Tri-County Regional Hazard Mitigation Plan

For

Clinton, Eaton, Ingham Counties
And
Delta Charter Township
In Mid-Michigan

Prepared by
Tri-County Regional Planning Commission
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EXECUTIVE SUMMARY

The Tri-County Regional Hazard Mitigation Plan was created to protect the health, safety, and economic interests of residents and businesses in Clinton, Eaton, and Ingham Counties and Delta Charter Township in mid-Michigan's greater Lansing region. The regional Plan will reduce the impacts of natural and technological hazards through hazard mitigation planning, awareness, and implementation.

This Plan is the foundation for hazard mitigation activities and actions within Michigan's Tri-County Capital area region. Implementation of recommendations will reduce loss of life, destruction of property, and economic losses due to natural and technological hazards. The plan provides a path toward continuous, proactive reduction of vulnerability to hazards that result in repetitive and oftentimes severe social, economic and physical damage. The ideal end state is full integration of hazard mitigation concepts into day-to-day governmental and business functions and management practices.

This Plan employs a broad perspective in examining multi-hazard mitigation activities and opportunities in the Tri-County region. Emphasis is placed on hazards that have resulted in threats to the public health, safety and welfare, as well as the social, economic and physical fabric of the community. The plan addresses such hazards as floods, tornadoes, windstorms, winter storms, forest fires, structural fires, hazardous material incidents, and secondary technological hazards that result from natural hazard events. Each hazard was analyzed from a historical perspective, evaluated for potential risk, and considered for possible mitigative action. The plan also lays out the legal basis for planning and the tools to be used for its implementation.

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Preface

This 2015 Tri-County Regional Hazard Mitigation Plan provides a combined plan with updated data, opportunities, and recommendations to address hazards in the mid-Michigan area. This Plan offers actions that complement and expand on existing efforts and provide a strong foundation for hazard mitigation activities and actions within the region. In mid-Michigan, Clinton, Eaton and Ingham Counties and Delta Charter Township make up an active Emergency Management community. Together they implement related programs and initiatives that improve the general health, safety and welfare within the region. They have worked together through the Tri-County Regional Planning Commission to improve and update this regional Hazard Mitigation Plan.

Although not all hazards can be mitigated completely, implementation of recommendations in this plan will reduce loss of life, destruction of property, and economic losses that result from natural, technological and human-related hazards. This Plan provides a path toward continuous, proactive reduction of vulnerability to hazards, and can prevent repetitive and oftentimes severe social, economic and physical damage. One important goal for our region is to fully integrate hazard mitigation concepts into routine governmental and business functions and management practices including planning, regulation, procedures and policy.

This new Plan is a regional plan. In 2005, Ingham, Clinton and Eaton Counties and Delta Charter Township completed four separate hazard mitigation plans. In 2015, these same entities now adopt a combined plan that meets the requirements of the Federal Emergency Management Agency (FEMA). This plan provides updated data on our region. It was developed with public input and with expert input from area emergency managers, municipal officials, and various municipal and infrastructure managers so the Plan describes the processes used to develop the plan. This Plan includes new goals and objectives that were not in previous plans.

This Plan employs a broad perspective in examining multi-hazard mitigation activities in the Michigan's Capital area region. Emphasis is placed on hazards that result in threats to the public health, safety and welfare, as well as those that impact the social, economic and physical fabric of the region. The plan addresses such hazards as floods, storms, hazardous material incidents, and school/institutional violence. The Plan provides a historical analysis of each hazard, evaluates each hazard for potential risk, and shares possible mitigation actions. This Plan also lays out the tools and strategies to be used for its overall implementation.

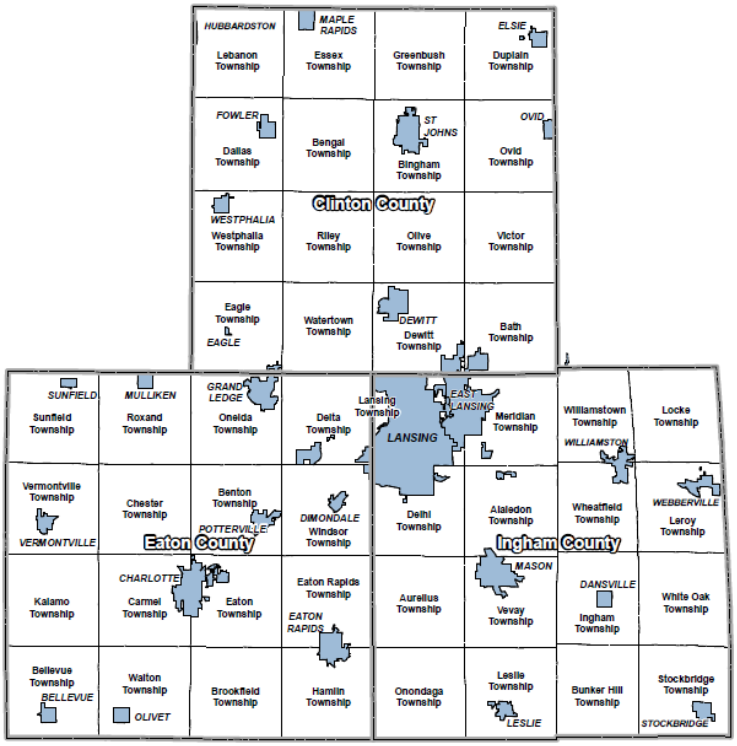
This Plan is a step toward fully integrating hazard mitigation into the normal operation of government and business. In the process of completing this Plan update, substantial effort was made to incorporate a range of expertise and information regarding local hazards. In addition, the Plan process included opportunities for the community to make adjustments so that it accurately represents specific jurisdictions, businesses and changes in our region. This Plan will remain active for a period of five years. Regional leaders should review and update this Plan again by 2020.

Chapter 1 - Planning Background and Process

Hazard mitigation is any action taken before, during, or after a disaster to permanently eliminate or reduce the long-term risk to human life and property. This 2015 Tri-County Regional Hazard Mitigation Plan provides a framework to enhance the general health, welfare and safety of residents in mid-Michigan's Ingham, Clinton and Eaton Counties and Delta Charter Township (see map below). Each of these four jurisdictions are continuing their participation since the adopting their 2004 Hazard Mitigation Plans. This Plan considers the potential impact of natural, technological and social hazards on our region, and identifies some level of mitigation for each hazard.

Hazard mitigation is an essential element of emergency management, along with preparedness, response, and recovery. There is a cyclical relationship between the four phases of emergency management. A community prepares for a disaster, and then responds when it occurs. Following the response, there is a transition into the recovery process when mitigation measures are evaluated and adopted. This, in turn, improves the preparedness of the community for the next incident, and so on. When successful, mitigation will lessen the impacts to such a degree that succeeding incidents will remain incidents and not become disasters. This Plan updates a regional plan adopted in 2004. All jurisdictions depicted in the map below are represented in this updated Plan except for the City of Lansing, which updated their plan separately.

Fig.1 Map of Tri-County Region



Source: TCRPC

The Greater Lansing Michigan Metropolitan Area last acted on its hazard mitigation plans with the 2004 adoption of four plans: the Ingham County plan, Clinton County plan, Eaton County plan and Delta Charter Township plan. We provide here the regional hazard analysis, mitigation actions, in support of each of those goals. There is brief comment on implementation steps for this Plan, but that is discussed at more length throughout the document.

The hazard mitigation planning process is a public and transparent activity with many steps and initiatives over time. The planning process is punctuated by specific planning events, activities, and documents. They included reestablishing goals and objectives, scoping and technical analyses, soliciting and integrating the needs and desires of our region's populace, then sharing and seeking responses to the resultant proposed plan. This chapter describes the planning steps implemented to update our 2004 plans.

The Tri-County Regional Planning Commission is committed to ensuring that citizen input figures prominently in the planning process. We implement a multi-faceted process to include citizens, residents, visitors, and others in developing, reviewing, and commenting on the Plan. In the development of this updated Plan, we sought input through traditional public meetings online forums, committee and workgroup sessions, public comment periods, and other approaches.

In addition to soliciting public participation, TCRPC acknowledges the critically important role of cooperating, collaborating, and coordinating regional activities with the many agencies and organizations with roles in transportation. This chapter also describes the consultation process that we followed for this Plan. We consulted with agencies and organizations responsible for land use planning, transit, air travel, non-motorized travel, environmental protection, natural resources management, economic development, human services and assistance, and community development. Their technical and specific expertise was invaluable in developing our regional plan.

Of the 78 local jurisdictions within the tri-county region, the following are those who have actively participated in this plan update as of its finalization and local adoption in July 2015:

Ingham County	**Total 2010 population:**	**280,895**
City of East Lansing	population:	46,605
Meridian Charter Township	population:	39,685
Williamstown Township	population:	4953
City of Williamston	population:	3864
Village of Dansville	population:	563
Village of Webberville	population:	1272
City of Mason	population:	8261
Delhi Charter Township	population:	25,873

Lansing Charter Township	population:	8114
Eaton County	**Total 2010 population:**	**107,759**
Delta Charter Township	population:	32,405
City of Grand Ledge	population:	7790
City of Charlotte	population:	9082
City of Eaton Rapids	population:	5235
Clinton County	**Total 2010 population**	**75,382**
DeWitt Charter Township	population:	14,317
City of DeWitt	population:	4507
Bath Charter Township	population:	11,605
City of St Johns	population:	7878
Dallas Township	population:	1161

Total Covered Population: 233,175

These eighteen participating communities constitute the majority of the region's population, including its top five most populous jurisdictions. This does not include the City of Lansing. They have their own hazard mitigation plan.

Hazard mitigation strives to reduce the impact of hazards on people and property through the coordination of resources, programs, and authorities. Hazard mitigation plans can prevent a cycle whereby communities contribute to the increasing severity of a hazard by allowing repairs and reconstruction that restore damaged property to pre-disaster conditions quickly. Such efforts may appear to expedite a return to normalcy. However, replication of pre-disaster conditions can result in a cycle of damage, reconstruction, and damage again. Through a combination of regulatory, administrative, and engineering approaches, losses can be limited by reducing susceptibility to damage. The mitigation process helps break disaster cycles by analyzing hazards and helping communities identify ways to create less vulnerable conditions before the next potential incident.

The tri-county region recognizes the importance of reducing vulnerability to natural and technological hazards, so we are actively addressing hazard mitigation through the development and implementation of this Plan. This effort will result in many benefits including protection of public health and safety, preservation of important services, reduction of property damage and more. This Plan is one important way to help our region remain a vibrant, safe and enjoyable place to live.

In 2004, the tri-county region developed and adopted its first Hazard Mitigation plan. Ingham, Clinton, Eaton Counties, the City of Lansing and Delta Charter Township each adopted their own plan and began implementing the mitigation actions that were recommended in each respective plan. Our region has undergone significant changes in the last ten years and will likely continue to experience change in the future. This Plan includes a revision of the previous plan, incorporating changes in technology, population and economic concerns.

Fig. 2 2005 Hazard Mitigation Plans

Source: TCRPC

This Plan includes a description of the planning update process and updated profiles of Clinton, Eaton, Ingham Counties and Delta Charter Township, the four jurisdictions addressed in the planning update. It provides an overview of the region and an analysis of hazards. The hazards analysis considers the current concerns and opinions of emergency services providers, citizens, and local government infrastructure managers. This Plan addresses the goals, objectives, and strategies of the original plan with a more current perspective and it provides a snapshot of potential and existing hazards to the mid-Michigan region.

In addition to meetings of the hazard mitigation steering group, the TCRPC Program and Grant Review Committee regularly discussed the plan update at their meetings in 2012-2013-2014 and 2015. Throughout the planning process technical groups such as the Greater Lansing Regional Committee for Stormwater Management and the Capital Area Regional Transportation Study-Technical Committee convened to discuss the Plan. These committees received progress reports, provided suggestions and gave input into planning for hazard mitigation and the prioritization of various hazards.

The following figure depicts the meetings, the number of attendees and communities/agencies represented.

Fig. 3 Plan Update Meetings

Hazard Mitigation Plan Update Meetings & Outreach			
Group	**Date**	**# of Attendees**	**Communities**
Program & Grant Committee	March&June 2013 July 2014	12	Eaton, Ingham, Clinton and Charlotte
Hazard Mitigation Advisory Group	May 2012 June 2013 April 2015	24	MSP, Eaton, Ingham, Clinton & Delta Twp
Public Forums (Presented findings of existing plans, presented overview of hazard occurrences, facilitated discussion on planning process and outcomes	July, August, September 2013	9	Clinton County EM (representing DeWitt & Bath Charter Townships) Village of Ovid Clinton Co Sheriff City of Potterville Eaton Co EM (representing Charlotte/Eaton Rapids etc) Ingham Co EM (representing Mason/Meridian Township/Williamston/Williamstow n Township, Lansing Charter Township, etc.)
Hazard Analysis Survey (online)	2015	24	The Library of Michigan The Michigan Dept of Transportation The City of East Lansing MSU City of Charlotte City of DeWitt Delhi Charter Township CATA

Hazard Mitigation: Unlocking the Disaster Equation

A good way to understand hazard mitigation is to understand the nature of disasters themselves. The basic equation for a disaster is simple: **Hazards + People and Structures = Disaster.** Disasters only occur because people and structures are in harm's way. The key to preventing or limiting disaster damage and impact is to unlock and separate the key components of this equation. Controlling the hazard may be difficult or impossible. A tornado is a good example. However, there are situations when vulnerability can be effectively reduced. Strategies to reduce or mitigate hazards include modifying the hazard (see strategy #1) or modifying the people and structures portion of the disaster equation (see strategies #2-5). Modifying the characteristics of people and structures is often easier and more effective in reducing or eliminating hazard vulnerability because these elements are more closely under our control. However, even that can be a daunting proposition at times, given the freedom of choice that our

citizens value and the widespread appeal of living near or in hazard-prone or at-risk areas such as by water, in the woods, on hillsides, etcetera. The following five basic hazard mitigation strategies can reduce or prevent the harmful interaction between hazards, people, and development that results in a disaster:

Strategy #1: Modification of the Hazard
The first strategy is to modify the hazard itself. That involves removing or eliminating the hazard, reducing its size or amount, or controlling the rate of release of the hazard. This strategy can be successful in the right circumstances but it is often difficult to do. Examples of this strategy include cloud seeding, slope planting to prevent erosion, and stream widening or modification to improve water flow. These measures can be cost-effective, but their application is limited and therefore may not be as effective as other strategies in reducing or eliminating damage on a wide scale.

Strategy #2: Segregating the Hazard
Segregating the hazard attempts to *"keep the hazard away from people."* In flood-prone areas this is accomplished through the construction of structural protection measures such as dams, levees, floodwalls, and debris basins. These and other public works projects redirect the impacts of a flood away from people and development. This strategy can be highly effective, but it can also be expensive and may cause or exacerbate environmental problems. Also, history has shown that structural protection measures constructed to protect one community can increase problems in other communities. For example, levees channel and increase the velocity of floodwaters which can cause severe flooding downstream. Economics and limited effectiveness may make this a marginal strategy in many situations and locations.

Strategy #3: Preventing or Limiting Development
The third strategy is to prevent or limit development in where people and development would be at risk. This approach is based on *"keeping the people away from the hazard"* and includes a variety of land use planning and development regulation tools, such as comprehensive planning, zoning, floodplain management ordinances, capital improvements planning, disclosure laws, and acquisition and relocation of hazard prone properties. This strategy is to reduce or eliminate community hazard vulnerability through prudent land use and development decision-making. When properly applied, this strategy can be highly effective in promoting safe, sustainable development.

Strategy #4: Altering Design or Construction
The fourth strategy involves altering developments' design or construction to make it less vulnerable to disaster damage. This strategy, commonly known as *"interacting with the hazard,"* allows the hazards to interact with human systems that have been planned and designed to withstand potentially destructive impacts. Examples of this strategy include elevating structures, employing wet and dry flood-proofing to resist flood damage, managing vegetation buffer zones in urban/wild land intermix areas, using wind bracing to resist wind damage, and insulating water and sewer lines to prevent ground freeze damage. This strategy allows development in hazard prone areas on the condition that it meets stringent disaster resistant performance criteria. This approach

can balance the dual needs of enhancing a community's economic base while also reducing community hazard vulnerability. History has shown that the two goals are not mutually exclusive. When careful and prudent development decisions are made that take into account the reduction of hazard vulnerabilities, the result is safe and sustainable community development.

Strategy #5: Early Warning and Public Education (overlaps with emergency management preparedness/response) This strategy seeks to ensure that the public is aware of the hazards it faces and that proper warning and communication systems and practices are in place to save lives and protect property. This strategy should be applied in all communities, as it is typically the last line of defense against serious disaster-related injury or loss of life.

Hazard Mitigation: Corrective and Preventive
Hazard mitigation strategies may also be grouped into two other broad categories:

Corrective Mitigation – correcting past practices that have increased hazard vulnerability; and

Preventative Mitigation – preventing future problems from occurring through public education, wise decision-making and disaster-resistant building and development practices.

The **corrective** form of hazard mitigation can be expensive, resource intensive, time consuming, and sometimes only marginally effective. Structural protection measures, hazard modification, and large-scale retrofitting fall under this category. Attempting to go back and fix something that is problematic is usually more difficult than doing it right the first time. However, when dealing with hazard prone property such as structures in a floodway, floodplain or other hazard area, it may be necessary to try to correct the problem in order to protect the affected community and individual property owners from future harm.

The **preventative** form of hazard mitigation is desirable because it seeks to prevent future problems from occurring in the first place. Wise land use planning and building design, small-scale retrofitting, and early warning and public education are considered preventative mitigation measures. When it comes to reducing community hazard vulnerability, the sensible old adage "an ounce of prevention is worth a pound of cure" could be restated as "an ounce of mitigation is worth a pound of recovery!"

Doing it right the first time is almost always preferable to going back and trying to correct recurring problems at a later date. Preventive mitigation is generally easier to implement than corrective mitigation because the administrative mechanisms that guide the land development process – planning and plan review, zoning, capital improvements programming, building codes and standards, etc. – are available to every local community and only require adoption and consistent application to be highly effective in reducing or eliminating hazard vulnerability. This plan addresses both types

of hazard mitigation—an ideal hazard mitigation program will involve both types being applied in appropriate amounts, in appropriate places, in a coordinated fashion.
Corrective hazard mitigation measures are effective and important for areas that suffer recurring or severe disaster damages or for areas with clear mitigation opportunities that can be addressed with existing resources. Preventive hazard mitigation helps state and local governments ensure that, at the very least, they do not contribute to the increasing severity of the problem through unwise decision-making.

Michigan's Vulnerability to Hazards

Michigan is vulnerable to a wide range of natural, technological and human-related hazards. Although Michigan is fortunate in that it is generally not susceptible to catastrophic disasters involving major earthquakes or hurricanes, it nonetheless has its share of potentially severe and widespread disasters and emergencies. Michigan is a heavily populated state with thousands of inland lakes, hundreds of rivers and streams, over 3,200 miles of Great Lakes shoreline, numerous major manufacturing centers, frequent wind and winter storms, and lies on the northern fringe of the nation's tornado belt. Michigan experiences major disasters and emergencies on a regular basis. The Hazard Analysis section in this document describes the state's vulnerability to more than two dozen different types of natural, technological, and human-related hazards, ranging from civil disturbances to snowstorms. Although these hazards all potentially affect Michigan, several of them cause more disaster events and generally result in more damage and/or impact to affected communities. Summaries and analyses appear in the Hazard Analysis sections of this plan.

Since 1953, Michigan has experienced 34 events that were declared a major disaster or emergency by the U.S. President. Since 1977, Michigan has experienced 64 events that resulted in a Governor's declaration of disaster or emergency. The majority of those declarations were granted for flooding, tornadoes, winter storms, or severe thunderstorms. Those disasters or emergencies resulted in hundreds of millions of dollars in damage and destruction and caused tremendous disruption to the affected communities. Clearly, there is a need to focus hazard mitigation efforts on those four particular hazards in Michigan. In addition to these natural hazards, the U.S. Federal Emergency Management Agency (FEMA) requires the state of Michigan to address land subsidence, coastal erosion, extreme temperatures, dam failures, earthquakes, and drought as part of Hazard Mitigation Planning.

Hazard Mitigation: National Perspective and Federal Government Role

The Michigan Hazard Mitigation Plan of 2014 states that nationally, hazard mitigation is at a crossroads. Recent catastrophic disasters across the United States resulted in unparalleled devastation, suffering, and economic loss. These events suggest that certain aspects of development strategy throughout the United States have been on a collision course with our natural environment. Increased development in hazard prone areas has put an ever-increasing number of people and structures in harm's way, greatly exacerbating our risk and vulnerability to natural, technological, and human-related hazards. As a result, when disasters occur they increasingly cause tremendous economic, social, and physical losses to the communities and people they affect.

Fortunately, due to a depressed economy in recent years, Michigan's slowed rate of development offers many of its communities a chance to prevent many risks from increasing though appropriate plans and policies. Michigan's population declined between the previous U.S. Censuses but, in some communities, the trend did not halt green field development trends and patterns. National efforts are under way to promote resilient communities and hazard mitigation.

Grant programs and updated guidance from the Federal Emergency Management Agency (FEMA) have supported the development of plans nationwide. The National Mitigation Strategy, National Pre-Disaster Mitigation Plan, National Flood Insurance Program (NFIP), Flood Mitigation Assistance Program (FMAP), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Program (PDMP), and the Disaster Mitigation Act of 2000 are the most prominent of the federal government's current efforts to reduce or eliminate the nation's risk and vulnerability to hazards. FEMA's efforts are in partnership with federal agencies, the Congress, the states, local governments, academia, the private sector, and individual citizens. The approach is one that invites the participation of the whole community—public, private, nonprofit, and the civil sectors.

Hazard Mitigation Plans Identify and Create Implementable Hazard Mitigation Opportunities

It must be emphasized that the hazard mitigation measures identified in this Plan and in counterpart local plans are, in reality, **hazard mitigation opportunities.** Identification of a possible hazard mitigation measure does not necessarily mean that it can or even should be implemented. The desirability or implementation of a hazard mitigation measure is highly dependent on a number of factors—environmental, social, economic and political. Just because a measure may reduce or eliminate hazard effects does not necessarily mean that it should be implemented. There may be factors or circumstances that could or should preclude its implementation. Decisions to adopt or implement hazard mitigation measures will be made in the local and state political arenas and in the land use and land development decision-making processes.

Typically, hazard mitigation measures will be implemented if they are able to balance environmental, social, economic and political factors, and are cost-effective. It does not make sense to implement a measure that will not be supported by officials and citizens or that cannot be economically justified. Accomplishing everything proposed in this plan will be a very tall order and will take years. Nevertheless, it is important to the future of this state that these issues be addressed, at least to some degree. Our nation, our state, our local communities and the insurance industry cannot continue to respond to and pay for increasingly large disasters. Proper application of hazard mitigation measures and strategies, coupled with wise land use and land development decision-making, can help our communities become more safe and sustainable, and our future as disaster-free as possible

The Role of the Citizen

The Michigan Hazard Mitigation Plan states that each citizen or resident of Michigan has a role in disasters and emergency preparedness that can protect lives during a serious event. Most of this document addresses the analysis and mitigation of hazards that could have a serious impact upon mid-Michigan or its communities. However, this small section describes personal and household preparedness actions that may become more important to your safety during a disaster than governmental efforts. Everyone should study the following list of preparedness actions along with a consideration of the types of hazards described throughout this document.

1. Develop an emergency plan for your household! Even an informal draft plan is a useful starting point. Consider the ways to prepare for responses to the various hazards that could occur in your area. Do you have a way to contact and meet your family members if something prevents you from staying in or returning to your home? Do you know the most reliable evacuation route if you have to leave your community in an evacuation?

2. Keep a supply of food and water. How many days could your home or community be without power or other utilities during a disaster event? You should always have a supply of fresh water (e.g. in bottles) and food that does not require refrigeration or cooking to help you endure periods without your community's normal utilities and services. In your preparation, consider the medicines that will be needed. Many emergencies cause a loss of power for 2 or 3 days, so your preparations should allow you to live independently for at least that long or longer.

3. Equip your home and vehicle. At a minimum, useful items to enable survival during a disaster would include a first aid kit, flashlight with batteries, a battery operated radio, and adequate clothing and blankets. Basic training in first aid may be vital to deal with the effects of injuries and weather.

4. During a disaster, use your available communication devices (battery operated radios and phones) to listen for instructions from official sources. Do what you can to obey those instructions. Be prepared to change your evacuation route, for example, if you learn that your original route is unavailable. Consider alternatives that you could evacuate to such as friends and family who live in areas less seriously affected by the emergency.

Process to Update the Tri-County Regional Plan

The Local Hazard Mitigation Planning Workbook (EMHSD-PUB207), with information on completing a successful mitigation plan, guided the planning process for this Tri-County Regional Hazard Mitigation Plan. This Plan update was based upon the extensive process to create a regional Hazard Mitigation Plan which was completed and adopted by the region in 2004**.** And, new and refreshed data for our area along with discussions, work sessions, and input from throughout the region in a variety of formats and venues over the past three years guided the development of the 2015 Tri-county Regional Hazard Mitigation Plan. The work was supported by a grant from the United States

Federal Emergency Management Agency, administered through the Michigan State Police, the tri-county region with the Ingham County Emergency Management Office serving as fiduciary. The Tri-County Regional Planning Commission facilitated the grant application in 2010 and, once awarded, was hired to develop a work agreement and lead the planning process to develop the plan.

The overall planning process included two approaches, one technical analysis in-house by TCRPC staff and the other a public planning process. The public planning process was conducted on two levels- level one with the direct and frequent interaction with area emergency management offices and level two interactions with other interested and concerned agencies or organizations in the region and with the general public.

In 2011, the process began with meetings and work plan agreements between the State of Michigan Police Planning Department (MSP) and Ingham County Emergency Management. TCRPC staff began a thorough review and analysis of the previous planning documents. Staff also began acquisition and compilation of updated data for the region including geographic information systems data for parcels and land use, hazard areas, and contracted for elevations and other data. Population changes, development densities, and other development data were compiled. Analysis for changes from the previous plan development began and continued alongside public involvement activities. In late 2011, TCRPC secured updated aerial photography data for the region from a 2010 flyover supported by U.S. Geological Survey and area municipalities. However, while the photography was collected with some elevations information, elevations detail was unavailable to use without necessary software and training. So, in 2012 TCRPC staff acquired ERDAS software and attended a national training workshop in Denver, CO to learn how to manipulate LiDAR data with ERDAS. TCRPC staff developed and analyzed the region with newly acquired LiDAR data that provided a detailed view of topography in the region. LiDAR maps of the region are included as supporting documents to this plan.

The Public Process, with a role for the technical advisory group began with a kick-off meeting for the Steering Committee hosted at the offices of the Tri-County Regional Planning Commission. The meeting included the emergency managers of the three Counties and Delta Charter Township and the Community Development Director of Eaton County. The Michigan State Police planner, Mike Sobocinski attended the meeting and provided an overview of the expected planning process for this project. The kick-off meeting provided the Committee with an understanding of FEMA requirements for a successfully adopted plan. The Steering Committee also reviewed the hazards and mitigation actions from the 2004 plans and narrowed them down to a new list of hazards and mitigation actions that address the known issues within our region nearly ten years later. This Plan is a product of those discussions about known hazards.

Throughout 2012 and 2013, TCRPC staff reviewed the existing Hazard Mitigation plans for the region and began editing the documents into one regional plan. In October of 2012, the Steering Committee met again at TCRPC to review the hazards that were

presented in the 2006 Plans and to discuss the applicability of these hazards to the new plan. Attendees included Sgt. Robert Ott of Ingham County's Emergency Management Office, Larry St. George of the Clinton County Emergency Management Office, and Claudine Williams of the Eaton County Community Development Office and staff members of the Tri-County Regional Planning Commission staff (Dan Dillinger, Harmony Gmazel). Discussions revolved around the need to remove certain hazards that deemed inapplicable in 2014, and to add certain hazards that have become an issue in recent years.

In 2013, four public workshops were publicized and held in Eaton, Ingham, Clinton Counties and Delta Charter Township, on August 20, 21, 23 and September 30 respectively. Emergency managers, Sherriff deputies, planning staff and local jurisdictions' representatives participated. The Clinton workshop, held at the Clinton County Courthouse in St. Johns, MI was attended by the County Sheriff and his staff; staff from the Villages of Ovid and Fowler, area townships and many others. The Eaton workshop, held at the Eaton County Courthouse in Charlotte, MI, was attended by Eaton County Sherriff's office staff, Charlotte residents, Village of Potterville staff. A workshop was scheduled for the Delta Charter Township Fire Department in Lansing, MI and was cancelled due to lack of response. The Ingham workshop was at the Hilliard Building in Mason, MI, and Ingham County Sheriff Department staff attended. In each jurisdiction TCRPC staff presented a PowerPoint show that reviewed existing plans, hazards and analyses and shared new topographic maps. Then TCRPC facilitated a discussion on recent hazard occurrences and preferred mitigation strategies.

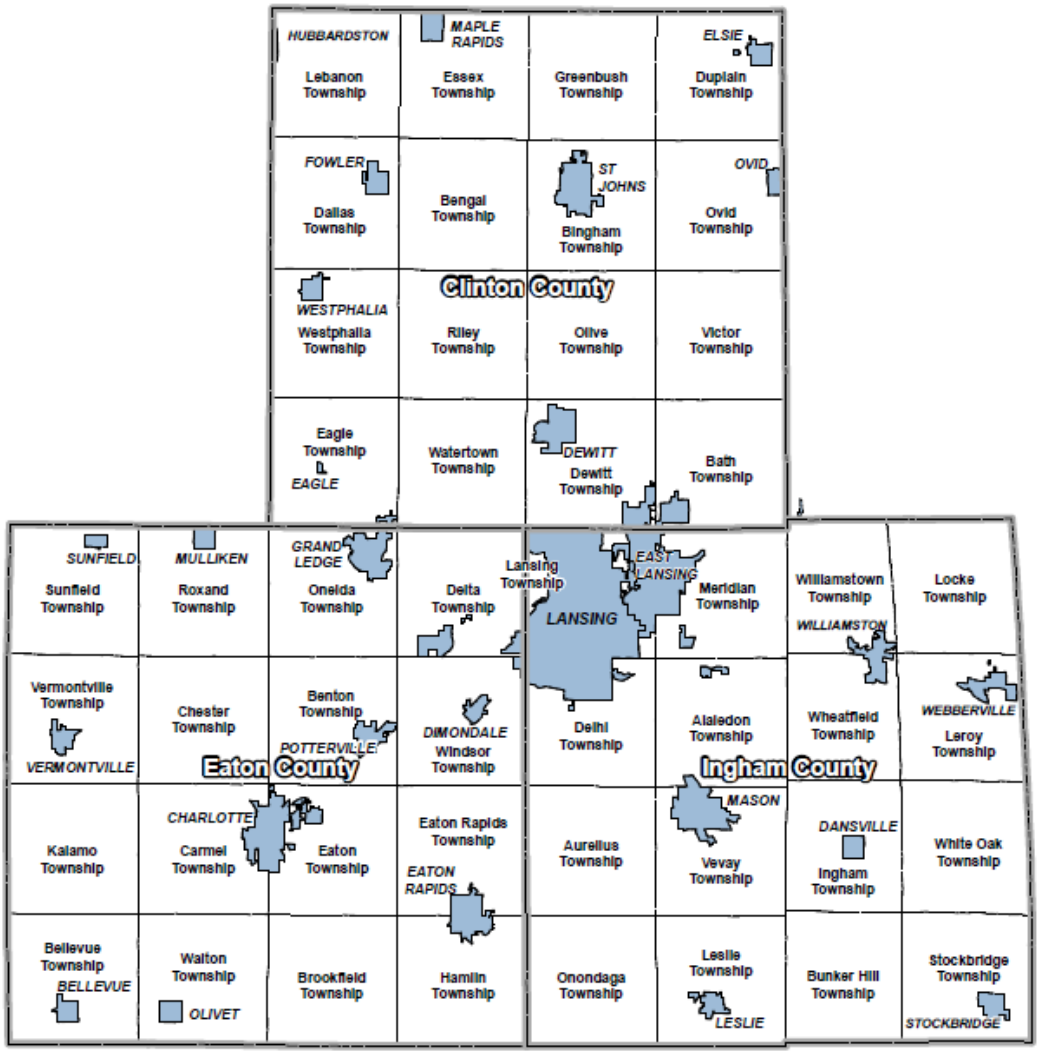
TCRPC provided a rough outline of the Plan document to workshop attendees and the region's emergency managers to share with emergency committee members and others in each county. Comments from agencies and the public in all jurisdictions were collected and incorporated into the plan. Neighborhood leaders, residents, local and regional agencies involved in emergency management and others such as academic institutions, non-profits and businesses were invited to the workshops and provided access to the draft plan. As a result of these activities, the Committee developed a general outline of this Plan. The major chapters are listed here:

- Community profile.
- Hazards and risks.
- Mitigation strategies.
- Maintenance of the plan.

TCRPC, working with representatives from each jurisdiction, researched and compiled data from the Regional Growth: Choice for our Future report, Greening Mid-Michigan and the Michigan State Hazard Mitigation Plan of 2014 about likely hazards, and also about potential responses. Maps of the region were developed and shared with committee members and the public at the workshops and the draft Plan was distributed and posted for public comment and adoption by FEMA and by the four local jurisdictions.

Chapter 2 - Community Profiles

Presenting a full Community Profile is the first step in creating an effective Hazard Mitigation plan. The information and data in this chapter provides an in-depth look at the different characteristics of the mid-Michigan region and its communities. Examination of characteristics that define each community's unique fabric is an effective means of identifying potential vulnerabilities that relate to a specific area in the county. This Community Profile contains a range of data and information about our region overall. It is also specific to the population and geography of each of the three counties and the township. The profiles are presented in alphabetical order, Clinton County, Delta Charter Township, Eaton County and Ingham County. Below is a map of the tri-county region, created by the Tri-County Regional Planning Commission.



Tri-County Regional Population Estimates and Projections

Population information for the tri-county region comes from a variety of sources. The most recent U.S. Census was 2010, so the Tri-County Regional Planning Commission analyzed and compiled data from a number of other sources to generate accurate estimates of current population and forecasts of future population. The base year calculations and projections were reviewed and adopted by the TCRPC board of Commissioners on behalf of the region most recently in spring 2014. Per those analyses, computing firm Woods & Poole estimated area population at 464,076. This is an increase of 7% or 30,662 persons since 1990. TCRPC projects that by 2045, our region will have 508,613 persons, an increase of 9.5% or 44,537 persons. The following chart, developed by the Tri-County Regional Planning Commission, depicts the historical population numbers and a projected forecast of regional population out to 2045.

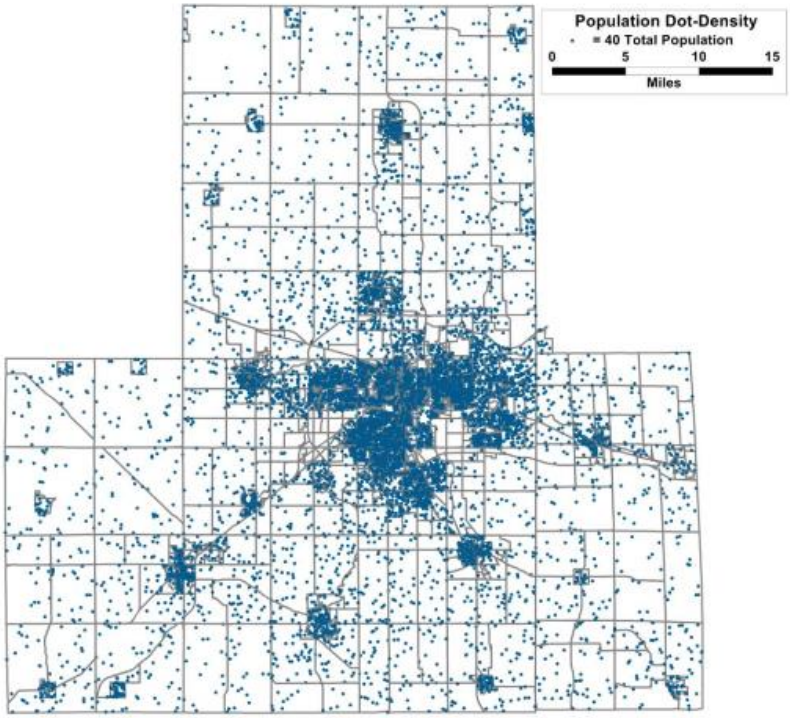
Fig. 4 Regional Population Estimates

Year	Historical Census	Global Insight	2012 Woods & Poole	REMI	Projected Population
1990	433,414	433,899	433,414		
1995	443,395	444,030	443,395		
2000	448,355	448,569	448,735		
2005	455,315	455,335	462,743		
2010	464,036	462,604	464,076	464,036	464,036
2015		470,666	474,086	470,032	473,192
2020		477,938	485,260	476,850	482,656
2025		484,405	496,862	485,021	490,995
2030		490,055	508,383	491,545	498,257
2035		494,101	519,719	495,706	502,207
2040		498,147	531,273	497,953	504,465
2045		502,193	542,827	502,090	508,613

Source: Tri-County Regional Planning Commission (2014)

TCRPC developed the following population density map with the above data and traffic/movement analyses in 2014. It depicts population centers across the three counties, providing a visual for where our urban centers are located.

Fig. 5 Population Density Map



Regional Climate

The continental type climate of mid-Michigan means that the area typically experiences larger temperature ranges than in locations of similar latitude. Our mid-peninsula location away from the Great Lakes can impact or moderate temperatures. The area seldom experiences prolonged periods of either extreme cold in the winter or extreme heat and humidity during the summer. The average possible sunshine varies from about 28% during December and 70% during July. The average possible sunshine is an average 51% annually in mid-Michigan.

Mid-Michigan has moderately warm summers with an average of eleven days annually that reach or exceed 90°F. There have been occasions with temperatures exceeding 100°F, but this is a rare event in our tri-county region. The record for temperature maximum occurred in 1936 with a temperature of 106°F. Winter weather in the county can bring extreme cold, but the Great Lakes typically modify the coldest arctic air masses. This area averages eleven days annually when the minimum temperature reaches zero or below. There is an average of fifty-seven days annually when the temperature does not rise above the freezing mark (32°F).

The average number of heating degree days in January is approximately 1360 and approximately 450 on average in October. On average the month of July brings 200 cooling degree days to the area, while in May the number of cooling degree days is closer to thirty. The average date of the last freezing temperature in the area is May 11th and the average date of the first freezing temperature is October 3rd. On average mid-Michigan experiences 145 freeze-free growing days.

Michigan is located on the northeast fringes of the Midwest tornado belt and mid-Michigan has experienced occasional severe tornados or high winds. But the severe weather events are primarily warmer weather activity, in the form of afternoon showers and thundershowers. Thunderstorms will occur in the area an average of about 33 days during the spring, summer and early fall.

Fig.6 Regional Climate Data

Month	Avg. Max	Avg. Min	Mean	Rec. Max	Rec. Min
January	28.5°	13.0°	20.7°	60°	-23°
February	31.6°	13.7°	22.6°	62°	-30°
March	41.3°	22.6°	31.9°	77°	-15°
April	57.1°	34.5°	45.8°	88°	8°
May	69.7°	44.5°	57.1°	92°	23°
June	79.1°	54.1°	66.6°	100°	34°
July	83.2°	58.3°	70.7°	106°	41°
August	81.2°	56.8°	69.0°	100°	36°
September	73.2°	49.4°	61.3°	99°	27°
October	61.5°	39.8°	50.6°	87°	16°
November	46.2°	30.1°	38.1°	77°	-6°
December	33.5°	19.4°	26.4°	67°	-14°
All temperatures are in degrees Fahrenheit.					

Month	Mean Liquid	Max Daily	Avg precipitation/day .10	.25	.50	Mean Snowfall	Max Monthly Amount	Max Daily Amount	Max Total Depth
January	1.37	1.28	4	2	1	10.0	28.1	17.0	26
February	1.12	1.05	3	2	1	6.8	38.0	7.0	22
March	1.99	2.15	5	3	1	6.6	24.0	12	14
April	3.19	3.35	7	4	2	1.9	11.6	8.7	10
May	2.84	3.35	6	4	2	0	T	0	0
June	3.20	3.39	6	4	2	0	0	0	0
July	3.22	4.25	6	4	2	0	0	0	0

Month	Mean Liquid	Max Daily	Avg precipitation/day .10	.25	.50	Mean Snowfall	Max Monthly Amount	Max Daily Amount	Max Total Depth
August	3.57	3.42	6	4	2	0	0	0	0
September	2.95	9.35	6	4	2	0	T	0	0
October	2.60	3.79	6	3	1	0.3	6.0	6.0	3
November	2.33	2.12	5	3	1	3.0	14.0	9.0	8
December	1.86	1.81	5	3	1	7.7	17.0	10.0	15
T = Trace. Precipitation values given in inches									

Environmental Protection Priorities

The U.S. Environmental Protection Agency has identified two National Priorities for contaminant clean up in this Plan region. Sites registered as National Priorities are eligible for long-term cleanup actions under the federal Superfund Program. These sites are scored in relation to their impact to public health and environment. For example, in Lansing Charter Township, Ingham County, Adams Plating Co. began doing chrome, nickel and copper electroplating in 1964. In 1989, it was placed on the National Priorities List of hazardous waste sites, making it eligible for cleanup under the EPA Superfund program. Waste disposal practices prior to 1980 led to contamination of surrounding soil and ground water. A Superfund cleanup in 1994 removed contaminated soil, placed vertical barriers to prevent recontamination of the clean fill dirt, restricted well use and installed monitoring wells to check whether the soil removal was helping reduce ground water pollution. Then the site entered a long-term maintenance phase, and MDEQ assumed oversight from EPA. Fire destroyed the building in December 2010 and a plan to monitor the site is in place.

Immediately to the south of our region, with potential marginal impacts on southern Ingham county communities of Stockbridge, Leslie, and Onondaga Township was an Enbridge Oil Pipeline leak. In the fall of 2014, Enbridge completed its remaining obligations to the 2013 EPA Order that directed specific sub-oil and sediment removal criteria pursuant to EPA authority. The final portion of this work, the sediment removal by dredging at Morrow Lake and the Delta, was completed in October 2014. Based on successful completion of the other work requirements of the 2013 Order, EPA determined that Enbridge has completed all of the prescribed actions, and has now transitioned the site to the Michigan Department of Environmental Quality.

The State of Michigan Department of Environmental quality has also identified sites potentially contaminated with hazardous materials throughout this region, particularly from Leaking Underground Storage Tanks (LUST) sites. This detailed information on those sites and their status is athttp://www.deq.state.mi.us/sid-web/LUST_Search.aspx. The maps on the following pages depict the leaking underground storage tanks within the tri-county region at the northwest corner of Ingham County, the northeast corner of Eaton County and south east corner of Clinton County. All other LUST maps of the counties are available at www.mitcrpc.org.

Fig.7 LUST Map- NW Ingham Co.

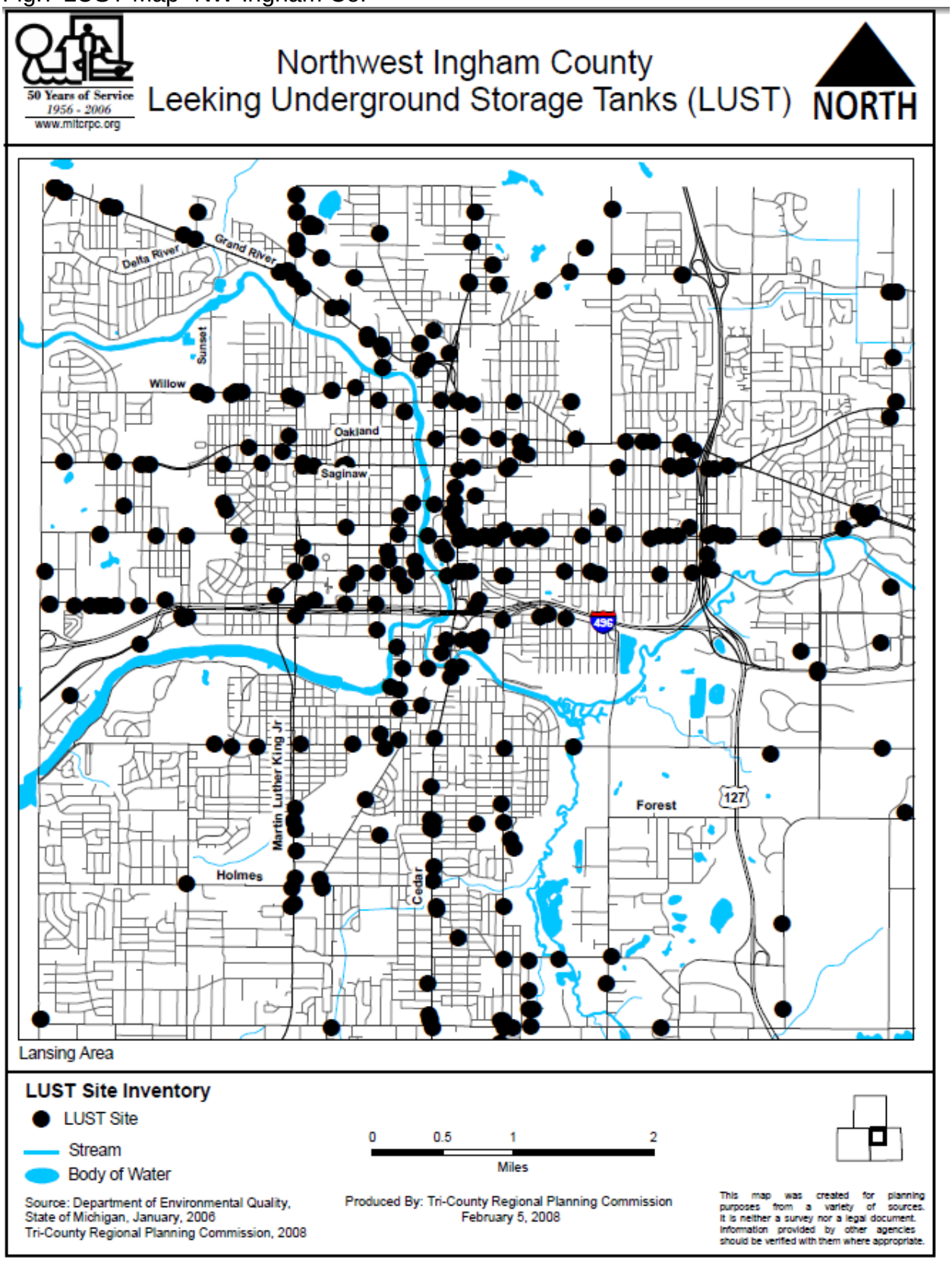


Fig. 8 LUST Map- NE Eaton Co.

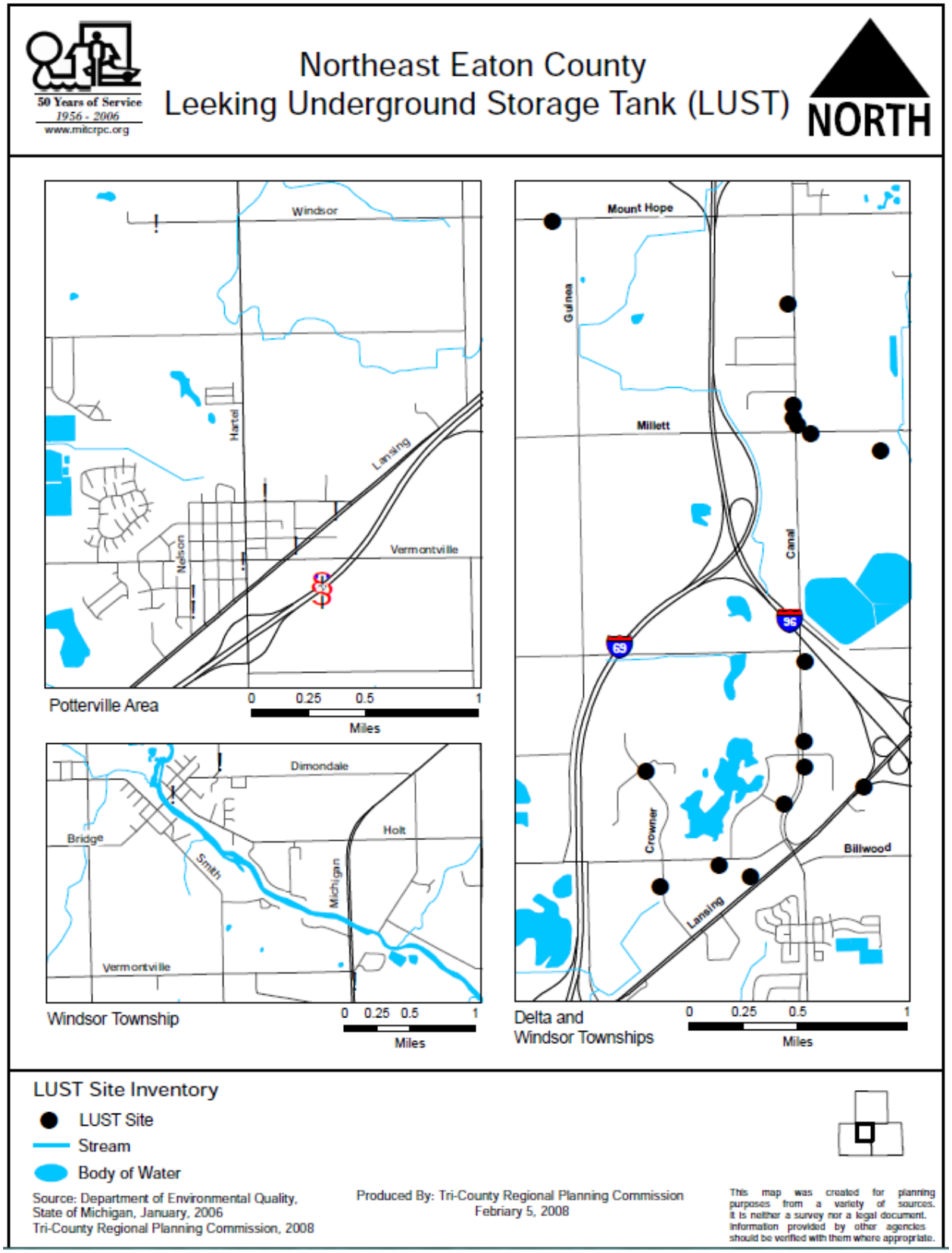
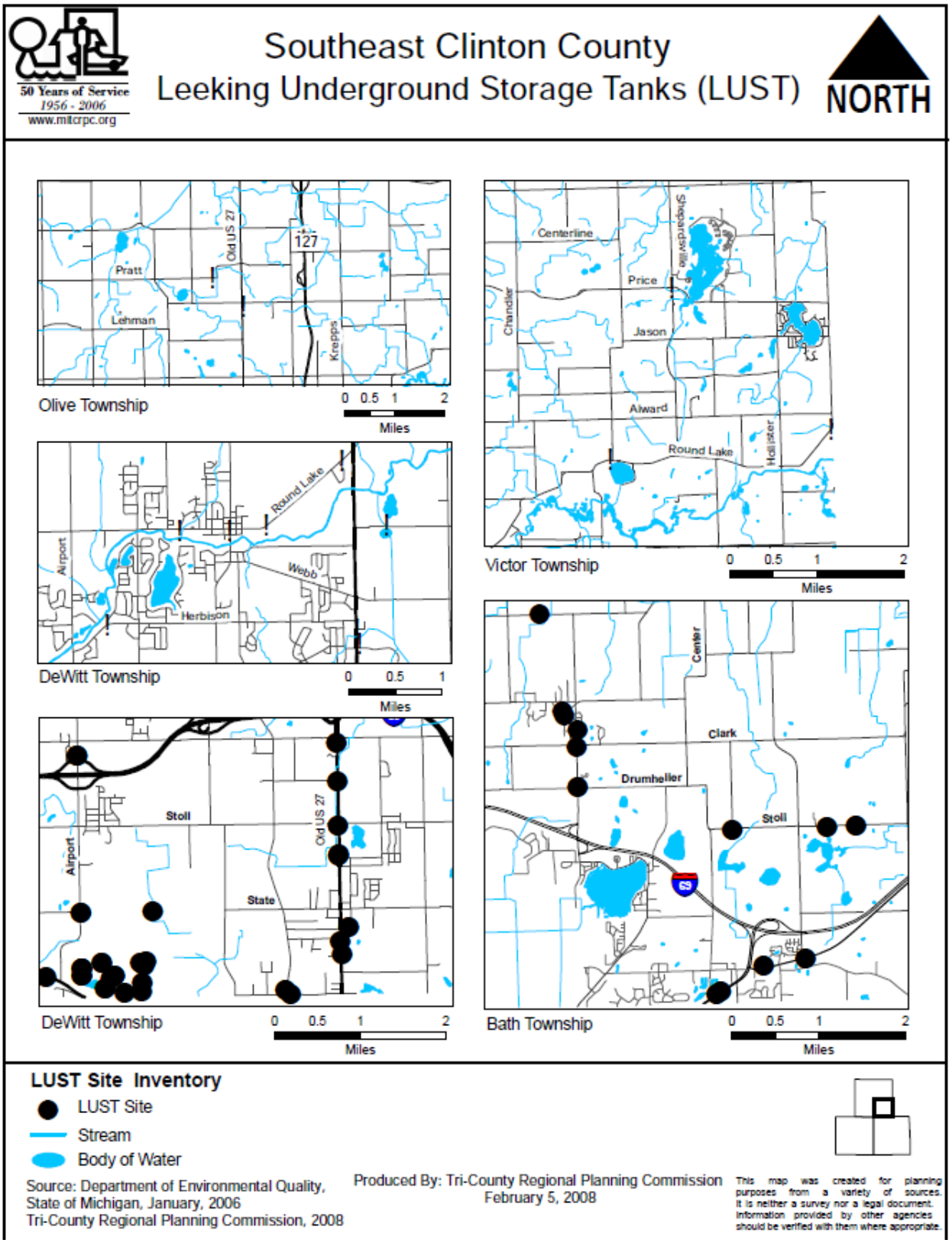


Fig. 9 LUST Map- SE Clinton Co.



Infrastructure & Historic Characteristics

The region's public infrastructure, excluding transportation features, is limited to population centers where sewer and water services are provided by the local municipality. The most comprehensive systems (sewer/water) are in place to serve residents in urbanized areas in East Lansing; all charter townships, St. Johns, Grand Ledge, DeWitt, Charlotte, Eaton Rapids, Leslie, Mason and Williamston. The following two maps are from the Tri-County Regional Planning Commission's *Urban and Rural Service Management Study* of 2011 developed by the Land Information Access Association. The top map depicts existing water service areas in fifteen jurisdictions and water treatment plants located at the geographical center of the tri-county region. The second map depicts existing sewer service and the locations of wastewater treatment plants.

Fig. 10 Water Service Area

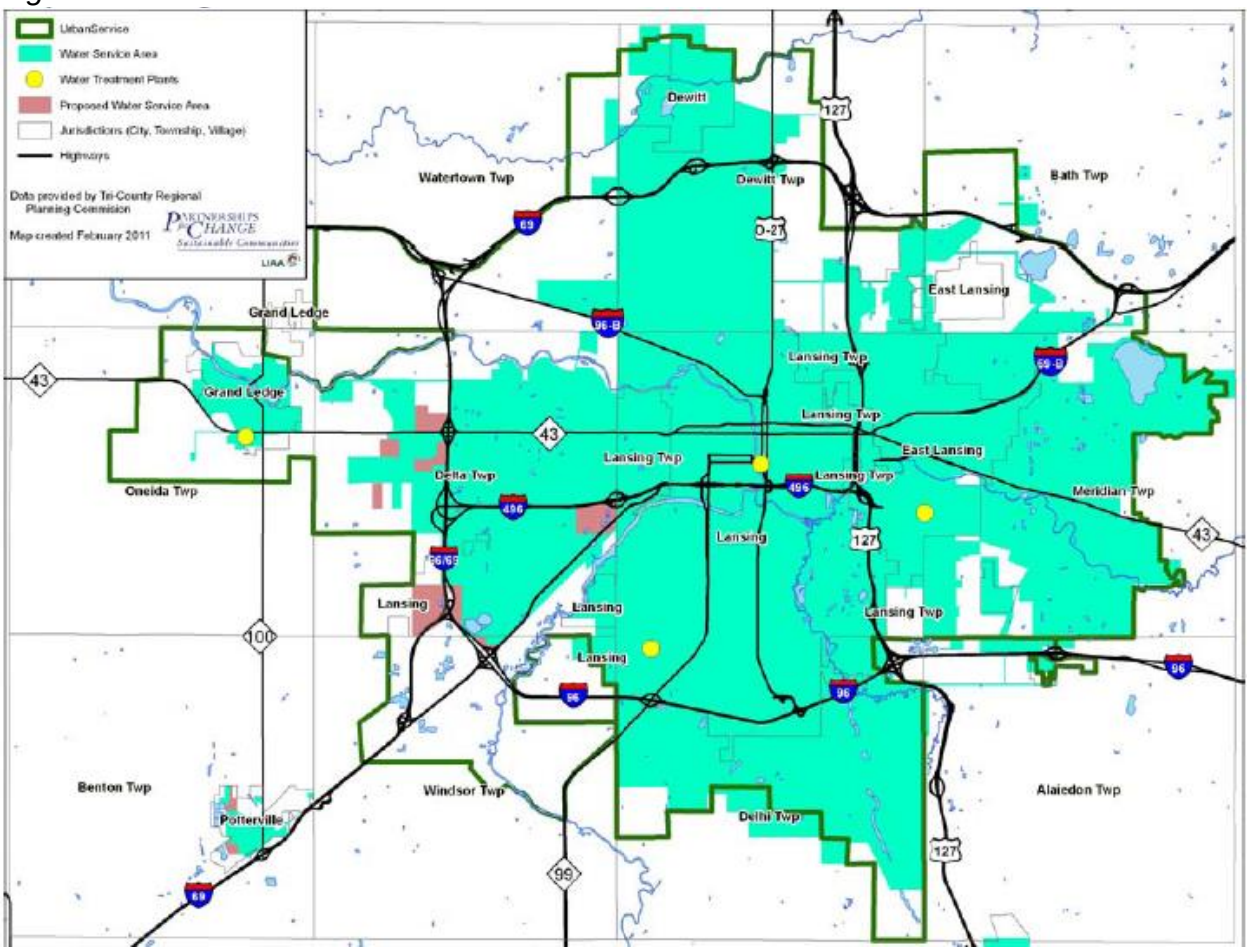
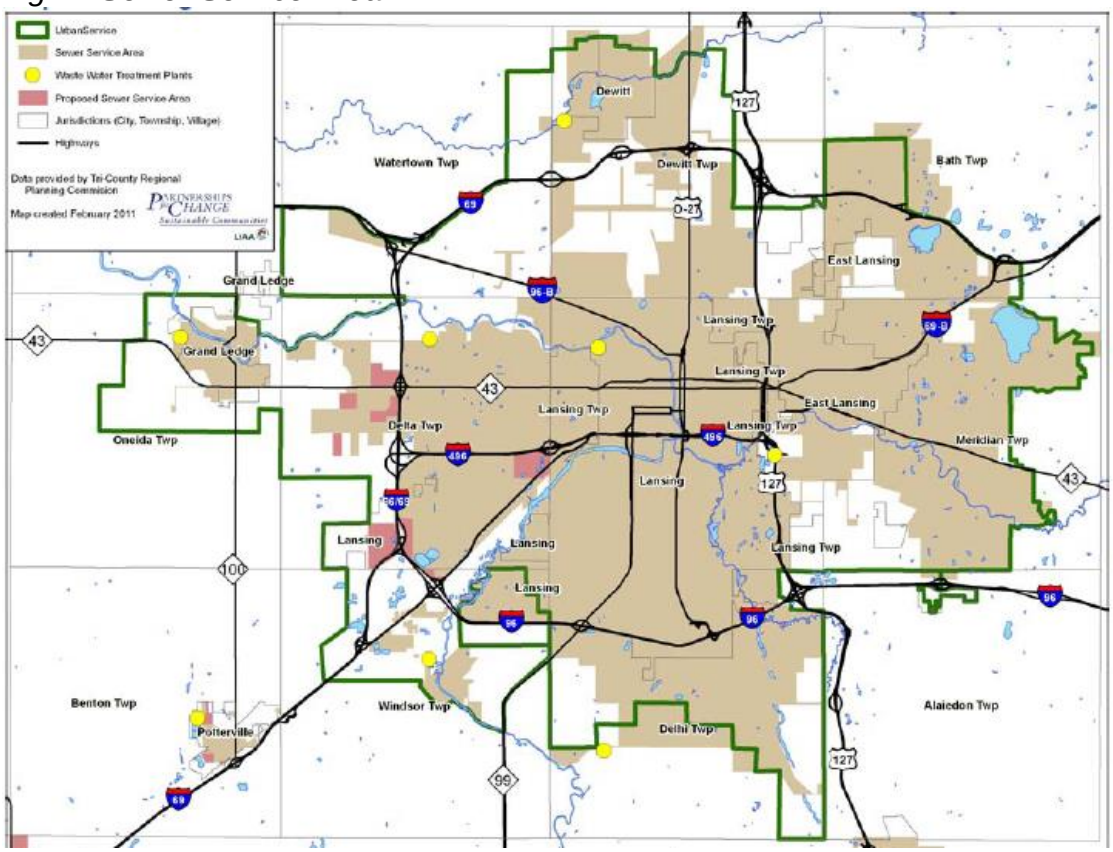


Fig 11 Sewer Service Area

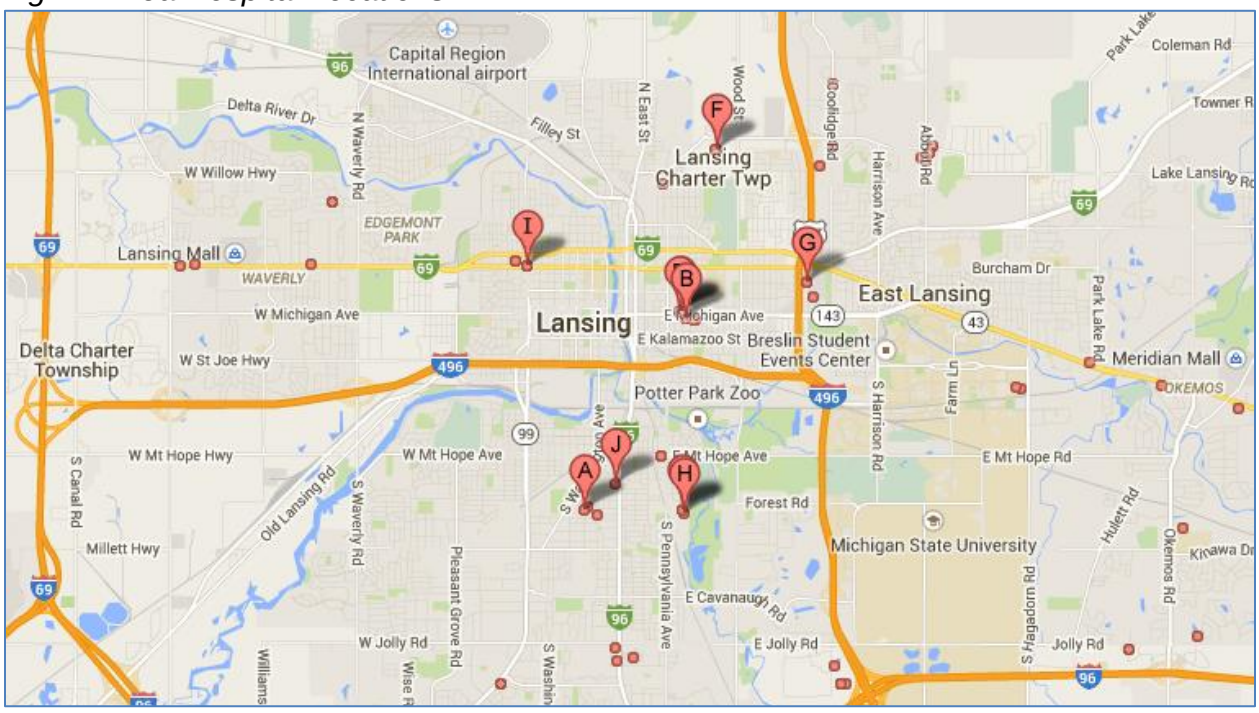


Major Community Services

Community services include a full suite of activities and departments that serve county, municipal and community interests. Mid-Michigan residents receive fire service from cities, villages, and townships. Police service is provided countywide by the Sheriff's Departments, and township-wide by various township police forces, but is supplemented on state routes by the Michigan State Police. Other policing entities include the Michigan State University police.

There are several clinics and hospitals located throughout the region. The Sparrow Health System and McLaren Greater Lansing Hospital serve the region, offering a full range of health and wellness services from the Hospital campuses and off-site locations. Hayes Green Beach Hospital in Charlotte and the Eaton Rapids Medical Center provide a full range of health care for Eaton County, particularly in the southern half of the county. Clinton Memorial Hospital is located in St. Johns and Memorial Health Care Hospital is near Owosso. Both serve Clinton County areas north of the urbanized Lansing area. The map below depicts hospitals located in the Lansing area.

Fig. 12 Area Hospital Locations



The counties provide emergency operations services on a countywide basis through their Emergency Operations Centers (EOCs). The EOC offices are co-located with 911 Dispatch, which also provides countywide 911 dispatch services.

Municipal level public works services of sewer and water exist at some level in incorporated cities region-wide. Municipalities with services include the larger communities of each county such as City of Charlotte, City of Eaton Rapids, City of Grand Ledge, and Delta Charter Township in Eaton County; the cities of East Lansing, Mason, Williamston, Meridian Township, Lansing Township, and Delhi Township in Ingham County; and the cities of St. Johns and DeWitt, and Watertown Townships in Clinton County. A variety of communities in the urbanized core area of the region has water and/or sewer services provided through contracts and joint services agreements with the Lansing Board of Water and Light. Partial services of water or sewer are common in the region's smaller villages and towns such as Sunfield, Olivet, and Vermontville in Eaton County; Webberville, Stockbridge, and Dansville in Ingham County; Ovid, Fowlerville, and Bath in Clinton County.

This region still maintains a good number of residents and businesses outside of public water and sewer service areas. There are rural individual structures and small residential and commercial developments throughout the region still only served by groundwater wells and individual or small shared septic systems.

Key Community Facilities/Organizations: Utility Services

Consumers Energy Company, the Lansing Board of Water and Light, and Detroit Edison provide electrical power and natural gas to residents and businesses in this region. The City of Eaton Rapids also has an electric generating utility. Natural Gas is

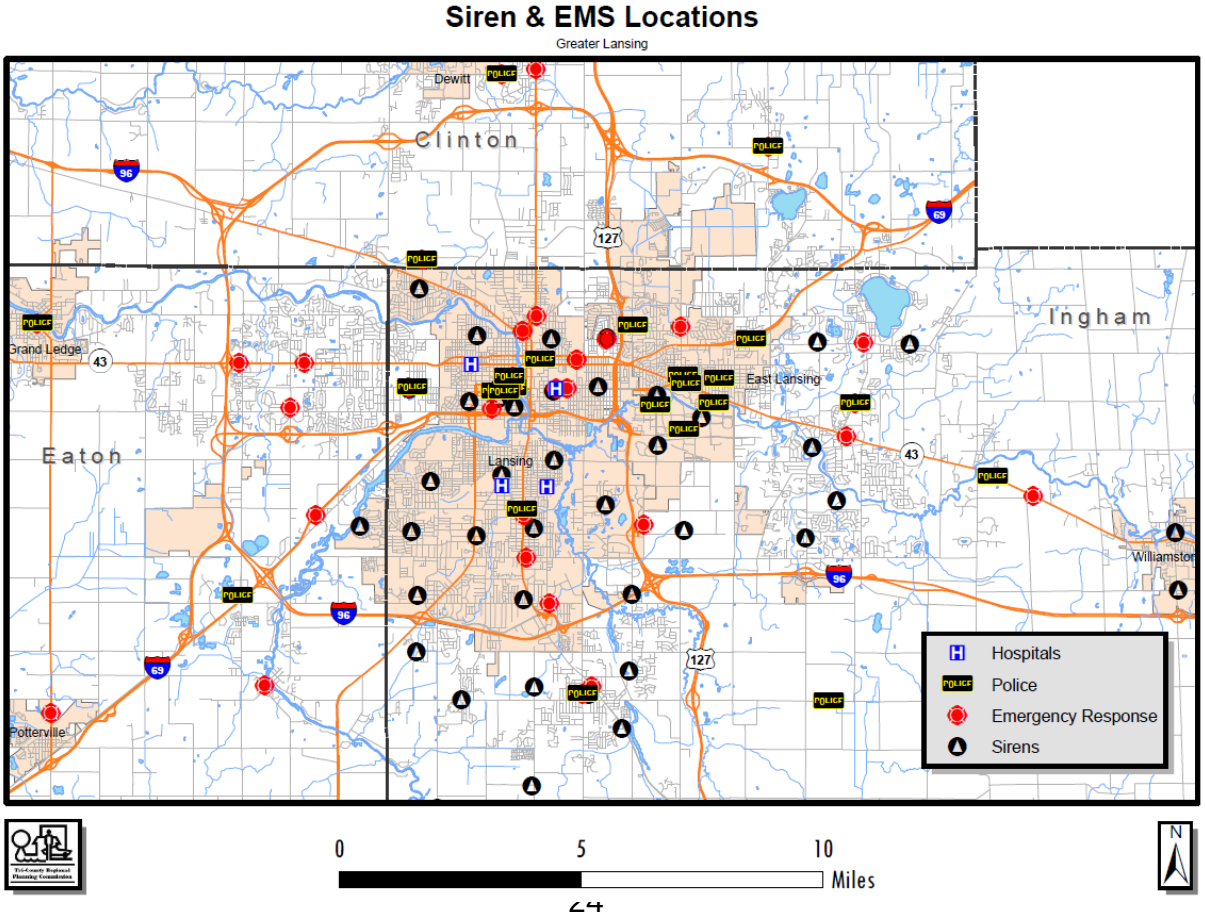
the most common form of heating fuel type for households and the communities in the urbanized central area of our region are mostly served by traditional gas utility lines. Bottled, tank or LP gas provides a large portion of the heat fuel to homes and businesses in the regions more rural areas. Some older areas still rely on oil fuel. There has been a growing trend to use wood-burning furnaces located outside the home. Fuel cost increases over the past few years caused a spike in the number of fuel-efficient burners such that use corn or wood pellets.

Emergency/Crisis Services

There are a number of organizations that provide emergency and/or crisis services in the mid-Michigan area. Primary amongst them is Central Michigan Chapter of the American Red Cross. The American Red Cross has created this Disaster and Safety Library in the event of a disaster or emergency. Here you will find fact sheets, preparedness checklists, recovery guides and other helpful information to keep you informed and safe. More information about the Red Cross and its emergency plan assistance for this region is available at http://www.redcross.org/prepare/disaster-safety-library. There are a variety of other organizations and entities listed hear: http://theear.org/newear/.

The region is home to many emergency warning sirens. They are depicted below, along with hospital locations, police stations and emergency response facilities.

Fig. 13 Area Siren and ER Locations



The regional 211 Service now serves all areas of our region and offers an online and telephone access line for assistance. http://www.referweb.net/uwjc/

Higher Learning Institutions

Michigan State University is the largest four-year institution located in the region. Olivet College is located in southern Eaton County. Great Lakes Christian College is located in Delta Township. Lansing Community College, a two-year institution, has a main campus in Lansing city and a large branch campus in Delta Charter Township. Western Michigan and Central Michigan Universities have small branches within the region, and Davenport University as well as Cooley Law School has campuses located in downtown Lansing.

Michigan State University (MSU) is located in the City of East Lansing and has an enrollment of more than 40,000 students on the local campus. Additionally, MSU employs approximately 10,000 faculty and staff. MSU's campus occupies a large portion of the City of East Lansing's land area and MSU provides many benefits to the community, but it also presents new challenges with respect to new potential threats to public safety and welfare. MSU operates its own infrastructure system of water, sewer, and power. It is also implementing its own master land use plan with transportation and utility developments.

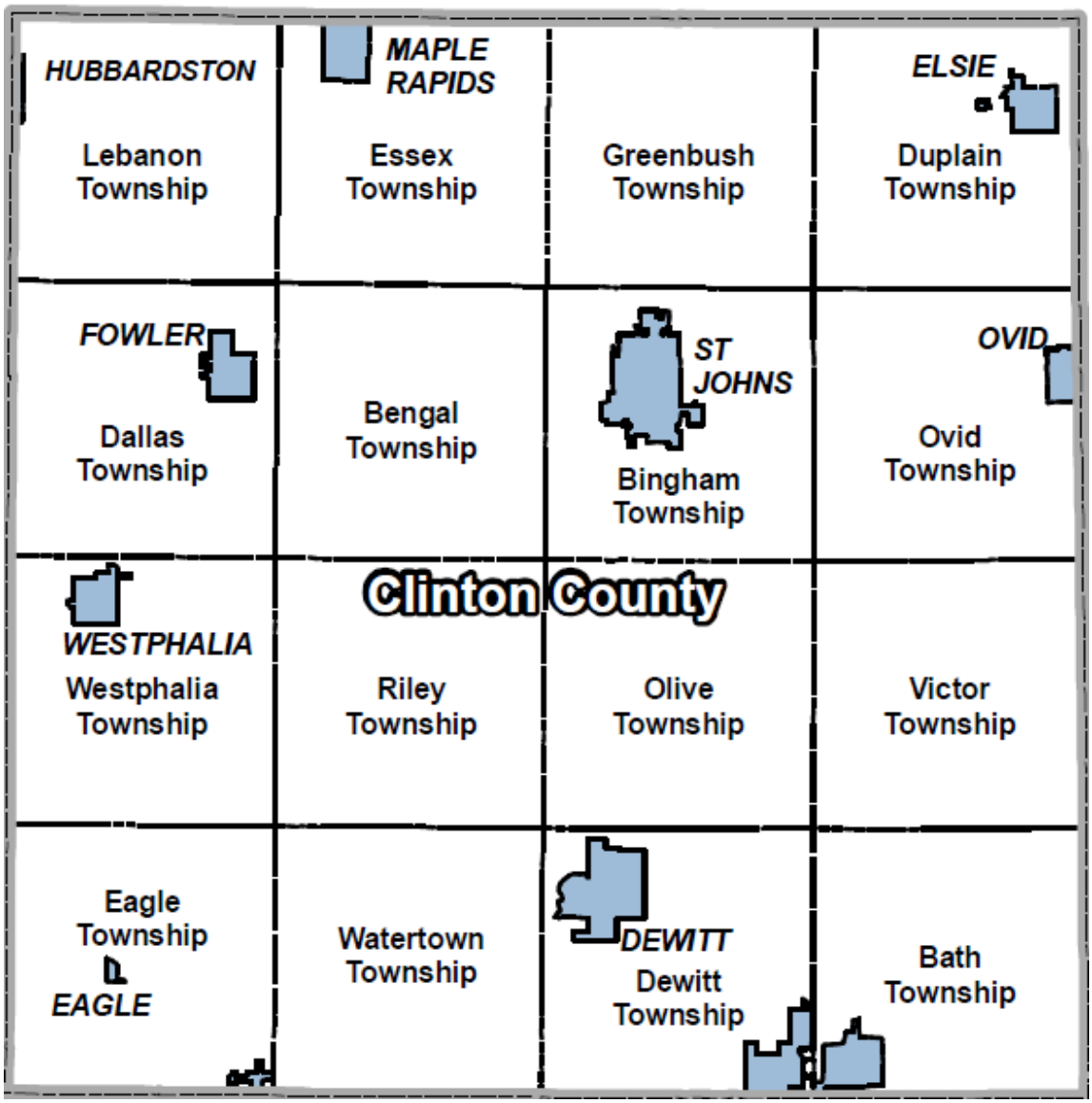
Major Events & Activities

Major events and activities occur frequently throughout mid-Michigan. They include a regular schedule of festivals and fairs in communities region-wide. Please see the regional convention and visitor's website for a current and comprehensive list of events at http://www.lansing.org/events/ . The East Lansing and MSU area, as well as city of Charlotte, Olivet College and Lansing Community College maintain large entertainment venues that host concerts and performances throughout the year. Each County hosts a County Fairgrounds that host events each year. The largest conference and event facilities are located in the city of Lansing and in East Lansing. There are a number of hotels and banquet conference centers located in Delta Township and East Lansing/Meridian Township areas. There are many smaller venues throughout the three counties, mostly in or near the larger cities and adjacent to major roadways.

The region has a number of large sports event venues including fields and field houses for football, baseball, soccer, lacrosse, basketball, and hockey. There are large ice arenas in Delta Township and East Lansing that host events drawing thousands from around and outside of the region. Michigan State University (MSU) sporting events such as football games draw crowds from 1,000-70,000 persons for games throughout the fall. New baseball fields at MSU and a new special needs sport complex in DeWitt draw thousands of people a season. For a complete schedule of entertainment events, including concerts, performances and sporting events visit Michigan State University's website at www.msu.edu.

CLINTON COUNTY PROFILE

Fig. 14 Clinton Co. Map



Clinton County is the northern most County of the Tri-County Region. It consists of 14 general law townships, 2 charter townships, 5 villages and 2 cities as presented in the following map. The charter townships and cities do not operate under the county planning commission. Clinton County is five hundred seventy-one (571) square miles in size and is centrally located in the lower peninsula of the State of Michigan. The County is bordered by Shiawassee County to the east, Gratiot County to the north, Ionia County to the west, and Eaton and Ingham Counties to the south. The City of Lansing, the State's capital is located immediately south of Clinton County. Interstate 69 and Interstate 96 pass through the southern portion of the County and US-127 bisects the county. The major east-west connector is State Highway 21, which connects Flint to

Grand Rapids. Considering its close proximity to the urbanized core city of Lansing, the County remains predominantly rural. The density of development is located in the southern tier of the County with concentrations in the County seat of St. Johns.

Population

Clinton County's current population is 72,922. Growth in Clinton County's resident population accelerated during the 1960's and 1970's with the construction and opening of regional highways. (I-496, I-96, I-69 and US-127). These trends continued during the 1970s and '80s and, by the 1990 Census, almost 58,000 people were living in the county. Though slowing somewhat through the decade of the 1990s, the county's rate of growth exceeds that of neighboring jurisdictions.

Clinton County's population is expected to approach 75,357 by 2020, a 9% increase from 69,360 residents in 2005. The combination of further regional in-migration and natural increase as county residents form new households and have children will result in continued growth to the year 2020 and beyond.

Fig. 15 Clinton Co. Population

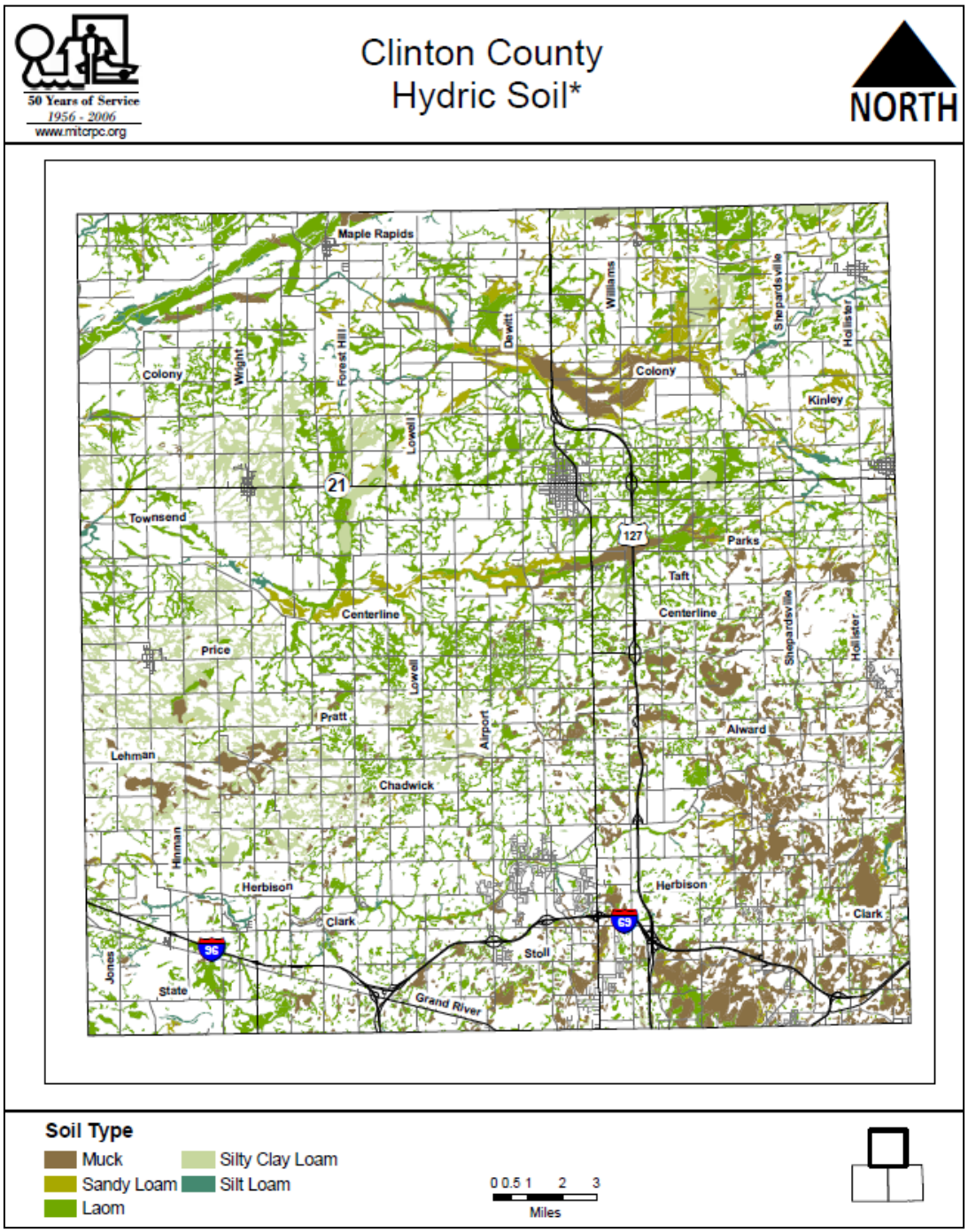
	POPULATION BY FORECAST YEAR								
Clinton County									
MCD	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Bath Twp	10,484	10,513	10,593	10,734	10,930	11,135	11,311	11,495	11,682
Bengal Twp	1,241	1,252	1,279	1,323	1,380	1,434	1,474	1,512	1,548
Bingham Twp	2,391	2,413	2,467	2,556	2,670	2,777	2,857	2,989	3,155
Dallas Twp	1,259	1,270	1,299	1,346	1,407	1,464	1,506	1,546	1,585
Dewitt	4,396	4,412	4,452	4,518	4,602	4,681	4,740	4,796	4,849
Dewitt Twp	12,947	14,001	14,817	15,720	16,556	17,053	17,186	17,284	17,366
Duplain Twp	1,321	1,333	1,362	1,411	1,474	1,532	1,576	1,618	1,657
Eagle	130	141	149	158	166	171	173	174	174
Eagle Twp	2,220	2,237	2,276	2,342	2,425	2,504	2,563	2,618	2,672
East Lansing	1,020	1,022	1,028	1,036	1,045	1,054	1,059	1,063	1,066
Elsie	1,002	1,009	1,024	1,050	1,083	1,114	1,137	1,159	1,180
Essex Twp	1,227	1,238	1,266	1,313	1,372	1,428	1,470	1,509	1,547
Fowler	1,082	1,086	1,096	1,113	1,135	1,155	1,171	1,185	1,199
Grand Ledge	5	5	5	6	6	6	6	6	6
Greenbush Twp	2,126	2,145	2,192	2,269	2,368	2,461	2,530	2,596	2,659
Lebanon Twp	792	800	818	848	886	922	949	975	999
Maple Rapids	614	619	631	651	677	700	718	735	751
Olive Twp	2,323	2,344	2,394	2,478	2,584	2,685	2,820	2,983	3,166
Ovid	1,416	1,422	1,437	1,462	1,494	1,524	1,547	1,568	1,588
Ovid Twp	2,024	2,042	2,088	2,163	2,259	2,350	2,417	2,481	2,542
Riley Twp	1,797	1,813	1,853	1,920	2,004	2,084	2,144	2,200	2,254
St Johns	7,574	7,595	7,648	7,735	7,846	7,951	8,029	8,103	8,174
Victor Twp	3,241	3,262	3,314	3,399	3,508	3,610	3,686	3,758	3,828
Watertown Twp	4,460	4,823	5,104	5,415	5,702	5,874	5,920	5,953	5,981
Westphalia	835	839	848	863	882	899	913	925	937
Westphalia Twp	1,436	1,449	1,480	1,531	1,597	1,659	1,705	1,749	1,790
Total Clinton County	69,360	71,084	72,922	75,357	78,058	80,229	81,604	82,979	84,354
% Change vs 2005		2%	5%	9%	13%	16%	18%	20%	22%

Source: Tri-County Regional Planning Commission (2014)

Soils

Clinton County has been an agricultural community since its settlement in the early 1800's. Clinton County's rich agricultural soils range from loam types to muck. In the map below, created by the Tri-County Regional Planning Commission from Natural Resource Conservation Service data, the majority of the county is covered by loam-type soils. Areas associated with water features provide a more muck-based soil.

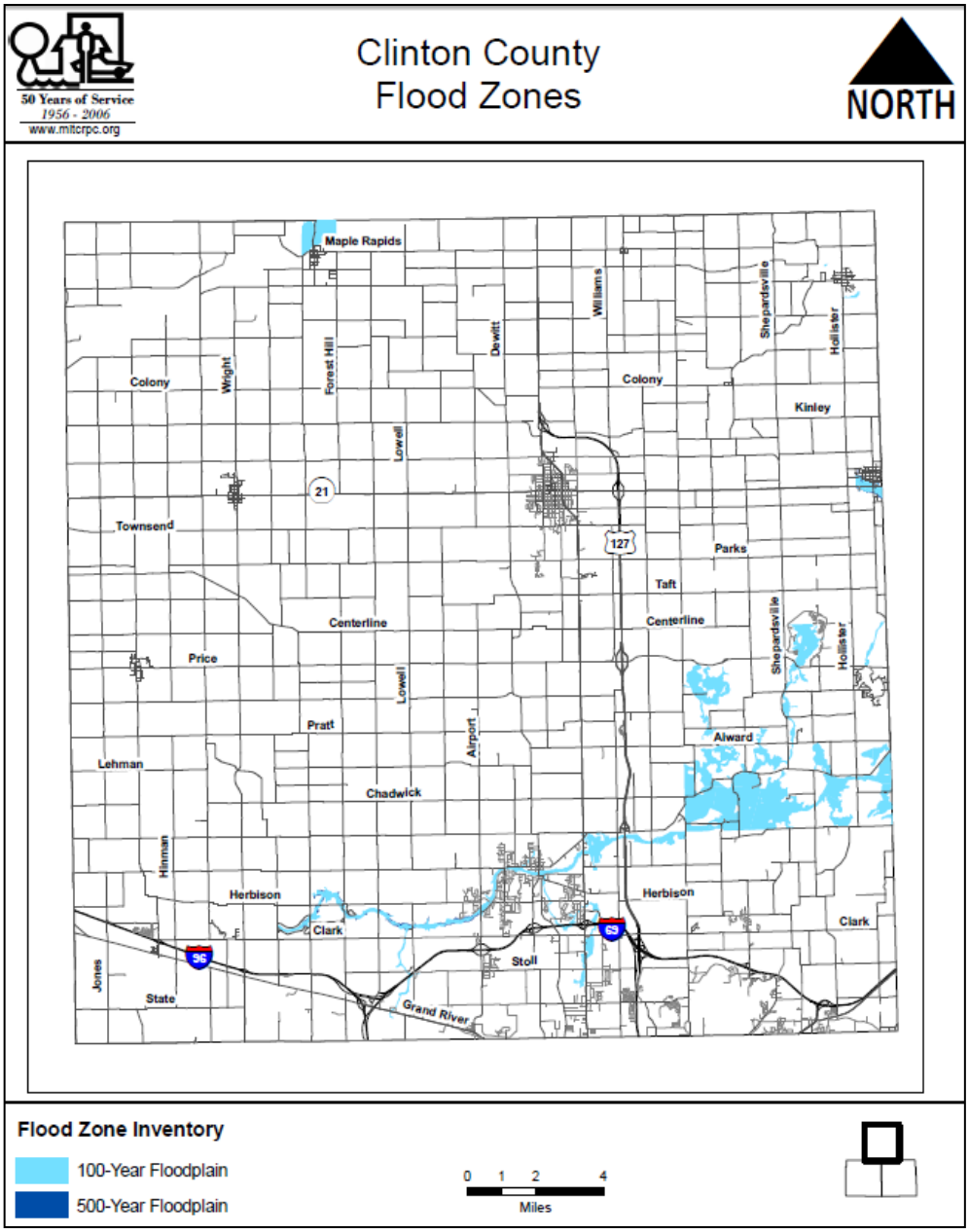
Fig. 16 Clinton Co. Soils



Water Features

Significant water features, including lakes and rivers in Clinton County include:
Lake Ovid, Park Lake, Round Lake, Looking Glass River, Maple River, and Muskrat Lake. The map below, created by the Tri-County Regional Planning Commission using FEMA Flood Insurance Rate maps, depicts the flood zones across Clinton County. Significant areas include the Maple River area along the northern border of the county, and the Lake Ovid area on the eastern edge of the county. The Looking Glass River, which runs along the southern tier of the county, is also an area of flood concern.

Fig. 17 Clinton Co. Flood Zones



Existing and Future Land Use

Clinton County land use categories were determined through analysis and revision of existing land use maps and field inspections. In an effort to simplify analysis and allocation of future land use, several of the existing land use categories were combined into more generalized categories. These generalized categories, along with a brief description and examples, are provided below.

Clinton County's land use statistics have changed significantly since the previous inventory in 1978. According to the 1999 land use statistics, over ten percent (10%) of the County is single family residential. This is an increase from 3.14 percent in 1978. This increase comes at the expense to agricultural land whose land share dropped from seventy-four percent (74%) in 1978 to sixty-six percent (66%) in 1999, almost 29,000 acres. In the Future Land Use Map, created by TCRPC, Clinton County is planning for increased residential growth near city and village centers.

Fig. 18 Clinton Co Land Use

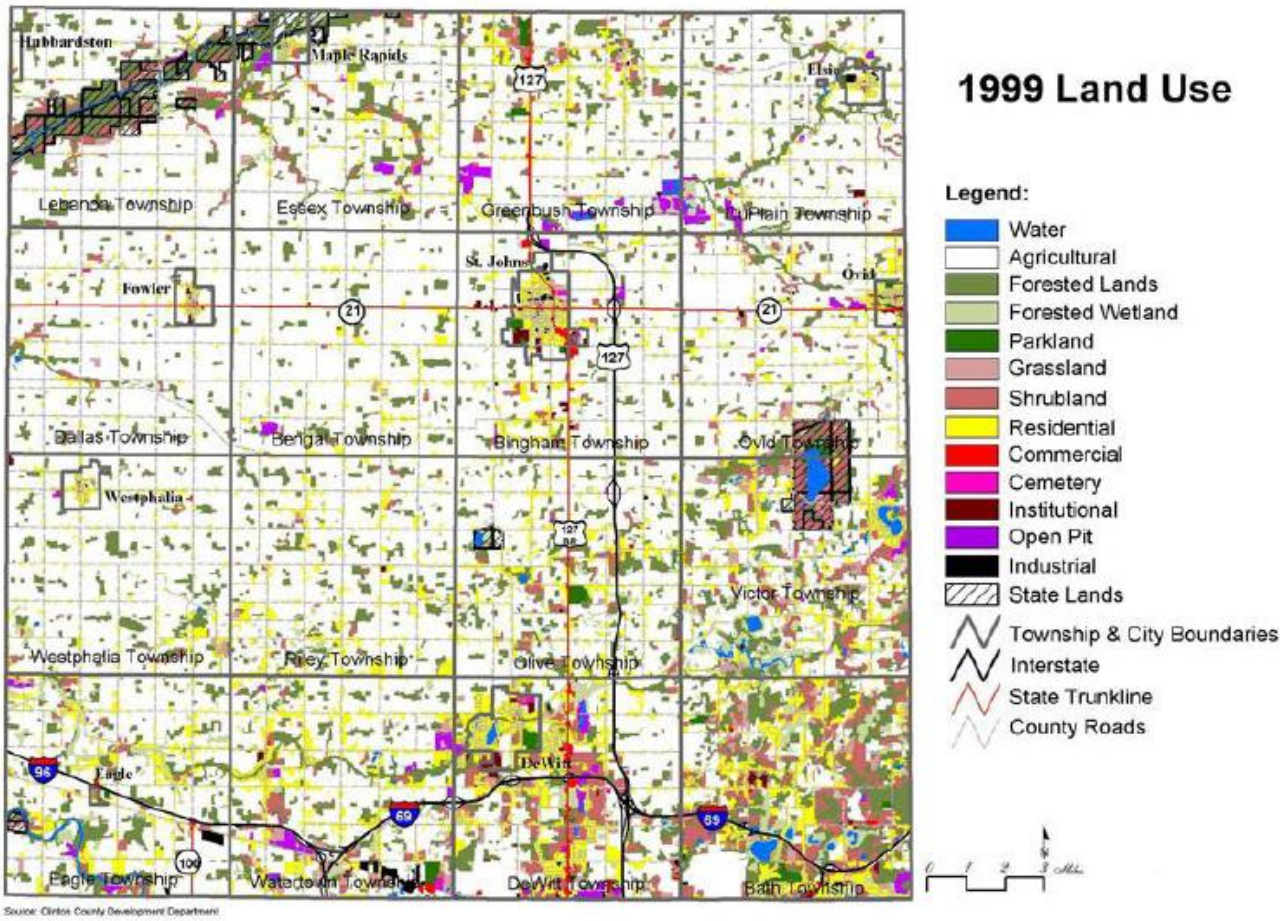
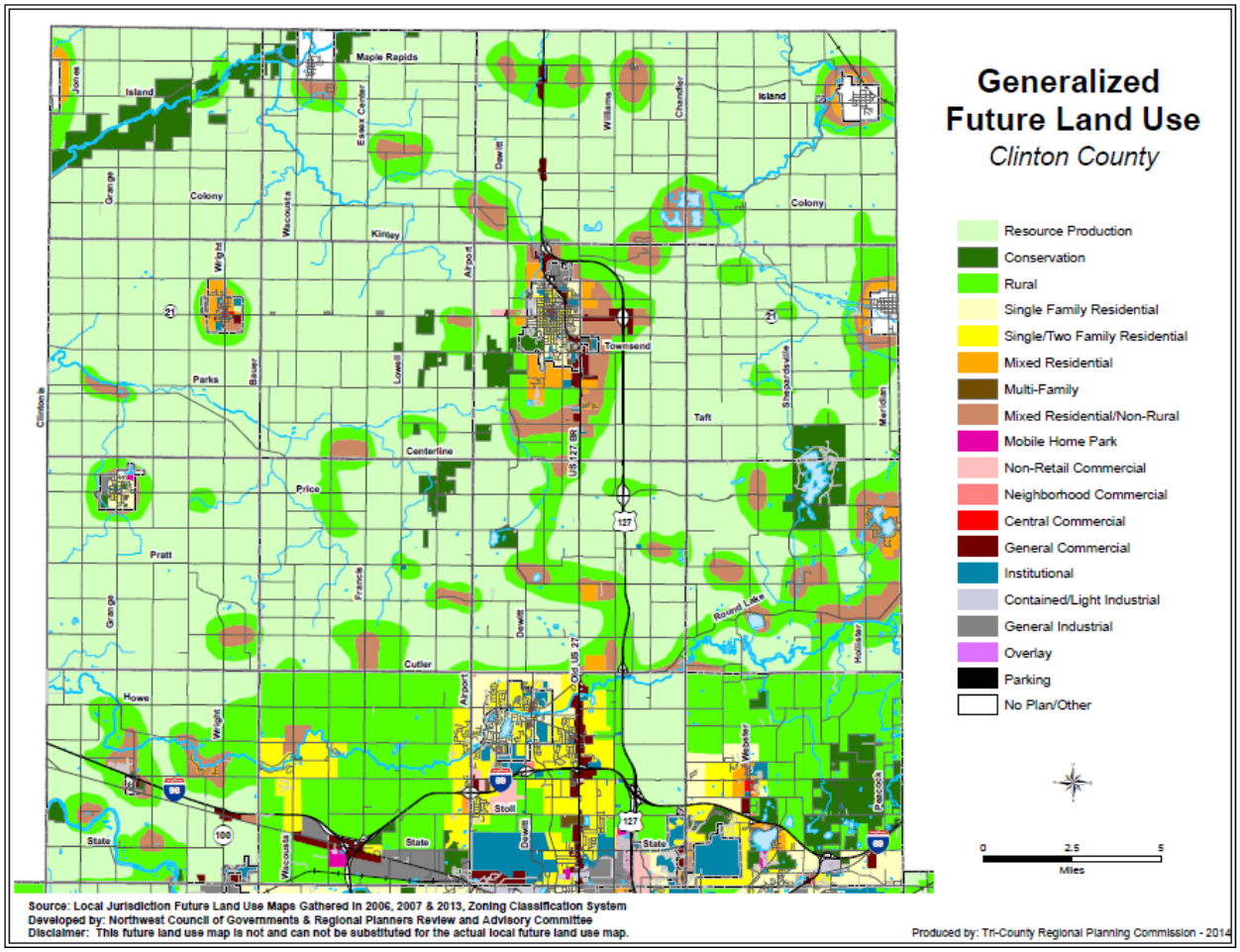


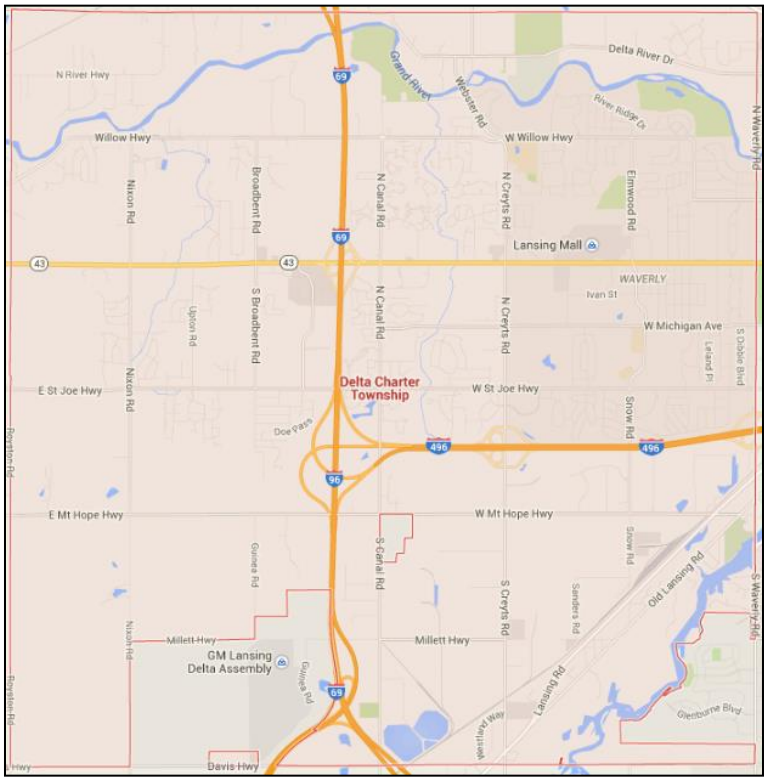
Fig. 19 Clinton Co Future Land Use



DELTA CHARTER TOWNSHIP PROFILE

Delta Charter Township is located in the northeastern corner of Eaton County, just west of the region's core City of Lansing. The Township's north and eastern borders are shared with the counties of Clinton and Ingham, respectively. To the south and west of Delta Township are the townships of Windsor and Oneida. The following map depicts Delta Charter Township.

Fig. 20 Delta Township Map



Source: Tri-County Regional Planning Commission (2013)

Delta Township is a Charter Township with a Supervisor, Clerk, Treasurer and four Trustees. The Township Hall is located on West Saginaw Highway (M-43) just east of the I-96/Saginaw Highway interchange. As a Charter Township, Delta Township has basic powers granted to general law townships by state statute as well as the power to levy more millage (up to 5 mills or 10 mills with the electorate's approval) and protect itself from annexation. The Township employs a full time manager, assessor, fire chief and other necessary personnel. Townships are mandated to administer assessments, hold elections, and collect taxes. They are also responsible for financial administration, including budgets, accounting, investments and deposits. In addition, townships may enact and enforce ordinances, which include zoning ordinances.

Population

According to the 2010 Census, Delta Township's population was 32,408. According to the Tri-County Regional Planning Commission, the Township's population in 2015 is estimated at 35,390 residents. The table below, taken from Delta Charter Township, depicts Delta's population growth in comparison to neighboring communities. It predicts a 25% growth rate between 2000 and 2025, compared to lesser growth rates nearby.

Fig. 21 Delta Township Population

POPULATION GROWTH ESTIMATES							
	2000	2005	2010	2015	2020	2025	Growth
Grand Ledge	7,804	7,956	8,124	8,420	8,719	8,965	15%
Delhi Township	22,570	24,678	25,250	25,732	26,462	27,278	21%
Delta Township	29,682	31,835	32,408	35,390	36,861	36,971	25%
Meridian Township	39,119	40,964	41,875	43,079	44,850	46,805	20%

Current and Future Land Use

The township has an area of approximately 23,096 acres. The majority of the central and northern areas are residential and commercial. The western area of the township is mainly agricultural, while the southern portions are typically industrial. In Delta Township's Future Land Use map, below, an urban service boundary is depicted and much of the northwest portion of the township is planned for residential.

Fig. 22 Delta Township Land Use Map

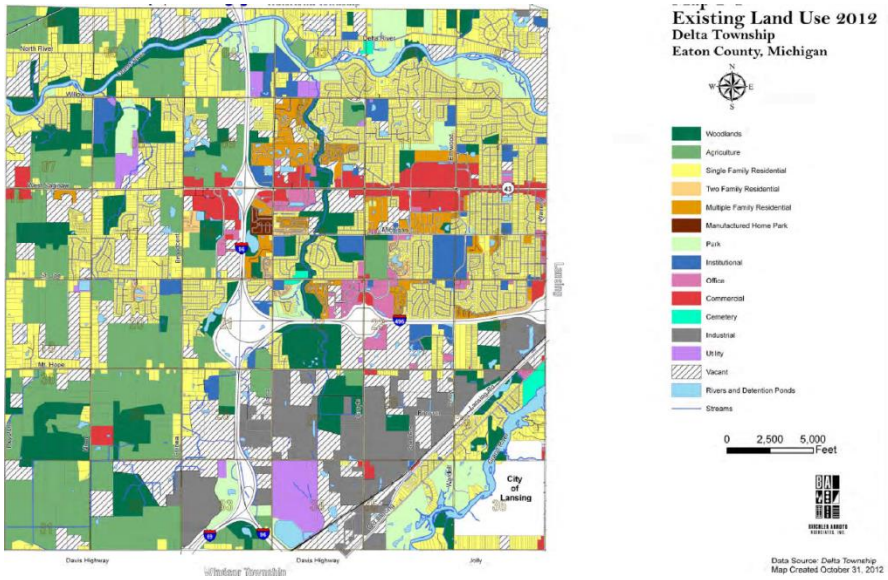
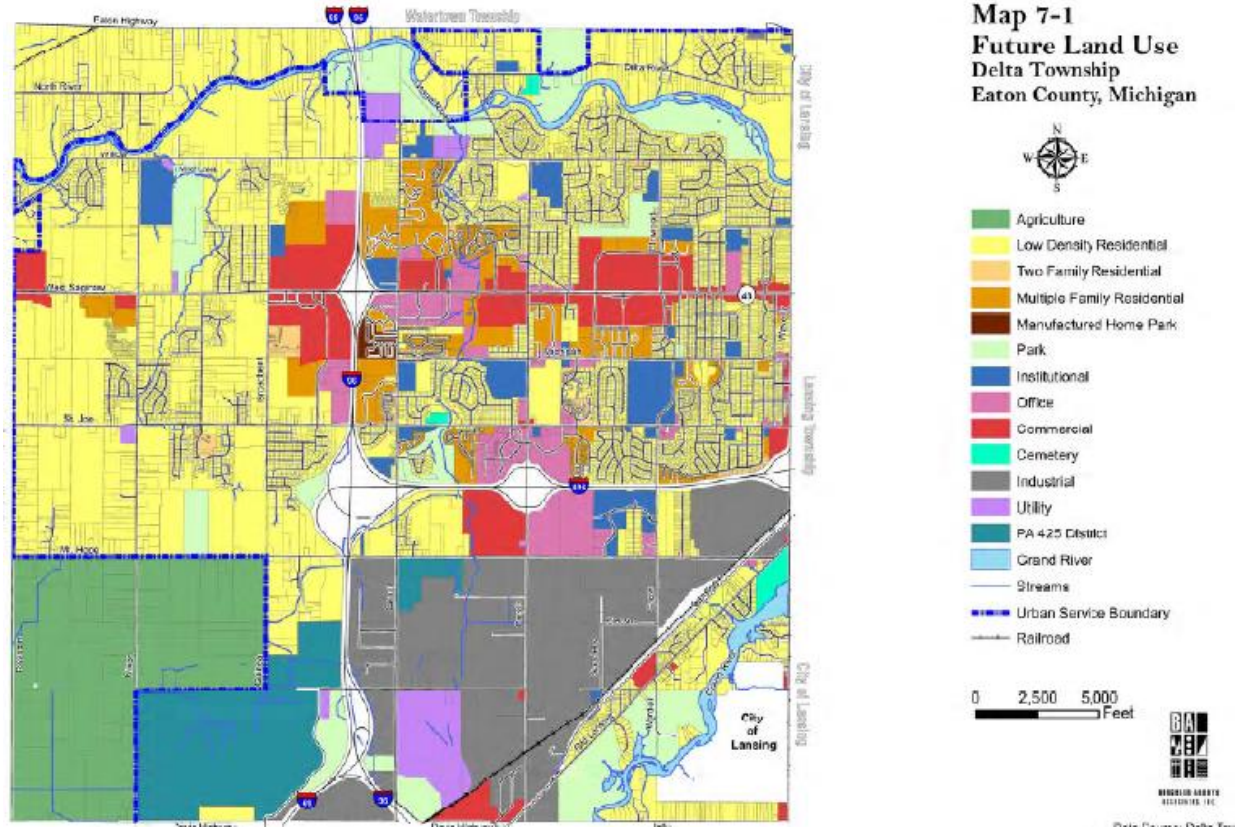


Fig. 23 Delta Township Future Land Use



Roads The transportation network within the Township can be divided into four classifications: freeways, arterial, collector and local streets. These classifications are based on the service function of the street and its relationship to other streets in the Township. In total, the transportation network within the Township occupies more than 2,500 acres and consists of more than 175 miles of roads. Interstates

Delta Township Transportation

Interstate highways I-69 and I-96 and the urban beltway, I-496 are the principal highways within the Township. I-69 is a major north/south highway in southern Lower Michigan. It passes through the Township connecting it to the county seat, Charlotte and providing access to I-94 to the south and offers a connection to Flint (I-75) to the east. It is part of an international trade corridor connecting to the U.S- Canada border. I-96 connects Delta Township with Grand Rapids on the west and Lansing then Detroit to the east. Within the Township, I-96 and I-69 occupy much of the same highway right-of-way. Interstate 96 merges with I-69 north of the Township where they continue south several miles as a single highway until they split just south of Delta Township. Interstate 96 continues east while I-69 continues southwest. A traffic count of 63,000 vehicles per day was recorded in 2003 for I-96 and I-69 just south of M-43. The I-96, I-69, and I-496 junctions is located in the southern portion of the Township, where I-496 penetrates

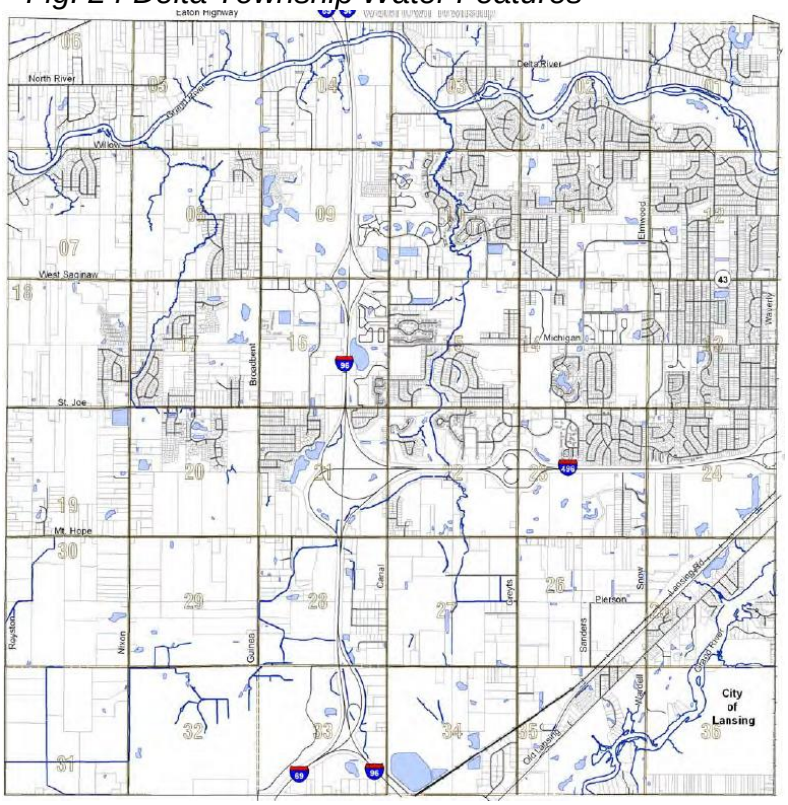
east into the City of Lansing.

Roads classified as “arterial roads” serve as the primary collectors of traffic generated on the collector and local streets in Delta Township. The collector streets in the Township generally follow a one-mile grid pattern that mirrors the township’s one-mile section lines that date back to the 19th century survey of the area. Some of the major roads in the Township include the following east-west routes: Michigan Avenue, M-43/Saginaw Highway, Mt. Hope Highway, Willow Highway and St. Joe Highway. In Delta Township, Creyts Road, Canal Road, Nixon Road, and Waverly Road, all north-south routes within the Township.

Water Resources

Located in the Grand River Watershed, the township has over 410 acres of ponds, rivers and streams within its boundaries. The principle water feature is the Grand River. The Grand River occupies approximately 348 acres and stretches more than 10 miles the Township. More of the Grand River is located in Delta Township than any other single governmental unit in the Tri-County area. Other water features in the Township include Miller Creek and Carrier Creek, both tributaries of the Grand River. These creeks, and the drains which feed them, flow from south to north draining much of the Township. The water features within the township are depicted in the map below, taken from Delta Township’s Master Plan.

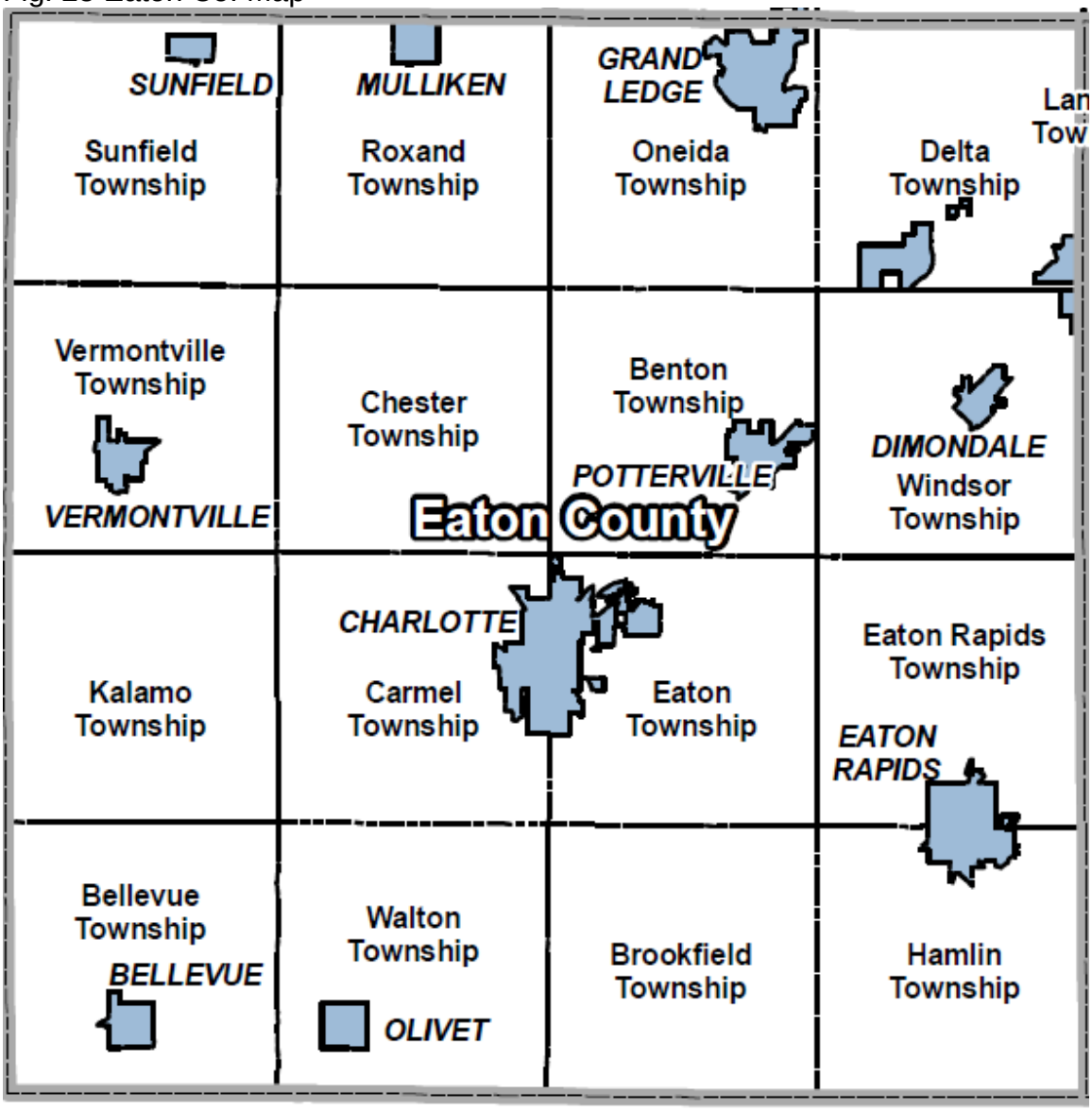
Fig. 24 Delta Township Water Features



EATON COUNTY PROFILE

Eaton County is located in south central Michigan and is part of the Tri-County region that also includes Ingham and Clinton Counties. The City of Lansing, the region's urban focal point, lies in the center of the three-counties. While the bulk of the urban area is within Ingham County, a portion of the City of Lansing extends into Eaton County at its northeastern corner.

Fig. 25 Eaton Co. Map



Source: Tri-County Regional Planning Commission (2013)

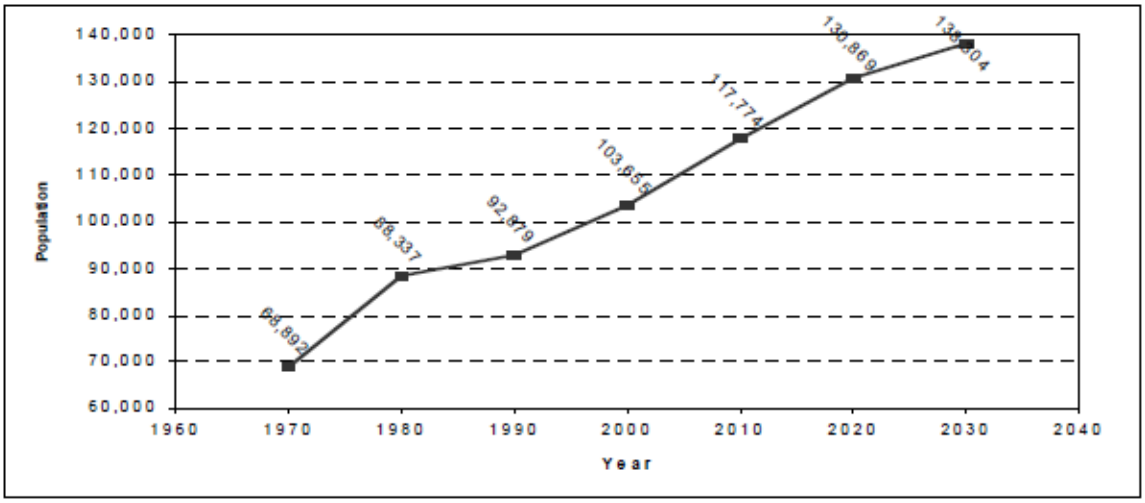
Eaton County is a mixture of rural farmlands, small industrial parks, traditional communities and suburban development. Within Eaton County's approximate 580 square miles are twenty-seven units of government including, six cities (including part of Lansing), five villages and sixteen townships. The higher development concentrations occur in the northeastern corner and along the eastern border of the County. The

County seat, Charlotte, is located just south of the county's geographic center. The county includes two other larger incorporated cities- Grand Ledge and Eaton Rapids- and villages including Sunfield, Milliken, Vermontville, Potterville, Bellevue, and Olivet. Population concentrations are highest in Delta Charter Township and in the City of Charlotte. Large and heavy industrial development is concentrated in southern Delta Township, in Charlotte, and adjacent to Eaton Rapids. Eaton County has planning and zoning authority over all unincorporated areas. Delta Charter Township controls its own planning and zoning, as do most incorporated municipalities.

Population

According to Eaton County's 2011 Master Plan, their 2000 Census population totaled 103,655 residents. As depicted in the table below, created by the Tri-County Regional Planning Commission, Eaton County's population is projected to increase to 117,400 residents by 2020. This is an 11.7% increase.

Fig. 26 Eaton Co. Population Chart

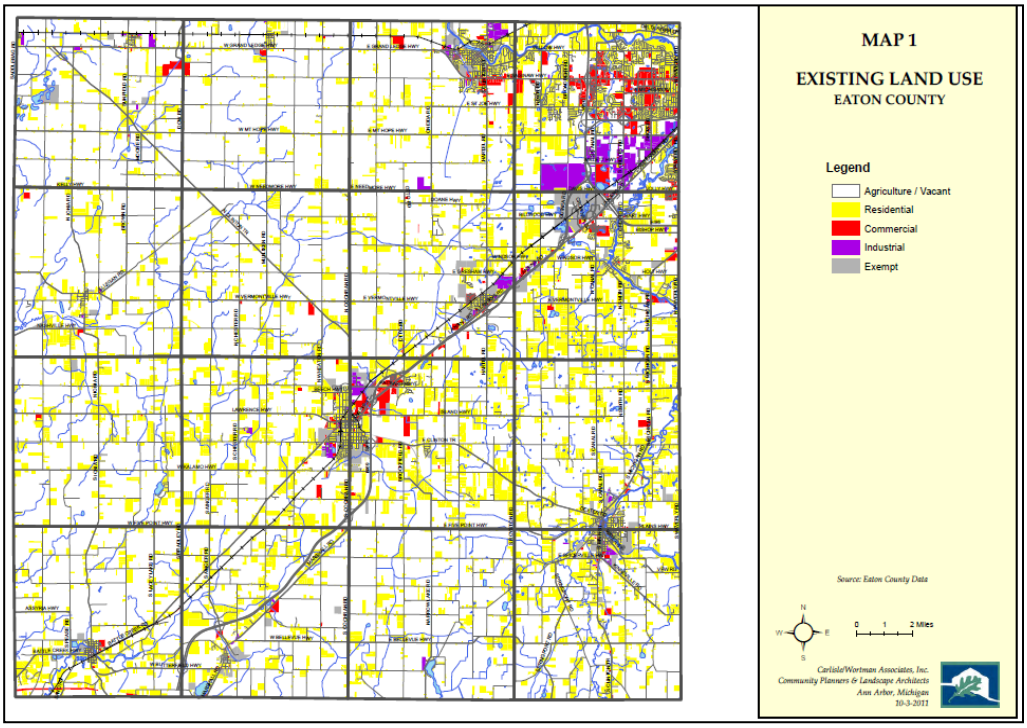


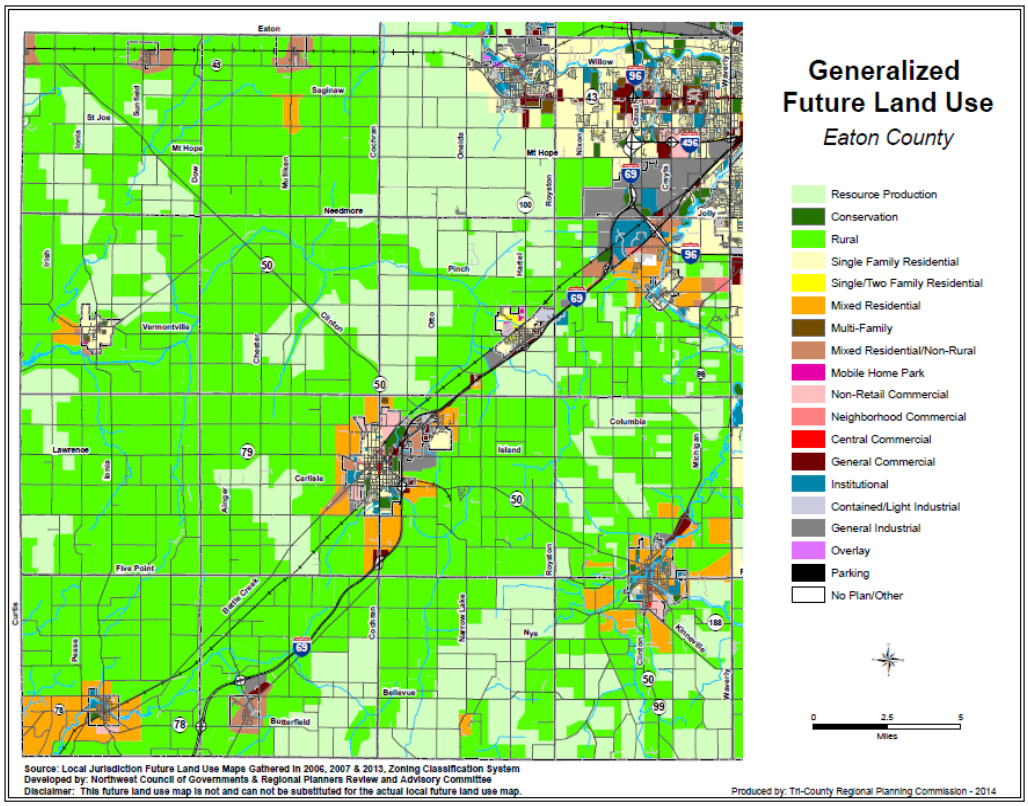
Transportation

Eaton County is reliant mostly on automobiles. The Interstate highway I-69 bisects the County southwest to northeast and is part of an international trade corridor connecting to the U.S-Canada border. It connects the county seat, Charlotte, to points south with access to I-94 and offers a connection to Flint (I-75) to the northeast. Michigan route M-43, a major east-west highway, crosses the top third of the county from west to east. I-69 and M-43 connect County residents to Lansing, East Lansing and points east via I-96 and the region's urban beltway, I-496. Within the county, I-96 and I-69 occupy much of the same highway right-of-way. M-100 is a north-south collector serving the County's northern tier and M-99 is another north-south route that connects the city of Lansing to Eaton Rapids and points south. M-50 slices across the County from west to east connecting Charlotte and Eaton Rapids with points east and south of the region.

There are active rail lines across the County with daily passenger service. There are no active passenger stops in Eaton County. Most rail lines carry very heavy freight traffic.

Fig. 27 & 28 Existing and Future Land Use Maps, Eaton Co.





Those lines run directly through population centers in Olivet, Charlotte, and Potterville and Grand Ledge and serve industrial developments in the county.

Current and Future Land Use

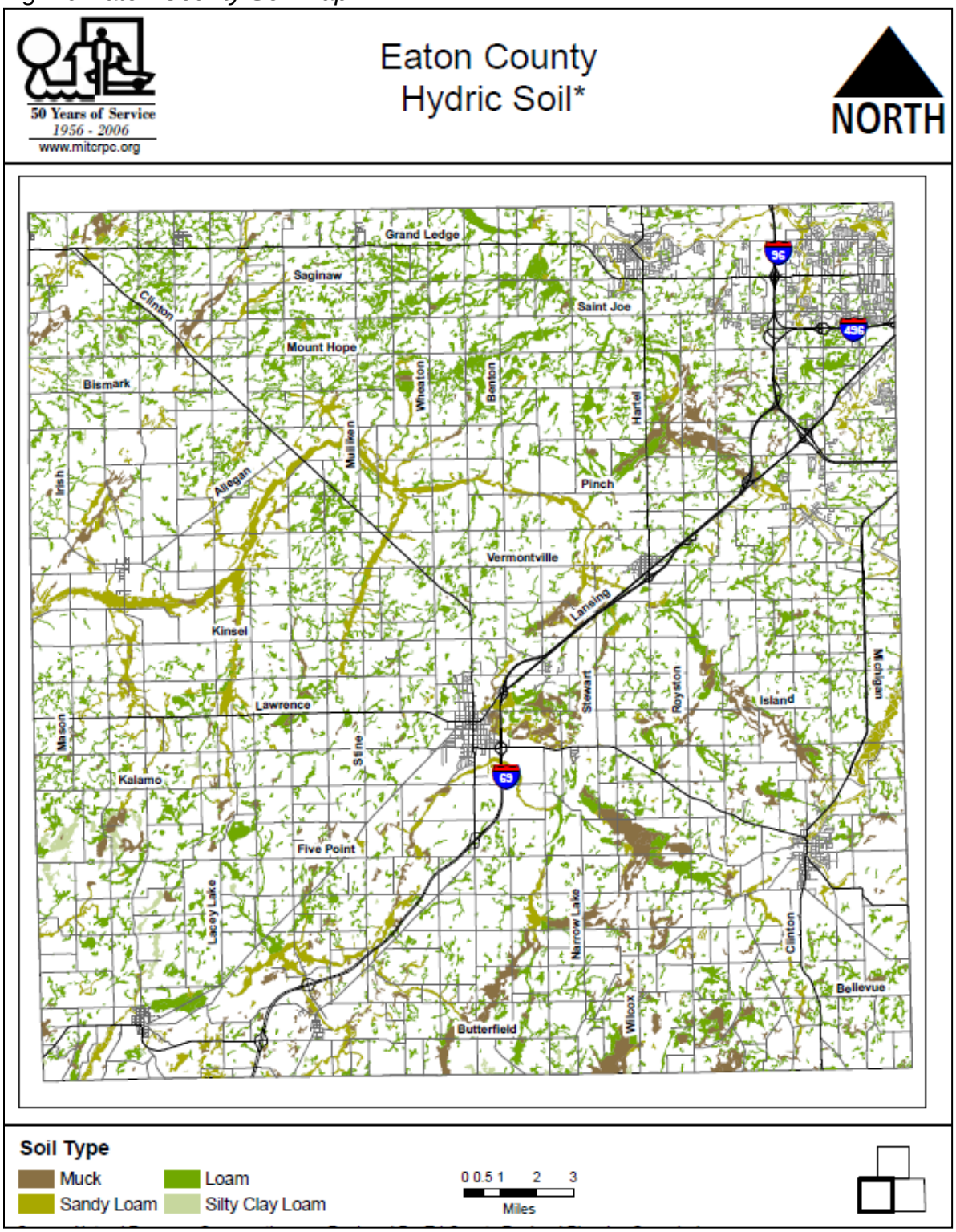
Agricultural property remains the predominant land use in Eaton County, encompassing approximately 72.8 percent of the County's entire area. The land use map developed for Eaton County's Master Plan demonstrates the rural nature of the county. Residential development currently occupies approximately 22.7% or 82,220 acres Eaton County's total land area. Residential uses are focused around the population centers and extend along the major transportation routes throughout the County. Whereas, commercial and industrial land uses continue to make up a relatively small portion of the County's land area, with the majority of commercial land uses found in the concentrated population centers such as Delta Township, Grand Ledge, Eaton Rapids and Charlotte. The Future Land Use Map, below, created by TCRPC depicts a growth of residential areas near town and city centers.

Eaton County Soils

Soils within the County are one of its most valuable natural resources. Agricultural land uses represent 62% (230,000 acres) of the County, and $53,054,000 in revenues through agricultural products. While half of the County contains well and moderately drained soils (43% or 160,000 acres), 48% of the County contains somewhat poorly Soils

Eaton County soils include large areas of well drained farmland and some poorly drained mineral soils. Those areas lend themselves to sand and gravel mining and there are a number of small mining operations throughout the county. The map below identifies where these soil categories are located. Prime farmland and farmland of local importance makes up approximately 51% of the County, while prime farmland if drained makes up 43%. Areas that are not considered prime farmland are primarily in urban areas or directly adjacent to rivers and other waterways. The map below, created by TCRPC, shows the muck and loam soils along areas affiliated with water features.

Fig. 29 Eaton County Soil Map

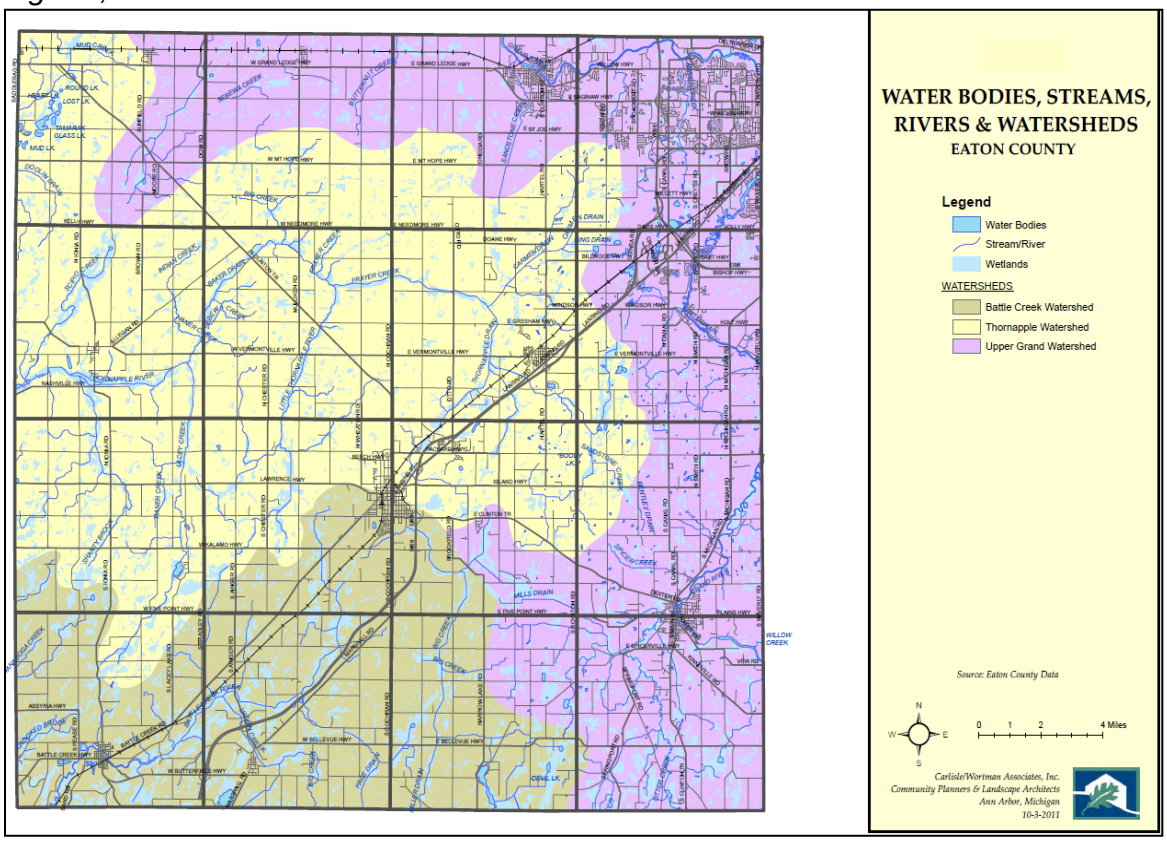


Water Resources

Eaton County is part of three watersheds. One is the Upper Grand River watershed, covering approximately 34% (or 128,000 acres) of the County. Another is the Thornapple River watershed, a sub-watershed of the Lower Grand River watershed. The Thornapple River watershed covers approximately 44% (or 163,000 acres) of Eaton County. The Battle Creek watershed, a sub-watershed of the Kalamazoo River watershed, covers approximately 21% (or 79,000 acres) of the County. These areas are depicted in the map below, taken from the 2011 County Master Plan.

Since 1999, the County has participated in several watershed-planning efforts, in conjunction with applying for and receiving a storm water permit from the state through the Phase II Stormwater National Pollutant Discharge Elimination System (NPEDS). The Eaton County Drain Commissioner's office has spearheaded these efforts in the County. The goal of NPDES is twofold: 1) to protect water *quality* in the nation's surface waters, and 2) to control the amount of storm water that reaches streams and rivers (or storm water *quantity*).

Fig. 30, Eaton Co. Water Features

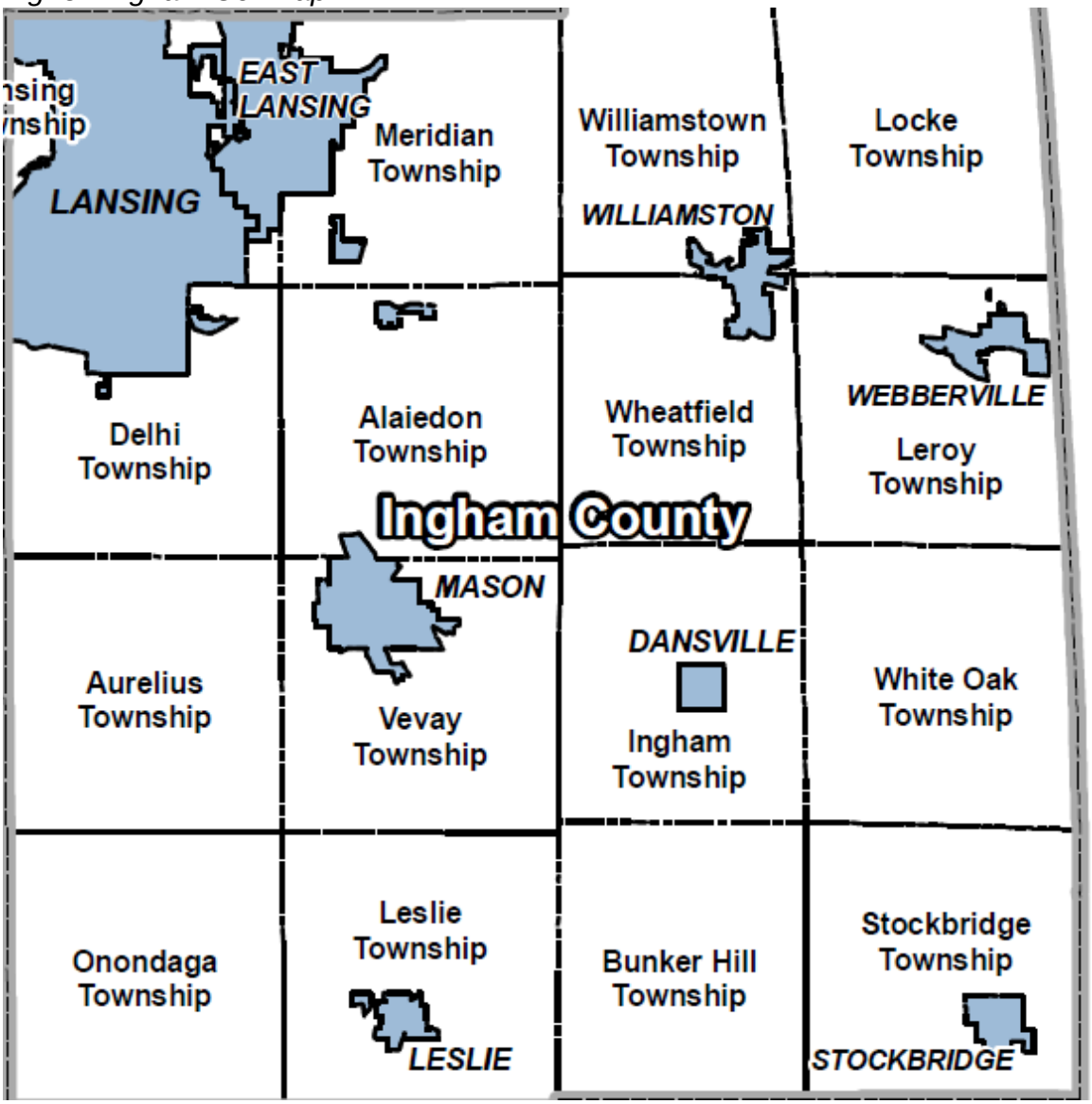


Watershed management plans were developed for the Upper Grand River, the Lower Grand River (which includes the Thornapple River sub-watershed), and the Battle Creek River. These plans describe the current condition of each watershed, and identify significant pollutants that need to be addressed in each watershed.

INGHAM COUNTY PROFILE

Ingham County is located in south central Michigan. As depicted in the Tri-County the map below, there are 13 general law townships, three charter townships, three villages and five cities in Ingham County. The City of Lansing has developed its separate Hazard Mitigation Plan and so that is not addressed in this plan. Besides the city of Lansing, Ingham County's largest communities include Meridian Township,

Fig. 31 Ingham Co. Map



Population

Population statistics indicate that Ingham County has a larger share of the region's population base. According to the 2010 U.S. Census, Ingham County's population was 280,895. It has steadily increased over the past several decades, and is projected to do so through 2045. By 2020, the population is projected to be 279,954 persons, According to TCRPC, by 2045, the population is projected to be 299,661, an increase of 8% since 2005.

Most of Ingham County's population is centered in the greater Lansing metropolitan area. Growth patterns tend to radiate primarily from the Lansing area outward, with growth decreasing as the distance from Lansing increases. There is a limited amount of commuting between the Lansing metropolitan area and outlying major cities such as Flint, Detroit, Ann Arbor, Jackson, Kalamazoo, Grand Rapids and Saginaw. Most Ingham County residents work within the Lansing metropolitan area.

Current and Future Land Use

The current and future land use maps, below, depict a pattern of residential and commercial land uses in urban core areas. A notable growth of residential near city and village centers is depicted in the future land use map.

Fig. 32 Ingham Co Land Use Cover

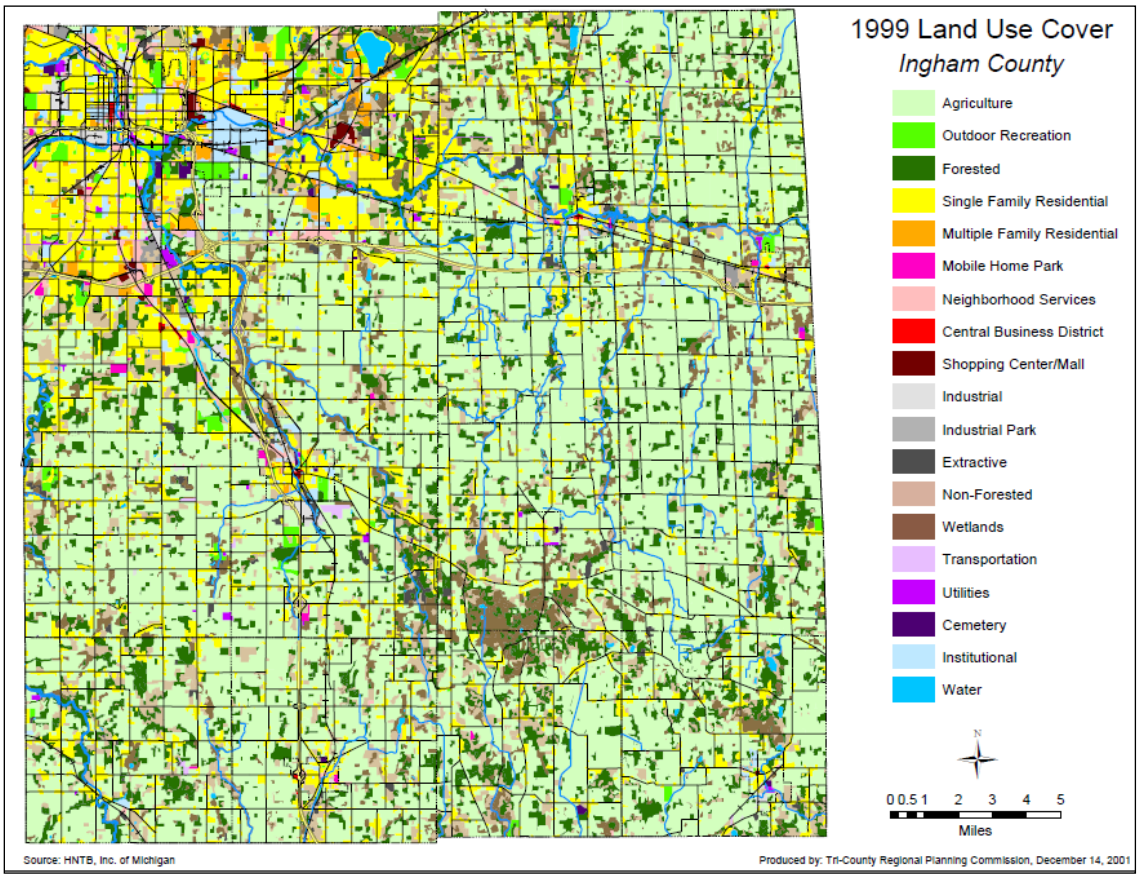
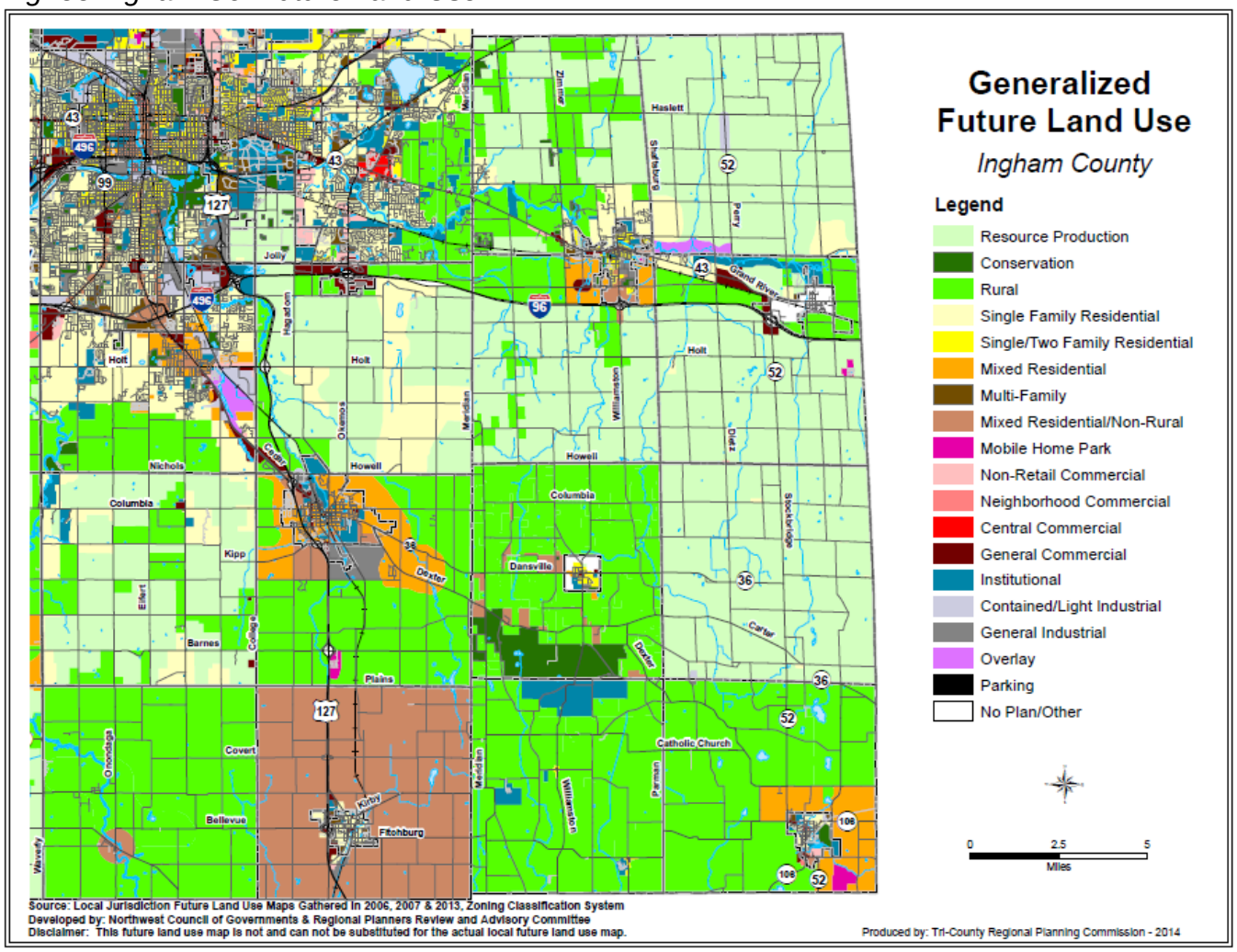


Fig. 33 Ingham Co. Future Land Use



Soils

Ingham County topography is characterized as flat to gently rolling. Two major rivers traverse the county: the Grand River and the Red Cedar River. Several glacial eskers also pass through the county. Land uses include: 15% urban areas, 67% agriculture and open space, 14% woodland and 4% wetlands. Of the wetlands, only 0.5% is classified as water, including both rivers and lakes.

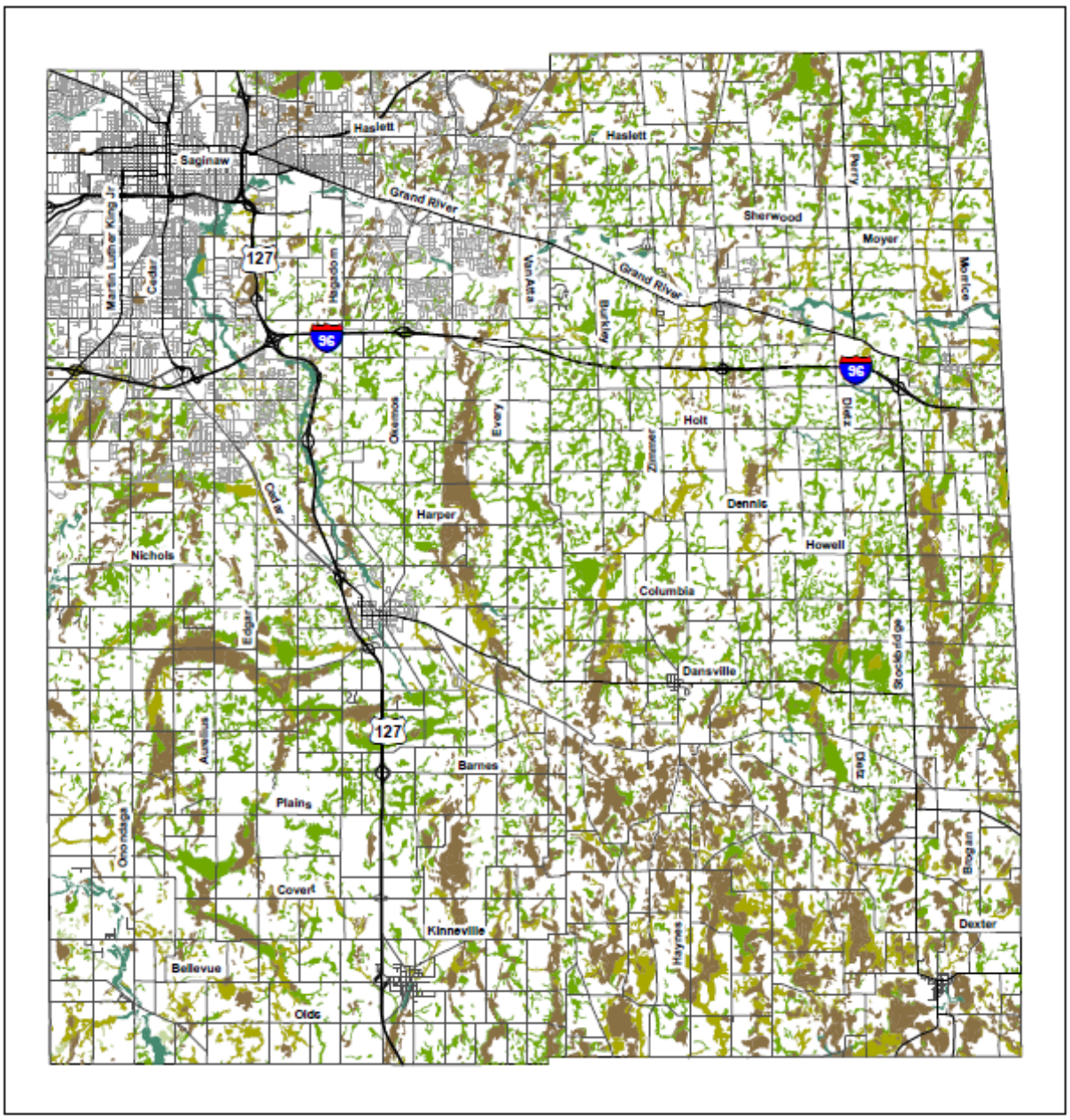
Wetlands cover 4% of the county, with lakes and rivers accounting for 0.5%. Lake Lansing, located in the north-central part of the county, is the largest natural lake. Several smaller lakes are located in the southeastern portion of the county,

Fig. 34 Ingham County Soil Map

50 Years of Service
1956 - 2006
www.mltcrpc.org

Ingham County Hydric Soil*

NORTH



Soil Type

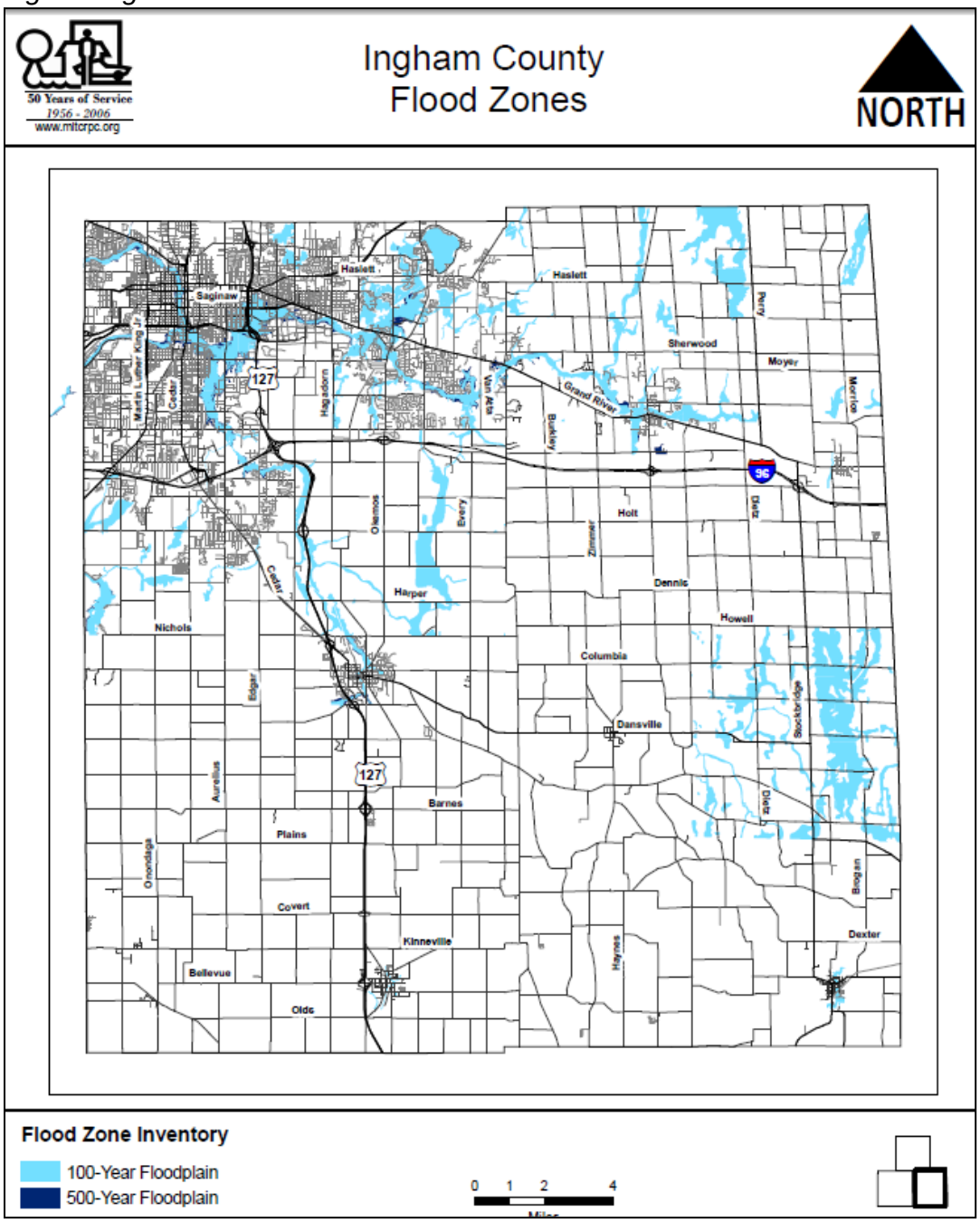
- Muck
- Sandy Loam
- Loam
- Silty Clay Loam
- Silt Loam

0 1 2 4
Miles

Water

Both the Grand River and Red Cedar River are significant in their impact on the county. The Grand River flows to the north along the west side of the county. The Red Cedar River flows westward along the northern portion of the county. Both meet in Lansing and flow out toward the northwest corner. Ingham County is within the Grand River drainage basin.

Fig. 35 Ingham Co. Flood Zones

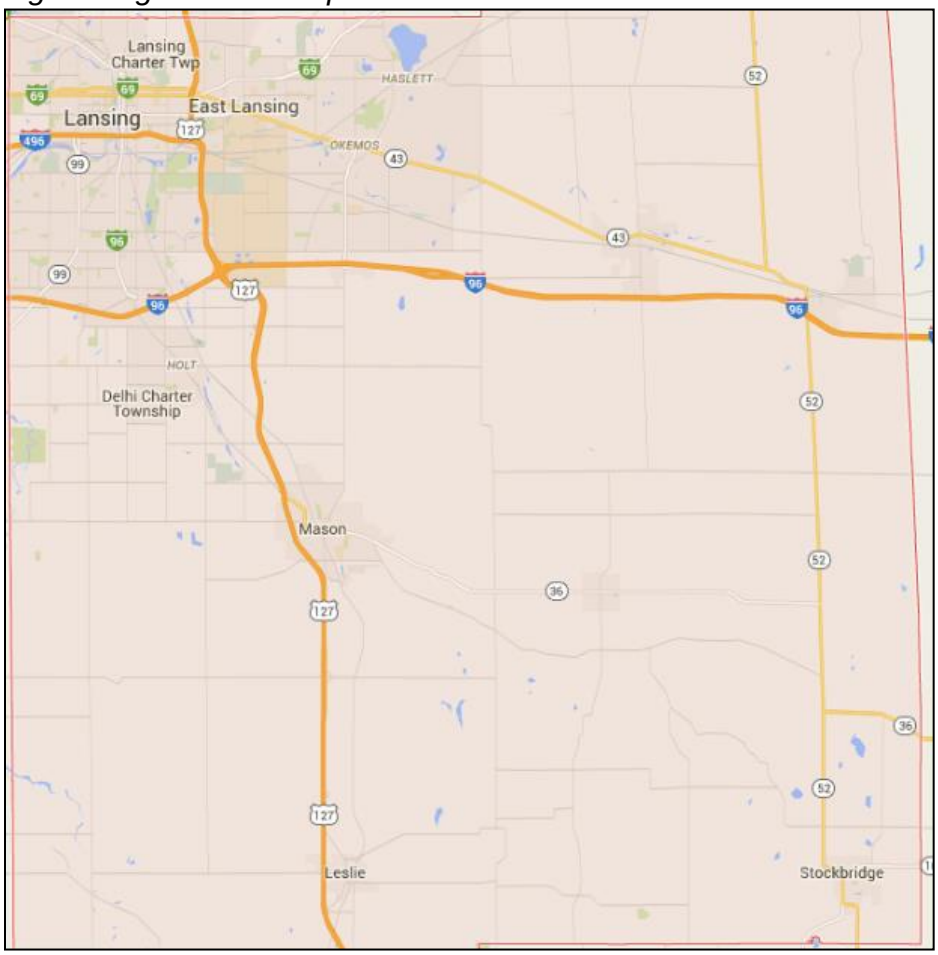


Transportation

The people of Ingham County are mainly dependent on the automobile for transportation. Other modes are available, but play a minor role in moving people. Roads and highways in the county are part of the regional and state network. The freeways, particularly I-96, I-496 and U.S. Route 127, are routes to destinations outside of Ingham County. Commercial centers are located adjacent to these routes to take advantage of the access.

The Capital Region International Airport, located north of Lansing, is the largest in the area. It is a full-service, all-weather, commercial-airline airport, serving the entire Lansing metropolitan area. In addition, the Airport Authority includes a smaller airfield, Jewett Airport, in Mason. It is used by crop dusters, small clubs and recreational pilots. There are a number of small airfields in rural areas. Conrail, CSX and Canadian National operate railroads in the county. Some railways, however, are no longer in use.

Fig. 36 Ingham Co. Map



Chapter 3 - Hazards Analysis

This section of the Plan provides an examination of hazards and determines a level of risk/vulnerability that each hazard presents. The hazard analysis process examines the risk/vulnerability of the community to technological hazards, natural hazards and human-related hazards. The hazard analysis process used included identifying hazards faced by the region, determining a level of risk/vulnerability to each hazard.

In 2004, Clinton, Eaton and Ingham Counties and Delta Charter Township proposed floods, tornadoes and ice/sleet storms as their top three hazards. This is in keeping with the new 2015 Plan update. Also, the earthquakes and forest fires that were identified as a hazard in 2005 do not play a major role in the 2015 update as our region is not host to substantial forested areas, nor is it prone to earthquakes.

Fig. 37 2004 Hazards- Clinton Co.

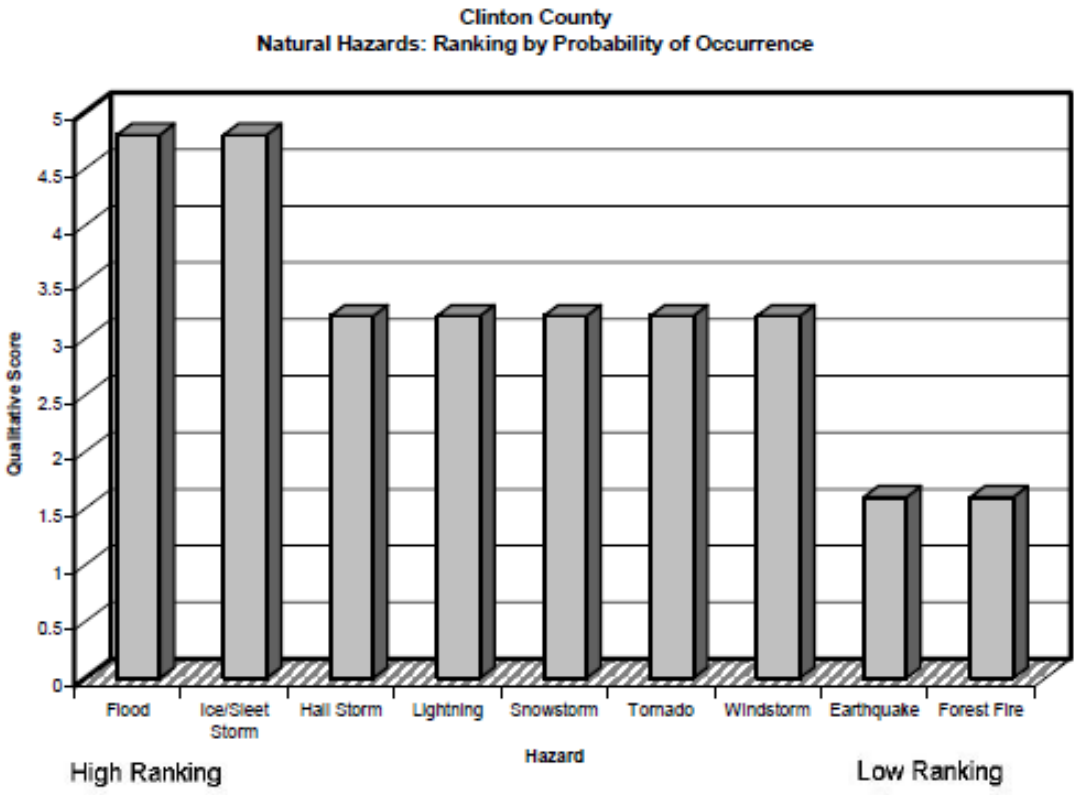


Fig. 38 2004 Hazards- Eaton Co.

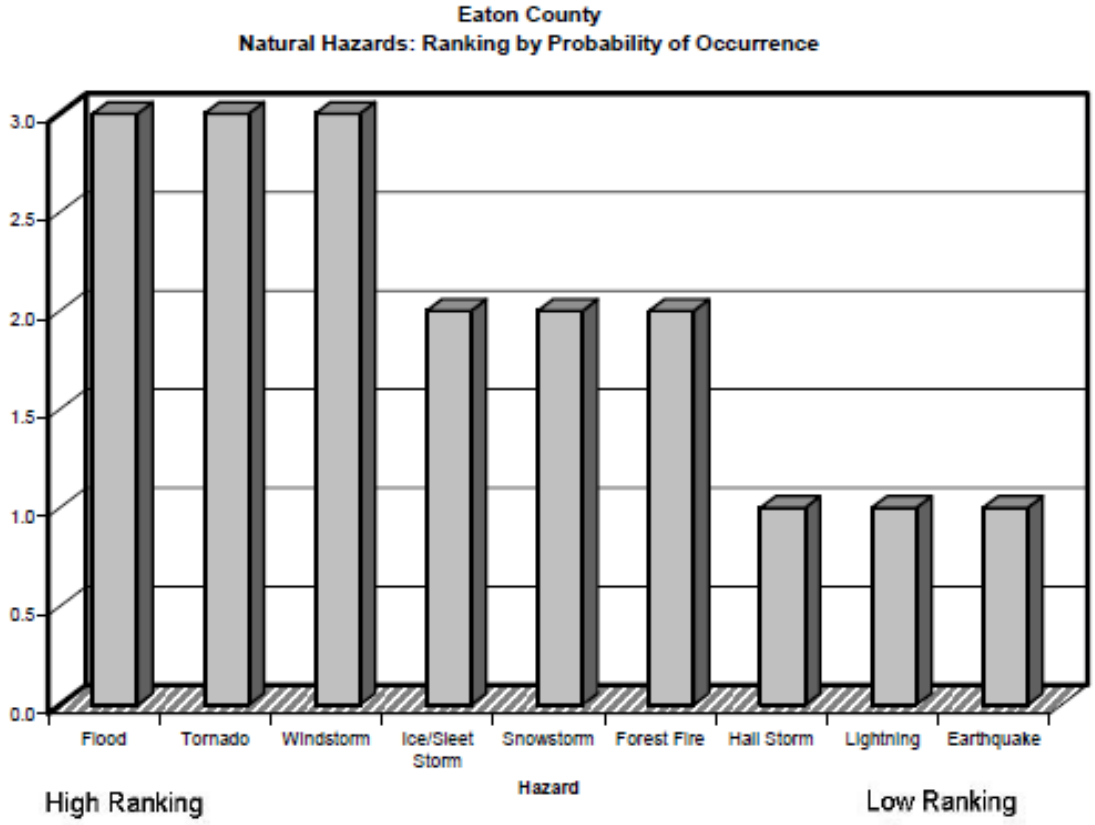


Fig. 39 2004 Hazards- Ingham Co.

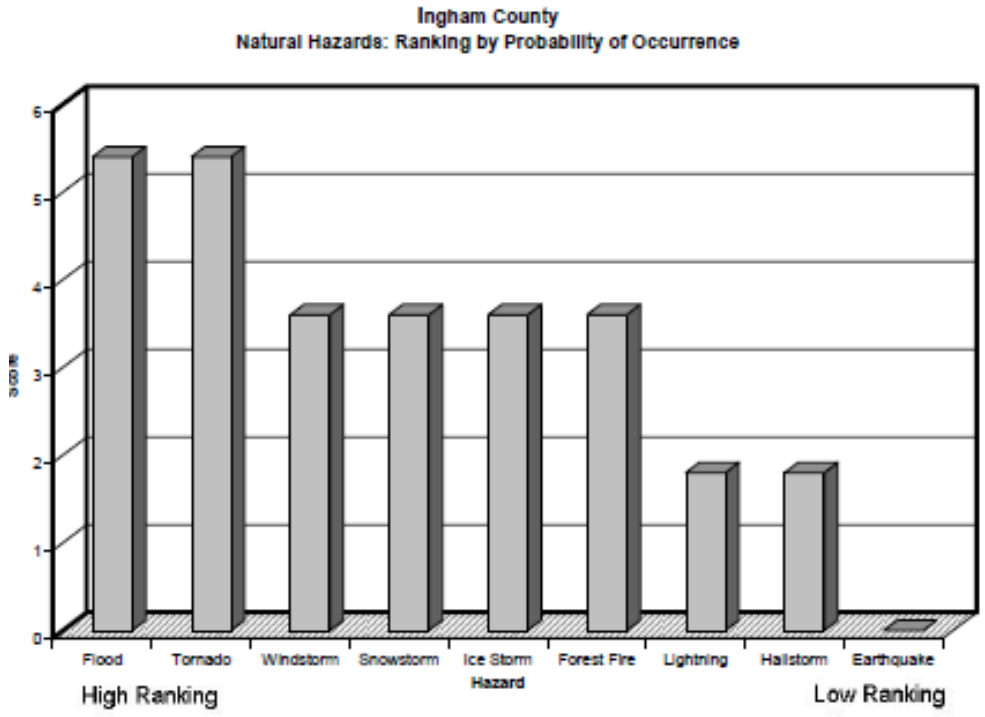


Fig. 40 2005 Hazards- Delta Township

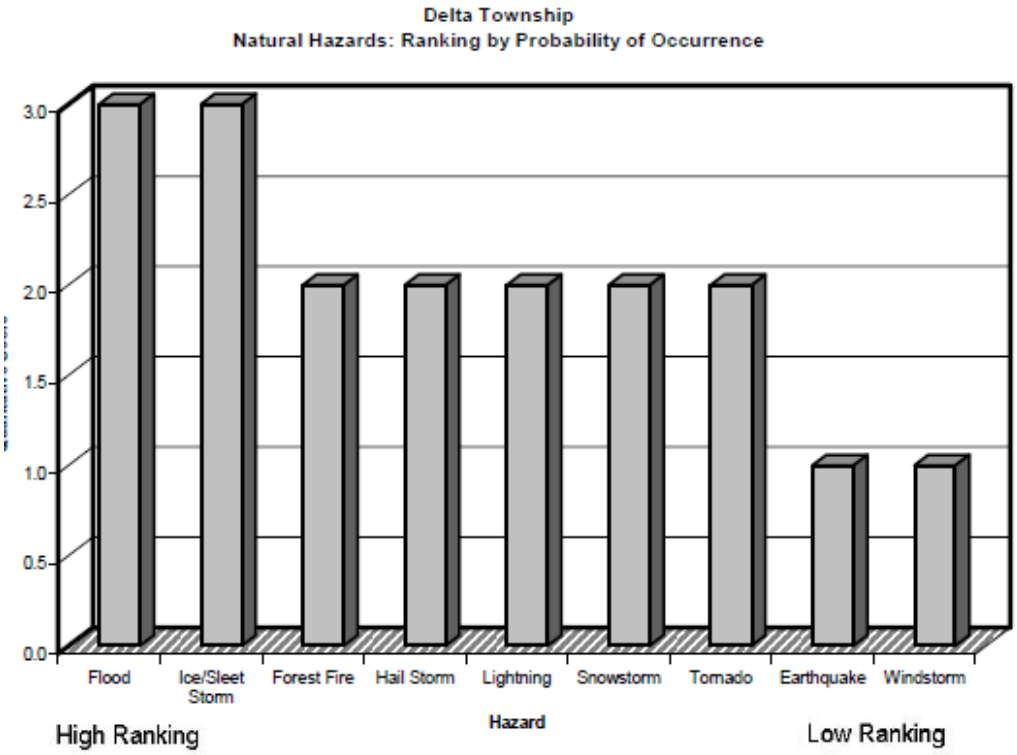


Fig. 41 Ingham County Flood Zones and Land Uses, Area 1

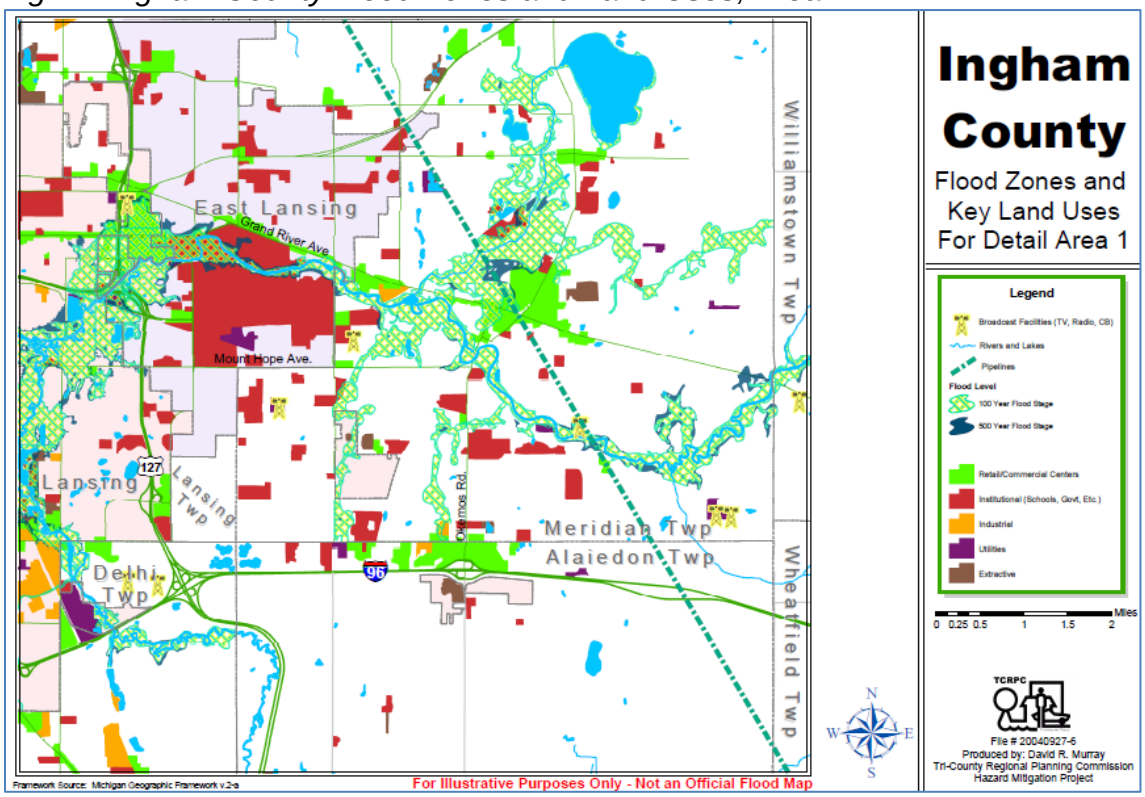


Fig. 42 Ingham County Flood Zones and Land Uses, Area 2

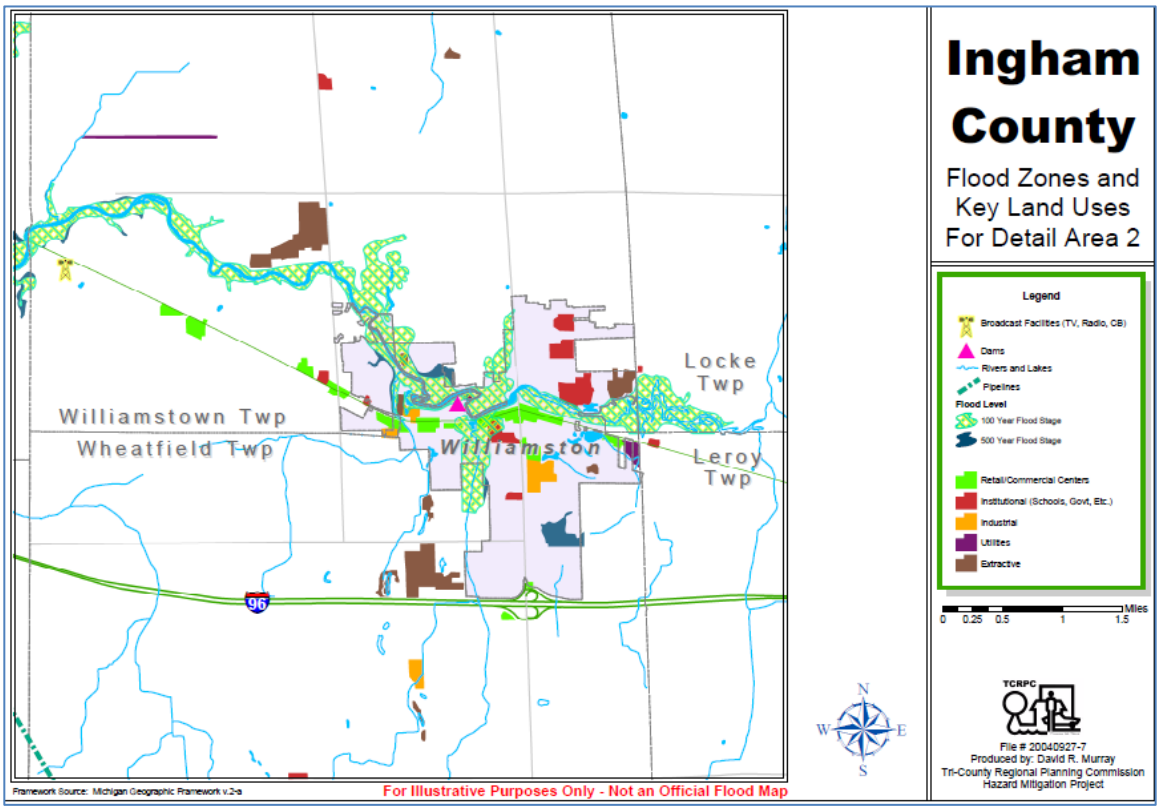
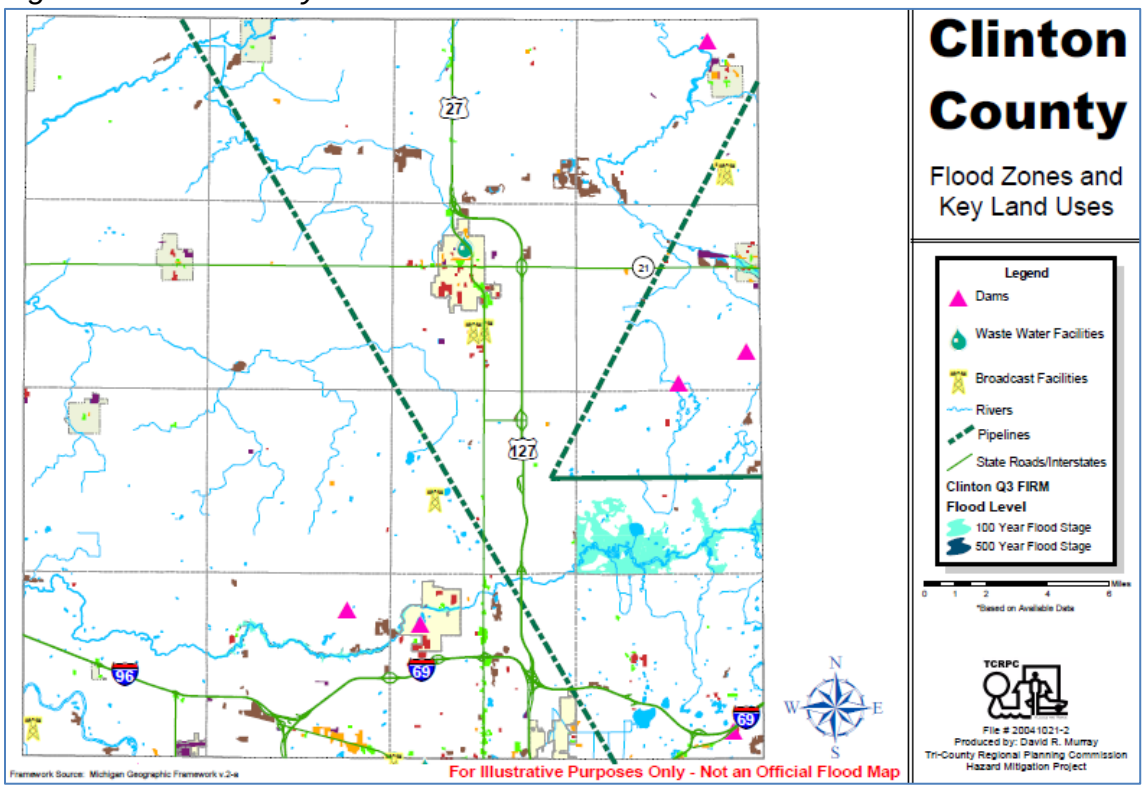


Fig. 43 Clinton County Flood Zones and Land Uses



The hazard analysis used for this plan is the process suggested in *The Local Hazard Mitigation Planning Workbook*. The Michigan Hazard Mitigation Plan of 2014 offers the following summary of top hazards in Clinton, Eaton and Ingham County and Delta Charter Township: Hail, Lightning, Ice/Sleet, Snowstorms, Severe winds, tornadoes, Extreme Heat and Cold, Fog, Flooding, Drought and Wildfires.

The following table summarizes historical information about these natural hazards in Clinton, Eaton, and Ingham Counties. The Michigan Hazard Mitigation Plan served as a reference for many of the hazards discussed in this section. Some multi-county damages and events may be counted twice in these data (once for each involved county). For clarification, when multiple events have happened in the same day, the number of event-days also is listed. Averages involve: tri-county average events, the average number of events per year, and the average county impact per event.

Fig. 44 Natural Hazards Historical Data (1996 2013)

PD = Property Damage, CD = Crop Damage, I = injuries, D = deaths

Hazard	**Clinton** events	Impacts	**Eaton** events	Impacts	**Ingham** events	Impacts	**Avg events regional**	**Average impacts per event**
Hail	26 (19 days)	$150,000 PD $115,000 CD	41 (33 days)	$435,000 PD $325,000 CD	40 (26 days)	$400,000 PD $235,000 CD	2 per year	$9,206 PD $6,308 CD
Lightning	0	--	0	--	0	--	0	Above $0
Ice/Sleet Storms	7	$330,000 PD	7	$325,000 PD	7	$340,000 PD	7 (0.4/year)	$47,381 PD
Snowstorms	40	$1,025,000 PD	45	$1,025,000 PD	46	$1,025,000 PD	43.7 (2.4/year)	$23,295 PD
Severe Winds	196 (116 days)	$3,077,000 PD $100,000 CD 2 deaths	196 (116 days)	$5,255,000 PD $210,000 CD	210 (116 days)	$6,060,000 PD $85,000 CD	200.7 (11.3/year)	$23,907 PD $342 CD 0.003 deaths
Tornadoes	2	$450,000 PD $150,000 CD	8	$50,357,000 PD $225,000 CD 6 injuries	7	$20,850,000 PD $200,000 CD 2 injuries 2 deaths	5.7 (0.3/year)	$4,215,118 PD $33,824 CD 0.47 injuries 0.12 deaths
Extreme Heat	0	--	0	--	0	--	0	Above 0.0 injuries
Extreme Cold	0	--	0	--	0	--	0	Above 0.0 injuries
Fog	1	--	1	--	1	--	1 (0.01/year)	--
Flooding	26 (21 days)	$12,395,000PD $475,000 CD	25 (21 days)	$11,945,000PD $825,000CD	26 (21 days)	$17,420,000PD $475,000 CD	25.7 (1.4/year)	$542,338 PD $23,052 CD
Drought	0	--	0	--	0	--	0	$0
Wildfires	0	--	0	--	0	--	0	$0

Source: Michigan Hazard Mitigation Plan, March 2014, adapted from the National Climatic Data Center's online Storm Events database

When the average impacts per event are multiplied by the average events per year, the result is an estimate of the expected annual damage from each hazard. This allows the list of hazards to be prioritized based on the history of past impacts. However, it is important to note that this "history" is really just a sample of events from limited time period, and estimate, and not as accurate as a long term set of records were readily available for all of these hazards. Nevertheless, the table presents an estimate of how these natural hazards are tentatively ranked in terms of the expected annual damages based upon this sample of historical event records.

In March-April of 2015, the Tri-County Regional Planning Commission (TCRPC) created and conducted a survey in order to collect input on local perceptions of hazards. The survey questionnaire was distributed to TCRPC committee members, County Road Commissioners and staff, local government staff, community leaders, technical staff throughout the region, infrastructure managers, transportation and land use planners, and the public. Twenty-four responses were collected. In response to the questionnaire, participants identified some hazards as being a threat to property, crops and human life. Respondents from across the tri-county region provided comments about the ranking of the following hazards and how they impact the region and our local communities.

1. **Tornadoes**
2. **Flooding**
3. **Severe Winds**
4. **Snowstorms**
5. **Hail**
6. **Ice/Sleet Storms**
7. **Drought**
8. **Wildfires**
9. **Lightning**
10. **Extreme Heat**
11. **Extreme Cold**
12. **Fog**

Eighty percent of the 24 respondents replied that this ranking was in keeping with their experience. After questions about the natural hazards, the following technological and social hazards were presented in the survey. Respondents were invited to comment and then rank them against the natural hazards previously listed. A majority of the respondents felt that these hazards were less of a threat to property, crops and human life than the top twelve natural hazards identified for the tri-county region.

Dam failures
Invasive species
Earthquakes
Subsidence (ground cave-ins)
Solar Storms
Erosion on river or stream shorelines
Major structural fires
Hazardous materials accidents (onsite)
Hazardous materials accidents (in transit)
Pipeline accidents
Oil or gas well accidents
Infrastructure failures
Civil disturbances
Public health emergencies
Terrorism/similar criminal activities

The majority of respondents reported that they felt hazardous material accidents should rank higher than a few natural hazards, namely tornadoes and snowstorms.

The following sections provide an overview of the main natural, technological and social hazards that face the tri-county region. The selection of Hazards discussed in this section is based on the Michigan Hazard Mitigation Plan of 2014 and the results of the tri-county region's 2015 survey, Each hazard is defined, placed into the context of the State of Michigan and also includes a statement of the impacts upon in the tri-county region. The following figure offers a snapshot of each participating jurisdiction and the natural hazards that they face.

Fig. 45 Hazard Overview of Local Participating Jurisdictions

Participating Jurisdictions	**Identified Natural Hazards**
City of East Lansing Meridian Charter Township Williamstown Township City of Williamston Village of Dansville Village of Webberville City of Mason Delhi Charter Township Lansing Charter Township Delta Charter Township City of Grand Ledge City of Charlotte City of Eaton Rapids DeWitt Charter Township City of DeWitt Bath Charter Township City of St Johns Dallas Township	**1. Tornadoes** **2. Flooding** **3. Severe Winds** **4. Snowstorms** **5. Hail** **6. Ice/Sleet Storms** **7. Drought** **8. Wildfires** **9. Lightning** **10. Extreme Heat** **11. Extreme Cold** **12. Fog**

Natural Weather Hazards

Thunderstorm Hazards (General)

Hazard Description - Weather systems accompanied by strong winds, lightning, heavy rain, and possibly hail and tornadoes. Severe thunderstorms can occur at any time in Michigan, although they are most frequent during the warm spring and summer months from May through September. The potential thunderstorm threat is often measured by the number of “thunderstorm days” – defined as days in which thunderstorms are observed. As the map below indicates, Michigan is subject to 20-60 thunderstorm days per year. According to the National Weather Service (NWS) the Lower Peninsula, in general, is subject to approximately 30-40 thunderstorm days per year per year.

Thunderstorms form when a deeper layer of cool overruns a shallow layer of warm, moist air, dry air. Cumulonimbus clouds, frequently called “thunderheads”, are formed in these conditions. These clouds are often enormous (up to six miles or more across and 40,000 to 50,000 feet high) and may contain tremendous amounts of water and energy. That energy is often released in the form of high winds, excessive rains, lightning, and possibly hail and tornadoes. Thunderstorms are typically short-lived (often lasting no more than 30-40 minutes) and fast moving (30-50 miles per hour). Strong frontal systems, however, may spawn one squall line after another composed of many individual thunderstorm cells.

Between 1996 and 2013 there were 726 major thunderstorm & high wind events reported in Ingham, Clinton and Eaton Counties. That amounts to an average of 13.6 events per year. The reported storms resulted in deaths that averaged 0.12 deaths per year directly attributed to the storms and property damage unadjusted for inflation valued at $36.7 million. The following sections address in detail these specific storm hazards:

1) Hail;
2) Lightning;
3) Severe winds; and
4) Tornadoes.

Hail

Hazard Description - Conditions where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth. Hail is a product of the strong thunderstorms. Hail is formed when strong updrafts within the storm carry water droplets above the freezing level, where they remain suspended and continue to grow larger until their weight can no longer be supported by the winds. As the thunderstorm passes over, hail usually falls near the center of the storm, along with the heaviest rain. Most hailstones range in size from a pea to a golf ball, but hailstones larger than baseballs have occurred. Sometimes, strong winds occurring at high altitudes in the thunderstorm can blow the hailstones away from the storm center, causing an unexpected hazard at places that otherwise might not appear threatened. They finally fall to the ground, battering crops, denting autos and injuring wildlife and people. Large

hail is a characteristic of severe thunderstorms, and it may precede the occurrence of a tornado.

Between 1996 and 2013 there were a total of 107 hail events reported for the tri-county region. They accounted for $985,000 in property damage and $675,000 in damage to crops.

Lightning

Hazard Description - The discharge of electricity from within a thunderstorm. Lightning is a random and unpredictable product of a thunderstorm's tremendous energy. The energy in the storm produces an intense electrical field like a giant battery, with the positive charge concentrated at the top and the negative charge concentrated at the bottom. Lightning strikes when a thunderstorm's electrical potential (the difference between its positive and negative charges) becomes great enough to overcome the resistance of the surrounding air. Bridging that difference, lightning can jump from cloud to cloud, cloud to ground, ground to cloud, or even from the cloud to the air surrounding the thunderstorm. Lightning strikes can generate current levels of 30,000 to 40,000 amperes, with air temperatures often superheated to higher than 50,000 degrees Fahrenheit (hotter than the surface of the sun) and speeds approaching one-third the speed of light.

Globally, there are about 2,000 thunderstorms occurring at any given time, and those thunderstorms cause approximately 100 lightning strikes to earth each second. In the United States, approximately 100,000 thunderstorms occur each year, and every one of those storms generates lightning. It is commonplace for a single thunderstorm to produce hundreds or even thousands of lightning strikes. However, to the majority of the public, lightning is perceived as a minor hazard. That perception lingers despite the fact that lightning damages many structures and kills and injures more people in the United States per year, on average, than tornadoes or hurricanes. Many lightning deaths and injuries could be avoided if people would have more respect for the threat lightning presents to their safety. Lightning deaths are usually caused by the electrical force shocking the heart into cardiac arrest or throwing the heartbeat out of its usual rhythm. Lightning can also cut off breathing by paralyzing the chest muscles or damaging the respiratory center in the brain stem. It takes only about one-hundredth of an ampere of electric current to stop the human heartbeat or send it into ventricular fibrillation. Lightning can also cause severe skin burns that can lead to death.
Statistics compiled by the National Oceanic and Atmospheric Administration (NOAA) and the National Lightning Safety Institute (NLSI) for the period 1959-1994 revealed the following about lightning fatalities, injuries and damage in the United States:

40% are at unspecified locations
27% occur in open fields and recreation areas (not golf courses)
14% occur to someone under a tree (not on golf course)
8% are water-related (boating, fishing, swimming, etc.)
5% are golf related
3% are related to heavy equipment and machinery

2.4% are telephone-related
0.7% are radio, transmitter and antenna-related

The NLSI estimates that 85% of lightning victims are children and young men (ages 10-35) engaged in recreation or work-related activities. Approximately 20% of lightning strike victims die, and 70% of survivors suffer serious long-term after-effects such as memory and attention deficits, sleep disturbance, fatigue, dizziness and numbness.

Lightning is such a common occurrence that records of specific events are not generally kept. The regional database is incomplete. In terms of property losses from lightning, statistics vary widely. The Insurance Information Institute (a national clearinghouse of insurance industry information) estimates that lightning-caused damage amounts to nearly five percent of all paid insurance claims, with residential claims alone exceeding $1 billion. Information from insurance companies shows one homeowner's damage claim for every 57 lightning strikes. The NLSI estimates that lightning causes more than 26,000 fires annually, with damage to property exceeding $5-6 billion. Electric utility companies across the country estimate as much as $1 billion per year in damaged equipment and lost revenue from lightning. The Federal Aviation Administration (FAA) reports approximately $2 billion per year in airline industry operating costs and passenger delays from lightning. Because lightning-related damage information is compiled by so many different sources, using widely varying collection methods and criteria, it is difficult to determine a collective damage figure for the U.S. from lightning. However, suffice it to say that annual lightning-related property damages are conservatively estimated at several billion dollars per year, and those losses are expected to continue to grow as the use of computers and other lightning sensitive electronic components becomes more prevalent.

Severe Winds and Tornadoes

Tornado
Hazard Description - An intense rotating column of wind that extends from the base of a severe thunderstorm to the ground. Tornadoes in Michigan are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the Polar Regions to generate severe thunderstorms. These thunderstorms can produce the violently rotating columns of wind that are called tornadoes. Michigan lies at the northeastern edge of the nation's primary tornado belt, which extends from Texas and Oklahoma through Missouri, Illinois, Indiana and Ohio.

Most of a tornado's destructive force is exerted by the powerful winds that knock down walls and lift roofs from buildings in the storm's path. The violently rotating winds then carry debris aloft that can be blown through the air as dangerous missiles. A tornado may have winds up to 300+ miles per hour and an interior air pressure that is 10-20 percent below that of the surrounding atmosphere. The typical length of a tornado path is approximately 16 miles, but tracks up to 200 miles have been reported. Tornado path widths are generally less than one-quarter mile wide. Typically, tornadoes last only a few minutes on the ground. But those few minutes can result in extreme damage and

devastation. Historically, tornadoes have resulted in tremendous loss of life, with the mean national annual death toll of 87 persons. Property damage from tornadoes is in the hundreds of millions of dollars every year. Tornado intensity is measured on the Fujita Scale, which examines the damage caused by a tornado on homes, commercial buildings and other man-made structures. The Fujita Scale rates the intensity of a tornado based on damaged caused, not by its size. It is important to remember that the size of a tornado does not necessarily indicate its intensity. Large tornadoes can be weak, and small tornadoes can be extremely strong, and vice versa. It is difficult to judge the intensity and power of a tornado while it is occurring. Measurements of the intensity of a tornado can be done after it has passed using the Fujita Scale.

The Enhanced Fujita Scale of Tornado Intensity:

EF0 Gale tornado 65-85: Light damage. Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.

EF1 Weak tornado 86-110: Moderate damage. The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.

EF2 Strong 111-135: Considerable damage. Roofs torn off frame houses; tornado mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.

EF3 Severe tornado 136-165 Severe damage. Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.

EF4 Devastating 166-200 Devastating damage. Well-constructed houses tornado leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

EF5 Incredible tornado; Over 200: Incredible damage. Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged; incredible phenomena will occur.

Fig. 46 Typical Tornado Damage

Source: FEMA

According to the National Weather Service (NWS), since 1950 approximately 74% of the tornadoes that occurred in the United States were classified as weak tornadoes (F0 or F1 intensity). Approximately 25% were classified as strong tornadoes (F2 or F3 intensity), and only 1% were classified as violent tornadoes (F4 or F5 intensity). Those violent tornadoes, while few in number, caused 67% of all tornado-related deaths nationally. Strong tornadoes accounted for another 29% of tornado-related deaths, while weak tornadoes caused only 4% of tornado-related deaths.

Michigan's Tornado Experience

National Weather Service data indicates that Michigan has experienced 923 tornadoes and 242 related deaths during the period from 1950 through 2009, an average of 15 tornadoes and 4 tornado-related deaths per year. The greatest number of tornadoes per year during that period occurred in 1974 with 39 tornadoes. The least number occurred in 1959 with only 2 tornadoes. From 1950 to March 2005, Michigan experienced 508 "tornado days" (defined as days in which tornadoes are observed), an average of nearly 9 days per year. Between 1996 and 2013 the tri-county region experienced 17 tornado events, totaling $71.7 Million total in property damage. These events caused $575,000 in crop damage, 8 injuries and 2 deaths. On average, the tri-county region experiences $4.2 Million in property damage per year, and $33,824 in crop damages.

Severe winds, which are wind events measured at velocities less than gale force, occurred 210 times in the tri-county region between 1996 and 2013. The region incurred $14.4 Million in property damage and $395,000 in crop damages and 2 deaths were reported for the time between 1996 to 2013.

Extreme Temperatures

Hazard Description - Prolonged periods of very high or very low temperatures, often accompanied by other extreme meteorological conditions. Prolonged periods of extreme temperatures pose severe problems for Michigan's citizens. Whether extreme summer heat or extreme winter cold, extreme temperature can be life threatening. Although they are radically different in terms of initiating conditions, the two hazards share a commonality in that they both primarily affect the most vulnerable segments of the

population – the elderly, children, impoverished individuals, and people in poor health. Due to their unique characteristics, extreme summer heat and extreme winter cold hazards will be discussed individually.

Extreme Summer Heat

Extreme summer weather is characterized by a combination of very high temperatures and exceptionally humid conditions. When persisting over a long period, this phenomenon is commonly called a heat wave. The major threats of extreme summer heat are heatstroke (a major medical emergency), and heat exhaustion. Because the combined effects of high temperatures and high humidity are more intense in urban centers, heatstroke and heat exhaustion are a greater problem in cities than in suburban or rural areas. Nationwide, approximately 200 deaths a year are directly attributable to extreme heat. Extreme summer heat is also hazardous to livestock and agricultural crops, and it can cause water shortages, exacerbate fire hazards and prompt excessive demands for energy. Roads, bridges, railroad tracks and other infrastructure are susceptible to damage from extreme heat.

Air conditioning is the most effective measure for mitigating the effects of extreme heat on people. However, many people most vulnerable to this hazard do not live or work in air-conditioned environments. The use of fans to move air may help some, but recent research indicates that increased air movement may actually exacerbate heat stress in many individuals.

Extreme Temperature Events: During the second week of July 1936, a terrible heat wave struck the mid-Michigan, with temperatures exceeding 100 degrees for up to seven consecutive days. The extreme heat was an equal opportunity killer, causing many healthy adults to succumb to the heat at work or in the streets. Also, because most people relied on iceboxes to keep their food fresh, many heat-related deaths and illnesses occurred when the ice melted, and food spoiled. The summer of 1953 included eleven days in a row with temperatures of 90 degrees or higher in Southern Michigan, nine of which were 95 degrees or hotter, and also including two days that each hit 100 degrees.

The 1988 summer drought and heat wave in the Central and Eastern U.S. also greatly impacted the tri-county region. Nationwide, the drought caused an estimated $40 billion in damages from agricultural losses, disruption of river transportation, water supply shortages, wildfires, and related economic impacts. The heat wave that accompanied the drought conditions was particularly long in Michigan – 39 days with 90 degree or better heat – eclipsing the previous record of 36 days recorded in the “dust bowl” days of 1934. Nationwide, the 1988 drought/heat wave caused an estimated 5,000 to 10,000 deaths. Extreme heat and humidity in the Midwest and Central Plains during parts of June, July and August of 2001 sent heat stress index readings soaring well above 100 degrees Fahrenheit on many days. On August 1 and August 8, heat advisories were issued for many counties in the southern Lower Peninsula, with heat indices at 105 degrees for some jurisdictions on the former date, and 110 degrees for some jurisdictions on the latter date.

Summary: Approximately once or twice per decade, extreme heat waves tend to cause human and infrastructure impacts across the county including power failures. Their frequency may be increasing, due to climate change. An extreme summer heat event inventory for the tri-county region is incomplete.

Extreme Winter Cold

Cold weather can result in a significant number of temperature-related deaths. Each year in the United States, approximately 700 people die because of severe cold temperature-related causes. This is substantially higher than the average of 200 heat-related deaths each year. It should be noted that a significant number of cold-related deaths are not the direct result of "freezing conditions. Rather, many deaths are the result of illnesses and diseases that are negatively impacted by severe cold weather, such as stroke, heart disease and pneumonia. It could convincingly be argued that, were it not for the extreme cold temperatures, death in many cases would not have occurred at the time it did from the illness or disease alone.

Severe winter weather hazards include snowstorms, blizzards, and extreme cold, ice and sleet storms. As a northern state, Michigan is vulnerable to all of these winter hazards. Most of the severe winter weather events that occur in Michigan have their origin as Canadian and Arctic cold fronts that move across the state from the west or northwest.

Extreme summer heat event inventory in the tri-county region database is admittedly incomplete.

Ice and Sleet Storms

Hazard Description - A storm that generates sufficient quantities of ice or sleet to result in hazardous conditions and/or property damage. Ice storms are sometimes incorrectly referred to as sleet storms. Sleet is similar to hail only smaller and can be easily identified as frozen rain drops (ice pellets) which bounce when hitting the ground or other objects. Sleet does not stick to trees and wires, but sleet in sufficient depth does cause hazardous driving conditions. Ice storms are the result of cold rain that freezes on contact with the surface, coating the ground, trees, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. When electric lines are downed, households may be without power for several days, resulting in significant economic loss and disruption of essential services in affected communities.

In December of 2013, a severe ice storm event occurred across mid-Michigan, impacting power grids for 1,000's of residents. In the tri-county region, there were 21 ice/sleet storm events between 1996 and 2013. Property damages totaled $995,000, an average of $47,381 per year.

The following is from a Report on the Lansing Board of Water and Light's Response to the December 2013 Ice Storm by the City of Lansing Community Review Team, a group

of citizen leaders and technical experts who assessed the situation and published a report to the City.

> The December 2013, ice storm was the most catastrophic event to ever hit the Lansing Board of Water & Light's (BWL) electric service territory. While the duration of the restoration effort was neither better nor worse than other similar restoration efforts based on national data, it did cause significant hardship and suffering for customers who were out of service during the holiday season. The combination of disrupted holiday plans, the duration of outages and the cold weather was particularly difficult for the BWL's customers. In the wake of the storm the BWL pledged a top-down review of its performance during the ice storm and its aftermath. Th

...

> Ice storms frequently result in a large number of extended outages because falling branches and trees take down individual services, secondary distribution lines, single and three phase primary lines, and can even damage high voltage transmission lines. Simply stated, they impact every segment of a utility's transmission and distribution system. These storms typically occur during the year when daylight hours are at a minimum and temperatures are below freezing, so crews must protect themselves from exposure. They may be accompanied by snow storms that further hinder restoration efforts. Unless the ice melts quickly, branches and trees continue to break days after the storm has passed damaging lines that had been repaired only days earlier. The BWL's crews experienced all these difficulties and in their restoration efforts.
>
> The ice storm resulted in approximately 40% of the BWL's customers losing power; there has been no comparable loss among Michigan utilities. The BWL sustained over 2,400 downed power lines and replaced 5 miles of service lines, or half the normal annual volume, in the ten day restoration period. The volume of restoration work was unprecedented.

...

> The ice storm had a devastating impact on the BWL's electric distribution system. Approximately 40,000, or about 40%, of the BWL's customers lost power. The combination of ice accumulation and wind gusts up to 64 mph tested the design limits of the BWL's distribution infrastructure. This combination of ice and wind caused widespread destruction and damage to trees and other vegetation causing them to fall onto power lines. The falling limbs, trees, and other vegetation combined with the ice loading on distribution lines caused more than 2,400 lines to break.
>
> Since much of the Lansing area has overhead distribution lines and extensive tree cover, line failures were extensive and included primary voltage lines, secondary voltage lines, and individual services. More than 1,000 individual service line failures occurred and these individual services required intensive one-on-one attention from restoration crews. In fact, the BWL replaced approximately 5 miles of service wire during the ten day restoration period. This accounts for nearly half of the BWL's typical annual replacement.

Snowstorms

Hazard Description - A period of rapid accumulation of snow often accompanied by high winds, cold temperatures, and low visibility. Because of being surrounded by the Great Lakes, Michigan experiences large differences in snowfall in relatively short distances. The average annual snowfall accumulation ranges from 30 to 200 inches of snow. The highest accumulations are in the northern and western parts of the Upper Peninsula. In Lower Michigan, the highest snowfall accumulations occur near Lake Michigan and in the higher elevations of northern Lower Michigan. Blizzards are the most dramatic and perilous of all snowstorms, characterized by low temperatures and strong winds (35+ miles per hour) bearing enormous amounts of snow. Most of the snow accompanying a blizzard is in the form of fine, powdery particles that 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.

Beginning on January 26, 1977, a significant snowstorm affected much of southern Michigan. Blizzard winds caused extensive drifting of snow, blocking many roads. Many residents were isolated in rural residences or stranded in public shelters. This storm also resulted in a Presidential Emergency Declaration for 15 counties in the southern part of the state. Then, a severe snowstorm struck the Midwest January 26-27, 1978 and Michigan was at the center of the storm. Dubbed a “white hurricane” by some meteorologists, the storm measured 2,000 miles by 800 miles and produced winds with the same strength of a small hurricane and tremendous amounts of snow. In Michigan, up to 34 inches of snow fell in some areas, and winds of 50-70 miles per hour piled the snow into huge drifts. At the height of the storm, it was estimated that over 50,000 miles of roadway were blocked, 104,000 vehicles were abandoned on the highways, 15,000 people were being cared for in mass care shelters, and over 390,000 homes were without electric power. In addition, 38 buildings suffered partial or total roof collapse. Two days after the storm, snow still blocked over 90% of the state's road system and 8,000 people were still being cared for in shelters. The storm stranded 70,000 vehicles and 52,000 homes were still without electricity days later. This storm resulted in a Presidential Emergency Declaration for the entire state to provide assistance with snow clearance and removal operations.

In the early morning hours of January 2, 1999 a severe winter storm moved across the middle and southern lower Michigan. The storm grew in intensity and size, producing record snowfall that affected much of the southern two-thirds of the Lower Peninsula by the evening of January 3rd. High winds and frigid temperatures created blizzard conditions that lasted until late in the day on January 4. Subsequent storms over the next several days dumped an additional foot of snow in many areas of the state, resulting in snowfall of historic proportions in several Michigan communities. Combined, these winter storms produced the worst winter conditions to hit Michigan since the 1978 statewide blizzard. A Presidential Emergency Declaration was granted for the 31

Michigan counties that received record or near-record snowfall making available Federal snow removal assistance under the Federal Emergency Management Agency's (FEMA) Public Assistance Grant Program.
Between 1996 and 2013, snowstorm events in the tri-county region totaled 131. Property damage totaled $3.07 Million during those same years, for an average of $23,295 per year. No deaths or injuries were reported.

Fig. 47 Severe Winter Driving Hazards

Source: TCRPC

Geologic Hazards

Subsidence
Hazard Description - The lowering or collapse of the land surface caused by natural or human-induced activities that erode or remove subsurface support. Subsidence is the lowering or collapse of the land surface due to loss of subsurface support. It can be caused by a variety of natural or human-induced activities. Natural subsidence occurs when the ground collapses into underground cavities produced by the solution of limestone or other soluble materials by groundwater. Human- induced subsidence is caused principally by groundwater withdrawal, drainage of organic soils, and underground mining. In the United States, these activities have caused nearly 17,000 square miles of surface subsidence, with groundwater withdrawal (10,000 square miles of subsidence) being the primary culprit. In addition, approximately 18% of the United States land surface is underlain by cavernous limestone, gypsum, salt, or marble, making the surface of these areas susceptible to collapse into sinkholes.

Generally, subsidence poses a greater risk to property than to life. Nationally, the average annual damage from all types of subsidence is conservatively estimated to be at least $125 million according to The National Research Council. There is little information or tracking of subsidence issues in mid-Michigan.

Flooding Hazards
Hazard Description - The overflowing of rivers, streams, drains and lakes due to excessive rainfall, rapid snowmelt or ice. Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of history. If these

floodplain areas were left in their natural state, floods would not cause significant damage. Development has increased the potential for serious flooding because rainfall that used to soak into the ground or take several days to reach a river or stream via a natural drainage basin now quickly runs off streets, parking lots, and rooftops, and through man-made channels and pipes. Floods can damage or destroy public and private property, disable utilities, make roads and bridges impassable, destroy crops and agricultural lands, cause disruption to emergency services, and result in fatalities. People may be stranded in their homes for several days without power or heat, or they may be unable to reach their homes at all. Long- term collateral dangers include the outbreak of disease, widespread animal death, broken sewer lines causing water supply pollution, downed power lines, broken gas lines, fires, and the release of hazardous materials.

The primary flooding sources include the Great Lakes and connecting waters (Detroit River, St. Clair River and St. Mary's River), thousands of miles of rivers and streams, and hundreds of inland lakes. Michigan is divided into 63 major watersheds. All of these watersheds experience flooding, although the following watersheds have experienced the most extensive flooding problems or have significant damage potential: 1) Clinton River; 2) Ecorse River; 3) Grand River; 4) Huron River; 5) Kalamazoo River; 6) Muskegon River; 7) Saginaw River; 8) Rifle River; 9) River Raisin; 10) Rouge River; 11) St. Joseph River; and 12) Whitefish River. The flooding is not restricted to the main branches of these rivers.

Most riverine flooding occurs in early spring and is the result of excessive rainfall and/or the combination of rainfall and snowmelt. Ice jams also cause flooding in winter and early spring. Severe thunderstorms may cause flooding during the summer or fall, although these are usually localized and have more impact on watercourses with smaller drainage areas. Oftentimes, flooding may not necessarily be directly attributable to a river, stream or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall and/or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain. That type of flooding is becoming increasingly prevalent in Michigan, as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow.

Flooding also occurs due to combined storm and sanitary sewers that cannot handle the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns.

Flood Events in the Tri-County Region

One of the most disastrous and extensive floods ever to occur in Michigan struck the central and southern Lower Peninsula during March 24-27, 1904. The flooding was caused by runoff resulting from intense rainfall, compounded by heavy snow pack and frozen soils. The flooding was most prevalent in the Grand, Kalamazoo, Saginaw and River Raisin basins and to a lesser extent in the Huron and St. Joseph River basins.

(The flood peaks from this flood are still the highest associated with spring flooding in the southern Lower Peninsula since record keeping began.) Damage was widespread and severe.
A flood on April 4-11, 1947 was caused by a combination of snow and rainfall that began in late March of that year. Two frontal systems in early April dumped several inches of rain in many localities across central and eastern Lower Michigan. The areas primarily affected by the April, 1947 flood included the Clinton, Detroit, Grand, Kalamazoo, Saginaw and St. Clair Rivers, and the River Rouge.

A series of intense thunderstorms struck southern Lower Michigan in the last two weeks of April 1975, spawning several tornadoes and causing widespread flooding over a 21 county area. Total public and private damage was nearly $58 million dollars. A Presidential Major Disaster Declaration was granted for the 21 affected counties.

Fig. 48 Flood of 1975, Lansing/East Lansing MI

Source: TCRPC

In May 2004, a stationary front over Iowa, Wisconsin, and Michigan brought severe thunderstorms and heavy rains, which caused widespread flooding across the region. Much of the rainfall occurred in saturated areas that had experienced well-above average precipitation for the month of May. Backyards were submerged under several feet of water. Total rainfall over the Grand River basin from May 20th through June 3rd varied from four to as much as seven inches. It was the biggest and longest duration flooding event in the past twenty years across southwestern and south central Lower Michigan. It was the wettest May on record in Lansing and Muskegon and the third wettest May on record in Grand Rapids. A Presidential Major Disaster Declaration was granted to 23 counties in Southern Lower Michigan.

Fig. 49 & 50 Flooding at MSU, and Meridian Township, 2004

Source: TCRPC

National Flood Insurance Program

For many years, the response to reducing flood damages followed a structural approach of building dams, levees and making channel modifications. However, this approach did not slow the rising cost of flood damage, plus individuals could not purchase insurance to protect themselves from flood damage. It became apparent that a different approach was needed.

The National Flood Insurance Program (NFIP) was instituted in 1968 to make flood insurance available in those communities agreeing to regulate future floodplain development. As a participant in the NFIP, a community must adopt regulations that:
1) Require any new residential construction within the 100- year floodplain to have the lowest floor, including the basement, elevated above the 100-year flood elevation;
2) Allow non-residential structures to be elevated or dry flood proofed (the flood proofing must be certified by a registered professional engineer or architect); and
3) Require anchoring of manufactured homes in flood prone areas. The community must also maintain a record of all lowest floor elevations or the elevations to which buildings in flood hazard areas have been flood proofed.

In return for adopting floodplain management regulations, the federal government makes flood insurance available to the residents of that community. In 1973, the NFIP was amended to mandate the purchase of flood insurance as a condition of any federally regulated, supervised or insured loan on any construction or building within the 100-year floodplain. Currently, there are about 25,956 flood insurance policies in force in Michigan, which amounts to approximately $2.5 billion worth of coverage. About 18,621 (71.1%) of these policies are within an identified flood hazard area, and the remainder are for properties located outside flood hazard areas. Officials from FEMA and the MDEQ estimate that only 15% of all flood prone structures in Michigan eligible to purchase flood insurance actually have flood insurance. Furthermore, since only about 40% of the communities in Michigan participate in the NFIP, there are thousands of structures that are flood prone, but are not eligible to purchase flood insurance.

All Flood Insurance Rate maps for the tri-county region are available at the FEMA Flood Map Service Center website:
https://msc.fema.gov/portal/search?AddressQuery=lansing%20MI.

Flood Insurance Rate Maps were analyzed as a part of this plan update. The four jurisdictions covered by this plan update are active in the NFIP. Any properties located within the identified flood areas are susceptible to flood events any given year. Sample maps from each County and Delta Charter Township are depicted below:

FEMA's Community Status Book reports that the following communities are participating in the national flood program:

Fig. 51 FEMA Community Status Chart

Clinton County	Eaton County	Ingham County
Bath Charter Twp	Bellevue (Village and Twp)	Alaiedon Twp
Bengal Twp	Brookfield Twp	Aurelius Twp
Bingham Twp	Carmel Twp	Bunker Hill Twp
Dallas Twp	City of Charlotte	Delhi Charter Twp
DeWitt (City & Charter Twp)	Delta Charter Twp	Lansing Charter Twp
East Lansing	Village of Dimondale	Leroy Twp
Village of Elsie	Eaton Rapids (City & Twp)	Leslie (City & Twp)
Lebanon Twp	City of Grand Ledge	Locke Twp

Village of Maple Rapids	Hamlin Twp	City of Mason
Olive Twp	Kalamo Twp	Meridian Charter Twp
Ovid (Village & Twp)	City of Olivet	Onondaga Twp
City of St Johns	Oneida Charter Twp	Stockbridge (City & Twp)
Watertown Charter Twp	City of Potterville	Vevay Twp
Westphalia Twp	Roxand Twp	Victor Twp
	Sunfield Twp	Village of Webberville
	Vermontville Twp	White Oak Twp
	Walton Twp	Williamstown Twp
	Windsor Charter Twp	City of Williamston

Fig. 52 Delta Charter Township FIRM

Fig. 53 City of Mason FIRM

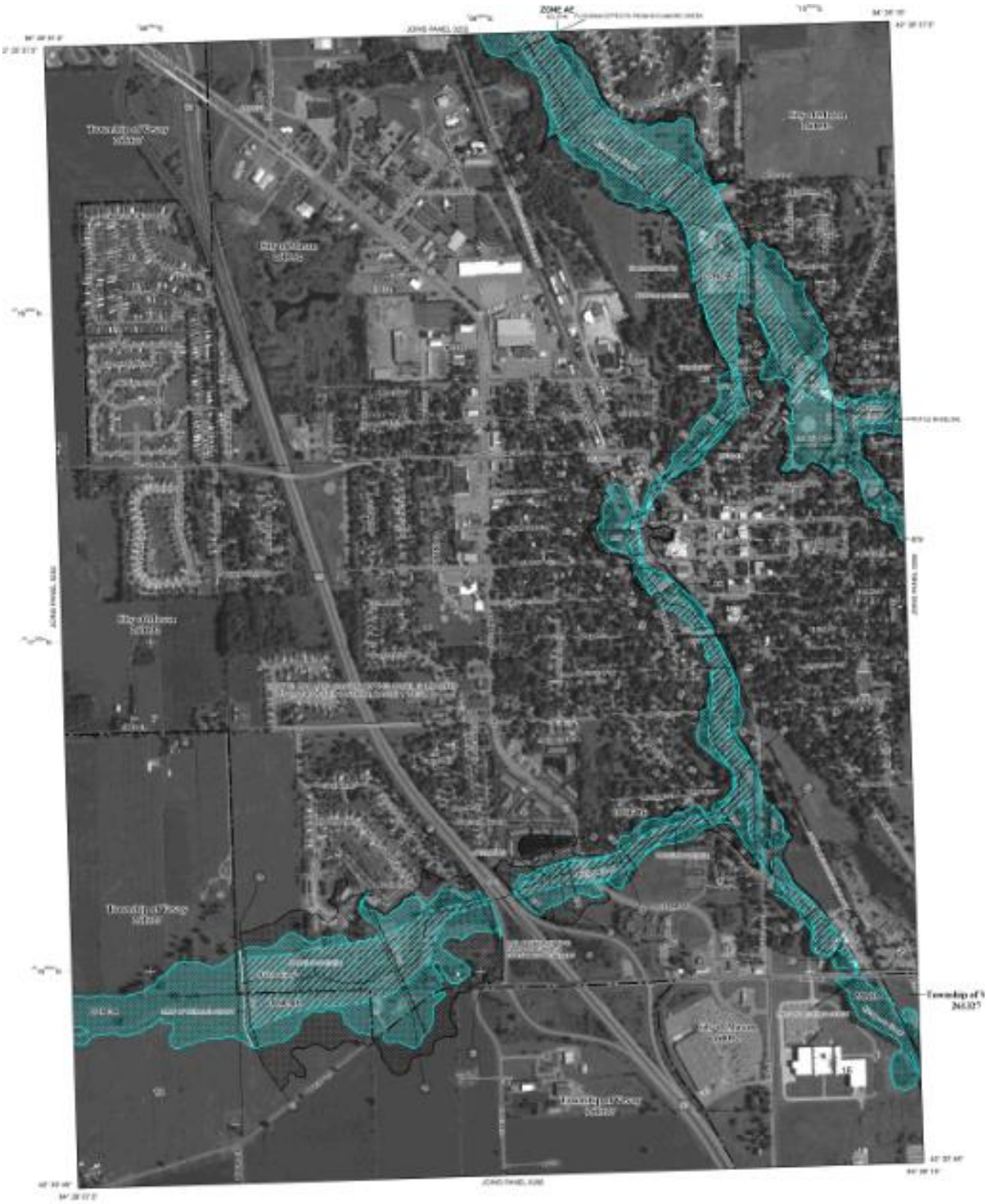
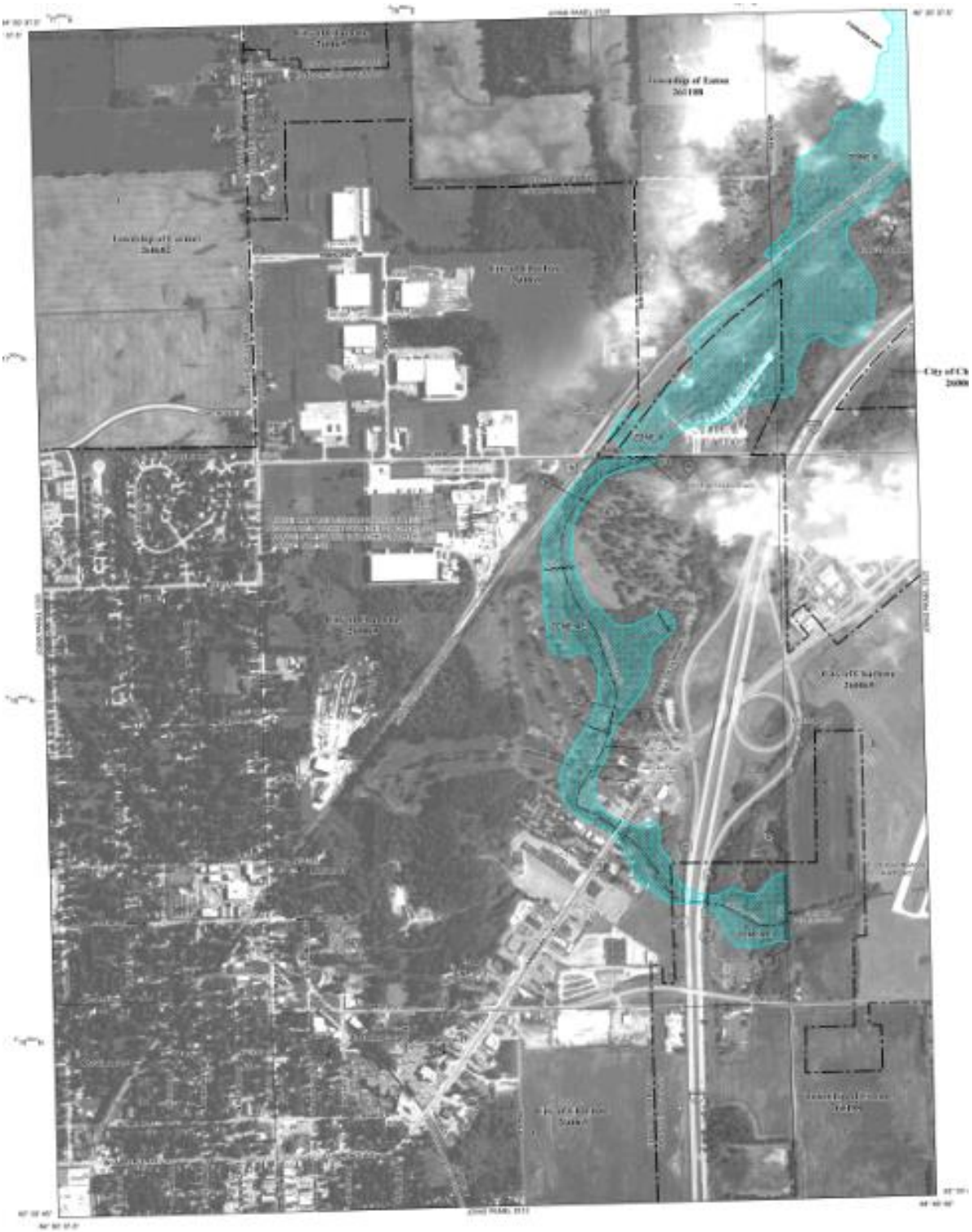

ZONE AE

Fig. 54 City of St. Johns FIRM

Fig. 55 City of Charlotte



Repetitive Loss Property Information in the Tri-County Region

The National Flood Insurance Program (NFIP) maintains a list of "repetitive loss properties" that have suffered from multiple costly incidents of flood damage. Special funds can be obtained through the Repetitive Flood Claims program in order to achieve flood mitigation objectives for these structures at a reduced non-federal cost share (10% rather than 25%). Although detailed insurance information must be kept confidential, it is necessary for this plan to include a consideration of these high-priority properties that are vulnerable to regular flooding. Within each county, the following repetitive loss properties should be prioritized for flood mitigation activities, due to their demonstrated recent need.

Clinton County's NFIP listings have a total of nine repetitive-loss properties officially identified by the NFIP. However, it is evident by inspecting the (confidential) property addresses that eight out of these nine properties have been misclassified by the NFIP as being within the wrong county, and should instead be included in the listings for Ingham County. Four of these properties are located in the City of East Lansing, and they include two single-family homes—the first of which had suffered an average of $5,225 per flood event, over three events since 1980, and the second of which had suffered an average of $15,780 per event in two events during the same time period. The other two East Lansing properties are classified as "other residential" type, which had suffered an average of $3,868 per event during two events in the 1980s, and "2-4 family" type, which had suffered an average of $8,900 per event during three events since 2008. There are four structures identified within the City of Lansing, one of which is listed as "mitigated." The three non-mitigated structures include one non-residential building that had two flood events since 2000 which caused an average of $38,062 per event; one single-family home that had two events during the 1980s with an average of about $1,500 in damage per event; and one "other residential" structure that saw an average of $2,123 in damage in each of its two reported flood events during the early 1980s. The one property on the list that is actually located in Clinton County is a non-residential structure within Victor Township, which suffered an average of $82,836 in damages from each of its two reported events since 2000.

Eaton County has a total of twelve repetitive loss properties listed in the official NFIP database. Two are in Delta Township—a single family home that has suffered an average of $4,263 per event during two events in the 1980s, and a non-residential structure that has seen an average of $20,861 in damage during each of its three reported events since 1980. One property was noted within the City of Eaton Rapids, a single-family home with two flood events since 1999, which averaged $2,498 in damage per event. Eaton Rapids Township also has a vulnerable single-family home that saw three damaging flood events starting in 2008, causing an average of $5,287 in damage each time. Finally, Windsor Township has eight single-family homes on the official list, three of which are located on the same street. All eight of these homes have a history of two reported flood events, mostly during the 1980s but a quarter of the events have occurred since 2004. The average damage per event for each home was $5,740.

Ingham County had eight properties mistakenly listed within Clinton County (see the paragraph above, for more information), but also has four properties correctly classified within the official NFIP database. (One additional listing of a property in the City of Mason has been denoted as "mitigated.") All four of the remaining Ingham County properties in the repetitive loss list are single-family homes located in Meridian Township, and two of them are located on the same street. Two of these homes have endured three reported flood losses since 1980, while the other two have experienced two flood events during that same time. The average loss per event to each of these four houses was $9,268.

Dam Failures

Hazard Description - The collapse or failure of an impoundment that results in downstream flooding. A dam failure can result in loss of life and extensive property or natural resource damage for miles downstream from the dam. Dam failures occur not only during flood events, which may cause overtopping of a dam, but also because of poor operation, lack of maintenance and repair, and vandalism. Such failures can be catastrophic because they occur unexpectedly, with no time for evacuation. The Michigan Department of Environmental Quality (MDEQ) has documented approximately 278 dam failures in Michigan.

The definition for these rating by Michigan law (Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act) is as follows: "High hazard potential dam" means a dam located in an area where a failure may cause serious damage to inhabited homes, agricultural buildings, campgrounds, recreational facilities, industrial or commercial buildings, public utilities, main highways, or class I carrier railroads, or where environmental degradation would be significant, or where danger to individuals exists with the potential for loss of life. "Significant hazard potential dam" means a dam located in an area where its failure may cause damage limited to isolated inhabited homes, agricultural buildings, structures, secondary highways, short line railroads, or public utilities, where environmental degradation may be significant, or where danger to individuals exists. There are several dams whose failure would potentially harm area property and residents with flash flooding, but there is no history of this occurring at any recent time within the county.

Drought

Hazard Description – Drought is a water shortage caused by a deficiency of rainfall, generally lasting for an extended period. Drought is a normal part of the climate of Michigan and of virtually all other climates around the world – including areas with high and low average rainfall. Drought differs from normal arid conditions found in low rainfall areas in that aridity is a permanent characteristic of that type of climate. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period, usually a season or more in length. The severity of a drought depends not only on its location, duration and geographical extent, but also on the water supply demands made by human activities and vegetation. This multi-faceted nature of the hazard makes it difficult to define a drought and assess when and where one is likely to occur. Drought differs from other natural hazards in several ways. First, it is difficult to

determine the exact beginning and end of a drought, since its effects may accumulate slowly and linger even after the event is generally thought of as being over. Second, the lack of a clear-cut definition of drought often makes it difficult to determine whether one actually exists, and if it does, its degree of severity. Third, drought impacts are often less obvious than other natural hazards, and they are typically spread over a much larger geographic area. Fourth, due primarily to the aforementioned reasons, most communities do not have in place any contingency plans for addressing drought. This lack of pre-planning can greatly hinder a community's response capability when a drought does occur.

Droughts can cause many severe impacts on communities and regions. Impacts include 1) water shortages for human consumption, industrial, business and agricultural uses, power generation, recreation and navigation; 2) a drop in the quantity and quality of agricultural crops; 3) decline of water quality in lakes, streams and other natural bodies of water; 4) malnourishment of wildlife and livestock; 5) increase in wildfires and wildfire-related losses to timber, homes and other property; 6) declines in tourism in areas dependent on water-related activities; 7) declines in land values due to physical damage from the drought conditions and/or decreased economic or functional use of the property; 8) reduced tax revenue due to income losses in agriculture, retail, tourism and other economic sectors; 9) increases in insect infestations, plant disease, and wind erosion; and 10) possible loss of human life due to food shortages, extreme heat, fire, and other health-related problems such as diminished sewage flows and increased pollutant concentrations in surface water.

The available NCDC drought records (those that use the Palmer drought index) began with a period of extreme drought throughout Michigan. Every one of Michigan's climate divisions registered drought conditions for at least 8 months—some as long as 17 months—during this period from 1895-1986. Recovery was spotty and temporary over the following few years, and it is probable that numerous areas felt little distinction between this drought event and the only that followed closely afterward.

Without a doubt, the "Dust Bowl" drought of the 1930s was the most famous drought ever to occur in the U.S. It was caused by misuse of the land combined with years with lack of rainfall. As the land dried up, great clouds of dust and sand, carried by the wind, covered everything and the term "Dust Bowl" was coined. As a result of this drought, millions of acres of farmland became useless, forcing hundreds of thousands of people to leave their farms and seek an existence elsewhere. Although exact figures were not kept, some researchers estimate that nearly $1 billion (in 1930s dollars) was provided in assistance to victims of the Dust Bowl drought. That event also ushered in a new era or farming and conservation programs and practices aimed at preventing a recurrence of a drought of the magnitude and impact of the Dust Bowl drought. In Michigan, this "dust bowl" period took the form of a most severe statewide drought condition from 1929 to 1932, followed by a less severe period from 1933 to 1937 in which the general pattern involved the south and western areas seeing the hardest conditions.

The most extreme conditions ever seen in Michigan occurred in the period from 1929 to 1932. Nine out of Michigan's ten climatic divisions set their all-time drought records during the beginning of 1931. Between 1930 and 1931, all nine of Michigan's most heavily affected climate divisions experienced this most unusual level of drought for at least 6 straight months. Unfortunately, those areas that experienced the more prolonged conditions of extreme drought were also the most heavily agricultural areas of the state, in the southern Lower Peninsula. The drought / heat wave that struck Michigan during the summer of 2001 damaged or destroyed approximately one-third of the state's fruit, vegetable and field crops, resulting in a U.S. Department of Agriculture Disaster Declaration for 82 of the state's counties. In 2002, moderate to extreme drought affected more than 45 percent of the country during the months of June, July and August. Nationwide, the summer was the third hottest on record, following only 1936 and 1934. The summer of 2002 was also very hot and dry in Michigan. During the first half of the month, hundreds of communities across the area were under water restrictions. Hardest hit from the drought was the agricultural industry. The severely dry weather was classified as a drought until mid-2003.

An analysis by year tends to overstate Michigan's drought-susceptibility, because the presence of a single drought month may be counted the same as an entire year of sustained drought (although longer drought periods often will be distinguished by having more severe Palmer Index values). A single month's drought will not necessarily cause severe agricultural impacts, because the timing of the drought with regard to the crop cycle is also important for the extent of drought impact. A drought event inventory in the tri-county region database is admittedly incomplete, with no damages or injuries reported between 1996 and 2013.

Storm Events

Clinton, Eaton, Ingham Counties and Delta Charter Township have each weathered many instances of storms since 2004. The National Climatic Data Center offers the following comprehensive listings of events within each jurisdiction. The following charts list the location, county, date, time, type of storm event, magnitude, deaths, injuries, property damage estimates and crop damage estimates beginning with Clinton County, then Eaton County and finishing with Ingham County.

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	9.349M	320.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	01/14/2004	04:00	EST	Heavy Snow		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	01/27/2004	07:00	EST	Winter Storm		0	0	0.00K	0.00K
MAPLE RAPIDS	CLINTON CO.	MI	05/14/2004	14:38	EST	Tornado	F0	0	0	150.00K	50.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	05/21/2004	23:32	EST	Flood		0	0	1.000M	200.00K
DE WITT	CLINTON CO.	MI	05/23/2004	18:10	EST	Thunderstorm Wind	53 kts. EG	0	0	30.00K	0.00K
WESTPHALIA	CLINTON CO.	MI	06/13/2004	16:43	EST	Thunderstorm Wind	53 kts. EG	0	0	5.00K	0.00K
ST JOHNS	CLINTON CO.	MI	06/14/2004	12:42	EST	Hail	1.00 in.	0	0	10.00K	10.00K
ST JOHNS	CLINTON CO.	MI	07/13/2004	20:10	EST	Hail	1.00 in.	0	0	5.00K	5.00K
DE WITT	CLINTON CO.	MI	07/13/2004	20:25	EST	Thunderstorm Wind	53 kts. EG	0	0	5.00K	0.00K
DE WITT	CLINTON CO.	MI	07/13/2004	21:15	EST	Thunderstorm Wind	53 kts. EG	0	0	10.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	10/30/2004	11:00	EST	High Wind	50 kts. EG	0	0	50.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	11/24/2004	12:00	EST	Winter Storm		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	01/21/2005	23:00	EST	Heavy Snow		0	0	0.00K	0.00K
WESTPHALIA	CLINTON CO.	MI	06/05/2005	17:06	EST	Thunderstorm Wind	52 kts. EG	0	0	20.00K	0.00K
DE WITT	CLINTON CO.	MI	06/09/2005	17:54	EST	Thunderstorm Wind	52 kts. EG	0	0	10.00K	10.00K
DE WITT	CLINTON CO.	MI	06/09/2005	18:26	EST	Thunderstorm Wind	52 kts. EG	0	0	10.00K	10.00K
MAPLE RAPIDS	CLINTON CO.	MI	07/24/2005	06:45	EST	Thunderstorm Wind	53 kts. EG	0	0	25.00K	0.00K
WESTPHALIA	CLINTON CO.	MI	07/24/2005	07:05	EST	Thunderstorm Wind	53 kts. EG	0	0	10.00K	0.00K
ST JOHNS	CLINTON CO.	MI	09/22/2005	12:40	EST	Thunderstorm Wind	53 kts. EG	0	0	20.00K	0.00K
ST JOHNS	CLINTON CO.	MI	09/22/2005	16:30	EST	Thunderstorm Wind	53 kts. EG	0	0	10.00K	5.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/08/2005	16:00	EST	Heavy Snow		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	01/20/2006	19:00	EST	Heavy Snow		0	0	0.00K	0.00K
OVID	CLINTON CO.	MI	06/03/2006	13:20	EST	Hail	0.88 in.	0	0	5.00K	5.00K
LANSING ARPT	CLINTON CO.	MI	08/02/2006	20:49	EST	Thunderstorm Wind	51 kts. MG	0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	09/23/2006	17:30	EST	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
WESTPHALIA	CLINTON CO.	MI	10/02/2006	13:45	EST-5	Hail	0.88 in.	0	0	10.00K	10.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/01/2006	04:00	EST-5	Ice Storm		0	0	30.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	01/14/2007	09:00	EST-5	Winter Storm		0	0	25.00K	0.00K
FOWLER	CLINTON CO.	MI	06/02/2007	13:30	EST-5	Thunderstorm Wind	50 kts. EG	0	0	10.00K	0.00K
ST JOHNS	CLINTON CO.	MI	06/04/2007	16:47	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	06/19/2007	04:10	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
BATH	CLINTON CO.	MI	07/05/2007	12:30	EST-5	Thunderstorm Wind	50 kts. EG	0	0	10.00K	0.00K
OVID	CLINTON CO.	MI	07/19/2007	13:26	EST-5	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
MAPLE RAPIDS	CLINTON CO.	MI	08/22/2007	20:58	EST-5	Thunderstorm Wind	50 kts. EG	0	0	0.00K	0.00K
WAOOUSTA	CLINTON CO.	MI	08/23/2007	18:12	EST-5	Thunderstorm Wind	50 kts. EG	0	0	50.00K	0.00K
EUREKA	CLINTON CO.	MI	08/29/2007	14:45	EST-5	Thunderstorm Wind	50 kts. EG	0	0	50.00K	0.00K
ST JOHNS	CLINTON CO.	MI	08/29/2007	15:10	EST-5	Thunderstorm Wind	50 kts. EG	0	0	25.00K	0.00K
OVID	CLINTON CO.	MI	08/29/2007	15:30	EST-5	Thunderstorm Wind	50 kts. EG	0	0	3.00K	0.00K
EAGLE	CLINTON CO.	MI	09/25/2007	17:10	EST-5	Thunderstorm Wind	50 kts. EG	0	0	0.00K	0.00K
WESTPHALIA	CLINTON CO.	MI	09/25/2007	17:15	EST-5	Thunderstorm Wind	50 kts. EG	0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/01/2007	17:00	EST-5	Winter Storm		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/15/2007	19:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	02/01/2008	03:00	EST-5	Winter Storm		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	02/06/2008	12:30	EST-5	Winter Storm		0	0	0.00K	0.00K
MAPLE RAPIDS	CLINTON CO.	MI	04/11/2008	15:53	EST-5	Hail	0.88 in.	0	0	0.00K	0.00K

MAPLE RAPIDS	CLINTON CO.	MI	04/11/2008	15:53	EST-5	Hail	0.88 in.	0	0	0.00K	0.00K
DE WITT	CLINTON CO.	MI	04/11/2008	16:32	EST-5	Hail	1.25 in.	0	0	10.00K	10.00K
DE WITT	CLINTON CO.	MI	04/11/2008	16:32	EST-5	Hail	0.88 in.	0	0	0.00K	0.00K
DE WITT	CLINTON CO.	MI	04/11/2008	16:34	EST-5	Hail	1.00 in.	0	0	10.00K	5.00K
MERLE BEACH	CLINTON CO.	MI	05/17/2008	17:03	EST-5	Thunderstorm Wind	50 kts. EG	0	0	1.00K	0.00K
ST JOHNS ARCHER FLD	CLINTON CO.	MI	05/17/2008	17:08	EST-5	Thunderstorm Wind	50 kts. EG	0	0	1.00K	0.00K
WESTPHALIA	CLINTON CO.	MI	06/06/2008	16:28	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	06/06/2008	16:29	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
MERLE BEACH	CLINTON CO.	MI	06/06/2008	16:30	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	06/06/2008	16:30	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
MERLE BEACH	CLINTON CO.	MI	06/06/2008	17:00	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	06/06/2008	17:15	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	06/06/2008	17:22	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	06/06/2008	17:36	EST-5	Thunderstorm Wind	65 kts. EG	0	0	50.00K	0.00K
DE WITT	CLINTON CO.	MI	06/07/2008	21:55	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
DE WITT	CLINTON CO.	MI	06/07/2008	22:00	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	07/02/2008	14:55	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	11/30/2008	12:30	EST-5	Winter Storm		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/01/2008	00:00	EST-5	Winter Storm		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/19/2008	04:30	EST-5	Winter Storm		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/28/2008	04:00	EST-5	High Wind	52 kts. EG	0	0	0.00K	0.00K
EAGLE	CLINTON CO.	MI	06/19/2009	21:30	EST-5	Flash Flood		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/24/2009	12:00	EST-5	Winter Weather		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	02/09/2010	07:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	02/22/2010	00:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
EAGLE	CLINTON CO.	MI	06/04/2010	17:24	EST-5	Thunderstorm Wind	65 kts. EG	0	0	200.00K	0.00K
(LAN)CAPITOL CTY ARP	CLINTON CO.	MI	06/04/2010	17:51	EST-5	Thunderstorm Wind	55 kts. EG	0	0	50.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	02/01/2011	19:00	EST-5	Winter Storm		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	02/20/2011	14:00	EST-5	Winter Storm		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	03/22/2011	20:00	EST-5	Winter Weather		0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	04/19/2011	22:18	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
OVID KOSHT ARPT	CLINTON CO.	MI	06/22/2011	12:30	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
ST JOHNS GLOWACKI FL	CLINTON CO.	MI	08/20/2011	13:45	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	11/29/2011	18:00	EST-5	Winter Storm		0	0	1.000M	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	02/23/2012	20:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	05/03/2012	16:45	EST-5	Thunderstorm Wind	65 kts. EG	0	0	100.00K	0.00K
MERLE BEACH	CLINTON CO.	MI	05/03/2012	17:03	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
FOWLER	CLINTON CO.	MI	07/05/2012	02:07	EST-5	Thunderstorm Wind	51 kts. MG	0	0	1.00K	0.00K
FOWLER	CLINTON CO.	MI	07/05/2012	02:07	EST-5	Thunderstorm Wind	51 kts. MG	0	0	1.00K	0.00K
ST JOHNS	CLINTON CO.	MI	07/05/2012	02:15	EST-5	Thunderstorm Wind	52 kts. EG	0	0	25.00K	0.00K
MATHERTON	CLINTON CO.	MI	04/17/2013	16:00	EST-5	Flood		0	0	5.000M	0.00K
(LAN)CAPITOL CTY ARP	CLINTON CO.	MI	05/28/2013	19:07	EST-5	Thunderstorm Wind	70 kts. EG	0	0	25.00K	0.00K
MERLE BEACH	CLINTON CO.	MI	05/30/2013	18:45	EST-5	Thunderstorm Wind	61 kts. EG	0	0	15.00K	0.00K
(LAN)CAPITOL CTY ARP	CLINTON CO.	MI	11/17/2013	16:39	EST-5	Thunderstorm Wind	53 kts. MG	0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	11/17/2013	19:00	EST-5	High Wind	61 kts. EG	0	0	100.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	12/21/2013	18:00	EST-5	Ice Storm		0	0	1.000M	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	01/04/2014	20:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
CLINTON (ZONE)	CLINTON (ZONE)	MI	03/12/2014	01:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
ST JOHNS	CLINTON CO.	MI	04/12/2014	17:31	EST-5	Thunderstorm Wind	70 kts. EG	0	0	50.00K	0.00K
ST JOHNS	CLINTON CO.	MI	07/06/2014	23:50	EST-5	Thunderstorm Wind	61 kts. EG	0	0	50.00K	0.00K
ST JOHNS GLOWACKI FL	CLINTON CO.	MI	07/07/2014	00:00	EST-5	Tornado	EF0	0	0	50.00K	0.00K
EAST DE WITT	CLINTON CO.	MI	07/27/2014	14:30	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
DE WITT	CLINTON CO.	MI	08/19/2014	14:41	EST-5	Thunderstorm Wind	52 kts. EG	0	0	2.00K	0.00K

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	5	55.203M	925.00K
EATON (ZONE)	EATON (ZONE)	MI	01/27/2004	07:00	EST	Winter Storm		0	0	0.00K	0.00K
CHARLOTTE	EATON CO.	MI	05/09/2004	12:50	EST	Thunderstorm Wind	53 kts. EG	0	0	20.00K	5.00K
MULLIKEN	EATON CO.	MI	05/10/2004	17:35	EST	Thunderstorm Wind	65 kts. EG	0	0	50.00K	10.00K
BELLEVUE	EATON CO.	MI	05/10/2004	19:15	EST	Thunderstorm Wind	53 kts. EG	0	0	25.00K	10.00K
BELLEVUE	EATON CO.	MI	05/14/2004	14:56	EST	Thunderstorm Wind	53 kts. EG	0	0	50.00K	10.00K
CHARLOTTE	EATON CO.	MI	05/21/2004	12:12	EST	Hail	0.75 in.	0	0	40.00K	10.00K
EATON (ZONE)	EATON (ZONE)	MI	05/21/2004	23:32	EST	Flood		0	0	1.000M	200.00K
CHARLOTTE	EATON CO.	MI	05/23/2004	15:50	EST	Hail	1.75 in.	0	0	40.00K	40.00K
VERMONTVILLE	EATON CO.	MI	06/14/2004	12:35	EST	Hail	0.75 in.	0	0	10.00K	5.00K
GRAND LEDGE	EATON CO.	MI	07/13/2004	21:05	EST	Thunderstorm Wind	53 kts. EG	0	0	15.00K	0.00K
VERMONTVILLE	EATON CO.	MI	08/02/2004	15:57	EST	Hail	0.75 in.	0	0	10.00K	5.00K
VERMONTVILLE	EATON CO.	MI	08/25/2004	16:50	EST	Thunderstorm Wind	85 kts. EG	0	0	100.00K	25.00K
VERMONTVILLE	EATON CO.	MI	08/25/2004	16:53	EST	Tornado	F0	0	0	50.00K	25.00K
EATON (ZONE)	EATON (ZONE)	MI	10/30/2004	11:00	EST	High Wind	50 kts. EG	0	0	50.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	11/24/2004	12:00	EST	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	01/21/2005	23:00	EST	Heavy Snow		0	0	0.00K	0.00K
MULLIKEN	EATON CO.	MI	06/05/2005	16:58	EST	Thunderstorm Wind	52 kts. EG	0	0	25.00K	0.00K
GRAND LEDGE	EATON CO.	MI	06/05/2005	17:42	EST	Hail	0.75 in.	0	0	10.00K	10.00K
GRAND LEDGE	EATON CO.	MI	06/09/2005	19:05	EST	Hail	0.75 in.	0	0	25.00K	15.00K
NEEDMORE	EATON CO.	MI	06/14/2005	14:13	EST	Hail	0.75 in.	0	0	5.00K	5.00K
EATON RAPIDS	EATON CO.	MI	06/26/2005	16:50	EST	Thunderstorm Wind	52 kts. EG	0	0	15.00K	0.00K
OLIVET STATION	EATON CO.	MI	06/30/2005	08:45	EST	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
CHARLOTTE	EATON CO.	MI	07/04/2005	17:00	EST	Thunderstorm Wind	53 kts. EG	0	0	10.00K	0.00K
CHARLOTTE	EATON CO.	MI	07/18/2005	13:45	EST	Thunderstorm Wind	53 kts. EG	0	0	10.00K	0.00K
BELLEVUE	EATON CO.	MI	07/20/2005	16:28	EST	Thunderstorm Wind	53 kts. EG	0	0	25.00K	0.00K
GRAND LEDGE	EATON CO.	MI	07/24/2005	07:15	EST	Thunderstorm Wind	53 kts. EG	0	0	25.00K	0.00K
EATON RAPIDS	EATON CO.	MI	07/26/2005	01:35	EST	Thunderstorm Wind	50 kts. MG	0	0	10.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/08/2005	16:00	EST	Heavy Snow		0	0	0.00K	0.00K
GRAND LEDGE	EATON CO.	MI	08/02/2006	20:37	EST	Thunderstorm Wind	53 kts. EG	0	0	10.00K	0.00K
BELLEVUE	EATON CO.	MI	09/13/2006	01:55	EST	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/01/2006	04:00	EST-5	Ice Storm		0	0	25.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	01/14/2007	09:00	EST-5	Winter Storm		0	0	25.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/02/2007	19:00	EST-5	Blizzard		0	0	0.00K	0.00K
MILLETT	EATON CO.	MI	05/15/2007	18:11	EST-5	Thunderstorm Wind	50 kts. EG	0	0	0.00K	0.00K
CHARLOTTE	EATON CO.	MI	06/02/2007	12:40	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
EATON RAPIDS SKYWAY	EATON CO.	MI	08/23/2007	18:04	EST-5	Thunderstorm Wind	50 kts. EG	0	0	100.00K	0.00K
KALAMO	EATON CO.	MI	08/24/2007	15:07	EST-5	Thunderstorm Wind	52 kts. EG	0	0	40.00K	0.00K
CHARLOTTE	EATON CO.	MI	08/24/2007	15:25	EST-5	Tornado	EF3	0	5	40.000M	0.00K
BELLEVUE	EATON CO.	MI	08/29/2007	16:55	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
MULLIKEN	EATON CO.	MI	10/18/2007	18:41	EST-5	Funnel Cloud		0	0	0.00K	0.00K
POTTERVILLE	EATON CO.	MI	10/18/2007	22:12	EST-5	Thunderstorm Wind	52 kts. EG	0	0	1.00K	0.00K
GRESHAM	EATON CO.	MI	10/18/2007	22:12	EST-5	Thunderstorm Wind	52 kts. EG	0	0	1.00K	0.00K
BELLEVUE	EATON CO.	MI	10/18/2007	22:30	EST-5	Thunderstorm Wind	59 kts. EG	0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/01/2007	17:00	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/15/2007	19:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/31/2007	20:30	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	01/01/2008	00:00	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/01/2008	02:18	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/06/2008	11:00	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	03/21/2008	14:00	EST-5	Winter Storm		0	0	0.00K	0.00K
GRAND LEDGE	EATON CO.	MI	04/11/2008	16:24	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K

SUNFIELD	EATON CO.	MI	06/06/2008	15:45	EST-5	Thunderstorm Wind	65 kts. EG	0	0	0.00K	0.00K
HOYTVILLE	EATON CO.	MI	06/06/2008	15:55	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
MULLIKEN ARPT	EATON CO.	MI	06/06/2008	16:00	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
SHAYTOWN	EATON CO.	MI	06/06/2008	16:25	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
BELLEVUE	EATON CO.	MI	06/07/2008	21:12	EST-5	Flash Flood		0	0	600.00K	200.00K
ONEIDA CENTER	EATON CO.	MI	06/07/2008	21:41	EST-5	Thunderstorm Wind	65 kts. EG	0	0	0.00K	0.00K
DAWN HAVEN ESTATES	EATON CO.	MI	06/07/2008	21:45	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
DAWN HAVEN ESTATES	EATON CO.	MI	06/07/2008	21:50	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
DAWN HAVEN ESTATES	EATON CO.	MI	06/07/2008	21:50	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
BELLEVUE	EATON CO.	MI	06/08/2008	14:42	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
KELLY	EATON CO.	MI	06/08/2008	14:43	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
NEEDMORE	EATON CO.	MI	06/08/2008	14:45	EST-5	Tornado	EF1	0	0	0.00K	0.00K
DAWN HAVEN ESTATES	EATON CO.	MI	06/08/2008	15:00	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
HOYTVILLE	EATON CO.	MI	06/08/2008	15:42	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
VERMONTVILLE	EATON CO.	MI	07/02/2008	16:12	EST-5	Thunderstorm Wind	55 kts. EG	0	0	0.00K	0.00K
OLIVET STATION	EATON CO.	MI	07/02/2008	16:35	EST-5	Hail	1.25 in.	0	0	0.00K	100.00K
OLIVET STATION	EATON CO.	MI	07/02/2008	16:35	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
OLIVET STATION	EATON CO.	MI	07/02/2008	16:37	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
CHARLOTTE	EATON CO.	MI	07/02/2008	16:37	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
CHARLOTTE	EATON CO.	MI	07/02/2008	16:38	EST-5	Hail	0.88 in.	0	0	0.00K	0.00K
CHARLOTTE	EATON CO.	MI	07/02/2008	16:46	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
BROOKFIELD	EATON CO.	MI	09/13/2008	17:00	EST-5	Tornado	EF0	0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/19/2008	04:00	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/28/2008	03:15	EST-5	High Wind	52 kts. EG	0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	01/09/2009	11:00	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	04/05/2009	22:30	EST-5	Winter Storm		0	0	0.00K	0.00K
DIMONDALE	EATON CO.	MI	06/08/2009	14:30	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
EATON RAPIDS	EATON CO.	MI	06/19/2009	21:30	EST-5	Thunderstorm Wind	55 kts. EG	0	0	50.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/24/2009	11:00	EST-5	Winter Weather		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/09/2010	07:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/21/2010	22:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
BELLEVUE	EATON CO.	MI	04/06/2010	10:04	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
BELLEVUE	EATON CO.	MI	07/10/2010	16:18	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/01/2011	19:00	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/20/2011	13:00	EST-5	Winter Storm		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	04/17/2011	12:20	EST-5	Strong Wind	41 kts. EG	0	0	1.00K	0.00K
CHARLOTTE	EATON CO.	MI	04/19/2011	22:18	EST-5	Hail	0.88 in.	0	0	0.00K	0.00K
WEST WINDSOR	EATON CO.	MI	05/13/2011	19:09	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
CHARLOTTE	EATON CO.	MI	05/29/2011	15:55	EST-5	Thunderstorm Wind	87 kts. EG	0	0	1.000M	0.00K
BROOKFIELD	EATON CO.	MI	05/29/2011	15:55	EST-5	Thunderstorm Wind	74 kts. EG	0	0	1.000M	0.00K
WOODBURY	EATON CO.	MI	07/28/2011	00:00	EST-5	Flash Flood		0	0	1.000M	250.00K
BELLEVUE	EATON CO.	MI	08/20/2011	13:01	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	11/29/2011	17:00	EST-5	Winter Storm		0	0	1.000M	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/23/2012	19:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
SUNFIELD	EATON CO.	MI	05/03/2012	18:00	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
WOODBURY	EATON CO.	MI	04/17/2013	16:00	EST-5	Flood		0	0	3.000M	0.00K
ONEIDA CENTER	EATON CO.	MI	06/13/2013	01:00	EST-5	Flash Flood		0	0	50.00K	0.00K
PETRIEVILLE	EATON CO.	MI	11/17/2013	16:45	EST-5	Thunderstorm Wind	61 kts. EG	0	0	50.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	11/17/2013	18:00	EST-5	High Wind	61 kts. EG	0	0	100.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	12/21/2013	18:00	EST-5	Ice Storm		0	0	5.000M	0.00K
EATON (ZONE)	EATON (ZONE)	MI	01/04/2014	19:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	02/17/2014	21:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	03/12/2014	01:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
CHARLESWORTH	EATON CO.	MI	07/27/2014	17:29	EST-5	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K

OLIVET STATION	EATON CO.	MI	09/05/2014	17:43	EST-5	Thunderstorm Wind	65 kts. EG	0	0	500.00K	0.00K
EATON (ZONE)	EATON (ZONE)	MI	11/17/2014	07:00	EST-5	Lake-effect Snow		0	0	0.00K	0.00K
Totals:								0	5	55.203M	925.00K

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								2	0	36.397M	320.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	01/27/2004	07:00	EST	Winter Storm		0	0	0.00K	0.00K
LANSING	INGHAM CO.	MI	05/10/2004	17:48	EST	Thunderstorm Wind	65 kts. MG	0	0	25.00K	10.00K
MASON	INGHAM CO.	MI	05/20/2004	22:25	EST	Hail	1.00 in.	0	0	15.00K	15.00K
MASON	INGHAM CO.	MI	05/21/2004	12:37	EST	Thunderstorm Wind	50 kts. MG	0	0	10.00K	0.00K
MASON	INGHAM CO.	MI	05/21/2004	12:46	EST	Thunderstorm Wind	53 kts. EG	0	0	25.00K	0.00K
LESLIE	INGHAM CO.	MI	05/21/2004	20:50	EST	Hail	1.00 in.	0	0	20.00K	10.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	05/21/2004	23:32	EST	Flood		0	0	1.000M	200.00K
LANSING	INGHAM CO.	MI	06/09/2004	12:30	EST	Hail	0.75 in.	0	0	10.00K	0.00K
LANSING	INGHAM CO.	MI	06/14/2004	13:25	EST	Hail	0.75 in.	0	0	5.00K	5.00K
HOLT	INGHAM CO.	MI	07/13/2004	21:15	EST	Thunderstorm Wind	53 kts. EG	0	0	20.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	10/30/2004	11:00	EST	High Wind	50 kts. EG	0	0	50.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	11/24/2004	12:00	EST	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	01/21/2005	23:00	EST	Heavy Snow		0	0	0.00K	0.00K
LESLIE	INGHAM CO.	MI	05/13/2005	16:30	EST	Thunderstorm Wind	53 kts. EG	0	0	0.00K	0.00K
MASON	INGHAM CO.	MI	06/05/2005	13:49	EST	Hail	1.50 in.	0	0	25.00K	25.00K
LANSING	INGHAM CO.	MI	06/05/2005	17:40	EST	Hail	1.00 in.	0	0	50.00K	25.00K
AURELIUS	INGHAM CO.	MI	06/26/2005	17:10	EST	Thunderstorm Wind	52 kts. EG	0	0	15.00K	0.00K
LANSING	INGHAM CO.	MI	07/18/2005	14:25	EST	Thunderstorm Wind	53 kts. EG	0	0	50.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/08/2005	16:00	EST	Heavy Snow		0	0	0.00K	0.00K
MASON	INGHAM CO.	MI	04/22/2006	19:44	EST	Hail	1.00 in.	0	0	10.00K	5.00K
WILLIAMSTON	INGHAM CO.	MI	04/22/2006	19:55	EST	Hail	0.75 in.	0	0	10.00K	5.00K
WEBBERVILLE	INGHAM CO.	MI	04/22/2006	19:57	EST	Hail	1.00 in.	0	0	10.00K	5.00K
WILLIAMSTON	INGHAM CO.	MI	06/19/2006	13:28	EST	Thunderstorm Wind	52 kts. EG	0	0	20.00K	10.00K
LANSING	INGHAM CO.	MI	08/02/2006	21:14	EST	Thunderstorm Wind	52 kts. EG	0	0	5.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/01/2006	04:00	EST-5	Ice Storm		0	0	40.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	01/14/2007	09:00	EST-5	Winter Storm		0	0	25.00K	0.00K
NORTH AURELIUS	INGHAM CO.	MI	05/15/2007	17:40	EST-5	Thunderstorm Wind	63 kts. MG	0	0	15.00K	0.00K
ONONDAGA	INGHAM CO.	MI	06/02/2007	17:50	EST-5	Thunderstorm Wind	52 kts. EG	0	0	15.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	06/27/2007	15:00	EST-5	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
WEBBERVILLE	INGHAM CO.	MI	07/05/2007	13:05	EST-5	Thunderstorm Wind	60 kts. EG	0	0	25.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	07/19/2007	13:35	EST-5	Thunderstorm Wind	50 kts. EG	0	0	20.00K	0.00K
WILLIAMSTON	INGHAM CO.	MI	07/19/2007	13:55	EST-5	Thunderstorm Wind	50 kts. EG	0	0	15.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	08/23/2007	18:16	EST-5	Thunderstorm Wind	50 kts. MG	0	0	25.00K	0.00K
LANSING	INGHAM CO.	MI	08/24/2007	15:55	EST-5	Tornado	EF1	0	0	300.00K	0.00K
LESLIE	INGHAM CO.	MI	08/29/2007	16:35	EST-5	Thunderstorm Wind	50 kts. EG	0	0	20.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	08/29/2007	17:42	EST-5	Thunderstorm Wind	50 kts. EG	0	0	0.00K	0.00K
VANTOWN	INGHAM CO.	MI	10/18/2007	21:28	EST-5	Tornado	EF2	2	0	15.000M	0.00K
NORTH AURELIUS	INGHAM CO.	MI	10/18/2007	23:06	EST-5	Thunderstorm Wind	52 kts. EG	0	0	5.00K	0.00K
BUNKER HILL CENTER	INGHAM CO.	MI	10/18/2007	23:06	EST-5	Thunderstorm Wind	52 kts. EG	0	0	5.00K	0.00K
DANSVILLE	INGHAM CO.	MI	10/18/2007	23:27	EST-5	Thunderstorm Wind	52 kts. EG	0	0	5.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/01/2007	17:00	EST-5	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/15/2007	19:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	12/23/2007	06:35	EST-5	Thunderstorm Wind	56 kts. EG	0	0	50.00K	0.00K
VANTOWN	INGHAM CO.	MI	12/23/2007	06:55	EST-5	Thunderstorm Wind	52 kts. EG	0	0	5.00K	0.00K
NORTH LESLIE	INGHAM CO.	MI	12/23/2007	07:05	EST-5	Thunderstorm Wind	56 kts. EG	0	0	5.00K	0.00K
MILLVILLE	INGHAM CO.	MI	12/23/2007	07:16	EST-5	Thunderstorm Wind	52 kts. EG	0	0	2.00K	0.00K

MILLVILLE	INGHAM CO.	MI	12/23/2007	07:16	EST-5	Thunderstorm Wind	52 kts. EG	0	0	2.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/31/2007	20:30	EST-5	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	01/01/2008	00:00	EST-5	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	02/01/2008	02:17	EST-5	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	02/06/2008	11:00	EST-5	Winter Storm		0	0	0.00K	0.00K
WAVERLY PARK	INGHAM CO.	MI	04/11/2008	16:25	EST-5	Hail	1.00 in.	0	0	10.00K	5.00K
NORTH LESLIE	INGHAM CO.	MI	06/06/2008	17:36	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	06/07/2008	21:55	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	06/07/2008	22:00	EST-5	Thunderstorm Wind	60 kts. EG	0	0	0.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	06/08/2008	14:59	EST-5	Tornado	EF1	0	0	0.00K	0.00K
ONONDAGA	INGHAM CO.	MI	06/08/2008	15:00	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	06/08/2008	15:00	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	06/08/2008	15:05	EST-5	Thunderstorm Wind	54 kts. MG	0	0	0.00K	0.00K
EAST LANSING ARPT	INGHAM CO.	MI	06/08/2008	15:10	EST-5	Thunderstorm Wind	56 kts. EG	0	0	0.00K	0.00K
MASON	INGHAM CO.	MI	06/08/2008	15:14	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
HASLETT	INGHAM CO.	MI	06/08/2008	15:15	EST-5	Thunderstorm Wind	61 kts. EG	0	0	0.00K	0.00K
FOREST HILLS	INGHAM CO.	MI	06/08/2008	15:30	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
WAVERLY PARK	INGHAM CO.	MI	06/08/2008	15:40	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
KINNEVILLE	INGHAM CO.	MI	07/02/2008	17:09	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
ONONDAGA	INGHAM CO.	MI	07/02/2008	17:26	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
BUNKER HILL CENTER	INGHAM CO.	MI	09/03/2008	13:08	EST-5	Hail	0.88 in.	0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/19/2008	04:30	EST-5	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/28/2008	03:30	EST-5	High Wind	55 kts. MG	0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	01/09/2009	12:00	EST-5	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	04/05/2009	22:30	EST-5	Winter Storm		0	0	0.00K	0.00K
ENSEL	INGHAM CO.	MI	04/25/2009	12:10	EST-5	Thunderstorm Wind	46 kts. EG	0	0	10.00K	0.00K
ONONDAGA	INGHAM CO.	MI	04/25/2009	16:35	EST-5	Thunderstorm Wind	50 kts. EG	0	0	0.00K	0.00K
LANSING	INGHAM CO.	MI	06/08/2009	14:30	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
HOLT	INGHAM CO.	MI	06/08/2009	14:37	EST-5	Hail	1.50 in.	0	0	0.00K	0.00K
HOLT	INGHAM CO.	MI	06/08/2009	14:40	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
HOLT	INGHAM CO.	MI	06/08/2009	15:00	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
WILLIAMSTON	INGHAM CO.	MI	06/08/2009	15:02	EST-5	Hail	1.75 in.	0	0	0.00K	0.00K
WILLIAMSTON	INGHAM CO.	MI	06/08/2009	15:09	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
WEBBERVILLE	INGHAM CO.	MI	08/09/2009	19:24	EST-5	Thunderstorm Wind	50 kts. EG	0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/24/2009	11:00	EST-5	Winter Weather		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	02/09/2010	07:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	02/21/2010	22:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	02/24/2010	05:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
NORTH AURELIUS	INGHAM CO.	MI	04/06/2010	10:20	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
EAST LANSING ARPT	INGHAM CO.	MI	06/04/2010	17:58	EST-5	Thunderstorm Wind	70 kts. EG	0	0	1.000M	0.00K
PACKARD	INGHAM CO.	MI	07/15/2010	15:25	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	09/16/2010	13:04	EST-5	Flood		0	0	25.00K	0.00K
WILLIAMSTON	INGHAM CO.	MI	09/21/2010	21:38	EST-5	Thunderstorm Wind	52 kts. EG	0	0	50.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	02/01/2011	19:00	EST-5	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	02/20/2011	13:00	EST-5	Winter Storm		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	03/04/2011	05:00	EST-5	Winter Weather		0	0	0.00K	0.00K
LANSING	INGHAM CO.	MI	05/22/2011	21:05	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
ONONDAGA	INGHAM CO.	MI	05/29/2011	16:05	EST-5	Thunderstorm Wind	74 kts. EG	0	0	1.000M	0.00K
NORTH AURELIUS	INGHAM CO.	MI	05/29/2011	16:07	EST-5	Thunderstorm Wind	74 kts. EG	0	0	500.00K	0.00K
MILLVILLE	INGHAM CO.	MI	05/29/2011	16:17	EST-5	Thunderstorm Wind	78 kts. EG	0	0	500.00K	0.00K
BELL OAK	INGHAM CO.	MI	05/29/2011	16:27	EST-5	Tornado	EF0	0	0	50.00K	0.00K
MASON	INGHAM CO.	MI	06/21/2011	20:20	EST-5	Thunderstorm Wind	61 kts. EG	0	0	25.00K	0.00K
TOWAR GARDENS	INGHAM CO.	MI	07/18/2011	16:44	EST-5	Thunderstorm Wind	51 kts. MG	0	0	0.00K	0.00K
OAK GROVE	INGHAM CO.	MI	07/27/2011	23:30	EST-5	Flash Flood		0	0	5.000M	0.00K

INGHAM (ZONE)	INGHAM (ZONE)	MI	11/29/2011	17:00	EST-5	Winter Storm		0	0	1.000M	0.00K
MASON	INGHAM CO.	MI	05/03/2012	18:30	EST-5	Hail	1.25 in.	0	0	0.00K	0.00K
HOLT	INGHAM CO.	MI	05/03/2012	18:35	EST-5	Thunderstorm Wind	61 kts. EG	0	0	25.00K	0.00K
STOCKBRIDGE	INGHAM CO.	MI	07/03/2012	16:07	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
MASON	INGHAM CO.	MI	07/05/2012	02:50	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
HOPWOOD ACRES	INGHAM CO.	MI	07/05/2012	15:13	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
BUNKER HILL CENTER	INGHAM CO.	MI	07/06/2012	19:50	EST-5	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
LANSING	INGHAM CO.	MI	04/17/2013	16:00	EST-5	Flood		0	0	5.000M	0.00K
MASON	INGHAM CO.	MI	05/20/2013	17:20	EST-5	Hail	0.75 in.	0	0	0.00K	0.00K
WILLIAMSTON	INGHAM CO.	MI	05/20/2013	17:20	EST-5	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
DANSVILLE	INGHAM CO.	MI	05/28/2013	16:56	EST-5	Thunderstorm Wind	52 kts. EG	0	0	5.00K	0.00K
HOLT	INGHAM CO.	MI	06/12/2013	21:45	EST-5	Hail	1.00 in.	0	0	0.00K	0.00K
STOCKBRIDGE	INGHAM CO.	MI	09/11/2013	16:50	EST-5	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
LANSING	INGHAM CO.	MI	11/17/2013	16:39	EST-5	Thunderstorm Wind	53 kts. MG	0	0	25.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	11/17/2013	19:00	EST-5	High Wind	61 kts. EG	0	0	100.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	12/21/2013	18:00	EST-5	Ice Storm		0	0	5.000M	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	01/04/2014	20:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	02/04/2014	22:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
INGHAM (ZONE)	INGHAM (ZONE)	MI	03/12/2014	01:00	EST-5	Heavy Snow		0	0	0.00K	0.00K
LESLIE	INGHAM CO.	MI	07/27/2014	14:38	EST-5	Thunderstorm Wind	52 kts. EG	0	0	10.00K	0.00K
LESLIE	INGHAM CO.	MI	07/27/2014	17:13	EST-5	Thunderstorm Wind	52 kts. EG	0	0	20.00K	0.00K
OKEMOS	INGHAM CO.	MI	08/26/2014	14:25	EST-5	Thunderstorm Wind	52 kts. EG	0	0	0.00K	0.00K
PACKARD	INGHAM CO.	MI	09/05/2014	17:57	EST-5	Thunderstorm Wind	56 kts. EG	0	0	50.00K	0.00K
Totals:								2	0	36.397M	320.00K

Regional Data

With LiDAR based-maps, contour maps and aerial photography, emergency management personnel can analyze natural and manmade environments with accuracy. All three types of maps were shared at public workshops of 2013 and were used to analyze hazards throughout the region, particularly flood-prone areas. The sample aerial photo below depicts the Frandor Shopping Center Area in Lansing. Aerial snapshots of the entire region are available on CD or on printed posters by request. Please contact the Tri-County Regional Planning Commission for more information.

Fig. 56 The Frandor Shopping Center and Environs

As a part of this plan update, the Tri-County Regional Planning Commission acquired software to utilize recently developed LiDAR (Light Detection and Ranging) data of the region. LiDAR is a remote sensing method that uses light in the form of pulsed radar to measure ranges to the earth. According to the National Oceanic and Atmospheric Administration, LiDAR uses these light pulses along with other data sets recorded by an airborne system to generate precise 3-D information about the shape of the earth and its surface characteristics.

The next three figures provide examples of LiDAR –based maps with building footprints and manmade structures. Hand drawings were incorporated onto these snapshots to accentuate landscaping and natural vs. man-made elements of the sites. Drawings of this type are available for the Sparrow Hospital area, Frandor area and Meridian Mall areas of northern Ingham County. The entire 22 mile corridor of Michigan Avenue and Grand River Avenue in northern Ingham County is available in building footprint maps. Please contact Tri-County Planning Commission for access to these mapping resources.

Fig. 57 & 58 The Meridian Mall/Meijer Store Area

Fig. 59 The Sparrow Hospital Area and Environs

Contour maps were also created and utilized as part of this plan update. Contour maps are available for the entire tri-county region. They are derived from LiDAR data and depict changes in ground elevations throughout each county. The images depicted below are contours within the City of Charlotte and in northern Eaton County. Due to the nature of the large data sets, local agencies who desire a customized contour map of an individual tile within a county may contact the Tri-County Regional Planning Commission. Three types of LiDAR based contour maps are depicted below, two of which are located in Eaton County and one is located in Clinton County.

Fig. 60 Northern Eaton County

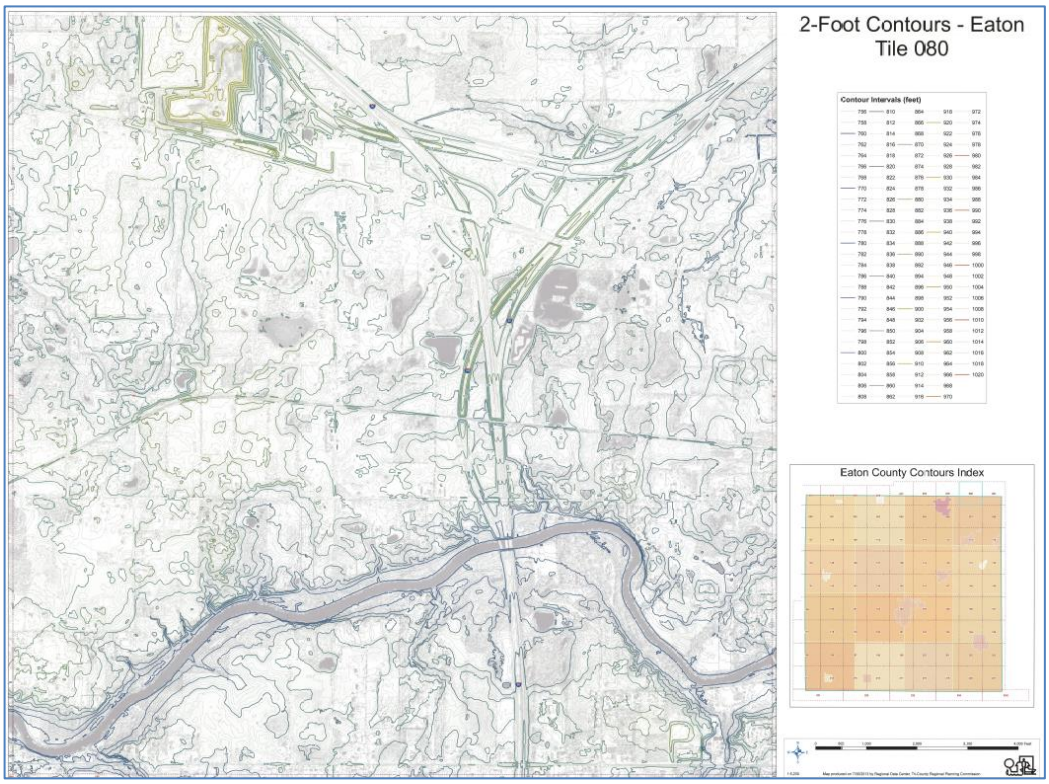


Fig. 61 City of Charlotte and Environs

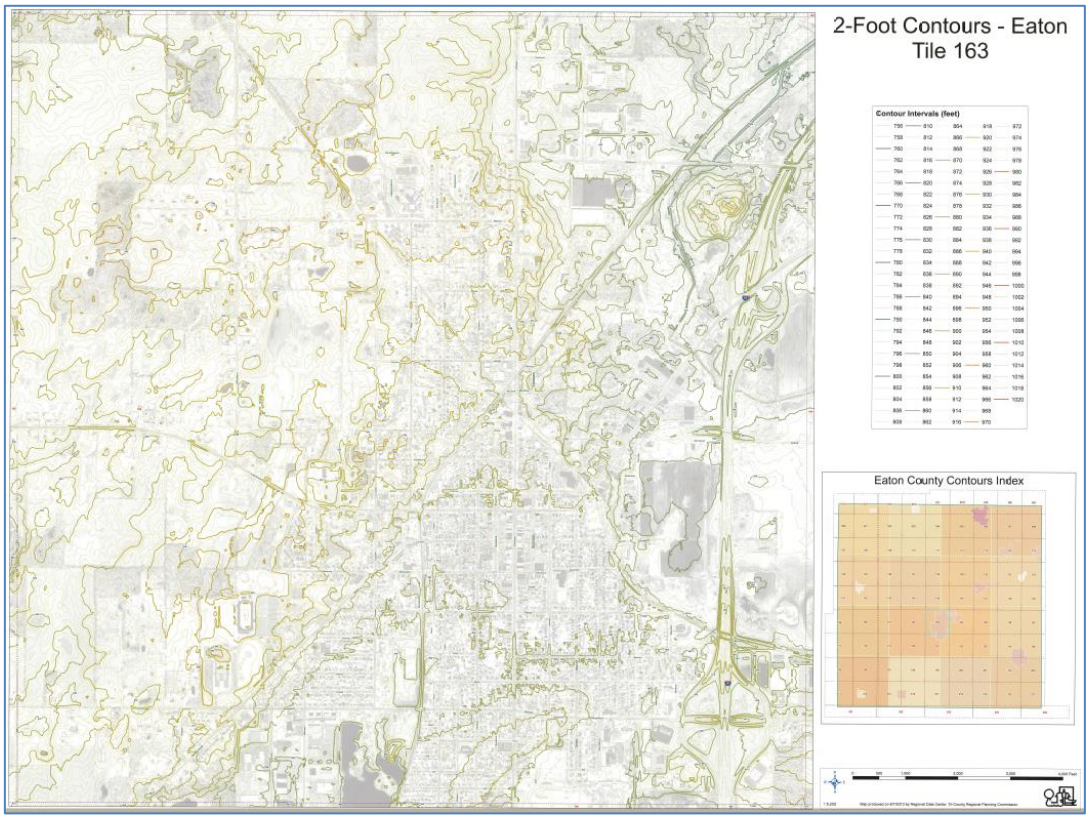
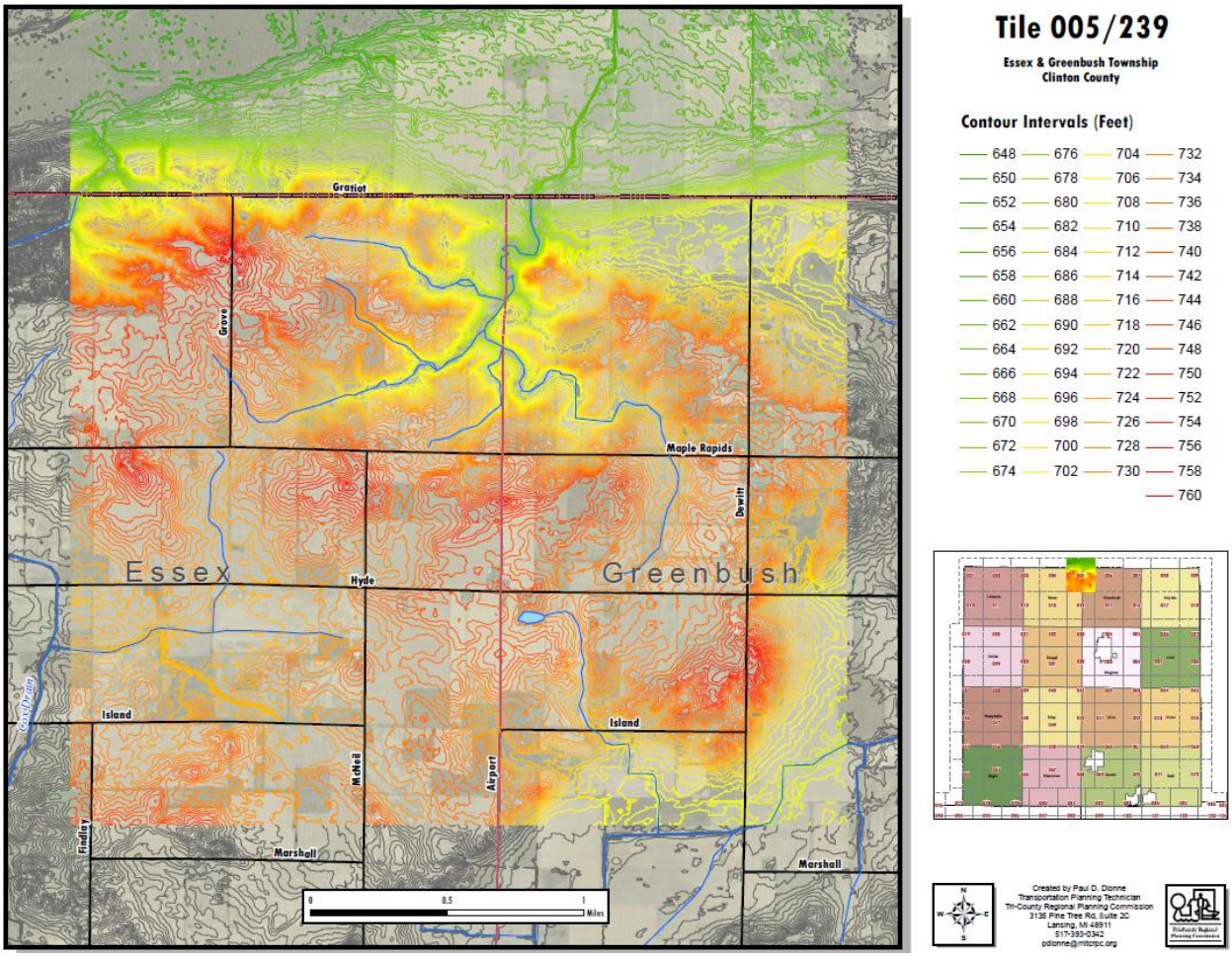


Fig. 62 North-Central Clinton County



Probability of Future Hazard Events

The probability of future hazard events within the tri-county region is calculated using storm event data provided by the National Climatic Data Center for Ingham, Clinton and Eaton Counties. Past events dating between January 1 of 2004 to August of 2014 were tallied and divided by the 10.5 years within that period. The Figure below depicts the probability of each event occurring per year in each county. Thunderstorms and Wind have the most probability of occurring the most during any given year throughout the region, followed by hail and winter storms.

Fig. 63 Probability of Future Hazard Events

	Heavy Snow	Winter Storm	Tornado	Flood	TStorm Wind	Hail	High Wind	Ice Storm	Blizzard	Funnel Cloud
Clinton	1	1.14	0.2	0.3	3.4	2.6	2	1		
Eaton	1	1.5	0.4	0.5	4	2	0.6	0.2	0.1	0.1
Ingham	0.1	1.5	0.4	0.4	5.5	2.1	0.7	0.1		

Past Disaster Declarations
Presidential and Governor Declarations between 2013 and 2003 are as follows for Clinton, Eaton, Ingham Counties and Delta Charter Township. Most recently, both Eaton and Ingham Counties were declared a major disaster in June of 2008 for thunderstorms and flooding. Notable declarations include flooding, Hurricane Katrina Evacuation declarations and Emerald Ash Borer declarations.

Fig. 64 Past Presidential & Governor's Disaster Declarations

Presidential Declarations		
Event/Date	**Jurisdiction**	**Type**
Thunderstorm/Flooding July 2008	Eaton & Ingham Counties	Major Disaster (4121)
Thunderstorm/Flooding May/June 2008	Eaton & Ingham Counties	Major Disaster (1527)
Hurricane Katrina Evacuation Area September 2005	All counties	Emergency (3225)
Electric Power Failure August 2003	Eaton & Ingham Counties	Emergency (3189)
Governor's Declarations		
Event/Date	**Jurisdiction**	**Type**
Thunderstorms/June 2008	Eaton County	Emergency
Hurricane Evacuation/ Sept 2004	All Counties	Disaster
Thunderstorms/Flooding June 2004	Ingham County	Disaster
Insect Infestation (Ash Borer) April 2004	Ingham County	Emergency
		Source: 2014 MHMP

Vulnerabilities within Participating Jurisdictions

The seventeen participating jurisdictions were contacted and interviewed about the potential hazards facing their communities and special projects that they are planning or implementing. The following communities responded with their hazard priorities and mitigation ideas.

Clinton County

Dallas Township- The Clinton County Drain Commissioner is currently in receipt of a petition to address repetitive urban flooding concerns for homes and streets located along the Waltz and Sturgis Drain in the Village of Fowler, in Dallas Township, MI. A Board of Determination has been held as required under the Drain Code and a project was found necessary to address the identified flooding problems and assess the contributing drainage district.

Based on conversations with the local Director of Public Works and testimony given at the Board of Determination, 15 homes are affected by the multiple floods that have occurred in the last several years. The objective of any proposed projects is to mitigate flood damage and reduce vulnerability to existing roads and structures. The proposed strategy is implementation of storm water management practices such as construction detention basins and replacement of undersized culverts with the goal to reduce the depth, duration, and frequency of flooding along the Waltz and Sturgis Drain.

The project reduces physical damages and potential for injury/loss of life by attenuating peak runoff discharges and increasing the conveyance through undersized culverts along 6th Street, Maple Street, 5th Street, 4th Street, and Sorrell Street within the Village of Fowler. There will be a reduction in depth, duration, and frequency of flooding of homes and streets that are adjacent to and downstream of the Waltz & Sturgis Drain due to the detention provided in the upper watershed. The proposed project will also serve to collect deposited sediments carried from upstream which will improve water quality within the Waltz and Sturgis Drain downstream of the proposed improvements. Constructing the detention basin will also serve to repair and restore location of exsiting sever gully erosion that contribute excessive sediment downstream.

DeWitt and Bath Charter Townships

Residents in both DeWitt and Bath Charter Townships face tornado, high winds and localized flooding on a semi-regular basis. They are planning for public outreach/education related to these hazards.

City of St. Johns

According to City officials, St Johns' past experience with hazards have been with high winds, snow/thaw/rain events. The City instituted an aggressive plan to remove and trim any dangerous trees in the public right of way beginning six years ago. This action was initiated by a DNR grant to have all trees in the ROW cataloged to its condition therefore establishing an action plan which is still ongoing today. St Johns acquired a DEQ grant to study a specific area in the City prone to flooding and have initiated an action plan and committed $500,000 for an engineered fix.

Eaton County

Cities of Charlotte and Eaton Rapids

According to City staff, the natural hazards most likely to pose the largest threat to life and property within these Cities would be severe weather in the form of winter snow and ice, as well as severe thunderstorms and tornadoes. Flooding is also an issue in Eaton Rapids. The new and future projects that might mitigate the impacts of these natural hazards include a newly-enacted sidewalk snow removal ordinance requiring all residents to clear walks of snow and ice, as well as a planned future upgrade to the city's tornado warning siren system and flood mitigation activities.

City of Grand Ledge
City officials report that they are most concerned with tornadoes, and that they are beginning to plan for education and mitigation efforts related to tornadoes.

Ingham County

City of Mason
According to City staff, natural hazards most likely to impact their residents would be tornadoes, ice storms and blizzards. Also heavy winds. The City is attempting to update their policies, training and identify equipment that would assist them to be sustaining for a level of self-sufficiency necessary to assist citizens during these types of events.

Village of Webberville
According to Village Officials, Tornadoes are a natural hazard that they do not have any plans to mitigate. Flooding is also an issue. The Village has turned local storm drains over to the Ingham County Drain Commissioner's Office and they are beginning a repair/replace project. They are in the planning stages now. The location of their industrial park on the outer edge of the populated area and the adjacent rail and highway interchange are well structured for emergency responses.

Village of Dansville
According to Village officials, the one square mile size of Dansville does not offer much in the way of hazards. The typical hazards that are identified within the plan for the entire Ingham County are those faced by Dansville. No special projects to mitigate hazards are underway currently.

Meridian Charter Township/Williamstown Township/Lansing Charter Township
According to staff, natural hazards most likely to impact their residents would be tornadoes, flooding, ice storms and blizzards and heavy winds. These jurisdictions are updating their policies, training and identify equipment that would assist them to be sustaining for a level of self-sufficiency necessary to assist citizens during these types of events.

Civil Disturbances
Hazard Description - A public demonstration or gathering, or a prison uprising, that results in a disruption of essential functions, rioting, looting, arson or other unlawful behavior.

Large-scale civil disturbances rarely occur. But when they do, they are usually a result of one or more of the following events: 1) labor disputes where there is a high degree of animosity between the participating parties; 2) high profile/controversial judicial proceedings; 3) the implementation of controversial laws or other governmental actions;

4) resource shortages caused by a catastrophic event; 5) disagreements between special interest groups over a particular issue or cause; 6) a perceived unjust death or injury to a person held in high esteem or regard by a particular segment of society.

Fig. 65 T-Shirt Graphic

Source: TCRPC

Mid-Michigan has few large crime events. There have been no recent distinctive or notable changes in crime patterns region wide. There are relatively few serious crimes and no notable trends or changes in serious crime patterns region wide. There were notable civil disobedience events, particularly related to Michigan State University (MSU) sports events. In March of 1999, a melee following a national championship sports game lasted for several hours before it was stopped by a multi-jurisdictional police force in East Lansing. Property damage exceeded $250,000 and over 130 people were arrested. Smaller types of these incidences occur most years during the college basketball and football seasons. But recent year incidents have been smaller and strongly controlled. Regional police and emergency services have worked with MSU to develop pro-active and effective approaches to reducing and mitigating the damage of such events with good success.

Hazardous Material Incidents

Fixed Site Hazardous Material Incidents (explosions and industrial accidents)
Hazard Description - An uncontrolled release of hazardous materials from a fixed site capable of posing a risk to life, health, safety, property or the environment. Hazardous materials are highly regulated by federal and state agencies to reduce risk to the public and the environment. Despite precautions taken to ensure careful handling during the manufacture, transport, storage, use and disposal of these materials, accidental releases do occur. Often, these releases can cause severe harm to people or the environment if proper mitigation action is not immediately taken. Most releases are the result of human error. Occasionally, releases are attributed to natural causes, such as a flood that washes away barrels of chemicals stored at a site. However, those situations are the exception rather than the rule.

Hazardous materials are materials or substances that, because of their chemical, physical, or biological nature, pose a potential risk to life, health, property, or the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers and dangerous gasses.

Industrial Accident

Hazard Description - A fire, explosion, or other severe accident involving hazardous materials at an industrial facility that results in serious property damage, injury, or loss of life. Industrial accidents differ from hazardous material incidents in the scope and magnitude of offsite impacts. Whereas 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. Nonetheless, industrial accidents such as fires, explosions and excessive exposure to hazardous materials, may cause injury or loss of life to the workers at the facility, and significant property damage. In addition, 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.

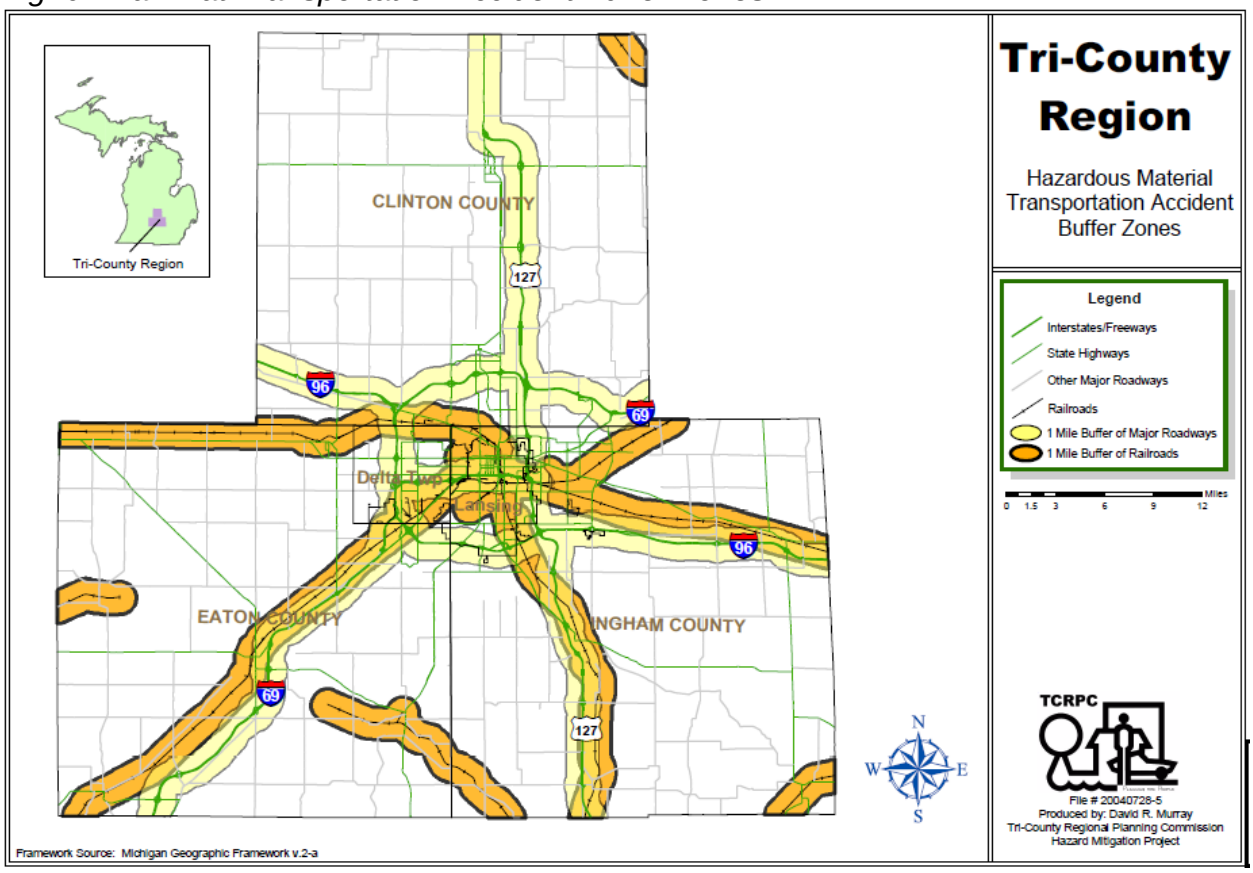
Hazardous Material Transportation Incidents

Hazard Description - An uncontrolled release of hazardous materials during transport capable of posing a risk to life, health, safety, property or the environment. Because of the extensive use of chemicals in our society, all modes of transportation – highway, rail, air, marine and pipeline – are carrying thousands of hazardous materials 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. Note: Many of the programs and initiatives designed to mitigate, prepare for, respond to, and recover from fixed- site hazardous material incidents have the dual purpose of also protecting against hazardous material transportation incidents. Consequently, there is some overlap in the narrative programs and initiatives descriptions for each respective hazard.

Fig. 66 The Potterville Train Derailment, 2002, Source: MSP

Occasional events do happen in the tri-county region every few years, and require some expensive resources to respond to, even though the situations can usually be resolved within a few days. In 2002, a train derailment in the City of Potterville evacuated the residents for five consecutive days. This was the longest evacuation in Michigan history.

Fig. 67 Haz Mat Transportation Accident Buffer Zones



Oil and Natural Gas Well Accidents

Hazard Description - An uncontrolled release of oil or natural gas, or the poisonous by-product hydrogen sulfide, from production wells. Oil and natural gas are produced from fields scattered across 63 counties in the Lower Peninsula. Since 1925, over 44,000 oil and natural gas wells have been drilled in Michigan, of which roughly half have produced oil and gas. To date, Michigan wells have produced approximately 1.4 billion barrels of crude oil and 4 trillion cubic feet of gas.

Communities that may be affected by oil or natural gas well accidents should have adequate procedures in their Emergency Operations Plans to address the unique types of problems associated with this hazard, including rescue and evacuation. Affected communities must work closely with company officials and surrounding jurisdictions to ensure compatibility of procedures for a fast, coordinated response. Mitigation possibilities include the use of community zoning regulations to provide suitable 100 open, unoccupied "buffer" areas around refineries and compressor stations. Michigan

Department of Environmental Quality regulations provide for buffer zones around wells and treatment and storage facilities.

Infrastructure Failures

Hazard Description - An actual or potential shortage of electrical power, gasoline, natural gas, fuel oil, or propane of sufficient magnitude and duration to threaten public health and safety, and economic and social stabilization.

Michigan has had numerous widespread and severe electrical power outages, caused mostly by severe weather such as windstorms or ice and sleet storms. (Note: Refer to those sections for more information on specific events.) Michigan has had several power outages in recent years that left upwards of 500,000 people without power for several hours to several days at a time. Fortunately, most of those occurred in months when severe cold temperatures were not a problem. An adequate energy supply is critical to mid-Michigan's economic and social well-being. Our economy and lifestyle are dependent on a non-interrupted, reliable, and relatively inexpensive supply of energy that includes gasoline to fuel our vehicles, and electricity, natural gas, fuel oil and propane to operate our homes, businesses and public buildings. Energy emergencies became a serious national issue in the 1970s when two major "energy crises" exposed America's increasing vulnerability to long term energy disruptions.

To date, we have always dealt with short term energy disruptions caused by severe weather damage (i.e., downed power lines and poles), broken natural gas and fuel pipelines, and shortages caused by the inability of the energy market to adequately respond to consumer demand and meet required production. However, the Oil Embargo of 1973-74, the natural gas shortage of 1976-77, and the 1979 major price increases in oil resulting from the Iranian Revolution rendered the County highly vulnerable to energy disruptions. That vulnerability was again exposed during the Gulf War in 1991 (after Iraq invaded Kuwait and destroyed many of its oil fields) and in the aftermath of the September 11, 2001 terrorist attacks in the U.S.

The power outage of August 14, 2003 started affecting Michigan at 4:09 p.m. when power surges affected southern Ohio, west to Indiana, north to western Michigan, east to the Detroit area, and south to northern Ohio. By 4:15 p.m., the power outage was essentially complete, with 2.3 million customers of Consumers Energy, Lansing BWL, and Detroit Edison without power. The area affected in Michigan was all of the Detroit Edison service territory, Consumers Energy customers located near the Detroit Edison service territory, and the cities of Lansing and East Lansing and other areas served by the Lansing BWL. At 10:00 p.m., Consumers Energy reported that 118,400 customers were without power.

In November of 2013, wind storms across the tri-county region brought down trees and power lines, knocking out power to residents for up to 3 days. Then, when the debris was still being collected and managed, a huge winter ice storm the week before

Christmas, brought down trees and wires and caused long term, widespread power loss which lasted from days to more than a week.

Public Health Emergencies

Hazard Description - 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. Public health emergencies can take many forms – disease epidemics, large-scale incidents of food or water contamination, extended periods without adequate water and sewer services, harmful exposure to chemical, radiological or biological agents, and large-scale infestations of disease-carrying insects or rodents – to name just a few. Public health emergencies can occur as primary events by themselves, or they may be secondary events to another disaster or emergency such as a flood, tornado or hazardous material incident. The common characteristic of most public health emergencies is that they adversely affect, 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.

One of Michigan's most serious emergencies occurred in 1973 when a local farmer fed PBB laced feed to his dairy herd. Michigan Chemical Corporation had accidentally supplied the Michigan Farm Bureau Services with sacks of fire-proofing chemical PBB, which is known to cause cancer, genetic mutation, and birth defects -- and the PBB was inadvertently substituted for magnesium oxide (commonly used in antacid tablets used for human consumption) in a custom dairy feed # 402. During the crucial eight-month period between the farmer's first observations and the discovery of the accident, serious contamination had already occurred.

By 1975 the state had quarantined more than 500 farms. Condemned for slaughter were more than 17,000 cattle; 3,415 hogs; 1.5 million chickens and 4.8 million eggs.
In the 1980s, the state health department confirmed that 95 percent of Michigan's population had PBB in their bodies from eating beef, drinking milk or consuming other products from contaminated farms. A cancer epidemic was feared. Although one has not occurred been diagnosed yet. Studies do show the most exposed families have increased breast and digestive cancer, and lymphoma. Among the effects observed in the exposed populations the daughters of the most highly exposed women began menstruation, on average, before they reached their twelfth birthdays.

The world's worst influenza pandemic – the "Spanish flu" of 1918-19 – resulted in 500,000-675,000 deaths in the United States and 20 to 40 million worldwide. More than 25 million Americans – nearly one quarter of the population at the time – fell ill. Scientists speculate that the virus that caused that pandemic may have percolated for several years within humans, or possibly pigs, until it grew strong enough to kill millions worldwide. The virus spread rapidly – moving around the world in a matter of a few months – in a time period in which there was much less movement of people than there is today. The virus reached Michigan in the fall of 1918. Over 8,000 of the 2.8 million state residents fell ill and half of those eventually succumbed to the disease. In retrospect, the spread of the illness was felt to be exacerbated by behavior of important

officials who had misguided concerns that the effects of “panic” might be more harmful than the disease itself—a notion that proved disastrous. The pandemic had an unusual aspect, however, in that many of those who died were persons who had been young and healthy, whereas the normal pattern for influenza deaths is to take a higher toll among those who are elderly or have compromised immune systems.

In December 2003, there were reports that Bovine spongiform encephalopathy (BSE), or "Mad Cow Disease" was struck the United States. BSE is linked to a similar form of the incurable and fatal brain-wasting disease in humans, called variant Creutzfeldt-Jakob Disease (VCDJ). There have been a small number of VCJD cases reported worldwide of people who ate BSE-contaminated meat. Within hours of the announcement, an official with Japan's agriculture ministry told CNN that his country would ban imports of U.S. beef. South Korea, Taiwan, Malaysia and Singapore, Mexico and others followed suit within hours of the announcement. News of an outbreak in mid-Michigan would likely cause great fear and panic and affect dairy farmers and milk producers as well as area beef cattle operators.

At least 144 adult patients were admitted to 10 academic and community hospitals in the greater Toronto, Ontario, area between March 7 and April 10, 2003. 1,700 students and staff at Father Michael McGivney Catholic Academy in Markham, a northern suburb of Toronto, were quarantined, where a student showed symptoms of SARS while going to classes for three days last week. Health officials closed the school until June 3. The majority of cases in the SARS outbreak in the greater Toronto area were related to hospital exposure.

The December 2003 reports that Michigan health officials were introduced to the emerging health threats posed by foot-and-mouth disease and the West Nile encephalitis virus caused widespread concern. Although foot-and-mouth disease is a highly contagious disease that only affects animals, a widespread outbreak such as occurred in parts of the United Kingdom in 2001 could have significant public health implications due to the potentially large numbers of dead animal carcasses to be disposed of. The West Nile encephalitis virus, which arrived in Michigan in August 2001, presents an equally challenging scenario for public health officials. Transmitted to humans by infected mosquitoes, the West Nile virus is common in Africa, Asia, and the Middle East. Health officials do not know how the virus was introduced to the United States. But in 1999 and 2000, it caused outbreaks of human encephalitis in New York raised fears across the country of a full-blown public health emergency. Fortunately that has not occurred, although the New York City outbreak did cause 62 persons to fall ill and resulted in 7 deaths. Real or perceived outbreaks of communicable diseases in or around the tri-county area would adversely affect trade, tourism, travel (e.g.: College/University students), and health.

Enough potential threats exist that some type of public health emergency tends to affect the county every couple of years (although some threats, such as influenza, occur annually) throughout the whole area. Medical impacts upon the county’s population are usually significant, but in a serious pandemic event, could become catastrophic.

Chapter 4 - Mitigation Strategies and Plan Implementation

The following strategies are projects or processes that will lessen the community's vulnerability to hazards. Mitigation strategies result from a process that identifies actions intended to meet the objectives and goals that have been set for the community. Mitigation strategies must present actions that are equitable to the community, technically possible, that do not harm the environment and that are economically feasible.

The impacts of a hazard can produce significant economic losses besides property damage that are difficult to measure. Economic losses may take time to spread entirely through a community and linger long after the actual disaster event. Government and business alike can experience economic hardships that eventually impact residents and other government functions or businesses in the community. A simple example of these longer-term losses is the accumulated cost of a winter when above average snow and ice removal is required. The additional funding required to remove the snow is taken from other programs or budget items, resulting in a potential loss or reduction of a services, employees, or other benefit to the local community.

The alternatives and actions listed in this updated Plan are the outcomes of discussions with county emergency managers and community agency partners over the project period. The alternatives offered are based on the locally available resources, funding, and the capacity of personnel in our region. The actions are also based on changes to local land use changes over time. Finally, the mitigation alternatives for our region are very much the same now as they were in the previous adopted Plan. Various actions were completed since 2005, such as the distribution of weather radios to residents, the adoption of low –impact development regulations across the region, and public service announcements pertaining to emergency preparedness. The TCRPC made every effort to ensure that actions can be accomplished and that they will reduce vulnerability. The implementable or practical nature of these alternatives is largely determined by the financial and personnel commitment of area residents and officials, the commitments of other resources, and a function of the benefits provided to the community.

Mitigation Alternatives

Following guidance of the Michigan Hazard Mitigation Plan, this section lists an array of hazard mitigation alternatives. Some alternatives, such as zoning decisions, are more appropriate for local implementation. Other alternatives, such as legislation, are more appropriate for implementation by state government. Some alternatives may involve the participation of multiple actors at different levels (local, state, and federal; public, private, and non-profit). An example of such a hazard mitigation idea could be an improvement in a local community's drainage infrastructure that obtains federal grant funds administered by a state agency and makes use of matching funds from a local community foundation, while providing benefits to downstream areas in the watershed region as well. Actions are presented here in order of hazard type.

Weather Hazards

Thunderstorm Hazards (General)

- Increased coverage and use of NOAA Weather Radio.
- Public early warning systems and networks.
- Tree trimming and maintenance to prevent limb breakage and safeguard nearby utility lines. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of-way.)
- Buried/protected power and utility lines. (NOTE: Where appropriate. Burial may cause additional problems and costs in case of breakage, due to the increased difficulty in locating and repairing the problem.)

Hail-specific (in addition to the General Thunderstorm Hazards list)

- Moving vehicles into garages or other covered areas.
- Inclusion of safety strategies for severe weather events in driver education classes and materials.
- Purchase of insurance that includes coverage for hail damage.
- Using structural bracing, window shutters, laminated glass in window panes, and impact-resistant roof shingles to minimize damage to public and private structures.

Lightning-specific (in addition to the General Thunderstorm Hazards list)

- Using surge protectors on critical electronic equipment.
- Installing lightning protection devices on the community's communications infrastructure.

Severe Winds and Tornadoes (in addition to the General Thunderstorm Hazards)

- Using appropriate wind engineering measures and construction techniques (e.g. structural bracing, straps and clips, anchor bolts, laminated or impact-resistant glass, reinforced entry and garage doors, window shutters, waterproof adhesive sealing strips, and interlocking roof shingles) to strengthen public and private structures against severe wind damage.
- Proper anchoring of manufactured homes and exterior structures such as carports and porches.
- Securing loose materials, yard, and patio items indoors or where winds cannot blow them about.
- Construction of concrete safe rooms in homes and shelter areas in mobile home parks, fairgrounds, shopping malls, or other vulnerable public areas.

Winter Weather Hazards (General)

- Increased coverage and use of NOAA Weather Radio.
- Tree trimming and maintenance to prevent limb breakage and safeguard nearby utility lines. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of-way.)

- Buried/protected power and utility lines, where appropriate.
- Establishing heating centers/shelters for vulnerable populations.

Ice and Sleet Storms (in addition to the General Winter Weather Hazards list)

- Home and public building design and maintenance to prevent roof and wall damage from "ice dams."

Snowstorms (in addition to the General Winter Weather Hazards list)

- Proper building/site design and code enforcement relating to snow loads, roof slope, snow removal and storage, etc.
- Agricultural activities to reduce impacts on crops and livestock.
- Pre-arranging for shelters for stranded motorists/travelers, and others.
- Using snow fences or "living snow fences" (rows of trees or vegetation) to limit blowing and drifting of snow over critical roadway segments.

Extreme Temperatures

- Organizing outreach to vulnerable populations during periods of extreme temperatures, including establishing and building awareness of accessible heating and/or cooling centers in the community, and other public information
- Campaigns about this hazard.
- Increased coverage and use of NOAA Weather Radio.

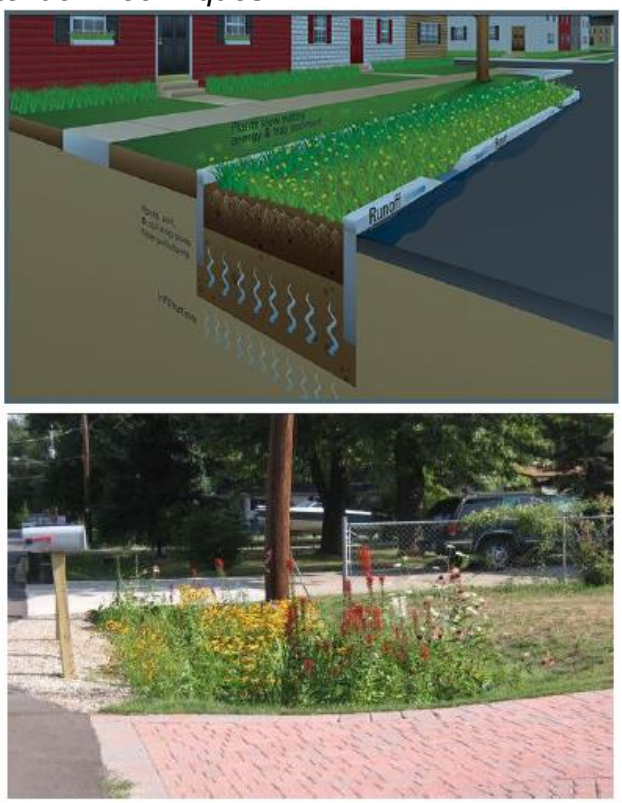
Hydrological Hazards

Riverine, Shoreline, and Urban Flooding

- Flood plain and coastal zone management – planning acceptable uses for areas prone to flooding (through comprehensive planning, code enforcement, zoning, open space requirements, subdivision regulations, land use and capital improvements planning) and involving drain commissioners, hydrologic studies, etc. in these analyses and decisions.
- Acceptable land use densities, coverage and planning for particular soil types and topography (decreasing amount of impermeable ground coverage in upland and drainage areas, zoning and open space requirements suited to the capacity of soils and drainage systems to absorb rainwater runoff, appropriate land use and capital improvements planning) and involving drain commissioners, hydrologic studies, etc. in these analyses and decisions.
- Dry flood proofing of structures within known flood areas (strengthening walls, sealing openings, use of waterproof compounds or plastic sheeting on walls).
- Wet flood proofing of structures (controlled flooding of structures to balance water forces and discourage structural collapse during floods).
- Elevation of flood-prone structures above the 100-year flood level.
- “Floating” architectural designs for structures in flood-prone areas
- Construction of elevated or alternative roads that are unaffected by flooding, or making roads more flood-resistant through better drainage and/or stabilization/armoring of vulnerable shoulders and embankments.

- Government acquisition, relocation, or condemnation of structures within floodplain or floodway areas.
- Employing techniques of erosion control within the watershed area (proper bank stabilization, techniques such as planting of vegetation on slopes, creation of terraces on hillsides, use of riprap boulders and geotextile fabric, etc.).
- Protection (or restoration) of wetlands and natural water retention areas.
- Obtaining insurance. (Requires community participation in the NFIP.)
- Joining the National Flood Insurance Program (NFIP).
- Participation in the Community Rating System (CRS).
- Structural projects to channel water away from people and property (dikes, levees, floodwalls) or to increase drainage or absorption capacities (spillways, water detention and retention basins, relief drains, drain widening/dredging or rerouting, debris detention basins, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, wetlands protection and restoration).
- Higher engineering standards for drain and sewer capacity, or the expansion of infrastructure to higher capacity.
- Drainage easements (allowing the planned and regulated public use of privately owned land for temporary water retention and drainage).
- Installing (or re-routing or increasing the capacity of) storm drainage systems, including the separation of storm and sanitary sewage systems.
- Farmland and open space preservation.
- Elevating mechanical and utility devices above expected flood levels.
- Flood warning systems and the monitoring of water levels with stream gauges and trained monitors.
- Increased coverage and use of NOAA Weather Radio.
- Anchoring of manufactured homes to a permanent foundation in flood areas, but preferably these structures would be readily movable if necessary or else permanently relocated outside of flood-prone areas and erosion areas.
- Control and securing of debris, yard items, or stored objects (including oil, gasoline, and propane tanks, and paint and chemical barrels) in floodplains that may be swept away, damaged, or pose a hazard when flooding occurs.
- Back-up generators for pumping and lift stations in sanitary sewer systems, and other measures (alarms, meters, remote controls, switchgear upgrades) to ensure that drainage infrastructure is not impeded.
- Detection and prevention/discouragement of illegal discharges into storm-water sewer systems, from home footing drains, downspouts and sump pumps.
- Employing techniques of erosion control in the area (bank stabilization, planting of vegetation on slopes, creation of terraces on hillsides).

Fig 68 Stormwater Retention Techniques



Source: EPA

Fig. 69 Flood Preparation

Source; TCRPC

- Increasing the function and capacity of sewage lift stations and treatment plants (installation, expansion, and maintenance), including possible separation of combined storm/sanitary sewer systems, if appropriate.
- Purchase or transfer of development rights – to discourage development in floodplain areas.

- Stormwater management ordinances or amendments.
- Wetlands protection regulations and policies.
- Use of check valves, sump pumps and backflow preventers in homes and buildings.

Dam Failures

- Regular inspection and maintenance of dams.
- Garnering community support for a funding mechanism to assist dam owners in the removal or repair of dams in disrepair.
- Regulate development in the dam's hydraulic shadow (where flooding would occur if a severe dam failure occurred).
- Ensuring that dams meet or exceed the design criteria required by law.
- Public warning systems.
- Obtaining insurance.
- Increased coverage and use of NOAA Weather Radio
- Increased funding for dam inspections and enforcement of the Dam Safety Program (Part 315 of the Natural Resources and Environmental Protection Act) requirements and goals.
- Constructing emergency access roads to dams, where needed.
- Pump and flood gate installation/automation.

Drought

- Storage of water for use in drought events (especially for human needs during periods of extreme temperatures, and for responding to structural fire and wildfire events).
- Legislative acts, local ordinances, and other measures to prioritize or control water use.
- Encouragement of water-saving measures by consumers (including landscaping, irrigation, farming, and low priority lawn maintenance and non-essential auto washing).
- Anticipation of potential drought conditions, and the preparation of drought contingency plans.
- Designs, for recreational and other water-related structures and land uses, that take into account the full range of water levels (of lakes, streams, and groundwater).
- Designs and plans for water delivery systems that include a consideration of drought events.
- Obtaining agricultural insurance.

Invasive Species

- Restrictions on the import and transport of species carriers.
- Adjustments to hunting, fishing, and other policies and regulations related to wildlife populations.
- Use of barriers to prevent invasive species travel.
- Use of competing species or other population control techniques.

Geological Hazards

Earthquakes – The greatest threats of earthquakes in our region would be damage to pipelines, buildings that are poorly designed or constructed, the shelving, furniture, mirrors, gas cylinders, etc. within structures that could fall and cause injury or personal property damage)

- Adopt and enforce appropriate building codes.
- Use of safe interior designs and furniture arrangements.
- Obtain insurance.
- "Harden" critical infrastructure systems to meet seismic design standards for "lifelines."

Subsidence

- Identifying and mapping old mining areas and geologically unstable terrain, and limiting or preventing development in high-risk areas.
- Filling or buttressing subterranean open spaces (such as abandoned mines) to discourage their collapse.
- Hydrological monitoring of groundwater levels in subsidence-prone areas.
- Insurance coverage for subsidence hazards.
- Real estate disclosure laws.

Technological Hazards

Structural Fires

- Code existence and enforcement.
- Designs that include the use of firewalls and sprinkler systems (especially in tall buildings, dormitories, attached structures, and special facilities).
- Landlords and families can install and maintain smoke detectors and fire extinguishers. Install a smoke alarm on each level of homes (to be tested monthly, with the batteries changed twice each year). Family members and residents should know how to use a fire extinguisher.
- Proper installation and maintenance of heating systems (especially those requiring regular cleaning, those using hand-loaded fuels such as wood, or using concentrated fuels such as liquid propane).
- Safe use and maintenance/cleaning of fireplaces and chimneys (with the use of spark arresters and proper storage of flammable items). Residents should inspect chimneys at least twice a year and clean them at least once a year.
- Safe installation, maintenance, and use of electrical outlets and wiring.
- Measures to reduce urban blight and associated arson (possibly including Crime Prevention through Environmental Design).
- Defensible space around structures in fire-prone wildland areas.
- Proper maintenance of power lines, and efficient response to fallen power lines.
- Transportation planning that provides roads, overpasses, etc. to maximize access and improve emergency response times to all inhabited or developed areas of a community. (Not just planning for average traffic volumes in the community.)

- Discourage civil disturbances and criminal activities that could lead to arson.
- Enforced fireworks regulations.
- Elimination of clandestine methamphetamine laboratories through law enforcement and public education.
- Condominium-type associations for maintaining safety in attached housing/building units or multi-unit structures.
- Obtaining insurance.

Fixed Site Hazardous Material Incidents (including explosions and industrial accidents)

- Compliance with/enforcement of Resource Conservation and Recovery Act (RCRA) standards.
- Elimination of clandestine methamphetamine laboratories through law enforcement and public education.
- Identification of radioactive soils and high-radon areas
- Proper separation and buffering between industrial areas and other land uses.
- Location of industrial areas away from schools, nursing homes, etc.
- Public warning systems and networks for hazardous material releases.
- Increased coverage and use of NOAA Weather Radio (which can provide notification to the community during any period of emergency, including large scale hazardous material incidents).
- Compliance with all industrial, fire, and safety regulations.
- Insurance coverage.
- Enhanced security and anti-terrorist/sabotage/civil disturbance measures.

Hazardous Material Transportation Incidents

- Improved design, routing, and traffic control at problem roadway areas.
- Long-term planning that provides more connector roads for reduced congestion of arterial roads.
- Railroad inspections, maintenance and improved designs at problem railway/roadway intersections (at grade crossings, rural signs/signals for RR crossing).
- Proper planning, design, maintenance of, and enhancements to designated truck routes.
- Public warning systems and networks.
- Increased coverage and use of NOAA Weather Radio (which can provide notification to the community during any period of emergency, including large scale hazardous material incidents).
- Use of ITS (intelligent transportation systems) technology.
- Locating schools, nursing homes, and other special facilities away from major hazardous material transportation routes.

Pipeline Accidents (Petroleum and Natural Gas)

- Locating pipelines away from dense development, critical facilities, special needs populations, and environmentally vulnerable areas whenever possible.

- Increasing public awareness and widespread use of the "MISS DIG" utility damage prevention service (800-482-7171).
- Proper pipeline design, construction, maintenance and inspection.

Oil and Natural Gas Well Accidents

- Using buffer strips to segregate wells, storage tanks, and other production facilities from transportation routes and adjacent land uses, in accordance with state regulations, and consistent with the level of risk.
- Adherence to all regulations and best industry practices, especially for relatively new techniques of hydraulic fracturing, in order to preserve Michigan's environmental quality and public confidence in the industry.

Infrastructure Hazards

Infrastructure Failures

- Proper location, design, and maintenance of water and sewer systems (to include insulation of critical components to prevent damage from ground freeze).
- Burying electrical and phone lines, where beneficial and appropriate, to resist damage from severe winds, lightning, ice, and other hazards.
- Redundancies in utility and communications systems, especially "lifeline" systems; to increase resilience (even if at the cost of some efficiency).
- Separation and/or expansion of sewer system to handle anticipated stormwater volumes.
- Use of generators for backup power at critical facilities.
- "Rolling blackouts" in electrical systems that will otherwise fail completely due to overloading.
- Replacement or renovation of aging structures and equipment (to be made as hazard-resistant as economically possible).
- Physical protection of electrical and communications systems from lightning strikes.
- Tree-trimming programs to protect utility wires from falling branches. (Ideal: Establishment of a community forestry program with a main goal of creating and maintaining a disaster-resistant landscape in public rights-of way.)
- Increasing public awareness and widespread use of the "MISS DIG" utility damage prevention service (800-482-7171).

Energy Emergencies

- Redundancies and alternatives in the energy supply system; provision of backup supply systems.
- The capacity to use more than one type of fuel to sustain necessary operations and functions.
- Use of alternative sources of energy (e.g. solar, wind sources) for key functions.
- Architectural designs that reduce the need for outside energy inputs.

Transportation Accidents

- Improved design, routing, and traffic control at problem roadway areas.

- Railroad inspections and improved designs at problem railway/roadway intersections (at grade crossings, rural signs/signals for RR crossing).
- Long-term planning that provides more connector roads for reduced congestion of arterial roads.
- Use of designated truck routes.
- Use of ITS (intelligent transportation systems) technology.
- Airport maintenance, security, and safety programs.

Human Related Hazards

Civil Disturbances (prison or institutional rebellions, disruptive political gatherings, violent labor disputes, urban protests or riots, or large-scale uncontrolled festivities)

- Some suggest that design, management, integration, and lowered density of poor or blighted areas will reduce vandalism, crime, and some types of riot events. Crime Prevention Through Environmental Design (CPTED) is a field of planning that deals with this.
- Structure and property insurance in risky areas, combined with anti-arson practices.
- Design requirements for schools, factories, office buildings, shopping malls, hospitals, correctional facilities, stadiums, recreation areas, etc. that take into consideration emergency and security needs.

Public Health Emergencies

- Immunization programs to vaccinate against communicable diseases.
- Improving ventilation techniques in areas, facilities, or vehicles that are prone to crowding, or that may involve exposure to contagion or noxious atmospheres.
- Radon detection and abatement activities, to reduce concentrations of radon in homes and buildings.
- Maintaining community water and sewer infrastructure at acceptable operating standards.
- Providing back-up generators for water and wastewater treatment facilities to maintain acceptable operating levels during power failures.
- Demolition and clearance of vacant condemned structures to prevent rodent infestations.
- Free or reduced-expense community clinics and school health services.
- Brownfield and urban blight clean-up activities.
- Proper location, installation, cleaning, monitoring, and maintenance of septic tanks.
- Separation of storm and sanitary sewer systems.

Terrorism and Similar Criminal Activities

- Using laminated glass and other hazard-resistant, durable construction techniques in public buildings and critical facilities.
- Establishing avenues of reporting (and rewards) for information preventing terrorist incidents and sabotage.
- Consistent use of computer data back-up systems and anti-virus software.

Implementation of 2004 Adopted Actions

In 2004, Clinton, Eaton Ingham Counties and Delta Charter Township adopted mitigation strategies to address their natural hazards. This section presents a review of mitigation activities completed since 2004 by each jurisdiction. In the 2015 Plan Update, many of these mitigation activities were review and revisited, and adjusted to reflect present-day hazard concerns. These now include protection of special needs populations, identification of gaps in response, protection from flooding, decrease infrastructure vulnerabilities, and protect against high wind damages.

Clinton County

In 2004, Clinton County identified flooding, population influx, power outages, ice storms, civil disturbances, school violence and “multi-hazards” as threats to their communities. The charts below list the proposed mitigation actions which should occur, ranging from building flood proof basements, to tree trimming, defensive architecture and the provision of disaster kits. County officials report that many of these items have been completed and /or promoted at various levels around the county including acquiring new aerial photography periodically; The four major festivals in our county plan with their respective public safety agencies; Both BWL and Consumers Energy engage in regular inspection and maintenance plans; The county supports and promotes the Do 1 Thing program which has information on preparing for power outages; Consumer’s Energy contracts out tree trimmers to maintain the safety of their lines; NOAA weather radio use is promoted via social media and other sources including Do 1 Thing; SKYWARN training is held annually; BTPD has done pre-planning for civil disturbance events; Regular EOC staff meetings, plan updates, public education, exercises, capability building and maintenance.

Flooding:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
FLD #1	Floodproof Basements				X				X				X			X			X			
FLD #2	Update FIRM Maps						X	X					X				X	X				
FLD #3	Replace to a Higher Standard				X			X					X				X		X			
FLD #4	Floodfighting Strategies						X	X						X	X				X			
FLD #5	ID of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #6	AQ of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #7	RL of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #8	Temporary Flood Protection	X	X					X	X				X				X		X			
FLD #9	Public Education					X				X				X	X				X			
FLD #10	Stakeholder Education					X				X			X		X				X			
FLD #11	Flood Signs					X				X			X		X					X		
FLD #12	Floodplain Manager						X	X	X	X	X	X	X			X			X			
FLD #13	Watershed Management			X	X			X				X		X	X				X			
FLD #14	Urban Flood Reduction				X			X					X		X			X				
FLD #15	Urban Flood Reduction Solutions				X			X					X			X			X			
FLD #16	Acquire Aerial Photography						X	X						X	X					X		
FLD #17	Bridge Survey				X			X					X		X			X				
FLD #18	Bridge Modification				X			X					X			X			X			
FLD #19	ID Temp Flood Shelters						X	X			X		X			X			X			
FLD #20	ID Temp Storage Sites						X		X				X			X			X			
FLD #21	Raise Manholes				X				X				X			X			X			
FLD #22	Increase Pump Capacity						X	X					X			X			X			
FLD #23	Wastewater Plant Floodproofing				X				X					X		X			X			
FLD #24	Flood Warning Sensors					X	X	X	X					X	X				X			

Population Influx:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
POP #1	Event Planning for Safety		X		X	X		X	X	X	X	X		X	X			X				
POP #2	Public Safety Presence					X		X	X		X			X	X			X				
POP #3	Pre-Planning and Coordination						X	X						X		X			X			
POP #4	First Aid Stations						X				X		X			X				X		

Power Outage:

		Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implementation			Project Priority			Project Evaluation *Perform in 2008*	
Project #	Project Name	Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
POW #1	Underground Utilities				X			X	X		X			X			X		X			
POW #2	Inspection and Maintainance						X	X						X	X			X				
POW #3	Tree Trimming						X	X	X		X			X		X			X			
POW #4	Public Education Re: Blackouts					X				X			X		X				X			

Ice/Sleet Storms:

		Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implementation			Project Priority			Project Evaluation *Perform in 2008*	
Project #	Project Name	Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
ICE #1	Underground Utilities				X			X	X		X			X			X		X			
ICE #2	Tree Trimming						X	X	X		X			X		X			X			
ICE #3	NOAA Weather Radio					X				X				X	X			X				
ICE #4	Storm Warning Public Education					X				X				X	X			X				

School Violence:

		Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implementation			Project Priority			Project Evaluation *Perform in 2008*	
Project #	Project Name	Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
SCH #1	Communication Systems						X	X	X		X			X	X			X				
SCH #2	On-Site Security					X		X	X		X			X		X			X			
SCH #3	Public Ed. Re: School Violence					X				X			X		X				X			
SCH #4	Oblique Aerial Photographs						X	X					X				X			X		

Civil Disturbance:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
CIV #1	Defensive Architecture				X			X	X		X			X		X			X			
CIV #2	Crime Prevent Through Env. Design				X			X	X		X		X				X			X		
CIV #3	Public Safety Presence						X	X	X		X			X	X			X				
CIV #4	Pre-Planning and Cooridination						X	X						X	X				X			

Multi-Hazards:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
MH #1	Adopt and Implement Plan						X	X	X	X	X	X	X		X			X				
MH #2	Incorporate into Local Plans						X	X	X	X	X	X	X			X		X				
MH #3	Maintain and Update Plan						X	X	X	X	X	X	X				X	X				
MH #4	Cost - Benefit Analysis						X	X					X			X			X			
MH #5	Evacuation Routes						X				X			X			X		X			
MH #6	Transportation Planning				X			X						X			X		X			
MH #7	NOAA All Hazards Radio					X				X				X		X			X			
MH #8	Enhance Data						X							X			X		X			
MH #9	Continue LEPC						X	X	X	X	X	X		X	X			X				
MH #10	Maintain EOC						X	X	X	X	X	X		X	X			X				
MH #11	Communication						X							X		X			X			
MH #12	Recordkeeping						X							X			X			X		
MH #13	Alternate Energy Sources				X			X					X				X			X		
MH #14	Special Needs Populations						X			X	X		X		X			X				
MH #15	Educational Outreach					X				X				X	X				X			
MH #16	"How To" Booth					X				X			X			X			X			
MH #17	School Mitigation Plan						X	X	X	X	X	X	X			X			X			
MH #18	Mitigation Curriculum					X	X			X			X			X			X			
MH #19	Public Service Announcements					X				X				X	X				X			
MH #20	Disaster Kit					X	X			X	X			X	X				X			

Delta Charter Township

Delta Charter Township identified flooding, hazardous materials, tornadoes, national security threats and “multi-hazards” as threats to their communities. The charts below list the proposed mitigation actions which should occur, ranging from building flood proof basements, to tree trimming, residential safe rooms and the provision of disaster kits. Township officials report that many of these items have been promoted or completed at various levels around the township.

Flooding:

		Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
Project #	Project Name	Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
FLD #1	Floodproof Basements				X				X				X			X			X			
FLD #2	Update FIRM Maps						X	X					X				X	X				
FLD #3	Replace to a Higher Standard				X			X					X				X		X			
FLD #4	Floodfighting Strategies						X	X						X	X				X			
FLD #5	ID of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #6	AQ of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #7	RL of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #8	Temporary Flood Protection	X	X					X	X				X				X		X			
FLD #9	Public Education					X				X				X	X				X			
FLD #10	Stakeholder Education					X				X			X		X				X			
FLD #11	Flood Signs					X				X			X		X					X		
FLD #12	Floodplain Manager						X	X	X	X	X	X	X			X			X			
FLD #13	Watershed Management			X	X			X				X		X	X				X			
FLD #14	Urban Flood Reduction				X			X					X		X			X				
FLD #15	Urban Flood Reduction Solutions				X			X					X			X			X			
FLD #16	Acquire Aerial Photography						X	X						X	X					X		
FLD #17	Bridge Survey				X			X					X		X			X				
FLD #18	Bridge Modification				X			X					X			X			X			
FLD #19	ID Temp Flood Shelters						X	X			X		X			X			X			
FLD #20	ID Temp Storage Sites						X		X				X			X			X			
FLD #21	Raise Manholes				X				X				X			X			X			
FLD #22	Increase Pump Capacity						X	X					X			X			X			
FLD #23	Wastewater Plant Floodproofing				X				X					X		X			X			
FLD #24	Flood Warning Sensors					X	X	X	X					X	X				X			

Hazardous Materials (Transportation –related)

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
HMT #1	Pre-Response Training						X	X						X	X			X				
HMT #2	LEPC						X	X						X	X			X				
HMT #3	Oblique Aerial Photographs						X	X					X			X				X		
HMT #4	Land Use Buffers		X	X				X			X			X			X		X			

Tornadoes:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
TRN #1	Residential Safe Rooms				X						X		X			X		X				
TRN #2	Institutional Safe Rooms / Spaces				X						X		X			X		X				
TRN #3	Free-Standing Safe Rooms				X						X		X			X		X				
TRN #4	Anchor Mobile / Temp Structures				X				X					X	X			X				
TRN #5	Bracing of Permanent Structures				X				X					X	X			X				
TRN #6	Wind Bracing For Signs				X			X					X			X				X		
TRN #7	Wind Bracing For Antennas				X			X					X			X				X		
TRN #8	Underground Utilities				X			X						X			X		X			
TRN #9	Tree Trimming						X	X	X					X	X				X			
TRN #10	Debris Management						X						X			X			X			
TRN #11	Early Warning Sirens					X		X			X			X		X			X			
TRN #12	Storm Spotters						X	X						X	X					X		
TRN #13	Storm Warning Public Education					X				X				X	X			X				
TRN #14	Severe Weather Awareness Week					X				X				X	X				X			
TRN #15	Public Storm Shelter Locations					X				X	X			X	X				X			
TRN #16	NOAA Weather Radio					X				X	X			X		X		X				

National Security Threat:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
NST #1	Public Safety Presence						X	X	X		X			X	X				X			
NST #2	Defensive Architecture				X			X	X		X			X		X			X			
NST #3	Oblique Aerial Photographs						X	X					X			X				X		
NST #4	Public Education Related to WMD					X				X				X	X			X				

Ice/Sleet Storms:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
ICE #1	Underground Utilities				X			X	X		X			X			X		X			
ICE #2	Tree Trimming						X	X	X		X			X		X			X			
ICE #3	NOAA Weather Radio					X				X				X	X			X				
ICE #4	Storm Warning Public Education					X				X				X	X			X				

Multi-Hazards:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
MH #1	Adopt and Implement Plan						X	X	X	X	X	X	X		X			X				
MH #2	Incorporate into Local Plans						X	X	X	X	X	X	X			X		X				
MH #3	Maintain and Update Plan						X	X	X	X	X	X	X				X	X				
MH #4	Cost - Benefit Analysis						X	X					X			X			X			
MH #5	Evacuation Routes						X				X			X			X		X			
MH #6	Transportation Planning				X			X						X			X		X			
MH #7	NOAA All Hazards Radio					X				X				X		X			X			
MH #8	Enhance Data						X							X			X		X			
MH #9	Continue LEPC						X	X	X	X	X	X		X	X			X				
MH #10	Maintain EOC						X	X	X	X	X	X		X	X			X				
MH #11	Communication						X							X		X			X			
MH #12	Recordkeeping						X							X			X			X		
MH #13	Alternate Energy Sources				X			X					X				X			X		
MH #14	Special Needs Populations						X			X	X		X		X			X				
MH #15	Educational Outreach					X				X				X	X				X			
MH #16	"How To" Booth					X				X			X			X			X			
MH #17	School Mitigation Plan						X	X	X	X	X	X	X			X			X			
MH #18	Mitigation Curriculum					X	X			X			X			X			X			
MH #19	Public Service Announcements					X				X				X	X				X			
MH #20	Disaster Kit					X	X			X	X			X	X				X			

Eaton County

Eaton County identified hazardous materials, dam failure, tornadoes, power outages, flooding, tornadoes and "multi-hazards" as threats to their communities. The charts below list the proposed mitigation actions which should occur, ranging from building flood proof basements, to tree trimming, bridge modifications and the provision of disaster kits. County officials report that many of these items have been promoted or completed at various levels around the County including the review of floodplain information for building permits obtained in 13 of the 16 townships and some cities and villages where the county administers the Building Code. Additionally, the Barry –Eaton District Health Department occasionally promotes disaster preparedness through their educational and marketing outreach.

For dam failures, the inspection and maintenance of dams in the county are ongoing by dam owners. A dam removal in Dimondale has addressed flooding issues in the Grand Pointe area. Power outages have been addressed by inspections and tree trimmings by

utilities and through ongoing public education with PSA's, workshops at churches, long term care and community centers. The Do1Thing program addresses this issue too. For the fixed sites and transportation of hazardous materials, the LEPC is active, responder trainings are ongoing, ortho photos were updated and assessments of materials that are moving through the county are ongoing. To address tornado hazards, a Debris Management Plan is in final form, storm spotter trainings are ongoing, early warning software is being used by school officials and responders, NOAA weather radios were provided to every school and governmental building in the county, along with day cares and senior centers. Preparedness campaigns and "Awareness Weeks" are ongoing.

Hazardous Materials (Fixed Site):

		Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
Project #	Project Name	Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
HMF #1	Enhance Pre-Planning						X	X						X	X			X				
HMF #2	Pre-Response Training						X	X						X	X			X				
HMF #3	LEPC						X	X						X	X			X				
HMF #4	Oblique Aerial Photographs						X	X					X			X				X		
HMF #5	Land Use Buffers		X	X				X			X			X			X		X			
HMF #6	Containment				X			X				X		X		X			X			

Dam failure:

		Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
Project #	Project Name	Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
DAM #1	Replace to Higher Standard	X			X			X					X				X	X				
DAM #2	Inspection and Maintenance						X	X	X					X	X				X			
DAM #3	Dam Survey						X	X					X			X			X			
DAM #4	Dam Breach Sensors				X	X	X		X	X	X		X				X			X		

Power outage:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
POW #1	Underground Utilities				X			X	X		X			X			X		X			
POW #2	Inspection and Maintainance						X	X						X	X			X				
POW #3	Tree Trimming						X	X	X		X			X		X			X			
POW #4	Public Education Re: Blackouts					X				X			X		X				X			

Flooding:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
FLD #1	Floodproof Basements				X				X				X			X			X			
FLD #2	Update FIRM Maps						X	X					X				X	X				
FLD #3	Replace to a Higher Standard				X			X					X				X		X			
FLD #4	Floodfighting Strategies						X	X						X	X				X			
FLD #5	ID of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #6	AQ of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #7	RL of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #8	Temporary Flood Protection	X	X					X	X				X				X		X			
FLD #9	Public Education					X				X				X	X				X			
FLD #10	Stakeholder Education					X				X			X		X				X			
FLD #11	Flood Signs					X				X			X		X					X		
FLD #12	Floodplain Manager						X	X	X	X	X	X	X			X			X			
FLD #13	Watershed Management			X	X			X				X		X	X				X			
FLD #14	Urban Flood Reduction				X			X					X		X			X				
FLD #15	Urban Flood Reduction Solutions				X			X					X			X			X			
FLD #16	Acquire Aerial Photography						X	X						X	X					X		
FLD #17	Bridge Survey				X			X					X		X			X				
FLD #18	Bridge Modification				X			X					X			X			X			
FLD #19	ID Temp Flood Shelters						X	X			X		X			X			X			
FLD #20	ID Temp Storage Sites						X		X				X			X			X			
FLD #21	Raise Manholes				X				X				X			X			X			
FLD #22	Increase Pump Capacity						X	X					X			X			X			
FLD #23	Wastewater Plant Floodproofing				X				X					X		X			X			
FLD #24	Flood Warning Sensors					X	X	X	X					X	X				X			

Hazardous Materials (Transportation –related)

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
HMT #1	Pre-Response Training						X	X						X	X			X				
HMT #2	LEPC						X	X						X	X			X				
HMT #3	Oblique Aerial Photographs						X	X					X			X				X		
HMT #4	Land Use Buffers		X	X				X			X			X			X		X			

Tornadoes:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
TRN #1	Residential Safe Rooms				X						X		X			X		X				
TRN #2	Institutional Safe Rooms / Spaces				X						X		X			X		X				
TRN #3	Free-Standing Safe Rooms				X						X		X			X		X				
TRN #4	Anchor Mobile / Temp Structures				X				X					X	X			X				
TRN #5	Bracing of Permanent Structures				X				X					X	X			X				
TRN #6	Wind Bracing For Signs				X			X					X			X				X		
TRN #7	Wind Bracing For Antennas				X			X					X			X				X		
TRN #8	Underground Utilities				X			X						X			X		X			
TRN #9	Tree Trimming						X	X	X					X	X				X			
TRN #10	Debris Management						X						X			X			X			
TRN #11	Early Warning Sirens					X		X			X			X		X			X			
TRN #12	Storm Spotters						X	X						X	X					X		
TRN #13	Storm Warning Public Education					X				X				X	X			X				
TRN #14	Severe Weather Awareness Week					X				X				X	X				X			
TRN #15	Public Storm Shelter Locations					X				X	X			X	X				X			
TRN #16	NOAA Weather Radio					X				X	X			X		X		X				

Multi-Hazards:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
MH #1	Adopt and Implement Plan						X	X	X	X	X	X	X		X			X				
MH #2	Incorporate into Local Plans						X	X	X	X	X	X	X			X		X				
MH #3	Maintain and Update Plan						X	X	X	X	X	X	X				X	X				
MH #4	Cost - Benefit Analysis						X	X					X			X			X			
MH #5	Evacuation Routes						X				X			X			X		X			
MH #6	Transportation Planning				X			X						X			X		X			
MH #7	NOAA All Hazards Radio					X				X				X		X			X			
MH #8	Enhance Data						X							X			X		X			
MH #9	Continue LEPC						X	X	X	X	X	X		X	X			X				
MH #10	Maintain EOC						X	X	X	X	X	X		X	X			X				
MH #11	Communication						X							X		X			X			
MH #12	Recordkeeping						X							X			X			X		
MH #13	Alternate Energy Sources				X			X					X				X			X		
MH #14	Special Needs Populations						X			X	X		X		X			X				
MH #15	Educational Outreach					X				X				X	X				X			
MH #16	"How To" Booth					X				X			X			X			X			
MH #17	School Mitigation Plan						X	X	X	X	X	X	X			X			X			
MH #18	Mitigation Curriculum					X	X			X			X			X			X			
MH #19	Public Service Announcements					X				X				X	X				X			
MH #20	Disaster Kit					X	X			X	X			X	X				X			

Ingham County

Ingham County identified hazardous materials, chemicals, explosives, tornadoes, flooding, and "multi-hazards" as threats to their communities. The charts below list the proposed mitigation actions which should occur, ranging from building flood proof basements, to tree trimming, bridge modifications and the provision of disaster kits. County officials report that many of these items have been promoted or completed at various levels around the County.

Ingham County identified hazardous materials, chemicals, explosives, tornadoes, flooding, and "multi-hazards" as threats to their communities in 2004. The charts below list the proposed mitigation actions which should occur, ranging from building flood proof basements, to tree trimming, bridge modifications and the provision of disaster kits. County officials report that many of these items have been promoted or completed at various levels around the County including working with Do1Thing to improve citizen preparedness through education and providing disaster kits, expanding the outdoor warning siren alert system, and through giving NOAA All-Hazards Alert Radios to schools, hospitals, and county facilities. Debris removal has taken place in Delhi

Township to reduce flooding along the Sycamore Creek, and a 24/7 river gauge has been installed to provide better forecasts and alerts.

Hazardous Materials (Fixed Site):

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implementation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
HMF #1	Enhance Pre-Planning						X	X						X	X			X				
HMF #2	Pre-Response Training						X	X						X	X			X				
HMF #3	LEPC						X	X						X	X			X				
HMF #4	Oblique Aerial Photographs						X	X					X			X				X		
HMF #5	Land Use Buffers		X	X				X			X			X			X		X			
HMF #6	Containment				X			X				X		X		X			X			

Multi-Hazards:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implementation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
MH #1	Adopt and Implement Plan						X	X	X	X	X	X	X		X			X				
MH #2	Incorporate into Local Plans						X	X	X	X	X	X	X			X		X				
MH #3	Maintain and Update Plan						X	X	X	X	X	X	X				X	X				
MH #4	Cost - Benefit Analysis						X	X					X			X			X			
MH #5	Evacuation Routes						X				X			X			X		X			
MH #6	Transportation Planning				X			X						X			X		X			
MH #7	NOAA All Hazards Radio					X				X				X		X			X			
MH #8	Enhance Data						X							X			X		X			
MH #9	Continue LEPC						X	X	X	X	X	X		X	X			X				
MH #10	Maintain EOC						X	X	X	X	X	X		X	X			X				
MH #11	Communication						X							X		X			X			
MH #12	Recordkeeping						X							X			X			X		
MH #13	Alternate Energy Sources				X			X					X				X			X		
MH #14	Special Needs Populations						X			X	X		X		X			X				
MH #15	Educational Outreach					X				X				X	X				X			
MH #16	"How To" Booth					X				X			X			X			X			
MH #17	School Mitigation Plan						X	X	X	X	X	X	X			X			X			
MH #18	Mitigation Curriculum					X	X			X			X			X			X			
MH #19	Public Service Announcements					X				X				X	X				X			
MH #20	Disaster Kit					X	X			X	X			X	X				X			

Chemicals:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
CHM #1	Public Safety Presence						X	X	X		X			X	X				X			
CHM #2	Defensive Architecture				X			X	X		X			X		X			X			
CHM #3	Oblique Aerial Photographs						X	X					X			X				X		
CHM #4	Public Education Related to WMD					X				X				X	X			X				

Flooding:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
FLD #1	Floodproof Basements				X				X				X			X			X			
FLD #2	Update FIRM Maps						X	X					X				X	X				
FLD #3	Replace to a Higher Standard				X			X					X				X		X			
FLD #4	Floodfighting Strategies						X	X						X	X				X			
FLD #5	ID of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #6	AQ of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #7	RL of Repetitive Loss Structures			X				X	X			X	X				X	X				
FLD #8	Temporary Flood Protection	X	X					X	X				X				X		X			
FLD #9	Public Education					X				X				X	X				X			
FLD #10	Stakeholder Education					X				X			X		X				X			
FLD #11	Flood Signs					X				X			X		X					X		
FLD #12	Floodplain Manager						X	X	X	X	X	X	X			X			X			
FLD #13	Watershed Management			X	X			X				X		X	X				X			
FLD #14	Urban Flood Reduction				X			X					X		X			X				
FLD #15	Urban Flood Reduction Solutions				X			X					X			X			X			
FLD #16	Acquire Aerial Photography						X	X						X	X					X		
FLD #17	Bridge Survey				X			X					X		X			X				
FLD #18	Bridge Modification				X			X					X			X			X			
FLD #19	ID Temp Flood Shelters						X	X			X		X			X			X			
FLD #20	ID Temp Storage Sites						X		X				X			X			X			
FLD #21	Raise Manholes				X				X				X			X			X			
FLD #22	Increase Pump Capacity						X	X					X			X			X			
FLD #23	Wastewater Plant Floodproofing				X				X					X		X			X			
FLD #24	Flood Warning Sensors					X	X	X	X					X	X				X			

Explosives:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
EXP #1	Public Safety Presence						X	X	X		X			X	X				X			
EXP #2	Defensive Architecture				X			X	X		X			X		X			X			
EXP #3	Oblique Aerial Photographs						X	X					X			X				X		
EXP #4	Public Education Related to WMD					X				X				X	X			X				

Tornadoes:

Project #	Project Name	Mitigation Strategy Applied						Project Goals Addressed					Project Type		Project Implement-ation			Project Priority			Project Evaluation *Perform in 2008*	
		Modify The Hazard	Segregate the Hazard	Prevent or Limit Development	Alter Design or Construction	Increase Public Awareness	Other Mitigation Approaches	Prevention / Risk Reduction	Property Protection	Public Education	Injury / Casualty Prevention	Natural Resource Protection	New Project	Ongoing Project	Short-Term	Medium Term	Long Term	High	Medium	Low	Has This Project Been Implemented (Yes / No) ?	If Yes, List Number of Impacts on the Community ?
TRN #1	Residential Safe Rooms				X						X		X			X		X				
TRN #2	Institutional Safe Rooms / Spaces				X						X		X			X		X				
TRN #3	Free-Standing Safe Rooms				X						X		X			X		X				
TRN #4	Anchor Mobile / Temp Structures				X				X					X	X			X				
TRN #5	Bracing of Permanent Structures				X				X					X	X			X				
TRN #6	Wind Bracing For Signs				X			X					X			X				X		
TRN #7	Wind Bracing For Antennas				X			X					X			X				X		
TRN #8	Underground Utilities				X			X						X			X		X			
TRN #9	Tree Trimming						X	X	X					X	X				X			
TRN #10	Debris Management						X						X			X			X			
TRN #11	Early Warning Sirens					X		X			X			X		X			X			
TRN #12	Storm Spotters						X	X						X	X					X		
TRN #13	Storm Warning Public Education					X				X				X	X			X				
TRN #14	Severe Weather Awareness Week					X				X				X	X				X			
TRN #15	Public Storm Shelter Locations					X				X	X			X	X				X			
TRN #16	NOAA Weather Radio					X				X	X			X		X		X				

Mitigation Goal Priorities

The mitigation goals and actions adopted and implemented as part of the 2004 Plans were a mix of actions for hazards that are not altogether deemed significant not on 2015. Early on in the planning process, the project team reviewed the 2004 hazards and agreed that the updated plan would address only natural hazards as required by FEMA. All strategies presented here will improve the health, safety and general welfare for citizens, business and government. There are, however, limitations to actionable items

in any plan. Two primary limitations for the mitigation strategies presented in this plan include funding opportunities and the general political processes that direct limited resources across expanding needs.

Consideration to these limitations is reflected in the selection of mitigation strategies, which seek to reduce vulnerability with actions that have been previously identified in an existing plan, that are volunteer based, that introduce manageable financial commitment from local government, or that provide a funding option from an external agency. Unfunded mitigation strategies have been estimated to provide a benefit over cost. The goals and activities listed here are in order of priority beginning with addressing the needs of vulnerable populations. Top priority items are critical to implement and address over the next 3 years. High priority items are critical to implement and address over the next 5 years.

Top Priority: Protect Special Needs Populations

A. **Mitigation Strategy**: Develop and promote contact list for local disaster planning and assistance organizations (Listening Ear, FIA, Commission on Aging, Red Cross) to be promoted to special needs populations.

Potential Lead Organization/Department: Emergency Operations Center, Red Cross, other community organizations

Potential Funding Sources: Local Government, State of Michigan, Community Organizations, Federal Government

B. **Mitigation Strategy**: Hold public seminar(s) on disaster planning and preparedness for special needs populations, caretakers planning officials and facilities caring for special needs populations.

Potential Lead Organization/Department: Emergency Operations Center, Red Cross, other community organizations

Potential Funding Sources: Local EOC, Local Government, Community Organizations

C. **Mitigation Strategy**: Seek funding for NOAA weather radios for facilities caring for special needs populations and special needs populations living independently.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, State EMD, FEMA, Local Government, SCT Two-percent Funding

D. **Mitigation Strategy**: Give disaster kits to caretakers of special needs populations, including hospice patients, and facilities caring for special needs populations.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, State EMD, FEMA, Local Government,

E. **Mitigation Strategy**: Mass mail all special needs facilities a brochure on facility disaster preparedness.

Potential Lead Organization/Department: Emergency Operations Center, Red Cross, other community organizations

Potential Funding Sources: Local EOC, Local Government, Community Organizations

F. **Mitigation Strategy**: Encourage each facility to conduct annual disaster drills.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, State EMD, FEMA,

G. **Mitigation Strategy**: Develop internal facility emergency/disaster warning systems.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, State EMD, FEMA, Private

High Priority: Identify gaps in community wide emergency response to hazards.

Objective: ***Conduct multi agency exercises for potential hazards to identify gaps and develop solutions.***

A. **Mitigation Strategy**: Conduct annual orientations with each response agency regarding the counties disaster plans.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, Local Government

B. **Mitigation Strategy:** Conduct disaster drills with each response agency to exercise county disaster plan.

Potential Lead Organization/Department: Emergency Operations Center

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Potential Funding Sources: Local EOC, State EMD, FEMA, Local Government,

C. **Mitigation Strategy**: Conduct a full scale disaster drill every third year with as many agencies as possible.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, State EMD, FEMA, Local Government, SCT Two-percent Funding

High Priority: Provide protective measures from severe wind, hail and tornadoes.

Objective: ***Construct shelters and raise awareness to safe rooms and other construction methods that provide protective measures from wind/storm events.***

A. **Mitigation Strategy:** Encourage the construction of shelters at City and County Parks.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, Sate EMD, FEMA, Local Government.

B. **Mitigation Strategy**: Encourage the construction of shelters at mobile home/manufactures housing communities.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, Sate EMD, FEMA, Local Government, SCT two-percent funding.

C. **Mitigation Strategy**: Increase public awareness of safe rooms and enhanced construction methods in newly constructed homes through brochures, Internet and other literature to be made available from county and private entities.

Potential Lead Organization/Department: Emergency Operations Center, Community Development

Potential Funding Sources: Local EOC, FEMA, Local Government, Private

D. **Mitigation Strategy:** Ensure that all schools located in Clinton County are within the outdoor warning siren range and have indoor warning capabilities (indoor weather warning via NOAA Weather Radios).

Potential Lead Organization/Department: Emergency Operations Center, Clinton-Gratiot ISD, Local School Districts

Potential Funding Sources: Local EOC, FEMA, State of Michigan

Objective: ***Raise public awareness of severe weather events and preventative actions.***

A. **Mitigation Strategy**: Increase attendance at National Weather Service Spotter classes through media (local weather stations, Internet, newspapers, etc.).

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, FEMA, NOAA,

B. **Mitigation Strategy:** Create public service announcements regarding severe weather events.

Potential Lead Organization/Department: Emergency Operations Center

Potential Funding Sources: Local EOC, FEMA, Local Government,

High Priority: Decrease vulnerability of county to infrastructure failures caused by natural events.

Objective: ***Include policies developed in Comprehensive Plan that promote growth in areas that have existing infrastructure in hazard mitigation plan.***

A. **Mitigation Strategy:** Discourage unplanned sprawl conditions in area without exist infrastructure.

Potential Lead Organization/Department: Local Legislative Body, Community Development, Planning Boards

Potential Funding Sources: Local Government

Objective: ***Rehabilitate infrastructure where applicable (storm water, water, sewerage, underground utilities etc.).***

A. **Mitigation Strategy:** Identify infrastructure that needs rehabilitation.

Potential Lead Organization/Department: Drain Commission, Public Works

Potential Funding Sources: Local Government, State of Michigan,

B. **Mitigation Strategy:** Suggest local governments find sources of funding (Michigan Hazard mitigation funding, local budgets, local grantors, etc…) to fund rehabilitation projects.

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Potential Lead Organization/Department: Local Governing Body, Community Development, Local EOC

Potential Funding Sources: Local Government

C. **Mitigation Strategy:** Create a digital GIS layer displaying locations of generators throughout county.

Potential Lead Organization/Department: Local EOC

Potential Funding Sources: Local EOC, State EMD, FEMA, Local Government.

High Priority: Reduce the impacts of riverine/urban flooding.

Objective: ***To preserve or improve the water quality of water resources, such Rivers, their tributaries, lakes, and wetlands.***

A. **Mitigation Strategy:** Create an overlay zoning district which can be applied to the lands abutting water resources to manage growth and development, ensure sufficient setback distances, and preserve natural features.

Potential Lead Organization/Department: Local Governing Body, Community Development, Planning Boards

Potential Funding Sources: Local Government, FEMA,

B. **Mitigation Strategy**: Work with the Department of Environmental Quality to enforce water quality regulations.

Potential Lead Organization/Department: Local Governing Body, Community Development

Potential Funding Sources: Local Government, Michigan DEQ

C. **Mitigation Strategy:** Consider the potential impacts of stormwater runoff on water quality.

Potential Lead Organization/Department: Community Development, MSU Extension, MDEQ

Potential Funding Sources: Local Government, Michigan DEQ, EPA, FEMA

Objective: ***To preserve the natural character of adjacent lands along the rivers...***

A. **Mitigation Strategy:** Provide incentives to preserve frontage and vegetation along the river banks.

Potential Lead Organization/Department: Local Governing Body, Community Development, Planning Boards

Potential Funding Sources: Local Government, FEMA,

B. **Mitigation Strategy**: Create an overlay zoning district which can be applied to the lands along the river banks.

Potential Lead Organization/Department: Local Governing Body, Community Development, Planning Boards

Potential Funding Sources: Local Government, FEMA,

C. **Mitigation Strategy**: Consider the established federal flood plain boundaries as a part of any proposed regulations. All local jurisdictions should participate in the National Flood Insurance Program and Repetitive Loss Programs, planning and implementing` federally recognized mitigation efforts.

Potential Lead Organization/Department: Local Governing Body, Community Development, Planning Boards

Potential Funding Sources: Local Government, FEMA

D. **Mitigation Strategy**: Encourage cooperative and coordinated planning efforts among neighboring communities.

Potential Lead Organization/Department: Local Governing Body, Community Development, Planning Boards

Potential Funding Sources: Local Government

Plan Implementation

With the support of a FEMA grant through the Michigan State Police, the tri-County region of Ingham Eaton, and Clinton Counties and the Charter Township of Delta have conducted research, convened advisory group and steering group meetings, and integrated the work of updating the regional Hazard Mitigation Plan. Beginning with research, mapping and the development of elevations data (LiDAR) followed by an analyses of hazards and vulnerable areas, the Tri-County Regional Planning Commission has worked to create a new and complete revised library of geographic

information systems. The anticipated goal is to complete an update of the regional Hazard Mitigation Plan and submit it for County approvals in July 2015. On behalf of the region, TCRPC will seek adoption of a final plan, which requires a resolution of adoption of the final Plan by the County and Township boards Formal adoption of this plan will make it active for a period of five years, in which time consideration should be given to updates for the next planning period. The Hazard Mitigation Plan will officially be transferred to the Emergency Management Agencies of Clinton, Eaton and Ingham Counties and Delta Charter Township, as will responsibilities for maintenance. The transfer will include all materials used to create the plan and a CD containing digital documentation and maps.

The Tri-County Regional Planning Commission provided planning work during the planning process. In large part, this was due to the availability of grant funding and a limitation of resources required in completing this plan. On transfer of deliverables, TCRPC will have completed its role in this planning process. The TCRPC will aid the counties and township during the transfer and adoption phase in any means possible. Any future involvement by TCRPC will depend on the availability of staff and funding.

TCRPC will maintain digital copies of all data and information used and produced for this plan, including GIS data and maps. Distribution of this data and information, including the plan, shall be directed to the Emergency Management Agencies. TCRPC will maintain contact with the County and Township Emergency Management Coordinators and provide assistance on a limited basis. All requests and questions regarding this plan shall be directed to the County and Township Emergency Operations Centers.

During the development of this plan key individuals came together, raised awareness and leveraged support for mitigation planning. While many of these individuals and agencies are integral components of the mitigation strategies, successful implementation will continue to require an engaged audience that extends beyond stakeholders.

Specific project implementation should consider what is most feasible in terms of resources, financial commitment and the ability to connect a project publicly to hazard mitigation. Successful implementation and reduction of vulnerabilities can leverage tremendous public and political support. Engaging in attainable projects first will facilitate further projects and support for future planning activities.

Using MSP's Condensed Hazard Mitigation Plan Review Sheets, this plan meets the requirements listed in Section 1, Items 1 through 5; Section 2, Items 6 through 9; Section 3, Items 10 through 14; and Section 4, Items 15 through 20. All grant agreement steps have been met in the development of this plan update such as review of the 2004 Plans, convening of workgroup meetings, hosting of public workshops, the creation of LiDAR based contour maps and building footprint maps, development of hazard analysis chapters and hazard mitigation actions.

Maintenance and Updates of the Hazard Mitigation Plan

A review report was provided by representatives of FEMA and the Michigan State Police on June 11, 2015 following their consideration of the final draft plan. The minor changes recommended were completed and this final Plan document has been produced and publicly posted at www.mitcrpc.org, the Tri-County Regional Planning Commission website. The final Tri-County Regional Hazard Mitigation Plan ws also submitted for formal adoption by the three counties and Delta Charter Township in June-July, 2015.

The Hazard Mitigation Plan will be active for five years beyond the date of FEMA approval. During that time, the Tri-County region's agencies will continue to consider how to maintain and improve the Hazard Mitigation Planning processes and their implementation. The Emergency Managers in the region will continue to monitor, evaluate and update the 2015 Hazard Mitigation Plan through many means including public participation in the plan maintenance process with periodic presentations to community groups, in public meetings, through internet and social media postings, or by the use of questionnaires and surveys.

To remain active with the planning process, this Plan recommends that a regional workgroup continue to meet at least annually after the adoption of this plan to review its implementation and ongoing maintenance and development. The implementation meetings should focus primarily on changes in the community, such as population shifts, new development patterns and changes to local, state and federal priorities. Regional participating agencies should conduct routine maintenance quarterly regarding the review and evaluation of mitigation strategies to ensure connectivity to projects and their stakeholders. Additionally, the maintenance topic should be introduced and discussed, when possible, at other forums such as local emergency response meetings. Over the next five years, local participating communities should recognize and adopt this hazard mitigation plan into or as an amendment to their local master land use plans. And, a variety of hazard mitigation action items should also be considered and adopted into local capital improvement plans so that local funds can be allotted to the implementation of the local community's chosen hazard mitigation activities.

During year five of this plan, in 2020, it is recommended that the regional emergency management agencies, municipalities, and other affected agencies organize their efforts to create the next version of a Hazard Mitigation Plan that recognizes and updates this five year Regional Hazard Mitigation Plan. Future meetings should carefully consider changes to the community and improving information as foundations for updating this plan. Maintenance and updates to this plan are the responsibility of the County and Township Emergency Management Agencies.

APPENDIX A: LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: Clinton, Eaton, Ingham Counties, MI	**Title of Plan: Tri-County Regional Hazard Mitigation Plan**	**Date of Plan: 2015**
Local Point of Contact: Susan M. C. Pigg	**Address: 3135 Pine Tree Rd, Suite 2C** **Lansing, MI 48911**	
Title: Executive Director		
Agency: Tri-County Regional Planning Commission		
Phone Number: (517) 393-0342	**E-Mail: spigg@mitcrpc.org**	
State Reviewer: Mike Sobocinski	**Title: Hazard Mitigation Planning Specialist**	**Date: 5/29/2015**
FEMA Reviewer: Kirstin Kuenzi	**Title: Community Planning Specialist**	**Date: 6/1/2015**
Date Received in FEMA Region ***(insert #)***	5/29/2015	
Plan Not Approved		
Plan Approvable Pending Adoption	XX- but please add additional text for the cities of Williamston, Eaton Rapids; the townships of Meridian Charter, Williamston, Lansing Charter, DeWitt Charter when adopting	

SECTION 1:

REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Plan Update Meetings, pp. 5. *Meetings were held in 2012, 2013, 2014, and 2015. An online survey was developed in 2015.*	X	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Figure 3: Plan Update Meetings, pp. 5. *Sheriff Departments, libraries, DOTs, and a representative from Michigan State University in Lansing participated in group meetings.*	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Plan Update Meetings, pp. 5. *Meetings were open to all (public forums) and an online survey was utilized.*	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan**	**Met**	**Not Met**
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Process to Update the Tri-County Regional Plan, pp. 10-12. *Existing information such as the Regional Growth: Choice for our Future report, the Greening Mid-Michigan Report, the State HM Plan, and various maps were reviewed and data was compiled.*	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Maintenance and Updates, pp. 131. *"The Emergency Managers in the region will continue to monitor, evaluate and update the 2015 HM Plan through many means: Public participation in the plan maintenance process with periodic presentations to community groups or at public meetings, internet and social media postings, or the use of questionnaires and surveys".*	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan**	**Met**	**Not Met**
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Maintenance and Updates, pp. 131. *"To remain active with the planning process it is recommended that the workgroup meet annually beginning one year from the adoption of this plan to consider its ongoing implementation".*	X	
ELEMENT A: REQUIRED REVISIONS N/A			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Hazard Analysis, pp. 48-98. *The ranking of hazards covered are, in order: tornado, flood, severe wind, snowstorm, hail, ice storm, drought, wildfire, lightning, extreme heat, extreme cold, and fog; manmade hazards covered are civil disturbance, hazmat, oil/natural gas accident, infrastructure failure, and public health emergency.*	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan**	**Met**	**Not Met**
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Hazard Analysis, pp. 48-98. *Previous occurrences are documented by disaster declarations as well as NCDC information; probability for each hazard event is also estimated by county.*	X	
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Hazard Analysis, pp. 48-98. *Impact is well described.*	X	
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Repetitive Loss Property Information in the Tri-County Region, pp. 74-75. *Clinton County has 1 rep loss property, Ingham County has 12 rep loss properties, and Eaton County has 12 rep loss properties.*	X	
ELEMENT B: REQUIRED REVISIONS N/A			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Hazard Mitigation: Unlocking the Disaster Equation, pp. 5-9. *Existing policies and programs are covered in the introduction as well as through maps in the plan.*	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan**	**Met**	**Not Met**
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Figure 51: FEMA Community Status Chart, pp. 69. *The table quotes FEMA's Community Status Books for documenting jurisdictional participation in the NFIP.*	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Mitigation Gal Priorities, pp. 123-129. *Goals include the highest priorities to these communities: protecting the special needs populations, identifying gaps in community-wide emergency response to hazards, providing protective measures from severe wind, hail, and tornadoes, decreasing vulnerability of the counties to infrastructure failures caused by natural events, and reducing the impacts of riverine/urban flooding.*	X	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Mitigation Strategies and Plan Implementation, pp. 99-123. *Mitigation actions are comprehensive and specific to each hazard addressed.*	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan**	**Met**	**Not Met**
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Mitigation Strategies and Plan Implementation, pp. 99-123. *Action plan, by county, is prioritized in terms of high, medium, or low as well as project timeline.*	X	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Maintenance and Updates, pp. 131. *"Over the next five years, local participating communities should adopt this hazard mitigation plan as an amendment of their local mast plans. Various action items should also be considered and adopted into local capital improvement plans so that local funds can be allotted to the implementation of the local community's chosen hazard mitigation activities".*	X	
ELEMENT C: REQUIRED REVISIONS N/A			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan**	**Met**	**Not Met**
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Community Profiles, pp. 13-47. *Current and future land use is well-documented within the plan by both maps and descriptions.*	X	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Mitigation Strategies and Plan Implementation, pp. 99. *"The mitigation alternatives for our region are very much the same now as they were in the previous adopted Plan. Various actions were completed since 2005, such as the distribution of weather radios to residents, the adoption of low-impact development regulations across the region, and public service announcements pertaining to emergency preparedness. The TCRPC made every effort to ensure that actions can be accomplished and that they will reduce vulnerability".*	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan	Met	Not Met
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Hazards Analysis, pp. 48. *Priorities have been updated. "In 2004, Clinton, Eaton and Ingham Counties and Delta Charter Township proposed floods, tornadoes and ice/sleet storms as their top three hazards. This is in keeping with the new 2015 Plan update. Also, the earthquakes and forest fires that were identified as a hazard in 2005 do not play a major role in the 2015 update as our region is not host to substantial forested areas, nor is it prone to earthquakes".*	X	
ELEMENT D: REQUIRED REVISIONS N/A			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	*Plan can be adopted post-FEMA approval.*		X
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	*Plan can be adopted post-FEMA approval.*		X
ELEMENT E: REQUIRED REVISIONS N/A			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan	Met	Not Met
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

SECTION 2:

PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

Element B: Hazard Identification and Risk Assessment

Element C: Mitigation Strategy

Element D: Plan Update, Evaluation, and Implementation (Plan Updates Only)

B. Resources for Implementing Your Approved Plan

There are many different resources that can assist your community in plan implementation. FEMA sources of funding include the following:

HMGP: The Hazard Mitigation Grant Program (HMGP) is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP is available, when authorized under the Presidential major disaster declaration, in the areas of the State requested by the Governor.

PDM: The Pre- Disaster Mitigation (PDM) program is authorized by Section 203 of the Stafford Act, 42 U.S.C. 5133. The PDM program is designed to assist States, Territories, Indian Tribal governments, and local communities to implement a sustained pre- disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding from future major disaster declarations.

The following are only available if you are a participating community in the NFIP

FMA: *The Flood Mitigation Assistance (FMA) program is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). The Repetitive Flood Claims (RFC) program has the goal of reducing flood damages to individual properties for which one or more claim payments for losses have been made under flood insurance coverage and that will result in the greatest savings to the National Flood Insurance Fund (NFIF) in the shortest period of time.*

SLR: The Severe Repetitive Loss (SRL) program is authorized by Section 1361A of the NFIA has the goal of reducing flood damages to residential properties that have experienced severe repetitive losses under flood insurance coverage and that will result in the greatest amount of savings to the NFIF in the shortest period of time.

RFC: *The Repetitive Flood Claims program is authorized by Section 1361A of the NFIA, 42 U.S.C. 4030 with the goal of reducing flood damages to individual properties for which one or more claim payment for losses have been made under flood insurance coverage and that will result in the greatest savings to the National Flood Insurance Fund in the shortest period of time.*

SECTION 3:

MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

Ingham County; the cities of East Lansing, Williamston, Mason; the villages of Dansville, Webberville; the townships of Meridian Charter, Williamston, Dehli Charter, Lansing Charter.

Eaton County; the cities of Grand Ledge, Charlotte, Eaton Rapids; Delta Charter Township.

Clinton County; the cities of DeWitt, St. Johns, the townships of DeWitt Charter, Bath Charter, Dallas.