HAZARD MITIGATION PLAN
City of Ann Arbor
August 2012

Resolution to Approve City of Ann Arbor 2012 Hazard Mitigation Plan

Whereas, The City of Ann Arbor is committed to the mitigation of potential hazards and the protection of the public health, and the reduction of property damage and loss of life that can result from hazardous events;

Whereas, The Federal Emergency Management Agency (FEMA) requires that communities have an adopted Hazard Mitigation Plan as a requirement to receive funding under certain FEMA programs;

Whereas, In 2004, the City prepared and adopted a City Hazard Mitigation Plan (R-471-11-04) in coordination with Washtenaw County's preparation of a County-wide Hazard Mitigation Plan;

Whereas, The City of Ann Arbor Hazard Mitigation Plan outlining mitigation strategies which are required under FEMA requirements to be periodically assessed and revised recognizing the physical development of the community, susceptibility to natural, technological and societal hazards and updating strategies for addressing these hazards

Whereas, The City of Ann Arbor is required for grant compliance to approve the 2012 Hazard Mitigation Plan to make the City eligible for future grants to implement the recommendations of the plan, if and when funds become available; and

Whereas, The Office of Emergency Management, working with the Michigan Department of State Police, Emergency Management Division, has identified and prepared the 2012 Hazard Mitigation Plan, including the updating of GIS Mapping, previous incident data and other hazard assessment information and strategies, where necessary.

RESOLVED, That City Council approve the City of Ann Arbor 2012 Hazard Mitigation Plan; and

RESOLVED, That Office of Emergency Management will be responsible for ensuring that the mitigation strategies in the City 2012 Hazard Mitigation Plan are implemented, with the understanding that implementation is based on the availability of funding and staff resources.

Approved Ann Arbor City Council Resolution R-12-____,

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1.0 INTRODUCTION

Hazard Mitigation is defined as any action taken before, during or after a disaster to permanently eliminate or reduce risks to human life and property from natural, technical or societal hazards.

The City of Ann Arbor has experienced hazards of varying degrees, and should expect to encounter hazards of many types and durations in the future. The value of a Multi-Hazard Mitigation Plan (Plan) lies in reducing future emergencies and events; by implementing mitigation strategies set forth in this Plan, the expectation is for hazard occurrences to result in fewer deaths and injuries to people, and lessened damage or destruction to structures and the environment. Response and recovery costs should also be reduced.

The Federal Emergency Management Agency (FEMA) provides assistance to local units of government when faced with disasters through the Robert T. Stafford Disaster Relief and Emergency Assistance Act - the Stafford Act. Recognizing that planning for hazards is an important component of hazard preparedness, response and recovery programs, the Stafford Act was amended in 2000 to require governments to have adopted a Hazard Mitigation Plan as a condition of receiving or directly benefiting from FEMA's Hazard Mitigation Assistance grants. This is the first full Ann Arbor hazard mitigation plan to be produced - the previously approved plans were a Washtenaw County plan in 2004 that had included a subsection for the City of Ann Arbor, and a flood-only plan for the city in 2007. The Office of Emergency Management and City Planning have reviewed the previous county plan and the flood mitigation plan to merge contents of both documents into a stand-alone city hazard mitigation plan. New details about hazard events have been included in the plan, but there has been no significant change to the city's infrastructure or hazard risk.

1.1 Purpose

There are three purposes for this Plan: 1) to identify and assess hazards in Ann Arbor; 2) to analyze areas particularly vulnerable to hazards; and 3) to identify feasible mitigation strategies that can be acted upon after adoption of the Plan. Hazard mitigation goals and strategies should also be incorporated into the city's Master Plan, and other plans, as applicable.

1.2 Plan Organization

This Plan was prepared by the City of Ann Arbor, in cooperation with Washtenaw County and the Emergency Management and Homeland Security Division of the Michigan State Police.

1.3 Planning Process

The Hazard Mitigation Plan is the result of a collaborative effort with the Michigan State Police, Washtenaw County, many departments within the City of Ann Arbor, and the general public. The plan was developed specifically by the Safety Services Area - Police Department – Office of Emergency Management. The plan not only recognizes that the City of Ann Arbor lies within the County of Washtenaw and experiences many shared hazards, but also describes several unique hazards and mitigation opportunities.

An initial draft of this plan started with the Ann Arbor section of the Washtenaw County Hazard Mitigation Plan, which was approved by FEMA in 2005. The city's portion of this plan formed an initial draft plan which was refined by the Office of Emergency Management. Driven by a need for more detail about flood hazards, the city of Ann Arbor developed a flood mitigation

plan in 2007, and this information was integrated into the current all-hazard mitigation plan for the city, with guidance from Hazard Mitigation Specialists of the Michigan State Police's Emergency Management and Homeland Security Division. Every page of the existing hazard mitigation plans was reviewed and revised as appropriate, to be up-to-date for the city as of July 2012, and supplemented with new text and information researched by the involved agencies during 2011 and 2012. In addition to the original documents and agency information from city departments, additional historical hazard event descriptions were found in the 2011 Michigan Hazard Mitigation Plan and the online "Storm Events" database for the National Climatic Data Center. All of these information sources were merged into the current document and reviewed for accuracy.

In addition to the activities involved in developing the Ann Arbor flood plan, numerous activities took place to produce the current all-hazard plan for the city. Over a period of several months during the end of 2011 and the beginning of 2012, the Director of Emergency Management worked on compiling the plan's information and meeting with city agencies and subject matter experts. Precise records about these meetings are not available, because the position was vacated in the midst of the plan update and taken over by a new person. Since that took place, there have been a number of additional meetings which are documented here.

On May 16, 2012, a planning meeting was held at the Attorney General's office, with the Director of Emergency Management, The Senior Assistant City Attorney, and the Stormwater and Floodplain Programs Coordinator discussing plan documentation, development, and update, and the inclusion of information from the 2007 Flood Mitigation Plan into the All Hazards Mitigation Plan for the City of Ann Arbor. During the same meeting, the outline for a standardized review sheet was developed for the various City Service Areas. Several additional meetings were held as this plan was refined and finalized, as described below.

On May 30, 2012, the Director of Emergency Management and the Senior Assistant City Attorney met at the City Attorney's Office to discuss distribution of the Draft Plan to City departments for review and additional information. A review sheet was developed to assist City departments in the review process and to ensure that correct and updated data was incorporated.

On June 27, 2012, the Director of Emergency Management met with the MSP/EMHSD Hazard Mitigation Planner for guidance on plan structure and review of additional needs. The 2007 Flood Plan was delivered and corresponding updates to date were reviewed. Methods of consolidating these materials were discussed.

On July 10, 2012, the Director of Emergency Management met with the Ann Arbor Fire Department Assistant Fire Chief and the Fire Training Officer to discuss updated data for structural fires and hazardous materials. The meeting took place at the Fire Chief's office at the Ann Arbor Fire Station 1.

On July 13, 2012, the Director of Emergency Management met with personnel from the Michigan State Police, Emergency Management and Homeland Security Division, to exchange information and discuss the remaining plan revisions. A follow-up meeting took place on July 16 with two EMHSD planners, to consolidate information into a single document, and to check for any remaining requirements left to complete in the plan.

Many informal conversations and telephone calls were made in order to clarify and further develop input from many agencies both in the City and Washtenaw County. E-mail was also used to exchange information. These communications helped to verify and improve the content of this plan.

During late 2011 and the early months of 2012, a draft hazard mitigation plan was distributed to all departments within the City along with a standardized review sheet in order to gather necessary data. Input was received from the following City Service Areas and personnel:

Public Services Area

- Water Treatment Services Unit Manager
- Systems Planning Unit, Environmental Coordinator
- Systems Planning Unit, Stormwater and Floodplain Programs Coordinator
- Systems Planning Unit, Transportation Program Manager
- Systems Planning Unit, Urban Forestry and Natural Resource Planning Coordinator
- Systems Planning Manager

Safety Services Area

- Police Services, Director of Emergency Management
- Police Services, Chief of Police
- Police Services, past Director of Emergency Management
- Police Services, Special Services Section, Special Services Lieutenant
- Fire Services Unit, Assistant Fire Chief
- Fire Services Unit, Fire Training Officer

Financial Services Area

Information Technology Services Unit, Director of Information Technology

City Attorney's Office

- Senior Assistant City Attorney

City Administration Office

- Communications Office, Communications Unit Manager
- Human Services Unit, Human Resources Assistant

Washtenaw County

- Sheriffs Office of Emergency Management
- Office of Community and Economic Development
- Hazardous Material Response Team Supervisor

Michigan State Police, Emergency Management Homeland Security Division (MSP/EMHSD)

- Local Hazard Mitigation Specialist
- Hazard Mitigation Planner

On March 19th, 2007 the Ann Arbor City Council approved the Flood Mitigation Plan. The Plan contained a comprehensive examination of floodplain best management practices, a meaningful public engagement process, damage loss estimates, information on historical flooding, a floodplain development patterns narrative, and extensive GIS analysis - including a detailed land use analysis and a flood depth analysis that went far beyond what was included in the 2004 Washtenaw County plan (that included a city subsection). The flood plan also provided guidance for plan implementation and the development of a Floodplain Ordinance. These plans had included the University of Michigan as well as surrounding communities. The core of the flood plan was a Flood Mitigation Strategy "toolbox" that included mitigation strategies and vulnerability estimates by parcel and structure, constituting a categorical risk approach that yielded a vulnerability index to rank each parcel's mitigation priority.

The flood plan's strategies addressed the following areas: Mapping & Technology, Education and Outreach, Planning and Zoning, Regulation and Development Standards, Corrective Actions, Infrastructure, and Emergency Services. A practical implementation process was outlined that set a clear action agenda that might be guided by an annual advisory meeting to include residents, stakeholders, decision makers, and staff.

On May 1, 2007, the City Planning Commission approved a resolution (Attachment 4) directing the city staff to work with a subcommittee on the development of a floodplain management ordinance. The resolution became the guiding document for city staff in prioritizing mitigation activity.

The Flood Mitigation Plan extended the work of two previous efforts: the Hazard Mitigation Plan (developed by Washtenaw County with a subsection for the City of Ann Arbor) and the Floodplain Policy Discussion. The development of an all-hazard Hazard Mitigation Plan will incorporate information from these existing documents, including a consideration of property acquisition, relocation, redevelopment, modifications, public works measures, planning and regulatory measures, incentives, leading by example, and public education. The Planning Commission's work in 2007 had researched and presented various floodplain policy options regarding the future development of the City's floodplains. The current all-hazard plan has incorporated these previous efforts.

The Flood Mitigation Plan had included an extensive review and approval process that served to supplement the thorough public engagement conducted during its planning process. Review and approval consisted of extended staff review, public comment via

email and the web, presentations to watershed groups, and review by the Environmental Commission, City Planning Commission, and City Council. The plan received unanimous support from the Environmental Commission and City Planning Commission and was approved unanimously by City Council. Both entities approved and adopted at the plan. State and Federal agencies also provided review and comment. Since Ann Arbor's initial FEMA approval for hazard mitigation grant eligibility in 2005, numerous additional planning activities and input opportunities have taken place. The public engagement process for the Ann Arbor flood plan included:

- Public Forums – The planning team attended six regular public meetings of various public entities, including the Downtown Development Authority, the Environmental Commission, and the Parks Advisory Commission. The report was also discussed at a Planning Commission working session in October of 2006. The Flood Mitigation Plan was submitted for review and endorsement by the Environmental Commission and Planning Commission. The plan was approved by City Council and the State of Michigan. The Flood Mitigation Plan was also discussed publicly in meetings that were held to discuss related events and planning efforts, such as the Allen Creek Greenway Task Force meetings and FEMA Map Modernization meetings.
- Outreach Meetings – The planning team conducted outreach to local interest groups and held a special outreach meeting in Council Chambers on June 29th 2005 dedicated solely to gaining public feedback on the Flood Mitigation Plan. The planning team met with; the Old West Side Association and the Allen Creek, Millers Creek, and Malletts Creek, watershed groups.
- Website Updates – A page was maintained on the City's Environmental Coordination website that contained an online information packet to update the public on the status of the project. This packet also contained contact information for the planning team and the workplan.
- Television Broadcasts - All of the public forum presentations and the special outreach meeting on June 29th were recorded and broadcasted on the local cable network CTN.
- Radio Broadcasts – An interview regarding the project was aired on "Issues of the Environment" on 89.1 WEMU in the spring of 2006.
- Educational Presentations – Several presentations were made regarding the plan at the University of Michigan and Eastern Michigan University
- Mailings – A mailing was sent to a list of over 200 people with development interests, planning interests and neighborhood interests seeking attendance at the special outreach meeting held on June 29th.
- Press Release – A Press Release was published in the Sunday June 25th addition of the Ann Arbor News announcing the special outreach meeting held on June 29th.
- Newspaper Articles – The Flood Mitigation Plan was mentioned in several Ann Arbor News articles during the planning period that dealt with downtown Ann Arbor planning and development issues. The planning team assisted in providing accurate information to Ann Arbor News Reporters. The Old West Side Association also publishes a Newsletter that featured an article about the Flood Mitigation Plan.
- Telephone Conversations – As a result of the outreach and provision of information the planning team received and responded to many telephone inquiries regarding the Flood Mitigation Plan.
- Emails – In addition to responding to telephone inquiries the planning team also responded to many email inquiries regarding the Flood Mitigation Plan.

- Public Approval Process – Public review presentations to Environmental Commission, Planning Commission, and City Council from January 2007- April 2007, with resolutions of support requested from Environmental Commission and Planning Commission and a resolution of approval requested from City Council.

1.4 Public Participation

The Plan was placed on the City's website with Public input sought from December 2011 thru February 1, 2012 with appropriate modifications made to this document before adoption. A much-expanded edition of the plan was again posted for public and agency review on the city's website at the beginning of August, 2012, with a press release issued to draw attention to the plan's posting. Public input for future updates and revisions of the Plan will be encouraged through the same method, with public notification through media outlets and the Ann Arbor Bulletin. Although no specific changes to the plan stemmed from these opportunities at the time of this writing, any such feedback will be considered in the future. Because of the need to continue with final plan adoption and promulgation, comments or suggestions received after mid-August may simply feed into the city's next plan update, if they are too late for consideration in the final 2012 plan. The final 2012 plan was reviewed by FEMA, with consideration given to FEMA's plan review feedback.

2.0 COMMUNITY PROFILE

2.1 Historic Overview

John Allen from Virginia and Elisha Rumsey from Connecticut founded, named and registered a 640-acre town tract of Ann Arbor in 1824. That same year, the town was designated the County Seat by Governor Cass at Allen and Rumsey's urging. In 1834, the Ann Arbor Land Company offered 40 acres of free land to the trustees of the newly-formed University of Michigan, then located in Detroit, if the University would relocate. By 1837, the University had approved Ann Arbor as the site of the University, and by 1841, the University was actually opened in the City. In 1839, the first railroad was completed along the Huron River. The completion of the railroad and the location of the University encouraged Ann Arbor's steady growth. By 1878, when a railroad link with Toledo finally was established, Ann Arbor had become one of the most thriving business centers west of Detroit. The University's influence on the neighborhoods was also evident. By 1865, enrollment had grown to 1,145, the largest University enrollment in the United States. The first students had boarded in dormitories, but these were soon inadequate and the majority of students began to board with townspeople.

2.2 Natural Features

Natural features are visible throughout both the developed and undeveloped areas of the City. The significance of the natural features is without question in both situations. Yet, the role of the natural landscape in urban development is different in each. In developed areas, natural features that remain or can be reclaimed are, in most instances, isolated from each other. In un-built or undeveloped areas, the significant natural features of a landscape are often contiguous and can be used to frame, guide, connect and buffer the various other forms of urban development. Some natural areas are continuous or can be reestablished to be continuous to form a unified network. Therefore, it is important that a park, recreation, and open space system be based partially on a philosophy of conservation and preservation of natural features.

Subsurface characteristics are directly related to surface features. For instance, soil type and ground water conditions influence vegetation and soil type while the degree of slope affects human use. Much documentation is available on the Ann Arbor

area's historical geology, particularly the effects of the glaciers on the landscape. In brief, glaciations are partially responsible for the many wet, swampy areas in the City and other landforms such as the kames and eskers.

Surface Water. Rivers and Watersheds. The Ann Arbor area's natural water resources are numerous, and include the Huron River; the streams and creeks flowing through the City and the surrounding townships; natural lakes and ponds; and various types of wetlands, such as marshes, swamps, and fens. These natural water resources, as well as other natural features, are subject to stresses when they are located within urbanized regions.

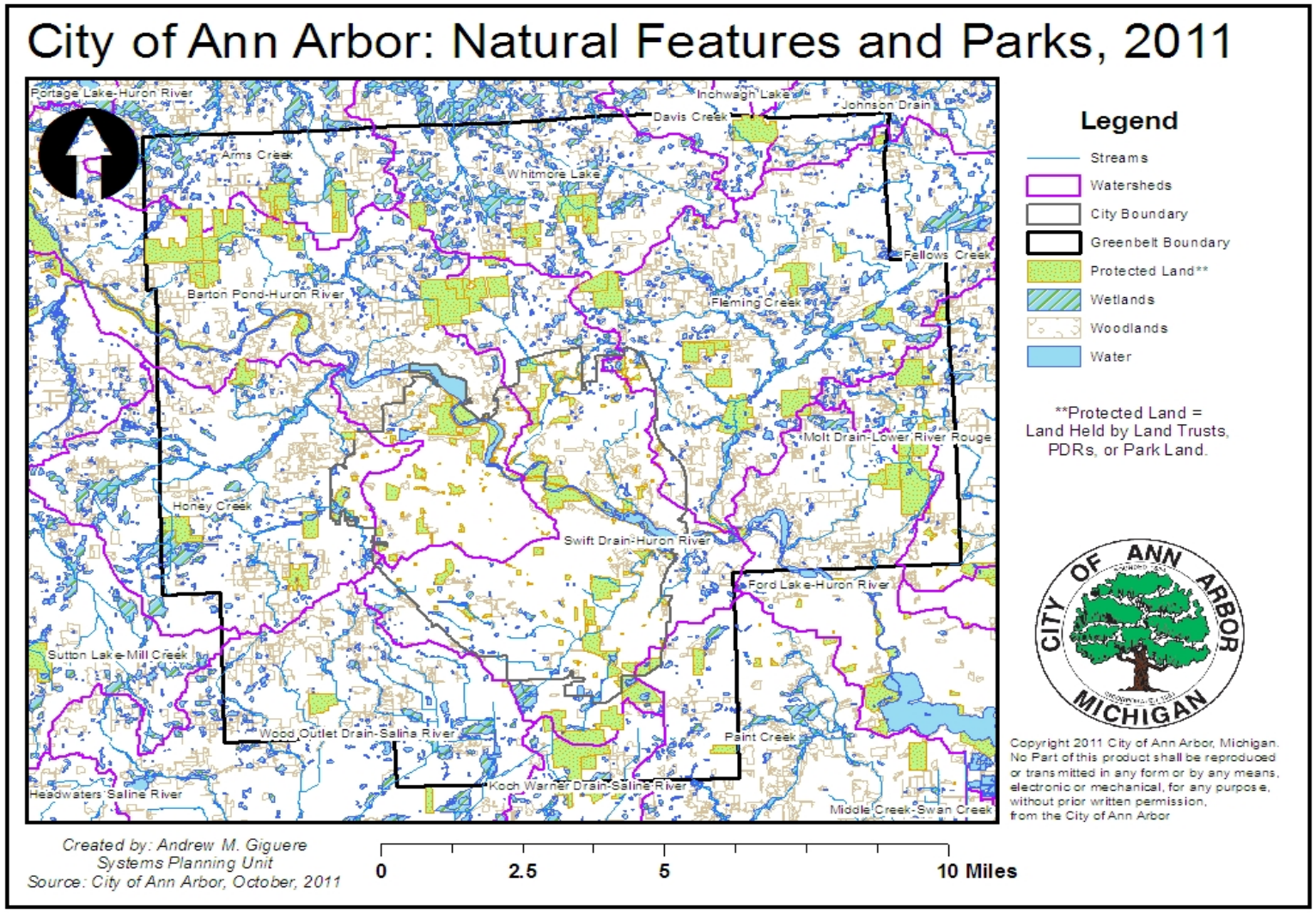
Water retention ponds are designed to contain surface water runoff that is not absorbed by the landscape following rainstorms. Either dry or wet, such areas are potentially part of an overall park and open space system. Drainage and erosion ordinances of the City and the County should be reviewed for their compatibility with respect to recreation and open space uses. Although they are manmade, retention ponds and official County drains could fulfill more than their functional role in a natural system through the concept of multiple use, allowing the inclusion of human leisure activities. Drainage corridors could provide pedestrian/bicycle path linkages of parks and neighborhoods and facilitate school access as well.

In addition, river and creek shed issues have evolved to include state of the art functions in storm water management through the introduction of soil bioengineering and the creation of wetland prairies. Water management functions need to include river water level fluctuation, creek water detention and the reintroduction of previously culvert-confined water systems.

As a result of the prevailing westerly winds, Ann Arbor does experience some lake effect. However, this is minimal and essentially limited to increased cloudiness during the late fall and early winter. The continental type of climate of Ann Arbor is characterized by larger temperature ranges than in areas at the same latitude near the Great Lakes, which have moderated temperatures. Diminished wind speeds or winds that do not traverse large unfrozen lakes often produce clearing skies and the colder temperatures expected at continental locations.

The highest average monthly maximum temperature of 89.2 F was recorded July 1966, and the lowest average monthly minimum temperature of 4.6 F was recorded January 1977. The following temperature extremes, based on the time period of this station's published record, are: maximum, 105 F, recorded July 24, 1934; minimum, -21 F, recorded February 10, 1912; warmest monthly mean, 77.6 F, recorded July 1955; and coldest monthly mean, 12.4 F, recorded January 1977.

Trees and Urban Forests Based on the 2012 i-Tree Eco analysis there is an estimated 1.4 million trees in Ann Arbor. The city-wide tree canopy cover is 32.9%. From the 2009 tree inventory of publically managed street trees and park trees (mowed areas only) there were 50,137 street trees, 7001 park trees and thousands more in natural areas managed by the city.


City of Ann Arbor: Natural Features and Parks, 2011
Portage Lake-Huron River
Inchwagh Lake
Johnson Drain
Davis Creek
Arms Creek
Whitmore Lake
Fellows Creek
Barton Pond-Huron River
Fleming Creek
Molt Drain-Lower River Rouge
Honey Creek
Swift Drain-Huron River
Ford Lake-Huron River
Sutton Lake-Mill Creek
Wood Outlet Drain-Saline River
Paint Creek
Headwaters Saline River
Koch Warner Drain-Saline River
Middle Creek-Swan Creek
Legend
Streams
Watersheds
City Boundary
Greenbelt Boundary
Protected Land**
Wetlands
Woodlands
Water
**Protected Land = Land Held by Land Trusts, PDRs, or Park Land.
CITY OF ANN ARBOR MICHIGAN
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Created by: Andrew M. Giguere
Systems Planning Unit
Source: City of Ann Arbor, October, 2011
0
2.5
5
10 Miles

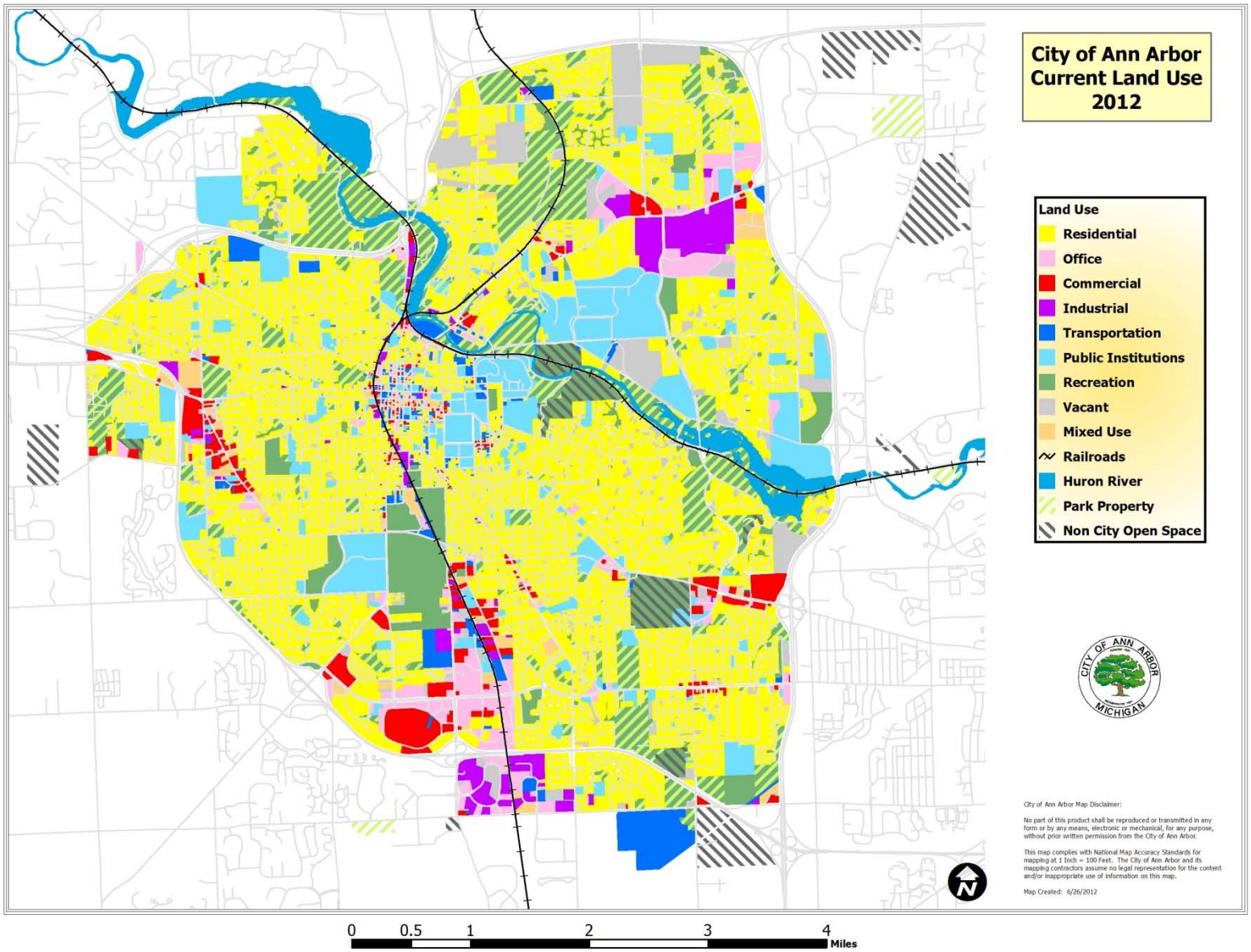
2.3 Land Use Patterns

See Land Use Map, page 13; no significant change 2004-2012. The rapid growth the City experienced through the 1960's and 1970's slowed in the early 1980's, but again proceeded at a fast pace through the end of the 1980's.The City's population from the 2010 census count was 113,934. Generally, the provision of park land kept pace with the residential growth through the land dedication policy and the 1988 Park Land Acquisition Millage. Almost 50% of the land within the City limits is residential. The center of the City contains a large proportion of commercial, office, and University of Michigan land uses. The Briarwood Shopping Center and surrounding area south of the central business district also accounts for a large share of commercial and office uses. The combined office, commercial and industrial land accounts for 9.5% of the land in Ann Arbor. The remainder of similar land uses are scattered throughout the City but are generally concentrated along major thoroughfares and freeway interchanges. There is no heavy manufacturing in the City and most light industry is along the railroad tracks that bisect the City north to south. Research uses, important to Ann Arbor, are divided between the south area, just south of I-94, and the northeast area, south of Plymouth Rd.

Table 1: Land Use %

Land Use	Acres	Percentage
Commercial	511.90	3.26%
Industrial	431.57	2.75%
Mixed Use	228.38	1.45%
Office	607.55	3.87%
Public Institutions	1,750.26	11.20%
Recreational	2,994.21	19.10%
Residential	7,835.93	49.98%
Transportation	444.27	2.83%
Vacant	872.49	5.56%
	15,676.25	100.00%

City of Ann Arbor



2.4 Transportation Network

Today, transportation in the Ann Arbor area is heavily dependent on the automobile. The road network is a radial pattern oriented toward the downtown, with the interstate freeways forming an outer ring. The major routes radiating from downtown are Plymouth, Washtenaw, Packard, State, Liberty, Huron, Miller, and Main. The Fuller/Glen/Geddes route is also a major carrier of traffic related to North Campus and the medical center. Within the freeway ring, Huron Parkway and Eisenhower Parkway form a partial ring serving the south and northeast areas. Huron Parkway is a major asset to the City's park and recreation system because of its visual quality, and Eisenhower Parkway, though of a different character, also has much potential. The yet undeveloped rights-of-way for Huron Parkway and Eisenhower Parkway can be used for bicycle access and as linear park spaces.

There is a major rail freight and intercity passenger railroad line that travels east/west through the city. Commodities are shipped by the Norfolk Southern RR and this same segment of track is utilized by AMTRAK for passenger rail service. The Ann Arbor Railroad owns a rail line running north/south through the city.

Three major public agencies provide bus service within Ann Arbor: The University of Michigan, the Ann Arbor Public Schools, and the Ann Arbor Transportation Authority (AATA).

2.5 Population

Ann Arbor represents a significant part of the total population of Washtenaw County. The 2010 Census shows the population of Ann Arbor at 113,394; virtually no change from the 2000 Census of 114,024. Ann Arbor contains 33% of the total population in Washtenaw County, and with predicted population growth, will comprise 32% of the total county population in 2020[2]. Ann Arbor's population growth is limited by land development opportunities; however the City Council is implementing policy[3] to increase population by creating opportunities within the City, particularly in the downtown area.

Ann Arbor not only represents the highest single population of any political jurisdiction in Washtenaw County, it also represents the second highest population density at 4,128 people per square mile[2]. Most of the population is focused into 2 large residential clusters on the Northeast, Southeast, Western and Central parts of the City. Maps on pages 16 and 17 reflect the density of the population per square mile, and total individuals. These maps show settlement patterns converging around waterways.

Gender

The City of Ann Arbor is almost divided 50/50 between males and females with females having a slightly higher population number with 50.6%. This slight difference remains steady, give or take 1.5%, throughout the age groups.

[2]Source: SEMCOG 2012, www.semcog.org
[3]Notably the Greenbelt Initiative and the Downtown Residential Task Force

Age

The largest age groups for the City of Ann Arbor are ages 20-24 and 25-29[2]. Due to the presence of the University of Michigan within the city boundaries, the largest age groups are in accordance with the population of the University. The largest growth age group from the 2000 to the 2010 Census was in the 20-24 group with an increase of 2,173 persons or 10%. The age group showing the largest decline during the same period was in the 35-39 group with a decrease of 1,862 persons or 24%. The total numbers of these age groups indicate the impact on the City of Ann Arbor due to the population of the University of Michigan. According to University Housing numbers, 70% of students live off-campus, and within Ann Arbor neighborhoods.

Due to the locations of students, it is important for the City of Ann Arbor to have a firm understanding of the University's activities and events during emergencies.

The bulk of Ann Arbor's population falls in the 15-34 age range comprising 56,515 persons or 50% of the City's population[2], according to the 2010 Census. There are 10,612 residents 65 and over, or approximately 10% of the population. The greatest forecasted growth through 2035 shows the 65 and over age range as the largest with a 137.1% increase or an additional 14,547 persons. A portion of this population is housed in senior housing facilities and may require some special services in the event of a hazard.

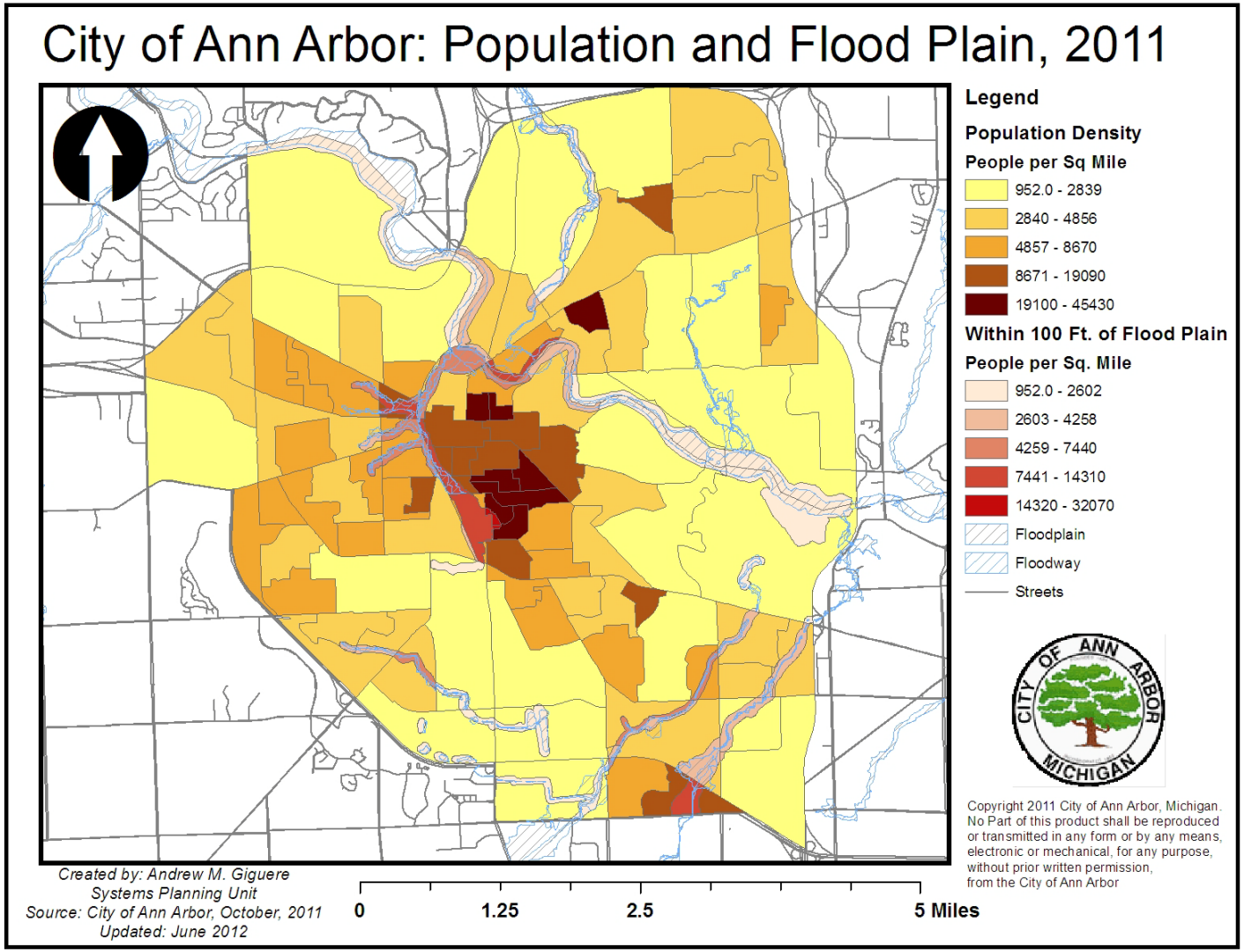
Language

According to the 2010 Census, 18.7% of the City's population over 5 years of age speaks a language other than English which accounts for approximately 20,415 people. Of that group, it is estimated that 27.5% or 5,614 people speak English less than "very well". Of the populations that speak a language other than English, the majority lies in the Asian, Pacific island, and other Indo-European languages. Emergency planning and mitigation efforts need to incorporate resources to address language barriers.

Housing Units

According to the 2010 Census, Ann Arbor has 49,871 housing units. 42% of these units are owner occupied. For the time period 2000 through 2010 the City added 2,657 housing units. An additional 332 units were permitted from 2010 through 2012 year-to-date.
The majority of the housing in the City is Multi-Unit Apartments which has increased by 1,939 units over the 2000 to 2010 time period with an additional 273 units permitted to date[2]. This aggregate would show a growth rate of 11% since 2000. 52% of the housing in the City is renter occupied, and most of this is student housing. Many of these are converted older homes within walking distance of the University of Michigan campuses. The majority of structures with 20 or more units (12.9%) are dormitories connected with the University.
The next highest group in terms of number of units and growth is Single Family Detached units which will show an additional 714 units year-to-date since 2000[2]. This accounts for a growth rate of 7% for the same time period.

[2]Source: SEMCOG 2012, www.semcog.org


City of Ann Arbor: Population and Flood Plain, 2011
Legend
Population Density
People per Sq Mile
952.0 - 2839
2840 - 4856
4857 - 8670
8671 - 19090
19100 - 45430
Within 100 Ft. of Flood Plain
People per Sq. Mile
952.0 - 2602
2603 - 4258
4259 - 7440
7441 - 14310
14320 - 32070
Floodplain
Floodway
Streets
CITY OF ANN ARBOR MICHIGAN
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Created by: Andrew M. Giguere
Systems Planning Unit
Source: City of Ann Arbor, October, 2011
Updated: June 2012
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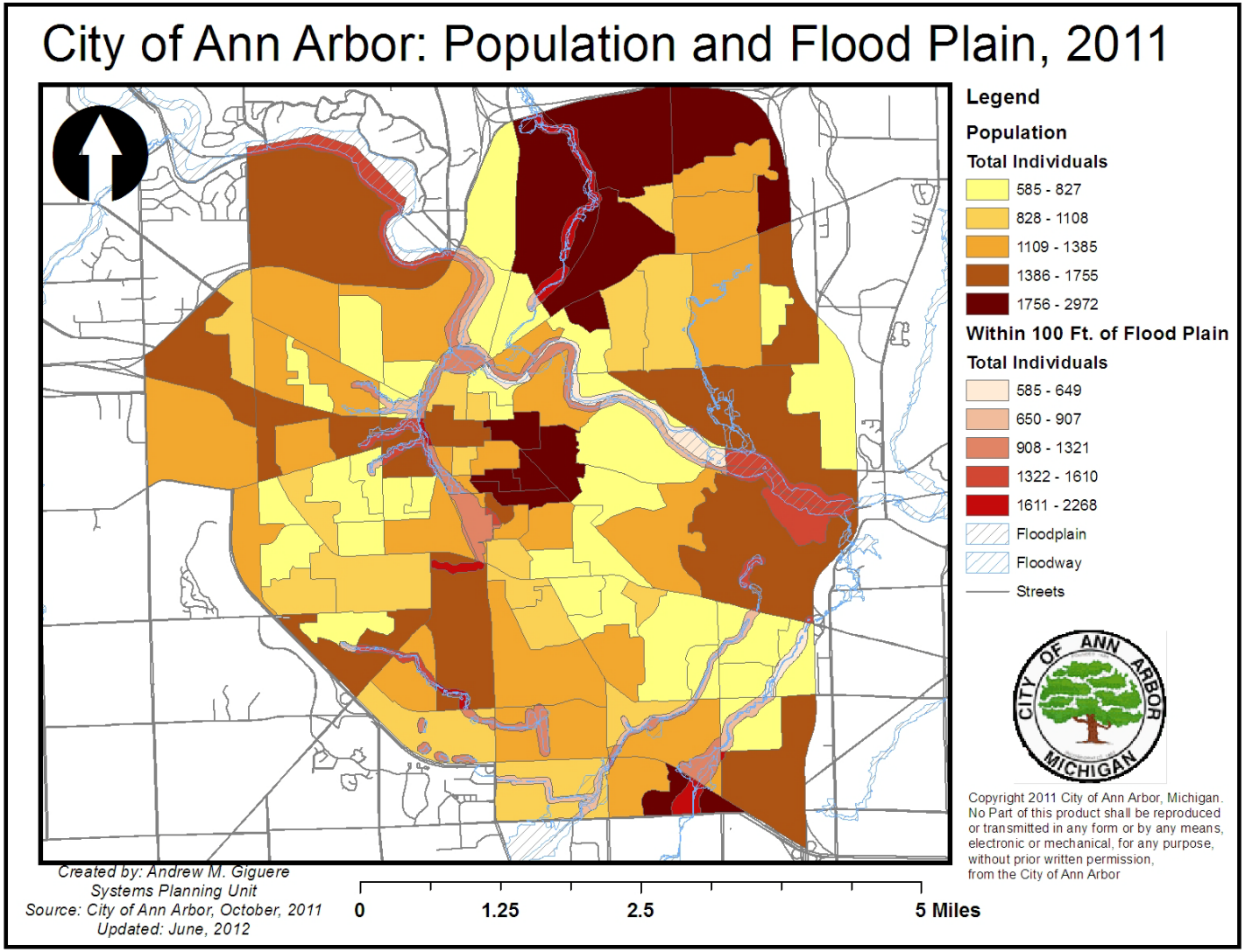
1.25
2.5
5 Miles


City of Ann Arbor: Population and Flood Plain, 2011
Legend
Population
Total Individuals
585 - 827
828 - 1108
1109 - 1385
1386 - 1755
1756 - 2972
Within 100 Ft. of Flood Plain
Total Individuals
585 - 649
650 - 907
908 - 1321
1322 - 1610
1611 - 2268
Floodplain
Floodway
Streets
CITY OF ANN ARBOR MICHIGAN
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Created by: Andrew M. Giguere
Systems Planning Unit
Source: City of Ann Arbor, October, 2011
Updated: June, 2012
0
1.25
2.5
5 Miles

City of Ann Arbor: Population at Risk Housing 2004

Emergency Response Plans, Risk Planning, Threat Assessment and Domestic Preparedness strategies contained in this document are part of the City of Ann Arbor's on-going security measures for the safety of its employees and the public and are exempt from disclosure under the Michigan Freedom of Information Act (MCLA 15.243(1)(u)and 15.243(1)(y) and the Michigan Anti-Terrorism Act (MCL 750.543k).

3.0 HAZARDS

The City of Ann Arbor is susceptible to a variety of natural, technological, and societal hazards. The purpose of this section is to rank the hazards for the City, analyze the risks for each hazard, identify vulnerable areas within the City, and appropriate goals and mitigation strategies for certain hazards.

3.1 Hazard Ranking

The ranking of hazards for the City of Ann Arbor is presented as Table 2. The ranking of hazards was determined on a citywide basis and adjusted based on input from local governments. The ranking order was developed by the City of Ann Arbor Office of Emergency Management. The model takes into account worst-case scenario data for frequency of occurrence, likelihood of occurrence, significance of impact/threat, potential size of geographic area impacted and total population impacted.

3.2 Hazard Assessment

The purpose of the hazard assessment is to map out where hazards exist and gain information about their frequency of occurrence, and potential for harm using worst-case scenario estimates. Different levels of risk analysis are performed, depending on the significance of the hazard for the community:

Cursory: A short statement explaining why the hazard is not a threat, prepared for hazards that have little impact or are unlikely to occur.
Standard: An explanation of concerns with limited quantitative research, prepared for hazards likely to occur and impact our communities.
Advanced (Vulnerability): A vulnerability determination using probabilities, prepared for hazards that have the highest frequency of occurrence and/or the most potential to cause death, injury or damage to personal property.

Table 2: Hazard Ranking

Hazard	Ranking
Convective Weather (Severe Winds, Lightening, Tornados, Hailstorms)	1
Infrastructure Failures	2
Severe Winter Weather Hazards (Ice/Sleet Storms and Snow Storms)	3
Fire Hazards: Structural Fires	4
Hazardous Materials Incidents: Fixed Sites	5
Extreme Temperatures	6
Hazardous Materials Incidents: Transportation	7
Flood Hazards: Dam Failures	8
Flood Hazards	9
Civil Disturbances	10
Transportation Accidents: Land and Air	11
Public Health Emergencies	12
Sabotage & Terrorism	13
Petroleum and Natural Gas Pipeline Accidents	14
Nuclear Power Plant Accidents	15
Fire Hazards: Wildfires	16
Oil and Gas Well Accidents	17
Nuclear Attack	18
Drought	19
Earthquake, Subsidence	20
Fire Hazards: Scrap Tire Fires	21
Infestation	22

Vulnerability assessments were prepared for convective weather, hazardous materials transportation incidents, hazardous materials fixed site incidents, infrastructure failures and severe winter weather hazards. This assessment was based upon that performed by Washtenaw County in 2005, as reviewed and agreed with in 2012, with its goal to provide a rough quantitative estimate of the threat experienced by the community. By placing a monetary value on hazards, a cost-benefit comparison can be made: the benefit of implementing a mitigation strategy compared to the cost of the hazard event.

Table 3 presents the results of the vulnerability assessment. The value of the vulnerability assessment is to estimate costs, through which the mitigation strategies may be compared.

Table 3. Vulnerability Assessment Summary

Rank	Hazard	Estimated Annual Cost	Total Expected Annual Cost
#1	**Convective Weather**		
	Tornado	$5,558,844	$5,560,000
	Severe Winds and Lightning	$8,972,118	$8,970,000
	Hail Storm	$13,570,221	$13,600,000
#2	**Infrastructure Failure**	$6,860,909	$6,860,000
#3	**Severe Winter Weather**	$12,850,495	$12,900,000
#4	**Fire Hazards: Structural, Ann Arbor**	$1,193,150	$1,200,000
#5	**Hazardous Material Fixed Site Incidences**	$1,145,290	$1,150,000

City of Ann Arbor: Critical Facilities, 2011

Emergency Response Plans, Risk Planning, Threat Assessment and Domestic Preparedness strategies contained in this document are part of the City of Ann Arbor's on-going security measures for the safety of its employees and the public and are exempt from disclosure under the Michigan Freedom of Information Act (MCLA 15.243(1)(u)and 15.243(1)(y) and the Michigan Anti-Terrorism Act (MCL 750.543k).

3.3 Hazard Analysis

The following sections provide an analysis of each hazard by category: natural, technological and societal. A description, mitigation strategies and assessment/ranking are provided for each hazard. For the top five hazards, vulnerability assessments are also included. Key community assets that may be impacted by hazard events are shown and referenced throughout the text.

3.3.1 Natural Hazards by Hazard Ranking

#1 Convective Weather

Convective weather refers to four types of hazards that may be encountered during a thunderstorm: thunderstorm winds, cloud-to-ground lightning strikes, hail and tornadoes. Storms may begin as a severe wind or hail storm, and develop into a tornado. Since most storms are often characterized by one or more of these elements, all storm types are classified under convective weather.

Description Severe thunderstorms are common to Ann Arbor, particularly during spring and summer months. On average, Ann Arbor experiences 30 to 60 days of thunderstorm activity per year (National Weather Service, White Lake, Michigan). According to Washtenaw County Emergency Management Division records, the County's Emergency Operations Center was activated for 86 thunderstorm watches between 1992 and 2002. That survey of previous warnings merely illustrates how frequent the threat is to the city of Ann Arbor. Thunderstorms tend to have a short duration (30 to 40 minutes) and can lead to other specific hazards, such as infrastructure failures.

Convective Weather: Severe Winds. Severe winds are defined as winds that reach to exceed 58 miles per hour. In Washtenaw County, the strongest wind speed recorded was officially 95 miles per hour (in June, 1890), but local storms have exceeded this speed on several occasions, according to estimates from damage assessments. Injuries and even death have been associated with area thunderstorm winds in recent years, according to the Washtenaw County plan, although many of these did not involve the City of Ann Arbor.

There are also periodic high-wind events that are not related to severe thunderstorms: during the same sample period of 1992 and 2002, two wind advisories, seven wind watches, and four high wind warnings were issued by the county.

Vulnerability Since city risks are similar to county risks, a Washtenaw County analysis suggests that about 6 significant severe wind and lightning storms are expected in any given year (the two hazards were evaluated together and the hazards often occur during the same event). The frequent need for an infrastructure failure response for each event causes the impacts of this weather to be greatly increased. Severe winds and lightning storms cause widespread damage: deaths and injuries, infrastructure failure, economic loss, and destruction of personal property (cars, homes, businesses). According to the National Climatic Data Center web site, the past 6½ years have seen a couple of significant events per year, of this type, affecting the city with winds of 50 to 62 knots, and hail of up to 2-inch diameter.

Convective Weather: Tornado. Tornadoes are also common to Ann Arbor, generally occurring during spring months. Tornadoes typically have wind speeds that easily exceed 100 miles per hour and have devastating impacts to life, property and natural resources. Between 1951 and 1996, at least 24 tornadoes touched down in Washtenaw County, which is indicative of the risk in the area of Ann Arbor. Tornado touchdowns are usually brief and last only several minutes, and fortunately, fewer tornadoes strike the city than the surrounding areas in the county. The map on page 29 illustrates these events, using linear paths, although these are only estimated: paths can range from 15 to 200 miles, are not linear, and are difficult to track. According to the National Weather Service, there have been no Level F4 (Devastating) to F6 (Inconceivable) tornadoes in Washtenaw County, nor does Washtenaw County show up on the "Notable Deadly Tornadoes in Michigan" database maintained by the Tornado Project. During a sample period from 1992 to 2002, the Washtenaw County Emergency Management Division had issued 27 tornado watches and 12 warnings. Many of these had placed the city of Ann Arbor on alert, as well (since the city is rather large and is located near the center of the county).

Vulnerability Based on past tornado touchdown data, Washtenaw County had calculated about a 27% chance of one tornado event occurring in any given year in the county. The city's risks appear to be significantly lower—perhaps a 10% chance per year. Severe winds have caused widespread damage: deaths and injuries, response costs, clean-up, power loss, destruction of personal property (cars, homes, businesses), economic loss, traffic delays, and loss of businesses productivity, tree damage or road closures due to fallen trees or power lines.

Areas in Ann Arbor that are more at risk from tornadoes than others include: manufactured housing communities (MHCs) without emergency shelters; manufactured housing units not properly secured to a foundation, outdoor recreation facilities, and populations not covered by a warning siren.

Convective Weather: Lightning. Lightning is the output of a thunderstorm's electrical potential. Lightning strikes can generate currents of 30,000 to 40,000 amperes, and speeds approaching one-third the speed of light, according to the Michigan State Police Emergency Management and Homeland Security Division (MSP/EMHSD). Lightning strikes can cause injury or death, as well as damage to property. In a sample of Michigan events involving lightning deaths and injuries, 28% of the deaths and 35% of the injuries were in open fields or ball fields, and 27% of the deaths and 15% of the injuries occurred under trees (not golf-related). Since 1992, fourteen injuries and at least one death have been attributed to lightning in Washtenaw County. As of 2012, no major lightning events have been noted for Ann Arbor in the NCDC records dating back to 2006.

Nationally, Michigan is ranked 2nd to Florida with regard to lightning injuries; and 12th with regard to lightning deaths.

Causes of Lightning Deaths in Michigan, 1959 to 2001

Number of Deaths	Location	Percent of Total
28	Open fields, ball fields	28%
26	Under Trees (not golf)	27%
11	Boats / water-related	11%
10	Golf course	10%
4	Near tractors/heavy equipment	4%
2	At telephone	2%
18	Other location / unknown	18%
Total: 99		100%

The National Lightning Safety Institute estimates that lightning causes more than 26,000 fires annually, with damage to property exceeding several billion dollars. Electric Utility Companies across the nation estimate as much as $1 billion cost per year, due to

*Appendix A, Washtenaw County Hazard Mitigation Plan

lightning related damages and losses. The Federal Aviation Administration (FAA) estimates approximately $2 billion per year in the airline industry operating costs and passenger delays from lightning. The MSP/EMHSD projects the costs of lightning related property damage are expected to increase as the use of computers and other lightening-sensitive equipment increases.

Vulnerability The definition of a thunderstorm is a cumulonimbus cloud that produces rain, lightning and thunder. About six to eight lightning-related thunderstorms are likely in any given year, causing costs for response, damage to housing units, infrastructure failure, and death and major injuries. Lightning and wind events are here evaluated together, as the two hazards often occur within the same event. The areas that are more at-risk in Ann Arbor from lightning than others include residences or recreational areas near water, as well as open recreation areas with few places to take shelter, such as golf courses.

Areas in Ann Arbor more at-risk than others to lightning are those residences or recreational areas near water, as well as open recreation areas with few places to take shelter, such as golf courses.

Convective Weather: Hail. Hail is produced during thunderstorms, and refers to forms of ice that typically fall from the center of the storm. Hail can range from the size of a pea to the size of a baseball; the larger the size, the more destructive the event. Large hail is inherent to severe thunderstorms, and may be indicative of a developing tornado. Hail events in Ann Arbor are common. Thunderstorms are a good indicator of hail severity: minor hailstorms (one-half inch diameter or less) generally coincide with garden-variety thunderstorms, and moderate to severe hailstorms (three- quarter inch to baseball sized) occur during thunderstorm and tornado warnings.

Vulnerability The definition of a thunderstorm is a cumulonimbus cloud that produces rain, lightning and thunder. About six to eight lightning-related thunderstorms are likely in any given year, causing costs for response, damage to housing units, infrastructure failure, and death and major injuries. Lightning and wind events are here evaluated together, as the two hazards often occur within the same event. Areas in Ann Arbor that are more at-risk from lightning than others include residences or recreational areas near water, as well as open recreation areas with few places to take shelter, such as golf courses.

Tornado of 1969 Numerous tornado events marred the 1969 Independence Day holiday in Michigan, including the Ann Arbor area. Although no fatalities were reported, there were injuries in Washtenaw County. The tornado was an F3 and caused $2.5 million in property damage.

Deracho of 1980 On the morning of July 16, 1980, National Weather Service forecasters issued a Severe Thunderstorm Watch and eventually Severe Thunderstorm Warnings for the entire metro Detroit area as a line of intense, fast- moving thunderstorms (called Deracho) developed over Wisconsin. As the skies turned green, winds began gusting to 75 MPH and torrential rainfall fell across all of Washtenaw County as the intense storms raced across the region at over 60 MPH. Once the storm had passed, almost half of the residents in southeast Michigan were without electrical power, numerous buildings were damaged, and trees blocked roadways for days awaiting removal. Power was not fully restored to the region until eight days following the storm.

Tornado of 1982 On June 15, 1982 an F3 tornado resulted in $2.5 million in damages in the Ann Arbor area.

Deracho of 1991 On the afternoon of July 7, 1991, another Deracho formed just to the west of Michigan, fed by temperatures in the 90's and extremely humid air. Storm watches were posted for all of Lower Michigan, as radar tracked an immense thunderstorm complex moving across the state. Severe Thunderstorm and Tornado Warnings were soon issued, as winds began to gust over 70 MPH, one inch hail and torrential rain began to fall, and constant lightning stuck ground. By storms' end, 61,000 homes and business were without electrical power. Some residents did not have power restored until 10 days following this storm. In all, over one million Detroit Edison customers were affected by the outage.

Tornado of 1992 A Severe Thunderstorm Watch was issued on the afternoon of April 16, 1992. Strong storms with 50 MPH winds and small hail were reported until 3:50PM, when reports of a tornado in Salem Township were received by 9-1-1 dispatchers. (Salem Township is northeast of Ann Arbor and many Michigan tornadoes travel in a northeast direction.) Five homes and three barns were severely damaged, before the storm went into western Wayne County, where it destroyed several mobile homes.

Thunderstorms of 1997 On July 2, 1997 a series of intense thunderstorms went through south-central and southeast Michigan (including the Ann Arbor area), spawning severe straight-line winds, several tornadoes, and heavy rainfall. In some areas, the straight-line winds reached speeds of 70-100 miles per hour, causing significant structural damage and massive amounts of debris including downed trees and power lines. A Presidential Major Disaster Declaration was granted for a five county area (all near Ann Arbor) most severely impacted by the storm event. However, Washtenaw County was not awarded despite feeling the effects of this event.

Thunderstorms of 1999 During the last two weekends of July 1999, a series of severe thunderstorms, fueled by high temperatures and extreme humidity, moved across southern Lower Michigan, including the Ann Arbor area. The storms produced strong wind gusts (estimated at 60-70 miles per hour), heavy rainfall, and hail in some areas. Most of the damage caused by the wind involved downed trees and power lines. Restoration efforts after the July 24 storms were further complicated when another series of storms struck on the 25th, forcing utility crews to temporarily halt their restoration efforts. Damage to homes, businesses, vehicles, and boats was reported in southeast Michigan, including the Ann Arbor area.

Supercell of 2000 A Tornado Watch was issued on the evening of May 9, 2000. Eventually, Severe Thunderstorm and Tornado Warnings were issued, as Skywarn spotters reported a rotating thunderstorm with a large funnel cloud and baseball-sized hail near Milan, eventually moving to the north of Ypsilanti. Almost simultaneously, spotters reported a line of severe storms with 2" hail and 65 MPH winds sweeping across the area from west to east. Hundreds of cars were seriously damaged from hailstones, 50,000 homes and businesses were left without electrical power, and many roads were blocked due to a large number of downed trees and power lines.

Severe Winds of 2001. On October 24, 2001, much of Michigan (including the Ann Arbor area) began experiencing severe weather as the result of a strong cold front colliding with warm, moist air. The result was widespread strong winds (in excess of 50 miles per hour) and severe weather throughout southern Lower Michigan. The vast majority of the damage produced by this storm system was from straight-line winds. Damage included extensive flooding of roads and streets, thousands downed of trees and power lines, closed schools and businesses, and damage to hundreds of cars, homes and businesses, and public buildings.

Severe Winds of 2003 A strong cold front moved through the Great Lakes region during the morning of the May 11, 2003. Wind gusts of 55 to 60 mph were estimated across much of Wayne and Washtenaw counties. The winds caused several trees to blow down across the Ann Arbor area and several homes and businesses across the area to lose power. The strong winds were also blamed for a hydrochloric acid leak from a plant in Ypsilanti. Investigators concluded that the high winds ripped a chunk of the plant's roof loose, smashing it into a distribution pipe, which caused roughly 100 gallons of acid to leak out.

Lightning Strike in 2003 On September 19, 2003 one roofer was killed and two others were badly injured in Ann Arbor when they were hit by lightning during a thunderstorm. The storm produced more than 2,300 lightning strikes in southeastern Michigan in about three hours.

Bow Echo of 2004. A Flash Flood Watch, Severe Thunderstorm Watch, and eventually a Severe Thunderstorm Warning and Flash Flood Warning was issued by the National Weather Service on the afternoon of May 21, 2004 as Doppler radar indicated a line of intense thunderstorms in Southwest Lower Michigan moving east at 55 MPH. Several Skywarn Spotters reported a wall cloud near M-52 and I-94 near Chelsea, 1 to 2 inch diameter hail storms in Ann Arbor and Ypsilanti, and numerous reports of downed trees, power lines, and power failures following 70 MPH gusts of wind. Several areas of the freeway system along with many primary and secondary roads were flooded by the sudden downpour of 2.5" of rain, producing up to four feet of standing water. Approximately 27,000 homes and businesses were without electrical power for more than eight hours.

Severe Winds of 2005 On November 6, 2005 a deep and rapidly intensifying storm system moved through Southeast Lower Michigan (including the Ann Arbor area) during the morning. High winds along the associated cold front knocked down trees leading to approximately 200,000 power outages. Winds were sustained out of the southwest at 30 to 40 mph with gusts as high as 60 mph from mid to late morning. Street signs were toppled, traffic lights were sent spinning, and power lines were split. Many streets and roads had to be temporarily closed until trees blocking the way could be cleared.

Hail Event of 2006 On June 27, 2006 strong storms tracked across the Ann Arbor area and produced hail up to the size of golf balls. There were also strong winds as evidenced by a measured wind gust of 56 Knots at the Ann Arbor airport.

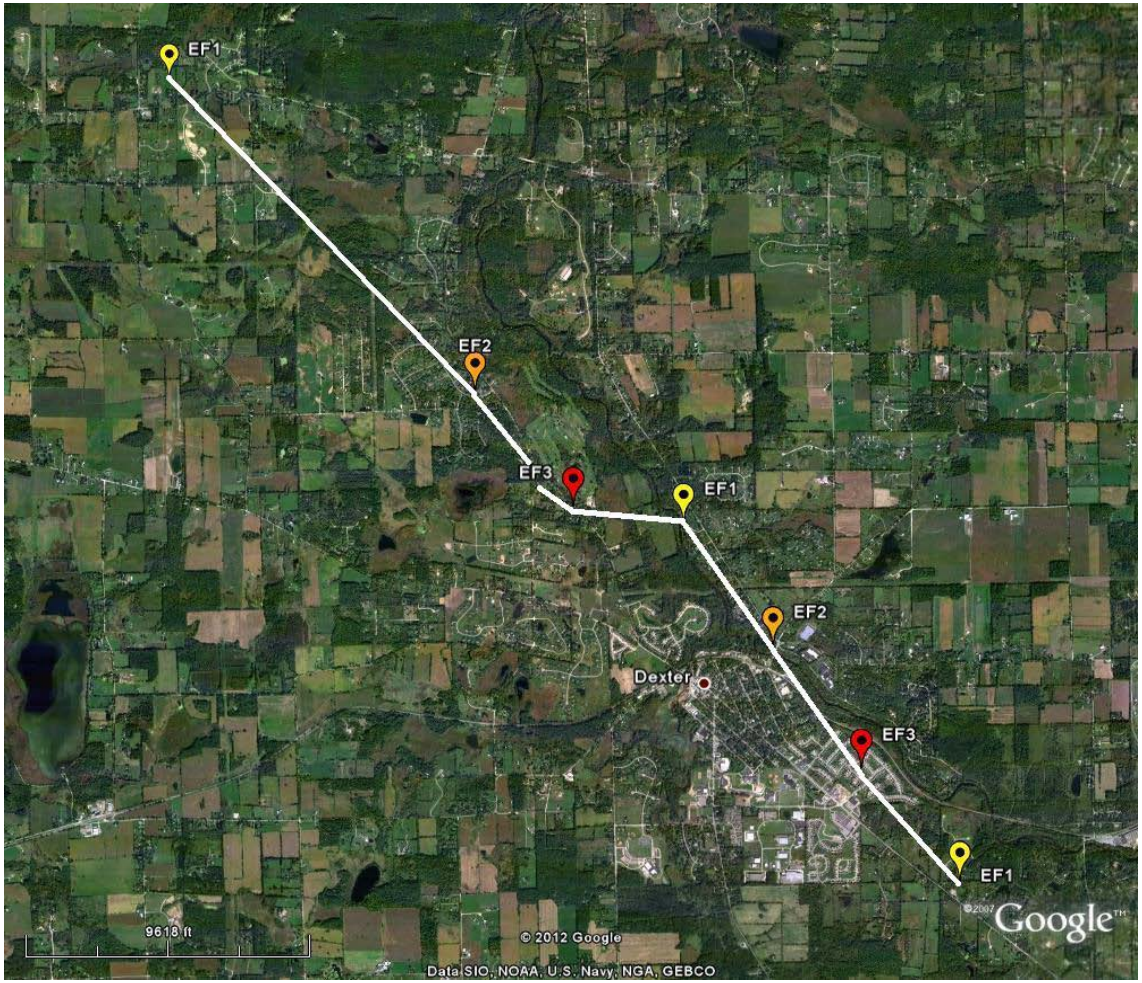
Derecho of 2008 On June 8, 2008, a Derecho swept across many counties (including Washtenaw) in the southern Lower Peninsula, involving winds as high as 74 knots. This was one of the worst such wind events to affect the Ann Arbor area in a decade. Thousands of trees were lost, and great property damage was caused as they toppled onto houses and cars. Numerous power lines were down resulting in wide spread power outages.

September 3, 2011 Michigan Stadium (with a capacity of over 100,000 people) was evacuated during a football game, due to a thunderstorm. The game was eventually called off in the third quarter, due to the strong winds, heavy downpours of rain, and several lightning strikes.

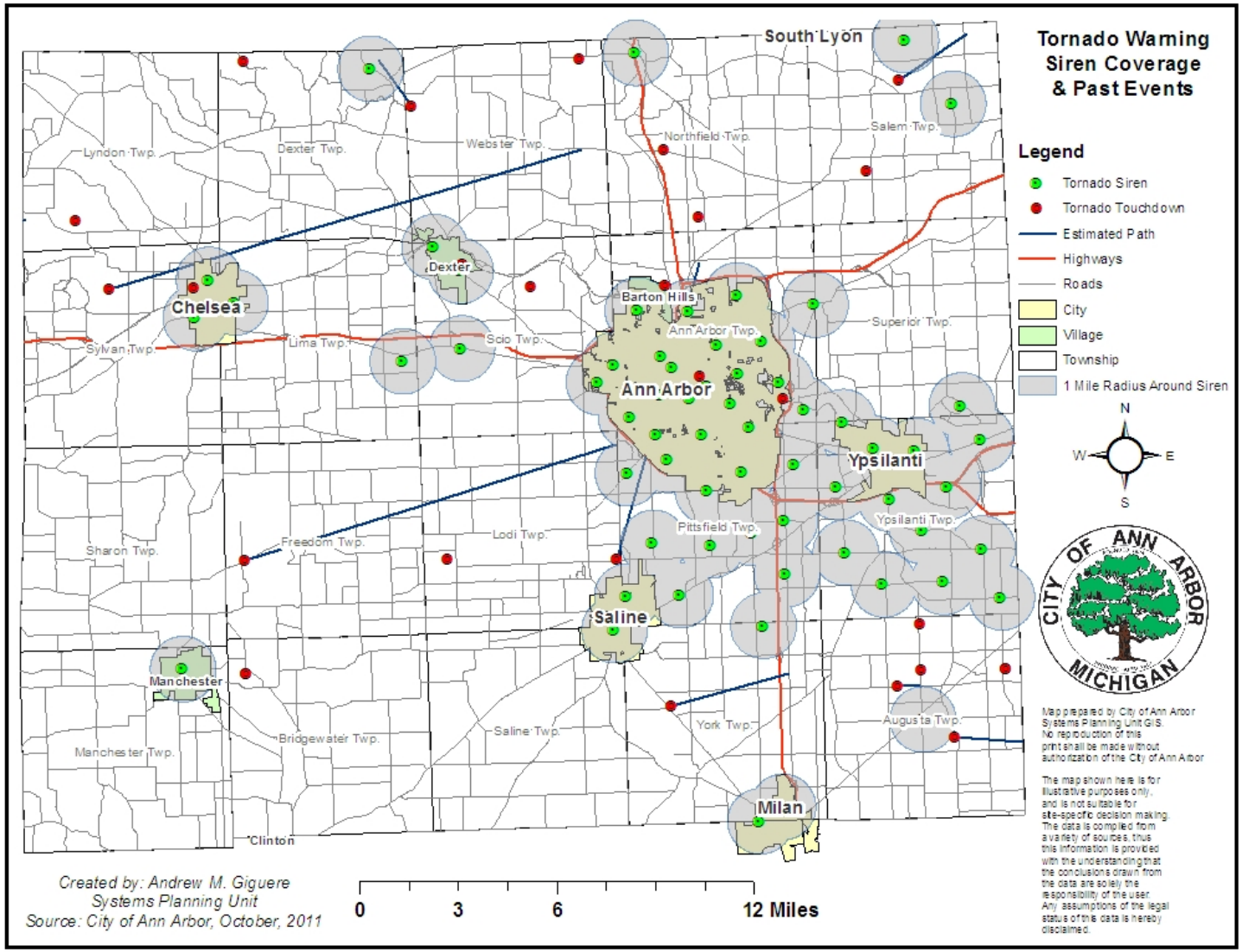
Dexter Tornado of 2012 On March 15, 2012, the National Weather Service Storm Survey confirmed an EF-3 tornado touched down near Dexter, MI with maximum wind speeds of 135-140 mph. The path length was 7.2 miles with a maximum width of 800 yards. The tornado touched down at 5:17pm just northeast of the intersection of N Territorial and Dexter Townhall Rd. The tornado moved

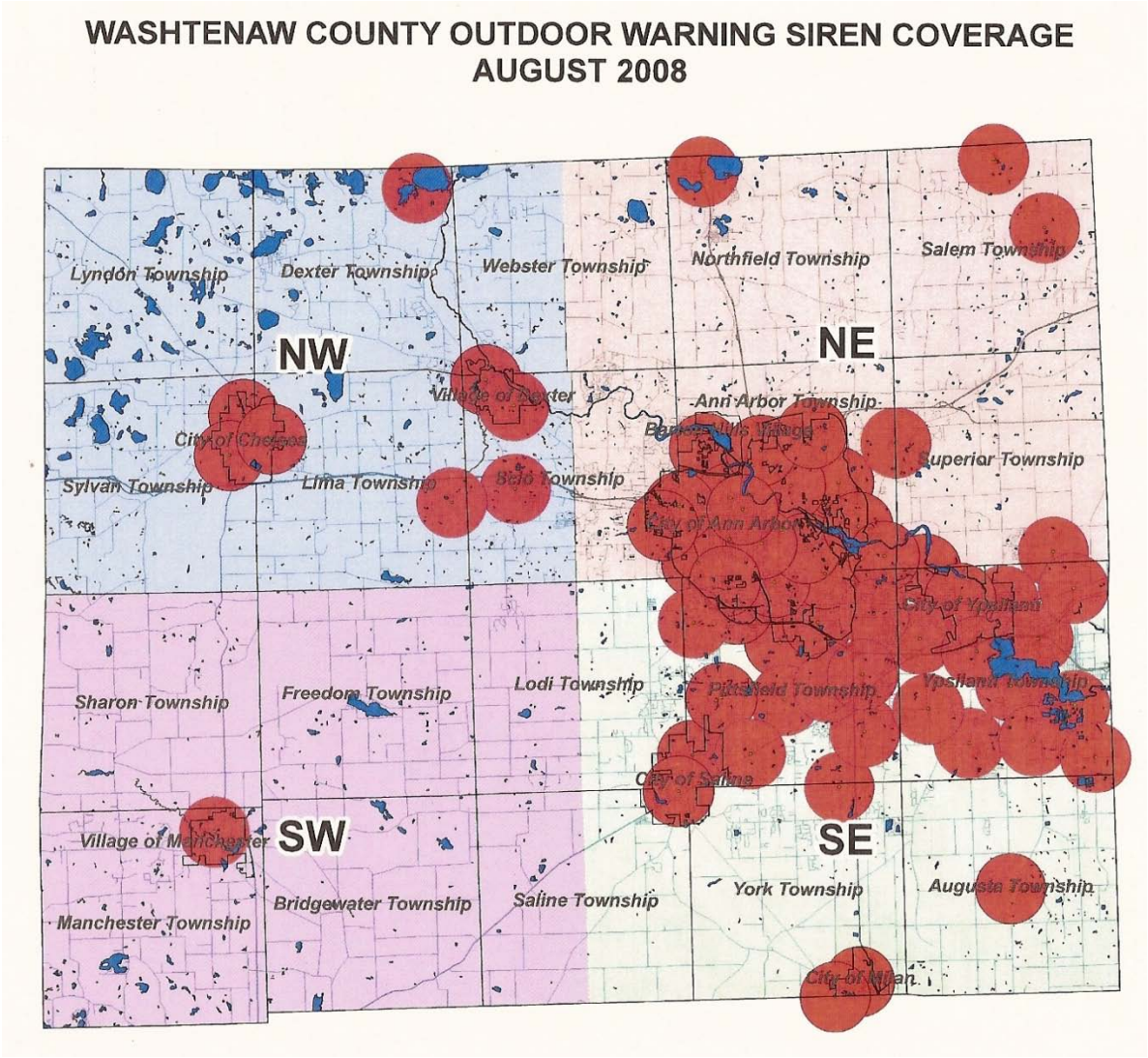
southeast and produced EF-1 damage with winds estimated at 100 mph. Damage was limited to uprooted and snapped trees as well as minor roof damage. The tornado strengthened as it hit the Horseshoe Bend Subdivision with winds estimated at 120 mph and structural damage to the outside of homes. The tornado then continued to track southeast alongside Dexter-Pinckney Rd. and produced EF-3 damage at 5:31pm. Winds estimated at 135-140 mph destroyed one home northwest of Dexter. The tornado then made a left turn and paralleled Huron River Dr. producing EF-2 damage on the north side of Dexter. The tornado then produced EF-3 damage again at 5:49pm in the Huron Farms Subdivision with winds estimated at 135-140 mph. One home was destroyed and another house had only interior rooms left standing. The tornado then weakened as it moved southeast and lifted at 5:52pm near the intersection of Zeeb Rd. and Ann Arbor-Dexter Rd.

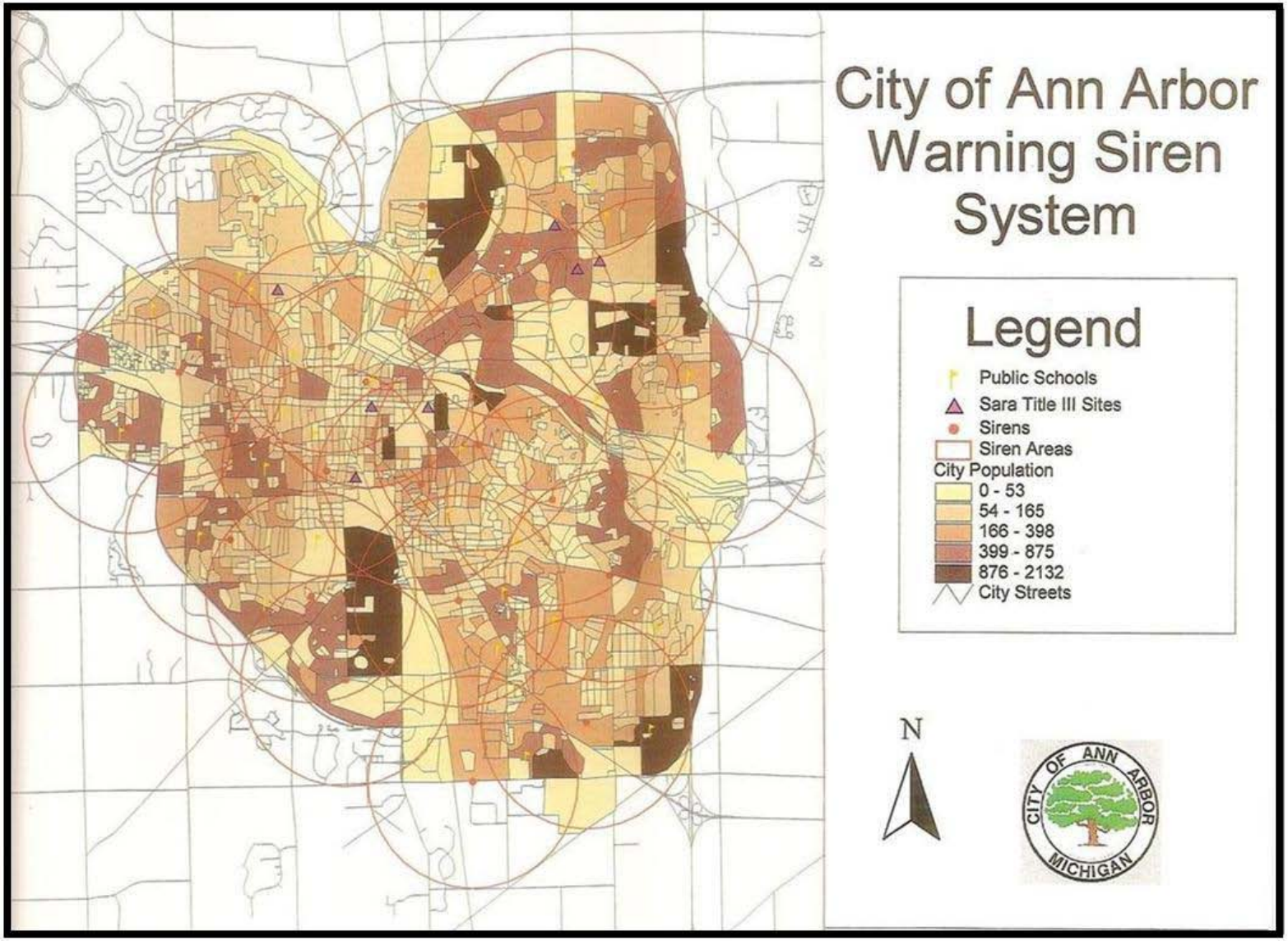
Path of the 3/15/2012 tornado that occurred near Dexter, MI in Washtenaw County



City of Ann Arbor




WASHTENAW COUNTY OUTDOOR WARNING SIREN COVERAGE
AUGUST 2008
Lyndon Township
Dexter Township
Webster Township
Northfield Township
Salem Township
NW
NE
Village of Dexter
Ann Arbor Township
City of Chelsea
Superior Township
Sylvan Township
Lima Township
Scio Township
City of Ann Arbor
City of Ypsilanti
Sharon Township
Freedom Township
Lodi Township
Pittsfield Township
Ypsilanti Township
City of Saline
Village of Manchester
SW
SE
York Township
Augusta Township
Bridgewater Township
Saline Township
Manchester Township
City of Milan


City of Ann Arbor
Warning Siren
System
Legend
Public Schools
Sara Title III Sites
Sirens
Siren Areas
City Population
0 - 53
54 - 165
166 - 398
399 - 875
876 - 2132
City Streets
N
CITY OF ANN ARBOR
MICHIGAN

#3 Severe Winter Weather Hazards

Description Severe winter weather conditions are a natural part of living in the Midwest. Over the past five years the monthly average snowfall was 2.5 inches, with a seasonal average accumulation of about 41 inches. However, it is not uncommon for events to occur that far exceed this amount. Responders face the challenges of winter weather hazards every year and are therefore prepared to act during such events. As a historical sample of winter storm events, note that between 1992 and 2002, Washtenaw County Emergency Management issued 22 winter storm watches, 21 winter storm warnings, and 50 winter advisories. Ann Arbor, located near the center of the county, tends to be strongly affected by all such events. The City of Ann Arbor generally activates the same weather tracking and warning systems as for convective weather events.

Severe Winter Weather: Ice/Sleet Storms. Ice/sleet storms are less common than snowstorms. Such storms have the potential to be more devastating than snow storms. In addition to keeping people home-bound, preventing travel, and causing school and business closings, ice/sleet storms can be the cause of more car accidents and extensive electrical power outages. Reports of storms in Michigan communities record figures in the hundreds of thousands of DTE customers left without power for days: 1997 514,000 people without power in southeast Michigan; 1985 over 430,000 people without power in lower Michigan. Businesses lose inventory and nursing homes and adult foster care facilities were evacuated due to loss of heat.

Severe Winter Weather: Snow Storms. Snow storms are defined as rapid accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility (MSP/EMHSD). Blizzards are snowstorms, which generate higher wind speeds, and colder temperatures. Impacts due to snow storms or blizzards are far-reaching: traffic accident deaths and injuries; structural fires due to snow melt seeping into electrical meter boxes; roofs collapsing under the weight of snow; school closings; business closings; flight/travel cancellations; loss of electricity; impassable streets causing many stranded people needing shelter, and high snow clearing and removal costs.

Vulnerability. Based on winter storm occurrences for Washtenaw County, at least 1.9 significant events per year (twenty-one warnings in eleven years) have tended to occur in Washtenaw County. Costs associated with an event include deaths and injuries, infrastructure failure (particularly with ice storms), response and damage to housing units.

Some residents may not be individually prepared to survive during prolonged periods of cold weather and/or power outages due to ice storms. A community that knows where such persons live, and the type of assistance they may need (e.g. medication, snow plowing), is better able to provide assistance during a severe winter storm.

There are no general areas of Ann Arbor that are considered more at-risk to a severe winter storm; however, some communities are more prepared than others. Areas of more specific concern include:

1. Special needs populations (elderly, physically or mentally impaired). Lack of heat or cleared roads (to get medication, medical attention), are a concern.

2. Facilities without an emergency generator or a designated shelter, which are necessary to help residents or stranded travelers.

Hazard Assessment This hazard received a high ranking because of the potential loss of life, property and natural resources, the potential size of the population impacted, impact on resources to respond, and the frequency and likelihood of occurrence.

Past Events As stated above, severe winter weather events in Ann Arbor are common, and have occurred in recent years. Events described below are the more serious events that have occurred within the recent past. Some type of severe winter weather is expected to strike the city every year (100% chance). It is only a matter of how severe and how many such events might occur in a particular year that is difficult to predict in advance.

The Blizzard of 1978 A Presidential Emergency Declaration was granted for the entire state following a blizzard from January 26-27, 1978 when a severe snowstorm struck the Midwest, and Michigan was at the center of the storm (including the city of Ann Arbor). Dubbed a "white hurricane" by some meteorologists, the storm measured 2,000 miles by 800 miles and produced winds with the same strength of a small hurricane and tremendous amounts of snow. In Michigan, up to 34 inches of snow fell in some areas, and winds of 50-70 miles per hour piled the snow into huge drifts. At the height of the storm, it was estimated that over 50,000 miles of roadway were blocked, 104,000 vehicles were abandoned on the highways, 15,000 people were being cared for in mass care shelters, and over 390,000 homes were without electric power. Two days after the storm, over 90% of the state's road system was still blocked with snow, 8,000 people were still being cared for in shelters, 70,000 vehicles were stranded, and 52,000 homes were still without electricity.

The Blizzard of 1999 A Presidential Emergency Declaration was granted for Washtenaw County following a blizzard on January 2, 1999 that brought over ten inches of snow to the area along with wind gusts to 45 MPH and extremely low wind chills. To compound the problem, heavy snows continued through the month, totaling almost 30 inches. These storms were responsible for numerous motor vehicle accidents, extreme traffic congestion, and government expenditure of an additional one million dollars for road maintenance and response costs.

The Blizzard of 2000 A Presidential Emergency Declaration was granted for Washtenaw County following a blizzard in December 2000. The severe winter storm produced record or near-record 24-hour snowfall levels in Washtenaw County, paralyzing the entire Ann Arbor region. High winds and frigid temperatures created blizzard conditions that lasted until late in the day on December 13. The storm produced great hardships for the area, resulting in many school closings for 2 to 4 days, including closing Eastern Michigan University for only the second time ever. Also, mail delivery the next day was spotty at best, and many businesses and government offices were closed. Another series of winter storms the following week dumped an additional foot or more of snow across southern Lower Michigan, increasing snow depths in the Ann Arbor area. The tremendous snow depths caused a host of public health and safety concerns across the region. The snow fell at such a steady rate in the area that public works crews worked at maximum capacity – often around the clock – for two weeks just to keep pace. The cumulative effects of the heavy snowfall, high winds, and severe cold temperatures that began on December 11 caused problems across the region for the next several weeks. The sheer volume of snow made it difficult to handle, and the process of clearing it out of the way became difficult and expensive, as there was almost no place to put it. The winter storms of December 2000 produced the worst winter conditions to hit the Ann Arbor area, and Michigan in general since the statewide blizzards that occurred in January 1978 and January 1999.

The Blizzard of 2011 From February 1-2, 2011 a major winter storm occurred throughout much of Michigan including the Ann Arbor region. The storm brought 10 to 15 inches of snow and blizzard conditions to much of the area with wind gusts in excess of 40 mph combined with heavy snow to produce whiteout conditions and snowdrifts of 3 to 5 feet. Thunder accompanied the snow with snowfall rates exceeding two inches per hour. Many businesses, schools, and some government offices were closed the next day. Most main roads were plowed by the next day but some side streets were not cleared for a couple more days.

6 Extreme Temperatures

Description Extreme Temperatures are extended periods with very high or very low temperatures. Long periods of extremely high temperatures are particularly difficult for the elderly portion of the population, who can suffer and die from conditions like heat exhaustion, heat stroke, heat syncope (fainting), and heat cramps. Reported heat waves during the summer months in Michigan include: 39 consecutive days where temperatures reached over 90F in 1998; 17 days in 1995; and extreme heat and humidity during practically the entire summer of 2001 (and long stretches of 2012 as well).

Extremely low temperatures impact a smaller sector of the population than high temperatures. Incidents are generally isolated, due to staying outside for prolonged periods of time. Shelters for homeless persons and programs to help people afford their heating bills are ways some communities can prevent cold-weather impact.

Hazard Assessment All Ann Arbor areas have at-risk populations with regard to extreme temperatures: the elderly, young children and impoverished people. This hazard received a lower ranking due to population impacted, frequency of occurrence, and ability to respond to the event.

Past Events Extreme temperatures may occur several times per year, but although evenings of extreme cold are a normal part of Michigan winters, there are various years in which extreme heat is not a large problem. There has been a large number of extreme temperature events in Ann Arbor, so those described below are the most serious events that occurred within the recent past.

Heat Wave of 1936 During the second week of July 1936, a terrible heat wave struck Michigan, with temperatures exceeding 100 degrees for several days in a row including in the Ann Arbor area. The temperature peaked at 112 degrees in Mio in the northern Lower Peninsula, setting a state record that still stands today. The extreme heat was an “equal opportunity” killer, causing many healthy adults to succumb to the heat at work or in the streets. Also, because most people relied on iceboxes to keep their food fresh, many heat-related deaths and illnesses occurred when the ice melted, causing the food to spoil. Statewide, 570 people died from heat-related causes, including some in the Ann Arbor area. Nationally, the heat wave caused 5,000 deaths.

Heat Wave / Drought of 1988 The 1988 drought/heat wave in the Central and Eastern U.S. also greatly impacted Michigan, including the Ann Arbor area. Nationwide, the drought caused an estimated $40 billion in damages from agricultural losses, disruption of river transportation, water supply shortages, wildfires, and related economic impacts. The heat wave that accompanied the drought conditions was particularly long in Michigan – 39 days with 90 degree or better heat – eclipsing the previous record of 36 days recorded in the “dust bowl” days of 1934. During that 39-day stretch, the temperature in the Ann Arbor area topped the 100 degree mark on 5 occasions.

Heat Wave of 1995 During the period from July 11-27, 1995, the Central United States and many East Coast cities experienced a devastating heat wave. According to the National Oceanic and Atmospheric Administration, that heat wave caused 1,021 deaths - 465 of those occurring in the Chicago metropolitan area alone. Many of the deaths were low-income elderly persons living in residential units not equipped with air conditioning. Local utilities in Chicago were forced to impose controlled power outages because of excessive energy demands, and water suppliers reported very low levels of water in storage. Michigan experienced 28 heat-related fatalities in 1995, most of them occurring during the intense heat period in July. In addition to this tremendous human toll, the intense heat also caused the loss of tens of millions of cattle and poultry throughout the Midwest. This was the hottest summer on record for Southeast Michigan, in terms of having the highest average temperature in Detroit (74.5 degrees). The average August temperature was even higher, at 77 degrees, which set a new record.

Cold Wave of 1995 During the first part of December an extreme cold spell occurred in Michigan including the Ann Arbor region. December 9, 1995 was especially severe as winds averaged 20 to 25 mph and resulted in Wind Chill Temperatures of -30 to -35 degrees.

Cold Wave of 1997 From January 17 to 19, 1997 the coldest weather of the winter occurred in southeast Michigan. Low temperatures reached -6 at Detroit Metro Airport.

Cold Wave of 2000 In late December 2000 after heavy snow had ended extreme cold temperatures invaded southeast Michigan, including the Ann Arbor area. Temperatures never got out of single digits on the 22nd, with Detroit seeing a high of only 4 degrees, after a morning low of -3. The arctic weather would take a toll on pipes. Ypsilanti High School in Washtenaw County had pipes burst over Christmas weekend, damaging classrooms. Several buildings on the University of Michigan campus in Ann Arbor had similar ruptures, including the School of Dentistry and Wolverine Tower. The end result was the 4th coldest December of all time in southeast Michigan. Combined with the high snowfall totals, and it's safe to say: if you don't like cold and snow, then December of 2000 was one of the most miserable Decembers in southeast Michigan history. No other December on record comes close to its combination of heavy snow and brutal cold.

Heat Wave of 2001 Extreme heat and humidity in the Midwest and Central Plains during parts of June, July and August sent heat stress index readings soaring well above 100 degrees Fahrenheit on many days. Communities across the region were forced to open “cooling centers” and take other steps in an attempt to avoid heat-related deaths among vulnerable segments of the population. Despite those efforts, heat-related deaths occurred in many areas – and unfortunately Michigan was no exception. On August 1 and August 8, heat advisories were issued in many areas in the southern Lower Peninsula, including the Ann Arbor region.

Heat Wave of 2006 A summer 2006 heat wave delivered the hottest weather the Ann Arbor region had experienced in at least 4 years. A 5 day stretch of temperatures at or above 90 degrees began on July 29th. A blanket of especially high heat and oppressive humidity settled over the area on July 31st, and remained relentless through August 2nd. Temperatures, on the 31st, soared above 90 by noon with heat indices over 100 degrees. Heat indices averaged between 105 and 110 degrees through the entire afternoon. Most significantly, Detroit Metro tied the all time record for the warmest minimum temperature, for any date, when it failed to record a temperature below 80 degrees on July 31st. This had happened only 3 other times in the previous 136 years of record keeping, and this was the first time in 64 years that it had happened again. The major power companies in the area reported an all-time record customer demand for power on the 31st. remarkably, very few heat related illnesses occurred during the event. Newspaper articles

revealed an extremely high level of awareness and preparedness from the communities across southeastern Lower Michigan. A large number of cooling centers were made available to those in need as folks reportedly heeded the warnings and took extra precaution.

Cold Wave of 2007 The worst cold wave event since the 1990s struck the southeast Michigan region on February 3, 2007 and did not let up until February 6, 2007. Wind Chill Temperatures ranged from -15 to -25 throughout almost the entire event, causing nearly every school district to cancel classes for one to two days. Hospitals reported numerous cold-related illnesses and frostbite cases. Area homeless shelters were filled to capacity. Frozen pipes and water main breaks occurred throughout the area, and flooding occurred in cases where these involved sprinkler system pipes. According to AAA, there were more than 20,000 vehicle service calls from Michigan due to the cold weather—more than had been seen for nearly 10 years.

Cold Wave of 2009 An arctic air mass become firmly established over the Great Lakes region on January 14, 2009 and persisted through the 18th producing the winter season's coldest temperatures. Temperatures fell below zero all four days, with wind chill values in the 5 to 30 below range during the majority of the time. Detroit's low temperatures for January 14-18th were as follows: -3, -3, -15, and -11.

Heat Wave of 2012 During June and July of 2012, Ann Arbor experienced periods of extreme heat prompting Heat Advisories on June 26 and 27 with heat indices in the 100-105 degrees Fahrenheit, and actual temperatures of 99-100 degrees. A similar event occurred during the July 2 through July 7 time period with actual temperatures reaching the upper 90's to 102 degrees. Several area agencies and libraries opened their doors for cooling stations. A widespread power outage occurred in Ann Arbor in the South and Southwest portion of the city caused by severe thunderstorms. The American Red Cross provided ice and water to a functional needs apartment community and Emergency Services was prepared to shelter larger numbers of the population, however restoration of power was relatively quick.

#8 and #9 Flooding: Riverine/ Urban Flooding

Description Flooding is the overflowing of rivers, streams, drains and lakes due to excessive rainfall or rapid snow or ice melt (MSP/EMHSD). Flooding can be terribly destructive, causing loss of lives, property and natural resources. Flooding can also cause temporary cessation of utility services, and make roads impassable or take out bridges, leaving people isolated in their homes.

The largest and most prominent water feature in the City of Ann Arbor is the Huron River. The Huron River is not only an important feature to Ann Arbor, but also to the region of Southeastern Michigan. The headwaters of the Huron River originate in Oakland County and the Huron River Watershed spans Oakland, Livingston, Washtenaw and Wayne County. For Ann Arbor residents the river is the primary drinking water source and provides valued recreational opportunities. The Huron River is also a source of hydropower generated at two of the four City dams.

The City of Ann Arbor's landscape is part of seven creek-sheds all tributaries of the Huron River: Traver, Malletts, Miller, Allen, Honey, Swift Run, and Flemming. For the purpose of this plan we will refer to these creek-sheds as watersheds. All of Ann Arbors creek-sheds flow into and are a part of the Huron River Watershed. Within Ann Arbor there is an area surrounding the Huron that flows directly to the Huron, not into one of the seven tributary watersheds associated with the City's creeks. For the purposes of this plan when we refer to the Huron river watershed we will mean the area that drains directly to the Huron.

Flooding is also exacerbated in urban watersheds as a result of increased imperviousness. Impervious surfaces, such as buildings, driveways, and roads, prevent storm water from being absorbed in areas of the watershed most suited for infiltration. Instead storm water moves quickly to the floodplains. Increases in impervious surfaces generally equate to an increase in the frequency of flood events because the watershed systems methods for absorbing storm events are being blocked.

FEMA first began the process of mapping floodplains in 1974. The first official flood insurance rate maps were delivered to City Officials in 1982. The initial floodplain and floodway boundaries were based somewhat on anecdotal information collected after a 100-year flood event the City experienced in 1968. Prior to 1968, the City experienced flood events of similar size in 1902 and 1947. With the regulatory framework established the City was able to begin efforts to manage risk in the designated flood areas, however until the City became a full participating member of the National Flood Insurance Program (NFIP) in 1982 there was little recourse for homeowners and business owners to protect themselves from flooding. The NFIP requires flood insurance to be purchased for all mortgaged properties in the floodplain, however; prior to the 1993 there was no penalty if the property owners did not acquire flood insurance. The City of Ann Arbor has 442 properties listed as covered by flood insurance. Approximately 71% of total buildings are in floodplain zone AE and A. The official FEMA list from late 2011 had 4 Ann Arbor structures designated as “repetitive-loss” properties: one non-residential, two single-family residential, and one “other residential” in structure type. The worst of these had 7 flood losses that totaled nearly $90,000 in reimbursable damages, while the least of them still amounted to more than $10,000 in damages.

This plan outlines the current requirements based on the City’s obligation to uphold the Standards of the National Flood Insurance Program (NFIP), and the minimum code requirements for each objective area. The City of Ann Arbor has been an NFIP participant for years, and continues to work with the State of Michigan to ensure that the relevant building codes and regulations are enforced in the City’s floodplains. This plan looks at ways to improve the current requirements with the recommended mitigation activities and strategies.

All open watercourses have an associated floodplain. In a large precipitation event it is a natural occurrence for the water levels of streams, rivers, and lakes to rise above their banks onto the adjacent lands. In urban areas these occurrences are exacerbated by the alteration of the natural landscape by the built environment. Homes, businesses, roadways, and other types of fill reside within the path of a watershed systems overflow. In effect, during a flood event, these human structures act as dams and push the overflow even further out into the watershed affecting lands that would not be at risk otherwise.

Areas that have been determined through FEMA approved methodologies and designated, as a 100-year floodplain will eventually experience a large-scale flood event. During the course of a 30-year mortgage a house in a 100-year floodplain has a 26% chance of being flooded. Compare that to a 9% chance of fire. For this reason dollars invested in flood mitigation pay off greater than dollars invested in other types of mitigation activities. By investing in time and resources into flood mitigation the City will ensure the safety of its residents and prevent the damage and loss of property.

FEMA has provided the City with National Flood Insurance Rate Maps that outline the 100-year floodplain and floodway. These maps serve as a basis for understanding the City’s risks and vulnerability to flood events. Risk analysis and vulnerability assessment are central steps to the success and eventual implementation of a mitigation plan. In order to make informed decisions about the implementation of mitigation activities decision makers and residents need accurate information about the risk the hazard poses and how vulnerable the City is to damage from the risk. According to the latest posted edition of FEMA’s “Community Status Book,” the

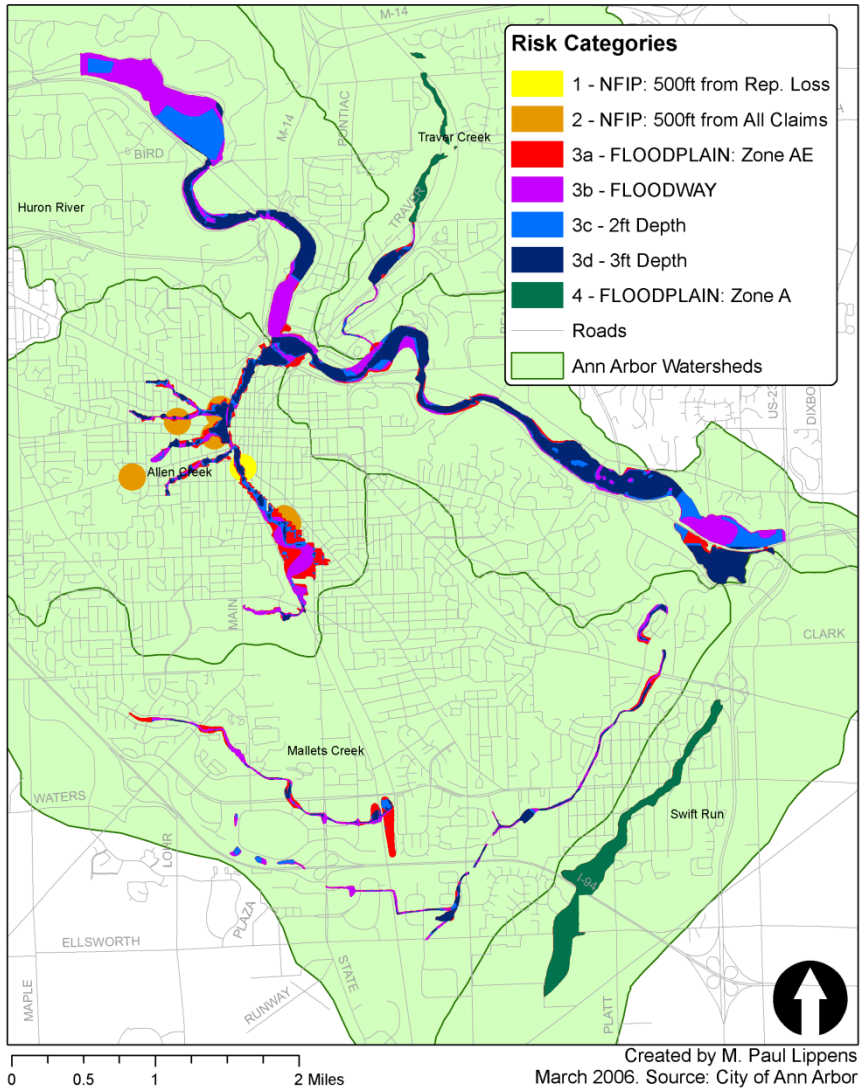
city's flood insurance rate maps have not yet been updated from the ones that were published in the 1980s, but since many hydrological conditions are fairly slow to change, these maps can still provide a useful means of starting to address the following two fundamental questions:

- Risk Analysis: What is the chance that a flood will occur in Ann Arbor? Which areas of Ann Arbor will be affected during a flood event?
- Vulnerability Assessment: If a flood occurs in Ann Arbor how much damage can it potentially cause to property? How many buildings will be affected?

Risk Analysis

The 100-year floodplain is a starting point to understand the flood risk and conduct a flood risk analysis for Ann Arbor. The 100-year floodplain is calculated as having at least a 1% chance of flooding every year. (The boundary line around the floodplain marks a set of connected points that have a 1% annual chance of flooding, but areas within that boundary, closer to the river, may have a greater than 1% annual chance.) All of the properties, including parcels of land and the associated structures or buildings within this area are located in an area with known flood risk. It is possible to further differentiate the risk by looking at other data, such as the floodway boundaries, the distance a structure is from the floodway, and the elevation of the structure's first floor (and thus expected water depth) when compared to the base flood elevation. The floodway describes the flow area of a flood event, which makes properties more susceptible to impacts from debris and wave action. Examine the risk topographically involves looking at where flood depths are likely to be deeper. Properties are more vulnerable to the hydrostatic and hydrodynamic forces of floodwater in deeper flood areas (which tend to be located closer to the source of the flooding and farther from the floodplain's outer boundary, except when those land surfaces are extremely flat and shallow). Lastly, it is possible to analyze potential risk based on what has happened before, if a property has been flooded, or repeatedly flooded, and no action has been taken to mitigate the risk, it is likely to be at-risk from future flood events as well. These principles of flood risk were used to conduct a location-based assessment of flood risk.

FMAP RISK ANALYSIS



Created by M. Paul Lippens
March 2006. Source: City of Ann Arbor

Vulnerability Assessment

Risk categories are used to conduct a vulnerability assessment. By calculating the number of parcels and buildings that fall into each risk category a measure of vulnerability is developed. We can further understand this vulnerability measure by land use or by watershed.

Flood Risk Analysis

The following risk categories formed the basis for the vulnerability assessment. These categories can be used to prioritize the implementation of flood mitigation strategies and serve as the guiding factor in the implementation of the flood elements of this plan.

1. First – Repetitive loss structures: Properties that have received multiple payouts from the NFIP.
2. Second – Reported damages: Properties that have made claims to the NFIP in the past.
3. Third – Location assessment: Properties located in the 100-year floodplain, classified by locational risk:
   - 3a: 100-year floodplain: All properties in the 100 year floodplain (zone AE).
   - 3b: 100-year floodway: Properties located within the floodway.
   - 3c: 2ft flood depth: All properties in the 100-year floodplain that will be in greater than 2 feet of floodwater. This is the depth at which heavy cars can be swept along by hydrodynamic forces.
   - 3d: 3ft flood depth: All properties in the 100-year floodplain that will be in greater than 3 feet of floodwater. The depth at which hydrostatic forces can cause structures to collapse.
4. Fourth – Floodplain zone A: All properties that are in floodplain zone A. In Ann Arbor there are two such zones mapped: Swift Run and the upper reaches of Traver Creek.

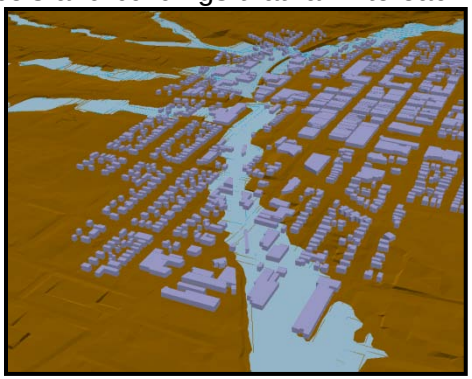


Figure 10: Downtown Floodplain-2ft

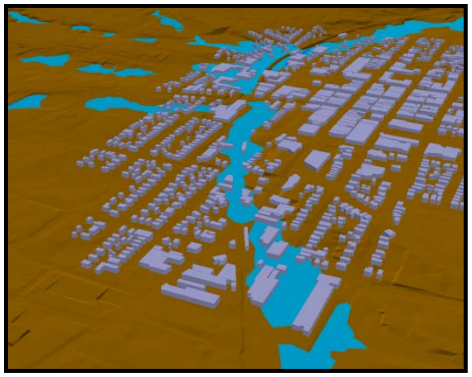
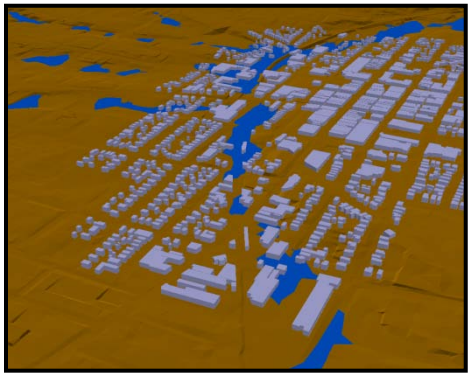


Figure 11: Downtown Floodplain-3ft



Category 1 is the highest priority for flood mitigation activities and Category 2 is the second highest priority. At this time the City of Ann Arbor has 4 repetitive loss sites (Category 1) and 8 other sites identified with NFIP claims (category 2). All of these sites are in the Allen Creek Watershed. Helping properties that have a history of flood damage is a proven successful method of preventing flood loss. Properties and structures that fall into Category 3 are also vulnerable to future flood damage and could in the future move into one of the higher priority categories. The City of Ann Arbor has not experienced a "100-year storm event" over the entire City since the inception of the NFIP. The City has an opportunity to preempt a significant portion of the vulnerable properties and structures from moving into higher risk categories by implementing mitigation activities on properties and structures prior to the next large storm event. Specifically, properties and structures in category 3 that have flood insurance will most likely make claims if flood damage occurs to the property and will move into Category 1 and 2 if nothing is done prior to the next large storm event in the City. Category 4 properties may be reduced as the

floodplains in Ann Arbor are restudied and remapped as part of the ongoing FEMA Map Modernization process. The risk categories are not mutually exclusive. For prioritization of properties a point value of one is assigned to each category. Additive values for risk categories of individual properties yields a vulnerability index to further describe each property's vulnerability.

Vulnerability Assessment

Since the City of Ann Arbor joined the national flood insurance program in 1978 there have been many claims made, coming from multiple properties. The total payout of claims in Ann Arbor is in the realm of six figures, in insured property damages alone, which only involves a fraction of actual costs and losses stemming from flooding. There are about 1450 (floodplain zone AE & zone A) properties that could be affected in a 100-year storm event. Multiplying an estimated average payout of $8 thousand by 1450 gives a total direct property damage estimate of over $11 million dollars from the next 100-year flood. Although not all properties may be affected in one event, it is reasonable to assume that damages could exceed an average that was based upon below-peak events.

FMAP Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	1	1	0	0	0	0	0
2 - NFIP Reported Damage	8	8	0	0	0	0	0
3a - Floodplain Zone AE	1180	707	136	298	0	62	23
3b - Floodway	773	359	117	263	0	45	11
3c - 2ft Depth	814	444	95	229	0	55	9
3d - 3ft Depth	671	325	89	212	0	54	9
4 - Floodplain Zone A	272	0	0	0	257	15	0

FMAP Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	1	1	0	0	0	0	0
2 - NFIP Reported Damage	8	8	0	0	0	0	0
3a - Floodplain Zone AE	506	425	11	49	0	23	2
3b - Floodway	263	200	10	38	0	16	1
3c - 2ft Depth	256	235	4	4	0	15	2
3d - 3ft Depth	185	169	3	3	0	11	1
4 - Floodplain Zone A	116	0	0	0	116	0	0

The preceding table presents the number of vulnerable parcels and structures within each of the risk categories defined in the risk analysis. The total for each category is presented along with a breakdown by watershed area. The redundancy column explains parcels or structures that may be partially in two or even three watershed areas.

The vulnerability assessment confirms the severity of the flood risk in the Allen Creek Watershed. This watershed contains 60% of the parcels and 84% of the structures in the Floodplain Zone AE (category 3a) and similarly high percentages of Category 3b, 3c, and 3d. Allen also contains all of the NFIP claims to date.

Based on the information in the preceding tables, it is possible to develop a monetary estimate of the flood vulnerability in Ann Arbor. The bullets below are intended to illustrate possible loss scenarios in the event of a 100-year flood. Loss estimates are based on a recent (2006-2010) Median Owner-Occupied Housing Value for the City of Ann Arbor of $240,400.

- *What would the loss be if the City were to experience a 25% average loss on all the parcels located in the floodplain?* A 25% loss on all floodplain parcels would equal $71,519,000.
- *What would the loss be if the City were to experience a 25% average loss on all the parcels located just in the floodway?* A 25% loss on all floodway parcels would equal $46,457,300.
- *What would the loss be if the City were to experience a 50% average loss on all the parcels located in the floodplain?* A 50% loss on all floodplain parcels would equal $143,038,000.
- *What would the loss be if the City were to experience a 50% average loss on all the parcels located just in the floodway?* A 50% loss on all floodway parcels would equal $92,914,600.
- *What would the loss be if the City were to experience a 75% loss on all the parcels located just in the 3ft depth areas?* A 75% loss on all 3ft depth floodplain parcels would equal $120,981,300.
- *What would the loss be if the City were to experience a 75% average loss on all the parcels located just in the 2ft depth areas?* A 75% loss on all 2ft depth floodway parcels would equal $146,804,000.

The questions above do not tell the whole story but rather begin to show how cost-benefit analysis can be conducted to evaluate the potential benefits of implementing flood mitigation strategies. It is also important to note that flood losses are not one-time losses—the more flood events that occur in the City before mitigations strategies have been implemented, the more risk the City has of properties becoming classified as repetitive loss structures. Just a few years ago, the City of Ann Arbor only had one repetitive loss structure, but now 4 have been officially classified as such. There is an opportunity to conduct useful flood mitigation prior to the occurrence of a large-scale loss event like the ones estimated in the above bullets. Project #15 – Detailed Flood Loss Model, describes the creation of a model to assess in more detail the potential flood losses than was performed above.

In addition to financial losses that can be incurred through property damage during a flood event, floods also pose a risk to human health. There are numerous threats that can harm persons caught in moderate or catastrophic flood events. These include drowning in forceful waters (e.g. a car that tips into a ditch or eroded section of roadway), being trapped in vulnerable structures, being electrocuted by electric currents active in the water, falling into exposed manholes, stepping on sharp metal hidden under the flood waters, or being struck by hazardous flood debris. Based on the year 2010 census estimate for average household size in Ann Arbor of 2.5, there are approximately 2,295 persons whose parcels are in a floodplain zone AE and zone A. City-wide the total number of persons living in a census block within 100 feet of the floodplain area is 21,000.

One way to manage residents' exposure to these risks is to employ sound land use planning in flood prone areas. Different land uses have inherently different vulnerabilities. For instance, residential use is a 24-hour land use in which people are particularly vulnerable

during sleeping hours. Comparatively, commercial and recreational uses may only be partial day uses, and many recreational uses have the added benefit of creating open spaces. Industrial uses may also be partial day uses, but they are also potential threats because industrial chemicals and toxins can be carried in floodwaters if facilities were to become compromised. The following tables examine the parcel and structure vulnerability by watershed for the land uses mentioned above: Residential, Commercial, Recreational and Industrial.

FMAP Residential Zone Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	8	8	0	0	0	0	0
3a - Floodplain Zone AE	736	501	22	173	0	47	7
3b - Floodway	424	229	16	152	0	30	3
3c - 2ft Depth	497	299	21	137	0	41	1
3d - 3ft Depth	398	206	21	131	0	41	1
4 - Floodplain Zone A	182	0	0	0	179	3	0

FMAP Residential Zone Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	8	8	0	0	0	0	0
3a - Floodplain Zone AE	417	362	6	30	0	21	2
3b - Floodway	210	166	6	26	0	14	2
3c - 2ft Depth	212	197	2	0	0	14	1
3d - 3ft Depth	148	136	1	0	0	11	0
4 - Floodplain Zone A	110	0	0	0	110	0	0

Residential use is the most prominent land use in the floodplain, comprising approximately 62% of the total land uses in the Floodplain Zone AE (category 3a). Of the residential use, the largest share, 68%, is concentrated in Allen Creek. This is followed by Malletts Creek, which has 24%.

FMAP Commercial Zone Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	1	1	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	150	86	6	52	0	7	1
3b - Floodway	105	51	5	42	0	7	0
3c - 2ft Depth	99	65	5	23	0	6	0
3d - 3ft Depth	81	49	5	21	0	6	0
4 - Floodplain Zone A	6	0	0	0	6	0	0

FMAP Commercial Zone Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	1	1	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	24	18	0	4	0	2	0
3b - Floodway	12	7	0	3	0	2	0
3c - 2ft Depth	10	9	0	0	0	1	0
3d - 3ft Depth	8	8	0	0	0	0	0
4 - Floodplain Zone A	1	0	0	0	1	0	0

Commercial land use is the third most intensive use of the land uses analyzed. It accounts for approximately 13% of the total land in the Floodplain Zone AE (category 3a). Of the commercial use, the largest share, 57%, is concentrated in Allen Creek. This is followed by Malletts Creek, which has 35%.

FMAP Parks & Vacant Zone Parcel Vulnerability

PARCELS by Risk Category	Total	Allen	Huron	Mallets	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	219	64	97	47	0	14	3
3b - Floodway	185	48	82	45	0	17	7
3c - 2ft Depth	163	35	76	41	0	16	5
3d - 3ft Depth	150	31	72	37	0	15	5
4 - Floodplain Zone A	136	0	0	0	121	15	0

FMAP Parks & Vacant Zone Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	9	7	1	1	0	0	0
3b - Floodway	6	4	1	1	0	0	0
3c - 2ft Depth	4	3	0	1	0	0	0
3d - 3ft Depth	2	2	0	0	0	0	0
4 - Floodplain Zone A	2	0	0	0	2	0	0

Parks & Vacant land uses is the second most intensive use of the land uses analyzed. It accounts for approximately 18% of the total land in the Floodplain Zone AE (category 3a). Only 4% of the 219 parcels in category 3a have buildings located in the area. Of the four repetitive loss properties in the city, three are in an area zoned AE.

PARCELS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	84	57	1	20	0	6	0
3b - Floodway	68	45	0	19	0	4	0
3c - 2ft Depth	63	43	0	16	0	4	0
3d - 3ft Depth	54	36	0	14	0	4	0
4 - Floodplain Zone A	0	0	0	0	0	0	0

FMAP Industrial Zone Building Vulnerability

BUILDINGS by Risk Category	Total	Allen	Huron	Malletts	Swift	Traver	Redundancy
1 - NFIP Repetitive Loss	0	0	0	0	0	0	0
2 - NFIP Claims	0	0	0	0	0	0	0
3a - Floodplain Zone AE	10	8	0	2	0	0	0
3b - Floodway	7	5	0	2	0	0	0
3c - 2ft Depth	6	6	0	0	0	0	0
3d - 3ft Depth	5	5	0	0	0	0	0
4 - Floodplain Zone A	0	0	0	0	0	0	0

Industrial land use is the least intensive use of the land uses analyzed. It accounts for approximately 7% of the total land in the Floodplain Zone AE (category 3a). Of the industrial land use, the largest share, 67%, is concentrated in Allen Creek. This is followed by Malletts Creek, which has 23%.

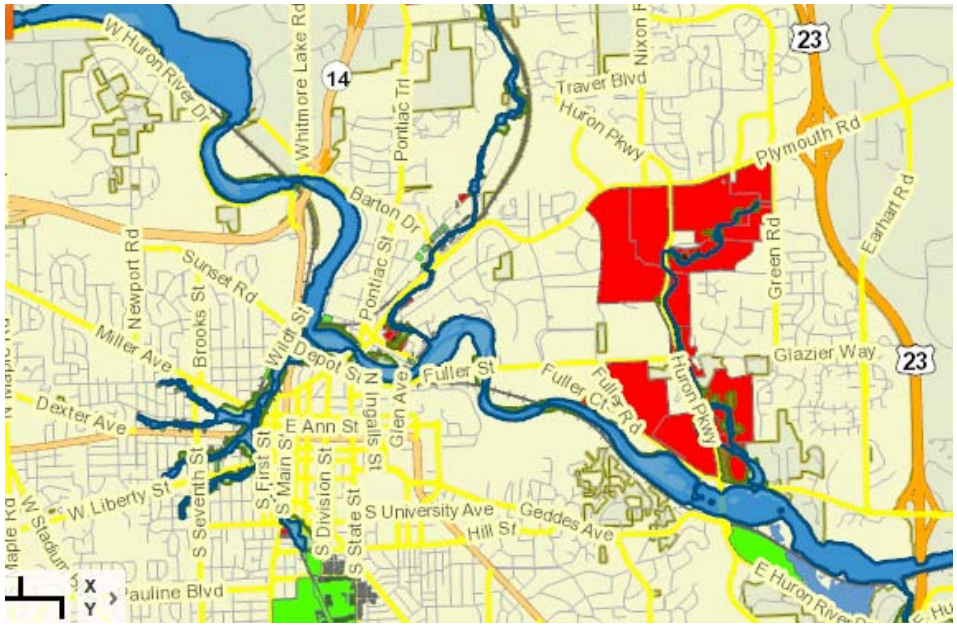
This land use analysis shows the different land use development patterns of the different watersheds in the City. For instance, looking at residential uses in Table 3 shows that only 17% of the buildings on the 173 parcels Malletts Creeks floodplain are also located the floodplain. Generally the assumption can be made that buildings in this watershed were built further away from the stream corridor than in Allen Creek, where 72% of the buildings on the 501 parcels in the floodplain are also located in the floodplain.

Understanding the Vulnerability Assessment

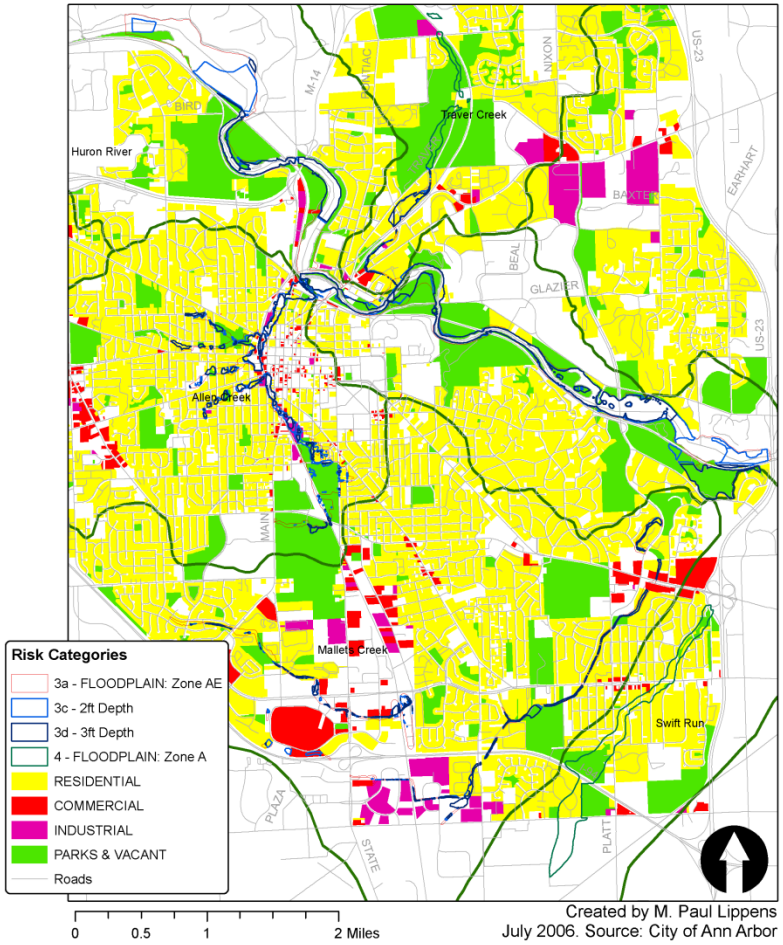
The estimates included in this section for vulnerability of parcel/buildings by watershed and land use were made using the best data available to the City of Ann Arbor in 2007. The estimates were initially produced for the 2007 Ann Arbor Flood Mitigation Plan, which utilized the most current geographic and informational data maintained by the City of Ann Arbor. The flood analysis was intended to be used for planning purposes, and it has been reviewed for this 2012 hazard mitigation plan and updated with 2010 census figures and the 2011 FEMA listing of repetitive loss properties. These estimates are not at a “survey” level of detail and individual properties that

fall into the risk categories should be subject to verification of vulnerability prior to conducting mitigation activities. Moreover, as the 2012 plan was nearing its completion, the FEMA Map Modernization Program resulted in a new Flood Insurance Rate Map (April 2012). This map was so new that, at the time of writing, this plan was being finalized; FEMA's web posted Community Status book did not even refer to it yet. Ideally, the new FIRM would be used for another thorough analysis of the city's flood hazards, but such an extensive analysis will have to be deferred until the next edition of the Ann Arbor Hazard Mitigation Plan. The current plan could not be delayed to allow the replication of such an involved study, because the result would be missed grant deadlines that would cause the loss of project funds for an important hazard mitigation product in the field. Therefore, the use of the new FIRM for an updated flood analysis is instead identified as an action item for the next edition (probably scheduled during 2016-7) of this hazard mitigation plan.

So far, however, the city has been able to begin making good use of the new Flood Insurance Rate Map. A web site at http://gisapp.ewashtenaw.org/mapannarborx/Viewer.html?Viewer=AnnArborFEMAFlood contains a web-based flood map viewer that allows anyone to view the information in relation to the city, its streets, facilities, and other features of interest. An example of that new map, showing the main floodplain across the central part of the city, is provided below:

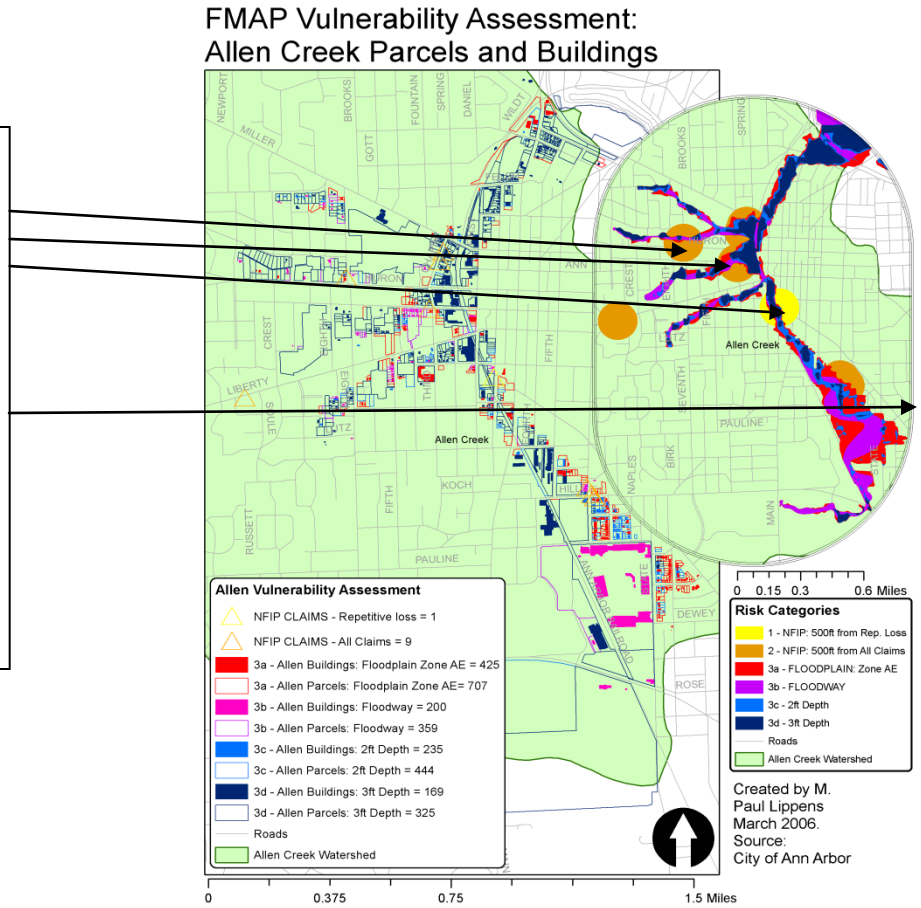


FMAP Vulnerability Assessment: Residential and Non Residential Land Uses

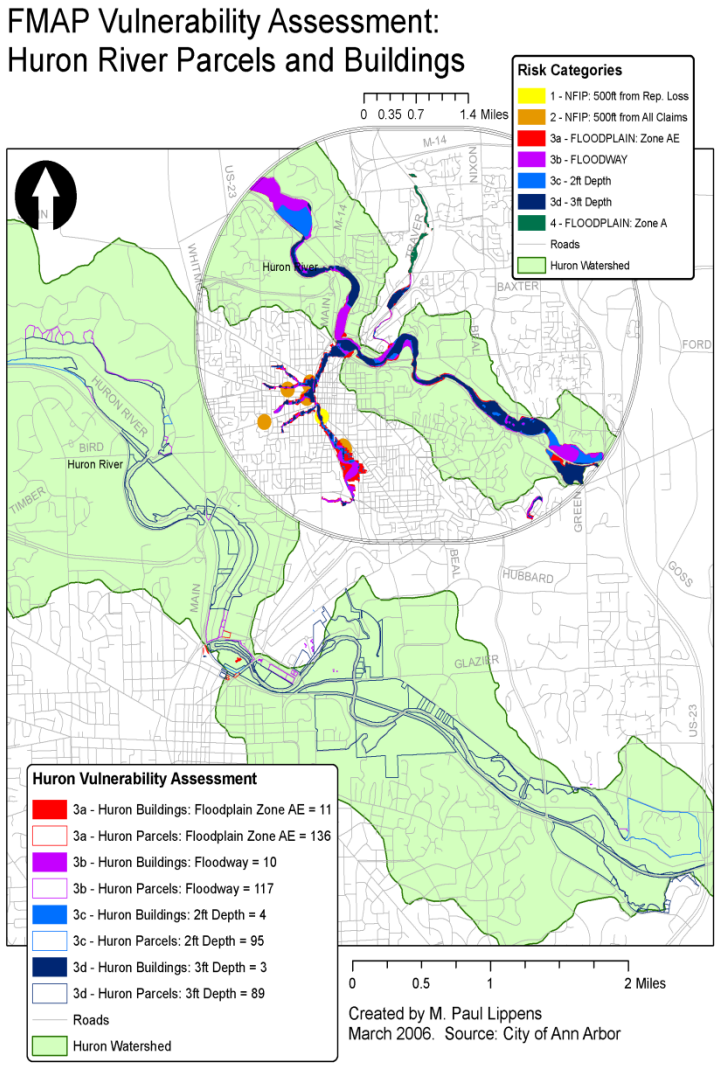


The following pages contain maps of the vulnerability assessment by watershed. These maps show the actual parcels and building structures that fall within each risk category by watershed.

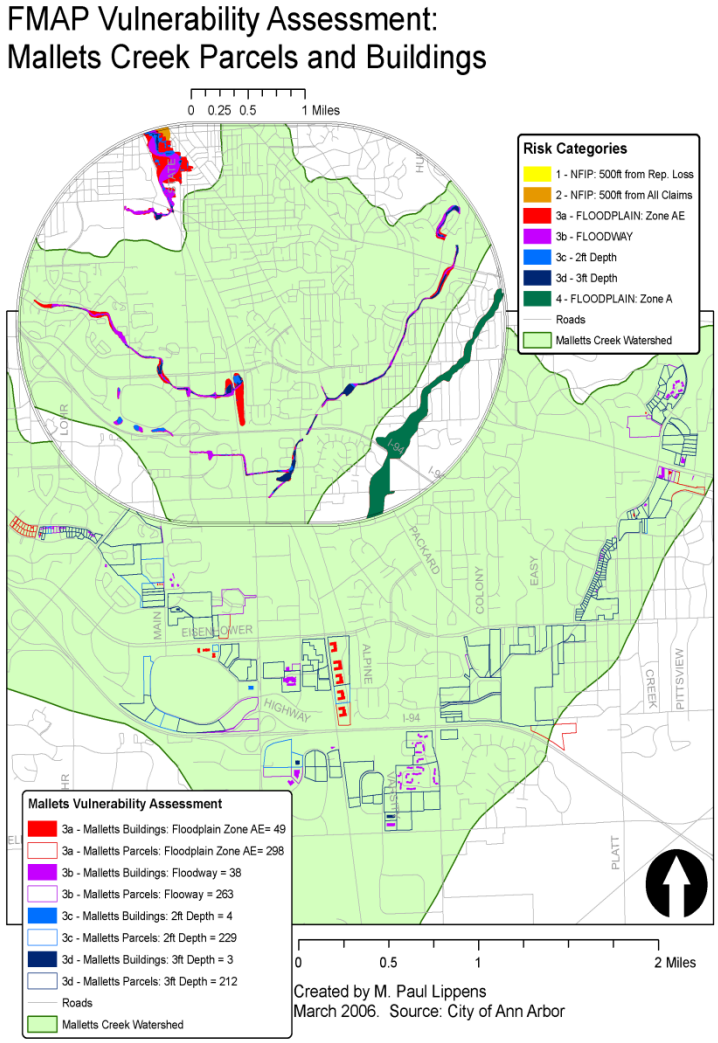
Approximate locations of the 4 repetitive loss properties in the latest available FEMA list (from 2011).
NOTE: these arrows do **not** refer to exact locations, which are required to be kept confidential. Instead, the approximate locations are merely suggested here, for a general overview.



The “circular” inset shows the risk categories for Allen Creek, and approximate locations of the city’s repetitive loss properties. The larger rectangular frame shows the results of the vulnerability analysis for Allen Creek.

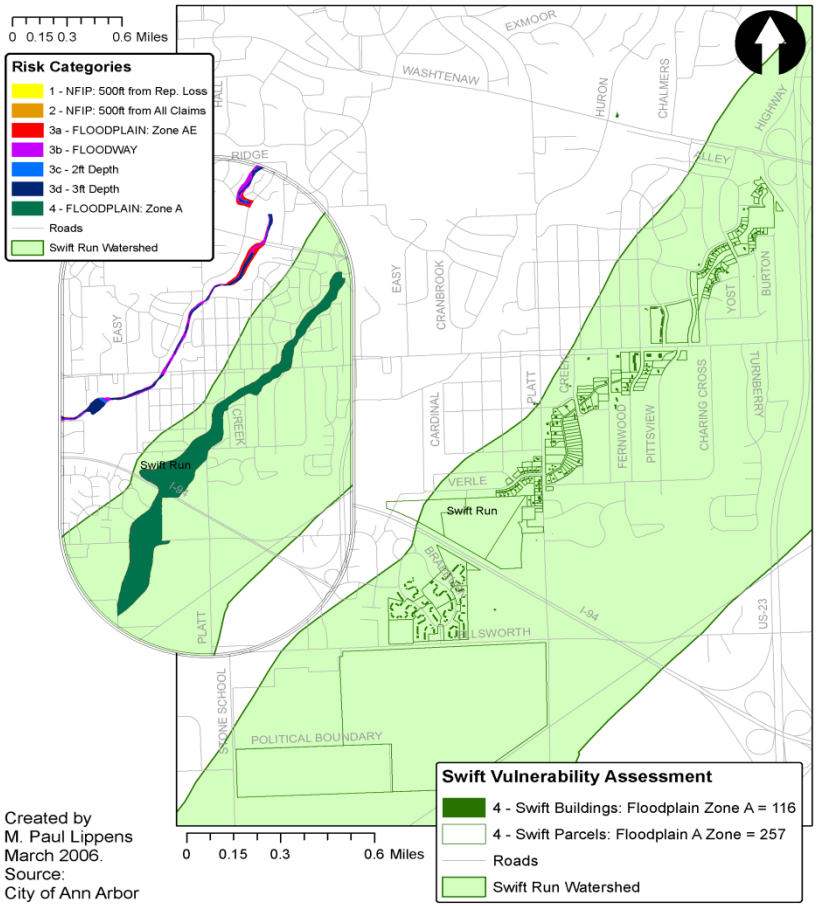


The “circular” inset shows the risk categories for the Huron River. The larger rectangular frame shows the results of the vulnerability analysis for the Huron River.



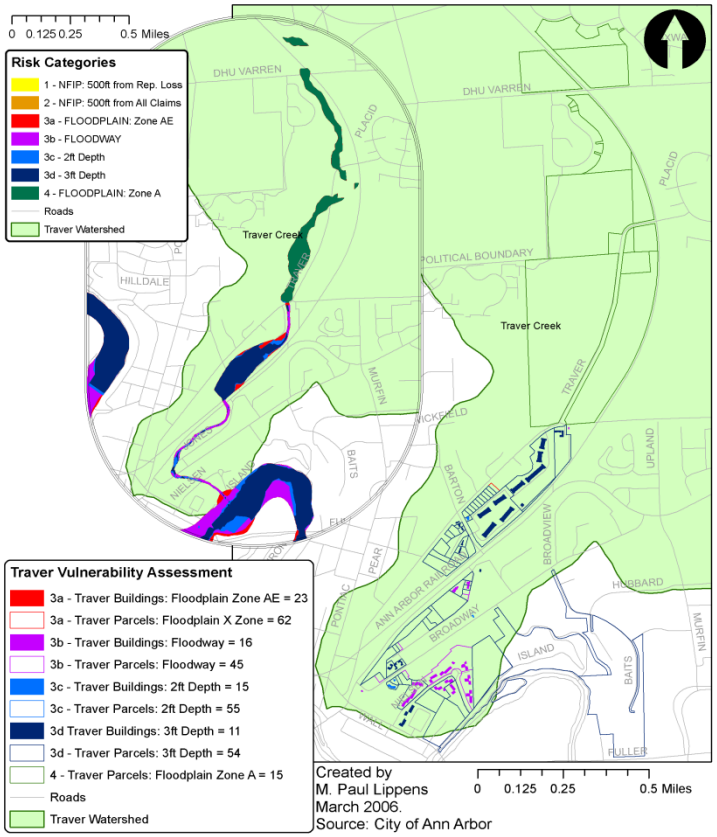
The “circular” inset shows the risk categories for Malletts Creek. The larger rectangular frame shows the results of the vulnerability analysis for Malletts Creek.

FMAP Vunerability Assessment:
Swift Run Parcels and Buildings



The “circular” inset shows the risk categories for Swift Run. The larger rectangular frame shows the results of the vulnerability analysis for Swift Run.

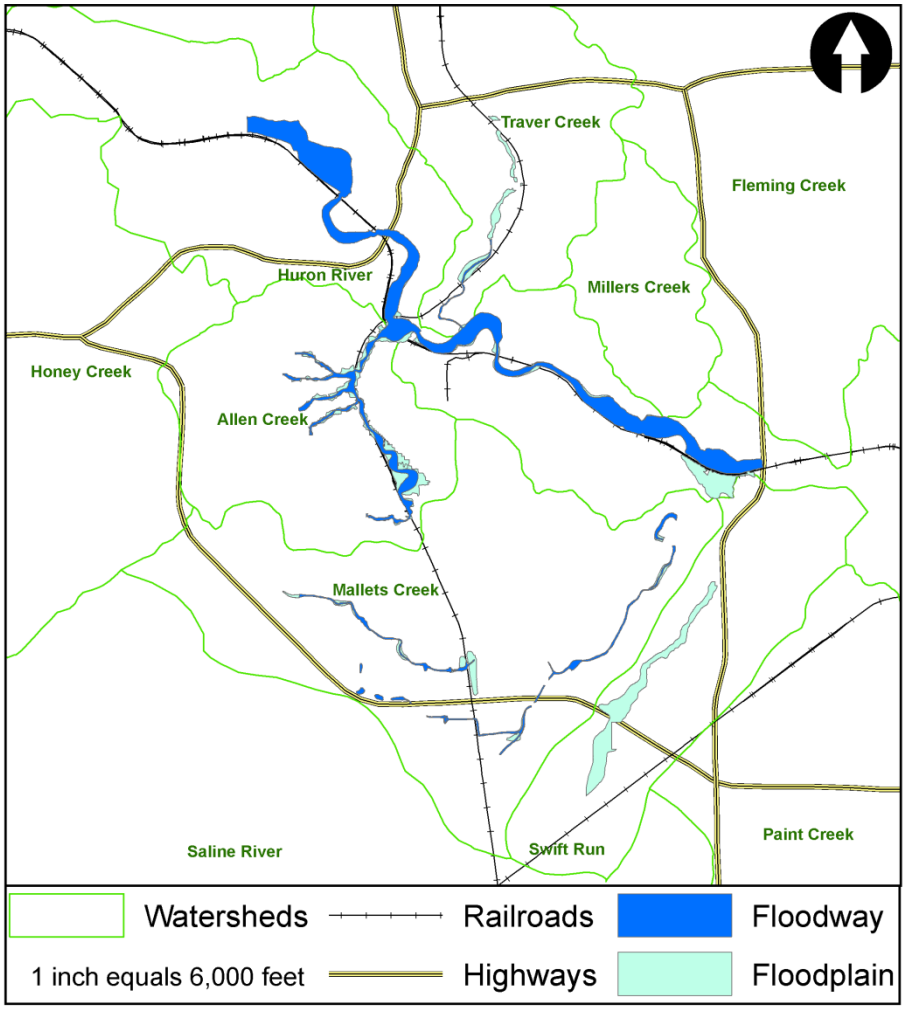
FMAP Vulnerability Assessment
Traver Creek Parcels and Buildings



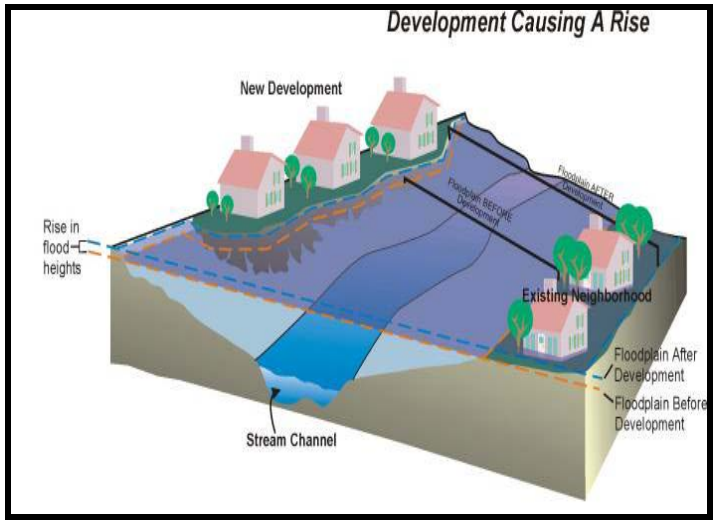
The “circular” inset shows the risk categories for Traver Creek. The larger rectangular frame shows the results of the vulnerability analysis for Traver Creek.

The City of Ann Arbor watersheds are part of the Huron River Watershed System. While each of the watersheds have specific considerations, there are many recommended mitigation strategies and activities the City of Ann Arbor could implement that are important to the entire system. This section is dedicated to mitigation strategy recommendations that apply to the whole watershed system. Cost estimates are based on a burdened salary figure of $100,000.

Ann Arbor Watersheds



Allen Creek, in Ann Arbor's central area, was put underground in about 1926. It had become an open sewer, with household waste from the growing population and industrial waste from the tanneries and factories crowded along its banks. The creek flooded



frequently due to the changes in land use that replaced absorbent vegetation with streets and buildings, leaving those of lower economic status, who tended to live along its banks, with flooded and unhealthy basements and yards. Allen Creek was piped and submerged under the ground to help improve health conditions and stop flooding in its immediate area. Although this solution may have been an improvement to the conditions that existed in the twenties, nothing was done to curb the development patterns in and around the creek's floodplain. Unfortunately, in the long-term, burying the creek may have had the opposite effect, with several buildings subsequently being constructed directly in the center of the watercourse. Burying the stream did not effectively mitigate the flooding experienced by residents in this area, and it still continues today.

Planning and Implementation of Storm Water Improvements in the Allen Creekshed

Washtenaw County, in partnership with the City of Ann Arbor, has begun conducting a feasibility assessment of the Allen Creek basin to determine practical options for storm water improvement projects. Issues to be addressed include flow management, flooding, phosphorus loading, and pathogen levels. Public input is important to the process of developing recommendations, and the public acceptability of recommendations is critical.

Flooding is an issue for Ann Arbor, whether involving rivers or overflows in the storm water system. During a sample period of 10 years, between the late 1990s and the late 2000s, 29 flood watches and 17 flood warnings were issued in Washtenaw County. Ann Arbor has long been a participant in FEMA's Flood insurance program, and has had its floodplains mapped. Flooding can also occur outside of known floodplains, in low-lying areas that suffer when quick rainfall events inundate the area's stormwater management system. These events generally coincide with slow moving storms that produce an enormous amount of rain in a short period of time. Most of the time, flooding can be considered as a temporary hazard, lasting from hours to days. The duration of the flooded area is dependent on the speed of the storm, quantity of precipitation, and condition of the drainage system.

<u>Revised Flood Insurance rate Maps for Washtenaw County and the City of Ann Arbor</u>

City Council adopted new flood maps that became effective on April 3, 2012. All property owners of buildings moving in or out of the floodplain were notified by letter. Although an extensive analysis of this new flood data will take substantial additional time to complete, the following charts were produced to document the effect of the revised maps within the City:

Parcels in 2012 Floodplain	
Watershed	**# of Parcels**
Allen Creek	481
Huron River	69
Mallets Creek	245
Millers Creek	21
Saline River	0
Swift Run	105
Traver Creek	53
Total	**974**

Parcels in 1992 Floodplain	
Watershed	**# of Parcels**
Allen Creek	636
Huron River	67
Mallets Creek	225
Millers Creek	0
Saline River	0
Swift Run	179
Traver Creek	60
Total	**1167**

Buildings in 2012 Floodplain	
Watershed	**# of Buildings**
Allen Creek	388
Huron River	28
Mallets Creek	56
Millers Creek	3
Saline River	0
Swift Run	26
Traver Creek	23
Total	**524**

Buildings in 1992 Floodplain	
Watershed	**# of Buildings**
Allen Creek	567
Huron River	24
Mallets Creek	65
Millers Creek	0
Saline River	0
Swift Run	210
Traver Creek	42
Total	**908**

Parcels Moving Into Floodplain	
Watershed	**# of Parcels**
Allen Creek	45
Huron River	12
Mallets Creek	30
Millers Creek	21
Saline River	0
Swift Run	13
Traver Creek	12
Total	**133**

Parcels Moving Out of Floodplain	
Watershed	**# of Parcels**
Allen Creek	200
Huron River	10
Mallets Creek	10
Millers Creek	0
Saline River	0
Swift Run	87
Traver Creek	19
Total	**326**

Buildings Moving Into Floodplain	
Watershed	**# of Buildings**
Allen Creek	42
Huron River	12
Mallets Creek	44
Millers Creek	3
Saline River	0
Swift Run	2
Traver Creek	8
Total	**111**

Buildings Moving Out of Floodplain	
Watershed	**# of Buildings**
Allen Creek	221
Huron River	8
Mallets Creek	53
Millers Creek	0
Saline River	0
Swift Run	186
Traver Creek	27
Total	**495**

Hazard Assessment. Flood events threaten lives, impair transportation, destroy property, and can stop utility services. While this hazard is a concern for Ann Arbor, it received a lower ranking, compared to other hazards, because past events have impacted a smaller portion of the population, a smaller geographic area, and required fewer resources to respond, relative to higher-ranked hazards.

Totals	
Parcels in 1992 Floodplain	**1167**
Parcels in 2012 Floodplain	**974**
Buildings in 1992 Floodplain	**908**
Buildings in 2012 Floodplain	**524**
Parcels Moving Into Floodplain	**133**
Buildings Moving Into Floodplain	**111**
Parcels Moving Out of Floodplain	**326**
Buildings Moving Out of Floodplain	**495**

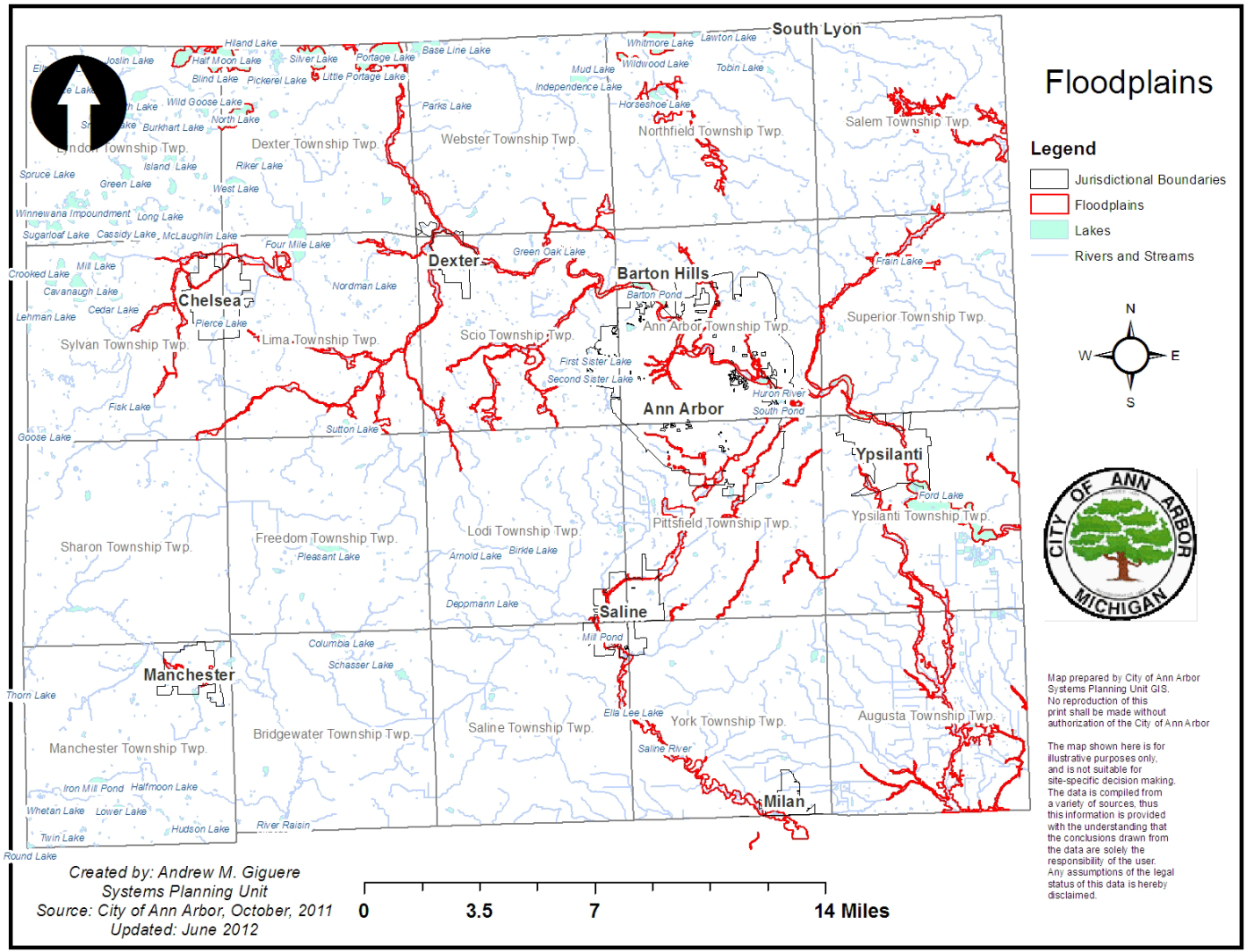
Past Events. There have been a various number of flooding events in Ann Arbor; those described below are the most serious events that occurred within the recent past.

Flood of 2004. In May 2004, a stationary front over Iowa, Wisconsin, and Michigan brought severe thunderstorms and heavy rains, which caused widespread flooding over Southern Lower Michigan. Much of the rainfall occurred in saturated areas that had experienced well-above average precipitation for the month of May. Over a 36 hour period (12 am May 22nd to 8 am May 23rd), 2 to 6 inches of rain fell across Southeast Michigan. Backyards were submerged under several feet of water and three roads were closed in Ann Arbor. It was the biggest and longest duration flooding event in the past ten to twenty years across south central Lower Michigan. Washtenaw County was one of the hardest hit and 28,000 homes also lost power. A Presidential Major Disaster Declaration was granted to 23 counties in Southern Lower Michigan, including Washtenaw County.

Flood of 2010. On June 5-6, 2010 a storm event dropped between 2 and 3 inches of rain over a 9 hour period, equating approximately to a 10% annual chance event. The event had a great deal of variability across the City. Flooding was reported in several areas of the City, particularly in the southwest portion.

Flood of 2012. On March 15, 2012 a tornado struck the Village of Dexter approximately 8 miles west of the City of Ann Arbor. The most intense area of the storm passed through the southwest part of Ann Arbor dropping about 2 inches of rain within a 2 hour period, equating to a 4% annual chance event. Numerous flooded basements were reported throughout the southwest portion of the City, mostly in areas above and outside the mapped floodplain. Only minor flooding was observed outside the southwest portion of the City.

Regional Floodplains (Washtenaw County)



City of Ann Arbor

The City of Ann Arbor takes a multi-faceted approach to floodplain management, working to protect natural floodplains and to mitigate flooding problems where the floodplain has already been developed. The city:

- Participates in the National Flood Insurance Program
- Provides Flood Insurance Rate Map information to the public
- Regulates floodplains as a natural feature during the site plan approval process (See Chapter 57 of City Code at http://library.municode.com/index.aspx?clientId=11782&stateId=22&stateName=Michigan) and the Guidelines for the Protection and Mitigation of Natural Features (which connects flood mitigation concepts with land use regulation) at http://www.a2gov.org/government/communityservices/planninganddevelopment/planning/Pages/LandDevelopmentRegulations.aspx)
- Ensures compliance with the flood resistance construction standards in the Michigan Building Codes
- Maintains an extensive park and greenway system in the floodplain along the Huron River, and has numerous other parks in the floodplain areas of the creeks flowing to the Huron River.
- Developed and is in the process of implementing a city Flood Mitigation Plan (4 MB pdf) (available online at http://www.a2gov.org/government/publicservices/systems_planning/waterresources/Documents/Floodplains/FloodplanMitigationPlan_Mar07.pdf)

#16 Wildfires

Description Wildfires are the uncontrolled burning of natural lands. According to the 2012 Michigan Hazard Analysis (published by MSP/EMHSD), only seven percent of wildfires throughout Michigan are due to lightning, with the majority caused by human activities. In Ann Arbor, many wildfires are caused by railroad sparks. More broadly, Washtenaw County has had nearly 400 wildfires in the past three years, but no reported injuries or deaths to either firefighters or civilians. So although this hazard is common in the area, it doesn't have a great history of substantial local impacts.

Together agricultural lands, grassland and shrub land, and wetlands and woodlands compose 73% of total County lands, and these land types extend into the city of Ann Arbor as well. Consequently, wildfires are a potential hazard in such areas. Wildfires tend to happen more in rural areas, where the fire has time to build up.

Several significant wildfires per year are common for Washtenaw County, particularly during the summer months. Such fires generally do not result in loss of lives, but do result in the loss of property. The potential for larger, more damaging wildfires is real. In the City of Ann Arbor, controlled burns are used to reduce the likelihood of this hazard, reducing the fuel available for wildfires to use in their spread.

Wildfire Events in Washtenaw County

	Frequency	Deaths	Injuries
2000	144	0	0
2001	121	0	0
2002	129	0	0
Total	394	0	0

Source: State of Michigan (NFIRS)

Hazard Assessment This hazard is a real concern, but given the lack of death/injuries during 400 area wildfire occurrences, there seems to be a demonstrated ability for fire departments to respond to wildfire occurrences and to make good use of existing mutual aid agreements between communities. Therefore, this hazard received a lower ranking relative to other hazards.

#19 Droughts

Description Drought is a prolonged period of time with a lack of precipitation. Drought impacts the economy (especially the agricultural sector) and can result in reduced water supplies for citizens and local businesses. Water conservation measures may be implemented, but only on the authority of the local governments.

There is very little record of Ann Arbor seeking aid for the area's agricultural community due to drought conditions. Although the 2012 Michigan Hazard Analysis documents a history of severe drought conditions in the surrounding area, the impacts on the city itself have been limited. This type of hazard is more a concern for areas with large agricultural sectors and lake/groundwater-based supply systems and water-oriented recreational sectors. By contrast, Ann Arbor is well situated on several watercourses. In addition, when drought conditions occur in any part of the United States, Federal aid is available to all farmers, regardless of geographic location. With regard to water resources, much of Ann Arbor's water supply comes from the Huron River in addition to groundwater wells. There is no reliance on outside systems for the City's water. A drought that impacts the city's water supplies would certainly be devastating to Ann Arbor, as well as the southeast Michigan region.

Hazard Assessment Given the low frequency of past occurrences affecting the city, and the low likelihood of future occurrence, this hazard received a lower ranking than other hazards.

Past Events There have been numerous minor drought events in Ann Arbor, but those described below are the most serious events that occurred within the past century.

Droughts of the 1930s Without a doubt, the "Dust Bowl" drought of the 1930s was the most famous drought ever to occur in the U.S. That drought was an ecological and human disaster of huge proportions. It was caused by misuse of the land combined with years with lack of rainfall. As the land dried up, great clouds of dust and sand, carried by the wind, covered everything and the term "Dust Bowl" was coined. As a result of this drought, millions of acres of farmland became useless, forcing hundreds of thousands of people to leave their farms and seek an existence elsewhere. Although exact figures were not kept, some researchers estimate that nearly $1 billion (in 1930s dollars) was provided in assistance to victims of the Dust Bowl drought. That event also ushered in a new era or farming and conservation programs and practices aimed at preventing a recurrence of a drought of the magnitude and impact of the Dust Bowl drought.

In Southwestern Michigan (including the Ann Arbor area), this "dust bowl" period took the form of a most severe statewide drought condition from 1930 to 1932, followed by a less severe period from 1933 to 1937, and finally a period of limited spotty problems between 1939 and 1940. Between 1930 and 1932, Michigan's 10th climate division experienced a severe level of drought for about 24 continuous months. The entire state was struck very hard by this event. During December and January of 1934-1935 the southeastern Michigan region set an all-time state record for the longest number of consecutive months under drought conditions—the 42 months between August 1933 and January 1937. Although the area had some months of relief in early 1938, drought conditions resumed by the end of the year for a period of 8 consecutive months; and then between 1939 and 1940, another 12 month period of drought followed.

Drought of the 1960s A time period from 1962-1965 was the only clear and serious statewide drought event to take place since the 1930s, which partially demonstrates a general trend of lessening drought problems in Michigan (including the Ann Arbor area) during the second half of the 20th Century when compared with the first half. Nevertheless, this was definitely the worst drought event to strike Michigan since the 1930s. In this event, the entire Southern Lower Peninsula had to endure at least 30 consecutive drought months, many of which were at the D2 level, or worse. Again, there was a pattern in which the drought was felt more intensely the farther to the east one was located. Southeastern Michigan experienced 9 consecutive months at the exceptional D4 level of drought. The middle years of 1963-1964 were the worst phase of this event, for most parts of the state.

#20 Earthquakes, Subsidence

Earthquakes

Description Earthquakes are a sudden movement in the earth's surface as a result of an energy release from the earth's crust. There are two potential sources of earthquake activity for Ann Arbor. The Grenville Front is a regional fault zone and crosses under Washtenaw County from the southeast to northeast. The Grenville Front is dormant and is therefore not a major concern. The New Madrid Fault, located from Cairo, Illinois through New Madrid, Missouri to Marked Tree, Arkansas, is predicted to have a strong to major earthquake – between 6.0 and 8.0 - in the next few decades. This event could impact Ann Arbor, at an Intensity Level of V in the modified Mercalli scale that describes earthquake shaking intensity and effects. Intensity V is described as "Felt by nearly

everyone, many awakened. Some dishes, windows, and so on broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop." There is a possibility for this hazard to impact natural gas and petroleum pipelines, as well as water supply mains, which is the most serious concern that the city has about this hazard. If a devastating New Madrid event were to occur, the city might be involved (if needed) in helping evacuees from affected major metropolitan areas, such as Memphis and St. Louis.

Hazard Assessment Ann Arbor should be prepared for an earthquake. However given the low frequency and local impacts of such an event; earthquakes were given a lower ranking in comparison to hazards that could impact the entire Ann Arbor population, and are likely to occur more frequently.

Subsidence

Description Subsidence is the lowering or collapsing of land surface caused by natural or human-induced activities that erode or remove subsurface support (MSP/EMHSD MHA). One major cause of subsidence is mining. The coal basin in Michigan just approaches the northwest corner of Washtenaw County. A recently reported subsidence incident occurred in 1999 in Milan City (Monroe County), and is attributed to a leaking storm sewer; US-23 reportedly sank eight inches over a 30-foot stretch of highway, causing traffic delays for several miles, lasting approximately 10 hours.

Hazard Assessment Given the lack of mining in Ann Arbor and the sparse history of subsidence occurrences impacting people, property and natural resources, this hazard is not ranked.

Past Events There have been very minor subsidence events in Ann Arbor; only one minor event is described below as the most serious event that occurred within the recent past.

Subsidence Event in 2011 A crack in a concrete retention system caused a 40 foot sinkhole to occur on March 23, 2011 in Ann Arbor outside an underground parking structure construction site. The combination of the retention wall, the thawing of the ground and sandy soils could have caused an underground cavity behind the concrete retention system to bubble up vertically to open the hole. Two businesses were closed for the day after the ground opened behind one business in a shared parking lot used by both businesses.

Not Ranked - Shoreline Flooding

Description This hazard refers to flooding and erosion along the shores of the Great Lakes. Ann Arbor does not border a Great Lake; therefore this hazard has not been ranked.

Hazard Assessment Ann Arbor is land-locked and not susceptible to flooding and/or erosion caused by the Great Lakes. This hazard is not ranked.

3.3.2 Technological Hazards

#2 Infrastructure Failures

Description Infrastructure failures are defined as loss of public or private utility infrastructure that causes temporary cessation of essential functions and/or services (MSP/EMHSD). The most recent example of this hazard was the electrical power outage that occurred on August14, 2003, impacting up to 50 million people from New York to Michigan, Toronto to Cleveland. The estimated cost of addressing this event is estimated at $220 million for Michigan alone, according to the Detroit Regional Chamber. Other types of infrastructure failures include: road network (bridges, culverts); water distribution systems; wastewater collection/treatment systems; surface water drainage systems; electrical systems, and telecommunications systems.

Ann Arbor's first responders and emergency management staff are trained to manage such events, by coordinating resources, response organizations and assets, collaborating with Federal and State Officials, and communicating with the public, through broadcast and print media.

Vulnerability Based on past data for Ann Arbor, at least one infrastructure failure is expected each year. Costs for Emergency Protective Measures and loss of productivity were taken from actual figures from the August 2003 blackout. Other estimated costs are loss of power and water for residences, economic loss, power restoration costs, and loss of life.

There are no areas in Ann Arbor that are more at-risk than others. Some buildings house special populations that are dependent on electricity and as a result, these buildings should be equipped with emergency generators: special care facilities hospitals and potentially daycare facilities, senior housing complexes and schools. At a minimum, every community government building, or an alternate building, should be equipped with emergency generators to adequately assist residents and stranded travelers in need during such emergencies.

Hazard Assessment Infrastructure failures have occurred in Ann Arbor, and are expected to occur in the future. The frequency of such events is magnified by other hazards (ice storm, severe winds) that affect the stability of infrastructure. As exemplified by the August 2003 power outage, infrastructure failures have the ability to severely impact the entire city population. This hazard was given a high rank due to the potential population impacted, the geographic area impacted, high frequency and likelihood of occurrence, and the impact on resources with which to respond.

Past Events. Infrastructure failures can occur apart from other hazards; however, it is also common for a failure to result from another hazard, such as an ice storm or severe winds. The probability of an infrastructure failure is based on a comprehensive examination of all events; the event described below is a more serious event that occurred within the recent past.

The 2003 Blackout Ann Arbor experienced a massive electrical power failure on Thursday August 14, 2003 at approximately 4:15 p.m., along with much of the eastern United States, and lasted approximately 16 hours. A local State of Emergency was declared, the Washtenaw County Emergency Operations Center was activated, and much of the community had to significantly reduce or cancel all business activities. Residents in and around Ypsilanti had to boil their water prior to consumption due to low water pressure. However, the City of Ann Arbor did not experience low water pressure. Local governments expended approximately $1.7 Million in the response effort. An additional $4.1Million was lost by local governments on wages and operating revenues. Two homes were destroyed by fire due to candles. One fire resulted in a death.

#4 Structural Fires

Description Structural fires are defined as the uncontrolled burning of any building—residential, agricultural, recreational, institutional, commercial, or industrial (MSP/EMHSD). Structural fires are a common occurrence in Ann Arbor, but a catastrophic structural fire has not occurred in Ann Arbor in recent years (MSP/EMHSD; Washtenaw County Emergency Management). Within a city, it can sometimes be difficult to limit the spread of a major fire to surrounding buildings. Large population centers, like dormitories, apartment buildings, senior housing or special care facilities, schools, large churches, and other buildings that house large numbers of people, tend to be regularly inspected, built with masonry, and have emergency evacuation procedures, reducing the potential for injury and death. Of greater concern are densely populated areas, such as student housing sections in our urban areas, where people live in over-crowded wood-built homes in close proximity to other over- crowded and wood-built homes. Preventing the spread of a fire in this situation could be extremely challenging.

Hazard Assessment For these reasons, the overall hazard ranking for structural fires is fairly high; this hazard has the potential to have a significant impact. Although existing prevention/inspection programs for buildings that hold large numbers of people, and the ability for authorities to respond quickly have limited the impacts of fires in the past, significant events are still known to occur every few years.

Past Events Below are descriptions of the more serious recent structural fire incidents that have occurred in or near Ann Arbor.

Buildings Destroyed by Fire in 2003 On July 24, 2003 four buildings were destroyed by a fire within the city resulting in a significant effort by firefighters.

Apartment Complex Fire in 2006 On March 3, 2006 an apartment complex was heavily damaged by fire. There was one fatality and two others injured. Over 100 people were evacuated by the responding fire fighters.

Historic Ypsilanti Building Destroyed in 2009 A historic building that was under renovation in Ann Arbor's neighboring city of Ypsilanti was destroyed by a large fire on the early morning of September 23, 2009. The building originally housed soldiers during the Civil War and was located in the downtown area known as Depot Town. The fire started on the second floor of the vacant three story building. Firefighters from several Ann Arbor area departments including Ann Arbor, Ypsilanti Township, Pittsfield Township, and Superior Township were at the scene for hours. There were no injuries reported. The fire appeared to be suspicious and was called a setback for plans to revitalize the neighborhood.

Building Fire in 2009 On the night of October 25, 2009 a large fire broke out near the University of Michigan campus near restaurants and bars along a crowded street. Fire crews immediately rushed to the scene and there were up to 55 firefighters actively fighting the fire. The fire became so large that an adjacent apartment building was evacuated due to fear of it spreading, resulting in approximately 600 students being temporarily displaced. Even though police officers had attempted to blockade the sidewalk, the crowds outside remained and onlookers were able to make their way to the scene through a passageway, between buildings across the street. While the fire burned on the west side of the street, the east side of the street remained a bustling night scene.

Fatal House Fire November 2009 Three people were killed in a residential house fire on the City's Westside. The house collapsed and was completely destroyed.

Student Housing Fire April 2010 One student was killed and other seriously burned. Pittsfield Fire Department was called through Mutual Aid to assist with RIT (Rapid Intervention Team, a team of two or more firefighters dedicated solely to search and rescue of other firefighters in distress) and overhaul.

Senior Citizen High Rise Fire August 2008 One Senior citizen was killed and over 50 seniors were displaced when a fire started in an occupied apartment complex for the elderly.

House Fire January 2011 On January 29, 2011 a house was destroyed by fire. There were two fatalities, both of who were trapped inside. Firefighters tried to rescue the victims using thermal imaging cameras.

#5 Hazardous Materials Fixed Site Incidents

Description Hazardous materials incidents (fixed sites) refer to uncontrollable releases of hazardous materials at a facility, which poses a risk to the health, safety, property, and the environment (MSP/EMHSD). The most well-known example of a large-scale fixed-site hazardous materials incident is that which occurred at the Union Carbide plant in Bhopal, India, 1984; this incident caused 2,500 deaths and injuries to many others. Ann Arbor, or any area in the United States, has not experienced an incident on that scale. Smaller-scale incidents-those requiring a response and evacuation or other protective measures-are relatively common.

Between 1993 and 2002, 180 Hazmat incidents occurred in Washtenaw County, with 24 related exposures/injuries.

Between 2008 and 2011, 31 Hazmat incidents have occurred in Washtenaw County and 6 incidents have happened in the first six months of 2012. Of these incidents, 19 were fixed site events.

Washtenaw County has a Local Emergency Planning Committee. This Committee ensures that SARA Title III[1] facilities provide an up-to-date list of on-site chemicals and quantities to response agencies. The Facilities must also have an Emergency Action Plan, which includes employee training on emergency response and evacuation procedures. Facilities are inspected by the Washtenaw County Department of Environmental Health, the Environmental Protection Agency (EPA), Office of Safety and Mission Assurance (OSMA) and the Michigan Department of Environmental Quality (MDEQ). Additionally, the County maintains a database of sites through its Pollution Prevention Program.

SARA Title III refers to facilities that use, store or release chemicals in quantities greater than established thresholds, and can range from manufacturing plants to farming operations. There are 62 known SARA Title III sites in Washtenaw County (page 68).There are approximately eight sites within the City of Ann Arbor.

[1] Section 304 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA Title III) and section 103 of the Comprehensive Environmental Response, Compensation and Liability of 1980 (CERCLA) require that facilities report certain releases of hazardous substances and extremely hazardous substances (EHSs) to the environment if they are about the reportable quantity for that substance. Releases are not reportable if they are "federally permitted." (http://www.michigan.gov)

Pollution Prevention sites are also shown on page 68. Such sites store or manufacture hazardous materials and are monitored and inspected by Washtenaw County Environmental Health. There are over 3,000 of these sites in Washtenaw County.

Vulnerability Based on past data for Ann Arbor, a few hazardous materials fixed site incidents are likely to occur each year. Costs include environmental clean-up, activation of emergency management and HazMat teams, response, deaths and major and minor exposures, evacuations of nearby residents and loss of economic activity. Areas that are more prone to fixed site incidents are those in proximity to a SARA Title III site. The map on page 64 shows an impact zone for existing sites. The radius is increased or decreased for each depending on the type of chemical(s) at the facility. Ann Arbor plans include maps of key community facilities that fall within the impact zone of a SARA Title III Site.

Hazard Assessment Fixed site accidents are a significant hazard to Ann Arbor. Such accidents have occurred in the past, are likely to occur in the future, and have the potential to impact a large population (injury and death) and cause severe damage. This hazard was given a relatively high rank due to the potential impact and occurrence. With Pfizer no longer maintaining labs in the community our incidents of fixed site Hazmat responses have significantly decreased. The University of Michigan campus houses multiple chemicals and labs. The University of Michigan maintains its own hazardous materials response team and generally does not call for assistance unless they are having difficulty containing the material, however a high impact potential must be considered.

Sara III Sites

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Past Events Below are descriptions of more serious hazardous material fixed-site incidents that have occurred in or near Ann Arbor. Most common responses for our municipality include; Natural Gas leaks, Fuel/Gasoline spills, and Mercury spills.

Clandestine chemical facility explodes On the evening of December 7, 1992; a 9-1-1 call was placed from a business in Scio Township reporting an explosion. Firefighters checked emergency plans to make sure the facility had no hazardous materials on the premises, and then entered the building with breathing apparatus to check for fire. In spite of the protective equipment, one of the firefighters began to complain of chest pain and difficulty breathing and that the facility was littered with 55-gallon barrels. Apparently an employee accidentally mixed two incompatible chemicals into a drum, resulting in explosion after he left the workplace. 277 barrels of various hazardous materials were discovered during the clean up. The business was immediately shut down.

Chemical fire On May 18, 1996, the main transformer of a 345-Kilovolt electrical power substation in Salem Township containing poly-chlorinated biphenyls ("PCB's") suddenly exploded, sending flames eighty-feet into the air. Approximately 800 residents who lived downwind of the facility were immediately evacuated until the fire could be extinguished and the toxic smoke cleared. 11,380 cubic yards of contaminated soil and 162,076 gallons of contaminated water and oil had to be removed after the fire was extinguished.

Employees subjected to toxic fumes On the afternoon of January 23, 1997, an employee of a photographic production facility in Scio Township placed a 9-1-1 call. The employee complained of sudden dizziness and nausea. Once responders arrived, it was determined that the entire facility was permeated with toxic solvent fumes, and that these fumes were periodically igniting small, short-lived gas fires in the laboratory. Five employees required medical treatment, and the facility was immediately shut down until it was cleaned and proper ventilation systems could be installed.

Hazardous gases released from plating plant On the evening of May 11, 2003, a chemical accident occurred at a major electroplating facility in the City of Ypsilanti. Fire and HazMat crews arrived to find a large cloud of toxic vapors being released into the air. A Civil Emergency Message was issued to the public through the media directing nearby citizens to "shelter in-place". By 1:00 a.m. HazMat crews were able to activate a shut-off valve to a tank of hydrochloric acid inside the facility, suspected to be responsible for the leak and subsequent vapor cloud. Seven citizens who were near the plant when the release began were treated at a local hospital for inhalation injuries.

#7 Hazardous Materials Transportation Incidents

Description Hazardous materials transportation incidents refer to uncontrollable releases of hazardous materials during transport, which pose a risk to the health, safety, property, and the environment (MSP/EMHSD). Small-scale incidents—those that require a response and implementation of evacuation procedures or other protective actions—are somewhat common in Ann Arbor. Over a 10 year sample period (between 1993 and 2002), 180 Hazmat incidents occurred in Washtenaw County, with 24 related exposures/injuries. Between 2008 and 2011, 31 Hazmat incidents have occurred in Washtenaw County and 6 incidents have happened in the first six months of 2012. Of these incidents, 18 were transportation related.

Vulnerability Based on past data for Ann Arbor, hazardous material transportation incidents are likely to occur each year. Costs include environmental clean-up, activation of emergency management and HazMat teams, response, deaths and major and minor exposures and traffic delays. Incidents have the potential to occur on any roadway in Ann Arbor: highways, avenues, boulevards, public or private streets, or gravel roads. Haulers of hazardous materials more frequently travel major highways and roads (WATS

Model). Such routes therefore have a greater chance of incident occurrence. In Ann Arbor, these routes include Interstate 94 (I-94), US-23, and Michigan State Road 14 (M-14). Nearly every area in Ann Arbor has the potential to be impacted an incident occurring on a Freeway or Secondary Road. It is unknown what materials, what frequency, or what quantities of materials are transported through this area.

The map on page 72 illustrates routes that are more prone to transportation hazards. A one-mile radius around these roads demonstrates that residents and businesses near these roadways are also at risk, as chemical spills on transportation routes can impact the immediate vicinity via land, water or air. However, incidents are not contained to these areas. Also, there are often secondary impacts on the community. For example significant traffic congestion due to closed roadways, traffic congestion may cause additional accidents, and the released chemicals can easily affect the surrounding communities. Railroad lines are also at-risk areas.

Two Railroad lines cross through the center of Ann Arbor, Ann Arbor Railroad and Norfolk Southern. These rail lines primarily transport sand, grain, telephone poles, ether, liquid asphalt, and fertilizer. Ann Arbor does not have the urban density to exclude the city from hazardous materials cargo; however, rarely do these rail lines carry any significantly hazardous materials through the city. All rail lines through the city are currently low speed rail lines.

Hazard Assessment Hazardous materials transportation incidents are a significant hazard to Ann Arbor. Such accidents have occurred in the past, and are likely to occur in the future. To date, responders have been able to manage these incidents; however there is the real possibility for more serious incidents that would have a significant impact on people, property and the environment. This hazard was given a high rank, given the high frequency, potential impact and difficultly with protecting/controlling environments after hazardous material incidents.

Past Events Below are descriptions of more serious hazardous material transportation incidents that have occurred in Ann Arbor.

Chemicals mix after truck crashes In the early morning hours of March 24, 1993, the driver of a tractor/trailer rig fell asleep at the wheel while transporting five different hazardous materials in two trailers. The truck hit two trees, splitting the front trailer open, and forcing the mixture of strong acids and bases which generated a toxic cloud on the freeway. One police officer and two good Samaritans, thinking the gasses were just fog (it was a foggy morning) rushed in to help the driver but soon collapsed from chemical inhalation. The freeway was closed for more than 12 hours during the complicated clean-up, creating chaotic travel conditions for miles around.

State workers injured investigating illegal dumping On June 12, 1996, 13 state and local government workers experienced chemical inhalation injuries in Salem Township when they responded to investigate illegally dumped containers along a roadway. As the employees approached the dumped containers, they noticed an awkward smell and began to feel ill. Many required medical treatment. HazMat crews eventually determined that a company, unwilling to dispose of the hazardous waste properly, dumped several barrels of phenol on the roadside, which leaked and caused the exposures.

Chemicals spilled along freeway On the morning of August 8, 2003, several motorists reported a truck leaking as it drove along westbound I-94 in Pittsfield Township. Within minutes, 8 motorists reported feeling sick after driving on that stretch of freeway.

Fire and HazMat crews determined that the truck was slowly leaking formaldehyde, and that the vapors were making drivers ill after inhalation. The freeway had to be closed during the response and clean-up phase, creating significant traffic congestion on I-94, US-23, and at nearby interchanges.

Transportation Routes Most Vulnerable to Hazardous Materials Accidents

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#8 Dam Failures

Description Dam failures include events from flooding (during a heavy rain), or from structural failures of the dam itself. Such events can result in loss of life, property and natural resources. In Michigan, dams are regulated and classified by the Michigan Department of Environmental Quality (MDEQ) and the Federal Energy Regulatory Commission (FERC). According to MDEQ records, there have been 278 dam failures in Michigan, four (1.4%) of which occurred in Washtenaw County.

The State of Michigan Department of Environmental Quality rated three dams as high-level hazards within the city of Ann Arbor (Argo Dam, Barton Dam, and Geddes Dam). The rating refers to the potential for the dam to impact downstream resources, not the potential for the dam to fail, in accordance with Part 315, Dam Safety. According to the MSP/EMHSD, there is not a strong correlation between the rating and failure. Owners of the dams are required by FERC and PA 451 to have an Emergency Action Plan (EAP), and to coordinate with Emergency Management Officials to ensure consistency with Emergency Operation Plans. The City also owns and operates a dam in Ypsilanti (Superior Dam).

Hazard Assessment Dam failures can occur without warning and can have a devastating impact on human life, property and natural resources. This hazard received lower ranking due to the number of past incidents, and the requirements for dam owners to have Action Plans and be in communication with the Emergency Management Officials, which reduces the potential for a hazard event.

Past Events

1968 Argo and Geddes dam failures Excessive flooding caused failure of the dams at Argo and Geddes. There was no loss of life or injury as a result of the failure. The dams were rebuilt by 1972.

#10 Civil Disturbances

Description Civil disturbances are events that involve a gathering of a large number of people, which presents the potential for rioting, looting, or other unlawful behavior. Civil disturbances can be due to a public event, like a basketball game, or political rallies and demonstrations. Riots inspired by demonstrations or football and basketball games have the potential to involve a great number of people–active participants as well as people and property in the surrounding area.

The City of Ann Arbor is the area where such civil disturbances are most likely to occur. Ann Arbor has a college, The University of Michigan, with sports teams that have the potential to ignite a riot. It is also the largest population center in the area, and therefore most likely to be selected by demonstrators. During the 1960s and 1970s, there was some level of civil unrest with the student population. Crowds also became unruly during the Gus Macker basketball tournament in the 1980's, but no riots ensued. The City of Ann Arbor has experienced riots due to sporting events, and some demonstrations have caused damage to property.

Communication between the Police Departments prior to potential events is the in-place measure for this hazard. Prison uprisings are another type of civil disturbance. The State Correctional Facility and mental hospital are also potential places where civil disturbances may occur. In Washtenaw County, there are five facilities where such uprisings may occur:

1. Michigan Department of Correction Facilities Huron Valley Correction Facility, Pittsfield Township
2. Federal Correction Institute, York Township
3. State Forensic Center, York Township
4. Cassidy Lake Special Alternative Incarceration Camp, Lyndon Township
5. Washtenaw County Jail, Pittsfield Township

Generally, prison uprisings are contained to the facility and would be of concern for Pittsfield Township, Lyndon Township and York Township.

Hazard Assessment. The overall hazard ranking for civil disturbances is low; civil disturbances are not considered a significant threat based on past occurrence, the predictability of an occurrence, and the ability for authorities to respond quickly.

Past Events Below is the description of a more serious civil disturbance incident that occurred in Ann Arbor.

Civil Disturbance of 1969 The night of June 17, 1969, ranks as one of the most contentious and frightening moments in Ann Arbor's existence, from the violence of the South University Avenue riot. Police from five agencies used tear gas and night sticks to twice clear the street of more than 1,000 people making 47 arrests in the process. The conflict began the night before partly out of an interest in creating a pedestrian mall or People's Park on the street, which some called "the liberation" of South University Avenue. The unruly crowd blocked cars, threw rocks and yelled obscenities at police who braced for a confrontation as the University of Michigan President Robben Fleming pleaded for restraint on both sides.

#11 Transportation Accidents: Air and Land

Description Transportation accidents involve crashes or accidents involving air and land transportation (MSP/EMHSD). Each type is detailed below. Because such accidents are likely to occur in the future and have the potential to significantly impact large population (injury and death), severe damage to property and natural resources, this hazard was given a high ranking. Transportation routes for rail and commercial vehicles and airports and fields are discussed in Section 2.4.

Land-Based Accidents While Ann Arbor is not listed on State's "Recent Passenger Transportation Accidents in Michigan" list; Interstate 94 (I-94) is a certified intercity carrier offering regular route service to passenger, charter, commuter and special bus service (MSP). The safety record for certified routes is excellent, yet the potential for accidents is high, especially when unpredictable weather patterns (e.g. fog, blizzard) common to Michigan are taken into account.

Air-Based Accidents Air travel over Ann Arbor is common, with the Willow Run airport located on the eastern portion of the County, Detroit Metro Airport in neighboring Wayne County, and several private facilities located throughout the County. Statistics indicate that 75% of airline crashes occur during flight take-offs or landings, and therefore the population immediately surrounding airports are most at-risk. However, 25% of the incidents may not occur within a predictable flight path, placing all sectors of the County population at risk.

Hazard Assessment Ann Arbor's concern with regard to land and air transportation hazards is for multiple accidents involving significant injuries and death to occur at the same time, stretching resources and capability of local emergency responders.

Although this hazard has the potential to significantly impact the population, environment and economy, the ranking is lower than other hazards due to frequency of past occurrences, and limitations on the geographic area impacted.

#12 Public Health Emergencies

Description Public Health Emergencies are defined as those that involve a widespread and/or severe epidemic, incident of contamination, or other situation that presents a danger to or otherwise negatively impacts the general health and well-being of the public (MSP/EMHSD). SARS, West Nile, pandemic Flu, waterborne disease outbreak, and septic system failures are examples of public health emergencies that are of concern for Ann Arbor residents.

Ann Arbor has an Emergency Operations Plan. The Plan includes specific guidelines and policies that the Ann Arbor Department of Public Health has implemented to reduce the potential for an emergency situation. These are similar to programs following an act of bio-terrorism, as these attacks could cause a public health emergency. Such programs include continual surveillance of reportable diseases, prevention and control (vaccinations, quarantines), and mutual aid agreements to provide additional emergency resources. The City of Ann Arbor's water treatment plant continually monitors the source and finished water for indicators of disease causing organisms. The Public Health department is also actively pursuing an educational campaign to keep the public informed about what to do in the event to of a public health emergency.

Hazard Assessment Public Health Emergencies are difficult to rank, given recent acts of terrorism, and recent outbreaks like SARS. Those kinds of Hazards have the potential to impact the entire Ann Arbor population – either through injury, illness or death. Compared to other hazards that have the same potential impacts (tornadoes, infrastructure failures), the frequency of this hazard is less and therefore it received a lower ranking.

#13Sabotage and Terrorism

Description Sabotage/Terrorism is defined as an intentional, unlawful use of force, violence or subversion against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political, social or religious objectives (MSP/EMHSD).

There are several Washtenaw County departments and committees actively involved with Preparedness Planning for Homeland Security:

- The Washtenaw County Homeland Security Task Force coordinates terrorism preparedness and response activities with all response organizations and provides direction for local Department of Homeland Security preparedness grant projects.
- The Washtenaw County E.M.S. Commission Bio-terrorism Committee coordinates biological terrorism preparedness with public health officials, local and regional health care facilities, first responders and volunteer groups; and has developed a local Bio-terrorism response plan
- The Washtenaw-Livingston Medical Control Board develops E.M.S. responseprotocols, including procedures for poisoning and provision of emergency field drug supplies.
- The Local Emergency Planning Committee reviews emergency response plans for chemical facilities that use, produce, or store significant quantities of Extremely Hazardous Substances.
- The Washtenaw County Hazardous Materials Team routinely trains on response to hazardous terrorist events and is available

24-hours a day; in 2001, the team responded to 20 suspicious package incidents.

Additionally, Washtenaw County has created an internal Homeland Security committee to enhance policies, procedures, communications and employee safety. Several projects are underway to make the government more resilient during times of international, national, state and local crisis situations.

Hazard Assessment Sabotage and Terrorism is difficult to rank due to the uncertainly of the type of attack, location(s), and lack of warning. Past events in Ann Arbor have not occurred. One assumption is that such attacks would be targeted at population centers or specific government, transportation, or industrial facilities. While this hazard is certainly of concern given the level of uncertainty, its rare occurrence within Michigan has meant that it received a lower ranking.

#14 Petroleum and Natural Gas Pipeline Accidents

Description Pipeline accidents are an uncontrolled release of petroleum, natural gas, or the poisonous by-product of hydrogen sulfide, from a pipeline (MSP/EMHSD). There are several major gas pipelines and petroleum lines running through Ann Arbor.

There are no reported incidents of pipeline accidents occurring within Ann Arbor. Contiguous area counties—Jackson, Livingston, Oakland and Wayne—have experienced one or more significant events within recent years. The worst of these happened in Jackson County, in 2000, when a gas pipeline rupture released 75,000 gallons of gas, and caused the evacuation of 500 homes within a mile radius for five days, caused a drop in pressure felt as far as Joliet, Illinois, as well as significant damage to the environment. It should also be noted that Michigan's Southern Lower Peninsula recently suffered the largest inland U.S. oil spill, with the break of the Enbridge Petroleum Pipeline in 2010, just one county west of Jackson. Therefore, despite Ann Arbor's fine record, the potential for loss of life, property and natural resources, and the potential response and recovery costs are considered significant.

Hazard Assessment Of the 90 investigations of incidents performed by the Michigan Public Service Commission (MPSC) since 1996, at least 50% have resulted in injuries, death or significant property damage. In addition, these types of incidents are increasing due to the increasing age of the pipelines and the prevalence of construction activities (MSP/EMHSD). This hazard therefore received an intermediate ranking, given the low frequency of past local occurrences, but also taking into consideration the likelihood of future occurrences.

#15 Nuclear Power Plant Accidents

Description Nuclear power plant accidents refer to the release of radioactive material at a commercial power plant or nuclear facility, in sufficient quantity to constitute a threat to the health and safety of the off-site population (MSP/EMHSD Pub 103). Examples of nuclear power accidents include Chernobyl, Ukraine in 1988, and Three-Mile Island, Pennsylvania, in 1979.

There are three commercial nuclear power plants in Michigan:

- The Enrico Fermi-2 plant, Monroe
- Donald C. Cook plant, Bridgman
- Palisades plant, South Haven

In addition, the University of Michigan's Cyclotron and Reactor is located in the City of Ann Arbor. This facility is considered a very small nuclear testing and research facility and is likely to be removed in the future. The security of the Enrico Fermi-2 plant is the shared responsibility of the Enrico Fermi facility, DTE Energy, the U.S. Department of Energy, and the U.S. Department of Homeland Security.

Hazard Assessment The Enrico Fermi-2 plant is located approximately 20 miles southeast of Washtenaw County's border. Ann Arbor is within the plant's secondary Emergency Planning Zone (EPZ), a 50-mile buffer (page 79) The secondary buffer refers to the area where contamination has the potential to infiltrate the food chain. Given the lack of historical occurrences of this hazard in Michigan, the limited likelihood of occurring in the future, and the fairly distant location within the secondary EPZ, this hazard received a lower ranking relative to other hazards.

City of Ann Arbor: Water Treatment Facilities, 2004

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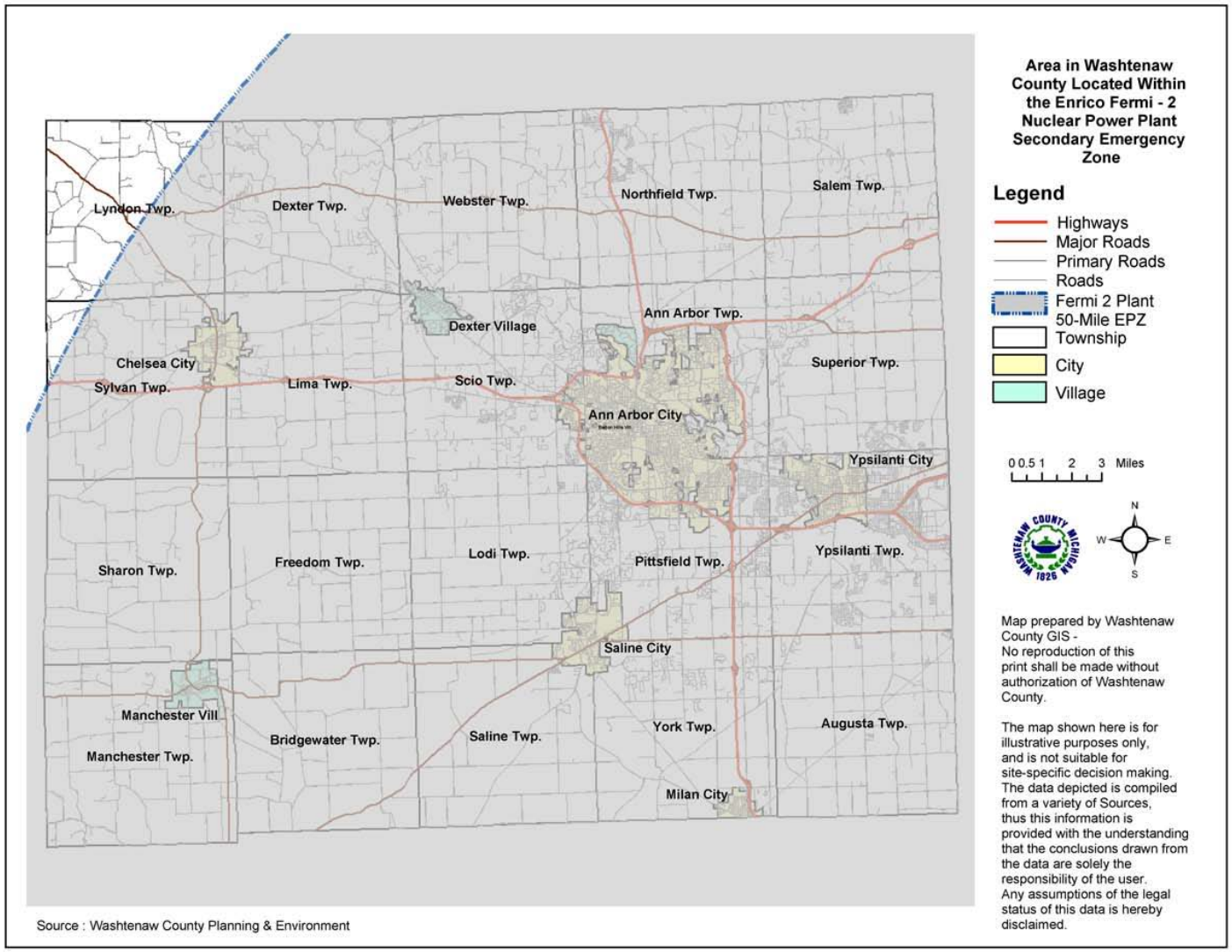
City of Ann Arbor



#17 Oil and Natural Gas Well Incidents

Description Oil and natural gas well incidents refer to uncontrolled releases of oil or natural gas, or the poisonous by-product hydrogen sulfide, from production wells (MSP/EMHSD). Incidents may also include explosions of these substances, at such sites. A total of 216 wells are reported for Washtenaw County (MDEQ, Geological Survey Division). Compression stations and well fields are located within Ann Arbor and are mapped by the MDEQ on the Washtenaw County map here:
http://www.dnr.state.mi.us/spatialdatalibrary/pdf_maps/mineral_lease_information/washtenaw_lease_information.pdf

The oil and gas industry is highly regulated by the Michigan Department of Environmental Quality (MDEQ). The MDEQ is known to have an excellent spill response plan and sound storage and containment regulations (STRONGER Report, 2003). MDEQ regulations also require buffer zones around wells, compressors, treatment and storage facilities and the like.

Hazard Assessment The potential impact of this hazard on human life, property and natural resources is great in the immediate area of the sites where well are located. However, this hazard received a lower ranking than others due to low frequency; no incidents or even "false alarms" have been reported in at least ten years.

#18 Nuclear Attack

Description A nuclear attack is a hostile attack against the United States through the use of nuclear weapons (MSP/EMHSD). Target areas in Michigan have been identified as commercial power plants, chemical facilities, counter force military installations, other military bases, military support industries, refineries, and political centers (EMD-PUB 207). Given the proximity to the City of Detroit, Ann Arbor is at-risk to an attack.

The Ann Arbor Emergency Management Division has nuclear attack procedures that were tested during the cold war. Washtenaw County has a supply of Geiger counters ready for deployment, and, HazMat members and other officials have been trained in radiological monitoring. Responses include ability to warn residents, evacuate residents to appropriate shelters, and communicate the time when people may emerge from shelters, and plan for provision of food and shelter under post-attack conditions.

Hazard Assessment The occurrence of this hazard would be exceedingly devastating to the entire city population. Nuclear attacks are significant threats, given immediate impact as well as the long-term impact on human life and the food chain. This hazard is ranked low because it is more effectively addressed through national-level foreign and defense policies.

#21 Scrap Tire Facility Fires

Description Scrap tire fires are large fires that burn scrap tires being stored for recycling or reuse (MSP/EMHSD). Fires due to scrap tire facilities are a hazard for Ann Arbor. The uncontrolled burning of tires requires significant resources to extinguish the fire, and there are high costs associated with managing the fire. Environmental damage occurs in the form of air pollution, and soil and water pollution, as the heat reduces the tires to an oily residue that leaches into the soil and water channels.

A threshold has not been established to determine what quantity of tires will become a hazard in the event of a fire. Much of this is related to weather pattern, adjacent uses, ability of Fire Department to respond, and other factors. Examples of significant scrap tire fires that occurred in the State of Michigan range from burnings of 10,000 tires out of a pile of 350,000 tires, to over one million tires.

According to the Michigan Department of Environmental Quality, (Map of Regulated/Registered Outdoor Scrap Tire Collection Sites - May 2012, http://www.michigan.gov/documents/deq/deq-whm-stsw-scraptiresites_230376_7.pdf) there are no major scrap tire collection sites in Washtenaw County.

Hazard Assessment Given the amount of tires located in the facilities, the low frequency of past occurrences, the likelihood of future occurrences, and the ability of local Fire Departments to respond, this hazard was ranked low.

#22 Pest Infestation of Trees

Description Infestations by insects and/or diseases is one of the biggest threats to trees. Infestations damage can range from the loss of branches to the complete death of the tree. Dead trees and large dead limbs are hazards to the community

Hazard Assessment: There are a number of pest infestations that have or may impact the tree's in the city, including:

- Emerald Ash Borer Emerald Ash Borer (EAB) is an exotic wood boring beetle that was discovered in southeast Michigan in 2002. The beetle destroys the water and nutrient-carrying vessels, causing an infested tree to die within 2 to 3 years of infestation. Ann Arbor has removed nearly all publicly managed ash trees along streets and in mowed areas of parks; however dead ash trees still remain standing in city-managed natural areas. Washtenaw County is in a Federal Quarantine area which prohibits the transport of firewood (a vector for the spread of EAB) and the sale of ash trees at nursery and garden centers.

- Gypsy Moth Caterpillar Gypsy moth are present throughout Michigan. The insect has four life stages: egg mass, caterpillar, pupa and moth. It is only in the caterpillar state of the gypsy moth life cycle that is destructive and a potential health concern. The caterpillars are serious tree defoliators; feeding on leaves of several hardwood trees including, oak, birch, basswood, apple and aspen. While healthy trees can usually withstand one or two defoliations without suffering permanent damage, older, diseased or stressed trees may not.

- Dutch Elm Disease Dutch Elm Disease is vascular disease of primarily American Elms. Trees are infected with the disease from elm bark beetles that carry the spores from diseased trees to healthy ones. The disease begins by killing branches but eventually the whole tree can succumb to the disease. Dutch elm disease began killing elm trees in Ann Arbor in the 1960's. Today, the city manages about 540 American elms larger than 8" in diameter. The average size of these trees is 20" DBH. Dutch elm disease still threatens the remaining elms and the city loses several dozen each year.

- Asian Longhorned Beetle Asian Longhorned beetle (ALB) is wood-boring beetle that infests hardwood trees, particularly maple, birch, horse-chestnut, willow and elm. ALB has not been found in Michigan but it has been detected in New York, New Jersey, Illinois (eradicated), Massachusetts, Canada and in 2011 in Ohio. Ann Arbor's publicly-managed tree population is nearly 40% maple (Acer) and an serious infestation of ALB could cause the death of many trees.

More than 400 species of non-native insects and diseases are established in the United States. These non-native pests arrive in shipping containers and other international commerce. The port of entry for most of these pests is northeastern and north central

cities, like Detroit and Ann Arbor. With the global nature of the economy it is not a question of whether another insect/disease will create a serious infestation of Ann Arbor's trees, but when.

4.0 Hazard Goals, Objectives and Strategies

The following sections present goals and strategies by hazard. Page 21 presents the City of Ann Arbor assets and critical facilities and page 92 presents the Hazards. These may be referred to in the following sections. The goals and strategies are not an inclusive list; rather the goals and strategies are those are that the City is focusing on at this time.

The repetition of strategies reflects the need for their implementation, not the duplication of services. For example, distribution of educational materials should not be performed several times, throughout the year per hazard, rather one mailing regarding family preparedness kits would address all hazards for which this strategy is listed. See Family Preparedness Kit below.

Family Preparedness Kits

1. Have Emergency Supplies at the ready:
   - A three-day supply of water one gallon/person/day and food that won't spoil
   - One change of clothing, footwear, and blanket/sleeping bag per person
   - First aid kit including family prescription medications
   - Tools: flashlight, battery-powered radio and extra batteries
   - Extra car keys, credit cards, cash or travelers checks
   - Sanitation supplies
   - Special items for infant, elderly or disabled family members
   - Extra pair of glasses
   - Locate the fuse box water service main and natural gas main and learn how to turn on and off.
2. Create a disaster plan where to meet, contact numbers, who will take care of the family pet, take first aid, learn how to use a fire extinguisher, etc.
3. Practice the Plan and maintain supplies! If having electric power is extremely important to you, consider having a qualified electrician install an emergency generator before a disaster strikes!

For more information, see FEMA website at http://www.fema.gov/pdf/library/yfdp.pdf

4.1 Goals, Objectives, and Strategies That Are Not Hazard-Specific

Goal: Integrate the implementation of hazard mitigation strategies into planning processes and regulatory measures.

Mitigation Strategy: Plans
Modify master plans to include hazard mitigation strategies.

Goal 1: Set up an interdepartmental committee/taskforce charged with the review of planning documents with respect to hazard mitigation; if an appropriate committee/taskforce already exists assign this to said committee/taskforce.

Goal 2: Develop a list of changes and revisions that can be made to include hazard mitigation strategies in the City's land use plans.

Goal 3: the City's planning area plans are reviewed, revised, and updated, assure that the list is considered and changes are made.

Mitigation Strategy: Regulatory
Utilize legislative bodies and regulatory commissions to implement hazard mitigation strategies.

Goal 1: Inform commissions and planning committees of hazard mitigation strategies.

Goal 2: Apply hazard mitigation strategies to development, zoning, and policy decisions when applicable.

Mitigation Strategy: Zoning
Modify zoning to reflect hazard mitigation strategies, update flood plain boundaries, and inform development policy.

Goal 1: Assign city staff with the task of seeking out opportunities to use zoning as a tool for hazard mitigation.

Goal 2: Review flood plain boundaries and policy recommendations with respect to zoning and mitigation strategies.

Mitigation Strategy: Plan Implementation
Secure grant funding and line item budgeting for hazard mitigation planning to assure the implementation of the strategies included herein.

Goal: Provide the Emergency Management Team and the City's first responders with access to current information and technological support.

Mitigation Strategy: Technology
Supply the Emergency Management Team, and first responders such as Police officials, and Fire officials with current technology and staffing to maintain up to data and information necessary to prevent and predict potential hazard events.

Goal: Train appropriate staff on ways to implement hazard mitigation strategies into their departmental activities and services provided.

Mitigation Strategy: Technology - Public Warning, Public Information
Increase and enhance the use of the CodeRED Reverse 911 system to integrate information with text, email, social media, and the City website, in addition to cell and landline voice.

Goal 1: Create marketing program to encourage citizen signup using not only landline telephone, but also cell with carrier, and email. Also, encourage citizens to create an account for self management.

Goal 2: Begin using CodeRED for non-emergency notifications such as street closures, accident notifications, crime reports, and other pertinent community information. Develop and market the program, integrate with appropriate City departments, provide training and

management.

Goal 3: Develop and market use of the CodeRED application for iPhone and Android devices, for citizen access, and for use at special events and sporting events. Develop mapping protocols for the application.

Goal 4: Explore the use of CodeRED for integration with the National Weather Service notifications and IPAWS, for more seamless weather alerts.

Goal 5: Enhance CodeRED notifications with the City of Ann Arbor's public information tools, including social media sites, e-mail notifications, the City website, and Community Television Network government cable channel programming.

Mitigation Strategy - Address Language Barriers

Goal: Continue development - Limited English Proficiency program (LEP) The City is committed to making its services, programs and activities available to everyone, regardless of language barriers. As residents, workers, and visitors who contribute to the quality of life in the City, LEP individuals are entitled to meaningful access to City services. As a recipient of federal funds, the City is required by federal law to plan for, and provide LEP individuals with meaningful access to City services, programs and activities. The City's LEP Plan has been prepared in accordance with Title VI of the Civil Rights Act of 1964, 42 U.S.C. §2000d et seq., and its implementing regulations, which state that no individual shall be subjected to discrimination on the basis of race, color, or national origin. Executive Order 13166, titled *Improving Access to Services for Individuals with Limited English Proficiency*, indicates that differing treatment, based upon an individual's inability to speak, read, write, or understand English, is a type of national origin discrimination. It directs Federal agencies to publish guidance for its respective recipients, clarifying their obligation to ensure that such discrimination does not take place. This Executive Order applies to all state and local agencies that receive federal funds, including all City service areas receiving federal funds.

Mitigation Strategy: Enhance Internal Callout for Special Teams and Groups
Enhance the use of CodeRED for internal notifications for team callouts such as Metro SWAT, and special groups such as EOC staff.

Goal 1: Have all first responders in the City, and those associated with cross jurisdictional teams, sign up for CodeRED notifications using multiple telephone numbers, text, and email. Utilize a special sign-up page for responders and staff that will allow the creation of an account for self-management.

Goal 2: Develop protocols for team callout and notifications using multiple methods.

Goal 3: Promote the use of Quick Text application in CodeRED, develop protocols and standardized messages.

Goal 4: Train the 911Center dispatchers and other appropriate City departments on use of the system.

Mitigation Strategy: Training
Hold annual and semiannual training events for all departments and staff integral to effective hazard response and prevention.

Use these training events to review progress made in the implementation of hazard mitigation strategies. Also schedule awareness training for the City Council, the Planning and Environmental Commissions, and the Environmental and Emergency Management Teams.

Mitigation Strategy: Incident Command, National Incident Management System
Training in NIMS has been ongoing within city agencies over the past several years. Current required NIMS compliancy is above the 90th percentile. This training will continue, will be incorporated into local plans, and be part of drills and exercises in order to provide an effective management structure in the event of emergencies or disasters.

Mitigation Strategy: Technology – Infrastructure Resilience
Enhance the availability of critical technology infrastructure shared by the City of Ann Arbor and Washtenaw County, including primary and secondary data centers and common technology.

Goal 1: Provide a common platform for data recovery.

Goal 2: Develop a shared technology recovery plan that provides access to critical systems in case of a primary data center failure.

Goal 3: Develop processes that automatically notify support staff of critical infrastructure failures.

Goal 4: Develop a critical technology infrastructure replacement plan, including identification of necessary funding, ensuring the planned replacement of critical technology infrastructure.

Mitigation Strategy: Technology – Government Facility Security
Enhance accessibility and controls around access to local government facilities.

Goal 1: Standardize the method of secure access to City facilities (such as proximity cards), ensuring interoperability between City and County physical security systems.

Goal 2: Develop a set of common access groups that allows key first responders and critical staff access to local government facilities, regardless of which local government their proximity card is issued through.

Goal 3: Develop a common training program so that staff from the City and County can operate each other's security systems.

NOTE: Additional detail about specific hazard mitigation activities will appear in a later section of this document.

The City of Ann Arbor Flood Mitigation Plan presented an extensive list of different mitigation strategies and activities that work toward achieving the plan's goals. The strategies in the plan can be used as guidelines for residents and developers in approaching properties in the Floodplain. They also can help to inform the City's decision makers on responsible uses of properties with a high flood risk. They have been carried forward into this current plan, and re-evaluated for appropriateness in 2012.

The adoption of the flood plan by Ann Arbor City Council alone did not itself affect flood mitigation in the City. The various technology improvements, code changes, regulatory changes, physical landscape changes, emergency preparations, infrastructure developments, and educational programs needed additional steps to be implemented. To become Ann Arbor City policy, the mitigation projects require integration into the City's development processes. To achieve corrective actions in the physical landscape, the city needs to be ready to assist residents who voluntarily pursue these actions, and be prepared to initiate projects as opportunities become available.

The implementation of flood mitigation planning would be difficult without a formalized process for oversight. For this reason, the planning team recommended that the responsibility of implementation be attached to two specific positions in the Systems Planning Unit of Public Services.

- **Storm Water and Floodplain Programs Coordinator (SWFPC)** – this is a newly created position responsible for stormwater management, floodplain management, and natural features planning.
- **The Water Quality Manager (WQM) –** this is a newly created position responsible for handling issues relating to water resource protection and preservation.

These two positions coordinate the implementation with all staff and departments that are affected by issues relating to floodplain management, including but not limited to: NFIP reporting and compliance, building, planning, infrastructure, engineering, and emergency management.

Further, the SWFPC and WQM are responsible for coordinating the implementation with the City of Ann Arbor Planning Commission. The Planning Commission can provide direction in the prioritization of the mitigation strategies and offer a critical opportunity to continue the public engagement process throughout implementation. The SWFPC and WQM can also look to the Environmental Commission and City Council for oversight.

Each of the projects suggested in the flood mitigation plan were placed into an implementation schedule. This schedule aimed to suggest a timeframe in which each project should be approached and completed (Columns A-E in the tables that follow). The SWFPC and the WQM are responsible for the maintenance and revision of the schedule. The SWFPC and the WQM should revise the schedule, as needed, based on *proactive opportunities* and *reactive opportunities*.

- Proactive opportunities: Staff creates opportunities to implement the projects. The committee meets regularly to discuss current projects and to plan for projects that staff had included on the annual agenda.

- Reactive opportunities: Staff stays current on development proposals, planning processes, and outreach campaigns, and looks for opportunities to implement projects based on "unplanned" opportunities.

The schedule is broken into columns A-E, to suggest a timeframe for task completion. The mitigation strategies were placed in different categories primarily on the basis of difficulty.

- Column A – "Low hanging fruit," able to be implemented immediately. Roughly Year 1.

- Column B – Item with slight difficulty or research involved. To be implemented as column A is nearing completion. Roughly Year 2.
- Column C – Difficult project with research component. To be implemented as column A-B are nearing completion. Roughly Year 3.
- Column D – Difficult project with research component. May build on the completion of other mitigation projects. To be implemented as column A-C are nearing completion. Roughly Year 4.
- Column E – Difficult project with research component. May build on the completion of other mitigation projects. To be implemented as column A-D are nearing completion. Roughly Year 5.

Flood Mitigation Plan: Implementation Schedule

Project #	Project Title	Page #	A	B	C	D	E	$ Labor	$ Other
1	Detailed Hydrologic Data.	39						$100,000	Technology
2	Map Additional Flood Related Hazards	39						$110,000	None
3	Use Future Conditions Hydrology for Flood Mapping	40						$100,000	None
4	Use Future Condition Hydrology for City Plans and Regs	40						$50,000	None
5	Improve Flood Maps on City Website	41						$20,000	None
6	Flood Information Links on City Website	42						$5,000	None
7	Public Information Campaign	42						$80,000	Production
8	Make Information Available at the Public Library	43						$5,000	None
9	Flood Protection Advice	43						$10,000	None
10	Flood Hazard Training and Education	43						$10,000	Staff Time
11	CFM Employment Criteria	44						$6,000	Per Person
12	Educating Decision Makers	44						$10,000	None
13	Environmental and Safety Education Program	45						$50,000	None
14	Floodplain Overlay Zoning District	46						$210,000	None
15	Detailed Flood Loss Model	48						$100,000	None
16	Multi-Objective Management Planning	48						$10,000	
17	Additional Freeboard	50						$30,000	None
18	Floodplain Foundation Certification	50						$30,000	None
19	Cumulative Improvement Standard	51						$20,000	None
20	Lower Threshold Improvement Standard	52						$20,000	None
21	Addition Improvement Standard	52						$10,000	None
22	Flood Fringe Limits	52						$10,000	None
23	Equivalent Compensation	53						$20,000	None
24	Green Infrastructure	53						$40,000	None
25	Freestanding Structures and Obstructions	54						$105,000	None
26	Prohibit Floodway Development	55						$10,000	None
27	Drain Setbacks	55						$20,000	None
28	Stream Buffer Zones	56						$30,000	None
29	Floodplain Open Space Dedication	57						$30,000	None
30	Greenway Open Space Dedication	57						$30,000	None
31	Floodplain PDR and TDR	58						$30,000	None
32	Code Enforcement	60						$70,000	None
33	Relocation	61						TBD	TBD
34	Acquisition	61						TBD	TBD
35	Elevation	62						TBD	TBD
36	Barriers	62						TBD	TBD
37	Dry Flood Proofing	62						TBD	TBD
38	Wet Flood Proofing	63						TBD	TBD
39	Floodplain Monitoring Program	63						$50,000	Ongoing
40	Environmental Remediation	64						TBD	TBD
41	Public Buildings - Flood Audit & Flood Insurance	65						$60,000	None
42	Critical facilities – Flood Audit and Emergency Action Plans	65						$100,000	None
43	Critical facilities – Higher standards for new critical facilities	66						$110,000	None
44	Open Space Creation	67						$250,000	Land&Cstr.
45	Flood Preparedness Plan	68						$190,000	None
46	Watershed Management Planning - Huron	70						TBD	None
47	Huron River Impoundment Study	70						TBD	None
48	Watershed Management Planning - Newport	70						TBD	None
49	Watershed Management Planning – Traver	70						TBD	None
50	Historic District Preservation	70						TBD	None
51	Railroad Berm Fill Removal	70						TBD	None
52	Watershed Management Planning - Allen	71						TBD	None
53	Downtown City Owned Sites	71						TBD	None
54	Watershed Management Planning - Mallets	71						TBD	None
55	Watershed Management Planning - Millers	71						TBD	None
56	Watershed Management Planning - Swift	71						TBD	None
	Totals							$2,141,000	

On May 1, 2007, the City Planning Commission approved a resolution (Attachment 4) directing the city staff to work with a subcommittee on the development of a floodplain management ordinance and to pursue Project #51 (Allen Creek Railroad Berm Opening Feasibility Study). The resolution became the guiding document for city staff in prioritizing mitigation activity.

Flood Mitigation Efforts (Since March 2007)

Structures Removed from the Floodplain (Since 2007)

Address	Building Description	Removed by	Flooding Source	Flood Zone	Date Removed
406 Maple Ridge St.	Single Family Residence	City of Ann Arbor - Public Services	West Park-Miller Drain (North)	AE/Floodway	June-08
3432 Platt Rd.	Single Family Residence	City of Ann Arbor - Public Services	Swift Run Drain	A	June-08
841 Broadway St.	Light Industrial/Office	Mich Con Gas Co.	Huron River	AE/Floodway	January-10
219 Chapin	Two Family Residence	City of Ann Arbor - Parks Dept.	West Park-Miller Drain	AE	July-12
219 W. Kingsley St.	Single Family Residence	City of Ann Arbor - Systems Planning Unit	Allen Creek	AE/Floodway	August-12

An issue that affected the SWFPC and the WQM's ability to implement the flood plan was funding availability. The good news is that the City had earned eligibility to receive hazard mitigation project funds through the State of Michigan and FEMA, as a result of its hazard mitigation planning activities. Although this is not the only means of hazard mitigation available, and the City of Ann Arbor needs to consider all funding possibilities, the ability to access federal funds for hazard mitigation projects is considered vitally important. The development of a new, all-hazard mitigation plan for the city during 2011 and 2012 is an essential part of remaining grant-eligible. Three fund-related activities should be considered the responsibility of the SWFPC and the WQM to coordinate with staff: *Grant writing*, *capital improvement plan participation*, and *budget participation*.

- Grant writing – FMAC should actively research grant opportunities that coincide with projects on the implementation schedule.
- Capital improvement plan participation – FMAC should participate in the capital improvement planning process, and should outline flood mitigation projects to include in the City's capital improvement plan.
- Budget participation – FMAC should participate in the City budget drafting and approval process. There may be some projects that should be included in the annual budget, whether as a line item or within a specific department.

Through participation in these processes, the SWFPC and the WQM can achieve planned funding for the implementation schedule and reduce the difficulties involved in "opportunistic" implementation (based upon the sudden availability or awareness of funding sources).

The SWFPC and the WQM will be responsible for the monitoring of the plan. The monitoring should consist of three elements: *Plan updating*, *project evaluation*, and *annual reporting*.

- Plan updating – Some circumstances will require updating of this plan. For instance, when map amendments are filed with the City, the plan should be updated to reflect the changes. Further, when new NFIP claims are made, those structures will become higher priority.

- Project evaluation – As projects are completed, an evaluation should be completed and then considered this plan for future updates of this plan.
- Annual reporting – Staff should prepare an annual progress report and presentation. This report should be submitted to the Environmental Commission, Planning Commission, and City Council for review.

The completion of these three tasks will help assure the successful implementation of the projects contained in the plan. Keeping the plan current through updates, evaluating the success of projects as they are completed, and reporting on progress to decision makers will assure that the goals are realized during the implementation process.

The Flood Mitigation Plan was funded in part by a Federal Emergency Management Agency (FEMA) Flood Mitigation Assistance Planning Grant in 2007 that was administered by the Michigan State Police Emergency Management and Homeland Security Division. The City of Ann Arbor Flood Mitigation Plan can be found at:

http://www.a2gov.org/government/publicservices/systems_planning/waterresources/floodplains/Pages/default.aspx or http://www.a2gov.org/government/publicservices/systems_planning/waterresources/Documents/Floodplains/FloodplanMitigationPlan_Mar07.pdf

City of Ann Arbor: Hazards and Sirens, 2004

Emergency Response Plans, Risk Planning, Threat Assessment and Domestic Preparedness strategies contained in this document are part of the City of Ann Arbor's on-going security measures for the safety of its employees and the public and are exempt from disclosure under the Michigan Freedom of Information Act (MCLA 15.243(1)(u)and 15.243(1)(y) and the Michigan Anti-Terrorism Act (MCL 750.543k).

4.2 Hazard-Specific Goals, Objectives and Strategies

Risk #1 - Convective Weather

Goal:
Ensure rapid notification to residents in the event of a convective weather hazard event.

Mitigation Strategy: Early Warning
Periodically review the city's siren coverage and other warning systems to assure that residents are notified advance of potential events. Utilize NOAA Weather Radio coverage. There are currently 22 warning sirens in the City of Ann Arbor that reach 100% of the citizens.

Mitigation Strategy: Technology
Evaluate new technology (like effective call-down systems) as it becomes available, to assure that the most effective notification systems are in place.

Mitigation Strategy: Tree Maintenance
Work with Ann Arbor Forestry Operations to assure that there is tree removal, limb trimming and removal, replacement, and maintenance.

Mitigation Strategy: Education
Distribution of public education materials, such as flyers regarding Family Emergency Preparedness Information or website links.

Mitigation Strategy: Manufactured Home Protection Proper anchors for Manufactured Home Units, and shelters for Manufactured Home Communities.

Risk # 2 - Infrastructure Failures

Goal:
Minimize the City's vulnerability to infrastructure failures and the potential impacts such failures could have on City residents.

Mitigation Strategy: Dams
Maintain dams as described in Federal and State regulations.

Mitigation Strategy: Protection of Critical Infrastructure - Water Treatment Plant Security
In 2012, the City installed fencing improvements, card control access, and security cameras at facilities determined to be critical to the water system, including elevated towers, source waters, water treatment plant, and pump stations. The project stemmed from recommendations in the City's Vulnerability Assessment. These security enhancements provide an additional layer of protection to the City's critical infrastructure. The cost of the project was approximately $2,100,000.00, funded through a low-interest loan through the Federal Drinking Water Revolving Fund.

Mitigation Strategy: Blackouts and Waterworks
Distribute information to residents on what do the case of a prolonged blackout or waterworks failure. Include where food, water and other supplies may be distributed or where to go for such information. This information should be included in a family preparedness kit.

Mitigation Strategy: Repairs and Maintenance
Complete repairs on bridges that are critical for emergency response, and make culvert replacements where necessary.

Risk # 3 - Severe Winter Weather

Goal:
Minimize the effect that severe winter weather can have on residents, and the potential damage that can result from such events.

Mitigation Strategy: Evaluation and maintenance
Evaluate the structural integrity of power lines, trees, signs, and other amenities that may become at risk of failure due to freezing or ice build-up during severe winter weather.

Mitigation Strategy: Plowing
Assure that roads are plowed promptly during snowstorms and that plow routes are continually evaluated for effectiveness. See page 97 for a map of current plow and salt routes.

Mitigation Strategy: Education
Distribute public education materials (flyers regarding Family Disseminate Emergency Preparedness Information, website links), including warming shelter information.

Risk #4 – Fire Hazards: Structural Fires

Most of the City involves residential construction types (almost 50%), and much of the remaining 50% are other structural uses like commercial, industrial, and public facilities. Because the vast majority of the City contains built features, the City is vulnerable to structural fires.

Goal: Reduce the City's vulnerability to structural fires.

Strategy: Structure Updating – Information
Facilitate the distribution of knowledge about the best ways that businesses and residents can protect their buildings from fires through modernization, which may include sprinkler addition and the use of fire resistant materials.

Strategy: Structure Updating – Incentives
Make sure that new building permits are reviewed for the use of up-to-date fire-resistant technologies. Explore incentive-based programs to encourage residents and business owners to install such new technologies when building or remodeling a structure. Incentives could include tax abatements that allow recovery of the initial costs of improvements. Additional building inspection staff would be needed for building permit reviews.

Risk # 5 – Hazardous Materials Incidents – Fixed Site

There are facilities in the community that store hazardous materials and therefore have the potential to cause both environmental and public health impacts.

Goal: Reduce the risks of hazardous material fixed site incidents in the City by increasing its ability to respond and assuring an up-to-date knowledge of site locations.

Mitigation Strategy: Emergency Generators
Secure funding for the replacement and upgrading of emergency generators for key facilities like the Police Department, dams, Department of Public Works, City Hall and fixed generator lift and pump stations.

Mitigation Strategy: Warning Sirens
Secure funding for the replacement and upgrading of current sirens, and for additional upgraded warning sirens.

Mitigation Strategy: Public Education
As part of inspection programs, distribute materials to residents that includes fire safety practices. See Family Preparedness Packet.

Mitigation Strategy: Training and Support

- Continue to belong to and participate in the Washtenaw County Hazardous Materials Response Authority.
- Support and cooperate with the Washtenaw County Pollution Prevention Program.

- Continue to participate in the Washtenaw County Emergency Preparedness Plan.
- Provide training and support to local emergency planning committees (LEPC)

Mitigation Strategy: Participation – City/County Hazmat Response Team
Continue with the participation in and development of the recently (2012) combined City/County Hazmat Response Team. Support the city's collaboration in its training, resources, and planning.

Mitigation Strategy: Enforcement

- The Fire Prevention Division is taking a more proactive role in performing fire safety inspections.
- Continue to enforce industrial, fire, and safety regulations.
- Ensure that regular inspections of all SARA Title III sites take place.
- Work with Washtenaw County's Pollution Prevention Program to ensure that facilities that store, manage or produce hazardous materials are using best management practices, and thus facilitate information exchange between the facility, the Fire Department, and the Hazardous Materials Response Team.

Mitigation Strategy: Equipment

- Consider up-to-date technology when equipment is purchased, to provide better on-scene performance.
- A foam suppression ATV has been added to the city's vehicle fleet, for easy access to small structure fires at densely populated events such as football games.

Risk # 6 – Extreme Temperatures

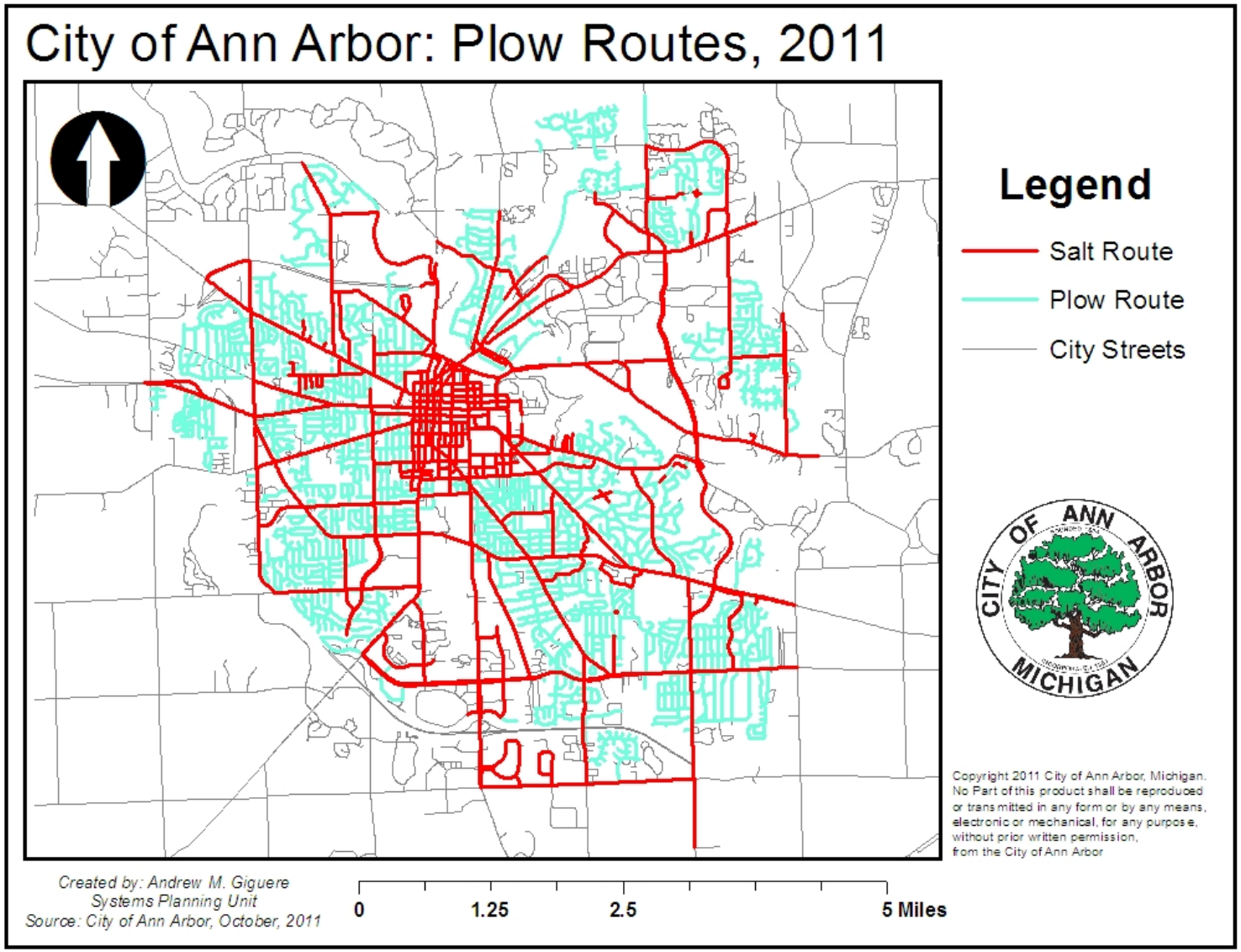
When extreme temperatures occur, the most vulnerable residents are the elderly, the young, and persons with disabilities.

Goal: Minimize the effect that extreme weather can have on residents and the potential damage that can result from such events.

Mitigation Strategy: Planning
Develop an extreme temperature response plan to outline the best and most effective ways to serve population at risk. See page 18 for a map of at-risk population housing and their proximity to hazard response facilities.

Mitigation Strategy: Education
Distribute public education materials (such as fliers) regarding family preparedness. Disseminate emergency preparedness information, website links, etc.

Mitigation Strategy: Code Enforcement
Use enforcement programs, including building codes to ensure that heating and cooling equipment is maintained.


City of Ann Arbor: Plow Routes, 2011
Legend
Salt Route
Plow Route
City Streets
CITY OF ANN ARBOR MICHIGAN
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Systems Planning Unit
Source: City of Ann Arbor, October, 2011
0
1.25
2.5
5 Miles

Risk # 7 – Hazardous Materials Incidents: Transportation

Goal: Reduce the risk of property damage, loss of life, and other costs associated with accidents involving the transportation of hazardous materials.

Mitigation Strategy: Route Choice

Create a brochure to distribute to hazardous material transporters, outlining the safest and most preferred routes through and to various destination points in the City.

- Work with Hazardous Material response teams, fire officials, police officials, and GIS technicians to determine response times to common destinations points.
- Find the routes with the quickest response times and the lowest affected population, to determine the preferred routes.
- Work with MDOT-licensed couriers and railroads to obtain information about (including the quantities of) hazardous materials that are routed near Ann Arbor.
- Distribute a route guide to hazardous material transporters.

Mitigation Strategy: Participation – City/County Hazmat Response Team

Continue the participation in and development of the recently (2012) combined City/County Hazmat Response Team. Support collaboration in training, resources, and planning.

Risks # 8 & # 9 Flood Hazards: Urban Flooding

Potential vulnerable areas with regard to flooding include the Huron River, Allen Creek, Malletts Creek, Traver Creek, Swift Run Drain and Millers Creek.

Goal: Reduce the City's vulnerability to urban flooding.

Mitigation Strategy: Planning

A 2004 all-hazard plan for Washtenaw County had recommended the development and implementation of a specific Flood Mitigation Plan for the City of Ann Arbor, which the City began working on immediately. The Plan was funded in part by a Flood Mitigation Assistance Planning Grant in 2004 from the Michigan State Police Emergency Management Division. That grant program is part of a National mitigation planning effort administered by Federal Emergency Management Agency (FEMA).

The 2007 Flood Mitigation Plan had involved an extensive review and approval process that served to supplement the thorough public engagement conducted during the planning process. Review and approval consisted of extended staff review, public comment via email and the web, presentations to watershed groups, and review by the Environmental Commission, City Planning Commission, and City Council. The plan received unanimous support from the Environmental Commission and City Planning Commission and was approved unanimously by City Council. The State and Federal governing levels also provided review, comment, and approval. City entities approved and adopted the plan.

The Flood Mitigation Plan's implementation process began quickly, with several projects already underway. The City Planning Commission passed a resolution to begin work on the development of a Floodplain Ordinance that included many of the recommended strategies to improve floodplain regulation and development standards. The Allen Creek Greenway Taskforce published a report of Findings and Recommendations that is consistent with the Plan's recommended greenway strategies and will require staff action.

The City of Ann Arbor FLOOD MITIGATION PLAN can be accessed at www.a2gov.org/floodplains

In June of 2001, the City of Ann Arbor Planning Commission had charged the City's Planning Department with the task of outlining an official policy for dealing with City owned property in the floodplain. The project identified two central goals and seven related goals that have since been threaded throughout City, State, and Federal Code and referenced in City Planning documents.

Central Goals: Minimize Life Endangerment; and minimize property damage and loss.

Related Goals: Preserve market value of existing real property, promote water quality and ecological health of each creek-shed, reduce Allen Creek Drain contamination to reduce outflow of contaminants into the Huron River, create Allen Creek Greenway in floodplain area, preserve neighborhood character, create affordable housing on vacant City-owned parcels, and retain National Flood Insurance Program by limiting/prohibiting development in floodplain.

Mitigation Strategies for Flooding:

- **Acquisition:** Public acquisition and management of flood prone properties.
- **Relocation:** Permanent relocation of flood prone structures to areas outside the floodplain.
- **Redevelopment:** Rebuilding damaged or flood prone structures in such a way that the risk is reduced.
- **Modifications:** Site and structural modification to flood proof structures.
- **Public Works Measures:** Storm water management system improvements to reduce flooding. Examples include in-line detention facilities, storm water pipe modifications, reforestation, and native landscaping.
- **Planning and Regulatory Measures:** Integrate floodplain management into master plan revisions, with new planning projects to prevent possible hazards associated with previously planned uses that are not supported by current floodplain management standards. Modify land use plans, modify zoning, incorporate re-mapped floodplain boundaries, develop additional floodplain development regulations, use development moratoria where appropriate, and plan for open space.
- **Incentives:** Create financial incentives and disincentives, based on flood risk factors.
- **Leading by Example:** Establish a clear and consistent government policy for publicly owned land in the floodplain, aimed at preventing public buildings in the floodplain.
- **Public Education and Awareness Measures:** Tools include public relations, information dissemination, public hearings, surveys, polls, workshops, seminars, etc.

Mitigation Strategy: Ann Arbor Storm Water GIS Data Collection and Hydraulic Model Development:

The City of Ann Arbor is working to develop a hydraulic model to better plan for storm water issues. Among other objectives, the project aims to create a GIS inventory of all storm water catch basins and catch basin leads, and to confirm the connectivity of catch basins to the main storm water system. Collected information will be analyzed to assess any system deficiencies and also used to create the model. From the model, a list of recommended storm water improvement projects will be created and a set of cost estimates for the recommended improvements will be prepared.

Mitigation Strategy: Feedback Exercise:

As a part of the public engagement process, the planning team worked with a staff advisory committee to develop a feedback exercise that would engage the public and answer the question: "What do Ann Arbor Residents view as acceptable methods to accomplish the goals of the Flood Mitigation Plan?" This question deals broadly with policy and planning issues. The planning team sought to develop a list of community-endorsed mitigation strategies and activities. Two feedback tools were developed to address the question, and were designated as iteration 1 and iteration 2. The feedback tools were administered in two separate meetings in 2001. The first was a meeting with the Old West Side Association. The Second was the special outreach meeting held on June 29th, mentioned above.

Iteration 1:

To develop the first feedback exercise, the planning team put together a comprehensive list of mitigations strategies that were organized around the seven mitigation areas:

- Objective 1: Mapping and Technology
- Objective 2: Education and Outreach
- Objective 3: Planning and Zoning
- Objective 4: Regulation and Development Standards
- Objective 5: Corrective Actions
- Objective 6: Infrastructure
- Objective 7: Emergency Service

For each of these mitigation objective areas, current regulations were explained (NFIP and Code Minimum) and a list of 55 strategies was presented in the local improvements/new standard format. Participants were asked to answer a general question – "Should the City of Ann Arbor pursue the following mitigation strategy?" for each of the 55 possibilities.

Iteration 2:

The results of the first exercise were compiled and used to create a refined exercise. The planning team decided to further examine all of the mitigation Strategies that received less than a 50% approval rating in the first exercise. It was also decided that, rather than asking about specific mitigation strategies, a list of questions would be developed to address multiple strategies, and examples would be provided during the exercise. There were 19 strategies that received an approval rating of less than 50%. A list of 11 questions was developed to further assess these strategies. For more information on these exercises and the results tabulation please see Appendix B in the Ann Arbor Flood Mitigation Plan.

Finally, it should be noted that the public engagement process is ongoing with regards to the implementation of the plan.

Mitigation Strategy: Consistency of Future Buildings with the Flood Vulnerability Analysis:
Implementation of the projects recommended will reduce vulnerability to any building projects that may be proposed within the risk areas. Many of the recommended projects require planning, research, and/or ordinance development/amendments. It is strongly recommended that all future projects proposed in the flood risk areas make a voluntary effort to comply with the recommended projects in this plan. Since the implementation process may take years, voluntary compliance will help to assure that no new vulnerable structures are added to vulnerable and at-risk areas. This is consistent with the primary goal of the flood plan: reduce flood losses, minimize damage to public and private property, and protect public health and safety.

Any future buildings built in accordance with the recommendations of the flood plan, and existing structures that are mitigated in ways consistent with its recommendations, can be tracked in future plan updates as mitigated structures.

Mitigation Strategy: Mapping and Technology:
Maintain and utilize up-to-date floodplain mapping techniques to assist in the identification and mitigation of flood related hazards. NFIP & Code Minimum: Currently the City of Ann Arbor is a participant in the National Flood Insurance Program. As a participant, FEMA supplies the City with Flood Insurance Rate Maps (FIRMs). Newly updated maps were made available just before this 2012 plan was completed (and therefore will have to be given further consideration under the next edition of this plan, in 2017). These FEMA NFIP maps show the City's floodplain and floodway and are used by the NFIP to determine the rate that homeowners will pay to receive flood insurance. The City of Ann Arbor is required at a minimum to enforce regulations that apply to these designated areas[1]. An example of regulations that the FIRM is used for includes the requirement that residential developments must be elevated above the Base Flood Elevation (BFE). All other development in the floodway and floodplain must meet building code requirements for flood-resistant construction.

As a participant in the National Flood Insurance Program, the City of Ann Arbor is required to adopt the FIRM. The previously adopted FIRM was dated January 2nd 1992. Starting in 2004, FEMA embarked on a National FIRM re-mapping effort that aimed to digitize & update the Nations FIRMs. From 2005 to 2007, FEMA worked on developing digital FIRMs for all of Washtenaw County. The MDEQ has partnered with FEMA on this effort. The City of Ann Arbor assisted in this process and supported FEMAs team with data and staff time. Key dates for the City's participation in the NFIP process involving FIRMs are: (1) The initial floodplain identification on June 28, 1974, (2) Flood Hazard Boundary Map Revisions on September 5, 1975, (3) FIRM Effective Date of June 15, 1982, (4) FIRM Revisions Date of August 5, 1985, (5) FIRM Revisions Date of January 2, 1992, and (6) the new FIRM availability date of April 3, 2012. A partial analysis of the 2012 FIRM was able to be done in recent months since it became available, but a more complete analysis will take more time and will be scheduled to appear in the City's hazard mitigation plan update of 2017.

The FIRM provides local governments and residents with one of the best available tools for the mitigation of future flood events. This usefulness stems from the maps being designed specifically to predict the areas that are most vulnerable to large storm events. The NFIP maps are most accurate when calibrated with sufficient local data for rainfall, flow, and land uses, but topography alone can yield an estimate for the fluvial floodplain. The fluvial floodplain is the area in a watershed that has been shaped by historic flood events. The FIRM allows local governments to have a more detailed understanding of the various levels of risk within the fluvial floodplain.

[1] The State of Michigan has jurisdiction only in floodplain and floodway areas with more than two square miles of drainage area.

Because the FIRM is such a useful tool, the City of Ann Arbor is committed to finding ways to improve the flood mapping process to ensure the accuracy of the maps.

Mitigation Strategy: Project 1: Detailed Hydrologic Data:
The City of Ann Arbor could invest in the collection of detailed hydrologic data that might result in a better representation of the floodway and floodplain. Collecting hydrological data will become more important in the coming years to gauge the effects of global climate change on local weather patterns. Better data would aid in flood model calibration. This project would have four components: *planning*, *technical implementation*, *hydraulic information gathering*, and *data maintenance*.

- Planning: Plan for the purchasing and placement of rain gauges. Lead the community through its initial phases.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.25 time = $25,000
- Technical implementation: Purchase and install rain gauges. Set up staff for the data collection.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.25 time = $25,000 + Technology Cost
- Hydrologic information gathering: Gather hydrologic information for both flood depth and velocity
  - Timeframe – Year 2
  - Cost – 1 staff at 0.25 time = $25,000 + Technology Cost
- Data maintenance: Organize rain flow data for model updating. Check gauges for accuracy. Provide information when requested.
  - Timeframe – Year 2, ongoing
  - Cost – 1 staff at 0.25 time = $25,000 + Technology Cost

Total Project Cost: $100,000 + Technology

Project 1 Update as of 2012 – The City has spent over $1.2 million documenting the City's Stormwater Management System and creating a Stormwater Management Model (SWMM) for the entire system within the City. CDM/Smith completed extensive information-gathering to populate the City's Geographic Information System and to create the stormwater model. The City has just signed a new contract with CDM/Smith to go through an extensive public outreach effort, field monitoring, and final model calibration effort, and system deficiency analysis. The end of the project, which will wrap up in 2014, will include a comparison between the stormwater model results and the April 3, 2012 Flood Insurance Study, and recommendations to resolve any differences.

Mitigation Strategy: Project 2: Map Additional Flood Related Hazards:
The current flood mapping procedure does not necessarily include a sensitivity analysis for certain kinds of flood hazards that may affect risk areas during a storm event. The types of hazards that should be examined are: dam failure inundation, uncertain flow paths, and debris & sediment blockage. The three components of this process will be *sensitivity analysis*, *flood modeling*, and *emergency management updating*.

- Sensitivity analysis: Identify dams that may fail, areas that may have uncertain flow paths and areas that are susceptible to blockage.
    - Timeframe – Year 3
    - Cost – 1 staff at 0.5 time = $50,000
- Flood modeling: Use the sensitivity analysis to model how the FIRM designations may change under certain scenarios.
    - Timeframe – Year 3
    - Cost – 1 staff at 0.5 time = $50,000
- Emergency management updating: Ensure that this information is included in the City of Ann Arbor's Emergency Response Plan.
    - Timeframe – Year 3
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $110,000

Mitigation Strategy: Project 3: Use Future Conditions Hydrology for Flood Mapping:
One of the data used to create the FIRMs is a run-off coefficient. The run-off coefficient is a value that is assigned to each land use within the watershed. This value is used to determine the amount of water that will flow off of the land and contribute to a flood. A Future Conditions Hydrology approach would estimate the floodplain and floodway based on the planned future land use instead of the existing land use. NFIP allows the future conditions hydrology lines to be drawn on the FIRM for informational purposes. This project would require a *future conditions hydrology map update* and a *floodplain volumes analysis*.

- Floodplain volumes analysis: To assist in future land use modeling, a floodplain volumes analysis can be conducted. How much of the volume of the floodplain area can be attributed to displaced water due to the buildings that currently occupy floodplain area?
    - Timeframe – Year 2
    - Cost – 1 staff at 0.5 time = $50,000
- Future conditions hydrology map update: Assign a runoff coefficient based on future land use and place new lines on the FIRM.
    - Timeframe – Year 3-4
    - Cost – 1 staff at 0.5 time = $50,000

Total Project Cost: $100,000

Project 3 Update – The stormwater system analysis effort the City is in the middle of (mentioned under Project 1), includes future condition hydrology analysis.

Mitigation Strategy: Project 4: Use Future Conditions Hydrology for City Plans and Regulations:
The City of Ann Arbor could choose to use a future conditions hydrology approach to regulate the floodplain and floodway. Taking this approach would ensure that the City's comprehensive planning efforts could be implemented without increasing the risk to properties

and people in and near the City's flood-prone areas. This project would consist of two components, an *ordinance development* and a *plan and regulation update*.

- Ordinance development: Write an ordinance and conduct the public outreach to inform residents of the proposed change. Work with decision makers throughout the process. This project could also be covered in a Flood Management Ordinance, see Mitigation Objective 4.
    - Timeframe – Year 5
    - Cost – 1 staff at 0.1 time = $10,000
- Plan and regulation update: Update the relevant planning documents and regulatory procedures to reflect the change in policy.
    - Timeframe – Year 5
    - Cost – 1 staff at 0.4 time = $40,000

Total Project Cost: $50,000

Mitigation Strategy: Education and Outreach:
Employ education and outreach as a means to reduce potential flood hazards and increase community knowledge about the floodplain.

NFIP and Code Minimum: Currently it is the policy of the City of Ann Arbor to respond to residents' and developers' inquiries regarding property in the floodplain and floodway. City staff works to promptly answer any questions that are asked. City staff provides answers to basic inquiries, such as whether a property is located in a floodway or floodplain.

Staff also provides answers to more complicated inquiries:

- What are the permitted uses on this property?
- How can I modify my structure in the floodplain to comply with the building code?
- Can I get the FIRM amended to take my structure out of the floodplain?

Providing this information is an essential part of the City's current efforts to ensure the responsible use of properties in the City's flood-prone areas.

In addition to staff efforts, the City uses its website to provide information. Currently the FIRMs are available on the website along with information about emergency response and planning efforts.

The City of Ann Arbor is committed to providing flood information to property owners and prospective developers as well as looking for opportunities to improve on the current education and outreach policies.

Mitigation Strategy: Project 5: Improve the Flood Maps on the City's Website:

The City of Ann Arbor currently provides static images of the NFIP maps on the City's website, through the Planning and Development Services Department. The City could improve this service by creating an interactive flood map that would be user-friendly. This project would consist of a *web update* using the available GIS information.

- Web update: Use the available GIS information to create an interactive web page for residents to learn about the location of the flood way and floodplain.
  - Timeframe – Year 1
  - Cost – 2 staff at 0.1 time = $20,000

Total Project Cost: $20,000

Project 5 Update – To go along with the approval of new flood maps on April 3, 2012, the City created an interactive flood mapping tool and made it available to the public through the City's web site. Both the old and new floodplain and floodway boundaries are provided by this tool. Properties and buildings that had moved in or out of the floodplain are color coded on these new, interactive maps. Users can turn on and off these layers, and others such as contours and air photos. The floodplain mapping tool can be accessed at www.a2gov.org/floodplains

Mitigation Strategy: Project 6: Flood Information Links on City Website:

The City of Ann Arbor can use the web as a resource to link residents to information about flood hazards. Many residents do not fully understand flood risk or how they are vulnerable to flood events. There are many groups that provide flood information including:

- FEMA
- Association of State Floodplain Managers
- State of Michigan

Providing links to these groups, and providing information from the risk analysis and vulnerability assessments, are simple ways to help inform Ann Arbor Residents about flood preparedness. This project would consist of a *web update*.

- Web Update: Find and research organizations that provide web-based information on flood risks and flood preparedness. Create a web page to link, display, and describe the available information.
  - Timeframe – Year 1
  - Cost – 1 staff at 0.05 time = $5,000

Total Project Cost: $5,000

Project 6 Update – Floodplain information and links have been added to the City's web site. Floodplain information can be accessed at www.a2gov.org/floodplains

Mitigation Strategy: Project 7: Public Information Campaign:

City of Ann Arbor

The City of Ann Arbor could pursue a Public Information Campaign that might consist of any of the following elements: *brochures*, *mailings*, *displays*, *articles*, *videos*, *signs*, *presentations*, and *emergency action plans*.

- Brochures: Create a brochure that describes the City of Ann Arbor's Flood Risk and Mitigation Objectives, and distribute the brochure.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000 + production costs
- Mailings: Create a mailing that describes the City of Ann Arbor's Flood Risk and Mitigation Objectives.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000 + production costs
- Displays: Create a display that describes the City of Ann Arbor's Flood Risk and/or Mitigation Objectives. Find places to exhibit the display.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000 + production costs
- Articles: Encourage local newspapers and publications to write about the City of Ann Arbor's Flood Risk and Mitigation Objectives.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000 + production costs
- Videos: Create a video that illustrates the City of Ann Arbor's Flood Risk and Mitigation Objectives in an easily accessible way. Make video accessible on the web and show on Ann Arbor's Cable Television Network (CTN).
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000
- Signs: Create signage that describes the City of Ann Arbor's Flood Risk and/or Mitigation Objectives. Post signs marking the location of the floodplain, along with risk categories or flood depth.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000 + production costs
- Presentations: Create a presentation that describes the City of Ann Arbor's Flood Risk and Mitigation Objectives. Look for forums in which to give the presentation.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000
- Emergency Action Plans: Create an Emergency Action Plan summary sheet that describes what steps residents should take in the event of a flood, and distribute that sheet.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000 + production costs

Total Project Cost: $80,000 + production

Mitigation Strategy: Project 8: Make Information Available at the Public Library:
The public library is a convenient and central location where residents can go to access important public documents and other information. The City of Ann Arbor should make an effort to assure that handbooks, maps, and other publications that address flood mitigation are available at the public library. This project consists of *information coordination*.

- Information coordination: Collect the relevant information and bring copies to the library
  - Timeframe – Year 1
  - Cost – 1 staff at 0.05 time = $5,000

Total Project Cost: $5,000

Project 8 Update – Local floodplain information has been made available at the main Ann Arbor Library at 343 South Fifth Ave., Ann Arbor, MI 48104.

Mitigation Strategy: Project 9: Flood Protection Advice:
As mentioned earlier, it is already a City policy that staff provides information to property owners and potential developers regarding property in the floodplain and floodway. This practice could be improved if staff is encouraged to provide flood protection advice about Best Management Practices (BMP) for the protection of floodplain and floodway properties. This project would consist of a *BMP training* element to relevant City Staff.

- BMP training: Identify the staff that interacts with the public regarding the floodplain and floodway. Designate a staff member to provide training to the relevant staff. Train the staff on the Best Management Practices and ways to provide flood protection advice.
  - Timeframe – Year 1
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $10,000

Mitigation Strategy: Project 10: Flood Hazard Training and Education:
Preparing for flood hazards and implementing flood mitigation strategies is a difficult task that affects many of the City of Ann Arbor's departments. Basic floodplain training should be provided to City Staff to foster a greater understanding of flood issues in the Ann Arbor. This project would consist of developing a *floodplain 101 training session* for participating departments.

- Floodplain 101 training session: Identify the departments that would benefit from floodplain training. Designate a staff member to develop and provide the training. Implement a training schedule.
  - Timeframe – Year 1
  - Cost – 1 staff at 0.1 time = $10,000 + Minimal Staff Time

Total Project Cost: $10,000 + Minimal Staff Time

Mitigation Strategy: Project 11: CFM Employment Criteria:

The Association of State Floodplain Managers administers the Certified Floodplain Manager (CFM) program. The knowledge and training required to become a CFM would benefit many of the staff positions responsible for oversight of the floodplain and floodway. The City should establish a *CFM training* requirement for appropriate staff positions.

- CFM Training: Identify the staff that interacts with the public regarding the floodplain and floodway. Make CFM Training a required element of these positions.
    - Timeframe – Year 1
    - Cost - 1 staff at 0.05 time = $5,000 + $1,000 exam fees & travel

Total Project Cost: $6,000 per employee

Mitigation Strategy: Project 12: Educating Decision Makers:

Elected and appointed decision makers will often be required to make difficult decisions regarding policy concerns in the floodplain and floodway. The City of Ann Arbor should be dedicated to providing these officials with the appropriate education and training to properly represent the concerns of their post in light of the decision at hand. The City of Ann Arbor should require that decision makers attend workshops, conferences, and presentations that address floodplain management issues. To aid in this requirement, the City should host a *floodplain management event* once per year.

- Floodplain management event: Designate a staff member responsible for organizing the hosting of an event related to floodplain management.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $10,000

Mitigation Strategy: Project 13: Environmental and Safety Education Program:

The City of Ann Arbor could also choose to pursue a formalized education program and partner with the Ann Arbor Public Schools to provide education to kids. An environmental and safety education program could cover many of the issues associated with floodplain management, including:

- The natural function of watersheds and floodplains
- The forces of nature that cause large storm events and floods
- Basic safety tips for storm events
- Environmental stewardship

The implementation of an *environmental and safety education program* would consist of development of educational materials and program coordination.

- Environmental and safety education program: Development the curriculum to cover within the program. Form a partnership with the AAPS to coordinate with teachers on how to teach the program.

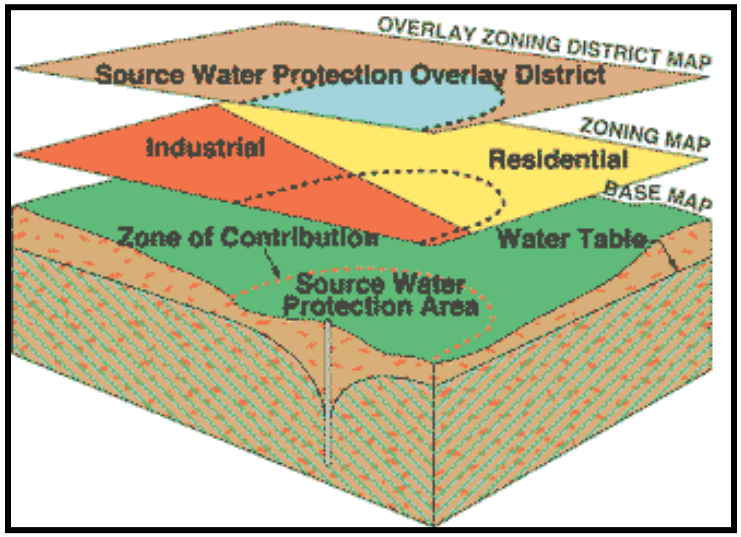
- Timeframe – Year 2
- Cost – 1 staff at 0.5 time = $50,000

Total Project Cost: $50,000

Mitigation Strategy: Planning and Zoning:
Integrate floodplain management into planning projects and prevent possible hazards associated with an unplanned floodplain. NFIP & Code Minimum: The City of Ann Arbor actively engages in comprehensive planning. Master Planning in the City is divided into five sub-areas: the South Area Plan, the Central Area Plan, the Ann Arbor Downtown Plan, Northeast Area Plan, and the West Area Plan. These plans guide the future land uses and development patterns in the City. The plans do not, however, make specific recommendations for land uses in the floodplain and floodway that are based specifically on the City's flood risk and vulnerability.

In addition to the master planning effort, the City has several special subject plans, including transportation plans, the Parks and Recreation Open Space Plan, the Natural Features Master Plan and the 2007 Flood Mitigation Plan. The City also has a Storm Water Management Plan and a Watershed Plan for Malletts Creek. The City required a plan be developed for Millers Creek as a part of a PUD approval; this plan is completed but has not yet been adopted by City Council. Special subject plans are often good ways to plan for unique situations and interests.

The City of Ann Arbor uses its Zoning Ordinance to regulate land uses. If planning documents recommend changes in zoning, those changes must be made through amendments to the Zoning Ordinance. Similar to special subject plans, the City can create special zoning districts and overlay zoning districts. In early 2005 the City of Ann Arbor began a project to create a downtown-zoning district, officially called A2 (Downtown Development Strategy). This project represents an opportunity to re-zone areas of the downtown that are within the floodplain and floodway. However, much of the City's floodplain and floodway is outside of the focus area of this project.



Mitigation Strategy: Project 14: Floodplain Overlay Zoning District:
The City of Ann Arbor could pursue the creation of a Floodplain Overlay Zoning District to implement changes in the development patterns within the City's floodplain and floodway. Sometimes called a Special Zoning District, a Floodplain Overlay Zoning District would provide the City with an enforceable way to regulate land use within the floodplain. Undertaking a project of this kind would also provide residents, property owners and decision makers with the opportunity to consider floodplain and floodway land use independently of other zoning decisions. Based on the feedback received through public engagement exercises these are the kinds of development restrictions a Floodplain Overlay Zoning District might help to implement:

- Restrict residential development in floodway
- Restrict residential development entire floodplain

- Restrict all development in floodway

Accessed At: http://www.planning.org/thecommissioner/19952003/winter01.htm; October, 2005

- Restrict damage-prone development

Over 70% of surveyed respondents strongly believed that these were appropriate restrictions that the City should pursue. There was far less support for the restriction of all development in the flood fringe. The idea of restricting damage-prone development would add a new caveat to floodplain regulation, such as the making of zoning decisions based on the two foot and three foot flood depth areas.

Floodplain and floodway development restrictions are already implemented by the State of Michigan, but the State only has jurisdiction in areas of the floodplain that have over two square miles of drainage area. This leaves much of the City's floodplain and floodway unprotected. A floodplain overlay district would provide the City with measures to regulate property that falls outside of State jurisdiction. This project would consist of three elements: *public engagement*, *writing and analysis*, and *approval*.

- Public engagement: Interact with residents, the development community, property owners and decision-makers on the best use of land within the floodplain and floodway.
  - Timeframe – Year 2
  - Cost – 2 staff at 0.5 time = $100,000
- Writing and analysis: Compile and analyze the information gathered, and write the code for the overlay district.
  - Timeframe – Year 3
  - Cost – 2 staff at 0.5 time = $100,000
- Approval: Take the project through the approval process. Make changes, if necessary.
  - Timeframe – Year 4
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $210,000

Project 14 Update – In May of 2007, the City Planning Commission passed a resolution directing City Staff to draft a Floodplain Overlay Ordinance, and formed a Floodplain Ordinance Committee. Several ordinance drafts were reviewed by the committee and City staff from Planning, Systems Planning, and the Attorney's Office. Subsequently, the project was delayed because of a Zoning Code reorganization and consolidation project. The zoning code project is nearing completion and the Stormwater and Floodplain Programs Coordinator in the Systems Planning Unit has begun working with the City Attorney on the Floodplain Ordinance once again. It is anticipated that an ordinance draft can be submitted for City Planning Commission consideration by the end of 2012.

Mitigation Strategy: Project 15: Detailed Flood Loss Model:

To fully understand the impacts that flood events may pose on the City of Ann Arbor, the City could prepare a Detailed Flood Loss Model. A Detailed Flood Loss Model, combined with vulnerability assessment and the flood risk analysis, can be used to estimate the actual economic loss of flood events at a variety of levels. A Detailed Flood Loss Model can be done in conjunction with map and model updating. This project would consist of two components: *Data collection* and *GIS analysis.*

- Data collection: Gather the data necessary to estimate the economic loss of flood events including (at a minimum): parcel tags, square footage, footprint area, assessed value, and replacement value.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.5 time = $50,000
- GIS analysis: Create a flood loss estimation model to estimate the economic losses from various degrees of flood events.
    - Timeframe – Year 3
    - Cost – 1 staff at 0.5 time = $50,000

Total Project Cost: $100,000

Special Recommendation: Watershed Management Planning: The City of Ann Arbor could consider the development of watershed management plans for the all of the watersheds that fall within its jurisdictional boundaries. Malletts Creek is the only watershed in Ann Arbor that has a City Council approved watershed management plan. The Millers Creek plan is completed but not yet approved. There is a resident-sponsored watershed management plan for Allen Creek that could be used as a cornerstone for the development of a City-sponsored, updated plan. The City also should consider partnering with Washtenaw County or with neighboring townships for watersheds that overlap jurisdictional boundaries, like Honey Creek and Traver Creek.

Mitigation Strategy: Project 16: Multi-Objective Management Planning:

Multi-Objective Management (M-O-M) Planning is a process in which all impacts, economic and environmental, are considered and incorporated. As the City's comprehensive plans are consolidated M-O-M strategies can be employed. This project would consist of conducting research and writing a *feasibility report.*

- Feasibility report: Research M-O-M planning and write a feasibility report on its use in Ann Arbor.
    - Timeframe – Year 2 and 3
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $10,000

Mitigation Strategy: Regulation and Development Standards:

Implement regulatory measures and development standards to limit flood impacts caused by the built environment. NFIP & Code Minimum: In 1991, the City of Ann Arbor adopted the current flood insurance study (FIS) and flood insurance rate map (FIRM) dated January 2, 1992 by enacting a floodplain management resolution, which allows the City to participate in the National Flood Insurance Program (NFIP). By participating in the NFIP, the City agrees to enforce to all state and federal regulations governing floodplain development. As a participant in the NFIP, the city must enforce a minimum of four basic requirements for floodplain regulations. These minimum standards are as follows:

- Floodplain development permits – All developments in the floodplain must obtain a permit. Development is defined by the NFIP as any man-made change.

- Discourage new buildings in the floodway – All development in the floodway should be discouraged and residential uses in the floodway should be strongly discouraged. For development in the floodway that is under State jurisdiction, the developer must submit an engineering study certifying that the development will not raise the Base Flood Elevation (BFE).

- Standards for new buildings in the flood fringe – New buildings may be built in the flood fringe, but residential structures must be elevated above the BFE, and non-residential must either be elevated above the BFE or flood-proofed to the BFE.

- Substantially improved buildings treated as new – All structures that are improved in the floodplain and floodway must meet the standards for new buildings if the value of the improvements exceeds 50% of the market value of the structure.

All of the above standards are legally enforced through the Michigan Building Code of 2003. The Michigan Building Code of 2003 additionally requires that structures in the floodplain must be elevated or flood-proofed to 1 foot above the BFE. The State also prohibits residential uses in the floodway, in areas that are under the Jurisdiction of the MDEQ. It should be noted that historic structures are exempt from the substantial improvement requirement.

There are two additional regulations that apply to floodplains in the City of Ann Arbor. First, the Washtenaw County Drain Commissioner requires a 30-foot easement on either side of the centerline of all above-ground and underground creeks that fall within the County's jurisdiction. Second, Chapter 57 of City Code states that new development in the City's floodplains must result in no net loss of flood storage capacity.

Special Recommendation: City of Ann Arbor Floodplain Ordinance: The City of Ann Arbor should facilitate the development of a floodplain ordinance. A floodplain ordinance will allow the City of Ann Arbor to go above and beyond the County, State, and Federal floodplain regulations for floodplains within the municipal boundaries.

<u>Mitigation Strategy: Project 17: Additional Freeboard:</u>
Currently new and substantially improved buildings must be raised to 1 foot above the base flood elevation (BFE). Additional height requirements above the BFE would benefit property owners by reducing their insurance rates by up to 27 cents per 100 dollars of coverage at a 3-4 foot freeboard. Additional freeboard will also protect structures if in the future the BFE were to rise, as a result of increased development in the watershed. This project would consist of *freeboard level research* and *ordinance drafting*.

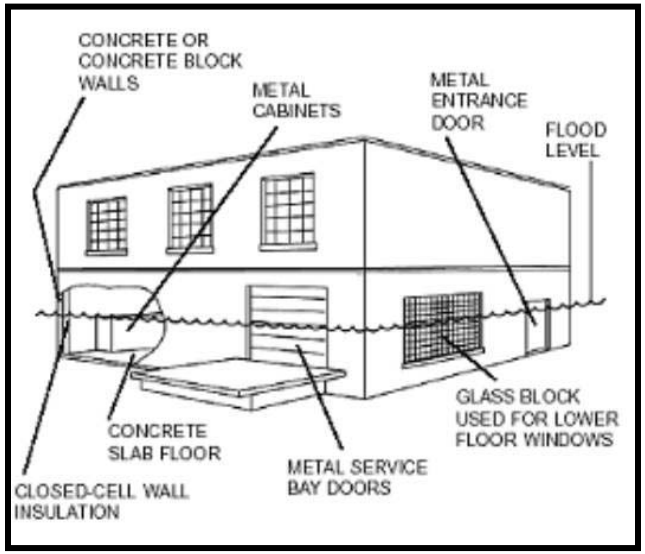
- Freeboard level research: Research the appropriate level of freeboard, include economic benefit of insurance reduction and build out scenario analysis that examines risk associated with rising BFE.
    - Timeframe – Year 2
    - Cost – 1 staff at .2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $30,000

<u>Project 17 Update</u> – It was determined that the Michigan Building Code would not allow additional freeboard to be regulated at the local level.

Mitigation Strategy: Project 18: Floodplain Foundation Certification:

Buildings in the floodplain and floodway can be vulnerable to increased damage resulting from the erosion, scouring, or settling of the material used to fill around the building. A higher standard for protecting the foundations of structures in the floodplain and floodway can assure that the placement, compaction, and protection of fill material is appropriate for the flood risk of the structure. A Floodplain Foundation Certification program can set standards for foundation protection in the floodplain and require that developers or architects certify the adequacy of the foundation. This project would consist of *foundation standards research* and *ordinance drafting*.



Accessed At: http://lift.wvlc.lib.wv.us/wvfema; October 2005

- Foundation standards research: Research measures, methods, levels, and other criteria to be used for certification. Outline a certification process.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $30,000

Mitigation Strategy: Project 19: Cumulative Improvement Standard:

Currently, structures in the floodplain and floodway are required to meet the standards for new buildings if the value of the improvements is greater than 50% of the market value of the structure. This requirement encourages property owners who do not wish to comply with flood resistant construction standards to "split" one projects into several project iterations of lesser value. The City of Ann Arbor could implement a Cumulative Improvement Standard to encourage compliance with flood-resistant construction standards. The City of Ann Arbor has the ability to track permits and could trigger a flood standard at a 50% value over a period of years. A Cumulative Improvement Standard could have a permit sunset clause that would suggest an appropriate number of years for an improvement to be tracked. This project would consist of two elements: an *improved permit tracking system* and *ordinance drafting*.

- Improved permit tracking system: Modify the current permit tracking system that was implemented on April 25th 2001 for this new use. Define the period of time in which improvements will be counted cumulatively.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $20,000

Project 19 Update – This will be included in the Floodplain Ordinance discussed in Project 14.

Mitigation Strategy: Project 20: Lowered Threshold Improvement Standard:
Another method to achieve a greater compliance with flood standards is to lower the threshold for substantial improvements from 50%. By lowering the threshold, more construction projects will need to comply with the flood-resistant construction criteria and it will be more difficult to avoid the regulations by "splitting" one project into several iterations. This project would consist of *threshold level research* and *ordinance drafting*.

- Threshold level research: Research an appropriate threshold level for substantial improvements.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $20,000

Mitigation Strategy: Project 20: Lowered Threshold Improvement Standard:
Another method to achieve a greater compliance with flood standards is to lower the threshold for substantial improvements from 50%. By lowering the threshold, more construction projects will need to comply with the flood-resistant construction criteria and it will be more difficult to avoid the regulations by "splitting" one project into several iterations. This project would consist of *threshold level research* and *ordinance drafting*.

- Threshold level research: Research an appropriate threshold level for substantial improvements.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $20,000

Project 20 Update – It was determined that the Michigan Building Code would not allow a lower percentage for the substantial improvement threshold to be regulated at the local level.

Mitigation Strategy: Project 21: Addition Improvement Standard:
The City of Ann Arbor could require that all additions to floodplain and floodway structures that are outside of the original footprint of the structure must comply with the requirements for new buildings in the floodplain and floodway. This project would consist of *ordinance drafting*.

Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
Timeframe – Year 2
Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $10,000

Project 21 Update – This will be included in the Floodplain Ordinance discussed in Project 14.

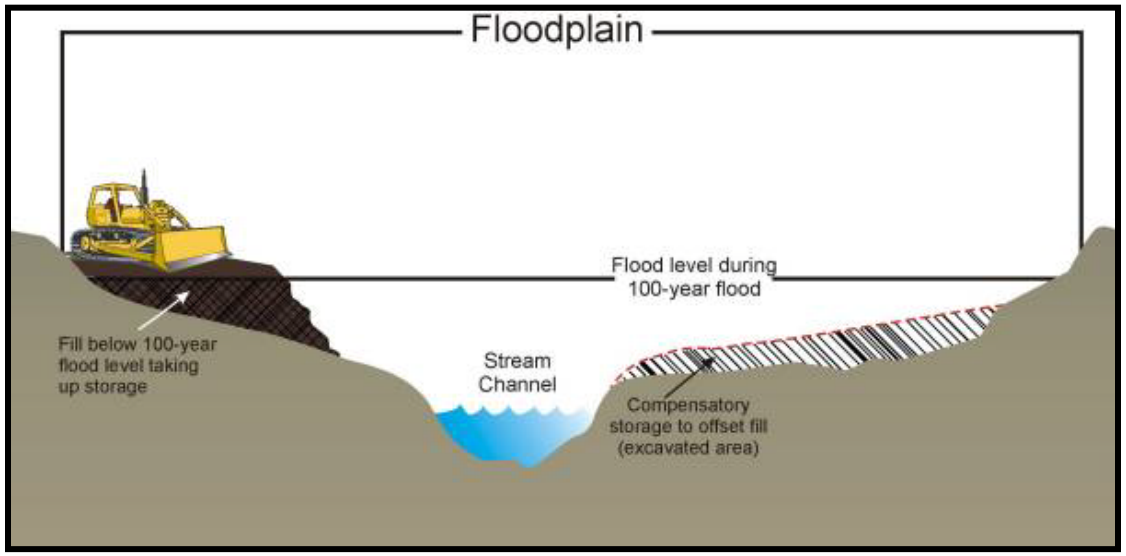
Mitigation Strategy: Project 22: Flood Fringe Limits:
The City could place additional restrictions on fill or buildings that displace floodwater in flood fringe. This could be achieved by requiring structures in the flood fringe to be placed on columns, to allow the free flow of floodwaters. This project would consist of *ordinance drafting*.

- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $10,000

Project 22 Update – This will be included in the Floodplain Ordinance discussed in Project 14.

Mitigation Strategy: Project 23: Equivalent Compensation:
Another approach would be to require hydrological equivalent compensatory storage, to replace all fill that is added. The City could require that all fill, whether it is in the form of buildings, earthen fill, barriers, etc. must be accompanied by the removal of an equivalent amount of material in or below the same hydrological area of the floodplain in which it is added. This approach would allow new buildings to be placed on mounds of fill if hydrological equivalent flood storage capacity is added elsewhere. This project would consist of a *methodology component* and *ordinance drafting*.



- Methodology component: Define a methodology for determining hydrological equivalency.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $20,000

Project 23 Update – This will be included in the Floodplain Ordinance discussed in Project 14.

Mitigation Strategy: Project 24: Green Infrastructure:
The City could place additional measures to protect or create natural features in the floodplain because green space aids in storm water conveyance. Natural features, trees, grasses, bushes, and other elements can be thought of as green infrastructure. Water quality improvements opportunities like rain garden installation or possible daylighting of creek segments can also be included. By protecting green space and natural features in the floodplain as green infrastructure, the City would acknowledge these resources as necessities and further commit to ongoing maintenance and restoration of this resource. This project would consist of a *feature characterization assessment* and *ordinance drafting*.

- Feature characterization assessment: Determine measures that will be used to define green infrastructure. Assess the floodplains to determine areas that will be characterized as green infrastructure zones.
    - Timeframe – Year 2
    - Cost – 3 staff at 0.1 time = $30,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $40,000

Project 24 Update – Independent from the FEMA grant to purchase 215 and 219 West Kingsley St., and to demolish the damaged home at 219 W. Kingsley St. (described further in Project #34), the City plans to install a rain garden at the site to increase stormwater infiltration and reduce flooding in the area. The City has contracted with the team of Conservation Design Forum (CDF) and PlantWise for rain garden design, construction, and maintenance services. Rain garden installation would follow a building demolition phase. Additionally, the Ann Arbor Public Art Commission will be working with CDF to potentially include an art installation at the site.

Mitigation Strategy: Project 25: Freestanding Structures and Obstructions:
Freestanding structures, like dumpsters, sheds, and even recreational structures like gazebos, fences, or picnic tables, can present a serious hazard during a flood event. The hydrodynamic forces of floodwater can sweep these objects up and lead to injuries and damming effects. In addition, the City right of way is used for parking of vehicles. Cars can be moved by floodwaters that reach two feet in depth. The City could regulate these potential hazards though a floodplain ordinance. This project would consist of three steps: conducting a *freestanding hazard assessment*, *regulatory approach* research, and *ordinance drafting*.

- Freestanding hazard assessment: Determine the number of industrial or commercial properties in the floodplain that have on-site waste storage and/or freestanding dumpsters, sheds, etc. Conduct a similar assessment for residential properties, apartment complexes, and public land. Determine how many public and private parking spots exist in the floodplain.
    - Timeframe – Year 2 - 3
    - Cost – 1 staff at 0.75 time = $75,000
- Regulatory approach: Research options for addressing the results of the freestanding hazard assessment.
    - Timeframe – Year 2 - 3
    - Cost – 1 staff at 0.2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City Floodplain Ordinance.
    - Timeframe – Year 2 - 3
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $105,000

Project 25 Update – This will be included in the Floodplain Ordinance discussed in Project 14.

Mitigation Strategy: Project 26: Prohibit Floodway Development:

The City of Ann Arbor could prohibit all new development in the floodway. This act would both preserve a long-term vision for reserving the floodway for flood events and support the other recommendations of this plan that deal with the protection of existing structures. This project would consist of *ordinance drafting*.

- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $10,000

Project 26 Update – This will be included in the Floodplain Ordinance discussed in Project 14.

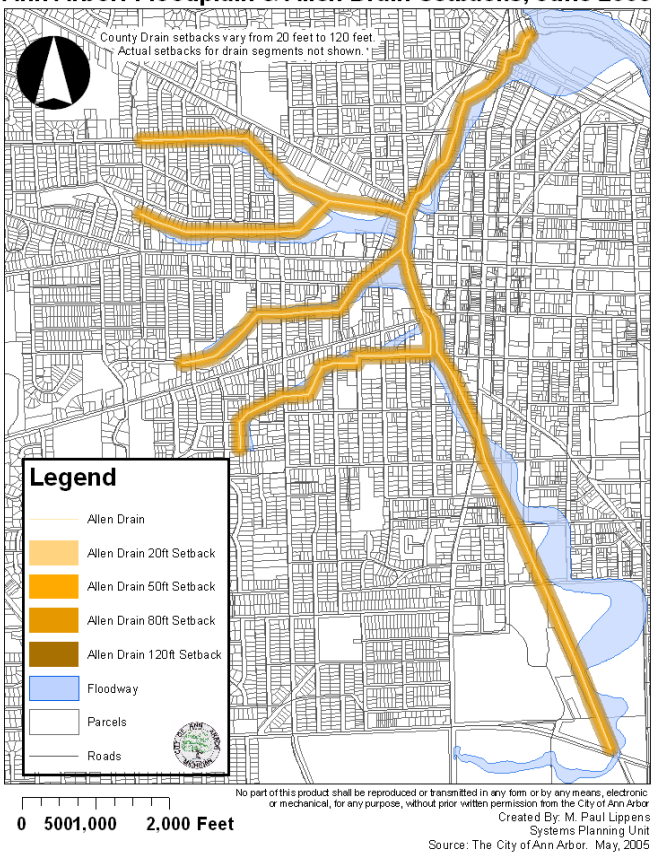
Mitigation Strategy: Project 27: Drain Setbacks:

Even though a drain is enclosed, it will still have an associated floodplain. In addition, there are portions of drains in Ann Arbor that do not have a Washtenaw County Drain Easement. The City of Ann Arbor could require a standard setback from enclosed drains in the floodplain. This project would consist of a *setback investigation* and *ordinance drafting*.

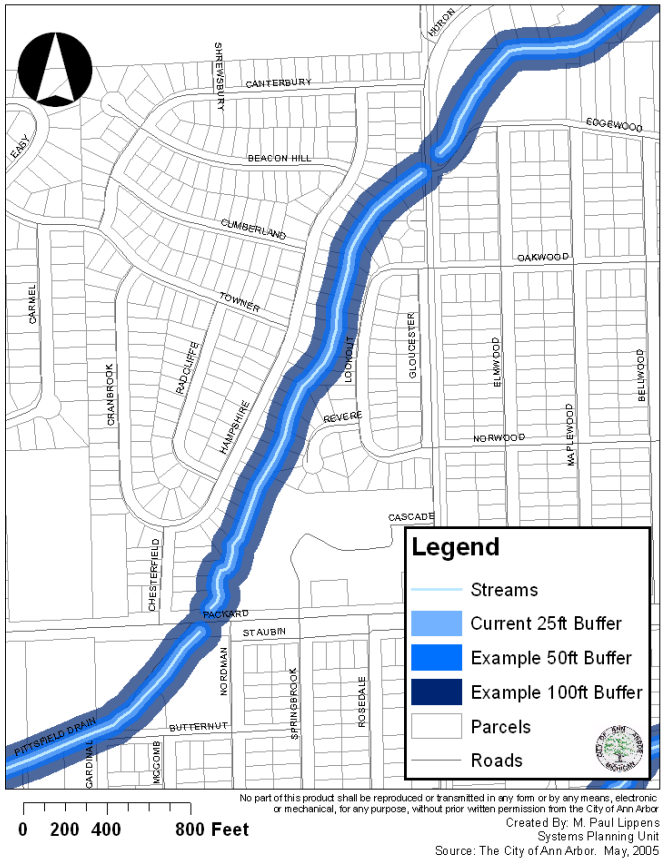
- Setback investigation: Gather data about the current drain easements in Washtenaw County. Compare these to the Setback requirements for open watercourses. Suggest an appropriate distance for drain Setback in the floodplains
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $20,000

Ann Arbor: Floodplain & Allen Drain Setbacks, June 2005



City of Ann Arbor: Mallets Creek Buffer, June 2005



City of Ann Arbor: Malletts Creek Buffer, June 2005

Mitigation Strategy: Project 28: Stream Buffer Zones:

Currently there is a required setback of 25 feet from streams in Ann Arbor. There are a number of methods that could be employed to make this buffer more effective in flood-prone areas.

- Change width to greater than 25 ft
- Measure buffer from floodway or floodplain edge
- Link buffer size to stream size, floodway size, or floodplain size
- Clarify the definition of buffer
  - Undisturbed zone
  - No-build zone
- Apply the buffer to non-site-planned projects

Implementing some or all of the above methods could create an effective way to regulate the floodplain. This project would consist of a *buffer zone definition* and *ordinance drafting*.

- Buffer zone definition: Investigate the above methods to create an appropriate definition of a Stream Buffer Zone for floodplains in Ann Arbor.
  - Timeframe – Year 2
  - Cost – 2 staff at 0.1 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $30,000

Mitigation Strategy: Project 29: Floodplain Open Space Dedication:

The City often requires that new developments set aside open space as a part of the site planning and approval process. Open space requirements are frequently applied to planned unit developments (PUDs) but can also be applied to other projects that need to offer public benefits, such as Brownfield developments. Currently, the City's Parks, Recreation, and Open Space (PROS) plan guides parkland dedication. The City of Ann Arbor could offer incentives to link open space dedication requirements to land in the floodplain and floodway. Consider the following examples.

- 1 acre onsite dedication = 0.25 floodway acres
- 1 acre onsite dedication = 0.5 floodplain acres

This would give the development community the option of utilizing their whole site and purchasing land in the floodway to dedicate to open space or get a premium for dedicating onsite floodplain land. This project would consist of a *land ratio investigation* and *ordinance drafting*.

- Land ratio investigation: Conduct an investigation to determine the appropriate land ratios to create incentives for floodplain open space dedication. Consider the economic values of land and the public benefit of the land in each alternative use.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $30,000

Mitigation Strategy: Project 30: Greenway Open Space Dedication:

The Above project, Floodplain Open Space Dedication, could be further refined by adding the requirement that the open space dedication be in the floodway or floodplain AND conform to a greenway plan. This project would consist of *additional land ratio investigation* and *ordinance drafting*.

- Additional land ratio investigation: Conduct additional investigation to determine the appropriate land ratios to create the incentive for floodplain and greenway open space dedication. Consider the economic values of land and the public benefit of the land in each alternative use.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $30,000

Mitigation Strategy: Project 31: Floodplain PDR and TDR:

The City of Ann Arbor could also create incentives for the protection of floodplain and floodway lands by enabling the City to purchase the development rights (PDR) of floodplain properties for mitigation activities. Likewise, a transfer of development rights (TDR) program allows residents and developers to purchase development rights in these areas and transfer the development rights for use in other areas of the City. If land in the floodplain was zoned for single-family residential use, the property owner could sell that use to a developer who could use that credit toward a density bonus on another property. This project would consist of a *PDR and TDR administration outline* and *ordinance drafting*.

- PDR and TDR administration outline: Outline the process for administering a PDR and TDR program for floodplain and floodway projects. Define how the rights that are purchased for each type of zoning in the floodplain could be applied to future development projects in other areas of the City. Consider a sending and receiving zone approach. Consider prioritization based on risk areas and vulnerability index. Additional prioritization can be based on parcels/buildings area, volume, assessed value, and/or replacement value. Decide what would happen to the land/rights after purchase, whether it would be dedicated to the City or if property owners could hold on to the properties and reserve some of the associated property rights.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.2 time = $20,000
- Ordinance drafting: Draft ordinance language to include this regulatory standard in a City of Ann Arbor Floodplain Ordinance.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.1 time = $10,000

Total Project Cost: $30,000

Mitigation Strategy: Corrective Actions:
Identify opportunities where corrective actions can be used to mitigate the flood risk for properties in the floodplain. NFIP and Code Minimum: Structural Flood Control and Flood Insurance: The City of Ann Arbor participates in the National Flood Insurance Program. This program offers flood insurance to property owners in the floodplain because they cannot be covered by standard homeowners insurance. The NFIP offers separate coverage, in addition to the standard reimbursement for property damage.

- Flood insurance can be purchased to cover part of the cost of relocation, acquisition, elevation, or other corrective mitigation actions.
- Increased Cost of Compliance (ICC) can provide additional mitigation funding, like structure replacement and the cost to bring the structure into compliance with the flood-resistant construction standards.

Flood insurance can also be purchased to cover damage to a structure's contents.

In addition to the insurance, there are several examples of structural flood control projects that the City of Ann Arbor has undertaken. Structural flood control projects are man-made system modifications that are believed to reduce flood risk and vulnerability. Some examples of structural flood control projects are: reservoirs, storage basins, levees, floodwalls, barriers, channel modifications, bridge and culvert improvements, dredging, and channel diversion. There is a misconception that structural flood control projects can significantly reduce the base flood elevation (BFE) of a floodplain, or perhaps eliminate the floodplain all together. While structural flood control projects may reduce flood damages, they also may cause adverse impacts like habitat destruction, a false sense of security, increased damages in the event of failure, high maintenance and construction cost, diversion of floodwaters, and reduction of the floodplains storage capacity. Some examples of structural flood control projects in Ann Arbor are:

- Private Storm Water Detention – The City requires site-planned projects to provide on-site storm water detention for first flush, bank full events, and 100-year (1% annual chance) storm events.
- Public Storm Water Detention – The City provides storm water detention in public projects like road improvements and parks and recreation construction projects whenever possible. Examples:

  - Fuller Road near the VA
  - Liberty Street Detention Facilities (Between Virginia and I-94)
  - Maple Road, South of Liberty
- The City has installed Storm Water Quality Devices at:
  - Packard Road
  - Stadium Blvd.
  - Benz Road
- The City installed the Depot Street Relief Drain that provides storm water conveyance in the 100-year (1% annual chance) floodplain through the 10-year (10% annual chance) storm event.
- The Washtenaw County Drain Commission provides regional storm water detention for the following water bodies:
  - Malletts Creek in Brown Park
  - Swift Run, north of I-94
  - Sister Lake Drain

Special Recommendation: Explore Joining the Community Rating System (CRS) – The City of Ann Arbor could explore joining the Community Rating System (CRS) that is managed through the National Flood Insurance Program. If the City joins the CRS, they will receive a ranking between 1 and 10, based on the overall flood management activities conducted by the municipality. For each rank below 10 all residents who purchase flood insurance will receive a 5% discount on their rate, up to a maximum of 45%. City of Ann Arbor residents currently pay $275,856 annually in flood insurance. Each 5% increment will save Ann Arbor residents $13,793, or $32 per policy. The discount received can help to defray any cost that residents may incur if they choose to voluntarily implement corrective mitigation actions on their property.

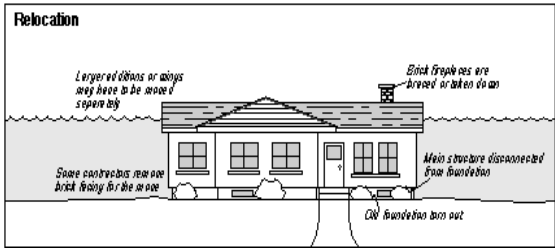
Mitigation Strategy: Project 32: Code Enforcement:

There may be instances where code regulations require property owners to make changes that are not enforced. Property owners may not know they are in violation or they may not want to incur the cost of compliance. If one property owner is allowed to violate a community flood standard, it could make it very difficult for City officials to enforce the standard at all. Code enforcement is currently taking place, but its emphasis may be increased. The City of Ann Arbor could increase its staff's ability to enforce of code. This project would consist of three elements: establish a *floodplain permit*, create a *floodplain permit review*, and conduct a *floodplain inspection*.

- Floodplain permit: Require that all projects in the floodplain acquire a special floodplain permit. Research and implement the permitting procedures.
  - Timeframe – Year 1
  - Cost – 1 staff at 0.1 time = $10,000
- Floodplain permit review: Permits requested in the floodplain need increased scrutiny. This requires extra staff time, training (see Objective 2), and a longer review period. The City could implement a performance-based service objective for floodplain properties that is longer than the length of the normal permit review service objective.
  - Timeframe – Year 1
  - Cost – 1 staff at 0.1 time = $10,000

- Floodplain inspection: Projects in the floodplain should be inspected. Staff time should be allotted for on-site follow up on all completed projects within the floodplain. Staff communication and on-site visits should be the standard service objective for all floodplain projects, even when flood-resistant construction compliance is not required.
    - Timeframe – Year 1
    - Cost – 1 staff at 0.5 time = $50,000

Total Project Cost: $70,000



Mitigation Strategy: Project 33: Relocation:
Relocating structures outside of the floodplain is the best way to assure that properties won't be damaged in flood events, but in some cases, moving structures to higher ground (on the same property) could reduce flood risk as well. Relocation projects will need to be examined case by case, but all properties that fit into the risk categories should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Mitigation Strategy: Project 34: Acquisition:
The City of Ann Arbor could consider acquiring properties for structure removal. Removing structures in the floodplain and floodway is the best method available to protect against flood damage. Properties could be considered for acquisition and removal if:

- The property fits into an open space or greenway plan
- The structure has no special (official) historic value
- The property owner is unwilling or unable to pursue another corrective measure.

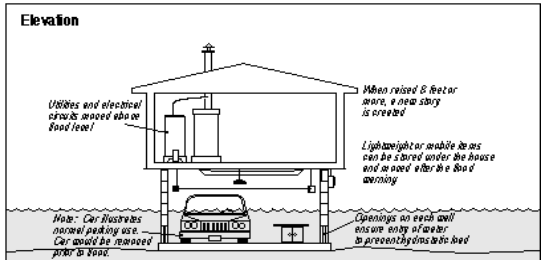
The City could also consider acquiring properties in the floodplain and floodway that do not have structures, to assure that they remain undeveloped. Acquisition projects would need to be examined case by case, but all properties that fit into the risk categories should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Project 34 Update – The City applied for and has been approved for a FEMA Pre-Disaster Mitigation Grant to purchase 215 and 219 West Kingsley St., and to demolish the damaged home at 219 W. Kingsley St. that sits in the Allen Creek floodway. On Sept. 7, 2010, FEMA issued a Grant Agreement to begin work on this project. The Ann Arbor City Council approved the acceptance of grant funds on Nov. 15, 2010. Purchase of the property and the deed restriction were completed on March 13, 2012. Demolition of this structure is expected to take place in 2012. The project maximum budget is $288,000 (City share: $72,000).

Mitigation Strategy: Project 35: Elevation:

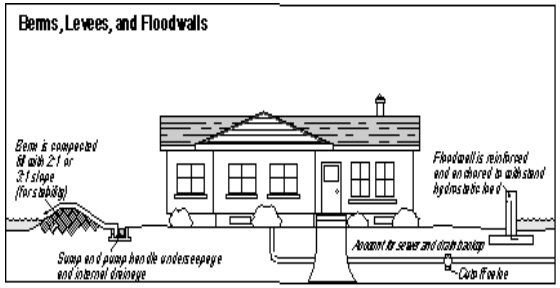


Structures in the floodplain and floodway can be protected from flood damage through elevation. The foundation of structures can be raised so that the first floor is above the base flood elevation of the floodplain. Elevation projects will need to be examined case by case, but all properties that fit into the risk categories should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Mitigation Strategy: Project 36: Barriers:

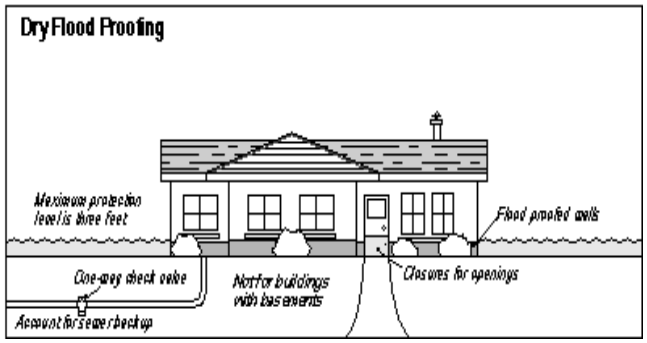


In some cases, barriers can be installed that protect the foundation from flood events. Barriers installed close to a foundation will have a minimal impact on displaced floodwaters and may in some cases be cheaper than alternative corrective measures. Barrier projects will need to be examined case by case, but all properties that fit into the risk categories should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Mitigation Strategy: Project 37: Dry Flood-proofing:

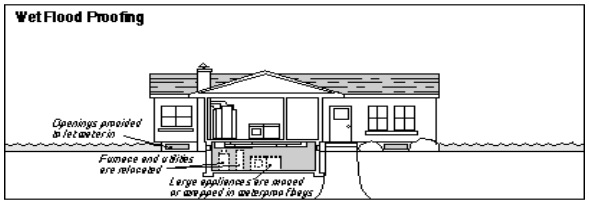


Dry flood-proofing is the process of sealing a building so that floodwaters cannot penetrate the foundation. Dry flood-proofing is a good option for structures with finished basements. Dry flood-proofing may be a good tool for historic districts that are exempt from the flood-resistant construction requirements or whose elevation may not be desirable, due to design standards. Dry flood-proofing projects will need to be examined case by case, but all properties that fit into the risk categories should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Mitigation Strategy: Project 38: Wet Flood-proofing:



Wet flood-proofing is the process of preparing to allow floodwater into a structure during a flood event. Furnaces, water heaters, fuse boxes, and other items stored in basements can be raised above the BFE, and "breakaway" walls can be installed that allow floodwaters in safely. Wet flood-proofing may be a good tool for historic districts that are exempt from the flood-resistant construction requirements

or in which elevation may not be desirable, due to design standards. However, wet flood-proofing is generally considered better for commercial properties than it is for residential properties. Wet flood-proofing projects will need to be examined case by case, but all properties that fit into the risk categories should be considered candidates, with priority going to the higher risk categories.

- Timeframe – Ongoing
- Cost – Case by case

Total Project Cost: TBD

Mitigation Strategy: Project 39: Floodplain-Monitoring Program:

To gauge the success of corrective measures, the City of Ann Arbor could implement a floodplain-monitoring program. As corrective mitigation projects are implemented, they can be tracked to judge which methods are the most successful in relation to the costs. This project will consist of two elements: *program outline* and *program monitoring*.

- Program outline: Define and outline the variables necessary to assess the variety of corrective measures taken in the floodplain. Prepare a work plan for the floodplain-monitoring program that assigns responsibilities to staff.
  - Timeframe – Year 4
  - Cost – 2 staff 0.2 time = $40,000

- Program monitoring: Implement the work plan defined for the floodplain-monitoring program.
  - Timeframe – 5 and ongoing
  - Cost – 1 staff at 0.1 time per year = $10,000 (ongoing)

Total Project Cost: $50,000

Mitigation Strategy: Project 40: Environmental Remediation:

The City of Ann Arbor could seek ways to pursue environmental remediation though floodplain management. Environmentally contaminated properties in the floodplain and the floodway present an additional risk in that, if flooded, the properties could spread the contamination onto adjacent lands and into the floodwaters and ecosystem. Additionally, household hazardous waste poses a threat in floodplain properties. There are currently known environmentally contaminated properties in the City's floodplain and floodway, and household hazardous waste may be present in many of the parcels identified in the vulnerability assessment. The remediation of contaminated sites should be pursued in conjunction with corrective measures taken for flood protection. Household hazardous waste removal should be instituted and prioritized for floodplain properties. Finally, dam removal opportunities are another area where there are potential environmental and flood mitigation benefits to be examined. Environmental contamination could be used as an additional factor for the risk categories, in determining a priority for implementation.

- Timeframe – Years 3, 4, 5 and ongoing
- Cost – Case by case

Total Project Cost: TBD

Mitigation Strategy: Infrastructure:

Evaluate the City's infrastructure within the floodplain and protect it from flood-related hazards. NFIP and Code Minimum: Currently, the City of Ann Arbor has no specific policy with regards to protecting infrastructure against flood events. Damage to infrastructure resulting from a flood will be handled as would damage resulting from any other Hazard; if damage were to occur, the City would respond by rebuilding or replacing the infrastructure.

Mitigation Strategy: Project 41: Public Buildings – Flood Audit & Flood Insurance:
The City does not currently hold flood insurance on any public properties in the floodplain and floodway. The properties are self-insured by the City. Conducting a flood audit would allow the City to evaluate which properties should be protected by flood insurance. This project would consist of an *audit report* and an *insurance evaluation*.

- Audit report: Compile a report on the current value and the replacement value of the City infrastructure within the floodplain and the floodway.
    - Timeframe – Year 3
    - Cost – 1 staff at 0.5 time = $50,000
- Insurance evaluation: Use the audit report to compare the replacement value with the cost of insurance.
    - Timeframe – Year 3
    - Cost – 1 staff at .1 time = $10,000

Total Project Cost: $60,000

Mitigation Strategy: Project 42: Critical Facilities – Flood Audit and Emergency Action Plans:
Critical Facilities located in or near the floodplain and floodway deserve special attention because of the function that they serve to the community: storing hazardous chemicals, serving as shelters, serving as emergency operation centers. The proximity of these facilities to flood-prone areas may inhibit their operation during flood events. The City of Ann Arbor could invest to protect critical facilities during a flood event. The City could conduct a *flood audit* of critical facilities, to assess their vulnerability, and encourage the facilities to develop *emergency action plans* to prepare for flood events.

- Flood audit: Conduct a flood audit that includes a list of hazardous substances stored in the floodplain and the roles that the facilities might play during a flood event. Include the value and replacement costs of the structure and the feasibility of relocation. Identify specific structures for relocation.
    - Timeframe – Year 3
    - Cost – 1 staff at 0.5 time = $50,000
- Emergency action plans: Work with critical facilities to develop emergency operation plans to assure their ability to function during a flood event.
    - Timeframe – Year 3
    - Cost – 1 staff at .5 time = $50,000

Total Project Cost: $100,000

Mitigation Strategy: Project 43: Critical Facilities – Higher Standards for New Critical Facilities:

As mentioned earlier, critical facilities are unique in that they require special attention to protect them from vulnerability from flood events. The federal standard is to go beyond the 100-year flood event and protect critical facilities from the 500-year flood event. In much of the City the 500-year floodplain has not been mapped. In these areas it may make sense to have a proximity definition. For example, all critical facilities within ¼ mile from the 100-year floodplain or the area should be 1-2 feet above the BFE. This project would require two steps: the definition of the *critical flood zone* and the application of the *"critical facilities – flood audit and emergency action plans"* project to the defined zone.

- Critical flood zone: Define the protected area for critical facilities, based on flood vulnerability and risk.
  - Timeframe – Year 3
  - Cost – 1 staff at 0.1 time = $10,000
- Critical facilities – flood audit and emergency action plans: See earlier project definition and apply it to the Critical Flood Zone area.
  - Timeframe – Year 3
  - Cost – 1 staff at full time = $100,000

Total Project Cost: $110,000

Project 43 Update – This will be included in the Floodplain Ordinance discussed in Project 14.

Mitigation Strategy: Project 44: Open Space Creation:

Most floodplain managers would agree that the best use for the floodplain is open space—that "The floodplain is for floods." The more open space that is created in the floodplain, the easier it will be for flood waters to pass through the system—less obstruction = less damage. One obvious way to create open space is to acquire land for parks and recreation. However, there is also a non-recreational component of open space—the landscape. Natural features, trees, grasses, bushes, and other elements can be thought of as green infrastructure. The maintenance and creation of green infrastructure can be extremely beneficial to a floodplain's ability to handle a storm event. The development of a greenway plan can be a catalyst to link a parks and recreation component with the concept of green infrastructure creation. Open space creation can be divided into three processes: *green infrastructure assessment*, a *greenway plan*, and *land acquisition & construction*.

- Green infrastructure assessment: Conduct a natural features inventory of the floodplain and floodway. Create a strategy that outlines opportunities for improvements.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.75 time = $75,000

- Greenway plan: Develop a greenway plan to implement the recommendations of the Green Infrastructure Assessment. Target land for acquisition, including pocket parks and linear corridor easements. Plan greenway amenities.
    - Timeframe – Year 3
    - Cost – 3 staff at 0.25 time = $75,000
- Land acquisition & construction: Use a flood loss estimation model to target properties or easements, to incorporate the results of the green infrastructure assessment and the greenway plan.
    - Timeframe – Year 4 - 5
    - Cost – 1 staff at full time = $100,000 + land & construction cost

Total Project Cost: $250,000 + land & construction cost.

Project 44 Update – There is a lot of public interest in this project. A nonprofit organization, the Allen Creek Greenway Conservancy, has formed to attempt to create the greenway envisioned by this project. City Council passed a resolution in December of 2011 directing City Staff to assist the Allen Creek Greenway Conservancy in their efforts.

Mitigation Strategy: Emergency Services:
Develop and/or refine a flood response/preparedness method for servicing the community before and after flood-related disasters. NFIP and Code Minimum: The City of Ann Arbor has an Emergency Response Plan that is maintained by the City's Office of Emergency Management. In addition to this plan, the City maintains a web page designed to help residents prepare for an emergency and respond in the event of an emergency. This website offers instructions to residents on several emergency situations common in the State of Michigan, including floods. This website offers information about flood forecasts, flood warnings and watches, and flash flooding. It also offers instructions on what residents should do before a flood event, during a flood warning, during a flood event, and after a flood event.

Mitigation Strategy: Project 45: Flood Preparedness Plan:
The City of Ann Arbor could pursue the development of a flood preparedness plan that deals specifically with responding to flood events. A flood preparedness plan could include information and processes that are specific to flood events, and that are not necessarily covered in a generic emergency response plan. A flood preparedness plan may involve the following elements:

- Creating a flood threat recognition system: Create a system that predicts the time and the height of the flood crest through the measurement of rainfall, stream flow, and soil moisture.
    - Timeframe – Year 2
    - Cost – 2 staff at 0.5 time = $100,000 + Technology
- Flood warning: Further define the process involved in flood warnings and response; how a flood warning will be distinguished from other disasters.
    - Timeframe – Year 2
    - Cost – 1 staff at 0.1 time = $10,000
- Flood information and instructions: Create a plan for the distribution of information in a flood event,
    - Timeframe – Year 2

  - Cost – 1 staff at 0.1 time = $10,000
- Flood response actions and responsible parties: Clearly define the actions and responsibilities of different agencies and emergency responders during flood events. Make sure those organizations are aware of their role in a response.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.5 time = $50,000
- Flood stage forecast map: Prepare a flood stage forecast map to aid emergency responders in responding to a flood event. A flood stage forecast map would show which areas of the City would be affected at different flood heights. Topographic information can be used to determine which areas will flood first and the time that these areas may be at risk. This information can be used to warn specific houses in the affected area.
  - Timeframe – Year 2
  - Cost – 1 staff at 0.2 time = $20,000

Total Project Cost: $190,000

Mitigation Strategy: Watershed Recommendations:
The watersheds in the City of Ann Arbor have specific considerations and there are many mitigation strategies and activities that could benefit one watershed that may not be applicable to another. The different watersheds in the City have different development patterns and pressures. The Allen Creek watershed is centrally located in the downtown area where there are considerable commercial use considerations, while Traver and Swift Run have agricultural land uses to consider. Both Malletts and Millers Creek have additional commercial uses to consider. This section is dedicated to mitigation strategy recommendations that apply to the specific watershed systems. Additional projects can be added in future revisions of this plan as identified.

Mitigation Strategy: Project 46: Watershed Management Planning – Huron River:
Review watershed plans for the Huron River and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Ann Arbor Flood Mitigation Plan (and other plans, as opportunities arise).

Mitigation Strategy: Project 47: Huron River Impoundment Study:
The City of Ann Arbor is currently undertaking a study of the impoundment areas of the Huron River in the area. The City should look for opportunities to implement flood mitigation strategies as this project unfolds.

Project 47 Update – After an extensive public engagement process, the Huron River Impoundment Study was completed in 2009. The planning process and report can be found at:
http://www.a2gov.org/government/publicservices/systems_planning/environment/hrimp/Pages/HRIMP.aspx

Mitigation Strategy: Project 48: Watershed Management Planning – Newport Creek:
Conduct a watershed management planning study for Newport Creek and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Ann Arbor Flood Mitigation Plan (and other plans, as opportunities arise).

Mitigation Strategy: Project 49: Watershed Management Planning – Traver Creek:

Review existing watershed plans for the Traver Creek and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Ann Arbor Flood Mitigation Plan (and other plans, as opportunities arise). Conduct a watershed management planning study.

Mitigation Strategy: Project 50: Historic District Preservation – Allen Creek:
Examine guidelines in the building code and the historic preservation ordinance that apply to floodplain management. Examine ways to apply regulatory measures to historic districts.

Project 50 Update – This may be included in the Floodplain Ordinance discussed in Project 14.

Mitigation Strategy: Project 51: Railroad Berm Fill Removal – Allen Creek:
Examine ways to remove the berm located between Depot St. and the Huron River to allow floodwater to travel to the river without a major barrier impeding the flow, acting like a dam. There are numerous structures within the influence of the railroad berm located near the mouth of Allen Creek. If the berm could be opened up enough to restore the floodplain to its more typical depth, some structures may no longer be within the smaller floodplain. Structures that would remain in the floodplain would experience reduced flood depth and reduced flood risk. The city desires to determine the feasibility of opening up the railroad berm near the mouth of Allen Creek and compare the project cost to the decreased cost associated with the lowered risk to the structures currently in the floodplain. Federal Emergency Management Agency (FEMA) Benefit-Cost Analysis (BCA) software will be used to determine the potential of a FEMA Pre-Disaster Mitigation Grant Program fundable project.

Project 51 Update – This project is currently underway. A request for proposals (RFP 836) was issued by the City in May of 2012. Proposals were due by June 25, 2012. The goal of the project is to determine the feasibility of opening up the railroad berm enough to reduce or eliminate its effect on the Allen Creek floodplain. The railroad berm near the mouth of Allen Creek is oriented perpendicular to the overland flow and causes the floodplain depth to be as deep as 10 feet. Upstream of the influence of this berm, flood depths are more typically in the 3 to 5 foot range. If the berm could be opened up enough to restore the floodplain to its more typical depth, some structures may no longer be within the smaller floodplain. Structures that would remain in the floodplain would experience reduced flood depth and reduced flood risk. It is anticipated that the feasibility study will be completed by the end of 2012. If a project is determined to be feasible, the City will pursue funding for the project.

Mitigation Strategy: Project 52: Watershed Management Planning – Allen Creek:
Review existing watershed plans for the Allen Creek and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Ann Arbor Flood Mitigation Plan (and other plans, as opportunities arise). Conduct a watershed management planning study.

Mitigation Strategy: Project 53: Downtown City-Owned Sites – Allen Creek:
The City of Ann Arbor owns several properties in the floodplain and floodway. Attachment 3 of this plan, the *Floodplain Policy Discussion*, was initiated by the City of Ann Arbor Planning Commission, and discusses the various policy options for addressing City-owned property in the floodway. In addition, in 2006, the Ann Arbor City Council assembled a greenway task force charged with looking at three of the City's largest holdings in the area. All city properties are opportunities for corrective mitigation actions. These

sites should be examined for priority implementation. The recommendations of the reports mentioned above should also be considered for mitigation funding, provided they are consistent with the recommended strategies of this plan.

Project 53 Update – In March of 2007, the Allen Creek Greenway Task Force completed a study of the three large publicly owned properties within the lower reach of the Allen Creek floodplain. Several options were developed for each site, but all keep the floodway free of buildings. The report can be accessed at: http://www.a2gov.org/greenway/Pages/AllenCreekGreenwayHome.aspx

Throughout the past five years, the City has gone through numerous committees and planning processes to determine the fate of these three sites, including a request for proposal process at 415 W. Washington St. No conclusions have yet been made about any of the sites, but they remain a high priority for the City.

Additionally, the City applied for and has been approved for a FEMA Pre-Disaster Mitigation Grant to remove a large vehicle storage building and a salt storage building on a City owned property at 721 North Main St. Accepting the grant will require the floodway to be deed-restricted. The project cost estimate is $116,000 (City share $29,000). The project was delayed since the City and County All Hazard Mitigation Plan had expired. FEMA cannot issue the final paperwork to begin work on removing these structures until the Hazard Mitigation Plan is updated and approved by FEMA, a requirement fulfilled by this current document.

Mitigation Strategy: Project 54: Watershed Management Planning – Malletts Creek:
Review the Malletts Creek Restoration Plan and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Ann Arbor Flood Mitigation Plan (and other plans, as opportunities arise).

Mitigation Strategy: Project 55: Watershed Management Planning – Millers Creek:
Review the Millers Creek Watershed Improvement Plan and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Ann Arbor Flood Mitigation Plan (and other plans, as opportunities arise).

Mitigation Strategy: Project 56: Watershed Management Planning – Swift Run:
Conduct a watershed management planning study for Swift Run and incorporate recommendations that are consistent with flood mitigation objectives into future revisions of the Ann Arbor Flood Mitigation Plan (and other plans, as opportunities arise).

Risk #10 - Civil Disturbances

The City of Ann Arbor is home to a major educational institution, The University of Michigan. Sporting events may give rise to riots, or civil disturbances. Since the University of Michigan houses the largest stadium in the United States, which seats over 113,000 persons, coordination to facilitate resident safety during sporting events is a necessity.

The City of Ann Arbor is also the cultural center of Washtenaw County. Given this, it is reasonable to assume that festivals, demonstrations or protests may also ignite undesirable behavior that requires police response.

Goal: Reduce the potential for civil disturbance occurrence, and ensure the best response to such events.

Mitigation Strategy: Training
- Continue to train local law enforcement agencies on crowd control.
- Police maintain a multi-jurisdictional Mobile Field Force (MFF) to respond to large scale Preplanned and spontaneous disturbances.
- Facilitate close working relationships with the Michigan Department of State Police and the Michigan National Guard.

Risk # 11 - Transportation Accidents: Land and Air

The most vulnerable areas with regard to transportation accidents are Interstate 94 (I-94), the railroad, and the nearby Ann Arbor Airport. These locations are near highly populated areas, and therefore have the potential to give rise to a serious accident.

Goal: Increase the City's ability to respond to transportation accidents, reducing the impact of such incidents on the community.

Mitigation Strategy: Training
- Continually train and equip emergency responders to handle transportation accidents, aircraft accidents and mass casualty accidents involving all modes of transportation.
- Train and maintain the Hazardous Materials Team.

Mitigation Strategy: Ordinances
- Establish road regulations, and enforce weight restrictions.
- Adoption of Hazardous Spills Expense Recovery Ordinances.

Risk # 12 - Public Health Emergencies

The most vulnerable area is the expansive river, lake, wetland, stormwater and sewer systems that are all potential breeding grounds for West Nile Virus or other mosquito- borne diseases.

Goal: Reduce the risk of Public Health Emergencies. Objective: Increase public awareness of public health emergencies, and the steps to take to reduce exposures

Mitigation Strategy: Plans
- Work with the Washtenaw County Department of Public Health on a public education plan, and on implementation of the plan.

Mitigation Strategy: Programs
- Work with Public Health officials to facilitate vaccinations and encourage residents to be vaccinated for all communicable diseases.
- Continue annual public information campaigns.
- Conduct annual larvicide application in the City at an annual cost of approximately $25,000.

Mitigation Strategy: Surveillance of Source and Finished Water

- Continue to monitor source and finished water for indicators of disease-causing organisms.

Risk # 13 - Sabotage and Terrorism

Goal: Decrease the risk of sabotage and terrorism, and increase the City's capacity to anticipate, manage and withstand potential incidents involving sabotage and terrorism. Prepare residents and businesses for sabotage or terrorism events.

Mitigation Strategy: Public Education

- Distribute an Emergency Preparedness booklet.

Risk # 14 Infestation- Pest Infestations of Trees

Goal: Reduce the vulnerability of Ann Arbor's trees to a catastrophic infestation of an exotic insect or disease.

Mitigation Strategy: Plan, Monitor, Diversify

- Adopt and implement the Urban and Community Forest Management Plan recommendations.
- Develop a pruning cycle to increase the health of trees and reduce their susceptibility to infestation.
- Develop and implement a pest monitoring program.
- Educate residents on exotic, invasive pests, including signs, symptoms and how to report their appearance.
- Continue to diversify the species composition to reduce the impact that a species-specific insect/disease will have on the urban forest.

5.0 Implementation, Funding, Maintenance, Monitoring, and Participation

The purpose of this plan is to identify mitigation strategies that will be implemented before, during or after a disaster to permanently eliminate or reduce risks to human life and property from natural, technical or societal hazards. The following sections present implementation actions, funding sources and the method for monitoring the plan.

5.1 Implementation

The following schedule is given for hazard mitigation strategies described in Section 4.0. Specific completion dates have not been included, since such dates are generally subject to multiple uncertain factors, and implementation will only begin after the mitigation strategy has been approved. While all strategies are important, priority has been given to those that may be funded by a FEMA hazard mitigation grant program (see Section 5.2). Action on strategies will also depend upon staff, resource and funding availability, with a particular emphasis upon activities that are likely to provide the most benefit for the amount of cost involved in achieving them.

High Priority Strategies

Mitigation Strategy: Plans
Modify master plans to include hazard mitigation strategies.

Responsible Agency: The City of Ann Arbor.
Estimated Cost: ***Additional/New*** **Staff Time**.

Mitigation Strategy: Training
Hold annual and semiannual training events for all departments and staff integral to effective hazard response and prevention. Also, schedule awareness training for the City Council, the Planning and Environmental Commissions, and the Environmental and Emergency Management Teams.

Responsible Agency: The City of Ann Arbor.
Estimated Cost: $10,000 - $15,000 annually.

Mitigation Strategy: Emergency Generators
Secure funding for replacement and upgrade emergency generators for key facilities like the Police Department, Dams, Department of Public Works, Fire Stations, City Hall, and fixed generator lift and pump stations.

Responsible Agency: The City of Ann Arbor.
Estimated Cost: $35,000 per generator.

Mitigation Strategy: Repetitive Loss Properties
Investigate the willingness of those who own FEMA-identified repetitive loss properties to undertake flood mitigation actions, using the federal grant funds potentially available through programs such as the Repetitive Flood Claims Program, the Severe Repetitive Loss Program, and the Flood Mitigation Assistance Program. (Alternatives include the Pre-Disaster Mitigation Program and the Hazard Mitigation Grant Program, but a greater percentage of federal match dollars may be obtained from the programs that are specific to repetitive loss properties.)

Responsible Agency: The City of Ann Arbor (Emergency Management or Flood Coordinator)
Estimated Cost: Varies by structure, but the best federal grants could cover 100% of the costs. Other grants would likely cover 75%. Private owners might be willing to provide the non-federal match component of such grants, making the City's cost primarily administrative in nature (the cost of staff time to apply for, oversee, and monitor grants and project implementation).

Other Important Strategies

Mitigation Strategy: Public Education
Distribute materials to residents. See the Family Preparedness Kit description in section 4.0.

Responsible Agency: The City of Ann Arbor.
Estimated Cost: $115,000 annually.

Mitigation Strategy: Dams
Maintain dams based on Federal and State regulations.

Responsible Agency: The City of Ann Arbor.
Estimated Cost: Staff Time

Mitigation Strategy: Flood Planning

- Review and update the Flood Mitigation Plan information for the City of Ann Arbor, based upon new FIRM information, and incorporate this information into the next edition of the all-hazards mitigation plan by 2016.
- Conduct exercises, including those required by the FERC to maintain compliance and improve preparedness, response, and recovery planning.

Responsible Agency: The City of Ann Arbor, Emergency Management, Flood Coordinator, and Planning Offices.
Estimated Cost: Staff Time

Mitigation Strategy: Programs

- Work with Public Health officials to facilitate vaccinations and encourage residents to be vaccinated for all communicable diseases.
- Continue annual public information campaigns and larvicide application for the prevention of West Nile Virus in the City

Responsible Agency: The City of Ann Arbor.
Estimated Cost: Staff Time & Include in Education Brochure (See Above).

Mitigation Strategy: Continued Compliance with the NFIP
Continue to process, distribute, be involved with, and answer questions about all information regarding the NFIP, including its new maps and identified repetitive loss properties within the City. Continue to explore the means by which the Community Rating System might be used by the City to obtain reductions in flood insurance premiums for flood-insured residents and property owners. Continue to build awareness of flood insurance and promote its use.

Responsible Agency: The City of Ann Arbor, Emergency Management, Flood Coordinator, and Building/Planning agencies.
Estimated Cost: Staff time

5.2 Sources of Financial Assistance

Implementation of the mitigation strategies is often dependent on funding assistance from Federal and State sources. FEMA provides funding for "bricks-and-mortar" projects through the Hazard Mitigation Assistance Program, which includes the Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, the Flood Mitigation Assistance Program, the Severe Repetitive Loss Program, and the Repetitive Flood Claims Program. Additional sources of hazard mitigation funds might be found in the numerous programs listed in Attachment C of the Michigan Hazard Mitigation Plan (March 2011 edition), which can be found at the MSP/EMHSD publications page at http://www.michigan.gov/msp/0,4643,7-123-1593_3507-14743--,00.html . Some of these are listed in Attachment 1 of this plan.

FEMA emphasizes the implementation of structural mitigation strategies. The strategies listed in this plan that qualify for FEMA funds include those with physical elements of an enduring nature, such as the altering or removal of properties within a vulnerable area, or the installation or expansion of protective infrastructure. Certain types of hazard mitigation funds have also allowed the purchase of emergency generators and warning sirens, which serve important functions in protecting the area's population, infrastructure, and critical facilities.

Financial support for other mitigation strategies proposed in this plan may be sought through alternative funding sources. For example, funds for public outreach, equipment and training may be obtained through the FEMA Emergency Management Performance Grant (EMPG). Projects may be implemented with the assistance of non-profit organizations, or funds secured from Community Foundations. There are many State and Federal programs that are available to local governments, as provided in Attachment 1.

5.3 Plan Maintenance

Maintenance of the plan is the responsibility of the City of Ann Arbor's Director of Emergency Management. Where appropriate, hazard mitigation goals, objectives and strategies will be recommended for inclusion in Ann Arbor master plans and will make use of the opportunity to comment that is required under the Municipal Planning Act and the Township Planning Act. The review and updating of this document should occur every 5 years to ensure that the City remains eligible for hazard mitigation funding sources, and that the plan continues to comply with mandated FEMA planning guidelines for hazard mitigation.

5.4 Monitoring, Evaluating, and Updating the Plan

The plan will be monitored on a regular basis, as the responsibility of the City of Ann Arbor Director of Emergency Management. The lists of prioritized mitigation strategies will be periodically reviewed, and discussion, meetings, or site visits will take place as needed to allow Emergency Management to monitor progress toward hazard mitigation activities, assess the adequacy of protective efforts, and identify any new or additional vulnerabilities that may be faced by the City and may need to be addressed in a future update of this plan. Emergency Management will note the number of projects pursued, and any known reasons for delays or lack of interest/pursuit of listed and proposed project ideas and strategies.

Although review of the plan will occur periodically in an ongoing basis, a formal revision will be needed in an official update of the plan approximately every five years, based on annual reviews, amendments, monitoring, evaluation and accumulation of official feedback and public input, in order to maintain the City's eligibility to apply for, receive, and directly benefit from federal funds for hazard mitigation projects. The revised plan will again be adopted by the City of Ann Arbor City Council, and this is next expected to take place in 2017 (five years after the completion of this current 2012 plan).

In addition to the City's review process, consisting of review by the Environmental Commission, Planning Commission, and final

approval by City Council, the City will also submit at least one draft (more, if required or appropriate) to the State of Michigan (Michigan State Police, Emergency Management) for review. Review opportunities will then be provided to FEMA. The plan will be approved at the Local, State, and Federal Level.

Evaluation of the plan during this monitoring, maintenance, and update process will be headed by the City's Emergency Management staff, assisted as needed by other agencies and subject matter experts from the local, state, and federal levels, and possibly including private firms and knowledgeable citizens. Experts connected with the University of Michigan may be consulted for their input, and reports from law enforcement, area fire and emergency medical staff, newspapers, and citizen feedback will also be considered. The primary criteria for plan evaluation will be (1) Has some information in the plan gone out-of-date? (2) Have new hazards or sources of risk been recently identified or publicized? (3) Have political priorities, funding sources, agency partners, or other opportunities changed so that certain possibilities have greater or lesser feasibility since the plan was last completed? (4) Have new development patterns or specific projects emerged within the City that require a new assessment of vulnerabilities? (5) Have there been changes in population patterns, major events, available technology, or common lifestyle characteristics, which may have affected vulnerability within the City? (6) Have new sources of information become available that provide new insights into particular risks and vulnerabilities of the City? These issues will all be considered to evaluate the validity, relevance, and feasibility of the hazard mitigation strategies and risk/vulnerability assessments contained in this plan.

5.5 Continued Public Participation

Continued public participation will be incorporated in the plan maintenance process. In addition to the ordinary opportunities that the public has to contact City officials and agencies, and the numerous open meetings held by the City for various purposes that may result in new information or opinions presented by members of the public, additional opportunities will specifically be sought and used to build the public's awareness of the City's hazard mitigation plan and to encourage the public to review and provide comments or questions about it to the City's Emergency Management office. Hazard Mitigation Plans have been, and will continue to be, posted on the City of Ann Arbor's public website for review and comment—first in draft forms and then in the final adopted form (currently completed in August 2012). Links to staff E-mail addresses along with telephone numbers will be provided for continual public comment; and all members of the community may attend any public meeting of city (public notice will be posted in ways that meet the requirements for open meetings), township and county legislative boards to make public comment and recommend changes to the plan. The plan will be referred to, discussed, and described at relevant public meetings, such as those of the City Council, and references to it will be made in the various public education and outreach activities described earlier. Efforts to further integrate hazard mitigation concepts into the City's master plan processes will provide additional means by which to increase the public's awareness of, and opportunities to review and comment upon, this hazard mitigation plan. Interviews with, and public announcements by, Emergency Management and related City staff and partners will provide additional opportunities for increasing public awareness and interest in the City's hazard mitigation and planning efforts. These will vary by circumstance, whether cautions about West Nile Virus, severe winter weather, extreme temperature events, infrastructure failures, terrorist reports, or severe summer weather, drought, and flooding. By keeping the plan available on the City's web site with an invitation and instructions on providing feedback, public awareness and comment opportunities will be maintained on a round-the-clock basis, 365 days per year. In an age of declining newspaper circulation and specialized media (narrowcasting), many residents today find the internet to be the most convenient and accessible means of connecting with the city and becoming informed about hazard risks and hazard mitigation activities. The internet has become an essential supplement to the traditional patterns of physical public record-keeping (at offices and libraries), as well as

the traditional patterns of public meetings (many of which may be observed remotely through video transmissions, rather than attended in person by all of the members of the public who are interested).

Attachment 1 – Alternative Funding Sources

Funding Source	Civil Disturbance	Drought	Earthquake	Extreme Temperature	Scrap Tire Facilities	Structural Fire	Wildfire	Dam Failure	Flooding: Riverine	Flooding: Urban	Hazardous Materials Incidents - Fixed Site	Hazardous Materials Incidents - Transportation	Infrastructure Failure	Nuclear Attack	Nuclear Power Plant Incidents	Oil/Nat Gas Well Incidents	Petrol/Nat Gas Pipeline Incidents	Public Health Emergencies	Sabotage/Terrorism	Hail	Lightning	Severe Winds	Severe Winter Weather	Transportation Accidents	Tornado	**Financial Assistance**	**Technical Assistance**
FEDERAL SOURCES																											
Business and Industry Loans	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
CDC-Investigations and Technical Assistance																		√								√	
CEPP Technical Assistance Grants Program											√	√						√								√	√
Community Assistance Program-State Support Services Element (NFIP)								√	√	√																	√
Community Development Block Grant/Economic Development Initiative									√	√			√									√				√	
Community Development Block Grant/Entitlement Grants	√	√	√	√	√	√	√	√	√	√	√	√	√					√	√	√	√	√	√	√	√	√	
Community Development Block Grant/Small Cities Program	√	√	√	√	√	√	√	√	√	√	√	√	√					√	√	√	√	√	√	√	√	√	
Community Development Block Grant/State's Program	√	√	√	√	√	√	√	√	√	√	√	√	√					√	√	√	√	√	√	√	√	√	
Community Disaster Loans	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Community Facilities Loans and Grants	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Community Outreach Partnership Center Program	√	√	√	√	√	√	√	√	√	√	√	√	√					√	√	√	√	√	√	√	√	√	
Conservation Reserve Program									√	√												√			√	√	√
Cooperative Forestry Research							√																			√	
Cora Brown Fund	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	
Direct Housing Natural Disaster (Very Low/Low Income Loans)						√	√		√											√	√	√			√	√	
Disaster Housing Program	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Disposal of Federal Surplus Property (Transfers)									√																		
Economic Adjustment Assistance								√	√	√												√			√	√	
Economic Development Tech Assistance									√																	√	√
Emergency Advance Measures for Flood Protection								√	√	√																√	

City of Ann Arbor

Funding Source	Civil Disturbance	Drought	Earthquake	Extreme Temperature	Scrap Tire Facilities	Structural Fire	Wildfire	Dam Failure	Flooding: Riverine	Flooding: Urban	Hazardous Materials Incidents - Fixed Site	Hazardous Materials Incidents - Transportation	Infrastructure Failure	Nuclear Attack	Nuclear Power Plant Incidents	Oil/Nat Gas Well Incidents	Petrol/Nat Gas Pipeline Incidents	Public Health Emergencies	Sabotage/Terrorism	Hail	Lightning	Severe Winds	Severe Winter Weather	Transportation Accidents	Tornado	**Financial Assistance**	**Technical Assistance**
FEDERAL SOURCES																											
Emergency Community Water Assistance Grants		√							√		√		√					√	√							√	
Emergency Conservation Program		√							√													√			√	√	
Emergency Flood and Shelter National Board Program	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Emergency Management Institute-Resident Ed Program	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
Emergency Management Institute-Training Assistance	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
Emergency Management Performance Grants	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Emergency Management-State and Local Assistance	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√
Emergency Operations Flood Response and Post-Flood Response								√	√	√																√	
Emergency Rehabilitation of Flood Control Works								√	√																	√	
Engineering Grants	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Farmland Protection Program									√																	√	
Fire Suppression Assistance							√																			√	
Fisheries Disaster Relief		√					√	√	√	√	√	√							√							√	
Flood Insurance								√	√	√																	√
Flood Mitigation Assistance									√	√																√	
Flood Plain Management Services								√	√	√																	√
Food Control Projects								√	√																	√	
Forestry Incentives Program																						√			√	√	
Forestry Research									√	√												√			√	√	
Grants for Public Works and Economic Development								√	√	√			√													√	

City of Ann Arbor

Funding Source	Civil Disturbance	Drought	Earthquake	Extreme Temperature	Scrap Tire Facilities	Structural Fire	Wildfire	Dam Failure	Flooding: Riverine	Flooding: Urban	Hazardous Materials Incidents - Fixed Site	Hazardous Materials Incidents - Transportation	Infrastructure Failure	Nuclear Attack	Nuclear Power Plant Incidents	Oil/Nat Gas Well Incidents	Petrol/Nat Gas Pipeline Incidents	Public Health Emergencies	Sabotage/Terrorism	Hail	Lightning	Severe Winds	Severe Winter Weather	Transportation Accidents	Tornado	**Financial Assistance**	**Technical Assistance**
FEDERAL SOURCES																											
Grants-in-Aid for Railroad Safety-State Participation												√												√			√
Habitat Conservation																										√	
Hazard Mitigation Grant Program	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
HazMat Training Program for Implementation of SARA											√	√															√
Health Program for Toxic Substances and Disease Registry											√							√								√	
Highway Planning and Construction													√													√	√
Historic Preservation Funds Grants-In Aid						√			√	√										√	√	√	√		√		√
HOME Investment Partnerships Program									√	√										√	√	√				√	
Hydrologic Research		√						√	√	√																√	
Individual and Family Grant Program		√	√	√			√	√	√	√																√	
Planning Grants (HazMat Emergency Preparedness Grant)											√	√														√	
Motor Carrier Safety												√															√
National Dam Safety Program							√																				√
National Pollutant Discharge Elimination System Related State Program Grants																√	√	√								√	
National Urban Search and Rescue Response System			√										√						√						√	√	
North American Wetlands Conservation Fund									√	√																√	
Nursing Homes						√																				√	
Planning (Land and Water Conservation Fund Grants)									√																	√	
Physical Disaster Loans	√		√		√	√			√	√			√						√	√	√	√	√		√	√	
Pipeline Safety																√	√									√	

City of Ann Arbor

	Civil Disturbance	Drought	Earthquake	Extreme Temperature	Scrap Tire Facilities	Structural Fire	Wildfire	Dam Failure	Flooding: Riverine	Flooding: Urban	Hazardous Materials Incidents - Fixed Site	Hazardous Materials Incidents - Transportation	Infrastructure Failure	Nuclear Attack	Nuclear Power Plant	Oil/Nat Gas Well Incidents	Petrol/Nat Gas Pipeline Incidents	Public Health Emergencies	Sabotage/Terrorism	Hail	Lightning	Severe Winds	Severe Winter Weather	Transportation Accidents	Tornado	**Financial Assistance**	**Technical Assistance**
FEDERAL SOURCES																											
Project Impact: Building Disaster-Resistant Communities	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Protection Clearing and Straightening Channels									√																	√	
Protection of Essential Highways, Highway Bridge Approaches, and Public Works								√	√																	√	
Public Assistance Grant Program	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Public Health and Social Services Emergency Fund (Post-Declaration Only)																		√								√	
Public Telecommunications Facilities Planning and Construction																									√	√	
Railroad Safety												√												√			√
Resource Conservation and Development		√	√	√			√		√	√																	√
Rivers, Trials, and Conservation Assistance									√																		√
Rural Business Opportunity Grants									√																	√	
Rural Development Grants									√				√													√	
Rural Electrification Loans													√								√	√	√		√	√	
Rural Housing and Economic Development	√	√	√	√	√	√	√	√	√	√	√	√	√					√	√	√	√	√	√	√	√	√	
Rural Housing Site Loans and Self-Help Housing and Development Loans									√																	√	
Snagging and Clearing for Flood Control								√	√																	√	
Soil and Water Conservation		√	√	√			√		√	√																	√
State and Community Highway Safety												√												√			√
State Domestic Preparedness Equipment, Support Program																			√							√	
Superfund State Site-Specific Cooperative Agreements											√							√								√	
Superfund Technical Assistance Grants for Citizen Groups at Priority Sites											√															√	√
Surveys, Studies, Investigations and Special Purpose Grants											√	√			√	√	√	√								√	

Funding Source	Civil Disturbance	Drought	Earthquake	Extreme Temperature	Scrap Tire Facilities	Structural Fire	Wildfire	Dam Failure	Flooding: Riverine	Flooding: Urban	Hazardous Materials Incidents - Fixed Site	Hazardous Materials Incidents - Transportation	Infrastructure Failure	Nuclear Attack	Nuclear Power Plant Incidents	Oil/Nat Gas Well Incidents	Petrol/Nat Gas Pipeline Incidents	Public Health Emergencies	Sabotage/Terrorism	Hail	Lightning	Severe Winds	Severe Winter Weather	Transportation Accidents	Tornado	**Financial Assistance**	**Technical Assistance**
FEDERAL SOURCES																											
Technology Development for Environmental Management												√			√											√	
Very Low Income Housing Repair Loans/Grants				√		√	√		√											√	√	√			√	√	
Very Low to Moderate Income Housing Loans				√		√	√		√											√	√	√			√	√	
Water and Waste Disposal System for Rural Communities									√		√		√					√	√							√	
Water/Waste Disposal Loans/Grants									√		√		√					√								√	
Watershed Protection and Flood Prevention								√	√	√								√								√	√
Watershed Surveys and Planning		√							√																		√
Weatherization Assistance for Low-Income Persons				√																						√	
Wetlands Protection-Development Grants									√	√																√	
Wetlands Reserve Program									√	√																√	√
Wildlife Habitat Incentive Program									√																	√	

City of Ann Arbor

Funding Source	Civil Disturbance	Drought	Earthquake	Extreme Temperature	Scrap Tire Facilities	Structural Fire	Wildfire	Dam Failure	Flooding: Riverine	Flooding: Urban	Hazardous Materials Incidents - Fixed Site	Hazardous Materials Incidents - Transportation	Infrastructure Failure	Nuclear Attack	Nuclear Power Plant Incidents	Oil/Nat Gas Well Incidents	Petrol/Nat Gas Pipeline Incidents	Public Health Emergencies	Sabotage/Terrorism	Hail	Lightning	Severe Winds	Severe Winter Weather	Transportation Accidents	Tornado	**Financial Assistance**	**Technical Assistance**
STATE OF MICHIGAN																											
Department of Agriculture																											
Energy Conservation Program									√													√				√	√
Groundwater Stewardship Program											√							√								√	√
Inter-County Drain Program (available to Drain Commissioner only)								√	√	√																	√
Economic Development Corporation																											
Community Development Block Grant									√	√			√													√	
Urban Land Assembly									√																	√	
Environmental Quality																											
Abandoned Well Mgmt. Program																		√								√	
Alternate Water Supply Replacement Program									√	√	√		√					√								√	
Brownfield Redevelopment Grants											√							√								√	√
Drinking Water Revolving Loan Fund													√					√	√							√	
Municipal Landfill Cost-Share Grant Program																		√								√	
Non-community Water Supply Program Grant																		√								√	
Scrap Tire Collection Site Cleanup Grants					√																					√	
State Revolving Loan Fund									√	√			√					√								√	
Wellhead Protection Program																		√								√	
Wetland Program Development									√	√																√	

City of Ann Arbor

Funding Source	Civil Disturbance	Drought	Earthquake	Extreme Temperature	Scrap Tire Facilities	Structural Fire	Wildfire	Dam Failure	Flooding: Riverine	Flooding: Urban	Hazardous Materials Incidents - Fixed Site	Hazardous Materials Incidents - Transportation	Infrastructure Failure	Nuclear Attack	Nuclear Power Plant Incidents	Oil/Nat Gas Well Incidents	Petrol/Nat Gas Pipeline Incidents	Public Health Emergencies	Sabotage/Terrorism	Hail	Lightning	Severe Winds	Severe Winter Weather	Transportation Accidents	Tornado	**Financial Assistance**	**Technical Assistance**
STATE OF MICHIGAN																											
Housing Development Authority																											
Community Development Block Grants/Housing Resource Fund						√			√	√										√		√			√	√	
Home/Property Improvement Loans						√			√	√										√		√			√	√	
Department of Natural Resources																											
Habitat Improvement Fund Project Grants									√																	√	
Land and Water Conservation Fund									√																	√	
Natural Resources Trust Fund						√			√																	√	
Recreational Trails Program Grants									√																	√	
Urban and Community Forestry Program																						√	√		√	√	
Volunteer Fire Assistance					√	√	√																			√	
State Police																											
Emergency Management Performance Grants	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Flood Mitigation Assistance									√	√																√	√
Hazard Mitigation Grant Program	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Individual and Family Grant Program									√	√			√													√	

City of Ann Arbor

Funding Source	Civil Disturbance	Drought	Earthquake	Extreme Temperature	Scrap Tire Facilities	Structural Fire	Wildfire	Dam Failure	Flooding: Riverine	Flooding: Urban	Hazardous Materials Incidents - Fixed Site	Hazardous Materials Incidents - Transportation	Infrastructure Failure	Nuclear Attack	Nuclear Power Plant Incidents	Oil/Nat Gas Well Incidents	Petrol/Nat Gas Pipeline Incidents	Public Health Emergencies	Sabotage/Terrorism	Hail	Lightning	Severe Winds	Severe Winter Weather	Transportation Accidents	Tornado	**Financial Assistance**	**Technical Assistance**
STATE OF MICHIGAN																											
State Police (continued)																											
Interagency HazMat Public Sector Training and Planning Grants (HazMat Emergency Preparedness Grant)											√	√		√	√	√	√									√	
Project Impact	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Public Assistance Grant Program	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Department of Transportation																											
Rail Loan Assistance Program												√	√													√	
Trans. Econ. Development Fund								√	√	√																√	
Department of Treasury																											
Municipal Bond Authority-Local Government Loan Program				√		√			√	√			√						√	√	√	√	√	√		√	
Municipal Bond Authority-State Aid Note Program				√		√			√	√			√						√	√	√	√	√	√		√	

Attachment 2 – Floodplain Policy Discussion

Document Index

Introduction

On June 5, 2001, the City Planning Commission asked staff to present them with policy options for floodplain parcels owned by the City. The goal of this document is to inform policy primarily on City-owned parcels, but discussion of specific policy options also explores the implications for privately-owned properties in the floodplain. As the City moves forward with this policy discussion, it will become more important to involve the community, especially because of the implications for private property in the floodplain. Parcels administered by the Parks and Recreation Department and used as recreational space are generally not included in this analysis. However, policy decisions made by the City will impact future use of those parcels as well.

Floodplain Background

The City of Ann Arbor contains property that is located within the floodplains for five drainage basins: Allen Creek, Malletts Creek, Swift Run, Traver Creek, and the Huron River (see cover page map). The following background information provides a framework for discussion of policy options.

Definitions

Base Flood/100-year flood – The flood having a one-percent chance of being equaled or exceeded in any given year.

"Cavity" Effect – The spread of property disinvestment from vacant/condemned properties to adjacent properties.

Community Rating System (CRS) – A program of the Federal Emergency Management Agency for communities participating in the National Flood Insurance Program. A municipality may apply for a higher rating (the default is 10) of their floodplain management system. Property owners receive a 5 percent discount on flood insurance for each one-point improvement in the municipality's score. The CRS also provides a guide to what FEMA values in floodplain management.

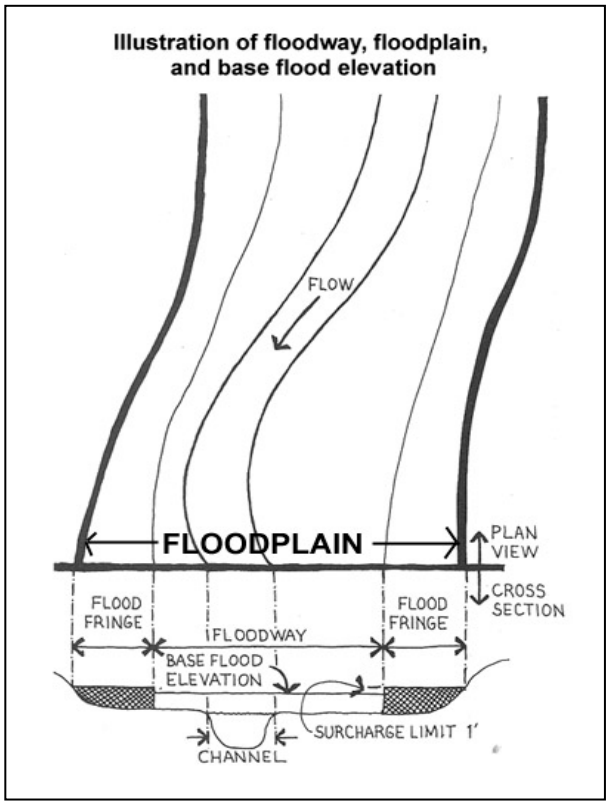
FEMA – (Federal Emergency Management Agency) The agency responsible for emergency planning and management at the federal level. FEMA administers the National Flood Insurance Program.

Floodplain – The area covered by floodwaters in a 100-year flood. (The floodplain *contains* the floodway and the flood fringe.)

Flood Fringe –The area of floodplain that does *not* have a strong current, i.e. the area not identified as the floodway.

Floodway – The area of floodplain where the water is flowing.

National Flood Insurance Program (NFIP) – Allows property owners in the floodplain to receive a subsidy for flood insurance. If communities do not enforce floodplain regulations, property owners in the City must pay market rate for flood insurance.



Shadow of Condemnation – The belief, founded or unfounded, that property will be condemned by a public entity. This belief typically causes disinvestment and neglect.

City-owned properties in the floodplain

This document focuses on City-owned properties with structures in the floodplain. The City can also utilize City-owned floodplain parcels without structures to maximize storm water management space. Examples of unobstructed floodplain parcels are parks, vacant lots, and parking lots. The City owns 13 parcels/parcel groups in the floodplain, other than parkland. They are:

With structures in floodplain

- 406 Maple Ridge (single-family dwelling)
- 3432 Platt (single-family dwelling)
- 223 S. Seventh (four duplex dwellings)
- 3457 Platt (four duplex dwellings)
- 2800 Ellsworth (Landfill structure)
- North Main City Yard (123 W. Summit etc.) (three maintenance buildings)
- Parks & Recreation Maintenance Yard (415 W. Washington etc.) (several maintenance buildings)

No structure on parcel

- Surface parking at William & First (216 W. William etc.)
- 404-406 S. Ashley (parking leased to Avalon housing; not mapped)
- 1585 Jones (vacant parcel; not mapped)
- Other Springbrook parcels (vacant; mapped with 3432 Platt)

Structure on parcel not in floodplain

- 2756 Hikone (not mapped)
- 805 W. Washington (not mapped)

These properties are described in Appendix A, toward the end of this document.

Public right-of-way in the floodway

Flooded streets represent a special hazard to human life, as do flooded sidewalks and other right-of-way surfaces. According to FEMA, over half of all fatalities associated with flash flooding are automobile-related. Just two feet of moving water is enough to wash away any size passenger vehicle, including trucks and SUVs, because of their proportionate buoyancy. Lower levels of moving water can also cause vehicles to lose traction. Depending on water velocity, even a few inches of flowing water can be dangerous to pedestrians.

This document focuses on parcels, not right-of-way. Looking ahead, however, the City may wish to address safety in the right-of-way with policies in the following areas:

- Emergency Response Plan
- Guidelines for new right-of-way through the floodplain

- Guidelines for creating access to flood-prone areas
- Permanent road signage in the floodway
- Public information campaigns

The City may also consider using right-of-way for storm water surcharge storage. Several Illinois municipalities currently use streets to temporarily store storm water surcharge, apparently motivated by problems with a combined sewer system (see References).

Note on floodplain mapping

The Michigan Department of Environmental Quality must certify the floodplain and floodway boundaries for any specific development site. The digitized maps currently used by the City show the floodplain and floodway as they were digitized from the Floodplain Insurance Rate Map (FIRM) paper copies, and have been determined to be accurate within 50 feet.

In the City of Ann Arbor, Swift Run's floodway and flood elevations are unmapped by FEMA, and Miller's Creek has not been studied at all, possibly because of its small catchment area (2.35 square miles). Recent site studies have also shown that the Allen Creek floodway may be underestimated on current FIRMs. For some policy goals, the City may consider commissioning hydrologic studies of these areas. For example, a new study of the Swift Run floodplain and floodway may show that the Springbrook parcels (3432 Platt, etc.) are outside the floodplain, or at least the floodway.

Regulatory Framework for Floodplain Policy

The focus of Michigan regulation is to "assure that the flow carrying capacity of a watercourse is not harmfully obstructed, and that the floodway portion of the floodplain is not used for residential construction" (Michigan Department of Environmental Quality (MDEQ) webpage). The laws governing floodplains are contained in Part 31 – Water Resources Protection, within the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended. State regulations are coordinated with the Federal Emergency Management Agency (FEMA).

Michigan State Laws
(NREPA, 1994 PA 451, Part 31 – Water Resources Protection; new Michigan Building Code)

Existing structures, residential or commercial/industrial, may continue to be maintained as they stand, subject to the following:

- *Substantial Improvement Rule.* For existing structures, if improvements worth over 50% of the value of the building are made, the structure must be brought into compliance with the regulations below.
- *Historic structure exemption.* Those structures listed on the National Register of Historic Places or a State Inventory of History Places are exempt from the substantial improvement rule.

No new residential construction is allowed in the floodway.

Residential construction is allowed in the flood fringe, outside the floodway but in the 100-year floodplain. However, all floors, including the basement, must be 1 foot above the flood level. Floodproofing is not sufficient for residential structures in the flood fringe.

Commercial and industrial construction are allowed in the floodway and floodplain but must have all floors elevated one foot above the flood water level or be floodproofed. However, development in the floodplain is subject to special scrutiny by the Michigan Department of Environmental Quality and will not be approved if it compromises floodwater movement or storage.

County Drain Commissioner's limits on building in the floodplain

Drain easement. The County Drain Commissioner requires a 30-foot easement to either side of the centerline of underground or aboveground creeks under County jurisdiction. This places distinct limits on any structures proposed for the area around the floodway, even those in compliance with building codes.

City regulations affecting floodplains

Chapter 57 (Subdivision and Land Use Control) of the City Code requires new development within the floodplain to create no net loss of floodwater storage capacity.

Floodplain Management Resolution. The City of Ann Arbor has passed a resolution pledging to adhere to the federal and state regulations governing floodplain development.

City Goals Related to Floodplain Properties

The future of floodplain properties touches on many issues related to the public health, safety and welfare of the City of Ann Arbor. This policy discussion focuses on interests as expressed in the laws, resolutions and plans adopted by the State of Michigan or the City of Ann Arbor.

	Goals	Related plans, laws, & resolutions
Two central goals	**1. Minimize life endangerment**	• MI: Part 31 of the NREPA • FEMA/NFIP: 44 CFR Parts 59-78 • Ann Arbor Floodplain Management Resolution
	2. Minimize property damage and loss	• MI: Part 31 of the NREPA • FEMA/NFIP: 44 CFR Parts 59-78 • Ann Arbor Floodplain Management Resolution
Related goals	a. **Preserve market value** of existing real property	• City Long Term Financial Plan (p. 7) • Central Area Plan (pp. 27-28) • West Area Plan (p. 36)
	b. Promote **water quality and ecological health** of each creekshed	• Parks and Recreation Open Space Plan (pp. F35-F36)
	c. **Reduce Allen Creek Drain contamination** to reduce outflow of contaminants into the Huron River	• Parks and Recreation Open Space Plan (p. F32)
	d. **Create Allen Creek Greenway** in floodplain area	• Downtown Plan (pp. 54, 57, 58)
	e. Preserve **neighborhood character**	• Central Area Plan (p. 24) • West Area Plan (p. 36)
	f. Create **affordable housing** on vacant	• Central Area Plan (pp. 25-26) • West Area Plan (p. 38)

Goals	Related plans, laws, & resolutions
City-owned parcels g. **Retain National Flood Insurance Program** by limiting/prohibiting development in floodplain	• Ann Arbor Floodplain Management Resolution • West Area Plan (p. 33)

Detailed Policy Discussions

The following represent several potential policy options for City-owned property in the floodplain. A summary table of all options and their relationship to community goals is provided in Table 1. Table 2 outlines probable short-term outcomes for the properties with structures and others under consideration for development.

1: DO NOTHING (No change to current policy)

City would buy and sell properties in the floodplain just as any other landowner would. Parks and Recreation Department may long-term assume management responsibilities for properties in line with their goals for land acquisition.

Short Term:

Residential properties: no immediate changes. Properties continue under possibility of destruction/damage through flooding.

Non-residential properties: no immediate changes. Properties continue under possibility of destruction/damage through flooding.

Long Term:

Residential properties will become vacant through natural loss of structure (fire, flood, etc.) or high maintenance needs (over 50 percent of value of structure), after which they cannot be rebuilt under Michigan laws.

Non-residential properties will need extensive remodeling when normal maintenance needs exceed 50 percent of the value of the property. At this point, buildings must be brought into compliance with Michigan State building code (all floors must be elevated to one foot over 100-year flood level or flood-proofed) which may be cost-prohibitive for their continued use.

Parks and Recreation Department assume administration over some parcels, but with a limited mandate, may not wish to focus on these issues. The current PROS (Parks and Recreation Open Space) Plan makes related recommendations, but acquisition is not focused specifically on floodplain properties.

Pro (DO NOTHING)

- Preserves old neighborhoods as long as possible, as they are
- Preserves older, more affordable housing stock

Con (DO NOTHING)

- Not clear when, if ever, Allen Creek Drain could be cleared of contaminants
- No plan for eventual replacement of housing that clears over time (e.g., Springbrook properties, where thwarted plans for housing development have left land in limbo)
- "Cavity" effect may accelerate over time as floodplain structures are removed or, like 3432 Platt, are allowed to decay in place
- Improvement of creekshed conditions indefinitely postponed

For Private Property, extending the DO NOTHING policy would also...

…(+) postpone tax income loss from floodplain property

…(+) retain commercial & industrial tax income

…(+) be short-term neutral for "shadow of condemnation"

…(–) contribute long-term to "cavity" effect

2: REACTIVE RESPONSE (Monitor natural decay of structures, and aggressively convert properties past a certain point of decay; provide some support for properties bordering on the floodplain.)

The City would begin by setting standards for levels of structural decay that lead to a building being unfit for occupancy. City-owned residential and non-residential properties would be measured based on these standards regularly. Properties which surpass pre-determined levels of maintenance needs (approaching demolition) would be converted to usable open space aggressively to prevent decayed structures from blighting neighborhoods.

For private properties, a tracking system would be set up to follow assessments, building inspections, and other measures of structural maintenance needed/completed on floodplain properties. This would also lead to conversion (through grants or public acquisition) to usable open space. In addition, the City could initiate a program of grants and other incentives for home improvements on parcels within a certain distance of floodplain properties.

For City properties in good shape, decisions would be made as in the DO NOTHING approach (buy and sell as any other property owner).

Short term

The need for this program will not be immediate, especially when the real estate market in Ann Arbor is strong. This program may however provide some security for the housing market should it decline or stop growing.

Long term:

As floodplain properties age, fall into disrepair and are declared unfit for occupancy, this program would become more important. The program can also shift funding to the private sector by encouraging neighbors to purchase empty lots.

Pro (REACTIVE RESPONSE)

- Avoids "cavity" effect.
- Avoids "shadow of condemnation" effect.
- Preserves neighborhood strengths at minimal cost.
- Preserves older housing abutting the floodplain.

Con (REACTIVE RESPONSE)

- Does nothing to reduce danger to property or life.
- Does not improve ecological health of the creekshed.
- Would be most costly at times of economic and real estate market weakness.

For Private Property, extending the REACTIVE RESPONSE policy would also...

(-)…cause increased open space in the floodplain, long-term increasing the value of other floodplain properties. This would make these properties more expensive should the City wish to purchase them at some point in the future.

(-)…cause increased open space, long-term reducing the rate of attrition through neglect, thereby prolonging the life of structures which are out of compliance with code.

3: REDEVELOPMENT AS NON-RESIDENTIAL (Since residential redevelopment in the floodplain is prohibited, promote commercial/industrial redevelopment that is consistent with floodplain regulations (elevated or floodproofed).)

No change to residential properties (406 Maple Ridge, 3432 and 3457 Platt, and 223 Seventh) unless they become marketable for commercial or industrial redevelopment. Non-residential structures would be torn down and their uses relocated (Ellsworth landfill structure, City Yard on N. Main, Parks and Recreation Maintenance facility at 415 W. Washington), and the City would sell these parcels for redevelopment with elevated/floodproofed buildings.

Short term

If any residential properties were commercialized, neighborhoods would likely see some change. Selling City properties in the floodplain could create revenue sources for other floodplain activities, however. Some overlay zoning or new floodplain zoning policy would be required in residential areas.

Private developers may find flood-appropriate building techniques prohibitively expensive, especially in high flood elevation areas. Barrier-free access, for example, is more expensive in elevated buildings.

Long term:

Neighborhoods would be reconfigured around a line of industrial/commercial properties similar to current areas around railroad lines. Storm water flow may improve somewhat if buildings are elevated on 'stilts' to allow water to pass beneath.

Pro (REDEVELOPMENT AS NON-RESIDENTIAL)

- Preserves real property values of parcels in floodplain.

Con (REDEVELOPMENT AS NON-RESIDENTIAL)

- Not in line with spirit of National Flood Insurance Program.
- Makes very little contribution to ecological health of floodplain.
- Not clear when Allen Creek Drain can be cleaned to reduce outflow of contaminants into the Huron River.
- No contribution to affordable housing; may call for removal of current affordable housing stock at some point.
- Neighborhood character would change with new buildings and new uses inserted.
- Puts newer property in path of flood and liable to damage if floodproofing fails.

For Private Property, extending the REDEVELOPMENT AS NON-RESIDENTIAL policy would also...

(+)…bolster value of commercially viable properties in floodplain.
(-)…create some neighborhood upheaval as businesses spring up along the floodway.
(-)…leave a policy void for properties which are not suitable for commercial redevelopment.

4: FLOODPLAINS FOR FLOODS (Plan to remove all structures, replace with parks/open space)

Residential properties (406 Maple Ridge, 3457 and 3432 Platt, and 223 Seventh) would be torn down and converted to parks. Non-residential structures would be torn down and their functions relocated (Ellsworth landfill structure, City Yard on North Main, Parks and Recreation Maintenance facility at 415 W. Washington).

Short term:

Funding sources are not clear for relocation of residents, but if it were successful, removing residential structures would create some upheaval in the affected neighborhoods. The City would also need to work to manage the demolition and park/open space conversion to prevent the "cavity" effect. For example, 3432 Platt (one of the Springbrook properties) has a single-family home that is currently standing vacant and is decaying rapidly for lack of another plan for the site or the structure.

Relocating non-residential structures (City Yard on North Main, 415 W. Washington) would be costly, especially with no revenues from sale of current sites. Some stretches of Allen Creek Drain would be open to cleanup.

Long term:

If this policy were carried out with private parcels, eventually the City would have a large greenway through several parts of Ann Arbor. Some sites are likely to be valuable enough that owners would prefer to flood-proof buildings than move, however, meaning the greenway will be incomplete.

Pro (FLOODPLAINS FOR FLOODS)

- Allen Creek Drain would be open to cleanup on City maintenance sites.
- Parkland/open space could be beneficial to neighborhoods if constructed properly.
- Prevents accidental loss of property, danger to life.

Con (FLOODPLAINS FOR FLOODS)

- Real property value would be lost by changing use (where the value of a City-owned site is measured by the cost of building a new one).
- Funding source unclear, both for conversion and maintenance.
- Loss of affordable housing units.
- Loss of residential continuity in neighborhoods.
- "Cavity" effect could be detrimental to neighborhood if new open space is not managed properly.

For Private Property, extending the FLOODPLAINS FOR FLOODS policy would...

(+)…remove residents from flood-prone properties

(-)…need a vigilant City staff to minimize "shadow of condemnation"

(-)…possibly cause real property value loss on parcels earmarked for condemnation.

(-)…if project were only partially completed, could cause detrimental "cavity" effect

(-)…cause a loss of business/property tax revenue

5: VARIED RESPONSE BASED ON FLOOD LEVEL (Rate the risk to each parcel in the floodplain based on flood elevations; depending on risk level, apply policy avenues 1-4.)

For residential properties where flood elevations have been determined (406 Maple Ridge and 223 Seventh), the policy would be DO NOTHING/OCCUPY CRUMBLING STRUCTURES. They would be kept in use – until decay takes over – because the flood elevations are relatively low (less than two feet) at these parcels. Long-term, the non-residential value would be tracked to determine if properties could be redeveloped (REDEVELOPMENT AS NON-RESIDENTIAL); otherwise, they would be converted to private or public open space.

Non-residential structures in the Allen Creek floodplain would fall under the FLOODPLAINS FOR FLOODS policy. They would be torn down and their functions relocated (City Yard on North Main, Parks & Recreation Maintenance facility at 415 W. Washington). Non-residential parcels without structures (e.g., parking lot at William and First) would not be built on if the flood elevation levels were above two feet.

The Swift Run floodplain would be studied to determine the flood elevations for the Springbrook Properties, 3457 Platt, and the structure on the City landfill (2800 Ellsworth). Action would be taken based on this information.

Short term:

The City must cover the loss of property value as the two maintenance facilities are downgraded to a lower use (open space/parks). This loss can be understood as the cost of building new sites for these functions. Also, the City must cover costs of cleaning and renovating these two properties, which are likely to have some contamination. Residential properties would see no changes.

Long term:

The City would have two high-quality parks for use near the downtown area. The parks could also be designed to improve storm water management.

As the residential properties are lost to natural decay and destruction, the City will need to invest in a productive re-use for these areas.

Pro (VARIED RESPONSE BASED ON FLOOD LEVEL)

- Minimizes life endangerment and potential for property damage by prioritizing areas with deep waters.
- Preserves neighborhood character in areas with low flood elevations.
- Preserves the value of real property in areas with low flood elevations.

Con (VARIED RESPONSE BASED ON FLOOD LEVEL)

- Lowers the value of property with high flood elevations.
- Does not quite align with the spirit of the National Flood Insurance Program, in that it creates a new flood risk measure not endorsed by the NFIP.
- The City would need to seek expert help in specifying an appropriate flood risk measure (based on elevations, possibly also considering duration of flooding and flood water velocity).

For Private Property, extending the VARIED RESPONSE BASED ON FLOOD LEVEL policy would...

(+)…remove residents and workers from buildings likely to flood to high levels.

(-)…cause upheaval in neighborhoods where flood elevations would call for removing houses.

(-)…cause a loss of tax revenue if industrial properties in the deeper areas of the Allen Creek floodplain are condemned by the City.

(-)…cause "shadow of condemnation" problems for areas falling under the FLOODPLAINS FOR FLOODS policy (those under deeper water).

6: VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN (Rate the risk to each parcel and to different areas within each parcel based on whether it is in the floodway or the flood fringe, allowing limited structures to remain/be built in the flood *fringe*, while allowing no structures to remain or be built in the flood*way*.)

Areas of parcels in the floodway are closed to all new structures. City-owned structures in the floodway would be removed. The City would seek funds from grants or other sources to remove existing structures. Also, the City may commission a study of the Swift Run floodway to determine which areas are in the floodway.

In the flood fringe, critical facilities would be prohibited. This would disallow the City Yard and the Parks maintenance building, as well as housing used for disabled or elderly occupants. Ideally, these areas would have 'unoccupied' structures only (e.g., parking decks).

Existing structures in the flood fringe would be brought into code compliance as the opportunity arises. The City would seek funds for bringing such buildings into compliance.

Short term:

Residents of the current 12 units in floodplain properties would be relocated. Most buildings would be removed from City-owned areas within the floodplain. Appropriate redevelopment of the flood fringe (no critical facilities) would be examined parcel by parcel.

Long term:

City properties would be in full compliance with FEMA regulations and recommendations for floodplain properties. Re-use (park, open space, surface parking) of non-structured parcel space would have to be determined separately.

Pro (VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN)

- Some structured uses would still be allowed in the flood fringe (in contrast to FLOODPLAINS FOR FLOODS policy).
- Limited redevelopment as non-residential would be allowed in the flood fringe areas.
- Prevents low-income tenants from being housed in flood-prone dwellings.

Con (VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN)

- Using the flood fringe for parking puts property in the way of floodwaters.
- Funding for resident relocation, and new City facilities unclear.

For Private Property, extending the VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN policy would...

(+)…remove residents from flood-prone properties

(-)…need a vigilant City staff to minimize "shadow of condemnation"

(-)…possibly cause real property value loss on parcels earmarked (or suspected to be earmarked) for condemnation.

(-)…if project were only partially completed, could cause detrimental "cavity" effect

(-)…cause a loss of business/property tax revenue

Table 1: Policy avenue pro/con overview, relative to City goals

Goals / **Policies**	1. Minimize Life Endangerment	2. Minimize Property Damage	a. Preserve Value of Real Property	b. Promote Ecological Health	c. Reduce Allen Creek Contamination	d. Create Allen Creek Greenway	e. Preserve Neighborhood Character	f. Preserve Affordable Housing	g. Retain National Flood Insurance Program
1. DO NOTHING	-	-	-	-	-	-	-	μ	-
2. VARIED RESPONSE BASED ON FLOOD LEVEL	μ	μ	μ/λ	-	-	μ/λ	μ	-	-
3. VARIED RESPONSE BASED ON FLOODWAY/ FLOODPLAIN	μ	μ	μ/λ	μ	μ	μ	μ/λ	λ	μ

μ Positive contribution towards goal

λ Detrimental for goal

\- No net gains or losses in terms of goal

Table 2: Probable short-term outcomes for selected City-owned properties in the floodplain under each policy avenue

	1. DO NOTHING	2. VARIED RESPONSE BASED ON FLOOD LEVEL	3. VARIED RESPONSE BASED ON FLOODWAY/ FLOODPLAIN
406 Maple Ridge	Sell property or convey to AAHC* for rental	Sell property or convey to AAHC for rental	Remove structure, convert to open space/water storage use (almost all in floodway)
3432 Platt Road	Sell structure if possible, otherwise demolish and lump with other Springbrook properties	Study Swift Run to determine flood levels; if no study, remove structure to be safe, convert to open space use.	Remove structures; study Swift Run to assess possibility for unoccupied use on part of parcel
Other Springbrook properties	Sell if possible; otherwise consider as park	Study Swift Run to determine flood levels; if no study, convert to open space use to be safe.	Study Swift Run to determine floodway; if no study, convert to open space use to be safe.
223 S. Seventh	Maintain as is (occupied)	Maintain as is (occupied)	Remove all current structures; relocate residents; part of property could be redeveloped as unoccupied use (in flood fringe)
North Main City Yard *Assuming this facility does need an upgrade currently	Sell for redevelopment	Remove structure, convert to open space/water storage use	Remove structure; part of parcel could be redeveloped for unoccupied use; part of parcel would need to be open space/water storage use

* AAHC: Ann Arbor Housing Commission

Appendix A: City-owned property in the floodplain

City-owned properties with structures in the floodplain

(Does not include Parks properties)

Map No.	Address	Description	Watershed	Acres in floodplain	Total acreage of parcel	Percent of parcel in floodplain
1	406 Maple Ridge	Single-family residence, currently vacant, administered by Utilities	Allen Creek	0.196	0.209	93.78%
2	3432 Platt	Small single-family home in residential neighborhood, currently vacant, no department is administering property	Swift Run	0.339	0.377	89.92%
(2)	Springbrook Parcels	Parcels adjacent to 3432 Platt, determined to be within floodplain by MDEQ.	Swift Run	n/a	1.356	n/a
3	223 S. Seventh	Duplex on Old West Side, administered by Ann Arbor Housing Commission	Allen Creek	0.825	0.880	93.75%
4	3457 Platt	4 multi-family buildings, administered by Ann Arbor Housing Commission	Swift Run	0.780	0.781	99.87%
5	2800 Ellsworth	Municipal Landfill – small structure located in floodplain area.	Swift Run	30.270	142.830	21.19%
6	123 W. Summit 717 N. Main	City Yard parcels (off N. Main Street).	Allen Creek	4.304	4.722	91.15%
7	415 W. Washington 300 W. Liberty 314 W. Liberty	Parks and Recreation Maintenance Facility, on Old West Side	Allen Creek	2.355	2.522	93.38%

Note: Digital floodplain and floodway maps are accurate to within 50 feet; final jurisdiction over floodplain boundaries rests with the Michigan Department of Environmental Quality (MDEQ).

City-owned properties with no structures in floodplain
(Does not include Parks properties)

Map No.	Address	Description	Watershed	Acres in floodplain	Total acreage of parcel(s)	Percent of parcel(s) in floodplain
8	216 W. William 307 S. First	Parking lot at 1st & William, under consideration for development	Allen Creek	0.886	0.893	99.22%
	406 S. Ashley 404 S. Ashley	Parking leased long-term to Avalon Housing	Allen Creek	0.040	0.178	22.47%
	1585 Jones	Vacant – purchased by Ann Arbor Engineering for Jones Street right of way; parcel contains Traver Creek culvert	Traver Creek	0.070	0.338	20.71%
	805 W. Washington	Duplex on Old West Side	Allen Creek	0.039	0.536	7.28%
	2756 Hikone	Multi-family housing	Malletts Creek	0.140	3.234	4.33%

Map 9: Parking structure at 1st & Washington

Note: Digital floodplain and floodway maps are accurate to within 50 feet; final jurisdiction over floodplain boundaries rests with the Michigan Department of Environmental Quality (MDEQ).

Appendix B: Excerpt from the FEMA Community Rating System Manual

This document is referenced in Policy Avenue 6, VARIED RESPONSE BASED ON FLOODWAY/FLOODPLAIN*. Critical facilities would be disallowed in any part of the floodplain under that policy avenue.*

Critical Facilities:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood;
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for flood response activities before, during, and after a flood; and
- Public and private utility facilities that are vital to maintaining or restoring normal services to flooded areas before, during, and after a flood.

Attachment 3 – Feedback Tool

Feedback Tool – Iteration 1

Residents were presented with the following questionnaire. A presentation was given that walked through each of the 55 elements and questions were addressed as they arose to make sure everyone understood the details of each mitigation strategy. The items are arranged based on the seven mitigation objectives outlined in the plan.

Floodplain Mitigation Project Options

Please Consider Providing Supplemental Information

This Information is Considered Confidential

Name:
Address:
Telephone:
Email:
Today's Date:
Group Affiliation?:
What Watershed Do You Live in?:
What Watershed Do You Work in?:
Additional Comments:

Floodplain Mitigation Project Options

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 1 - Mapping and Technology:

Description: Maintain and utilize up-to-date floodplain mapping techniques to assist in the identification and mitigation of flood related hazards	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Mapping additional flood related hazards. Dam failure inundation; uncertain flow paths, and debris & sediment blockage						
A NEW STANDARD	Use future conditions hydrology for mapping						
	Incorporate future condition hydrology into plans and regulations						

Mitigation Objective 2: Education and Outreach

Description: Employ education and outreach as a means to reduce potential flood hazards and increase community knowledge about the floodplain.	Mitigation Projects:	Strongly Agree	Somewhat Agree	No Preference	Somewhat Disagree	Strongly Disagree	Need More Information
LOCAL IMPROVEMENTS	Make flood maps available on City website						
	Make other flood information and links available on City websites						
	Outreach projects: Brochures, mailing, displays, articles, video, signs, presentations, and emergency action plans						
	Make handbooks, maps and other publications available at public library						
	Flood protection advice						
A NEW STANDARD	Flood hazard training and education of City staff						
	Establish certified floodplain manager employment criteria for appropriate staff positions						
	Educating Decision Makers, workshops and conferences, models or presentations						
	Environmental and safety education						

Floodplain Mitigation Project Options

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 3: Planning and Zoning

Description: Integrate floodplain management into planning projects and prevent possible hazards associated with an unplanned floodplain	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Restrict residential development in floodway						
	Restrict residential development in entire floodplain						
	Restrict all development in floodway						
	Restrict all development in entire floodplain						
	Restrict damage-prone development						
	Low density zoning in floodplain						
	Pursue detailed vulnerability analysis and flood loss modeling						
	Develop watershed management plans						

Mitigation Objective 4: Regulation and Development Standards

Description: Implement regulatory measures and development standards to limit flood impacts caused by the built environment	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Freeboard – additional height requirements above the BFE						
	Higher standard for foundation protection						
	Count improvements cumulatively						
	Lower threshold for substantial improvements						
	Additions meet new standards						
	Limit fill or buildings that displace floodwater in flood fringe						
	Require hydrologically equivalent compensatory storage to replace fill						
	Protect or create natural features in floodplain as green infrastructure						
A NEW STANDARD	Prohibit development in floodway						
	Prohibit development entire floodplain						
	Require setbacks from enclosed drains in floodplains						
	Increase stream buffer zone requirements						
	Link open space dedication requirements to floodplain						
	Create parks and greenways in floodplain						
	Purchase development rights in floodplain						
	Develop stream restoration program						

Floodplain Mitigation Project Options

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 5: Corrective Actions

Description: Identify opportunities where corrective actions can be used to mitigate the flood risk for properties in the floodplain	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Increase staff enforcement of code						
	Structure Relocation						
	Property Acquisition						
	Structure Elevation						
	Install Protective Barriers						
	Dry floodproofing of structures						
	Wet floodproofing of stuctures						
A NEW STANDARD	Floodplain and watershed management plan monitoring						
	Seek ways to pursue environmental remediation though floodplain management						

Mitigation Objective 6: Infrastructure

Description: Evaluate the City's infrastructure within the flood plain and protect it from flood related hazards.	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Public property – flood audit & flood insurance						
	Critical facilities – flood audit and emergency action plans						
A NEW STANDARD	Parks – acquisition and greenway plan						
	Critical facilities – higher standards for new critical facilities						

Mitigation Objective 7: Emergency Services

Description: Develop and/or refine a flood response/preparedness method for servicing the community before and after flood related disasters.	Mitigation Projects:	Strongly Agree	Somewhat Agree	Neutral	Somewhat Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Create flood threat recognition system						
	Flood warning						
	Flood information and instructions						
	Flood response actions and responsible parties						
	Flood stage forecast map						

Feedback Tool – Iteration 1, Results

The results for iteration #1 are presented below. The total responses are tabulated on the far left. The percentages are represented by color categorization for visual ease.

- Red = Greater than 50% support
- Dark Blue = 25-50% support
- Light Blue = 0-25% support

Dark Grey = No Response or 0% support.

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 1 - Mapping and Technology:

Description: Maintain and utilize up to-date floodplain mapping techniques to assist in the identification and mitigation of flood related hazards	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Mapping additional flood related hazards. Dam failure inundation; uncertain flow paths, and debris & sediment blockage	15	86.67%	6.67%	0.00%	0.00%	0.00%	6.67%
A NEW STANDARD	Use future conditions hydrology for mapping	11	72.73%	0.00%	18.18%	0.00%	0.00%	9.09%
	Incorporate future condition hydrology into plans and regulations	16	87.50%	0.00%	6.25%	0.00%	0.00%	6.25%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 2: Education and Outreach

Description: Employ education and outreach as a means to reduce potential flood hazards and increase community knowledge about the floodplain.	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Make flood maps available on City website	16	87.50%	12.50%	0.00%	0.00%	0.00%	0.00%
	Make other flood information and links available on City websites	16	87.50%	6.25%	0.00%	6.25%	0.00%	0.00%
	Outreach projects: Brochures, mailing, displays, articles, video, signs, presentations, and	16	68.75%	25.00%	6.25%	0.00%	0.00%	0.00%
	Make handbooks, maps and other publications available at public library	16	87.50%	6.25%	0.00%	0.00%	6.25%	0.00%
	Flood protection advice	16	87.50%	12.50%	0.00%	0.00%	0.00%	0.00%
A NEW STANDARD	Flood hazard training and education of City staff	14	85.71%	14.29%	0.00%	0.00%	0.00%	0.00%
	Establish certified floodplain manager employment criteria for appropriate staff positions	14	78.57%	21.43%	0.00%	0.00%	0.00%	0.00%
	Educating Decision Makers, workshops and conferences, models or presentations	13	92.31%	7.69%	0.00%	0.00%	0.00%	0.00%
	Environmental and safety education	16	75.00%	25.00%	0.00%	0.00%	0.00%	0.00%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 3: Planning and Zoning

Description: Integrate floodplain management into planning projects and prevent possible hazards associated with an unplanned floodplain	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL	Restrict residential development in floodway	16	75.00%	18.75%	0.00%	0.00%	0.00%	6.25%
IMPROVEMENTS	Restrict residentialdevelopment entire floodplain	16	68.75%	6.25%	6.25%	12.50%	0.00%	6.25%
LOCAL	Restrict all development in floodway	16	81.25%	0.00%	0.00%	6.25%	0.00%	12.50%
IMPROVEMENTS	Restrict all development entire floodplain	15	46.67%	26.67%	6.67%	0.00%	13.33%	6.67%
	Restrict damage-prone development	14	71.43%	14.29%	0.00%	0.00%	0.00%	14.29%
	Low density zoning in floodplain	14	50.00%	7.14%	14.29%	0.00%	14.29%	14.29%
	Pursue detailed vulnerability analysis and flood loss modeling	15	73.33%	13.33%	13.33%	0.00%	0.00%	0.00%
	Develop watershed Management Plans	15	86.67%	0.00%	0.00%	0.00%	0.00%	13.33%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 4: Regulation and Development Standards

Description: Implement regulatory measures and development standards to limit flood impacts caused by the build environment	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Freeboard – additional height requirements above the BFE	11	45.45%	9.09%	9.09%	0.00%	0.00%	36.36%
	Higher standard for foundation protection	11	45.45%	18.18%	0.00%	0.00%	0.00%	36.36%
	Count improvements cumulatively	13	46.15%	7.69%	15.38%	0.00%	0.00%	30.77%
	Lower threshold for substantial improvements	14	28.57%	7.14%	7.14%	14.29%	7.14%	35.71%
	Additions meet new standards	14	57.14%	14.29%	7.14%	0.00%	0.00%	21.43%
	Limit fill or buildings that displace floodwater in flood fringe	14	71.43%	0.00%	7.14%	0.00%	0.00%	21.43%
	Require hydrologically equivalent compensatory storage to replace fill	16	37.50%	25.00%	0.00%	0.00%	12.50%	25.00%
	Protect or create natural features in floodplain as green infrastructure	16	87.50%	6.25%	0.00%	0.00%	0.00%	6.25%
A NEW STANDARD	Prohibit development in floodway	15	80.00%	0.00%	0.00%	6.67%	0.00%	13.33%
	Prohibit development entire floodplain	14	35.71%	42.86%	0.00%	0.00%	7.14%	14.29%
	Require setbacks from enclosed drains in floodplains	15	73.33%	6.67%	0.00%	0.00%	0.00%	20.00%
	Increase stream buffer zone requirements	13	69.23%	7.69%	0.00%	0.00%	0.00%	23.08%
	Link open space dedication requirements to floodplain	15	66.67%	13.33%	6.67%	0.00%	0.00%	13.33%
	Create linear parks and greenways in floodplain	15	86.67%	6.67%	0.00%	0.00%	0.00%	6.67%
	Purchase development rights in floodplain	15	53.33%	13.33%	13.33%	6.67%	6.67%	6.67%
	Develop stream restoration program	15	53.33%	33.33%	6.67%	0.00%	0.00%	6.67%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 5: Corrective Actions

Description: Identify opportunities where corrective actions can be used to mitigate the flood risk for properties in the floodplain	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Increase staff enforcement of code	13	69.23%	7.69%	15.38%	0.00%	0.00%	7.69%
	Structure Relocation	13	30.77%	15.38%	23.08%	15.38%	0.00%	15.38%
	Property Acquisition	13	30.77%	15.38%	23.08%	15.38%	0.00%	15.38%
	Structure Elevation	11	18.18%	18.18%	27.27%	0.00%	27.27%	9.09%
	Install Protective Barriers	12	8.33%	16.67%	8.33%	8.33%	16.67%	41.67%
	Dry floodproofing of structures	13	0.00%	7.69%	23.08%	0.00%	15.38%	53.85%
	Wet floodproofing of stuctures	13	0.00%	7.69%	23.08%	7.69%	7.69%	53.85%
A NEW STANDARD	Floodplain and watershed management plan monitoring	11	90.91%	9.09%	0.00%	0.00%	0.00%	0.00%
	Seek ways to pursue environmental remediation though floodplain management	15	80.00%	6.67%	0.00%	0.00%	0.00%	13.33%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 6: Infrastructure

Description: Evaluate the City's infrastructure within the flood plain and protect it from flood related hazards.	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Public property – flood audit & flood insurance	12	33.33%	8.33%	8.33%	0.00%	8.33%	41.67%
	Critical facilities – flood audit and emergency action plans	13	53.85%	15.38%	7.69%	0.00%	0.00%	23.08%
A NEW STANDARD	Parks – acquisition and greenway plan	15	86.67%	6.67%	0.00%	0.00%	0.00%	6.67%
	Critical facilities – higher standards for new critical facilities	12	66.67%	8.33%	8.33%	0.00%	0.00%	16.67%

Should the City pursue this flood mitigation project? - Please Check the Box that Reflects Your Opinion.

Mitigation Objective 7: Emergency Services

Description: Develop and/or refine a flood response/preparedness method for servicing the community before and after flood related disasters.	Mitigation Projects:	Responses	Strongly Agree	Somewhat Agree	Neutral	Some-what Disagree	Strongly Disagree	Need More Info
LOCAL IMPROVEMENTS	Create flood threat recognition system	14	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Flood warning	14	92.86%	0.00%	0.00%	0.00%	0.00%	7.14%
	Flood information and instructions	14	92.86%	0.00%	0.00%	0.00%	0.00%	7.14%
	Flood response actions and responsible parties	14	85.71%	0.00%	0.00%	0.00%	0.00%	14.29%
	Flood stage forecast map	14	85.71%	7.14%	0.00%	0.00%	0.00%	7.14%

Feedback Tool – Iteration 2

The Items from Iteration # 1 that received less than 50% support from residents were chosen to receive additional feedback. The following list of questions was developed to address these issues.

Item	*Mitigation Project*	*Central Concept*	*New Question*
1	Restrict all development entire floodplain	Uses in the floodfringe	1 - Should the flood plain be a special zoning district
2	Freeboard – additional height requirements above the BFE	Construction standards in floodplain	2 - Should the bulding standards for construction in the floodpljain be strenthened
3	Higher standard for foundation protection	Construction standards in floodplain	
4	Count improvements cumulatively	Trigger for floodproofing requirements	3 - Should the limit for home improvements without flood proofing be strengthened
5	Lower threshold for substantial improvements	Trigger for floodproofing requirements	
6	Additions meet new standards	Trigger for floodproofing requirements	
7	Limit fill or buildings that displace floodwater in flood fringe	Flood water displacement	4 - Should the regulations limiting the displacement of floodwater be strefthened
8	Require hydrologically equivalent compensatory storage to replace fill	Flood water displacement	
9	Prohibit development entire floodplain	Development Resriction	5 - Should the Floodfringe be regulated as strictly as the floodplain
10	Require setbacks from enclosed drains in floodplains	Development Resriction	6 - Should State standards be enforced on entire floodplain
11	Increase stream buffer zone requirements	Development Resriction	7a - Should Steam buffers and setbacks be increased? 7b - Should buffers and setbacks be pplied to enclosed drains?
12	Structure Relocation	Voluntary Corrective Action	8 - Should the City support residents in pursuing voluntary corrective mitigation actions?
13	Property Acquisition	City Sponsored Corrective Action	9 - Should the City pursue corrective mitigation actions on public parcels if funding becomes available?
14	Structure Elevation	Voluntary Corrective Action	10 - Should the City activley aquire property in the floodplain
15	Install Protective Barriers	Voluntary Corrective Action	
16	Dry floodproofing of structures	Voluntary Corrective Action	
17	Wet floodproofing of stuctures	Voluntary Corrective Action	
18	Public property – flood audit & flood insurance	Public Risk	11 - Shouldl the City conduct a flood audit and insure public investments in the floodplain?
19	Critical facilities – flood audit and emergency action plans	Public Risk	

Feedback Tool – Iteration 2, Results.

Two additional questions were added to this list.

1. Should the City prohibit new structures in the floodway?
2. Should the City prohibit new structures in the entire floodplain?

The questions were also ordered subjectively from least restrictive to most restrictive.

The results for iteration #2 are presented below. The total responses are tabulated on the far left. The percentages are represented by color categorization for visual ease.

- Red = Greater than 50% support
- Dark Blue = 25-50% support
- Light Blue = 0-25% support
- Dark Grey = No Response or 0% support

The results of the feedback exercises assisted the planning team with the development of the recommendation strategies that were included in the plan. These results can also assist the Implementation committee with the task of prioritizing the project recommendations.

Iteration # 2 Results:

Question to Address Resultsof Iteration #1	Responses by #						Responses by Percentage					
	Big Yes	Yes	Neutral	No	Big No	Total	Big Yes	Yes	Neutral	No	Big No	Total
1 - Should the City conduct a flood audit and insure municipal investments in the floodplain?	3	4	3	1	0	11	27%	36%	27%	9%	0%	100%
2 - Should the City support property owners in finding alternative funding sources for voluntary corrective mitigation actions?	7	1	2	1	0	11	64%	9%	18%	9%	0%	100%
3 - Should the City pursue corrective mitigation actions on municipal parcels (including public housing) if funding becomes available?	8	2	1	0	0	11	73%	18%	9%	0%	0%	100%
4 - Should the City actively acquire property in the floodplain for mitigation activities?	8	1	1	1	0	11	73%	9%	9%	9%	0%	100%
5 - Should the building standards for construction in the floodplain be strengthened?	8	2	1	0	0	11	73%	18%	9%	0%	0%	100%
6 - Should the regulations limiting the displacement of floodwater be strengthened?	9	2	0	0	0	11	82%	18%	0%	0%	0%	100%
7 - Should the limit for home improvements, or other building improvements without flood resistant construction be strengthened?	6	2	2	1	0	11	55%	18%	18%	9%	0%	100%
8 - Should stream buffers and setbacks be increased?	10	0	0	0	1	11	91%	0%	0%	0%	9%	100%
9 - Should stream buffers and setbacks be applied to enclosed drains?	8	1	1	1	0	11	73%	9%	9%	9%	0%	100%
10 – Should the City apply State standards to the entire floodplain?	9	1	0	0	1	11	82%	9%	0%	0%	9%	100%
11 - Should the flood fringe be regulated as strictly as the floodway?	4	3	2	1	1	11	36%	27%	18%	9%	9%	100%
12 - Should the floodplain be a special zoning district?	8	2	0	0	1	11	73%	18%	0%	0%	9%	100%
13 - Should the City prohibit new structures in the floodway?	10	0	0	0	1	11	91%	0%	0%	0%	9%	100%
14 - Should the City prohibit new structures in the entire floodplain?	4	3	3	0	1	11	36%	27%	27%	0%	9%	100%

Attachment 4 – Floodplain Resolution: City Planning Commission

Resolution of majority policy positions of the Ann Arbor City Planning Commission with regard to Floodplains

Whereas the Ann Arbor City Planning Commission is the recommending body for Land Use Planning appointed by City Council, and

Whereas land use of areas defined as floodplains is an issue with substantial short and long term impacts to the quality of life, financial well-being, and public health, safety, and welfare of residents of the City of Ann Arbor, as well as the City at large, and

Whereas floodplains currently defined by the Federal Emergency Management Administration and also interpreted and defined by the Michigan Department of Environmental Quality, Michigan State Building Code, and other regulatory agencies or regulations have been known to exist in the City of Ann Arbor, and

Whereas information provided in the City's Flood Mitigation Plan has provided approximate, realistic estimates of potential risks, recent history, and other information related to floodplains, and

Whereas substantial anecdotal and verified historical information has been well documented regarding floodplains, historic flooding, and known deficiencies in the existing stormwater management system in specific areas of the City of Ann Arbor, and

Whereas the City of Ann Arbor has continued to expend capital and other funds to address these known system deficiencies and flood-prone areas, and
Whereas many of these flood-prone areas have flooded for decades, under varying conditions of imperviousness within their contributing watersheds, and

Whereas City staff and the Ann Arbor City Planning Commission has recently (2001-2003) and more recently (2006-2007) undertaken substantial education, discussion and other means to understand the nature of floodplains in general, their impacts on specific areas of the City, and the potential positive and negative impacts of as wide a range as possible of regulation within floodplains, and

Whereas the referenced Flood Mitigation Plan has provided several possible avenues to reduce risk, including some that are currently included in the City's current Capital Improvement Plan and some that are not currently included, and

Whereas the Ann Arbor City Planning Commission has a vested interest in recommending policy to protect the Health, Safety, and Welfare of the general public while respecting the lawful rights of existing property owners, and

Whereas the Ann Arbor City Planning Commission is in unanimous agreement that clearer floodplain policy is needed IN ALL 100-year FLOODPLAIN AREAS WITHIN THE CITY OF ANN ARBOR, including those with a catchment area of less than 2 square miles, and

Whereas the Ann Arbor City Planning Commission recognizes the substantial added risk to public health, safety, and welfare in moving from floodplain areas of two (2) foot depth to areas of three (3) foot or greater depths, and

Whereas it is suspected that floodplains have generally existed to some extent in certain areas prior to any settlement in this area or others, and

Whereas this leads to an understanding that floodplains are bound to exist to some degree at certain locations, regardless of other conditions, and

Whereas this leads to a further understanding that it is not feasible to eliminate floodplains, and

Whereas a practical alternative to eliminating floodplains has been demonstrated to be sound policy to reduce the risk to public health, safety, and welfare from periodic storm events of certain probabilities,

Be it therefore resolved that the Ann Arbor City Planning Commission recommends the following:

1) A Floodplain Subcommittee to the Ordinance Revisions Committee shall be formed of no less than three members, including no less than one Officer. The primary purpose of this subcommittee shall be to work with City staff to prepare a

comprehensive floodplain ordinance for review by the Ordinance Revisions Committee and recommendation to the City Planning Commission for subsequent review and recommendation to City Council. Timetable shall be as soon as practical for staff, or as otherwise directed by City Council.

2) The Floodplain Subcommittee may also consider other recommendations subject to approval of the Chair of the City Planning Commission, particularly with respect to ancillary regulation, to complement floodplain policy, and generally limited to landuse planning. Ancillary regulation may include but not be limited to such areas as overlay zoning, amendments to Chapter 55, 57, 63, and/or other areas of land use regulations utilized or anticipated to be utilized relative to development within or near floodplains or other flood prone areas. The City Planning Commission shall disband the subcommittee upon recommendation for approval of a floodplain ordinance, unless other action is recommended at that time.

3) Further staff or consultant analysis of the cost-benefit of addressing the impact of the railroad embankment in the lower reaches of Allen's Creek. Quantify cost, risk reduction, and the 100-year floodplain elevation reduction at the embankment, and whether it would generally propagate this same reduction along the contiguous floodplain of Allen's Creek, for two (2) to four (4) scenarios of varying cost that would address the substantial damming effect of the embankment.

4) Item 2) above is intended to allow consideration by the Floodplain Subcommittee of other projects outlined in the Flood Mitigation Plan – Section 2.2 – Objective 4: "Regulation and Development Standards" that have not been specifically referenced in this resolution. Again, subject to approval of the Chair, and if it is feasible to explore these projects in a practical time period, such projects may be considered by the Floodplain Subcommittee for inclusion in a recommended draft City of Ann Arbor Floodplain Ordinance or other appropriate policy documents. Projects that require extended analysis may also be considered in the future to be included as amendments to said ordinance or policy documents.

5) It is the intent of Planning Commission to consider the following policy positions in comment or review of any proposed development of the properties currently owned by the City within 100-year floodplains, until such time that a floodplain ordinance is approved by City Council, or a revised policy position is resolved by the Ann Arbor

City Planning Commission.

6) It is Planning Commission's expectation that the following policy positions be considered in the preparation of any development proposal within 100-year floodplains, until such time that a floodplain ordinance is approved by City Council, or a revised policy position is resolved by the Ann Arbor City Planning Commission. This expectation is consistent with the recommended approach for *future buildings and flood vulnerability* of the City's Flood Mitigation Plan.

7) In draft format, the desired floodplain ordinance and/or ancillary regulation shall address the following policy positions of the City Planning Commission (all floodplain or floodway references consider the commonly defined 100-year base flood elevation unless otherwise noted):

a) No new structures within floodway zones shall be permitted. Criteria for redevelopment, including additions and other substantial improvements, shall be clearly defined but must at a minimum reduce flood vulnerability, demonstrate a reduction of the base flood elevation, and have no new residential component.

b) Construction in the floodplain shall have a finished floor a minimum of 2 feet above the base flood elevation. The bottom of joists or other load-bearing substructure elements shall be a minimum of 1 foot above the base flood elevation.

c) Hydrologically equivalent floodplain compensation shall be mandatory for any permitted fill within any floodplain area.

d) The Planning Commission desires a simple method of establishing the degree of floodplain impact due to an individual structure, for two reasons. The first reason would be to determine whether repairs to an existing structure are counter to the purpose of the final policy and Ordinance. The second reason is likewise for prioritizing removals.

It is preferred that all permitted repairs or additions to existing buildings include floodproofing, including retrofitting the existing structure with

floodproofing. Sites determined to be non-conforming with respect to the final policy or ordinance should not be permitted to add impervious surface or floor area without floodproofing the entire structure.

8) The floodplain subcommittee should address long-term policy recommendations for removing structures from the floodway, addressing items such as: attrition, purchase, development rights, providing a simple method of prioritization based on impact, and other appropriate tools.

By prioritization, we mean removal preference for those structures or features currently having the greatest vulnerability or impact on base flood elevation. Community and neighborhood assets should be identified and other mitigation activities should be pursued to reduce vulnerability with a preference given to structure elevation. Residents are encouraged to pursue such activities on a voluntary basis.

And whereas the Ann Arbor City Planning Commission supports land-use policy that recognizes the need to have at a minimum, zero negative impact on existing flooding problems, and where possible, a positive impact on existing flooding problems,

Be it further resolved that the Ann Arbor City Planning Commission supports evaluation and if appropriate, amendment of appropriate land-use ordinance(s) or policy documents in the following stormwater policy areas to assist in water quantity management, if practical to the City and acceptable to the Washtenaw County Drain Commissioner:

1) For development or redevelopment proposals, in areas of known flooding, modify development policy regarding stormwater management to require that stormwater quality, discharge rate and total discharge volume exiting the site mimic or improve upon pre-development conditions. One approach would be to determine a required percent reduction in total discharge volume for all development or redevelopment in such areas.

Terms such as “known flooding areas” and “Pre-development” shall be clearly defined and allow for community input prior to adoption. An overlay may be considered.

2) Development policy regarding stormwater management also needs to consider similar stormwater requirements for sites discharging upstream of known flood-prone or flow-constricted areas. Modeling may be required to demonstrate no negative downstream impacts.

3) Strong consideration shall be given to extending the above core policies as appropriate into the small areas of higher-risk 3-foot depth zones identified in the Flood Mitigation Plan, due to hydrostatic pressure on structures at these depths.

Resolved this 1st day of May 2007.

Evan Pratt, Chair
Bonnie Bona, Secretary
Approved by the Ann Arbor City Planning Commission
May 1, 2007
8 Yeas, 1 Nay

Attachment 5 – Authorities and Resource Overview

The development of feasible hazard mitigation strategies is partially determined in respect to, and having the knowledge of, local capabilities, resources, authorities and personnel. This would also include the knowledge of the structure of the organization and the various areas of responsibilities. The City of Ann Arbor is basically structured into functional Service Areas which is further delineated into Service Units. Every Service Area is represented in the Emergency Action Guidelines as part of the City Emergency Response Plan as are appropriate Service Units.
In addition, other relevant agencies that can supply significant capabilities and resources, either located within the City, or having responsibilities covering the City, are listed.

http://www.a2gov.org/

City Administration

http://www.a2gov.org/government/city_administration/Pages/Home.aspx

- City Clerk
  - Boards and Commissions
- Communications Office
  - Cable Television Network
- Human Resources

City Attorney's Office

http://www.a2gov.org/services/OtherServices/cityattorneysoffice/Pages/default.aspx

Community Services Area

http://www.a2gov.org/government/communityservices/Pages/default.aspx

- Community Development
- Parks and Recreation
  - Recreational Facilities
- Planning and Development
  - Master Planning
  - Construction/Building

- Permits
- Board of Appeals
- Historic Preservation
- Rental Housing
- Appeal Boards
- Soil & Sediment Control
- Zoning

Financial & Administrative Services Area

http://www.a2gov.org/government/financeadminservices/Pages/Home.aspx

- Accounting Services Unit
  - Payroll
  - Procurement/Purchasing
- Assessor Service Unit
- Finance Administration and Budget Planning Services Unit
- Information Technology
- Risk Management
- Treasury Services

Public Services Area

http://www.a2gov.org/government/publicservices/Pages/Home.aspx

- Administration and Fiscal Management Unit
- Safety Management
- Customer Service/Call Center Unit
- W. R. Wheeler Service Center
- Field Operations Services Unit
  - Forestry and Parks Operations
  - Sign, Signals, and Communications
  - Street Lighting
  - Solid Waste/Collection and Recycling

    - MRF
    - Natural Area Preservation-Leslie Science and Nature Center
    - Street Maintenance
    - Stormwater Collection System Maintenance
- Fleet and Facilities Services Unit
    - Building Maintenance
    - Fleet Services
    - Ann Arbor Airport
- Project Management Unit
- Systems Planning Unit
    - Capital Projects
- Wastewater Treatment Services Unit
- Water Treatment Services Unit

Safety Services Unit

http://www.a2gov.org/government/safetyservices/Pages/home.aspx

- Emergency Management Services Unit
    - Emergency and Disaster Preparedness
    - Emergency Operations Center Management
    - Grant Management
    - Outdoor Warning Sirens (22)
    - CodeRED Reverse 911 System
- Police Services Unit
    - 119 Sworn Officers
    - 24 Civilian Staff
    - 1 Substation
    - Full complement of patrol and unmarked administrative vehicles
    - Mobile Command Post
        - Fully interoperable communications
        - Video surveillance camera
    - Participate in County-Wide Metro Swat Team
        - 1 Commander
        - 2 Assistant Commanders

        - 30 Tactical Team Officers (7 snipers)
        - All SCBA and CBRNE Certified
        - 10 Negotiators
        - 3 Vehicles, 2 Trailers
    - Investigation Support Unit
        - Computer forensics
        - Evidence/property management
        - Process scenes for forensic evidence
        - Crime scene response vehicle
        - Crime scene tech assigned to patrol
    - 14 Detective Staff
    - 2 K-9 Officers
- Fire Services Unit
    - Station 1, 111 N. Fifth Avenue
        - 1 Rescue
        - 1 95’ Ladder Tower
        - 1 Command vehicle

o Station 3, 2130 Jackson Avenue
        - 1 Engine
    - Station 4, 2415 Huron Parkway
        - 1 Engine
    - Station 5, 1946 Beal
        - 1 75' Ladder
        - 1 Water/Ice Rescue Boat
    - Station 6, 1881 Briarwood Circle
        - 1 Engine
        - 1 Hazmat Unit
- Additional Capabilities
    - Technical Rescue
    - Water Rescue
    - Ice Rescue
    - MUSAR Strike Team
    - Hazardous Materials Team

Other Agencies Located within the Jurisdiction

- University of Michigan Police
- University of Michigan Hospital
- Veterans Administration Hospital

Agencies with Jurisdictional Responsibilities

- St. Joseph Mercy Hospital
- Washtenaw County Health Department
- American Red Cross of Washtenaw/Lenawee Counties