58	$10,230,334	$176,385.07
Fort Gratiot Twp.	349	$91,133,200	$261,126.65
Grant Twp.	137	$24,834,142	$181,271.11
Greenwood Twp.	21	$4,254,768	$202,608.00
Ira Twp.	543	$100,881,120	$185,784.75
Kenockee Twp.	198	$35,956,122	$181,596.58
Kimball Twp.	359	$51,862,900	$144,464.90
Lynn Twp.	212	$41,187,440	$194,280.38
Mussey Twp.	150	$27,203,614	$181,357.43
Port Huron Twp.	160	$32,721,200	$204,507.50
Riley Twp.	123	$23,399,194	$190,237.35
St. Clair Twp.	523	$122,521,858	$234,267.41
Wales Twp.	192	$29,006,002	$151,072.93
Flood Prone Parcels Total	10,280	$2,031,208,718	
% of Total County	14%	32%	

Table 3.9c: Flood-Prone Tax Parcel Statistics in St. Clair County – Non-homestead Properties

Municipality	Flood-prone Count	Total Property Value Non-Homestead Properties	Average Property Value
Algonac	278	$34,449,200	$123,917
Marine City	119	$17,794,080	$149,530

Marysville	53	$55,081,078	$1,039,265
Memphis	18	$2,813,420	$156,301
St. Clair	93	$38,341,654	$412,276
Yale	33	$5,247,936	$159,028
Berlin Twp.	112	$10,774,992	$96,205
Brockway Twp.	88	$8,884,200	$100,956
Burtchville Twp.	93	$11,257,856	$121,052
Casco Twp.	67	$16,149,510	$241,037
China Twp.	74	$824,191,300	$11,137,720
Clay Twp.	2,817	$303,597,514	$107,773
Clyde Twp.	80	$10,731,826	$134,148
Columbus Twp.	120	$23,374,000	$194,783
Cottrellville Twp.	73	$14,912,576	$204,282
East China Twp.	195	$1,413,927,800	$7,250,911
Emmett Twp.	16	$2,199,504	$137,469
Fort Gratiot Twp.	155	$52,035,500	$335,713
Grant Twp.	37	$3,228,258	$87,250
Greenwood Twp.	4	$429,370	$107,343
Ira Twp.	309	$57,131,724	$184,892
Kenockee Twp.	52	$7,033,170	$135,253
Kimball Twp.	71	$5,384,800	$75,842
Lynn Twp.	48	$6,305,434	$131,363
Mussey Twp.	53	$5,023,188	$94,777
Port Huron Twp.	78	$15,294,700	$196,086
Riley Twp.	33	$6,182,720	$187,355
St. Clair Twp.	150	$26,721,816	$178,145
Wales Twp.	63	$5,743,266	$91,163
Flood Prone Parcel Totals	5,382	$2,984,242,392	
% of total County	7.5%	24%	

Median Housing Value for County***: $141,800

*Figures based on assessment roll maintained by St Clair County Equalization.

**Based on GIS query of SCC Parcels, FEMA FIRMettes Map Service Center.

***Figures based on 2012 Census.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) is aimed at reducing the impact of flooding on private and public structures. This is achieved by providing affordable insurance for property owners and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. Overall, the program reduces the socio-economic impact of disasters by promoting the purchase and retention of Risk Insurance in general, and National Flood Insurance in particular. The following communities within St. Clair County participate in the National Flood Insurance Program.

Repetitive Loss Properties

The term "repetitive loss properties" refers to those that are officially listed as such by the National Flood Insurance Program (NFIP). A repetitive loss property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A repetitive loss property may or may not be currently insured by the NFIP. Currently there are over 122,000 repetitive loss properties nationwide. Repetitive Loss properties are a concern for the community because structures that flood frequently strain the National Flood Insurance Fund. In fact, the repetitive loss properties are the biggest draw on the Fund. FEMA has paid almost $3.5 billion dollars in claims for repetitive loss properties. Repetitive loss properties not only increase the NFIP's annual losses and the need for borrowing; but they drain funds needed to prepare for catastrophic events. Community leaders and residents are also concerned with the repetitive loss problem because residents' lives are disrupted and may be threatened by the continual flooding. Based upon information in a government database, St. Clair County has approximately 53 repetitive loss properties officially identified by the National Flood Insurance Program. These properties break down as follows into different local jurisdictions within the county:

The City of Algonac has three such properties, and they were all single-family homes, but not located right next to each other. One home was severely damaged by floodwaters in December, 1985, causing more than $30,000 in losses to the structure and some of its contents. This same home had also seen less severe damage during April of that same year, along with the other two homes identified on the repetitive loss list within the City of Algonac. During the April event, the three homes each suffered an average of more than $2,400 to their structures and contents (combined), while during the December event, an amount comparable to what the lower two of these three homes had suffered in the December event ($2,875 each). The third such home was also damaged in a January 1980 flood event, which nearly doubled the average damage amount seen in 1985.

Three single-family houses in China Township were also identified on the official repetitive loss list, although two of them have the same street address and therefore it is unclear whether this represents two housing units in the same building (thus an error in the data's classification as "single family residential" structure types) or some sort of problem with the data. Treating them as only two separate structures, since the flood dates listed in the first entry with a shared address are different from the dates listed in the second entry for that address, it appears that the first of the two structures has been flooded several times - in October 1981, February 1985, February 2001, and May 2004. The earlier two events did less damage than the later two, averaging just over $1,300 in damages to the home's contents in each event. The later two events (or the second unit at that address?), by contrast, suffered an average of more than $64,000 in damage, the bulk of which involved the structure itself rather than just its contents. The final officially-identified house in the township had been affected by damaging floods in February 2001, May 2004, and February 2009. The home's damages averaged nearly $50,000 per event (structure and contents damage combined), with a pattern of increasing damage over time, as the 2009 damages were nearly double the 2001 damages.

Clay Township contains 13 properties identified by the NFIP as suffering repetitive losses. Ten of these properties are single-family homes, while three of them are non-residential structures (a professional office, a commercial establishment, and an additional structure not readily identifiable due to confidentiality requirements and address peculiarities). The first listed nonresidential property was damaged by two floods in April and December of 1985, causing an average of about $2,180 in structural damages, per event. The second nonresidential property has averaged about $4,500 in damages during each of its three flood events, in 1984,

1985, and 1986, the majority of which involved structural damage during the 1986 event. The third nonresidential property suffered from two damaging floods in 1985 which each caused about $9,000 worth of damage to the building's contents. The ten homes are most easily referred to by number and the date of flood the flood events in which they were damaged. The first event, in April 1985, affected homes #1, 2, 3, 5, and 8, causing an average of about $5,500 in damage to each home (after combining their reported damages to the structures and their contents). Then, a May 1985 event caused slightly less damage to home #9. The second major event was in December 1985, and affected homes #1, 2, 4, 5, 6, 7, 9, and 10, causing an average of about $3790 in total damages to each home. This was followed by three isolated reports during May, June, and August of 1986, before the third major event in October of that year. The May event involved less than $2,000 in damages to home #8, the June event was similar but only affected home #6, and the August event involved about $6400 in damages to home #5 only. The third major event of October 1986 involved an average of $3,700 total damage to each of homes #2, 3, 4, 5, 7, 9, and 10.

Cottrellville Township has two single-family homes on the official "repetitive loss list," and they are not next to each other. The first home saw three damaging flood events in April 1985, December 1985, and June 1986, which caused an average of $1,802 in structural damages per event. The second home was damaged in two flood events in December 1985 and February 1987, causing an average of about $9,600 per event.

East China Township lists 9 homes and 1 condominium with repeated flood damages. The condominium had been damaged in January 1986 and February 1987, totaling an average of about $7,860 per event. The 9 homes can most easily be referenced by number to describe which ones were involved in a series of flood events since the early 1980s. The first such events, in March 1982 and February 1985, involved home #7, causing about $7,900 in total damages during each event. Then, a December 1985 flood caused about $2,500 in damage to home #2, and a January 1986 flood caused about $3,900 in damage to home #3. The first major event evident in this data occurred in February 1987, involving an average of about $4,180 in structural damage, each, to homes #1, 2, and 3. This was quickly followed by a March 1987 event in which home #1 suffered over $17,000 in structural damage, and the damages to home #3 amounted to about $3,500. Then, in February 2001, substantial damages were suffered by home #4 (over $18,000) and home #5 (over $11,000). A third major event occurred in May 2004, in which homes #5, 7, and 8 suffered about $3,700 in total damages a piece, on average, while homes #4, 6, and 9 suffered more than $30,000 a piece, on average. Finally, the last major event recorded in this data was in February 2009, involving homes #5 through 9. Four of these homes suffered an average of about $13,350 in total damages during this event, but the structural damages to home #6 (more than $72,000) amounted to nearly half its total estimated property value.

Fort Gratiot Township has 7 properties on the list, one of which is a single-family home while the others are apartment buildings. The single family home had experienced nearly $5,000 in structural damage during an October 1986 event, followed by more than $18,000 worth in a February 1987 event. The various apartment buildings each sustained an average of about $5,750 in structural damages during a December 2008 flood event, and then about another $5,600 a piece, during a subsequent event in February 2009. The database displayed two properties classified within the City of Port Huron, but the addresses matched those of these same apartment buildings in Fort Gratiot Township, suggesting yet another problem with the NFIP records. Those two additional records refer to an additional $25,000 in damages from the December 2008 event, and just over $18,500 in damages from the February 2009 event.

Ira Township has 6 listed properties that were affected by floods in the 1980s, and while 5 of these properties are single-family homes, one of them involves a non-residential structure (a commercial establishment). That business had substantial structural damages in December 1985 (nearly $11,000) plus almost $3,000 in additional damage to the building's contents. In March 1986, another flood event resulted in more than $3,500 in total damages. The five residential houses have been impacted in different amounts by three different flood events. First, in April 1985, homes #1, 3, 4, and 5 endured a wide range of damages from $1,600 to $35,000, but averaging a total of about $11,485 for each home. Second, in December 1985, homes #2, 3, 4, and 5 each suffered an average of nearly $2,000 in damages. Finally, in October 1986, homes #1, 2, and 5 each experienced an average of $4,270 in damage to their structures and contents.

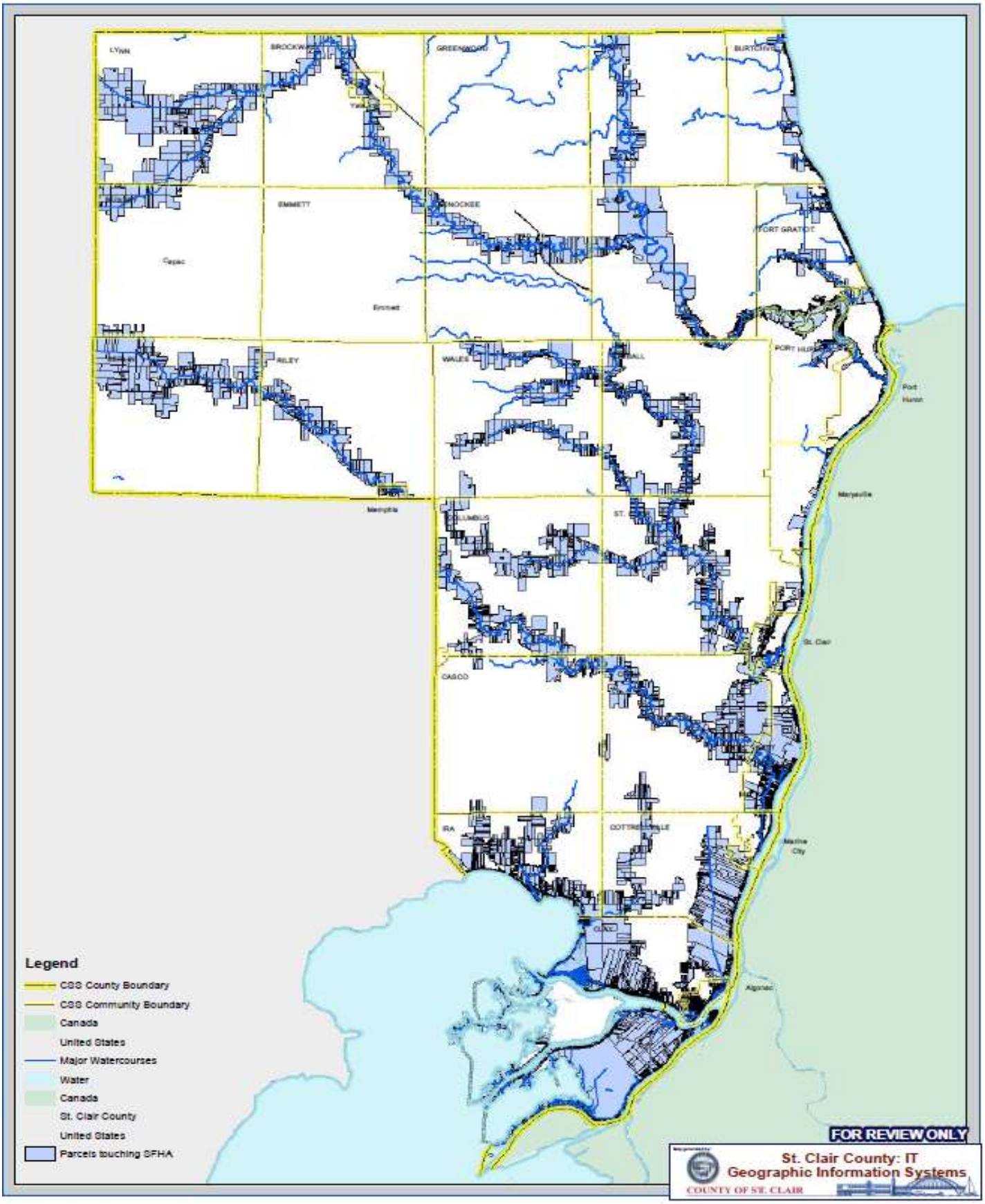
Kimball Township had only one single-family home on the list. A June 1996 flood and a February 2001 flood caused $10,000 and $1,694 in damage, respectively.

Finally, Marine City has 7 properties on the list, 6 of which are single-family homes and the other being a moderate-sized multi-unit residential complex. The multi-family structure experienced about $3,650 in damage during a December 1985 event, and about $4,500 in damage during a February 1987 event. The 6 homes experienced a diverse array of comparable damages over time: A March 1982 event damaged home #4 to the tune of $2,785, and in the following month, home #6 suffered to the amount of $1,700. Home #3 was hit twice during April 1984, the first causing nearly $10,000 in total damage and the second causing about $5,500. A February 1985 event caused home #4 to suffer more than $5,500 in total damages, while an April 1985 event resulted in over $1,200 in damage to home #3. December 1985 saw just over $1,000 in additional damage to home #3, nearly $3,000 in damage to home #5, and more than $3,000 in total damage to home #6 (and its contents). October 1986 resulted in an additional $1,300 in flood damage to home #5. February 1987 brought about $1,800 in damage to home #2, nearly $5,000 in damage to home #3, and over $7,500 in damage to home #5. The next month brought an additional $3,300 in damage to home #2. Much later, home #1 experienced flood damages on the order of $8,700 in March 2001, $11,240 in May 2004, and nearly $80,000 in February 2009 (although the value of the home was not reported as this high, in the database).

Table 3.9d: NFIP Participation within St. Clair County

NFIP Communities within St. Clair County	
Communities Participating in the NFIP	**Communities NOT Participating in the NFIP**
Algonac	Brockway Twp.
Berlin Twp.	Capac
Burtchville Twp.	Emmett Twp.
Casco Twp.	Emmett
China Twp.	Grant Twp.
Clay Twp.	Greenwood Twp.
Clyde Twp.	
Columbus Twp.	
Cottrellville Twp.	
East China Twp.	
Fort Gratiot Twp.	
Ira Twp.	
Kenockee Twp.	
Kimball Twp.	
Lynn Twp.	
Marine City	
Marysville	
Memphis	
Mussey Twp.	
Port Huron	
Port Huron Twp.	
Riley Twp.	
St. Clair	
St. Clair Twp.	
Wales Twp.	
Yale	

Flood-prone Tax Parcels



Flood Prone Tax Parcels. Source: St. Clair County IT Geographic Information Systems

Table 3.10: Flood events in St. Clair County

County	# of Townships involved	Date	Time	Inches of water	Property & Crop Damage	Cause of Flood	Source
St. Clair County	7 Townships	9/14-15/2008	2:00 pm - midnight	3-6	$30 Million	Due to Heavy Rain	Trained Spotter
St. Clair County	4 Townships	6/17/2009	2:00 pm - 5:00 pm	NA	$10 Million	Due to Heavy Rain	Law Enforcement
St. Clair County	3 Townships	6/22/2011	10:15 pm - 12:15 am	3-8	0	Flash Flood	Law Enforcement
St. Clair County	4 Townships	6/22/2011	2:00 pm - 5:00 pm	5-10	$50,000	Due to Heavy Rain	Law Enforcement
St. Clair County	5 Townships	4/10-12/2013	NA	3-7	$25 Million	Due to Heavy Rain	911 Call Center

Flood events that have taken place in St. Clair County. Source: NOAA (National Oceanic & Atmospheric Administration)

Significant Past Occurrences

Significant flood events in St. Clair County include:

- **April 10, 2013:** A frontal boundary stalled over Michigan dropping 3 to 6 inches of rain. This resulted in the flooding of some rivers, streams and low-lying areas. Dozens of roads were closed across the following counties: Midland, Bay, Saginaw, Tuscola, Lapeer, and St. Clair. Several roads were also reported to be damaged. Hundreds of basements were flooded, with some property damage also reported. Due to the flooding; $25 million was reported in property and crop damage.

  June 21-23, 2011: Central dispatch reported numerous roads closed and washed out. There was a substantial amount of flooding in Burtchville, Fort Gratiot, and the northeastern townships. Up to 100 homes received some form of flood damage, as the rain overwhelmed the drainage system. Due to the rain, $50,000 was reported in property and crop damage.

- **June 17, 2009:** Three to six inches of rain fell in and around the I-69 corridor during the daytime hours of June 17th. This amount of rain, coupled with the wet spring, lead to flooding across a few counties. Road closures and basement flooding were common. Due to the heavy rain, $10 million was reported in property and crop damages.

- **September 14-15, 2008:** Heavy rain fell over southeast Michigan from September 12th-14th, with widespread 3 to 6 inches reported. Isolated amounts around 8 inches were even reported across northwest Genesee County. A Clinton Township woman also had to be rescued as her car became submerged at Millar and Utica Roads. In addition to the heavy rain, the remnants of Ike did cause some strong winds which caused small tree limbs to fall and power outages to around 15,000 customers.

- **August 11th, 2014:** Detroit was pummeled with torrents of record-breaking rain. The city received 4.57 inches of rain, second highest on record following a rainfall of 4.74 inches in 1925, according to the National Weather Service. Some communities received more than 6 inches of rain. In contrast, the average rainfall for all of August is just 3 inches. Rain fell throughout the day, but during afternoon

commuting hours it filled local freeways. Water reached heights of 14 feet on certain roadways, according to the Detroit News, forcing some drivers to abandon their cars.

Water floods the intersection of Interstates 75 and 696 in Hazel Park, MI, Tuesday, August 12th, 2014
Source: www.HuffingtonPost.com Photo by Carlos Osorio

Transportation Structure Failure

Description

Transportation structure failure can include bridge or tunnel collapse, structural instability, or the occurrence of sinkholes. Typical frequent failure modes in seriously damaged bridges and overpasses include the unseating of bridge girders, shear failure at piers, flexural plastic hinging and abutment slumping.

The major damage to bridges occurs during floods. Damage is caused for various reasons, the main reason being scour at bridge foundations, namely piers and abutments. Scour is the hole left behind when sediment (sand and rocks) is washed away from the bottom of a river. Although scour may occur at any time, scour action is especially strong during floods. Swiftly flowing water has more energy than calm water to lift and carry sediment down river. If sediment or rock on which bridge supports rest is scoured by a river, the bridge could become unsafe for travel. By mandate of the Federal Highway Administration, all over water bridge sites are to be inspected for stream stability and scour potential. Knowledge of bridge sites where scour is a potential problem will enable the county to monitor and improve conditions at these bridges ahead of time--before they become dangerous.

Some stretches of road may be susceptible to collapse or subsidence. According to the USGS, sinkholes are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by ground water circulating through them. As the rock dissolves, cavernous holes develop underground. If there is not enough support for the land above the holes then a sudden collapse of the land surface can occur. These collapses can be small or large and can occur where a road or structure is on top.

Frequency

There have been approximately 945 total transportation disruption/ accidents and structure failures in St. Clair County since 1990, an average of 63 incidents per year.

Health and Safety

When transportation structures fail and require closure, traffic volumes can increase on other roads that may not be able to adequately handle such increases. Increased volumes can potentially lead to serious accidents and other traffic delays. In addition, emergency responders may have to alter their routes to get to and from an emergency scene when a particular structure is out. The response time may increase due to poor access to the scene, which could be detrimental in the event that a person needs immediate attention.

Affected Areas

Transportation disruptions impact the entire community. When drivers have to take an alternate route to their destination, other roads in the community take on the added capacity. This can cause further congestion and potential for accidents. All areas of the community are susceptible to this hazard.

Economic Impact

When roads are closed, access to trade or employment centers can potentially be blocked or altered, which can negatively impact businesses and productivity. The cost to local governments to repair failing or damaged transportation structures can be very high. The St. Clair County Road Commission spent a total of $1,295,400 in the year of 2013 to primary road surfacing and a total of $2,404,300 on bridge and drain replacements. The 2014 projects are estimated at $1,080,500 for road replacements.

Critical Facilities/Services

Transportation structure failures often require the services of police and fire departments, the St. Clair County Road Commission, MDOT, and local departments of public works.

Significant Past Occurrences

Past transportation structure failures in St. Clair County include:

2013 Bridge Replacements:

- **Riley Center Road over Belle River –** Total Bridge Replacement, 90’0” single span. The entire existing bridge was removed due to advanced deterioration and load restricts that detoured trucks and was replaced with new concrete abutments and wing walls on steel H – piling, side by side precast concrete box beams, concrete deck and road approach improvements. The total cost of the project was $1,538,000.

- **Carrigan Road over Brace Drain –** Total Bridge Replacement, Twin Steep Arch Culverts. The entire existing bridge was removed due to advanced deterioration and one – lane road width restriction and was replaced with new twin CSP steel arch culverts (larger low flow culvert and smaller flood flow culvert), concrete deck and road approach improvements. The total cost of the project was $71,700.

Source: St. Clair County Road Commission

- **Short Cut Road over Meldrum Drain Outlet –** Total Bridge Replacement, 44'0" Single Span. The entire existing bridge was removed due to advanced deterioration and load restricts that detoured trucks and was replaced with new 3 – sided precast concrete box culvert on stell H – piling, and road approach improvements. The total cost of the project was $794,600.

Source: St. Clair County Road Commission

2014 Road and Bridge Projects:

- **May 21, 2014 –** Shea Road between Palms Road to Marsh Road, resurfacing work. Work included was crushing and shaping the existing pavement and then overlaying with asphalt, restoring the aggregate shoulders, a cross road culvert replacement at McKinley, and new pavement markings. There was a 1 day closure of Shea Road between Morrow Road and McKinley Road for the cross road and culvert replacement. Access was maintained to local traffic within the closure zone. There was a posted detour for McKinley Road, Genaw Road and Morrow Road. The closure was May 28, 2014 and the total cost of the project was $1,034,549.
- **July 18, 2014 – (This is an ongoing project)** Fred Moore Highway resurfacing ½ mile east of Mayer Road to ½ mile east of Allington Road. Full closure of Fred Moore Highway and Allington Road between St. Clair Highway and Trumble Road for a maximum of 14 days to permit the concrete rubblizing and placement of new aggregate base, asphalt and gravel shoulders. Access will be

maintained to local traffic within the construction and closure zone, including homes and businesses, during the closure. The posted detour will be Wadhams Road and I – 94. This closure is scheduled to occur July 25th to August 8th. Local Residents and Emergency Vehicles will have access to local properties throughout the entire project. Delays are expected to local residents in the area due to the construction. Total cost of project is estimated at $957,250.

- **July 21, 2014 –** in Clay Township there was an intermittent lane closure on M – 154 between Bates Highway and North Channel Drive for crack filling. 1 lane closure for the day, however residents and emergency vehicles still had access to homes and local business's.
- **July 21, 2014 –** in Burtchville there was an intermittent land closure on North Road between Burtch Road and Carrigan Road for crack filling. 1 lane closure for the week, however residents and emergency vehicles still had access to homes and local business's.
- **July 28th, 2014 –** Capac Road Bridge over Belle River. The work will include removing the entire bridge deck and portions of the foundation. Capac Road will be reduced to 1 lane traffic at the bridge site between Hunt Road and Terry Road during the construction. Total cost of project is estimated at $1,273,205.48.
- **Mid to Late July – (This is an ongoing project)** St. Clair County highway I – 94/I – 69 in the city of Port Huron. As part of the Michigan Department of Transportation's (MDOT) project to rebuild the I – 94/I – 69 interchange, I – 94 and I – 69 will need to be closed at times during the last two weeks of July and throughout August in order to put steel bridge beams into place. Motorists should expect overnight closures, with other limited, short – duration closures occurring at various times of the day as well. Portable message signs will be in place to alert motorists well in advance of these closures.

Source: St. Clair County Road Commission

The 1st closure will occur on westbound I – 69 business loop (BL) to westbound I – 94 from 7 pm to 6 am nightly from Tuesday July 22nd through Thursday July 24th.

The 2nd closure will occur on eastbound and westbound I – 94/I – 69 and on westbound I – 69 BL to Westbound I – 94 from 8 pm to 6 am nightly Friday July 25th through Saturday July 26th.

Traffic impacts will include Eastbound I – 94 traffic will be diverted to I – 94 BL (Gratiot Ave.), which leads through Marysville and into Port Huron and the Blue Water Bridge.

Table 3.11: SCCRC 2014 Projects

Project	Location	Description	Length in Miles	SCCRC Budget
Hot Rubber	Various	Hot Rubber	N/A	$250,000
Wedging	Various	Wedging	N/A	$150,000
Palms	From I - 94 south to Lindsey	Profile Mill/Overlay	2.75	$328,000
Meisner	Mckinley to Mayer	Single Seal	2	$60,400
North Road	Wadhams to Lightle	Micro Surface	1.5	$90,500
Capac Road	Downey to Dudley	Chip Seal	7.7	$192,000
Winn Road	Yale Road to Fisher	Chip Seal	2	$50,000
Yale Road	Capac Road to Mason	Chip Seal	2	$50,000
Richman Road	Smiths Creed Road to Griswold	Chip Seal	3.1	$74,000
Meisner Road	Mayer Road to McKinley	Chip Seal	2.1	$50,500
2013 total			23.15 Miles	$1,295,400

Table 3.12: SCCRC Primary Road Surface Preservation

Projects	Location	Description	Length	Total Budget
Hot Rubber	Various	Hot Rubber	TBD	$200,000
Wedging	Various	Wedging	TBD	$100,000
King Road Sewer	St. Clair Hwy to Puttygut	Sewer Rehab	N/A	$129,000
Burt Road Culvert	Wade to Harvey	Replace Culvert	N/A	$125,000
Palms Road	Lindsey Road to Marine City Hwy	Overlay	3.1	$394,500
Goodells Road	County Park Drive to Lapeer	Crush and Shape	0.5	$132,000
	2014 Total		3.60 Miles	$1,080,500

Source: St. Clair County Road Commission 2013 – 2014 Annual Report

Ice Storm

Description

An ice storm involves rain, which freezes upon impact. An ice coating at least one-fourth inch in thickness is heavy enough to damage trees, overhead wires, and similar objects and to produce widespread power outages. Ice storms are the result of cold rain that freezes on contact with the surface, coating the ground, trees, buildings, overhead wires, etc. with ice, sometimes causing extensive damage. When electric lines are downed, inconveniences are felt in households and economic loss and disruption of essential services is often experienced in affected communities. In addition to keeping people home-bound, preventing travel, and causing school and business closings, ice and sleet storms can be the cause of more car accidents and extensive electrical power outages.

Ice encased buds from 2007 snow storm. Source: www.personal.umich.edu

Frequency

Since 1990, there have been seven major ice storms in St. Clair County. The probability for ice and sleet storms to occur in St. Clair County is high and is most likely to occur from December to March.

Health and Safety

The magnitude and severity depends on the amount of accumulation, the duration of the storm event and the duration of freezing temperatures. Deaths and injury caused directly from an ice or sleet storm are difficult to determine. Deaths and injury are usually caused by secondary effects such as auto accidents, downed power lines, hyperthermia, and heart attacks from overexertion.

Affected Areas

All of St. Clair County is susceptible to the dangers of ice and sleet storms. Roadways present a significant hazard when coated with sleet or ice, and downed tree limbs and utility lines pose a danger when located near populated areas.

Thomas Edison Museum Train Depot during 2013 Winter Storm at the Blue Water International Bridge in Port Huron Michigan. Source: www.worldofstock.com

Economic Impact

The cost of snow removal, repair of property damage, and loss of business can have a significant impact on the economy. In rural areas, homes and farms may be isolated for days and unprotected livestock may be lost. Ice or severe freezing during the growing season can also damage crops, resulting in significant loss of revenue.

Critical Facilities/Services

The major impact of snow and ice on property is damage to utilities and roads. Strong winds, accumulations of heavy snow, and ice can bring down trees, electrical wires, telephone lines, communication towers, and even collapse buildings. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. This type of damage can create high infrastructure costs for government and private industry.

Significant Past Occurrences

Major ice storms that have occurred in St. Clair County include:

- **January 14-15, 2007:** An ice storm ensued from I-69 south to I-94, causing widespread ice accumulations of a quarter to a half inch brought down numerous trees, power poles and power lines. Over 150,000 customers were without power at one time during the ice storm. Many were without power for 2 days, and some for over 3 days. Several senior homes lost power and 200 residents had to be evacuated. Most of the damage and associated power outages occurred between M-59 and I-94, although roads were just warm enough to remain wet, patchy slick spots and downed tree debris made traveling very hazardous. A mixture of freezing rain, sleet, and snow fell, with reports confirming up to 5 inches of snow and one tenth of an inch of ice. Nearly all schools in Southeast Michigan closed due to the storm. Numerous car accidents occurred across the affected areas. Several vehicles were destroyed by large trees that fell under the extra weight of the ice and there were at least two incidents of trees falling onto moving vehicles. Most injuries were minor, and total property damage was roughly

estimated in excess of $2 million. This included damage to vehicles, homes, businesses, and electrical poles and transformers. Downed power lines also sparked several garage fires. In addition many businesses in the hardest hit areas reported losses due to the extended power outages.

- **April 3, 2003:** Thunderstorms brought up to three inches of heavy rain to the area over a three-day period. By the morning of April 5th, ice accumulations led to considerable tree damage and widespread power outages across the county. Tree damage was so severe that dozens roads were blocked by trees and damage occurred to hundreds of homes, businesses, and automobiles as tree limbs, or in many cases large trees themselves, were brought to the ground under the weight of the ice. It was estimated that 450,000 homes and businesses lost power during the storm. In fact nearly 50,000 people were without power for up to a week as persistent cold temperatures keep the heavy ice on the trees for 4 days after the storm.

Snow Storm

Description

A snow storm is described as a period of rapid accumulation of snow often accompanied by high winds, cold temperatures, and low visibility. Blizzards are the most dramatic and perilous of all snow storms, characterized by low temperatures and strong winds bearing enormous amounts of snow. Most of the snow accompanying a blizzard is in the form of fine, powdery particles of snow which are wind-blown in such great quantities that, at times, visibility is reduced to only a few feet. Blizzards have the potential to result in property damage and loss of life. Just the cost of clearing the snow can be enormous. As a result of being located on a Great Lake, St. Clair County experiences large differences in snowfall in relatively short distances. Snowstorms tend to be more severe if prevailing winds bring them in from over Lake Huron., creating a "lake effect".

Impacts due to snow storms or blizzards are far-reaching: traffic accident deaths and injuries; structural fires due to snow melt seeping into electrical meter boxes; roofs collapsing under the weight of snow; school closings; business closings; flight or travel cancellations; loss of electricity; impassable streets causing many stranded people needing shelter, and high snow clearing and removal costs.

Frequency

There have been 51 heavy snow storm events in St. Clair County since 1990, including twenty major regional snow storm events since 1997. St. Clair County experiences an average snowfall of 42.7 inches annually, but this varies considerably from year to year. The probability of future snow storm events occurring in the county is high.

Health and Safety

Urban snowfall may disrupt normal activities and poses a danger to travelers and outdoor workers. The hazard of snowstorms and blizzards results from the interrelationship among snowfall, temperature, wind and patterns of human activity. Impacts of such events can be extensive and may include: traffic accidents resulting in death and injury; structural failure of roofs from the weight of snow; closure of schools, businesses and government functions; travel and flight delays; and loss of community services such as electricity, water, and telecommunications.

Affected Areas

All of St. Clair County is vulnerable to the hazards associated with snowstorms and blizzards, although because of the concentration of facilities and people in urban areas there is a greater likelihood for damage or loss. Since snowstorms are usually accompanied by cold temperatures, areas with large elderly or infant populations may be most susceptible to harm, as are those areas with concentrations of low income households or those households lacking personal transportation.

Economic Impact

Major snowstorms in St. Clair County have caused nearly $188 million in property damage in the county and surrounding areas. Primary costs would include property damage and snow removal. Economic losses are dependent upon the degree of storm severity.

Critical Facilities/Services

Response to a snow related emergency would primarily be localized. Initial response activities due to emergencies from snowstorms would primarily be associated with local response from medical emergency services, public works departments, and facilities such as MDOT. Municipalities would have increased costs in snow removal activities. There would also be transportation-related impacts and schools and businesses may have to close down.

Below is a chart showing the winter storms and heavy snow falls in St. Clair County

Table 3.13: Winter Storms and Heavy Snow falls from 2006 to 2013 in St. Clair County

Counties Involved	Date	Weather Type	Deaths and Injuries/Property Damage	Amount of Snow	Temperature	Wind
7 Counties	2/13-14/2007	Winter Storm	1 death	3-5 ft.	15 below 0	NA
15 Counties	12/16/2007	Winter Storm	0	1-3 ft.	NA	35-45 mph
12 Counties	1/1/2008	Winter Storm	0	12-16 in.	NA	NA
14 Counties	2/6-7/2008	Winter Storm	52 injuries	8-18 in.	3 below 0	45 mph
10 Counties	12/12/2008	Heavy Snow	0	2-5 in.	NA	NA
7 Counties	3/4-5/2008	Heavy Snow	0	4-10 in.	NA	NA
St. Clair County	3/8/2008	Winter Storm	7 injuries	7 in.	NA	50 mph
17 Counties	12/19/2008	Winter Storm	0	6-12 ft.	NA	NA
2 Counties	2/3-4/2009	Heavy Snow	0	5-11 in.	NA	NA
11 Counties	4/5-6/2009	Winter Storm	0	1-8 in.	NA	30 mph
15 Counties	2/9-10/2010	Heavy Snow	0	5-10 in.	NA	20-30 mph
9 Counties	2/22/2010	Heavy Snow	0	2-8 in.	5 below 0	NA
7 Counties	12/12/2010	Winter Storm	0	6-15 in.	NA	25-50 mph
St. Clair County	1/11-12/2011	Heavy Snow	0	2-8 in.	NA	NA
10 Counties	2/1-2/2011	Winter Storm	1 injury	6-14 in.	NA	25-35 mph
12 Counties	2/20-21/2011	Heavy Snow	0	5-10 in.	NA	NA
3 Counties	3/10-11/2011	Heavy Snow	0	1-7 in.	NA	NA
7 Counties	3/22-23/2011	Winter Storm	$20,000 in Damages	3-8 in.	NA	NA
6 Counties	12/26-27/2012	Heavy Snow	0	6-14 in.	NA	NA
2 Counties	1/24/2013	Heavy Snow	0	1-8 in.	NA	NA
6 Counties	2/8/2013	Heavy Snow	0	6-13 in.	NA	NA

Winter Storm occurrences in St. Clair County, including number of counties the storm affected. Source: www.noaa.gov

Significant Past Occurrences

Significant snow storm events in St. Clair County include:

- **February 8, 2013:** a strengthening low pressure system tracked across the southern Great Lakes Thursday and Friday (February 7-8) bringing widespread snowfall to Southeast Michigan. Snow Started earlier across the Saginaw Valley and the Thumb, bringing the highest snowfall totals of 7 to 10 inches to that region, with generally 3 to 6 inches further south. Lesser amounts were found south of the Metro Detroit area, as dry air had to be overcome and warm air filtered in ahead of the system. This lead to a period of freezing rain and sleet with some locations reporting up to .10 inches of ice.
- **January 24, 2013:** Lake effect snow developed over Lake Huron early on January 24th, bringing up to 8 inches of heavy snow to the eastern Thumb region during the morning hours. Further inland snowfall amounts were much lighter but still amounted to 1 to 3 inches along the Interstate 69 corridor.
- **December 26-27, 2012:** The northwest flank of a significant winter storm impacted post-holiday travel across southeastern Michigan on December 26th. Widespread snow lifted across the Michigan-Ohio Stateline during the late morning hours, arriving over portions of the I-69 corridor during the mid-afternoon. While the storm system tracked through Tennessee valley transferring energy to the east coast during the afternoon, an axis of enhanced moisture became anchored over much of southeast Michigan throughout the evening. By day break of December 27th, a general 4 to 7 inches of snowfall fell southeast of a line from Bad Axe to Manchester, with amounts in excess of 10 inches common for locations in eastern St. Clair and Sanilac counties adjacent to Lake Huron.
- **March 22-23, 2011:** A strong low pressure system tracked through the Western Great Lakes, allowing a strong warm front to lift north into Southeast Michigan, resulting in a mixed bag of precipitation. Mostly snow fell north of I-69, snow and ice along I-69 and M-59 corridors, with mostly rain south of M-59. Power outages along with scattered downed trees and large limbs were reported along the I-60 corridor. A little over $20,000 was reported in damages.
- **February 9-10, 2010:** A strong pressure system passing through the Ohio River Valley dropped the largest snowfalls totals of the season across southeast Michigan. Most locations received between 5-10 inches with the highest amounts observed along the Ohio border, and in between Flint and Saginaw, where up to a foot was reported. Strong winds, gusting between 20 and 30 mph at the tail end of the storm produced blowing snow which caused some large drifts to form.
- **December 12, 2010:** A low pressure tracked near the Michigan/Ohio border and then northeast into Ontario. Precipitation started as rain before changing to snow. Snowfall accumulations across southeast Michigan were generally in the 3 to 7 inch range before Arctic air ushered in. additional Lake Effect accumulations occurred over the Thumb region, where storm totals reached 15 inches at Bad Axe. In addition, gusty winds of 25 to 40 mph occurred during Sunday afternoon which led to scattered power outages. Wind gusts to 50 mph were even reported across the northern Thumb region. The snow and blowing snow lead to Blizzard conditions over Huron and Sanilac counties, which stranded at least two dozen cars.
- **April 5-6, 2009:** A low pressure system tracking northeast through the Ohio River Valley produced a late season of heavy snowfall across Southeast Michigan. Snowfall totals averaged 1 to 4 inches south of I-94, 4 to 8 inches between I-94 and I-69, and 1 to 4 inches north of I-69. Due to the heavy snow and winds to around 30 mph, tree branches came down which resulted in power outages focused along the M-59 corridor.
- **February 6-7, 2008:** A cold front moved through Southeast Michigan. A secondary low then developed along the trailing front, with the center passing just south of the area. This allowed heavy precipitation to spread north into southeast Michigan, with predominantly snow along and north of M-59. Widespread heavy snowfall of 8 to 12 inches occurred along and north of I-69, with the heaviest snow, 16 to 18 inches occurring over Saginaw County, making this storm the biggest singe the Blizzard of 1978. Strong northeast winds off of Saginaw Bay also lead to near blizzard conditions. Road crews in Saginaw County could not keep up with the snow, which fell at a rate of 2-4 inches per hour. Two accumulations quickly, with less than 3 inches across Wayne County and points south.

- **February 13-14, 2007:** A low pressure system tracked from Arkansas to the Upper Ohio Valley and spread heavy snow north into Michigan. This Valentine's snow storm marked the season's first snowfall over 2 inches for much of the affected area. Northeasterly winds frequently gusted to 30 MPH and created extensive blowing and drifting snow. In addition, temperatures were in the single digits with wind chill values around 15 below zero. The snow began Tuesday afternoon of the 13th and became heavy at times through the evening and into the early morning hours of the 14th. The winds made it extremely difficult to measure the snow, but trained spotters estimated 6 to 9 inches of snow fell on areas along and east of a line from Port Huron to Adrian. Snow drifts from 3 to 5 feet were reported across this same area. A number of county roads were impassable, prompting officials to close some roads. Several motorists had to be rescued when their vehicles became stuck in snow drifts in Lenawee County. Although lesser amounts of snow (3 to 5 inches) fell across Livingston, Genesee, and Lapeer Counties, numerous accident and multiple cars in ditches were reported in those counties as well. Nearly all schools along and south of M-59, including Livingston County schools, closed on Valentine's Day due to the very poor road conditions. A 70 year old man from Roseville died (indirectly) of a heart attack while shoveling snow. The snow ended by sunrise on the 14th, but poor visibilities persisted for several more hours as the wind continued to blow the snow around.

Thunderstorm

Description

Thunderstorms are one of the most common and most noticeable weather products of our atmosphere. They develop in warm, moist air in advance of eastward-moving cold fronts and affect small areas when compared with hurricanes and winter storms. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes.

Nearly 1,800 thunderstorms are happening at any moment around the world. Thunderstorms are particularly dangerous since they can produce occurrences of other hazards, such as lightning, hail, strong winds, flash floods, and tornadoes. All thunderstorms produce lightning, which kills more people each year than tornadoes. Lightning is the discharge of electricity from within a thunderstorm.

Strong winds can reach up to 100 miles per hour and cause damage equal to a tornado.

According to the National Weather Service, winds 58 miles per hour or greater are classified as a windstorm. Windstorms are a fairly common occurrence in many areas in Michigan. Along the Great Lakes shoreline, strong winds occur with regularity, and gusts of over 74 miles per hour (hurricane velocity) do occasionally occur in conjunction with a storm system. Severe windstorms can cause damage to homes and businesses, power lines, trees and agricultural crops, and may require temporary sheltering of individuals without power for extended periods of time. Windstorms occur in all areas of Michigan, although more often along the lakeshore and in central and southern Lower Michigan.

Hail is a condition where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth. Hailstones range in size from a pea to a golf ball, and hailstones larger than baseballs are possible in the most severe thunderstorms. Hail is formed when strong updrafts in thunderstorms provide a medium for the growth and accumulation of ice crystals. A hailstone continues to grow until updrafts can no longer hold its weight aloft. Hailstones then descend to the ground, battering crops, denting autos, and injuring wildlife and people.

St. Clair County is certified by the National Weather Service as a StormReady Community. StormReady is a program aimed at arming America's Communities with the communication and safety skills necessary to save lives and property. StormReady prepares communities with an action plan that responds to the threat of all types of severe weather.

The Local National Weather Service forecast office worked with the St. Clair County Office of Emergency Management to complete the application and review process. To be officially StormReady, St. Clair County must:

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive severe weather forecast and warnings to alert the public;
- Create a system that monitors local weather conditions
- Promote the importance of public readiness through community seminars
- Develop a formal hazardous weather plan, which includes training server weather spotters and holding emergency exercises

Thunderstorm in Port Huron Michigan. Source: St. Clair County Emergency Management

On September 25, 2002, the National Weather Service certified St, Clair County as a StormReady Community and issued road signs for posting in the county.

Frequency

Since 1980, there have been nearly 221 thunderstorm and high wind events in St. Clair County. There have also been 52 storms that have produced hail, with hail at least one inch in size in the county since 1980.

Health and Safety

People are in danger of lightning if they can hear thunder. If the time delay between seeing lightning and hearing thunder is less than 30 seconds, there is a risk of a lightning strike. Strong winds can hurl heavy objects through the air and can break weak limbs and carry them at high speed, causing damage to property or injury to humans and animals. Hail of all sizes can be harmful to people, as well as pets and livestock. People who are in or near water, on the telephone, or just outdoors in general are more susceptible to lightning.

St. Clair County Thunder storm, June 22, 2011, Source: St. Clair County Emergency Management

Affected Areas

Hailstorms can be either widespread or centralized, and can be very brief or last for several minutes. The magnitude and severity depends on these variables as well as other conditions such as wind speed. The severity of damage also depends on the actual size of the hailstones, and whether there is dust and debris mixed with the ice.

Lightning is a common phenomenon that can cause isolated atmosphere, never reaching the ground. The severity of an actual lightning strike depends on what type of object is struck, as well as the proximity to people, animals, structures and other vulnerable objects.

Economic Impact

Thunderstorm events in St. Clair County have left close to $26 million in damage to property. These storms have caused trees to fall on structures and automobiles, have knocked down power lines, and have torn roofing off of homes, businesses, and barns.

Critical Facilities/Services

In severe thunderstorm events, local emergency responders are most likely to respond to lightning strikes. Power outages or other infrastructure failures can hinder response efforts. Severe wind and lightning can take out communications systems, which can also be detrimental to emergency response activities. Depending on

the severity of a storm event, it may take utility companies many hours or even days to get utility systems back to normal operating status. Refer to tables 3-12 – 3-14 for thunderstorm events in St. Clair County.

Table 3.14: Thunderstorms that have produced hail in St. Clair County Michigan

Location	Date	Time	Hail Size	Wind Speed	Source
St. Clair County, Smiths Creek	5/15/2007	5:10 PM	.75 Inch	60-70 mph	Trained Spotter
St. Clair County, Wadhams	8/29/2007	5:31 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Ruby	5/31/2008	11:25 AM	.88 Inch	NA	Trained Spotter
St. Clair County, Port Huron	5/31/2008	11:35 AM	.88 Inch	60 mph	Trained Spotter
St. Clair County, St. Clair	6/21/2008	2:40 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, St. Clair	6/21/2008	2:48 PM	.75 Inch	NA	NWS Employee
St. Clair County, Port Huron	6/21/2008	2:48 PM	1.25 Inch	NA	Trained Spotter
St. Clair County, Marysville	6/21/2008	2:52 PM	1.00 Inch	NA	Fire Department/Rescue
St. Clair County, Wadhams	6/21/2008	2:55 PM	1.75 Inch	NA	Trained Spotter
St. Clair County, St. Clair	6/21/2008	2:58 PM	.75 Inch	NA	Amateur Radio
St. Clair County, Port Huron	6/21/2008	3:02 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, Port Huron	6/21/2008	3:04 PM	1.75 Inch	NA	Trained Spotter
St. Clair County, Port Huron	6/21/2008	3:10 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Wadhams	6/22/2008	1:38 PM	.75 Inch	NA	Trained Spotter
St. Clair County, South Park	6/22/2008	1:44 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Yale	6/27/2008	3:28 PM	.75 Inch	NA	Public
St. Clair County, Ruby	6/27/2008	4:45 PM	.75 Inch	55 mph	COOP Observer
St. Clair County, Atkins	6/27/2008	4:55 PM	.88 Inch	NA	Trained Spotter
St. Clair County, Capac	7/16/2008	5:22 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, Brockway	7/16/2008	5:25 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, Yale	7/16/2008	5:40 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, Yale	7/16/2008	5:45 PM	1.75 Inch	NA	SHAVE Project
St. Clair County, Yale	7/16/2008	5:50 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, Yale	7/16/2008	5:55 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, Algonac	4/6/2010	11:55 AM	1.75 Inch	NA	Trained Spotter
St. Clair County, Pearl Beach	5/5/2010	2:25 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Algonac	5/5/2010	2:45 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Capac	7/17/2010	12:31 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Avoca	7/7/2010	12:47 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Atkins	7/7/2010	12:55 PM	1.00 Inch	NA	Trained Spotter

St. Clair County, Gardendale	6/22/2011	4:25 PM	1.75 Inch	NA	Public
St. Clair County, Anchorville	7/2/2011	6:48 PM	.88 Inch	NA	Trained Spotter
St. Clair County, Jeddo	8/24/2011	5:25 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Marysville	8/24/2011	7:05 PM	1.75 Inch	NA	Trained Spotter
St. Clair County, Kimball	7/15/2012	1:56 PM	.88 Inch	NA	Trained Spotter
St. Clair County, Marysville	7/15/2012	2:00 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, Marysville	7/15/2012	2:04 PM	1.00 Inch	NA	Trained Spotter
St. Clair County, Yale	5/20/2013	6:55 PM	.75 Inch	NA	Trained Spotter
St. Clair County, Port Huron	5/20/2013	7:35 PM	1.00 Inch	NA	Law Enforcement

Thunderstorms that produced hail. Source: National Oceanic and Atmospheric Administration

Table 3.15: Thunderstorms that produced high winds 2007 to 2013

Location	Date	Time	Property Damage	Wind Speed
St. Clair County, Fair Haven	5/15/2007	2:45 PM	$1,000	52 Knots (59.8 mph)
St. Clair County, Port Huron	5/15/2007	5:07 PM	0	52 Knots (59.8 mph)
St. Clair County, Smiths Creek	5/15/2007	5:12 PM	0	52 Knots (59.8 mph)
St. Clair County, Algonac	6/8/2007	1:00 PM	0	55 Knots (63.3 mph)
St. Clair County, Port Huron	7/10/2007	4:16 PM	$50,000	50 Knots (57.5 mph)
St. Clair County, Yale	8/24/2007	5:48 PM	$3,000	56 Knots (64.4 mph)
St. Clair County, Marine City	8/24/2007	6:10 PM	$2,000	55 Knots (63.3 mph)
St. Clair County, St. Clair	8/24/2007	6:12 PM	$3,000	55 Knots (63.3 mph)
St. Clair County, St. Clair	8/24/2007	6:15 PM	0	54 Knots (62.1 mph)
St. Clair County, St. Clair	8/24/2007	6:15 PM	$25,000	61 Knots (70.2 mph)
St. Clair County, Harsens Island	8/24/2007	6:23 PM	0	56 Knots (64.4 mph)
St. Clair County, Algonac	8/24/2007	6:27 PM	$3,000	56 Knots (64.4 mph)
St. Clair County, Capac	8/29/2007	5:02 PM	$15,000	54 Knots (62.1 mph)
St. Clair County, Marysville	9/11/2007	5:00 PM	0	50 Knots (57.5 mph)
St. Clair County, Ruby	5/31/2008	11:25 AM	0	52 Knots (59.8 mph)
St. Clair County, Port Huron	6/6/2008	9:28 PM	0	56 Knots (64.4 mph)
St. Clair County, Port Huron	6/6/2008	9:30 PM	0	54 Knots (62.1 mph)
St. Clair County, Capac	6/6/2008	4:23 PM	$1,000	54 Knots (62.1 mph)
St. Clair County, Marine	6/8/2008	4:36 PM	$1,000,000	74 Knots (85.1 mph)

City				
St. Clair County, Port Huron	6/8/2008	4:45 PM	$1,000	52 Knots (59.8 mph)
St. Clair County	6/26/2008	4:30 PM	0	52 Knots (59.8 mph)
St. Clair County, Atkins	6/27/2008	4:55 PM	0	52 Knots (59.8 mph)
St. Clair County, Port Huron	7/22/2008	5:43 PM	$5,000	52 Knots (59.8 mph)
St. Clair County, Brockway	4/25/2009	1:30 PM	$2,500	65 Knots (75.8 mph)
St. Clair County, Riley Center	4/25/2009	1:30 PM	$25,000	56 Knots (64.4 mph)
St. Clair County, Blaine	4/25/2009	1:37 PM	$25,000	56 Knots (64.4 mph)
St. Clair County, Jeddo	4/25/2009	1:40 PM	$25,000	56 Knots (64.4 mph)
St. Clair County, Thornton	4/25/2009	1:45 PM	0	52 Knots (59.8 mph)
St. Clair County, Port Huron	4/25/2009	1:50 PM	$6,000	59 Knots (67.9 mph)
St. Clair County, Blaine	4/25/2009	1:50 PM	$25,000	56 Knots (64.4 mph)
St. Clair County, Fair Haven	4/25/2009	6:05 PM	0	52 Knots (59.8 mph)
St. Clair County, Anchorville	8/9/2009	7:35 PM	$1,000	52 Knots (59.8 mph)
St. Clair County, Lakeport	8/20/2009	1:45 PM	0	52 Knots (59.8 mph)
St. Clair County, Lakeport	8/20/2009	1:45 PM	0	50 Knots (57.5 mph)
St. Clair County, Jeddo	8/20/2009	1:45 PM	0	50 Knots (57.5 mph)
St. Clair County, Port Huron	8/20/2009	2:05 PM	$18,000,000	57 Knots (65.6 mph)
St. Clair County, Pearl Beach	7/11/2010	2:30 PM	$20,000	52 Knots (59.8 mph)
St. Clair County, Yale	7/15/2010	4:49 PM	0	52 Knots (59.8 mph)
St. Clair County, Anchorville	7/18/2010	7:00 PM	0	50 Knots (57.5 mph)
St. Clair County, Marysville	6/16/2011	4:55 PM	$5,000	50 Knots (57.5 mph)
St. Clair County, Algonac	6/21/2011	4:25 PM	0	52 Knots (59.8 mph)
St. Clair County, Anchorville	6/21/2011	9:31 PM	0	52 Knots (59.8 mph)
St. Clair County, Port Huron	6/21/2011	10:15 PM	$3,000	52 Knots (59.8 mph)
St. Clair County, Lakeport	6/22/2011	4:24 PM	$15,000	56 Knots (64.4 mph)
St. Clair County, Port Huron	6/22/2011	4:25 PM	$12,000	65 Knots (75.8 mph)
St. Clair County, Emmett	7/2/2011	5:49 PM	$15,000	54 Knots (62.1 mph)
St. Clair County, Grande Pt.	7/2/2011	7:07 PM	0	52 Knots (59.8 mph)
St. Clair County, Algonac	8/24/2011	7:48 PM	0	50 Knots (57.5 mph)
St. Clair County, Anchorville	9/3/2011	8:15 PM	$10,000	56 Knots (64.4 mph)
St. Clair County, Port Huron	6/21/2012	3:30 PM	$150,000	50 Knots (57.5 mph)
St. Clair County, Adair	6/21/2012	4:28 PM	0	52 Knots (59.8 mph)
St. Clair County, Ruby	4/18/2013	2:49 PM	0	56 Knots (64.4 mph)

St. Clair County, Port Huron	4/18/2013	2:49 PM	0	56 Knots (64.4 mph)
St. Clair County, Starkville	5/22/2013	5:30 PM	0	50 Knots (57.5 mph)
St. Clair County, Brockway	5/29/2013	7:01 AM	0	52 Knots (59.8 mph)
St. Clair County, Smiths Creek	5/29/2013	7:02 AM	0	52 Knots (59.8 mph)
St. Clair County, Port Huron	5/29/2013	7:07 AM	0	52 Knots (59.8 mph)
St. Clair County, Port Huron	5/30/2013	2:27 PM	0	56 Knots (64.4 mph)
St. Clair County, Port Huron	5/30/2013	2:40 PM	$10,000	59 Knots (67.9 mph)
Total In Damages			$19,448,500	

High wind events in St. Clair County, Source: NOAA (National Oceanic and Atmospheric Administration).

Table 3.16: Strong wind events in St. Clair County

Counties Involved	Date	Time	Property Damage	Wind type	Max Wind Knots
St. Clair County, plus 8 Other	4/16/2007	11:00 AM - 6:00 PM	$35,000	Strong Wind	43 Knots (49.4 mph)
St. Clair County, plus 10 Other	12/23/2007	7:00 AM - 10:00 AM	$35,000	High Winds	50 Knots (57.5 mph)
St. Clair County, plus 10 Other	1/30/2008	4:00 Am - Noon	0	High Winds	50 Knots (57.5 mph)
St. Clair County, Plus 2 Other	9/14/2008	5:00 PM - 8:00 PM	$10,000	Strong Wind	43 Knots (49.4 mph)
St. Clair County, Plus 16 Other	12/28/2008	4:00 AM - 10:00 AM	$50,000,000	High Winds	56 Knots (64.4 mph)
St. Clair County, plus 6 Others	10/7/2009	12:00 AM - 8:00 AM	$10,000,000	High Winds	50 Knots (57.5 mph)
St. Clair County, Plus 16 Other	9/7/2010	6:00 PM - 10:00 PM	$5,000	Strong Wind	39 Knots (44.8 mph)
St. Clair County, Plus 9 Others	10/27/2010	4:00 PM	$5,000	High Winds	52 Knots (59.8 mph)
St. Clair County, Plus 16 Other	10/15/2011	9:00 AM - 3:00 PM	$2,000	Strong Wind	39 Knots (44.8 mph)
St. Clair County, plus 6 Other	3/2/2012	9:00 PM - 2:00 AM	$15,000	High Winds	50 Knots (57.5 mph)
St. Clair County, Plus 6 others	4/16/2012	11:00 AM - 4:00 PM	$15,000	High Winds	50 Knots (57.5 mph)
St. Clair County, Plus 2 other	10/29/2012	10:00 PM - 10:00 AM	$10,000	High Winds	64 Knots (73.6 mph)
St. Clair County, Plus 13 Other	1/19/2013	11:00 PM - 5:00 AM	$1,000,000	High Winds	53 Knots (61 mph)

Strong wind events in St. Clair County Michigan. Source: NOAA

Significant Past Occurrences

The worst hail storm occurred in Algonac in July 2000, when hail nearly 3 inches in size caused over $125,000 in property damage.

Lightning often occurs with thunderstorms throughout the year in St. Clair County. Since 1990, there have been four major lightning events associated with thunderstorms:

- **August 29, 2007:** a strong cold front moved through Southeast Michigan during the peak heating of the day and led to another big event, especially for late August. Severe thunderstorms with large hail and damaging wind gusts impacted nearly all of the Southeast Lower Michigan, including all neighboring marine areas. A couple of storms across the Thumb showed rotation and prompted the issuance of a couple of tornado warnings. No tornadoes were reported. Lightning struck the National Weather Service office during this event, causing total damages in excess of $15K.
- **January 30, 2008:** a strong cold front moved through southeast Michigan just before midnight, with strong post frontal wind gusts of 50 to 60 mph reported across much of the area. The highest wind occurred across the Thumb region, extending south into the Detroit Metro area. A few buildings and houses sustained damage, mostly shingle and roof damage. Trees and power lines were blown down, which led to power outages. Utility companies reported thousands of residents and businesses lost power due to downed power lines across the northern Thumb region, with close to 100,000 in the Lower Peninsula, with a majority of those occurring in southeast Michigan.
- **October 7, 2009:** A strong pressure system tracked north of the Great Lakes region, with the associated cold front swinging through Lower Michigan. Wind gusts between 45-55 mph over a six to eight hour time frame during the morning hours. With leaves still on the trees, tree branches and trees were reported down in and around the Detroit Metro Area. About 110,000 customers were without power from this event.
- **September 7, 2010:** Wind gusts between 40 and 50 mph across southeast Michigan, with the strongest winds occurring over the Detroit Metro area. A few trees and tree branches were blown down, some of which fell onto power lines. Very low humidity levels, less than 25%, allowed the sparking wires to touch off fires across Wayne County. The wind swept fires destroyed 90 occupied homes and damaged 71 vacant homes and garages. No injuries were reported.
- **October 15, 2011:** A strong cold front pushed through southeast Michigan, with post frontal westerly wind gusts up around 45 mph. Tree limbs and power lines were brought down, which led to 85,000 customers to be without electricity.
- **October 29, 2012:** The remnants of Hurricane Sandy caused strong northerly winds over southeast Michigan, gusting between 55 and 65 mph over the Thumb Region with isolated 70 mph along the shoreline. Numerous trees and power lines were downed in the Thumb region. Some minor beach erosion was reported as well. Northerly wind gusts of 45 to 50 mph lead to some isolated downed trees and tree limbs over the rest of southeast Michigan due to the unusual wind direction which affected weaker tree structures. $10,000 was reported in damages and many without power for days.
- **April 18, 2013:** A warm front lifted through Southeast Michigan, with strong winds within the warm sector leading to gusts up to 60 mph over Washtenaw and Wayne Counties, causing a few downed trees and power lines. A surface through then initiated scattered severe thunderstorms which produced wind damage. Trees were reported down, no damage was reported.

Wildfire

Description

A wildfire is an uncontrolled fire in forested areas, grass or brush lands. The most immediate dangers from wildfires are the destruction of homes and timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area. Long-term effects can be numerous and

include scorched and barren land, soil erosion, landslides, mudflows, water sedimentation, and loss of recreational opportunities.

The risk is increased and compounded by increasing development within the zone commonly referred to as the "urban-wildland interface." Within this zone of natural landscape, buildings become additional fuel for fires when fires do occur. Most wildfires are man-caused and occur in the interface of developed lands and forest and range lands. In particular, the dry conditions, high temperatures, and low humidity that characterize drought periods set the stage for wildfires.

Harsen Island Grass Wildfire. Source: www.media2.wxyz.com

According to the Michigan State Police Emergency Management Division, in any given year, between 6,000 and 8,000 wildfires occur in Michigan, and they damage or destroy around 200 homes and outbuildings. While most of these are small wildfires – burning between 5 and 50 acres – many wildfires exceed 100 acres and some have consumed thousands of acres. Wildfires occur throughout the spring, summer and fall, however, most wildfires in Michigan take place in March, April, and May. During this period, much of the existing vegetation has been killed due to winter temperatures and most of the vegetation is dead, brown and combustible. Also, there is little green vegetation to serve as a barrier for a moving wildfire. In the spring, residents are raking yards and collecting yard waste that has accumulated over winter. Many residents elect to burn their yard waste, leave the fire unattended, leading to the majority of wildfires. The Michigan Department of Natural Resources (MDNR) estimates that one-third to one-half of Michigan wildfires are due to people burning debris. A common cause of wildfires is use of illegal burn barrels. According to Michigan law, a burn barrel must have a lid and holes no larger than 1 inch in diameter. Burning embers called firebrands can float out of an open barrel and into nearby vegetation.

Frequency

The Michigan Department of Natural Resources (DNR) reported 96 wildfires in St. Clair County from 1981-2000 on lands managed by the MDNR. While these fires have varied in size and damage, the majority of them seem to have been caused by human factors such as the improper disposal of cigarette butts, careless campfire tending, and/or burning debris. Time of year is also a factor as more fires are reported during the summer months when more people are active outdoors and the warmer weather creates a more conducive environment to support burning vegetation.

Table 3.17: 2013 Wildfires by Cause to Date

Cause	Percentage
Incendiary	2%
Debris Burning	38%
Railroad	0%
Campfire	5%
Smoking	2%
Equipment	13%
Lightning	3%
Burning Building	0%
Power Line	6%
Fireworks	2%
Misc.	27%
Children	2%

Source: Department of Natural Resources

Health and Safety

The dangers of wildfires cannot be under estimated. Wildfires create situations that can lead to severe injuries or even fatalities to people and to firefighters trying to extinguish a blaze.

Affected Areas

St. Clair County had a total of 82,714 acres of woodland and wetland areas and 50,882 acres of grass and shrub land in 2000. Populations and development adjacent to open space or vacant land will be directly affected in the event of a wildfire. The extent of the affected area depends greatly on response time and fire control. Open spaces and vacant land are most at-risk for forest or field fires. There are also many areas in the county where residents have homes on large secluded, wooded lots. This means there will be an increase in activities that can lead to wildfire and emergency responders may have a more difficult time accessing the site.

Economic Impact

Responding to these wildfires is financially taxing to the jurisdictions involved - both in the cost of fighting the fire and in the recovery of damage. Secondary effects of forest or field fires include infrastructure damage, timber loss, property loss, wildlife loss and loss of life or injury to persons.

Critical Facilities/Services

There are 21 fire departments that respond to fires within St. Clair County. The ability for firefighters and first responders to mitigate a wildfire depends on many factors, including the weather condition, as dryer and windier conditions yield a higher vulnerability to the spreading of fire; the size of the affected or vulnerable area; and the accessibility for emergency vehicles.

Significant Past Occurrences

Past Wildfires in St. Clair County include:

- **April 4, 2013:** A fire ripped through the area of Green Drive near the airport on Harsens Island after it was reported at 3:35 pm. The fire was mostly put out by 6 pm that night after multiple fire agencies helped tackle the blaze. There were no injuries or damaged buildings; the cause of the fire was unknown.

Structure Fire

Description

Structure fires are fires in urban, suburban or rural areas where structures and their contents are the primary fire fuel. Ever since the first volunteer fire department was established in the United States in 1648, the primary focus of most fire departments has been to reduce the risk of structure fires. Historically, structure fires have posed the greatest threat to both property and life safety. In dealing with structure fires, fire departments have three primary objectives: first, to minimize casualties; second, to prevent a single structure fire from spreading to other structures; and third, and to minimize damage to the structure and contents. Structural fires impact both urban and rural areas of the county. Rural homes are susceptible during the winter due to fires associated with wood stoves or other modes of heating, and in the summer months due to wildfires. Urban areas are equally at risk as it can be difficult to limit the spread of a fire to surrounding buildings.

In terms of average annual loss of life and property, structural fires - often referred to as the "universal hazard" because they occur in virtually every community - are by far the biggest hazard facing most communities in Michigan and across the country. Each year in the U.S., fires result in approximately 5,000 deaths and 300,000 injuries requiring medical treatment.

Frequency

Between 2009 and 2011, St. Clair County has averaged 23.5 fires per year. In 2009, there were 35 total fires in St. Clair County that caused over $10,000,000 in property damage. Seventeen percent of those fires were attributed to arson or suspicion of arson. In 2010, there were 18 total fires in the county and in 2011, there were 19 total fires.

Table 3.18: St. Clair County Fires, 2001-2011

Year	Arson per 100,000
2001	17.1
2002	0
2003	0
2004	16.9
2006	0
2007	33.7
2008	0
2009	34.7
2010	17.7
2011	18.2

Arsons per 100,000 per year.
Source: SEMCOG Data

Firefighters battle large fire in downtown Yale. Source: www.wxyz.com

Health and Safety

According to the United States Fire Administration, there were 3,925 civilians that lost their lives as the result of fire and 18,125 civilian injuries that occurred as the result of fire. Nationally, 81% of all civilian fire deaths occurred in residences. People are at risk for smoke inhalation and/or severe burns. In particular, children constitute special planning considerations since they tend to be curious about fire, especially when they have easy access to matches or lighters.

Affected Areas

Structure fires are usually confined to the structure that is burning. However, depending on how quickly the fire spreads, how close structures are to one another, and what the weather conditions are like, structure fires can potentially spread to adjacent structures or abutting open spaces. Run down or abandoned structures are especially susceptible to arson.

Economic Impact

Structure fires, especially those caused by arson, can decrease the attractiveness of neighborhoods or business districts and lead to a loss of residents, businesses, or customers.

Critical Facilities/Services

The ability for firefighters and first responders to mitigate a structure fire depends on many factors, including the weather conditions, as dryer and windier conditions yield a higher vulnerability to the spreading of fire; the size of the affected or vulnerable area; and the accessibility for emergency vehicles. Fire hazards rarely reach the extent of a disaster, although it is possible given the right circumstances.

Significant Past Occurrences

Significant structure fires in St. Clair County include:

- **September 26, 2013**: House fire in the 1400 block of 17th street. No injury, fire was contained to the kitchen, damage in kitchen only.
- **February 15, 2013:** 1 dead from house fire in Berlin Twp. 4 people were in the house when it started, 3 made it out uninjured, one was not able to escape, cause of fire unknown.
- **February 11, 2014:** A fire broke out around 5 am in a downtown business located in Yale. Crews arrived on scene shortly before 6 am. Efforts to extinguish the fire were complicated by the collapsed roof and unstable walls within the burning structure. They water used to extinguish the fire froze in single-digit temperatures. At one point it was unclear if the fire was going to take out the whole block, however the crews were able to contain the fire to one building, although the adjacent buildings did

suffer a little bit of smoke damage. This fire either directly or indirectly affected every fire department in St. Clair County, 5 departments in Sanilac County, 3 in Lapeer County, and 2 in Macomb County.

- **June 26, 2014:** Structure fire at 1920 Ninth Street in Port Huron. Ninth Street was closed between Minnie and Bancroft. Flames were showing from the back of the home upon arrival shortly after 8 pm. Fire damage was contained to the back of the house.
- **July 3, 2014:** Rescue crews extinguished a garage fire in Kimball Township. The incident happened at 3 am in the 1400 block of Wadhams Road. St. Clair County Sheriff deputies evacuated 1 person from the home before fire crews arrived. No injuries and the flames caused minor damage to the garage.

Drought

Description

Drought is generally defined as a condition of climatic dryness severe enough to reduce soil moisture and water supplies below the requirements necessary to sustain normal plant, animal, and human life. Agricultural drought is considered a dry period of sufficient duration and intensity that crop and animal agriculture are markedly affected. Hydrologic drought is considered a long-term condition of abnormally dry weather that ultimately leads to the depletion of surface and ground water supplies. During hydrologic drought, a significant reduction in flow of rivers, streams, and springs is notable. Drought can also adversely affect urban areas – particularly those dependent on reservoirs for their water. Decreased water levels due to insufficient rain can lead to restriction of water uses and amounts. It is difficult to predict or forecast when a drought will begin, and how long it will last.

Frequency

There have been two major drought events in St. Clair County since 1980. In addition, there have been several periods of below normal precipitation and above average temperatures, which have had a limited effect on the community at large. Because a large portion of St. Clair County's economy is based upon agriculture and industry, a drought could negatively alter the quality and quantity of crops, livestock, and other agricultural activities, resulting in severe economic and social hardships throughout the community.

Health and Safety

Drought could result in possible loss of human life due to extreme heat, food shortages, fire, and other heat and health related problems could be caused by diminished sewage flows and increased pollutant concentrations in surface water.

Affected Areas

Agriculture is by far the most prevalent land use, land cover type in St. Clair County. In 2000, the county had 242,034 acres of active agricultural land. Impacts primarily would affect those employed in agriculture. Drought affects large widespread areas. However, the greatest impact is generally to agricultural lands. Natural resources such as lakes, streams, and other bodies of water could be affected by decreases in water levels. Also, fires resulting from drought can result in the destruction of trees and other natural habitats, as well as homes and businesses.

Economic Impact

A drought can cause severe economic hardships that impact communities and regions. One of the most common and severe impacts to a community like St. Clair County would be the drop in quantity and quality of agricultural crops. The direct impacts of drought can cause other indirect impacts to a community, such as reduced revenue in other areas of agriculture, retail, declines in land values due to physical damage from drought conditions, and decreased functional use of properties.

Critical Facilities/Services

Most facilities impacted from drought would be related to agriculture. Farms, large grain facilities, fruit and vegetable vendors and markets could potentially see a significant decrease in production and sales. Drought

may cause agricultural operations to utilize irrigation systems more and result on the lowering of the water table, which could affect private water wells of surrounding homes.

Local and regional governmental services may be required to respond to drought. However, if the severity of the drought is significant, State and Federal assistance could be required. Agricultural services and departments such as the Farm Bureau Agency and The U.S. Department of Agriculture may also be required to provide assistance.

Significant Past Occurrences

St. Clair County has experienced two drought events since 1980. September 2002 was hot and dry from the northern suburbs of Detroit to the Midland-Bay City-Saginaw area. Most areas in those regions recorded .05 inches of precipitation during the first half of the month. Moreover, record high temperatures were set all across the eastern half of Michigan. The heat was just an extension of a hot and dry July and August, which made drought conditions worse. Water restrictions were implemented in many communities and farmers were hit hard. September yields were estimated at below 50% and many counties were declared agricultural disaster areas.

St. Clair County Beaches. Source: www.facebook.com/StClairCountyBeaches.

The other major drought occurred in July 2001 when an upper level high pressure ridge took over the weather pattern across southeast Michigan. This ridge prevented rainfall from entering the region from the west. As a result, the entire region was hit with a dry spell. Water conservation measures had to be enacted across the metropolitan Detroit area. It is estimated that yields of corn, soybeans and dry beans were one-third of their normal yield.

Two of the Great Lakes have hit their lowest water levels ever recorded, according to NOAA, capping more than a decade of below normal rain and snowfall and higher temperature that boost evaporation. Measurements taken in January 2013 show Lake Huron and Michigan have reached their lowest ebb since record keeping began in 1918, and the lakes could set additional records over the next few months. The lakes were 29 inches below their long-term average and had declined 17 inches since January 2012. The other Great Lakes – Superior, Erie and Ontario - were also well below average. The low water has caused heavy economic losses by forcing cargo ships to carry lighter loads, leaving boat docks high and dry, and damaging fish-spawning areas. Studies show that Huron and Michigan fell by 10 to 16 inches due to the warming weather and dredging.

Agriculture Pests and Invasive Species

Description

Agriculture has been a strong economic component throughout St. Clair County's history. Farms create jobs and produce revenue for county residents and grow crops consumed within the county and around the world. Local orchards and truck farms are especially popular because of the local character they provide and the produce they bring to community farmers' markets.

Agricultural pests are an important factor in reducing crop yields or in raising costs, thereby limiting the competitive advantage of southeastern farmers. St. Clair County crops include corn, soybeans, hay, wheat, pumpkins, apples, tomatoes, and snap beans. Common agricultural pests include the armyworm, the Colorado potato beetle, and the seed corn maggot. In addition, weeds compete with crop plants for moisture, nutrients, light and space and can interfere with harvest operations.

An invasive plant known as the Phragmites, found in the Great Lakes Region. Source: Coastal Habitat Restoration and Conservative.

An invasive species hazard is defined as a plant or animal that is nonnative (or alien) to the local ecosystem and whose introduction causes or is likely to cause economic harm, environmental harm, or harm to human health. Invasive species also pose a threat to water bodies, vegetation, and woodlands in St. Clair County. St. Clair County is one of the counties with the most invasive species with 305 invasive species reported.

Frequency

There have been many occurrences of invasive or exotic species in Michigan and in St. Clair County. Exotic species impact nearly half of the species currently listed as "Threatened" or "Endangered" under the U.S. Federal Endangered Species Act.

Health and Safety

While it is acknowledged that invasive species are unlikely to cause casualties or injuries, they can cause substantial damage to the natural environment and also have large economic impacts.

Affected Areas

The location of this hazard can be anywhere in St. Clair County as this hazard is not location specific. Invasive species can negatively impact both water and land ecosystems.

Economic Impact

Restoring ecosystems to their natural states and eradicating invasive species to help native species thrive can be an expensive battle for local governments. Often times, public-private partnerships are necessary to be successful. Severe infestations can lead to poor aesthetic character and can harm tourism-related activities.

Critical Facilities/Services

Local, state, and federal governmental services, as well as a variety of public and private agencies, may be required to manage invasive species. All of these agencies will require some participation from landowners to protect natural and aesthetic resources.

The National Fire Danger Rating System has designated phragmites as a fire hazard described as "Marsh situations where the fuel is coarse and reed-like. One third of the aerial portion of the plants is dead. Fast-spreading, intense fires can occur even over standing water." – National Fire Danger System, Gen. Tech Rep – INT 169, 1983

Significant Past Occurrences

Invasive plants that have impacted St. Clair County include:

- **Phragmites:** Also known as common reed is a perennial wetland grass that can grow up to 15 feet in height and leaves are often 8 to 16 inches long and ½ to 2 inches wide near the base, tapering to a point at the end. Phragmites has gray-green foliage during the growing season, with distinctive purple-brown-silver seed head plumes appearing by late July. Phragmites grows in large areas and creates dense stands. It is capable to grow by seeds, but primarily does so asexually by means of rhizomes. Mechanical cutting is one way to control phragmites; however, it results in accelerated regrowth and the expansion of the growth area.

Local officials are attempting to control Phragmites through these controlled burns. Photo courtesy of: St. Clair County Emergency Management

- **Purple Loosestrife:** A beautiful but aggressive invader, perennial that grows from .5-1.5 meters (1.6-5 ft.) in height. Habitat occurs in moist soils, in wet meadows and prairies, shallow marsh, ditches, waste areas and along lakes, ponds, streams and rivers. When a purple loosestrife gets a foothold, the habitat where fish and wildlife feed, seek shelter, reproduce and rear young, quickly becomes choked under a sea of purple flowers. Purple loosestrife also invades drier sites, which concern is increasing as the plant becomes more common on agricultural land, encroaching on farmers' crops and pasture land. An estimated 190,000 hectares of wetlands, marshes, pastures and riparian meadows are affected in North America each year, with an economic impact of millions of dollars.

- **Curly Pondweed:** A submergent, aquatic perennial; range from 30-80 cm (1-2.5 ft.) in length; and forms dense mats. Leaves alternate, oblong, up to 9 cm (3.5 in) long and 10 cm (4 in) wide, wavy leaf margins with fine teeth. Flowers are found on dense cylindrical spikes that rise above the water. The habitat life grows in shallow to deep waters of lakes and rivers; pollution-tolerant; prefers alkaline, nutrient-rich waters. The curly pondweed reproduces by vegetative buds (turions), fragmentation; carried by water and boats. No seed germination observed. It has spread to almost every state, where it grows into thick mats that can make lakes impenetrable for boats and swimmers. It can make it impossible for native plants to grow, affecting fish and wildlife. Once established, it can be managed but not eradicated.

Invasive species that have impacted St. Clair County include:

- **Round Goby:** In 1990, a small stowaway was dumped from the ballast tank of an ocean-going freighter in the waters of the St. Clair River. Two decades later, the round goby, an aggressive, voracious bottom-dwelling fish has invaded all five Great Lakes and has had profound impacts on other fish populations. Round gobies have been linked to declines in populations of other bottom-dwelling Great Lakes native fish like mottled sculpin, log perch, and darters. Gobies consume the eggs and fry to lake

Zebra Mussels which have overtaken the Great Lakes causing problems in clogging pipes and power plants. Source: Great Lakes Information Network

trout, posing a substantial threat to this economically andecologically valuable native fishery. They are also troublesome to recreational anglers given their ability to "steal" bait, replacing the catch of desired species such as walleye.

- **Sea Lamprey:** (Petromyzon marinus) are predaceous, eel-like fish native to the coastal regions of both sides of the Atlantic Ocean. They entered the Great Lakes through the Welland Canal about 1921. They contributed greatly to the decline of whitefish and lake trout in the Great Lakes. Since 1956, the governments of the United States and Canada, working jointly through the Great Lakes Fishery Commission, have implemented a successful sea lamprey control program.

- **Zebra Mussels:** (Dreissena polymorpha) are small, fingernail-sized mussels native to the Caspian Sea region of Asia. Considered one of most damaging of the invasive species introduced to this country, zebra mussels were transported to the Great Lakes in ballast water from a transoceanic vessel. Since that time, they have spread rapidly to all of the Great Lakes and waterways in many states. One of the zebra mussels most defining characteristics is its tendency to colonize hard substrates (e.g. rocky bottom and water intake structures) in high densities, with as many as tens of thousands living in a square yard. They have had deleterious effects on local ecosystems. They reduce the amount of phytoplankton available for other organisms and increase water clarity, causing changes to the ecological structure of the lake community. Zebra mussels cause a great deal of economic damage by clogging intake pipes of water treatment and power plants as well as boat engine cooling systems. Unfortunately, solutions to these problems are few and not highly effective, resulting in high costs for cleaning and control measures.

Invasive species have negative ecological, economic, and social and public health impacts. They have been widely identified as a serious threat to global and local biodiversity. Once established they often out-compete native species for limited resources such as food and habitat, alter and damage existing habitat, displace native species and in some cases pre directly upon native species. Their impacts are found in our waterways, along our roadsides, in our wilderness areas and in both rural and urban communities. The Michigan Department of Natural Resources recognizes these threats and is working hard to prevent new invasions, limit the spread of existing invasions and limit their associated impacts.

The Department of Natural Resources