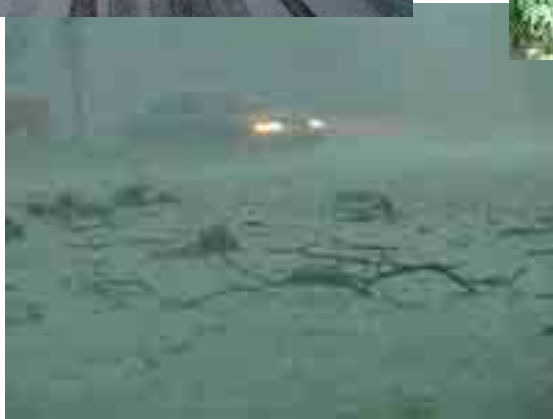




BERRIEN COUNTY HAZARD MITIGATION PLAN



**Berrien County Office of
Emergency Management**

January 2005

**Prepared with assistance from the
SOUTHWESTERN MICHIGAN COMMISSION**



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INTRODUCTION

Berrien County is vulnerable to a wide range of hazards. Periodic disasters resulting from severe winter weather, severe windstorms, flooding, and other similar events can cause significant property damage, interruption of services, personal injury, loss of life, and disrupt the stability of the local economy.

To address the threat these hazards pose to residents, Berrien County has developed the *Berrien County Hazard Mitigation Plan*. This *Plan* will help Berrien County develop into a Disaster Resistant Community able to help residents of all the local communities protect themselves from the effects of disasters by encouraging damage prevention and preparation before a disaster occurs.

“Hazard mitigation” is defined as any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event. – FEMA

This document, the *Berrien County Hazard Mitigation Plan*, is a comprehensive study of the hazards that have impacted Berrien County in the past, as well as those that have the potential to occur in the future. Some of these hazards are a greater threat to some communities than others, and some of the hazards could harm one sector of society more than others. This *Plan* covers Berrien County and all of the cities, villages and townships within Berrien County.

This document consists of a narrative description with the following sections: 1) Planning Approach; 2) Community Profile; 3) Hazard Ranking; 4) Hazard Analysis; 5) Goals and Objectives; 6) Mitigation Strategies; and 7) Action Plan.

The Planning Approach section describes how this plan was developed. The Community Profile provides geographic, economic, social, and land use information that is relevant to Berrien County and how it is affected by, and responds to, hazard events. The Hazard Ranking section shows the overall ranking of hazards affecting Berrien County and also explains the methodology the County utilized to rank them. The Hazard Analysis section describes in detail the hazards that have the potential to occur in Berrien County. The Goals and Objectives section establishes the County’s overall direction for hazard mitigation planning and actions. The Mitigation Strategies section explains general structural and managerial actions that should be pursued to lessen the impacts of hazards. In the Action Plan, the mitigation strategies are prioritized and each action is assigned a responsible party and timeline for implementation.

Records of the National Weather Service, Federal Emergency Management Agency, Michigan Department of State Police - Emergency Management Division, newspapers, and numerous other federal, state, county, local agencies, and private organizations were used as sources for the data presented in this *Hazard Mitigation Plan*.

PLANNING APPROACH

This *Plan* is the product of a rational thought process that reviews alternatives then selects and designs those that will work best for the situation. This process is an attempt to avoid the need to make quick decisions based on inadequate information. The *Plan* provides carefully considered directions to the County government and to the participating municipalities by studying the overall damage potential of hazards and ensuring that public funds are well spent.

The Hazard Mitigation Sub-Committee of Berrien County's Disaster Committee led plan development. In addition, the municipalities within Berrien County were invited to participate in the planning process. Each municipality passed a resolution stating their commitment to the plan development and completed worksheets that identified critical facilities and any specific hazards unique to their community. Further, each municipality had the opportunity to submit potential hazard mitigation projects to be included in the *Plan*.

The Hazard Mitigation Sub-Committee met monthly during the planning process. The members reviewed the hazards and their effects on people and property, considered a variety of ways to reduce and prevent damage, and recommended the most appropriate and feasible measures for implementation. Technical and planning support was provided by the Berrien County Planning and GIS Department, Berrien County's Emergency Management Division, the Southwestern Michigan Commission, and the Michigan State Police - Emergency Management Division.

Planning Process

The Hazard Mitigation Sub-Committee followed a standard planning process, based on guidance from the Michigan State Police - Emergency Management Division. The Southwestern Michigan Commission led the planning process.

Public Involvement

Public involvement during a planning process is very important. Many opportunities were provided to obtain input from the public, particularly residents and businesses that have been affected by hazards. The public was invited to participate through several concurrent means, including:

- Contact with Disaster Committee members and their organizations
- A standing invitation to attend Committee meetings
- Press releases on plan development (January 29, 2004 and October 15, 2004)
- Information available on Southwest Michigan Commission's website (including a fact sheet at www.swmicomm.org)
- Articles in Southwestern Michigan Commission's January 2004 newsletter
- A public meeting on October 28, 2004, to receive comments on the draft plan

Beyond the general public involvement, the following activities were also conducted to receive input from each municipality in the planning process:

- Public Officials Day presentation on June 2, 2004 (Educated local officials on the importance of hazard mitigation planning.) (See Appendix A for list of attendees.)

The following materials were distributed to all municipalities for input:

- Cover letter (explaining Hazard Mitigation Plans and importance of municipal input)
- Hazard Mitigation Planning Fact Sheet
- Community Profile Worksheet
- Hazard Identification Worksheet
- Hazard Ranking Worksheet
- Sample Resolution of Support for Planning Effort
- Call for Projects soliciting Specific Hazard Mitigation Projects

Berrien County led the planning process. All municipalities within Berrien County participated in the plan development process. The table below documents each municipality's participation in the process. Several municipal officials were also involved in meetings and other events that are not documented in the table.

Municipality	Signed resolution supporting plan development	Completed community profile worksheet	Completed hazard identification worksheet	Completed hazard ranking worksheet	Submitted specific hazard mitigation project(s)	Signed resolution for plan adoption**
<i>Cities</i>						
Benton Harbor	X	X	X	X		
Bridgman	X	X	X	X		
Buchanan	X	X	X	X		
Coloma	X	X	X	X		
New Buffalo	X	X	X	X		
Niles	X	X				
St. Joseph	X	X	X	X		
Watervliet	X	X	X	X	X	
<i>Villages</i>						
Baroda	X	X	X	X		
Berrien Springs	X	X	X	X	X	
Eau Claire	X	X	X	X	X	
Galien	X	X	X	X		
Grand Beach	X	X	X	X		

Michiana	X	X	X	X		
Shoreham	X	X	X	X		
Stevensville	X	X	X	X		
Three Oaks	X	X	X	X		
<i>Townships</i>						
Bainbridge	X	X	X	X	X*	
Baroda	X	X	X	X		
Benton Charter	X	X	X	X		
Berrien	X	X	X	X	X	
Bertrand	X	X	X	X		
Buchanan	X	X	X	X	X*	
Chikaming	X	X	X	X		
Coloma	X	X	X	X		
Galien	X	X	X	X	X*	
Hagar	X					
Lake Charter	X	X	X	X		
Lincoln Charter	X	X	X	X		
New Buffalo	X	X	X	X	X*	
Niles	X	X	X	X		
Oronoko Charter	X	X	X	X		
Pipestone	X	X	X	X	X*	
Royalton	X	X	X	X	X*	
St. Joseph Charter	X	X	X	X	X	
Sodus	X	X	X	X		
Three Oaks	X	X	X	X		
Watervliet	X	X	X	X	X	
Weesaw	X	X	X	X		

*Projects were identified and submitted by either the County Road or County Drain Commission.

**Resolutions will be signed after FEMA approval of plan and adoption by Berrien County Board of Commissioners.

Berrien County Planning Meetings

All municipalities and several organizations are invited to attend Berrien County's Disaster Committee and LEPC meetings. Further a hazard mitigation sub-committee was formed to deal with specific hazard mitigation items. See Appendix A for list of members on Disaster Committee and Hazard Mitigation Sub-Committee.

Disaster Committee meetings/LEPC meetings (on-going)

- Kept groups abreast of plan progress
- Asked groups to review community profile and hazard analysis (Jan 2004)

- Asked groups to review draft goals and objectives (April 2004)
- Asked groups for potential mitigation strategies and prioritization of strategies (summer–fall 2004)

Hazard Mitigation Sub-Committee meetings (on-going)

- Educated committee on Hazard Mitigation Planning (summer 2003)
- Reviewed hazard mitigation planning process with committee (fall 2003)
- Asked committee to review community profile and hazard analysis (January 2004)
- Goal/priority setting activity (March 31, 2004)
- Mitigation strategy development (tornados/high winds – March 31, 2004)
- Mitigation strategy development (winter weather/extreme temperatures – June 2004)
- Other potential mitigation strategies (specific to each municipality) – September 2004

Coordination

Existing plans and programs were reviewed during the planning process. It should be underscored that this *Plan* does not replace other planning efforts such as the County’s comprehensive plan, stormwater management planning, or the Local Emergency Planning Committee (which focuses on hazardous materials). This *Plan* complements those efforts and builds on their recommendations. During the planning process, contacts were made with regional, state, and federal agencies and organizations. The *Action Plan* will describe how existing plans will be updated to include information from the Hazard Mitigation Plan.

Community Profile

This portion of the *Plan* is based on Berrien County’s General Development Plan 2003-2008 and adapted for hazard mitigation purposes.

Hazard Analysis and Ranking

Berrien County’s Emergency Management Division compiled an initial hazard identification document. This document was used as the basis for the Hazard Analysis. The Southwestern Michigan Commission and the Hazard Mitigation Sub-Committee collected information from each municipality, local, state, and federal agencies, schools, businesses, and non-profit organizations to complete the hazard analysis. The Berrien County Emergency Management Division was responsible for the ranking of the hazards (see more detail in the Hazard Ranking section of the *Plan*).

Goals and Objectives

The Southwestern Michigan Commission conducted a goal setting exercise at a Hazard Mitigation Sub-Committee meeting to develop draft goals and objectives. The Disaster Committee then revised these at subsequent meetings.

Mitigation Strategies

The Hazard Mitigation Sub-Committee considered everything that could affect the impact of the hazards and reviewed a wide range of alternatives. The Committee's work, and the subsequent plan document, explored six general strategies for reaching the goals:

- Preventive: e.g., zoning, building codes, and other development regulations
- Property protection: e.g., relocation out of harm's way, retrofitting buildings, insurance
- Resource protection: e.g., wetlands protection, urban forestry programs
- Emergency services: e.g., warning, sandbagging, evacuation
- Structural projects: e.g., levees, reservoirs, channel improvements
- Public information: e.g., outreach projects, technical assistance to property owners

Action Plan

After many alternatives were reviewed, the Sub-Committee drafted an "action plan" that specifies recommended projects, who is responsible for implementing them, and when they are to be done. It should be noted that this *Plan* serves only to *recommend* mitigation measures. Implementation of these recommendations depends on adoption of this *Plan* by the Berrien County Board and the city council or board of trustees of each participating municipality. It also depends on the cooperation and support of the offices designated as responsible for each action item.

COMMUNITY PROFILE

OVERVIEW

Berrien County is located in the extreme southwestern portion of Michigan, bordering Lake Michigan and Indiana (Map 1). It has a land area of 373,120 acres or 583 square miles. There are 86 inland lakes totaling 4,500 acres, and Berrien County enjoys 42 miles of shoreline along Lake Michigan. Lake Michigan has a total area of 22,400 square miles and is 923 feet at its deepest point.

Three major rivers, the St. Joseph River, the Paw Paw River and the Galien River empty into Lake Michigan. The St. Joseph River is the largest and most important to the area. Its uses include recreational, agricultural irrigation, discharge, and hydroelectricity. The St. Joseph River Basin is one of the larger basins in Michigan and has a drainage area of 4,591 square miles.

Farming is one of the main economic enterprises in the County. Prevailing winds from Lake Michigan moderate air temperature, making the climate in the northern part of the County favorable for orchard crops and vineyards. The southern part of the County is favorable for cash crops and livestock farming.

Berrien County contains 22 townships, 8 cities and 9 villages (Map 2), with the County seat located in the City of St. Joseph. For more information about Berrien County view the County's Development Plan for 2003-2008 at: www.berriencounty.org/planning/pdfs/masterplan.pdf.

CLIMATE

The lake effect on the Berrien County climate is quite strong throughout much of the year, especially for those communities located along the lakeshore, and along the Michigan/Indiana State Border. Lake effect conditions are produced by prevailing westerly winds passing over Lake Michigan. This effect typically increases cloudiness and snowfall during the fall and winter, while creating moderate temperatures throughout most of the year. Being located at the southern end of Lake Michigan, Berrien County can experience severe spring and summer weather, which is difficult to predict as the storms curve around the bottom edge of the lake. The modifications of the climate are partially responsible for the diverse agriculture in Berrien County.

WEATHER STATISTICS FOR BERRIEN COUNTY

Average Annual Rainfall	35.12 inches
Average Annual Snowfall	69.9 inches
Average January Low Temperature	17.9 degrees
Average July High Temperature	81.9 degrees
Average Growing Season	May 2–October 21 (32 degrees) 171 days
Prevailing Wind	Southwest 3.5 to 7 mph

(Source Michigan State University Agriculture Extension Office Benton Harbor)

Figure 1. Location Map, Berrien County

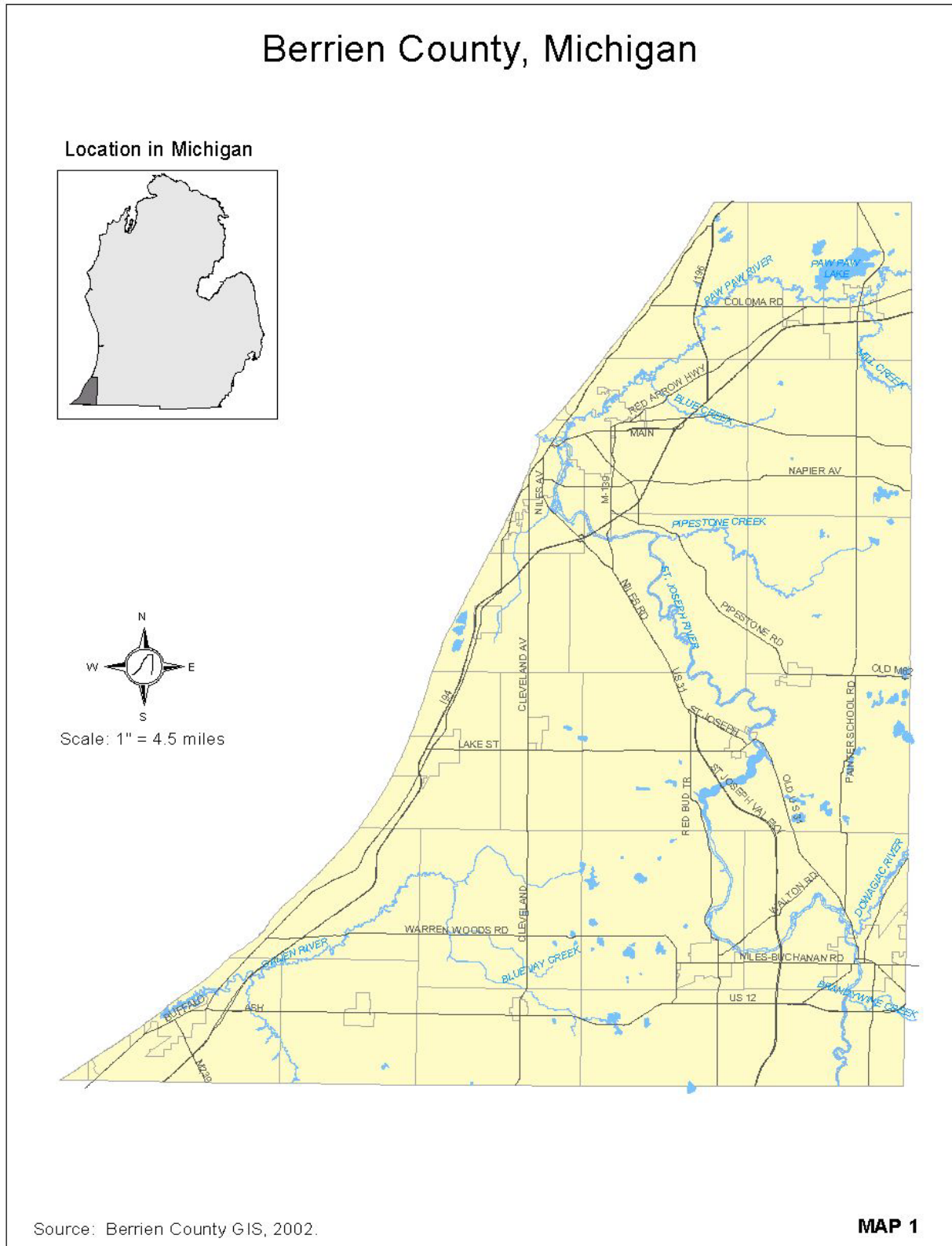


Figure 2. Local Municipalities, Berrien County

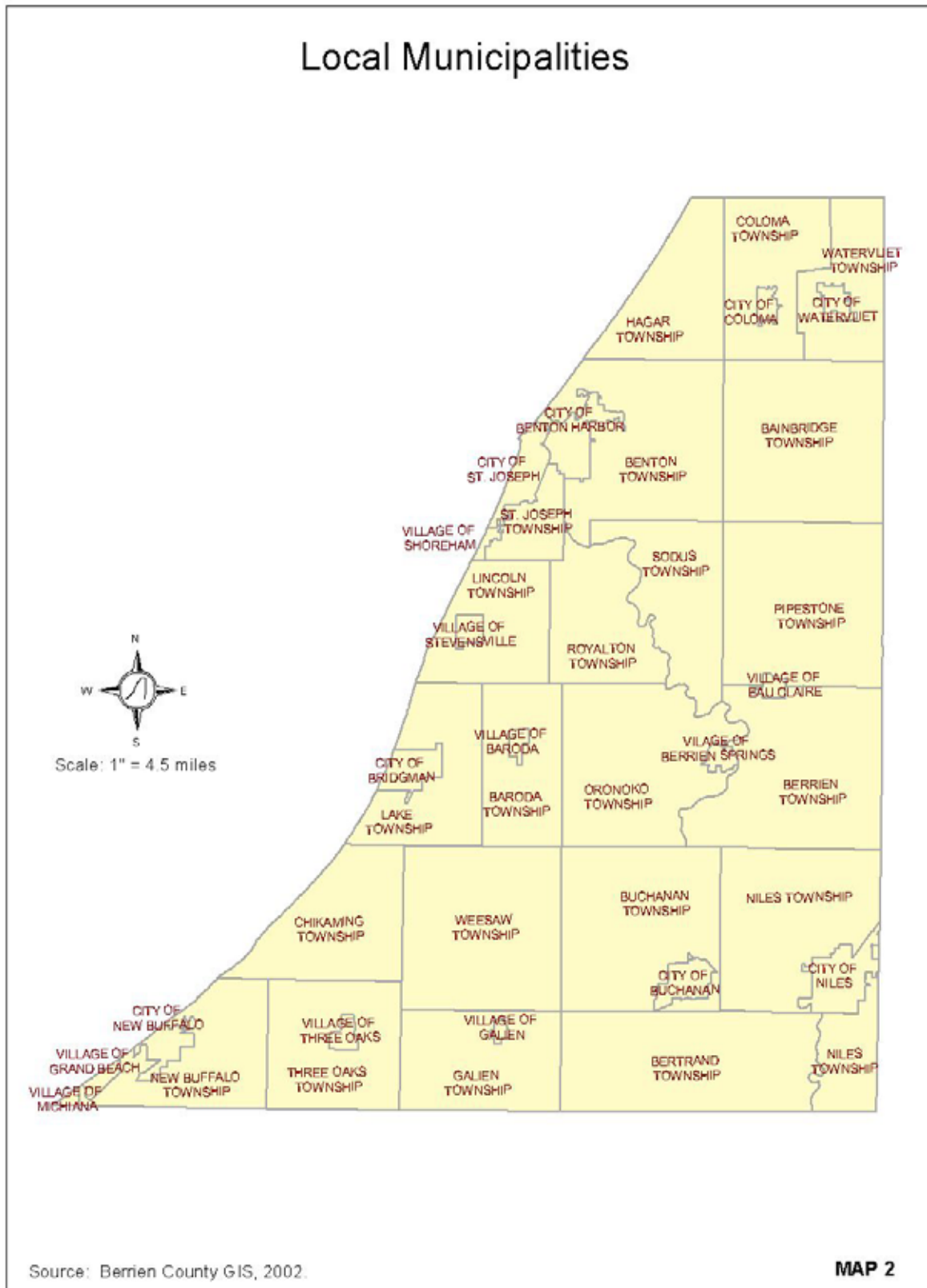
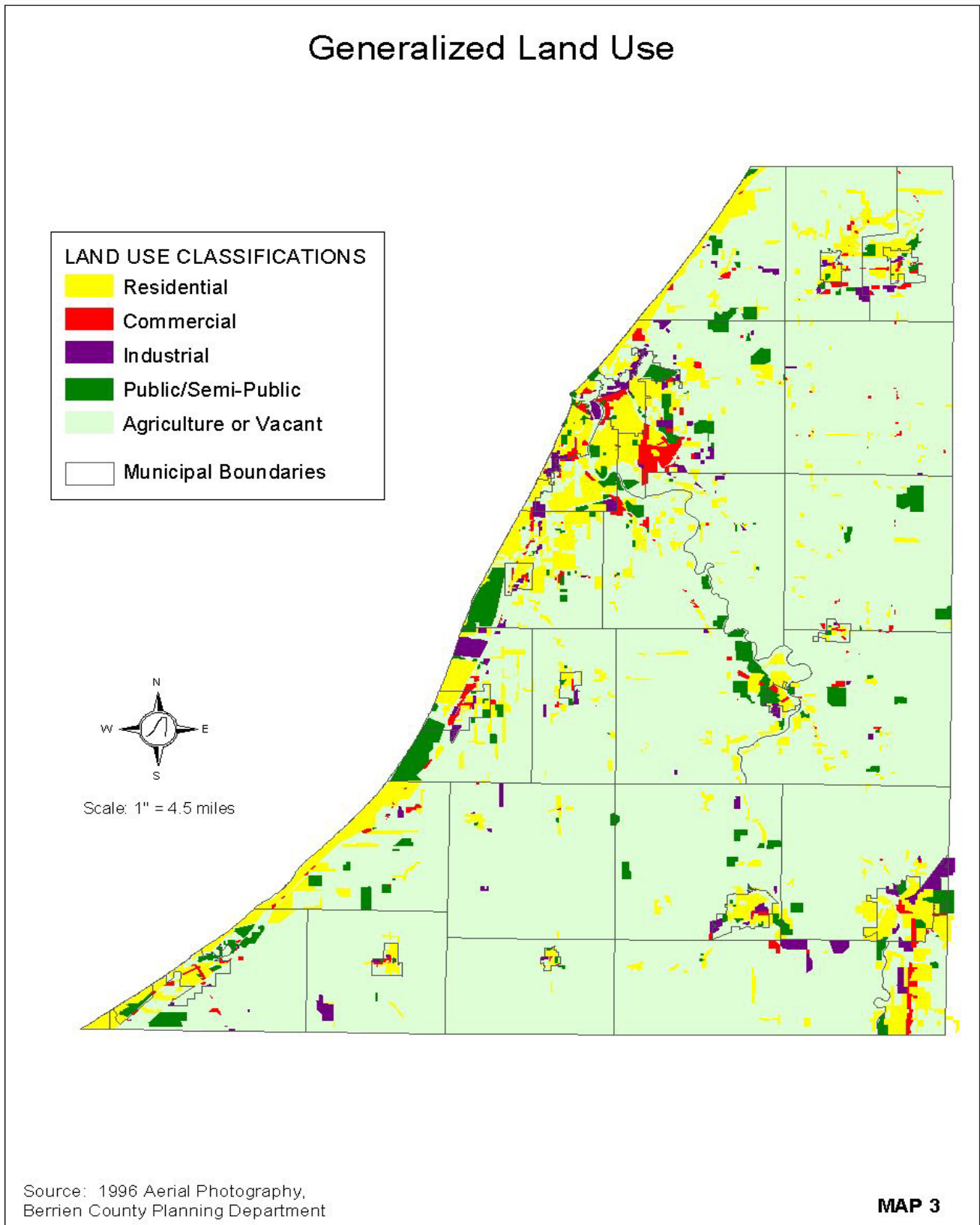


Figure 3. Generalized Land Use, Berrien County, 1996



DEMOGRAPHICS

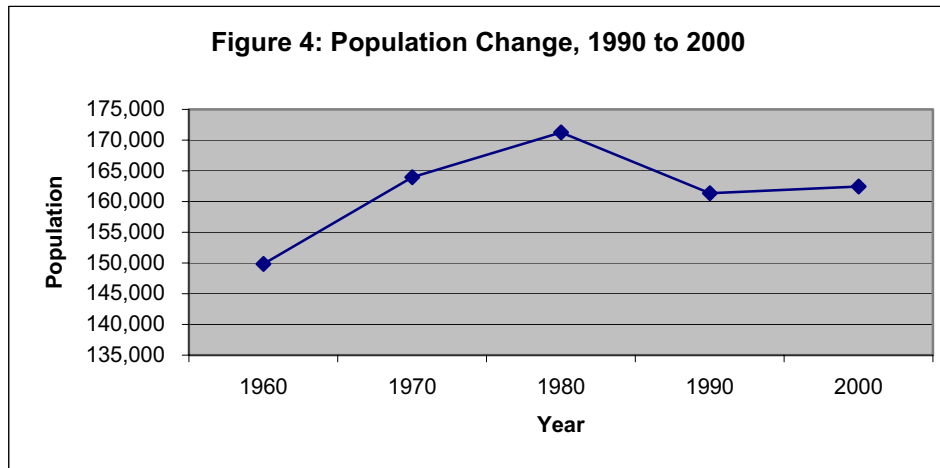
Data from the 2000 U.S. Census of Population and Housing, released in 2001 and 2002, and other relatively current information compiled from other public and private sources are used in this section.

Socioeconomic Profile

A demographic analysis provides important insights about a community and serves as a basis upon which future land use decisions can be made. Included in this analysis is an overview of the County's population, housing, employment trends and projections, tax base, and education statistics. Current estimates, historic trends, and projections are presented.

Population

Population change in Berrien County since 1960 is illustrated in Figure 4. In the 1970s, the County had a significant increase in population.



Statistics show slight growth in total population throughout the County since 1990. The U.S. Census data indicates a slight drop in the future population projects for Berrien County. Due to an increase in construction of new homes, and indications from building permits, it can be concluded that many of these new homes are being built for a population sector that does not list Berrien County as primary residence.

Population density can be calculated by dividing the total population by the land area. With 571 square miles of land area that make up the 39 municipalities, the following table will show the population density of each community. At the County level, density is about 0.44 persons per acre. (See Population Tables on the following pages).

Figure 5. Percent Change in Population, Berrien County, 1990-2000

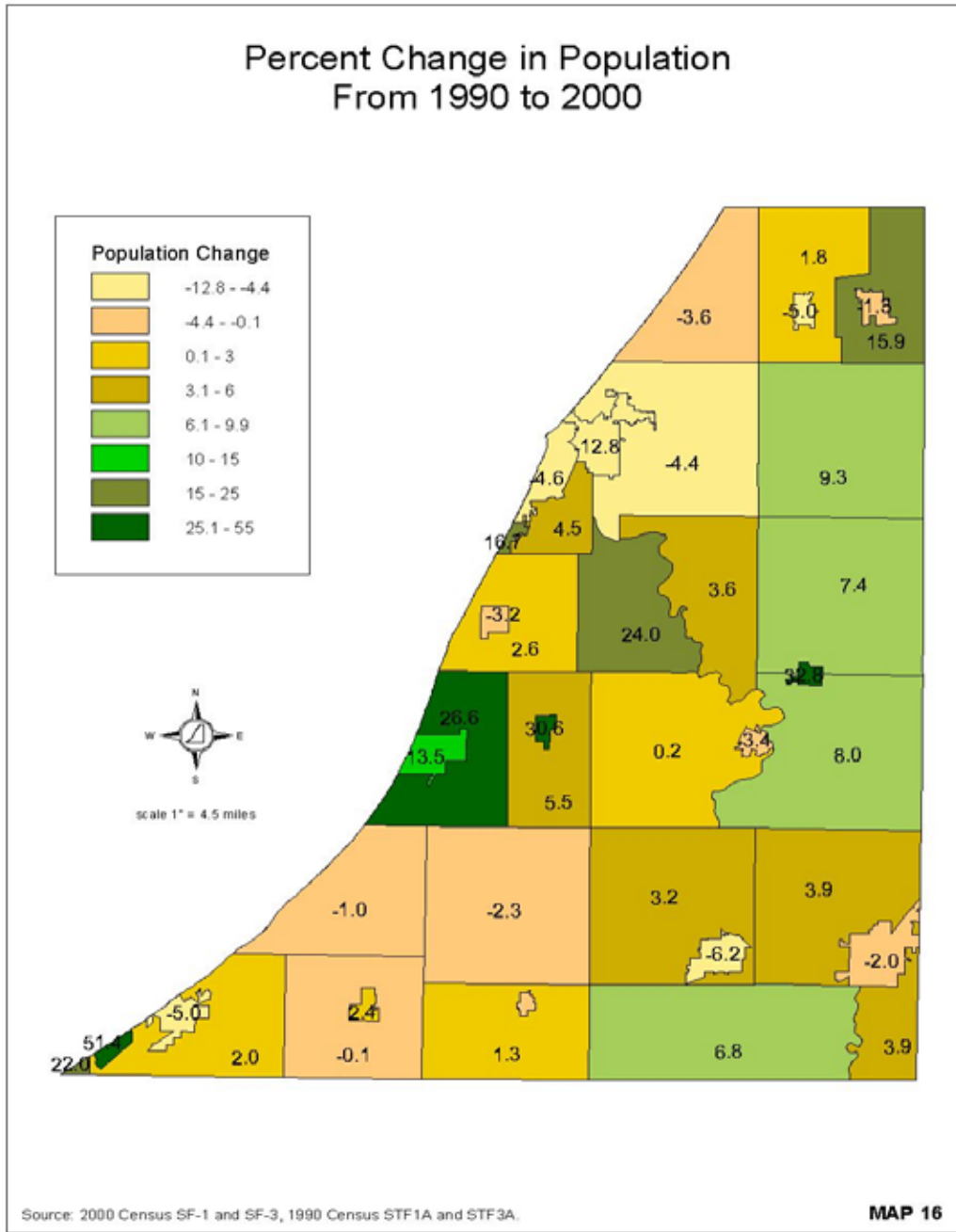


Table 1 identifies the population change from 1990 to 2000 by municipality. This is also illustrated in Figure 5.

Table 1. Change in Population, Berrien County, 1990-2000

	Population 2000	Population 1990	Population Change 1990-2000
Townships and Villages:	162,453	161,378	0.7%
Bainbridge Township	3,132	2,865	9.3%
Baroda Township	2,022	2,074	-2.5%
Baroda Village	858	657	30.6%
Benton Township	16,404	7,163	-4.4%
Berrien Township	4,419	4,203	5.1%
Eau Claire Village	656	494	32.8%
Bertrand Township	2,380	2,228	6.8%
Buchanan Township	3,510	3,402	3.2%
Chikaming Township	3,678	3,717	-1.0%
Coloma Township	5,217	5,123	1.8%
Galien Township	1,018	995	2.3%
Galien Village	593	596	-0.5%
Hagar Township	3,964	4,113	-3.6%
Lake Township	3,148	2,487	26.6%
Lincoln Township	12,761	12,374	3.1%
Stevensville Village	1,191	1,230	-3.2%
New Buffalo Township	2,047	2,109	-2.9%
Grand Beach Village	221	146	51.4%
Michiana Village	200	164	22.0%
Niles Township	13,325	12,828	3.9%
Oronoko Township	7,981	7,892	1.1%
Berrien Springs Village	1,862	1,927	-3.4%
Pipestone Township	2,474	2,303	7.4%
Royalton Township	3,888	3,135	24.0%
St. Joseph Township	9,182	8,876	3.4%
Shoreham Village	860	737	16.7%
Sodus Township	2,139	2,065	3.6%
Three Oaks Township	1,120	2,286	-51.0%
Three Oaks Village	1,829	1,786	2.4%
Watervliet Township	3,392	2,926	15.9%
Weesaw Township	2,065	2,114	-2.3%
Cities:			
Benton Harbor City	11,182	12,818	-12.8%
Bridgman City	2,428	2,140	13.5%
Buchanan City	4,681	4,992	-6.2%
Coloma City	1,595	1,679	-5.0%
New Buffalo City	2,200	2,317	-5.0%
Niles City	12,204	12,458	-2.0%
St. Joseph City	8,789	9,214	-4.6%
Watervliet City	1,843	1,867	-1.3%

Source: U.S. Census Bureau Summary File 1

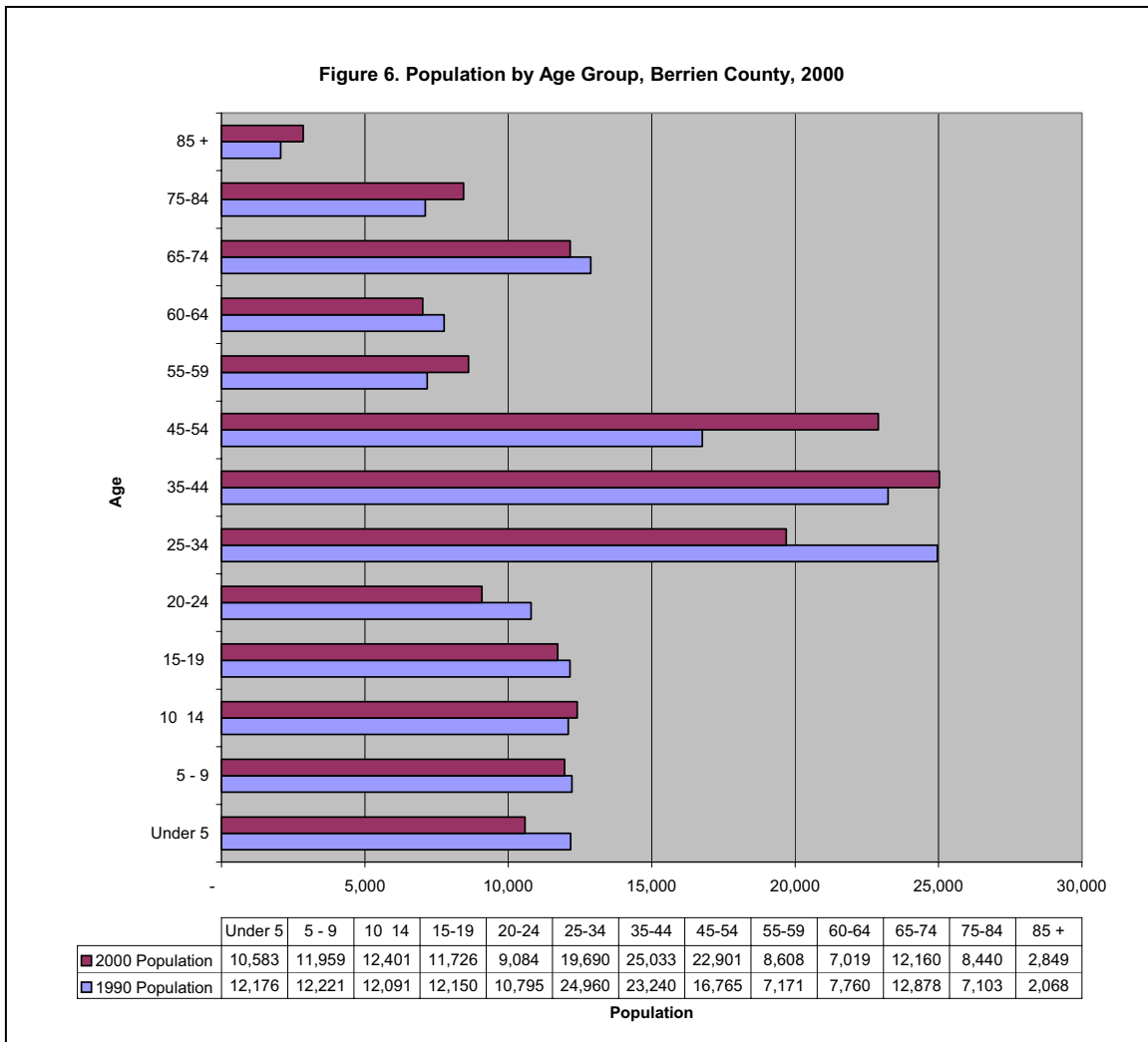
Table 2. Population Density, Berrien County, 2000

Population Density of Local Municipalities, 2000				
Community	Population Total	Area in Square Miles	Area in Acres	Population Density People/Acre
BERRIEN COUNTY	162,453	571	365,440	0.44
Bainbridge Township	3,132	35	2,632	0.14
Baroda Township	2,880	17	10,994	0.26
Benton Township	16,404	33	21,005	0.78
Berrien Township	5,075	36	23,161	0.22
Bertrand Township	2,380	35	22,436	0.11
Buchanan Township	3,510	38	24,520	0.14
Chikaming Township	3,678	22	14,164	0.26
Coloma Township	5,217	21	13,312	0.39
Galien Township	1,611	22	14,389	0.11
Hagar Township	3,964	19	11,964	0.33
Lake Township	3,148	19	11,915	0.26
Lincoln Township	13,952	17	10,989	1.27
New Buffalo Township	2,468	19	12,221	0.20
Niles Township	13,325	38	24,586	0.54
Oronoko Township	9,843	32	20,761	0.47
Pipestone Township	2,474	36	22,788	0.11
Royalton Township	3,888	19	11,857	0.33
St. Joseph Township	10,042	6	4,079	2.46
Sodus Township	2,139	20	12,830	0.17
Three Oaks Township	2,949	22	14,384	0.21
Watervliet Township	3,392	17	10,877	0.31
Weesaw Township	2,065	36	22,806	0.09
Benton Harbor City	11,182	4.5	2,860	3.91
Bridgman City	2,428	2.9	1,887	1.29
Buchanan City	4,681	2.6	1,661	2.82
Coloma City	1,595	0.9	568	2.81
New Buffalo City	2,200	2.4	1,550	1.42
Niles City	12,204	5.3	3,396	3.59
St. Joseph City	8,789	3.7	2,352	3.74
Watervliet City	1,843	1.3	808	2.28
Baroda Village	858	0.7	436	1.97
Berrien Springs Village	1,862	0.9	607	3.07
Eau Claire Village	656	0.8	487	1.35
Galien Village	593	0.4	272	2.18
Grand Beach Village	221	0.8	530	0.42
Michiana Village	200	0.4	233	0.86
Shoreham Village	860	0.6	366	2.35
Stevensville Village	1,191	1.1	673	1.77
Three Oaks Village	1,829	1.0	628	2.91

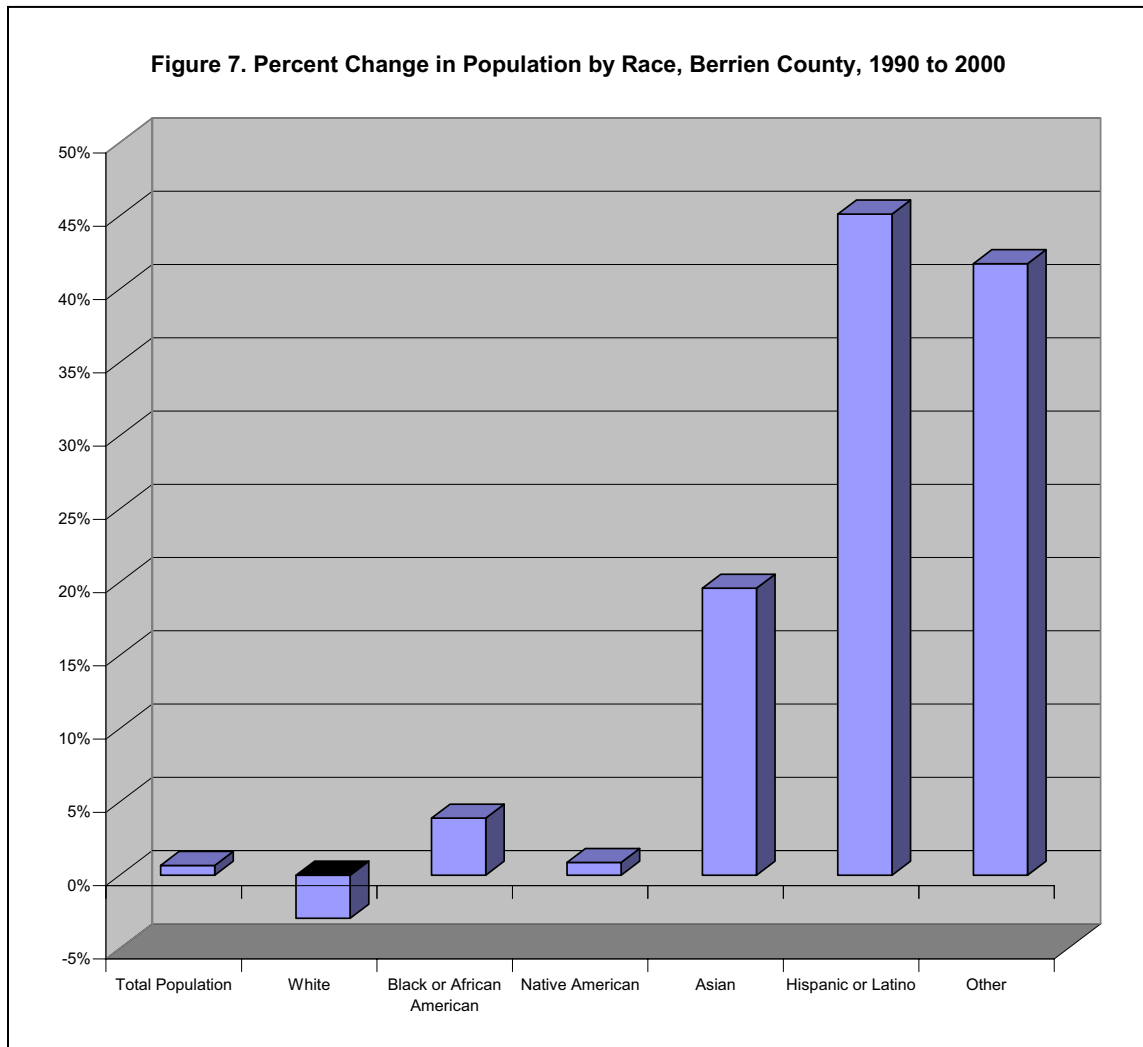
Table 3. Population by Race, Berrien County, 1990-2000

Population by Race	1990	2000	% Change
Total Population	161,378	162,453	1%
White	133,259	129,459	-3%
Black or African American	24,872	25,879	4%
Native American	685	691	1%
Asian	1,487	1,849	20%
Hispanic or Latino	2,683	4,888	45%
Other	1,075	1,845	42%

The change in population by age from 1990 to 2000 reveals that the median has increased from 33.5 in 1990 to 37.4 in 2000. Figure 6 shows the change in age groups from 1990 to 2000.



Racial composition throughout the County varies significantly. The 2000 Census indicates that there has been an increase in minority populations and a slight decrease in the majority (white) population. Figure 7 shows that percent in population by race. As the graph indicates, the County has seen a significant increase in the Hispanic/Latino population.



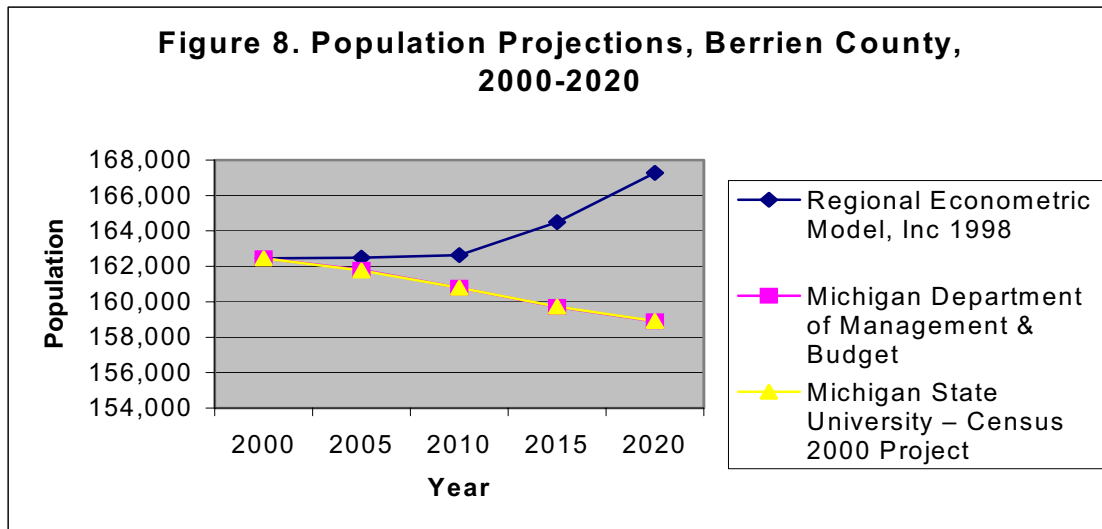
Population Projections

Three factors that modify the population of an area are births, deaths, and migration. The birth and death rate are factors that can be predicted based upon trends. The in-and-out migration is largely influenced by the local economy, transportation accessibility, development policies, and local lending policies.

The inability to predict population growth with pinpoint accuracy does not diminish the importance of projections as a guide to local decision-making. For the purpose of this *Plan*, projections are used to assess the effect of growth on current, and desired, conditions in the County. Population projections serve as a tool for determining the desired level of growth the community can bear without harming its physical and social environment.

Table 4. Population Projections, Berrien County, 2000-2020

Information Source	YEAR				
	2000	2005	2010	2015	2020
Regional Econometric Model, Inc 1998	162,453	162,482	162,636	164,496	167,284
Michigan Department of Management & Budget	162,300	161,800	160,800	159,700	158,900
Michigan State University – Census 2000 Project	162,268	161,761	160,788	159,721	158,914



TRENDS, PATTERNS AND PROBLEMS

Over the past 20 years, changes in land use have been influenced primarily by economic development and population changes. To understand and predict what Berrien County will look like in 2020 is by no means an easy task. To predict future land use patterns and trends, it is necessary to carefully analyze the changes in several factors.

Twenty years ago, the County consisted of residential and commercial uses complementing each other in the urban centers. Industrial uses were developed near urban centers or just outside the edge of the urban boundary. Then, as now, parks and recreational facilities were scattered throughout the County, with the natural beauty of Lake Michigan enhancing the quality of life in the area. Although farmland dominated the rural landscape, the trend of development encroaching upon prime farmland was beginning. Because much of this farmland may not drain well due to soil conditions and/or because of high water tables, future development in these areas could result in flooding problems.

Today, residential development appears to be moving away from core urban centers and extending farther out. This “sprawling” effect is prevalent throughout the nation and is among many of the hot issues facing community planners, environmentalists, economists, and citizens.

It is evident that population growth in the County is stagnant. Over the last 10 years, the County has grown only 7 percent. As two of the three population projections indicate, the County will have a slight decrease in population, but the growth and development rate may continue to increase. This reflects the current trend of smaller household sizes and the increasing popularity of the further development of subdivisions and condominiums. The economy and market will also be a significant factor in determining the future land uses for 2020.

Preservation is the “buzzword” of the 21st century. Interest in farmland, open space, and historic preservation are all on the rise with legislation providing the tools to regulate, manage, and control growth. That is, in effect, what a future land use map does by creating desired goals and strategies based on what the community values.

Figure 9 is a compilation of future land uses identified by local municipalities in their development plans. The goal for each township, city, and village future land use map is to guide growth based on an inventory of existing land uses, current development trends, and community input.

Due to the autonomy of local municipalities in creating their own development plans, each uses their own definitions of residential land use, which can include a wide range of densities. In general, residential land use will continue to locate along major road corridors and in urban centers. One issue to be concerned with are areas where industrial uses are adjacent to residential uses without the use of transition zones. This can often be seen between municipalities and within a single municipality. These types of issues are among many addressed under the new township, city, and village planning and zoning

laws (PA 263, 264, 265 of 2001), which require that neighboring municipalities review new/updated development plans to see if there are areas of conflict that should be addressed.

Commercial uses concentrate in major road corridors and within urban boundaries. In a dynamic environment, a variety of commercial uses will continue to increase along major roads and complement the character of the neighborhoods.

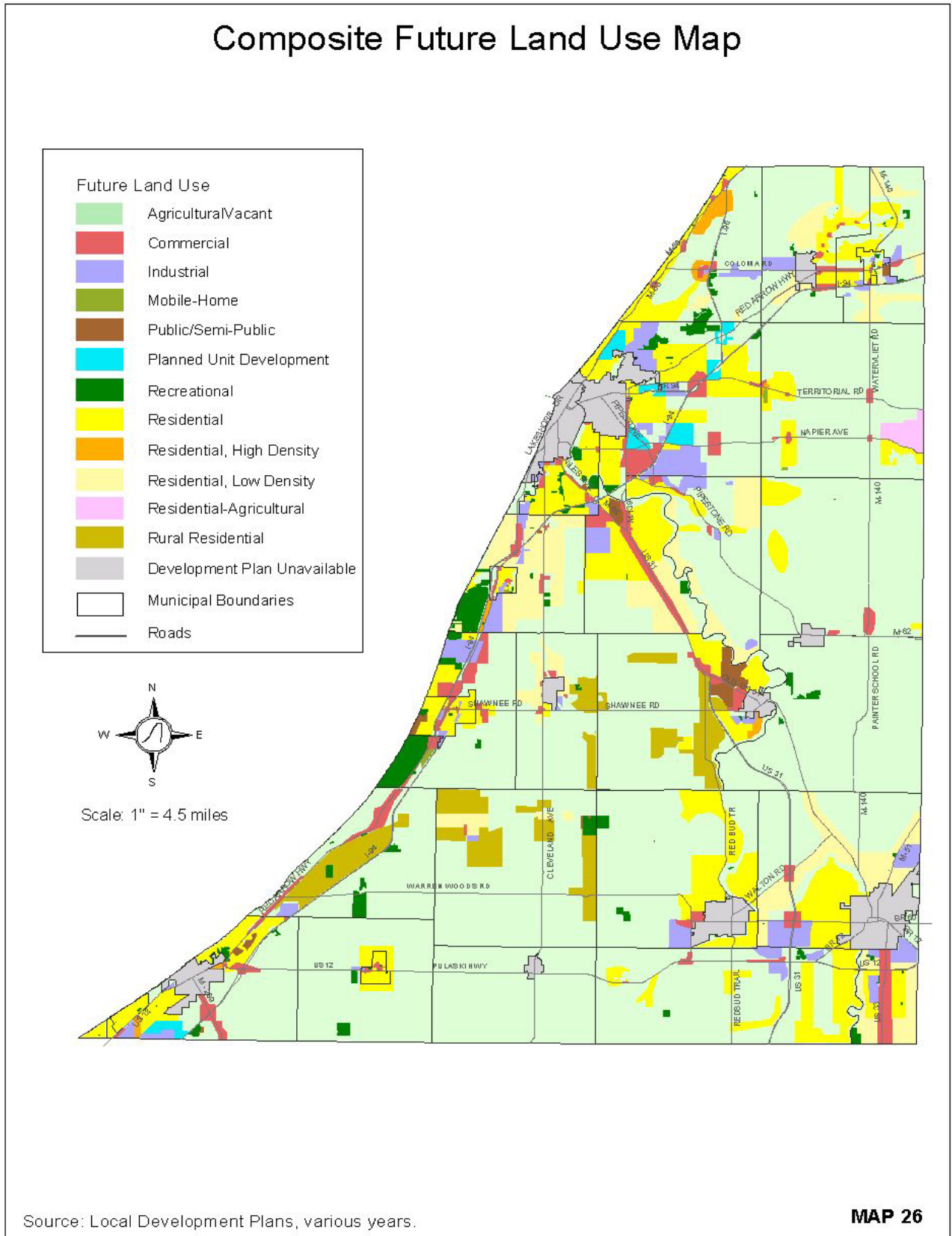
Industrial districts are scattered throughout Berrien County. Municipalities should require industrial uses to locate on vacant lands already planned for industrial use, rather than creating new industrial areas. The community benefits when industrial businesses are required to use already available sites that comply with the municipality's adopted plan, which should locate industrial uses where they have the least impact on neighboring land uses.

Open Space and Recreational Uses range from small corner lots to state parks. There are several beautiful parks and recreational areas throughout the County. The Galien River County Park, and several community skateboard parks have been acquired in response to the needs and requests of the community. Over the next 20 years, these recreational and open spaces will remain a symbol of Berrien County.

The future of agricultural land was addressed at the beginning of this document and is an important resource that helps to make up the character of Berrien County. The pressure to guide growth, while not negatively impacting farmland, is placed on each municipality and the County.

Other future developments that will affect emergency management planning include: 1) a proposed casino in the New Buffalo area, 2) a proposed passenger ferry running from Chicago to St. Joseph/Benton Harbor, 3) a proposed aquarium in Benton Harbor, and 4) development (residential and commercial) throughout the County in floodplains and areas with high water tables or unsuitable soils (poor drainage).

Figure 9. Composite Future Land Use, Berrien County

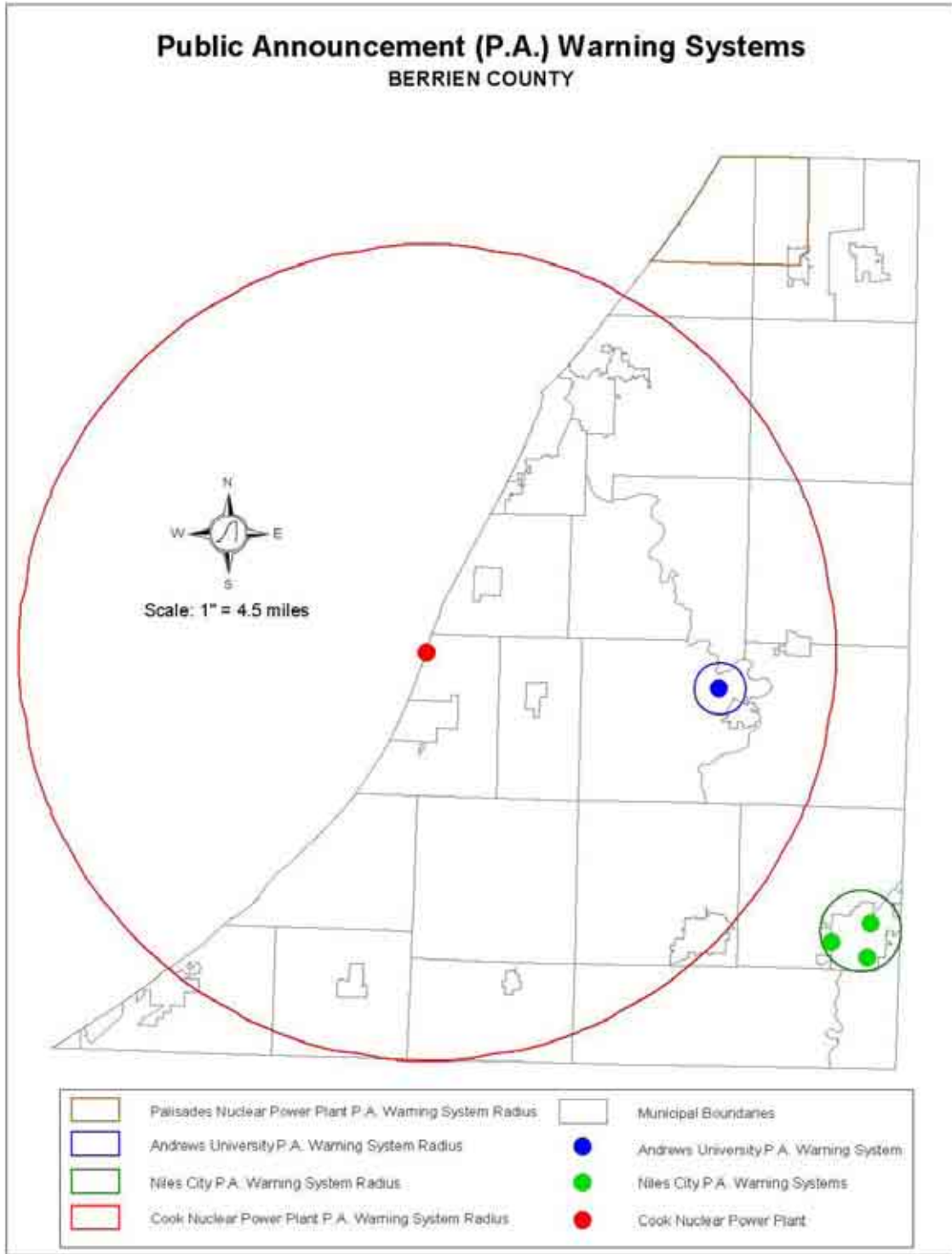


CRITICAL FACILITIES/WARNING SYSTEM COVERAGE

Critical facilities are defined in the FEMA planning guide as those facilities that “Are essential to the health and welfare of the whole population and are especially important following hazard events.” For example, the impact of a tornado hitting a hospital is greater than on a home. Critical facilities are defined as fire stations, police/law enforcement facilities, hospitals, shelters, administration buildings, airports, nursing home/assisted care facilities, schools, places of assembly, etc. County staff and municipal officials provided information regarding the number and location of these facilities within Berrien County. Table 5 lists type and number of Critical Facilities per municipality.

Warning system coverage is vital to providing adequate notice of imminent dangers to residents. This is especially true for those outside such as families at ball fields or playgrounds, construction workers and agricultural workers. Figure 10 shows the existing warning system coverage in Berrien County. During investigation of coverage it was discovered that almost all fire departments in the county have old siren systems that are no longer used or maintained. These systems are not included in the map.

Figure 10. Warning System Coverage, Berrien County, 2004



Source: Berrien County Sheriffs Department, 2004

HAZARD RANKING

PROCESS

After a thorough review of the community profile, a county hazard ranking was completed using a three-step process. The first step was the selection of evaluation criteria, the second step was assigning relative weights to each of the rating criteria and the third step was assigning point values to the selected criteria for each of the hazards.

The selection of the evaluation criteria was done by determining which aspects of the hazards were of greatest concern to the community. Six evaluation criteria (see below) were selected. Each of the evaluation criteria was then assigned a “weight” to express the level of importance each of the criteria will have in ranking hazards. The sum of the weights of all of the evaluation criteria must equal 100 percent. Point values between 0-10 were assigned; with 0 posing the least threat or least negative impact and 10 posing the greatest threat and greatest impact. Using a spreadsheet, values were input and calculated to provide a hazard score and ranking as shown in Table 6.

Hazard Analysis Evaluation Criteria

The six evaluation measures used to evaluate each hazard facing the community are as follows:

1. *Likelihood of Occurrence* Likelihood of occurrence measures the frequency with which a particular hazard occurs. The more frequently a hazard event occurs, the more potential there is for damage and negative impact on a community.
2. *Percent of Population Affected* This aspect of the hazard determines how widespread the effects of a hazard will be by the amount of people impacted.
3. *Potential for Causing Casualties* Potential for causing casualties refers to the number of casualties (deaths and injuries) that can be expected if a particular hazard event occurs.
4. *Potential for Negative Economic Effects* Economic effects are the monetary damages incurred from a hazard event, and include both public and private damage. Direct physical damage costs, as well as indirect impact costs such as lost business and tax revenue, are included as part of the total monetary damages.
5. *Corollary Effects* Corollary effects are consequences of the hazard but often are considered an indirect effect. Corollary effects can include economic effects, but also other effects that are not easy to put a price tag on.
6. *Public Awareness of Hazard* Public awareness of the hazard is important because the more aware the public is the more prepared the public will be to deal with the effects of a hazard. Many of the hazard mitigation actions require the public to use safe behavior and take corrective actions with homes and businesses.

Table 6. All-Hazard Ranking and Scoring Summary, Berrien County

Rank	Hazards	Score
1	Severe Winter Weather	6.95
2	Nuclear Power Plant Accident	6.60
3	Extreme Temperature	6.35
4	Tornado	6.25
5	Infrastructure Failures	6.15
6	Severe Winds	5.60
7	Structural Fires	4.95
8	Terrorism/Sabotage/CBRNE	4.75
9	Dam Failures	4.70
10	HazMat Transportation Accident	4.60
11	HazMat Fixed Site Accident	4.30
12	Transportation Accidents	4.00
13	Public Health Emergencies	3.95
14	Lightning	3.80
15	Pipeline Accidents	3.70
16	Drought	3.60
17	Shoreline Flooding/Erosion	3.25
18	Hail	3.20
19	Riverine Flooding	3.00
20	Civil Disturbance	2.65
21	Wildfires	2.45
22	Oil and Gas Well Accidents	2.20
23	Earthquakes	2.05
24	Scrap Tire Fires	1.55
25	Subsidence	1.15

Table 7. Natural Hazard Ranking and Scoring Summary, Berrien County

Rank	Natural Hazards	Total Hazard Score
1	Severe Winter Weather	6.95
2	Extreme Temperature	6.35
3	Tornado	6.25
4	Severe Winds	5.60
5	Dam Failures	4.70
6	Public Health Emergencies	3.95
7	Lightning	3.80
8	Drought	3.60
9	Shoreline Flooding/Erosion	3.25
10	Hail	3.20
11	Riverine Flooding	3.00
12	Wildfires	2.45
13	Earthquakes	2.05
14	Subsidence	1.15

Table 8. Man Made Hazard Ranking and Scoring Summary, Berrien County

Rank	Man-Made Hazards	Total Hazard Score
1	Nuclear Power Plant Accident	6.60
2	Infrastructure Failures	6.15
3	Structural Fires	4.95
4	Terrorism/Sabotage/ WMD	4.75
5	HazMat Transportation Accidents	4.60
6	HazMat Fixed Site Accidents	4.30
7	Transportation Accidents	4.00
8	Pipeline Accidents	3.70
9	Civil Disturbance	2.65
10	Oil and Gas Well Accidents	2.20
11	Scrap Tire Fires	1.55

Table 9. Berrien County All-Hazards Scoring Table

Hazard	Evaluation Criteria										Total Rating Sum of All Columns (100%)
	Likelihood of Occurrence (30%)	Percent of Population Affected (20%)	Potential for Causing Casualties (20%)	Potential for Negative Economic Effects (15%)	Corollary Effects (10%)	Public Awareness of Hazard (5%)					
Civil Disturbance	2 x .30 =0.6	2 x .20 =0.4	2 x .20 =0.4	6 x .15 =0.9	3 x .10 =0.3	1 x .05 =0.05	2.65				
Drought	3 x .30 =0.9	6 x .20 =1.2	1 x .20 =.2	6 x .15 =0.9	3 x .10 =0.3	2 x .05 =0.1	3.60				
Earthquakes	1 x .30 =0.3	5 x .20 =1.0	1 x .20 =0.2	2 x .15 =0.3	2 x .10 =0.2	1 x .05 =0.05	2.05				
Extreme Temperatures	8 x .30 =2.4	10 x .20 =2.0	4 x .20 =0.80	3 x .15 =0.45	4 x .10 =0.4	6 x .05 =0.3	6.35				
Scrap Tire Fires	1 x .30 =0.3	1 x .20 =0.2	1 x .20 =0.2	4 x .15 =0.6	2 x .10 =0.2	1 x .05 =0.05	1.55				
Structural Fires	9 x 30 =2.7	2 x .20 =0.4	4 x .20 =0.8	4 x .15 =0.6	2 x .10 =0.2	5 x .05 =0.25	4.95				
Wildfires	2 x .30 =0.6	2 x .20 =0.4	2 x .20 =0.4	2 x .15 =0.3	3 x .10 =0.3	9 x .05 =0.45	2.45				
Dam Failures	2 x .30 =0.6	4 x .20 =0.8	8 x .20 =1.6	7 x .15 =1.05	5 x .10 =0.5	3 x .05 =0.15	4.70				
Riverine Flooding	4 x .30 =1.2	2 x .20 =0.4	1 x .20 =0.2	2 x .15 =0.3	5 x .10 =0.5	8 x .05 =0.4	3.00				
Shoreline Flooding	5 x .30 =1.5	1 x .20 =0.2	2 x .20 =0.4	4 x .15 =0.6	2 x .10 =0.2	7 x .05 =0.35	3.25				
Fixed-Site Hazmat Incident	6 x .30 =1.8	3 x .20 =0.6	4 x .20 =0.8	4 x .15 =0.6	4 x .10 =0.4	2 x .05 =0.1	4.30				
Transportation Hazmat Incident	7 x .30 =2.1	3 x .20 =0.6	4 x .20 =0.8	4 x .15 =0.6	4 x .10 =0.4	2 x .05 =0.1	4.60				
Infrastructure Failures	7 x .30 =2.1	9 x .20 =1.8	3 x .20 =0.6	5 x .15 =0.75	5 x .10 =0.5	8 x .05 =.40	6.15				
Nuclear Power Plant Accidents	3 x .30 =0.9	10 x .20 =2.0	4 x .20 =0.8	10 x .15 =1.5	9 x .10 =0.9	10 x .05 =0.4	6.60				
Oil & Gas Well Accidents	2 x .30 =0.6	1 x .20 =0.2	3 x .20 =0.6	3 x .15 =0.45	3 x .10 =0.3	1 x .05 =0.05	2.20				
Pipeline Accidents	2 x .30 =0.6	3 x .20 =0.6	5 x .20 =1.0	6 x .15 =0.9	5 x .10 =0.5	2 x .05 =0.1	3.70				
Public Health Emergencies	4 x .30 =1.2	4 x .20 =0.8	4 x .20 =0.8	5 x .15 =0.75	3 x .10 =0.3	2 x .05 =0.1	3.95				
Terrorism/Sabotage/WMD	2 x .30 =0.6	4 x .20 =0.8	7 x .20 =1.4	7 x .15 =1.05	8 x .10 =0.8	1 x .05 =0.1	4.75				
Subsidence	1x .30 =0.3	1 x .20 =0.2	1 x .20 =0.2	1 x .15 =0.15	2 x .10 =0.2	1 x .05 =0.1	1.15				
Hail	5 x .30 =1.5	4 x .20 =0.8	1 x .20 =0.2	2 x .15 =0.3	3 x .10 =0.3	2 x .05 =0.1	3.20				
Lightning	6 x .30 =1.8	2 x .20 =0.4	2 x .20 =0.4	4 x .15 =0.6	4 x .10 =0.4	4 x .05 =0.2	3.80				
Severe Winds	6 x .30 =1.8	9 x .20 =1.8	3 x .20 =0.6	4 x .15 =0.6	6 x .10 =0.6	4 x .05 =0.2	5.60				
Tornadoes	8 x .30 =2.4	6 x .20 =1.2	4 x .20 =0.8	5 x .15 =.75	7 x .10 =0.7	8 x .05 =0.4	6.25				
Transportation Accidents	4 x .30 =1.2	2 x .20 =0.4	5 x .20 =1.0	6 x .15 =0.9	4 x .10 =0.4	2 x .05 =0.1	4.00				
Severe Winter Weather	8 x .30 =2.4	9 x .20 =1.8	4 x .20 =0.8	5 x .15 =0.75	7 x .10 =0.7	10 x .05 =0.5	6.95				

MUNICIPALITY HAZARD RANKING

Each municipality was given the opportunity to either accept the County's ranking of the hazards or to rank the hazards differently for their community. The results are below:

Table 10. Municipality Ranking of Hazards

County Rank	Hazards	Bainbridge Twp	Baroda Twp	Benton Twp	Berrien Twp	Bertrand Twp	Buchanan Twp	Chikaming Twp	Niles Twp	Shoreham Village	Sodus Twp	Three Oaks Twp	Watervliet City
1	Severe Winter Weather	1	1	2	2	1	1	1	1	1	1	1	1
2	Nuclear Power Plant Accident	5	2	3	2	6	8	2	2	2	2	2	2
3	Extreme Temperature	6	3	6	3	14	3	11	4	3	3	3	4
4	Tornado	25	4	16	1	4	4	6	5	4	5	4	5
5	Infrastructure Failures	10	6	4	5	5	5	12	6	5	6	5	6
6	Severe Winds	3	7	9	5	2	9	5	8	6	7	6	7
7	Structural Fires	7	8	7	7	7	10	13	9	7	8	7	8
8	Terrorism/Sabotage/CBRNE	24	9	10	8	8	13	9	10	9	9	8	9
9	Dam Failures	15	25	25	4	9	6	15	11	10	10	18	3
10	HazMat Transportation Accident	14	10	5	10	10	11	3	12	8	11	10	10
11	HazMat Fixed Site Accident	12	11	14	11	11	2	10	13	12	12	11	11
12	Transportation Accidents	11	12	1	12	12	12	4	14	13	13	12	12
13	Public Health Emergencies	13	13	17	13	13	14	16	15	14	14	13	13
14	Lightning	8	14	13	14	3	17	17	16	15	15	14	19
15	Pipeline Accidents	16	5	8	15	15	7	7	7	16	16	15	15
16	Drought	4	15	12	16	16	16	18	17	17	17	16	16
17	Shoreline Flooding/Erosion	23	16	18	17	17	18	8	18	11	18	17	17
18	Hail	2	17	11	18	18	19	19	19	18	4	9	18
19	Riverine Flooding	22	18	19	19	19	15	14	20	19	19	19	14
20	Civil Disturbance	18	19	15	20	20	20	20	21	20	20	20	20
21	Wildfires	9	20	20	21	21	21	21	22	21	21	21	21
22	Oil and Gas Well Accidents	21	21	21	22	22	22	22	3	22	22	22	22
23	Earthquakes	20	22	23	23	23	23	23	23	23	23	23	23
24	Scrap Tire Fires	17	23	24	3	24	24	24	24	24	24	24	24
25	Subsidence	19	24	22	25	25	25	25	25	25	25	25	25

The following municipalities accepted the County's ranking of the hazards:

Baroda Village	Benton Harbor City	Berrien Springs Village
Bridgman City	Buchanan City	Coloma City/Twp
Eau Claire Village	Galien Village/Twp	Grand Beach Village
Hagar Twp	Lake Twp	Lincoln Twp
New Buffalo City/Twp	Niles City	Oronoko Twp
Pipestone Twp	Royalton Twp	St. Joseph City/Twp
Stevensville Village	Three Oaks Village	Weesaw Twp
Watervliet Twp		

RISK AND VULNERABILITY ASSESSMENT

Based on the weighted hazard ranking process recommended in the Michigan Hazard Analysis workbook and the 2002 Berrien County Hazard Analysis, a composite of hazards and relative risk are presented below. This list will be used as the foundation for developing hazard mitigation goals and strategies in subsequent chapters. For risk assessment, the following definitions apply:

High Risk: Very likely to occur over the hazard mitigation planning horizon of 20 years

Medium Risk: Somewhat likely to occur

Low Risk: Not likely to occur

The vulnerability assessment looks at such points as population concentrations, age-specific populations, development pressures, types of housing (older homes, mobile homes), presence of agriculture, sprawl (spreading resources too thin), and other issues that may make Berrien County more vulnerable (as defined below) to specific hazards.

High Vulnerability: If an event occurred it would have severe impacts over large geographic areas or more densely populated areas and have a serious financial impact on County residents and businesses.

Medium Vulnerability: If an event occurred it would have confined impacts on the safety of residents but would have a financial impact on County residents and businesses.

Low Vulnerability: If an event occurred it would have very minimal impact on the safety of County residents and minimal financial impact on County residents and businesses.

The combination of these two factors (risk and vulnerability assessment) result in the composite hazard ranking of high, moderate, or low.

Table 11. Risk and Vulnerability Assessment Summary, Berrien County

Hazards	Risk Assessment	Vulnerability Assessment	Composite Hazard Ranking
Severe Winter Weather	High	High	High
Nuclear Power Plant Accident	Low	High	High
Extreme Temperature	High	Medium-High	High
Thunderstorms (tornados, severe winds, lightning, hail)	High	High	High
Infrastructure Failures	High	High	High
Structural Fires	High	Low – High	Moderate
Terrorism/Sabotage/CBRNE	Medium	Medium-High	Moderate
Dam Failures	Medium	Medium – High	Moderate
HazMat Transportation Accident	High	Medium	Moderate
HazMat Fixed Site Accident	Medium	Medium	Moderate
Transportation Accidents	High	Medium	Moderate
Public Health Emergencies	Low-Medium	Medium-High	Moderate
Pipeline Accidents	Low	Medium-High	Moderate
Drought	Low	Medium	Moderate
Shoreline Flooding/Erosion	High	Low- Medium	Moderate
Riverine Flooding	High	Low -Medium	Moderate
Civil Disturbance	Low	Low	Low
Wildfires	Low	Low	Low
Oil and Gas Well Accidents	Low	Low	Low
Earthquakes	Low	Low	Low
Scrap Tire Fires	Low	Low	Low
Subsidence	Low	Low	Low

HAZARD ANALYSIS

SEVERE WINTER WEATHER

“Periods of extreme meteorological conditions usually accompanied by high winds, cold temperatures, and freezing precipitation”

Severe winter weather hazards include snowstorms, blizzards, extreme cold, freezing rain, and sleet. As a northern state, Michigan is vulnerable to all of these winter hazards. Most of the severe winter weather events that occur in Berrien County have their origins in Canadian and Arctic cold fronts that move across the state from the west or northwest and utilize the warmer Lake Michigan waters as a catalyst for producing extreme weather conditions. Severe snow and ice storms have a significant impact on Berrien County. In communities along the shoreline, the lake effect increases cloudiness and snowfall during the winter months.

Severe winter weather is the highest-ranking hazard affecting Berrien County. In surveying the local governments in Berrien County, severe winter weather is a concern for all. Many local governments are concerned with the icy road conditions on Interstate 94 and possible infrastructure failures due to power outages.

Frequency

Berrien County often receives a large number of snowstorms because of its shoreline location. Lake effect snows have resulted in significant snowfall amounts for the County, with yearly averages of 71 inches. Ice and sleet storms also occur frequently from January through March. The tables below show annual monthly mean snowfall and record snowfall totals for the winter months in Berrien County. The three recording locations in Berrien County (Niles, Benton Harbor, and Eau Claire) receive about the same annual average snowfall. Niles has a slightly higher annual monthly mean snowfall in March, April, October, and November compared to Benton Harbor and Eau Claire.

At the Niles weather station, the 1950-51 through 1979-80 average seasonal snow accumulation was 68.3 inches. During this period, 69 days per season averaged 1 inch or more of snow on the ground, but varied greatly from season to season. At the Eau Claire weather station, the 1950-51 through 1979-80 average seasonal snow accumulation was 69.8 inches. During this period, 74 days per season averaged 1 inch or more of snow on the ground, but varied greatly from season to season. At the Benton Harbor weather station, the 1950-51 through 1979-80 average seasonal snow accumulation was 70.8 inches. During this period, 59 days per season averaged 1 inch or more of snow on the ground, but varied greatly from season to season.

Table 12. Annual Monthly Mean Snowfall for Berrien County (in inches) 1951-1980

Month	Benton Harbor	Niles	Eau Claire
January	22.7	17.2	21.5
February	13.9	12.3	13.2
March	7.8	8.7	7.3
April	1.6	3.1	1.9
October	0.4	1.0	0.8
November	5.9	9.4	7.8
December	18.0	15.8	17.4
Annual Average	70.3	67.5	69.9

(Source: MSU Climatology Program)

Table 13. Record Snowfall Total/Year for Berrien County (in inches) 1951-1980

Month	Benton Harbor	Niles	Eau Claire
January	29/1966	39/1978	31/1978
February	29/1966	38/1978	29/1978
March	19/1978	23/1978	22/1963
April	12/1970	5/1970	10/1970
October	5/1954	2/1962	6/1954
November	10/1964	9/1951	9/1969
December	33/1962	30/1962	25/1962
Annual Bests	33/1962	39/1978	31/1978

(Source: MSU Climatology Program)

According to the NOAA, (National Oceanic and Atmospheric Administration) 49 snow and ice events were reported in Berrien County between January 1, 1950 and February 29, 2004. (Source: <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>) Between 1974 and 2001, Berrien County has experienced four Presidential Emergency Declarations and three Governor Disaster Declarations due to severe winter weather. (See tables below.)

Table 14. Presidential Declarations, Berrien County, 1974-2001

Date	Area	Disaster	Declaration
December 11-31, 2000	39 Counties	Blizzard/Snowstorm	Emergency
January 2-15, 1999	31 Counties	Blizzard/Snowstorm	Emergency
January 26-27, 1978	Statewide	Blizzard/Snowstorm	Emergency
January 26-31, 1977	15 Counties	Blizzard/Snowstorm	Emergency

Table 15. Governor's Declarations, Berrien County 1974-2001

Date	Area	Disaster	Declaration
January 15, 1985	13 Counties	Ice storm	Disaster
January 26, 1978	Statewide	Blizzard/Snowstorm	Disaster
January 28, 1977	15 Counties	Blizzard	Disaster

Significant Severe Winter Weather Events in Berrien County

Winter Season 1962-1963

Berrien County received excessive amounts of snow during the entire winter season of 1962-1963. In December of 1962, Berrien County received nearly 33 inches of snow - almost double the monthly average.

March 2-7, 1976

During the period from March 2-7, 1976, an ice storm with accompanying high winds and tornados struck a 29-county area in central Lower Michigan. This storm, one of the worst to ever hit the state, caused \$56 million in damage and widespread power outages.

January 26-30, 1977

Beginning January 26, and lasting for several days, a severe snowstorm affected vast portions of southern Michigan, including Berrien County. Winds of blizzard speeds resulted in extensive drifting of snow that blocked many roads. This storm was so severe that it resulted in a Governor's Disaster Declaration and a Presidential Emergency Declaration for a 15-county area.

January 26-27, 1978

On these two days, a severe snowstorm affected the entire state, dumping nearly the entire monthly total of 33 inches of snow on Berrien County in just one storm. At the height of the storm it was estimated that, statewide, over 50,000 miles of roadway were blocked, 104,000 vehicles abandoned, and over 390,000 homes were without electrical power. This storm resulted in both a Governor's Disaster Declaration and a Presidential Emergency Declaration for the entire state.

February 21-24, 1993

An Arctic blast, fueled by strong northwest winds, produced a three-day lake effect snowfall event dumping 10- 20 inches of snow on Berrien County. This snow fell on top of what had fallen during the previous two days with a synoptic storm, leaving snow depths of up to 27 inches in parts of the County.

January 20-24, 1995

Heavy snow fell across large areas of southern Lower Michigan as a low pressure cell stalled and became stationary near Lake Ontario, leaving behind up to 12 inches of snow across most of southern Lower Michigan.

January 10-12, 1997

Many schools and businesses closed early on the 10th due to heavy snowfall from a lake effect snowstorm. This snowstorm continued to blanket much of the area for three days, leaving 12-28 inches of snow in its wake causing numerous roadways to be closed. Schools throughout the area were used as warming shelters for stranded motorists.

January 15-16, 1997

In a 23-hour period, lake effect snows piled up as much as 12 inches throughout most of the area. High winds of 20-30 miles per hour, with gusts up to 40 miles per hour, created blizzard conditions for most of the day, closing schools, businesses, and roadways.

December 30-31, 1997

A northwest wind flow around a strong low-pressure system moving up the East Coast brought a surge of Arctic air across Lake Michigan. Lake effect snow brought accumulations of 6-12 inches throughout Berrien County, snarling traffic and closing businesses for two days.

January 7-8, 1998

A winter storm system produced a mix of snow, sleet, and freezing rain across Berrien County. Freezing rain first covered the area during the early evening hours of the 7th. As colder air moved south, the freezing rain and sleet changed over to lake effect snow, resulting in storm accumulation totals of approximately six inches. The preceding ice accumulated about one quarter inch, downing power lines and trees from the weight of the glaze. Icy roads caused multiple traffic accidents throughout the area.

January 20-21, 2000

The coldest air of the season, coupled with a vigorous low-pressure system, created a tremendous shore parallel snow band as it blew in over the warmer waters of Lake Michigan. Many areas throughout Berrien County reported snowfall rates of 2 to 3 inches per hour with whiteout conditions. Snow accumulation ranged from 8-15 inches, with the heaviest amounts falling near the Berrien/Cass County line.

December 23-24, 2001

Heavy lake effect snow began falling across Berrien County the evening of the 23rd and throughout the day and night of the 24th. Snow accumulation totals averaged 12 inches during this 24-hour storm.

January 31, 2002

The first major winter storm of the season brought an ice storm to much of Berrien County with ice accumulations of up to one half inch in some locations. Many trees and power lines were reported down, leaving over 250,000 homes without power. Icy roads resulted in many traffic accidents and stranded motorists. Despite the widespread icing, actual property damage was limited to minor vehicle damage.

March 2, 2002

An area of low pressure moved across the area, forcing very cold air to pass over the unfrozen waters of Lake Michigan, which resulted in widespread heavy lake effect snow. A total of 6-12 inches fell throughout Berrien County as a result of this late season snow event.

January 23-24, 2003

Lake effect snow developed as a result of very cold air moving across warmer Lake Michigan. Snow accumulations ranged from 2-7 inches across the area.

February 7, 2003

A heavy band of lake effect snow fell over Berrien County throughout the day with accumulations of nearly 12 inches reported in Benton Harbor. The near total whiteout conditions in the early afternoon hours caused a massive 80-car pileup on Interstate 94,

killing one and injuring over 25 others and forcing the closure of this major highway for nearly 24 hours. This accident holds the record for the largest scale multiple car accident in the country.

Safety/Health

Severe winter weather contributes to a number of deaths in Berrien County each year. Winter storms are known as “deceptive killers” because most deaths occur indirectly due, in part, to traffic accidents, heart attacks, and hypothermia.

Heavy snow can immobilize a region and paralyze a community by stranding motorists, stopping the flow of supplies and commodities, and disrupting emergency and medical services. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians.



The best personal protection against severe winter weather is to stay indoors, only travel outside if it is absolutely necessary, and dress warmly by wearing loose fitting, layered, lightweight clothing.

Damage/Critical Facilities

The major impact of snow and ice on property is damage to utilities and roads. Strong winds, accumulations of heavy snow, and ice can bring down trees, electrical wires, telephone lines, communication towers, and even collapse buildings. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. This type of damage can create high infrastructure costs for government and private industry. Small accumulations of ice can be extremely dangerous to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces.

Economic Impact

The cost of snow removal, repair of property damage, and loss of business can have a significant impact on the economy. In rural areas, homes and farms may be isolated for days and unprotected livestock may be lost. Ice or severe freezing during the growing season can also damage crops, resulting in significant loss of revenue. The costs associated with a severe winter storm are widespread affecting both private and public entities. It is very difficult to estimate the annual costs of severe winter weather events.

NUCLEAR POWER PLANT ACCIDENTS

“An actual or potential release of radioactive material at a commercial nuclear power plant or other nuclear facility, in sufficient quantity to constitute a threat to the health and safety of the off-site population”

Though the construction and operation of nuclear power plants is closely monitored and regulated by the Nuclear Regulatory Commission (NRC), accidents at these plants are considered a possibility and appropriate on-site and off-site emergency planning is conducted. An accident could result in the release of potentially dangerous levels of radioactive materials into the environment that could affect the health and safety of the public living near the plant. A nuclear power plant accident might involve both a release of air-borne radioactive materials and radioactive contamination of the environment around the plant. The degree and area of environmental contamination could vary greatly depending on the type and amount of radioactivity released and prevailing weather conditions. Response to a nuclear power plant accident requires specialized personnel who have been trained to handle radioactive materials safely, who have specialized equipment to detect and monitor radiation, and who are trained in personal radiation exposure control.

Since the Three Mile Island accident in 1979, federal, state, and local governments have developed detailed radiological emergency response plans for each nuclear power plant based on NUREG 0654 and subsequent federal regulations and guidance. These plans are exercised on a biennial basis and are reviewed by the Federal Emergency Management Agency (FEMA) and the Nuclear Regulatory Commission (NRC).

The federal government strictly regulates ownership and use of radioactive materials. Nuclear power plants must follow strict building and safety codes. Material storage, use, and waste management practices are strictly monitored. In 1977, President Carter placed a moratorium on the shipping of spent fuel from commercial nuclear power plants to burial sites or spent-fuel reprocessing centers. Spent fuel is now stored at the plant site in spent fuel pools or dry cask storage facilities on-site until the issue of permanent nuclear waste disposal is resolved.

Response to a nuclear power plant accident in Michigan is the joint responsibility of the plant owner/operator and federal, state, and local government. State and local government implementation of protective actions, and other preparedness and response activities, are based on the Nuclear Accident Emergency Action Level Classification System. In most cases, the Primary Emergency Planning Zone (EPZ) around a nuclear power plant is 10 miles. Within this zone, plans are developed to protect the public through in-place sheltering and evacuation in the event of an accident. The area within the Primary EPZ for which protective actions are implemented will depend on the type and amount of radioactive material released and current weather factors. The Secondary EPZ, consisting of a 50-mile radius around most plants, exists for planning considerations that prevent the introduction of radioactive contamination into the food chain.

With three commercial nuclear power plants currently operating in Michigan, emergency preparedness is required in all potentially affected jurisdictions. Two of those plants, D.C. Cook in Berrien County (Bridgman) and Palisades in Van Buren County, could

directly affect the residents of Berrien County should a disaster occur. According to the responses on the hazard identification worksheets completed by Berrien County municipalities, almost all are concerned about potential impacts from an accident at the D.C. Cook Nuclear Plant or the Palisades Nuclear Plant.

Although there have been recorded incidents at both plants (Palisades and Cook) resulting in *Unusual Events*, the lowest classification of alert, safety designs and features mandated by the federal government have safely and effectively prevented the events from cascading into full-blown emergencies and no significant major event has ever occurred in Berrien County. Even though there has been no documented releases or major problems, this hazard is ranked high in Berrien County. This is because of the potential devastating effects to the population if there was an accident with a release.

Even though this is ranked a high hazard in Berrien County, nuclear power plant accidents are not given much attention in this document because there are already many mitigation activities in place. Most activities are mandated such as emergency warning systems and regular drills. Federal, state, and local governments, and utility personnel take extensive precautions to ensure that should a nuclear accident happen its impact on the safety and well being of the general public and the environment will be minimal. These precautions include continual development and testing of emergency plans, training of response personnel, bi-annual full-scale drills, coordination of response actions, and the development and dissemination of emergency public information. These plants are strictly monitored and regulated by both the Nuclear Regulatory Commission (NRC) and the Federal Emergency Management Agency (FEMA) and are held accountable to higher standards of operation than any other industry in the United States.

Figure 11. Nuclear Power Plants in Michigan



EXTREME TEMPERATURE

“Prolonged periods of very high or very low temperatures, often accompanied by other extreme meteorological conditions”

Prolonged periods of extreme temperatures, whether extreme summer heat or extreme winter cold, can pose severe and often life-threatening problems for residents of Berrien County. Although they are radically different in terms of conditions and impacts, 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. Extreme temperatures can also negatively impact livestock, crops, and wildlife. Extreme temperatures are ranked as a high hazard priority for Berrien County.

Extreme summer weather is characterized by a combination of very high temperatures and exceptionally humid conditions. When these conditions persist over a long period of time, this phenomenon is commonly called a heat wave. A heat index is often used in summer months to express the possible dangers of extreme heat. The heat index is designed to show how hot it really *feels*, based upon the combination of heat and humidity. Exposure to full sunshine can increase the heat index by 15 degrees Fahrenheit.

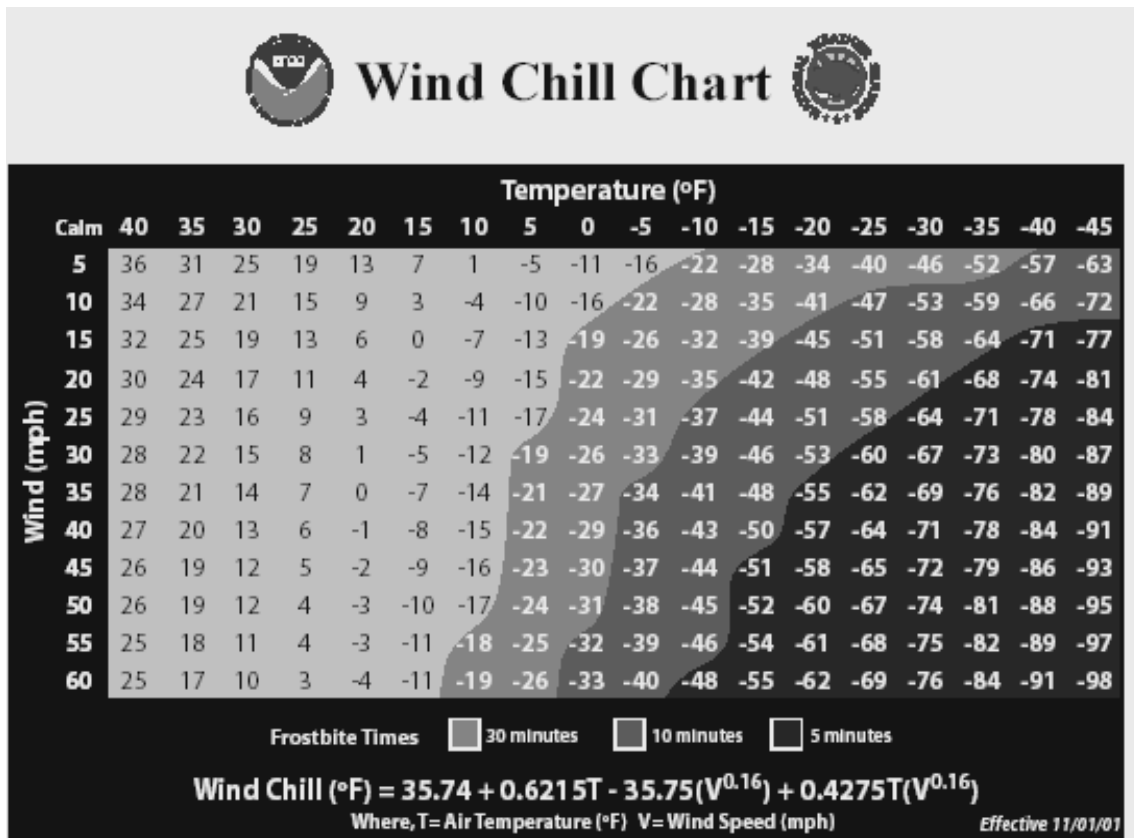
Figure 12. Heat Index

Temperature (F) versus Relative Humidity (%)									
°F	90%	80%	70%	60%	50%	40%	30%	20%	10%
65	65.6	64.7	63.8	62.8	61.9	60.9	60.0	59.1	58.1
70	71.6	70.7	69.8	68.8	67.9	66.9	66.0	65.1	64.1
75	79.7	76.7	75.8	74.8	73.9	72.9	72.0	71.1	70.1
80	88.2	85.9	84.2	82.8	81.6	80.4	79.0	77.4	76.1
85	101.4	97.0	93.3	90.3	87.7	85.5	83.5	81.6	79.6
90	119.3	112.0	105.8	100.5	96.1	92.3	89.2	86.5	84.2
95	141.8	131.1	121.7	113.6	106.7	100.9	96.1	92.2	89.2
100	168.7	154.0	140.9	129.5	119.6	111.2	104.2	98.7	94.4
105	200.0	180.7	163.4	148.1	134.7	123.2	113.6	105.8	100.0
110	235.0	211.2	189.1	169.4	151.9	136.8	124.1	113.7	105.8
115	275.3	245.4	218.0	193.3	171.3	152.1	135.8	122.3	111.9
120	319.1	283.1	250.0	219.9	192.9	169.1	148.7	131.6	118.2

(Source: National Weather Service)

Temperatures well below the freezing mark of 32° Fahrenheit (F) are characteristic of extreme cold and are often accompanied by high winds and severe winter weather. The longer these cold spells last, the more significant the negative impact upon the community. Unseasonably low temperatures, such as nighttime temperatures that drop below freezing in late spring or early summer, may also be considered extreme cold. Like the heat index, the wind chill index expresses how weather conditions feel. The wind chill index is an air temperature index that measures heat loss from exposed skin surfaces.

Figure 13. Wind Chill Chart



(Source: National Weather Service)

Frequency

The “lake effect” on Berrien County’s climate is quite strong throughout much of the year. The prevailing westerly winds, in combination with Lake Michigan to the west, produce this unique effect. The lake effect moderates temperature in the County through all four seasons. Because the movement of pressure systems controls the day-to-day weather across the nation, Berrien County seldom experiences prolonged periods of hot, humid weather in the summer or extreme cold during the winter. However, days of extreme heat and cold have been recorded and do periodically occur. Therefore, residents of Berrien County must be aware of the dangers and prepared to respond when these extreme temperatures occur.

The Benton Harbor weather station reported that summers are dominated by moderately warm temperatures with a 1951-80 average of 11 days exceeding the 90⁰F mark. During the same period 1 day was 100⁰ F or higher. The lake influence was reflected in the minimum temperatures; an average of 132 days was 32⁰ F or lower, an average of 4 days was 0⁰ F or lower, and only 5 years stayed above 0⁰ F. The highest average monthly maximum temperature of 85.8⁰ F was recorded August 1959, and the lowest average monthly minimum temperature of 6.6⁰ F was recorded January 1977. The following temperature extremes, based on the time period of this station's published record, are: maximum, 104⁰ F, recorded June 1, 1934; minimum, -21⁰ F, recorded January 12, 1918; warmest monthly mean, 76.4⁰ F, recorded August 1959; and coldest monthly mean, 13.9⁰ F, recorded January 1977.

At the Eau Claire weather station, summers are dominated by moderately warm temperatures with a 1951-80 average of 12 days exceeding the 90⁰ F mark. During the same period, two days in one year were 100⁰ F or higher. The lake influence was reflected in the minimum temperatures; an average of 133 days was 32⁰ F or lower, an average of five days was 0⁰ F or lower, and for four years stayed above 0⁰ F. The highest average monthly maximum temperature of 89.0⁰ F was recorded July 1955, and the lowest average monthly minimum temperature of 5.2⁰ F was recorded January 1977. The following temperature extremes, based on the time period of this station's published record, are: maximum, 107⁰ F, recorded July 24, 1934; minimum, -21⁰ F, recorded January 16, 1972; warmest monthly mean, 77.2⁰ F, recorded July 1955; and coldest monthly mean, 12.4⁰ F, recorded January 1977.

Table 16. Daily Average Temperatures, Berrien County, 1951-1980 (degrees F.)

	Benton Harbor	Eau Claire
Month	Maximum/Minimum	Maximum/Minimum
January	31.5 / 17.9	30.3 / 16.5
February	34.5 / 19.7	33.7 / 19.0
March	44.2 / 27.6	44.2 / 27.4
April	57.9 / 37.7	58.9 / 38.2
May	68.9 / 47.2	70.2 / 48.1
June	78.7 / 57.1	79.7 / 57.8
July	81.9 / 61.4	83.2 / 61.9
August	80.6 / 59.6	81.5 / 60.6
September	74.7 / 53.2	74.8 / 54.0
October	63.4 / 43.2	63.0 / 43.7
November	48.8 / 33.3	47.8 / 32.9
December	36.7 / 23.6	35.3 / 22.5
Annual Average	58.5 / 40.1	58.5 / 40.2

(Source: MSU Climatology Program)

Table 17. Record Temperatures, Berrien County, 1951-1980 (degrees F.)

Month	Benton Harbor		Eau Claire	
	High/Year	Low/Year	High/Year	Low/Year
January	64 / 1967	-20 / 1979	63 / 1967	-21 / 1972
February	71 / 1976	-13 / 1978	68 / 1976	-15 / 1951
March	81 / 1963	-6 / 1960	79 / 1963	-2 / 1962
April	87 / 1962	15 / 1972	87 / 1980	10 / 1972
May	93 / 1975	25 / 1955	92 / 1977	24 / 1978
June	101 / 1953	35 / 1972	99 / 1971	6 / 1955
July	97 / 1955	41 / 1968	98 / 1955	46 / 1979
August	97 / 1956	38 / 1964	98 / 1964	40 / 1964
September	98 / 1953	30 / 1964	100 / 1953	32 / 1957
October	87 / 1971	17 / 1980	90 / 1963	20 / 1960
November	77 / 1975	6 / 1955	76 / 1975	0 / 1959
December	69 / 1997	-9 / 1963	67 / 1970	-9 / 1960
Annual Bests	101 / 1953	-20 / 1979	100 / 1953	-21 / 1972

(Source: MSU Climatology Program)

Safety/Health

Heat waves and prolonged periods of unusually cold weather can result in a significant number of temperature-related health problems and even death. The major threats of extreme summer heat are heatstroke (a major medical emergency), heat exhaustion, heat syncope and heat cramps. Each year in the United States, approximately 700 people die as a result of severe cold temperature-related causes. 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.

However, prolonged exposure to cold can cause frostbite or hypothermia and become life threatening. Infants and elderly people are most susceptible, as are those who take part in outdoor activities during extreme cold events. Insufficient home heating and/or poor insulation may create health problems for the elderly, ill, and infants and may cause water pipes to freeze and burst resulting in damage to the home. People with mobility limitations may find it difficult to leave home and become more dependent on outside assistance. The City of Benton Harbor feels that a major temperature fluctuation would negatively affect the relatively substantial number of rental residents and elderly individuals on fixed incomes who live in poorly insulated structures.

Damages/Critical Facilities

Often power failures occur during peak use times in very hot weather. Extreme cold conditions may cause ice jams on local rivers and streams, which could lead to flooding during the spring thaw.

Economic Impact

Extremely cold temperatures occurring during the agricultural growing season may lead to crop failure and reduced yields. Extremely high temperatures could also damage sensitive crops and/or contribute to drought conditions. Either circumstance could cause economic hardships for local farmers and the communities at large.

Specific costs related to human illness and problems are not easily obtainable because most mitigation and response efforts are carried out by several different volunteer and government agencies.

THUNDERSTORMS

Tornado: “An intense column of wind that extends from the base of a severe thunderstorm to the ground” Severe Winds: “Non-tornadic winds of 58 miles per hour or greater” Lightning: “The discharge of electricity resulting from the buildup of positive and negative charges from within a thunderstorm” Hail: “Conditions where atmospheric water particles from a thunderstorm form into rounded or irregular lumps of ice that fall to the earth”

With high risk and vulnerability, Berrien County considers thunderstorms (including tornados) a high priority hazard affecting the county.

Severe Winds/Tornados

Severe winds spawned by thunderstorms and other weather events can have devastating effects in terms of loss of life, injuries, and property damage. Prior to 1970, 115 deaths, over 660 injuries, and hundreds of millions of dollars in damage to public and private property and agricultural crops were reported throughout the state of Michigan. According to the National Weather Service, Michigan experienced nearly 9,200 severe wind events (not including tornados) between January 1970 and August 1999.

Severe wind events are characterized by wind velocities of 58 miles per hour, or greater, with gusts exceeding 74 miles per hour (hurricane force) but do not include tornados. 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 of a mile wide. Historically, tornados have resulted in tremendous loss of life, with a national average of 111 deaths per year. Property damage from tornados is in the hundreds of millions of dollars every year in the United States.

Another severe weather event that Berrien County must deal with is rip tides along the Lake Michigan shoreline. These rip tides have resulted in several deaths over the recent years. Swimmers need to be educated and forewarned about the dangers of rip tides.

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 damage caused, not by size. The actual size of a tornado is not necessarily an indication of its intensity. Large tornados can be weak, whereas smaller ones can be extremely strong. It is difficult to judge the intensity and power of a tornado while it is occurring and generally can only be done when the event is over.

Table 18. Fujita Scale of Tornado Intensity

<i>The Fujita Scale of Tornado Intensity</i>			
<i>F-Scale Number</i>	<i>Intensity Description</i>	<i>Wind Speed (MPH)</i>	<i>Type/Intensity of Damage</i>
<i>F0</i>	<i>Gale Tornado</i>	<i>40-72</i>	<i>Light damage. Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages signboards.</i>
<i>F1</i>	<i>Moderate Tornado</i>	<i>73-112</i>	<i>Moderate damage. The lower limit is beginning of hurricane wind speed; peels off roof surfaces; mobile homes off foundations; moving autos pushed off roads; attached garages may be destroyed.</i>
<i>F2</i>	<i>Significant Tornado</i>	<i>113-157</i>	<i>Considerable damage. Roofs torn off house frames; mobile homes demolished; large trees uprooted; light object missiles generated; boxcars pushed over.</i>
<i>F3</i>	<i>Severe Tornado</i>	<i>158-206</i>	<i>Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees uprooted; heavy cars lifted off ground and thrown.</i>
<i>F4</i>	<i>Devastating Tornado</i>	<i>207-260</i>	<i>Devastating damage. Well-constructed homes leveled; structures with weak foundations blown considerable distances; cars thrown; large missiles generated.</i>
<i>F5</i>	<i>Incredible Tornado</i>	<i>261-318</i>	<i>Incredible damage. Strong frame houses lifted off foundations and carried considerable distances; trees debarked; steel reinforced concrete structures damaged; automobile size missiles; incredible phenomena occurs.</i>
<i>F6</i>	<i>Inconceivable Tornado</i>	<i>319-379</i>	<i>These winds are very unlikely. The area of damage they might produce would be unrecognizable.</i>

(Source: The Tornado Project, National Climatic Data Center)

National Weather Service forecasts of severe winds and tornados often give sufficient warning time to allow residents to take appropriate action to reduce, to some degree, the effects of wind and tornados on structures and property. However, when these events occur during the night or early morning hours when people are most likely not listening to their radios or televisions, both damage and injury can be more severe.

Even with sufficient warning, little can be done to prevent damage from flying objects. Removing loose objects such as planters, lawn furniture, and yard equipment from outside can keep these items from becoming airborne debris and, therefore, help reduce some property damage. Proper structural bracing techniques can also help minimize or even eliminate major damage due to the loss of the roof or movement of the building off its foundation.

In terms of response to a severe wind or tornado event, the primary challenges facing Michigan communities are providing for the mass care and sheltering of residents left without heat or electricity and mobilizing sufficient resources to clear and dispose of downed trees, limbs, branches, and other debris from roadways. In addition, downed power lines present a public safety threat that requires close coordination of response efforts between local agencies and utility companies. Severe winds and tornados can affect every Michigan community. Therefore, every community, including Berrien County, should adequately plan and prepare for this type of emergency. In Berrien County, the local chapter of the American Red Cross maintains a list of potential shelter and evacuation sites as well as sources of emergency supplies. Depending on the severity and location of the disaster, the Red Cross will be the lead agency and establish a shelter in one or more of these pre-approved sites.

Every community should develop debris management procedures so that the removal of tree and construction debris can be handled in the most expedient, efficient, and environmentally safe manner possible. Both FEMA and the Michigan State Police-Emergency Management Division offer debris management courses to provide local, state, and federal personnel at all levels with information regarding the recommended actions necessary to respond to, plan for, and recover from a major debris generating event.

Lightning

Lightning is a random and unpredictable product of a thunderstorm's tremendous energy. Most direct impacts from lightning are relatively site specific in scope and therefore do not have a tremendous impact on the community as a whole. With the temperature of a bolt of lightning approaching 50,000 degrees Fahrenheit (hotter than the surface of the sun) in a split second, the most common direct damage from a lightning strike is fire.

The most common indirect effect of lightning strikes is power outages. This indirect effect can have an impact on a much larger segment of the community by leaving hundreds, and sometimes thousands, of homes without electricity. Almost all impacts of lightning are associated with thunderstorm activity, although lightning strikes have been known to occur in the absence of severe weather.



NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory (NSSL)

Hail

Hail is a product of a strong thunderstorm, usually falling near the center of the storm along with the heaviest rainfall. However, sometimes strong winds occurring at high altitudes in a thunderstorm can blow the hailstones away from the center of the storm causing an unexpected hazard in places that otherwise might not appear threatened. Most hailstones range in size from a pea to a golf ball, however, hailstones larger than baseballs have also been reported. Hail is formed when strong updrafts from 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. The hailstones then fall to the ground, battering crops, denting automobiles, and injuring wildlife and people.

Nothing can be done to prevent hail; however, the National Weather Service announcements of severe weather warnings usually give sufficient time for residents to take appropriate action to reduce the effects of hail damage to vehicles and property. Unfortunately, little can be done to prevent damage to crops and landscaping. The best defense against hail hazards is public education and awareness to stay indoors during severe weather.

Frequency

Figures from the National Weather Service indicate that severe winds occur more frequently in the southern half of the Lower Peninsula than in any other area of the state of Michigan. On average, severe wind events can be expected 5-7 times per year in southwestern Michigan, including Berrien County. Historically speaking, 140 severe wind-related events have been reported in Berrien County from 1950 to February 2004.

These numbers refer to winds from thunderstorms and other forms of severe weather and **do not** include tornados.

Tornados in Michigan are most frequent in spring and early summer (April- June) when warm, moist air from the Gulf of Mexico collides with cold air from the Polar Regions to generate severe thunderstorms. These thunderstorms often produce tornados. Over half of all tornados hit between 3:00 p.m. and 7:00 p.m. There are no official recurrence intervals calculated for tornados. Michigan lies at the northeastern edge of the Midwest tornado belt. Within Michigan, tornados occur more frequently in the southern half of the Lower Peninsula than any other area of the state. Most tornados in the state come from the southwest and travel to the northeast.

The low frequency of tornados occurring in Michigan may be, in part, the result of the cold Lake Michigan waters during the spring and early summer months, the prime period of tornado activity. In Berrien County, the natural sand dunes of the shoreline also have a direct effect on the low number of tornado events that occur. During 1950-1987, Michigan averaged 15 tornados each year. Between 1950 and 2002, 27 significant tornados were reported in Berrien County. There have been two Presidential, and three Governor's Declarations of Disaster in Berrien County from 1974 to 2001 for severe summer weather events (tornados, thunderstorms, severe winds). In Berrien County, with 26 occurrences over 51 years, the likelihood of a tornado hitting somewhere in the County is 0.5 percent in any given year. Assuming a tornado affects one square mile and there are 583 square miles in Berrien County, the odds of a tornado hitting any particular square mile in the County is 1 in 1,111 each year or a 0.0009 percent chance.

Globally, there are about 2,000 thunderstorms occurring at any given time, with nearly 100 lightning strikes to earth each second. In the United States each year, approximately 100,000 thunderstorms occur and each one produces lightning strikes. It is not uncommon for a single thunderstorm to produce hundreds, or even thousands, of lightning strikes. Despite this, and the fact that on average, lightning damages many structures and kills and injures more people per year in the United States than tornados or hurricanes, lightning is perceived as a minor hazard to a majority of the general public.

Berrien County has many thunderstorms throughout the summer storm season. Many of these storms have the potential to produce dangerous and damaging hail. Since 1950, there were 47 significant hailstorm events reported in the County. It should be noted that this is only a small number of the actual events, as many others go unreported due to more serious threatening severe weather. With 47 reported events over 54 years, the likelihood of a hailstorm any given year is 0.87 percent.

At the end of this section on Thunderstorms/Severe Summer Weather is a listing of significant events. Table 19 describes the presidential and governor declared disasters relating to severe summer weather for Berrien County.

Table 19. Severe Summer Weather Declarations, Berrien County, 1974 – 2001

Presidential Declarations for Berrien County 1974 - 2001			
Date	Area	Disaster	Declaration
July 15-20, 1980	10 Counties	High Winds	Major Disaster
April 18-30, 1975	21 Counties	Flooding/Tornados	Major Disaster
Governor’s Declarations for Berrien County 1974-2001			
Date	Area	Disaster	Declaration
September 1, 1998	City of Niles	Thunderstorms/Winds	Emergency
July 21, 1980	9 Counties	Thunderstorms/Winds	Disaster
June 30, 1978	Countywide	Thunderstorms/Winds	Disaster

The following municipalities reported concerns with severe summer weather related events:

- **In Lincoln Charter Township** Spring Lake Manufactured Housing Community has sustained severe wind damage on several occasions in the last seven years.
- **New Buffalo** has experienced waterspouts that have come ashore, causing extensive damage to structures.

Health/Safety

Although tornados are a fairly rare event in Berrien County, a few of those that have hit have been quite destructive and one even deadly. Improved surveillance and warning systems implemented by the National Weather Service and emergency management agencies, coupled with public education, have been effective in keeping the death toll down in recent years. However, if a strong tornado should strike a highly populated area of Berrien County, a number of deaths could still occur. Tornados must always be considered with the utmost caution.

Tornados cannot be predicted until almost the last moment, nor can they be prevented. However, their potential impact on the citizens of Berrien County can certainly be reduced with appropriate forethought, preparation, and planning. Having emergency plans in place and regularly practicing them will better prepare the community should another devastating tornado hit the County. Clearing debris, removing downed trees, and the mass care of residents left without power are the primary challenges facing Berrien County in the aftermath of a tornado event. Working with entities such as the American Red Cross for mass sheltering and evacuation, public and private contractors for debris removal, and event recovery is crucial preparedness prior to a disaster happening.

According to the NOAA, from 1950 to February 2004, 140 thunderstorm and high wind events have resulted in one death and six injuries in Berrien County. Since 1956, tornados have resulted in one death and fifteen injuries in Berrien County. Residents in mobile homes are at the greatest risk. There are 25 mobile home parks within Berrien County (see map for locations).

The major health hazard from tornados and severe winds is physical injury from flying debris or being in a collapsed building or mobile home. Based on national statistics for 1970 – 1980, for every person killed by a tornado, 25 people were injured and 1,000 people received some sort of emergency care. Within a building, flying debris or missiles are generally stopped by interior walls. However, if a building has no partitions, any glass, bricks, or other debris blown into the interior is life threatening. Following a tornado, damaged buildings are a potential health hazard due to instability, electrical system damage, and gas leaks. Sewer and water lines may also be damaged.

Lightning events can cause fire, extensive property damage, injuries, and even death. In the United States, between 75 and 100 people are hit and killed by lightning each year. The National Lightning Safety Institute estimates that 85 percent of lightning victims are children and young men (ages 10-35) engaged in recreation or work-related activities. Approximately 20 percent of lightning strike victims die, and 70 percent of those who survive suffer long-term effects such as memory loss, attention deficits, sleep disturbance, fatigue, dizziness, and numbness. Because nothing can be done to prevent the lightning that often accompanies severe thunderstorms, the best defense against this hazard is public education and awareness of the dangers of lightning. These educational efforts include advice about staying indoors, keeping away from windows, and not using electrical devices or telephones during severe weather.

Table 20. Lightning Strike Injuries and Deaths, 1959-1994

Location of Lightning Strike	Michigan (Injury)	Michigan (Death)	United States (Injury and Death)
Open field and recreation areas (non-golf course)	34 percent	27 percent	27 percent
Under a tree (non-golf course)	15 percent	28 percent	14 percent
On or near water (boating, swimming, fishing, etc.)	4 percent	12 percent	8 percent
Golf Course	5 percent	11 percent	5 percent
On or near equipment and machinery	3 percent	2 percent	3 percent
At a telephone	3 percent	2 percent	2.4 percent
Other or unspecified	36 percent	18 percent	40.6 percent

(Source: National Lightning Safety Institute)

Damage/Critical Facilities

Although tornados strike at random, making all buildings vulnerable, three types of structures are more likely to suffer damage:

1. Mobile homes (see map for location of mobile home parks),
2. Homes on crawl spaces (more susceptible to lift), and
3. Buildings with large spans, such as airplane hangers, gymnasiums and factories.

Structures within the direct path of a tornado vortex are often reduced to rubble. However, structures adjacent to the tornados path are often severely damaged by high winds flowing into the tornado vortex, known as inflow winds. It is here, adjacent to the tornado’s path where the building type and construction techniques are critical to the structure’s survival.

In 1999, FEMA conducted an extensive damage survey of residential and non-residential buildings in Oklahoma and Kansas following an outbreak of tornados on May 3, 1999, which killed 49 people. The assessment had the following results:

- The failure for many residential structures occurred where the framing was attached to the foundation or when nails were the primary connectors between the roofing and the walls. A home in Kansas was lifted from its foundation where the addition of nuts to the bolts anchoring the wood framing to the foundation may have been all that was needed to have kept this from happening.
- Roof geometry also played a significant role in a building's performance.
- Failure of garage doors, commercial overhead doors, residential entry doors or large windows caused a significant number of catastrophic building failures.
- Manufactured homes on permanent foundations were found to perform better than those that were not on solid walls.

Because a tornado can hit anywhere in the county, all critical facilities are susceptible to being hit. Schools are a particular concern though for two reasons:

1. They have large numbers of people present, either during school or as a storm shelter, and
2. They have large span areas, such as gyms and theaters.

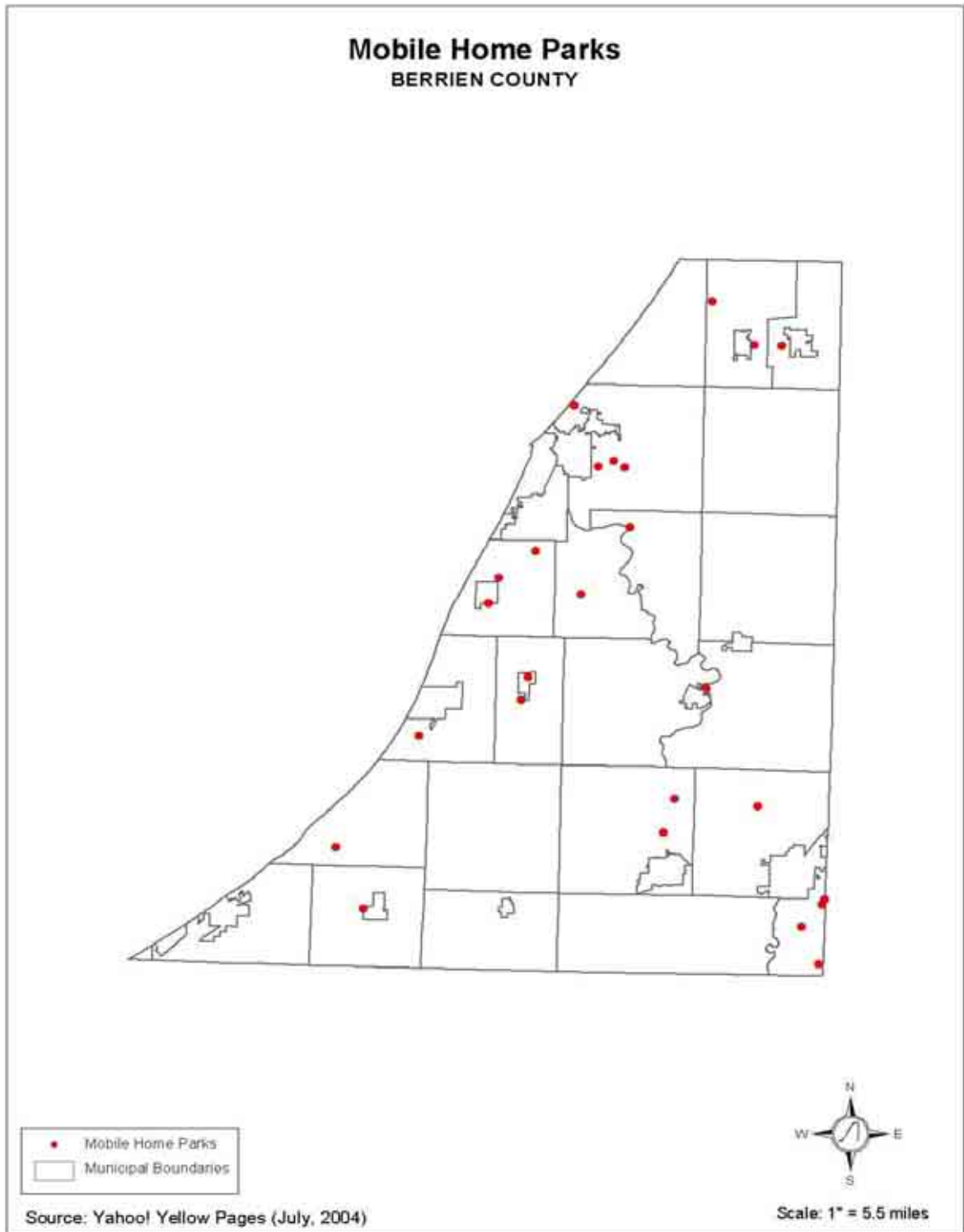
A big concern with thunderstorm events is the loss of electrical power. Winds associated with severe weather cause trees to uproot and lose limbs and often knock out power lines. Falling trees and branches can also damage houses and cars.

As with tornados, mobile homes are at a high risk to damage from thunderstorms. Any building could suffer damage from wind and water resulting from flying debris or hail breaking windows. Lightning can cause direct damage to structures (especially those without lightning protection systems) and can cause fires that damage forests and structures.



Communication towers and components of the electrical distribution system are particularly vulnerable to lightning damage. Hail can inflict severe damage to roofs, windows, and siding depending on hail stone size and winds. Hail can also be very damaging to crops.

Figure 15. Mobile Home Parks, Berrien County



Economic Impact

The major impact of a tornado on the local economy is damage to businesses and infrastructure. A heavily damaged business, especially one that was barely making a profit, often has to be closed. Infrastructure damage is usually limited to above ground utilities, such as power lines. Damage to utility lines can usually be repaired or replaced relatively quickly. Damage to roads and railroads are also localized. If they can't be repaired promptly, alternate transportation routes are usually available. Public expenditures include search and rescue, shelters, and emergency protection measures. The large expenses are for repairs to public facilities and clean up and disposal of debris. Most public facilities are insured, so the economic impact on the local treasury may be small. Clean up and disposal can be a larger problem.

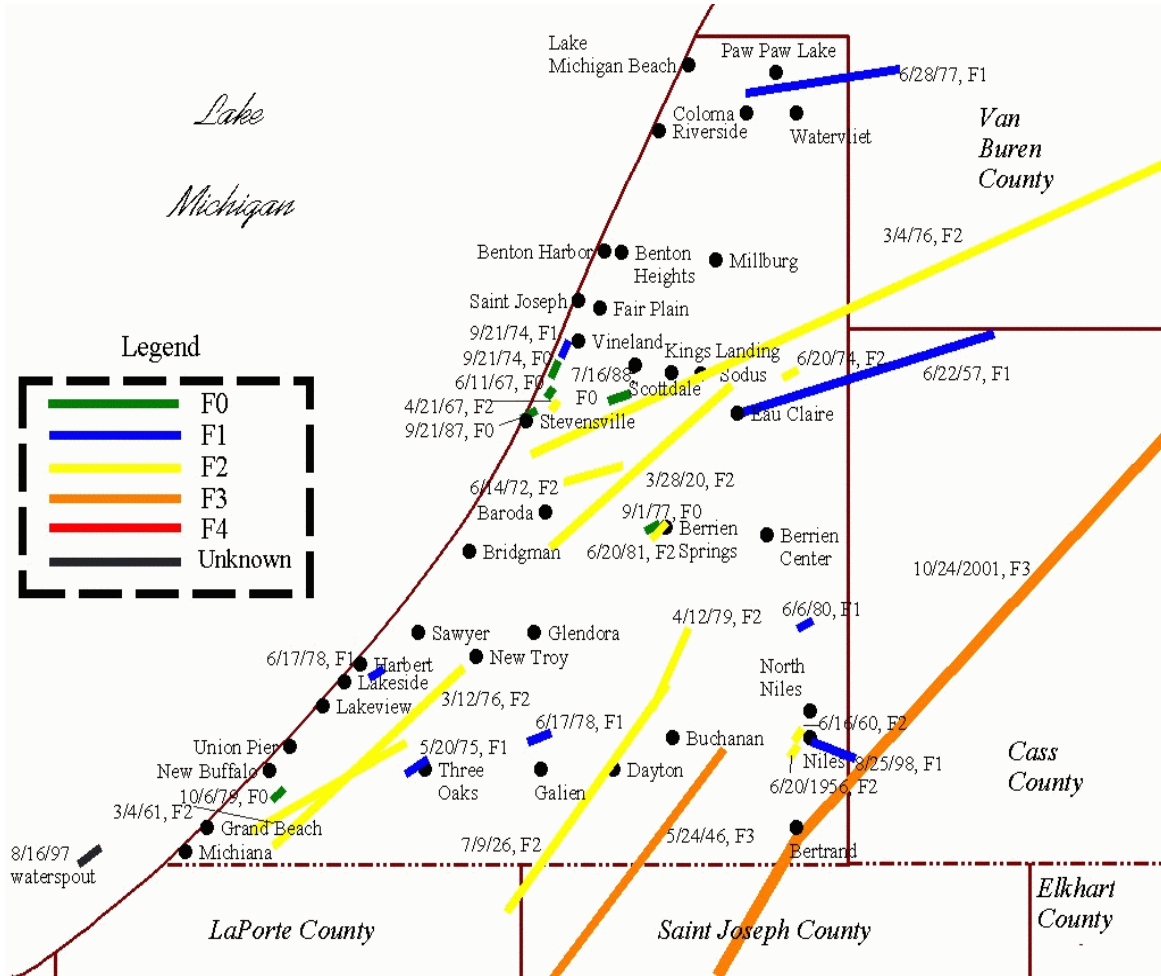
According to the NOAA, from 1950 to February 2004, with 140 thunderstorm and high wind events over \$5.5 million in property damage was reported in Berrien County. This equates to an average of about \$102,000 per year. Over \$3.61 million in damages were reported for the 27 tornado events in Berrien County. This is an average of \$80,000 per year. Damages from hail and lightning events vary widely. For example, a 1997 hail event caused nearly \$1.2 million in agricultural losses in Berrien County. In 2001, a lightning strike caused an apartment building to burn resulting in over \$800,000 in damages.



NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory (NSSL)

Figure 14. Tornado Paths, Berrien County, 1950-2002

Tornado Path Tracks Across Berrien County 1950-2002



(Source: NOAA National Climatic Data)

Table 21. Tornado Occurrences, Berrien County, 1950-2002

Date	Magnitude	# Deaths	# Injuries	\$ Damage
06/26/1956	F2	0	0	0
06/22/1957	F1	0	0	25K
05/31/1958	F0	0	0	25K
06/16/1960	F2	0	0	3K
03/04/1961	F2	0	0	250K
04/21/1967	F2	0	0	250K
06/11/1967	F0	0	0	0
06/14/1972	F2	0	0	3K
06/20/1974	F2	0	0	25K
09/21/1974	F0	0	0	25K
09/21/1974	F1	0	0	25K
05/20/1975	F1	0	0	25K
03/04/1976	F2	0	9	250K
03/12/1976	F2	0	0	25K
06/28/1977	F1	0	0	3K
09/01/1977	F0	0	0	0
06/17/1978	F1	0	0	3K
06/17/1978	F1	0	0	25K
04/12/1979	F2	0	6	250K
10/06/1979	F0	0	0	25K
06/06/1980	F1	0	0	25K
06/20/1981	F2	0	0	250K
09/21/1987	F0	0	0	0
07/16/1988	F0	0	0	250K
08/16/1997	Waterspout	0	0	0
08/25/1998	F1	1	0	1.1M
10/24/2001	F3	0	0	750K
Total	27	1	15	3.61M

(Source: NOAA National Climatic Data Center)

Significant Tornado Events in Berrien County

March 4, 1961

An F2 rated tornado touched down in the southwestern portion of Berrien County and left a 7-mile long, 440-yard wide path of destruction between Grand Beach and Three Oaks. Extensive property damage was reported with numerous downed trees and power lines. In total, over \$250,000 in damage was reported in this tornado's wake.

April 21, 1967

A small, F2 rated tornado was reported just north of the Village of Stevensville. Although the path of damage was small, 1 mile long and only 27 yards wide, over \$250,000 of property damage was recorded with no fatalities or injuries.

March 4, 1976

Strong thunderstorms across much of southwestern Michigan spawned a huge F2 rated tornado that injured 9 people, downed trees and power lines, leveled numerous buildings, and left in excess of \$250,000 in damage. This tornado measured 100 yards wide and its 20-mile track started just south of Stevensville and traveled northeast through Berrien County and into Van Buren County.

April 12, 1979

6 people were injured and over \$250,000 in damage was reported when an F2 rated tornado touched down northwest of Buchanan and left a 3-mile, 60-yard wide path of destruction.

August 25, 1998

Over 41,500 people were without power and extensive was damage reported when strong thunderstorms produced a 2-mile long, 400-yard wide F1 rated tornado just southeast of the city of Niles. Although this tornado was small by comparison, over \$1.1 million in damage was reported. An off-duty Michigan State Police Trooper tragically lost his life when a downed power line electrocuted him.

Table 22. Ocean/Lake Surf Events, Berrien County, 1950-2004

2 OCEAN/LAKE SURF events were reported in Berrien County, Michigan between 01/01/1950 and 02/29/2004								
<i>If viewing on-line, click on Location or County to display Details.</i>								
Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Bridgman	07/01/2001	05:00 pm	Rip Currents	N/A	1	0	0	0
2 Bridgman	08/17/2001	10:00 am	Rip Currents	N/A	1	0	0	0
TOTALS:					2	0	0	0

Source: <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>

Significant Severe Wind Events in Berrien County

April 30, 1984

A severe windstorm struck the entire Lower Peninsula, resulting in widely scattered damage, one death, and several injuries throughout the region. Wind gusts of up to 91 miles per hour were reported, causing damage to an estimated 6,500 buildings, 300 mobile homes, and 5,000 vehicles. Over 500,000 homes lost power due to the severity of the winds while 10-16 foot waves on Lake Michigan caused extensive shoreline erosion, collapsed buildings, and washed many boats aground.

March 27, 1991

Severe thunderstorms and accompanying high winds caused considerable damage across a large portion of southern Lower Michigan. A total of 3 deaths, 27 injuries, and 450,000

homes reported without electricity was attributed to this storm system. Over \$30 million in damage to private and public property was caused by these severe winds.

July 7, 1991

A line of severe thunderstorms crossed the southern Lower Peninsula with recorded wind speeds of 60-70 miles per hour and gusts in excess of 80 miles per hour in some locations. Over 1 million homes were left without power and several million dollars in damage reported throughout the entire region.

April 6-7, 1997

An intense low-pressure system moving across the Great Lakes brought gale force winds throughout much of Lower Michigan. Sustained wind speeds of nearly 50 miles per hour were reported during the 2-day event, with gusts of up to 70 miles per hour causing widespread shoreline erosion. 10-15 foot waves pounded the Lake Michigan shoreline, causing as much as 20 feet of beach in some places to disappear. Unusually high lake levels, nearly 38 inches above average at the time of this event, helped to attribute to this massive beach erosion. Although no deaths or serious injuries were reported, nearly \$5 million in damage occurred over a widespread area.

July 2, 1997

A series of intense thunderstorms passed through the area, spawning straight-line winds, tornados, and heavy rainfall. Winds with speeds in excess of 70 miles per hour caused extensive property damage. Downed trees caused nearly 22,000 homes to be without power. Hail up to 2 ¼ inches in diameter was reported in the Berrien Springs area. Across the entire area, 16 deaths were reported and over 120 injured due to this massive weather event.

September 29-30, 1997

The merging of two pressure systems, an intense low centered over Lake Superior and a building high pressure to the south, created gale force winds for 2 days throughout Berrien County. Numerous downed trees and branches left nearly 35,000 homes without electricity and massive amounts of debris and property damage was reported.

November 10-11, 1998

On the 23rd anniversary date of the severe storm that sunk the freighter Edmund Fitzgerald in Lake Superior in 1975, one of the strongest storms ever recorded in the Great Lakes rolled across much of the entire state of Michigan. Sustained wind speeds of 50-80 miles per hour and gusts to 95 miles per hour caused extensive property damage. Strong winds generated 15-20 foot waves on Lake Michigan resulting in widespread beach erosion. Over \$20 million in damage was reported in the aftermath of this fierce severe wind event.

May 17, 1999

A strong storm system raced through Berrien County bringing with it high winds, heavy rain, and hail. Wind gusts of up to 70 miles per hour downed many trees and branches, causing widespread power outages and property damage.

October 24, 2001

A strong thunderstorm system brought straight-line winds in excess of 50 miles per hour to a large portion of Berrien County. Numerous trees were reported downed and large areas were left without power in the storm's wake.

March 9, 2002

An unusually strong cold front moved through the Berrien County area, bringing with it strong winds averaging up to 70 miles per hour and gusts of up to 85 miles per hour. Widespread reports of downed trees, branches, and power lines left many without power for hours. Many reports of wide-scale property damage were also reported in the wake of this weather event.

May 21, 2004

Berrien County experienced a very severe windstorm with sustained 99 mile per hour (mph) winds with 102 mph gusts. The County declared a local state of emergency. There were some flooding, widespread power outages, one death and seven to twelve injuries. Of the 67,500 without power, 600 were special needs cases and 192 were in life threatening situations. Higman Park was hit the worst with several damaged homes. The Benton Harbor Water Treatment Plant was without power and a water boil advisory had to be issued.

Significant Lightning Events in Berrien County

The following examples are three of the more notable lightning related events in Berrien County in recent years.

June 13, 1994

A woman in St. Joseph Township received a jolt from lightning while inside her house. She was treated and released from the local hospital with minor burns.

June 12, 2001

Lightning from a passing thunderstorm struck the Briarwood Apartments in Benton Township. 35 residents were evacuated from one building of this multi-unit community as the roof and the resulting fire destroyed two apartments. Many other apartments in the building received extensive smoke and water damage. No injuries or fatalities occurred due to this event, which reported over \$800,000 in damages.

June 30, 2002

A Berrien Springs Police Officer received a shock from a jolt of lightning while directing traffic during a thunderstorm. Although the actual impact of the lightning bolt was in open ground over one-quarter of a mile away, the officer received a hit from "trailers" off of this main bolt. He was treated and released from the local hospital, but remained off duty for some time for recuperation from this event.

Significant Hailstorm Related Events in Berrien County

The following are three examples of the more notable hailstorm events that have occurred in Berrien County.

March 27, 1991

Severe thunderstorms, accompanied by high winds and hail, caused considerable damage across a large portion of central and southern Lower Michigan, damaging homes, businesses, farms, and some public facilities. A total of 3 deaths and 27 injuries were reported throughout the entire affected area. Baseball-size hail was reported in the vicinity of Buchanan in central Berrien County, causing massive damage to crops and properties.

July 2, 1997

A severe thunderstorm during the early morning hours pounded Berrien County with 1 to 2.25-inch diameter hail that caused agricultural losses of nearly \$1.2 million. The hail destroyed 280 acres of fruits and 100 acres of vegetables on one farm alone in a two-mile swath from Stevensville southeast to the County line. Many other area farms reported extensive agricultural losses as well due to this 20-minute hailstorm. The hail, and accompanying straight-line winds, estimated as high as 70 miles per hour, caused widespread property damage and left nearly 22,000 homes without power.

May 7, 2003

Extensive damage was reported in the Berrien Springs area as hail the size of quarters fell for nearly 20 minutes, damaging crops and property. One area nursery estimated over \$8,000 in damage to its plants, flowers, and buildings.

INFRASTRUCTURE FAILURES

“The failure of critical public or private utility infrastructures resulting in a temporary loss of essential functions and/or services”

Michigan’s citizens are dependent on the public and private utility infrastructure to provide essential life supporting services such as electric power, heating and air conditioning, water, sewage disposal and treatment, storm drainage, communications, and transportation. When one or more of these independent yet interrelated systems fail for even a short period of time, due to disaster or other cause, it can have devastating consequences. For example, when power is lost during periods of extreme heat or cold, people can die in their own homes if immediate mitigation action is not taken. When the water or wastewater treatment systems in a community are inoperable, serious public health problems can arise and must be addressed immediately to prevent outbreaks of disease. When storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur. These are just some examples of the types of infrastructure failures that can occur.

Berrien County is a well-developed county. As such, it is heavily dependent on public and private utility systems for the provision of essential life-supporting services, for the movement of people and goods, and for communications and the transmission of information. As a result, the possibility of infrastructure failure must be addressed on the County level through wise system design and community development practices, and through prudent emergency preparedness that takes into account the issues and needs specific to infrastructure failures. In addition, the County needs to continue to push for greater system reliability through its infrastructure hazard mitigation efforts. Although the problem of infrastructure failure will never be completely eliminated, it can certainly be greatly diminished through proper planning, design, construction, and maintenance practices. Berrien County considers infrastructure failure as a high priority hazard for mitigation purposes.

It is possible to design and operate facilities that are virtually “disaster-proof”. However, in many cases, it is not economically feasible to do so. Small increases in integrity and reliability can result in prohibitive increases in costs, making it too expensive to upgrade infrastructure standards beyond current levels. However, in those cases where recurring severe damage and system failures occur, due to natural or technological hazard events, it makes sense to explore enhancing infrastructure design, construction, and operational codes and standards.

As Michigan’s public and private utility infrastructure systems continue to age, infrastructure disasters will undoubtedly become more common. Many communities simply can’t afford to upgrade aging systems or replace the old equipment. In addition, increasing demands on the systems also leads to increased deterioration. This increases the numbers of infrastructure related events, either as a primary event, or as a secondary event to a flood, severe winds, or other hazard. When those disasters occur, they can cause a great inconvenience to the affected population as well as severe public health and safety concerns.

As Michigan's villages, towns and cities have grown, the drains that were designed to primarily serve agriculture have also been used to carry storm water from municipalities and subdivisions, as well as serve as outlets for sanitary treatment plants and a variety of other permitted discharges. This increases the operation, maintenance, and improvement of drains in suburban and urban areas. Increasing demands on the drainage system in many areas of the state requires that continuous improvements be made to enhance drain capacity and flow characteristics, reduce sedimentation, and improve structural integrity.

The Michigan Drain Code allows for landowners and/or municipalities to petition for maintenance or improvement of the drainage systems. Drain commissioners or drainage boards, in the absence of a petition, are allowed to maintain the drainage systems but are limited by law in the amount of money they are allowed to expend. The maintenance limit is equal to \$2,500 per mile of established drain. This amount is generally sufficient for ordinary operation and maintenance, but is inadequate during times of widespread damage such as occurs during a disaster. Because drainage districts stand on their own, money or the maintenance limit cannot be shared between districts. This greatly limits flexibility and can severely constrict drain reconstruction, improvement, and damage mitigation efforts in a post-disaster setting. Efforts are underway to amend the Michigan Drain Code, to more adequately address current and anticipated future problems and concerns, and to make it more applicable to modern development circumstances.

Health/Safety

Many types of infrastructure failure can lead to disastrous public health and safety consequences if immediate actions are not taken. Typically, it is the most vulnerable members of society, such as the elderly, very young, impoverished, and people in poor health, that are the most heavily impacted by an infrastructure failure. If the failure involves more than one system, or is large enough in scope and magnitude, whole communities and possibly even regions can be severely impacted. (Note: Refer to the Dam Failures and Petroleum and Natural Gas Pipeline Accidents sections for more information on those particular types of infrastructure failures).

Damages/Critical Facilities

By definition, this hazard has great potential to result in damages, especially to critical facilities that provide essential services such as electricity and water and sewage treatment. Damages will depend on the type and extent of the failure. The following municipalities reported infrastructure related problems:

- **Benton Township** is concerned with sanitary system and water distribution system.
- **Chikaming** has the potential for sewage overflow at Red Arrow Highway and Cherry Beach Road.
- **Eau Claire Village** does not have sufficient back up power to operate wastewater treatment and water supplies during a prolonged power outage. Further, the village has no source of back up power to provide emergency sheltering of residents.
- **New Buffalo Township's** storm sewer system is inadequate to handle large rain events (10 inches/24 hours).
- **Niles Township's** sewer lift stations are still generator operated.

- **Three Oaks Township** has had some past concerns with combined sewer overflows.
- **Watervliet** has an AEP power substation located along M-140.

It is also known that Hickory Creek experiences sanitary sewer problems and there are issues with the Berrien Springs wastewater treatment plant being located in a floodplain. There are probably more issues in the county with regards to aging and/or inadequate infrastructure. A more thorough investigation of problems with aging infrastructure needs to be completed in Berrien County to get a better handle on the situation and to devise steps for corrective actions.

Economic Impact

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

Significant Infrastructure Failures in Berrien County

To date, there has not been a major significant infrastructure failure within Berrien County. Although severe weather plays a vital role in causing electrical power and communication failures on a regular basis throughout the County, these failures are usually short in duration and limited to a specific area. Prompt response by the local utility companies to repair downed lines and broken poles as well as safety mechanisms in place at the generating and transmission stations help limit widespread disaster. However, two recent national events could have had a significant impact on the residents of Berrien County.

January 2000

The most anticipated electric power failure in the history of mankind never actually happened. The much-celebrated year 2000 computer conversion crisis turned out to be the biggest non-event ever. Several years of mitigation and preparedness, as well as millions of dollars spent, paid off when critical infrastructure utilities continued to operate as designed on the morning of January 1, 2000 in spite of fears of total worldwide shutdown.

August 2003

A severe thunderstorm in central Ohio produced a lightning strike that took out an electrical power transformer. Due to a series of related systems failures, in addition to the affected transformer, a large area of the central and northeastern United States lost electrical service for several days. The resulting “cascade” of failures put nearly a dozen states, including eastern Lower Michigan, in the dark. Some of these states were affected statewide by this event. Berrien County was not affected by this event.

Figure 16. Water Lines, Berrien County

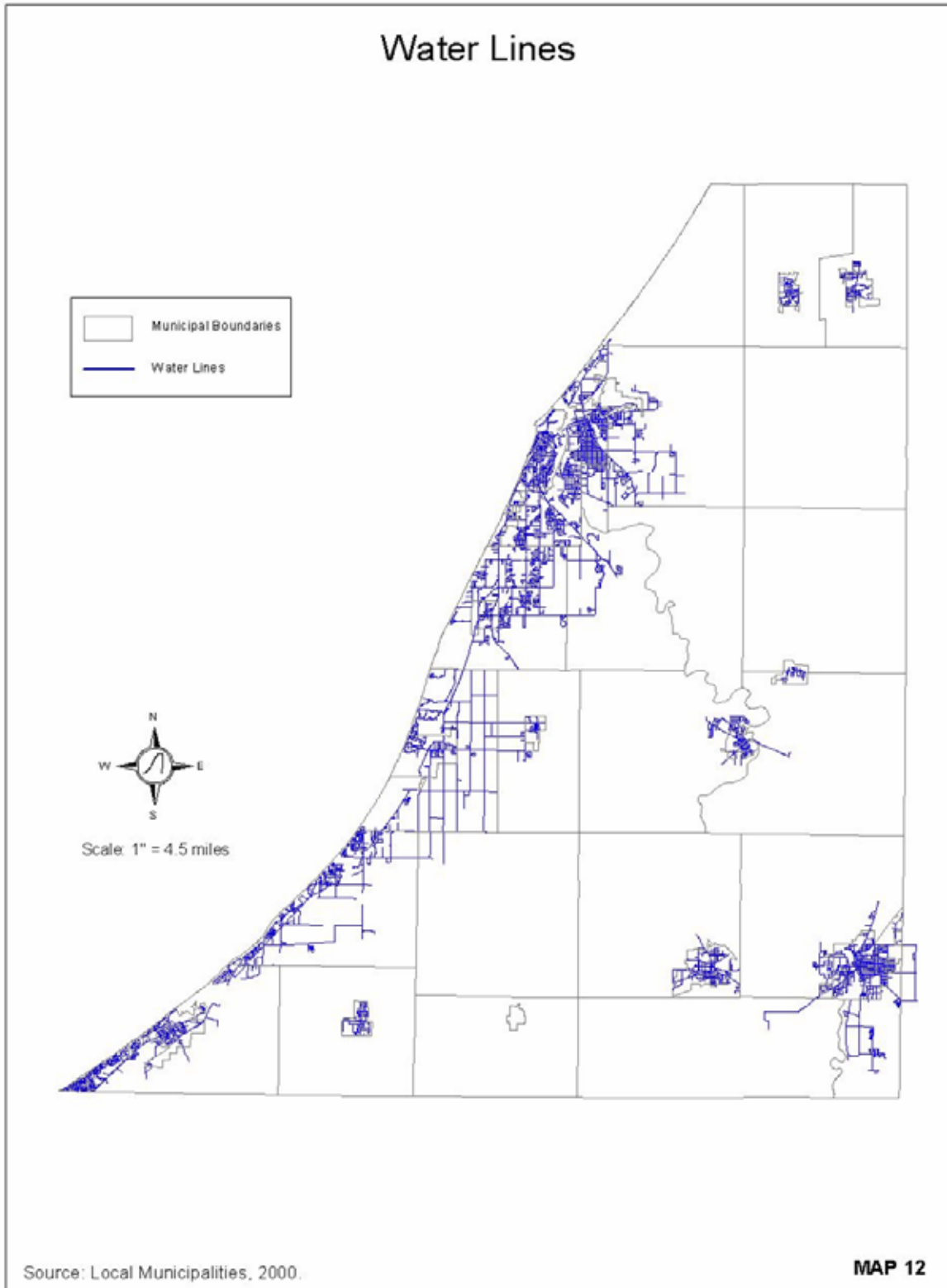
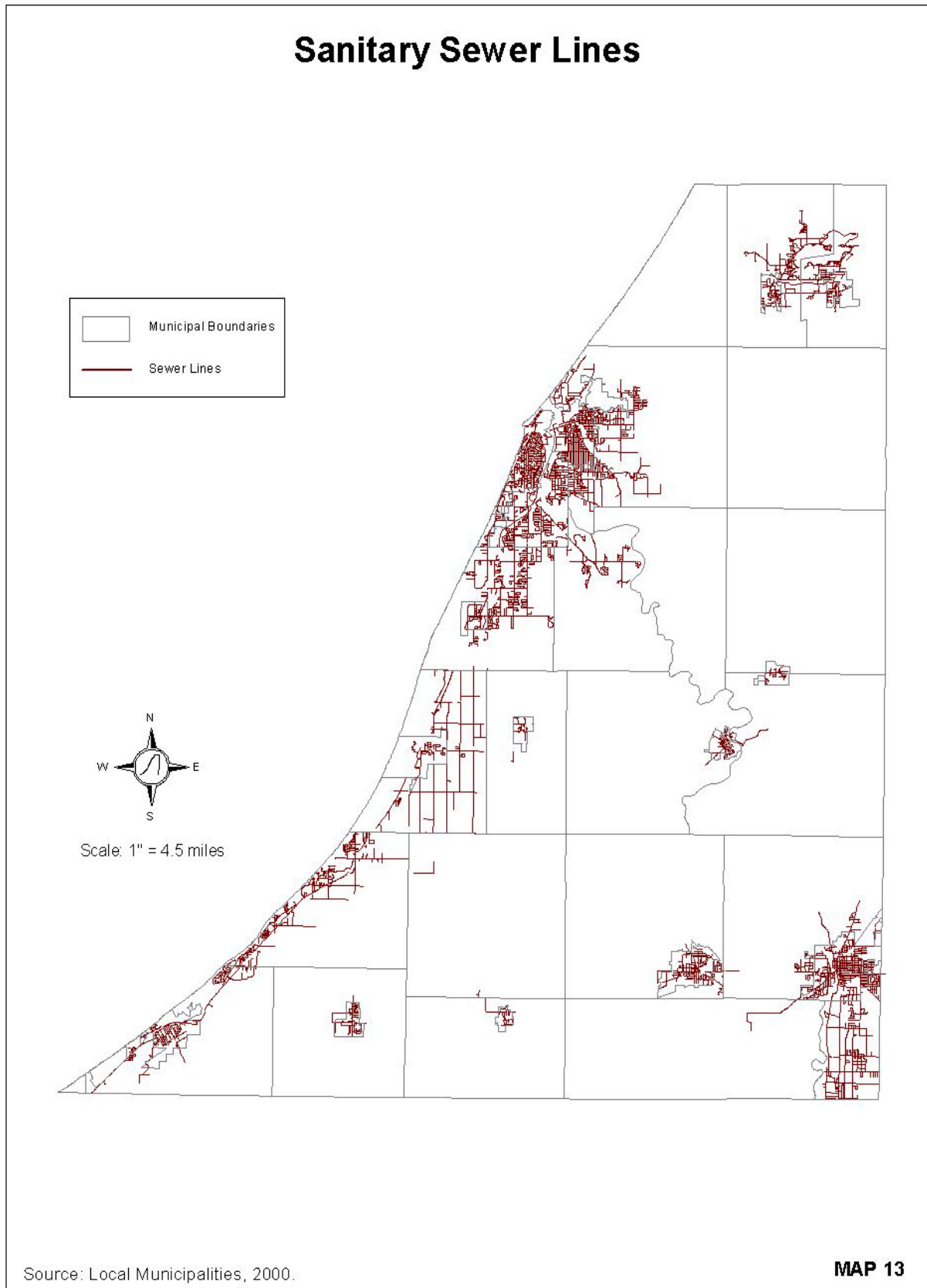


Figure 17. Sanitary Sewer Lines, Berrien County



FIRES

Wildfires: “An uncontrolled fire in grasslands, brush lands or forested areas”

Structural Fires: “A fire, of any origin, that ignites one or more structures, causing loss of life and/or property”

Scrap Tire Fires: “A large fire that burns scrap tires being stored for recycling/re-use”

Wildfires

Contrary to popular belief, lightning strikes are **not** the primary cause of wildfires in Michigan. Today, only about two percent of all wildfires in Michigan are caused by lightning strikes; the rest are caused by human activity such as outdoor burning, which is the leading cause of wildfires in Michigan. Most Michigan wildfires occur close to where people live and recreate, which puts both people and property at risk. The immediate danger from wildfires is the destruction of property, timber, wildlife, and injury or loss of life to persons who live in the affected area or who are using recreational facilities in the area.

Fires in rural dunes and woodlands are also hard to control and create special accessibility challenges. Not only do the brush, dry grasses, and trees create more fuel for the fire, rural structures are often not close to fire stations and tend to be difficult to access with fire suppression equipment. An inadequate supply of water can also impede fire suppression. While urban firefighters usually have access to water mains and hydrants, rural departments often must protect remote and rural areas with water shuttled in via tankers.

According to 1993 calculations, Berrien County contains approximately 67,000 acres of forested land, accounting for 18 percent of the total land area of the County. In addition, there are long stretches of dune land covered by grass and shrubbery. Both the forested areas and the dunes contain vegetation that, given the appropriate conditions, can be highly flammable.

Because Berrien County’s landscape has changed substantially over the last several decades due to increased development, the potential danger from wildfires has become more severe. This development, in and around rural areas, has increased the potential for loss of life and property from wildfires. There are simply not enough fire suppression forces available in rural areas to protect every structure from wildfire.

Unless residents in rural and urbanizing areas of Berrien County take the necessary precautions to ensure that their homes are properly constructed and maintained to minimize the risk of ignition, and that all measures are in place to suppress a fire that does ignite, it is anticipated that the number of wildfires in the County, and the property damage associated with these fires, will increase as rural areas continue to become more populated in the coming years.

Planning for rural fire suppression is a multi-step process. The four steps that must be considered are:

1. How much water is needed?
2. Where are available water supplies?
3. What are the advantages of a dry hydrant system?
4. How is water moved to the fire?

Strategic placement of dry hydrants can be a successful method for ensuring an accessible water supply in rural areas. Property owners, developers, and local fire departments should consider the installation of dry hydrants at plentiful water supplies, such as ponds and streams. When appropriately placed with sufficient vehicle access, a dry hydrant can allow more water to be distributed in less time.

Most of the concern with wildfires is along Lake Michigan where single drives serve several homes (often very expensive homes). The following municipalities reported concerns with wildfires:

- In **Chikaming Township**, Warren Woods State Park, and the length of the township between Red Arrow Highway and Lake Michigan, have the potential for wildfires.
- In **Galien**, large parcels of undeveloped village-owned land and a five-acre parcel owned by the Nature Conservancy have been subject to wildfires in the past.
- In **Lake Charter Township**, the dune grass along I-94, Warren Dunes, and Grand Mere state parks are prone to wildfires.
- **New Buffalo** has had instances of dune grass igniting due to illegal fireworks on the Lake Michigan shoreline.

Wildfires are not considered a priority hazard for the County. However, there are areas in the county (such as those mentioned above) that wildfires do pose a greater risk.

Frequency

To date, the County Emergency Management Office reports that there has not been a significant wildfire reported in Berrien County. However, local jurisdictions throughout the County respond to hundreds of grassfires every year. The Michigan Department of Natural Resources (MDNR) reported four wildfires in Berrien County from 1981-2000 on lands managed by MDNR. In 1999, local agencies responded to 235 wildfire calls throughout Berrien County. While these fires have varied in size and damage, the majority of them seem to have been caused by human factors such as the improper disposal of cigarette butts, careless campfire tending, and/or burning debris. Time of year is also a factor as more fires are reported during the summer months when more people are active outdoors and the warmer weather creates a more conducive environment to support burning vegetation.

Table 23. Number of Wildfires, Berrien County, 1999-2003

Year	Number of Wildfires	Damages Reported
1999	235	\$480
2000	118	\$4,850
2002	181	\$2,850
2003	224	\$11,400

Safety/Health

The dangers of wildfires cannot be under estimated. In one Berrien County incident, one person was killed and a firefighter was injured as a result of fighting the blaze.

Damage/Critical Facilities

With more people living in wooded and rural areas, there is an increase in the activities that lead to wildfires. Debris burning accounts for over one-third of the fire starts in Michigan. These fires, by nature, occur in close proximity to homes and other structures, which increases the potential for loss of life and property from fire. Properties that have not been properly fire-protected by clearing leaf and tree debris, or by planting fire resistant vegetation also increase the hazard. Carelessness and inattentiveness to a debris fire can also allow a contained fire to get out of hand.

Economic Impact

Responding to these wildfires is financially taxing to the jurisdictions involved - both in the cost of fighting the fire and in the recovery of damage. In 2000, there were nearly half as many wildfire calls reported as there were in 1999. However, the property damage total of \$4,850 was ten times higher than in the previous year. From 1999 to 2003, total losses reported per year have ranged from \$480 to \$11,400 in Berrien County.

Structural Fires

In terms of average annual loss of life and property, structural fires – often referred to as the “universal hazard” because they occur in virtually every community – are by far the biggest hazard facing most communities in Berrien County and across the country. Each year in the United States, fires result in approximately 5,000 deaths and 25,000 injuries requiring medical treatment. According to some sources, structural fires cause more loss of life and property damage than all types of natural disasters combined. Direct property losses due to fire exceed \$9 billion per year, with much of that figure the result of structural fires.

Berrien County and local fire departments are always proactive in attempting to reduce the number, scope, magnitude, and impacts of structural fires within the County. State and local fire service efforts in the areas of training, public education, incident tracking, construction plan review, site inspection, and fire analysis are oriented toward structural fire mitigation and prevention. However, like most programs, the amount of work that can be done is directly related to available funding.

A primary challenge facing Berrien County is the nature and composition of the local fire service. Almost all of the nearly 700 firefighters in the County are either volunteer or paid part-time. This presents a significant challenge to sustaining adequate code enforcement and inspection efforts. In addition, the relatively high level of turnover within these departments places an additional demand on training resources.

The lack of full-time, professional firefighters means less time is available to conduct fire inspections and take other preventive measures necessary to lessen the structural fire threat. Many times, in these communities, efforts are directed solely at fire suppression and little is done in the areas of prevention.

Another major challenge facing the fire service is the lack of a state-mandated fire safety code and code enforcement programs for all types of occupancies. Although the state enforces fire safety codes in schools, dormitories, health care facilities, and correctional institutions, all other enforcement is left to local officials. Because there is not a uniform, mandated fire safety code, local agencies tend to adopt their own regulations, if any at all. This results in allowing serious fire safety violations to go unchecked, often for years at a time.

Even if a mandated fire safety code were to be instituted statewide, it wouldn't totally solve the problem of structural fire prevention because the cost of compliance in existing buildings would be prohibitive for some owners. Such a measure would, however, help ensure that new construction wouldn't compound the problem.

Overall, structural fires are considered a moderate hazard in Berrien County. However, as reported by Berrien Springs, buildings in downtown areas share common walls, so a structural fire would be very damaging. This holds true in the downtown areas of every village and city in the County.

Frequency

Berrien County's fire statistics are a little better than the national averages. According to National Fire Information Reporting System (NFIRS) statistics, there were a total of 3,441 fires responded to in Berrien County between January 1, 1999 and December 31, 2002, resulting in 16 deaths, 89 injuries, and nearly \$181 million in property losses. Of these fires, 1,565 were structural fires or nearly 45 percent. This equates to an average of 860 total fires per year (390 structural fires per year) in Berrien County with an annual average estimated loss of \$45,250,000 per year, 4 deaths per year and 22 injuries per year.

Significant Structural Fires in Berrien County

Berrien County has not had a catastrophic structural fire disaster in recent years that resulted in a significant loss of life or property. However, in any given year, it is not uncommon for several multiple-casualty residential fires to occur. Despite the best efforts of fire officials in fire safety education and prevention, deadly residential fires continue to occur year after year. Below is a description of historic fires in Berrien County.

September 5, 1898

On the night of September 5, 1898, a terrible fire broke out at the Yore Opera House in Benton Harbor. Firemen from several surrounding departments rushed to the scene to assist in battling the massive blaze. Twelve firefighters died while fighting the fire when a portion of the roof collapsed, sending them into the raging inferno.

February 1999

Six family members, including four young children, perished when a fire destroyed their home in Coloma Township. By the time first responders made it to the scene, the residence was fully engulfed and the intensity of the heat and smoke prevented rescuers from entering the premise to affect a rescue attempt.

June 16-18, 2003

A total of 32 residential structures were burned to the ground during two days of civil unrest in Benton Harbor. At the height of the disturbances, firefighters were unable to get to the burning structures due to the massive crowds, and several fire trucks were attacked with rocks and bottles. Firefighters were forced to retreat, leaving dozens of homes to burn. Luckily, no fire-related injuries occurred during this event.

2003

Three separate incidents occurred between January and September 2003 involving apartment complex communities in Berrien County. In each incident, a multiple-unit building erupted in flames, forcing the evacuation of up to 100 families and resulting in hundreds of thousands of dollars in property damage. All three buildings were extensively damaged. Lightning was the cause of one fire and the other two were undetermined in origin.

Safety/Health

Structural fires can result in the injury, or death, of citizens and responders. Ironically, while the United States has made great strides in lessening deaths and injuries caused by other types of disasters, structural fires are a more substantial problem in this country than in many other industrialized countries, even those with a more densely developed population pattern. Fire-associated mortality rates in this country are two-three times greater than those in other developed countries. According to the National Fire Data Center, residential fires represent 74 percent of all structural fires and cause 80 percent of all fire fatalities. Approximately 85 percent of those fatalities occur in single-family homes and duplexes. In Berrien County, between January 1, 1999 and December 31, 2002, fires caused 16 deaths and 89 injuries. A major fire in a downtown area could result in more lives lost and a higher number of injuries.

Damage/Critical Facilities

Most critical facilities are located in city and village centers or other densely populated areas. This increases the risk of these critical facilities to structural fires. Another consideration is the possible loss of historic structures in downtown areas. These structures may not conform to newer building standards designed to limit the effects of structural fires.

Economic Impact

The economic impact of structural fires includes, but is not limited to the loss of the structure, displaced citizen housing needs, disruption to utilities, and loss of economic activity if a commercial or industrial area is affected. In Berrien County, between January 1, 1999 and December 31, 2002, structural fires caused \$181 million in property losses. This equates to an annual average estimated loss of \$45,250,000 per year

Structural fires are given high-level priority in Berrien County.

Scrap Tire Fires

With the disposal of an estimated 250 million vehicle tires annually in the United States, management of scrap tires has become a major economic and environmental issue. Michigan generates approximately 7.5 to 9 million scrap tires each year. Although responsible means of disposal have become more common, tire dumps of the last forty years present environmental and safety hazards that will last well into the foreseeable future. The State of Michigan has identified at least 24 million scrap tires in disposal sites scattered around the state.

Issues pertaining to the management of scrap tire disposal sites are difficult and diverse. Whole tires are difficult to dispose of in landfills because they tend to float to the surface and are banned by many licensed landfills due to associated problems. In addition, scrap tires are breeding grounds for mosquitoes, which can reproduce at 4,000 times their natural rate in a scrap tire disposal site. From an emergency management perspective, the most serious problem that scrap tire disposal sites pose is that they can be a tremendous fire hazard if not properly designed and managed.

Tire disposal sites can be fire hazards due to the large number of tires typically present at a site. This large quantity of "fuel", coupled with the fact that the shape of a tire allows

air to flow into the interior of a large tire pile, renders standard fire fighting practices nearly useless. Flowing, burning, oil released by the tires spreads the fire to adjacent areas. Some scrap tire fires have burned for months, creating acrid smoke and an oily residue that can leach into the soil, creating long-term environmental problems.

Scrap tire fires differ from conventional fires in several respects:

- Even relatively small scrap tire fires can require significant resources to control and extinguish
- The costs of fire management are often far beyond that which local government can absorb
- The environmental consequences of a major tire fire are significant - the extreme heat converts a standard passenger vehicle tire into about two gallons of oily residue, which can leach into the soil or migrate to streams.

Current technologies are sufficient to address the reuse of newly generated scrap tires, but some waste tires still migrate to the least expensive disposal method, which usually means they end up in a scrap tire disposal site, sometimes illegally.

Even with the improvements to the State's regulatory authority, much work still needs to be done to mitigate the impacts of scrap tire fires in Berrien County. Incident management planning, recognition of the hazardous material potential of fires, and improving and enhancing disposal site selection and design processes are all critical pre-incident preparedness factors that must be addressed by local governments and the private sectors. In light of the potential consequences of scrap tire fires, prevention must become a primary goal in the treatment of scrap tire disposal sites.

To be effective, scrap tire management must be viewed from two perspectives. First, methods for dealing with the millions of scrap tires currently being generated must be devised to stop the problem from growing in scope and magnitude. Recycling and re-use appear to be the best options in that regard. Second, measures must be devised to address the issues pertaining to the millions of scrap tires already present in existing disposal sites. In developing such a corrective solution, the economic realities of the problem must be understood.

The vast majority of disposal site owners have neither the financial means nor the incentive to address the health and fire hazards that result from the storage of scrap tires on their property. Unless the value of the tires increases dramatically through technological development, the piles will continue to grow, exacerbating the health and safety hazards for surrounding communities.

Although scrap tire fires occur in Michigan on an increasingly frequent basis, there have been no reported significant scrap tire fire events in Berrien County to date. There have been several recent events in which improperly disposed tires in trash piles were inadvertently set on fire when the whole trash pile was incinerated, but nothing on a grand or large-scale incident. The only large scrap tire pile in Berrien County was located in Berrien Township and was recently cleaned up. This hazard is considered low priority for mitigation planning.

TERRORISM/SABOTAGE/WMD

“An intentional, unlawful use of force, violence or subversion against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political, social, or religious objectives”

In today’s world, terrorism/sabotage can take many forms, although civilian bombings, assassination, and extortion are the methods with which we are most familiar. Internationally, such acts have become somewhat commonplace, as various religious, ethnic, and nationalistic groups have attempted to alter or dictate political and social agendas, seek revenge for perceived wrongdoings, or intentionally disrupt the political, social, and economic infrastructure of individual businesses, units of government, or nations. The Middle East and the European continent have been particularly hard hit by acts of sabotage and terrorism over the past several decades. Parts of Asia and South America have also experienced a high level of activity.

Unfortunately, with advances in transportation and technology, terrorism/sabotage incidents have now occurred in the United States. Equally alarming is the rapid increase in the scope and magnitude of terrorism/sabotage methods and threats, which now, in addition to bombings, include:

1. Nuclear, chemical and biological weapons
2. Information warfare
3. Ethnic/religious/gender intimidation (hate crimes)
4. State and local militia groups that advocate the overthrow of the U.S. Government
5. Eco-extremism, designed to destroy or disrupt specific research or resource-related activities
6. Pre-meditated attacks upon schools, workplaces, transportation systems or other places of public assembly
7. Organized criminal enterprises and activities

The methods and potential instigating groups have increased, so too, have the potential targets of terrorism/sabotage. As recent events across the country have shown, virtually any public facility, infrastructure, or place of public assembly can be considered a target of sabotage. In addition, certain types of businesses engaged in controversial activities are also potential targets. With the advent of the information age, and growth in the number of computer “hackers”, computer systems, especially those of government agencies, large businesses, financial institutions, health care facilities, and colleges/universities, are potential targets as well.

One of the primary common denominators of most saboteurs is their general desire for organizational and/or ideological recognition, but not necessarily individual recognition. They often seek publicity for their “cause” or specific agenda, but go to great lengths to avoid individual detection by law enforcement agencies. The exception to this might be organized criminal enterprises involved in narcotics and other illegal activities, which seek to keep their clandestine operations away from public and law enforcement scrutiny. Another commonality is that innocent people are almost always the ones that suffer the most in these senseless and cowardly criminal acts.

Berrien County, although it has never experienced an act of terrorism, sabotage, or WMD (weapon of mass destruction) in its history, must become more aware of the potential for such an act to occur here. Berrien County could be considered a prime target for this type of activity because it is home to one nuclear power plant is less than 10 miles away from a second one. In addition, being a smaller county with fewer resources than other, more populated counties could make Berrien County an ideal target for terrorism/sabotage. Berrien County considers terrorism to be a moderate hazard for mitigation planning purposes.

The Berrien County Hazardous Materials Response Team is not only responsible for hazardous materials events in Berrien County, but also has letters of agreement to respond to those events in the surrounding counties of southwestern Michigan. The team is also one of twenty recognized Regional Response Teams throughout the state of Michigan. As such, team members are trained and equipped to respond to, and mitigate, an event of terrorism, sabotage, or WMD should one occur anywhere in Michigan.

The nature and tools of terrorism/sabotage have changed over time. Whereas sabotage/terrorism used to be something that United States citizens saw happening elsewhere, such incidents are becoming increasingly frequent in this country. Terrorism/sabotage is now a bona fide domestic problem. Emerging threats, such as nuclear, chemical, and biological weapons of mass destruction and information sabotage make it all the more critical that effective mitigation and response strategies be developed to counteract this increasingly dangerous hazard. This will require the combined efforts and cooperation of government at all levels, business and industry, public institutions, and individual citizens.

Because it is impossible to put 24-hour security at each potential target, everyone must become increasingly aware of their surroundings and report any suspicious persons or activities to appropriate law enforcement agencies. Public facilities, places of assembly, and businesses must always be on guard against the possibility of an incident. Increased security measures may have to be instituted, facilities may have to be “hardened” to a greater degree, and a higher priority may have to be placed on emergency planning and preparedness for terrorism and other hazards.

Local and state response agencies, such as police, fire, emergency medical and public works, must be cognizant of the fact that they may, at some point, be involved in an incident of terrorism/sabotage. This necessitates that they be properly trained in appropriate response techniques for operating in a potentially dangerous environment. Local and state law enforcement and emergency management agencies must continue to work together in emergency planning, training, and practicing for terrorism/sabotage incidents. In addition, law enforcement must continue its efforts to identify potential perpetrators and to prevent terrorism/sabotage incidents before they are given a chance to occur.

Through these combined efforts, domestic terrorism/sabotage can at least be slowed down and made a more difficult and risky endeavor in which to engage. Unfortunately, there will never be a way to totally eliminate all terrorism/sabotage activities. Individuals and organizations determined to cause death and destruction are usually capable of

finding a way to carry out their plans. As perpetrators of terrorism/sabotage improve their ability to collect information, raise money, and issue rhetoric, implementation of effective countermeasures becomes even more important. Without a doubt, saboteurs and terrorists have learned from past incidents, making them even more dangerous in the future. Law enforcement and individual citizens must become equally adept at monitoring, investigating, and apprehending these individuals and groups before they have a chance to carry out their criminal activities.

Significant Terrorism/Sabotage/WMD Events in Berrien County

Although Berrien County experiences numerous potential bomb threats every year, it has never had a major, significant terrorism/sabotage/WMD event in its history. To date, none of the bomb threats responded to by the County bomb squad have been linked or tied to terrorism/sabotage groups.



(Bath, Michigan/May 18, 1927)

October 2001

A series of Anthrax contamination incidents began occurring throughout the eastern United States resulting in 5 deaths, 22 confirmed cases of exposure, and the closing of several postal distribution centers due to spore contamination. Although no confirmed cases of the Anthrax spore were ever detected in Berrien County, the County Hazardous Materials Response Team responded to several potential calls of contamination, including one to the local newspaper. In that event, the editor of the paper opened a letter that contained a white powder and a note claiming it was Anthrax. The powder tested negative for Anthrax spores and the newspaper resumed operations when the area was cleaned up.

According to the 2001 Michigan Hazard Analysis, there have been over 26 reported and confirmed terrorism/sabotage events in the State of Michigan dating back to 1927. Every incident to date can be associated with domestic terrorism and acts of terrorism by American citizens against Americans on homeland soils, rather than international terrorism involving radical religious groups and affiliations

According to Health Department official, there are no indications of an unusual threat in SW MI. However, from studying unclassified sources, Berrien County is in as much jeopardy as any other location, with the possible exception of large, high-value targets (national symbols). In addition, any intentional release of weaponized pathogens or toxins or even more common ones (e.g., home-brewed salmonella as in the 1983 Oregon incident) will create a massive public health and media response.

The following municipalities reported concerns with terrorism/sabotage:

- In **Berrien Springs**, contamination of the water supply would affect Oronoko Township in general.
- **Lake Charter Township** is concerned with the potential for fallout from the nuclear plant.
- If **Royalton Township's** water supply was contaminated, it could affect about 45 percent of the population.



(New York City, September 11, 2001)

The U.S. Department of Justice/Office of Justice Programs (DOJ/OJP) developed a needs-assessment process for states that provides for the allocation of future federal anti-terrorism grants based upon the potential risk of terrorist activities occurring within the state. As part of this process, states are required to produce a “Three-Year Statewide Domestic Preparedness Strategy” that is directly linked to response shortfalls identified in Needs Assessments completed by local jurisdictions in the state. These local Needs Assessments examine threat, vulnerability, public health capacity, current response capabilities, and a number of other factors to determine the needs of a jurisdiction to achieve the required response capability consistent with local emergency operations plans. The local Needs Assessments in Michigan were completed in 2000 and 2001. Michigan’s Three-Year Domestic Preparedness Strategy, based on the results of the local Needs Assessments and other factors, was approved by the DOJ/OJP in October 2001, allowing grants to be awarded to local governments to address shortfalls in equipment, training and exercises, and technical assistance.

During the past two years, the Michigan State Police, Emergency Management Division and the Michigan State University School of Criminal Justice joined together to facilitate a series of Safe School Summits across the state in support of Act 102. The goal of these Summits was to provide information and guidance to school districts and local community agencies in the development and/or refinement of multi-hazard emergency plans that address not only school violence, but also the vast array of other natural and technological hazards faced by Michigan schools.

Further, the County Health Department has been planning for a smallpox event. Based upon this planning effort it would cost more than \$10,000,000 to vaccinate Berrien County residents for smallpox. The cost of one person going through a team of 7 persons, not counting the overhead would be about \$60 (\$60 X 162,000 persons in Berrien County = \$ 9,720,000). In addition, there would also be the cost of the facility, e.g., the Mendel Center (plus overhead), Law enforcement, supervisors, additional medical support personnel, and all of their overtime. This assumes that some items are “free,” such as vaccine provided by the Federal government.

Seven Person Vaccination Team

1. Security (on the way in)
2. Greeter (greet, hands out the questionnaires and associated papers).
3. Educator # 1(pre-vaccination education and controls area where video is shown)
4. Nurse # 1 (medically screens the patient)
5. Nurse # 2 (performs vaccination)
6. Educator # 2(post vaccination education, issues dressings, collects paperwork)
7. Security (on the way out)

Local governments, particularly those in southeastern Michigan, are also becoming better prepared. Local law enforcement and personnel from fire departments, public works, and emergency medical agencies are being trained in how to properly respond to potential sabotage/ terrorism incidents. In addition, communities are also beginning to develop plans and procedures for such incidents, and will then test those plans and procedures in disaster exercises centered on sabotage/terrorist activities. Local jurisdictions are also starting public information and awareness campaigns aimed at educating businesses and individual citizens of the risks associated with this hazard, as well as steps they can take to adequately protect themselves. Many businesses, especially larger ones that could potentially be a target of terrorism/sabotage, are developing and testing internal emergency plans and procedures and training personnel in anti-terrorism/sabotage methods.

FLOODING AND EROSION HAZARDS

Shoreline Flooding/Erosion: “The flooding or erosion of shoreline areas caused by high Great Lakes water levels, storm surges, or winds” **Riverine Flooding:** “The overflowing of rivers, stream, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice” **Dam Failure:** “The collapse or failure of an impoundment that results in downstream flooding”

Overview

Shoreline Flooding and Erosion, Riverine Flooding and Dam Failures have been combined in this section because these hazards are so closely interrelated and Berrien County is susceptible to each of these hazards. To understand these hazards, one must understand the water features and other natural factors in Berrien County that will contribute to these hazards. Following is a general description and maps of the natural features (lakes, rivers, wetlands, soils, critical dunes, high risk erosion areas) in Berrien County.

Water Features

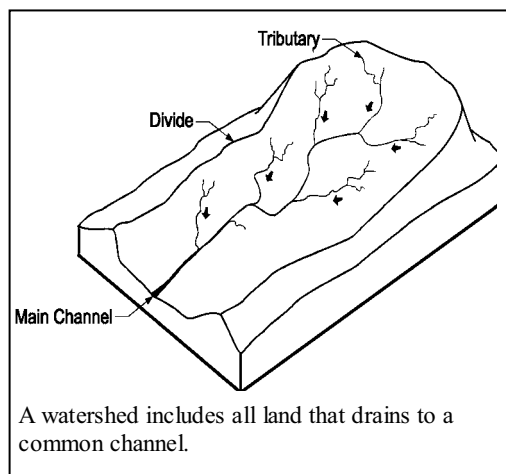
Berrien County’s abundant water resources provide many opportunities for outdoor recreation and education. Overall, there are 3,078 acres of inland lakes, 500 miles of streams and rivers and 42 miles of Lake Michigan shoreline. The largest inland lakes in Berrien County are the Paw Paw Lake near Watervliet and Coloma [900 acres of surface area], and Lake Chapin near Berrien Springs [600 acres of surface area]. Berrien County’s three main rivers are the St. Joseph River [46 miles in the County], the Paw Paw River [13 miles] and the Galien River [33 miles]. Dams on the St. Joseph River corridor have created impoundments near Niles, Buchanan, and Berrien Springs. Paw Paw Lake and Dayton Lake are impoundments resulting from dams.

The St. Joseph and Paw Paw River valleys are extensively terraced. The Galien River is deeply entrenched with a steep gradient. The St. Joseph, Paw Paw, and Galien Rivers exhibit a relatively low level of development along their banks with rather large wooded floodplain areas, which contribute to their wild and scenic character.

Watersheds

A “watershed” is an area of land that drains into a lake, stream or other body of water. The runoff from rain or snowmelt is collected by smaller channels (tributaries), which send the water to larger channels and eventually to the lowest body of water in the watershed (main channel). When a channel receives too much water, the excess flows over its banks and into the adjacent area – causing a flood.

Figure 19. Watershed graphic and definition



Berrien County has two major watersheds, the St. Joseph River Watershed and the Galien River Watershed. The St. Joseph River Watershed contains smaller sub-watersheds including the Paw Paw River Watershed and the Dowagiac River Watershed.

Table 24. Watersheds of Berrien County

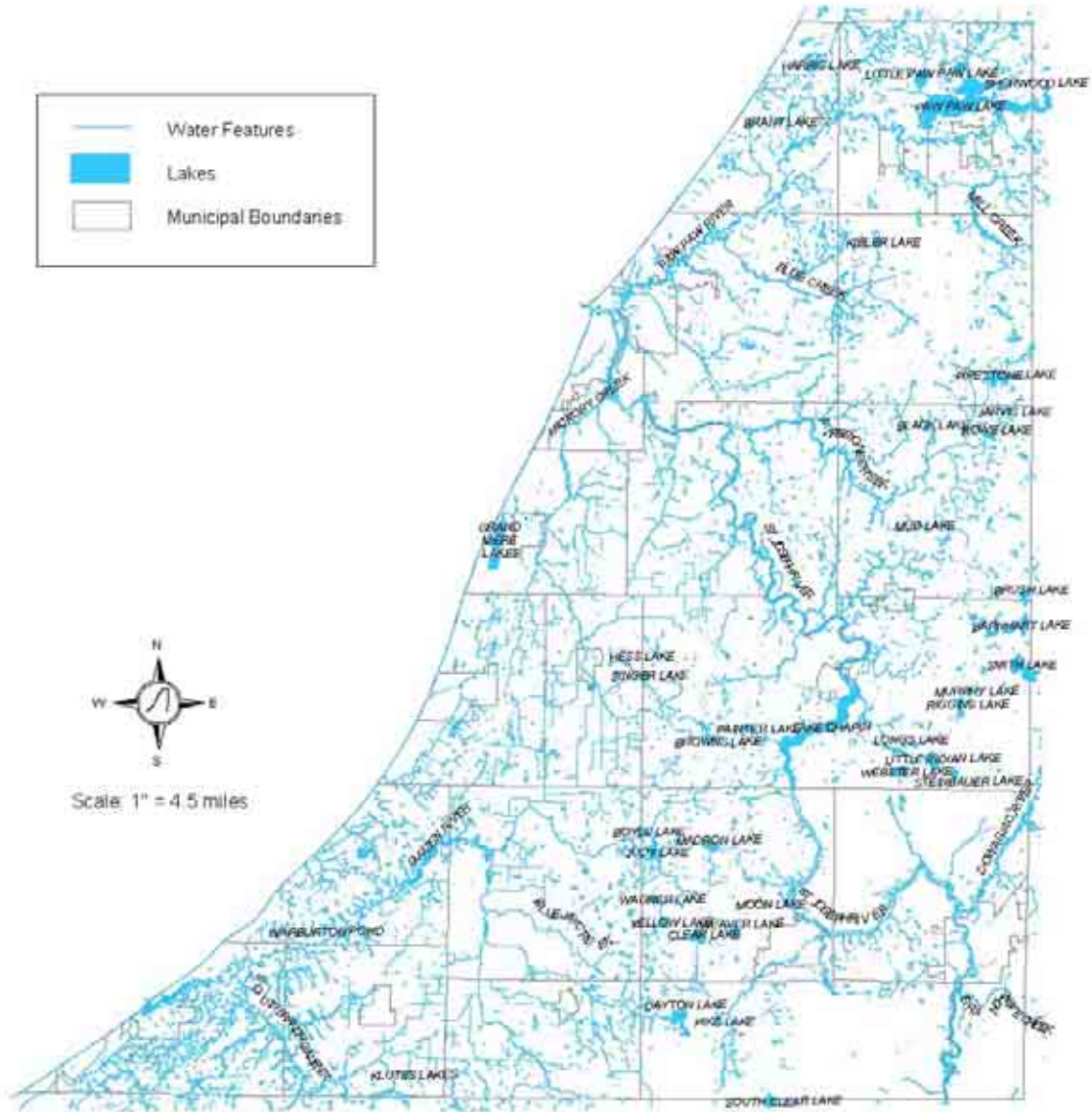
Watershed	Primary Contact	Status of Management Plan
Dowagiac River	Cass County Conservation District (269) 445-8643 x3	Completed October 2002
St. Joseph River	Friends of the St. Joseph River www.fotsjr.org	To be completed by March 2005
Galien River	Conservation Fund (269) 426-8825	Being updated 2004-2005
Lower St. Joseph/ Galien River Phase II area	Berrien County/Cass County	To be completed by February 2005

Wetlands

Wetlands serve as a transition between land and water and are important for mitigating floods. They are low areas characterized by the presence of water at a frequency that is sufficient to support wetland vegetation or aquatic life. Other than providing overflow areas for flooding, wetlands provide a variety of other benefits that include soil erosion prevention, improved water quality, and habitat for a variety of vegetation and wildlife.

Figure 20. Water Features, Berrien County

WATER FEATURES



Source: Berrien County GIS, 1996.

MAP 7

Wetlands found in Berrien County fall into four general categories – marshes, swamps, bogs, and fens. Marshes are wetlands dominated by soft-stemmed vegetation, while swamps have mostly woody plants. Bogs are freshwater wetlands, often formed in old glacial lakes, characterized by spongy peat deposits, evergreen trees and shrubs, and a floor covered by a thick carpet of sphagnum moss. Fens are freshwater peat-forming wetlands covered mostly by grasses, sedges, reeds, and wildflowers. New Buffalo has the County’s largest remaining marsh. The National Wetland Inventory (NWI) of the U.S. Fish & Wildlife Service produces a map of wetlands (Figure 21). The Emergency Wetland Resources Act of 1986 requires that the NWI archive and disseminate wetland maps and add newly discovered wetlands to the maps as they become available. Information on the NWI can be obtained by calling 727-570-5400.

The Michigan Department of Environmental Quality (MDEQ) through the Goemaere-Anderson Wetland Protection Act, Public Act 203, as amended, regulates any wetlands greater than five acres in size or contiguous with a waterway. Any activity that requires these regulated wetlands be filled or drained requires a permit from the MDEQ. Permits will generally not be granted unless the issuance is in the public interest and necessary to realize the benefits derived from the activity. If a wetland fill permit is granted, mitigation should be required, such as creating new wetlands within the same drainage way or enhancement of existing wetlands. Questions about MDEQ regulations can be answered by calling 517-373-1170.

Soils

The United States Department of Agriculture Soil Conservation Service published the Soil Survey of Berrien County, Michigan in 1979. The Soil Survey describes the characteristics of the soils in a given area, classifies the soils according to a standard classification system, and includes soil location maps. The Soil Survey also interprets the uses and limitations of the different soil types. This information is used to make a variety of land use, agricultural management, engineering, and wildlife management decisions.

Most of the County is comprised of gently sloping soils that are predominantly well drained or moderately well drained. These soils are well suited to agriculture and urban development. Broad areas that have a distinctive pattern of soils, relief, and drainage are referred to as soil associations. These associations are named for the major soil types found in them. Of the 42 different soil types identified in Berrien County, eight distinctive associations were formed. See Figure 22.

The High Water Table map is derived from the soils map (Figure 23). The southwestern portion of the County has areas with the highest water tables. As these areas are developed, flooding concerns will increase if proper watershed and stormwater management activities are not undertaken.

Figure 21. Wetland, Berrien County

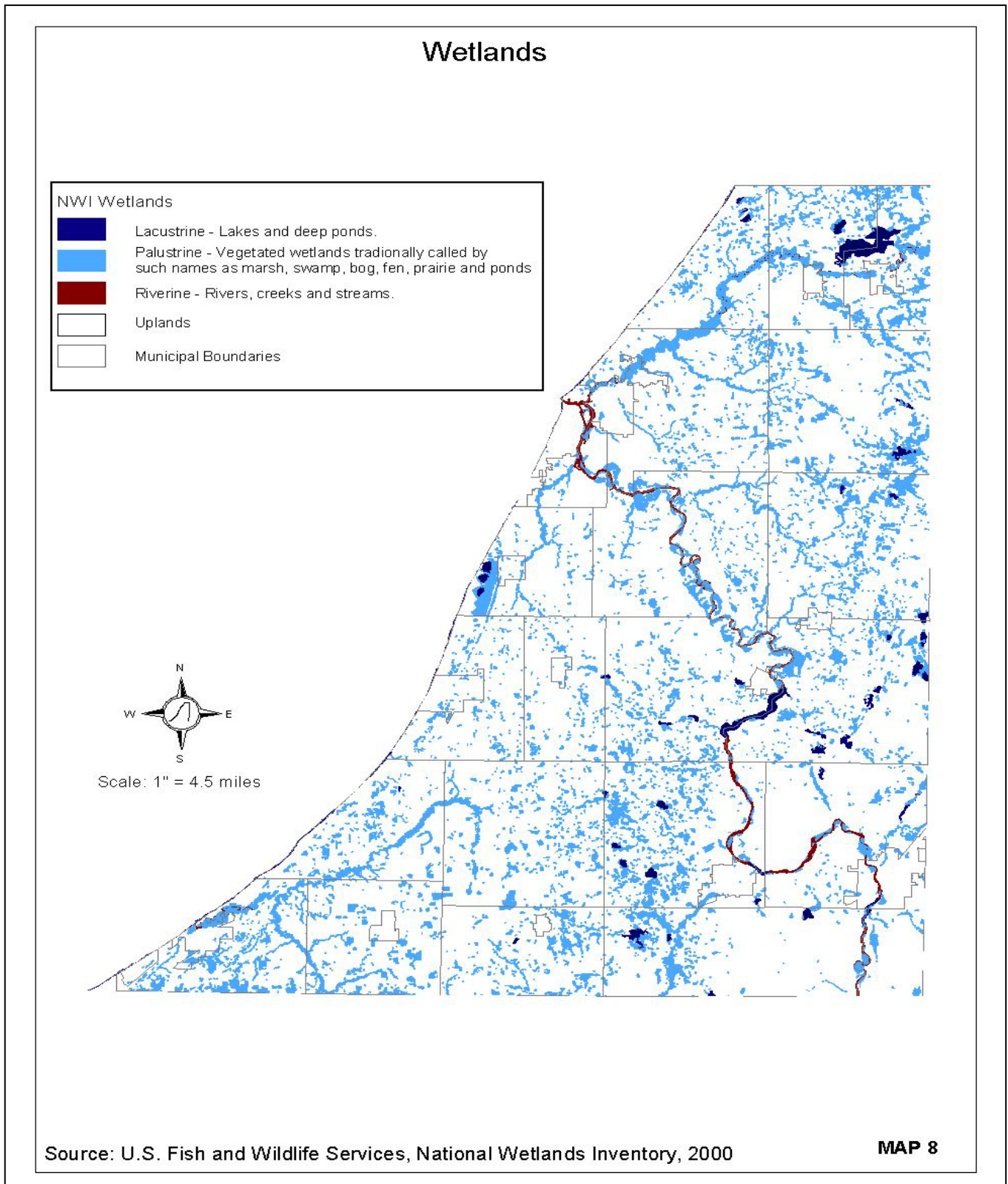


Figure 22. General Soils Map, Berrien County

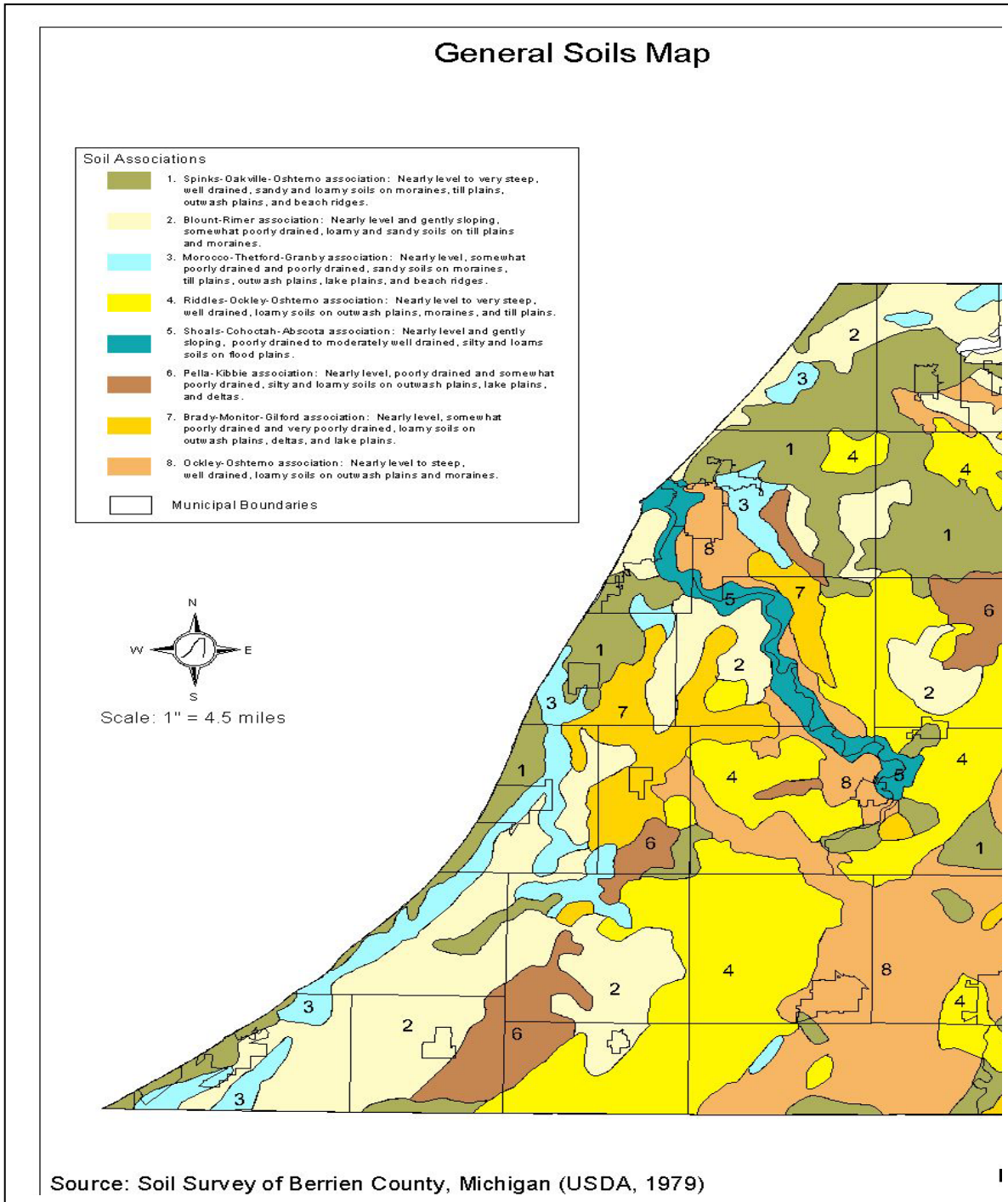
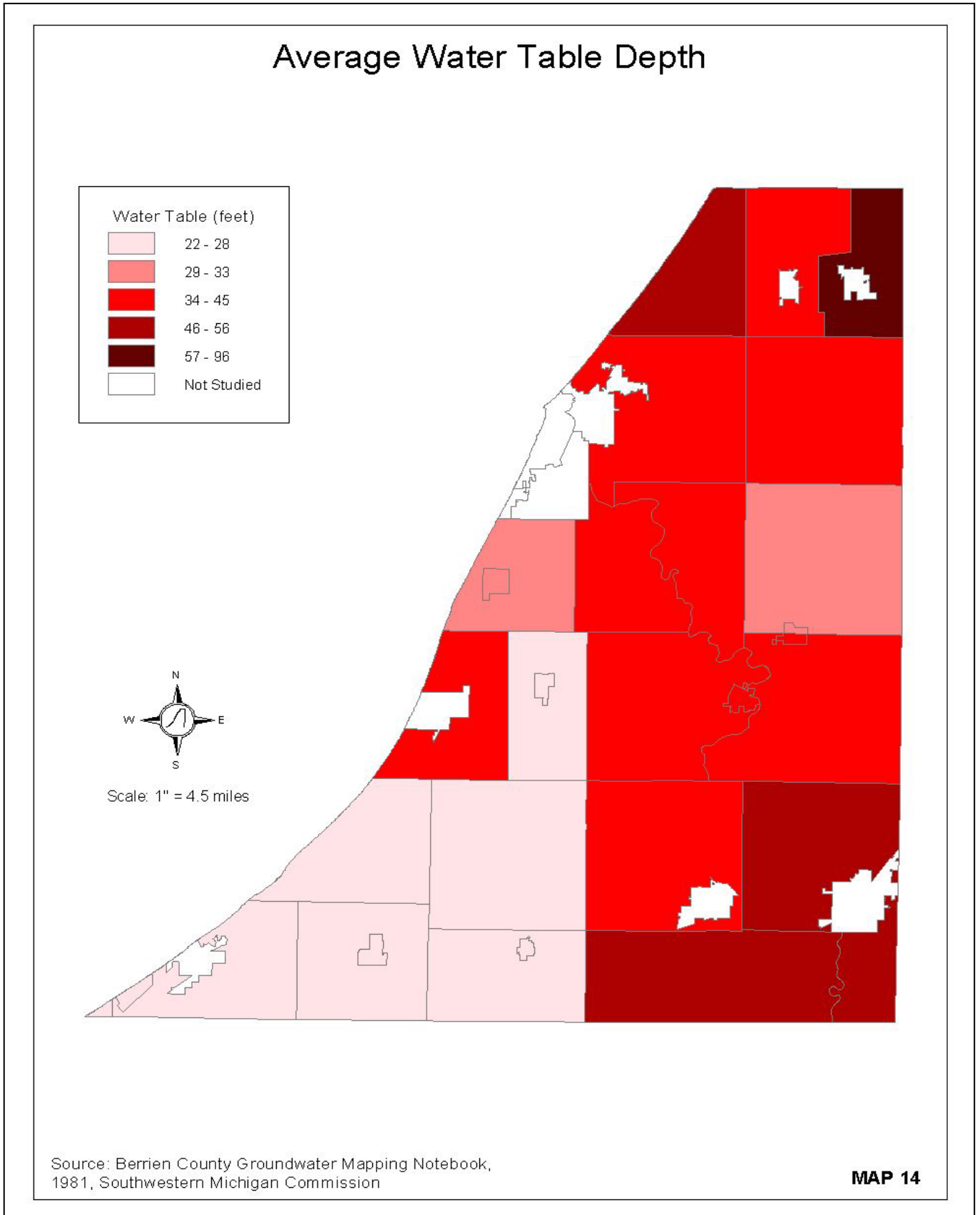


Figure 23. Average Water Table Depth, Berrien County



Critical Dune Areas

Michigan's critical dune areas are a unique, irreplaceable, and fragile resource that provides significant recreational, economic, scientific, scenic, educational and ecological benefits to the people of Michigan and to all who visit them. These critical dune areas represent the largest assemblage of fresh water dunes in the world and support numerous threatened and endangered species. Berrien County has approximately 4,000 acres of Michigan's 80,000 acres of critical dunes. With over 1,200 acres of critical dunes falling within state and local parks, it is easy to see the importance they have on the tourism industry of Berrien County. (See Figure 24.)

The Michigan Department of Environmental Quality (MDEQ) in their Atlas of Critical Dune Areas, 1989, designates critical dune areas. These critical dune areas are regulated by Part 353, Sand Dune Protection and Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451. The Sand Dune Protection and Management Act regulates the sand mining industry, along with developmental, silvicultural, and recreational activities in Michigan's designated dune areas.

The Sand Dune Protection and Management Act allows for local units to assume permitting authority by adopting or amending a zoning ordinance that provides the same, or a greater, level of protection for critical dune areas as the Act's model zoning plan. In the model, uses are prohibited on slopes measuring greater than 33 percent without a variance, and structures are prohibited on the first lake ward-facing slope of a critical dune area. Currently, there are no municipalities in Berrien County that have assumed permitting authority for critical dunes.

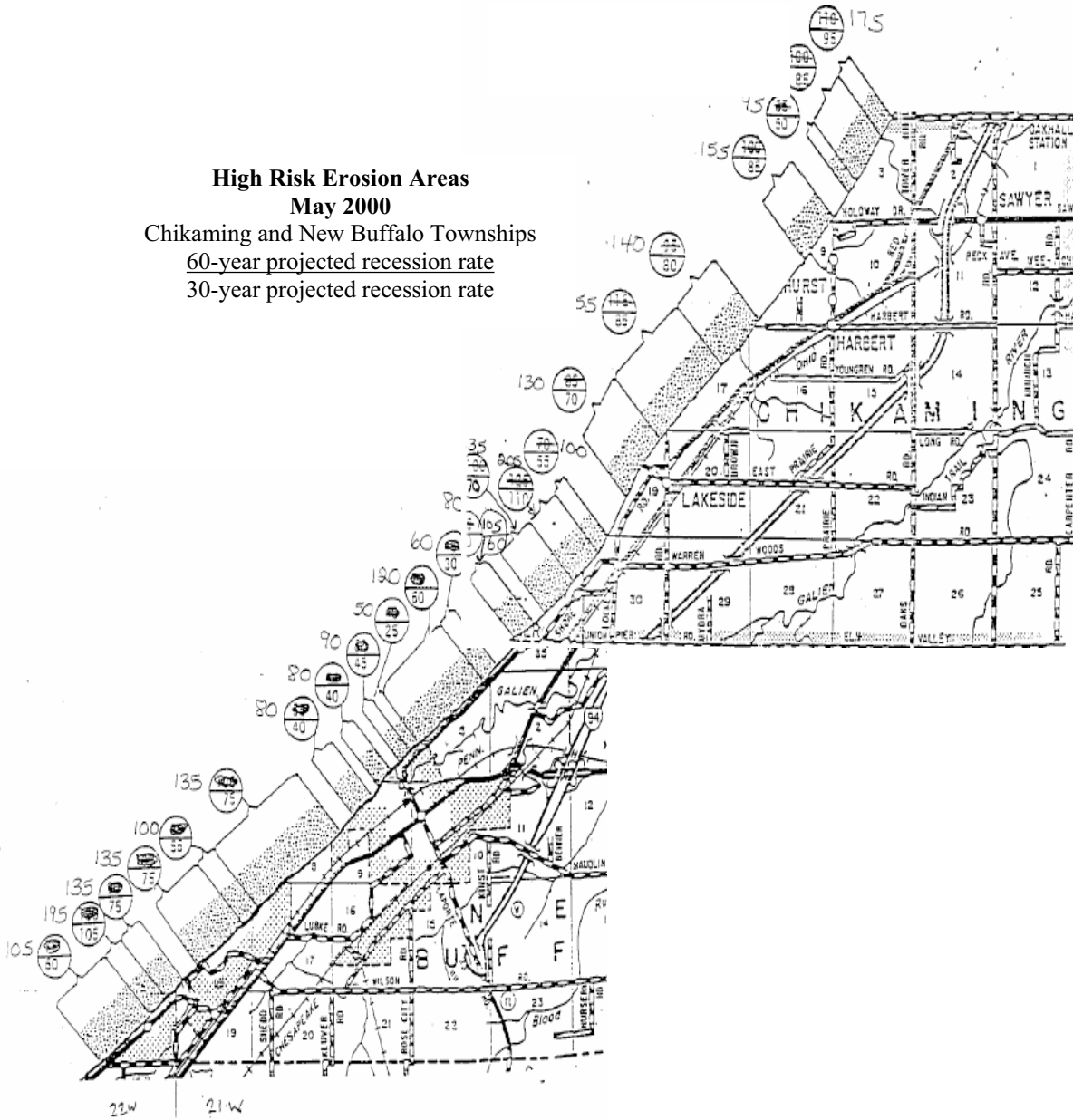
High Risk Erosion Areas

High-risk erosion areas are those shorelines of the Great Lakes and connecting waters where recession of the zone of active erosion has been occurring at a long-term average rate of one foot or more per year. This erosion can be caused by any, or all, of the following factors: high water levels, storms, wind, ground water seepage, surface water runoff, or frost.

In accordance with Part 323, Shorelands Protection and Management, of the Natural Resources and Environmental Protection Act, 1994, Public Act 451, the Department of Environmental Quality is required to notify all local governmental agencies, along with the affected land owners, of the designation of high risk erosion areas in their jurisdiction which are subject to zoning regulations or other protective measures as specified in this act. (See Figures 25-27.)

Figure 27. High Risk Erosion Area, Chikaming and New Buffalo Townships

High Risk Erosion Areas
May 2000
Chikaming and New Buffalo Townships
60-year projected recession rate
30-year projected recession rate



Shoreline Flooding and Erosion

With approximately 42 miles of beach and dune shoreline along Lake Michigan, Berrien County is subject to shoreline flooding and erosion. Wind, waves, and water levels constantly affect the communities along the shoreline. Shoreline flooding and erosion is a natural process and occurs at normal, high, and even low water levels. However, flooding and erosion are more frequent during periods of high water, storms, wind, and ice, causing serious damage to homes, businesses, roads, and other structures along the shore. Homes in Berrien County have sustained damage and even been completely washed away due to shoreline erosion. Overall, Berrien County considers shoreline flooding and erosion to be a moderate hazard for mitigation planning.

Seasonal and long-term variations in precipitation and evaporation rates contribute to the fluctuation of Lake Michigan's water levels. Lake Michigan is generally at its lowest level in the winter months when cold, dry air passes over the warmer water resulting in water evaporation. With more water leaving the lake than entering, the water level drops. As the snow melts in the spring, water runoff to the lake increases. In addition, the evaporation rate is lower because the air above the lake is warm and moist, causing the water levels to rise. Lake Michigan water levels are, therefore, typically higher in the summer months.

No regular, absolutely predictable cycle of levels has been indicated in over one hundred years of record keeping. The time periods between high and low water levels can vary widely. Records indicate the maximum difference in Lake Michigan water levels have varied as much as six and a half feet. Seasonal fluctuations caused by more water runoff can cause lake level fluctuation averages of nearly one foot. Weather-related events can cause lake level fluctuations as well. Windstorms, coupled with differences in barometric pressure, can temporarily tilt the surface of the lake up at one end as much as eight feet. This "*storm surge*" can drive lake waters inland over large areas causing widespread flooding and damage.

Berrien County does not suffer from a chronic shoreline-flooding problem. According to National Flood Insurance Program Studies, the 100-year flood elevation along Lake Michigan for this area is 584 feet. Army Corps of Engineers' lake level studies indicate that the highest monthly mean water level for Lake Michigan is 582.6 feet, recorded in 1886. The highest monthly mean level in recent years was approximately 582.4 feet in 1987.

No communities in Berrien County have been designated as Great Lakes Flood Risk Areas in the Administrative Rules for Great Lakes Shorelands. This does not mean that shoreline flooding will never occur in the County, it simply indicates that no area in the County has a history of flooding, nor does the regional topography indicate a high risk for flooding.

Shoreline erosion, on the other hand, is a significant problem in Berrien County. Almost all of the Lake Michigan shoreline in the County has been designated as a high-risk erosion area. Many homes and structures have been destroyed due to the shoreline erosion process. This destruction has resulted in severe financial loss to property owners.

Structures threatened by erosion must be moved back away from the shoreline, protected by shore protection measures, or risk being lost.

Within the high risk erosion area, (areas where erosion studies have indicated the erosion hazard line is receding at an average of one foot or more per year over a minimum 15-year period) any new permanent structure must comply with building setback regulations that require a minimum distance between the existing erosion hazard line and the structure.

In the spring of 1999, Lake Michigan had the lowest water levels recorded since 1990. The average monthly water level in March 1999 was 20 inches below the 1998 level, and five inches below the long-term monthly mean measured from 1918 to 1998. These low water levels have been the result of low rainfall levels and below normal snowfall. Shoreline managers fear that the several years of low water levels will lull property owners into a false sense of security. Even though shoreline erosion can occur at any water level, most severe short-term damage occurs at high water levels and during storms. With the low water levels in recent years, the Department of Environmental Quality has received more requests to build closer to the shoreline than in past years.

Although natural wind and water processes cause erosion, the rate and severity can be affected by human activity. It should be remembered that humans place themselves in harm's way by building structures in dynamic coastal regions. If that did not occur, there would not be significant damage due to shoreline flooding or erosion in Berrien County. Pedestrian and vehicle traffic destroy vegetation, degrade dunes, and weaken bluffs and banks. Docks, jetties, and other structures interrupt the natural shoreline movement of water and redirect erosive forces, possibly in undesirable directions. Inappropriate building practices in high bluff areas can seriously reduce bluff stability. In particular, drainage patterns from new building construction can cause infiltration of runoff directly into a bluff and can weaken its normal cohesive forces. Dune dredging and bulldozing remove natural protection against wind and waves. Wise management of shoreline construction and land uses can significantly reduce economic losses due to erosion.

Frequency

In nearly every decade, high water levels on Lake Michigan have caused significant damage and impact to coastal communities. Shoreline erosion is a more immediate and common threat than shoreline flooding in Berrien County. Several sections of the County's Lake Michigan shoreline are classified as *high-risk erosion areas*. Most areas of the shoreline are at least receding at the rate of over 100 feet in a 60-year period. Some sites are receding at a rate over 200 and 300 feet in a 60-year period. MDEQ is currently updating shoreline recession rate studies in Berrien County.

Significant Shoreline Flooding/Erosion Events in Berrien County

1972-1973

Record-high lake levels in 1972-1973 caused flooding in over 30 Michigan counties, resulting in an excess of \$50 million in public and private damage. Thousands of people were forced to evacuate their homes. Similar high water level flooding occurred in the early 1950s and late 1960s as well, resulting in millions of dollars worth of damage to shoreline communities.

April 30, 1984

A severe windstorm struck Michigan's Lower Peninsula. Wind gusts of up to 91 miles per hour produced 10-16 foot waves on Lake Michigan, which caused extensive shoreline damage, collapsed buildings, and washed many boats aground.

April 6-7, 1997

An intense low-pressure system moving across Lake Michigan brought gale force winds to much of Lower Michigan, including Berrien County. Sustained wind speeds of 50 miles per hour with gusts of up to 70 miles per hour spawned 10-15 foot waves on Lake Michigan, causing widespread wind damage and massive beach erosion. In addition to the high waves, Lake Michigan was nearly 38 inches above average at the time of this storm.

November 10-11, 1998

One of the strongest storms ever recorded in the Great Lakes struck much of the entire state of Michigan. Wind with speeds of 50-80 miles per hour and gusts of up to 95 miles per hour created 15-20 foot high waves on Lake Michigan and caused massive beach and shoreline erosion and property damage. Ironically, this was the 23rd anniversary of the severe storm that sunk the freighter Edmund Fitzgerald in Lake Superior in 1975.

Table 25. Governor's Declarations, Berrien County, 1974-2001

Date	Area	Disaster	Declaration
February 21, 1986	17 Counties	Great Lakes Flooding/Wave Action	Disaster

Safety/Health

There have been no historical safety or health issues related to shoreline erosion and flooding. However, there is the potential for safety issues if a shoreline bank were to collapse unexpectedly or a storm surge caused flooding of a structure with inhabitants. An unexpected collapse would be more likely to occur in northern Berrien County (near the City of St. Joseph) rather than the southern portion where there are more sand dunes instead of bluffs.

Damage/Critical Facilities

Many buildings have sustained damage or been totally lost from shoreline erosion and flooding. Large financial investments have been made to protect buildings and property from shoreline erosion. In 1998, the Eastern Michigan University Institute for Community and Regional Development conducted a survey of shoreline property owners. Shoreline residents reported spending a total of \$1,561,207 on riprap, seawalls and other

actions to protect their homes and properties from damages with an average expenditure per property of \$27,879. Governmental agencies and private companies have also spent money on protection efforts. For example, the City of St. Joseph has spent about \$2,500 per year on protection measures. The U.S. Army Corps of Engineers spent \$4.06 million from 1980 to 1988 and the CSX Corporation spent \$1.01 million. A total of \$5.32 million from 1972 to 1988 was spent on public and private shoreline protection efforts (this equals \$324.46/foot of shoreline) in the St. Joseph area.

Economic Impact

As mentioned above, shoreline protection is an expensive mitigation activity. Not only are there the protection measures, but there are also losses in the market value of shoreline property. The 1998 Eastern Michigan University study indicated that there has been a very appreciable market value loss in Berrien County for shoreline property owners. The perceived average market loss was calculated to be 34.6 percent, which equaled \$23,404,132 in 1998.

Riverine and Urban Flooding

Flooding of land adjoining the normal course of a stream or river is a natural occurrence. 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.

Every year, floods damage more homes in the United States than any other natural disaster. These floods cost homeowners more than \$2 billion in property damage annually. Nationally, riverine flooding is the most common form of flooding. Flood prone areas are found throughout Michigan, as every lake, river, stream and county drain has a floodplain. Several areas of Berrien County are considered high-risk locations for *riverine flooding*, especially along the St. Joseph, Paw Paw, and Galien Rivers and their tributaries. Riverine flooding occurs when an increased amount of water in a stream or river channel overflows onto the adjoining floodplain. Most riverine flooding occurs in the early spring as a result of excessive rainfall or the combination of rainfall and snowmelt. Ice jams can also create riverine flooding problems in winter and early spring. However, there are many other factors that can lead to riverine flooding.

Severe thunderstorms may cause flooding during the summer or fall, although these floods are normally localized and have more impact on watercourses with smaller drainage areas. 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 or frozen ground, and inadequate drainage. With no place to go, the water will find the lowest elevations – areas that are often not in a floodplain.

Cold winters, like those experienced in Berrien County, can produce thick river ice and the potential for ice jams. An ice jam develops when pieces of snow and ice build up along a river. As the ice build-up increases, water moves more slowly and flooding develops behind the dam of ice. Water levels can also rise rapidly when temperatures rise resulting in snowmelt runoff or rain, thus adding more water to the river behind an

ice jam. In the spring, or when temperatures rise, the ice build-up will thaw and break up, and may unleash all of the dammed up water in a short period of time. When this occurs, flooding can rapidly result downstream. The combination of ice, debris, and water released from the ice jam can cause tremendous physical damage to homes, docks, and other structures.

Table 26. Monthly Mean Precipitation in Berrien County, 1951-1980

Month	Benton Harbor	Niles	Eau Claire
January	2.99	2.51	2.32
February	1.88	1.98	1.58
March	2.58	2.92	2.45
April	3.76	4.13	3.70
May	3.00	3.16	3.18
June	3.45	4.05	3.46
July	3.06	3.64	3.26
August	3.19	3.77	3.14
September	3.38	3.26	3.38
October	3.20	3.57	3.18
November	2.90	2.98	2.76
December	3.12	3.18	2.71
<i>Annual Average</i>	<i>36.51</i>	<i>39.15</i>	<i>35.12</i>

Measurements are in inches. (Source: MSU Climatology Program)

Table 27. Maximum Daily Rainfall Amounts/Year, Berrien County, 1951-1980

Month	Benton Harbor	Niles	Eau Claire
January	2.15 / 1960	3.83 / 1960	3.06 / 1960
February	1.80 / 1964	2.07 / 1954	1.47 / 1960
March	1.95 / 1972	2.24 / 1956	1.93 / 1974
April	3.29 / 1976	1.98 / 1973	1.92 / 1954
May	1.89 / 1966	2.21 / 1951	2.10 / 1973
June	2.37 / 1968	4.64 / 1978	4.77 / 1968
July	2.65 / 1954	5.16 / 1970	3.00 / 1954
August	3.00 / 1955	3.23 / 1963	3.50 / 1955
September	2.75 / 1968	2.20 / 1951	2.35 / 1961
October	2.30 / 1967	2.72 / 1954	3.32 / 1955
November	1.65 / 1957	2.08 / 1957	1.67 / 1966
December	1.97 / 1967	2.98 / 1965	2.03 / 1965
Annual Bests	3.29 / 1976	5.16 / 1970	4.77 / 1968

Measurements are in inches. (Source: MSU Climatology Program)

In the more incorporated areas of the County, flooding often occurs when storm sewers and drains overflow. During periods of heavy rain, storm systems can be inundated with massive amounts of water in a relatively short period of time and, by design, be unable to keep up with the sudden increase in volume and flow. Damaged or obstructed storm drains can also prevent the flow of water runoff and lead to flooding of streets, basements, and property. Failures with sanitary sewer lift stations, unable to keep up

with the large volume of water runoff entering the system from a heavy rainstorm, have also led to flooding events in Berrien County. When this happens, water and sewage backs up into homes through sewer lines. Power outages have also caused lift stations to fail, resulting in similar backups. In the City of St. Joseph, a city park was entirely submerged under six feet of water and sewage when a sanitary sewer line ruptured. The resulting flood washed out one road and left the park unusable for days. This event cost the City thousands of dollars in repairs and man-hours to mitigate.

Land development can increase the amount of flooding by changing the natural hydrology of an area. Covering the ground with streets, buildings, parking lots, and other impervious surfaces increases riverine flooding by increasing runoff. These impervious surfaces do not absorb the stormwater; therefore more water flows directly and swiftly into storm sewers and ultimately nearby rivers or lakes.

Continued development in the 100-year floodplain and surrounding areas also increases the potential for flood damage to homes, businesses, and the infrastructure. Flooding has become especially significant in portions of Berrien County where development has disrupted the ability of natural land areas such as open fields, woodlands, marshes, and wetlands to absorb water and properly drain and disperse the water flow. Developed areas have more impervious surfaces that generate more volumes of water runoff, causing rivers to rise to higher levels and increasing the impact of flooding. The proximity of structures and inhabitants to flood waters increases the potential for personal injury and property damage during floods.

Controlling floodplain development is widely accepted as the key to reducing flood-related damages. Although there are state and local floodplain regulations designed to manage new development in flood prone areas, floodplain development continues to increase, resulting in increased potential for flood-related damage. Proper land use management and strict enforcement of zoning ordinances and building codes can make communities safer from flood hazards and help reduce the high costs of flood losses.

The best way to limit flood losses is to avoid building in flood hazard areas; however, this is not always an easy or viable option, especially when economic and political pressures make floodplain development attractive for some communities. Methods must be found to mitigate the impacts of development and reduce flood losses while still allowing property owners some reasonable use of their land.

Flood zones

The 100-year floodplain is the measure used to gauge flood risk. The definition of the 100-year flood is the “flood level which has a one-percent chance of being reached in any given year”. The land along the St. Joseph, Paw Paw, and Galien Rivers predominantly make up the areas designated by the Federal Emergency Management Agency (FEMA) as being within the 100-year floodplain. Map 6 identifies the flood zones for the Berrien County municipalities that are participating in the flood insurance rate program. The municipalities on the map labeled “undetermined” are municipalities that did not participate in the flood insurance rate program. The FEMA Federal Insurance Rate Maps (FIRMs) are the basis for floodplain management, mitigation, and insurance activities for the National Flood Insurance Program.

Most flood-prone communities in the United States have chosen to participate in the National Flood Insurance Program (NFIP) as a condition for the availability of federal flood insurance. The NFIP provides basic flood hazard data and a flood hazard management framework for every flood-prone community in the United States. The NFIP offers insurance coverage and other benefits to local communities dependent on the communities undertaking certain flood hazard mitigation steps. The NFIP is implemented through the Federal Insurance Administration, which is a component of the Federal Emergency Management Agency (FEMA). Anyone with questions about the program should either contact FEMA by telephone at 877-336-2627, or the offices of their local municipality.

Berrien County municipalities reported the following concerns related to flooding:

- In **Baroda and Baroda Township**, Hickory Creek occasionally floods.
- **Galien** has had erosion on the shoreline of Lake Michigan, which caused the loss of some homes and property.
- In **Lincoln Charter Township**, James Drive neighborhood is considered to be in a floodplain.
- In **New Buffalo**, there was flooding at the Lake Michigan shoreline due to a surge and **New Buffalo** frequently experiences severe lakefront and river basin erosion due to wind and water from Lake Michigan.
- **Niles Township** has flooding and erosion issues from the St. Joseph River off Old US-31 at the Harbor Towne Apartments and in the ThorneAcre, Washington Court, and Echo Valley areas. **Niles Township** is also concerned about Brandywine Creek flooding around the Bond and Beeson Road areas and on 3rd Street, north of Beeson.
- **Shoreham** has had flooding on South Lakeshore Drive after heavy rain and has a problem with shoreline erosion on Lake Michigan.
- In **St. Joseph Charter Township**, Eagle Pointe Marina and adjacent properties are in a floodplain. **St. Joseph Charter Township** has properties at risk for flooding near the St. Joseph River and Hickory Creek.
- In **Watervliet**, Mill Creek is a potential flood concern.

Overall, Berrien County considers riverine and urban flooding to be a moderate hazard for mitigation purposes. However, as mentioned above some of the impacts individual communities due to flooding are considerable and will require mitigation planning for implementing effective solutions.

Frequency

Flooding is a natural occurrence and does not become a disaster until people put themselves and objects of value into harm's way of this natural process. When left undisturbed, the land that surrounds a waterway serves as a natural flood and erosion control system by providing temporary storage of floodwaters, reducing the velocity of the water, and minimizing the amount of sediment that can accumulate downstream. Floodplains also help maintain water quality by filtering nutrients and impurities from stormwater runoff.

Across the country, and throughout much of Berrien County, flooding is the most common form of natural hazard. According to the National Flood Insurance Program (NFIP), the risk of flood is much greater than the risk of fire. For structures located in the 100-year floodplain, there is a 26 percent chance of experiencing a flood during the life of a 30-year mortgage compared to a four percent chance of experiencing a fire.

In Berrien County, there are nearly 50,000 acres of land in the 100-year floodplain and 1,569 structures in flood prone areas. These areas are predominately located along the St. Joseph, Paw Paw, and Galien Rivers and their tributaries. However, even a home or business that is not located in a 100-year floodplain, or near a lake or river, can be flooded.

What are the odds of a flood?

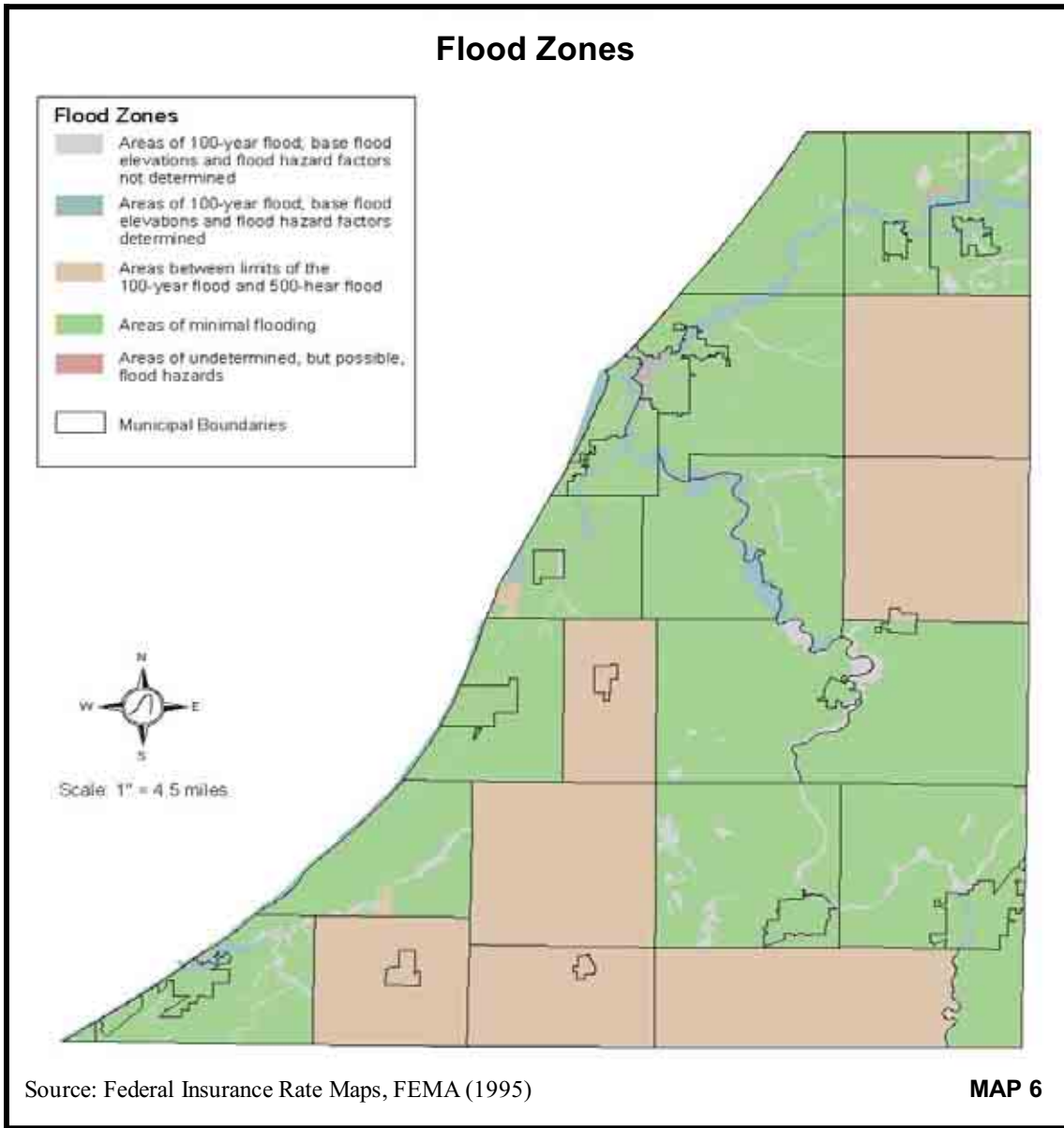
The term “100-year flood” has caused much confusion for people not familiar with statistics. Another way of looking at it is to think of the odds that a base flood will happen sometime during the life of a 30-year mortgage (26 percent chance).

Chance of Flooding over a Period of Years

Time Period	10 year	25 year	50 year	100 year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Even these numbers do not convey the true flood risk because they focus on the larger, less frequent, floods. If a house is low enough, it may be subject to the 10- or 25-year flood. During the proverbial 30-year mortgage, it may have a 26 percent chance of being hit by the 100-year flood, but the odds are 96 percent (nearly guaranteed) that a 10-year flood will occur during the 30-year period. Compare those odds to the only 5 percent chance that the house will catch fire during the same 30-year mortgage.

Figure 28. Flood Zones, Berrien County



Since 1950, there have been approximately 14 significant flood events reported in Berrien County. These flooding events were attributed to both riverine and urban flooding. There is a likelihood of 0.26 percent that a significant flooding event will occur in any given year in Berrien County. There have been two presidential declared disasters and two governor declared disasters in Berrien County for flooding between 1974 and 2001.

Table 28. Flooding Disaster Declarations, Berrien County, 1974-2001

Presidential Declarations for Berrien County 1974 – 2001			
Date	Area	Disaster	Declaration
March 12-20, 1982	2 Counties	Flooding	Major Disaster
April 18-30, 1975	21 Counties	Flooding/Tornados	Major Disaster

Governor’s Declarations for Berrien County 1974-2001			
Date	Area	Disaster	Declaration
May 22, 1996	Countywide	Flooding	Disaster
March 19, 1982	2 Counties	Flooding	Disaster

Significant Riverine/Urban Flooding Events in Berrien County

The following is a description of a few of the events that have occurred in recent history.

May 9-11, 1996

Nearly nine inches of rain fell in a three-day period, resulting in massive urban flooding in the southern portion of Berrien County. Numerous rural roads were washed out and city streets flooded. Interstate 94 was under nearly a foot of water between the 7 and 8-mile markers. Sawyer Road and US-12 were submerged under nearly two feet of water in places. Over 100 miles of county roadways and approximately 269 homes and 31 businesses reported damage. The St. Joseph River crested nearly a foot above flood stage in Niles, causing widespread riverine flooding. A Governor’s Disaster Declaration was granted due to the magnitude of the event.

May 16-18, 1996

Two days of saturating rains dumped nearly five inches of precipitation across much of southern lower Berrien County, flooding low lying areas and washing out many roadways that had just been previously repaired after flooding earlier in the month. Water reached near the top of the Dayton Mill Dam but did not overflow it. The St. Joseph River crested at its 11-foot flood stage in Niles before receding the next day.

June 9, 1996

At one point, three inches of rain fell on the city of New Buffalo in one hour, as heavy rains pounded much of the County throughout the entire day. The city sewer system was unable to keep up with the massive rainfall and created backup flooding in many homes and businesses. Many roadways were closed due to standing water. The St. Joseph River in Niles crested at 2½ feet above flood stage for three days before receding.

July 18, 1996

In a three-hour deluge, between two and four inches of rain fell, resulting in massive road flooding and closures. US-12 in Galien was closed to all traffic due to damage from washouts. Many roads in the New Buffalo/Three Oaks area were reported to be under water.

February 21, 1997

A spring-like storm system tracked into southern Michigan, bringing warm, moist air from the Gulf of Mexico. The resulting weather front produced thunderstorms and heavy rainfalls for two days before changing to snow. Widespread flooding occurred throughout Berrien County with the St. Joseph River cresting to three feet above flood stage in some areas.

March 1, 1997

Melting snow from a massive spring-like storm system two weeks earlier continued to wreak havoc on Berrien County. The snowmelt, along with the earlier addition of saturating rains, caused the St. Joseph River to exceed flood stage for nearly two weeks.

March 1982

A combination of heavy rainfall and melting snow resulted in a major flood disaster for Berrien County. Damage from the event was estimated at \$12 million and resulted in a Presidential Major Disaster Declaration being declared. One death was directly attributed to the flood conditions.

Table 29. Flood Events, Berrien County, 1950-2004

14 FLOOD event(s) were reported in Berrien County, Michigan between 01/01/1950 and 02/29/2004 with at least 0 deaths with at least 0 injuries.

Mag: Magnitude
 Dth: Deaths
 Inj: Injuries
 PrD: Property Damage
 CrD: Crop Damage

If viewing o-line, click on *Location or County* to display Details.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 South Half	05/09/1996	04:00 PM	Flash Flood	N/A	0	0	0	0
2 South Half	05/09/1996	11:30 PM	Flash Flood	N/A	0	0	5.4M	0
3 MIZ077	05/11/1996	03:00 AM	Flood	N/A	0	0	0	0
4 South Half	05/16/1996	03:00 PM	Flash Flood	N/A	0	0	0	0
5 Calvin Center	05/16/1996	08:15 PM	Flash Flood	N/A	0	0	0	0
6 Galien	05/17/1996	03:00 AM	Flash Flood	N/A	0	0	0	0
7 MIZ077	05/18/1996	06:00 AM	Flood	N/A	0	0	0	0
8 New Buffalo	06/09/1996	09:00 PM	Flash Flood	N/A	0	0	50K	0
9 West Central	06/17/1996	11:30 PM	Flash Flood	N/A	0	0	0	0
10 Southern	07/18/1996	01:00 AM	Flash Flood	N/A	0	0	0	0
11 MIZ037 - 045 - 050 - 052 - 057 - 059 - 064>065 - 077 - 079	02/21/1997	06:00 AM	Flood	N/A	0	0	0	0
12 Bridgman	02/21/1997	08:00 AM	Flash Flood	N/A	0	0	0	0
13 MIZ057 - 077 - 079	03/01/1997	12:00 AM	Flood	N/A	0	0	0	0
14 Coloma	08/25/1998	12:48 AM	Urban/small Stream Flood	N/A	0	0	0	0
TOTALS:					0	0	5.450M	0

<http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>

Safety/Health

People's lives are at risk during flood events. Floods may leave people stranded in their homes for several days without power or heat, or they may be unable to reach their homes at all. In the March 1982 flood event, one death occurred. Fortunately there have been few deaths and injuries related to flooding in Berrien County.

Damage/Critical Facilities

Floods can damage or destroy public and private property, disable utilities, render roads and bridges impassable, destroy crops and agricultural lands, cause disruption to emergency services, and result in fatalities. 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.

Because almost no property is completely safe from flooding, residents in Berrien County should consider purchasing flood insurance from the National Flood Insurance Program (NFIP), especially if those homes or businesses are located within flood prone areas. Most homeowners and business insurance policies do not cover losses in the event of a flood, which often means that the owner is responsible for all the cleanup, replacement, and repair costs associated with the flood disaster. Many times, people inhabiting flood prone areas assume the federal government will provide financial assistance to help recover from a flood. However, in order for a community to receive federal assistance monies, a federal disaster area must be declared. This only happens in a small percentage of all flood events. Also, most federal assistance is offered in the form of a loan, which must be paid back, with interest.

Enforcing floodplain regulations, implementing strict building ordinances, preserving valuable land resources, elevating flood prone structures, installing sewer backflow devices, maintaining stream buffers, and ensuring that retention ponds and man-made lakes are properly designed, are just some of the ways Berrien County can help keep flood damage and losses to a minimum. As stated earlier, there is no guaranteed protection from a flood or flood-related event anywhere within the County.

In the municipal worksheets, the following municipalities reported critical facilities being affected by flooding:

- In **Berrien Springs**, there has been flooding at the wastewater treatment plant and Shamrock Park from the St. Joseph River.
- **Chikaming Township** is in the floodplain of the Galien River, and there is potential for flooding near the electrical substation on East Road. Chikaming Township also has wind and water erosion along the Lake Michigan bluff, which affects roads and railways.
- **Lake Charter Township** has flooding issues at the lift station area west of the corner at Lemon Creek and Date Road; the county drain south of Date Road and Snow Road and along Livingston Beach.

- **Watervliet** has concerns that failure of the aging dams on the Paw Paw River would cause flooding.

The following municipalities reported flooding problems and damages due to inadequate infrastructure:

- In **Buchanan**, the McCoy Creek floods in some low lying areas, and the storm water system has backed up, causing damage in the Colonial Gardens area.
- In **New Buffalo**, there was flooding on Franklin Street, Water Street, Creek Drive and at 105 E. Buffalo Street due to 100-year rain and inadequate storm water removal system.

The following table indicates the number of claims, and associated costs in dollar amounts, made in each Berrien County municipality since 1978. Watervliet, Royalton and Coloma Townships have had the most number of claims since 1978. St. Joseph Township has had the most in total dollars claimed since 1978 with \$461,767. The City of New Buffalo has the most amount of coverage with a coverage total of \$10,968,600.

Table 30. National Flood Insurance Program Report, Berrien County

NFIP INSURANCE REPORT BY COMMUNITY								
CID	Community Name	Total Premium	V-Zone	A-Zone	Current Total	Coverage Total	Claims since 1978 Total	Dollars since 1978 Total
260032	Benton Harbor, City of	4796	0	3	3	720,600	5	39,849
260031	Benton, Township of	1830	0	1	3	407,500	7	193,400
260330	Berrien Springs, Village of	747	0	2	2	65,000	5	7,487
260733	Berrien, Township of	2333	0	4	4	405,300	0	0
260033	Bridgman, City of	897	0	0	2	438,000	1	466
260554	Buchanan, City of	4286	0	3	5	435,000	4	144
260555	Buchanan, Township of	2790	0	6	6	454,900	1	0
260258	Chikaming, Township of	4656	0	0	8	2,266,000	4	300,460
260556	Coloma, City of	0	0	0	0	0	3	3,585
260034	Coloma, Township of	2004	0	1	6	606,500	27	67,856
260268	Grand Beach, Village of	6098	0	1	8	2,395,000	5	22,333
260035	Hagar, Township of	3605	0	3	6	850,900	18	275,340
260036	Lake, Township of	1470	0	1	3	727,100	2	985
260037	Lincoln, Township of	15880	0	20	31	3,398,900	21	105,778
260275	Michiana, Village of	667	0	0	2	620,000	1	0
260038	New Buffalo, City of	30427	0	80	140	10,968,600	5	0
260039	New Buffalo, Township of	4986	0	3	13	1,568,100	3	0
260041	Niles, Township of	3126	0	6	9	1,200,500	4	3,386
260040	Niles, City of	4365	0	7	11	2,040,900	7	15,222
260042	Oronoko, Township of	611	0	0	2	560,000	0	0
260043	Royalton, Township of	21901	0	25	39	6,776,800	30	92,651
260280	Shoreham, Village of	0	0	0	0	0	12	248,284
260046	Sodus, Township of	1825	0	2	6	246,600	0	0
260044	St. Joseph, City of	4589	0	3	12	1,748,000	6	113,233
260045	St. Joseph, Township of	3638	0	2	8	2,305,900	10	461,767
260047	Watervliet, City of	1914	0	2	5	491,500	12	319,239
260048	Watervliet, Township of	6681	0	10	12	1,149,700	40	123,728
	COUNTY TOTAL	136,122	0	185	346	42,847,300	233	2,395,193

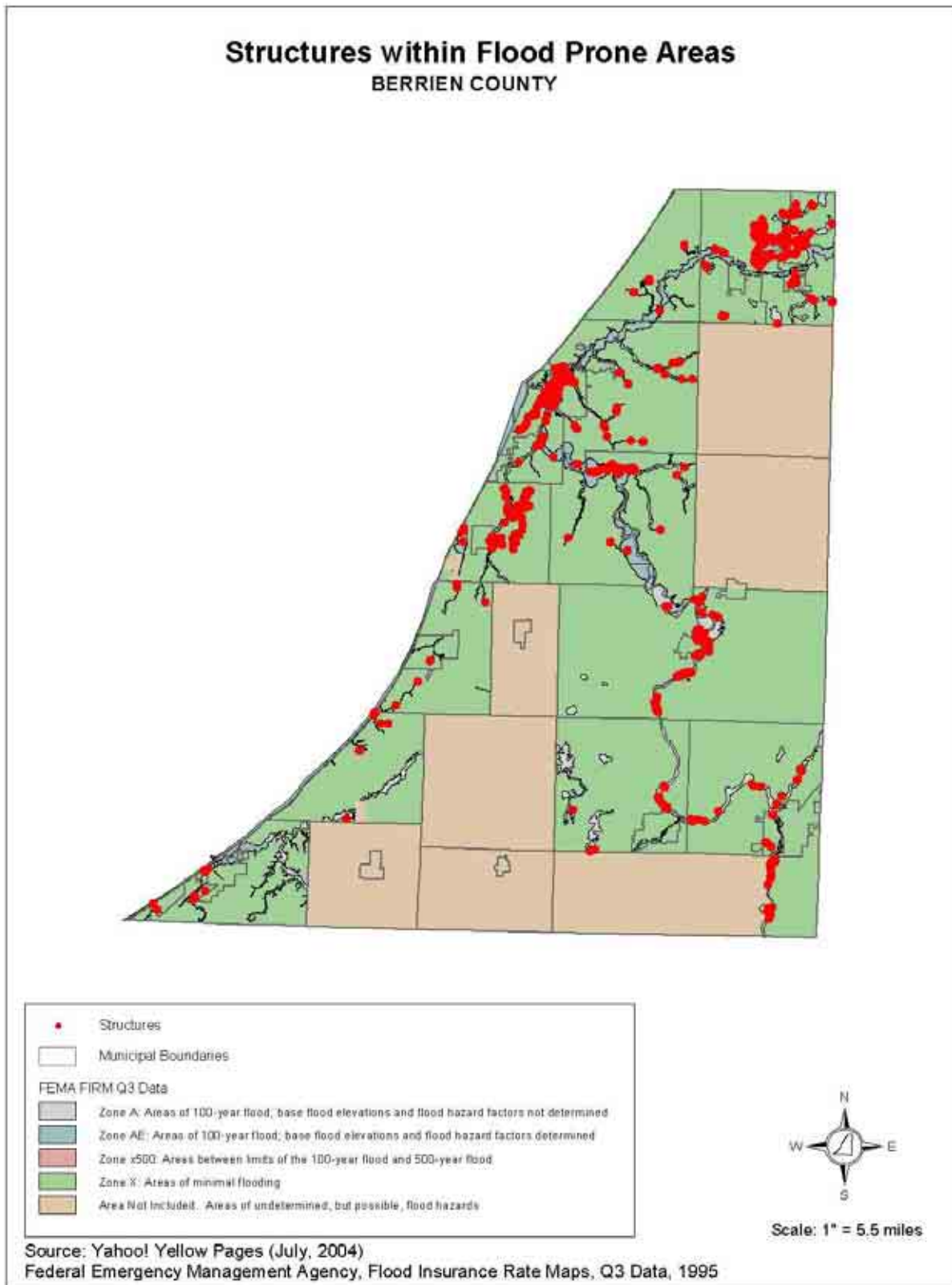
Source: FEMA: Community Information System; Insurance Reports, Berrien County, April 2004

The following table indicates the number of structures in flood prone areas in each municipality. The structures were identified by addresses in the Yahoo Yellow Pages on the Internet. The addresses were geocoded and added to a map showing floodplains (Figure 29). The structures include both residential and commercial buildings. Aerial photographs were also consulted to ensure accuracy. It should be noted that the floodplain maps in Berrien County are currently being updated by FEMA. According to the table and map, Coloma and Watervliet Townships have the most structures in flood prone areas compared to the other municipalities in Berrien County. There are a total of 1569 structures in flood prone areas in Berrien County.

Table 31. Structures in Flood Zones, Berrien County

Number of Structures in Flood Zones Per Municipality	
BENTON TOWNSHIP	53
BERRIEN TOWNSHIP	164
BUCHANAN TOWNSHIP	23
CHIKAMING TOWNSHIP	12
CITY OF BENTON HARBOR	99
CITY OF BRIDGMAN	5
CITY OF NEW BUFFALO	4
CITY OF NILES	19
CITY OF ST. JOSEPH	47
CITY OF WATERVLIET	29
COLOMA TOWNSHIP	354
HAGAR TOWNSHIP	15
LAKE TOWNSHIP	5
LINCOLN TOWNSHIP	128
NEW BUFFALO TOWNSHIP	7
NILES TOWNSHIP	74
ORONOKO TOWNSHIP	59
ROYALTON TOWNSHIP	52
SODUS TOWNSHIP	59
ST. JOSEPH TOWNSHIP	25
VILAGE OF BERRIEN SPRINGS	40
VILLAGE OF GRAND BEACH	1
VILLAGE OF STEVENSVILLE	25
WATERVLIET TOWNSHIP	270
TOTAL:	1,569

Figure 29. Structures in Flood Prone Areas, Berrien County



Economic Impact

In 1996, Berrien County reported \$5.45 million in property damages related to flooding. Damage was reported to 269 homes and 31 businesses. In a 1982 spring flood event, an estimated \$12 million dollars worth of damage was reported. With 1,569 structures in flood prone areas, economic damages are a real concern for Berrien County residents and businesses. Damages to roadways and other infrastructure due to flooding is also a concern for local municipalities.

Dam Failure

Dam failures occur not only during flood events, which may cause overtopping of a dam, but also as a result of poor operation, lack of maintenance and repair, and vandalism. Such failures can be catastrophic because they can occur unexpectedly, with no time for evacuation. A common form of dam failure occurs when tree roots disrupt the integrity of an earthen dam. Water can pass through the dam where the soil has been broken apart by the roots.

In Michigan, all dams over six feet high, and create an impoundment with a surface area of more than five acres, are regulated by Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act, (451 P.A. 1994), as amended. This regulation requires that the Michigan Department of Environmental Quality (DEQ) rates each dam as either a *low*, *significant*, or *high hazard* potential. This rating system is based solely on the potential downstream impact if the dam were to fail and not according to the physical condition of the dam. The potential downstream impact is figured by assessing the population concentration and economic activities located downstream from the dam.

In Berrien County, there are a total of 31 dams on record with Michigan Department of Environmental Quality. Five are privately owned dams primarily used to generate hydroelectric power. In addition, there are numerous earthen dams throughout the County used to regulate drainage of rainwater and agricultural watering purposes. Two dams have a *high hazard* rating and one has a *significant hazard* rating. The remaining 28 dams are assigned a *low hazard* potential rating because their failure would result in no probable loss of human life and low economic and environmental impacts. Losses are generally limited to the owner's property. Dams assigned the *significant hazard* potential rating are those dams where failure results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, and other impact concerns. Dams assigned the *high hazard* potential rating are those where failure will most likely cause loss of human life as well as significant economic and environmental damages.

Since Berrien County does have two high and one significant hazard dam, dam failure is considered a moderate hazard in Berrien County.

Dam owners are required to maintain an Emergency Action Plan (EAP) for *significant* and *high hazard* potential dams. Owners are also required to coordinate with local emergency management officials to assure consistency with local emergency operation plans. Since the hazard level of dams is based upon the potential downstream impacts if the dam were to fail, it is possible for the hazard status of a dam to change over time. As Berrien County becomes more developed and more people and businesses locate

downstream from dams, the potential human and economic impact from a catastrophic dam failure is increased.

Table 32. Dams, Berrien County

DAM NAME	HAZARD RATING	RIVER
Ackerman Dam	Low	Spring Creek
Andres Dam	Low	Pipestone Creek
Andres Dam	Low	Love Creek
Berrien Springs Dam	High*	Saint Joseph River
Buchanan Dam	High*	Saint Joseph River
Chikaming Springs Farm Dam	Low	Tributary to Galien River
Christie Dam	Low	Tributary to Madron Lake
Dayton Lake Dam	Significant*	Galien River
Denardo Dam	Low	Tributary to Lake Michigan
Fisher Dam	Low	Tributary to Farmers Creek
Forkers Dam	Low	Tributary to Galien River
Forraht Dam	Low	Tributary to Lake Michigan
French Paper Company Dam	Low	Saint Joseph River
Grand Mere Lake Level Control Structure	Low	
Jelinek Dam	Low	Tributary to Galien River
Kriel Dam	Low	Rogers Creek
Lake Louise Dam	Low	Tributary to Galien River
McCormick Dam	Low	Tributary to Paw Paw
McCoy Creek Dam	Low	McCoy Creek
Niles Dam	Low	Dowagiac River
O'Leary Dam #1	Low	Tributary to Paw Paw
Oronoko Lakes Dam	Low	Lemon Creek
Paw Paw Lake Level Control Structure	Low	Paw Paw Lake Outlet
Pipestone Lake Dam	Low	Pipestone Creek
Rowe Lake Level Control Structure	Low	Pipestone Creek
Schmuhl Dam	Low	Tributary to Paw Paw River
Storick Dam	Low	Tributary to Lemon Creek
Trickett Dam	Low	Painter Creek
Watervliet Dam	Low	Paw Paw River
Welch Dam	Low	Tributary to Paw Paw
Yellow Creek Dam	Low	Tributary to Yellow Creek

*Emergency Plans are on file at County Emergency Management Office.

Development of an emergency management plan for each dam in the County might help lessen the risk in the event of a dam failure. An effective emergency plan requires accurate prediction of water levels at specific times at a given location. A Breach Inundation Study has been performed for several dams within Berrien County and can be found on file at the County's Emergency Management office. These studies examine the

potential downstream impacts if a dam failed and is crucial to characterizing and reducing threats due to potential dam failures.

Municipalities in Berrien County indicated the following concerns related to dam failures:

- In **Berrien Township**, there are many areas below the dam that are vulnerable to flooding.
- **Berrien Springs** dam failure would affect Oronoko Township and other cities and villages along the St. Joseph River.
- **Bertrand Township** is concerned that the failure of Dayton Lake Dam would cause flooding of houses and roadways
- A failure of the **Buchanan** Hydro Dam could flood the area downstream.
- **Buchanan Township** has concerns with 12 homes on Bachelor Island should the Buchanan Dam fail.
- **Galien** is concerned that failure of Dayton Lake Dam could cause flooding.
- **Watervliet** has two aging dam structures along the Paw Paw River.

Frequency

Although Berrien County has numerous earthen dams, which require maintenance, and other dams that have had water seepage, there have been only three recorded dam failures in the County. These dams, New Troy Mill, Keill's Dam, and Pears Mill, were privately owned earthen dams that completely failed due to being overloaded, resulting in major flooding of the properties in which they were located.

Privately owned earthen dams in Berrien County have the most potential of failure. However, in most instances, the resulting flooding of one of these earthen dams would be limited to the surrounding property and not be a serious threat to other portions of the County. Many of these earthen embankments cross small ravines that, if not properly maintained, could weaken and leak due to tree roots that grow on or near the dams. These roots weaken the integrity of the embankment as they wind their way through the earthen structure.

The Watervliet Paper Mill Dam was closed in mid-1970 due to structural degradation. Steel beams were completely rotted through and one side of the dam had no support at all. It was deemed easier to pay \$970,000 to decommission and remove the dam, before an imminent failure occurred, than to pay the several million dollars it would cost to repair it.

Historically Significant Dam Failures in Berrien County

Mid 1970s

The American Electric Power Hydroelectric Dam in Berrien Springs underwent a major renovation when portions of the east embankment collapsed due to erosion. Although the dam was never in danger of failing, the outcome downstream would have been catastrophic had it done so. The utility company brought in heavy equipment and both sides of the structure were shored up and reinforced.

Summer 1981

Heavy rains throughout the spring and early summer placed major stress on the Dayton Lake Dam in southern Berrien County. The large volumes of water added to the already degrading structural integrity of the dam caused portions of the earthen embankments to wash out. Several surrounding areas were flooded and one major road was washed out due to this event. Although the dam held, major renovation was completed to upgrade and improve the dam since this was the second incident in less than 15 years and a catastrophic failure was deemed imminent.

Safety/Health

A dam failure can result in loss of life and extensive property or natural resource damage for miles downstream from the dam. There are two high hazard rated dams in Berrien County that have the potential to cause loss of human life.

Damage/Critical Facilities

Dam failures can result in great property damage. Failure of *low* hazard rated dams will most likely result in losses limited to the owner's property. There are 28 dams in Berrien County with a low hazard rating. The failure of significant and high hazard dams can result in major damage of homes, businesses, infrastructure and critical facilities. There are two high hazard and one significant hazard dams in Berrien County. Locations of the dams are on file at the County Emergency Management Office.

Economic Impact

The economic impact from dam failure will be minimal for low hazard dams, but great for significant or high hazard dams.

HAZARDOUS MATERIAL ACCIDENTS

Transportation related - “An uncontrolled release of hazardous materials during transport capable of posing a risk to life, health, safety, property or the environment”
Fixed Site - “An uncontrolled release of hazardous materials from a fixed site capable of posing a risk to life, health, safety, property or the environment”

Transportation Related

As a result 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 through local communities on a daily basis. A transportation accident involving any one of those hazardous material shipments could cause a local emergency affecting many people. Berrien County is no exception. With Interstate 94, a major Chicago to Detroit thoroughfare, Interstate 196, US-31 (St. Joseph Valley Parkway), two major railroad lines, and a Great Lakes shipping port in St. Joseph, hazardous materials traverse the County every day. The potential of a transportation accident involving a hazardous substance occurring in the County is great.

Hazardous material transportation incidents can affect the immediate vicinity of an accident site or a small portion of the surrounding community. These types of incidents, while problematic for the affected community, are relatively common and are effectively dealt with by local and state emergency responders and hazardous material response teams. Larger incidents, however, pose a whole new set of problems and concerns for the affected community. Large-scale or serious hazardous material transportation incidents that involve a widespread release of harmful material, or have the potential for such a release, can adversely impact the life, safety and/or health and well-being of those in the immediate vicinity of the accident site, as well as those who come in contact with the spill or airborne plume. In addition, damage to property and the environment can be severe as well. Statistics show almost all-hazardous material transportation incidents are the result of an accident or other human error. Rarely are they caused simply by a mechanical failure of the carrying vessel.

In Berrien County, one of the most dangerous hazardous material transportation accident scenarios that could occur would be the spill or release of oil, petroleum, or other harmful materials from a marine cargo vessel into Lake Michigan or one of its connecting waterways. Such an incident, if it involved a large quantity of material, could cause environmental contamination of unprecedented proportions. Fortunately, the Great Lakes states, working in partnership with oil and petroleum companies and other private industries, have taken significant steps to ensure that a spill of significant magnitude is not likely to occur on the Great Lakes.

Figure 30 shows the Great Lakes Ports in Michigan. Figures 32-35 in the next section on Transportation Accidents illustrate the major railroads, highways, and transportation systems that traverse and serve Berrien County. These transportation links and modes have the greatest probability of experiencing a hazardous materials transportation accident. Although the greatest risk involving hazardous materials comes from highway and rail shipments, a petroleum or chemical spill into Lake Michigan could have a disastrous consequence for shoreline communities, recreational areas, tourism, and the environment of Berrien County.

Berrien County has a large amount of hazardous materials transported through the County each day on its transportation arteries. A transportation accident involving hazardous materials can affect any community at any time. The County's Emergency Management officials work to mitigate, prepare for, respond to, and recover from such emergencies.

The following communities reported concerns with hazardous materials transportation related accidents:

- **The City of Benton Harbor** has I-94 concerns.
- **Bridgman City** has four railroad crossings with trains carrying several shipments per day of hazardous materials. I-94 also runs through the city.
- **Chikaming Township** has I-94 concerns.
- **Lake Charter Township** has I-94 concerns.
- **Lincoln Charter Township** has concerns about I-94 and the CSX railroad.
- **The City of New Buffalo** has two railways, which facilitate the movement of large amounts of assorted chemicals. **New Buffalo City's** southern portion has been evacuated due to the Dow Chemical trains that pass through the community.
- **New Buffalo Township** has I-94 running its length and also two railroads with freight.
- **Niles Township** has a large number of gasoline transport trucks traveling through the township. **Niles Township** also has an Amtrak railway that passes through.
- **Shoreham Village** has a railway that runs through the town.
- **The City of St. Joseph** has a commercial lake/river port.
- **Benton Charter Township** has a regional airport, which has a fair amount of corporate freight use.
- **St. Joseph Charter Township** has I-94 and the CSX Railroad that run through the township.
- **The Village of Stevensville** has I-94 and the CSX Railroad running through it.
- **The City of Watervliet** has a CSX railway that runs along the main street.
- **Watervliet Township** has I-94, M-140 and a CSX railway running through it.

Overall Berrien County considers Hazard Materials Transportation Accidents to be a moderate hazard for mitigation planning.

Significant Hazardous Material Transportation Events in Berrien County

Berrien County has not experienced a large-scale, serious hazardous materials transportation incident. However, the County has had numerous smaller-scale incidents that required response by local fire departments and hazardous materials teams. Many times, some portions of the population required evacuation in response to the seriousness of the incident.

Berrien County averages four to eight hazardous materials transportation incidents every year. So far, no injuries or fatalities have occurred. However, road closures of major

highways and evacuations of nearby residences and businesses have resulted as a result of these accidents.

August 7, 1981

A freight train derailment in the City of Bridgman resulted in a spill of fluorosulfonic acid, which formed a vapor cloud that forced the evacuation of 1,000 persons. A State Police trooper died as a result of breathing the toxic fumes.

April 11, 1982

A freight train derailed near the City of St. Joseph, causing a spill of ethylene benzoyl and benzene. The accident prompted the evacuation of 500 nearby residents until the spill could be contained and cleaned up.

Figure 30. Great Lakes Ports, Michigan

Great Lakes Commercial Shipping Ports in Michigan



Produced by:
Michigan State Police
Emergency Management Division
13 November 2000

Fixed Site Hazardous Material Accidents

Over the past few decades, new technologies have developed at a stunning pace. As a result, hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other facilities in our communities. 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.

Hazardous materials are highly regulated by federal and state agencies to reduce risk to the general 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 can be 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.

Industrial accidents are a type of fixed site that 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 often, 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 materials are highly regulated by federal and state laws; however, hazardous material accidents do occur on a regular basis. Most hazardous material releases are the result of human error and can be prevented. Very seldom does the accident occur due to a mechanical failure. Through the efforts of the Local Emergency Planning Committee (LEPC), plans for most of the hazardous material sites in Berrien County have been established and identified. These plans can be used by responders to help mitigate, respond to, plan for, and recover from an accident involving hazardous materials at one of these sites.

Like all heavily industrialized areas, Berrien County will always be concerned with the prospects of accidental hazardous material releases. However, the threat of accidental hazardous material releases that can affect life, health, property, or the environment can be greatly reduced by: 1) developing and maintaining adequate community hazardous material response plans and procedures; 2) adequately training hazardous material workers and off-site emergency responders; 3) educating the public about hazardous materials safety; 4) enforcing basic hazardous material safety regulations; and 5)

mitigating, wherever possible, the threat of accidental hazardous material releases. Fortunately, many local communities are making great strides in these important areas.

The following municipalities reported concerns with fixed site incidents:

- **Bertrand Township** has concerns about a chemical leak or fire at LaPorte County Co-op.
- **Bridgman City** has concerns with Ameri-gas propane storage facility and the City Water Works facility.
- **Buchanan's** wastewater treatment plant has up to 1,500 lbs. of chlorine on hand.
- **Coloma** is concerned with the methamphetamine labs in the area.
- In **Galien**, Cast Coatings, Inc. and Precision Plastics could both release hazardous materials.
- **Eau Claire Village** is concerned with a fire or explosion at the Fruit Exchange or at Primar Gas Station.
- **Lake Charter Township** has factories, gas and ANR pipelines, and a water plant (chlorine gas release).
- **New Buffalo City** water treatment plant stores and uses chlorine gas. **New Buffalo** has the potential for gas, fire, and explosive accidents at the gas docks at Oselka Marina, a 1,000-slip marina.
- **The City of St. Joseph** has multiple (302) sites with stored hazardous chemicals.
- **St. Joseph Charter Township** has a gas line distribution facility on Hilltop Road.
- **Three Oaks Township** is concerned with an underground gas service in the village.

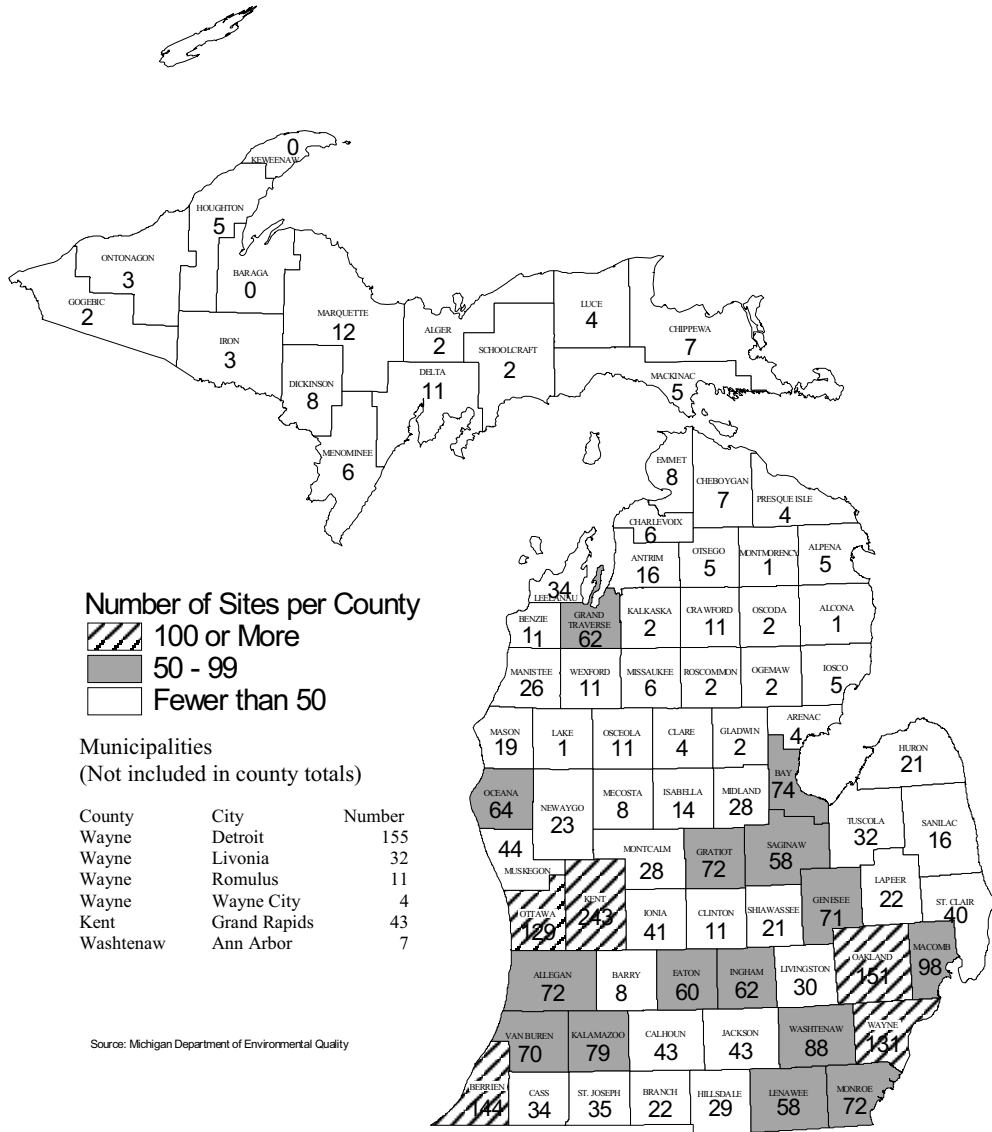
Berrien County considers Hazardous Materials Fixed Site Accidents to be a moderate hazard for mitigation purposes.

Michigan has 89 designated LEPCs (Local Emergency Planning Committee), one for each of the 83 counties and 6 more in major cities. The LEPCs are responsible for developing emergency response plans for communities that have facilities in their jurisdiction subject to SARA Title III emergency planning requirements. The LEPC is the primary mechanism through which local SARA Title III planning, training and exercising activities are implemented. A facility is subject to SARA Title III provisions if extremely hazardous substances, as determined by the U.S. Environmental Protection Agency, (EPA) are present at the facility in quantities at or above the minimum threshold quantities established in Section 302 of the Act.

Nearly 3,000 facilities across the state have been identified as being subject to Title III emergency planning provisions, 144 of those are in Berrien County, making it the fourth highest jurisdiction in the state.

Figure 31. SARA Title III Sites by County, Michigan

SARA Title III Sites in Michigan



Produced by
Michigan State Police
Emergency Management Division
12 December 2001

Significant Fixed Site Hazardous Material Incidents in Berrien County

Berrien County has not experienced a large-scale hazardous materials release from a fixed site resulting in multiple deaths or serious injuries such as occurred in Bhopal, India in 1984. In that event, over 30 tons of methyl isocyanate gas were released by the Union Carbide chemical plant, killing 2,500 people and injuring tens of thousands of others as the cloud drifted over the city. This fact can be attributed, in large part, to the steps taken by government and private industry to carefully regulate those processes and practices that could cause an accidental hazardous material release.

Berrien County has 144 fixed sites where extremely hazardous materials are stored and used on a daily basis. These sites include commercial, industrial, and agricultural facilities. From 1994 through 1998, local fire departments in Berrien County responded to 42 hazardous material incidents in which the Berrien County Hazardous Materials Team was requested. This is an average of 10.5 events per year. Of those 42 reported incidents, approximately 45 percent, or 19 incidents, occurred at an industrial or service business site. In most of these events, implementation of evacuation, in-place sheltering, or other protective actions were undertaken in the mitigation of the hazardous material released.

A reportable hazardous material incident is one in which all three of the following conditions apply: 1) a material is present that is suspected to be other than ordinary combustible by-product material; 2) the material is in such a state that, if left unattended, it is presumed to pose a threat to life, health, property, or the environment; and 3) special hazardous material resources were dispatched or used, or should have been dispatched or used, for assessing, mitigating, or managing the situation.

April 28, 1983

A chemical spill of over 6,500 gallons of Toluene diisocyanate at a local manufacturing plant in Benton Harbor resulted in the closing of state highway M-139 for many hours while emergency crews worked to clean up the area. Many businesses and residents were displaced during the duration of this event.

July 26, 1999

Two persons were injured in St. Joseph when they were hired to clean out the garage of a deceased, retired Leco Corporation chemist. The two private contractors were transported to the local hospital and treated for exposure to unknown chemical inhalation. The County Hazardous Materials Team was called in when numerous, unstable chemicals were discovered to be stored in the garage.

March 6, 2002

A leak of Anhydrous Ammonia from a storage facility in Buchanan forced the evacuation of over 100 residents when prevailing winds blew the poisonous cloud into the city limits. A valve that was broken during an attempted theft of the product by unknown individuals caused the leak.

March 8/August 1, 2003

On two separate incidents, the attempted theft of Anhydrous Ammonia from a Benton Harbor metal treatment facility resulted in the evacuations of nearby residents when, in both cases, the product was left to escape from its storage container. Emergency workers wore protective suits while working to stop the leaks.

TRANSPORTATION ACCIDENTS

“A crash or accident involving an air, land or water-based commercial passenger carrier”

Air Transportation Accidents

There are four main causes of an air transportation accident: 1) an airliner colliding with another aircraft in the air; 2) an airliner crashing while in the cruise phase of a flight due to mechanical problems, sabotage, or other cause; 3) an airliner crashing while in the takeoff or landing phases of a flight; or 4) two or more airliners colliding with one another on the ground during staging or taxi operations. When responding to any of these types of air transportation accidents, emergency personnel may be confronted with a number of problems, including: 1) suppressing fires; 2) rescuing and providing emergency burn treatment for survivors; 3) establishing mortuary facilities for victims; 4) detecting the presence of explosive or radioactive materials; and 5) providing crash site security, crowd and traffic control, and protection of evidence.

Airports – Regional General Aviation

Southwest Michigan Regional Airport

1123 Territorial Road
Benton Harbor, MI 49022

Airports – General Aviation

Andrews University Airpark

Griggs Road
Berrien Springs, MI 49103

Jerry Tyler Memorial Airport

2018 Lake Street
Niles, MI 49120

Watervliet Airpark

Airport Drive
Watervliet, MI 49098

Water Transportation Accidents

A water transportation accident involving one of the 19 commercial marine passenger ferries operating from Michigan’s Great Lakes shoreline communities could have significant life safety consequences. Most of these marine ferry services operate on a seasonal basis, typically May through November. Vessel sizes vary, but it is not uncommon for 100-200 passengers, or more, to be on board any of these ferries during peak tourist season. In a typical year, these ferries make thousands of trips across each of the Great Lakes. Although the vessels have an excellent safety record, and they must pass rigorous Coast Guard inspections, the potential for an accident is always present. Accidents in other states or countries involving similar vessels validate the need for rigorous emergency preparedness actions to prevent loss of life in an open water setting such as the Great Lakes. Currently, a feasibility study for a passenger ferry service from Chicago to Benton Harbor/St. Joseph is being undertaken.

St. Joseph River Harbor

The St. Joseph/Benton Harbor commercial port accommodates deep draft freighters as well as river barge shipping via the Mississippi River. The commercial status of the port currently enables the Army Corps of Engineers to justify dredging the channel every few years. According to Acting Harbormaster Robert Grimm, commercial docks on the Harbor received more than one million tons of materials in 2001. This is the highest amount since the 1960s.

The St. Joseph River Harbor Authority was established for the administration, development, and promotion of commercial and recreational usage of the St. Joseph River Harbor and environs.

Contact Information:

St. Joseph River Harbor Authority
Berrien County Administration Center
701 Main Street
St. Joseph, MI 49085
Telephone: 269-983-7111 x 8617
Website: www.berriencounty.org

In 2001, the St. Joseph River Harbor Authority contracted Mariport Group Ltd. to do a study of the St. Joseph River Harbor. The following is among the study's findings:

- The port fulfills an essential shipping function within Berrien County and southwest Michigan.
- Over 80 percent of the cargo received is delivered within a 50-mile radius of the port.
- If the port ever ceased to be an effective commercial port, it would be difficult to persuade the Army Corps of Engineers to maintain the channel, with serious implications to the small-boat community.

Michigan's High Speed Rail Program

In 1999, Michigan began implementation of its High Speed Rail Program. As one of the first projects, train speeds will be increased from 79 miles per hour to over 100 miles per hour on a segment of the Detroit-Chicago Amtrak passenger train route between Kalamazoo and Grand Beach (This route crosses through Berrien County). These higher speed trains will continue to operate on the existing rail corridor, which has been upgraded with improvements to the track, the signal and communication system, and the grade crossing warning devices. The state-of-the-art signal and communication system uses advanced technology to communicate between the grade crossings and the train, and also utilizes a Differential Global Positioning (DGP) train location system. These improvements will ensure the highest level of passenger safety. The goal of Michigan's High Speed Rail Program is to reduce travel time on the entire Detroit-Chicago rail corridor from approximately six hours to three and one half-hours. Future plans also include an increase in the number of trips on the corridor, from the current four daily round trips up to eight or possibly even ten daily round trips.

From a hazard perspective, the new, higher speed train service will provide unique challenges for communities on the Detroit-Chicago rail corridor to address in their emergency planning and preparedness efforts. To ensure all communities are adequately prepared, the Federal Rail Administration (FRA), the Michigan Department of State Police (MSP), the Michigan Department of Transportation (MDOT), and the affected communities' emergency managers have been working with *Operation Respond Institute* to install an emergency information system on the corridor. This system is designed to

quickly provide detailed railroad passenger equipment information to emergency responders.

Land Transportation Accidents

A land transportation accident in Michigan could involve a commercial inter-city passenger bus, a local public transit bus, a school bus, or an inter-city passenger train. Although these modes of land transportation have a good safety record, accidents do occur. Typically, bus accidents are caused by busses slipping off roadways in inclement weather or colliding with other vehicles. Inter-city passenger train accidents usually involve a collision with a vehicle attempting to cross the railroad tracks as a train is approaching the crossing. Unless the train accident results in a major derailment, serious injuries are usually kept to a minimum. Bus accidents, on the other hand, can be quite serious, especially if the bus has tipped over. Numerous injuries are a very real possibility in those types of situations.

Major Transportation Corridors and Truck lines

Within Berrien County there are approximately 70 miles of freeway consisting of segments of Interstate I-94, I-196, and the Saint Joseph Valley Parkway (US-31). Old US 31-33, M-140, M-63, US-12, M-139 and Red Arrow Highway are at-grade truck lines that provide the through-route system. Some sections of US-12, Old US-31, Red Arrow Highway, and M-139 are developed in a four-lane boulevard-type cross section. Most of the through-route system carries significant local traffic volumes, as well as regional commuter traffic.

Regional Transportation Systems

The Benton Harbor Bus Center serves as a terminal for Greyhound Bus Lines & Indian Trails Motor Coach Amtrak's Pere Marquette line provides commuter service with stops at rail stations in the cities of St. Joseph, Niles and New Buffalo.

Amtrak Train Station Locations

New Buffalo Station	Niles Station	St. Joseph Station
Whittaker Road	598 Dey Road	410 ½ Vine Street
New Buffalo, MI 49117	Niles, MI 49120	St. Joseph, MI 49085

Public Transportation Systems

Berrien Bus is a non-urban system that provides transportation to all areas not served by Dial-A-Ride service areas. The service includes both semi-fixed route service and demand-response service. Buchanan Dial-A-Ride is a non-urban city system serving the City of Buchanan and parts of Buchanan Township with service to Niles. Niles Dial-A-Ride is a small city urban system serving the City of Niles, and part of Niles and Bertrand Townships. Twin Cities Transportation Authority (TCATA) is a small city urban system providing service to the cities of St. Joseph and Benton Harbor, and part of Benton Charter and St. Joseph Charter Townships.

Pedestrian/Non-motorized Transportation

Biking or walking can be a healthy, economical, and relaxing form of transportation. Providing safe and convenient facilities is required to facilitate this sort of transportation.

As part of the Southwest Non-Motorized Investment Plan Study, the Michigan Department of Transportation, Southwest Region, developed an inventory of existing and proposed non-motorized facilities (Map 25). The goal of the *Plan* was intended to integrate non-motorized considerations into Southwest Michigan's transportation planning and programming activities.

The following municipal concerns with transportation accidents are noted below.

- **Berrien Township** has no township access to US-31 for emergency vehicles.
- **Benton Harbor** Airport is currently classified for small private aircraft, but the City is trying to expand the airport and receive a commercial carrier.
- **Benton Harbor** has concerns about I-94.
- **Bertrand Township** concerned about limited access to certain area for emergency responders.
- **Buchanan** has Amtrak on its south border.
- **Chikaming Township** is on the flight pattern for O'Hare, Midway, and South Bend Airports. **Chikaming Township** is also concerned about I-94.
- **Galien** has an Amtrak railway running through the village.
- In **Lake Charter Township**, I-94, the railroad and ships/barges pose potential transportation accidents.
- **Lincoln Charter Township** has concerns about I-94 and the CSX railroad.
- **New Buffalo** is on the Victor Highway flight path for O'Hare, Midway, and South Bend airports.
- **Three Oaks Township** has US-12 and a railroad line traversing through the township.
- **Shoreham** has a railway that runs through the town.
- **The City of St. Joseph** has a commercial lake/river port.
- **Benton Charter Township** has a regional airport, which has a fair amount of corporate freight use.
- **St. Joseph Charter Township** has I-94 and the CSX Railroad running through the township.
- **Stevensville** has I-94 and the CSX Railroad running through it.
- **Watervliet** has a CSX railway that runs along the main street.
- **Watervliet Township** has I-94, M-140 and a CSX railway running through it.

Overall Berrien County considers transportation accidents a moderate hazard affecting the county.

Significant Transportation Accidents in Berrien County

Minor transportation accidents occur with some regularity every year in Berrien County. Bad weather, human error, mechanical defect, or other extenuating circumstances are usually the cause of these occurrences. Although in For Berrien County, large-scale accidents are rare, two notable events have occurred involving transportation accidents in the County's history.

January 21, 1985

The passenger liner *Chicora*, a Lake Michigan ferryboat that was designed for winter sailing on the Great Lakes, was lost during a sudden storm that blew in during its return trip from Chicago to its homeport in St. Joseph. The *Chicora* sailed from Chicago under clear skies, but less than an hour later, word from the City of St. Joseph arrived advising of bad weather on the Michigan side of Lake Michigan. All 23 crewmembers were lost and wreckage of the ship was found frozen in the lake's ice from South Haven to Saugatuck once the storm subsided the following day. None of the crewmember's remains were ever recovered from this accident.

February 7, 2003

A series of snow squalls was to blame for a multi-car accident that occurred on Interstate 94 in Benton Charter Township. Snow started falling early that morning, making roads ice-covered and slippery. In the early afternoon hours, a snow squall erupted, which produced blowing snow and zero visibility conditions. The resulting whiteout led to a chain reaction crash that involved over 80 vehicles. One person was killed and dozens more were injured as a result of this accident, which is being called the largest multi-vehicle accident ever to occur in the United States.

The one commonality all transportation accidents share, whether air, land, or water based, is that they can result in mass casualties. Air transportation accidents in particular can result in tremendous numbers of deaths and injuries with major victim identification and crash scene management problems. Water transportation accidents, on the other hand, may require a significant underwater rescue and recovery effort that few local jurisdictions may be equipped or trained to handle.

Berrien County, with a commercial Great Lakes port, three small airfields, two major interstate thoroughfares, and directly in the flight path for outbound O'Hare International Airport air traffic from Chicago, has been fortunate to have experienced only one major, significant transportation accident event in its history; the earlier mentioned multi-vehicle pileup on Interstate 94 in February, 2003. Even with that event, the County was spared the trauma of massive fatalities and only had to mitigate and recover from extensive property damage. The outcome could have been much worse considering the circumstances.

That event did demonstrate the need for all local communities within the County to prepare for, and with practice be ready to respond to, a major accident event. Although all modes of travel and transportation have excellent safety records and are strictly overseen by various state and federal government entities, accidents do occur. The combination of large numbers of passengers, unpredictable weather conditions, potential mechanical problems, and human error always leaves open the potential for a transportation accident involving mass casualties. Berrien County, and all communities served by a major transportation system, need to have in place, and practice regularly, emergency plans that address the needs for mitigating and recovering from a mass fatality event.

Figure 32. Transportation Systems, Berrien County

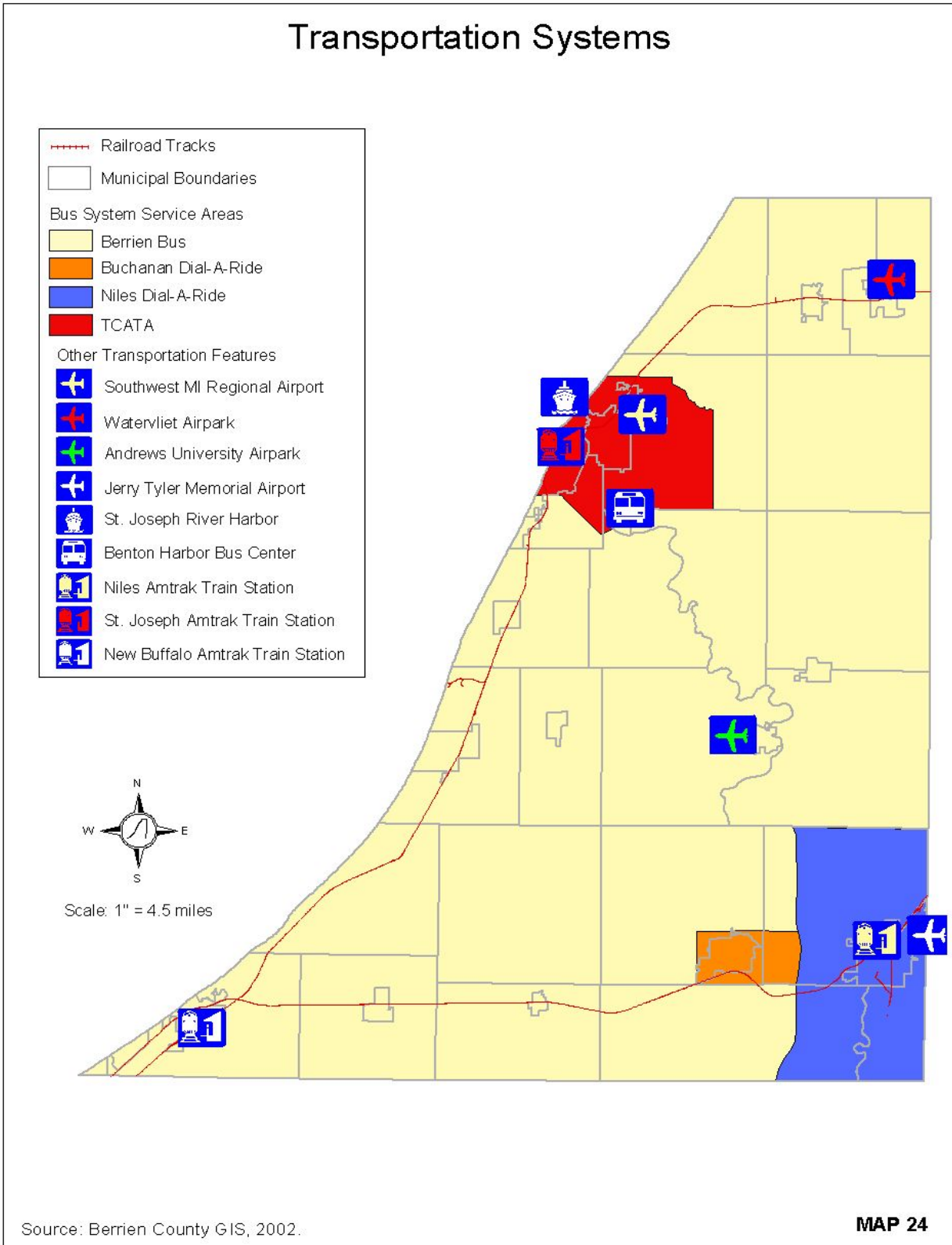


Figure 33. Non-motorized Transportation, Berrien County

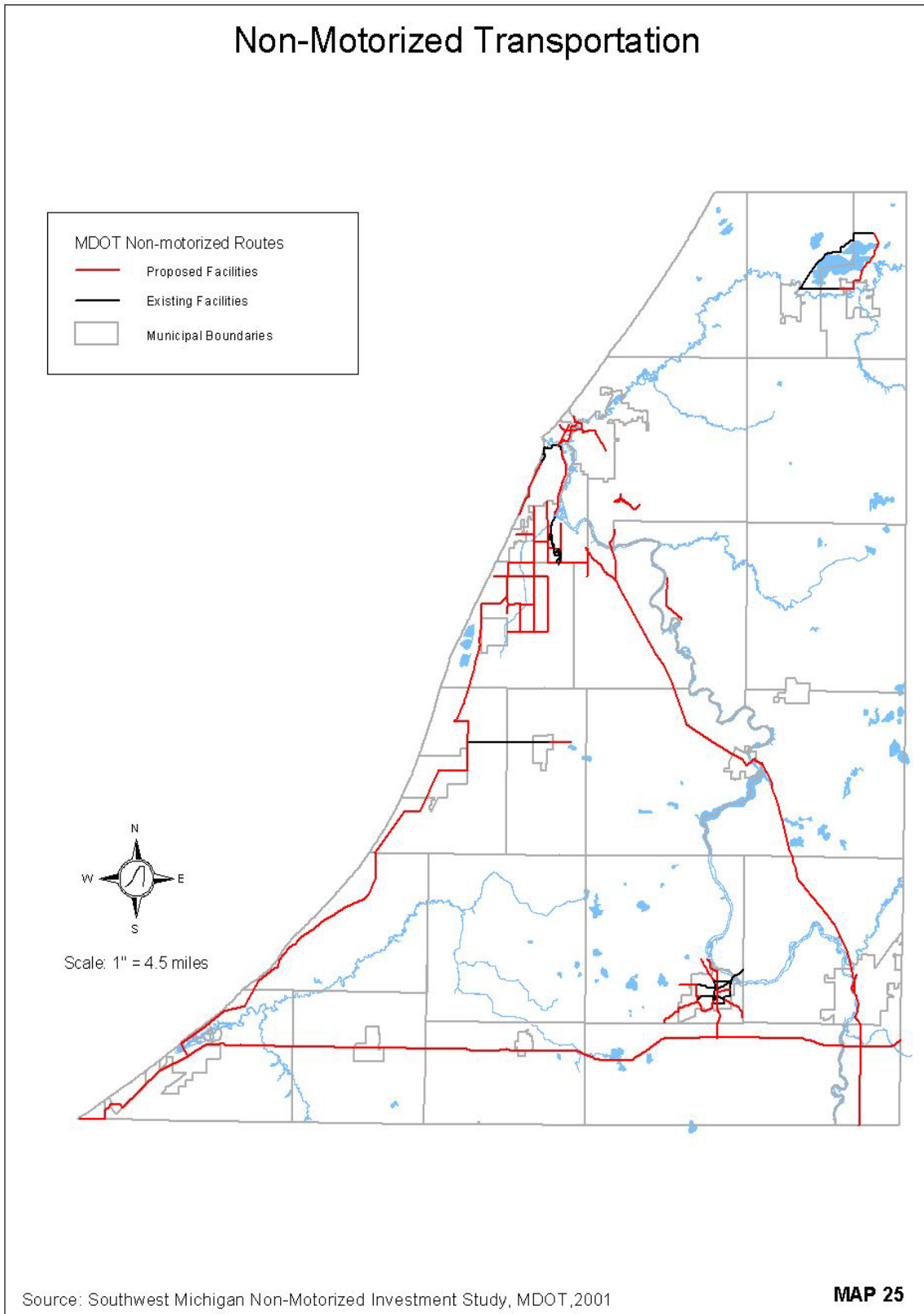


Figure 34. Freight Railroads in Michigan

Freight Railroads in Michigan



Produced by:
Michigan State Police
Emergency Management Division
13 November 2000

Figure 35. Major Highways in Michigan



PUBLIC HEALTH EMERGENCIES

“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, wide-spread incidents of food or water contamination, extended periods without adequate water and sewer services, harmful exposure to chemical, biological, or radiological agents, and large-scale infestations of disease-carrying insects or rodents, to name 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 have the potential to adversely impact a large number of people with a nationwide, regional, statewide, or localized scope and magnitude.

Some of the more common and serious pathogenic illnesses that could possibly develop into a public health emergency in Berrien County include food-borne illnesses, arthropod-borne illnesses, water-borne illnesses, and other communicable diseases. There are approximately 250 known food-borne illnesses, which can be caused by many different types of bacteria, viruses, parasites, and natural or man-made chemicals. People can contract these agents by ingesting contaminated food, with or without subsequent spreading of the illness from person to person by the fecal/oral route. A few of the more common food-borne illnesses that have the potential to result in a widespread outbreak include Salmonellosis, Escheria coli 0157:H7 (E. Coli), Listeriosis, Botulism, and Hepatitis A. In the general population, it is the individuals who are either elderly, very young, or immune-compromised are more susceptible to these illnesses. Most of these illnesses can be eliminated with hand washing and careful and proper handling of food (especially raw meat).

Other communicable diseases include Influenza, HIV/AIDS and other sexually transmitted diseases. In Michigan, 200 to 500 people die annually from flu-related illness. The most important preventive measure against influenza is for individuals, especially those at risk for complications, to get vaccinated in the fall prior to the onset of flu season, which typically runs from late December through March.

Arthropod-borne illnesses are caused by viruses that are transmitted between susceptible vertebrate hosts (people, birds, and other animals) by blood feeding arthropods such as mosquitoes and ticks. These illnesses include several types of encephalitis such as West Nile, St. Louis, and Eastern Equine Encephalitis. The risk of these and other arthropod-borne illnesses can be greatly reduced through effective mosquito control and public education programs.

Water-borne illnesses are those caused by viruses that are transmitted to the human population through parasites that live and thrive in water environments. One of these illnesses is Cryptosporidiosis. For people with pre-existing health conditions, infection with Cryptosporidium can be life threatening. Cryptosporidium is present in approximately 97 percent of all surface water and 39 percent of the drinking water supply

in the United States. To prevent the spread of Cryptosporidium, proper hand washing is vital, as is boiling untreated water adequately.

Groundwater Quality

Most of the drinking water in Berrien County households comes from groundwater, which comes from precipitation that has seeped through the surface of the ground. Several areas in Berrien County the groundwater is monitored and tested through certain test wells. These wells provide information on the depth of the water table, any contamination problems, and the strata of the surrounding soil.

Berrien County has groundwater ranging in quality from very good to contaminated. When examining the potential hazard of a particular area of groundwater, it is best to look at the land use of the surrounding area. The fertilization of crops, the salting of roads in the winter, and pesticide use are among the factors that can contribute to groundwater contamination.

The depth of the water table is an important factor in the quality of the water. The deeper the water table, the deeper the water must infiltrate providing more chance that any contamination can be filtered out. The depth of the water table in Berrien County ranges from 22' - 96' deep. This range of water table depths can be seen in Figure 23.

Surface Water Quality

Surface waters in Berrien County include Lake Michigan, numerous inland lakes, and perennial and intermittent rivers. Overall, Michigan's surface waters meet the water quality standards set by the state. However, these resources are threatened by non-point source pollution from runoff near urban areas, construction sites, and agricultural lands and by point discharges from municipal and industrial processes. This can result in increased nutrient enrichment, sedimentation, and toxins in the water.

Non-point source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water. These pollutants include:

- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas;
- Oil, grease, and toxic chemicals from urban runoff and energy production;
- Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks;
- Salt from irrigation practices and acid drainage from abandoned mines;
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems

Non-point source pollution is the leading remaining cause of water quality problems. The effects of non-point source pollutants on specific waters vary and may not always be fully assessed. However, we know that these pollutants have harmful effects on drinking water supplies, recreation, fisheries, and wildlife.

Lake Michigan is classified as having a moderate nutrient level, and its water quality has improved with decreasing discharges of phosphorus from point sources. However, the

water quality is threatened by the introduction of exotic aquatic species and the presence of persistent toxic pollutants. Due to bioaccumulation of toxins in fish tissues, Public Health Advisories regarding fish consumption are in effect for the Great Lakes.

Nutrient levels are of concern for inland lakes in the southern Lower Peninsula because the majority of lakes in this area have high to excessive nutrient levels. The only lake studied in Berrien County, Paw Paw Lake, was classified as eutrophic (high nutrient levels). Elevated nutrient levels are problematic due to the associated nuisance plant growth and algal blooms. Sources of excess nutrients include sewage, fertilizers, detergents, and other surface runoff. Additionally, all of Michigan's inland lakes are under mercury-based fish consumption advisories. The mercury largely enters lake waters via atmospheric deposition.

Berrien County's rivers, streams, and creeks are generally considered to be of good quality. Areas of reduced river quality can be associated with urban areas and human activities. According to a 1997 study, the majority of the Galien River watershed meets the state's water quality standards. Untreated sewage discharges, E. Coli, PCBs, and nuisance algal growths harmed the sections of this watershed that did not meet these standards. (Over 30 miles of the St. Joseph River had similar water quality problems.) Watershed Management Plans have been, or are being, developed in cooperation with MDEQ for the following watersheds in Berrien County: Dowagiac, St. Joseph and the Galien Rivers. (See Table 24 in the flooding section for more information.)

Air Quality

Another growing concern for public health is air quality. In Berrien County, air quality is monitored by the Michigan Department of Environmental Quality's Air Quality Division (MDEQ's AQD). Currently, there is one air-monitoring site within the County, which is located at 4689 Defield Road in Coloma at the Paw Paw Lake wastewater treatment plant. Pollutant levels and associated weather conditions are measured at this site. Specifically, the ozone level has been monitored on a daily basis since 1992, and levels of particulate matter with diameter less than 2.5 um (micrometer) have been recorded since 1999. Other parameters monitored include the air temperature, wind speed, wind direction, and barometric pressure.

This monitoring site is also used to determine the overall daily health hazards related to air pollution in the Benton Harbor metropolitan area. The Air Quality Index, created by the U.S. Environmental Protection Agency (EPA), categorizes each day based on a six-point scale ranging from "good" to "hazardous". Since 1991, this area has had eight days classified as "unhealthy" for the general public. Specific data measurements for this air monitoring station can be found in the Atmospheric Infrared Sounder (AIRS) database on the EPA's website (www.epa.gov/airsweb/).

Although Michigan has had some large-scale public health emergencies in recent history, to date there have been no significant occurrences of serious public health emergencies in Berrien County. There are; however, numerous new pathogens emerging, creating new and unique causes of illness, while familiar strains of pathogens are becoming more resistant to treatment, which could potentially create a public health emergency in the County.

Although no area in Berrien County is immune to public health emergencies, areas with high population concentrations will be most vulnerable to the threat. In addition, more vulnerable members of society such as the elderly, children, poor, and people in poor health, are at more risk than the general public. That is why it is so important to ensure that those in these high-risk categories are properly immunized against preventable pathogens like the flu.

Berrien County is fortunate in that it has an excellent public health system that constantly monitors the threats that could lead to a widespread and significant public health emergency. However, even the best monitoring and surveillance programs cannot always prevent such incidents from occurring. Consumers need to educate themselves on the potential dangers of food-borne pathogens, how to recognize symptoms of infection, and how to protect themselves against contamination and illness.

The impact on safety, health, and economics will vary widely depending on the type and magnitude of a public health emergency. The Berrien County Health Department has plans for emergency response actions and other information that is not included in this plan. It is very difficult to predict future occurrences of many of the diseases affecting Berrien County. However, Table 23 depicts a five-year trend of communicable diseases in Berrien County: (source: Berrien County Communicable Disease Review; Five Year Data Trends, Laura E. Miles, Epidemiologist). Overall Berrien County considers public health emergencies to be a moderate hazard for mitigation planning purposes.

Table 23. Communicable Diseases, Berrien County, 1999-2004

Disease	Statistics	1999	2000	2001	2002	2003	Mid 2004
<i>Food borne</i>							
Amebiasis	Count	6	3	4	1	1	0
	Rate per 100,000	3.69	1.84	2.46	.61	.61	0
Campylobacteriosis	Count	17	14	19	14	10	6
	Rate per 100,000	10	8.61	11	8.61	6.15	3.69
Cryptosporidiosis	Count	0	0	0	0	3	0
	Rate per 100,000	0	0	0	0	1.84	0
Escherichia coli 0157:H7	Count	0	1	1	1	2	0
	Rate per 100,000	0	.61	.61	.61	1.23	0
Giardiasis	Count	24	15	9	2	10	1
	Rate per 100,000						
Listeriosis	Count	1	0	0	0	0	0
	Rate per 100,000	.61	0	0	0	0	0
Salmonellosis	Count	16	14	12	8	11	4
	Rate per 100,000	9.84		7.38	4.92		
Shigellosis	Count	8	18	2	6	2	0
	Rate per 100,000	4.92	11.08	1.23	3.69	1.23	0
Yersiniosis	Count	0	0	1	0	1	0
	Rate per 100,000	0	0	.61	0	.61	0
<i>Vaccine Preventable</i>							
Chicken Pox – Varicella	Count	300	222	138	110	72	92
	Rate per 100,000	184	136	84	67	44	57
Haemophilus influenzae	Count	0	0	1	0	2	0
	Rate per 100,000	0	0	.61	0	1.23	0
Pertussis	Count	0	1	0	0	0	0
	Rate per 100,000	0	.61	0	0	0	0
Hepatitis A	Count	0	1	1	3	1	1
	Rate per 100,000	0	.61	.61		.61	.61
Hepatitis B	Count	4	0	1	1	1	2
	Rate per 100,000	2.46	0	.61	.61	.61	1.23
Influenza Like Disease	Count	16713	13460	8497	9759	12058	5700
	Rate per 100,000	10287	8285	5230	6007	7422	3508
Meningococcal Disease	Count	3	2	1	0	0	0
	Rate per 100,000	1.84	1.23	.61	0	0	0
<i>Sexually Transmitted</i>							
Chlamydia	Count	522	606	791	1064	958	
	Rate per 100,000	321	373	486	654	589	
Gonorrhea	Count	443	505	473	375	417	
	Rate per 100,000	272	310	291	230	256	
Syphilis	Count	1	1	0	0	2	0
	Rate per 100,000	.61	.61	0	0	1.23	0
AIDS	Count	127	142	160	170	184	No data
<i>Vector-borne</i>							
Dengue Fever	Count	0	0	1	0	0	0
	Rate per 100,000	0	0	.61	0	0	0
Malaria	Count	0	0	6	2	0	0
	Rate per 100,000	0	0	3.69	1.23	0	0
West Nile	Count	0	0	0	1	0	0
	Rate per 100,000	0	0	0	.61	0	0
Lyme Disease	Count	0	0	0	1	0	2
	Rate per 100,000	0	0	0	.61	0	1.23

Petroleum and Natural Gas Pipeline/Well Accidents

Pipeline Accidents: “An uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide, from a pipeline”

Oil/Gas Well Accidents: “An uncontrolled release of oil or natural gas, or the poisonous by-product hydrogen sulfide, from production wells”

Though often overlooked, petroleum and natural gas pipelines pose a real threat in many Michigan communities. Petroleum and natural gas pipelines can leak or fracture causing property damage, environmental contamination, injuries, or even loss of life. The vast majority of pipeline accidents that occur in Michigan are caused by third party damage to the pipeline, often due to construction or some other activity that involves trenching or digging operations.

Michigan is a major producer and consumer of natural gas and petroleum products. According to the Michigan Public Service Commission (MPSC), approximately 25 percent of the natural gas consumed in Michigan is produced within the state. Five interstate pipeline companies, with access to the major natural gas producing regions in North America, import the remaining 75 percent. Michigan not only cycles more natural gas through its storage system than any other state, it also ranks 11th in the nation in the production of natural gas, and ranks 6th in consumption at 937.2 billion cubic feet. Michigan's petroleum product consumption in 1997 was 189 million barrels, ranking 10th nationally. These figures underscore the fact that vast quantities of petroleum and natural gas are extracted from, transported through, and stored in the state, making many areas vulnerable to petroleum and natural gas emergencies. Michigan's gas and petroleum networks are highly developed and extensive, representing every sector of the two industries, from wells and production facilities, to cross-country transmission pipelines that bring the products to market, to storage facilities, and finally to local distribution systems.

Petroleum and natural gas industries have historically had good safety records; pipelines are by far the safest form of transportation for these products. However, the threat of fires, explosions, ruptures, and spills still exists. In addition to these hazards, there is the danger of a hydrogen sulfide (H₂S) release. These dangers are present around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil has high sulfur content. Hydrogen sulfide is not only an extremely poisonous gas, but it is also explosive when mixed with air at temperatures of 500 degrees Fahrenheit or above.

Figure 36 shows the location of the five major petroleum and natural gas pipelines within Berrien County. As the map depicts, two of these pipelines cross the entire county. Major compression stations that receive and redistribute natural gas are located at key points along the pipelines. These stations monitor and maintain pressure levels within the pipelines. In the event of a pipeline rupture, the compressor stations shut down to stop the flow of product. Many smaller compressor stations are located across the state to complete the distribution process to consumers.

Because petroleum and natural gas pipeline accidents are inevitable occurrences, Berrien County and its local communities must be prepared to:

- Respond to the accident
- Institute necessary protective actions
- Coordinate with federal and state officials and pipeline company emergency crews to effectively manage and recover from such an occurrence

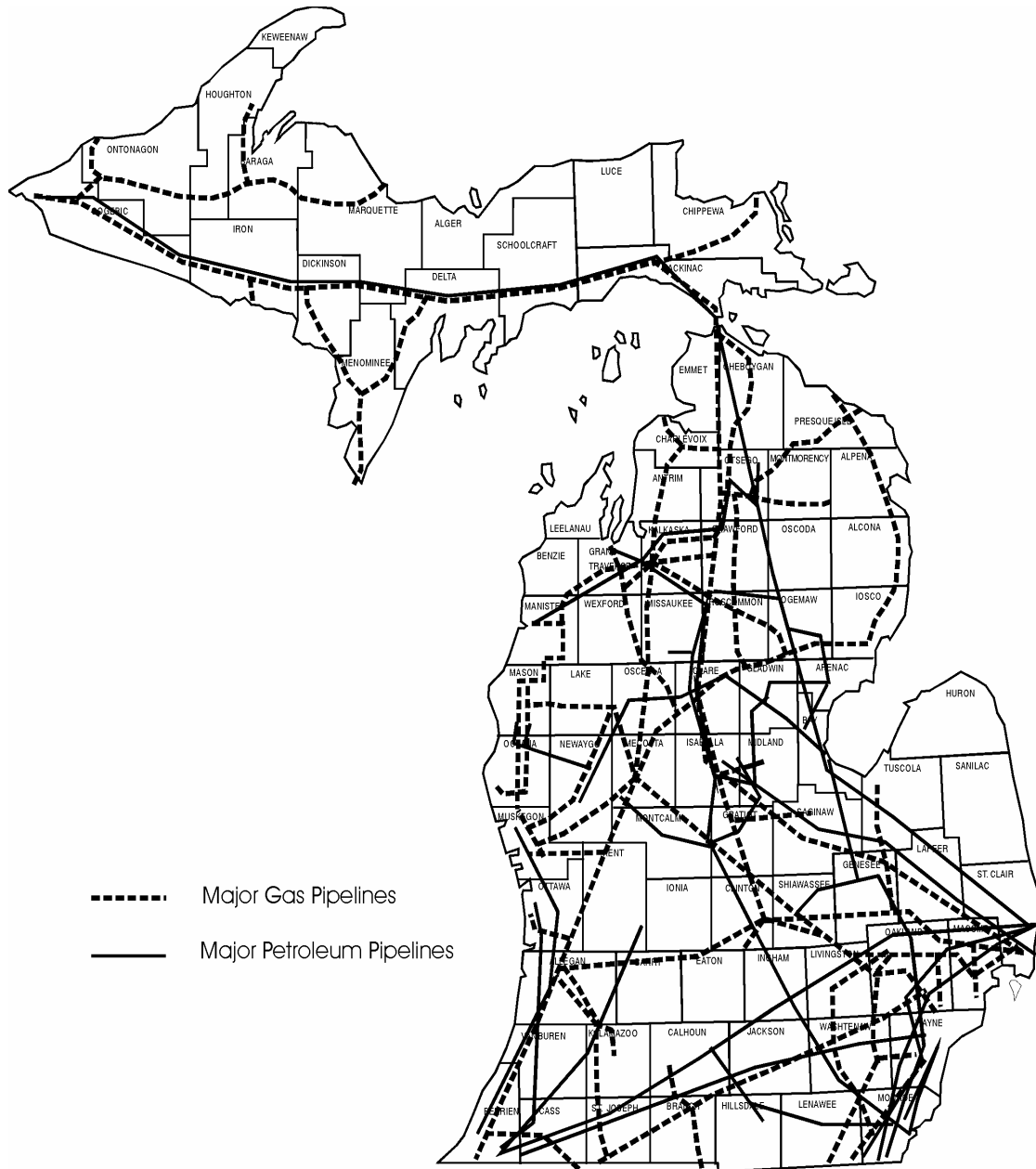
This preparedness can be accomplished best through collaborative planning, training, and the exercising of emergency procedures with all potentially involved entities.

The following municipalities expressed concerns with pipeline accidents:

- In **Baroda Township**, natural gas pipelines run through the township from the intersection of Snow and Holden Roads to the corner of Linco and Hollywood Roads.
- **Benton Township** has petroleum gas pipeline.
- **Bertrand Township** has major pipelines and a failure could cause evacuation and possible closure of US-12 and US-31.
- **Chikaming Township** has natural gas pipelines running through it.
- **Coloma** has an ANR gas pipeline passing through the area.
- **New Buffalo City and Township** has a natural gas transmission pipeline.
- **Royalton Township** has petroleum and ANR gas pipelines running through the township.
- **The Village of Stevensville** has natural gas lines that run through it.

To date, there have been no significant petroleum or natural gas pipeline accidents reported in Berrien County. As the following graphic demonstrates, two major gas pipelines and three major petroleum pipelines traverse Berrien County. There is also a large petroleum storage area located outside the City of Niles. The possibility exists of a major event occurring in Berrien County involving one of these pipelines or storage areas; therefore, the County needs to be aware of the hazards and have plans in place to mitigate an accident should it occur. Overall Berrien County considers pipeline accidents to be a moderate hazard.

Figure 36. Major Petroleum and Natural Gas Pipelines, Michigan



Oil and Natural Gas Well Accidents

Oil and natural gas are produced from fields scattered across 63 counties in the Lower Peninsula of Michigan. Since 1925 over 44,000 oil and natural gas wells have been drilled in Michigan, of which approximately half produced oil and gas. To date, Michigan wells have produced approximately 1.4 billion barrels of crude oil and one trillion cubic feet of natural gas.

The petroleum and natural gas industry is highly regulated and has a good safety record, but the threat of accidental releases, fires, and explosions still exists. In addition to these hazards, many of Michigan's oil and gas wells contain extremely poisonous hydrogen sulfide (H₂S) gas. Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in the oil or brine and released upon exposure to atmospheric conditions. Over 1,300 wells in Michigan have been identified as having hydrogen sulfide levels exceeding 300 parts per million (ppm). Levels of 300 ppm cause the olfactory nerve to lose sensitivity. At first a "rotten egg" odor is detected but on the second or third breath, the odor is no longer noticed. At 600 ppm, breathing is inhibited, as the lungs fill with the gas. At concentrations of 700 ppm, as little as one breath of hydrogen sulfide can kill. Although hydrogen sulfide can be detected by a "rotten egg" odor in concentrations from .03 ppm to 150 ppm, larger concentrations paralyze a person's olfactory nerves so that odor is no longer an indicator of the hazard. For humans, small concentrations can cause coughing, nausea, severe headaches, irritation of mucous membranes, vertigo, and loss of consciousness. Hydrogen sulfide forms explosive mixtures with air at temperatures of 500 degrees Fahrenheit or above, and is dangerously reactive with powerful oxidizing materials. Hydrogen sulfide can also cause the failure of high-strength steels and other metals. This requires that all company and government responders be familiar not only with emergency procedures for the well site, but also with the kinds of materials that are safe in handling a hydrogen sulfide release.

Michigan reaps tremendous economic and social benefits from oil and natural gas production. As with all industrial and commercial activities, along with those benefits come some risks as well. Despite the best efforts of the MDEQ Geological Survey Division and the drilling companies to minimize oil and natural gas well accidents, it is inevitable that such accidents will occur from time to time. When they do, the affected local communities must be prepared to respond to the accident, institute necessary protection actions, and coordinate with state officials and the drilling company emergency crews to effectively manage and recover from the accident. This can best be accomplished through planning, training, and exercising emergency procedures with all potentially involved parties.

There are 106 documented oil and natural gas wells located throughout Berrien County. Although there have been significant oil and gas well accidents in other parts of Michigan, as well as around the world, Berrien County has been fortunate. To date, there have been no recorded significant events involving oil and/or natural gas wells in this County.

Overall, this hazard is considered low priority for Berrien County. However, communities that may be affected by oil or natural gas well accidents should have adequate procedures in their Emergency Operations Plan 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 open and unoccupied buffer areas around refineries and compressor stations. The Michigan Department of Environmental Quality regulations provide for buffer zones around wells and treatment and storage facilities.

DROUGHT

“A water shortage caused by a deficiency of rainfall, generally lasting for an extended period of time”

Drought is the consequence of a natural reduction in the amount of precipitation received over an extended period of time, 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. Several agricultural communities such as Eau Claire and Bertrand Township are concerned about the impact of drought on crop yields. Overall drought is considered a moderate hazard for Berrien County.

Frequency

To date, there has not been a significant recorded incident of drought within Berrien County. There has been, however, several periods of below normal precipitation and above average temperatures, which have had a limited effect on the community at large. Because a large portion of Berrien County’s economy is based upon agriculture and industry, a drought could negatively alter the quality and quantity of crops, livestock, and other agricultural activities, resulting in severe economic and social hardships throughout the community.

Safety/Health

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

Damage/Critical Facilities

Other negative impacts that can be attributed to a drought include shortages of water available for human consumption, industrial, business, and agricultural uses, power generation, recreation and navigation, declines in the water quality of lakes, rivers, streams, and other bodies of water, malnourishment of wildlife and livestock, increases in fires and wildfires with related losses to timber, homes, and other property, increases in wind erosion, and declines in tourism in areas dependent on water-related activities.

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

Drought also increases the threat of wildfires, especially in forested and vegetated areas found throughout Berrien County. A drought-impacted landscape can quickly turn a small fire into an inferno. Wildfires could destroy homes, businesses, and other properties located in the County’s rural residential areas.

Economic Impact

A drought can cause severe economic hardships that impact communities and regions. One of the most common and severe impacts to a community like Berrien County would be the drop in quantity and quality of agricultural crops. Figure 37 shows the location of prime and unique farmlands in Berrien County. Farmland is an important part of Berrien

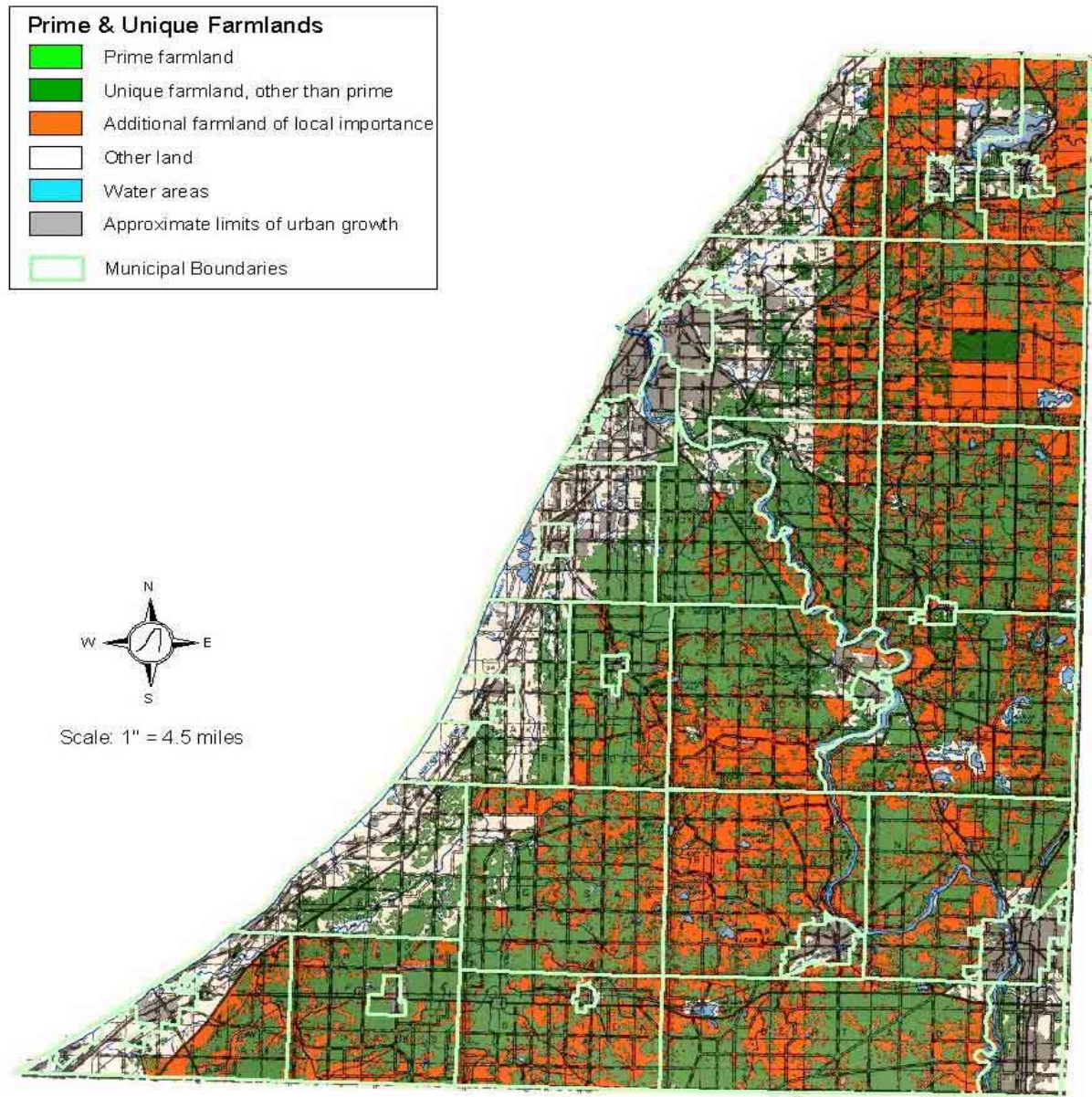
County's history, culture, and economic structure. In 1997, the Census of Agriculture reported there were 173,958 acres of farmland in the County (this is about half of the County's land). Farmland, and its economic bearing, is so important to the County, the County is taking steps to preserve farmland through the purchase of development rights program.

The direct impacts of drought can cause other *indirect* impacts to a community, such as reduced revenue in other areas of agriculture, retail, declines in land values due to physical damage from drought conditions, and decreased functional use of properties.

Berrien County's 42 miles of Lake Michigan shoreline, scenic sand dunes, and inland lakes and streams make it an attractive tourist location. A drought could adversely affect the economic infrastructure of the tourist community, resulting in loss of revenue, increased unemployment, and eventually, population decreases.

Figure 37. Prime and Unique Farmlands, Berrien County

Prime and Unique Farmlands



Source: United States Department of Agriculture (1983)

MAP 11

CIVIL DISTURBANCES

“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, and are typically caused by 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) 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; or 7) a “celebration” of an important victory by a sports team.

Berrien County has only had two civil disturbances in its history, and although civil disturbances are rare, the impact can be great. Civil disturbances are generally violent in nature and can attract national media attention. This national exposure can be detrimental to the County’s image and are costly to local and county governments. Public Safety budgets are strained trying to cope with, and mitigate, the situation. Damaged buildings must be repaired; debris from the streets cleaned up, and lives put back together. It can take years to recover and “heal” from an event of this type.

Civil disturbances mostly occur without warning making them difficult to prevent or predict. Though the best thing local public safety officials can do to prepare for such an event is to properly train and equip its personnel, local governments must also implement measures to address the concerns of its citizens and develop strategies to diffuse potentially volatile incidents before they erupt.

Civil disturbances are difficult for local communities to handle. Officials must walk the fine line between the Constitutional right of individuals and groups to assemble, and the overall needs of the community to provide essential services, ensure the safety of its citizens, prevent property damage, and facilitate normal commerce. Fortunately, most demonstrations and large public gatherings are held in a peaceful, responsible manner. However, there are groups whose primary objective is to disrupt normal activities and even cause injury and property damage.

Handling events that could result in civil disturbance is a difficult operation at best. Normally, law enforcement personnel are greatly outnumbered and they are often ill-equipped and under-trained to handle a large, unruly crowd. Many police departments offer some disturbance training, but because the events happen so infrequently, and turnover is relatively high in law enforcement positions, constant re-training is necessary. Unfortunately, that training costs money, and many departments are already hard-pressed to meet basic training needs. Nevertheless, proper training of law enforcement personnel, adequate resources, and incident anticipation and planning are the keys to successful incident management.

Another important element in responding to civil disturbances is proper visual documentation of the incident. Many police departments have begun to videotape

incidents that could result in a civil disturbance. Such documentation can then be used to identify criminal acts and perpetrators, review actions, and make determinations as to incident cause and finally, to develop future prevention techniques.

In most civil disturbances, local law enforcement resources, augmented when necessary by the Michigan State Police, are sufficient to manage and end the incident. If, however, local resources are not adequate, the Michigan National Guard can be mobilized to assist in maintaining peace and restoring order. A Governor's emergency mobilization order is necessary to activate the Michigan National Guard.

The following municipalities expressed concerns with civil disturbances:

- **Lake Charter Township** has concerns of anti-nuclear demonstrations at Cook Nuclear Plant.
- **The City of Benton Harbor** has had several occasions of civil unrest requiring assistance from the State of Michigan, Berrien County and neighboring law enforcement.
- **The City of St. Joseph** has the possibility of civil unrest in Benton Harbor leaking over into St. Joseph or requiring the assistance of St. Joseph's police

Overall Berrien County considers this hazard to be a low priority for mitigation planning purposes.

Significant Civil Disturbances in Berrien County

June 16-18, 2003

The City of Benton Harbor experienced two nights of civil unrest after the death of a motorcyclist during a high-speed police chase. Hundreds of the City's residents, mostly young adults and teenagers, took to the streets in protest of perceived police indifference and corruption. Dozens of bystanders were transported to the local hospital and treated for injuries received from flying rocks, bottles, and gang beatings. Angry crowds also damaged many vehicles and buildings. A total of 32 structures were burned to the ground, many unable to be saved as responding firefighters were also attacked by the crowds and forced to retreat. Six hundred state police troopers were called in to help the overwhelmed local law enforcement authorities quell the unrest and return calm and quiet to the city. Costs associated with overtime for local and county officers were over \$20,000 to deal with this event. In addition, damage to fire and police equipment was about \$70,000. These totals do not include estimates from the Michigan State Police or clean up from the fires.

Late 1960s

Benton Harbor experienced two to three days of civil unrest in the late 1960's.

EARTHQUAKE/SUBSIDENCE

Earthquake: “A shaking or trembling of the crust of the earth caused by the breaking and shifting of rock beneath the surface”

Subsidence: “The lowering or collapse of the land surface caused by natural or human-induced activities that erode or remove subsurface support”

Earthquakes

Earthquakes range in intensity from slight tremors to great shocks. They may last from a few seconds to several minutes, or come as a series of tremors over a period of several days. The energy of an earthquake is released in seismic waves, usually occurring without warning. Earthquakes tend to occur along fault lines, which are formed when large plates of the earth’s crust below the surface push and move against one another.

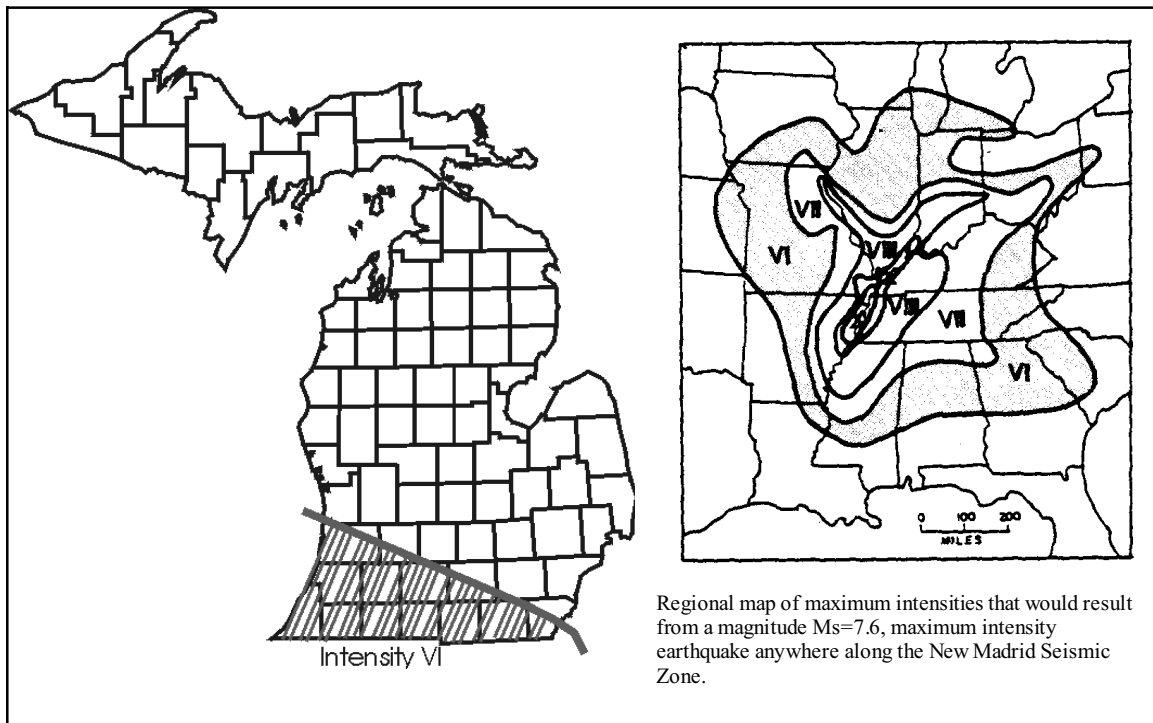
Michigan is not located in an area subject to major earthquake activity. Although there are fault lines in the bedrock of Michigan, they are now considered relatively stable. According to the U.S. Geological Survey, although Michigan is in an area in which there is a low probability of earthquake occurrences, distant earthquakes that occur in the New Madrid Seismic Zone (see Figure 38) and upstate New York may affect portions of Michigan, including all of Berrien County. There is only a slight risk of earthquake activity in Berrien County.

To date, no destructive earthquake has ever been documented in Berrien County, although several minor tremors have been reported. However, it cannot be assumed that an earthquake will never impact Michigan or Berrien County. Based on recent scientific studies, portions of Berrien County could be expected to receive minor damage were such an earthquake to occur along the New Madrid fault. Damage to property would most likely be negligible in well-designed and constructed buildings. However, poorly designed and constructed, or older, dilapidated buildings could suffer considerable damage and/or collapse.

The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling objects and debris. Disruption of communications systems, power lines, and gas, sewer, and water mains can be expected. Water supplies can become contaminated by sewage leaks, and other seepage, around water mains. Damage to roadways and other transportation systems may create food and other resource shortages if transportation is interrupted. In addition, earthquakes may trigger other emergency situations such as natural gas leaks, fires, and hazardous materials spills, thereby compounding the situation.

The greatest impact on Berrien County could come from damage to natural gas and petroleum pipelines. If the earthquake occurs in the winter, many areas of the state could be severely impacted by fuel shortages. In addition, Interstates 94 and 196 are major transportation arteries traversing Berrien County; damage to these critical roadways, resulting from an earthquake of great magnitude, could adversely affect transportation systems throughout the mid-western United States, affecting the shipment of supplies and commodities throughout the country.

Figure 38. New Madrid Seismic Zone



Source: United States Geological Survey

The federal government has several programs and initiatives in place to help reduce the hazardous impact of earthquakes. The most recent, and perhaps most prominent, is the development of the Federal Response Plan (FRP) which coordinates federal assistance to victims of a catastrophic earthquake or other similar disaster. Coordinated through the Federal Emergency Management Agency (FEMA), the FRP outlines the responsibilities of 27 federal agencies with a role in disaster response and/or recovery. Should a catastrophic earthquake ever impact Michigan, federal response and recovery assistance would be coordinated under the provisions set forth in the FRP.

In January 1990, Executive Order 12699, Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction, was signed into law. This Executive Order (EO) requires that appropriate seismic design and construction standards and practices be adopted for any new construction, or replacement, of a federal building or federally regulated building receiving federal assistance. The purpose of this EO is to reduce risks from failure of federal buildings during or after an earthquake.

Berrien County considers earthquakes as a low priority for hazard mitigation purposes.

Subsidence

Subsidence is the lowering or collapse of the land surface (sink holes) due to loss of subsurface support. It can be caused by a variety of natural or human-related 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 over 10,000 square miles attributed to groundwater withdrawal. In addition, nearly \$125 million in damage related to subsidence is reported annually across the country. In Michigan, the primary cause of subsidence is underground mining.

There has never been a reported significant occurrence of subsidence in Berrien County. This is primarily due, in part, to the fact that commercial underground mining has not occurred in this area. However, smaller subsidence incidents have occurred that involved a single site or structure and caused very little property damage. It is not uncommon for sinkholes to develop in roadways with underground drainage lines or in areas subject to large amounts of flowing rainwater.

Subsidence does not have as much potential of widespread impact as do other natural and technological hazards prevalent throughout Berrien County. Subsidence is considered a low priority hazard in Berrien County. As such, a large number of resources are not devoted for this hazard. The impacts of subsidence tend to be limited in scope to individual sites and structures. The most effective way to mitigate subsidence hazards in Berrien County is through community awareness and education.

Goals and Objectives

The Hazard Mitigation Sub-Committee developed the following goals and objectives with input from Disaster Committee members. The goals were developed to reflect current community priorities, be consistent with current countywide planning efforts, and in consideration of the impact of each hazard that affects Berrien County. These goals and objectives guided the County in the development and prioritization of the mitigation strategies. Each mitigation action must help accomplish one or more of the following goals and objectives:

1. Minimize loss of life and protect public health and safety during hazard events.
 - Improve warning systems to adequately warn the public in high-risk areas.
 - Improve communication systems to better respond to disasters.
 - Better serve elderly, disabled and LEP (Limited English Proficiency) populations.
2. Reduce the risk and effects of hazards on public and private property.
 - Maintain and protect essential public services, critical facilities and public infrastructure.
 - Require new development to pay the full cost of protection measures.
 - Protect floodplains, wetlands and other important natural areas.
 - Limit building in high-risk areas.
 - Improve building construction.
3. Explore funding options for priority mitigation activities.
 - Use a cost-benefit review of mitigation activities to evaluate impact and feasibility.
 - Develop public/private partnerships to implement mitigation activities.
 - Leverage grant dollars by using county/municipal funds to implement mitigation activities.
4. Increase awareness of hazards and of existing and potential mitigation activities.
 - Encourage people to assume some responsibility for their own protection.
 - Develop public outreach campaigns about priority hazards to make people aware of hazards and mitigation activities.
 - Involve local municipalities and general public in hazard mitigation planning.

Mitigation Strategies

The next step in the hazard mitigation planning process is to identify mitigation actions suitable to the community, evaluate the effect the action will have on the specified mitigation objective, and prioritize actions to decide in what sequence or order these actions should be pursued. General mitigation strategies, addressing the top 12 hazards, will be described in this section. Many mitigation strategies will address more than one hazard. In addition, a mitigation strategy may be included for a municipality that ranks a particular hazard higher than the County’s ranking.

County Rank	Hazard
1	Severe Winter Weather
2	Nuclear Power Plant Accident
3	Extreme Temperature
4	Tornado
5	Infrastructure Failures
6	Severe Winds
7	Structural Fires
8	Terrorism/Sabotage/CBRNE
9	Dam Failures
10	HazMat Transportation Accident
11	HazMat Fixed Site Accident
12	Transportation Accidents

Mitigation actions can be grouped into six broad categories:

1. **Prevention.** Government, administrative, or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities designed to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.
2. **Property Protection.** Actions that involve the modification of existing buildings or structures to protect property from a hazard, or removal of property from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.
3. **Public Education and Awareness.** Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. Actions include outreach projects, real estate disclosure, hazard information centers, and educational programs for children and adults.
4. **Natural Resource Protection.** Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed

management, forest and vegetation management, and wetland restoration and preservation.

5. **Emergency Services.** Actions that protect people and property during, and immediately after, a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.
6. **Structural Projects.** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

Action Plan

Action items are identified for addressing general program items and projects at the county and municipal levels, addressing public information and awareness activities, and for administering and supporting plan implementation. A call for projects was sent to each municipality in Berrien County, several county departments, and non-profit organizations that solicited mitigation actions. Each municipality and organization was asked to prioritize the mitigation actions. The Hazard Mitigation Sub-Committee then developed and prioritized several mitigation actions. The costs and benefits of each project were weighed when choosing alternatives and prioritizing projects. Prioritization was also based on the hazard ranking and by evaluating if the action item helped to meet the overall plan's goals and objectives. Further the cost effectiveness of each action is indicated in the last column in Table 34.

Table 34 summarizes the priority actions, hazards to be mitigated, location or jurisdiction, responsible agencies, funding sources and estimated timeline. Each action item can be tied to the goals and objectives found previously in the plan. Several action items refer to the Hazard Mitigation Sub-Committee. The Hazard Mitigation Sub-Committee is the instrument responsible for monitoring the implementation of the *Plan*, reporting to the Disaster Committee and participating municipalities on its progress, and recommending revisions to this *Plan* as needed.

***Hazards listed in Table 34**

- SWW – Severe Winter Weather
- NPP – Nuclear Power Plant Accident
- EXT – Extreme Temperatures
- SSW – Severe Summer Weather
- IF – Infrastructure Failure
- FI- Fires
- TE – Terrorism/Sabotage/WMD
- FL – Flooding
- HM – Hazardous Materials Accidents
- TA – Transportation Accidents
- PH – Public Health Emergencies
- PN – Petroleum/Natural Gas Pipeline/Well
- D – Drought
- CD – Civil Disturbance
- ES – Earthquake/Subsidence
- EM – Emergency Management

Other acronyms used in Table 34:

- HLS – Homeland Security Grant FEMA – Federal Emergency Management Agency
- SWMC – Southwestern Michigan Commission
- MDEQ – MI Dept. of Environmental Quality MDOT – MI Dept of Transportation
- MSUE – MI State University Extension
- NRCS – Natural Resource Conservation Service
- GIS Dept. – County Planning and GIS Department

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Keep current siren systems functioning and in good repair.	High	All	County-wide	Cook and Palisades Nuclear Plants, Niles City, Andrews University	Cook, Palisades, Niles City, Andrews University	On-going	?
Evaluate the need for expanded warning siren coverage.	Low	All	County-wide	EM, Local Municipalities	EM staff time, local officials	2006	?
Provide subsidized NOAA weather radios (or alternate warning systems such as a tone activated radio) to critical facilities (especially schools).	High	SWW, SSW	County-wide	EM, local municipalities, mitigation sub-committee	Hazard Mitigation grant, EM, local municipalities (\$45/radio - \$22,500 for 500 radios)	2005-2006	Y
Continue to support and increase participation in SkyWarn Program.	High	SWW, SSW	County-wide	EM, National Weather Service	EM Staff and Disaster Committee time	On-going	Y
Continue to improve weather forecasting abilities.	Medium	SWW, SSW, FL	County-wide	Weather forecasters	National Weather Service	On-going	N/A
Purchase and install remote weather stations to monitor bridge decks for ice and frost.	High	TA, SWW	6 bridges County-wide	Road Commission, EM	Road Commission, Hazard Mitigation Grants (\$80,000)	2005	Y
Purchase and implement a countywide notification system (Dialogic) to improve communications.	High	All	County-wide	EM, Disaster Communication sub-committee	Berrien County, HLS grant	2004-2005	Y
Explore the feasibility of utilizing the EAS (Emergency Alert System) to warn and provide instructions for residents during hazard events.	Medium	All	County-wide	EM	Hazard Mitigation Grant (\$12,000)	2005	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Purchase and install warning sirens on public beaches.	High	All	Silver, Lions, and Jean Kloch Parks and other beach/parks in the county as needed.	EM, County Parks, Cities of Benton Harbor and St. Joseph	Hazard Mitigation Grant, Berrien County (\$20,000/each system)	2005-2006	Y
Design, purchase and install educational signs on Rip Tides for public beaches.	Medium	SSW	Public beaches in county	Cities of St. Joseph and Benton Harbor	Cities of St. Joseph and Benton Harbor, County Parks (\$1,000/beach)	2006	Y
Explore the feasibility and funding sources of installing a Radio Broadcast System for I-94 and I-196 (includes amber alert, weather advisory, accident and detour routes, evacuation for nuclear power plant incident, tourism messages).	Medium	SSW, SSW, NPP, TE, HM, TA	County-wide (maybe even partner with Van Buren County)	EM, MDOT, MSP, Cook and Palisades Nuclear Plants, Tourist Agencies	Unknown	2006	?
Improve and install signage for alternative routes for I-94 when an accident occurs.	High	TA	Along I-94 county-wide	MDOT, MSP, EM, local municipalities	MDOT, grants	2004-2006	Y
Municipal officials should encourage new developments (especially in densely populated areas) to bury utility lines.	High	SSW, SSW	County-wide	Local municipalities (planning commissions), Berrien County Planning Commission	Developers (cost depends on many factors)	On-going	Y
Encourage municipalities to become members of Tree City USA with tree trimming and maintenance programs.	Medium	SSW, SSW, IF	County-wide	Mitigation sub-committee, EM	Staff and committee time	2006 – 2009	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Maintain adequate road and debris clearing capabilities. Explore opportunities for coordinated debris management efforts between municipalities and County Road Commission that follows post disaster bidding regulations.	High	SWW, SSW	County-wide	EM, Road Commission, Local Municipalities	County Road Commission, Local Municipalities, EM staff time	2005-2006	Y
Continue to use snow fences to limit drifting on critical roadways. Continue to evaluate the need for additional coverage.	High	SWW, TA	County-wide	County Road Commission	County Road Commission	On-going	Y
Each season; provide severe weather press releases that explain citizen preparedness activities.	High	SWW, SSW	County-wide (could combine efforts with Cass and Van Buren Counties)	Public information sub-committee, EM	Staff and committee time	On-going	Y
Encourage home and business owners to secure roofs, walls and foundations with adequate fasteners or tie downs, strengthen garage doors and other large openings, install storm shutters and storm windows, install/incorporate backup power supplies. Proper building site design and code enforcement for snow loads, roof slope, etc. Home and public building maintenance to prevent roof and wall damage from ice dams.	High	SSW, SSW	County-wide	EM, Red Cross, Economic Development staff, Municipal Officials, code enforcers	Homeowners	On-going	Y
Continue to produce and distribute family preparedness information. Also, place information on county website.	High	All	County-wide	EM, Red Cross, County IS Dept	Berrien County, local grants	2005	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Translate family preparedness information into Spanish and include on website.	High	All	County-wide	EM, public information sub-committee, Red Cross, Student Intern from Andrews	EM, Andrews University	2005	Y
Distribute Red Cross brochure on the need for homeowners and renters to purchase adequate insurance coverage.	Medium	All	County-wide	Red Cross, Public Information sub-committee	Staff and committee time	2006	Y
Distribute Red Cross information regarding the need for home disaster plans.	Medium	All	County-wide	Red Cross, Public Information sub-committee	Staff and committee time	2006	Y
Work with partners to develop methods for disseminating multi-lingual hazard warnings for non-English speaking residents of the County.	High	All	County-wide	EM, Red Cross, Andrews University	Staff time	2005	Y
Help partner agencies to publicize existing services for special populations (elderly, LEP, etc).	High	All	County-wide	Disaster Committee (public information sub-committee)	Staff and committee time	2005	Y
Assist local businesses in planning for and responding to natural hazard events when they do occur.	Medium	All	Identify vulnerable businesses county-wide	Berrien County Economic Development, Red Cross, EM	Staff time	2005-2009	Y
Develop partnerships with business associations to develop a mechanism for assessing damages, estimating indirect losses and reporting information about local businesses after a disaster.	Medium	All	County-wide	Berrien County Economic Development, EM	Staff time	2005- 2009	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Investigate building codes/incentives for adequacy for tornadoes, high winds and other natural disasters.	Medium	SSW, SWW, EXT	County-wide (priority faster growing communities) County-wide	SWMC, EM, Mitigation Sub-committee, municipal officials	Staff and committee time	2005-2009	Y
Encourage housing codes requiring and enforcing heating requirements.	Medium	EXT	County-wide	Local municipalities, Area Agency on Aging, mitigation sub-committee	Staff and committee time	2006	Y
Examine local government master plans, zoning ordinances and other documents and policies for level of preventative and other measures to be a disaster resistant community.	Medium	All	County-wide (priority faster growing communities)	SWMC, EM, mitigation Sub-committee, municipal officials	Staff and committee time	2005 - 2009	Y
Encourage local governments to include hazard mitigation concepts in the development of their comprehensive plans. Distribute progress report to all units of government, encouraging further involvement in mitigation planning. Integrate report into a comprehensive biannual plan evaluation. Assist interested local governments in pursuing hazard mitigation plans.	High	All	County-wide	EM, hazard mitigation sub-committee, local municipalities	Unknown	2005-2009	?
Ensure that adequate shelters (including warming/cooling places) are available to county residents.	Medium	All	County-wide	Red Cross, EM, Department of Public Health, Area Agency of Aging	Staff time	2006-2007	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
If not already in place, encourage local governments to require that mobile home parks have storm shelters with enough capacity to adequately protect all residents of the development. Assist local governments in applying for pre-disaster mitigation funds to construct tornado shelters in mobile home parks when needed.	Medium	SSW	County-wide (see Figure 15 for locations of mobile home parks)	EM, Red Cross, local municipalities	Staff time	2006	?
Assist local governments in applying for pre-disaster mitigation funds to construct storm shelters in public facilities such as parks, fairgrounds or other vulnerable public areas. Inventory all parks, fairground and public areas in the County without storm shelters. Determine the needed size and location of storm shelters within parks. Acquire funding or assist local units of government in acquiring funding to help finance storm shelters in parks.	Low	SSW	County-wide	EM, County Parks Dept, local parks departments.	Mitigation grants, local	2007-2009	?
Encourage farmer preparedness to address livestock needs.	Low	SWW, SSW, D, EXT	County-wide	MSUE, NRCS	Staff time	2007	Y
Include safety strategies for severe weather in driver education classes.	Medium	SWW, SSW, TA	County-wide	Driver Education Teachers, mitigation sub-committee	Staff and committee time	2006	Y
Continue special arrangements for heating bill assistance for low income and elderly.	Medium	EX, SWW	County-wide	SW MI Community Action Agency (SMCAA), Utility Companies, Area Agency on Aging	SMCAA	On-going	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Install back flow prevention devices on fire hydrants.	Low	TE, PH	County-wide (in populated areas)	Fire Departments, Local Municipalities	Fire departments, HLS grants	2007	?
Encourage and promote homeland security training of responders and government officials.	High	All	County-wide	EM, Lake Michigan College	Responders, HLS grants	On-going	Y
Conduct annual damage assessment training for local officials and others in need of training.	High	All	County-wide	EM, Disaster Committee, Local Municipalities	HLS grants	2005 (on-going)	Y
Encourage and promote training of water treatment and wastewater treatment plant operators (take advantage of free private sector annual training opportunities such as that offered by Alexander Chemical).	High	HM, TE	All municipalities with public water and wastewater treatment plants	Water and Wastewater Treatment Plants, EM	Treatment Plants, private sector	On-going	Y
Purchase and install generator for Benton Harbor Water Treatment Plant.	High IF, SSW, SWW,		Benton Harbor	Benton Harbor Water Treatment Plant	Hazard Mitigation grant, BH Water Treatment Plant	2004-2005	Y
Purchase and install generator for County Road Commission headquarters to provide back up power for communications and equipment during a power failure.	High	IF	County Road Commission, 2869 E. Napier Avenue, Benton Harbor	Road Commission, EM	Road Commission, Hazard Mitigation Grant (\$70,000)	2005	Y
Purchase and install generator at St. Joseph Charter Township Hall for public safety services (police, fire, administration) and for use as a community shelter.	High	IF, EXT, SSW, SWW	St. Joseph Township	St. Joseph Township, SWMC (assistance with grant writing)	Hazard Mitigation Grant, St. Joseph Township (\$325,000-\$650,000)	2005-2006	Y
Purchase and install generator at Eau Claire Village Hall for public safety services.	High	IF, SSW, SWW, EXT	Eau Claire Village	Eau Claire Village, SWMC (assistance with grant writing)	Hazard Mitigation Grant, Eau Claire Village	2005-2006	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Purchase and install generator for Berrien Township public safety services.	High	IF, SSW, SWW, EXT	Berrien Township	Berrien Township, SWMC (assistance with grant writing)	Hazard Mitigation Grant, Berrien Township	2005-2006	Y
Expand the County GIS capabilities to assess critical facilities that are affected by several hazards.	High	All	County-wide	County GIS Dept., EM, local municipalities, SWMC	HLS grants, Berrien County, local municipalities, SWMC	2005-2009	Y
Continue to update 302 list to ensure plans are developed for all locations.	High	HM	County-wide	EM, MDEQ, County GIS Dept.	Staff time	On-going	Y
Maintain Emergency Response Team and continue to provide adequate training opportunities.	High	HM	County-wide	EM	HLS grants	On-going	Y
Encourage Brownfield clean-up and redevelopment	High	HM, PH	County-wide	Economic Development, MDEQ, EPA, private industry	Brownfield redevelopment grants	2005-2009	Y
Purchase and install permanent generator for lift station #4 and one portable generator to prevent wastewater from backing up into houses during power outages.	High	FL, IF	Watervliet Township	Watervliet Township, SWMC (assistance with grant writing)	Watervliet Township, hazard mitigation grants (\$60,000 - \$80,000)	2005	Y
Install protective measures to limit stream bank erosion on Red Bud Trail.	High	FL, ER, IF	Red Bud Trail (from Moccasin Trail south 2100 feet along St. Joseph River)	Road Commission, EM	Road Commission, Hazard Mitigation grant (\$355,000)	2005	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Replace undersized culverts to reduce flooding, increase accessibility for emergency vehicles and to lessen erosion and possible future failure of the road.	High (listed in order of priority in location column)	FL	<ol style="list-style-type: none"> 1. New Buffalo Twp, Sec. 11, Maudlin Road west of Hoder 2. Galien Twp, Sec. 21, Spring Creek Road west of Nye Road 3. Galien Twp. Sec 8, Buffalo Road ½ mile west of Hampton Road 4. Pipestone Twp, Sec 15, Bailey Road north of Town Hall Road 5. Bainbridge Twp, Sec 18, Territorial Road west of Park Street and east of Milburg 6. Berrien Twp, Sec 9, Eau Claire Road north of Huckleberry Road 7. Royalton Twp, Sec 31, Rocky Weed Road west of Scottdale Road 	Drain Commission, Road Commission, EM	Drain Commission, Road Commission, EM, hazard mitigation grants <ol style="list-style-type: none"> 1. 75,000 2. \$20,000 - \$30,000 3. \$15,000- \$20,000 4. \$15,000- \$20,000 5. \$5,000- \$10,000 6. \$5,000- \$10,000 7. \$5,000- \$10,000 	<ol style="list-style-type: none"> 1. 2005 2. 2005 3. 2005 4. 2005-2006 5. 2005-2006 6. 2006 7. 2006-2007 	Y to all seven projects

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Replace undersized culverts to reduce flooding of property.	High	FL	1. Pipestone Twp, Sec. 4, Black Lake Road, East of Michael Road 2. Royalton Twp, Sec 28 and 33, Rocky Weed Road west of US31	Drain Commission, Road Commission, EM	Drain Commission, Road Commission, EM, hazard mitigation grants 1. \$20,000- \$25,000 2. \$100,000	1. 2006 2. 2006-2007	Y to both projects
Continue to determine the feasibility of reducing the flow of floodwaters over roads by evaluating road elevation and culvert sizing standards for construction and upgrade for all County roads, but especially for roads in low lying or flood prone areas.	Medium	FL	County-wide	Road Commission, local road agencies, drain commissioner, EM	Road agency funding, hazard mitigation grant	2005-2009	Y
Relocate the Berrien Springs Wastewater Treatment Plant out of the floodplain.	High	FL, PH, IF	Berrien Springs Village	Berrien County Emergency Management	Total project \$8.7 million USDA Rural Development Grant and Loan, FEMA Pre-Disaster Mitigation Grant, State Revolving Loan Funds	2005-2006	Y
Remove two aging dams on Paw Paw River to ensure safety and protection of property in Watervliet.	High	FL	City of Watervliet	City of Watervliet, Berrien County MDEQ, MDNR	City, County, MDNR, Great Lakes Fisheries Trust	2005-2006	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Develop comprehensive watershed management plans and policies for Berrien County, considering the connections between land-use, urban growth, and surface water, and ground water issues.	Medium	FL, PH	County-wide	Berrien County, local municipalities, drain commissioner, MDEQ, watershed groups, SWMC	MDEQ, Berrien County, local municipalities, SWMC	2004-2009	Y
Update FEMA flood prone maps for Berrien County.	High	FL	County-wide (participating municipalities)	FEMA, GIS Dept., local municipalities	FEMA	2004-2005	Y
Identify (map), conserve, and restore land of potential flood mitigation value. Lands of potential flood mitigation value are wetlands, floodplain corridors, upland storage, and areas of high infiltration potential.	Medium	FL	County-wide	Berrien GIS Dept., local municipalities, drain commissioner, MDEQ, watershed groups	MDEQ grants, FEMA, County, local	2006	?
Discuss formation of a policy that guides or further restricts development around flood prone areas and areas of high flood mitigation value. Lands of potential flood mitigation value are wetlands, floodplain corridors, upland storage, and areas of high infiltration potential.	Medium	FL	County-wide	Berrien County, local municipalities, drain commissioner, MDEQ, watershed groups	MDEQ grants, FEMA, County, local	2007	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Evaluate the County's and other units of governments' erosion control and stormwater management, floodplain zoning, and shore land zoning ordinances, and NFIP status to determine regulatory deficiencies, necessary improvements, enforcement shortcomings in order to bring governments into compliance and to strengthen and maximize the benefits of current regulations.	High	FL	County-wide (priority on Galien Watershed)	SWMC, local municipalities, county planning dept., FEMA, MDEQ, watershed groups	MDEQ, SWMC, Local Municipalities	2005-2009	Y
Improve regional stormwater management practices to minimize localized flooding. Flood management and stormwater management should form a single integrated system over the entire watershed. The streams and waterways of a watershed must be capable of carrying present and future runoff loads generated by all of the existing and future planned development patterns within the watershed. The County is uniquely situated to coordinate and facilitate projects that involve watershed or multi-jurisdictional efforts.	High	FL	County-wide (especially in Phase II regulated area)	Drain commissioner, MDEQ, local municipalities, watershed groups	County, local, grants for innovative stormwater management practices (Great Lakes Basin, etc.)	2004-2009	Y
Promote low impact development techniques that reduce stormwater run-off and lessens flooding.	High	FL, PH	County-wide	SWMC, watershed groups, drain commissioner, local municipalities, MDEQ	MDEQ, local	2005-2009	Y

Action	Priority	Hazard(s) Mitigated*	Jurisdiction(s)	Partnering Agencies	Potential Funding Sources	Time frame	Action is Cost Effective? Y- yes, N- no, ? – more research needed
Improve citizen and local elected officials understanding of floodplain maps and floodplain regulations, flood proofing options, development and stormwater management considerations, and other information to assist in good decision-making.	High	FL	County-wide (priority on Galien Watershed)	SWMC, local municipalities, county planning dept., FEMA, MDEQ, watershed groups	unknown	2005-2009	Y
The County should encourage local units of government to apply structural hazard mitigation and sustainability concepts when building or remodeling their facilities.	Medium	All	County-wide	EM, County Planning Dept.	Unknown	On-going	Y
Encourage all critical facilities to employ hazard mitigation and sustainability concepts when building or remodeling their facilities. Encourage critical facilities to plan for power outages and install back up power supplies. This should include an assessment of the applicability of renewable energy sources as a potential power supply.	Medium	All	County-wide	EM, County Administration	Unknown	On-going	Y
Assess wildfire prone areas by conducting windshield surveys. Provide Fire Wise educational materials to residents/businesses in high hazard areas.	Low	FI	Along Lake Michigan in Berrien County	MSUE	MSUE	2005-2006	Y
Ensure that emergency plans are maintained for significant and high rated dams in Berrien County.	High	FL	Significant and High rated dams	EM, Dam owners, MDEQ	Dam owners	On-going	Y

After adoption of this plan, Berrien County, and its local jurisdictions, will begin to incorporate mitigation recommendations into comprehensive plans, capital improvement schedules, zoning ordinances, building codes, site plan reviews, permitting and other planning tools. The Berrien County Planning Commission will review the Hazard Mitigation Plan and ensure that the County's Comprehensive Plan includes the relevant mitigation priority activities (many are already included in the County's Comprehensive Plan). The County has no local land use authority, but the county planning commission does have the opportunity to review and comment on local plans and ordinances. During this county review process, the county planning commission will recommend that local jurisdictions include hazard mitigation actions into their planning and zoning documents when appropriate. Further, the resolution of adoption for the Hazard Mitigation Plan will include a statement committing the county and local units to incorporating relevant information from this *Plan* into their local jurisdictional plans and policies.

Berrien County has developed a method to ensure that the Hazard Mitigation Plan is reviewed annually and updated every five years. The Berrien County Office of Emergency Management will lead the evaluation and updating process. This process should start by November 2008 to ensure completion within a five-year cycle as required by FEMA. The Berrien County Office of Emergency Management will review the risk assessment portion of the plan to determine if this information should be updated or modified. The Hazard Mitigation Sub-Committee, with assistance from the Office of Emergency Management, will monitor and evaluate the progress of hazard mitigation strategies in the plan. The sub-committee will include staff and members of the county planning commission, local jurisdictions, the Office of Emergency Management, and other relevant agencies and organizations. The sub-committee will review each goal and objective to determine their relevance to changing situations in the County, as well as changes in state or federal policy, and to ensure that the plan addresses current as well as anticipated conditions. The sub-committee will determine if the responsible agencies or municipalities have implemented the priority actions listed in the action plan. The sub-committee will report on the status of the mitigation actions and which actions should be revised if necessary.

The Office of Emergency Management will utilize the sub-committee's evaluation report to determine if the plan needs to be updated. If needed, the Office of Emergency Management will update the plan and send it to the sub-committee, county planning commission, local jurisdictions, and state officials for comment. The county planning commission review will ensure that the plan is consistent with other planning efforts in the County. Any comments received will be incorporated into the final plan and the adoption process will follow.

There will also be the opportunity for public involvement in the updating process. The sub-committee will represent the public to some extent. For further public input, the current plan and any updates will be posted on the Berrien County website (www.berriencounty.org) along with a contact name and number for people to direct their comments or concerns.

Conclusion

A variety of hazards pose a threat to the residents of communities in Berrien County. Some hazards, such as drought, develop over a matter of months and may be nearly impossible to avoid. Other hazards, such as flooding or tornadoes, can create a disaster situation in a matter of minutes, but through preparation and a variety of structural and non-structural mitigation measures, the devastating effects may be minimized.

As the human and economic cost of disasters continues to rise across the nation, government, businesses, and individuals are beginning to realize the need to work together to find feasible solutions to make communities more resistant to disasters. This includes ensuring that redevelopment of policies in the aftermath of devastating disasters continue to lessen the community's vulnerability to future impacts.

Hazard mitigation, preparation, and response are not solely the responsibility of the agencies and organizations that have been described in this document; it is the responsibility of communities and individuals. Citizens must also take personal responsibility to protect themselves and the lives of those in their family and community.

The first step in preventing disaster loss is to know the risks. Effective risk management requires an informed citizenry. This *Plan* has presented findings of how various hazard situations have affected the lives and economies in Berrien County in the past, and the potential impact of these hazards in the future. This *Plan* goes a step further and prioritizes strategies to lessen the impacts of the hazards facing the County. This *Plan* can guide local and county actions to ensure that our communities are more resistant to disasters. The County looks forward to working with the cities, townships, villages, residents, non-profit organizations and local state and federal agencies to mitigate disasters.

APPENDIX A

LIST OF MEETING ATTENDEES AND COMMITTEE MEMBERS

PUBLIC OFFICIALS DAY, JUNE 2, 2004 ATTENDEES

Name	Representing	Name	Representing
James Brow Wendie Shafer Susan Newcomer John Newcomer	Baroda Twp.	Robert Getz Diane Mensinger William Bennitt Steve Dunkel Ed Rath	Baroda Village
Paul Harvey Carolyn Phillips Linda Scarbrough Carolyn Fowler Rosie Hudson Nora Jefferson	Benton Township	Paul Sprung	Berrien Township
Kathleen Ramso Dorothea Crocker Linda Gedeon-Kuhn	Bridgman City	Mary Ellen Schutze	Buchanan City
Carl Anderson Jeanne Dudeck	Chikaming Township	Kenneth Parrigin	Coloma Township
Bill Smith	Coloma City	John Gast Gloria Payne Betty Korcek	Lake Charter Township
Richard Stauffer	Lincoln Charter Township	Jack Kennedy Becky Borglin Rosann Dudiak	New Buffalo City
Agnes Conway Will Lawson	New Buffalo Township	Ruth Harte David Flowers Georgia Boggs Daniel Vandenheede Larry Lamb	Niles City
Doug Davis	Pipestone Township	Mary Goff Robert Judd Michael Gary	St. Joe City
Ronald Griffin Janel Helsley Dave Vonk Roger Seely	St. Joe Charter Township	Virginia Palis Marie Grajauskis	Sodus Township
Donald Schlipp	Stevensville Village	Chris Ranzenenger	Three Oaks Village
Merle Bujack Butch Jarvis	Watervliet Township	Craig Massey	Berrien County Health Department
Jeanette Leahey Debra Panozzo Dick Bartz Larry Clymer Don Gast Victoria Chandler Andy Vavra Bret Witkowski Don Ryman	Berrien County Commissioners	John Burt, Planning Director Bill Wolf, Treasurer Lori Jarvis, Register of Deeds Mike Henry, County Administrator	Berrien County staff
Bill Marx Gayle Baugher Chuck Heit	Berrien County Sheriff's Department	Marcy Colclough John Egelhaaf Larry Koepfle	Southwestern Michigan Commission
Jim Fuerstenau	Michigan Community Farmland Alliance		

Members of the Berrien County Disaster Committee

Name	Organization	Name	Organization
Agens, David	BCSD 911	Golob, Martin	United Way
Anderson, Roger	AEP	Grimes, Valerie	BC Animal Control
Balow, Brian	Coloma EMS	Hanson, Derri	Andrew's Univ.
Bartz, Dick	Commissioner	Hanson, Gaylord	Andrew's Univ.
Baugher, Gayle	BCSD Emer. Mgmt.	Hellenga, Lori	Lakeland, EM Serv.
Beach, Marlene	SMCAS	Hines, Ralph	Berrien Twp Supervisor
Beach, Stewart	Lake Twp Water	Johnson, Roy	FBI
Bell, Rory	Benton Harbor FD	Kalinowski, Jim	Medic I
Blackwell, Eric	Watervliet CH	Kalinowski, Joyce	Watervliet Comm. Hospital
Bradley, Mike	BCSD Emer. Mgmt.	Lamb, Larry	Niles City FD
Burch, Ann	Area Agency on Aging	LaVanway, Angie	Red Cross
Burks, Corey	BCSD	Laya, Marsha	Red Cross
Cason-Orton, Lori	Medic I	Leahey, Jeanette	Commissioner
Chaddock, John	SWM Airport	Leich, Capt. John	Niles PD
Chaudoir, Jan	Berrien Springs Village	Lepley, Eric	Coast Guard
Clapp, Mark	St. Joseph PD - Chief	Luhrs, Kevin	St. Joseph FD-Chief
Clark, Robert, MD	BC Med. Examiner	Margol, Joseph	BC Road Commission
Clymer, Larry	LEPC Chairman	Massey, Craig	BC Health Dept
Colclough, Marica	SW MI Commission	Mays, Willie	MSP - Paw Paw
Connell, Jeremy	Benton Harbor FD	McCoy, John	BCSD Emer. Mgmt.
Corteville, Chris	BCSD Emer. Mgmt.	McNeil, David	Bridgman PD
Cottier, Robert	Coloma Township PD Chief	Merriman, James	Niles City PD
Daignault, Sandra	Watervliet Comm. Hospital	Morris, Randy	Coloma FD
DiBrito, Al	FBI	Parren, Mark	Medic I
Dievendorf, Bob	5th DMRC	Penrod, Kevin	Andrew's Univ.
Ferguson, Tom	Abermarche	Prince, Chris MD	SJ Med. Assoc.
Fisher, Jack Jr.	Medic I	Quinn, Matt	Coloma EMS
Gatchell, Dan	Benton Township FD Chief	Richcreek, Scott	Watervliet PD
Gillette, Kevin	Lincoln Twp Supervisor	Robaska, Janis	BCISD

Members of Berrien County Disaster Committee continued

Name	Organization
Rucker, Ron	Riverwood
Scherwitz, Lee	SWM Airport
Sexton, Denny	BCSD 911
Smith, Jeffrey	AEP
South, Paul	MDOT-Coloma TSC
Sullivan, Dan	Lincoln Twp PD
Tucker, Bill	BCSD
Walton, Cullen	Benton Harbor Schools
Warshaw, Myron	New Buffalo Twp
Weaver, Warren	Buchanan Fire
Williams, Ralph	EOC Runner
Woodward, David	Coloma FD

Members of Hazard Mitigation Sub-Committee

Name	Organization	Name	Organization
Sandra Daignault	Watervliet Comm Hospital	Jeanette Leahy	Berrien County Commissioner
Roy Johnson	FBI	Bruce Leach	City of Niles FD
Joe Margol	Road Commission	Mike Bradley	Emergency Mgt
Mark Parren	Medic 1	Paul South	MDOT
Mark Clapp	St. Joseph PD	Marsha Laya	Red Cross
Kevin Luhrs	St. Joseph FD		
Eric Lepley	Coast Guard		
Marcy Colclough	Southwestern Michigan Commission		
Larry Clymer	Berrien County Commissioner		

APPENDIX B

SAMPLE RESOLUTION OF PLANNING SUPPORT

RESOLUTION OF SUPPORT

_____ (municipality)
Berrien County, Michigan

WHEREAS, the Berrien County Office of Emergency Preparedness is developing a Hazard Mitigation Plan that will satisfy the requirements of the Disaster Mitigation Act of 2000 and 44CFR 201.6. The plan will identify, analyze and prioritize significant hazards in the county. The plan will also outline strategies to effectively lessen the impacts of hazards (mitigation strategies).

WHEREAS, local units of government that wish to receive funding for hazard mitigation projects from the Hazard Mitigation Grant Program will be required (by the Federal Emergency Management Agency) to create or participate in the creation of an approved local hazard mitigation plan satisfying the requirements of the Disaster Mitigation Act of 2000.

WHEREAS, the Berrien County Office of Emergency Preparedness will develop a plan that reflects the needs and concerns of the community and the local units of government within the county. In addition, mitigation strategies may need to be implemented at the local level or with cooperation from the local units. To achieve these objectives, local input is an essential element of the planning process.

NOW THEREFORE, BE IT RESOLVED that _____ (municipality) Board of Trustees/Council will support the County's efforts in developing the Hazard Mitigation Plan. _____ (municipality) will participate in the hazard mitigation planning process by doing the following:

- select a representative that will serve as a liaison between the county and the local unit by attending meetings throughout the planning process to develop and prioritize hazards and mitigation strategies (if no one from the local unit can attend a scheduled meeting, a meeting summary will be sent to the local unit);
- complete and return the hazard identification and community profile worksheets;
- allow County staff to present the draft plan at a board/council meeting;
- provide comments and suggestions on the draft plan to ensure that the plan reflects the needs of the local unit;
- and consider adopting a resolution of support for the final Hazard Mitigation Plan.

Adopted:

Date _____ Signed _____

Please send a copy of the signed resolution to:
Marcy Colclough, SWMC, 185 E. Main Street, Benton Harbor, MI 49022

APPENDIX C

SAMPLE RESOLUTION OF PLAN ADOPTION

RESOLUTION OF ADOPTION

_____ (municipality)
Berrien County, Michigan

WHEREAS, _____, Michigan is aware of the damages, lives lost and costs associated with disasters and recognizes the need to plan for and mitigate disasters in Berrien County. Disasters in Berrien County have damaged commercial, residential, and public properties, displaced citizens and businesses, closed streets and bridges and presented general public health and safety concerns; and

WHEREAS, Berrien County in cooperation with each local unit has prepared a Hazard Mitigation Plan that outlines options to reduce overall damage and impact from hazards affecting Berrien County and its local units; and

WHEREAS, the Hazard Mitigation Plan has been made available to the general public, business owners and federal, state and local agencies and has been revised to reflect their concerns;

NOW, THEREFORE, BE IT RESOLVED THAT

1. _____, Michigan adopts the Berrien County Hazard Mitigation Plan as an official plan.
2. _____, Michigan will choose a representative to sit on the disaster committee and/or hazard mitigation sub-committee.
3. _____, Michigan will continue to participate in efforts to implement and update the plan.

Adopted:

Date _____

Signed _____