

BRIDGETON TOWNSHIP  
FLOOD MITIGATION PLAN



June 2008

**WMSRDC**  
WEST MICHIGAN SHORELINE  
REGIONAL DEVELOPMENT COMMISSION

**WEST MICHIGAN SHORELINE  
REGIONAL DEVELOPMENT COMMISSION  
(WMSRDC)**

The WMSRDC is a regional council of governments representing 127 local governments in the West Michigan counties of Lake, Mason, Muskegon, Newaygo, Oceana, and northern Ottawa.

The mission of WMSRDC is to promote and foster regional development in West Michigan... through cooperation amongst local governments.



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Prepared by WMSRDC in conjunction with the  
Bridgeton Township Planning Commission

**ON THE COVER**

Muskegon River looking east at  
the Maple Island Road Bridge.

**Picture Taken by WMSRDC**

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## *Bridgeton Township*

*Newaygo County, Michigan*

Drake made a motion to adopt the Bridgeton Township Flood Mitigation Plan as presented, Alvesteffer seconded.

Roll call vote:

Alvesteffer – yes, Schuiteman – yes, Schooley – yes, Drake – yes, Kooistra -yes

Motion carried unanimously

I certify this to be a true copy of the motion adopting the Bridgeton Township Flood Mitigation Plan at the June 9, 2008 Township Board meeting.

  
\_\_\_\_\_  
Carolyn Drake, Clerk

# PART A

## PURPOSE AND PLANNING PROCESS

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### I. PURPOSE

The Bridgeton Township Flood Mitigation Plan was created to protect the health, safety, and economic interests of residents by reducing the impacts of floods through mitigation planning, awareness, and implementation. Flooding carries the potential for repetitive and often severe social, economic and physical damage. Flood mitigation is any action taken to permanently eliminate or reduce the long-term risk to human life and property from flooding. It is an essential element of emergency management along with preparedness, response and recovery.

This plan serves as the foundation for flood mitigation activities within Bridgeton Township. Implementation of the plan's recommendations will reduce injuries, loss of life, and destruction of property attributable to floods. The plan provides a path toward continuous, proactive reduction of vulnerability to flooding; one of the township's most damaging natural hazards. Ideally, this plan will spur total integration of flood mitigation activities, programs, capabilities and actions into day-to-day governmental functions and management practices.

Some of the mitigation activities recommended in this document are inexpensive to carry out while others require funding. The Federal Emergency Management Agency's (FEMA's) Flood Mitigation Assistance Program (FMAP) can assist with funding for many activities, as can the related Pre-Disaster Mitigation (PDM) program and the Hazard Mitigation Grant Program (HMGP). FMAP was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP) through flood mitigation planning and activities by states and communities.

FMAP is administered by the Emergency Management and Homeland Security Division of the Michigan State Police and offers three types of grants: planning, technical assistance, and project. The preparation of this document was partially funded by FMAP planning and technical assistance grants, made available after the floods of 2004. Bridgeton Township was eligible for such funding due to flood damages sustained by properties along the Muskegon River. It provided matching funds as required.

FMAP also provides project funds to states, communities, and Indian tribal governments so that cost-effective measures are taken to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. Eligible communities must be participating in, and in good standing with, the NFIP. Eligible property owners must have current flood insurance policies on the structures to be mitigated.

To be eligible for project grants, a community must also develop, and have approved by the FEMA Regional Director, a Flood Mitigation Plan in accordance with 44 CFR Part 78.5 prior to grant award. The plan must address flood issues; serve as a cost-effective way to reduce both direct damage and subsequent negative impacts from future floods; be the most practical, effective, and environmentally sound alternative; foster feasible long-term flood relief and protection; consider long-term changes; and provide manageable future

maintenance and modification requirements. Adoption and approval of the Bridgeton Township Flood Mitigation Plan (2007) allows Bridgeton Township to apply for project grants for activities identified in the document, as funds become available.

## **II. PLANNING PROCESS**

The planning process followed in the development of the Bridgeton Township Flood Mitigation Plan required the use of many sources of information and input and consisted of the following steps.

- Identification and mapping of flood hazards, risks and vulnerabilities;
- Identification and definition of goals and objectives;
- Identification of alternatives for solving problems;
- Selection of evaluation criteria to prioritize alternatives;
- Selection of potential flood mitigation actions;
- Preparation of a draft flood mitigation plan;
- Preparation of the final flood mitigation plan;
- Implementation of the flood mitigation plan; and
- Monitoring and periodic revision of the flood mitigation plan.

Documents reviewed during the formation of the Bridgeton Township Flood Mitigation Plan included the Bridgeton Township Land Use Plan (2002), the Bridgeton Township Zoning Ordinance (1995), the Bridgeton Township Parks and Recreation Master Plan (2004), the Newaygo County Hazard Mitigation Plan (2005), and the Michigan Hazard Analysis (2001). Pertinent information from these documents was included in this plan so that it complements and builds upon prior recommendations. Existing flood mitigation plans from other communities were also referenced, including the City of Vassar Flood Hazard Mitigation Plan (1998).

Additional sources utilized in the preparation of this document included the 2000 United States Census of Population; the 2005 Newaygo County Equalization Report; the 1990 Flood Insurance Rate Maps-Township of Bridgeton and the 1990 Flood Insurance Study-Township of Bridgeton, all from the National Flood Insurance Program; USGS topographic maps; plat maps; the Soil Survey of Newaygo County, Michigan (1995); and web sites of the National Oceanic and Atmospheric Administration, the State of Michigan, Michigan Geographic Data Library and many others.

## **III. PLANNING APPROACH**

The Bridgeton Township Flood Mitigation Plan was developed by the West Michigan Shoreline Regional Development Commission (WMSRDC) under the guidance and with the assistance of the Bridgeton Township Planning Commission. The WMSRDC is a regional council of governments representing over 120 local governments in the West Michigan counties of Lake, Mason, Muskegon, Newaygo and Oceana. The Commission utilized its own Geographic Information System (GIS) to create the maps within the document.

The Planning Commission is a seven-member body composed of a chair, a secretary and five appointed citizens. It has been delegated authority in ordinance and zoning issues as well as

in long-range community planning. It is also responsible for regulating zoning, with the Township Board having final approval on all zoning ordinances. The Planning Commission provided guidance, held a public meeting during the development of the draft plan, reviewed both the draft plan and the final plan, and provided input to the Board of Trustees. The Board subsequently held a formal public hearing to officially record any additional comments from the public prior to its consideration and adoption of the final plan.

Public participation took place at many stages throughout the development of the document. It was sought during plan development from residents (particularly those living along the Muskegon River), emergency responders and those involved in emergency preparedness, neighboring communities, and local and county officials.

Letters explaining the Flood Mitigation Plan process; along with surveys asking for information on previous flooding events, vulnerabilities to flooding, recommendations for mitigation activities, etc.; were mailed or distributed to the following. These folks were requested to return a completed survey or, if given ample notice, attend a public meeting and provide verbal or written comments.

- Adjacent townships; including Ashland, Garfield, and Sheridan in Newaygo County as well as Cedar Creek, Egelston, Moorland, and Casnovia in Muskegon County.
- Additional municipalities along the Muskegon River; including Brooks and Croton Townships as well as the City of Newaygo in Newaygo County and Muskegon Charter Township in Muskegon County.
- County and local officials; including the Newaygo County District 6 Commissioner, Newaygo County Drain Commission, Newaygo County Road Commission, Newaygo County Department of Building Safety and Permits, Muskegon County Road Commission, Muskegon County Public Works, Muskegon County Drain Commission, Bridgeton Township Building Inspector, Bridgeton Township Planning Commission, Bridgeton Township Board, and the Bridgeton Township Supervisor.
- Emergency responders; including Newaygo County Emergency Services, Newaygo Central Dispatch, Newaygo County Sheriff’s Department, Muskegon County Emergency Services, Muskegon State Game Area, District 10 Health Department, Fremont Fire Department, Ashland-Grant Fire District, American Red Cross, and Consumers Energy.

The public meeting was held on April 18, 2007 at the Bridgeton Township Hall. The entire community was invited to attend via notices in the Fremont Times-Indicator and the Hi-Lites Shoppers’ Guide, which is a free weekly publication distributed to 20,000 Fremont-area homes and businesses, including households in Bridgeton. These notices also allowed for comments to be submitted in writing prior to the meeting. Ten people attended the meeting, which included the Township Supervisor, the Township Clerk, the Township Planning Commission Chair, a Township Board member, and township homeowners. Newaygo County Emergency Services was also represented at the meeting. All attendees participated in meeting discussions, which produced valuable information regarding flooding history and flooding concerns. In addition, the discussions resulted in creative approaches to mitigation such as raising/lowering houses according to flood elevation and placing “cluster” septic systems out of the floodplain to serve homes within the floodplain.

The flood mitigation plan was also addressed at a Bridgeton Township Planning Commission meeting on August 20, 2007. The six commissioners in attendance discussed and approved

Goals and Objectives of the plan presented by WMSRDC staff. Richard Kooistra, Bridgeton Township Supervisor, and a planner from LSL Planning, Inc. (contracted to update the township's zoning ordinance), were also present at the meeting.

At the meeting on April 21, 2008, the Bridgeton Township Planning Commission focused on "Part I - Plan Implementation". Action items were reviewed and subsequent questions were answered by WMSRDC staff. The Planning Commission then approved the Bridgeton Township Flood Mitigation Plan – Draft (as presented); authorized the draft plan to be submitted to the Michigan State Police, Emergency Management Division for official review; and voted to send the Flood Mitigation Plan to the Township Board of Trustees with its support. Attendance at the meeting included six township planning commissioners, Township Supervisor Richard Kooistra, WMSRDC staff, and three guests from the community.

The final meeting of the planning process took place at a public hearing on June 9, 2008 at the Bridgeton Township Board of Trustees' regular monthly meeting. Attendance at the meeting included the five board members, two WMSRDC staff, and 28 guests from the community. Rich Kooistra gave a broad explanation of the purpose of the plan, and also presented a number of implementation actions from the plan. An opportunity for public comments immediately followed, and a question was raised regarding the public availability of the plan after its final FEMA approval. It was announced that a copy of the plan will be available to the public at the township hall and also that it will be posted on the WMSRDC website.

The flood mitigation planning process was featured several times in the WMSRDC's bi-monthly newsletter, Commission Communications. Not only was the newsletter mailed to all constituents within the Commission's five-county region, which included all of Bridgeton Township's neighboring communities, but it was also presented on the web site at [www.wmsrdc.org](http://www.wmsrdc.org). Both resources invited public input during plan development, with electronic response to or download of the survey being available on the website. The website also provided more detailed information about the planning process and excerpts from the plan including descriptions of historical flood events and a map illustrating water features.

Input from these sources assisted in the identification of existing and potential flood hazards and vulnerabilities and guided the establishment of goals and objectives, the recommendation of activities, and the prioritization of actions. For example, many residents voiced concern over dam releases, and timely warnings of such, as well as the cost of flood insurance. Requests were also made for flood mitigation information. A neighboring township recommended consistency in flood mitigation efforts by all communities along the river.

The thorough and careful planning approach used in the preparation of this document helped to ensure that all local concerns were addressed and that all possible solutions were explored. It also helped to ensure compliance with plan requirements. With the June 9, 2008 adoption of the plan by the Board of Trustees (following the public hearing), Bridgeton Township is free to dedicate its efforts and energies towards implementing the plan and mitigating flood hazards.

(A copy of the resolution of adoption has been included at the beginning of this document, following the Table of Contents.)

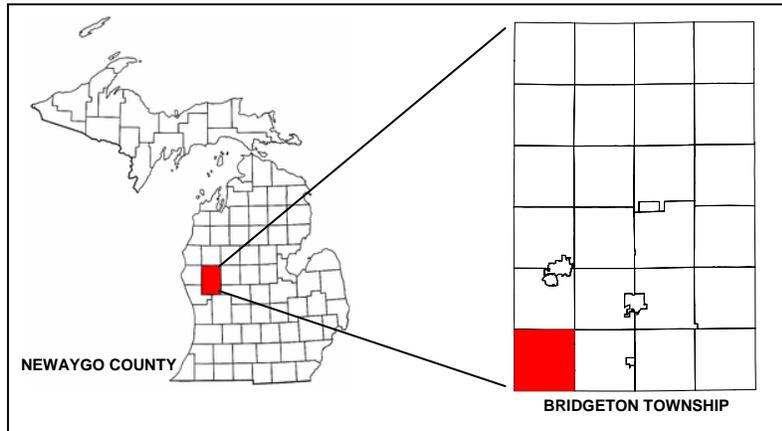
# PART B

## BRIDGETON TOWNSHIP COMMUNITY DESCRIPTION

### I. COMMUNITY PROFILE

Bridgeton Township is a rural community located in the southwest corner of Newaygo County, itself located in the west-central part of Michigan's Lower Peninsula. Newaygo County is bordered by Muskegon and Oceana counties to the west, Lake County to the north, Montcalm and Mecosta counties to the east, and Muskegon and Kent counties to the south.

MAP 1 – Location



Newaygo County has an area of 842 square miles, or approximately 538,880 acres. According to the U.S. Census, the 1990 population was 38,202 persons (45.4 persons per square mile) while the 2000 population rose to 47,874 (56.8 persons per square mile). The projected population for 2005 is 52,164 persons. According to the 2000 U.S. Census, Newaygo County had 23,202 total housing units (27.5 per square mile), with 17,599 of them occupied and 5,603 vacant. A significant portion of the vacant units, 4,394, was for seasonal, recreational, or occasional use. The median household income was \$35,549.

Bridgeton Township is bordered by Sheridan and Ashland townships in Newaygo County to the north and east. It also shares municipal boundaries with the Muskegon County townships of Egelston and Moorland to the south and Cedar Creek to the west. The Muskegon River meanders through the center of the township from northeast to southwest. The township has a total area of six square miles with a population of 2,098, according to the 2000 Census (59.1 persons per square mile). The peak seasonal population is estimated at 2,218 in the Newaygo County Hazard Mitigation Plan.

MAP 2 – Municipal Neighbors



According to the 2000 census, Bridgeton Township's population was comprised of 31.0% under the age of 18, 8.3% from 18-24, 32.2% from 25-44, 20.3% from 45-64, and 8.2% 65 years of age or older. The median age was 32.7 years. Of the population, 22.5% was living with disability or mobility limitations. The median household income was \$38,750 and 9.1% of families lived in poverty. 86.5% were homeowners.

In 2000, Bridgeton had 812 total housing units (22.9 per square mile), with 737 of them occupied and 75 vacant. About half of the vacant units, 37, were for seasonal, recreational, or occasional use. One-third of the total housing units (276 or 33.9%) were mobile homes. Of the 737 households; 39.6% had children under the age of 18 living with them, 9.0% consisted of a female householder, and 5.7% had someone living alone who was 65 years of age or older. The average household size was 2.85 persons. The majority of residents, 96.2%, spoke English only while 2.9% spoke Spanish only. The Spanish speaking population more than doubled from 22 individuals in 1990 to 56 in 2000.

The township's 2005 Equalized Valuation in 2005 was \$58,995,200. This amount was divided among the types of real and personal properties listed below in Table 1.

**TABLE 1**

<b>Analysis of Equalized Valuations Bridgeton Township 2005</b>				
	Number of Parcels	Assessed Valuation	Equalized Valuation	Percent of County
Real Property				
Agricultural	52	7,069,600	7,069,600	4.14
Commercial	8	577,900	577,900	0.48
Industrial	7	110,600	110,600	0.23
Residential	1206	51,237,100	51,237,100	3.82
Total	1273	58,995,200	58,995,200	3.52
Personal Property				
Agricultural	-	-	-	-
Commercial	16	107,200		
Industrial	-	-	-	-
Residential	-	-	-	-
Utility	11	1,304,800	-	-
Total	27	1,412,000	1,412,000	1.63

*Source: 2005 Newaygo County Equalization Report*

Bridgeton Township was established and incorporated in Newaygo County in 1852. It is organized under a general law form of government and operates under a Supervisor-Trustee form of government. The Township Supervisor is the direct link between the Board and the Township's operations. The Supervisor is responsible for the day-to-day operations of the Township with assistance from the Clerk and support staff. Other township officials include a Zoning Administrator and Building inspector.

The five-member Township Board sets policy, directs staff in fulfillment of those policies, and establishes priorities for capital expenditures, operations and maintenance. It works under a general operating fund budget for its fiscal year. The Township Board also makes appointments to its Planning Commission. Commission members take advantage of Citizen Planner courses offered through the Michigan State Extension Office as a means of keeping abreast of current legislation, environmental issues and concerns, zoning regulation, and litigation updates. Other bodies appointed by the Bridgeton Township Board include a three-member Board of Review and the Zoning Board of Appeals.

## II. HISTORY

Bridgeton Township's history is closely linked to use of the Muskegon River, with the earliest known use being by Native Americans as a major transportation route. It was also used by French trappers who traded with Native Americans. Beginning in approximately 1840, the river helped enable and propagate the lumber industry. It connected the area to Muskegon, a major lumber town at the time, and sawmills along Muskegon Lake. According to the Soil Survey of Newaygo County, "it is believed that more logs have floated down the Muskegon River than any other river in the world".

Early historical records indicate that Joseph Troutier, an Indian fur trader, set up a trading post in 1840 south of the river near today's Truckey Lake. European settlement began with lumbering and saw speculators making claims over vast timber resources, establishing squatter's rights at river mouths, and running sawmills with water power. The first sawmill in Bridgeton Township was built around 1845 near the present day Warner Avenue bridge and a steam sawmill was later constructed near Truckey Lake. Early legislative bodies recognized the need for roads to open the timbered areas and authorized a road connecting Muskegon-Bridgeton-Newaygo-Forks (Croton). The Board of Supervisors approved \$300 in 1851 for a new bridge located where the Warner Avenue bridge is now located.

Although use of the township's waterways for transportation of goods and lumber gradually came to a halt in the early 1900's, and transportation is now land-based, the waterways remain extremely important to the community. They have become intertwined with the township's rural setting to provide residents and visitors with year-round recreation opportunities as well as desirable locations to live. Little evidence remains of the historic use of the Muskegon River in Bridgeton Township.

## III. LAND USE AND DEVELOPMENT

According to the Bridgeton Township Parks and Recreation Master Plan, the region's "lumber-era origins defined the community settings, the roots of towns and villages, and the connections of trails and roadways between peoples." Today, Bridgeton Township could be described as a "bedroom community" since it is primarily rural and has scattered housing with pockets of more concentrated residential areas. Other land uses in the township are limited to outdoor recreation and commercial businesses which serve residents and tourists coming to the area to hunt and fish.

In recent years, Bridgeton Township has experienced significant population growth. According to the U.S. Census, the township population grew 33.3 percent from 1,574 in 1990 to 2,098 in 2000. The number of housing units increased by 188 units, or 30.1 percent, from 624 in 1990 to 812 in 2000. The township's growth is likely attributable to a combination of land availability and cost, natural beauty, and recreational opportunities with the township's proximity to employment in both Newaygo and Muskegon counties.

Development within the township has not occurred in any particular pattern but is generally located along and north of the Muskegon River; especially in the northeast quarter of the township. There are four subdivisions along the river, largely developed by 1980, known as Bell Meadow, Leisure Land, Freight Hill, and Home Site Park. There has not been much new development along the Muskegon River in the last 20 years; however there have been some instances of remodeling, upward additions, and construction of accessory buildings.

Development tends to occur when a land owner decides to sell property, and a buyer wants to build on that property.

The township will most likely continue to grow in the future for the same reasons it has grown in the past. According to population projections made by the West Michigan Shoreline Regional Development Commission, Bridgeton will be home to approximately 3,793 people by the year 2035. Table 2 contains a list of past population totals and future projections for the township.

**TABLE 2**

<b>Population Projections</b>											
	Actual				Est.	Projected					
Year	1970	1980	1990	2000	2004	2010	2015	2020	2025	2030	3035
Bridgeton Township	870	1,562	1,574	2,098	2,348	2,576	2,784	3,008	3,250	3,511	3,793

*Source: Actual and Estimated Figures from the U.S. Bureau of the Census – Projected figures from the WMSRDC*

*Note: Population projections are developed at the county level. As a result of this, in-county migration from urban to non-urban areas may be understated.*

In preparation for future growth, the township has adopted the 2002 Bridgeton Township Land Use Plan and the legally enforceable 1995 Bridgeton Township Zoning Ordinance, as amended. The Future Land Use Plan and its Future Land Use Map place most of the Muskegon River in the Rural Residential land use category, which calls for development of single family residential on large lots. “Many of the areas have significant natural limitations such as wetlands or severe soil limitations and are not planned for sanitary sewer.” The northeastern portion of the river is in the Medium Density Residential or Private Recreation classifications, while the northwest corner of the Agricultural area abuts the river.

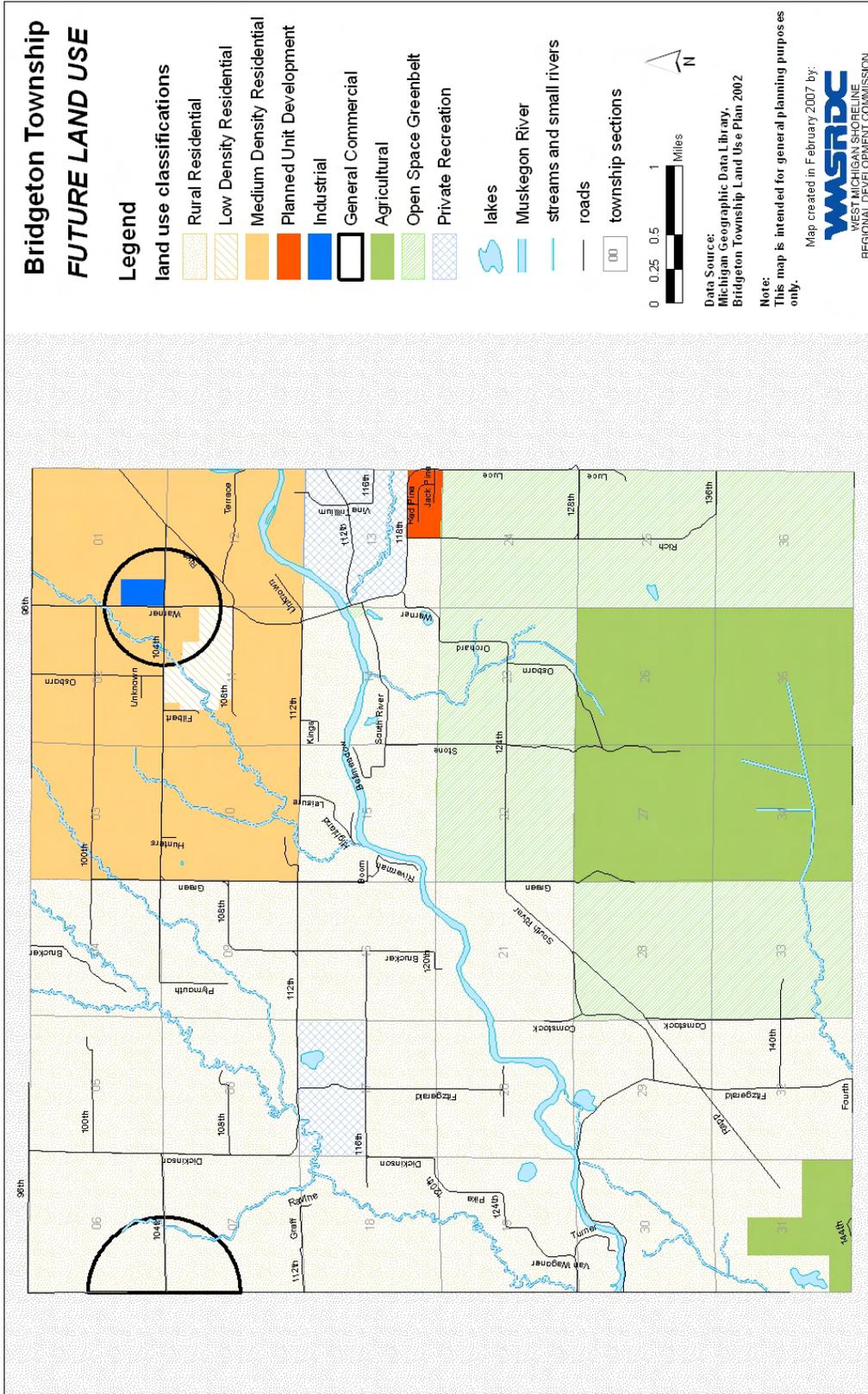
The Zoning Ordinance places most of the Muskegon River in the Agricultural Rural-Residential zone, which is separated from the river by the Greenbelt District. The only exceptions are in the western-most and eastern-most sections where Recreational zones exist. Listed below are the three zones that occur along the Muskegon River.

**Agricultural Rural Residential District** – This district is primarily intended to conserve and to protect appropriate Township lands for farming. Agricultural density single family residential use and institutional and public use are also permitted.

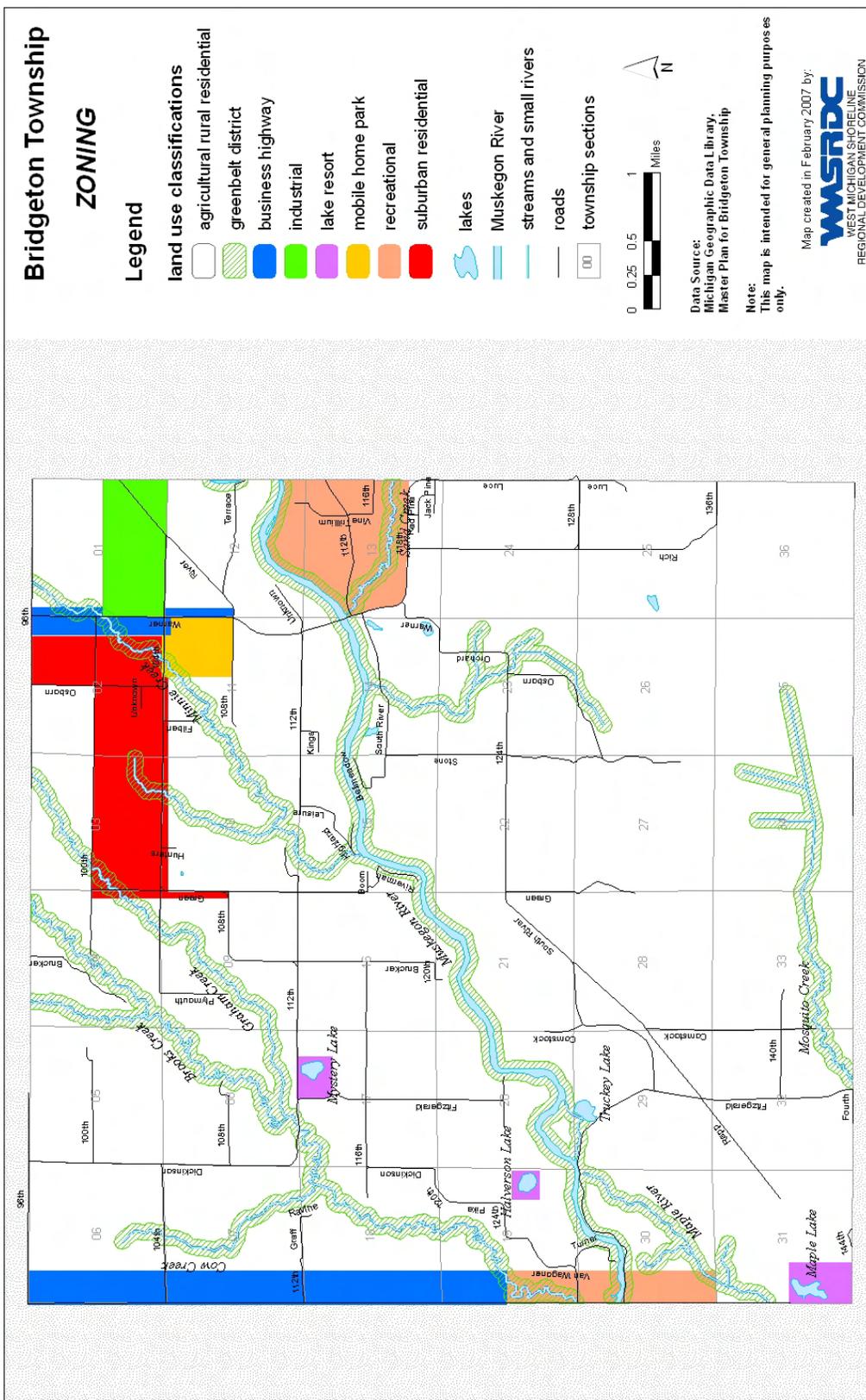
**Greenbelt District** – In order to preserve water quality in rivers and streams of the township and to prevent deterioration of these streams and the major Great Lakes tributaries to which these waters drain, it is necessary to regulate the use of adjoining lands. All land within three hundred feet of the water’s edge of the Muskegon River and all of its tributary streams shall comprise the Greenbelt Zone. No structure may be erected within 150 feet of the water edge, with adjustments for bank height permitted.

**Recreational District** – This district is intended to provide for the development of land on or near waterways in Bridgeton Township, but not governed by Greenbelt or Lake Resort.

# MAP 3



# MAP 4



**IV. INFRASTRUCTURE**

Bridgeton Township’s infrastructure includes both paved and gravel roads as well as seasonal roads. The main east-west traffic route is 104<sup>th</sup> Street on the north side of the township. County Road B-31 (Maple Island Road), a primary north/south route, runs along Bridgeton’s western border and converges with M-120 to the north. It is the dividing line between Bridgeton Township and Cedar Creek Township in Muskegon County. County Road B-35, on the east side of the township, meanders north/south and is composed of Warner Avenue, 118<sup>th</sup> Street and Luce Avenue. The township also has access to highways within 10 miles in every direction from its center. The following table gives approximate distances.

**TABLE 3**

<b>Regional Roadways</b>		
Roadway	Description	Distance from Bridgeton*
I-96	major east/west route through western Michigan	18.5 miles south
US-31	major north/south route along Lake Michigan	12 miles west
M-37	north/south	8.5 miles east
M-46	east/west	7 miles south
M-82	east/west	6.5 miles north
M-20	east/west	16 miles north
M-120	north/south	7 miles west

*\*Distances were approximately measured from the center of Bridgeton Township*

There are two bridges over the Muskegon River within the township. The first is located on Warner Avenue (B-35) while the second is located on Maple Island Road (B-31), and is shared with Muskegon County. The closest bridge upstream from Bridgeton is at the junction of the Muskegon River with M-37 in the City of Newaygo, while the closest downstream bridge is located at the junction of Muskegon River and US-31 in Muskegon Township.

Air transportation is available through the Muskegon County Airport, approximately 20 miles to the southwest in the City of Norton Shores, and Fremont Municipal Airport, eight miles to the north near the City of Fremont. There is currently no railroad access within the township.

The Township Hall is located at 11830 S. Warner Avenue, not far from the township-owned Bridgeton Boat Launch. A state-owned boat launch is located east of Maple Island Road on the north side of the Muskegon River. An additional access point, one mile east of Maple Island Rd on the south side of the river, is utilized by a private business.

Chinook Campgrounds is located southeast of the Bridgeton Bridge. Another recreational facility is a 170-acre parcel at the northeast corner of 112<sup>th</sup> Street and Green Avenue. It is owned by the Muskegon Motorcycle Club, which hosts national and amateur motorcycle events three weekends every year. The property is also used by the Klein Rodeo to host an IPRA rodeo. This event draws between 3,000 and 5,000 people annually to Bridgeton Township.

According to the 2000 census, 584 people leave the township to attend schools since there are no operating schools within the township. Group or nursing homes, large apartment buildings, large office buildings, stadiums, amusement parks, fairgrounds, or correctional

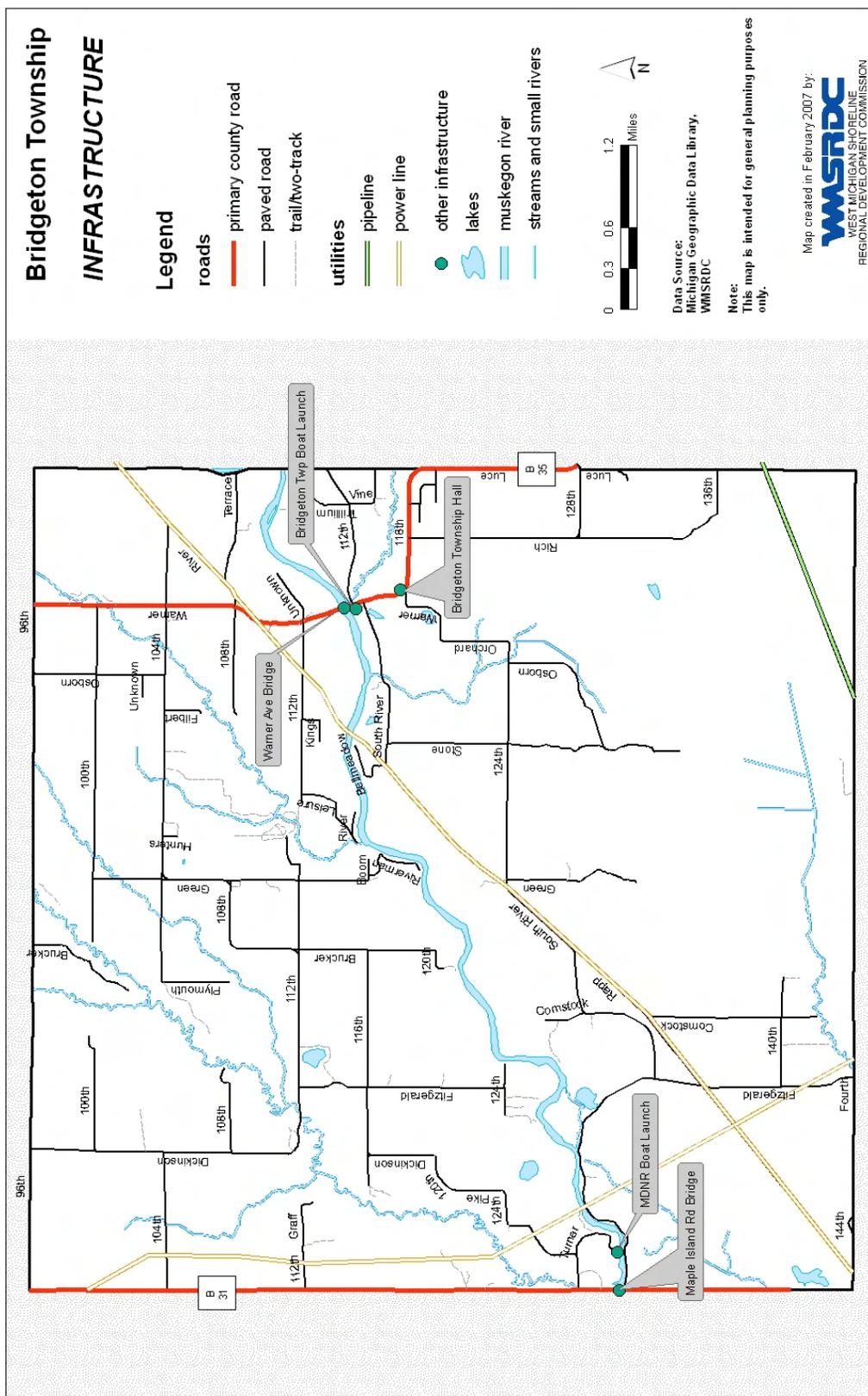
facilities are not found within township boundaries either. Since there are no major employers, 2000 U. S. Census data indicates that 893 residents commute to work with an average commuting time of 35.8 minutes.

There are no police precincts, fire stations, public works yards, community medical facilities, or hospitals. Police protection is provided by the Newaygo County Sheriff's Department in White Cloud and the Michigan State Police Post in Newaygo. Fire protection is provided by the Fremont Fire Department and the Ashland-Grant Fire Districts to the north and east respectively.

Bridgeton Township is not serviced by public water or sewer systems and consequently does not contain pumping stations, water treatment plants, or sanitary lift stations. The nearest are approximately five miles away in the City of Fremont to the north and in the City of Newaygo, which is further up the Muskegon River. In addition, there are no power stations, bus terminals, or train stations. However, the township's infrastructure does include Consumers Energy electric power lines, which cross the Muskegon River, and a MichCon natural gas pipeline.

Although there are no designated shelters within the township, the township hall is centrally located and can be used as such. It was built with this use in mind but does not have back-up power. Although there are no dams in Bridgeton Township, there are two significant dams upstream: the Croton Dam in Croton Township and the Hardy Dam in Big Prairie Township. Information on these dams is presented in Part C.

## MAP 5



## V. NATURAL RESOURCES

Bridgeton Township's topography is level to rolling and contains some very steep slopes and ravines. Generally, it is dominated by the relatively deep channel cut by the Muskegon River and the tributaries of the Muskegon River watershed and basin. Map 7 – Topographic illustrates the overall relief of the township where elevations range from 606 feet in the southwest quarter of the township to 787 feet in the southeast quarter.

The surface features of Newaygo County are generally the result of glacial action. There are two major physiographic regions in the county. One consists of several outwash plains and lake plains. The other consists of hilly and rolling morainal areas. The outwash and lake plains consist of organic materials formed from deposited glacial material of ancient glacial meltwater channels. There are also kettle lakes located in the outwash and lake plains. Glacial materials left behind by retreating glaciers formed the hilly and rolling morainal areas that rise above the outwash and lake plains.

### a. Water Features

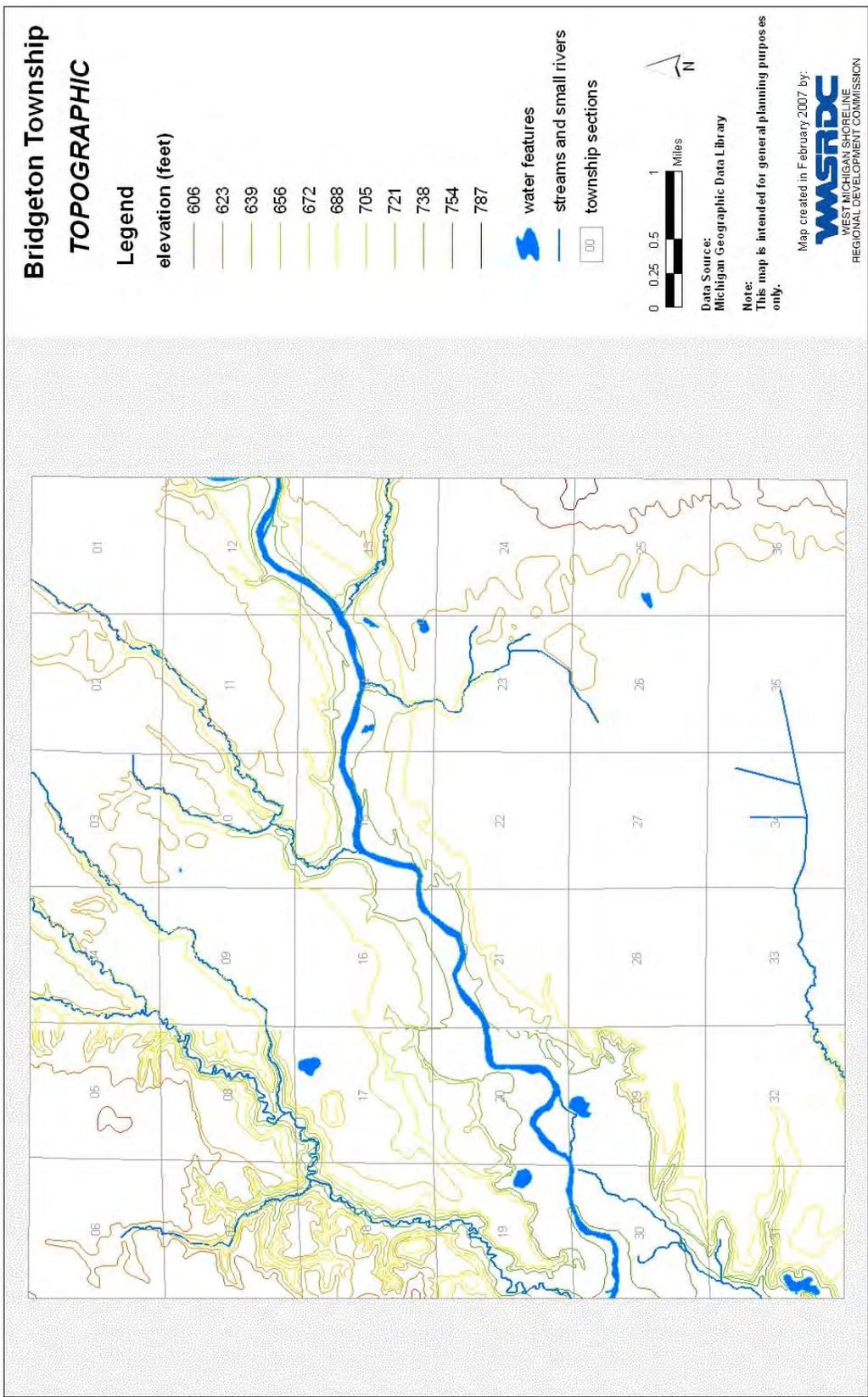
Without a doubt, the Muskegon River is the primary water feature in the township. It is also a major natural feature in the State of Michigan, since it is second only to the Grand River in size. The Muskegon River headwaters lie northeast of Cadillac in north-central Lower Michigan. From there the river flows southwest towards the Muskegon Lake where it ultimately empties into Lake Michigan. The Muskegon River watershed drains portions of the counties of Clare, Lake, Mecosta, Missaukee, Montcalm, Osceola, Roscommon, and Wexford before it drains most of the southern half of Newaygo County and terminates in Muskegon County.



Muskegon River and its tributaries; along with numerous creeks, lakes, and wetlands; comprise a notable portion of the township's total area. Most of the township is situated within the Muskegon River watershed; but the southeast corner is located within the Black Creek watershed. Other watercourses include the Maple River, Brooks Creek, Chidister Creek, Minnie Creek, and Sand Creek; all of which flow into the Muskegon River. Other water features include Bartron Lake, Wallison Lake, Maple Lake, Mystery Lake, and Truckey Lake. The township also contains a significant amount of wetlands. For a visual depiction of these features, see Map 8 – Water Features & Wetlands.

The township's water table varies from a minimum of about 590 feet above mean sea level in the southwest quarter of the township to a maximum of approximately 770 feet above mean sea level in the southeastern part of the township. Wells average between 50 feet and 200 feet deep, with the shallowest (less than 55 feet) concentrated in the northeast quarter of the township.

# MAP 7



Bridgeton Township’s wetlands are located near the Muskegon River and its tributaries, and also in the southeast quarter of the township. The U.S. Fish and Wildlife Service (FWS) defines wetlands, which are commonly known as marshes or swamps, to be "lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

For purposes of classification in the National Wetlands Inventory, “wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of the year.” Wetlands are classified according to the following definitions.

**TABLE 4**

<b>Wetland Class Definitions</b>	
<b>aquatic bed</b>	Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Water regimes include subtidal, irregularly exposed, regularly flooded, permanently flooded, intermittently exposed, semipermanently flooded, and seasonally flooded.
<b>emergent</b>	Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. All water regimes are included except subtidal and irregularly exposed.
<b>forested</b>	Characterized by woody vegetation that is 6 m (20 ft) tall or taller. All water regimes are included except subtidal.
<b>scrub-shrub</b>	Includes areas dominated by woody vegetation less than 6 m (20 ft) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. All water regimes except subtidal are included.
<b>unconsolidated bottom</b>	Includes all wetland and deepwater habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%. Water regimes are restricted to subtidal, permanently flooded, intermittently exposed, and semipermanently flooded.

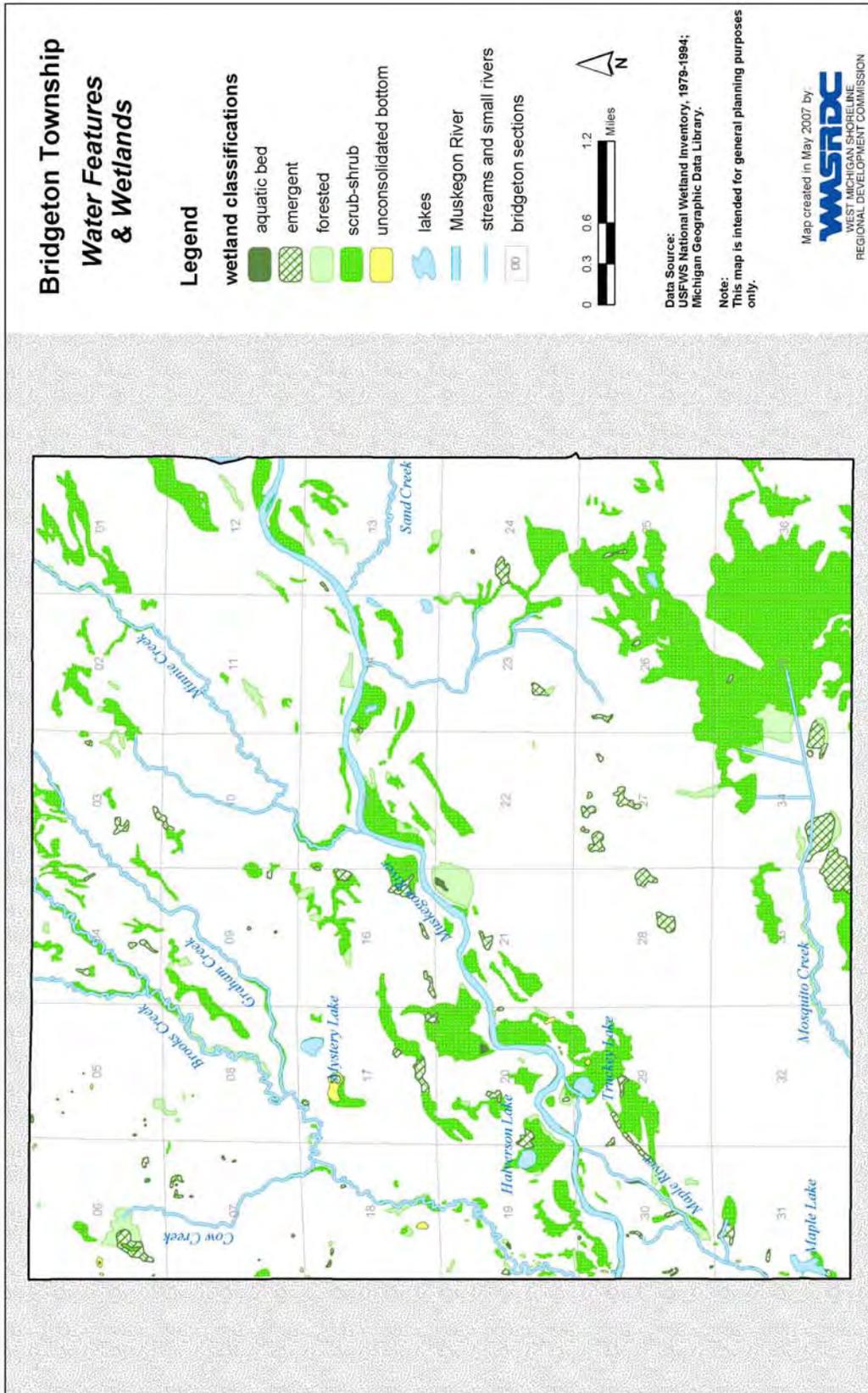
*Source: Cowardin. 1979. Classification of Wetlands and Deepwater Habitats of the United States.*

While it is possible for a parcel to be both a wetland *and* located within a floodplain, wetlands and floodplains are not to be confused. It is also possible for a wetland to exist outside of a floodplain; and for floodplains to exist as non-wetland. In Michigan, and nationally, the term floodplain has come to mean the land area that will be inundated by the overflow of water resulting from a 100-year flood (a flood which has a 1% chance of occurring any given year)<sup>1</sup>. Floodplains are designated by the Federal Emergency Management Agency (FEMA). Refer to Part C for additional information.

Wetlands and floodplains should be given serious attention in all development decisions due to the importance of preserving their natural functions and ensuring the safety and security of development. Wetlands are protected under Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This act restricts and/or prohibits development in areas of significant wetlands, which provide needed habitat for many organisms and also filter water as it seeps into the groundwater supply.

<sup>1</sup> Michigan Department of Environmental Quality. “Floodplains”. January 8, 2007. Website: [http://www.michigan.gov/deq/0,1607,7-135-3313\\_3684\\_3725-11255--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3313_3684_3725-11255--,00.html)

## MAP 8



**b. Soils**

The Soil Survey of Newaygo County, Michigan-1995 indicates that Bridgeton Township consists of over forty different soil types ranging from slow to rapid permeability. These various soils can be combined into three general soil associations, as named and described below. Typically, an association consists of one or more major soils and some minor soils but is named for the major soils.

**TABLE 5**

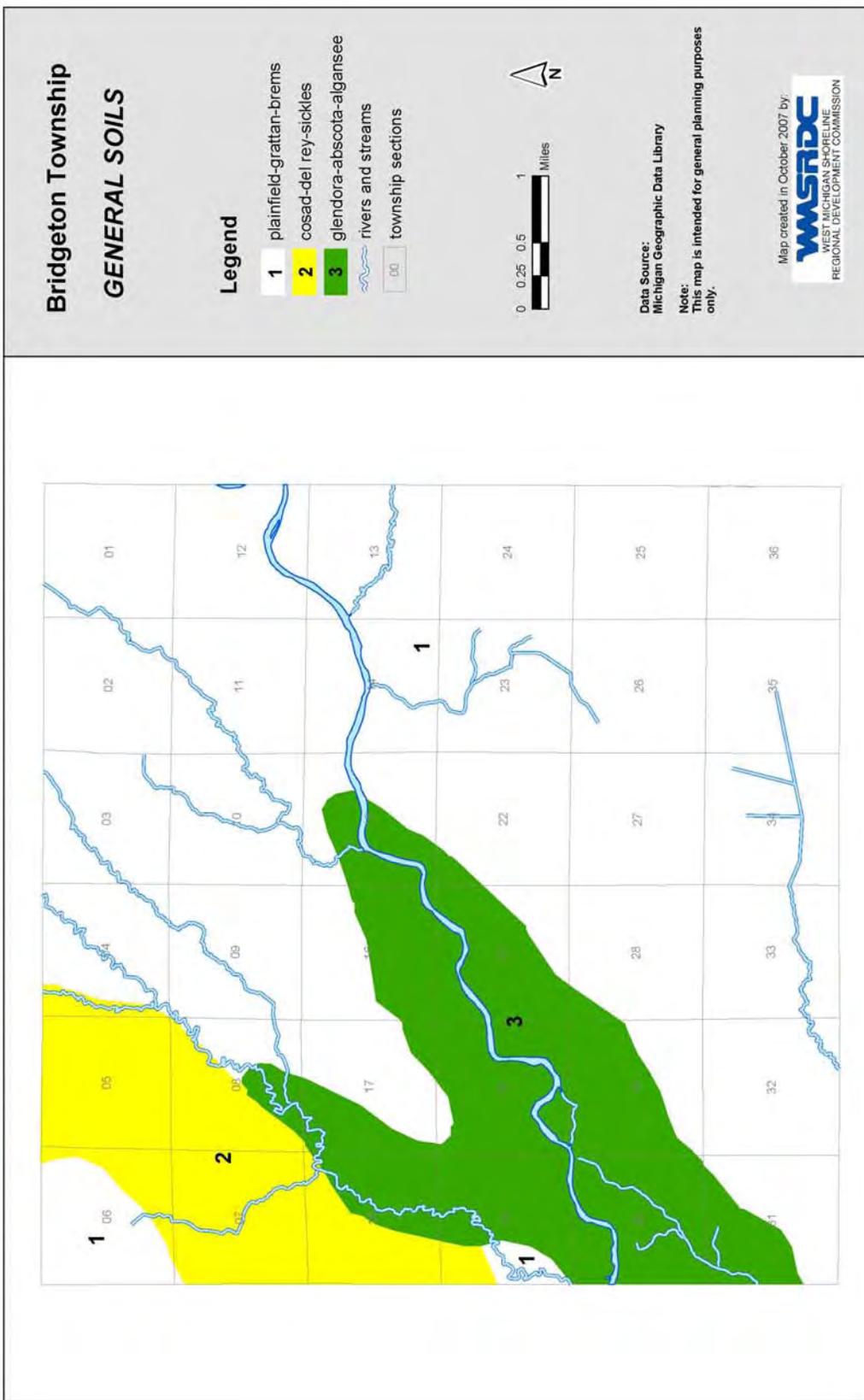
<b>General Soils</b>	
<b>1. Plainfield- Grattan-Brems Association</b>	<i>Nearly level to steep, excessively drained and moderately well drained, sandy soils on outwash plains and moraines. This association consists mainly of Plainfield soils on outwash plains and Grattan and Brems soils on outwash plains and moraines. Slope ranges from 0 to 30 percent. Most areas in this association are used as woodland and wildlife habitat. They are fairly well suited to woodland. The major soils are well suited, fairly well suited, or poorly suited to building site development, depending on the slope. They are poorly suited to septic tank absorption fields because of a poor filtering capacity.</i>
<b>2. Cosad-Del Rey-Sickles Association</b>	<i>Nearly level and gently undulating, somewhat poorly drained and poorly drained, sandy and loamy soils on lake plains. Areas of the major soils in this association are intermingled on broad plains, low ridges, and knolls. Slope ranges from 0 to 4 percent. Most areas of this association are used as cropland. Some areas are used as woodland or are left idle. The major soils are well suited to cropland. Wetness, water erosion, and soil blowing are the major concerns in managing cropland. The major soils are poorly suited or generally unsuited to septic tank absorption fields and building site development. Wetness and restricted permeability are the major management concerns.</i>
<b>3. Glendora- Abscota- Algansee Association</b>	<i>Nearly level and gently undulating, very poorly drained, somewhat poorly drained, and moderately well drained, sandy and loamy soils on flood plains. This association consists mainly of Glendora soils, commonly on the first bottoms of flood plains, and Abscota and Algansee soils on the first or second bottoms of flood plains and on natural levees in areas of the first bottoms. Slope ranges from 0 to 3 percent. Most areas of this association are used as woodland or are left idle. A few areas are used as cropland. Abscota and Algansee soils are fairly well suited to cropland and well suited to woodland. Glendora soils are generally unsuited to cropland. Wetness and flooding are the major concerns in managing cropland. The major soils are generally unsuited to septic tank absorption fields and building site development because of wetness and flooding.</i>

*Source: Soil Survey of Newaygo County, Michigan (USDA, 1995).*

Bridgeton Township’s soil associations are graphically presented in Map 9 – General Soils. A general soil map, such as this, can be used to compare the suitability or unsuitability of large areas for general land uses. In contrast, a detailed soil map provides a key to existing soils and their characteristics. It is important to note that information based on soil data is less specific than that provided by detailed engineering surveys that are capable of determining site-specific soil characteristics.

The Soil Survey of Newaygo County gives detailed information on the county’s soils, which can be used for determining the suitability and potential for specific uses as well as to plan the management needed for those uses. Appendix A contains this information, in narrative and table format, on the fourteen soils along the Muskegon River.

# MAP 9



**c. Land Cover**

The natural landscape in Bridgeton Township primarily includes deciduous and coniferous forests, herbaceous vegetation, and wetlands. In other words, the area is primarily forested, with river floodplain and wetland areas spread throughout the interior. Very little of the township would be considered as being “developed”, wherein constructed materials have replaced natural land cover.

While some of the township has been cleared for agricultural purposes, agricultural uses have not flourished and a large portion of the land remains heavily wooded. Such land cover especially exists along the banks of the Muskegon River and in the southern sections of the township where half of the land is owned by the State of Michigan (6,000 acres). Much of the state-owned land is within the Muskegon State Game Area, a 10,500-acre site lying in both Muskegon and Newaygo counties.

Map 10 – Land Cover circa 1992 is shown on the next page and verifies that the vast majority of the township is dominated by natural land cover. Information for this map was derived from the National Land Cover Dataset (NLCD) published by the United States Geological Survey (USGS) in 1999. The USGS states that this data is most accurate when viewed at the state or multi-state level. Therefore the map is very general and should not be consulted for site-specific land cover analysis.

The table below lists definitions of the NLCD classifications found on Map 10.

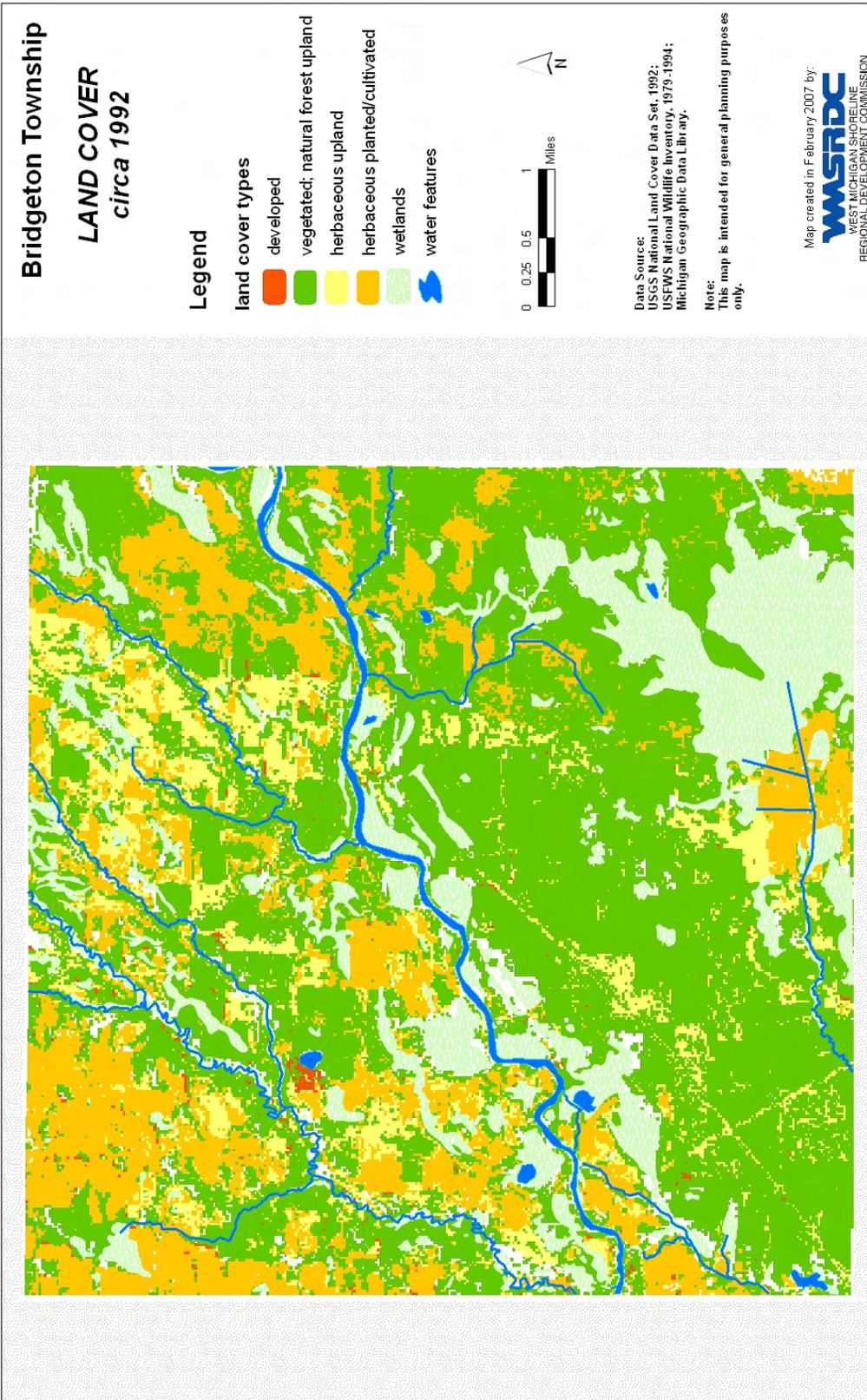
**TABLE 6**

<b>NLCD Land Cover Classification Definitions</b>	
<b>Developed</b>	Areas characterized by high percentage (approximately 30% or greater) of constructed material (e.g. asphalt, concrete, buildings, etc.).
<b>Vegetated/ Natural Forest Upland</b>	Areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); Tree canopy accounts for 25 to 100 percent of the cover.
<b>Wetlands</b>	Areas where the soil or substrate is periodically saturated with or covered with water.
<b>Herbaceous Planted/ Cultivated</b>	Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75-100 percent of the cover.
<b>Herbaceous Upland</b>	Upland areas characterized by natural or semi-natural herbaceous vegetation; herbaceous vegetation accounts for 75-100 percent of the cover.

*Source: Michigan Center for Geographic Information*



# MAP 10



## VI. CLIMATE

The climatology data presented below is based on a 30-year span of weather observations taken at the National Weather Service station in the Village of Hesperia, approximately 15 miles north of the township's western border. It is assumed that the township and the village experience comparable climatic conditions since they have the same proximity to Lake Michigan. The lake has a moderating effect on climate, making summers cooler and winters milder on the western side of Michigan's Lower Peninsula than in other areas of the state. In addition, precipitation tends to be greater in those communities which are located near Lake Michigan.

August is usually the wettest month of the year in Hesperia, averaging 3.79 inches of rain while February is the driest, averaging 1.63 inches of precipitation. The average annual snowfall is 75.5 inches, with one or more inches of snow on the ground an average of 97 days per season. For the years 1951 through 1980, the greatest snow depth recorded at any one time was 30 inches and the greatest seasonal snowfall was 120 inches.

January is usually the coldest month of the year, with an average daily maximum of 28.6°F and an average daily minimum of 12.7° F. July is typically the warmest month of the year with an average daily maximum temperature of 82.1° F and an average daily low of 56.1° F. The average date of the last freezing temperature in the spring is May 26, while the average date of the first freezing temperature in the fall is September 25.

TABLE 7

TEMPERATURE AND PRECIPITATION SUMMARY FOR HESPERIA FOR THE 30-YEAR PERIOD BETWEEN 1951 AND 1980								
Month	Average Daily Temperatures (Fahrenheit)			Average Monthly Precipitation (Inches)				Snowfall  maximum month amount
	maximum	minimum	mean	Liquid Equivalent				
				mean	mean # of days with at least:			
.1"	.25"	.5"						
January	28.6	12.7	20.6	2.40	7	3	1	48.1 (1979)
February	31.6	12.5	22.0	1.63	5	2	>1/2	28.0 (1958)
March	41.2	21.3	31.2	2.30	6	3	1	28.0 (1965)
April	56.4	32.9	44.6	3.34	7	4	2	12.0 (1965)
May	69.0	42.5	55.7	2.70	6	4	2	T (1979)
June	78.2	51.8	65.0	3.05	6	4	2	0.0
July	82.1	56.1	69.1	2.81	6	4	2	0.0
August	80.1	54.7	67.4	3.79	6	4	2	0.0
September	72.2	47.6	59.9	3.22	6	4	2	0.0
October	60.7	38.3	49.5	3.05	7	4	2	3.0 (1962)
November	45.7	29.0	37.3	2.78	8	4	2	17.0 (1966)
December	33.4	18.6	26.0	2.50	7	3	1	40.0 (1968)
<b>Annual Averages</b>	<b>56.6</b>	<b>34.8</b>	<b>45.7</b>	<b>33.57</b>	<b>77</b>	<b>43</b>	<b>19</b>	<b>48.1 (1979)</b>

Source: Michigan State Climatologist's Office. <http://climate.geo.msu.edu/stations/3769/>. 1-8-07.

# PART C

## IDENTIFICATION OF FLOOD AND FLOOD-RELATED HAZARDS AND RISKS

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This chapter contains a comprehensive definition of flooding, locations and descriptions of past flooding events in Bridgeton Township, predictions of flooding risks, and brief descriptions of other flood related hazards. Much of the information has been taken from the Newaygo County Hazard Mitigation Plan, an all-hazards mitigation plan authored by the WMSRDC in 2005, as well as the 2001 Michigan Hazard Analysis, prepared by the Emergency Management Division (EMD) of the Michigan State Police (MSP). Additional resources included the U. S. Department of Agriculture’s (USDA) 1995 Soil Survey of Newaygo County; FEMA’s 1990 Flood Insurance Study–Township of Bridgeton, Michigan–Newaygo County and corresponding Flood Insurance Rate Maps, which are part of the National Flood Insurance Program; and the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA).

### I. DEFINITION OF FLOODING

According to the National Flood Insurance Program (NFIP), flooding is defined as a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties. It results from overflow of inland or tidal waters, unusual and rapid accumulation or runoff of surface waters from any source, or mudflow. According to the Soil Survey, flooding is the temporary inundation of an area and is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

According to MSP/EMD, types of floods in Michigan can be grouped into three categories.

- **Riverine** flooding includes the overflowing of rivers, streams, drains, and lakes and is caused by excessive rainfall, rapid snowmelt, or ice jams. It happens when ground becomes saturated beyond its absorption capacity or when the precipitation is too intense for quick absorption.
- **Shoreline** flooding includes the flooding and erosion of shoreline areas caused by high Great Lakes water levels, storm surges, or winds.
- **Urban** flooding is caused by the excessive runoff of large amounts of precipitation into watercourses from surfaces such as paved roads and parking lots. Heavy rainfall cannot be absorbed into the ground due to the impermeability of these urban features.

Since Bridgeton Township is located approximately 15 miles inland from Lake Michigan and is not heavily developed, there is no significant risk of shoreline and urban flooding. However, primarily due to the Muskegon River, there is risk of riverine flooding. Riverine flooding is a natural event that occurs, and has occurred since the beginning of time, along the normal courses of streams and rivers. It is normally the result of a combination of meteorological and hydrological factors. Although excessive rainfall alone can cause flooding, the most severe riverine floods usually have multiple causative factors. These

factors may include:

- Heavy prolonged rainfall from large-scale storms or a series of large-scale storms;
- Heavy rainfall from a near-stationary or slow-moving thunderstorm complex;
- Saturated soil conditions from previous rainfall events;
- High existing river flows from previous rainfall events;
- Extreme cold temperatures followed by thawing, leading to river ice jams;
- Rapid snowmelt. Snowmelt floods can develop over periods ranging from several hours to several days, depending upon the water content of the snow and temperatures during the melting period. The combination of large-scale storm rainfall and rapidly melting snow can cause severe flooding; and
- Silt buildup in river channels during previous storm events that reduce the capacity of the river to carry water.

In addition flooding can be due to technological failures. Overland flooding can occur outside a defined river or stream when a levee is breached. Flooding can also occur when a dam breaks, producing effects similar to a flash flood. Flash floods often have a dangerous wall of roaring water, which carries rocks, mud, and other debris with the potential to sweep away most objects in its path.

All floods are not alike. Some floods develop slowly, sometimes over a period of days. Floods on large river systems may continue for several days. On the other hand, flash floods can develop quickly, sometimes in just a few minutes and without any visible signs of rain. They occur on small streams or in normally dry creeks within six hours of a rain event, or after a dam or levee failure, or following a sudden release of water held by an ice or debris jam. They are dangerous because they catch people unprepared.

Once a river reaches flood stage, the severity categories used by the NWS include minor flooding (minimal or no property damage), moderate flooding (some inundation of structures and roads near streams and some evacuation of people and/or transfer of property to higher elevations), and major flooding (extensive inundation of structures and roads and significant evacuations of people and/or transfer of property to higher elevations). The following factors will affect the severity of a riverine flood.

- **Impermeable Surfaces.** Excessive amounts of buildings and paved areas in the watershed, replacing the natural vegetation and covering the soil, can increase the amount and rate of water runoff. When rain falls in an undeveloped area, as much as 90 percent of it will infiltrate the ground; in a highly developed area, as much as 90 percent of it will run off.
- **Steeply sloped watershed.** In hilly and mountainous areas, a flood may occur minutes after a heavy rain. These flash floods allow little or no warning time and are characterized by high velocities.
- **Constriction.** Re-grading or filling within or on the edge of floodplains obstructs flood flows, backing up floodwaters onto upstream and adjacent properties. It also reduces the floodplain's ability to store excess water, sending more water downstream and causing floods to rise to high levels. This also increases floodwater's velocity downstream of the constriction.
- **Obstructions.** Bridges, culverts and other obstructions can block flood flow and trap debris, causing increased flooding upstream and increased velocity downstream.
- **Debris.** Debris from the watershed, such as trees, rocks, and parts of damaged

buildings, increases the hazard posed by moving water. Moving water will float, drag or roll objects, which then act as battering rams than can knock holes in walls and further exacerbate the effects of debris.

- **Contamination.** Few floods have clear floodwater, and the water will pick up whatever was on the ground within the floodplain, such as soil, road oil, farm and lawn chemicals, and animal waste. In addition, if a wastewater treatment plant or septic system was inundated, the floodwaters will likely include untreated sewage. Contamination is also caused by the presence of hazardous material storage in the floodplain and in the community, as well as upstream from the community. Floodwaters effectively acquire, transmit, and distribute these contaminants, which are then left behind in the floodplain and within flooded structures following a flood.
- **Soil saturation.** Rainfall in areas already saturated with water will increase the runoff.
- **Velocity.** Flood velocity is the speed of moving water, measured in feet per second. High velocities (greater than 5 feet per second) can erode stream banks, lift buildings off their foundations and scour away soils around bridge supports and buildings.
- **Ground Cover.** Lack of natural ground cover is also a contributing factor for floods. Water runoff is greater in areas with little or no vegetation such as in agricultural lands planted in row crops. Lack of natural vegetation also makes stream banks more vulnerable to erosion, which increases the sediment content of the watercourse.

Like other types of floods, riverine floods have the potential to inflict or trigger a wide array of damages and hazardous situations. Effects of flooding are worsened when vulnerable land is developed without consideration of flood risks. If flood-prone areas were left in their natural state, floods would not cause significant damage. Therefore, the types of land use within a floodplain will help determine the extent of flood damage.

Some potential effects include: damage or destruction of public and private property; damage or destruction of crops and agricultural land; damage to utilities such as broken power, gas and sewer lines; failed septic systems; disabled transportation systems and emergency services; fires; outbreak of disease; widespread animal death; release of hazardous chemicals; groundwater and surface water pollution; and erosion.

Groundwater is particularly susceptible to contamination from septic system failure when soils become saturated due to intense rain or flooding. Pollution of groundwater is possible as toxins are removed from septic tanks and allowed to flow freely into groundwater or surface waterways. This is especially so in locations where soils are poorly suited for septic systems.

In the worst cases, human injury and death may occur if people are swept away by flood currents. According to the Michigan Emergency Management Association, even 6 inches of fast-moving water can knock a person off his or her feet and a depth of only 2 feet of water will float many of today's automobiles. More frequently, people may be stranded in their homes for several days without power or heat, while others may not be able to reach their homes at all. Finally, the inundation of properties by contaminated, sediment-filled water can impose a significant financial burden upon property owners following a flood.

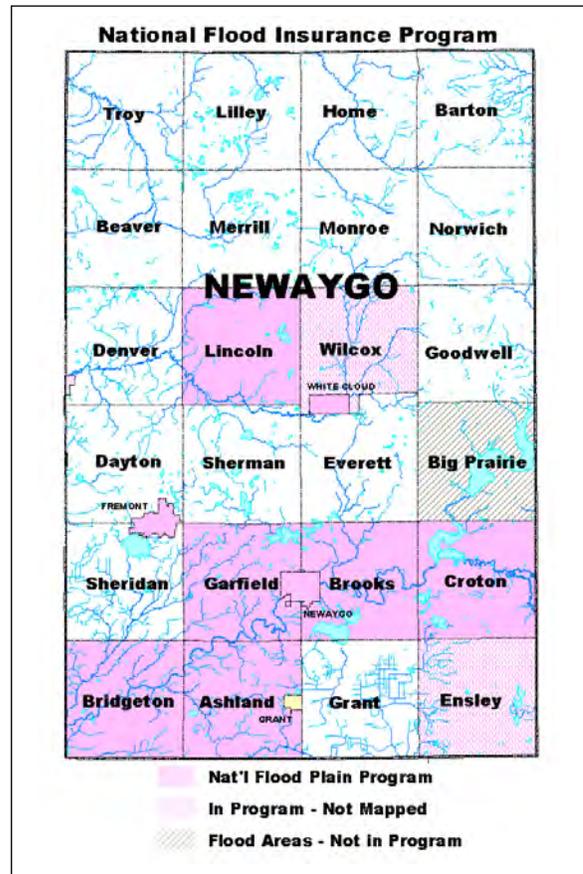
## II. FLOOD LOCATIONS IN BRIDGETON TOWNSHIP

There are a number of sources that provide information on the previous and potential locations of flooding in Bridgeton Township. FEMA's 1990 Flood Insurance Study provides a summary statement of Bridgeton Township's flooding situation. It simply says that "flood problems result from the severe meandering of the Muskegon River, which causes the shifting of a large percentage of the flow between the channel and the overbanks". The Bridgeton Township Parks and Recreation Master Plan states that "those areas especially prone to flooding are primarily in the vicinity of wetlands, tributaries, and those home-sites along the Muskegon River which lie in the flood plain". More specific information from the National Flood Insurance Program and the Newaygo County Soil Survey follows.

### a. National Flood Insurance Program

The National Flood Insurance Program (NFIP) is designed to identify and map floodplains, to provide flood insurance to flood-prone locations in participating communities, and also to encourage flood protection activities. According to the NFIP, a floodplain is a land area that may occasionally become inundated by the overflow of an adjacent water body such as a river, stream, lake, or drain. Flood Insurance Rate Maps (FIRMs) are a critical part of the NFIP, and may contain a great deal of information regarding floodplains and flooding. They are utilized by insurance agents and lenders, flood-plain managers and administrators, and homeowners. There are currently 12 municipalities in Newaygo County participating in the NFIP. Bridgeton Township has been participating since 1975, and fully intends to continue its participation in the program. The Bridgeton Township Flood Insurance Rate Map was initially published in 1975 and subsequently updated in 1990. It identifies flood information such as the **100-year floodplain** (also known as a Special Flood Hazard Area or SFHA), a **floodway**, and **base flood elevations**. Calculations are based on the area's topographical, hydrological, pedological, and land cover characteristics.

MAP 11



Source: WMSRDC 2004

The **100-year floodplain** is an area that has a one percent chance, on average, of being equaled or exceeded in any year. It does not mean that a flood of this size only happens every 100 years; such a flood could occur more than once in a 12 month period. The 100-year flood is also referred to as the base flood and is the standard adopted by the NFIP. It represents a compromise between minor floods and the greatest flood likely to

occur and constitutes a reasonable compromise between the need for building restrictions to minimize potential loss of life and property and the economic benefits to be derived from floodplain development.

There is actually a range of floods, other than just the 100-year flood, that could happen within an area. For example, a house located close to a flood source might experience some level of flooding every 5 to 10 years although the flooding would not be as deep. The risk created by the 100-year flood would be much greater, because of the depth, than the risks from the annual flood based on the amount of damages each event produces – once. But the annual flood would occur more frequently and over time may in fact produce a much greater risk to the structure than the 100-year flood.

The probability of a flood is based on a statistical chance of a particular size flood occurring in any given year. The annual flood is usually considered the single greatest event expected to occur in any given year. The percent of annual chance of floods is estimated based on watershed and climatic characteristics or watershed models, water surface elevations, and hydraulic models that reflect topographic characteristics.

The **floodway** is the stream channel of a river or other watercourse and the adjacent land areas that must remain open to permit passage of the base flood without increasing the water surface elevation more than one foot. The area between the floodway and the edge of the base floodplain is referred to as the flood fringe.

**Base flood elevations** are points where the water surface elevation of the 100-year flood

### **FYI: What Are the Odds of Being Flooded?**

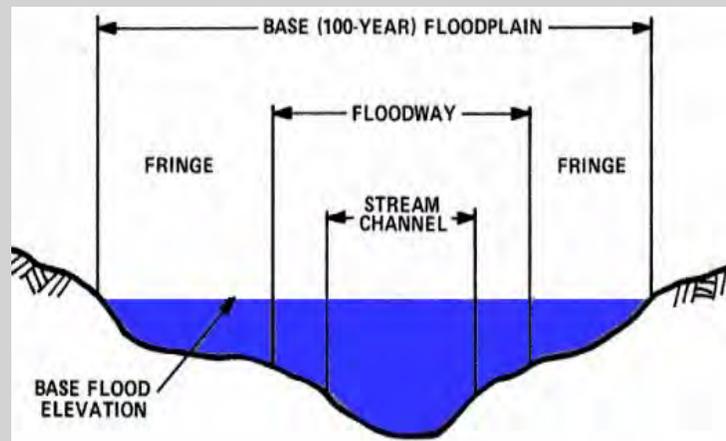
The term “100-year flood” has caused much confusion for people not familiar with statistics. Another way to look at flood risk is to think of the odds that a 100-year flood will happen sometime during the life of a 30-year mortgage – a 26% change for a structure located in the Special Flood Hazard Area.

<b>Chance of Flooding Over a Period of Years</b>				
Time Period	10-year flood	25-year flood	50-year flood	100-year flood
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 a 30-year mortgage, it may have a 26% chance of being hit by the 100-year flood, but the odds are 96% (nearly guaranteed) that it will be hit by a 10-year flood. Compare those odds to the 1-2% chance that the house will catch fire during the same 30-year mortgage.

*Source: FEMA*

### **Special Flood Hazard Areas**



has been identified. They are calculated in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The Base Flood Elevation (BFE) is used as the standard for the National Flood Insurance Program. Base Flood Elevations on the Muskegon River range from 610 feet on the west side of Bridgeton Township to 622 feet on the east side. In comparison, Ashland Township's Base Flood Elevations range from 622 feet to 626 feet while Garfield Township's fall between 627 feet and 642 feet.

According to the Bridgeton Township FIRM, there are two special flood hazard areas (SFHA) within the township: "Zone AE" and "Zone A". Zone AE corresponds to the 100-year floodplain where base flood elevations have been derived from detailed hydraulic analyses. This zone borders the Muskegon River, Truckey Lake and parts of the Maple River. Zone A corresponds to the rest of the 100-year floodplain, as determined by approximate methods rather than by detailed hydraulic analyses. Base flood elevations are not shown in this small area located along Minnie Creek between the Muskegon River and 112<sup>th</sup> Street. The remaining areas of the township have been designated "Zone X" because they have been determined to be located outside the 100- and 500-year floodplains.

Map 12 – 100-Year Flood Features displays selected information from the Bridgeton Township FIRM, including the floodplain, floodway, base flood elevations, and the three zone designations. It is important to remember, when viewing this map, that it illustrates the 100-year floodplain in a general manner. More detailed information can be obtained from the Flood Insurance Rate Map while property-specific information must be obtained from a survey.

# MAP 12

## Bridgeton Township 100-YEAR FLOOD FEATURES

### Legend

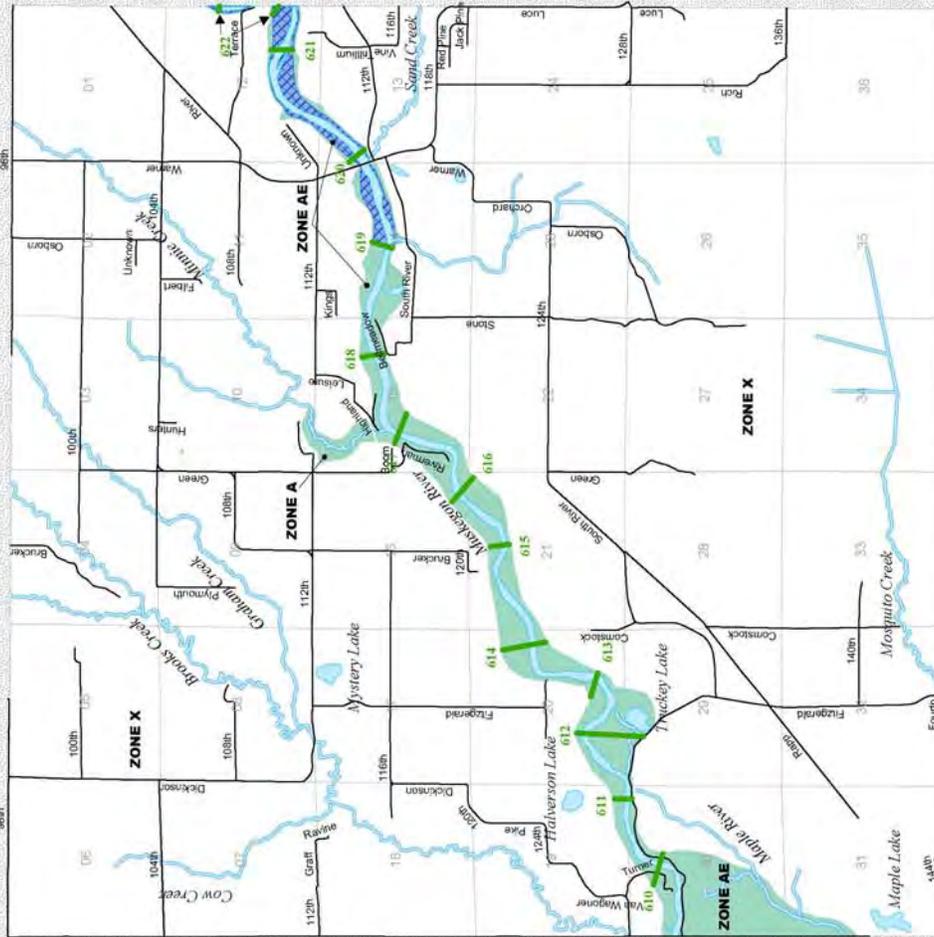
-  lakes
-  Muskegon River
-  streams and small rivers
-  100 year floodplain areas
- ZONE A** no base flood elevations determined
- ZONE AE** flood elevations determined
- ZONE X** areas outside floodplain
-  floodway areas in zone ae
-  base flood elevations (feet)
-  bridgeton sections



Data Source:  
Michigan Geographic Data Library,  
NFIP Flood Insurance Rate Map (3-5-90)

Note:  
This map is intended for general planning purposes only.

Map created in May, 2007 by:  
**WMSRDC**  
WEST MICHIGAN SHORELINE  
REGIONAL DEVELOPMENT COMMISSION



## **b. Newaygo County Soil Survey**

The Soil Survey of Newaygo County contains information which can be mapped to display the locations of previous flooding along with information on flooding frequency, flooding duration, and flooding months. Unlike the National Flood Insurance Program, the Soil Survey does not identify or differentiate between depths of flooding. Thus, the information presented is pertinent to both major and minor floods, the latter of which can be seasonal.

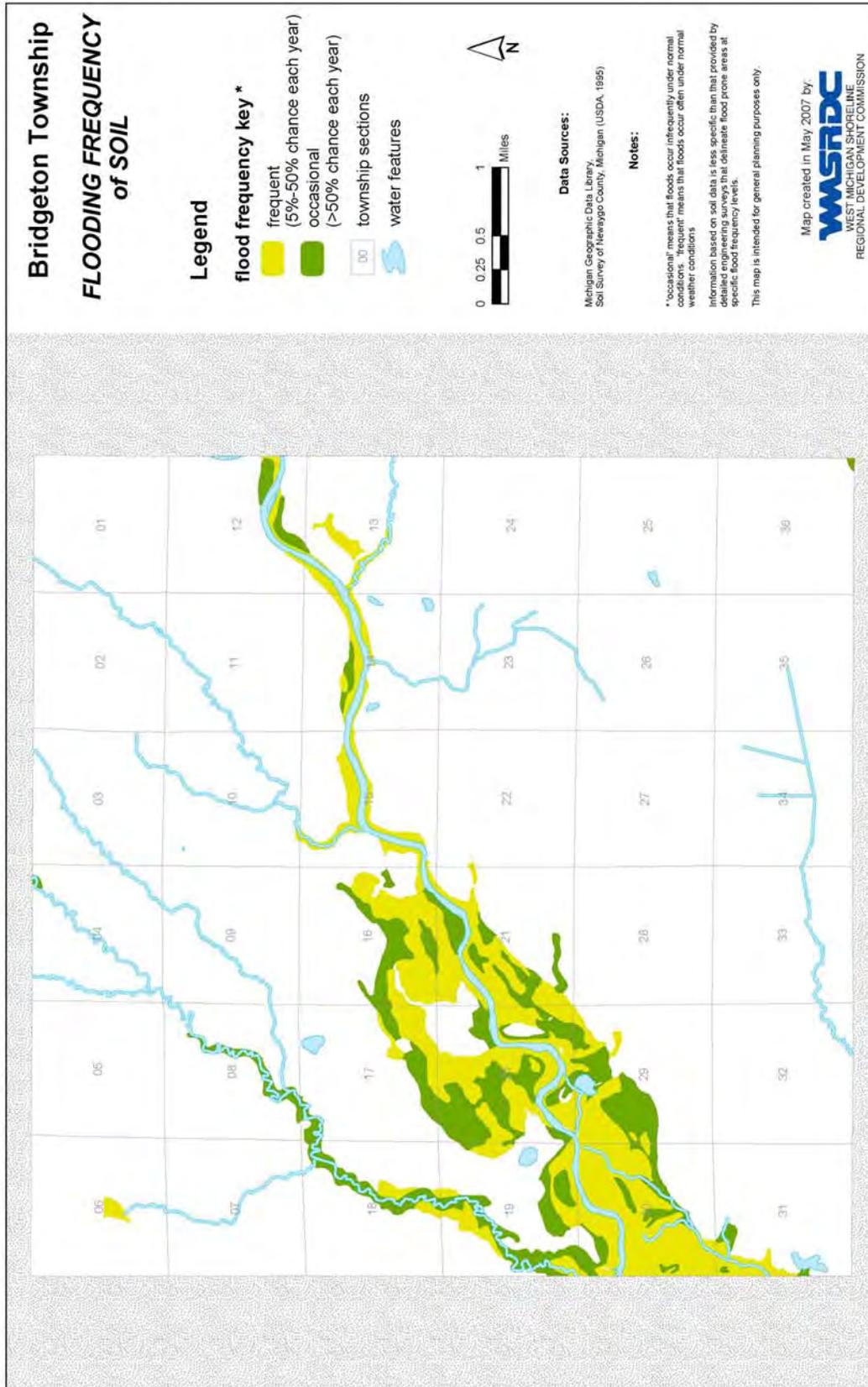
Flood frequency, or how often an area is inundated with water, depends on the climate, soil, and channel slope. The less permeable the soil and/or the higher the water table, the more prone the area is to flooding. Where substantial precipitation occurs in a particular season each year or where annual flooding is derived principally from snowmelt, the region may be inundated nearly every year.

Map 13 gives a visual display of flood frequencies within Bridgeton Township and presents two classifications of flooding frequency. The term “occasional” means that floods occur infrequently under normal conditions. There is a 5% - 50% chance of occurrence per year. The term “frequent” means that floods occur often under normal weather conditions. There is greater than a 50% chance of occurrence per year.

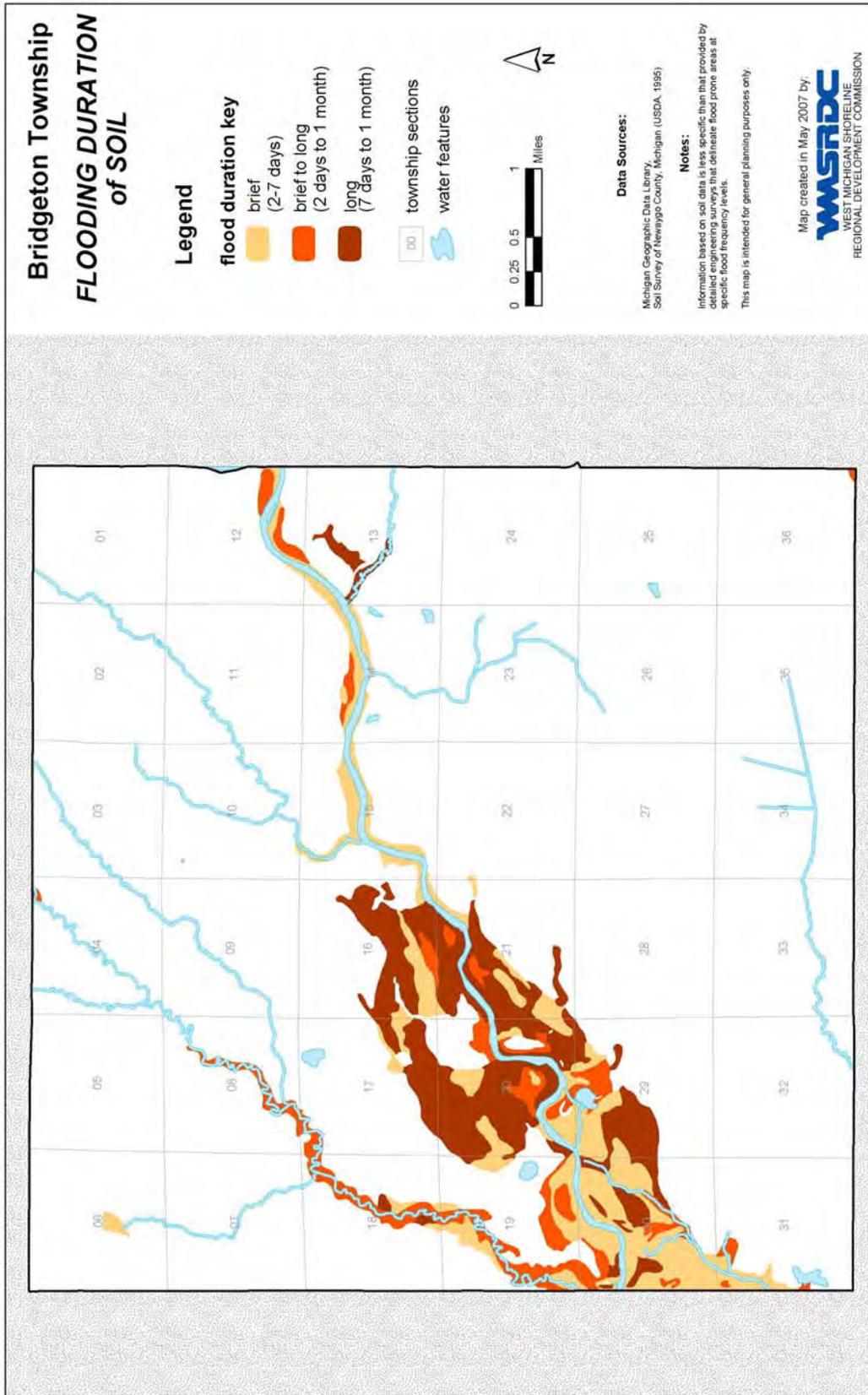
Map 14 presents visual information on flooding duration according to the categories of “brief”, “brief to long”, and “long”. As defined in the Soil Survey, “brief” means flood duration of two to seven days, while “long” means seven days to one month. The hybrid term of “brief to long” encompasses floods of the entire period and includes those that last anywhere from two days to one month.

Map 15 illustrates the months floods are expected to occur, with about two-thirds to three-fourths of all flooding occurring during the stated period. In areas such as Bridgeton Township; where flooding is caused by melting snow, and occasionally compounded by rainfall and ice jams; the flood season is normally spring or early summer. There are, however, flooding events in these areas during the summer and fall which are strictly due to rainfall and thunderstorms. While some are directly related to major flooding events, they are normally localized and have more impact on watercourses with smaller drainage areas.

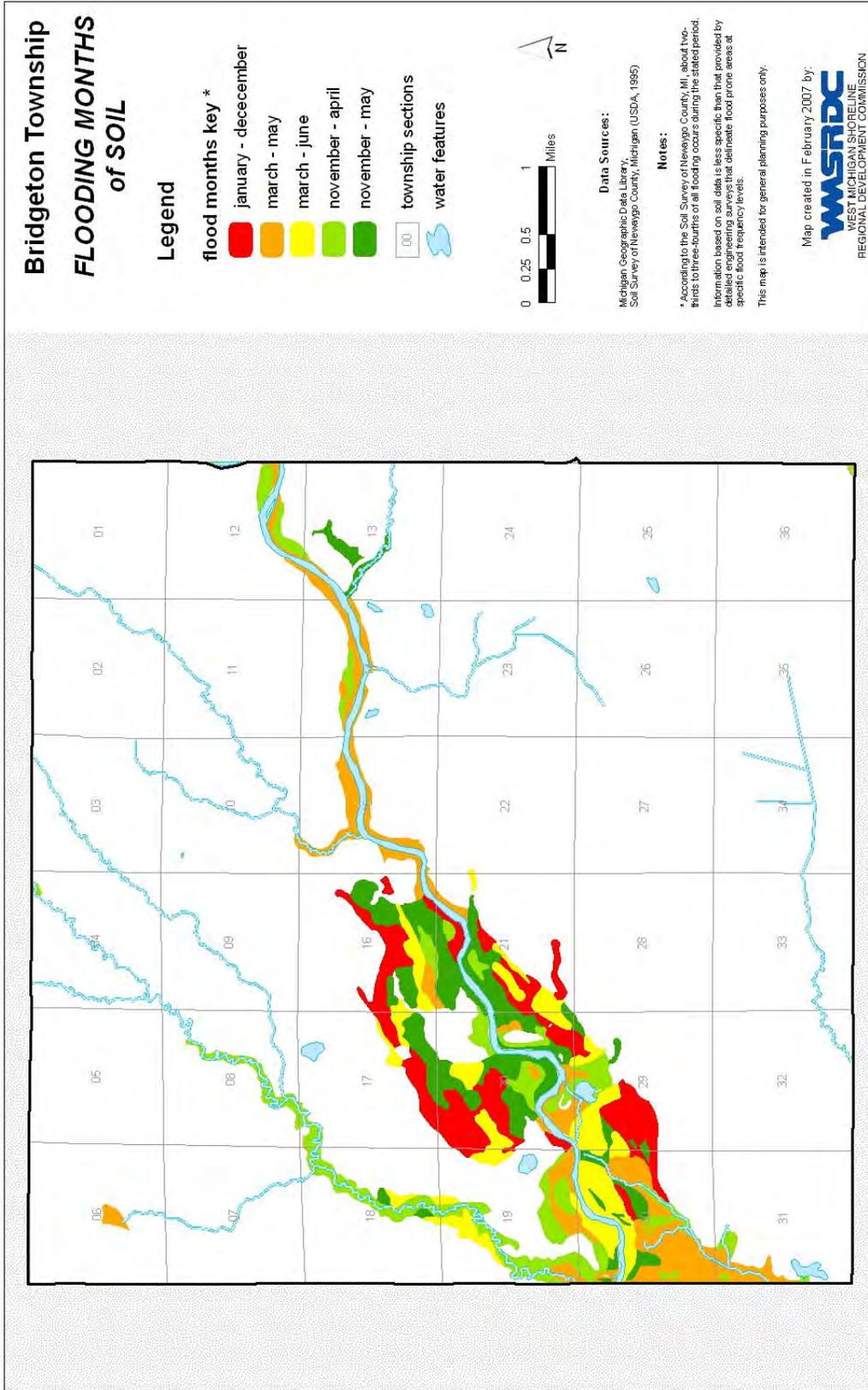
# MAP 13



# MAP 14



# MAP 15



### III. HISTORIC FLOODING EVENTS

Flood events in Newaygo County have been documented by a number of sources; including the National Climatic Data Center (NCDC), the Michigan State Police (MSP) and its Michigan Hazard Analysis (2001), FEMA, and Bridgeton Township residents and officials.

FEMA’s 1990 Flood Insurance Study (FIS) gives data, such as flood discharges and elevations, on historic flooding events, recorded at both the Newaygo and the Croton river gages. It does not give data from the river gage in Bridgeton, which was only in use from 1979 to 1984. (This gage was likely located on the Maple Island Road Bridge and lost when the bridge’s super structure was replaced in 1985.) The Newaygo gage was in use from 1910 to 1993 while the Croton gage is still in use, with funding partially by Consumers Energy. It now provides “real-time” data through an automated Data Collection Platform.

“Real-time” data typically is recorded at 15-60 minute intervals, stored onsite, and then transmitted to USGS offices every one to four hours, depending on the data relay technique used. Recording and transmission times may be more frequent during critical events. Data is relayed to USGS offices via satellite, telephone, and/or radio and is available for viewing within minutes of arrival. It is also available on the internet at [www.weather.gov/ahps](http://www.weather.gov/ahps).

The FIS states that “the largest flood of record in this century on the Muskegon River occurred on September 12, 1986. The flood had a discharge of 23,100 cubic feet per second (cfs) and reached an elevation of 645.39 feet National Geodetic Vertical Datum of 1929 (NGVD) at Newaygo, resulting in damage to many structures along the river”. With the gage at 625.83 feet, the flood depth or crest was recorded at 19.56 feet. The gage at Croton Dam is currently located at 675.62 feet above sea level, according to NGVD measurements.

**TABLE 8**

<b>Past Floods at Newaygo</b>			
Years	Gage Height (ft)	Elevation (ft)	Discharge (CFS)
1986	19.56	645.39	23,100
1913	*	*	14,950
1912	*	*	13,400
1945	53.76 **	639.59	11,600
1976	13.67	639.20	10,800
1957	52.83 **	638.66	10,000
1919	*	*	9,880
1950	52.70 **	638.53	9,830
1975	12.75	638.58	9,800
1959	52.65 **	638.48	9,750
* gaging station location at Croton Dam, stage not recorded at Newaygo			
** datum of gaging station from 1939 to 1963 was at 583.83 NGVD, 40.00 feet lower than existing datum of gage			

Source: Bridgeton Township Flood Insurance Study – 1990

The gage or stage height, also called the stream stage, is the height of the water surface, in feet, above an established datum plane where the stage is zero. The zero level is arbitrary, but is often close to the streambed. The streambed is defined as “the channel occupied or formerly occupied by a stream”.

According to the Michigan Hazard Analysis, both the 1975 and the 1986 floods were included in Declarations of Major Disasters by the President as well as in Declarations of Disasters by the Governor. A later flood, occurring in 2004, received a Gubernatorial Declaration as a disaster in Newaygo County, but Presidential Declarations in other counties. Accounts of these floods are presented below, following the definition of a major disaster.

A Presidential Declaration of Major Disaster is defined as “any natural catastrophe (including any hurricane, tornado, storm, high water, wind driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), regardless of cause, any fire, flood, or explosion, in any part of the U.S. which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby”.

- ***August 20-September 6, 1975: Declaration of major disaster by President.***

During the last week of August and first week of September 1975, intense thunderstorms and severe winds pounded a 16-county area in west-central and central Lower Michigan. Intense rainfall accompanying these storms caused widespread flooding, resulting in nearly \$3 million in public and private damage. A Presidential Major Disaster Declaration was granted for the sixteen affected counties, including Newaygo (MSP).

For several reasons, there is not a lot of information available on damages in the county or the township. The NCFD was not yet reporting flooding events and the township was just entering the National Flood Insurance Program. It is likely that many properties were not covered with flood insurance and that damage claims were not made. The event is becoming more distant in history, but local knowledge indicates that floodwaters did not rise above Maple Island Road. It is also suspected that there were some septic system failures that likely contributed to contamination of water wells.

- ***September 10-19, 1986: Declaration of major disaster by President.***

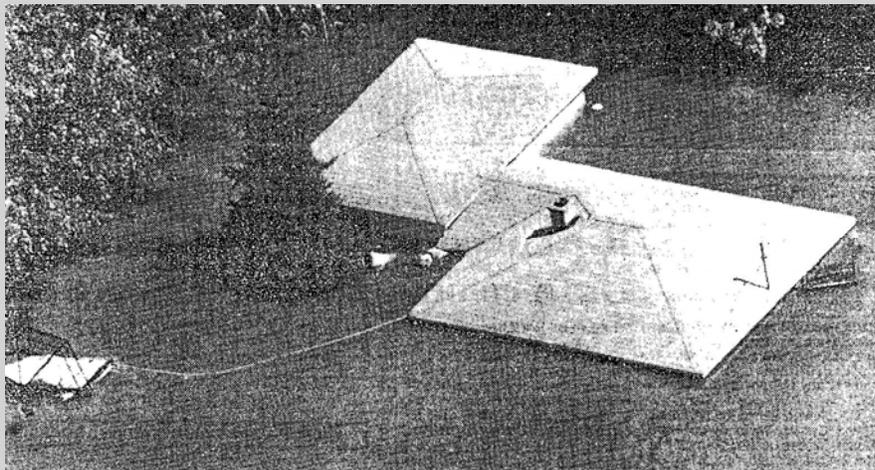
Beginning on September 10, 1986 a slow moving low-pressure system moved across the middle of the Lower Peninsula. In a 24-hour period, the intense rainstorm produced rainfall ranging from 8 to 17 inches over an area 60 miles wide and 180 miles long. The storm resulted in thousands of people being evacuated due to flooding. Five people were killed and 89 injured. About 30,000 homes suffered basement and structural damage and 3,600 miles of roadways were impassable as a result of the failure of four primary bridges and hundreds of secondary road bridges and culverts. The heavy rainfall resulted in eleven dam failures and nineteen others threatened with failure. Over \$300 million in damages resulted from the flood. This was the worst flood in Michigan in 50 years. Thirty counties were included in the Presidential Major Disaster declaration (MSP).

The Fremont Times Indicator, which serves Newaygo County and surrounding townships, published a Souvenir Edition on September 17, 1986 stating that “untold millions of dollars in property damage resulted locally from the estimated 12 to 14 inches of water which fell within the two days. No deaths were reported as a result of the flooding”. “Massive Hardy Dam, the largest in the state, produced some anxious hours on Thursday night as water poured over the spillway and threatened to erode the earthen embankment holding back part of the 3,200 acre reservoir. Emergency officials and dam

engineers feared that the spillway could fail, sending a wall of water on to Croton, where that dam would be likely to burst and send a surge of destruction all the way to Muskegon. By Friday night, however, Hardy Dam was determined to be in good enough shape that emergency evacuation orders for the river valley were lifted, allowing residents to return to homes that, in many cases, were nearly covered with water". An estimated 500 homes were evacuated, sending many to wait out the flood with friends or relatives while others were forced to spend the night in hastily set up shelters.

In Garfield Township, Bridgeton's neighbor to the northeast, 62 homes were flooded in the developments of Anderson Flats and Old Woman's Bend, two miles downstream of the City of Newaygo. About thirty of the homes were essentially destroyed and one mobile home was lifted off its foundation and swept several miles downstream. In response, the State of Michigan awarded \$987,000 of Community Development Block Grant (CDBG) and National Flood Insurance Program (NFIP) funds to the township for the acquisition of fifty parcels, subsequent demolition or relocation of structures out of the floodway, and site restoration. The remaining residences were repaired to meet building code requirements. The state later made another \$7 million of CDBG funds available to numerous communities throughout Michigan for flood hazard mitigation. The City of Newaygo received a portion of this funding and used the financial assistance to relocate a wastewater treatment plant out of the floodplain and to stabilize a stream bank.

In Bridgeton Township, the flood affected all developments within Bridgeton's portion of the Muskegon River floodplain. This included the four subdivisions (Bell Meadow, Freight Hill, Homesite Park, and Leisure Land) and locations south of the river along South River and Breuker Roads. Damages were difficult to calculate or estimate because many properties were not covered with flood insurance and NFIP claims were not made. However, it is known that flood depths rose to roof lines and were at least eight feet over the ground level for some structures. They were estimated at five and one-half feet over ground level at Leisure Land, four feet at Freight Hill and three feet at Home Site. It also rose to within one and one-half feet of the low steel of the Maple Island bridge structure. The Maple Island roadway was flooded one mile south and one-quarter mile north of the river and River Road was completely inundated.



Bridgeton Township home along Muskegon River in September 1986.  
Source: *Muskegon Chronicle*

Unanchored LP tanks were sent downstream by floodwaters. Many tanks slowly leaked gas, adding to pollution and creating a potential fire hazard. Many had to be “fished” out of wetlands after the flood. There were also power outages; either caused by shorted fuse-boxes or shut-offs by home-owners or by Consumers Power. Septic systems and the Newaygo wastewater treatment plant were flooded, resulting in contamination of the river and wells. People were warned to avoid contact with the river water and wells had to be purified after the flood receded.

In addition, many household possessions floated downstream. The Newaygo County Sheriff Department reported problems with looters on the flooded Muskegon River. According to a deputy “so many out-of-towners are coming on the river and grabbing things that don’t belong to them”. Boats were able to motor through Leisure Land with their motors all the way down and at full speed at the peak of the flood.

- ***May 21-23, 2004: Declaration of disaster by governor.***

Flooding across Lower Michigan in May 2004 proved to be the worst flooding event in Bridgeton and throughout Newaygo County since 1986. May 20<sup>th</sup> found the rivers at very high levels and the ground saturated. Numerous thunderstorm complexes and areas of heavy rainfall developed repeatedly in the vicinity of a quasi stationary frontal boundary draped across southern Lower Michigan. The heaviest rain fell on May 22<sup>nd</sup>, when over two inches of rain fell over most of the area. The Muskegon River at Newaygo crested at 12.49 feet on May 24. This was reported to be its 6<sup>th</sup> highest crest in history.

The flood caused an estimated \$25 million of property damage and \$4.6 million of crop damage across 23 counties in south western and south central Lower Michigan. When it was all over, about 500 homes were flooded, three dams were damaged, two schools were flooded, one state university building had flooding problems, and a zoo was flooded and closed for four days. Although the monetary estimate of flood damages incurred was in the millions of dollars, there was no loss of life due to all of the flooding (NCDC).



West River View Drive in Bridgeton township near the Muskegon River and Minnie Creek.

Source: *Newaygo County Equalization Department, May 2004*

On June 1<sup>st</sup>, Governor Jennifer Granholm issued a disaster declaration for the impacted counties in Michigan, including Newaygo County which reported ten homes flooded along the Muskegon River on May 28. President George Bush supported the governor's declaration for 19 of the counties, but **not** Newaygo County, and federal disaster relief was made available to just the 19 counties.

However, the township later became a beneficiary of federal assistance when FEMA’s Hazard Mitigation

Grant Program was accessed by the Michigan State Police. Funds were awarded to the township to assist with a residential dwelling elevation project.

Bridgeton Township flooding primarily involved damages to residential properties and accessory buildings along Muskegon River, particularly in the Freight Hill and Leisure Land Subdivisions of Section 15. Documented flooding depths at residential properties ranged from .5 foot to 2.5 feet above ground level. Damages ranged from “major” (required extensive repairs) to “minor” (minor repairs needed) and included water damage to floors, walls and contents. There were no reports of residences being “destroyed” (not habitable or not usable). There were flooded septic tanks, which likely contaminated the river and near-by wells, as well as power outages and flooded roads.

#### **IV. RISK OF FLOODING**

Lesser but notable flood events were reported to the National Climatic Data Center (NCDC). NCDC, billed as the world’s largest archive of climatic data, maintains records of tornadoes since 1950; of thunderstorm winds and hail since 1955; and of all storm events since 1993. The website and information about reported hazard events can be viewed at <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>.

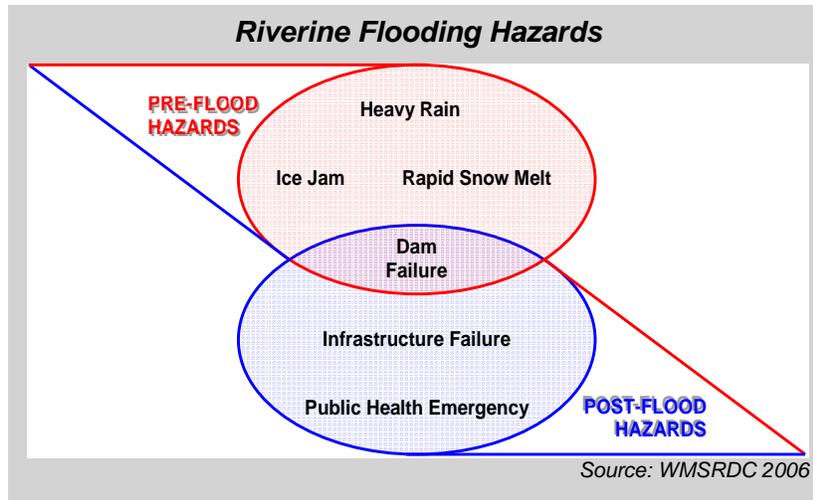
The NCDC lists eight flood events in Newaygo County from 1993 through October 31, 2006 and attributes damages to six of these events. Dates of the floods are: January 3, 1993; April 19, 1993; August 17, 1995; February 21, 1997; February 9, 2001; February 24, 2001; May 15, 2001-May 16, 2001; and May 21, 2004.

This data, along with information in the previous section, indicates that Bridgeton Township is at risk for flooding hazards. The 2005 Newaygo County Hazard Mitigation Plan estimates that a damaging flooding event had occurred bi-annually and a major event, such as those of 1986 and 2004, struck approximately every 20 years.

Minor riverine flooding is expected to occur annually near the Muskegon River and its tributaries. The Soil Survey confirms this expectation with its information on flooding frequency, duration and months. Although the township’s normal flood season is the spring and NCDC flood events tended to occur then, the township’s most intense flood (1986) occurred in the fall (September).

#### **V. FLOOD-RELATED HAZARDS**

There are a number of hazardous situations associated with flooding; some of which may result in flooding and some of which are the results of flooding. As discussed previously, riverine flooding may result from heavy rainfall, ice jams, and rapid snowmelt. On the other hand, a flood has the potential to trigger a slew of other hazards, including infrastructure failures and public health emergencies. Dam failures are unique in that they may be caused by weather events, including flooding, and also have the potential to cause flooding. These hazards are listed and described in the narratives below.



**a. Severe Thunderstorms**

Severe thunderstorms can occur at any time in Michigan, although they are most frequent during the warm spring and summer months from May through September. They often contain tremendous amounts of water and energy, which can be released in the form of high winds, excessive rains, lightning, hail, and tornadoes. In order to be classified as “severe”, a thunderstorm must produce winds measuring 50 knots (58 mph) or greater, 3/4 inch hail or larger, or tornadoes. Regardless of severity, every thunderstorm produces lightning and heavy rain, which can lead to flooding.

On average, Newaygo County experiences 40-50 thunderstorm days per year according to the National Lightning Safety Institute. According to the Soil Survey of Newaygo County, thunderstorms occurred about 36 days each year in Hesperia between 1951 and 1980. However, heavy rain may occur with or without thunderstorms. The annual average of mean monthly precipitation was 33.57 inches. The heaviest one-day rainfall recorded was 6.19 inches.

**b. Snow/Ice/Sleet Storms**

Snow, ice, and sleet storms have tremendous potential for causing damage, especially because they often cover large areas and affect all residents. Snowstorms involve the rapid precipitation and accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility. Since they occur frequently and because they can have so many effects, they were rated as the number one hazard for Bridgeton Township in the Newaygo County Hazard Mitigation Plan. Between 60-80 inches of snow fall every year on Newaygo County, generally in the months between November and March.

Information on snowstorms in Newaygo County can be obtained in the county’s Hazard Mitigation Plan, while information on storms in Bridgeton Township can be obtained in Appendix B of this document. In the past 30 years, Newaygo County has had four Presidential Declarations of Major Disaster or Emergency granted as a result of severe winter weather. These events include the ice storm of March 2-7 of 1976, the blizzard of January 26-31 of 1977, the blizzard of January 26-27 of 1978, and the blizzard of January 2-25 of 1999. The National Climatic Data Center list 45 heavy snow events, or 3-4 per year, for the 12-year period from 1993 through 2005.

There appears to be little or no correlation between winter weather events and flooding. It is, instead, the accumulation of snow, coupled with cold weather, which could present a flooding problem. Melting snow adds water to the ground that drains away in the same way as water from rainfall, particularly if the ground is frozen or saturated. This, and the presence of ice jams, can create or compound flooding situations.

On average, one inch of fresh snowfall contains about a tenth of an inch of water. However, as snow accumulates and becomes compacted during the winter, the ratio of snow to water decreases. Thus, ten inches of snow remaining on the ground into early spring may contain as much as five inches of water. Three days with the maximum temperature of about 50 degrees would create enough melting to cause ice breakup on small streams and melt two inches of snow. The resultant snowmelt can cause additional water load on streams and rivers during warm spells and in the spring.

It should be noted that six of the eight floods listed by the NCDC occurred in “snow-melt” months of February, April, and May. In addition, Map 15 (Flooding Months of Soil) illustrates the fact that most flooding along Muskegon River occurs in the months of March to May or March to June.

**c. Dam Failure**

Dam Failure, or the uncontrolled release of impounded water causing downstream flooding, can result in loss of life and extensive property or natural resource damage within many miles downstream from the dam and particularly in the “hydraulic shadow” of the dam. Dam failures occur not only during flood events, which may cause overtopping of a dam, but also as a result of poor operation, vandalism, and/or lack of maintenance and repair. Such failures can be catastrophic because they occur unexpectedly, with no time for evacuation. They are not to be confused with releases of water to prevent damages associated with ice, which are carefully supervised so as not to cause flooding downstream.

Michigan’s Dam Safety Program, run by the Michigan Department of Environmental Quality (MDEQ), has responsibility for regularly inspecting dams (every three to five years based on hazard potential), overseeing dam modifications, and assuring that owners keep Emergency Action Plans. The program was established in 1990, four years after the flood of 1986 wiped out several small dams in Michigan and nearly burst the Hardy Dam on the Muskegon River upstream from Bridgeton Township. Since its inception, the number of dam failures has dramatically declined as proven by MDEQ records.

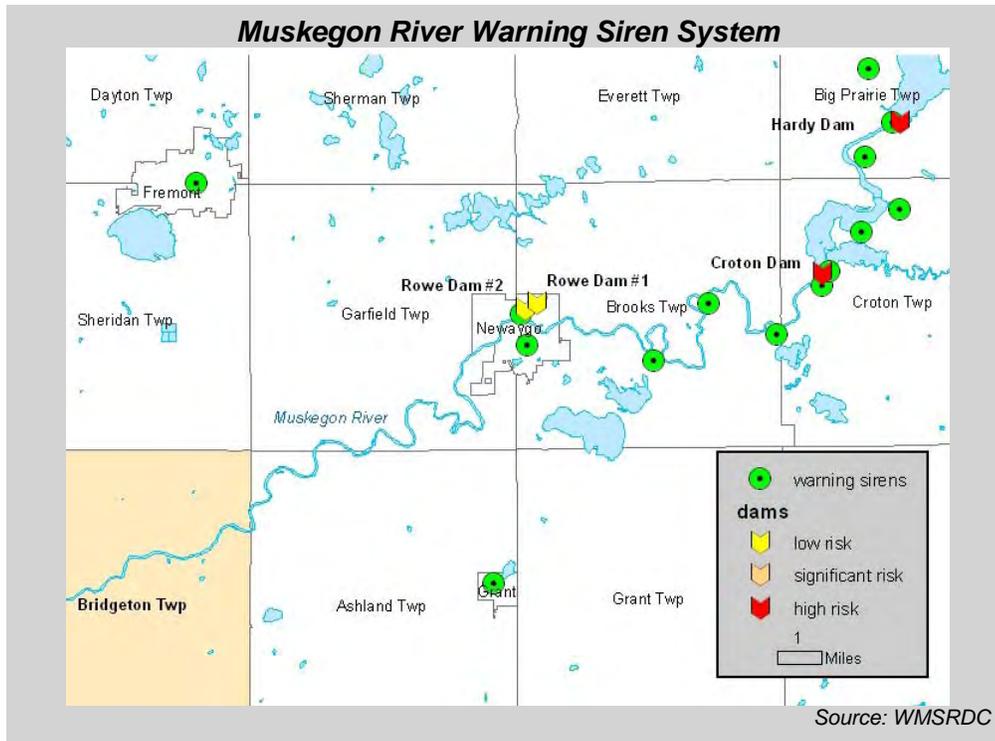
While there are no dams within Bridgeton Township, there are ten dams in Newaygo County. Four of these dams are upstream from Bridgeton Township in the Muskegon River watershed. They include Rowe Dam No. 1, Rowe Dam No.2, Croton Dam and Hardy Dam. Map 16 shows the locations of these dams in relation to Bridgeton Township. The Rowe dams are situated in the City of Newaygo on Penoyer Creek. According to the National Inventory of Dams (NID), both of these dams are rated “low hazard potential”. As such, failure of one or both is not likely to have a significant impact.

The Hardy Dam is located in Big Prairie Township and is the largest earthen dam east of the Mississippi River. The Croton Dam is located in Croton Township. Both dams are classified as hydroelectric dams, owned by Consumers Energy, and licensed to operate

through 2034. They have formed two man-made reservoirs, known as the Hardy Dam and Croton Dam ponds. Hardy Pond, completed in 1932, is 2,845 acres in size, while Croton Dam Pond, completed in 1907, is 1,235 acres large.

These dams are rated as “high hazard potential” because of the large amounts of water they impound and because they are upstream from agricultural areas and populated areas. Failure of one or both of these dams could cause severe flooding conditions and would likely result in loss of life and/or damage to structures, roads, utilities, crops and the environment; especially if there is no or inadequate warning. The following map shows the proximity of these dams to Bridgeton Township, about 15-20 miles to the southwest, as well as the numerous warning sirens which are found in the Muskegon River area. These rotating siren/speaker units are approximately one mile apart from each other, with the nearest to Bridgeton Township being over six miles away. They are mounted on 50-foot poles and can be activated by Newaygo County Central Dispatch.

MAP 16



The MDEQ has documented approximately 278 dam failures in Michigan, with a total of six in Newaygo County between at least 1970 and 2004. This would appear to be an average of up to one failure every five to six years. However, since the beginning date of record keeping for dam failures is unknown, this estimated frequency might be too high. In addition, all of these dam failures may have been the result of the record 1986 flood when the Hardy Dam spillway was threatened. Mud squirted from between the concrete slabs, where a crack between the wall and the edge of the roadbed was later discovered, and over-flow water poured over the spillway wall and across the roadway.

It could be argued that there will be a weather event every 35 years severe enough to cause dam failures. Although dams in Newaygo County appear to be in good condition

and are monitored constantly, future failures are possible. As time passes, dams age and become more vulnerable to failures.

**d. Infrastructure Failure**

Infrastructure failure includes the failure of critical public or private utility infrastructure resulting in a temporary loss of essential functions and/or services. Bridgeton Township’s citizens are dependent on private utility infrastructure to provide essential life supporting services such as electric power and heating. Electric power service is offered by Consumer’s Energy while heat is powered by LP gas. The township is also dependent on electricity for the function of wells and septic tanks.

When one or more of these independent, yet interrelated, systems fail due to disaster or other cause, even for a short period of time, there can be devastating consequences. Isolated residences in rural areas and special populations may be exceptionally vulnerable, especially during the winter months, to extended power losses. When wells and/or septic systems are inoperable, serious public health problems may arise and require immediate attention in order to prevent outbreaks of disease. When storm drainage systems fail due to damage or an overload of capacity, serious flooding can occur. When bridges are covered by floods, normal transportation routes cannot be used and re-routing can become time-consuming and expensive.

Infrastructure failures are common in Newaygo County and can be expected to happen every year. Power loss is the most significant and frequent failure. The NCDC reported minor power outages or downed power lines from severe thunderstorm winds nine times in Newaygo County between 1994 and 2004. Additionally, the county was involved in widespread power outages across Lower Michigan in April 1997 from high winds (not associated with thunderstorms), on May 31, 1998 from thunderstorm winds, and in April 2003 from an ice storm. While none of the NCDC reports attribute power outages to flooding in Newaygo County, there were limited power outages during the 1986 and 2004 flooding events.

**e. Public Health Emergencies**

Public health emergencies can take many forms such as disease epidemics, large-scale incidents of food or water contamination, extended periods without adequate water and sewer services, harmful exposure to chemical, radiological or biological agents, and large-scale infestations of disease-carrying insects or rodents. The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people. They can be statewide, regional, or localized in scope and magnitude.

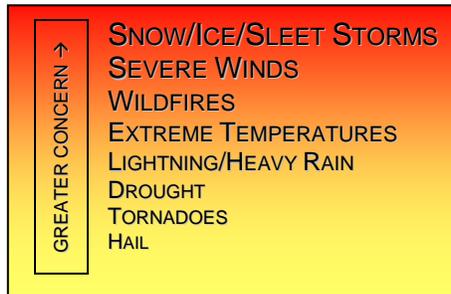
Public health emergencies can occur as primary events by themselves, or they may be secondary events to another disaster or emergency such as a flood, tornado, power outage, or hazardous material incident. The county annually experiences power losses, with subsequent septic and well failures creating the potential for unhealthy conditions. While the more noticeable outages are generally related to storms, minor outages in Bridgeton Township have been related to flooding events. In addition, floods have resulted in septic failure and contamination of both the Muskegon River and wells with both sewage and chemicals.

These events have not been connected to public health emergencies or widespread health problems but do present health concerns. There have been no recorded public health emergencies in Newaygo County within recent history. District Health Department #10 officials continually monitor health threats.

Since there are no sites in Bridgeton designated under the Superfund Amendments and Reauthorization Act (SARA), and very few in Newaygo County, the threat of harmful exposure to chemicals is greatly reduced. According to the Newaygo County Hazard Mitigation Plan, “a facility is subject to SARA Title III provisions if extremely hazardous substances, as determined by the US 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.”

**f. Other Natural, Technical, or Human-Related Hazards**

For more detailed assessments of the previously mentioned hazards, along with other hazards not related to flooding in Newaygo County, please refer to the Newaygo County Hazard Mitigation Plan in its entirety or to Appendix B of this document for its Bridgeton Township Hazard Identification and Assessment. The appendix covers natural, technological, and human-related hazards and includes a list of historical hazardous events, a hazard/risk profile map, and hazard assessment ratings and rankings for the township. Natural hazards other than flooding are ranked by the Hazard Mitigation Plan in the following order of concern, with the greatest concern at the top of the list.



# PART D

## VULNERABILITY ASSESSMENT

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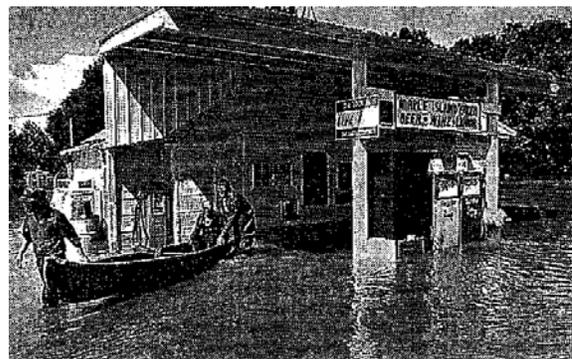
The purpose of this chapter is to provide detailed analyses of areas prone to flooding and to assess the vulnerability of the existing and future built environment in these areas to flood damages (i.e. to conduct a vulnerability assessment). According to FEMA definition, a vulnerability assessment focuses on “the extent of injury and damage that may result from a flooding event of a given intensity in a given area” while vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset’s construction, contents, and the economic value of its functions. The vulnerability of one element of a community is often related to the vulnerability of another. For example, residents depend on uninterrupted electrical service. If an electric substation is flooded, it not only affects the substation but a number of residences as well. Often, indirect effects can be much more widespread and damaging than direct ones.

FEMA recommends consideration of the following categories in a vulnerability assessment, some of which Bridgeton Township contains, in or out of the floodplain, and some of which it doesn’t.

- **Critical facilities** (those that contribute to the health and welfare of the population; including transportation systems such as airports and railroads, lifeline utility systems such as power and water/wastewater plants and systems, high potential loss facilities such as dams and power plants, and hazardous material facilities such as SARA sites);
- **Vulnerable populations** (such as non-English speaking people or elderly people who may require special response assistance or medical care);
- **Economic elements** (such as major employers that could affect the local economy if disrupted);
- **Special Considerations** (such as areas of high density residential or commercial development);
- **Historic, cultural, and natural resource areas** (especially those identified or protected under state or federal law); and
- **Governmental facilities.**

As detailed in the previous chapter, Bridgeton Township’s critical facilities consist of a pipeline, which is not in the floodplain, and three power lines and two bridges crossing over the Muskegon River. There are no major employers in the township and many residents commute to Grand Rapids or Muskegon for employment. Should Bridgeton’s bridges be out of service, these folks would have to drive long distances to reach other bridges.

While commercial development is sparse and residential development is scattered in the township; there is a grocery store in Muskegon County, just across Maple Island Road, and there are four subdivisions along the river which have higher densities. Some homes are occupied on a seasonal basis while some are occupied year-round. Consequently, it can be assumed that there are residents, some of which are probably vulnerable, in the floodplain. It is apparent from the photograph that the grocery store is vulnerable to flooding.



*Maple Island Rd. Grocery, September 1986*

Neither the state-owned nor the township-owned boat launch is a protected natural resource area. There are no designated historic areas. Bridgeton’s sole government facility, the township hall, is not vulnerable. It is primarily existing residential properties, as well as residents, along Muskegon River that are vulnerable.

Probable damage to existing residences is predicted by the National Weather Service’s Advanced Hydrologic Prediction Service, which provides river and flood forecasts and water information across America to protect life and property and ensure the Nation’s economic well-being. Forecasts for Bridgeton Township are based on flood levels measured at the Croton river gauge and are as follows.

- 8.0’** River begins to exceed its banks and **minor flooding begins in low lying areas** along the river.
- 9.0’** Expect **minor flooding of cottages and cabins** downstream of Newaygo at Old Woman’s Bend and **lower Bridgeton** area.
- 10.0’** Expect **minor flooding of cottages and cabins** downstream of Newaygo at Old Woman’s Bend, Anderson Flats, and **lower Bridgeton** area.
- 11.0’** Expect **moderate flooding of cottages and homes** downstream of Newaygo in the Old Woman’s Bend, Anderson Flats, and **lower Bridgeton** area.
- 13.0’** Expect **major flooding of cottages and homes** downstream of Newaygo at Old Woman’s Bend, Anderson Flats, and **Bridgeton** area.

It is not anticipated that the supply of developed properties along the river will expand greatly in the future, based on trends from the past three decades. The township’s zoning ordinance currently enforces Greenbelt District restrictions within 300 feet of the Muskegon River and its tributaries. Beyond that lies the agricultural residential district, which prohibits lot sizes less than 2.5 acres. In addition, most of the twelve predominate floodplain soils along the river (see Appendix B) possess properties which severely limit the development of residential dwellings with and without basements as well as the use of septic tanks. Several of these soils are contained in areas with significant wetlands, which have legal restrictions or prohibitions against development. Finally, topography prohibits or constrains development in some upper portions of the river where steep hills abut the river.

## **I. VULNERABLE STRUCTURES AND POPULATIONS**

It has been noted that Bridgeton Township is primarily rural and has scattered housing with pockets of more concentrated residential areas, particularly along the Muskegon River and its tributaries. These pockets are contained in the subdivisions called Bell Meadow, Leisure Land, Freight Hill, and Homesite Park; all of which are primarily located in the floodplain of the Muskegon River. In addition, there are a few homes along the river that are outside the subdivisions.

In an attempt to identify floodplain structures for this plan, aerial photos taken in 2003 were imported into a GIS and visually inspected. All potential houses, structures, and properties were marked and noted. This initial inventory of floodplain properties was then compared against estimated floodplain boundaries (derived from the Bridgeton Township FIRM) with the GIS. Many properties were partially located within the floodplain, but had structures built outside the floodplain. The inventory was checked to ensure that the identified properties contained structures that were situated within the floodplain and that no residential dwellings were overlooked. Parcel information for these pertinent properties was then

obtained from the Newaygo County Equalization Department and used to identify characteristics of development within the floodplain such as building values, building types (single family homes, mobile homes, equipment shops, agricultural buildings, etc.), and the years structures were built.

The final inventory of structures, presented in Table 9, lists the number of single family homes, mobile homes, and other structures likely to be in the Muskegon River floodplain. (Accurate determinations must be based on professional surveys and are done for insurance purposes.) All sections containing parts of the floodplain are included in the table to illustrate concentrations of development within areas of the floodplain. Also included are total building values, according to current assessments, for identified properties.

**TABLE 9**

<b>Floodplain Structure Estimates Bridgeton Township</b>				
<b>Section</b>	<b>Single Family</b>	<b>Mobile Home</b>	<b>Auxiliary/ Other*</b>	<b>Total Structures</b>
12	-	-	-	<b>0</b>
13	-	-	-	<b>0</b>
14	-	-	-	<b>0</b>
15	17	13	4	<b>34</b>
16	-	-	-	<b>0</b>
19	-	-	-	<b>0</b>
20	-	1	1	<b>2</b>
21	-	-	-	<b>0</b>
29	-	-	-	<b>0</b>
30	24	4	12	<b>40</b>
31	2	1	-	<b>3</b>
<b>Total</b>	<b>43</b>	<b>19</b>	<b>17</b>	<b>79</b>
<b>Assessed Building Values for Identified Structures</b>				
<b>Total</b>	<b>\$1,479,400</b>	<b>\$433,000</b>	<b>\$101,200</b>	<b>\$2,013,600</b>

*\* Auxiliary/Other includes: accessory buildings (equipment/tool sheds, garages etc.); "vacant" parcels with building values; recreational improvements; and any other identified/verified property modification.  
Source: Newaygo County Equalization, 2006*

It should be noted that vulnerability of structures is not entirely determined by location. A property can be located in the floodplain and not be vulnerable to flooding. Mitigating factors include both elevation and the manner of construction, which varies for each property. Historically, however, there is evidence of structural vulnerability. According to the NFIP, there are twenty-four residential flood insurance policies in-force in the township with a total of \$3,101,900 of flood insurance coverage. Records indicate that there were nine flood insurance policy losses between January 1, 1978 and October 31, 2007 amounting to \$106,145.54 in payments. These NFIP claims do not represent the entire picture as not all properties were NFIP-insured and not all damages were covered by NFIP insurance.

In addition, there was one repetitive loss property in Bridgeton Township, as of December 2004. (It was caused by the flood of 1986; however more specific information about the location of this repetitive loss property cannot be given, due to the need to preserve the confidentiality of that information.) Repetitive Loss properties are those properties for which two or more claims of more than \$1,000 have been paid by the NFIP within any 10-year period since 1978. Repetitive loss properties are of special concern to FEMA since they represent only 1% of all the NFIP's insurance policies nation-wide, but they have accounted for nearly one-third of the claim payments.

The current population of the floodplain can only be approximated, since the number of structures is approximated and since the smallest geographic area for the U.S. Census of Population is the Census Block. While exact counts of houses, people, and people per household are provided in the block data (see appendix C), the blocks include statistics for areas outside the floodplain. The best approximation was obtained by multiplying the

number of residences (not structures, since that classification includes auxiliary buildings that are not occupied, such as garages) likely to be in the floodplain by the Census Block count of persons per household.

The following table presents the results of these efforts by Census Block. The floodplain population estimate must be viewed as the maximum possible since there is no consideration of occupancy, either year-round or seasonal. While more specific information is not given on the vulnerability of this population, it can be assumed that there are, indeed, vulnerable residents. Census data indicates that 8.2 % of the township’s population is over 65 years of age, 22.5% are living with disability or mobility limitations, and 2.9% speak only Spanish. When these percentages are applied to the estimated floodplain population of 147 persons, the following estimates result: twelve persons over age 65, thirty-two persons with some limitations, and four Spanish speaking persons. See Appendix C for a map of Census Block divisions along the Muskegon River and other census information.

**TABLE 10**

<b>Estimated Floodplain Population Bridgeton Township</b>					
		<b>Block</b>	<b>Residential Dwellings</b>	<b>People per Household</b>	<b>Estimated Population</b>
Section 15	Bell Meadow	2004	6	2.48	<b>14.88</b>
	Freight Hill	4036	17	1.83	<b>31.11</b>
	Leisure Land	4032	7	2.3	<b>16.1</b>
Section 20	floodplain	4042	1	2.84	<b>2.84</b>
Section 30	Homesite Park	4042	9	2.84	<b>25.56</b>
	floodplain	2013	1	2.57	<b>2.57</b>
		2014	11	2.46	<b>27.06</b>
		4042	4	2.84	<b>11.36</b>
		4043	3	2.67	<b>8.01</b>
Section 31	floodplain	2048	1	3	<b>3</b>
		2049	2	2	<b>4</b>
<b>TOTALS</b>			<b>62</b>	<b>2.35</b>	<b>146.49</b>

*Sources: Newaygo County Equalization, 2006; United States Census Bureau Census 2000*

## II. VULNERABLE SECTIONS

Since the majority of damages due to flooding are reported to be in Sections 14, 15, 20, and 30 of Bridgeton Township; with 90% reported to be in Sections 15 and 30; more in-depth information follows on these locations. It is apparent that Sections 15 and 30 contain the majority of residents and residences in the floodplain and will have the most impact from flooding events. Section 20 has vulnerability due to its river bend and natural channel constriction. The Warner Avenue Bridge is located primarily in Section 14 but also in Section 13.

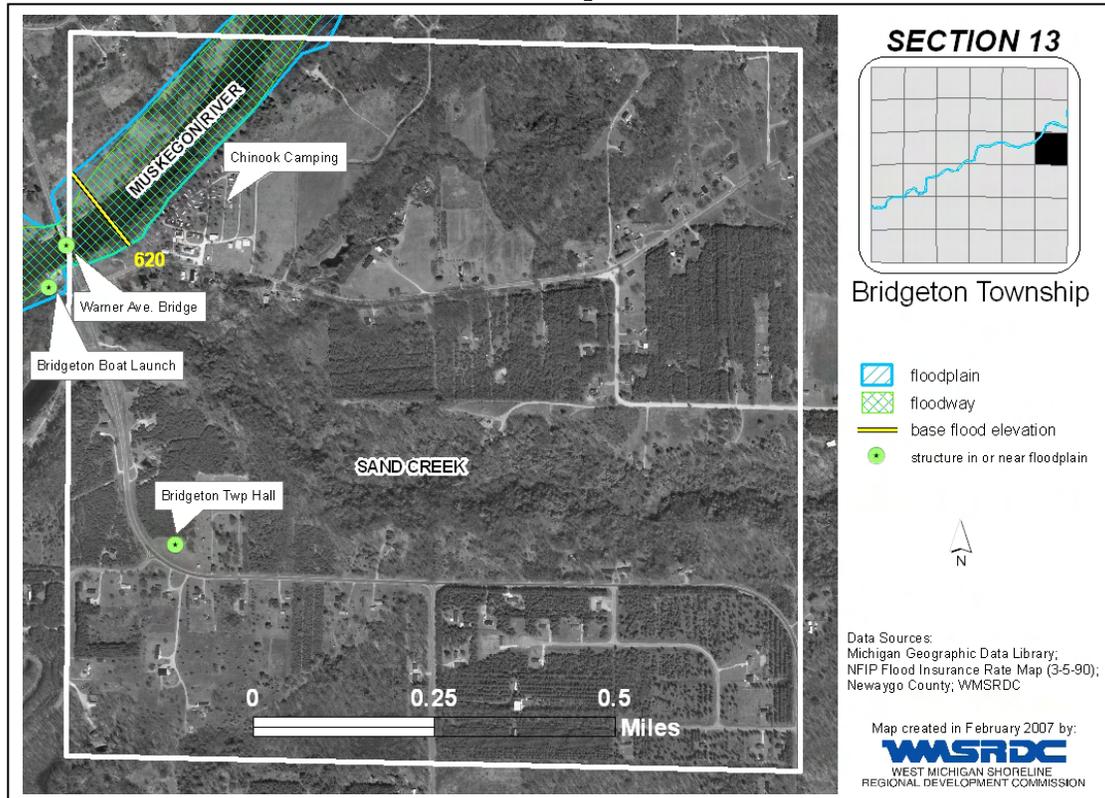


### a. Section 13

The Muskegon River slices through the northwest quarter of Section 13. This portion of the river contains a narrow floodplain and floodway areas, which primarily affect the

north bank of the river. Additionally, Sand Creek feeds into the southern bank of the Muskegon River near the Warner Avenue Bridge, where the base flood elevation has been determined to be 620 feet. Wetlands are scattered along the north and south banks of the Muskegon River and in the north-central part of the section. The Warner Avenue Bridge straddles the section's border with Section 14 and is the only development in the floodplain. Other developments in Section 13 include the Township Hall; Chinook Camping, a privately owned campground containing 106 sites, electric and water hook-ups, modern bath houses, a swimming pool, and a restaurant; and scattered residential dwellings across the southern and eastern portions of the section.

**MAP 17 – Section 13 Floodplain and Notable Features**



**b. Section 14**

The Muskegon River rolls through the center of Section 14 and has floodplains along its banks. At the center of the Section, a creek feeds into the southern bank of the river. A few yards downstream from this point, the base flood elevation drops to 619 feet; the location at which the river's designated floodway ends; and the floodplain opens up to include a small pond near the river's south bank. Wetlands are located along the north and south banks of the Muskegon River and also are scattered south of River Drive.

Analysis of the Soil Survey of Newaygo County provided in Part C indicates the presence of soils with properties associated with flooding along the Muskegon River shoreline. These soils have a tendency to experience brief flooding on an occasional basis. About two-thirds to three-fourths of all flooding on these soils occur during the months of March through May. The Soil Survey also identified the existence of another group of soils along the north banks of the river which tend to experience frequent flooding for

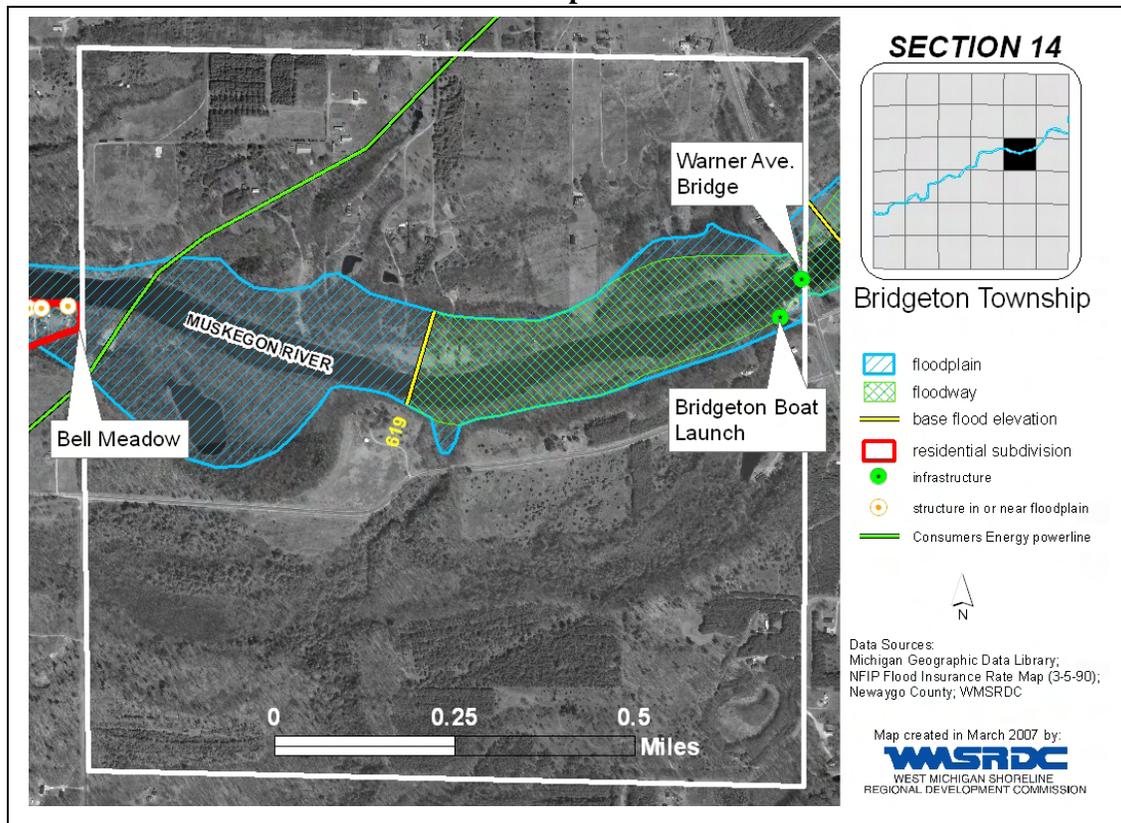
brief to long periods in the cold months of November through April. Refer to the Newaygo County Soil Survey sub-section in Part C for soil maps and additional Soil Survey information.

The primary flooding concern in Section 14 is the Warner Avenue Bridge, which enters from Section 13 as it passes over the river, floodplain, and floodway. This bridge is owned and operated by the Newaygo County Road Commission and is part of County Road B-35. This road connects the unincorporated neighborhood of Bridgeton to highways M-82 to the north and M-46 to the south. The bridge was built in 1971 and has a concrete cast-in-place deck and steel beams. It measures 344.8 feet in length and 34 foot in width curb to curb, and would cost an estimated \$3.5 million to replace. The surface of the bridge has not experienced flooding. There were no dwellings identified within the floodplain.

Other developments in Section 14's floodplain include the Bridgeton Township Boat Launch, located southwest of the Warner Avenue Bridge, and Consumers Energy power lines crossing over the Muskegon River. The power lines are held by towers, anchored in cement, from 300 feet to 1,000 feet apart depending on the terrain.

The boat launch site is composed of 1.8 acres acquired by the township in 2003 and has limited parking capacity (10 vehicles). The township plans to acquire 5 more acres on the south and west sides of the property to expand the boat launch, add 50 feet of river frontage, protect 2 acres of wetlands, increase recreation opportunities, and address bank erosion and traffic safety problems. The entrance is on Warner Avenue, a primary road, and would be moved to River Drive, a secondary road.

**MAP 18 – Section 14 Floodplain and Notable Features**



Developments in the township that are located outside of the floodplain include widely scattered residential dwellings, primarily in the northern half of the township along 112<sup>th</sup> Street; and West Shore Christian Fellowship, containing camp sites and several covered pavilions on the north bank of the river outside of the floodplain.

**c. Section 15**

The Muskegon River flows into the center of Section 15 from the east and exits it near the southwest corner. Minnie Creek feeds into the northern bank of the Muskegon River in the western half of the section. Base flood elevations in the Section have been estimated to be 618 feet at the Bell Meadow subdivision, and 619 feet at the Freight Hill subdivision. Significant contiguous wetlands are situated along the Muskegon River’s south bank and along Minnie Creek, both of which exist within the 100-year floodplain.

Analysis of the Newaygo County Soil Survey provided in Part C indicated the presence of soils with properties associated with flooding. These soils are located along the Muskegon River and Minnie Creek and have a tendency to experience brief flooding on an occasional basis. About two-thirds to three-fourths of all flooding on these soils occur during the months of March through May. Refer to the Newaygo County Soil Survey sub-section in Part C for floodplain soil maps and additional Soil Survey information.

The primary flooding concerns in Section 15 are three residential subdivisions located along the Muskegon River named Bell Meadow, Freight Hill, and Leisure Land. This section contains 30 residential dwellings within the 100-year floodplain; 13 of which are mobile homes. In all, 34 structures were identified within the floodplain. The combined assessed value of these buildings is currently \$647,463. Table 10 contains a list of structures and their assessed building values within the Section 15 floodplain.

**TABLE 11**

<b>Section 15 Floodplain Residential Structures</b>			
Single Family	Mobile Home	Auxiliary/ Other*	Total Structures
17	13	4	<b>34</b>
<b>Total Assessed Building Values for Floodplain Structures</b>			
Bell Meadow		\$209,900	
Freight Hill		\$342,963	
Leisure Land		\$ 94,600	
<b>Section 15 Total</b>		<b>\$647,463</b>	

*\* Auxiliary/Other includes: equipment/tool sheds, etc.; “vacant” parcels with building values; and any other identified/verified property modification.*

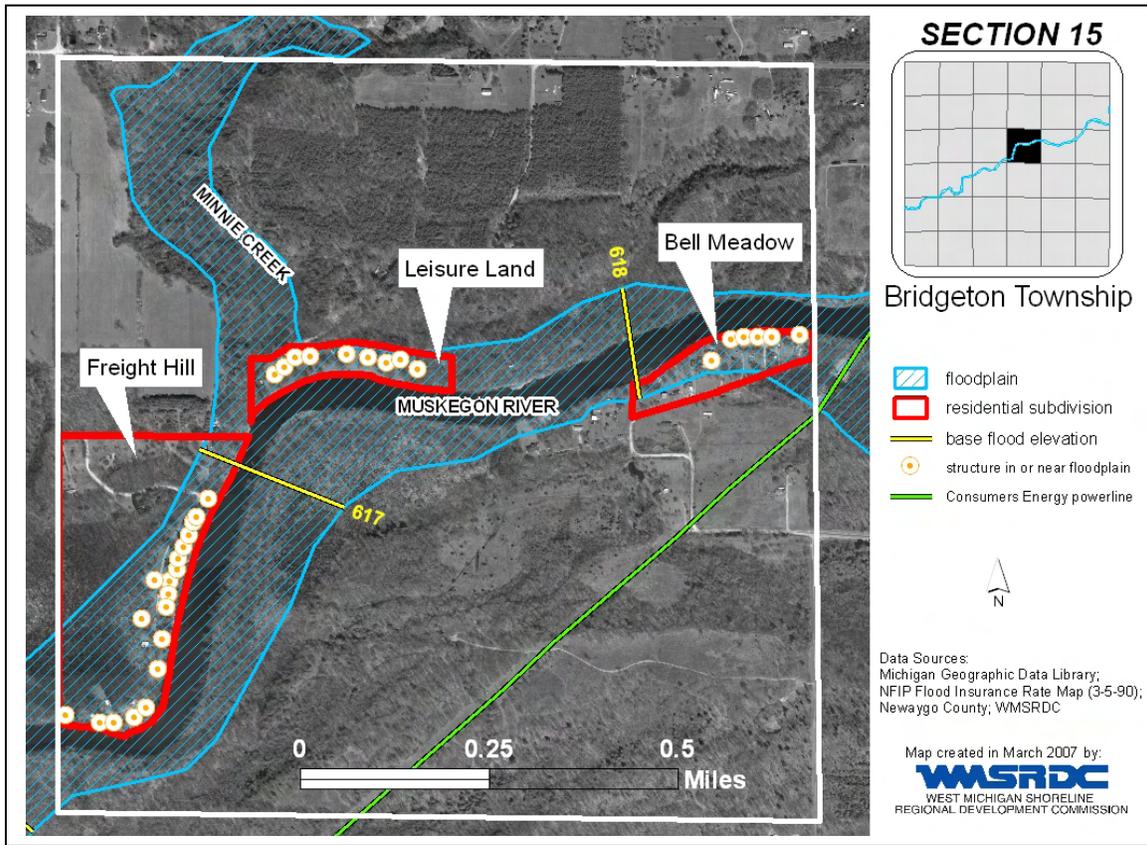
According to parcel information provided by the Newaygo County Equalization Department, the average recorded year-built for houses in Bell Meadow is 1978; in Freight Hill is 1974; and in Leisure Land is 1977. The most recent recorded household construction in Bell Meadow occurred in 1993; in Freight Hill in 2005; and in Leisure Land in 1979.

Throughout the Section 15 floodplain, about 88% of the single family residential structures are one-story, while 10 of them have crawl space

foundations, four have slab foundations, and one home has a basement. The average square footage of residential use is approximately 819. The average assessed building value for all residential dwellings is \$21,067. The average value for each subdivision is as follows: Bell Meadow – \$34,984; Freight Hill – \$19,330; Leisure Land – \$13,358.

Although the Consumers Energy power lines cross Section 15, they cross the flood plain in Section 14 rather than Section 15.

**MAP 19 - Section 15 Floodplain and Notable Features**



**d. Section 20**

The Muskegon River enters Section 20 from the east, forms a u-shape in the middle, and exits at the southwest corner. The u-shape presents certain vulnerabilities since the eastern edge would take the brunt of a flood and overland flooding is a possibility. Base flood elevations along the river have been estimated to be 612, 613, and 614 feet in the Section. Wetlands dominate the landscape in this largely undeveloped square mile.

**TABLE 12**

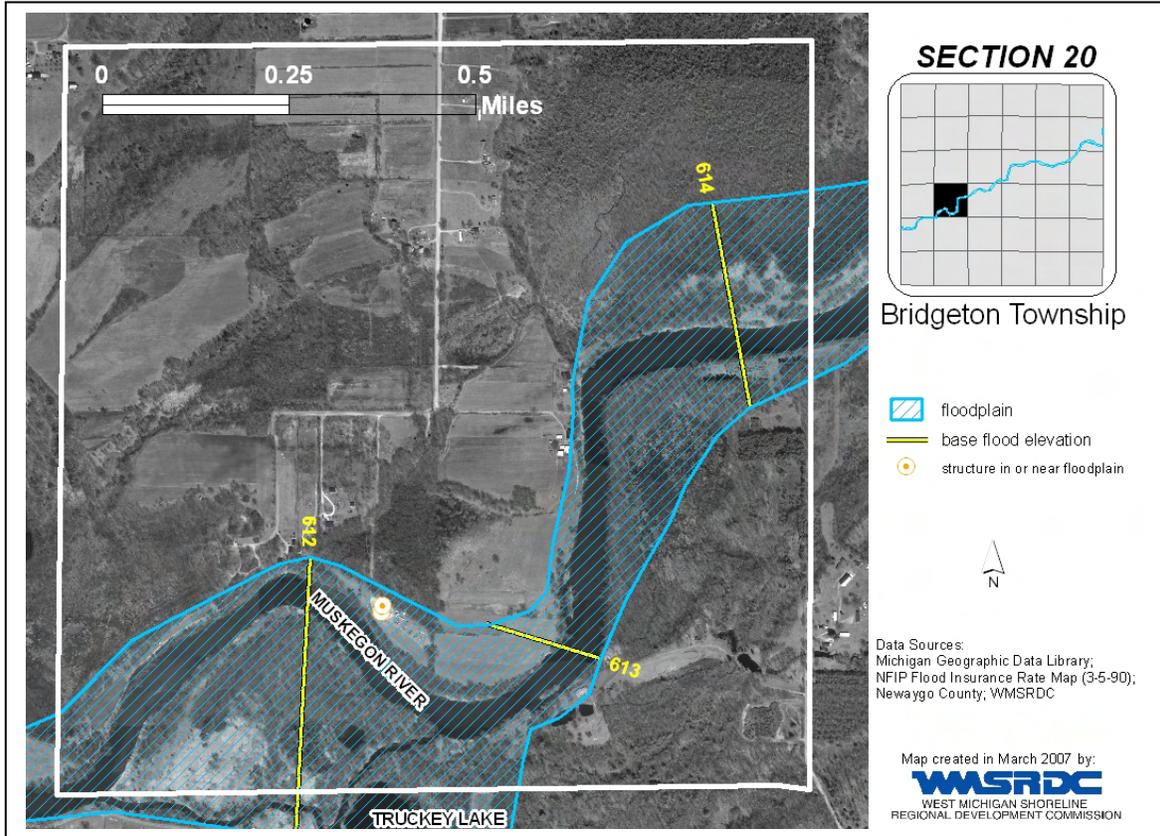
Section 20 Floodplain Residential Structures			
Single Family	Mobile Home	Auxiliary/ Other*	Total Structures
-	1	1	2
Total Assessed Building Values for Floodplain Structures			
Information suppressed.			

\* Auxiliary/Other includes: equipment/tool sheds, etc.; "vacant" parcels with building values; and any other identified/verified property modification.  
Source: Newaygo County Equalization, 2006

Analysis of the Soil Survey of Newaygo County provided in Part C indicated the presence of many soils with properties associated with flooding covering the Section. Flooding tendencies in Section 20 cannot be generalized due to the wide range of properties contained by the soils; such as flooding frequency, duration, and months. Refer to the Newaygo County Soil Survey subsection in Part C for floodplain soil maps and additional Soil Survey information.

Very little development exists within the 100-year floodplain in this Section. In fact, just one mobile home was identified. Five other residential buildings were also identified; however, these homes are situated above the base flood elevation and outside the floodplain.

**MAP 20 –Section 20 Floodplain and Notable Features**



**e. Section 30**

The Muskegon River lies in the northern half of Section 30, entering from the northeast and exiting into Muskegon County at the Maple Island Bridge. This happens to be the lowest elevation in Newaygo County and the widest floodplain in Bridgeton Township due to topography. Base flood elevations in the Section have been estimated to be 611 feet in the northeast corner of the Section and 610 feet at the Homesite Park subdivision. Wetlands are situated to the north of the Muskegon River, along the Maple River, and in the southern and eastern areas.

Analysis of the Soil Survey of Newaygo County provided in Part C indicated the presence of soils containing a range of properties associated with flooding. In this Section, many soils along the Muskegon River have a tendency to experience brief flooding on an occasional basis. About two-thirds to three-fourths of all flooding on these soils occur during the months of March through May. Refer to the Newaygo County Soil Survey sub-section in Part C for floodplain soil maps and additional Soil Survey information.

The main flooding concern in Section 30 is residential development along the Muskegon River, which has primarily occurred in the northwest quarter. This section contains 28 residences within the 100-year floodplain. Of those properties, the Homesite Park subdivision, located on the north bank of the Muskegon River, contains eight single family homes and one mobile home. The subdivision is composed of 20 lots which have

**TABLE 13**

<b>Section 30 Floodplain Residential Structures</b>			
Single Family	Mobile Home	Auxiliary/ Other*	Total Structures
24	4	12	<b>40</b>
<b>Total Assessed Building Values for Floodplain Structures</b>			
Homesite Park		\$ 441,656	
Others in floodplain		\$ 809,881	
<b>Section 30 Total</b>		<b>\$1,251,537</b>	

\* Auxiliary/Other includes: equipment/tool sheds, etc.; "vacant" parcels with building values; and any other identified/verified property modification.  
Source: Newaygo County Equalization, 2006

been divided into 12 separately owned parcels. There are also four other lots which are not considered part of the subdivision but are located adjacent to the subdivision in the 100-year floodplain. Structures built in three of these lots include three single family properties. Table 12 lists the number of structures and their assessed building values within the Section 30 floodplain.

According to parcel information provided by the Newaygo County Equalization Department, the average

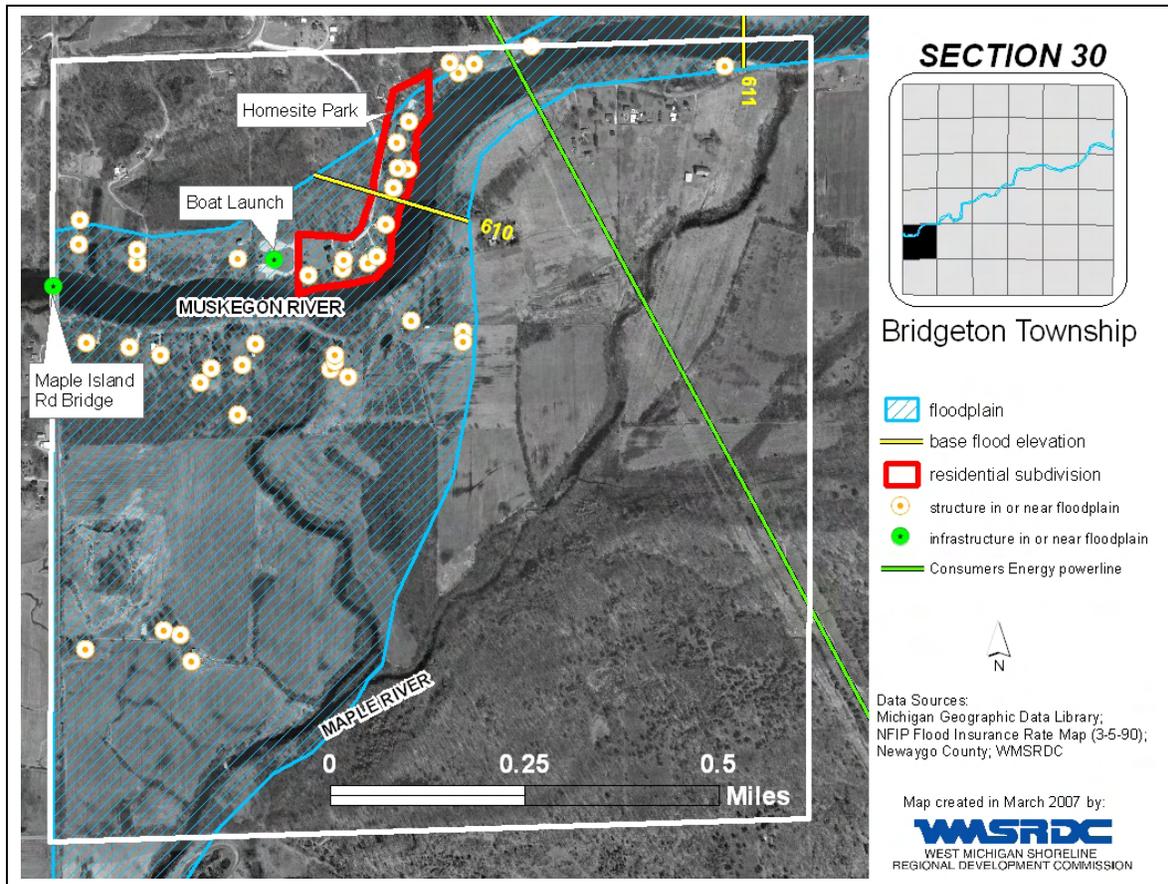
recorded year-built for households in Homesite Park is 1973; compared to 1967 in the remainder of the Section's floodplain. The most recent recorded household construction in Homesite Park occurred in 1992, and 1996 in the rest of the Section's floodplain.

Throughout the Section 30 floodplain, about 75% of the single family residential structures are one-story, while 15 of them have crawl space foundations, four have slab foundations, and four homes have basements. The average square footage of residential use is approximately 1,302. The average assessed building value for all residential dwellings is \$41,636.

Another primary concern is the Maple Island Road Bridge (B-31) over the Muskegon River. The bridge is owned and operated by the Muskegon County Road Commission. It is part of County Road B-31, which connects M-47 to the south in Muskegon County, to M-120 along the Muskegon/Newaygo County border. In 1985, a new superstructure consisting of a reinforced concrete deck on continuous steel girders was placed on existing abutments and piers. The cost of the superstructure replacement was about \$700,000 and the estimated replacement cost is now \$3.5 million. The three-span bridge is 330 feet long with two lanes plus two shoulders for a total roadway width of forty feet. As such, this bridge provides greater traffic capacity than the remainder of Maple Island Road. Although the record flood of 1986 saw the Maple Island roadway flooded one mile south and ¼ mile north of the river, the low steel of the bridge structure was 1.5 feet over the flood waters.

Other developments in Section 30 include a State of Michigan boat launch, located on Turner St. adjacent to Homesite Park; and two sets of Consumers Energy power lines crossing over the Muskegon River and through the floodplain. One set of lines is held by towers anchored in cement while the other set is held by wood poles. The supports range from 300'-1,000' apart, depending on topography and type. The towers have the greater of the spans and are less likely to be anchored in the flood plain. The three acre boat launch includes 63 parking spaces, primitive toilet facilities, and a boat ramp.

## MAP 21 – Section 30 Floodplain and Notable Features



### III. ESTIMATE OF POTENTIAL DAMAGES

The basic technique for estimating the amount of damage from flood events is to find the replacement value of a residential structure and to equate different flood depths with appropriate percentages of that replacement value. The easiest method of calculating replacement value is to apply the typical construction price per square foot by the approximate square footage of residential use. An alternative is to use property assessments and appraisals.

The following table, taken from the Local Hazard Mitigation Planning Workbook (2/2003) of the Michigan State Police, estimates damages to structures, in terms of percentages of replacement values, for different flood depths and structure types. It was adapted from Flood Administration guidance, based on historical averages from observed flood damages.

**TABLE 14**

<b>FLOOD DAMAGE ESTIMATION TABLE</b>						
<b>(Numbers given are damages as a percentage of the structure's replacement value)</b>						
Flood depths (depth of flooding in feet)	Type of Structure					
	1 story, no basement	2 story, no basement	Split-level, no basement	1 or 2 story with basement	Split level with basement	Mobile home
Under ½ foot, in basement only	0	0	0	4	3	0
About 1 foot, in basement only	0	0	0	8	5	0
2+ feet in basement, <½' surface	<b>9</b>	<b>5</b>	<b>3</b>	<b>11</b>	<b>6</b>	<b>8</b>
About 1 foot flooding at surface	14	9	9	15	16	44
About 2' flooding on ground floor	22	13	13	20	19	63
About 3' flooding	27	18	25	23	22	73
About 4' flooding	29	20	27	28	27	78
About 5' flooding	30	22	28	33	32	80
About 6' flooding	40	24	33	38	35	81
About 7' flooding	43	26	34	44	36	82

**NOTE: Since replacement value may exceed the current market value of a structure, damages greater than 50% of replacement value can be considered a total loss of the structure, unless special historic or service functions require that additional expenses be undertaken to repair and preserve it.**

Source: Local Hazard Mitigation Planning Workbook (Michigan State Police Emergency Management Division, 2003)

The Michigan State Police made three assumptions in viewing the estimate of property losses due to flooding on a state-wide level. The first was to assume the probability of flooding to be 1% for a given year, thus matching the base flood elevation. The second was to assume that the average level of flooding suffered by vulnerable structures is best represented by the FEMA damage category described as “up to one-half foot” of flood depth. The third was to assume that each damaging event would average 8% of the value of the structure for mobile homes, which don’t have basements, or 10% for non-mobile home residential structures, many of which have basements, in each hundred-year flood.

Given these assumptions, estimating total annual residential property losses in Bridgeton Township becomes a matter of multiplication. The formula is simple and requires the estimator to calculate the following: the estimated number of at-risk structures, times the average value of these structures, times 10% of the value of the structure, times .01 for the annual chance of a base flood event (**# structures times \$average times .1 times .01**). For mobile homes, the calculations are similar, with 10% being substituted by 8% (**# structures times \$average times .08 times .01**). Damages to the contents of structures can be estimated by assuming that their value is 30% of the replacement value of the structure, and then assuming that damages to those contents will be 1.5 times the percentages to the structures.

While this system could be utilized for each vulnerable property in the township, it has only been calculated collectively for all residential properties likely to be in the floodplain in this document. In addition, replacement value was calculated as double the average assessment for each type of home instead of the average construction cost per square foot, which could well result in a higher amount.

The calculations are detailed below but the calculated amounts do not give the total picture, since they do not include estimated costs of damages to contents nor do they give property losses for accessory buildings. They do not give the cost from other damages to infrastructure, road closures, diverted traffic, loss of work hours, and so on. More information on losses in the categories of “loss of function”, “casualty costs”, “response and

clean-up costs”, and “loss of property” can be obtained in the Newaygo County Hazard Mitigation Plan. That document contains a table with cost estimates for several items in each of these categories.

**TABLE 15**

<b>ESTIMATED ANNUAL RESIDENTIAL PROPERTY LOSSES DUE TO FLOODING</b>								
	#	*	\$(Average * 2)	*	.1	*	.01 =	TOTAL ANNUAL PROPERTY LOSS
Non-mobile Residences	43	*	\$68,809.32	*	.1	*	.01 =	\$2,958.81
	#	*	\$(Average * 2)	*	.08	*	.01 =	TOTAL ANNUAL PROPERTY LOSS
Mobile Residences	19	*	\$45,578.96	*	.08	*	.01 =	\$692.81
<b>Total</b>							<b>=</b>	<b>\$3,651.62</b>

Source: WMSRDC

# **PART E**

## **FLOOD MITIGATION GOALS AND OBJECTIVES**

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Goals are general guidelines that explain what the township wants to achieve in regards to the mitigation of floods. They are usually long-term and represent global visions such as “lessen the environmental impact of flooding” or “reduce property damages from flooding”. Objectives define strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific, measurable, and have potential completion dates. The development of clear goals and objectives helps clarify problems, issues, and opportunities in flood hazard mitigation as well as other areas.

The following goals and objectives have been established for flood mitigation efforts in Bridgeton Township. They are based on input from the township’s Planning Commission and elected officials as well as from residents and emergency management officials with the above problems, issues, and opportunities in mind.

**OVERALL HAZARD MITIGATION GOAL: To reduce or eliminate the long-term risk to human life and property from flooding.**

**GOAL 1. Promote growth in a sustainable, hazard-free manner.**

- Objective 1.1. Incorporate flood hazard provisions in building code standards, ordinances, and procedures.
- Objective 1.2. Incorporate flood hazard mitigation into land use and capital improvement planning and development activities.
- Objective 1.3. Incorporate flood hazard mitigation into existing land use regulation mechanisms to ensure that development will not put people in danger or increase threats to existing properties.
- Objective 1.4. Research, recommend, adopt and enforce other plans and ordinances that protect natural resources so that they can, in turn, provide flood hazard protection.

**GOAL 2. Protect existing and new properties.**

- Objective 2.1. Use the most cost-effective approaches to protect existing sites, buildings, and facilities from flood hazards.
- Objective 2.2. Utilize insurance coverage to provide financial protection against flood hazard events.
- Objective 2.3. Maximize the resources for investment in flood hazard mitigation, including the use of outside sources of funding.

**GOAL 3. Protect public health and safety.**

- Objective 3.1. Review threat recognition (watches) and warning systems to assure that they are adequate and appropriate and that they utilize the latest technology.
- Objective 3.2. Protect infrastructure and services.
- Objective 3.3. Build and support local capacity, commitment and partnerships to continuously become less vulnerable to flood hazards.



Objective 3.4. Enlist support of committed volunteers to safeguard the community before, during, and after a flood.

**GOAL 4. Increase public understanding and support of, and participation in, flood hazard mitigation.**

Objective 4.1. Heighten public awareness of flood hazards and actions they can take to prevent or reduce the risk to life or property from them.

Objective 4.2. Encourage participation in the flood hazard mitigation process.

Objective 4.3. Encourage cooperation and communication between planning and emergency management officials.

In order for these goals and objectives to succeed, they must be integrated into and compatible with other township goals. They must also be divided into manageable components, or actions, that can be accomplished, and they must be prioritized so local officials can better focus their attention on implementation. An important feature of developing them is raising community awareness of the relationship between community development practices and the level of flood hazard vulnerability and risk. Raising citizen awareness can help gain support for ongoing mitigation planning efforts.

# PART F

## FLOOD MITIGATION TOOLS

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According to the Michigan State Police's 2003 Local Hazard Mitigation Planning Workbook, the five basic hazard mitigation approaches, or strategies, are as follows for flooding.

Five Basic Hazard Mitigation Approaches	
✓	<b>Strategy #1 – Modify the Hazard</b> to remove or eliminate it. Modification will reduce its size or amount, or control the rate of release of the hazard. Examples include slope planting (to reduce erosion) and stream widening or modification to improve water flow.
✓	<b>Strategy #2 – Segregating the Hazard</b> to try to " <i>keep the hazard away from the people.</i> " This is often accomplished in flood prone areas through the construction of structural protection measures such as dams, levees, floodwalls, etc. that redirect the impacts of a flood away from people and developed properties.
✓	<b>Strategy #3 – Preventing or Limiting Development</b> in locations where people and structures would be at risk. This approach seeks to " <i>keep the people away from the hazard</i> " and includes a variety of land use planning and development regulation tools, such as comprehensive planning, zoning, floodplain management ordinances, capital improvements planning, disclosure laws, and the acquisition and relocation of hazard-prone properties.
✓	<b>Strategy #4 – Altering Design or Construction</b> to make it less vulnerable to disaster damage. Also known as " <i>interacting with the hazard,</i> " it focuses on engineering structures to withstand potentially destructive impacts. Examples include elevation above flood levels as well as wet and dry floodproofing measures.
✓	<b>Strategy #5 – Early Warning and Public Education</b> to ensure that the public is aware of potential hazards, and that proper warning and communication systems are in place to save lives and protect property.

*Source Local Hazard Mitigation Planning Workbook, EMD/MSP, February 2003*

All five of these **strategies** for mitigating flood hazards were considered by Bridgeton Township. This process resulted in the following potential **tools**, or alternatives, for flood mitigation. The tools are categorized as being preventive, corrective, protective, responsive, or educational, with several categories containing some structural components.

While the intent of utilizing these tools is to mitigate flood hazards, an additional benefit will be reaped. Property values for homes in the floodplain should be increased since their risks and vulnerabilities will be decreased.



## I. PREVENTIVE MEASURES

Preventive measures protect new construction from hazards and assure that future development does not increase the potential for losses. They are particularly important in Bridgeton Township where there is an abundance of land that could be developed. They are usually administered by planning, zoning, code enforcement, and local officials and include the following:

- Building Permits;
- Building Codes;
- Standards for Manufactured Homes;
- Planning;
- Zoning;
- Capital Improvements Planning;
- Subdivision Regulations; and
- Stormwater Management.

### a. Building Permits

The National Flood Insurance Program (NFIP), in which Bridgeton Township participates, sets minimum requirements for regulating development in identified floodplains. All new buildings must be protected from base flood elevations (BFE), or 100-year floodplains, and no development can cause an increase in flood heights or velocities. Participating communities are required to regulate all development in these special flood hazard areas (SFHA).

Regulation of development in SFHA's may include requiring state and local permits for activities such as new building construction; additions to existing buildings; substantially improving existing buildings; placing manufactured (mobile) homes; subdivisions of land, temporary buildings and accessory structures; agricultural buildings; parking/storage of recreational vehicles; temporary or permanent materials storage, including gas/liquid tanks and sand/gravel; roads, bridges, and culverts; fill, grading, excavation, mining, and dredging; and altering stream channels.

According to township procedures since the late 1980's, anyone interested in obtaining a building permit for a property in or near the floodplain must complete a series of prerequisites; the first of which is to obtain an elevation certificate to determine if the property is located within the SFHA. These certificates are kept by and available through the township building inspector. If the property is found to be located within the SFHA, the applicant must procure a septic permit from the county Health Department, as well as a floodplain permit from the Michigan Department of Environmental Quality (MDEQ).

Part 31, Water Resources Protection of the Natural Resources and Environmental Protection Act, 451 PA 1994, as amended, is the primary state regulation that deals with construction within **floodplains** and requires permits to occupy, fill, or grade lands in it. MDEQ's Land and Water Management Division (LWMD) has responsibility to review permit applications to assure that channels and **floodways** are not inhabited, that the capacity of the floodway is not unduly restricted, and that the watercourse's flow carrying capacity is maintained for those projects that are permitted in the floodplain.

While the Act is quite specific about prohibiting the residential occupation of the floodway, there are many existing structures within floodways and these structures are “grandfathered in”. A structure can be remodeled, as long as its size (also referred to in this case as its “footprint”) is not increased, and can remain in the floodway indefinitely.

The effectiveness of these regulations rests on a municipality’s ability to identify floodways and floodplains so that it can enforce development restrictions within them. The Bridgeton Township Flood Insurance Study and the Flood Insurance Rate Map, both published in 1990, are important tools in this process. Unfortunately these documents are not as complete and accurate as they should be. For example, only the uppermost ¼ of the township’s Muskegon River floodplain was given detailed analyses. Information for the remaining ¾ of the floodplain was obtained from approximate analyses previously conducted for the 1986 version of the FIRM and does not include specific delineation of the floodway. Floodway in these areas is considered to be all land surfaces situated one foot or more below the estimated base flood elevation shown on the FIRM.

The accuracy and delineation of many mapped floodplains is subject to continuing debate. For that reason, FEMA is undertaking a map modernization initiative to map all communities in the nation and produce updated digitized flood maps. The MDEQ has proposed a statewide floodplain mapping business plan to complement and supplement the federal map modernization program.

Under the Cooperating Technical Partner Program of the MDEQ/LWMD, the state and local communities with demonstrated resources and expertise are delegated the authority to review and publish NFIP studies without the need for further federal review. They may also process revisions to existing NFIP studies and then re-map the floodplain. Local community resources may include, but are not limited to, gathering of field data, labor, funding, in-house information, and providing technical expertise to print the floodplain maps. The MDEQ/LWMD devotes staff time and technical expertise to develop hydraulic models and produce the NFIP reports and associated digital floodplain maps which are then made available on the MDEQ/LWMD web site.

**b. Building Codes**

Building codes are designed to ensure that a building or other structure will be constructed in such a manner as to be safe for occupancy and use and provide one of the best methods of addressing hazards. Flood protection standards for all new and improved/repared vulnerable buildings can be incorporated into the local building code and are sometimes mandated by federal and state government.

Bridgeton Township employs its own building inspector, and utilizes Newaygo County employees for electrical, mechanical, and plumbing inspections. Both municipalities abide by the 2003 Michigan Residential Code and the 2003 Michigan Building Code for commercial construction, often called the State Construction Code. It incorporates standards for building, plumbing, electrical, and mechanical work and was based on updates to the 2003 International Building Codes.

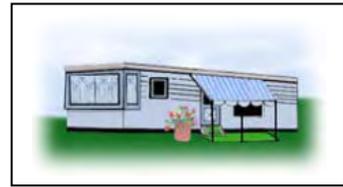
For residential structures within or affected by floodplains, the State Construction Code requires that structures have lowest floors, including basements, one foot above the base flood elevation. The Code also requires that utilities and mechanical equipment be elevated above the 100-year flood elevation or protected so as to prevent water from

entering or accumulating within the components during the occurrence of a 100-year flood.

At the national level, the Insurance Services Office (ISO) has undertaken a major initiative designed to foster better building code enforcement. Under the ISO's Building Code Effectiveness Grading Schedule (BCEGS), local building departments are "graded" on their code enforcement efforts. The NFIP's Community Rating System (CRS) awards credit for BCEGS participation, which is used by the insurance industry to determine how well new construction is protected from non-flood natural hazards. Both the BCEGS and the CRS operate under the assumption that communities with well-enforced, up-to-date codes will experience fewer damages.

**c. Standards for Manufactured Homes**

Manufactured or "mobile" homes (of which there are 279 in the township) are usually not regulated by local building codes since they are built in out-of-state factories and then shipped to sites. However, they must comply with the U.S. Department of Housing and Urban Development's local standards for on-site installation, both in terms of location and technique. The greatest flood mitigation concern with manufactured housing is appropriate installation. FEMA's Building Performance Assistance Team (BPAT), following assessments of hurricane damage, found that building officials were often unaware of manufacturer's installation guidelines with respect to permanent foundations.



The Michigan Manufactured Housing Commission Act (Act 96 PA 1987, as amended) provides regulation on the placement of manufactured homes and establishes construction criteria. Manufactured homes are prohibited from being placed within a **floodway**, as determined by the Department of Environmental Quality (MDEQ). In addition, manufactured homes sited within a **floodplain** must install an approved anchoring system to prevent the home from being moved from the site by floodwaters, and be elevated above the 100-year elevation. Proper permits must be obtained from the Michigan Department of Environmental Quality before placing mobile homes in flood plains.

The township's Greenbelt Preservation District, which roughly corresponds to the 100-year floodplain, expressly prohibits permanent mobile home parks. Mobile homes may be temporarily located in the greenbelt provided a special use permit, not to exceed 120 days, is procured from the township. These mobile homes must be removed upon expiration of the permit unless the following requirements are met: (1) the mobile home meets floor area requirements of the L-R Zone; and (2) the mobile home is located in a public or private seasonal park; provided the park is secured against public entry during the months it is closed. The zoning ordinance also stipulates that no mobile homes located within the Greenbelt should be inhabited on a permanent basis.

**d. Planning**

Comprehensive planning is the primary tool used by communities to address future development. While building codes provide guidance on how to build in hazardous areas, planning activities direct development away from these areas, especially floodplains and wetlands. Comprehensive plans can also reduce future flood-related

damages by recommending open space preservation or recreational development within floodplains and other hazardous areas. They do this by designating land uses that are compatible to the natural conditions of the land or by simply allowing developers more flexibility in arranging structures on a parcel of land through the planned development approach.

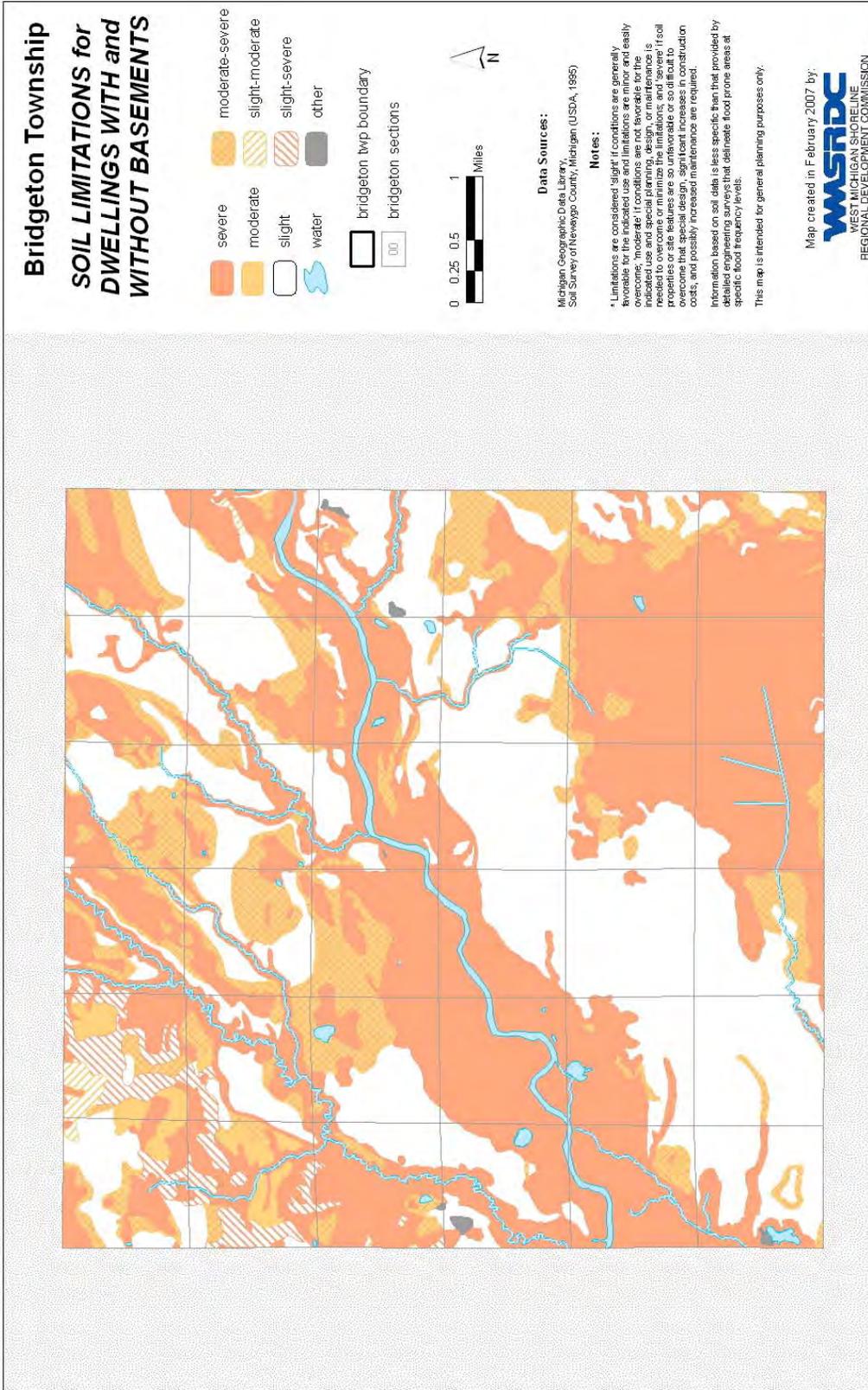
Natural resources and features aid in determining the land's suitability for different types of development. Topography, water features, and soils must be taken into account in development decisions in order to help protect development from predictable damage caused by natural features. The suitability of soils for roads, foundations, wells, and septic systems is critical in determining the location and intensity of development. Characteristics such as depth, slope, permeability, wetness, shrink-swell potential, sedimentation potential, and weight-bearing capacity should be carefully considered.

According to the Soil Survey of Newaygo County, the majority of soils along and near the Muskegon River possess properties which severely limit the development of residential dwellings; both with and without basements. The list below describes soil limitations within the sections discussed in Chapter D.

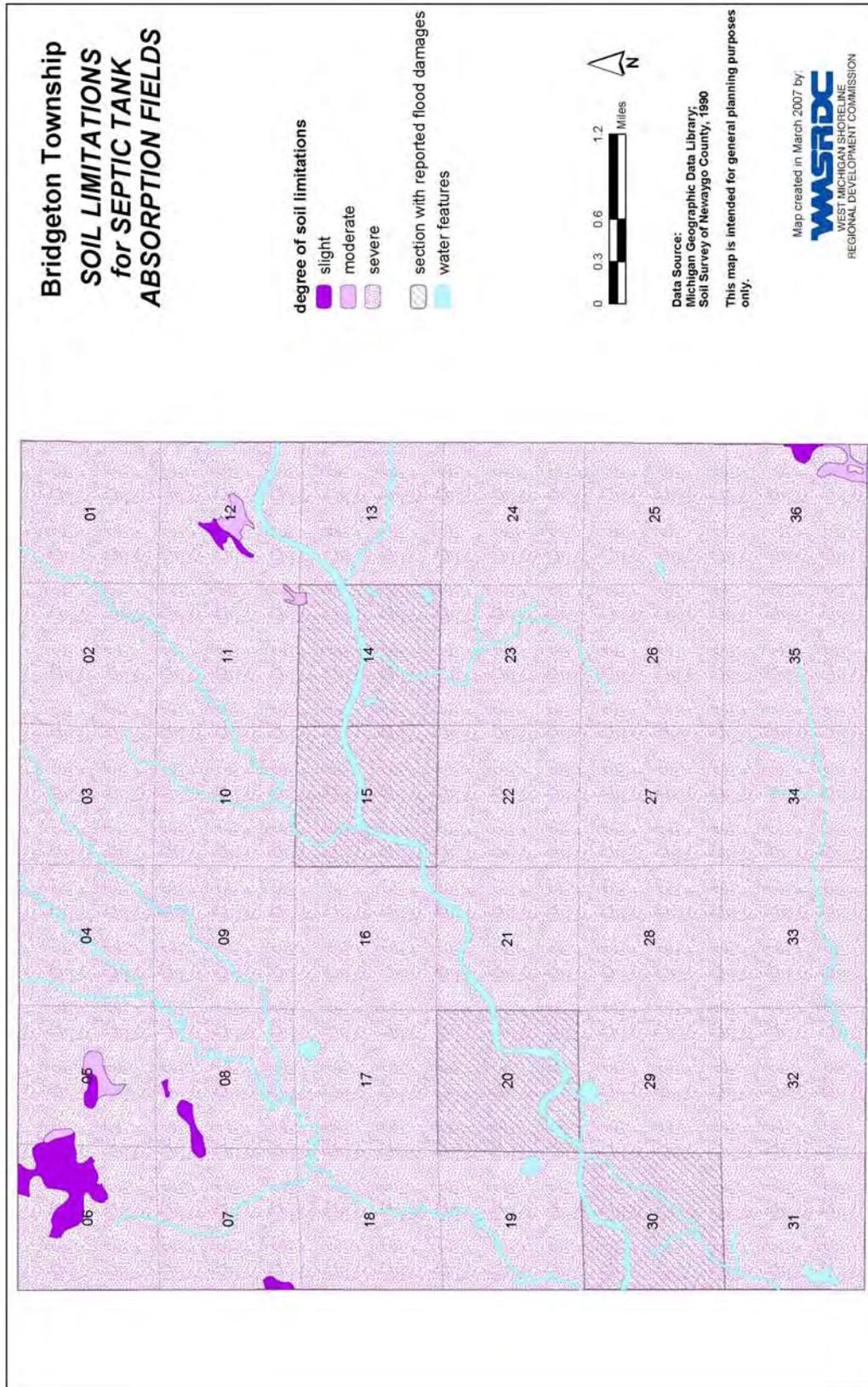
- **Section 13** – Limiting soils are located along and near the Muskegon River and Sand Creek, and in the north-central portion of the section
- **Section 14** – Limiting soils are widespread. The only soils without severe limitations are located well away from the Muskegon River in the southern quarter of the section.
- **Section 15** – Limiting soils are widespread. Isolated locations without these soils are located north of the Muskegon River, east of Minnie Creek, and also in the southeast corner of the section.
- **Section 20** – Limiting soils are widespread.
- **Section 30** – Limiting soils are widespread. Only the southeast and northwest corners of the section contain soils without such limitations.

Probably the biggest obstacle to effective utilization of comprehensive planning as a tool for reducing community risk and vulnerability is the lack of a requirement to incorporate hazard mitigation as an element of a plan. Unfortunately, plans do not always consider natural hazards in specific land use recommendations and, also, are not always connected to implementation ordinances. Additionally, the level of detail is different than that of the implementation or zoning ordinance. For instance, Bridgeton Township's 2002 Land Use Plan does not have a land use classification for wetlands or areas along the river. In contrast, the Zoning Ordinance contains a Greenbelt District. Conversely, the Land Use Plan has a PUD classification while the Zoning Ordinance does not.

## MAP 22

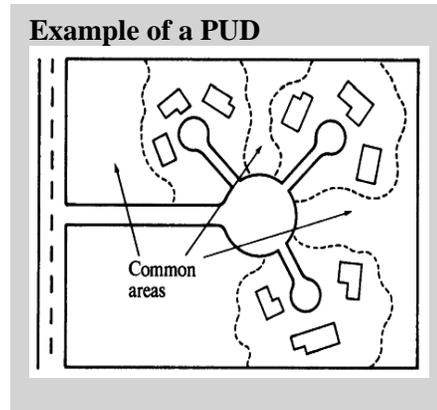


# MAP 23



**e. Zoning**

Zoning codes are considered the primary tool to implement a comprehensive plan’s guidelines for how land should be developed and must be based on adopted land use plans to be legally defensible and enforceable. They regulate development by prohibiting development in some areas, such as in floodplains, and by dividing communities into zones or districts and setting development criteria for each zone or district. While zoning ordinances set minimum lot sizes for each zoning district, communities can allow flexibility in lot sizes and location so that developers can avoid hazardous areas. One way to encourage such flexibility is to use the planned unit development (PUD) approach, which allows the developer to easily incorporate flood hazard mitigation measures into the project. Open space and/or floodplain preservation can be accommodated with site design standards and adjusted land use densities. Granting larger minimum lot sizes, i.e. four or five acres, for areas next to watercourses not only allows streams to run near lot lines but also gives developers the flexibility to build on higher ground while still including floodplains in backyards.

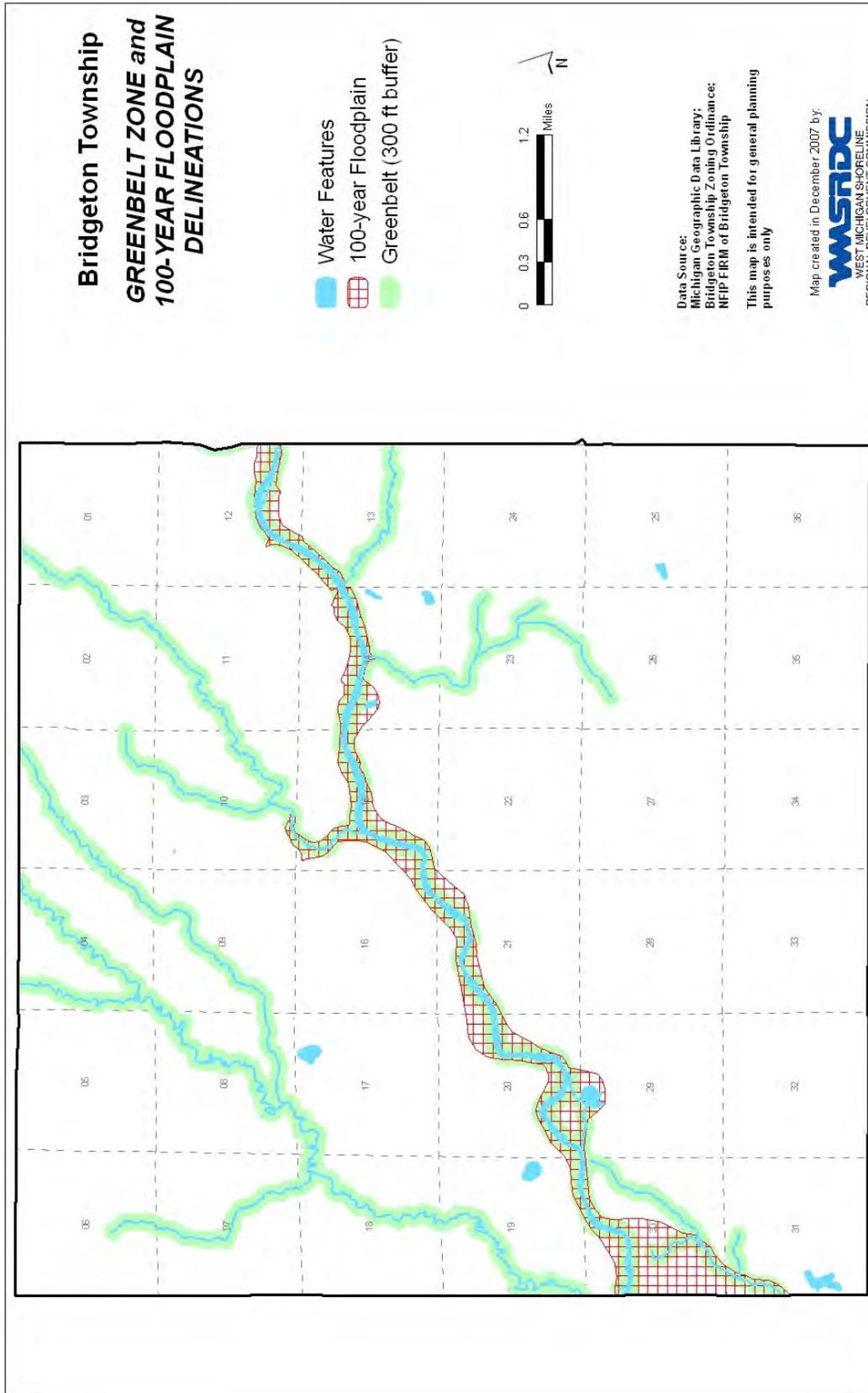


Bridgeton Township’s current zoning ordinance, which is undergoing revision, enforces Greenbelt District restrictions within 300 feet of the Muskegon River and its tributaries. These restrictions are described below. It should be noted that the Greenbelt District does not exactly align with floodplain boundaries as is evidenced on the following map.

**BRIDGETON TOWNSHIP GREENBELT DISTRICT**

- ≈ All land within 300 ft of the water’s edge of the Muskegon River and all its tributaries comprise the Greenbelt Zone.
- ≈ No structure may be erected within 150 feet of the water edge, except that for every foot of bank height above a minimum of seven feet above normal river flow, the new structures can be placed five feet closer to the river to a minimum of 100; provided that pumphouses may be built except in the floodplains; and docks which do not extend more than four feet into the water are permitted.
- ≈ Every residential lot shall have a minimum lot area of 60,000 square feet and a minimum lot width of 150 feet.
- ≈ Trees and shrubs may be pruned or trimmed to obtain view of the river or stream.
- ≈ Plans for any construction, grading of any lot or subdivision preparation which involves removal of ground cover shall conform to the sedimentation control rules of the Newaygo County Soil Conservation District and no building permits shall be issued until such conformity is assured.
- ≈ No septic tank drainfield may be closer than 100 feet to the water’s edge or less than four feet above the high water table and shall in placement and design conform to all regulations of the Health Department.
- ≈ Permitted land uses include: one residence on each lot; farms, provided that no animals, fowl, structures, enclosed pens, or runs required for keeping the same are located within the greenbelt; home occupations and private swimming pools; signs, as regulated; institutional uses or essential services.
- ≈ Special land uses include recreation, campgrounds (supervised), and public or private recreational parks.
- ≈ Expressly prohibited uses include: motel, hotel, apartments, mobile home parks, row houses, and garage apartments.
- ≈ A pumphouse may be permitted in a waterfront yard provided it is not more than 30 inches in height.
- ≈ Docks are permitted, provided they do not extend more than four feet into water.

# MAP 24



**f. Capital Improvements Planning**

Capital improvement plans guide major public expenditures for communities for the next five to twenty years. Capital expenditures may include: acquisition of open space within hazardous areas; extension of public services into hazardous areas; installing or improving drainage ditches, culverts and spillways; retrofitting existing public structures to withstand hazards; tree management; water detention and retention basins; debris detention basins; debris removal; bridge construction and modifications; etc. In Bridgeton Township, capital improvement expenditures are not governed by a formal plan. Approximately 30-40% of its funds are expended on road improvements, with roads and the township hall being the main capitals.

**g. Subdivision Regulations**

The purpose of Michigan’s Land Division Act (P.A. 591 of 1996), formerly known as the Subdivision Control Act (P.A. 288 of 1967), is to regulate the division of land. It also gives power to provide for proper ingress and egress to lots and parcels and to control residential building development within floodplain areas. Standards for roads, utilities, and drainage ways; can include the following hazard protection standards:

- Identification of all hazardous areas;
- Road standards that are no more than one foot below flood elevation; and
- Lots with building sites above the flood level.

While the Subdivision Control Act was operative when parts of Bridgeton’s four subdivisions were being developed, the Land Division Act now sets construction standards. The Land Division Act allows county drain commissions to publish rules governing the internal drainage of proposed subdivisions and outlets for drainage. Proposed subdivisions are reviewed by the County Drain Commissioner for proper drainage and by the Michigan Department of Environmental Quality/Land and Water Management Division for floodplain impacts.

**h. Stormwater Management**

New construction in a floodplain increases the amount of development exposed to damage and can aggravate flooding on neighboring properties. Development outside a floodplain can also contribute to flooding problems since stormwater runoff is increased when natural ground cover is replaced by development. Development in a watershed that drains to a river can aggravate downstream flooding, overload the community’s drainage system, cause erosion, and impair water quality.

Stormwater management encompasses two approaches to protecting new construction from damage by surface water:

- Regulating development in the floodplain to ensure that it will be protected from flooding and that it won’t divert floodwaters onto other properties; and
- Regulating all development to ensure that the post-development peak runoff will not be greater than under pre-development conditions.

Michigan’s Drain Code (Act 40 of 1956), administered by county drain commissioners, contains regulations regarding set-backs from the established drain channels to assure proper carrying capacity of the drains. The code officially “establishes laws relating to the laying out of drainage districts, the consolidation of drainage districts, the construction and maintenance of drains, sewers, pumping equipment, bridges, culverts, fords, and the structures and the mechanical devices to properly purify the flow of drains”. It also “gives authority to provide for flood control projects, to provide for water management, water management districts and sub-districts, and for flood control and drainage projects within the districts”.

Currently, Newaygo County abides by regulations laid out in the March, 2003 document entitled “Newaygo County Drain Commissioner Subdivision Drainage Rules and Stormwater Design Criteria”. Stormwater runoff regulations supplement efforts to regulate development by requiring developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. In general, each development must not let stormwater leave at a rate higher than it did under pre-development conditions.

Stormwater ordinances can be adopted by townships and can be more restrictive than county rules and criteria. They may set requirements for managing runoff from new developments and may require storage facilities based on the size of the development and capacity. Examples include:

- Promoting the use of native vegetation within the runoff storage basins;
- Requiring buffers along streams, lakes, wetlands, etc.;
- Requiring retention or infiltration of the initial runoff; and
- Requiring existing depressional storage (areas not designated as floodplains) to be compensated for at a 1:1 ratio.

## II. CORRECTIVE MEASURES

When structures and communities are located in hazardous areas, corrective measures are directed at working with current conditions. Examples of the more common corrective measures include:

**Modifications.** Modifications to a site and/or to a structure. Examples include constructing barriers, landscape grading, or retrofitting existing structures to be damage resistant (i.e. floodproofing existing buildings, etc.).

**Relocation.** Permanent evacuation of hazard-prone areas through movement of existing hazard-prone development and population to safer areas. The two common approaches to relocation are physical removal of buildings to a safer area with future use of the vacated area limited to permanent open space, and replacing existing land uses with others that are less vulnerable to the hazard.

**Acquisition.** Public acquisition and management of lands that are vulnerable to damage from local hazards. Following acquisition, land uses more appropriate to the degree of risk may be chosen. Public acquisition has been achieved by: (a) purchase at full market value; (B) purchase at less than market value through such methods as foreclosure of tax

delinquent property, bargain sales, purchase and lease back, etc.; (c) donation, through reserved real estate, donation by will, donation and lease back; (d) leases; and (e) easements.

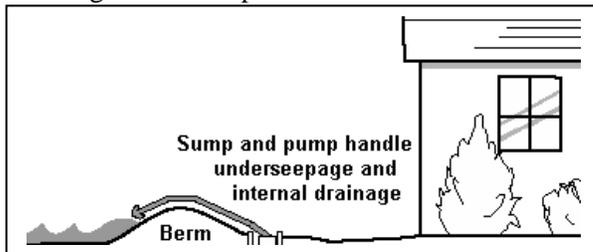
Modification measures are normally implemented by property owners and include actions to modify the site to keep the hazard from reaching the building; to modify the building/site, or retrofit it, so that it can withstand the impacts of the hazard; and to insure the property to provide financial relief after damage occurs. Relocation and acquisition measures can be implemented by property owners and/or government through technical and financial assistance. Repetitive loss properties deserve special attention because they are more prone to damage by natural hazards than other properties and protecting such buildings is a priority with FEMA and EMD/MSP mitigation funding programs.

**a. Site Modification (Keeping the Hazard Away)**

Natural hazards generally do not damage vacant areas but instead threaten people and improved property. In some cases, properties can be modified so the flooding hazard does not reach the damage-prone improvements. Four common methods to accomplish this include:

- Erect a barrier between the building and the source of the flooding;
- Move the building out of the flood-prone area;
- Elevate the building above the flood level; and
- Demolish the building.

A flood protection barrier can be built of dirt or soil; which is called a “berm” or “levee”; or concrete or steel; which is called a “floodwall”. Careful design is needed so as not to create flooding or drainage problems on neighboring properties. Depending on how porous the ground is, if floodwaters stay up for more than an hour or two, the design must account for leaks, seepage of water underneath, and rainwater that falls inside the perimeter. This is usually done with a sump and/or drain to collect the internal groundwater and surface water, and a pump and pipe to remove the internal drainage over the barrier. Barriers can only be built so high and can therefore be overtopped by floods higher than expected. Berms can settle over time, and are susceptible to erosion from rain and floodwaters if not properly



sloped, covered with grass, and maintained, lowering their protection level. Floodwalls can crack, weaken, and lose their watertight seals. Therefore, barriers need careful design and maintenance and should be insured in case of failure.

The surest and safest way to protect a building from flooding is to move it to higher ground, such as was done in Bell Meadow in the late 1980's by a private homeowner. Almost any building can be moved but the cost climbs for heavier structures, such as those with exterior brick and stone walls, and for large irregularly-shaped buildings. In areas subject to flash flooding, deep waters, or other high hazard, relocation is often the only safe approach. Relocation is also preferred for large lots that include buildable areas

outside the floodplain or where the owner has a new flood-free lot (or portion of the existing lot) available.

Raising a building above the flood level, as was done twice in Freight Hill, can be almost as effective as moving it out of the floodplain. It is appropriate in areas where flood waters can spread (such as where Bridgeton's repetitive loss property is located), thereby reducing the force of the current. Water flows under the building, causing little or no damage to the structure or its contents. Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. Elevation has proven to be an acceptable and reasonable means of complying with floodplain regulations that require new, substantially improved, and substantially damaged buildings to be elevated above the base flood elevation. On the other hand, several concerns with building elevation are listed below.

- Elevating a building will change its appearance. If the required amount of elevation is low, the result is similar to putting a building on a 2' or 3' high crawlspace. If the building is raised 4', 6', or more; owners are concerned that it will stick out like a sore thumb and may decline to implement an elevation project.
- Only the first floor and higher are elevated, while the basement remains as the foundation. All utilities are elevated and the basement is filled in to protect the walls from water pressure. The owner loses the use of the basement, which may deter him or her from trying this approach.
- Elevation may expose the structure to greater impacts from other hazards. If not braced and anchored properly, an elevated building may have less resistance to the pressures of high winds.
- Access can be lost when floodwaters overtop local roads, driveways, and culverts or ditches. If this happens frequently and alternate access is not available, roadways might have to be elevated and crossing points improved.

Some buildings, especially heavily damaged or repetitively flooded ones (such as those in the floodways), are not worth the expense to protect them from future damage (floodways have many code requirements for repair, expansion or replacement of structures). It is cheaper to demolish them and either replace them with new, flood-protected structures, or relocate the occupants to a safer site. In general, demolition projects are undertaken by a government agency so the cost is not borne by the property owner. The land may then be converted to public use, such as a park.

Acquisition, followed by demolition, is also appropriate for buildings that are difficult to move (such as larger, slab foundation, or masonry structures) and for dilapidated structures that are not worth protecting. One problem sometimes resulting from an acquisition and demolition project is a "checkerboard" pattern in which non-adjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to relocate.

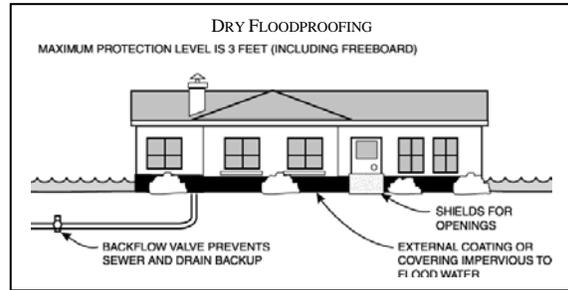
Following the flooding of September 1986, Newaygo County experienced two acquisition projects and a relocation project. In Everett Township, a parcel on the White River was acquired and flood-damaged structures were demolished. Along the Muskegon River, a wastewater treatment plant in the City of Newaygo was relocated out

of the floodplain, and 50 parcels in Garfield Township were purchased, demolished, and returned to their natural state.

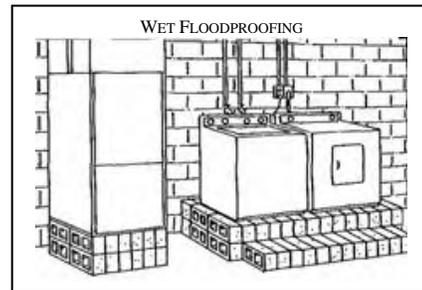
**b. Building or Site Modification (Retrofitting)**

An alternative to modifying the site to keep the hazard away is to modify or “retrofit” the site or building to minimize or prevent damage. There are a variety of techniques to do this. This section looks at the measures that can be implemented to protect existing buildings from damage by floods.

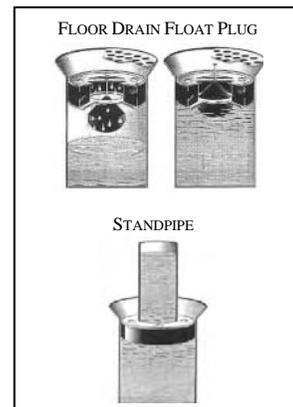
Flood retrofitting measures include dry floodproofing where all areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings (doors, windows, and vents) are closed either permanently, or with removable shields or sandbags. Sump pumps are used to remove any water that enters. Dry floodproofing of new and existing non-residential buildings in the regulatory floodplain is permitted under state and FEMA regulations. Dry floodproofing existing residential buildings in the floodplain is also permitted as long as the building is not substantially damaged or being substantially improved. Dry floodproofing is also a viable option for homes located outside the regulatory floodplain.



The alternative to dry floodproofing is wet floodproofing, where water is let in and everything that could be damaged by a flood is removed or elevated above the flood level. Structural components below the flood level are replaced with materials that are not subject to water damage. For example, concrete block walls are used instead of wooden studs and gypsum wallboard. The furnace, water heater, and laundry facilities are permanently relocated to a higher floor or raised on blocks or platforms where the flooding is not deep. Simply moving furniture and electrical appliances out of a basement can prevent a great deal of damage.



A third flood protection modification addresses flooding caused by overloaded septic systems. Four approaches may be used to protect a structure against septic backup: floor drain plugs, floor drain stand-pipes, overhead sewers, and backflow protection valves. The first two devices keep water from discharging from the lowest opening (the floor drain) into the building and are inexpensive. However, if water becomes deep enough in the sanitary system, it can flow out of the next lowest opening, such as a toilet or tub, or it can overwhelm a drain plug by hydrostatic pressure and flow into the building through the floor drain. The other two measures, overhead sewers and backflow protection valves, keep water in the sewer line during backup and are more secure but more



expensive.

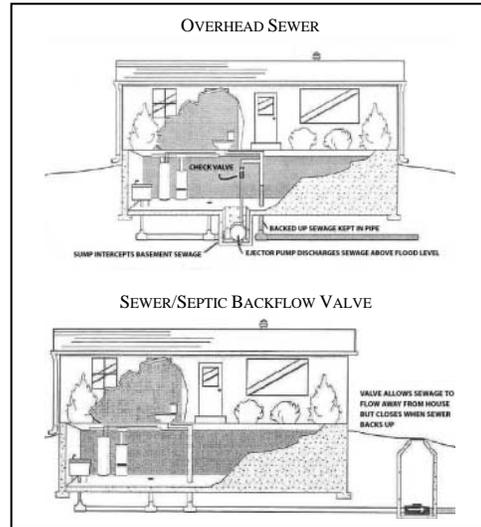
Other considerations for the minimization of flooding damages include: stronger anchoring requirements for mobile homes, propane tanks, and hazardous materials in the floodplain/floodway; assurance of proper location, cleaning, and maintenance of septic tanks; and backup power for sump pumps. Septic tanks should be closed or sealed and should be vented at least 1 foot above the base flood elevation. Septic tanks in the flood plain are allowed by the Health Department to have access covers for cleaning.

### c. Insurance

Technically speaking, insurance does not mitigate damage caused by a natural hazard. However, it does help the owner repair, rebuild and (hopefully) afford to incorporate some of the other mitigation measures in the process. Flood insurance can protect property owners and renters from flood related damage even if the flood only covers a small area. Fortunately, unlike most other federal disaster assistance which is only available if the President declares a disaster, a flood insurance claim does not depend on a government disaster declaration.

Standard homeowner's insurance policies almost always exclude damage from surface flooding and owners must purchase such coverage through the National Flood Insurance Program (NFIP), which is available if they live in communities participating in the program (such as Bridgeton Township). Banks and mortgage companies require flood insurance when loans are for purchase or repair of properties located in floodplains if the loans are federally insured. The purchase of flood insurance is frequently prudent even outside floodplains. Single family dwellings and 1-4 family dwellings in Zone X are eligible for special low cost coverage at predetermined, reduced premium rates. These policies are referred to as Preferred Risk Policies.

Flood insurance may be purchased through a licensed private insurance company or independent property and casualty insurance agent. A number of factors are considered in determining the premium for flood insurance



#### ***FYI: Claims for Flood Insurance***

may be made any time there is flood damage to a covered structure, structural component, utilities, or contents covered by contents coverage. A "flood" is defined in the Standard Flood Insurance Policy as follows:

- ≈ A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is the policyholder's property) from:
  - Overflow of inland or tidal waters; or
  - Unusual and rapid accumulation or runoff of surface waters from any source; or
  - Mudflow; or
- ≈ Collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

coverage. They include the amount of coverage purchased; location; age of the building; building occupancy; design of the building; and, for buildings in SFHAs, elevation of the building in relation to the base flood elevations.

The goals of the Community Rating System (CRS) of the NFIP are to reduce flood losses (especially for repetitive loss properties), facilitate accurate insurance rating; and promote the awareness of flood insurance. Through the NFIP's Community Rating System (CRS), NFIP communities are awarded points based on the various flood protection activities they are engaged in. These points are then applied to a rating system (see Table 16) used to grant insurance premium reductions based on the number of points attained by each community. This can result in savings to property owners, who spend substantial amounts of money for flood insurance each year. The township's twenty-four in-force residential flood insurance policies, with a total of \$3,101,900 in flood insurance coverage, have annual premium costs totaling \$13,568, or an average of \$565.33 per policy per year.

**TABLE 16**

<b>NFIP CRS Credit Scale</b>			
<b>Credit Points</b>	<b>Class</b>	<b>Premium Reduction</b>	
		<b>SFHA *</b>	<b>Non-SFHA **</b>
4,500+	1	45%	10%
4,000 – 4,499	2	40%	10%
3,500 – 3,999	3	35%	10%
3,000 – 3,499	4	30%	10%
2,500 – 2,999	5	25%	10%
2,000 – 2,499	6	20%	10%
1,500 – 1,999	7	15%	5%
1,000 – 1,499	8	10%	5%
500 – 999	9	5%	5%
0 – 499	10	0	0

\* Special Flood Hazard Area  
 \*\* Preferred Risk Policies are available only in B, C, and X Zones for properties that are shown to have a minimal risk of flood damage. The Preferred Risk Policy does not receive premium rate credits under the CRS because it already has a lower premium than other policies. Although they are in SFHAs, Zones AR and A99 are limited to a 5% discount. Premium reductions are subject to change.

Source: FEMA

**d. Technical and Financial Assistance**

Although corrective measures are usually considered the responsibility of the property owner, there are various roles the county or a municipality can play in encouraging and supporting implementation of these measures. Providing basic information to property owners is an important action that can be taken to support property protection measures. In addition, communities can assist residents with referrals to home repair programs.

Another step is to help pay for a retrofitting project. Some communities assume responsibility from street flooding and other problems that arise from an inadequate public drainage system. Less expensive community programs include low-interest loans, forgivable (after a certain period of occupancy) loans, and rebates. Cost-sharing programs, such as rebates, to encourage low-cost (under \$10,000) property protection measures on private property (surface and sub-surface drainage, sewer back-up

protections, berms, furnace and water heater relocations, etc.) should be considered. These approaches don't always fully fund the project but they either cost the community less or increase the owner's commitment to the retrofitting project.

The community can be the focal point in an acquisition project. Most funding programs require a local public agency to sponsor the project. The county or township could process the funding application, work with the owners, and/or provide some or the entire local share. In some cases, the local government would be the ultimate owner of the property, but in other cases a public agency could assume ownership and maintenance responsibilities. The West Michigan Land Conservancy is an organization that can help by purchasing and holding certain lands until a government agency or other party can take possession.

Financial assistance can range from full funding of a project to helping residents find money from other programs. The more common outside funding sources for hazard mitigation are listed below. Unfortunately, some are only available after a disaster, not before, when damage could have been prevented. Following such disaster declarations in the past, FEMA, the Emergency Management Division of the Michigan State Police, and the Michigan Department of Natural Resources have provided assistance on how to qualify and apply for these funds.

Pre-Disaster Funding Sources

- FEMA's Flood Mitigation Assistance (FMA) grants (administered by EMD/MSP);
- FEMA's Pre-Disaster Mitigation (PDM) grants (administered by EMD/MSP);
- Community Development Block Grant (CDBG) funds (administered by the Michigan Economic Development Corporation);
- Michigan Department of Natural Resources (MDNR);
- Natural Resources Conservation Service (NRCS), United States Department of Agriculture (USDA); and
- Conservation organizations, although generally these organizations prefer to purchase vacant land in natural areas, not properties with buildings on them.

Post-Disaster Funding Sources

- Insurance claims; and
- The National Flood Insurance Program's Increased Cost of Compliance provisions, which increases the claim payment to cover a flood protection project required by code as a condition to rebuild the flooded building (administered by FEMA).

Post-Disaster Funding Sources Based on a Federal Disaster Declaration

- FEMA's disaster assistance for public properties. However, the amount of assistance will be reduced by the amount of flood insurance that the public agency should have carried on the property (administered by EMD/MSP);
- Small Business Administration (SBA) disaster loans (for non-governmental properties);
- FEMA's Hazard Mitigation Grant Program (HMPG) funds (administered by EMD/MSP); and
- CDBG Disaster Recovery Assistance (administered by the US Department of Housing and Urban Development).

**e. Mandates**

Mandates are considered a last resort if information, funding, and incentives aren't enough to cause protective actions. An example of mandated retrofitting is the requirement that buildings in floodplains be elevated or brought up to current flood protection codes if "substantial" repair costs equal or exceed 50% of the value of the original building. Another possible mandate is to require less expensive hazard protection steps as a condition of approval from a home improvement project. For example, if a person were to apply for a permit for major rehabilitation, the community could require that the service box be moved above the base flood elevation or that separate ground fault interpreter circuits be installed in the basement. Such requirements could be supported by Michigan's 2003 Rehabilitation Code for Existing Buildings, akin to the Construction Code, which can be adopted by local municipalities.

An extreme mandate would be to "Fill Your Basement with Water". If the mandate were issued in an NFIP community during flood conditions, under FEMA procedures, FEMA funds would later be made available to assist with repairs. However, those repairs would be less expensive since filling the basement would equalize pressure from saturated soils on building walls with water tight, near water tight, or pumped out basements. It would also facilitate clean-up because there is clean water instead of silt and sewage-laden muddy water in the structure.

**f. Summary**

Appropriate property protection measures are based on studies of flood and building conditions. General guidelines, which are not site specific, are as follows.

- Buildings in high hazard areas (in the floodway or where the 100-year flood is two or more feet over the first floor) or in less than good condition should be acquired and demolished.
- Buildings with basements and split-level foundations in high hazard areas should be acquired and demolished. They are too difficult to elevate and the hydrostatic pressure on the wall from deeper flooding make them too risky to protect in place.
- Buildings subject to shallow flooding from local drainage should be protected through area-wide flood control or sewer improvement projects.
- Buildings in good condition on crawlspaces should be elevated or relocated.
- Buildings in good condition on slab, basement or split-level foundations subject to shallow flooding (less than 2 feet) can be protected by barriers and dry floodproofing.

**III. RESOURCE PROTECTION**

Resource protection activities are generally aimed at preserving (or in some cases restoring) natural areas as development occurs so that these areas can, in turn, provide hazard protection. For instance, watersheds, floodplains, and wetlands can reduce run-off from rainwater and snowmelt in pervious areas; reduce overland flood flow and store floodwaters; remove and filter excess nutrients, pollutants, and sediments; absorb flood energy; reduce flood scour; and recharge groundwater. If growth is not appropriately controlled and site

planning is not monitored; natural features can be lost and their ecological functions can be destroyed or altered.

Wetland preservation is of the utmost importance and is likely since wetlands have serious constraints for building. Other features, such as open space and vegetation, are more vulnerable and must be preserved. Areas of dense vegetation efficiently absorb and retain rainfall and prevent sedimentation. They are extremely beneficial in mitigating flood damages. Open spaces, adjacent to flood prone areas, are an ideal land use to help prevent extensive and expensive property damage when a flood occurs.

Floodplains, in their natural state, have an important impact on flooding. Flood waters can spread over a large area in floodplains that have not been encroached upon. This reduces flood velocities and provides flood storage to reduce peak flows downstream. Natural floodplains reduce wind and wave impacts and their vegetation stabilizes soils during flooding.

These natural benefits can be preserved through regulatory steps for protecting natural areas or natural functions. General regulatory programs are discussed in the section on Preventive Measures. This section covers resource protection programs and standards, including the following:

- Open space preservation;
- Wetland protection;
- Soil erosion and sedimentation control;
- River restoration;
- Best management practices;
- Dumping regulations; and
- Farmland protection.

**a. Open Space Preservation**

The best approach to preventing damage to new developments is to limit, prevent, or remove development within hazardous areas such as floodplains. Open space can be maintained in agricultural use or can serve as parks, greenways corridors, and golf courses.

Capital improvement plans and comprehensive land use plans can also identify areas to be preserved through any or all of the following means:

- Acquisition;
- Dedication by developers;
- Dedicating or purchasing an easement to keep the land open; or
- Specifying setbacks or buffer zones where development is not allowed.

The Bridgeton Township Parks and Recreation Master Plan - 2004 contains an inventory of the township's natural resources and parks. Documents such as this play an important role in increasing awareness of natural areas and helping to encourage preservation and protection of more open spaces. Pursuant to the creation and adoption of the Plan, Bridgeton Township was able to secure a grant to acquire an additional 5 acres adjacent to its 1.8-acre boat launch on the Muskegon River. This acquisition and subsequent

development (paved parking lot and building, including rest rooms) of the property will both increase recreational opportunities and prevent intensive development of it.

**b. Wetland Protection**

Wetlands that are part of the waters of the United States are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency (EPA) under Section 404 of the Clean Water Act. Proposed development in these wetlands requires a “404” permit, which can’t be issued until plans are reviewed and approved by several agencies including the Corps and the U.S. Fish and Wildlife Service. Small projects that meet certain criteria, as well as projects that are not in the Corps’ wetlands, may proceed under nationwide permits instead of under individual permits and are regulated by local authorities (i.e. the Michigan Department of Environmental Quality (MDEQ)). In either case, the impact of development must be mitigated.

Wetland mitigation, as defined in each issued permit, can include creation, restoration, enhancement or preservation of wetlands on the site or elsewhere – even in another watershed. It should be noted that, when a wetland is mitigated at another site, there are drawbacks to consider. First, it takes many years for a new wetland to approach the same quality as an existing one. Second, a new wetland in a different location (especially if it is in a different watershed) will not have the same flood damage reduction benefits as the original one did. Some developers and government agencies mitigate by buying into wetland banks, which are large wetlands created for the purpose of mitigation. The bank accepts money to reimburse the owner for setting the land aside from development.

**c. Soil Erosion and Sedimentation Control**

Farmlands and construction sites typically contain large areas of exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Erosion also occurs along streambanks as water flow (drainage, high water, and flooding such as in 1986) and wave action (sometimes caused by boats) wash away the soil. Suspended sediment tends to settle out where flowing water slows down and can clog storm sewers, drain tiles, culverts and ditches and can reduce the transport and storage capacity of water channels. When they are constricted and flooding cannot deposit sediment in the bottomlands, even more is left in the channels. The result is either clogged streams or increased dredging or “channelization” (straightening, deepening or widening the channel) costs.

There are two principal strategies to address these problems: minimize erosion and control sedimentation. Techniques to minimize erosion include phased construction, minimal land clearing, stabilizing bare ground and slopes as soon as possible with vegetation, no-wake laws when rivers are high, and other soil stabilizing practices (geo-textile fabrics, rip-rap boulders, etc.). Techniques to control sedimentation include: silt fences, sediment traps and vegetated filter strips. Runoff can be slowed down by terraces, contour strip farming, no-till farm practices, hay or straw bales, constructed wetlands, and impoundments (e.g., sediment basins and farm ponds) to reduce the volume of topsoil eroded from the site.

Erosion and sedimentation control regulations, which are usually oriented toward construction sites, mandate that these types of practices be incorporated into construction plans. They also require applicants for permits to submit erosion and sediment control

plans for construction projects. Michigan’s Soil Erosion and Sedimentation Control (Part 91 of 1994 P.A. 451, as amended) ordinance requires permits for projects or activities (not crop production) involving earth changes that disturb one or more acres of land or are located within 500 feet of a lake or stream. Enforcement of the ordinance can be handled by a designated county department, with assistance from the Conservation District, or a municipality. Newaygo County has five such agencies: Newaygo County Erosion Control, Newaygo County Road Commission, Newaygo Conservation District, Newaygo County Drain Commission, and the City of Fremont. Bridgeton Township’s Land Use Plan references the rules of the Newaygo County Soil Conservation District. Municipalities have the opportunity to adopt and enforce more stringent regulations, as long as they receive state approval and don’t conflict with state ordinance.

#### d. River Restoration

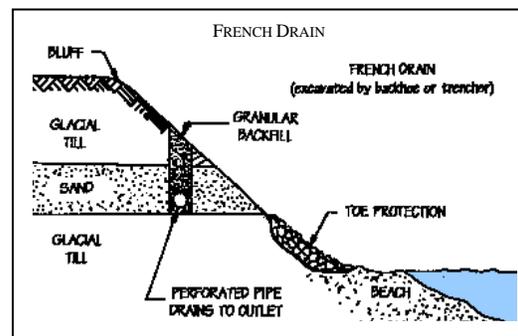
Approaches such as “stream conservation,” “bioengineering” or “riparian corridor restoration” aim to return streams, streambanks, and adjacent land to more natural conditions. Fortunately, Bridgeton’s portion of the Muskegon River is largely in its natural state.

“Ecological restoration” aims to restore native indigenous plants and animals to an area. Native plantings along banks; such as willow cuttings, wetland plants, and/or rolls of landscape material covered with natural fabric that decomposes after plants take root; resist erosion. Studies have shown that, after establishing appropriate vegetation on banks, long-term maintenance costs are lower than for maintenance of concrete banks or conventional landscape (e.g., mowing turf grass). These approaches are not required but are recommended by economics. However, care must be taken to prevent tree branches from hanging or dropping into the river and impeding the flow of it.

#### e. Best Management Practices

*Point source* pollutants are discharged from pipes (such as the outfall of a municipal wastewater treatment plant) and are regulated by the U.S. EPA and the MDEQ. *Non-point source* pollutants come from non-specific locations and are harder to regulate. Examples of non-point source pollutants are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. The term “best management practices” (BMP’s) refers to design, construction and maintenance practices and criteria that minimize the impact of stormwater runoff, prevent erosion, protect natural resources and capture non-point source pollutants (including sediment). They can prevent increases in downstream flooding by attenuating runoff and enhancing infiltration of stormwater. They also minimize water quality degradation, maintain natural base flows, and provide multiple uses of drainage and storage facilities.

Reducing the amount of water reaching a steep slope will help with stabilization and can be accomplished by diversion or re-routing. A French Drain is a narrow trench set back from, but parallel to, the top of the slope and filled with free-draining sand or gravel. A perforated, corrugated



plastic pipe at the bottom collects water and drains away from the slope. The entire perforated length of pipe is wrapped with fabric or a filter sock. Deeper drains will intercept more ground water and provide better protection for the slope but shallower drains are also effective and may cause fewer disturbances on it.

**f. Dumping Regulations**

BMP's usually address pollutants that are liquids or are suspended in water while dumping regulations address solid matter, such as shopping carts, appliances, and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' ability to convey or clean stormwater. Nuisance ordinances can prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations can prohibit "non-objectionable" waste (grass clippings or tree branches), which can kill ground cover or cause obstructions in channels. These regulations can be enforced with penalties but programs should have public information components since property owners might not be aware of the impact of their actions (i.e. re-grading their yards, discarding leaves or branches in a watercourse, etc.). Voluntary compliance by property owners and annual "clean-up" programs sponsored by local communities can be quite effective.

**g. Farmland Protection**

The purpose of farmland protection is to provide planning and zoning mechanisms for preserving prime, unique, or important agricultural land from conversion to non-agricultural uses. Farm owners feel forced to sell their land to residential or commercial developers if it is taxed based on the value of the property if developed instead of farmed and the increased taxation can't be afforded. The ensuing development brings more buildings, roads, and other infrastructure that can create additional stormwater runoff and emergency management difficulties. To offset this situation, the Farmland Protection Program in the U.S. Department of Agriculture's 2002 Farm Bill (Part 519) allows for funds to go to states, tribes, local governments, and non-profit organizations to help purchase easements on agricultural land to protect against the development of the land. Eligible lands include cropland, range land, grass land, pasture land, and forestland that are part of an agricultural operation. Certain lands with historical or archaeological resources are also included. The hazard mitigation benefits of farmland protection are similar to those of open space preservation.

**IV. EMERGENCY SERVICES**

Emergency service measures protect people during and after a disaster. A good emergency management program addresses all hazards and involves all departments. At the state level, programs are coordinated by the Emergency Management Division of the Michigan Department of State Police (EMD/MSP), while at the county level, programs are coordinated through Newaygo County Emergency Services in White Cloud. Emergency service measures can be divided into four stages:

- Threat Recognition (Watch);
- Warning;

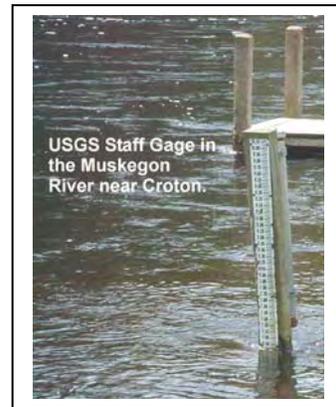
- Response; and
- Post-Disaster Recovery and Mitigation.

**a. Threat Recognition (Watch)**

The first step in responding to an impending flood is to know when weather conditions are such that an event could occur and issuing a “watch” or “advisory”. Proper and timely threat recognition systems allow for adequate warnings to be disseminated. Different systems used for the dissemination of flood watches are described below.

A flood threat recognition system predicts the time and height of the flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels. On smaller rivers, local rainfall and river gauges are needed. In the absence of gauges, local personnel and/or volunteers monitor rainfall and stream conditions. While specific flood crests and times are not predicted, advance notice of potential local or flash flooding is provided. A small stream flood advisory indicates that flooding of small streams, street, and low-lying areas is occurring.

On larger rivers, the measuring and calculating is done by the National Weather Service (NWS), which is in the U.S. Department of Commerce’s National Oceanic and Atmospheric Administration (NOAA), with support from cooperating state and local partners. Forecasts are made through the Advanced Hydrologic Prediction Service (AHPS), which utilizes river gauges for information. There are two USGS-operated gauges in Newaygo County. One is located near Croton on the Muskegon River, while the other is located on the Little Muskegon River near Oak Grove. The NWS utilizes USGS observations taken at Croton for the AHPS. It is possible for emergency officials to obtain observations taken at this gauge by telephone.



Additionally, current stream data for this site, and 3,849 other river gauges across the United States, can be viewed at the NWS website: <http://www.weather.gov/ahps/>.

Flood threat predictions are broadcasted on the NOAA Weather Wire and Weather Radio, the official source for weather information, to those who have equipment to receive it (state police, 911 and dispatch centers, municipalities, and critical facilities). Weather radios can be tone-activated through the Emergency Alert Radio System (EARS). Predictions are also transmitted by television, radio, and cable television through the Emergency Alert System (EAS), previously known as the Emergency Broadcast System.

The NWS is the prime agency for detecting meteorological hazards and uses a transmitter located south of Hesperia to relay weather information to Newaygo County. Severe weather warnings are first transmitted through the NOAA Weather Radio System and then subsequently relayed through the Michigan State Police’s Law Enforcement Information Network (LEIN). The network includes law enforcement agencies and emergency service providers such as “911” who then issue their own warnings. NWS coverage is done on a large scale and only considers if conditions are appropriate for formation of a tornado, thunderstorm, or flood. More site-specific and timely recognition

is provided by sending out NWS trained spotters to watch the skies when the NWS issues a watch or warning. Spotter training in the county is provided yearly, generally in the spring, through cooperation of Newaygo County Emergency Services, fire departments, and the NWS office in Grand Rapids.

**b. Warning**

When the NWS determines that a flood or other hazard has been observed or is coming, a warning is issued to take immediate action and the systems described above are again utilized to notify police, 911 and dispatch centers, municipalities, the public, and staff of other agencies and critical facilities. Early warning allows for a greater number of people to implement protection measures. For severe flooding, such measures would be to get out of the areas subject to flooding and to avoid areas where flooding has occurred.

More specific warnings may be issued by communities and are included on the following list, which contains methods already discussed as well as common and cutting edge methods.

- NOAA Weather Radio;
- The Weather Channel;
- Commercial or public radio or TV stations;
- Cable TV emergency news inserts;
- Tone activated receivers in key facilities;
- Outdoor warning sirens and fire department call-in sirens;
- Sirens on publicly owned vehicles;
- Mobile public address systems;
- E-mail notifications;
- Broadcast faxes;
- Pocket paging services for the hearing impaired;
- AT&T language line for those who speak a different language;
- Automated telephone notification services;
- Telephone trees/mass telephone notification; and
- Door-to-door contact.

Warning systems need to be continually evaluated, updated to include new technologies, and expanded to include warnings to people with “special needs” such as the elderly, the handicapped, and the Spanish-speaking population. Additionally, the public should be educated on the purpose and conditions of all warning systems so as to eliminate any possible confusion.

There are no warning sirens located within Bridgeton Township, although there has been community interest in placing sirens on the bridges to alert nearby residents and travelers of flood dangers. The most effective means of warning in the township are radio, television, and cable systems (EAS), the EARS tone alert radios, and NOAA Weather Radios. Newaygo County Emergency Services may provide emergency and disaster early warning information on a request basis to special needs populations. It utilizes the CityWatch notification system for land telephones and is about to add cellular telephones to its data bank.



Multiple or redundant systems are very effective. If people do not hear one warning, they may still get the message from another. In addition, the most effective warnings provide public information about the hazard and what to do. However, each method has advantages and disadvantages that are partially described below.

- Radio and television, when turned on, provide useful information.
- NOAA Weather Radio, where available, can provide short messages of any impending weather hazard or emergency and advise people to turn on their radios or televisions.
- Outdoor warning sirens can quickly reach many people, particularly those who are outside, and trigger them to turn on a radio or television to find out what hazard is coming. They do not reach people in tightly insulated buildings or those surrounded by loud noise, such as in a factory, during a thunderstorm, or near an air conditioning unit.
- Automated telephone notification services are also fast, but can be expensive and do not work when phone lines are down or for unlisted numbers and calling screener services.
- Going door-to-door and conducting manual “telephone trees” can be effective but require a longer lead time.

The NWS established the “Storm Ready” program to help local governments improve the timeliness and effectiveness of hazardous weather-related warnings for the public. To be officially designated “Storm Ready”, a community must:

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

NWS also established the “Turn Around-Don’t Drown” program (TADD) “to reduce the loss of life due to underestimating the force and power of water”. One activity is to warn motorists of the dangers of flooded roads, particularly when there are barricades, since it is impossible to tell the depth of the water or the condition of the road under the water. Barricades are very definite warnings and should never be ignored. An additional and inexpensive warning technique is the use of PVC markers on roads prone to flooding which show the depth at which motorists should not attempt passage. Bridgeton Township residents have also suggested painting flood stage measurements on bridge supports.



### **c. Response**

The protection of life and property is the foremost task of emergency responders. A community should respond to hazards with threat recognition, warnings and actions that

can prevent or reduce damage and injuries. Typical actions and possible responding parties in a flooding event include the following:

- Activating the emergency operations center (emergency management);
- Closing streets or bridges (police or public works);
- Shutting off power to threatened areas (utility company);
- Passing out sand and sandbags (public works);
- Ordering an evacuation (governor, upon local recommendation);
- Holding children at school/releasing children from school (school district);
- Opening evacuation shelters (Red Cross);
- Activating volunteers to check on/assist vulnerable populations;
- Monitoring water levels (engineering);
- Security and other protection measures (police); and
- Check on those needing assistance during times of infrastructure failure (volunteers).

An emergency action plan ensures that all bases are covered and that response activities are appropriate for the expected threat. These plans can be developed for municipalities, critical facilities, SARA sites, businesses, etc. and should include coordination with all of the agencies, offices, first responders and service providers that are given various responsibilities. Emergency response plans should be updated annually to keep contact names and telephone numbers current, that communications equipment is interoperable, and to make sure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and changing conditions. They should also consider the possibility of “mutual aid” and utilize volunteer groups such as Radio Amateur Civil Emergency Services (RACES) and the Medical Reserve Corps (MRC) of Newaygo County. The mission of the MRC is to be the catalyst for trained medical and supportive service volunteers to serve Newaygo County when disasters or emergencies strike. The MRC, consisting of medical, health-related and other professionals, is designed to supplement local emergency plans and resources already in place in Newaygo County.

Newaygo County Emergency Services has an Emergency Operations Plan (EOP) to guide emergency operations. The county plans to switch to an Emergency Action Guidelines (EAG) document in the near future to improve emergency response coordination. An EAG is a document designed to provide a measure for determining whether the community’s emergency management planning documents are adequate, and also to expedite this evaluation process again in the future. EAG’s are commonly created and revised under the supervision of the Michigan State Police Emergency Management Division. An EAG should help to present a common platform for coordination of major response activities for all types of hazards. It should be augmented with annexes, standard operating procedures, and other guidance documents that cover the details of various aspects of emergency response, such as communications, evacuation, sheltering, public health, damage assessment, and severe weather.

The Incident Response section in an EAG is required for a county in Michigan to participate in the Michigan Emergency Management Assistance Compact (MEMAC), an initiative of the Michigan State Police Emergency Management Division (EMD). MEMAC is designed to help Michigan’s local political subdivisions share vital public safety services and resources more effectively and efficiently. It addresses problematic

issues concerning workmen’s compensation insurance, expense reimbursement and liability coverage, before assistance is needed and requested. Designed to be flexible, MEMAC is also intended to supplement existing local mutual aid agreements already in place to handle “routine” public safety services among neighboring jurisdictions and fire departments. It is important to note that the implementation of MEMAC is a requirement for the receipt of state or federal disaster funds through the Public Assistance Program.

Planning is best done with adequate data. One of the best tools in a flooding event is a flood stage forecast map that shows what areas would be under water at various flood stages. Emergency management staff can identify the number of properties flooded, which roads will be under water, which critical facilities will be affected, etc. With this information, an advanced plan can be prepared that shows problem sites and determines what resources will be needed to respond to the predicted flood level. Newaygo County is in the process of developing flood storage/damage maps while Consumers Energy has prepared flood models for both “high flow” dam failures and “sunny day” failures.

A Geographic Information System (GIS) allows for this type of analysis as it works with computerized layers of mapped data. In this document, the locations of buildings were overlaid with areas of concern for development (topography, infrastructure, land use, zoning, etc.) and areas of concern for flooding (floodplains, hydraulic shadows of dams, etc.). GIS can also model the effects of different levels of flooding and be used for hydrologic monitoring and modeling of the effects of removing/raising bridges over rivers to remove constriction to the flow of floodwater.

Protecting critical facilities during a disaster is the responsibility of the facility owner or operator. Some critical facilities, such as Consumers Energy, are required to have their own emergency response plans. Michigan law requires hospitals, nursing homes, and other public health facilities to develop such plans. Many facilities would benefit from early warning, response planning, and coordination with community response efforts. If critical facilities are not prepared for an emergency and are damaged, workers and resources may be unnecessarily drawn away from other disaster response efforts. If the owner or operator adequately prepares them, the community's emergency response efforts will be better supported.

**d. Recovery and Mitigation**

After a disaster, a flood statement may be used for follow-up information regarding the event. Communities should undertake activities to protect public health and safety, facilitate recovery, and help prepare people and property for the next disaster. Throughout the recovery phase, everyone wants to get “back to normal”. However, “normal” can’t mean the way things were before the disaster or there would again be the same exposure to future disasters. Appropriate measures are included in the following lists.

Recovery Actions

- Patrolling evacuated areas to prevent looting (police).
- Providing safe drinking water (public works).
- Monitoring for diseases (health department).
- Vaccinating residents for tetanus (health department).

- Clearing streets (road commission).
- Cleaning up debris and garbage (road commission).
- Providing referrals to recovery vendors for post-disaster goods and services (emergency services).
- Reporting damages to insurers (property owners).
- Regulating reconstruction to ensure that it meets all code requirements (building inspectors).
- Restoring streambeds and affected infrastructures to their condition prior to storm events (drain commission and owners).
- Immediately removing debris from prior storm events from affected waterways (drain commission).

Requiring permits for building repairs and conducting inspections are vital activities to ensure that damaged structures are safe for people to re-enter and repair. There is a special requirement to do this in identified floodplains, regardless of the type of disaster or cause of damage. The National Flood Insurance Program (NFIP) directs local officials to enforce the substantial damage regulations. These rules require that if the cost to repair a building in the mapped floodplain equals or exceeds 50% of the building's market value, the building must be retrofitted to meet the standards of a new building in the floodplain. In most cases, this means that a substantially damaged building must be elevated above the base flood elevation. This requirement can be very difficult for understaffed and overworked offices after a disaster. If these activities are not carried out properly, not only does the community miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP.

A chance is also available to assess the strength of buildings; the effectiveness of emergency action plans for communities, critical facilities, and businesses; and the readiness of responders. Should efforts be deemed inadequate, improvements can be recommended such as revisions to building codes, increased training for responders, and improvements to existing plans or creation of sample plans. Reviews of emergency response plans and programs should focus on whether all emergency responders involved were coordinated, if all information was provided (flood plain map, critical facilities, etc.), if there were post-disaster procedures for public information, and if adequate warnings were provided.

Reviews of building strengths should be similar to FEMA's, wherein a Building Performance Assessment Team (BPAT) may recommend revisions after a disaster. Other considerations for revisions could include the following.

- Did critical facilities have necessary back-up generators?
- Did electrical distribution systems have built-in redundancies to limit the impact of failures?
- Did the Road Commission have the equipment and personnel to be able to clear the roads?
- Was there a place to store personal property?
- Were shelters available to house displaced residents?
- Were there detention areas for debris disposal (branches, power/phone lines, etc.)?
- Was the Health Department able to monitor threats and take the necessary steps to prevent or limit the scope and magnitude of threats?

- Were emergency responders sufficiently trained and able to communicate?

An assessment of damages is necessary and can be provided by state and federal officials, as is the case in flooding events, or by local emergency responders and emergency staff. An EAG should delegate who will take on this responsibility. Assessments can be facilitated by a GIS, which could detail damages, identify mitigation projects, establish environmental baselines, and monitor changes in land use. FEMA offers courses, free of charge, to emergency staff for evaluation training.

In addition to identifying the amount of damage, communities can acquire substantially or repeatedly damaged properties from willing sellers, plan for long-term mitigation activities, and apply for post-disaster mitigation funds.

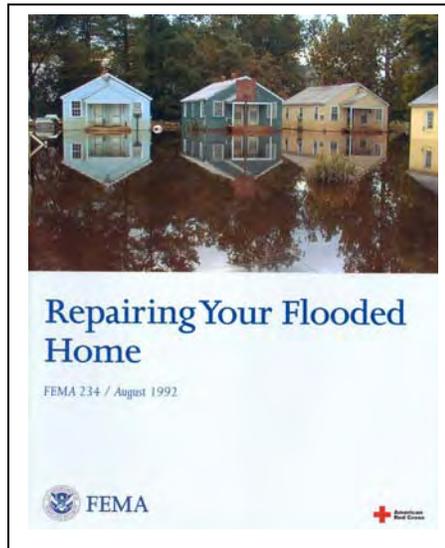
## V. PUBLIC EDUCATION AND AWARENESS

Public education and awareness programs are necessary to periodically inform the public (property owners, renters, businesses and local officials) about the township’s flood hazards, the measures necessary to minimize potential damage and injury, and what actions are being taken. This information is primarily intended to precipitate appropriate actions.

Information can be disseminated through the media (newspapers, newsletters, websites, television, radio, etc.) and at public forums and civic meetings. It can be distributed through schools and made available in public buildings or shopping areas. Brochures can be available at libraries and government offices, including building inspection offices. Special populations can be reached through direct mailings, workshops, and seminars. Signage along hazardous areas can also be effective.

### a. Distribution of Existing Information

There is a great deal of information regarding flood hazards and flood hazard mitigation available to communities and the public on the national level. Both FEMA and American Red Cross present information on the internet and in videos, documents and brochures. The NWS makes information available through its “Storm Ready” and “Turn Around



Don’t Drown” programs, to name just a few. Insurance companies and non-profit programs have been heavily involved in identifying and responding to hazards. Many of these groups may be able to provide helpful supplemental information.

Unfortunately, this information doesn’t always reach the intended target audience; whether that audience is a local community, the general public, or specific populations. Local efforts can be made to select pertinent information and get it out to places and people where it is needed (such as information on flash flooding to fisherman and canoers and recommendations to secure debris, yard items, and stored objects to property owners

facing potential flooding). Programs and web sites can be publicized, while brochures can be stockpiled and distributed. This flood information can be very helpful, although it may not apply to the entire community.

**b. Distribution of Local Information**

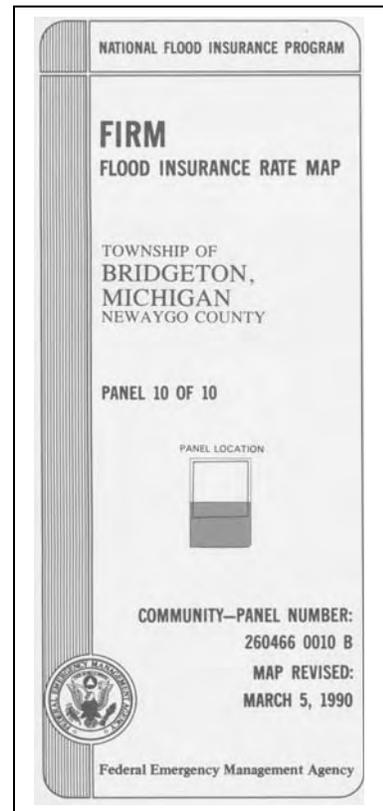
In addition to the national-level information discussed above, there is an abundance of information available locally to educate and warn the public of flood hazards. Local newspapers and television stations frequently update the public on hazards. Newaygo County Emergency Services is an excellent source of information on a variety of topics as varied as the location of shelters or financial assistance in hazard response and mitigation. Building inspectors can provide advice regarding protection measures, property compliance, and required building permits. District health department reports may also prove to be valuable resources for local hazard information.

Mitigation efforts the township takes to protect its residents, including the creation and adoption of this plan to qualify itself for federal disaster funding, can be publicized. The general public, or eligible target groups, can be notified when financial resources for hazard response and mitigation become available.

**c. Technical Assistance**

The township has information that may assist homeowners. For example, FEMA’s Flood Insurance Rate Maps and Flood Insurance Studies can provide information to residents and can assist them in submitting requests for map amendments and revisions when a building is not in the floodplain but a part of the property is. Lenders will notify applicants for federally insured loans if the involved property is in the floodplain and require flood insurance as a condition of the loan.

Local building inspectors may also provide advice regarding protection measures, property compliance and required building permits. Bridgeton Township can recommend that residents develop Family Emergency Plans, including the preparation of Disaster Supply Kits, identification of emergency telephone numbers, and the preparation of pre-planned escape routes. The township can assist local citizens through the provision of local information regarding flood hazards, risks and protections.



# PART G

## POTENTIAL FLOOD MITIGATION ACTIONS

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The previous chapter identified a multitude of options for addressing flooding concerns. Not all of these options are economically feasible or appropriate for a township, such as Bridgeton, with limited resources and without professional in-house planning staff. In addition, since flooding is commonly caused by nature, it cannot be easily mitigated or controlled. Nothing can be done to eliminate heavy or persistent precipitation or to alter its frequency, intensity or spatial distribution across the landscape. Mitigation actions associated with flood hazards must focus on limiting the impacts on the populations or structures that are being affected. For instance, flood damage may be greatly reduced through mitigation actions such as dry and wet floodproofing. Better yet, flood damage may be averted altogether through establishment and enforcement of development restrictions within areas that have been designated as “special flood hazard areas”.

The following mitigation items are presented according to the township’s goals and objectives for flood mitigation identified in Part E. For each goal, there are several objectives and under each object, there are several action items. These items are “snapshots” of some of the alternatives discussed in the previous chapter. Actions that are considered high priority are presented in italics and are also discussed further in “Part I. Plan Implementation”, where additional information is presented on how they can be accomplished, who can accomplish them, and when they should be done.

### **GOAL 1. PROMOTE GROWTH IN A SUSTAINABLE, HAZARD-FREE MANNER**

#### **Objective 1.1 Incorporate flood hazard provisions in building code standards, ordinances, and procedures.**

- Item 1. (a) Enforce the flood protection standards of existing building codes and advocate for continuing evaluation of them thereby complying with National Floodplain Insurance Program (NFIP) requirements. (b) Participate in ISO’s Building Code Effectiveness Grading Schedule (BCEGS), as recognized by FEMA for the Community Rating System (CRS) of the NFIP.*
- Item 2. Evaluate the need to: (a) strengthen anchoring requirements for mobile homes, propane tanks, and hazardous materials in the floodplain; and (b) prohibit such items within the floodway.*
- Item 3. Assure proper location, installation, venting, cleaning, and maintenance of closed septic tanks in the floodplain and the floodway and around lakes.*

#### **Objective 1.2 Incorporate flood hazard mitigation into land use and capital improvement planning and development activities.**

- Item 4. Incorporate flood mitigation provisions into the Land Use Plan; especially as it addresses open space preservation and development restrictions in floodplains and areas with soil restrictions, such as wetlands; and develop a distinct land use designation for floodplains.*

- Item 5. Integrate hazard mitigation into the capital improvement planning process so that public infrastructure does not lead to development in flood-prone areas and so that possible set-asides for the acquisition and preservation of open space as well as planned and engineered structural projects (berms, levees, floodwalls, detention and retention ponds, debris storage areas, etc.) are considered.

**Objective 1.3 Incorporate flood hazard mitigation into existing land use regulation mechanisms to ensure that development will not put people in danger or increase threats to existing properties.**

- Item 6. *Consider participating in the Cooperating Technical Partners (CTP) program to revise the FIRM. Better identify floodways so that enforcement of NREPA and NFIP regulations prohibiting their development is more precise and effective.*
- Item 7. *Incorporate flood mitigation provisions and recommendations into the Zoning Ordinance as it restricts or directs development; with consideration given to floodplains, soil type, and topography; and as it allows flexibility in lot sizes and locations. Consider expansion of and stricter restrictions in the Greenbelt District.*
- Item 8. Enforce the existing Michigan Drain Code requirement for “set-back” from the drain channel, thereby assuring proper carrying capacity of the drain.
- Item 9. Support enforcement of Michigan’s Soil Erosion and Sedimentation Control ordinance, regarding earth changes affecting an acre or more or within 500’ of a lake or stream, as well as Newaygo County’s Subdivision Drainage Rules and Stormwater Design Criteria.
- Item 10. Enforce Michigan’s Land Division Act as it furthers the orderly layout and use of land, provides for proper ingress and egress to lots and parcels, controls residential building development within floodplain areas, provides for reserving easements for utilities, and governs internal drainage.
- Item 11. Enforce the Clean Water Act permit and mitigation requirements for proposed developments in wetlands.

**Objective 1.4 Research, recommend, adopt, and enforce other plans and ordinances that protect natural resources so that they can, in turn, provide flood hazard protection.**

- Item 12. Develop, adopt, and enforce a Stormwater Ordinance to manage run-off from new development; including vegetation, buffers, depressional storage areas, and retention basins; and regulations stipulating that stormwater cannot leave at a rate higher than it did prior to development.
- Item 13. Develop, adopt, and enforce a Nuisance Ordinance to prevent dumping “objectionable” solid matter into channels and wetlands and Waterway Dumping Regulations to prevent dumping “non-objectionable” waste.

- Item 14. Consider adopting and enforcing more stringent township regulations regarding sedimentation control, such as a “No Wake” ordinance when the river level is high.
- Item 15. Research BMP’s and river restoration techniques to determine possible benefits to the township. Consider the use of French Drains in the floodplain, particularly as the boat launch expansion occurs, and channel deepening activities.
- Item 16. Develop and implement a tree maintenance program (pruning, maintenance, removal, and replacement) to prevent branches from dropping into the river and impeding its flow.

**GOAL 2. PROTECT EXISTING AND NEW PROPERTIES**

**Objective 2.1 Use the most cost-effective approaches to protect existing sites, buildings, and facilities from flood hazards.**

- Item 17. Consider the construction of berms, levees, or floodwalls to contain high waters.
- Item 18. Assist property owners, especially those with repetitive loss properties, in raising or relocating buildings in areas that flood and/or acquire properties in flood areas for demolition and re-use of the land as open space.*
- Item 19. Maximize the participation of property owners in protecting their properties from flood hazards such as but not limited to dry floodproofing, wet floodproofing, and incorporating sanitary sewer controls to protect against flooding. Additionally maximize the participation of mobile home owners in anchoring their homes to protect against the forces of flooding.*
- Item 20. Adopt and enforce the 2003 Michigan Rehabilitation Code for Existing Buildings to hold repaired buildings to higher standards for protection against flood hazards, similar to the standards for new buildings.
- Item 21. Utilize mandates for upgrading homes, such as requiring upgraded electrical work for substantial rehabilitation of existing properties or issuing “Fill Your Basement With Water” orders.
- Item 22. Enforce NFIP requirements that buildings in flood plains be elevated or brought up to current flood protection codes if repair costs are 50% or greater of the property values.
- Item 23. Research possibilities of off-site (outside the 100-year floodplain) “cluster” septic systems to serve existing development within the floodplain. Consider the feasibility of constructing such systems to serve entire subdivisions located within the floodplain. Also consider requiring such systems for future floodplain developments.*



**Objective 2.2 Utilize insurance coverage to provide financial protection against flood hazard events.**

- Item 24. Encourage private property owners to purchase flood insurance coverage on properties likely to be flooded, including those in the SFHA and those categorized as “Preferred Risk” and to obtain additional insurance coverage as appropriate (sump pump failure, septic backup, etc).*
- Item 25. Reduce the cost of NFIP flood insurance through on-going participation in the NFIP, participation in the NFIP’s Community Rating System (CRS), and implementing additional flood loss reduction activities such as the adoption of this plan.*

**Objective 2.3 Maximize the resources for investment in flood hazard mitigation, including the use of outside sources of funding.**

- Item 26. Utilize federal programs; such as but not limited to FEMA’s Flood Mitigation Assistance Program, Pre-Disaster Mitigation Program, and Hazard Mitigation Grant Program; to address community needs for flood mitigation.
- Item 27. Utilize; and assist those with special needs to utilize; available programs for assistance with flood hazard retrofitting measures to increase safety of persons and reduce loss to properties.
- Item 28. Consider establishing cost sharing programs, such as rebates, to encourage low cost (under \$10,000) property protection measures against flooding (“flood-proofing program”) where acquisition and/or relocation is not required.
- Item 29. Establish a voluntary, on-going floodway property acquisition and land re-use program, with corresponding changes in zoning, and purchase/transfer of development rights for properties.*

**GOAL 3. PROTECT PUBLIC HEALTH AND SAFETY**

**Objective 3.1 Review threat recognition (watches) and warning systems to assure that they are adequate and appropriate and that they utilize the latest technology.**

- Item 30. Evaluate the effectiveness of the public warning system including the threat detection process, management system, communication links, and methods of dissemination. Evaluation should consider new technologies, public views of the warning system and the effect this has on response to warnings, disseminating warnings to people with “special needs”, redundancies, and effective methods of risk communication.



- Item 31. *Advocate for improvements and updates to the public warning system effectiveness and coverage as deemed necessary. Sirens on bridges would deliver flood warnings to riverside residents, folks engaged in recreation or other outdoor activities along the river, and drivers preparing to cross the bridges. Listing of cell phone numbers would increase CityWatch coverage.*
- Item 32. Encourage the county to detail the public warning process and coordinate actions in a section of the Newaygo County Emergency Action Guidelines (EAG), with special attention paid to flood hazard risks in Bridgeton Township.
- Item 33. Increase use of NOAA All-Hazards radios and weather alert systems (Emergency Alert Radio System, etc.) by people in need.
- Item 34. Encourage the MDNR, U.S. Geological Survey, National Weather Service, and the U.S. Army Corps of Engineers to continue to operate and monitor stream gauging stations and groundwater monitoring wells and consider whether the exposure to flooding on smaller rivers and streams warrants additional Advanced Hydrologic Prediction Services (AHPS) or local rain and stream gauging and flood threat recognition systems.
- Item 35. Encourage the District Health Department to take necessary steps to prevent or limit the scope and magnitude of flood-related illnesses before, during and following flood events. Recommend the prohibition of covers on septic tanks in the floodplain and requirements for venting above the base flood elevation.
- Item 36. Utilize the NES “Turn Around Don’t Drown” (TADD) system to warn motorists to not cross roads with flooding over indicated levels and install PVC markers alongside roads illustrating those levels. Consider the demarcation of flood depths on bridge supports.

**Objective 3.2 Protect infrastructure and services.**

- Item 37. Coordinate with Consumers Energy regarding power outages and the need to shut off power during floods.
- Item 38. *Install backup generator hook-up at the township hall (a location which may serve as an emergency shelter) to provide short-term relief from power failures.*
- Item 39. Establish secure “community storage” areas for temporary hazard-free storage of personal property and detention areas for temporary debris disposal (snow, ice, tree branches broken power/phone lines, etc.).
- Item 40. Assure that state, county and local road maintenance programs (including management of bridges and vegetation) are continued and refined and that the county Road Commission has adequate equipment (including road barriers, sand bags, portable lighting, etc.) to respond to flooding events.

**Objective 3.3 Build and support local capacity, commitment and partnerships to continuously become less vulnerable to flood hazards.**

- Item 41. Adopt this flood mitigation plan by official resolution to assure both consideration of flood hazards and eligibility for FEMA funding through the Flood Mitigation Assistance Program.
- Item 42. Encourage coordinated response plans and programs across service providers and agencies to assure both mutual aid and the ability to communicate during emergencies (compatibility of radio frequencies, impact of adverse weather on warning systems, etc.).
- Item 43. Encourage and support county participation in MEMAC, thereby assuring eligibility for funding from the Public Assistance Program.
- Item 44. Refer emergency responders and emergency staff to FEMA and EMD/MSP training for conducting Damage Assessments and determining “Substantial Damage” for an efficient and accurate assessment of building damages.*
- Item 45. Retrofit the township hall to function as an emergency shelter.
- Item 46. Encourage Newaygo County to meet the criteria to become a NWS-approved “Storm Ready” community including: maintaining a 24-hour warning and emergency operations center, having more than one way to receive weather warnings and alert the public, assuring a local monitoring system for weather conditions, providing public information regarding readiness, and adopting a formal hazardous weather plan which includes training weather spotters and holding emergency exercises.

**Objective 3.4 Enlist support of committed volunteers to safeguard the community before, during, and after a flood.**

- Item 47. Encourage county to utilize volunteer communication networks by amateur radio operators (RACES) to facilitate communication during emergencies when phone lines may be inoperable.
- Item 48. Designate amateur radio operators who are able to communicate information on “immediately dangerous” weather situations between NWS-trained (SKWARN) spotters and Central Dispatch and/or Emergency Management.
- Item 49. Encourage county to coordinate with local volunteer organizations, such as Newaygo County Community Services’ Medical Reserve Corps and local amateur radio operator groups (RACES), to supplement local emergency plans, aid emergency responders, and also to address the needs of elderly, disabled and homebound persons, and other special-needs groups during and after severe flood conditions.
- Item 50. Utilize NWS-trained (SKYWARN) volunteer weather spotters to watch for developing storms, trained volunteers to take flood water measurements and to monitor stream conditions, and volunteer amateur radio operators to report the findings, as needed, especially in the event of power failure.



- Item 51. Conduct an annual “cleanup” program when trash, limbs, barrels, and other potential blockages are removed from water courses, flood-prone areas, and adjacent lands and when branches are trimmed prior to reaching water levels.

**GOAL 4. INCREASE PUBLIC UNDERSTANDING AND SUPPORT OF, AND PARTICIPATION IN, FLOOD HAZARD MITIGATION**

**Objective 4.1 Heighten public awareness of flood hazards and actions they can take to prevent or reduce the risk to life or property from them.**

- Item 52. Distribute already produced information on flood hazards and cost-effective mitigation actions individuals can implement to township residents and/or targeted groups most likely to experience significant impacts due to floods.*
- Item 53. Produce and distribute local emergency preparedness and safety information concerning flooding to the general public and/or targeted groups (seasonal populations, floodplain residents, developers and builders, farm owners and operators, decision makers, Spanish speaking, etc.). Include local resources for flood information.
- Item 54. Encourage dialogue between Consumers Energy, Newaygo County Emergency Services, and township residents regarding safety procedures, warning systems for dam failure, and consideration of Bridgeton Township in emergency action plans.*
- Item 55. Produce and distribute information on flood mitigation measures the township is taking/will take, as identified in this plan, to local citizens and encourage them to participate in the plan and take mitigation actions.
- Item 56. Encourage residents to develop a Family Emergency Preparedness Plan; including the preparation of a Disaster Supply Kit, the posting of emergency telephone numbers, and pre-planned escape routes.
- Item 57. Stockpile ARC, FEMA, NWS, USACE and other flood hazard, damage prevention, post-disaster repair, and cleanup publications for distribution by the township.
- Item 58. Research availability of local and Michigan-based recovery “vendors” for post-disaster goods and services (e.g., cleaning, drying, pumps, repairs, construction supplies, portable refrigeration units, disaster recovery experts) to support disaster recovery efforts.
- Item 59. Through coordination with the District Health Department, increase public awareness of the causes, symptoms and protective actions for possible disease outbreaks and other potential public health emergencies associated with floods.



**Objective 4.2 Encourage participation in the hazard mitigation process.**

- Item 60. Participate in programs such as NFIP, CRS, BCEGS, Storm Ready, TADD, etc.; and assess and respond to local concerns regarding program requirements and obstacles to participation.
  
- Item 61. Notify residents of the availability of flood mitigation funds, as they become available, and assist them in applying for funds.

**Objective 4.3 Encourage cooperation and communication between planning and emergency management officials.**

- Item 62. Assist the Newaygo County Local Emergency Planning Committee (LEPC) and Emergency Services in activities related to developing and continually revising Emergency Action Guidelines (EAG) detailing coordinated response plans of emergency responders by providing information about Bridgeton Township.
  
- Item 63. Cooperate with the Newaygo County GIS Department to expand upon current GIS resources to better support pre-disaster planning (such as the creation of flood stage forecast maps), disaster response activities, and post-disaster recovery activities.
  
- Item 64. Coordinate with the American Red Cross to ensure the availability and public awareness of a designated and accessible emergency shelter (such as the township hall); with consideration given to the seasonal populations in homes, cabins and mobile homes without basements; and assure that the facility is inspected, certified, and has backup power.

# **PART H**

## **EVALUATION CRITERIA TO SELECT AND PRIORITIZE ACTION ITEMS**

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To determine the specific problems that exist in Bridgeton Township because of flood hazards and the recommended actions to address them, the planning process tapped into public and expert opinion. First, problems associated with flood hazards were discussed and prioritized by township officials. Surveys were also sent to neighboring officials, service providers, and emergency responders (see Part A for detailed information) giving them a chance to participate in the plan. In addition, input was requested from the public through notices and meetings.

All identified hazards and recommended actions were carefully reviewed before several were selected as Action Items for the Action Agenda presented in the next part of this document. Some ideas, such as raising/lowering homes, were not included in the Action Agenda. Although it is technically feasible to raise and lower a home, and it is being done in the Netherlands, it is much more expensive than permanently raising a home or re-locating it to higher ground.

The review was done according to the commitments made in the application for funding to create this plan, which promised that Action Items would: 1) solve a problem independently, or constitute a functional portion of a solution, where there is assurance that the project as a whole will be completed and 2) be cost-effective, and 3) substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster. To meet these requirements, actions had to:

- Address a problem that has been repetitive, or a problem that poses a significant risk if left unsolved.
- Cost less than the anticipated value of the reduction in both direct damages and subsequent negative impacts to the area if future disasters were to occur.
- Be the most practical, effective, and environmentally sound alternative after consideration of a range of options.
- Contribute, to the extent practicable, to a long-term solution to the problem it is intended to address.
- Consider long-term changes to the areas and entities it protects, and have manageable future maintenance and modification requirements.
- Be technically feasible.

These criteria helped to ensure that the proposed range of action items was evaluated in a manner that best reflects the values, policies and desires of the township and gave a better idea to the appropriate governing officials as to which alternatives are the most meritorious and desirable. Selected alternatives, or actions, assure that goals will be supported and objectives will be achieved by laying out detailed steps to do so. They also acknowledge the NFIP’s “continued compliance” requirements by providing the following benefits, as identified in its Community Rating System:

- Provide enhanced public safety.
- Reduce property and public infrastructure damage.
- Avoid economic disruption and losses.
- Reduce human suffering.

- Protect the environment.

The next chapter presents a plan for implementation. For each action item, the plan identifies the basic steps to be taken to accomplish that objective, including who will take the action and when it will be taken. Possible funding sources, as previously discussed in Part F – Flood Mitigation Tools, are now matched to the actions. The information is presented in a brief and “to-the-point” format, according to the following categories.

- **RESPONSIBLE PERSON(S)/DEPARTMENT(S)** - Identifies who is responsible for initiating and implementing each action. One person or department could take the lead role (zoning administrator or planning commission), but often the work will be shared by a number of other individuals and agencies. Identifies all of the involved individuals and agencies up front.
- **TIME SCHEDULE/PRIORITY** - Identifies when to take each action and states the timeframe and the sequence of events, particularly if there are fixed deadlines. For example, a hearing date may be scheduled to gather public comments on an environmental impact statement for a proposed facility to be located in the watershed. In other cases, general deadlines are sufficient. One action may not begin until another is completed. A general plan or guide, which considers all the timeframes, helps plan and implement work.
- **POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE** - Identifies how each action will be taken. Also, includes a list of potential funding sources. This helps when funds become available from Federal, State, foundations, corporations, or other sources that have been researched and identified. If matching funds are needed, potential sources might have already been identified in this section of the plan, and can therefore be contacted when assistance is needed. Also identifies the tools or methods for implementing the action. For example, flood proofing a commercial building means hiring an engineering or architectural consultant to develop flood proofing concepts for each building, meetings with the property owner, regulatory review of each design concept, developing final plans and specifications for the concept, and implementing the concept through construction.



# PART I

## PLAN IMPLEMENTATION

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The actions listed in the following Action Agenda have been selected from those presented in Part G – Potential Flood Mitigation Actions according to the criteria presented in Part H. They are regarded as “top priority” actions for having the highest relevance to flood mitigation in the township and being technically feasible.

Please note that Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA) Program are all potential funding sources administered through the Emergency Management Division of the Michigan State Police (EMD/MSP). Also note that the “lead” Responsible Person or Department is noted with an asterisk (\*).

### ACTION AGENDA

#### **Action Item 1.**

*(a) Enforce the flood protection standards of existing building codes and advocate for continuing evaluation of them, thereby complying with National Floodplain Insurance Program (NFIP) requirements. (b) Participate in ISO’s Building Code Effectiveness Grading Schedule (BCEGS), as recognized by FEMA for the Community Rating System (CRS) of the NFIP.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Newaygo County building inspectors, Bridgeton Township Zoning Administrator, Bridgeton Township Board\*.

TIME SCHEDULE/PRIORITY:

→ (a) 2008 (continual process). (b) After completion of Action Item 25.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ FMA, Community Development Block Grant (CDBG) (following disaster declaration), HMGP (following disaster declaration), and local funds.

#### **Action Item 2.**

*Evaluate the need to: (a) strengthen anchoring requirements for mobile homes, propane tanks, and hazardous materials in the floodplain; and (b) prohibit such items within the floodway.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ (a) Newaygo County building inspectors \*, (b) Bridgeton Township Zoning Administrator \*.

TIME SCHEDULE/PRIORITY:

→ 2008 (continual process).

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ HMGP (following disaster declaration) and local funds.

#### **Action Item 3.**

*Assure proper location, installation, venting, cleaning, and maintenance of closed septic tanks in the floodplain and the floodway and around lakes.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ District Health Department #10\*, Bridgeton Township Zoning Administrator.



TIME SCHEDULE/PRIORITY:

→ 2008 (continual process).

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ HMGP (following disaster declaration), Michigan Department of Community Health, and local funds.

**Action Item 6.**

*Consider participating in the Cooperating Technical Partners (CTP) program to revise the FIRM. Better identify floodways so that enforcement of NREPA and NFIP regulations prohibiting their development is more precise and effective.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ FEMA, Bridgeton Township Zoning Administrator, Bridgeton Township Board\*.

TIME SCHEDULE/PRIORITY:

→ 2008.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ CTP program of FEMA, MDEQ (currently participating w/FEMA), HMGP (following disaster declaration), and local funds.

**Action Item 7.**

*Incorporate flood mitigation provisions and recommendations into the Zoning Ordinance as it restricts or directs development; with consideration given to floodplains, soil type, and topography; and as it allows flexibility in lot sizes and locations. Consider expansion of and stricter restrictions in the Greenbelt District.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Bridgeton Township Planning Commission\*, Bridgeton Township Zoning Administrator.

TIME SCHEDULE/PRIORITY:

→ This action should always coincide with Zoning Ordinance updates and revisions.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ Local funds.

**Action Item 18.**

*Assist property owners, especially those with repetitive loss properties, in raising or relocating buildings in areas that flood and/or acquire properties in flood areas for demolition and re-use of the land as open space.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Bridgeton Township Zoning Administrator, Bridgeton Township Board\*, and local residents.

TIME SCHEDULE/PRIORITY:

→ As funding becomes available; especially following a declaration of disaster.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ FMA, NFIP (Increased Cost of Compliance), PDM, Individuals and Households Program of FEMA (following disaster declaration), CDBG (following disaster declaration), HMGP (following disaster declaration), Michigan Natural Resources Trust Fund, and local funds.

**Action Item 19.**

*Maximize the participation of property owners in protecting their properties from flood hazards such as, but not limited to, dry floodproofing, wet floodproofing, and incorporating sanitary sewer controls to protect against flooding. Additionally, maximize the participation of mobile home owners in anchoring their homes to protect against the forces of flooding.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Bridgeton Township Zoning Administrator, Bridgeton Township Board\*, and local residents.

TIME SCHEDULE/PRIORITY:

→ 2008.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ FMA, NFIP (Increased Cost of Compliance), PDM, Individuals and Households Program of FEMA (following disaster declaration), CDBG (following disaster declaration), HMGP (following disaster declaration), and local funds.

**Action Item 23.**

*Research possibilities of off-site (outside the 100-year floodplain) “cluster” septic systems to serve existing development within the floodplain. Consider the feasibility of constructing such systems to serve entire subdivisions located within the floodplain. Also consider requiring such systems for future floodplain developments.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Bridgeton Township Zoning Administrator, Bridgeton Township Board, and Bridgeton Township Planning Commission\*.

TIME SCHEDULE/PRIORITY:

→ 2010.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ Water and Waste Disposal Systems for Rural Communities (Rural Utilities Service, USDA), PDM, CDBG (following disaster declaration), HMGP (following disaster declaration), Failing On-site Septic Systems (MDEQ), non-profit/private grants, and local funds.

**Action Item 24.**

*Encourage private property owners to purchase flood insurance coverage on properties likely to be flooded, including those in the SFHA and those categorized as “Preferred Risk” and to obtain additional insurance coverage as appropriate (septic pump failure, septic backup, etc).*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Bridgeton Township Board\* and local property owners.

TIME SCHEDULE/PRIORITY:

→ 2008 (continual process; particularly after adoption of this plan, and participation in the CRS, and anytime CRS insurance discounts have been awarded).

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ HMGP (following disaster declaration) and local funds.

**Action Item 25.**

*Reduce the cost of NFIP flood insurance through on-going participation in the NFIP, participation in the NFIP’s Community Rating System (CRS), and implementing additional flood loss reduction activities such as the adoption of this plan.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Bridgeton Township Board.

TIME SCHEDULE/PRIORITY:

→ 2009.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ FMA, NFIP, PDM, HMGP (following disaster declaration), Michigan Stormwater-Floodplain Association, and insurance industry. Look into collaboration with neighboring municipalities.

**Action Item 29.**

*Establish a voluntary, on-going floodway property acquisition and land re-use program, with corresponding changes in zoning, and purchase/transfer of development rights for properties.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Bridgeton Township Board.

TIME SCHEDULE/PRIORITY:

→ 2010.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ FMA, PDM, HMGP (following disaster declaration), Land Conservancy of West Michigan, Michigan Natural Resources Trust Fund, non-profit/private grants, and local funds.

**Action Item 31.**

*Advocate for improvements and updates to the public warning system effectiveness and coverage as deemed necessary. Sirens on bridges would deliver flood warnings to riverside residents, folks engaged in recreation or other outdoor activities along the river, and drivers preparing to cross the bridges. Listing of cell phone numbers would increase CityWatch coverage.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Newaygo County Emergency Services\*, Bridgeton Township Board, Consumers Energy.

TIME SCHEDULE/PRIORITY:

→ 2008.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ HMGP (following disaster declaration), Department of Homeland Security (not PDM), Newaygo County Emergency Services, non-profit/private grants, local funds, and Consumers Energy.

**Action Item 38.**

*Install backup generator hookup at the township hall (a location which may serve as an emergency shelter) to provide short-term relief from power failures.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Bridgeton Township Board.

TIME SCHEDULE/PRIORITY:

→ 2009.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ HMGP (following disaster declaration), Michigan Department of Community Health, Rural Housing Service of the USDA, and local funds.

**Action Item 44.**

*Refer emergency responders and emergency staff to FEMA and EMD/MSP training for conducting Damage Assessments and determining “Substantial Damage” for an efficient and accurate assessment of building damages.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Newaygo County Emergency Services\*; and Bridgeton Township Board if anyone with township will do assessments.

TIME SCHEDULE/PRIORITY:

→ 2008 (continual process).

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ FEMA, EMD/MSP, and HMGP (following disaster declaration).

**Action Item 52.**

*Distribute already produced information on flood hazards and cost-effective mitigation actions individuals can implement to township residents and/or targeted groups most likely to experience significant impacts due to floods.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Newaygo County Emergency Services, Bridgeton Township Board\* at Township Hall, local citizens groups.

TIME SCHEDULE/PRIORITY:

→ 2009 (following the adoption of this plan and the updated Zoning Ordinance)(continual process).

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ NFIP (for distributable information), HMGP (following disaster declaration), and local funds.

**Action Item 54.**

*Encourage dialogue between Consumers Energy, Newaygo County Emergency Services, and township residents regarding safety procedures, warning systems for dam failure, and consideration of Bridgeton Township in emergency action plans.*

APPLICABLE RESPONSIBLE PERSONS OR DEPARTMENTS:

→ Newaygo County Emergency Services, Bridgeton Township Board\*, Consumers Energy.

TIME SCHEDULE/PRIORITY:

→ 2008.

POTENTIAL TECHNICAL/FINANCIAL ASSISTANCE SOURCES:

→ HMGP (following disaster declaration), Newaygo County Emergency Services, non-profit/private grants, local funds, and Consumers Energy.



# **PART J**

## **PLAN MONITORING, REVISIONS, AND INCORPORATION**

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Communities and plans are both dynamic entities. Communities grow and change over time. In order to be effective, plans must also grow and evolve to avoid becoming void and obsolete. Planning doesn't stop once the plan is initiated. The plan must be evaluated and updated periodically to ensure the success of the flood hazard mitigation program.

This section describes a monitoring system that will help in the periodic Flood Mitigation Plan evaluation and possible update. A monitoring system also helps keep the plan running on schedule even when there are other jobs or duties to perform. Township officials wear different hats and are responsible for multiple assignments. Few have the luxury of focusing on one assignment, task, or plan. Because the Township is often involved in administering numerous other programs, it is important to develop a monitoring system (e.g. project work schedule) to help remind participants of their parts in carrying out the plan as well as when associated tasks should be completed.

For nearly four decades, Bridgeton Township has maintained its participation in the NFIP. The township fully intends to continue this essential component of flood hazard mitigation well into future. It also intends to maintain NFIP compliance by assuring Newaygo County's implementation of the State Construction Code within its jurisdiction. Additionally, in accordance with this plan, the township's commitment to flood hazard mitigation will expand with its intended participation (see Action Item 25) in the Community Rating System (CRS) and the associated activities and requirements.

### **I. MONITORING**

The Bridgeton Township Planning Commission would be responsible for monitoring the implementation of the Flood Mitigation Plan at the end of each calendar year, as schedules allow. Such monitoring would include noting the following events throughout the year: occurrence of floods, applications for flood mitigation funds, grant awards, and project implementation. In addition to Planning Commission knowledge, input would be obtained from comments submitted to the Township, the Newaygo County Emergency Services office, or to the website of the West Michigan Shoreline Regional Development Commission. It would also be obtained from declarations of disasters and emergencies by the President and the Governor and updates on NOAA and NCDC websites.

### **II. EVALUATING**

The Planning Commission would also prepare a brief progress report annually to present to the Board of Trustees at its first meeting of the year. This report would include recommendations to achieve goals and objectives of the plan, or explain the need to change them in light of new issues and circumstances. The National Flood Insurance Program (NFIP)/Community Rating System (CRS) progress report format, which provides a simple outline that can be followed in preparing an annual progress report, would be utilized and would include:

- A review of the goals and objectives of original plan;
- A review of any disasters or emergencies that occurred during the year;

- A review of each element or objective of the original plan, including what was accomplished the previous year;
- A discussion of why any objectives were not reached or why implementation is behind schedule; and
- Recommendations for new projects/action items (with updated information on responsible persons, time schedules and sources of assistance) or revised objectives.

**III. UPDATING**

The township would periodically review the plan and update it, if necessary, when funding to do so becomes available. The Planning Commission would do this work through a contract with a consultant. Projects that were completed over that time would be replaced with new ones. Priorities would be re-assessed. Development patterns would be analyzed to see if they have rendered the previous hazard analysis out-of-date.

The review and update of the Flood Mitigation Plan is necessary because of ever-changing circumstances. Risks may change, areas may have increased or decreased risks and vulnerabilities, and therefore goals and priorities might have to be altered. Evaluations of the plan should also assess how well the plan is working and if there are problems (financial, legal, coordination, etc.) with implementing the action items in the document.

While adjustments would be made throughout the process as new issues emerge and evolve, this method would ensure that the township remains on course in implementing the program.

**IV. CONTINUING PUBLIC INVOLVEMENT**

Should the plan be updated, all methods previously used for assuring public involvement would be utilized again: surveys, contacts with neighboring counties, public hearings, etc. There must be a process by which public involvement can continue to occur as the Flood Mitigation Plan is updated. Copies of the plan will be available at the Township Hall, in the Newaygo County Emergency Services office, and at the West Michigan Shoreline Regional Development Commission. It will also be presented, in part, on the Commission’s website, [www.wmsrdc.org](http://www.wmsrdc.org). The website offers an on-going and continuous opportunity for public input into the plan, its implementation, and its update. All comments will be submitted, in turn, to the Planning Commission who will receive all other forms of correspondence.

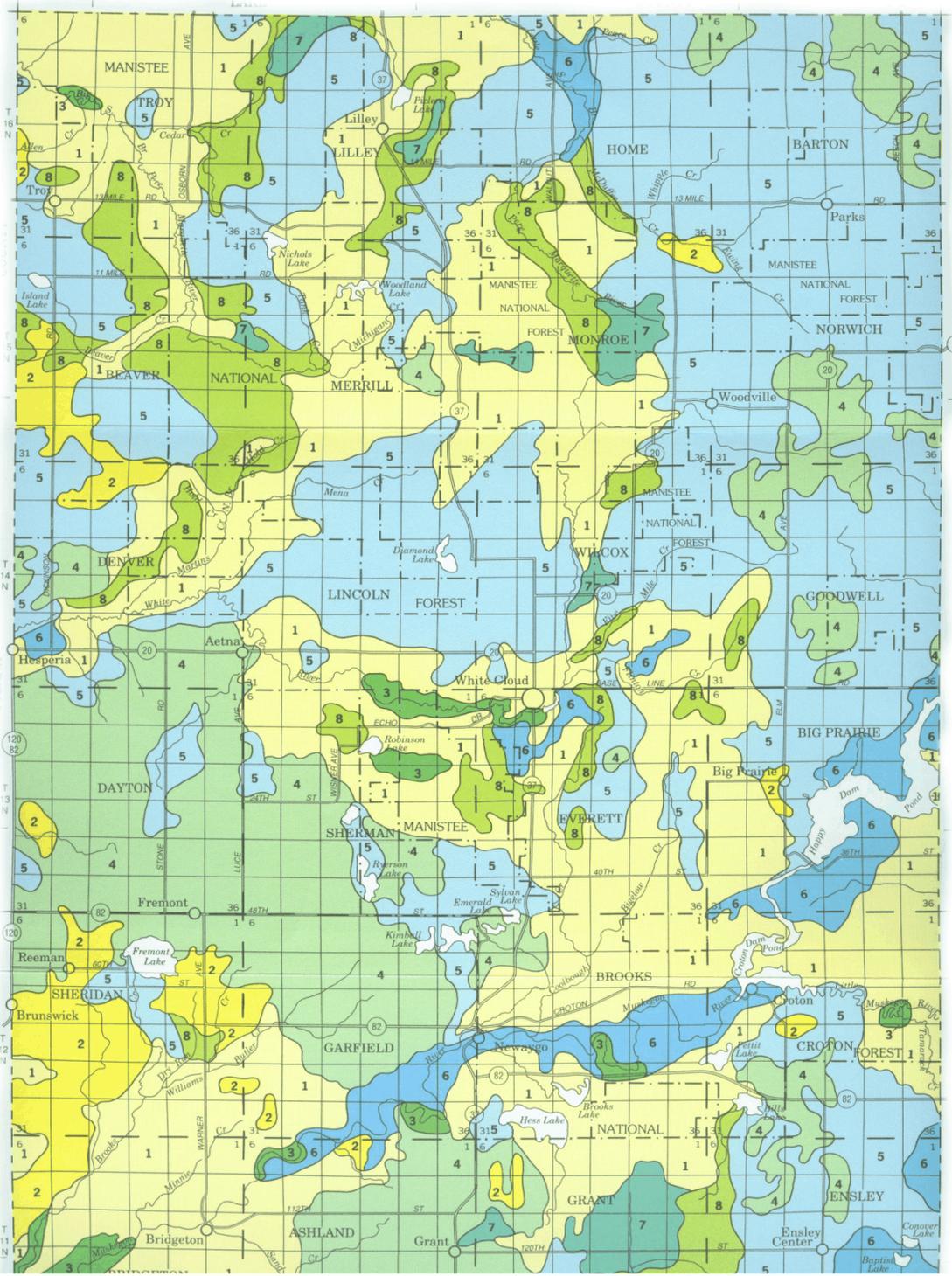
**V. INCORPORATION INTO EXISTING PLANNING MECHANISMS**

Bridgeton Township would incorporate elements of the Flood Mitigation Plan into its Land Use Plan and Zoning Ordinance, as appropriate, when they are being updated. Incorporation into the Land Use Plan would require coordination with neighboring jurisdictions. According to Public Acts 263, 264, and 265 of 2001; municipal jurisdictions must notify neighboring jurisdictions, the county, the region, and any registered public utility, railroad, or other governmental entities of the municipality’s intention to amend, revise, or create a totally new plan. By law, each of these entities has the opportunity to comment on local land use plans, and is encouraged to do so in order to promote more coordinated land use planning.

**APPENDIX A**  
**SOIL INFORMATION**

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# GENERAL SOILS MAP Newaygo County



- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #fff9c4; border: 1px solid black; margin-right: 5px;"></span> 1 Plainfield-Grattan-Brems association</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #fff176; border: 1px solid black; margin-right: 5px;"></span> 2 Cosad-Del Rey-Sickles association</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #c8e6c9; border: 1px solid black; margin-right: 5px;"></span> 3 Glendora-Abscota-Algansee association</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #a5d6a7; border: 1px solid black; margin-right: 5px;"></span> 4 Marlette-Metea-Spinks association</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #bbdefb; border: 1px solid black; margin-right: 5px;"></span> 5 Coloma-Spinks-Metea association</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #90caf9; border: 1px solid black; margin-right: 5px;"></span> 6 Toogood-Boyer association</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #81c784; border: 1px solid black; margin-right: 5px;"></span> 7 Adrian-Carlisle-Martisco association</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: #66bb6a; border: 1px solid black; margin-right: 5px;"></span> 8 Pipestone-Covert-Kingsville association</li> </ul> |
|---|---|

Source: USDA/Mich.Dept.Agr.(issued Feb., 1995)

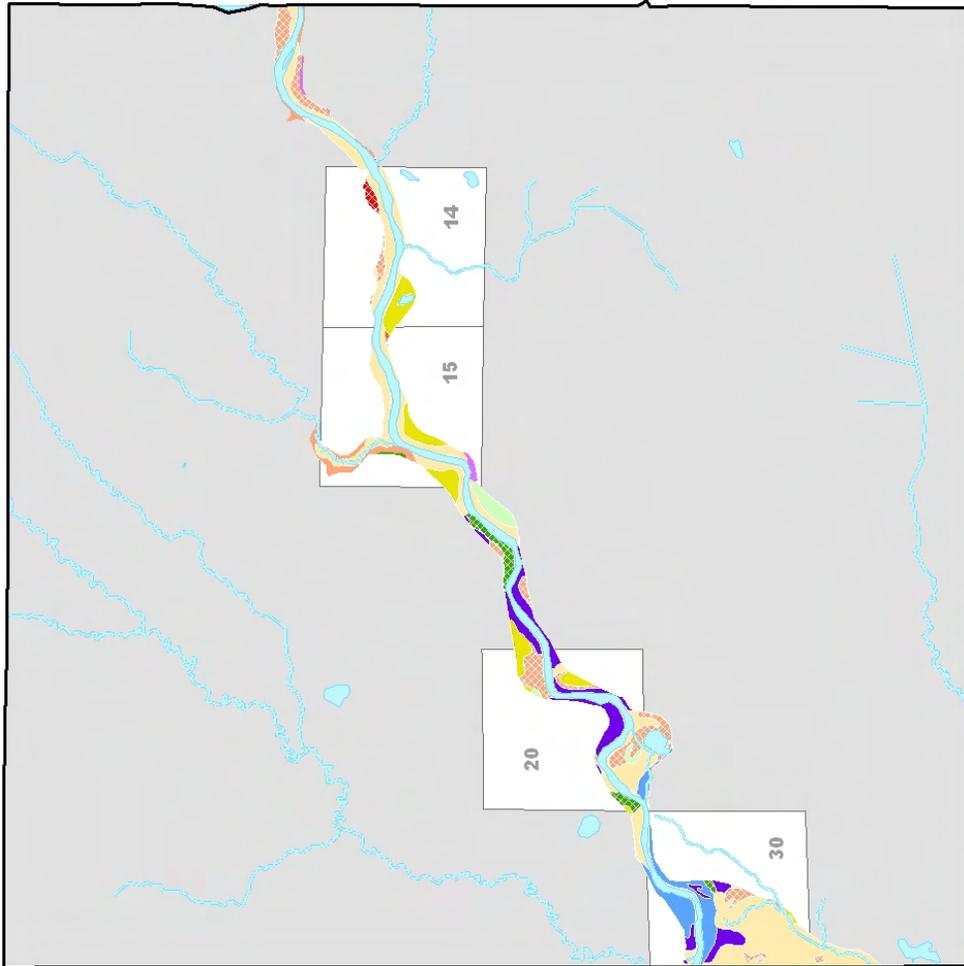
# Bridgeton Township FLOODPLAIN SOILS

- 2 - Glendora Mucky Sand
- 8 - Cohoctah Fine Sandy Loam
- 15B - Capac Loam
- 32 - Carlisle Muck
- 39B - Boyer Loamy Sand
- 47B - Toogood Loamy Sand
- 82 - Algansee Loamy Fine Sand
- 88 - Ceresco Fine Sandy Loam
- 90 - Histosols and Aquents, ponded
- 91B - Plainfield Sand
- 95A - Abscota Loamy Sand
- 98F - Plainfield-Perrinton Complex
- higher-risk township section
- water features



Data Source:  
Michigan Geographic Data Library:  
Soil Survey of Newaygo County, 1990  
This map is intended for general planning purposes only.

Map created in March 2007 by:  
**WMSTDC**  
WEST MICHIGAN STATE UNIVERSITY  
REGIONAL DEVELOPMENT COMMISSION



## FLOODPLAIN SOILS

### **2 – Glendora Mucky Sand** *0 to 2 percent slopes.*

This nearly level, very poorly drained soil is on the first bottoms of floodplains. It is frequently flooded. Permeability is rapid and the available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is set at or near the surface from late fall through late spring and during excessively wet periods. Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields.

### **8 – Cohoctah Fine Sandy Loam** *0 to 2 percent slopes.*

This nearly level, poorly drained soil is on the first bottoms of flood plains. It is frequently flooded. Permeability is moderately rapid and the available water capacity is moderate. Surface runoff is very slow. The seasonal high water table is at or near the surface from early fall through spring and during excessively wet periods. Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields.

### **15B – Capac Loam** *0 to 5 percent slopes.*

This nearly level to undulating, somewhat poorly drained soil is in convex areas on low knolls and ridges and in depressions on till plains. Permeability is moderately slow and the available water capacity is high. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during excessively wet periods. Because of wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of wetness and moderately slow permeability.

### **32 – Carlisle Muck** *0 to 2 percent slopes*

This nearly level, very poorly drained soil is in depressions on till plains, outwash plains, and moraines. Permeability is moderately slow to moderately rapid and the available water capacity is very high. Surface runoff is very slow. The seasonal high water table is near or above the surface from early fall through late spring and during excessively wet periods. Because of wetness and low strength, this soil is unsuited to septic tank absorption fields and building site development.

### **39B – Boyer Loamy Sand** *0 to 6 percent slopes.*

This nearly level to gently sloping, well drained soil is on outwash plains and terraces. Permeability is moderately rapid in the upper part of the Boyer soil and very rapid in the lower part. The available water capacity is low and surface runoff is very slow. This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity.

### **47B – Toogood Loamy Sand** *0 to 6 percent slopes.*

This nearly level to gently sloping, somewhat excessively drained soil is on outwash plains and terraces. Permeability is rapid in the upper part and very rapid in the low part. The available water capacity is low and surface runoff is very slow. This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity, which can result in the pollution of groundwater.

### **82 – Alganssee Loamy Fine Sand** *0 to 3 percent slopes.*

This nearly level and very gently sloping, somewhat poorly drained soil is on the first or second bottoms of flood plains. It is occasionally flooded. Permeability is rapid and the

available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during excessively wet periods. Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields.

**88 – Ceresco Fine Sandy Loam** *0 to 3 percent slopes.*

This nearly level, somewhat poorly drained soil is on the first or second bottoms of flood plains. It is occasionally flooded. Permeability is moderate and available water capacity is high. Surface runoff is very slow. The seasonal water table is at a depth of 1 to 2 feet from fall through spring and during excessively wet periods. Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields.

**90 – Histosols and Aquents, ponded** *0 to 1 percent slopes.*

These nearly level, very poorly drained soils are in bogs, along drainage ways, and in depressions in the uplands. They are covered by shallow water most of the year. Permeability and the available water capacity vary. Surface runoff is ponded. The high water table is above the surface most of the year. These soils are unsuited to septic tank absorption fields and building site development because of ponding and wetness.

**91B – Plainfield Sand** *0 to 6 percent slopes.*

This nearly level to gently sloping excessively drained soil is on outwash plains. Permeability is rapid and available water capacity is low. Surface runoff is very slow. This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent in absorption fields. The poor filtering capacity can result in the pollution of groundwater.

**95A – Abscota Loamy Sand** *0 to 3 percent slopes.*

This nearly level and very gently sloping, moderately well drained soil is in large, flat areas on natural levees on flood plains. It is occasionally flooded. Permeability is rapid and available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2.5 to 5 feet during the winter and spring and during excessively wet periods. Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields.

**98F – Plainfield-Perrinton Complex** *35 to 70 percent slopes.*

These steep and very steep soils are in areas where sand out wash overlies lake laid sediments. These areas formed when drainage ways cut through the soils. The excessively drained Plainfield soil is on the upper part of the slopes and the well-drained Perrinton soil is on the lower part. In the Plainfield soil, permeability is rapid, available water capacity is low, and surface runoff is medium. In the Perrinton soil, permeability is slow, available water capacity is high and surface runoff is rapid. Most areas are used as woodland. Because of the slope, these soils are unsuited to building site development and septic tank absorption fields.

**Bridgeton Township Limitations of Soils for Building Site Development:  
Residential, Commercial, and Light Industry Development, and Roadways**

<b>Degree of Limitations Affecting Use For:</b>						
<b>Soil Series</b>	<b>Residential</b>	<b>Septic Tank Absorption Fields</b>	<b>Sewage Lagoon Areas</b>	<b>Commercial and Light Industry</b>	<b>Traffic-ways</b>	<b>Soil and Water Features: Flooding and High Water Table Depth</b>
2- Glendora	Severe: flooding, wetness	Severe: flooding, wetness, poor filter	Severe: seepage, flooding, wetness	Severe: flooding, wetness	Severe: wetness, flooding	Flooding: frequent Depth: 0-1.0 ft
8- Cohoctah	Severe: flooding, wetness	Severe: flooding, wetness	Severe: seepage, flooding, wetness	Severe: flooding, wetness	Severe: wetness, flooding, frost action	Flooding: frequent Depth: 0-1.0 ft
15B- Capac	Severe: wetness	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: frost action	Flooding: none Depth: 1.0-2.0 ft
32- Carlisle	Severe: subsides, ponding, low strength	Severe: subsides, ponding, percs slowly	Severe: seepage, excess humus, ponding	Severe: subsides, ponding, low strength	Severe: subsides, ponding, frost action	Flooding: none Depth: +.5-1.0 ft
39B- Boyer	Slight	Severe: poor filter	Severe: seepage	Slight	Moderate: frost action	Flooding: none Depth: > 6.0 ft
47B- Toogood	Slight	Severe: poor filter	Severe: seepage	Slight	Slight	Flooding: none Depth: > 6 ft
82- Algansee	Severe: flooding, wetness	Severe: flooding, wetness, poor filter	Severe: seepage, flooding, wetness	Severe: flooding, wetness	Severe: flooding	Flooding: occasional Depth: 1.0-2.0 ft
88- Ceresco	Severe: flooding, wetness	Severe: flooding, wetness	Severe: seepage, flooding, wetness	Severe: flooding, wetness	Severe: flooding, frost action	Flooding: occasional Depth: 1.0-2.0 ft
90- Histosols and Aquentis	Severe: ponding, low strength	Severe: ponding	Severe: excess humus, ponding	Severe: ponding, low strength	Severe: ponding, frost action	Flooding: none Depth: +1-1.0
91B- Plainfield	Slight	Severe: poor filter	Severe: seepage	Slight	Slight	Flooding: none Depth: > 6 ft
95A- Abscota	Severe: flooding, wetness, poor filter	Severe: seepage, flooding, wetness	Severe: flooding, wetness,	Severe: flooding	Severe: flooding	Flooding: occasional Depth: 2.5-5.0 ft
98F-Plainfield-Perrinton Complex	Severe: slope	Severe: poor filter, percs slowly, slope	Severe: seepage, slope	Severe: slope	Severe: low strength, slope	Flooding: none Depth: > 6'

*Slight*- Soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome.

*Moderate*- Soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations.

*Severe*- Soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance required.

Source: United States Department of Agriculture, Natural Resources Conservation Service and Forest Service. Soil Survey of Newaygo County, Michigan 1990.

**APPENDIX B**  
**HAZARD IDENTIFICATION AND ASSESSMENT**  
**(from the Newaygo County Hazard Mitigation Plan)**

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## **Hazard Identification** Bridgeton Township

### **1. NATURAL HAZARDS**

- a. Thunderstorm Hazards** (severe winds, tornadoes, hail, lightning, heavy rain):
- Thunderstorm days per year: 40-50
  - August 20 - September 6, 1975: Rainstorms, high winds. Declaration of major disaster by President.
  - March 2-7, 1976: Tornadoes. Declaration of major disaster by President.
  - May 31, 1998: Thunderstorms & high winds. Declaration of major disaster by President. \$1.2m public property damage in Newaygo County.
  - June 3-5, 1998: Thunderstorms & high winds. Declaration of disaster by Governor.
  - April 11 2001: Severe thunderstorm winds. \$100k property damage in Newaygo County.
  - October 6, 2002: Severe thunderstorm winds. \$25k property damage throughout Newaygo County.
- b. Severe Winter Weather** (ice, sleet, snow storms):
- March 20, 1976: Icestorms. Declaration of major disaster by President.
  - January 26-31, 1977: Blizzard, snowstorm. Declaration of disaster by Governor, declaration of emergency by President.
  - January 26-27, 1978: Blizzard, snowstorm. Declaration of disaster by Governor, declaration of emergency by President.
  - January 12, 1993: Heavy snow. \$50k property damage, northern Lower Michigan.
  - January 27, 1994: Heavy snow and freezing rain. \$5m property damage across region.
  - October 26, 1997: Heavy snow. \$1.2m property damage across southwestern Lower Michigan.
  - March 9, 1998: Winter storm. \$100k property damage across region.
  - January 2-15, 1999: Blizzard, snowstorm. Declaration of emergency by President.
  - April 3, 2003, Ice storm. \$4.9m property damage throughout West Michigan.
- c. Floods** (shoreline, riverine, urban):
- August 20-September 6, 1975: Flooding. Declaration of major disaster by President.
  - September 10-19, 1986: Flooding. Declaration of major disaster by President.
  - October 28, 1986: Flooding & heavy rain. Declaration of disaster by Governor.
  - February 10, 2001: Flooding. \$100k property damage across Western Michigan.
  - May 15-16, 2001: Flash flood and flooding. \$75k property and \$75k crop damage across Newaygo County.
  - May 21-23, 2004: Flooding: \$25m property damage and \$4.6m crop damage across western Lower Michigan. Declaration of disaster in Newaygo County by governor.
- \*note\* melting snow and ice from February through March may produce hazardous flooding*
- d. Extreme Temperatures:**
- July 1936: Heat wave. 570 deaths statewide, 364 in Detroit.
  - Summer, 1988: 39 days with temperatures over 90 degrees.
  - January 20, 1994: Record cold. \$50m property damage across Michigan.
- e. Drought:**
- Summer 1871: Prolonged drought over much of the Great Lakes Regions.
  - May-September 1891: Drought devastated Michigan's lumber industry.
  - Statewide: 1930-1937, 1960-1967, 1976-1980, and 1986-1989.
  - Lower Peninsula: 1939-1942 (crop damage).
  - 1964: Record "low" water levels.
- f. Wildfires:**
- October 1871: Wildfires across much of the Lower Peninsula. 200 fatalities, 1.2 million acres burned.
  - May-September, 1891: Uncontrollable wildfires across Michigan during the drought of 1891.

- 1981-2000: Approximately 1 wildfire and 13.6 acres burned per year on county lands under MDNR jurisdiction (18 total wildfires, 244 total acres burned).

**g. Earthquakes:** - None Identified; No significant threat.

## **2. TECHNOLOGICAL HAZARDS**

**a. Structural and Scrap Tire Fires** (including explosions, industrial accidents):

- No Fires Identified; scrap tire inventory at Newaygo County disposal sites in 2001: 1,014,000.

**b. Dam Failures:** - None Identified

**c. Hazard Material Incidents** (fixed site and transportation related, nuclear material):

- SARA Title III sites within Newaygo County: 11.

**d. Infrastructure Failure** (water distribution, storm and sanitary sewers, electrical power system, communications systems):

- April 6-7, 1997: 180,000-200,000 without power; 70,000 on second day, statewide. High wind.

- June 1, 2000: Downed trees and power lines throughout Newaygo County. Severe thunderstorm winds.

- April 3, 2003: Hundreds of thousands lose power in Lower Michigan. Ice storm.

- July 4, 2003: Downed trees and power lines throughout Newaygo County. Severe thunderstorm winds.

*\*note\* severe thunderstorms and winter weather often disrupt electrical power systems*

**e. Oil and Gas Well/Pipeline Accidents:**

- 1,025 oil and gas wells within Newaygo County.

**f. Land Subsidence:** - None Identified

**g. Transportation Accidents:** - None Identified

*\*note\* severe winter weather is likely to create transportation hazards from October through April*

## **3. HUMAN-RELATED HAZARDS**

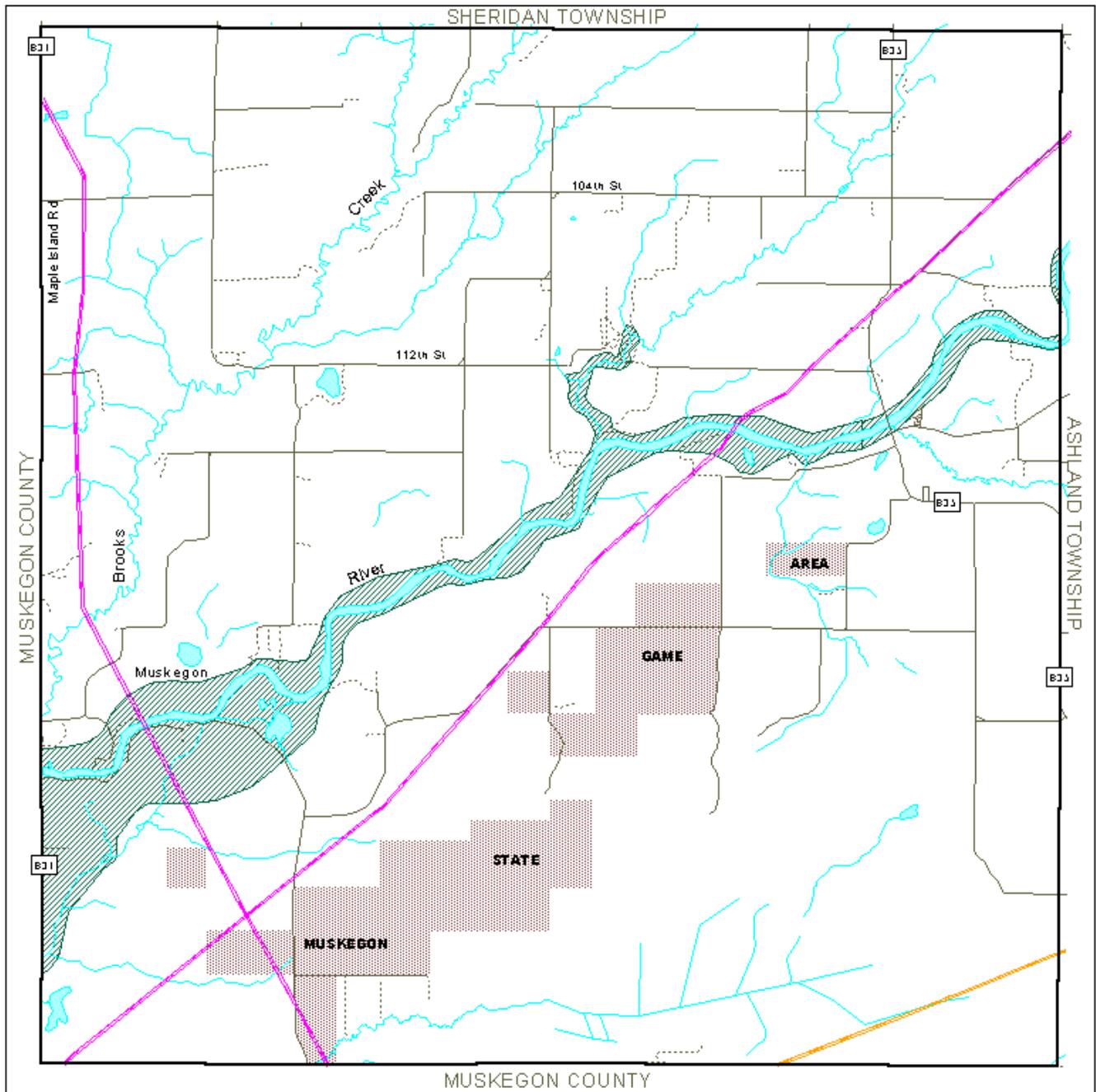
**a. Public Health Emergencies:** - None Identified

**b. Civil Disturbances** (riots, prison uprisings, etc.): - None Identified

**c. Nuclear Attack/Civil Defense Emergency:** - None Identified

**d. Weapons of Mass Destruction/Terrorism/Sabotage:** - None Identified

# Hazard/Risk Profile Map BRIDGETON TOWNSHIP



AREA WIDE HAZARDS
- Snow/Ice/Sleet Storms
- Tornadoes
- Severe Wind Storms
- Extreme Temperatures
- Drought
- Wildfire
- Public Health Emergencies

Hazard Sites	
	Flood Plains
	Muskegon St Game Area
	Gas Pipeline
	Electric Power Line

N

0 1 Miles

Source: Michigan Geographic Data Library  
Created by WMSRDC  
May 2005

**Hazard Assessment – Ratings**  
**BRIDGETON TOWNSHIP**

Type of Hazard	Likelihood of Occurrence	Percent of Population Affected	Potential for Causing Casualties	Potential for Negative Economic Effects	Corollary Effects	Public Awareness of Hazard
<b>1.0 NATURAL HAZARDS</b>						
1.01 Drought	4	7	3	7	5	3
1.03 Extreme Temperatures	7	8	4	5	5	4
1.04 Fire Hazards: Wildfire	9	4	5	5	5	6
1.05 Flooding: Riverine/Urban	8	4	2	4	5	7
1.07 Hail	9	3	1	2	2	3
1.08 Lightning/Heavy Rain	8	7	2	2	4	6
1.09 Severe Winds	10	6	2	5	6	7
1.10 Snow/Ice/Sleet Storms	9	10	5	7	6	10
1.11 Tornadoes	7	2	5	2	3	8
<b>2.0 TECHNOLOGICAL HAZARDS</b>						
2.01 Dam Failures	7	2	2	6	5	7
2.02 Fire Hazards: Scrap Tires	1	1	1	1	4	1
2.03 Fire Hazards: Structural	10	3	5	5	2	6
2.04 HAZMAT: Fixed Site	1	1	1	1	1	1
2.05 HAZMAT: Transportation	3	1	2	1	1	2
2.06 Infrastructure Failures	9	6	4	5	7	5
2.07 Land Subsidence	-	-	-	-	-	-
2.09 Oil/Gas Well Accidents	-	-	-	-	-	-
2.10 Pipeline Accidents	2	1	4	6	4	2
2.11 Transportation Accidents	3	1	3	1	2	2
<b>3.0 HUMAN RELATED HAZARDS</b>						
3.01 Civil Disturbances	1	1	1	2	1	1
3.03 Public Health Emergencies	4	4	4	5	4	4

Scale: from 0 (poses the least threat) to 10 (poses the greatest threat)

**Hazard Assessment – Rankings**  
**BRIDGETON TOWNSHIP**

Likelihood 30%	Population 20%	Casualties 20%	Economic 15%	Corollary 10%	Awareness 5%	Total	Type of Hazard
2.7	2	1	1.05	0.6	0.5	<b>7.85</b>	Snow/Ice/Sleet Storms
2.7	1.2	0.8	0.75	0.7	0.15	<b>6.3</b>	Infrastructure Failures
3	1.2	0.3	0.75	0.6	0.35	<b>6.2</b>	Severe Winds
2.7	0.8	1	0.75	0.5	0.3	<b>6.05</b>	Fire Hazards: Wildfire
2.1	1.6	0.8	0.75	0.5	0.2	<b>5.95</b>	Extreme Temperatures
3	0.6	1	0.75	0.2	0.3	<b>5.85</b>	Fire Hazards: Structural
2.4	1.4	0.4	0.3	0.4	0.3	<b>5.2</b>	Lightning/Heavy Rain
2.4	0.8	0.4	0.6	0.5	0.35	<b>5.05</b>	Flooding: Riverine/Urban
1.2	1.4	0.6	1.05	0.5	0.15	<b>4.9</b>	Drought
2.1	0.4	0.4	0.9	0.5	0.35	<b>4.65</b>	Dam Failures
2.1	0.4	1	0.3	0.3	0.4	<b>4.5</b>	Tornadoes
2.7	0.6	0.2	0.3	0.2	0.15	<b>4.15</b>	Hail
1.2	0.8	0.8	0.75	0.4	0.2	<b>4.15</b>	Public Health Emergencies
0.6	0.2	0.8	0.9	0.4	0.1	<b>3</b>	Pipeline Accidents
0.9	0.2	0.6	0.15	0.2	0.1	<b>2.15</b>	Transportation Accidents
0.9	0.2	0.4	0.15	0.1	0.1	<b>1.85</b>	HAZMAT: Transportation
0.3	0.2	0.2	0.15	0.4	0.05	<b>1.3</b>	Fire Hazards: Scrap Tires
0.3	0.2	0.2	0.3	0.1	0.05	<b>1.15</b>	Civil Disturbances
0.3	0.2	0.2	0.15	0.1	0.05	<b>1</b>	HAZMAT: Fixed Site
-	-	-	-	-	-	<b>0</b>	Land Subsidence
-	-	-	-	-	-	<b>0</b>	Oil/Gas Well Accidents

# APPENDIX C

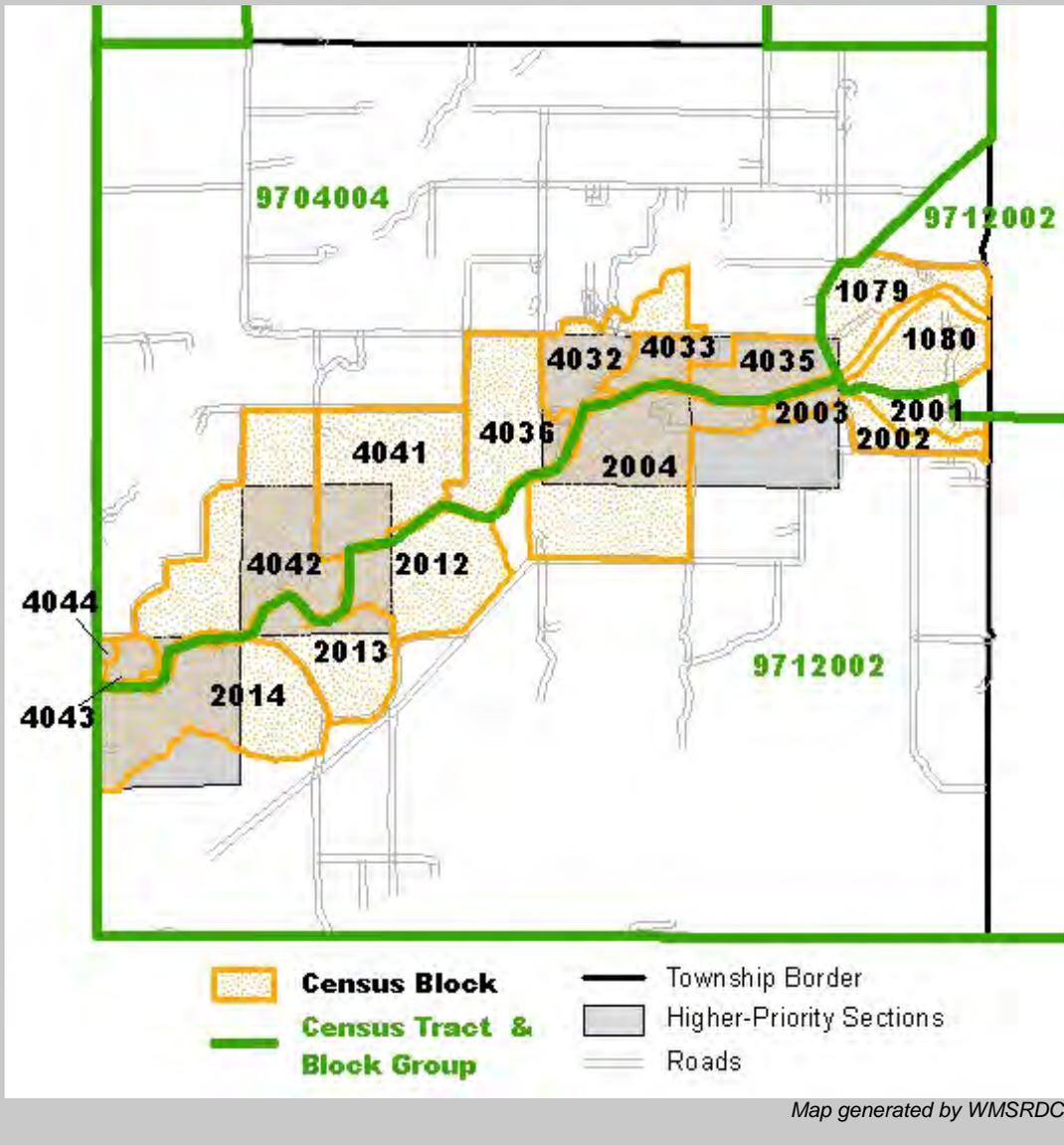
## CENSUS

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Bridgeton Township Housing Along the Muskegon River								
Tract	Block Group	Blocks Along Muskegon River	Population	Total Units	Occupied	Vacant (Seasonal)	People Per Occupied Unit	Units Occupied by Elderly (65+) Householder
9704	4	-	1541	586	528	58 (24)	2.92	90
		4032	23	20	10	10 (2)	2.3	0
		4033	28	15	11	4 (4)	2.5	0
		4035	29	10	10	0	2.9	1
		4036	22	24	12	12 (9)	1.83	7
		4041	55	19	18	1 (1)	3.06	1
		4042	122	46	43	3 (2)	2.84	6
		4043	8	3	3	0	2.67	2
		4044	1	1	1	0	1	0
9712	1	-	1973	780	703	77 (45)	2.81	151
		1079	37	11	11	0	3.36	1
		1080	32	13	12	1 (0)	2.67	4
9712	2	-	1137	468	396	72 (57)	2.87	54
		2001	33	15	15	0	2.20	0
		2002	15	7	6	1 (1)	2.50	3
		2003	11	4	4	0	2.75	1
		2004	52	26	21	5 (5)	2.48	2
		2012	65	21	20	1 (1)	3.25	3
		2013	18	9	7	2 (1)	2.57	2
		2014	64	28	26	2 (1)	2.46	2
<b>totals for selected blocks</b>			<b>615</b>	<b>272</b>	<b>230</b>	<b>42 (27)</b>	<b>2.55</b>	<b>35</b>

Source: United States Census Bureau. Census 2000 Summary File 1 (SF1) 100-Percent Data.

**2000 Census Divisions Along the Muskegon River in Bridgeton Township**



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