



CITY of NOVI CITY COUNCIL

Agenda Item E
September 24, 2018

SUBJECT: Adoption of Oakland County Hazard Mitigation Plan

SUBMITTING DEPARTMENT: Public Safety - Police

CITY MANAGER APPROVAL:

BACKGROUND INFORMATION:

The Oakland County Homeland Security Division is seeking local community adoption of the revised Oakland County Hazard Mitigation Plan (HMP). The HMP was originally prepared in 2005 and adopted by the City of Novi by way Council Resolution on July 10, 2006 and again on June 3, 2013.

The revised, multi-jurisdictional HMP addresses natural and man-made hazards that can threaten life and health in the community of Novi and throughout Oakland County. These hazards can impact the quality of life, property, the environment, and infrastructure. The HMP provides strategies that minimize the impact of these hazards by committing to a multi-step program, including defining the problem, identifying preventative measures, implementing mitigation strategies, and incorporating hazard mitigation in County-wide planning efforts.

The HMP was revised with the assistance of the Oakland County Homeland Security Division, Oakland County Advisory Committee, Oakland County Local Emergency Planning Committee (LEPC), local communities, schools, colleges and universities, and ASTI Environmental. On April 2, 2018, the Federal Emergency Management Agency (FEMA) conditionally approved the updated HMP contingent upon adoption by each municipality. The HMP was adopted by the Oakland County Board of Commissioners on July 19, 2018. By adopting this plan the City of Novi maintains its eligibility for FEMA hazard mitigation grant funding or federal disaster relief in the event Novi suffers a man-made or natural disaster.

RECOMMENDED ACTION:

Approval of a Resolution adopting and accepting the Oakland County Hazardous Mitigation Plan.

CITY OF NOVI

COUNTY OF OAKLAND, MICHIGAN

RESOLUTION ADOPTING THE REVISED OAKLAND COUNTY HAZARD MITIGATION PLAN

Minutes of a Meeting of the City Council of the City of Novi, County of Oakland, Michigan, held in the Civic Center of said City on September 24, 2018, at 7:00 o'clock P.M prevailing Eastern Time.

PRESENT: Council Members _____

ABSENT: Council Members _____

The following preamble and Resolution were offered by Council Member

_____ and supported by Council Member _____

WHEREAS, the mission of the City of Novi includes the charge to protect the health, safety, and general welfare of the people of the City of Novi; and

WHEREAS, Novi, Michigan is subject to flooding, tornadoes, winter storms, and other natural, technological, and human hazards; and

WHEREAS, and the Oakland County Homeland Security Division and the Oakland County Local Emergency Planning Committee, comprised of representatives from the County, municipalities, and stakeholder organizations, have prepared a recommended Hazard Mitigation Plan that reviews the options to protect people and reduce damage from these hazards; and

WHEREAS, the City of Novi has participated in the planning process for development of this Plan, providing information specific to local hazard priorities, encouraging public participation, identifying desired hazard mitigation strategies, and reviewing the draft Plan; and

WHEREAS, the Oakland County Homeland Security Division (HSD), with the Oakland County Local Emergency Planning Committee (LEPC), has developed the OAKLAND COUNTY HAZARD MITIGATION PLAN (the "Plan") as an official document of the County and establishing a County Hazard Mitigation Coordinating Committee, pursuant to the Disaster Mitigation Act of 2000 (PL-106-390) and associated regulations (44 CFR 210.6); and

WHEREAS, the Plan has been widely circulated for review by the County's residents, municipal officials, and state, federal, and local review agencies and has been revised to reflect their concerns; and

NOW THEREFORE BE IT RESOLVED by the City of Novi and Novi City Council that:

1. The Oakland County Hazard Mitigation Plan is hereby adopted as an official plan of the City of Novi.
2. The Director of Public Safety / Chief of Police is charged with supervising the implementation of the Plan's recommendations, as they pertain to the City of Novi and within the funding limitations as provided by the City of Novi or other sources.
3. The Director of Public Safety / Chief of Police shall give priority attention to the following action items recommended in portions of the Plan specific to the City of Novi:
 - a) Conduct additional training to address the potential civil disturbance/terrorist target at the Twelve Oaks shopping mall as identified in section 2.37.3.
 - b) Provide additional hazmat training and equipment for the public safety departments in section 2.37.3.2.1.
 - c) Increase public awareness of the dangers of tornadoes in section 2.37.3.3.1.

AYES:

NAYS:

RESOLUTION DECLARED ADOPTED.

Cortney Hanson, City Clerk

CERTIFICATION

I hereby certify that the foregoing is a true and complete copy of a resolution adopted by the City Council of the City of Novi, County of Oakland, and State of Michigan, at a regular meeting held this 24 day of September, 2018, and that public notice of said meeting was given pursuant to and in full compliance with Act No. 267, Public Acts of Michigan, 1976, and that the minutes of said meeting have been kept and made available to the public as required by said Act.

Cortney Hanson, City Clerk
City of Novi

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1 Oakland County, MI Hazard Mitigation Plan 2017

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Volume I: [PDF Version \(Click to Download\)](#)

Oakland County Hazard Mitigation Plan



2017 HAZARD MITIGATION PLAN

December 2017

FOR OFFICIAL USE ONLY – LIMITED DISTRIBUTION

Prepared for:

Oakland County Homeland Security Division
1200 N Telegraph Road
Pontiac, MI 48341

1.1 Letter from the Oakland County Executive

Published 7/5/2018 13:59 by Nathaniel Marlette



L. BROOKS PATTERSON, OAKLAND COUNTY EXECUTIVE

To the Residents of Oakland County:

Oakland County has a reputation as the best managed county in America because we are always looking to the horizon to see what challenges lie ahead and then plan accordingly to meet them. That planning includes being prepared for any natural or manmade hazards such as severe weather or an act of terrorism.

Oakland County updates its Hazard Mitigation Plan every five years with your input, in keeping with Federal Emergency Management Administration (FEMA) guidelines. In 2017, Oakland County Homeland Security Division contracted Integrated Solutions Consulting (ISC), a small business focused on implementing

comprehensive crises and consequence management solutions, to survey residents, business, schools, and other organizations to identify policies and actions that will help reduce the impact of a disaster on our community and mitigate losses during an emergency. Oakland County and ISC then reviewed and prioritized that information in order to update the Hazard Mitigation Plan. It is worth noting that a pre-disaster mitigation planning grant which Oakland County won in 2016 funded ISC and the survey.

Oakland County has updated its Hazard Mitigation Plan in collaboration with the communities in which you live, work, and play. It is through this team effort that Homeland Security Division ensures Oakland County and its cities, villages, and townships have adopted response plans that will keep residents safe and prepared.



A handwritten signature in black ink, appearing to read "L. Brooks Patterson".

L. Brooks Patterson
Oakland County Executive

1.2 Executive Summary

Published 1/11/2018 09:33 by Daiko Abe

Oakland County is subject to natural and man-made hazards that may impact health, quality of life, property, the environment and/or infrastructure. Because of the location and land use of Oakland County, certain hazard events have historically been more significant than others. Future conditions may cause other hazards to increase in significance. Providing strategies that minimize the impact of these hazards requires a commitment to a multiple-step program, including defining the problem, identifying preventive measures, implementing mitigation strategies and incorporating hazard mitigation in County-wide planning efforts. Oakland County has prepared this multi-jurisdictional 2017 *Oakland County All Hazard Mitigation Plan (HMP) Update* (Plan) to better understand significant Oakland County hazards and their impacts and to identify ways to mitigate those hazards. All 62 communities and 28 school districts in Oakland County participated in this process and are included in the Plan.

1.2.1 The Plan Process

Published 7/5/2018 14:04 by Nathaniel Marlette

This Plan was completed with the assistance of the Oakland County Homeland Security Division, members of the Oakland County Local Emergency Planning Committee (LEPC), members of the community, representatives and leaders from each of the 62 communities and many of the 28 school districts in the County, the Michigan State Police Emergency Management and Homeland Security Division Mitigation Recovery Section and numerous other stakeholders. Over 150 individuals were involved in the preparation, evaluation, and community outreach components of this Plan. The Plan was prepared using three (3) groups: An Advisory/Steering Committee provided guidance, evaluation and assessment; a group of community representatives provided local input from each community in Oakland County; and a group of community leaders provided local input and assisted with community outreach and Plan adoption.

The goal of hazard mitigation is to eliminate or reduce loss of life and property from hazards that occur in the County by protecting the health, safety and economic interests of its residents. Oakland County identified the following hazard mitigation goals.

1. Retain access to Federal Emergency Management Agency (FEMA) funding for Oakland County and its communities by complying with Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, and Related Authorities dated May 2017 (42 USC 5165) and Code of Federal Regulations (CFR), Title 44, Part 201.
2. Provide a basis for identifying and mitigating hazards that affect Oakland County and its communities.
3. Develop a method to incorporate and integrate hazard identification and mitigation into the planning process of Oakland County and its communities.

Specific tasks for the completion of this Plan included the following:

- Identifying hazards and risks
- Updating the hazard history
- Updating the community profiles
- Assessing vulnerabilities
- Identifying repetitive loss properties
- Defining and updating mitigation goals and objectives
- Evaluating the status and relevance of previous goals and strategies
- Identifying and prioritizing hazard mitigation strategies
- Developing and updating Action Plans for a select list of mitigation strategies
- Preparing a draft report for Oakland County, municipal and public review
- Soliciting Oakland County, municipal and public feedback
- Preparing a final report
- Providing community outreach and communication
- Documenting the planning process
- Adopting the final Plan

1.2.2 Hazard Assessment

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The Plan evaluated over 50 hazards during the 2017 Oakland County HMP Update. Hazards were identified using a combination of historical research, surveys, workshops, community and public meetings, and the 2012 Plan. Based on this evaluation, specific hazards were identified as requiring additional consideration, and therefore are the focus of this Mitigation Plan. These hazards were selected to represent both County-wide and local community concerns. Evaluation of these hazards does not reduce the significance of a hazard event from any of the hazards evaluated, but provides a method for Oakland County to focus mitigation activities and resources.

The following hazards were identified as significant:

Table 1: Oakland County Hazard Ranking

Natural Hazards		Score
1	Winter Storm and Blizzards	52
2	Riverine Flooding	49
3	Urban Flooding	46
4	High Winds/Severe Winds	46
5	Hail	42
6	Tornadoes	40
7	Extreme Cold	40
8	Thunderstorms (Lightning)	39
9	Ice and/or Sleet Storms	33
10	Extreme Heat	30
11	Drought	25
12	Fog	23
13	Earthquake	21
14	Wildfire	19
15	Natural Subsidence	10
Manmade/Technological Hazards		Score
1	Structural Fire	41
2	Transportation Accidents: Highway	40
3	Hazardous Materials Incidents: Transportation	38
4	Hazardous Materials Incidents: Fixed Facility	38
5	Petroleum and Natural Gas Pipeline Accidents	38
6	Infrastructure Failure: Electrical System Failure Incident	35
7	Infrastructure Failure: Water System Disruption	33
8	Transportation Accidents: Rail	32
9	Criminal Acts: Vandalism	32
10	Infrastructure Failure: Storm Water System Incident	32
11	Criminal Acts: Arson	31
12	Infrastructure Failure: Communication System Failure Incident	29
13	Invasive Species	28
14	Dam Failure	26
15	Criminal Acts: Mass Shootings/Active Assailant	25
16	Infrastructure Failure: Sewer System Incident	25
17	Nuclear Power Plant Accidents	22
18	Transportation Accidents: Air	21
19	Gas/Oil Shortage	21
20	Oil and Gas Well Incident	20
21	Infrastructure Failure: Transportation (Bridges, Road, Overpasses) Infrastructure System Failure Incident	20
22	Scrap Tire Fire	17
Political Hazards		Score
1	Terrorism and Sabotage	33
2	Civil Disturbances	23
3	Weapons of Mass Destruction	19
Public Health Hazards		Score
1	Public Health Emergencies	37

1.2.3 Hazard Mitigation

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Plan participants assessed over 300 hazard mitigation strategies, including strategies from FEMA documents, strategies from the 2012 Oakland County Plan and suggestions from the communities, Advisory Committee members and school districts. These strategies were evaluated by the Advisory Committee during the third meeting held on November 3, 2017, resulting in a prioritized list of 147 new strategies, in addition to 229 ongoing/updated mitigation strategies from the 2012 Plan, and 126 completed strategies. Fifteen were removed or considered not relevant.

Major categories that represented the identified mitigation strategies, included (in order of priority as identified by the Advisory Committee):

1. Emergency Planning
2. Emergency Training for First Responders
3. Infrastructure work
4. Culverts/General Flood/Water System
5. Personal Preparedness Encouragement
6. Radio/Communication/Notification System
7. Security Improvements
8. Emergency Supplies/Small Equipment
9. Generator
10. Warning Sirens/Loud Speakers
11. Hire/Train Staff
12. Large Response Equipment or Construction Project
13. Emergency Shelters

1.3 Introduction

Published 7/5/2018 14:09 by Nathaniel Marlette

Oakland County is subject to natural and man-made hazards that can threaten life, health, property and the environment. The Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, and 44 CFR Part 201, require local governments to develop a Hazard Mitigation Plan (HMP) that identifies strategies to minimize the impact of these hazards in order to be eligible for pre- or post-disaster mitigation funding. In response, Oakland County prepared a multi-jurisdictional Hazard Mitigation Plan (HMP), dated January 17, 2005 and completed the first update in 2012 to better understand significant Oakland County hazards, their impacts and to identify ways to mitigate those hazards. The second update took place in 2017.

Figure 1: Location Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

1.3.1 Acknowledgements

Published 7/5/2018 14:11 by Nathaniel Marlette

Development of the multi-jurisdictional 2017 Oakland County All Hazard Mitigation Plan (HMP) Update (Plan) required the time, talents, effort and ideas of numerous individuals. Over 150 stakeholders, community leaders, residents and Oakland County staff participated in the development of this Plan. Staff from the Oakland County Homeland Security Division, members of the Oakland County Local Emergency Planning Committee (LEPC), members of the community and representatives and leaders from all 62 communities and many of the 28 school districts in Oakland County provided input. In addition, this Plan would not have been completed without the assistance of the Michigan State Police Emergency Management and Homeland Security Division Mitigation Recovery Section.

Oakland County Homeland Security Division

- Thomas Hardesty, Manager
- Michael Kuzila, Emergency Management Coordinator

Oakland County Hazard Mitigation Steering Committee/LEPC

- L. Brooks Patterson, Oakland County Executive
- Sharon Stahl (LEPC Chair), Gage Products Company
- Glori Macias, Oakland County Homeland Security
- John Reardon, LEPC
- Paul Tombouljian, Ph.D., Oakland University
- John D. Misaros, Hamtramck Energy Services (HES)
- Jim Goetzinger, Great Lakes Crossing Outlets
- Tim Krockta
- Pat Schultz, General Motors LLC
- Connie Sims, Oakland County Water Resources Commission
- Stan Barnes, Farmington Hills Fire Department
- Calleen E. Austin, Salvation Army
- Tony Drautz, Environmental Health | Oakland County Health Division
- Jim Williams, Huron Valley Sinai Hospital Lab
- Mike Kazyak, Auburn Hills Police Dept, Retired
- Don McLellan, Ph.D., Lake Angelus Police Dept
- Lee Graham, Operating Engineers Local 324
- Jack Blanchard, Berkley
- Marci Wieggers, Oakland County Health Division
- Sara Stoddard, Oakland County Health Division
- Michael Crum, Berkley DPS
- James Neufeld, Farmington Hills Fire Department
- John Cieslik, Rochester Fire Department
- Peter Zell, Rochester Fire Department
- Bill Cooke, Rochester Hills Fire Department
- John Brennan, T&T Marine
- Tony Averbuch, Franklin-Bingham Fire Department
- Bill Johns, City of Southfield
- Tim Ketvirtis, MSP-EMHSD
- Michael Bastianelli, Franklin PD
- Ron Moore, Wixom PD
- Thom Hardesty, Oakland County Homeland Security
- Mike Kuzila, Oakland County Homeland Security
- Dave DeBoer, West Bloomfield FD
- Scott McKee, Lathrup Village PD
- Wes Goodman, Lake Orion Schools
- John B Martin, Novi Fire
- Kevin Sullivan, Ferndale Fire
- Tedd Strobehn, Boehle Chemicals
- Melanie Ben-Ezra, OCHD
- Kevin Scheid, OCHSD
- Brian Crane, Franklin
- Dean Schultz, OCRISK

Oakland County Advisory Committee Members

- City of Auburn Hills: James Manning, Fire Chief
- City of Berkley: Matthew Koehn, PS Director
- City of Bloomfield Hills: David Hendrickson, PS Director
- City of Birmingham: John Connaughton, Fire Chief
- City of Ferndale: Kevin Sullivan, Fire Chief
- City of Huntington Woods: Andrew Pazuchowski, PS Director
- City of Novi: David Molloy, Police Chief

- City of Troy: Brian Kischnick, City Manager
- City of Walled Lake: Jim Coomer, Fire Chief
- Township of Addison: Bruce Pearson, Twp Supervisor
- Township of Highland: Ken Chapman, Fire Chief
- Township of Orion: Robert Smith, Fire Chief
- Township of Springfield: Dave Feichtner, Fire Chief
- Township of White Lake: Andrew Gurka, Fire Chief
- City of Clarkston: Mitch Petterson, Fire Chief
- City of Clawson: Harry Anderson, Police Chief
- City of Farmington: Frank Demers, PS Director
- City of Farmington Hills: Lt. James Neufeld, EMC
- City of Hazel Park: Richard Story, Fire Chief
- City of Keego Harbor: Ken Hurst, Police Chief
- City of Lake Angelus: Jim Prosser, Police Chief
- City of Lathrup Village: Scott McKee, Police Chief
- City of Madison Heights: Greg Lelito, Fire Chief
- City of Northville: Michael Carlson, Police Chief
- City of Oak Park: Steve Cooper, PS Director
- City of Orchard Lake Village: Joe George, Police Chief
- City of Pleasant Ridge: James Breuckman, City Manager
- City of Pontiac: John Lyman, Fire Chief
- City of Rochester: John Cieslik, Fire Chief
- City of Rochester Hills: Sean Canto, Fire Chief
- City of South Lyon: Lloyd T. Collins, Police Chief
- City of Southfield: William Johns, EMD
- City of Sylvan Lake: John Martin, Police Chief
- City of Wixom: Clarence Goodlein, PS Director
- Township of Bloomfield: Dave Piche, Fire Chief
- Township of Brandon: Dave Kwapis, Fire Chief
- Township of Commerce: Todd A. Martin, Fire Chief
- Township of Groveland: Steve McGee, Fire Chief
- Township of Holly: George Kullis, Supervisor
- Township of Independence: Mitch Petterson, Fire Chief
- Township of Lyon: Ken VanSparrentak, Fire Chief
- Township of Milford: Don D. Green, Twp Supervisor
- Township of Novi: John J. Juntunen, Twp Supervisor
- Township of Oakland: Paul Strelchuk, Fire Chief
- Township of Oxford: Pete Scholz, Fire Chief
- Township of Rose: Jeremy Lintz, Fire Chief
- Township of Southfield: Tony Averbuch, Fire Chief
- Township of Waterford: John Lyman, Fire Chief
- Township of West Bloomfield: Greg Flynn, Fire Chief
- Village of Beverly Hills: Richard Torongeau, PS Director
- Village of Bingham Farms: Tony Averbuch, Fire Chief
- Village of Bloomfield: Dave Piche, Fire Chief
- Village of Franklin: Daniel Roberts, Police Chief
- Village of Holly: Steve McGee, Fire Chief
- Village of Lake Orion: Jerry Narsh, Police Chief
- Village of Leonard: Mike McDonald, Vlg President
- Village of Milford: Tom Lindberg, Police Chief
- Village of Ortonville: Dave Kwapis, Fire Chief
- Village of Oxford: Pete Scholz, Fire Chief
- Village of Wolverine Lake: John Ellsworth, Police Chief
- Township of Royal Oak: Donna Squalls, Twp Supervisor
- Michigan State Police: Lieutenant Timothy Ketvirtis, District 2 Coordinator

Michigan State Police Emergency Management Division Mitigation Recovery Section

- Michael Sobocinski, Local Hazard Mitigation Specialist

1.4 Hazard Mitigation Plan Process

Published 7/5/2018 14:28 by Nathaniel Marlette

Figure 2: Plan Development and Planning Process



This multi-jurisdictional Hazard Mitigation Plan (the Plan or HMP) was originally created in 2005 and updated in 2011-2012 for Oakland County, and the communities within Oakland County, to better understand natural and man-made hazards and their impacts and to identify ways to mitigate those hazards to protect the health, safety and economic interests of its residents. The plan was again updated in 2017. Each of the 62 communities and 28 school districts within Oakland County participated in this Plan and, therefore, are covered by this Plan. Each of the 62 communities were included in the 2005 and 2012 plans and are again included in this update.

This Plan is designed to comply with requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, and Related Authorities and 44 CFR Part 201, which states that local governments, to be eligible for pre-disaster and/or post-disaster mitigation funds, must have an approved Hazard Mitigation Plan in place. The Plan is also designed to comply with the Federal Emergency Management Act, Federal Emergency Management Agency (FEMA) and Michigan State Police Emergency Management and Homeland Security Division Mitigation Recovery Section (EMHSD) guidance documents (particularly the *Local Multi-Hazard Mitigation Planning Guidebook* dated 2013) and other applicable federal, state and local regulations. This was accomplished by evaluating the impacts of known natural and man-made hazards, prioritizing mitigation alternatives and coordinating hazard mitigation with other Oakland County programs and policies.

During the planning process, Oakland County and community representatives discussed nearly 50 hazards in 4 categories as described below. Some of these were consolidated into similar groupings (e.g., all forms of infrastructure failure were ultimately combined) and Advisory Committee and community representatives rated the importance of these hazards.

Per FEMA's mandate to address all natural hazards, the following natural hazards were not included because these hazards do not directly impact the County. They are:

- Hurricanes
- Sea Level Rise
- Storm Surge
- Tsunami

Hazard definitions are included in **Hazard Profile & Risk Assessment**. These hazards were selected based on the requirements of the *Local Multi-Hazard Mitigation Planning Guidebook* and the Michigan State Police Emergency Management and Homeland Security Division.

Natural Hazards

- Drought
- Earthquake
- Extreme Temperatures - Extreme Cold
- Extreme Temperatures - Extreme Heat
- Fire - Wildfires
- Flooding - Riverine
- Fog
- Invasive Species
- Subsidence - Natural
- Thunderstorms - Hail
- Thunderstorms - Lightning
- Thunderstorms - Severe Wind
- Tornadoes
- Winter Hazards - Ice and Sleet
- Winter Hazards - Snowstorms

Manmade/Technological Hazards

- Criminal Acts - Vandalism and Arson
- Criminal Acts - Mass Shootings
- Fire - Scrap Tire
- Fire - Structural
- Flooding - Dam Failure

- Flooding - Urban
- Hazmat Incidents - Fixed Site
- Hazmat Incidents - Transportation
- Infrastructure Failure - Bridges, Roads, Overpasses
- Infrastructure Failure - Communications
- Infrastructure Failure - Electrical Systems
- Infrastructure Failure - Sewer System
- Infrastructure Failure - Storm Water System
- Infrastructure Failure - Water System
- Oil and Gas Well Accidents
- Petroleum and Natural Gas Pipeline Accidents
- Subsidence - Mining
- Transportation Accidents - Air
- Transportation Accidents - Highway
- Transportation Accidents - Marine
- Transportation Accidents - Rail
- Gas/Oil Shortages or Supply Disruptions

Political Hazards

- Civil Disturbance
- Terrorism and Sabotage
- Weapons of Mass Destruction

Public Health Hazards

- Public Health Emergencies

1.4.1 Plan Goals and Objectives

Published 7/5/2018 14:29 by Nathaniel Marlette

The general goals of any Hazard Mitigation Plan include: saving lives and protecting property, preserving and protecting an area's environment and economy and preserving and maintaining an area's essential services and quality of life. The Plan includes these general goals.

In 2017, the Advisory Committee chose to keep the 2012 goals. These goals, objectives and means for achieving them are discussed further in **Mitigation Goals and Objectives**.

1. Protect public health and safety and prevent and reduce loss of life and injury.
2. Improve and support public and private organizational response capabilities.
3. Increase awareness and preparedness of public, business, non-profit, government, etc. about hazards.
4. Prevent and reduce damage to public and private property and infrastructure.
5. Protect critical assets - hospitals, nursing homes and schools.
6. Encourage personal responsibility.

1.4.2 Planning Process

Published 7/5/2018 14:35 by Nathaniel Marlette

The Plan was prepared to provide a basis for identifying and managing natural, technological and human hazards and to meet federal, state and local requirements for hazard mitigation and FEMA grant funding. Plan preparation involved completion of the following tasks:

- Identify hazards and risks.
- Update the hazard history.
- Update the community profiles.
- Assess vulnerabilities.
- Identify repetitive loss properties.
- Define and update goals and objectives.
- Evaluate the status and relevance of previous goals and strategies.
- Identify and prioritize hazard mitigation strategies.
- Develop and update Action Plans for a select list of mitigation strategies.
- Prepare a draft report for Oakland County, municipal and public review.
- Solicit Oakland County, municipal and public feedback.
- Prepare a final report.
- Provide community outreach and communication.
- Document the planning process.
- Adopt the final plan.

With approved FEMA grant funding, Oakland County contracted Integrated Solutions Consulting to facilitate the hazard mitigation planning process and prepare the final 2017 Oakland County HMP Update. As described below, updating this Plan involved assistance in identifying and evaluating hazards and mitigation options from 4 key groups: An Advisory Committee, community representatives from the 62 municipalities and 28 school districts in the County, public input and other stakeholders. Each of these is described further in the section **Plan Participation**.

Planning Approach

Updating the Plan began with an initial meeting between project staff and staff of the Oakland County Homeland Security Division which was held on May 5, 2017. Following this meeting, the planning process involved review of the existing Plan; updating Oakland County's hazard history; gathering information on local hazards from individual communities; gathering input on hazard priorities; identifying specific vulnerabilities and desired mitigation strategies; evaluating the previous Plan goals, objectives, and mitigation strategies; determining the status of previous mitigation strategies and Action Plans; identifying repetitive loss properties; facilitating the activities of the Advisory Committee and conducting multiple public meetings.

A meeting to identify/discuss hazard risk concerns and participate in the hazard identification and risk prioritization process was conducted on August 4, 2017.

Information regarding hazards in the County and applicable mitigation strategies was also obtained from 4 workshops held throughout the County and a comprehensive public survey that reached 1,150 residents and resulted in 854 completed responses. Advisory Committee members, community and school representatives, and the public were asked to rate each of the hazards in terms of perceived risk. They were also asked to rate "mitigation importance" for each of the identified hazards in the plan. Information from this survey was used to inform the hazard risk prioritization process.

During the month of October 2017, four (4) workshops were held throughout the County, and municipal and school representatives were invited to attend. These workshops included local planning members from each of the communities and schools. Participants validated the County's risk assessment findings, described specific hazard risks and concerns for their own communities and schools, updated existing mitigation actions/strategies from the 2005 and 2012 Plan, and worked with their local planning team to identify new mitigation initiatives. Through a combination of ranking exercises, worksheets and discussion, workshop participants evaluated hazard risk results; evaluated the 2012 Plan goals, objectives, mitigation strategies, Action Plans and rankings; identified goals and objectives for the 2017 Oakland County HMP Update and selected options for mitigating specific hazards to be included in this Plan.

Existing Plans and Programs

Since a Hazard Mitigation Plan is only a part of the emergency planning, mitigation, preparedness, response and recovery process, a second objective of the planning process was to coordinate Plan preparation with existing Oakland County emergency plans, programs, procedures and organizations. For purposes of this Plan, existing hazard mitigation goals and objectives within Oakland County were reviewed. It should be noted that this Plan does not replace any existing plans or programs, but is intended to provide a reference on hazard mitigation to be used in planning and program development.

County Goals and Objectives

Successful implementation of this Plan requires that it fit within, and be consistent with, other goals, objectives and programs of Oakland County government. As such, identified goals and objectives, mission statements and other guiding principles of relevant Oakland County agencies were reviewed as part of the planning process. Oakland County's Hazard Mitigation Planning Process is not intended to replace any other County planning effort, but should be considered in future County-wide planning. Specific goals and objectives developed as part of this 2017 Oakland County HMP Update fit within the context of the existing role of the Oakland County Homeland Security Division and the strategic initiatives of Oakland County.

Coordinating Oakland County's hazard mitigation planning and implementation is, largely, a function of including this Plan's information and a general focus on hazard mitigation within the overall planning and goal setting activities of the County. Future coordination of this Plan with other activities in Oakland County will be conducted by the Oakland County LEPC as described in the **Plan Maintenance Process**.

Homeland Security Division

In 2005, Oakland County Emergency Response and Preparedness (ERP) served as the lead agency for development of the Oakland County Hazard Mitigation Plan. ERP has since been renamed the Oakland County Homeland Security Division (HSD). The HSD handles all matters of emergency management within Oakland County and is the lead agency for both development and implementation of this HMP Update. Roles and responsibilities of the Homeland Security Division include the following.

- **Mitigation:** Eliminate, reduce or prevent long-term risk to human life and property from natural and man-made hazards.
- **Emergency Preparedness:** Advance emergency planning that develops operational capabilities and facilitates an effective response in the event an emergency occurs.
- **Emergency Response:** Action taken immediately before, during or directly after an emergency to save lives, minimize damage to property and enhance the effectiveness of recovery.
- **Recovery:** Short-term activity to return vital life support systems to minimum operating standards and long term activity designed to return life to normal or improved levels.

Oakland County

The key initiatives in 2005 included the following:

- Making Oakland County the economic engine of Michigan.
- Conservative and prudent fiscal management of Oakland County government.
- Create and promote innovative programs and service.
- Technological superiority.

The current key initiatives of Oakland County in 2012 were:

- Increase jobs and diversify the job market while increasing the presence in international markets.
- Conservative and prudent fiscal management of Oakland County government.
- Increase educational opportunities available to children to prepare them for success.
- Create and promote innovative programs and services that increase the quality of life of the residents including the Rail-to-Trails system and Oak Street program.
- Reduce infant mortality rates for residents and encourage maternal health.
- Provide free wireless internet to all residents of Oakland County.

Oakland County's key initiatives in 2017 were:

- Promoting Oakland County as "A Great Place to Live, Work, and Play".
- Emerging Sectors Initiative: job creation and diversification are transferring Oakland County's economy from manufacturing based to knowledge based.
- Medical Main Street®: A no-cost network of health care and life science leaders in health-related industries, your partner to life science, biotechnology, pharmacology, and health care.
- Develop innovative life-saving Autonomous Vehicle Network Pilot Program at no cost to taxpayers.

Source: Oakland County Homeland Security Division website, <http://www.oakgov.com/homelandsecurity/about/>, January 5, 2012.

Source: Oakland County Executive website, <http://www.co.oakland.mi.us/exec/initiatives/>, September 7, 2004.

Source: Oakland County Executive website, <http://www.co.oakland.mi.us/exec/initiatives/>, January 5, 2012

1.4.3 Plan Participation

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The focus of the 2017 Oakland County HMP Update was a series of structured discussions with, and opportunities for feedback from, Oakland County officials, municipal officials, affected stakeholders and the general public. Social media and email communications, as well as an online planning system, enabled project staff to keep in contact with the affected parties and supply information to a broad audience. In particular, these included the following opportunities for outreach and input:

- A project online planning system (<https://oakland.isc-cemp.com>)
- Email notices describing the planning process made available to the Advisory Committee and municipal/school officials
- Online and hardcopy survey provided to the Advisory Committee, municipal/school officials, and the general public (<http://oakland.preparedness.sgizmo.com/s3/>)
- A series of Webinars to introduce the mitigation planning process to local and school officials.
- Four (4) workshops held strategically throughout the County for the identification and prioritization of hazards, hazard mitigation strategies and Action Plans.
- Creation and distribution of online forms so county, municipal, and school stakeholders could easily submit local hazard risk concerns and mitigation strategies.
 - Hazard Form: <https://integratedsolutions.wufoo.com/forms/khx8k751tbt3wg/>
 - New Mitigation Action Projects Form: <https://integratedsolutions.wufoo.com/forms/qo0ndg617ys5lw/>
- Email and phone communication with leaders and representatives from each of the communities, school districts and Advisory Committee.
- Telephone and face-to-face interviews with leaders and representatives from the County, municipalities, and public school districts.
- Three (3) public meetings were held throughout the County during the month of October
- Copies of the draft plan were made available for review and comment on the Oakland County web site.

County Participation

The Oakland County Homeland Security Division provided contract administration, participation on the Advisory Committee, local matching funds for the development of this Plan (in the form of staff salaries and direct expenses), Geographic Information System (GIS) data, technical and regional information, meeting facilities and printing and duplication services. Oakland County continued to be instrumental in preparing county maps and data, providing a meeting location for the Advisory Committee, and coordinating various Oakland County departments. Oakland County is responsible for utilization, updating and oversight of the Plan and supporting local units of government with grant funding.

Advisory Committee

A project Advisory Committee was formed to provide input on the hazards and mitigation options applicable to Oakland County and to oversee the 2017 Oakland County HMP Update. The Advisory Committee was made up of people who assisted in the previous plan, as well as new members. The existing Oakland County Local Emergency Planning Committee (LEPC) made up the core of the Advisory Committee. Additional stakeholders within Oakland County were also invited to participate. The Advisory Committee participated in the hazard identification and risk assessment, determined Plan goals and objectives, evaluated mitigation alternatives and prepared the final Action Plans through a series of workshops and surveys.

Community Representatives

Representatives from each of the 62 municipalities coordinated community input and met with project staff to discuss hazard identification, mitigation options and community-specific vulnerabilities. The communities also evaluated the status of the 2012 Plan goals, hazards and mitigation strategies. Based on availability, individual community representatives were composed of the municipality's Emergency Management Coordinator (EMC), fire and police personnel, and/or community leaders (mayor, township supervisor, etc.) for each of the 62 municipalities.

Community representatives were kept informed on the planning progress through the online planning system, webinars and email correspondence, and were invited to comment on the Draft Plan posted on the web site. Community representatives received an initial announcement concerning the project, emails outlining various methods of participating in the project, and access to the draft Plan. A list of community representatives that participated is included in Volume II.

Table 2: Oakland County Plan Participation Documentation

Jurisdiction	Attended Mtg/Webinar	New Action(s) Submitted	Old Actions Updated	Other Outreach Efforts: Conference Call	Other Outreach Efforts: Direct Email	Participated in Plan Update
Bloomfield Hills City	Yes	No	Yes	11/20, 11/29	11/15/2017	Yes
Keego Harbor City	No	Yes	Yes	11/13/2017, 12/11/2017	11/13/2017	Yes
Pleasant Ridge City	Yes	Yes	Yes	11/14/2017	11/14/2017	Yes
Sylvan Lake City	No	Yes	Yes	11/20/2017	11/14, 11/20	Yes
Addison Twp	Yes	Yes	Yes		11/20, 11/27	Yes
Auburn Hills City	Yes	Yes	Yes		11/15/2017	Yes
Berkley City	Yes	Yes	Yes		11/15/2017	Yes
Beverly Hills Village	Yes	Yes	Yes			Yes
Bingham Farms Village	Yes	Yes	Yes			Yes
Birmingham City	No	Yes	Yes	11/13/2017	11/13/2017	Yes
Bloomfield Twp	N/A	N/A	N/A			Own Plan
Bloomfield Village	N/A	N/A	N/A			Own Plan
Brandon Twp	Yes	Yes	Yes	11/20, 11/29	11/15/2017	Yes
Clarkston City	Yes	Yes	Yes	11/20/2017	11/16/2017	Yes
Clawson City	Yes	Yes	Yes			Yes
Commerce Twp	No	Yes	Yes	11/13/2017		Yes
Farmington City	Yes	Yes	Yes		11/15/2017	Yes
Farmington Hills City	Yes	Yes	Yes	11/27/2017	11/15/2017	Yes
Ferndale City	Yes	Yes	Yes			Yes
Franklin Village	Yes	Yes	Yes			Yes
Groveland Twp	Yes	Yes	Yes	11/13/2017	11/13/2017	Yes
Hazel Park City	Yes	Yes	Yes	11/13/2017	11/13/2017	Yes
Highland Twp	Yes	Yes	Yes	11/13/2017	11/13/2017	Yes
Holly Twp	Yes	Yes	Yes			Yes
Holly Village	Yes	Yes	Yes	11/13/2017	11/13/2017	Yes
Huntington Woods City	Yes	Yes	Yes			Yes
Independence Twp	Yes	Yes	Yes	11/20/2017	11/16/2017	Yes
Lake Angelus City	Yes	Yes	Yes	11/14/2017	11/14/2017	Yes
Lake Orion Village	Yes	Yes	Yes	11/20/2017	11/15/2017	Yes
Lathrup Village City	Yes	Yes	Yes	11/20/2017	11/15/2017	Yes
Leonard Village	Yes	Yes	Yes		11/20/2017	Yes
Lyon Twp	Yes	Yes	Yes	11/20/2017	11/15/2017	Yes
Madison Heights City	Yes	Yes	Yes	11/20/2017	11/15/2017	Yes
Milford Twp	Yes	Yes	Yes	11/20, 11/21	11/15/2017	Yes
Milford Village	Yes	Yes	Yes			Yes
Northville City	Yes	Yes	Yes			Yes
Novi City	Yes	Yes	Yes			Yes
Novi Twp	Yes	Yes	Yes	11/14/2017	11/14/2017	Yes
Oak Park City	Yes	Yes	Yes	11/14, 11/20	11/20/2017	Yes
Oakland Twp	Yes	Yes	Yes	11/14/2017	11/14/2017	Yes
Orchard Lake City	Yes	Yes	Yes		11/15/2017	Yes
Orion Twp	Yes	Yes	Yes	11/14/2017	11/14/2017	Yes
Ortonville Village	Yes	Yes	Yes	11/20, 11/29	11/15/2017	Yes
Oxford Twp	Yes	Yes	Yes		11/16/2017	Yes
Oxford Village	Yes	Yes	Yes		11/16/2017	Yes
Pontiac City	Yes	Yes	Yes		11/20/2017	Yes
Rochester City	Yes	Yes	Yes			Yes
Rochester Hills City	Yes	Yes	Yes			Yes
Rose Twp	Yes	Yes	Yes	11/20/2017	11/15/2017	Yes
Royal Oak City	N/A	N/A	N/A			Own Plan
Royal Oak Twp	Yes	Yes	Yes	11/14/2017	11/14/2017	Yes
South Lyon City	Yes	Yes	Yes			Yes
Southfield City	Yes	Yes	Yes		11/15/2017	Yes
Southfield Twp	Yes	Yes	Yes	11/20/2017	11/15/2017	Yes
Springfield Twp	Yes	Yes	Yes		11/15/2017	Yes
Troy City	Yes	Yes	Yes		11/29/2017	Yes
Walled Lake City	Yes	Yes	Yes	11/20/2017	11/15/2017	Yes
Waterford Twp	Yes	Yes	Yes		11/20, 11/30	Yes
West Bloomfield Twp	Yes	Yes	Yes	11/14/2017	11/14/2017	Yes
White Lake Twp	Yes	Yes	Yes	11/15/2017	11/15/2017	Yes
Wixom City	Yes	Yes	yes	11/20/2017	11/15/2017	Yes
Wolverine Lake Village	Yes	Yes	Yes		11/20/2017	Yes

School District Representatives

Emergency planning and response personnel and/or safe school representatives for each of Oakland County's 28 public school districts and 2 public universities were contacted and interviewed by project staff. Each school representative was asked to identify hazards associated with the school district and ways in which those hazards could be mitigated. As a historical note, the schools were not included in the 2005 Plan since public school districts were not considered separate government agencies when the 2005 Plan was written; therefore, no evaluation of past goals, hazards or mitigation strategies was conducted at that time. However, schools were invited to participate in the 2012 and 2017 Plan. A list of the

school district representatives is included in Volume III.

Public Outreach

Three public meetings were held throughout the County during the month of October and November 2017. The first public meeting was held at Oakland County International Airport on October 17, 2017 from 6 p.m. to 8 p.m. Another public meeting was held October 23, 2017 at the Farmington Hills Fire Station #5 from 6 p.m. to 8 p.m. The final public meeting was held on November 1, 2017 at the Oakland County Homeland Security Division from 7 p.m. to 9 p.m. The purpose of the meetings was to share and validate the hazard risk findings, receive public input on important mitigation initiatives, and to provide an overview of the project, discuss the processes and purposes of the planning process and resulting HMP and to provide the project contacts and web links to individuals who wanted to receive further information, or to provide input, regarding the Plan and planning process.

The public meetings were publicized with advertisements in the Oakland Press and by e-mail sent to members of the Advisory Committee and municipal/school stakeholders. Invites were also sent to key community groups. Copies of public meeting materials and outreach efforts are provided in Appendix B.

Other Stakeholders

In addition to involving representatives of regional agencies and neighboring communities as part of the project Advisory Committee, the following stakeholders were invited to provide input on the draft Plan:

- American Red Cross – Southeastern Michigan Chapter
- Michigan State University Cooperative Extension Service
- Oakland County Water Resources Commissioner's Office
- Road Commission for Oakland County
- Oakland County Planning and Economic Development Services
- Oakland County Health Division
- Oakland County Sheriff's Office
- Friends of the Rouge
- Clinton River Watershed Council
- Huron River Watershed Council
- Genesee County LEPC
- Lapeer County LEPC
- Livingston County LEPC
- Macomb County LEPC
- St. Clair County LEPC
- Washtenaw County LEPC
- Wayne County LEPC
- U.S. Geological Survey
- U.S. Army Corps of Engineers
- National Weather Service
- Southeast Michigan Council of Governments (SEMCOG)

1.4.4 Plan Activities

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Online Planning System

One of the key features of the Online Planning System was the ability to provide real-time access to the plan and to allow stakeholders to comment on key sections (<https://oakland.isc-cemp.com>). Advisory Committee members and municipal/school stakeholders were given access to the system. Comments can be used to encourage collaboration for plan maintenance. The Comments tool allowed the user to make comments on any page within the manual and mark the comment as an observation or feedback. Comments for pages were visible to all administrators and users who had editing privileges for the specific page.

To make a comment, users were instructed to click on the Comment link on the bottom of the content page and a pop-up box would appear. The person used the drop-down box to designate whether the comment was a Feedback or an Observation. After entering the comment, they clicked the Send Comments button to submit.

The comment would appear after the page refreshes (if user is allowed to view comments). An email notification was sent to users who were designated to receive comment notification.

Figure 3: Online Planning System

The screenshot shows the 'MI: Oakland County' dashboard. At the top, there's a navigation bar with links like 'Home', 'CEMP Navigation', 'My Profile', 'Groups/Teams', 'Calendar', 'My CEMPs', 'Modules', 'Help', and 'System Administration'. A search bar is on the right. Below the navigation is a red banner with a message about FEMA's grant requirements and a link to a training page. The main content area has a 'Welcome' message and two buttons: 'Hazard Mitigation Participation Module' (orange) and 'Disaster Preparedness and Mitigation Survey' (blue). Below these are four sections: 'CEMP Index' (listing various documents), 'Your Workgroups, Committees, and Strike Teams' (listing various project teams), 'Most Recently Published CEMP Pages' (listing recent updates), and 'Your Favorite CEMP Pages' (listing favorites).

Surveys

A hazard mitigation and preparedness questionnaire was developed to gauge household preparedness for all hazards and the level of knowledge of tools and techniques that assist in reducing risk and loss. This questionnaire was designed to help identify areas vulnerable to one or more hazards. The answers to its questions helped guide the Advisory Committee in prioritizing hazards of impact and in selecting goals, objectives and mitigation strategies. The 30-question survey reached 1,150 residents and resulted in 854 completed responses. On average, it took respondents 16 minutes to complete the survey. Advisory Committee members, community and school representatives, and the public were asked to rate each of the hazards in terms of perceived risk. They were also asked to rate "mitigation importance" for each of the identified hazards in the plan. Information from this survey was used to inform the hazard risk prioritization process.

The complete questionnaire and a summary of its findings can be found in Appendix D and E. The online version of the questionnaire can be accessed at: <http://oakland.preparedness.sgizmo.com/s3/>

Figure 4: Online Questionnaire



Advisory Committee Meetings

The Advisory Committee met four (4) times between May and December 2017, in a series of meetings.

Meeting agendas and attendance logs can be found in Appendix B of this document. All Advisory Committee meeting times and locations were sent via e-mail and with follow-up phone calls, as needed. See Appendix B for a copy of Agendas, meeting materials, and photos of the meetings.

Webinars

Multiple Webinars were conducted between August 29, 2017 and September 8, 2017. In total, seven (7) webinars were offered to municipal and school district representatives. Webinars lasted about 1 hour. The purpose of these webinars was to provide stakeholders with an orientation to the mitigation planning process, and to provide a brief tutorial on the online planning system so municipal and school stakeholders could access their community or school district's portion of the plan.

Workshops

Four (4) workshops held strategically throughout the County for the identification and prioritization of hazards, hazard mitigation strategies and Action Plans. The workshops were specifically geared for municipal and school district stakeholders. Specifically, participants validated the County's risk assessment findings, described specific hazard risks and concerns for their own communities and schools, updated existing mitigation actions/strategies from the 2005 and 2012 Plan, and worked with their local planning team to identify new mitigation initiatives. Through a combination of ranking exercises, worksheets and discussion, workshop participants evaluated hazard risk results; evaluated the 2012 Plan goals, objectives, mitigation strategies, Action Plans and rankings; identified goals and objectives for the 2017 Oakland County HMP Update and selected options for mitigating specific hazards to be included in this Plan.

Participants were encouraged to bring their local planning team, which included the following:

- Building Code Enforcement
- City Management/County Administration
- Emergency Management
- Fire Department/District
- Floodplain Administration
- Geographic Information Systems
- Parks and Recreation
- Planning/Community Development
- Public Works
- Storm water Management
- Transportation (Roads and Bridges)
- City Council/Board of Commissioners
- Planning Commission
- Planning/Community Development
- Regional/Metropolitan Planning Organization(s)
- City/County Attorney's Office
- Economic Development Agency
- Local Emergency Planning Committee
- Police/Sheriff's Department
- Sanitation Department
- Tax Assessor's Office

- Special Districts and Authorities
- Airport, Seaport Authorities
- Fire Control District
- Flood Control District
- School District(s)
- Transit Authority
- Utility Districts

Workshops were held at the following locations:

Tuesday, October 17th	Oakland International Airport 6500 Highland Rd. Waterford MI 48327	Local/School Emergency Management Team 2pm to 4 pm Public Meeting 6 pm to 8 pm
Wednesday, October 18th	Independence Twp Fire Station 1 6500 Citation Dr. Clarkston MI 48346	Local/School Emergency Management Team 2 pm to 4 pm
Monday, October 23rd	Farmington Hills Fire Station 5 21455 W. 11 Mile Rd Farmington Hills MI 48336	Local/School Emergency Management Team 2 pm to 4 pm Public Meeting 6 pm to 8 pm
Tuesday, October 24th	Baker's of Milford 2923 S. Milford Rd. Milford MI 48381	Local/School Emergency Management Team 2 pm to 4 pm

The agenda, meeting materials and photos are presented in Appendix B and C.

Community Meetings and Outreach

Representatives from each community in Oakland County were contacted to identify hazards of particular concern to that community and to evaluate the status of the 2012 mitigation strategies and goals. Local community concerns regarding individual hazards may be based on the history of hazard occurrence, potential for future hazard occurrence, consequence(s) of the hazard or hazards that are highlighted in community mitigation goals and objectives.

1. Initial e-mail/phone contact: A representative for each community, typically the emergency management coordinator, was identified as the initial contact. The individual was contacted to confirm their community's participation and was asked to identify other individuals within the community that should also participate in discussion involving hazard mitigation.
2. Telephone interviews and meetings (Workshops and Webinars) with the community representatives: Project staff contacted representatives from each community to identify and discuss locally significant hazards and preferred mitigation strategies. Meeting participation varied, but typically included the police and/or fire chief or local emergency management coordinator; the mayor, township supervisor, or village president and/or the leaders of one or more other municipal department. A list of meeting participants for each community is included in Volume II and III.
3. To further facilitate municipal and school district participation, the creation and distribution of online forms so county, municipal, and school stakeholders could easily submit local hazard risk concerns and mitigation strategies were created and distributed.
 - Hazard Form: <https://integratedsolutions.wufoo.com/forms/khx8k751tbt3wg/>
 - New Mitigation Action Projects Form: <https://integratedsolutions.wufoo.com/forms/qo0ndg617ys5lw/>

1.4.5 Plan Adoption

Published 7/5/2018 15:27 by Nathaniel Marlette

Formal adoption of a Hazard Mitigation Plan is required for FEMA for approval. The Draft Plan was provided to members of the project Advisory Committee. Copies of the Draft Plan were also provided to each municipality in Oakland County, to other stakeholders and the public via the Oakland County Homeland Security Division website. Comments received on the Draft Plan are included in Appendix D.

Upon completing the comment/review period, the plan was submitted to the Michigan State Police, for review and comment. Following the State's review, the plan was submitted to FEMA for their review and conditional approval.

Upon FEMA review and conditional approval, the Plan was presented to the Oakland County Board of Commissioners for approval and adoption. The Oakland County Hazard Mitigation Plan was formally adopted by the Oakland County Board of Commissioners on **[Insert Date of Adoption]**. A copy of the County's resolution is included in Appendix G.

FEMA and the Michigan State Police also require that all multi-jurisdictional Plans be adopted, in whole or in part, by individual municipalities within the planning area. Municipal officials were informed of this requirement by letter and during the face-to-face interviews. A sample resolution of adoption was provided to each community by mail with a letter announcing the availability of the Draft Plan for review. Information regarding local hazard priorities and local hazard mitigation strategies is included in separate subsections of the Plan so that each community may readily reference and adopt sections specific to their municipality. The communities listed in Table 2 have adopted this Plan, either in whole or in part, as indicated.

1.4.6 Plan Maintenance

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Oakland County Homeland Security Division staff and the Oakland County Local Emergency Planning Committee (LEPC) will periodically review the Plan for required changes. Plan evaluation and maintenance is the responsibility of the Oakland County Homeland Security Division. Reviews of the hazard priorities, mitigation strategies and Action Plans will be conducted as necessary to maintain consistency with changes in the community, hazard history, and goals and objectives of Oakland County.

Changes constituting a substantive revision to the Plan will require that the new Plan be provided to the Oakland County Board of Commissioners, and the individual communities participating in the Plan, for approval and re-adoption.

The Plan must be updated and approved by FEMA within 5 years of the previous Plan's approval for Oakland County and Oakland County communities and school districts to remain eligible for pre-disaster and post-disaster funding. Please refer to the **Plan Maintenance and Implementation** section for additional information regarding this process.

1.4.7 Community Adoption

Published 9/18/2018 14:49 by Tracey McGee

Table 3: Community Adoption

Community	Items Adopted	Date Adopted
Addison, City of	Resolution to adopt Hazard Mitigation Plan	
Auburn Hills, City of	Resolution to adopt Hazard Mitigation Plan	8/13/18
Berkley, City of	Resolution to adopt Hazard Mitigation Plan	8/13/18
Beverly Hills, Village of	Resolution to adopt Hazard Mitigation Plan	
Bingham Farms, Village of	Resolution to adopt Hazard Mitigation Plan	7/23/18
Birmingham, City of	Resolution to adopt Hazard Mitigation Plan	
Bloomfield Hills, City of	Resolution to adopt Hazard Mitigation Plan	
Bloomfield, Township of	Resolution to adopt Hazard Mitigation Plan	
Bloomfield, Village of	Resolution to adopt Hazard Mitigation Plan	
Brandon, Township of	Resolution to adopt Hazard Mitigation Plan	8/13/18
Clarkston, City of	Resolution to adopt Hazard Mitigation Plan	
Clawson, City of	Resolution to adopt Hazard Mitigation Plan	8/21/18
Commerce, Township of	Resolution to adopt Hazard Mitigation Plan	
Farmington, City of	Resolution to adopt Hazard Mitigation Plan	8/20/18
Farmington Hills, City of	Resolution to adopt Hazard Mitigation Plan	
Ferndale, City of	Resolution to adopt Hazard Mitigation Plan	
Franklin, Village of	Resolution to adopt Hazard Mitigation Plan	
Groveland, Township of	Resolution to adopt Hazard Mitigation Plan	
Hazel Park, City of	Resolution to adopt Hazard Mitigation Plan	
Highland, Township of	Resolution to adopt Hazard Mitigation Plan	
Holly, Township of	Resolution to adopt Hazard Mitigation Plan	
Holly, Village of	Resolution to adopt Hazard Mitigation Plan	8/14/18
Huntington Woods, City of	Resolution to adopt Hazard Mitigation Plan	
Independence, Township of	Resolution to adopt Hazard Mitigation Plan	
Keego Harbor, City of	Resolution to adopt Hazard Mitigation Plan	
Lake Angelus, City of	Resolution to adopt Hazard Mitigation Plan	
Lake Orion, Village of	Resolution to adopt Hazard Mitigation Plan	8/14/18
Lathrup Village, City of	Resolution to adopt Hazard Mitigation Plan	7/23/18
Leonard, Village of	Resolution to adopt Hazard Mitigation Plan	8/13/18
Lyon, Township of	Resolution to adopt Hazard Mitigation Plan	
Madison Heights, City of	Resolution to adopt Hazard Mitigation Plan	
Milford, Township of	Resolution to adopt Hazard Mitigation Plan	8/15/18
Milford, Village of	Resolution to adopt Hazard Mitigation Plan	7/16/18
Northville, City of	Resolution to adopt Hazard Mitigation Plan	8/20/18
Novi, City of	Resolution to adopt Hazard Mitigation Plan	
Novi, Township of	Resolution to adopt Hazard Mitigation Plan	
Oakland, Township of	Resolution to adopt Hazard Mitigation Plan	8/14/18
Oak Park, City of	Resolution to adopt Hazard Mitigation Plan	8/27/18
Orchard Lake, City of	Resolution to adopt Hazard Mitigation Plan	
Orion, Township of	Resolution to adopt Hazard Mitigation Plan	8/6/18
Ortonville, Village of	Resolution to adopt Hazard Mitigation Plan	
Oxford, Township of	Resolution to adopt Hazard Mitigation Plan	
Oxford, Village	Resolution to adopt Hazard Mitigation Plan	
Pleasant Ridge, City of	Resolution to adopt Hazard Mitigation Plan	
Pontiac, City of	Resolution to adopt Hazard Mitigation Plan	
Rochester, City of	Resolution to adopt Hazard Mitigation Plan	
Rochester Hills, City of	Resolution to adopt Hazard Mitigation Plan	7/30/18
Rose, Township of	Resolution to adopt Hazard Mitigation Plan	
Royal Oak, City of	Resolution to adopt Hazard Mitigation Plan	

Royal Oak, Township of	Resolution to adopt Hazard Mitigation Plan	
Southfield, City of	Resolution to adopt Hazard Mitigation Plan	
South Lyon, City of	Resolution to adopt Hazard Mitigation Plan	9/10/18
Southfield, Township of	Resolution to adopt Hazard Mitigation Plan	7/10/18
Springfield, Township	Resolution to adopt Hazard Mitigation Plan	8/9/18
Sylvan Lake, City of	Resolution to adopt Hazard Mitigation Plan	
Troy, City	Resolution to adopt Hazard Mitigation Plan	
Walled Lake, City	Resolution to adopt Hazard Mitigation Plan	
Waterford, Township of	Resolution to adopt Hazard Mitigation Plan	
West Bloomfield, Township of	Resolution to adopt Hazard Mitigation Plan	
White Lake, Township of	Resolution to adopt Hazard Mitigation Plan	
Wixom, City of	Resolution to adopt Hazard Mitigation Plan	
Wolverine, Village of	Resolution to adopt Hazard Mitigation Plan	7/11/18

1.5 Community Profile

Published 1/11/2018 12:41 by Daiko Abe

1.5.1 Historical Overview

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The earliest inhabitants of the area were Native Americans of the Ottawa, Ojibwa, and Potawatomi Tribes. Many of Oakland County's main transportation routes originated from Native American trails such as the Saginaw Trail (Woodward Avenue), Shiawassee Trail (Orchard Lake Road) and Grand River Trail (Grand River Avenue).

In 1818, a group of men from Detroit and Macomb County formed the Pontiac Company with intent to purchase land and establish a town within Oakland County. Later that same year, a group of professionals and businessmen from Detroit surveyed the area and reported on Oakland County's abundant natural resources.

On January 12, 1819, Oakland County was officially organized by proclamation of Governor Lewis Cass. The Oakland County seat was established in Pontiac, with financial and property contributions from the Pontiac Company. Oakland County was divided into 2 townships, Oakland Township in the north and Bloomfield Township in the south. By 1827, Oakland County was further divided to encompass 5 townships with the addition of Farmington, Troy and Pontiac Townships.

The first official census of Oakland County was conducted in 1820 and reported a population of 330 people. The population quickly grew within the next 10 years to include 4,911 people in 1830. By 1870, Oakland County, population 40,867, was the fifth largest in the state. The 2010 U.S. Census reported 1,202,362 residents, which is second in Michigan only to Wayne County. According to Census projections, Oakland County is the thirty-third (33rd) most populous County in the United States with an estimated population of 1,243,970 people in 2016.

United States Census Bureau website, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2016_PEPANNRES&src=pt, About United States County Populations, visited June 14, 2017

1.5.2 Geography and Climate

Published 7/5/2018 15:32 by Nathaniel Marlette

Oakland County covers approximately 907 square miles and is located in southeast Michigan, north of Wayne County and west of Macomb County. The topography of Oakland County ranges from flat to gently rolling. Oakland County contains the headwaters for 5 major river systems or watersheds.

Weather in Oakland County is consistent with non-coastal areas of southeastern Michigan. Table 3 provides average monthly weather conditions in Oakland County from 2012 - 2016 as published by the National Climatic Data Center.

**Note: Consistent data could not be found for average snowfall from 2012 - 2016. Data for average snowfall in Table 3 reflects averages up to 2012.*

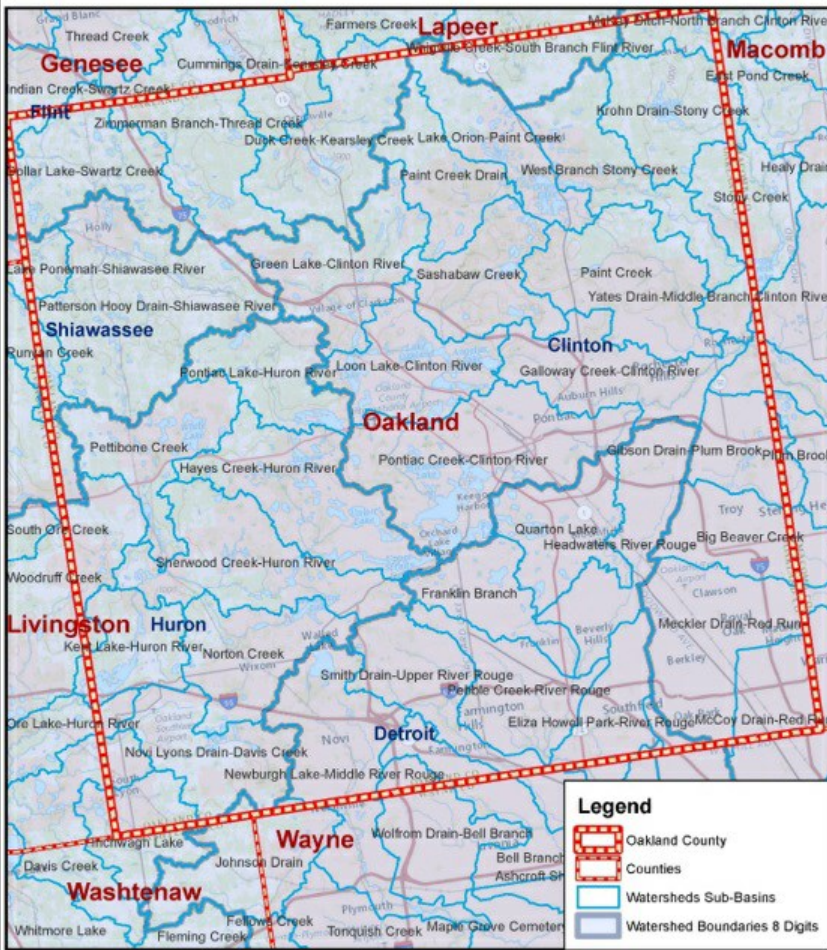
Table 4. Oakland County Temperature and Precipitation Averages

Month	Average Daily Temperature (F ^o)	Average Precipitation (inches)	Average Snowfall (inches)
January	23.08	1.39	7.9
February	22.06	.794	7.3
March	35.64	1.34	5.8
April	45.52	2.73	1.6
May	60.4	3.06	0.0
June	68.06	3.14	0.0
July	72.14	3.42	0.0
August	70.7	3.39	0.0
September	63.58	2.68	0.0
October	51.68	2.39	0.1
November	39.4	1.45	2.5
December	30.98	1.41	8.1
Annual/Ave Total	48.6	27.19	33.3

Source: National Oceanic and Atmospheric Administration Data Center, www.ncdc.noaa.gov, Pontiac Michigan, June 2017.

Figure 5: Watersheds

Watersheds in Oakland County, Michigan



Project Title: Oakland County All Hazard Mitigation Plan
 Produced By: Integrated Solutions Consulting/Developer
 Data Sources: county and watershed boundaries are from Michigan Dept. Natural Resources.
 Date Saved: 9/18/2017 6:49:32 PM



Source: Michigan DNR

1.5.3 Land Use Patterns

Published 7/5/2018 15:33 by Nathaniel Marlette

Although Oakland County's Planning and Economic Development Services Department provides a variety of planning tools and services, Oakland County does not exercise land use or zoning control. Instead, each of the individual cities, townships and villages in Oakland County are zoned and exercise their own control regarding land use planning and permitting. The exception is the Village of Bloomfield which is a subdivision within Bloomfield Township and not a separate political jurisdiction.

The current major land use in Oakland County is single-family residential followed by parks and recreational lands and open space. Since 1990, the land use category that has exhibited the greatest acreage increase has been single-family residential. The greatest decline exhibited has been in agricultural acreage. The Land Use Patterns and Trends table below details land use/land cover in Oakland County.

The increase in single-family residential land use is mirrored by Oakland County's housing characteristics. 2016 American Community Survey, 68.7% of Oakland County's housing units consist of single-family detached homes and 22.0% consist of multiple family housing units. The median home value of owner-occupied housing units in Oakland County is approximately \$191,500 and the median gross rent is \$968 per rental unit per month. Approximately 6.8% of all housing units in Oakland County are vacant.

Table 5. 2000 to 2008 Land Use Patterns & Trends

Land Use Types	2000 Acres	2008 Acres	Change
Single-Family	218,285	313,547	95,262
Multiple-Family	12,608	7,369	-5,239
Commercial	19,655	26,589	6,934
Governmental/Instrumental	13,711	26,014	12,303
Industrial	18,961	29,442	10,481
Transportation, Communication and Utility	9,917	60,623	50,706
Park, Recreation, and Open Space	22,789	66,314	43,525
Agriculture	42,920	21,005	-21,915
Other	193,302	832	NA
Water	28,310	28,895	585
Total Acres	540,458	580,628	170

Source: Southeast Michigan Council of Governments, www.semco.org. Community Profile for OaklandCounty, viewed June 15, 2017

Census Reporter, <https://censusreporter.org/profiles/05000US26125-oakland-county-mi/>, viewed June 15, 2017

1.5.4 Transportation Network

Published 7/5/2018 15:40 by Nathaniel Marlette

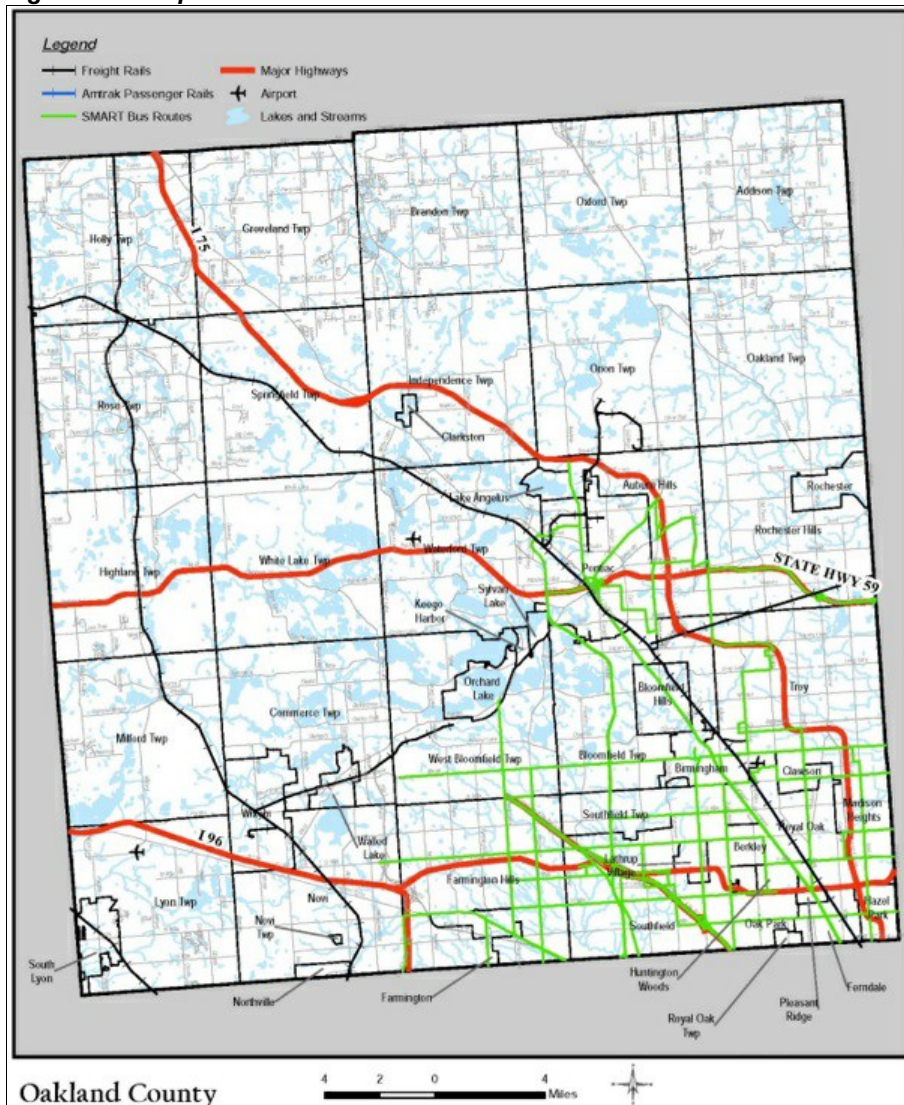
There are approximately 7,343 miles of public roads within Oakland County. Oakland County roads are maintained by the Road Commission for Oakland County. This Road Commission is charged with maintaining over 2,700 miles of county roads, 230 miles of state highway and approximately 1,500 county, city, and state traffic signals in Oakland County. Portions of the County road system are also maintained by the Michigan Department of Transportation and some municipalities.

The Suburban Mobility Authority for Regional Transportation (SMART) provides bus service to 54 fixed routes throughout Oakland, Wayne and Macomb Counties. SMART buses run 7 days per week, 22 hours per day and provide 12 million rides per day. SMART also provides specialized services to the elderly and handicapped.

Oakland County has 3 first-class airports: Oakland County International Airport, Oakland Southwest Airport and Oakland Troy Airport. The Oakland County International Airport is designated a general aviation reliever airport that serves individuals, business and industry. It is the world's 13th busiest general aviation airport with approximately 128,766 takeoffs/landings per year. Over 554 aircraft are based at the airport. The Oakland Southwest Airport is a public airport located in Hudson, Michigan, and services southwest Oakland County. Approximately 59 aircraft are based at the airport, 54 of which are single engine planes. Oakland Troy Airport is used by private, corporate and charter aircraft. Approximately 103 aircraft are based at the airport, of which 92 are single engine planes and five are helicopters. Charter passenger, air freight, aircraft maintenance and fueling are available on the field.

Passenger rail service is provided by Amtrak with stations located in Pontiac, Birmingham, and Royal Oak. The rail service connects to Detroit, which further connects passengers to numerous cities throughout the country. Freight rail lines are located throughout Oakland County and are operated by Canadian National Railway and CSX Transportation.

Figure 6: Transportation Networks



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

SEMCOG, <http://www.semco.org/Community-Profiles#Transportation>, viewed June 15, 2017.

Oakland County Road Commission, <http://www.rcocweb.org/27/About-Us>, viewed June 15, 2017.

SMART, <http://www.smartbus.org/aboutus/overview/Pages/default.aspx>, viewed June 15, 2017.

Oakland County, <http://www.oakgov.com/aviation/>, viewed June 15, 2017.

Ibid.

Air Nav, www.aimav.com/airport/Y47, viewed June 15, 2017.

Air Nav, www.aimav.com/airport/KVLL, viewed June 15, 2017.

Oakland County, <http://accessoakland.oakgov.com/datasets/oc-railroad>, viewed June 15, 2017.

1.5.5 Population and Demographic Characteristics

Published 7/5/2018 16:06 by Nathaniel Marlette

Oakland County is the second most populous county in Michigan. Population projections estimate that in 2035 the population will increase approximately 10% above 2010 U.S. Census values. The following tables contain demographic information for Oakland County, as provided by the Southeast Michigan Council of Governments (SEMCOG), 2010 U.S. Census Bureau and 2015 American Community Survey.

Table 6. 1990 through 2035 Oakland County Population Projection

Year	Population Count/Projection
1990	1,083,592
2000	1,194,156
2010	1,202,362
2020	1,218,449
2035	1,232,672

Source: SEMCOG, viewed June 15, 2017

Table 7. 2016 Household Characteristics

Subject	Number	Percent
Total Housing Units	533,097	
Households (Occupied Units)	496,727	93.2
Family Households	321,879	64.8
Family Households with Own Children Under 18	138,587	27.9
Average Household Size	2.46	-

Source: 2016 American Community Survey, viewed December 14, 2017

Table 8: 2016 Oakland County Age, Gender, and Race Statistics

Subject	Number	Percent
Total Population	1,235,215	100.0
Age		
Under 5 Years	68,130	5.5
5 to 9 Years	74,219	6.0
10 to 14 Years	79,556	6.4
15 to 19 Years	80,087	6.5
20 to 24 Years	72,466	5.9
25 to 34 Years	153,031	12.4
35 to 44 Years	159,762	12.9
45 to 54 Years	188,161	15.2
55 to 59 Years	93,929	7.6
60 to 64 Years	79,927	6.5
65 to 74 Years	107,043	8.7
75 to 84 Years	52,645	4.3
85 Years and Over	26,259	2.1
Race		
Non-Hispanic	1,188,732	96.2
White	937,568	75.9
Black or African-American	170,742	13.8
Asian	80,680	6.5
Multi-racial	33,360	2.7
Other	9,390	.8
Hispanic	46,483	3.8

Source: 2016 U.S. Census Bureau, viewed June 15, 2017

Source: SEMCOG, viewed June 15, 2017

Table 9. 2016 School Enrollment

Subject	Number	Percent
Population 3 Years and Over Enrolled	312,733	100.0
Nursery School, Preschool	19,939	6.4
Kindergarten	13,619	4.4
Elementary School (grades 1-8)	123,217	39.4
High School (grades 9-12)	69,323	22.2
College or Graduate School	86,636	27.7

Source: 2016 American Community Survey, viewed December 14, 2017

Table 10. 2016 Educational Attainment

Subject	Number	Percent
Population 25 Years and Over	860,757	100.0
Less than 9th Grade	18,343	2.1
9th to 12th Grade, No Diploma	37,959	4.4
High School Graduate	167,959	19.5
Some College, No Degree	182,857	21.2
Associate's Degree	66,118	7.7
Bachelor's Degree	221,412	25.7
Graduate or Professional Degree	166,109	19.3

Source: 2016 American Community Survey, viewed December 14, 2017

Table 11: 2016 Disability Status of the Civilian

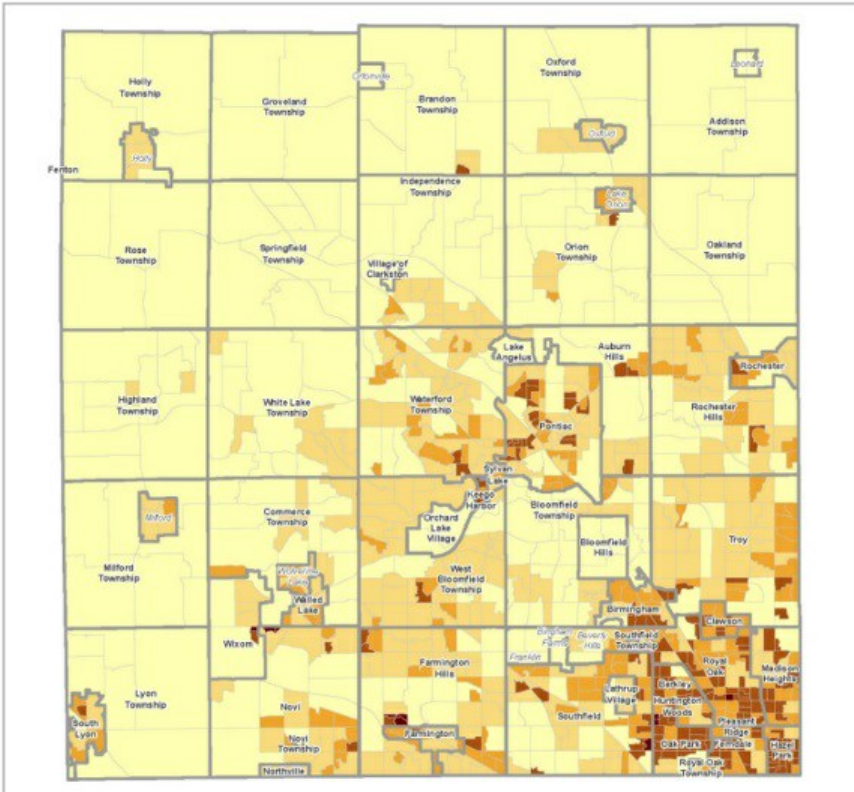
Disability Status of Civilian	Number	Percent
Total Civilian Noninstitutionalized	1,229,304	100.0
With a Disability	143,237	11.7
Under 5 Years	68,121	100.00
With a Disability	812	1.2
5 to 17 Years	204,829	100.00
With a Disability	10,356	5.1
18 to 34 Years	253,222	100.00
With a Disability	15,308	6.0
35 to 64 Years	520,670	100.00
With a Disability	56,735	10.9
65 to 74 Years	106,431	100.00
With a Disability	23,556	22.1
75 Years and Over	76,031	100.00
With a Disability	36,470	48.0

Table 12. 2016 Language Spoken at Home

Subject	Number	Percent
Population 5 Years and Over	1,167,085	100.0
English Only	997,467	85.5
Language Other than English	169,618	14.5
Spanish	29,923	2.6
Other Indo-European Languages	62,165	5.3
Asian and Pacific Islander Languages	43,429	3.7
Other Languages	34,101	2.9

Source: 2016 American Community Survey, viewed December 14, 2017

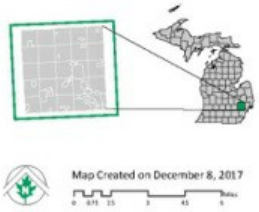
Figure 7: Population Density



The information provided herewith has been compiled from recorded deeds, plats, tax maps, surveys and other public records. It is not a legally recorded map or survey and is not intended to be used as one. Users should consult the information sources mentioned above when questions arise.

2016 Population Density

Oakland County



Number of People Per Square Mile

0-1,800
1,801 - 3,600
3,601 - 5,400
5,400 - 10,000
10,000+

OAKLAND COUNTY MICHIGAN
ECONOMIC DEVELOPMENT & COMMUNITY AFFAIRS
 Executive Office Building
 L. Brooks Patterson County Executive
 2100 Pontiac Lake Road, Bldg. 41W
 Waterford, MI 48328-0412
 248.858.0721
 www.AdvantageOakland.com

Source: Oakland County, MI

U.S. Census Bureau, <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>, viewed June 15, 2017.

SEMCOG, <http://www.semco.org/Community-Profiles>, viewed June 15, 2017.

American Community Survey, US Census Bureau, viewed August 15, 2017

1.5.6 Economic Characteristics

Published 7/5/2018 16:10 by Nathaniel Marlette

According to the SEMCOG 2040 Forecast produced in 2012, there were approximately 901,219 jobs within Oakland County as of 2015. Based off of U.S. Census Bureau estimates, approximately 80% of the Oakland County population is over 16 years of age with 66% of that population in the workforce.

Table 13: Industries

Industry	Number	Percent
Agriculture, forestry, fishing and hunting, and mining	1,601	0.3%
Construction	24,315	3.9%
Manufacturing	113,152	18.3%
Wholesale trade	16,202	2.6%
Retail trade	62,192	10.0%
Transportation and warehousing, and utilities	17,566	2.8%
Information	12,767	2.1%
Finance and insurance, and real estate and rental and leasing	47,726	7.7%
Professional, scientific, and management, and administrative and waste management services	87,708	14.2%
Educational services, and health care and social assistance	140,927	22.8%
Arts, entertainment, and recreation, and accommodation and food services	52,857	8.5%
Other services, except public administration	24,922	4.0%
Public administration	17,138	2.8%
Total (Employed Civilian population over age 16)	619,073	100%

Source: Table DP03 2016 American Community Survey 5-Year Estimates

Table 14: Household Income

Income	Number	Percent
Less than \$10,000	26,372	5.3%
\$10,000 to \$14,999	18,287	3.7%
\$15,000 to \$24,999	40,393	8.2%
\$25,000 to \$34,999	39,878	8.1%
\$35,000 to \$49,999	59,411	12.0%
\$50,000 to \$74,999	85,151	17.3%
\$75,000 to \$99,999	63,752	12.9%
\$100,000 to \$149,999	81,666	16.5%
\$150,000 to \$199,999	36,993	7.5%
\$200,000 or more	41,586	8.4%
Median household income (dollars)	67,465	13.7%
Mean household income (dollars)	92,580	18.8%
Total Households	493,489	100%

Source: Table DP03 2015 American Community Survey 5-Year Estimates

1.5.7 Community Services/Organizations

Published 7/5/2018 16:10 by Nathaniel Marlette

Natural gas service is provided to Oakland County customers by Consumers Energy, DTE Gas, and SEMCO. Those outside of natural gas service areas and those using other heating fuels are serviced by AmeriGas, Ferrellgas, Hamilton's Propane, Northwest Energy and Oakland Fuels. Electrical service is provided by Consumers Energy and DTE Electric. The primary telephone service providers are AT&T, CenturyTel Midwest, Frontier and Verizon North. Water and sewer services for a large portion of Oakland County are overseen by the Water Resources Commissioner's Office.

Oakland County provides a number of services to residents through various agencies and departments, including the Office of the Water Resources Commissioner, Homeland Security Division, Equalization, Health Division, Parks and Recreation, Planning and Economic Development Services and the Oakland County Sheriff's Office. Many of the County's services operate from the Oakland County government campus at 1200 North Telegraph Road in Pontiac, Michigan.

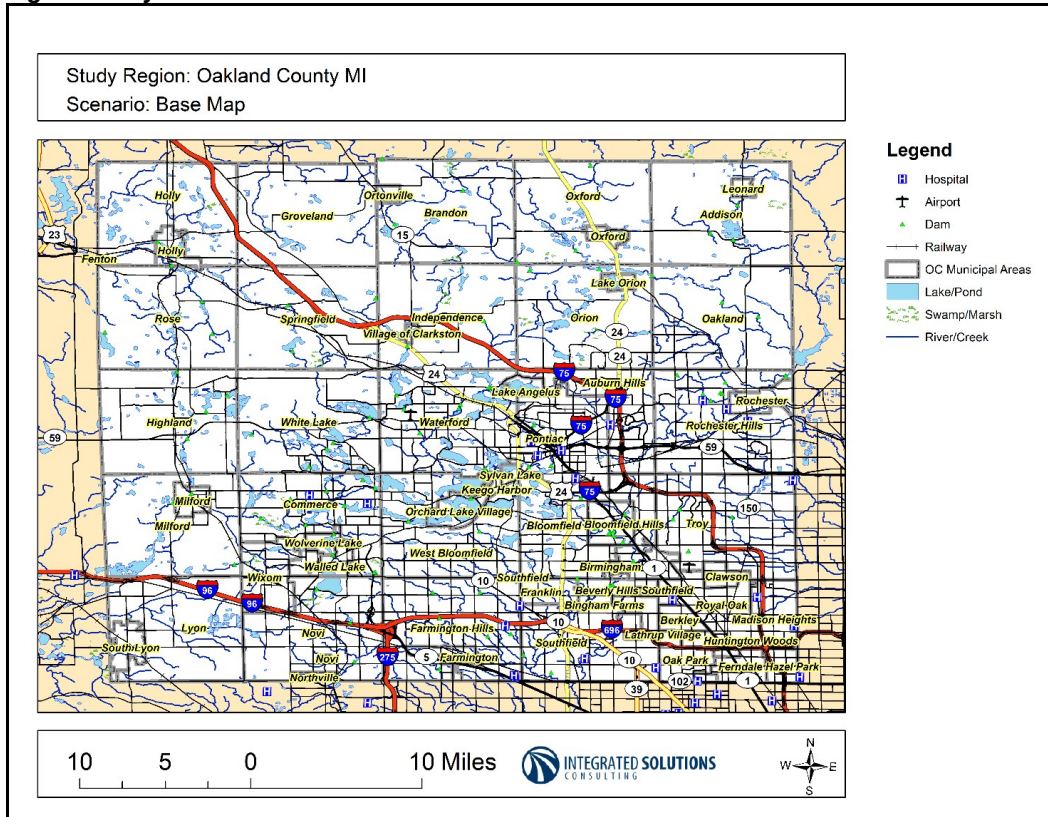
Oakland County is served by 28 school districts. Also within Oakland County are multiple colleges and universities. Additional learning resources are provided through public library services throughout the County.

Oakland County has an extensive Parks and Recreation Department which maintains 13 County parks. The County is also home to numerous festivals such as the annual Arts, Beats and Eats; Renaissance Festival and the Woodward Dream Cruise. Major shopping and entertainment venues within the County include the Great Lakes Crossing Outlets, the Somerset Collection, Twelve Oaks Mall, the Suburban Collection Showplace, and the DTE Energy Music Theatre.

1.5.8 Critical Assets

Published 7/5/2018 16:21 by Nathaniel Marlette

Figure 8: Key Infrastructure and Assets



The following list of the top critical assets was developed based on current and future land use in Oakland County, the nature of hazards which may affect the County and the results of community input. The following facilities and infrastructure were identified as critical to providing essential products and services to the general public, preserving the welfare and quality of life of the community and assuring public safety, emergency response and disaster recovery. Changes to the critical assets list from the 2005 Plan included adding "other response facilities" to hospitals and removing natural areas from the list. Natural areas are included under open spaces. The advisory committee voted on the following critical assets list during the plan update process:

- Central business districts
- Commercial sites
- Hospitals/other response facilities
- Industrial sites
- Open spaces
- Public facilities
- Residential areas
- Roads, railroads and bridges
- Schools and churches
- Sports and entertainment venues
- Utility facilities

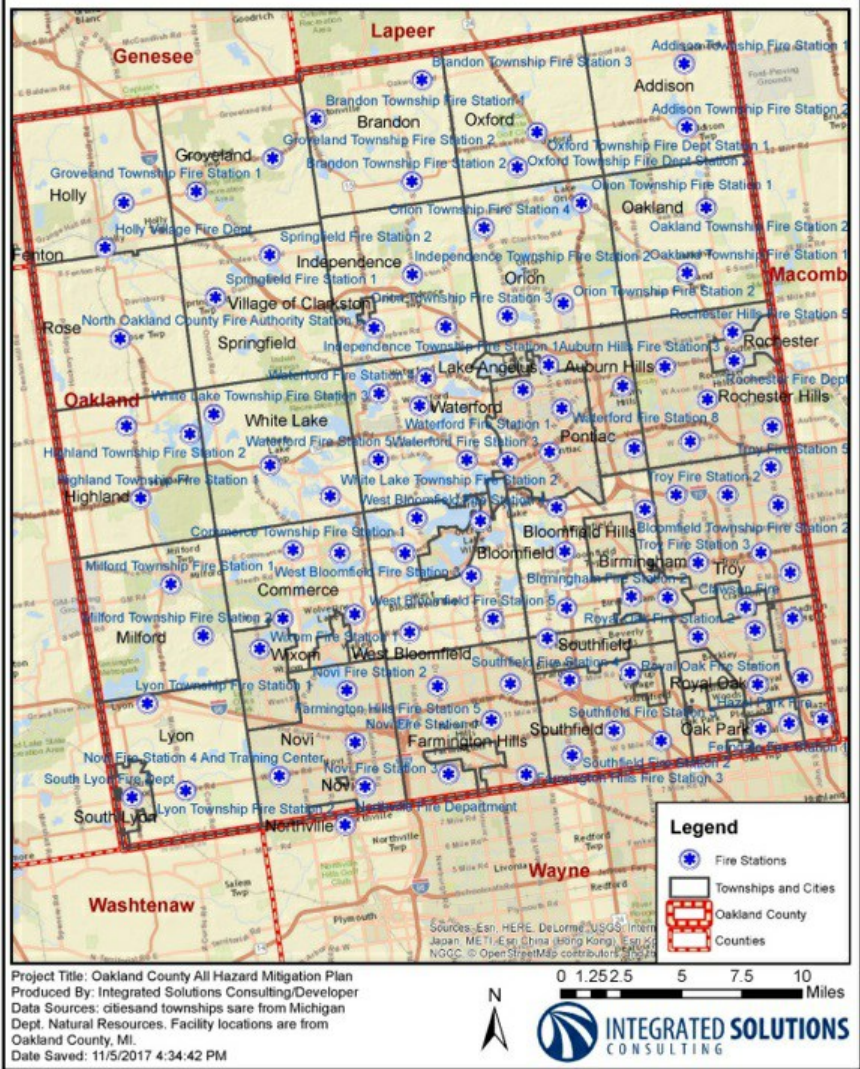
Natural features are highly valued assets in Oakland County. Oakland County Planning and Economic Development Services has established a priority ranking for all natural features to preserve the remainder of the County's natural heritage. The purpose of establishing priority areas is to maintain the economic, environmental, educational and recreational benefits that natural areas provide.

Additional assets, because of their increased vulnerability and/or importance to the community, are noted in this section of the plan. They include:

- Historical Sites
- Manufactured Housing

Figure 9: Fire Stations

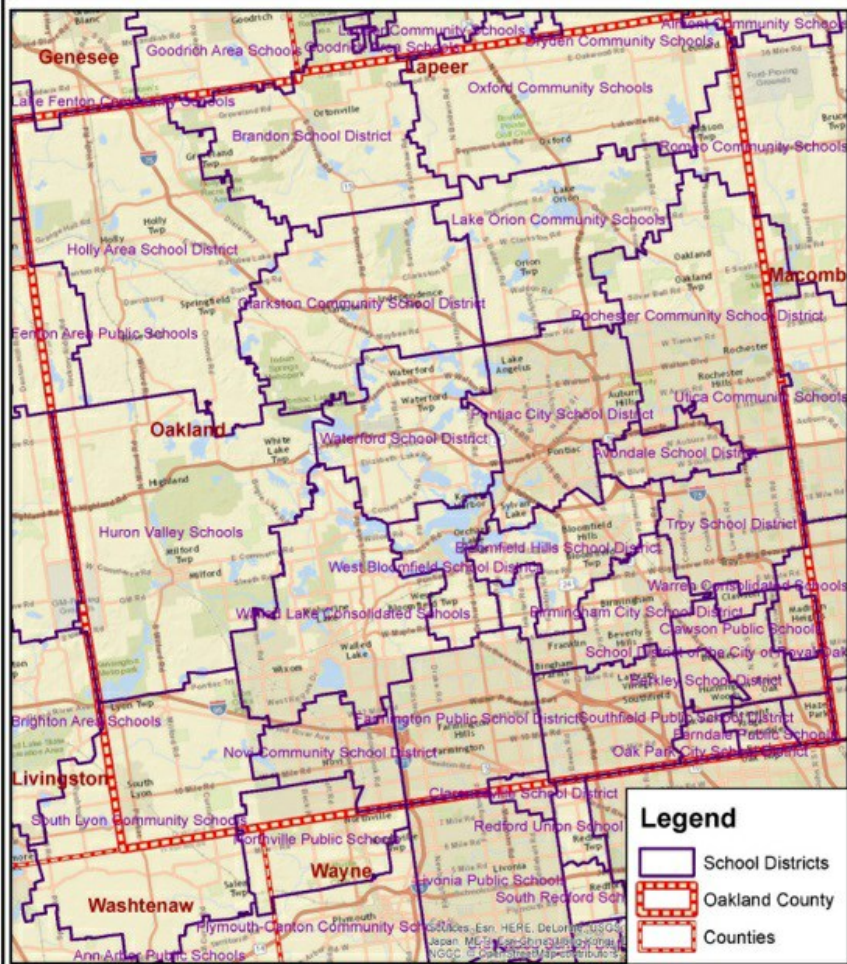
Fire Stations in Oakland County, Michigan



Source: Oakland County, MI

Figure 10: School Districts

School Districts in Oakland County, Michigan

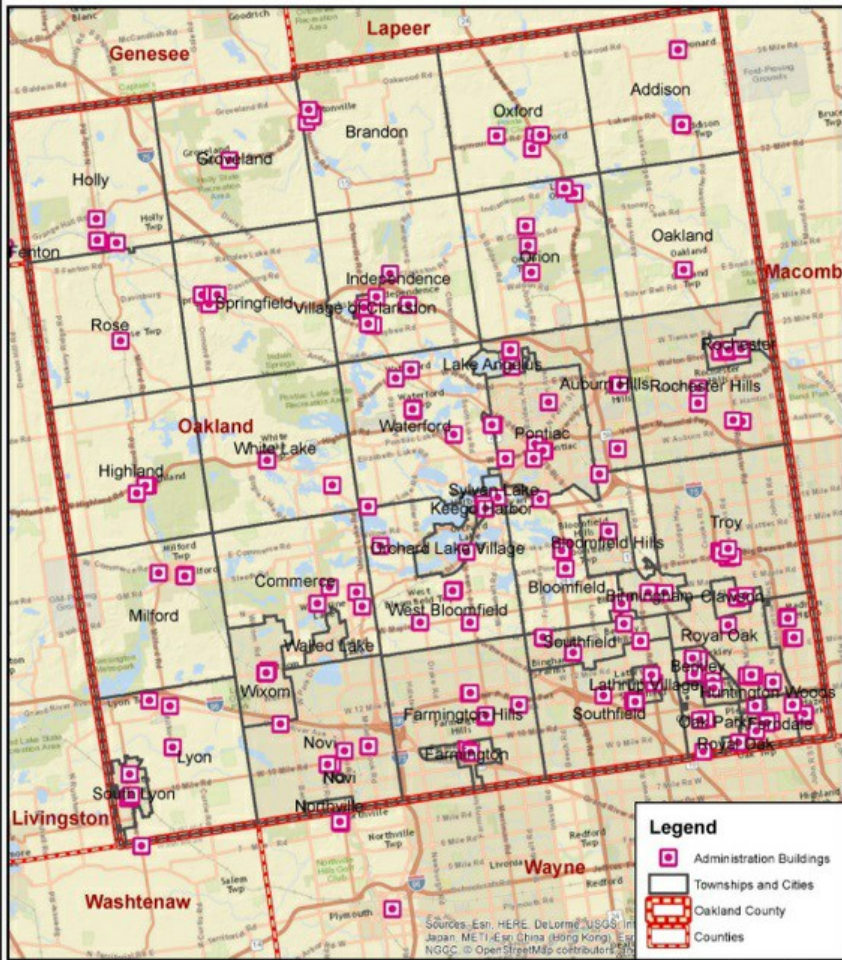


Project Title: Oakland County All Hazard Mitigation Plan
 Produced By: Integrated Solutions Consulting/Developer
 Data Sources: cities and townships sare from Michigan Dept. Natural Resources. Facility locations are from Oakland County, MI.
 Date Saved: 11/5/2017 4:48:03 PM

Source: Oakland County, MI

Figure 11: Administration-related Buildings

Administration Buildings in Oakland County, Michigan

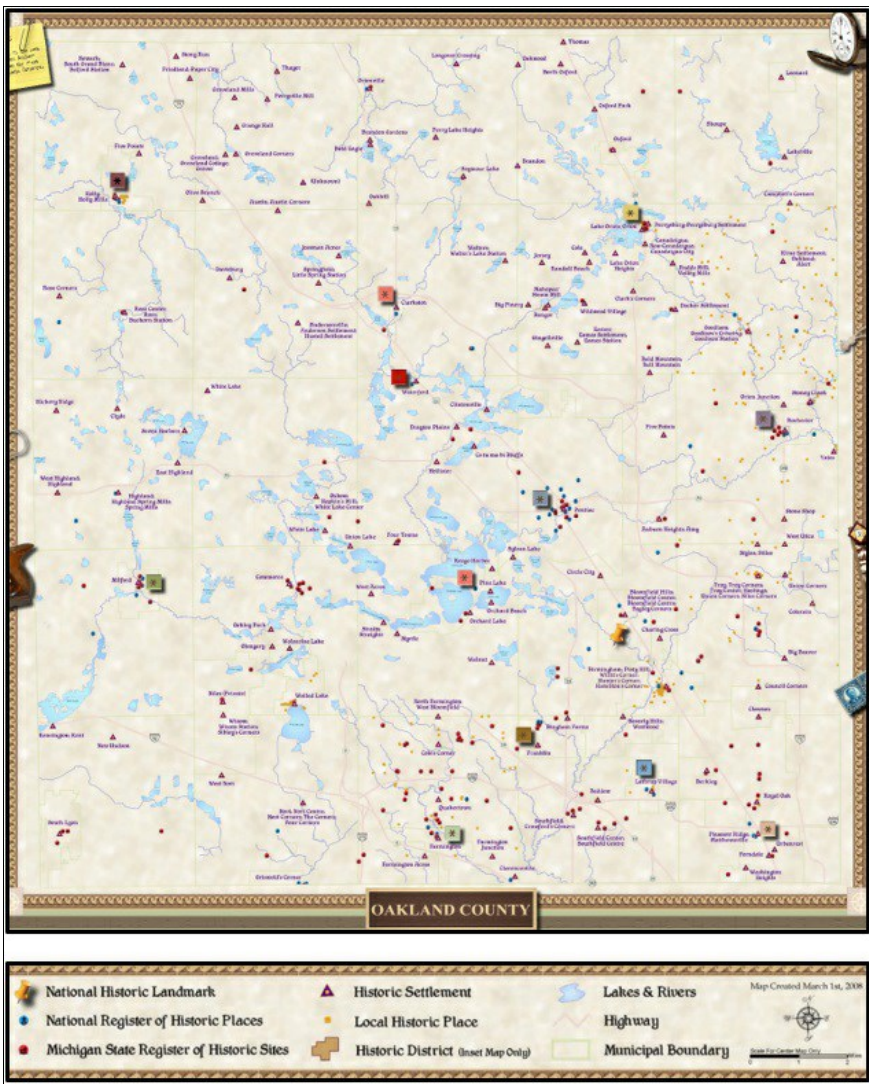


Project Title: Oakland County All Hazard Mitigation Plan
 Produced By: Integrated Solutions Consulting/Developer
 Data Sources: cities and townships sare from Michigan Dept. Natural Resources. Facility locations are from Oakland County, MI.
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Source: Oakland County, MI

Figure 12: Historical Sites and Districts



Source: Oakland County, MI

Table 15: Historical Designations

**Oakland County
Historic Designations**

REVISED
12/8/2017

Community	CVT Type	National Historic Landmarks	National Register of Historic Places	Michigan State Register of Historic Sites	Local Historic District
Addison	Township	No	No	2	
Auburn Hills	City	No	No	2	
Berkley	City	No	No	2	
Beverly Hills	Village	No	No	1	
Bingham Farms	Village	No	No	No	
Birmingham	City	No	3	2	Yes
Bloomfield Hills	City	1	2	1	
Bloomfield	Township	No	2	4	
Brandon	Township	No	No	1	
Clarkston	City	No	1	No	Yes
Hazel Park	City	No	No	No	
Commerce	Township	No	1	8	
Farmington Hills	City	No	3	29	Yes
Leonard	Village	No	No	No	
Fenton		No	No	No	
Oak Park	City	No	No	No	
Waterford	Township	No	1	5	Yes
Groveland	Township	No	No	No	
Holly	Township	No	2	No	
Lathrup Village	City	No	2	No	Yes
Wixom	City	No	No	3	
Clawson	City	No	No	No	
Huntington Woods	City	No	No	1	Yes
Independence	Township	No	1	2	
Keego Harbor	City	No	No	No	
Lake Angelus	City	No	No	No	
Farmington	City	No	1	2	Yes
Ferndale	City	No	No	2	
Franklin	Village	No	2	4	Yes
Lyon	Township	No	No	1	
Madison Heights	City	No	No	No	
Milford	Township	No	1	1	
Milford	Village	No	3	6	Yes
Northville	City	No	1	No	
Novi	City	No	1	1	
Novi	Township	No	No	No	
Holly	Village	No	3	3	Yes
Oakland	Township	No	3	2	Yes
Orchard Lake	City	No	1	3	Yes
Orion	Township	No	No	3	
Lake Orion	Village	No	No	6	Yes
Oxford	Township	No	1	1	
Ortonville	Village	No	1	1	
Pleasant Ridge	City	No	2	No	Yes

**Oakland County
Historic Designations**

REVISED
12/8/2017

Community	CVT Type	National Historic Landmarks	National Register of Historic Places	Michigan State Register of Historic Sites	Local Historic District
Oxford	Village	No	No	3	
Rochester Hills	City	No	3	5	Yes
Pontiac	City	No	15	11	Yes
Rose	Township	No	1	1	
Royal Oak	City	No	1	7	Yes
Royal Oak	Township	No	No	1	
South Lyon	City	No	No	3	
Southfield	City	No	No	8	Yes
Southfield	Township	No	No	No	
Springfield	Township	No	No	1	
Sylvan Lake	City	No	No	No	
Troy	City	No	2	10	Yes
Rochester	City	No	2	7	
Highland	Township	No	2	No	
West Bloomfield	Township	No	No	No	
White Lake	Township	No	No	2	
Walled Lake	City	No	No	1	Yes
Wolverine Lake	Village	No	No	No	
Total		1	64	159	

Source: Oakland County, MI

Figure 13: Manufactured Home Communities



The information provided herewith has been compiled from recorded deeds, plats, tax maps, surveys and other public records. It is not a legally recorded map or survey and is not intended to be used as one. Users should consult the information sources mentioned above when questions arise.

Manufactured Home Communities

Oakland County

Existing Land Use 2016

■ Mobile Home Park


OAKLAND
 COUNTY MICHIGAN
 ECONOMIC DEVELOPMENT
 & COMMUNITY AFFAIRS
 Executive Office Building
 L. Brooks Patterson County Executive
 2100 Pontiac Lake Road, Bldg. 41W
 Waterford, MI 48328-0412
 248.858.0721
www.AdvantageOakland.com

Map Created on December 8, 2017
 0 1 2 4
 Miles

Source: Oakland County, MI

1.6 Hazard Profile & Risk Assessment

Published 7/5/2018 16:40 by Nathaniel Marlette

The Plan evaluated over 50 hazards during the 2017 Oakland County HMP Update. Hazards were identified using a combination of historical research, surveys, workshops, community and public meetings, and the 2012 Plan. Based on this evaluation, specific hazards were identified as requiring additional consideration, and therefore are the focus of this Mitigation Plan. These hazards were selected to represent both County-wide and local community concerns. Evaluation of these hazards does not reduce the significance of a hazard event from any of the hazards evaluated, but provides a method for Oakland County to focus mitigation activities and resources.

Some of the hazards were consolidated into similar groupings (e.g., all forms of infrastructure failure were ultimately combined). Per FEMA's mandate to address all natural hazards, the following natural hazards were not included because these hazards do not directly impact the County. They are:

- Hurricanes
- Sea Level Rise
- Storm Surge
- Tsunami

While this section provides a detailed description and profile of each hazard, the analysis is provided at the county level. **Specific hazard risks and concerns for the municipalities and school districts are addressed in Volume II and Volume III of this Plan.** The hazards that are addressed in this section are:

Natural Hazards

- Drought
- Earthquake
- Extreme Temperatures - Extreme Cold
- Extreme Temperatures - Extreme Heat
- Fire - Wildfires
- Flooding - Riverine
- Fog
- Invasive Species
- Subsidence - Natural
- Thunderstorms - Hail
- Thunderstorms - Lightning
- Thunderstorms - Severe Wind
- Tornadoes
- Winter Hazards - Ice and Sleet
- Winter Hazards - Snowstorms

Manmade/Technological Hazards

- Criminal Acts - Vandalism and Arson
- Criminal Acts - Mass Shootings
- Fire - Scrap Tire
- Fire - Structural
- Flooding - Dam Failure
- Flooding - Urban
- Hazmat Incidents - Fixed Site
- Hazmat Incidents - Transportation
- Infrastructure Failure - Bridges, Roads, Overpasses
- Infrastructure Failure - Communications
- Infrastructure Failure - Electrical Systems
- Infrastructure Failure - Sewer System
- Infrastructure Failure - Storm Water System
- Infrastructure Failure - Water System
- Nuclear Power Plant Accidents
- Oil and Gas Well Accidents
- Petroleum and Natural Gas Pipeline Accidents
- Subsidence - Mining
- Transportation Accidents - Air
- Transportation Accidents - Highway
- Transportation Accidents - Marine
- Transportation Accidents - Rail
- Gas/Oil Shortages or Supply Disruptions

Political Hazards

- Civil Disturbance
- Terrorism and Sabotage
- Weapons of Mass Destruction

Public Health Hazards

- Public Health Emergencies

This section provides a comprehensive profile of each hazard. It identifies those hazards that have occurred or could occur in Oakland County. Each hazard profile is organized, as such:

1. Definition

The description gives an overarching picture of the hazard.

2. Historical Events

This section describes actual occurrences. If local examples or occurrences were not available, state and/or relevant national and international instances were used.

3. Frequency/Probability & Previous Occurrences

This section describes how often the hazard has occurred. The National Climatic Data Center was used to populate this section for many natural hazards. If there were no previous examples of this hazard affecting the County, or the County was only minimally affected, other geographical areas were considered, including State, National and in some cases, International locations.

4. Area Impacted

The location identifies which area(s) the hazard has impacted and/or is most likely to affect.

5. Health and Safety

This section describes the life safety considerations related to the hazard.

6. Economic Impact

The economic impact of disasters can be devastating. This section attempts to capture the direct and indirect costs, damages, and cascading impacts resulting from the hazard.

7. Critical Facilities/Services

This section describes the key assets within the County and services that are most likely to be affected by the hazard, such as property damages or other vulnerabilities.

8. Hazard Evaluation and Impact/consequence Assessment

Finally, the hazard assessment section shows the ratings assigned to the various categories of the Community Vulnerability, Risk, and Resiliency (CVR2) process. The CVR2 process is a scientific and patented method developed by Integrated Solutions Consulting for analyzing and ranking hazard risk. A detailed description of the methodology is provided in the Hazard Assessment & Analysis section.

1.6.1 Civil Disturbances

Published 7/5/2018 16:46 by Nathaniel Marlette

Definition

A public gathering or inmate uprising that disrupts essential functions and results in unlawful behavior such as rioting or arson. This event involves a large number of people and requires a significant response effort by law enforcement and/or emergency responders.

Historical Events

In Michigan, large civil disturbances are not common and typically are a result of the following causes:

- Labor disputes
- Controversial court judgment or government actions
- Resource shortages
- Demonstrations by special interest groups
- Unfair death or injury
- Celebrating a victory by a sports team.

Although not in Oakland County, the five-day 1967 Detroit Riot (from July 23rd to 27th) left 43 people dead and 1,189 injured. Over 7,200 people were arrested and property damages reached into the hundreds of millions of dollars. Racial tensions sparked the Detroit Riot.

An anti-war demonstration at Memorial Park in Royal Oak, Michigan took place on May 6, 1970. Upon leaving the park, the protesters (many of whom were young) got into a confrontation with local police. Five protesters were arrested, three protesters were injured, and one policeman was injured.

The Memorial Park Riot took place between August 24th and 27th, 1970 in Royal Oak, Michigan. Police shut down the park due to drug sales, drug use, and illegal parties. When the police went to shut down the park, 800 youths confronted the police officers and sparked a four-hour riot. Windows were broken and barricades were built on Woodward Avenue. One hundred protesters were arrested the second night of the riots and a curfew was imposed. Due to the curfew, at least 1,000 young rioters moved north into Birmingham on the third night (some estimates have up to 2,000 rioters involved). Over 560 people were arrested on the third night, and a curfew was imposed in both Royal Oak and Birmingham. No violence occurred on the fourth night, although 90 people were arrested for breaking curfew.

In 2008, approximately 100 people started rioting with police at what is now McLaren Hospital in Pontiac following a police investigation into the shooting of a local man. The Pontiac Police called for assistance from Michigan State Police and the Oakland County Sheriff's Office to bring the crowd under control. Neighboring areas, such as the City of Detroit, have a history of major civil disturbances, primarily as a result of civil rights demonstrations and labor disputes.

Frequency & Probability

A civil disturbance occurs in Michigan approximately once every 10 years. Civil disturbances are most common in areas of economic or social inequality, sporting events, universities and colleges and prisons. The most likely causes for a civil disturbance in the County would be a result of a labor dispute, a sporting event or a demonstration at a college, government or military facility within the County. Oakland County houses the Palace of Auburn Hills, 19 universities and colleges, 10 detention facilities/correctional camps and numerous cities.

Although there is limited history of civil disturbances within Oakland County, the potential for this hazard to occur is somewhat elevated due to the number of sport/entertainment venues, educational facilities, detention facilities and government facilities within the County.

Health & Safety

The 2008 Pontiac riot was small and localized. There were no reports of death or serious injuries resulting from the riot. State-wide, there have been over 75 deaths and over 1,700 injuries from major civil disturbances from 1943 - 2008.

Area Impacted

Civil disturbance events often involve acts of arson, looting and vandalism which can result in devastating levels of property damage. There were no reports found listing the amount of property damage resulting from the Pontiac riot. From 1967 to 2001, civil disturbances in Michigan have totaled over \$50 million in property damage.

Places of public gathering such as festivals, sporting and entertainment venues, colleges and universities, detention facilities and government facilities are the most likely places for a civil disturbance to occur.

Economic Impact

The economic impact of a civil disturbance reaches far beyond emergency response costs and property damage. Economic recovery from civil disturbances is very slow and often requires government assistance to revive the local economy. This hazard can tarnish an area's image and deter potential investors and residents. The Pontiac riot was small and localized. The economic impact of the riot was localized and short term because of limited publicity and short duration without any reported deaths or serious injuries.

Critical Facilities/Services

The nature of civil disturbances is such that local emergency response services are often overwhelmed. As a result, aid is often required from other local or state units.

The high degree of property damage that may occur from this hazard can greatly impact the ability to operate or provide services at the hazard location (particularly sporting and entertainment venues, colleges and universities, detention facilities and government facilities). The Pontiac riot required Michigan State Police and the Oakland County Sheriff's Office to assist the Pontiac Police Department. The riot occurred at a hospital after the police arrived to inspect the body of a rapper who had been shot and killed. Fortunately, the police were able to keep the riot localized and were able to diffuse the situation before any serious impacts.

Civil Disturbance Risk & Vulnerability Assessment

A civil disturbance in Michigan occurs, on average, once every 10 years. The most likely causes for a civil disturbance in the County are labor disputes, sporting events, viewed inequality, or demonstration at a college, government facility, detention facility, or military facility.

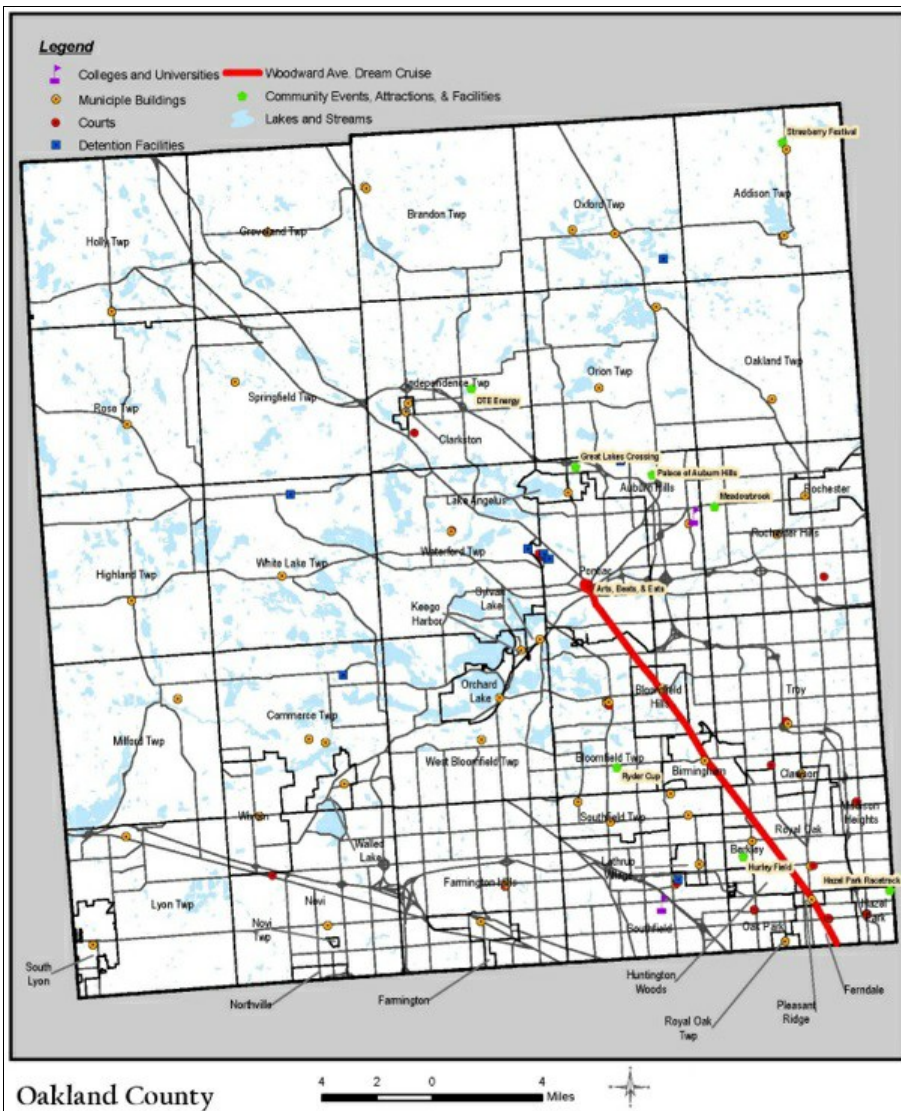
In 2008, approximately 100 people started rioting with police at what is now McLaren Oakland Hospital in Pontiac, following a police investigation into the shooting of a local man. The Pontiac Police Department called for assistance from the Michigan State Police and Oakland County Sheriff's Office to bring the crowd under control. No serious injuries or fatalities were reported.

Oakland County features numerous places of public gathering including major entertainment venues, festivals, national events, major athletic facilities, places of political protest, and governmental facilities. The most vulnerable locations/events include the following.

- Courthouses and federal buildings
- Detention facilities
- DTE Energy Music Theatre
- Great Lakes Crossing Outlets
- Hazel Park Raceway
- Meadowbrook Hall & Theater
- Michigan State Fair
- Oakland Community College
- Oakland County Fair
- Oakland University
- Renaissance Festival
- Royal Oak Arts, Beats, & Eats
- Woodward Dream Cruise

Police stations are vulnerable in response to a civil disturbance event. Figure 14 displays the locations/events listed, as well as those of specific concern to communities. Locations of police stations in the County are also shown in Figure 14.

Figure 14: Civil Disturbance Vulnerability Map



Source: Oakland County, MI, USDA SEMCOG | Created by: ASTI

Table 16: Civil Disturbance Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	13
Potential Magnitude and Scale ¹	22
Physical Vulnerability Hazard Impact ¹	58
Social Vulnerability Hazard Impact ¹	59
Community Conditions Hazard Impact ¹	40
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	43
Overall Risk Rating ³	23

Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Oakland County Sheriff Report, July 2, 2008.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, page 7 and 16-22.

Oakland County Sheriff Report, July 2, 2008.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 7 and 16-22.

1.6.2 Criminal Acts

Published 2/17/2017 08:27 by Nathan Marlette

1.6.2.1 Vandalism

Published 7/5/2018 16:53 by Nathaniel Marlette

Definition

Vandalism is the willful or malicious destruction, injury, disfigurement or defacement of any public or private property, real or personal, without consent of the owner or person having control. A vandalism offense is an act of vandalism which is reported to a law enforcement agency.

Historical Events

Examples of acts of vandalism can include graffiti, tampering with traffic signs and damage to vacant buildings. In more extreme cases, vandalism can occur to public facilities or infrastructure and has the potential to result in significant impact to the community.

Oakland County certainly is not immune from acts of vandalism. In February 1984, vandals entered a parking lot for public school buses in Lake Orion. The vandals discharged extinguishers in nearly entire fleet of 52 buses. This act of vandalism cancelled school for 5,000 Lake Orion students

Table 17: Total Vandalism Offenses in Oakland County

Year	Total
1997	10,753
1998	11,444
1999	8,206
2000	10,110
2001	10,117
2002	9,471
2003	9,610
2004	8,207
2005	8,002
2006	8,287
2012 (Damage to property)	5,132
2013 (Damage to property)	4,101
2014 (Damage to property)	3,819
2015 (Damage to property)	3,524
2016 (Damage to property)	3,785

Source: Michigan State Police, Uniform Crime Reports, Requested June 26, 2017

Frequency and Probability

From 1997 through 2006, there were a total of 94,207 vandalism offenses reported in Oakland County, an average of 9,421 vandalism offenses each year. It must be noted that no data for vandalism could be found for 2007 - present. To capture current data, "Damage to Property" was used to identify instances of vandalism. Given the well-established frequency of this hazard in previous years, it is anticipated that this hazard will continue to occur in the future.

Health & Safety

There is no data available for death or injury rates due to acts of vandalism. It is anticipated that the majority of these acts do not pose a threat to human health or safety. However, this may not be the case in instances of vandalism involving public infrastructure.

Area Impacted

Due to the nature of vandalism, property damage can be expected with each occurrence. Data regarding property damage due to vandalism is not available for Oakland County; however, the amount of property damage is directly related to the severity of the event. All areas of Oakland County are potential targets for vandalism. Higher rates of occurrence can be anticipated in areas of urban blight or vacant buildings.

Economic Impact

No information is available regarding the economic impact of vandalism in Oakland County. However, considering the effects of this crime, high rates of vandalism can decrease the attractiveness of neighborhoods or business districts. This can result in economic loss due to loss of business.

Critical Facilities/Services

Although not common, critical facilities and services can be directly impacted by vandalism. The 1984 vandalism of the Lake Orion school bus fleet is an example of the potentially far-reaching effects of vandalism.

Vandalism Risk & Vulnerability Assessment

Oakland County averages 9,421 vandalism offenses each year. The entire County area is susceptible to vandalism. Facilities that have the highest vulnerability to an act of vandalism are government facilities, educational institutions, and registered historic sites. Police stations are a vulnerable asset in response to acts of vandalism.

Educational facilities, municipal buildings, court facilities, registered historic sites, and police station locations are included on Figure 15. Oakland County has over 26,000 land use acres of institutional establishments.

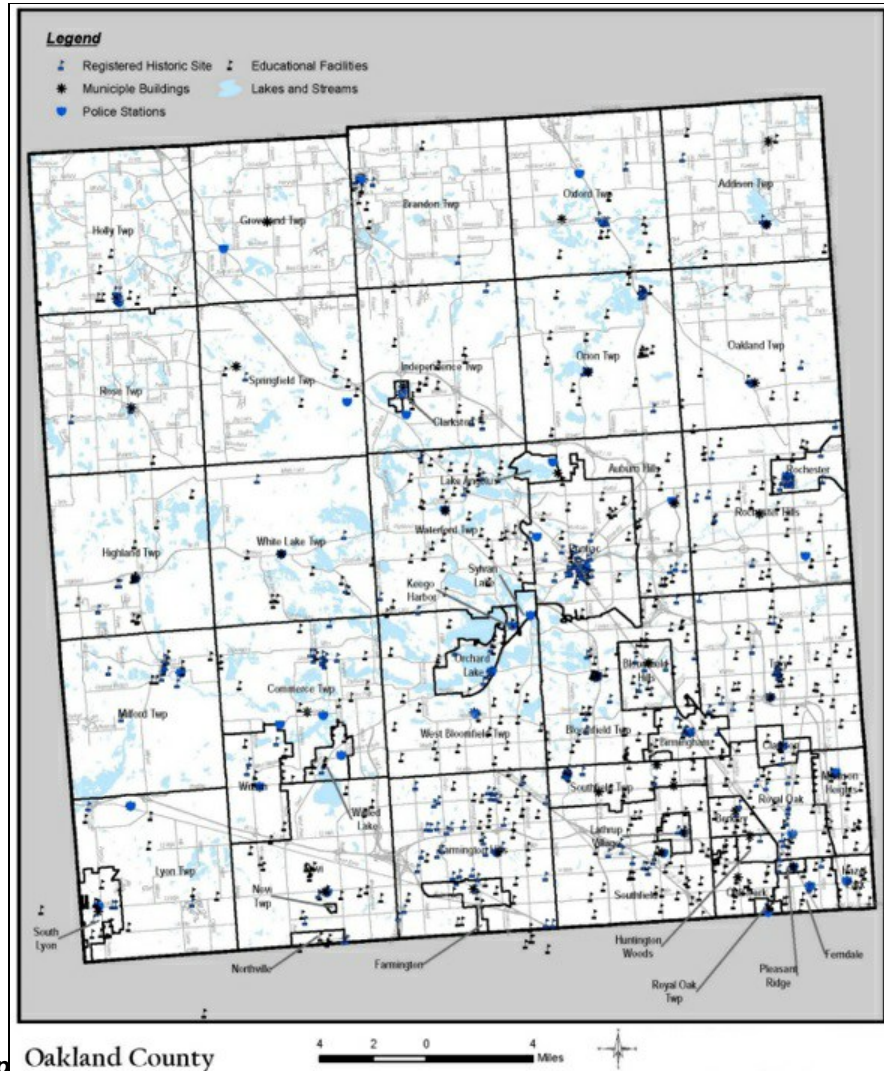


Figure 15: Vandalism Vulnerability Map
 Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Table 18: Vandalism Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	38
Potential Magnitude and Scale ¹	6
Physical Vulnerability Hazard Impact ¹	39
Social Vulnerability Hazard Impact ¹	40
Community Conditions Hazard Impact ¹	28
Overall Capability and Capacity ²	79
Mitigation ²	83
Hazard Consequence & Impact Score ¹	27
Overall Risk Rating ³	32

Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Detroit Free Press, State Edition, February 17, 1984, Page 3A.

Michigan State Police, Uniform Crime Reports, Crime Statistics, Oakland County, 1997-2006 Requested on June 26, 2017.

1.6.2.2 Arson

Published 7/5/2018 16:55 by Nathaniel Marlette

Definition

Arson is the willful or malicious burning or attempt to burn, with or without intent to defraud, a dwelling, public building, motor vehicle or personal property of another. An arson offense is an act of arson which is reported to a law enforcement agency.

Historical Events

According to the National Fire Protection Association, arson is the fourth leading cause of residential fires and fifth leading cause of residential fire deaths in the United States. At commercial sites, arson is also a major cause of deaths, injuries, and dollar loss. There were 1,222 reported arson fires in Oakland County from 2008 through 2015. Oakland County has experienced numerous arson fires at both private and public properties.

A residential arson fire on April 7, 2000, in Royal Oak Township killed 5 children, seriously injured 2 children and destroyed a home.

On April 24, 2015, several fires were set throughout Myth Golf and Banquets in Oakland Township. More than 50 golf carts and a building containing gasoline, fertilizer, and other chemicals burned in three separate fires – resulting in almost \$1 million in property damage.

Frequency & Probability

For the period of 2010 through 2015, Oakland County averaged 132 arson fires per year. This period saw arson rates drop significantly from previous levels (196 incidents in 2010 to 81 in 2015). It is likely that arson will continue to occur periodically in Oakland County, but with steady declines in annual frequency.

Health & Safety

According to the Oakland County Sheriff's Office, there were 6 arson related deaths investigated in 2007 and 2008.

Area Impacted

In the United States, arson is the leading cause of dollar loss from fires and one-fifth of all property loss is due to arson. According to the Michigan Chapter of the International Association of Arson Investigators, Oakland County had \$19.2 million worth of arson and suspicious fire damage in 2010, ranking fourth amongst Michigan counties. Any property is a potential target for arson. Given that arson is a property crime, it is anticipated that arson will occur in areas with high property crime rates.

Economic Impact

Information regarding the economic impact of arson in Oakland County is not available. However, considering the effects of this crime, high rates of arson can decrease the attractiveness of neighborhoods or business districts. This can result in economic loss due to loss of residents or businesses.

Critical Facilities/Services

Although not common, critical facilities and services can be directly impacted by arson. The April 2015 arson at Myth Golf Course is an example of the potential costly effects of this crime. Although arson can occur anywhere within Oakland County, an arson fire involving any of the County's assets could temporarily impede the County's ability to provide that service.

Arson Risk & Vulnerability Assessment

There were 1,222 reported arson fires in Oakland County from 2008 through 2015. Any property is a potential arson target. However, residential areas and historic sites are most vulnerable to acts of arson. Fire departments are a vulnerable asset in response to acts of arson. There are over 40 departments which respond to fires within Oakland County. Residential land use is shown on Figure 16, along with the locations of the County's registered historic sites and fire stations.

Figure 16: Arson Vulnerability Map

1.6.2.3 Mass Shootings

Published 7/5/2018 16:58 by Nathaniel Marlette

Definition

A mass shooting is the discharge of firearm(s) multiple times by 1 or more parties resulting in the death of at least 4 persons.

Historical Events

There have been at least 2 mass shootings in Michigan since 1991, with 1 in Oakland County. On November 14, 1991, Thomas McIlvane killed 4 supervisors and wounded 5 other employees before killing himself at the Royal Oak Post Office after being fired for insubordination. Another incident at the Ford Motor Company factory in Wixom occurred November 14, 1996. It did not result in 4 or more deaths and, therefore, did not meet the technical definition of a mass shooting. However, 1 person was killed and several Ford employees and 2 Oakland County Sheriff's deputies were shot and wounded. This incident and September 11, 2001 have been credited with the push to implement the Oakland County Wireless Integrated (OakWin) System in Oakland County communities.

The most recent mass shooting event that occurred in Michigan was on February 20, 2016. Jason Dalton, a driver for Uber, went on a several hour rampage throughout the city selecting his victims randomly. Six people were killed and two more injured during the six hours before his arrest - including five people who were shot in the parking lot of a Cracker Barrel restaurant.

Another notable incident occurred in June 11, 1999 when Joseph Brooks opened fire at his former psychiatrist's clinic, killing two people and injuring four others. Brooks then committed suicide. This occurred in Southfield, Michigan.

Frequency & Probability

The majority of mass shootings occur at the place of employment or schools and are conducted by someone that the victims know. Since 1991, there has been 1 occurrence of mass shooting in Oakland County and at least 3 in the state. The probability of this act occurring in the County is relatively low.

Health & Safety

The mass shooting incidents that have occurred in the state have been conducted by a single gunman. The single gunman limits the amount of guns, bullets and casualties. The number of deaths and injuries is dependent on the type of guns and bullets used, the location, number of people present, cover and escape routes and the intent of the gunman. The impact to health and safety has the potential to be high.

Area Impacted

The area impacted by mass shootings tends to be relatively localized to a single building or block. However, nearby schools, nursing homes and shopping districts may be temporarily locked down or closed to ensure the safety of individuals.

Economic Impact

The economic impact is dependent on the incident location, target and severity. A single gunman in a residential neighborhood who targets and kills known persons may affect housing values in the area in the short term. While multiple gunmen in a crowded business district with no discernible target may affect housing values, commercial values, retail sales, etc. for longer period of time. Mass shooting incidents disrupt the feeling of security and can have long term psychological effects on the community.

Critical Facilities/Services

Critical facilities and services have been historically targeted by gunmen. Critical facilities in the United States that have been targeted by mass shooting gunmen include open space, military bases, civic centers, nursing homes, schools, central business districts, and churches.

One of the most famous incidents is the 1999 Columbine shootings in which 2 teenage boys shot and killed 12 classmates and a teacher before killing themselves. In 2007, a student shot and killed 32 people and wounded 15 others at Virginia Tech before taking his own life. In that same year, a gunman killed 9 people and injured 5 others in a shopping center in Nebraska. In 2009, a man killed 13 people at a civic center in New York. In that same year, a US Army psychologist opened fire at a military base in Texas, killing 13 and injuring 31.

Mass Shooting Risk & Vulnerability Assessment

There have been approximately 2 attempted mass shootings in Michigan since 1991, but the act has been on the rise in the United States over the past decade.

Mass shooting acts tend to occur in the place of (former) employment or at schools and universities; although they can occur in other crowded venues such as shopping centers and arenas. Mass shootings that occur in residential neighborhoods are normally centered around individuals the gunmen are familiar with. The most vulnerable targets would be the following:

- K-12 Schools
- Courthouses and federal buildings
- DTE Energy Music Theatre
- Detention facilities
- Great Lakes Crossing Outlets
- Hazel Park Raceway
- Meadowbrook Hall & Theater
- Michigan State Fair
- Oakland Community College
- Oakland County Fair
- Oakland University
- Renaissance Festival

- Royal Oak Arts, Beats, & Eats
- Woodward Dream Cruise
- Somerset Collection Mall
- Private corporations and corporate headquarters

Table 20: Mass Shooting Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	19
Potential Magnitude and Scale ¹	19
Physical Vulnerability Hazard Impact ¹	28
Social Vulnerability Hazard Impact ¹	54
Community Conditions Hazard Impact ¹	38
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	34
Overall Risk Rating ³	25

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 202-205.

Oakland Press. July 27, 2010, New radio system to be fully implemented by year's end. http://www.theoaklandpress.com/articles/2010/06/27/news/local_news/doc4c28009cacd9e959991745.txt

Mother Jones, "U.S. Mass Shootings, 1982 -2017: Data From Mother Jones' Investigation". Data set accessed June 16, 2017.

USA Today. [Jury sentences Hasan to death for '09 Fort Hood massacre](#). viewed June 26, 2017

Associated Press, Los Angeles Times, "Ex-Patient Kills Psychiatrist, Self," June 12, 1999, <http://articles.latimes.com/keyword/murder-suicides-michigan>.

Associated Press, Lundington Daily News, "Family, Friends Remember Slain Psychiatrist as Mentor, Teacher," June 14, 1999, <http://news.google.com/newspapers?nid=110&dat=19990614&id=AdILAAAIBAJ&sjid=0FUDAAAIBAJ&pg=4308,8035071>.

1.6.3 Drought

Published 7/5/2018 17:02 by Nathaniel Marlette

Definition

Drought is an extended period with significantly low precipitation levels that usually occurs during planting and growing seasons.

Historical Events

Extreme drought conditions in 1976-1977 contributed heavily to the large wildfire that struck the Seney area in Michigan's Upper Peninsula in July 1976.

During a drought in 1988, Michigan took several steps to combat the impacts of the drought on businesses, natural resources and individual citizens. A statewide burning ban was enacted and water use restrictions were put into place in many communities.

During a drought that struck Michigan from 1998-2003, one-third of the state's fruit, vegetable and field crops were destroyed. This drought resulted in an U.S. Department of Agriculture Disaster Declaration for 82 of the state's counties, including Oakland County. The drought led to water shortages in southeast Michigan forcing local officials to issue water usage restrictions.

The Upper Peninsula of Michigan suffered from drought conditions for between 16 and 22 months starting in 2005. The hay crop in the Eastern U.P. was only 50 to 70 percent of normal, and the resulting lack of feed led some farmers to downsize their cattle herds. In the northern tip of the Lower Peninsula, very high utility bills were suffered by the proprietors of farms and golf courses, due to the need for near-constant irrigation. Corn and bean crops were severely impacted. A burning ban was also issued for most of the state (the first such ban since 1998) to reduce the risk of wildfires.

Frequency & Probability

On average, there is 1 significant damaging drought every 10-15 years in the State of Michigan. Between January 1, 1950 and 2010, 2 moderate to severe drought events have been recorded for Oakland County, specifically. As of 2011, the State of Michigan had a Palmer Drought Severity Index (PDSI) reading below zero for 3 or more consecutive months during the growing season in 27 out of the last 60 years. From January, 2013, to October, 2017, there have been four times at least 40% of the area of Michigan has been classified as abnormally dry – including twice when approximately 18% experienced moderate drought. The probability of a drought event occurring in Oakland County is likely because droughts affect the entire state and occur on average once every 10-15 years.

Health & Safety

The risk to human life from a drought event is low. Possible loss of human life from a drought event is due to secondary effects such as extreme heat, fire and other health-related problems such as increased pollutant concentrations in surface water.

Area Impacted

Impacts primarily affect those employed in agriculture. Drought affects large widespread areas; however, the greatest impact is generally to agricultural lands. As of 2008, Oakland County contained approximately 21,005 acres of active agricultural land (3.6% of total).

Natural resources such as lakes, streams and other bodies of water could be affected by decreases in water levels. Also, fires resulting from drought can result in the destruction of trees and other natural habitats, as well as homes and businesses. The July 2001 drought affected 12 southeast Michigan counties, including Oakland County. The drought in September 2002 affected 12 counties, including Oakland County.

Economic Impact

The impacts of drought on a community include water shortages; a decrease in the quantity and quality of agricultural crops; a decline of water levels in lakes, streams and other bodies of water; poor nourishment for wildlife and livestock; an increase in wildfires and increases in insect infestations, plant disease and wind erosion.

The 1988 drought/heat wave in the central and eastern U.S. (an event that greatly impacted Michigan) caused an estimated \$40 billion in damages from agricultural losses, disruption of river transportation, water supply shortages, wildfires and related economic impacts.

The July 2001 drought resulted in \$150 million in crop damage over a 12 county area of southeast Michigan reducing yields of corn, dry beans and soybeans to one-third of normal. The drought that occurred in September 2002 resulted in agriculture yields less than 50% of normal and many counties across eastern Michigan were declared agricultural disaster areas.

Critical Facilities/Services

Most facilities impacted from drought would be related to agriculture. Farms, large grain facilities and fruit and vegetable vendors/markets could potentially see a significant decrease in production and sales. Local and regional governmental services may be required to respond to drought. However, if the severity of the drought is significant, state and federal assistance could be required. Agricultural services and departments such as the Farm Bureau Agency and the U.S. Department of Agriculture may also be required to provide assistance.

Critical Facilities/Services

Most facilities impacted from drought would be related to agriculture. Farms, large grain facilities and fruit and vegetable vendors/markets could potentially see a significant decrease in production and sales. Local and regional governmental services may be required to respond to drought. However, if the severity of the drought is significant, state and federal assistance could be required. Agricultural services and departments such as the Farm Bureau Agency and the U.S. Department of Agriculture may also be required to provide assistance.

Drought Risk & Vulnerability Assessment

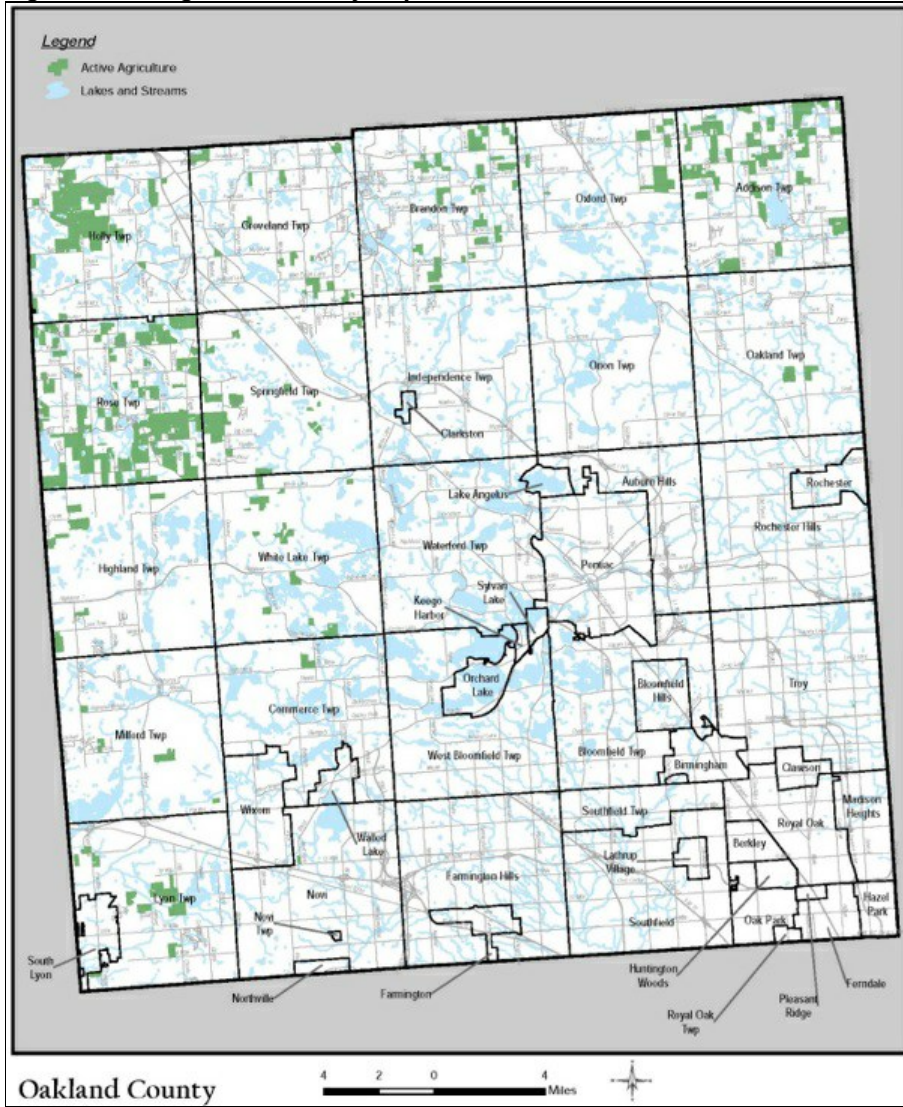
Between 1950 and 2017, 2 moderate to severe drought events have been recorded for Oakland County. The entire County's active agricultural lands are vulnerable to drought. Oakland County contains approximately 21,005 acres of active agricultural land.

Figure 17, shows the location of active agricultural lands in Oakland County. Agricultural land in Oakland County has been decreasing as

development moves in. The vulnerability to drought will continue to decrease as active agriculture decreases.

Natural Resources such as lakes, waters, streams, and other bodies of water could be affected by decreases in water levels. Water features are also shown on Figure 17. Waterford Township, West Bloomfield, and White Lake Township contain the most acreage for water land use in the County.

Figure 17: Drought Vulnerability Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Table 21: Drought Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	25
Potential Magnitude and Scale ¹	6
Physical Vulnerability Hazard Impact ¹	28
Social Vulnerability Hazard Impact ¹	29
Community Conditions Hazard Impact ¹	35
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	25
Overall Risk Rating ³	25

Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, page 23.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated 2014 Edition)*, March 2014, page 224.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 23-28.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/>, *Standard Query for Severe Weather*, June 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, November 2011.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 23-28.

SEMCOG, *Land Use in Southeast Michigan 2000-2010, Specific to Oakland County*, November 2011.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/>, *Standard Query for Severe Weather*, June 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, page 24.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/eventdetails>, *Standard Query for Severe Weather*, November 2011.

Ibid.

1.6.4 Earthquake

Published 7/5/2018 17:07 by Nathaniel Marlette

Definition

An earthquake is a sudden movement or motion in the earth caused by an abrupt release of slowly accumulating strain which results in ground shaking, surface faulting or ground failures.

Historical Events

Most earthquakes that occur in Michigan are minor tremors resulting in little damage. Several mildly damaging earthquakes have been documented in Michigan since the late 1700s. Michigan has fault lines in the bedrock geology that are considered stable; however, data is poorly documented. Michigan is most likely to be affected by earthquakes which occur in the New Madrid Seismic Zone (centered near the Arkansas/Tennessee state line) and upstate New York.

No severely destructive earthquakes have been documented in Michigan. However, several mildly damaging earthquakes have occurred since the late 1700's. There are no records of earthquakes originating within Oakland County. However, there have been several low- magnitude earthquakes centered outside of the County which have been felt in the County.

Frequency & Probability

Since 1938, there have been earthquakes that have been reported as centered in Michigan. The largest recorded earthquake originating in Michigan was centered in Coldwater and registered a 4.7 on the Richter scale. Since 1938, there have been approximately 26 earthquake related disturbances in Michigan. An earthquake of significant magnitude is unlikely to occur due to Oakland County's distance from the fault and the type of fault in Michigan. The frequency is assumed to be once every 100 or more years. Although a small disturbance from an earthquake is possible, the probability for a significant earthquake to occur in Oakland County is very low.

Some earthquakes have been attributed to hydraulic fracturing, or fracking. Environmental experts from the USGS have determined that recent earthquakes in Ohio and Oklahoma may be the direct result of fracking. Fracking involves the use of a mixture of chemicals in a high-pressure water stream that is pushed into layers of bedrock. This causes the natural gas located in the area to be freed. Scientists state that fracking increases damage to existing fault lines causing them to shift or become unsteady.

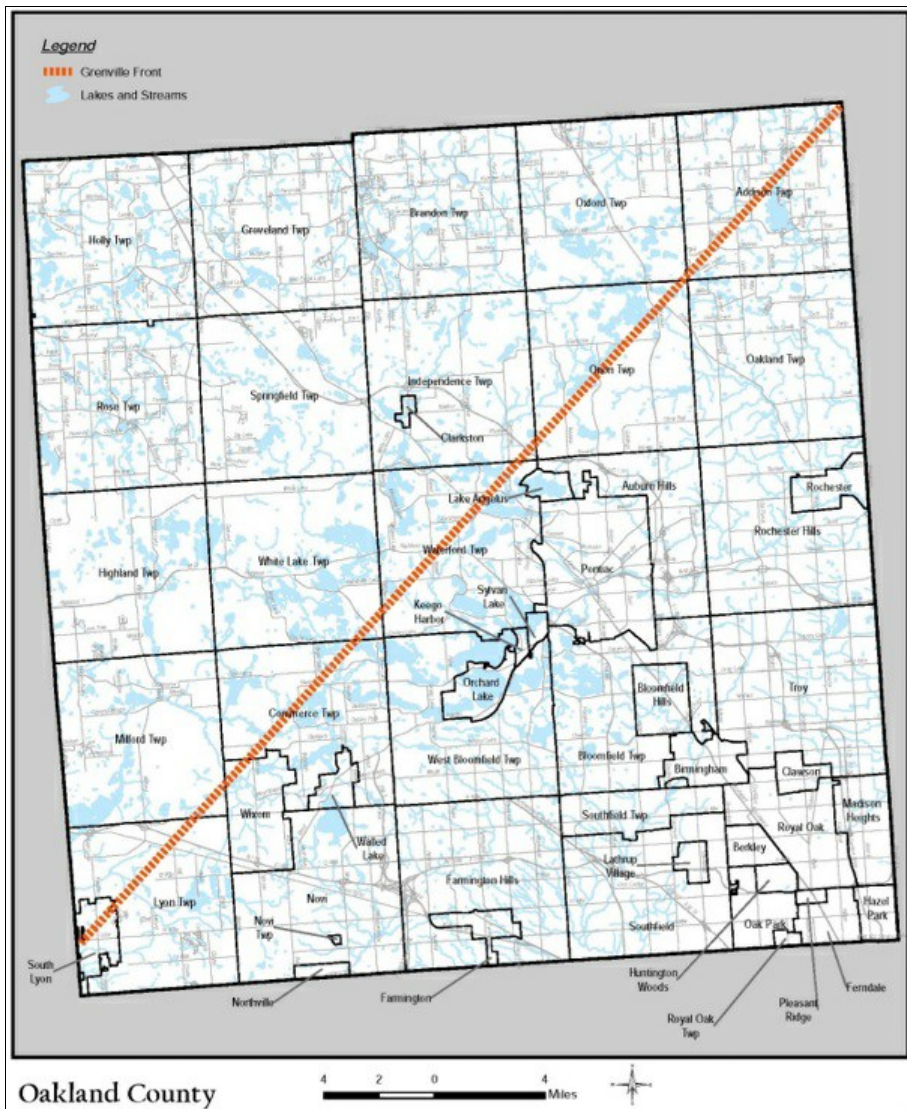
Health & Safety

There have not been any recorded deaths or injuries related to earthquakes in Michigan. The risk rating for human life related to earthquake events is low.

Area Impacted

The number of people affected is dependent upon the earthquake magnitude and distance from the epicenter. Typically, an earthquake affects a large region, not a specific location. Because earthquakes typically have regional affects, the entire Oakland County population could be affected. However, given the historic severity, only a fraction of the population would be affected by a typical event. The impact of an earthquake would be primarily on water, sewer and gas pipelines which are located throughout Oakland County. Oakland County includes an area of low seismic activity referred to as the Grenville Front. This front is a line marking relatively old changes in geological changes making it less of a hazard than a true fault line.

Figure 18: Earthquake Map (Grenville Front)



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Economic Impact

Damage occurs primarily to any type of structure or improvement. The amount of damage is directly proportional to the earthquake magnitude and a large amount of property damage could be anticipated due to the high development density in southern Oakland County. Given the historical severity, economic impacts are expected to be minimal. Since 1884, only a few earthquakes (most of which were minor tremors) resulted in minimal structural damage such a cracked plaster and damaged chimneys.

In Oakland County, the impact of an earthquake would be primarily on water, sewer and gas pipelines. The United States averages approximately \$550,000 per accident to natural gas and liquid pipelines due to earth movements.

Critical Facilities/Services

Due to the low probability of a severely destructive earthquake, response would most likely be limited to primary utility services and pipeline owners. Due to the lack of earthquake events in Michigan, additional investigation of the impact to critical facilities/services is not recommended at this time.

Earthquake Risk & Vulnerability Assessment

Most earthquakes that occur in Michigan are minor tremors resulting in little damage. Several mildly damaging earthquakes have been felt since the early 1800s. The primary vulnerable assets to an earthquake occurrence are the County's water, sewer, and natural gas services and natural gas/petroleum pipelines. The entire County has gas service available either through Consumers Energy or DTE. Municipal, community and County operated water and sanitary services are vulnerable, as well as all storm water drains. The Oakland County Water Resources Commissioner's Office water and sanitary sewer serviced areas are shown on the Earthquake Vulnerability Map, along with natural gas and petroleum pipeline locations. There are approximately 120 miles of natural gas distribution pipelines, 363 miles of natural gas transmission lines, and 107 miles of petroleum gas pipelines in the County.

Hydraulic fracturing (fracking) is believed to increase the frequency of earthquakes by disturbing the bedrock. Currently, the EPA and MDEQ are reviewing the hydraulic fracturing techniques and determining proper regulations.

- See Earthquake Vulnerability Map in **Appendix A**

Table 22: Earthquake Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	13
Potential Magnitude and Scale ¹	4
Physical Vulnerability Hazard Impact ¹	53
Social Vulnerability Hazard Impact ¹	54
Community Conditions Hazard Impact ¹	40
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	37
Overall Risk Rating ³	21

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March 2014)*, March 2014, pages 260-265.

United States Geological Survey, *Information by Region - Michigan*, <https://earthquake.usgs.gov/earthquakes/byregion/michigan.php>, viewed June 19, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March 2014)*, March 2014, pages 260-265.

Reuters, *Fracking Official Cause of Ohio Earthquakes*, January 4, 2011.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 29-31.

Oakland County Michigan Emergency Management, *Hazard Study*, August 1998, page 13.

1.6.5 Extreme Temperature

Published 7/5/2018 17:14 by Nathaniel Marlette

Extreme Heat

Definition

A prolonged period of extreme heat often accompanied by conditions such as high humidity, high winds and lack of rain. Although no standardized temperature is used to define extreme heat, prolonged periods of temperatures greater than 90° F are certainly of concern. The minimum mortality temperature threshold is lower in northern latitudes (from 65° to 70° F) than in the southern United States (from 76° to 90° F). Human health effects of heat are also dependent upon the age, health and physical activity of an individual, as well as humidity and access to air conditioning.

Historical Events

The highest temperature recorded in Michigan was 112° F on July 13, 1936, in Mio. During that week, 570 people died state-wide and there were 5,000 deaths nationwide attributed to the heat wave.

During a heat wave in the summer of 1988, 39 days had temperatures of 90° F or greater. Temperatures in southeast Michigan topped the 100° F mark on 5 occasions.

In July 1999, a heat wave that struck the Midwest and east coast resulted in an estimated 256 heat-related deaths in 20 states, including 1 in Michigan.

In mid July of 2011, a heat wave helped cap off the warmest month on record at Detroit. Three direct deaths were reported (including one fatality in Oakland County) due to the heat wave, as heat indices were above 100 degrees.

Frequency & Probability

Between 1996 and 2013, there were 13 extreme heat days in Oakland County, although high temperatures that can lead to heat stress occur annually in the state. Extreme heat events are likely in Oakland County, but are based on seasonal weather patterns.

Health & Safety

The major threats associated with extreme heat are heatstroke and heat exhaustion. Nationally, extreme heat is responsible for 200 deaths a year. Extreme heat primarily affects the most vulnerable segments of society such as the elderly, children, impoverished individuals and people in poor health.

Area Impacted

Extreme heat typically affects entire counties or regions of Michigan. Although the entire County would be affected, open spaces (at-risk for wildfires) and elderly housing areas (there are approximately 50 nursing homes in Oakland County.) would be most impacted.

Economic Impact

Extreme heat is often accompanied by drought and can have hazardous effects on livestock, agricultural crops and energy demands and is associated with wildfires. Medical costs and increased emergency response costs would be anticipated.

Critical Facilities/Services

Primarily local and regional governmental services would be requested to assist in the event of extremely high temperatures. Hospitals and clinics would expect an increase in heat exhaustion and other heat-related illness cases.

Local utility companies would be essential for providing enough resources to supply an increased demand for power (increased demand for air conditioning).

If the severity of the extreme heat is significant enough to cause a drought, state and federal assistance could be available. Agricultural services and departments such as the Farm Bureau Agency and the U.S. Department of Agriculture will be the most likely type of agencies to provide assistance and aid.

Extreme Heat Risk & Vulnerability Assessment

Extreme temperature periods occur every year in the state and impact the entire County. Also, vulnerable to extreme temperatures are the elderly, young, disabled, and impoverished persons. Hospitals are vulnerable due to increase cases of heat stroke and heat exhaustion and other extreme temperature health-related illness cases. Almost 19% of the Oakland County population is vulnerable to extreme temperature based on age alone.

There are approximately 50 nursing homes in Oakland County. The Extreme Temperature Vulnerability Map displays the locations of the Oakland County Water Resources Commissioner's Office water and sanitary sewer service areas, adult care facilities, day care facilities, and hospitals in the County.

- See Extreme Temperature Vulnerability Map in **Appendix A**

Table 22: Extreme Heat Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	25
Potential Magnitude and Scale ¹	22
Physical Vulnerability Hazard Impact ¹	28
Social Vulnerability Hazard Impact ¹	59
Community Conditions Hazard Impact ¹	35
Overall Capability and Capacity ²	79
Mitigation ²	67
Hazard Consequence & Impact Score ¹	35
Overall Risk Rating ³	30

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Extreme Cold

Definition

A prolonged period of extreme cold is usually accompanied by snowstorms, sleet and ice storms or hail. As with extreme heat, no standardized temperature is used to define extreme cold, although prolonged periods of temperatures below freezing, and especially below 20°F are of concern. Also, similarly to extreme heat, human mortality temperature thresholds vary with latitude. Areas of the southern United States are more susceptible to human health impacts from cold than areas in the north. Human health effects vary with an individual's age, physical condition, physical activity, wind chill and access to heated buildings.

Historical Events

The lowest temperature ever recorded in Michigan was -51°F on February 9, 1934, in Vanderbilt.

Between 1993 and 2016, 12 cold/extreme cold events were reported in Oakland County. The events resulted in a total of 4 deaths, 14 injuries, and \$25,000 in property damages in the county.

During an extreme cold event on January 4, 1999, 3 cold related deaths were reported in Oakland County: A Pontiac man died of exposure while walking home, an elderly woman died of exposure in the driveway at her nursing home and in West Bloomfield, a young adult male was found dead outside, though the exact cause of death was unknown. Four additional people were injured.

An extreme cold event in that impacted Oakland County and the rest of southeast Michigan beginning on December 21, 2000 caused an estimated \$475,000 in property damage in Washtenaw County. Pipes burst due to the cold across the region. December 2000 remains one of the coldest Decembers in southeast Michigan history.

On March 2, 2002, it was reported that an 84-year-old woman in Troy was found dead on her retirement home patio. Hypothermia was the suspected cause of death.

During February 3-6, 2007, wind chills were between -15°F and -25°F. Schools were forced to close because it was too cold for students to walk or wait for a bus. Hospitals reported numerous cold related injuries including frostbite (in total, one person died and 170 were injured). Frozen pipes and water mains ruptured throughout southeast Michigan, flooding some areas and leaving many without water. Fire sprinkler lines froze and ruptured flooding large areas. Area homeless shelters were filled to capacity. In all, property damages to southeast Michigan were estimated at \$425,000 (Oakland County accounted for \$25,000 of those damages).

Frequency & Probability

Michigan has 3 to 50 days per year below 0°F and 90-180 days per year below freezing. An extreme cold event in Oakland County is likely, but is based on seasonal weather patterns.

Health & Safety

Nationally, extreme cold is responsible for approximately 700 deaths per year. Hypothermia and frostbite are the most common conditions associated with extreme cold. It should be noted that a significant number of cold-related deaths are due to illnesses and diseases that are exacerbated by severely cold weather.

Extreme cold poses a significant health risk to the same segments of the population as extreme heat. Although extreme cold would impact all residents, the populations most at-risk for health hazards from extreme cold include young, elderly, disabled, and impoverished persons. Over half of the approximately 700 annual deaths nationally are persons 60 years of age or older. According to the 2010 census for Oakland County, nearly 6% of the population is under the age of 5 and over 13% is aged 65 years or older. Therefore, approximately 19% of the Oakland County population is at risk in extreme cold.

Area Impacted

Extreme cold events are caused by arctic air and polar winds causing wide areas to become bitterly cold. The elderly, young and those with pre-existing medical conditions are most at risk for injury or death. Water mains are at risk of freezing and rupture, which can cause flooding and leave citizens without water. Rapid freezing of lakes can damage structures stored in the water and can damage aquatic life populations short term.

Economic Impact

Water mains and household pipes are at risk of freezing and rupture. Bus systems may be forced to close down because it is too cold for people to be outdoors. Medical costs and increased emergency response costs would be anticipated.

Critical Facilities/Services

Primarily local and regional governmental services would be needed to assist those in need. Hospitals and clinics would see an increase in hypothermia, frostbite and other cold-related illnesses. Schools and transportation services may be closed due to safety concerns. Nursing homes, homeless shelters and other vulnerable populations would need to have the resources available to ensure the safety of the residents. Local distribution companies would be essential in repairing lines and providing enough resources to supply an increased demand for heat.

Extreme Cold Risk & Vulnerability Assessment

Extreme temperature periods occur every year in the state and impact the entire County. Underground utilities, primarily water and gas service areas, are vulnerable to extreme cold. The entire County has natural gas services available through Consumers Energy or DTE. Pontiac, Rochester Hills, Novi and Troy have the highest utility land use acreage in the County.

Also, vulnerable to extreme temperatures are the elderly, young, disabled, and impoverished persons. Hospitals are vulnerable due to increase cases of frost bite, hypothermia, and other extreme temperature health-related illness cases. Almost 19% of the Oakland County population is vulnerable to extreme temperature based on age alone.

- See Extreme Temperature Vulnerability Map in **Appendix A**

Table 24: Extreme Cold Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹		38
Potential Magnitude and Scale ¹		28
Physical Vulnerability Hazard Impact ¹		53
Social Vulnerability Hazard Impact ¹		59
Community Conditions Hazard Impact ¹		35
Overall Capability and Capacity ²		79
Mitigation ²		67
Hazard Consequence & Impact Score ¹		42
Overall Risk Rating ³		40
Legend		
Score	1: Vulnerability Rating	2: Capability and Capacity Rating
0 – 25	Minimally Vulnerable	Minimally Capable
26 – 50	Somewhat Vulnerable	Somewhat Capable
51 – 75	Vulnerable	Capable
76 - 100	Very Vulnerable	Very Capable
N/A	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 45-49.

Ibid.

Ibid.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=332675>, viewed December 20, 2011.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 45-49.

CarePathways, Search for [Nursing Homes-Oakland County](#), search, June 26, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, page 49.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=26%2CMICHIGAN>, *Standard Query for Severe Weather*, viewed January 5, 2012.

Ibid.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, page 49.

Ibid.

U.S. Census Bureau, Profile of General Demographic Characteristics: 2010, Oakland County, Michigan.

1.6.6 Fire Hazards

Published 7/5/2018 17:24 by Nathaniel Marlette

Wildfire

Definition

An uncontrolled fire within an open space, forested area, brush or grassed area or wild land.

Historical Events

In October 1871, Michigan's first recorded catastrophic fire occurred after a prolonged drought over much of the Great Lakes region. The wildfire killed 200 people and burned 1.2 million acres in Michigan's Lower Peninsula.

In August 1976, a fire near Seney burned approximately 74,000 acres. Fire suppression and damage costs exceeded \$8 million.

In May 2012, a lightning strike caused two wildfires in Luce County. Strong south winds gusting over 30 mph on the quickly fanned the Duck Lake Wildfire and caused it to spread rapidly toward the Lake Superior shore forcing mandatory evacuations for people in the Pike Lake, Bodi Lake, Culhane Lake and Little Lake Harbor areas. The 21,069 acre wildfire, the third largest in modern Michigan history, burned 136 structures (including one store and one motel) before it was fully contained in mid-June. The Pine Creek North Wildfire spread to 3500 acres by the 25th but was 95 percent contained by the 28th. The Marshland Wildlife Drive, Fishing Loop, Pine Ridge Nature Trail and many interior roads within the refuge were all closed due to the fire. Governor Rick Snyder declared a state of disaster in Luce County on the 25th. The total cost of property lost and resources used to fight the fire was estimated to be approximately \$12 million.

Frequency & Probability

Michigan has between 8,000 and 10,000 wildfires per year, most of which are small in size burning between 5 and 50 acres. Most wildfires occur between March and May.

The National Climatic Data Center does not list any significant wildfires or forest fires for Oakland County between 1950 and 2016. Between 1981 and 2005, Oakland County had 54 (DNR jurisdiction only) wildfires. Oakland County has over 60,000 acres of parks, recreation lands and open space.

The Michigan Bureau of Fire Services does report some wildfires in Oakland County; however, those incidents are typically small.

Table 25: Forest, Woods, Wildland Fires in Oakland County

Year	Frequency	Fatalities	Casualties	Total Loss (Property and Content Loss)
2012	28	0	1	-
2013	9	0	0	0
2014	4	0	0	0
2015	14	0	1	0
2016	16	0	0	0

Source: Michigan Bureau of Fire Services Health & Safety

Health & Safety

Between 2012 and 2016 a total of 2 injuries were reported in Oakland County as a result of wildfires. Generally, heat exhaustion and smoke inhalation pose the greatest risk of injury. The risk to human life is low to moderate for wildfires.

Area Impacted

In Michigan, 7% of all wildfires are caused by lightning strikes and 83% are caused by human activity. Forests cover approximately 49% (18.2 million acres) of Michigan's total land base. Approximately 11% of Oakland County is forest or other open space.

Populations adjacent to open space or undeveloped land may be affected by wildfire. The extent of the affected area depends greatly on response time, weather conditions, wind direction and fire control. Open spaces and undeveloped land are most at-risk for wildfires.

Economic Impacts

The risk rate for property damage resulting from a wildfire is moderate to high (very high for timber loss).

Total property loss due to wildfires for the 5 counties in Michigan's Metro region (Washtenaw, Wayne, Livingston, Oakland, & Macomb) between January, 1996 and October, 2013 was \$20,000.

Secondary effects of wildfires include infrastructure damage, timber loss, property loss, wildlife loss and loss of life or injury to persons.

Critical Facilities/Services

There are 40 fire departments which respond to fires within Oakland County. Emergency response assistance is provided to fire departments through mutual aid agreements. For all types of fire department responses, mutual aid is provided amongst the fire departments in Oakland County an average of 100 times each year.

Wildfire Risk & Vulnerability Assessment

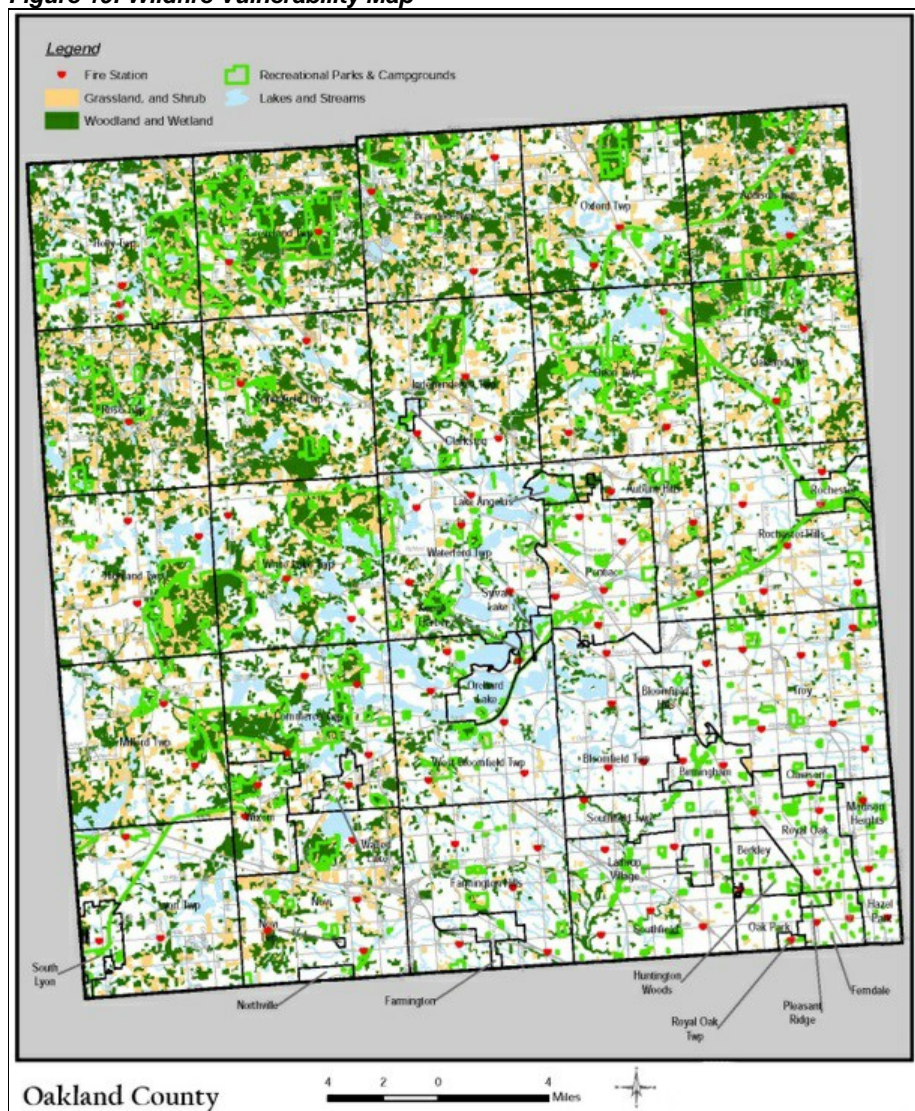
Michigan has between 8,000 and 10,000 wildfires per year, most of which are small in size burning between 5 and 50 acres. Michigan had 24 significant fires between 1995 and 2016, resulting in over \$19 million in property damage. Most wildfires occur between March and May. Woodlands,

wetlands, grassland, shrub land, and areas near railroad right-of-ways are vulnerable to wildfires. Oakland County has over 60,000 acres of park, recreation, and open space.

Addison Township, Rose Township, and Springfield Township have the highest acreage of forest land use in the County. Addison Township, Rose Township and Groveland Township have the highest total acreage in the County for grassland and shrub land use.

The fire departments in the County are a vulnerable critical asset in response to wildfires. Figure 19 indicates the coverage of forest woodland, grassland, and shrub land, railroad locations, and the location of fire stations in the County.

Figure 19: Wildfire Vulnerability Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Table 26: Wildfire Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹		13
Potential Magnitude and Scale ¹		0
Physical Vulnerability Hazard Impact ¹		53
Social Vulnerability Hazard Impact ¹		48
Community Conditions Hazard Impact ¹		24
Overall Capability and Capacity ²		79
Mitigation ²		100
Hazard Consequence & Impact Score ¹		29
Overall Risk Rating ³		19

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Definition

Scrap tire fires are large fires which occur at a location where scrap tires are being stored for processing, recycling or re-use.

Historical Events

Oakland County does not have an extensive history of scrap tire fires. Although no records of scrap tire fires were found, there was a tire fire at a retail tire store in Farmington in 1994.

The Michigan Department of Environmental Quality (MDEQ) requires a scrap tire collection site to be registered if it exceeds established tire storage thresholds. Scrap tire collection sites can include businesses such as scrap tire processors, new tire retailers, junkyards, farms and go kart tracks. In 2004, the U.S. EPA, Region 5, developed a program to reduce the number of scrap tire collection sites. The MDEQ has developed additional programs and grant funding to encourage the reduction of scrap tires. Oakland County has a regulated commercial scrap tire site in Pontiac.

Frequency & Probability

There has been 1 tire fire at a retail tire store in Farmington. This fire occurred in 1994 at Farmington Auto Parts and was controlled by the local fire department. In Michigan there have been 16 major scrap tire fires since 1987.

Health & Safety

Scrap tire facilities present significant environmental and fire hazards. In addition, scrap tires are known for providing breeding grounds for mosquitoes, thus contributing hazards to public health. Scrap tire fires are also capable of producing acrid smoke and an oily residue which can leach into the soil.

Area Impacted

Scrap tire fires can be difficult to contain and, aside from the fire hazard presented, inhaling the smoke produced from the fire can be hazardous to human health. As a result, scrap tire fires often require people in surrounding areas to evacuate or shelter-in-place.

The oily material produced by scrap tire fires can also negatively impact the soil, and possibly groundwater and surface water, in the area of the fire. If groundwater or surface water is impacted, the affects can potentially extend significantly beyond the boundaries of the fire.

Within Oakland County, there is one registered scrap tire facility: Warehouse Tire in Pontiac. No unregistered scrap tire facilities were found. The EPA and MDEQ have made a significant effort to reduce the number of scrap tire facilities in the region.

Economic Impact

A scrap tire fire will inevitably result in property damage and inventory loss to the collection site. In addition, environmental clean-up costs after the fire is extinguished can be significant.

Due to the amount of response required, extinguishing a scrap tire fire can be financially draining for local emergency response departments. For example, the largest scrap tire fire in recent Michigan history occurred in Osceola County in 1997. That fire burned over 1.5 million tires and cost approximately \$300,000 to extinguish. The State of Michigan paid \$100,000 to Osceola County as reimbursement for fighting that fire.

Critical Facilities/Services

Scrap tire fires can be very difficult to extinguish, often lasting for extended periods, and can require a substantial amount of resources from local emergency response departments. The response effort typically requires assistance from neighboring fire departments.

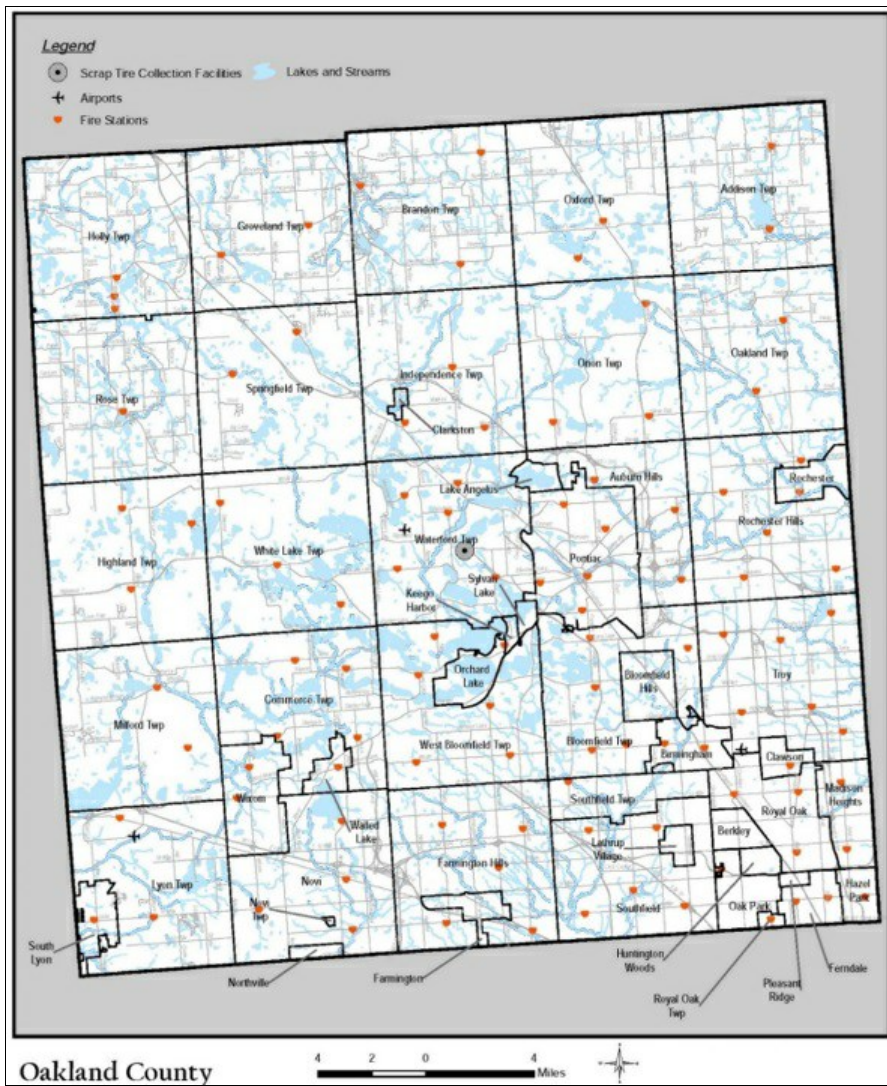
Scrap Tire Fire Risk & Vulnerability Assessment

In 2004, the EPA Region 5 put together a program to reduce the number of scrap collection sites. The MDEQ put together additional programs and grant funding to encourage the reduction of scrap tires. This initiative has significantly reduced the number of scrap tire facilities within Oakland County. Currently, the MDEQ has record of 2 registered and no unregistered scrap tire facilities. In the past 20 years, there has been 1 tire fire in Oakland County which was at a retail tire store in Farmington.

Due to the toxic smoke produced by tire fires and potential environmental impact, residents living near these facilities are considered vulnerable for impact. Figure 20 shows the location of the registered scrap tire facility with a 1-mile radius of census block groups. Also shown on Figure 20 are the locations of fire stations and air transportation facilities in the County.

Air transportation facilities are considered to be vulnerable, as the smoke produced by a fire may interrupt flight patterns. As shown on Figure 20, the Oakland County International Airport is approximately 2 miles from the registered scrap tire facility located in Waterford.

Figure 20: Scrap Tire Fire Vulnerability Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Table 27: Scrap Tire Fire Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	13
Potential Magnitude and Scale ¹	5
Physical Vulnerability Hazard Impact ¹	28
Social Vulnerability Hazard Impact ¹	40
Community Conditions Hazard Impact ¹	24
Overall Capability and Capacity ²	79
Mitigation ²	83
Hazard Consequence & Impact Score ¹	24
Overall Risk Rating ³	17

Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Structural Fire

Definition

A structural fire is a fire of any origin which ignites 1 or more structures and causes loss of life and/or property.

Historical Events

Structural fires are commonly known as the “universal hazard” because they can occur anywhere.

In the last 5 years, there has been an average of 610 structural fires per year in Oakland County. Oakland County has experienced numerous structural fires throughout its history. One (1) of the most tragic structural fires in recent history occurred at a residence in Royal Oak Township during the early hours of April 7, 2000. The fire claimed the lives of 5 children and injured 4 others.

On August 24, 2004 a fire broke out in a Southfield apartment complex. Although the residents were safely evacuated, the facility was destroyed.

Table 28: Major Causes of Structural Fires in Oakland County

Fire Cause	% of Structural Fires Due to Cause
Unknown	27.89%
Cooking	24.45%
Heating Equipment	8.38%
Incendiary or Suspicious	6.06%
Other Equipment	5.14%
Appliances or Air Conditioning	4.33%
Other Heat, Flame or Spark	3.45%
Open Flame, Ember or Torch	3.24%
Electrical	3.04%
Smoking	2.34%
Natural	1.22%
Child Playing	0.28%
Exposure	0.09%

Source: NFIRS 5.0 National Reporting, Tally by Incident Type, January 1, 1998 through December 31, 2003, report generated on June 24, 2004, filtered for Oakland County reporting only. *Note: Access to NFIRS data is no longer available to the public. As of 2017, updated information could not be accessed

Frequency & Probability

In the last 5 years, there has been an average of 610 structural fires per year in Oakland County. The occurrence of structural fires within Oakland County has a well-established history. This hazard will continue to occur in the future

Table 29: Building Fires in Oakland County

Year	Frequency	Fatalities	Casualties	Total Loss (Property and Content Loss)
2012	661	6	35	32,783,507
2013	607	3	44	29,351,057
2014	599	5	34	21,250,648
2015	572	3	32	23,901,481
2016	636	9	28	38,717,949

Source: Michigan Bureau of Fire Services

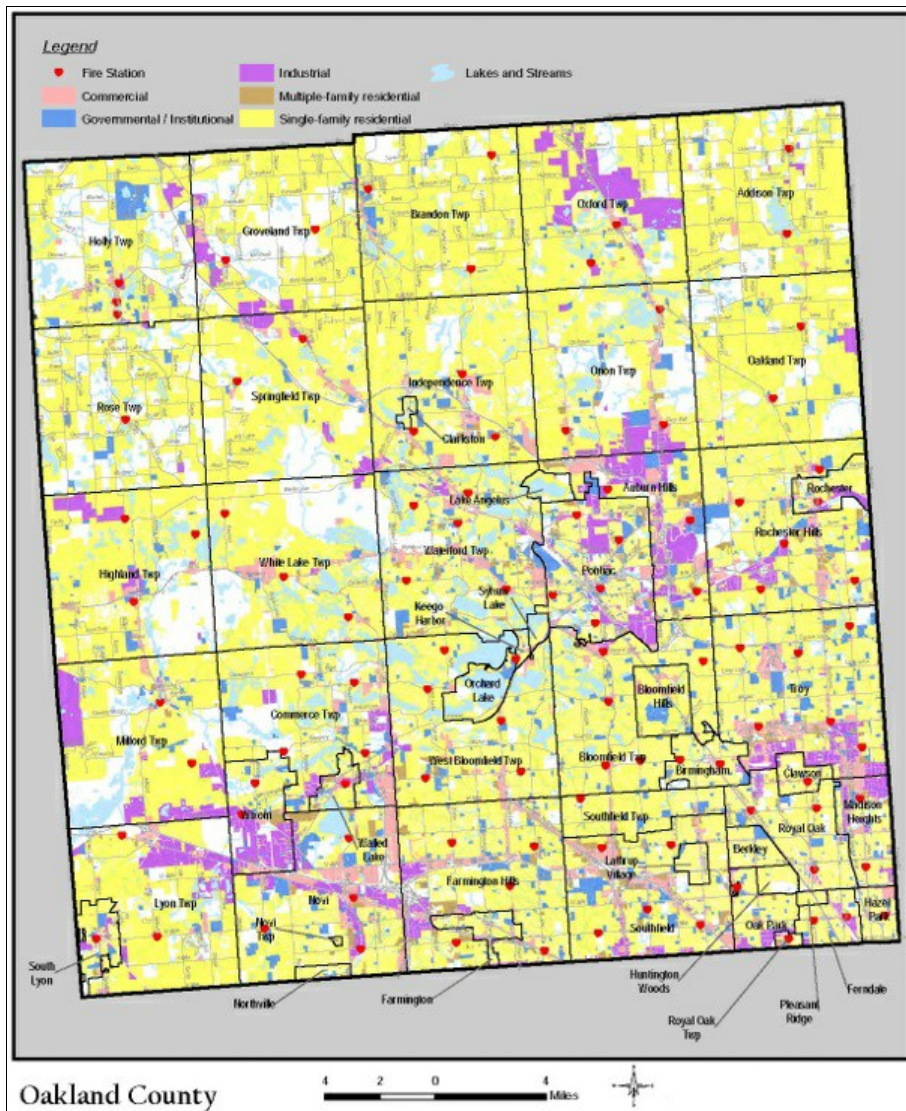
Health & Safety

Structural fires in Oakland County account for 63% of deaths and nearly 72% of injuries from all fire types from 2012-2016. From 2012 through 2016, there were a total of 26 deaths and 173 injuries due to structural fires in Oakland County. This equates to an average of 5 deaths and nearly 35 injuries per year.

Area Impacted

Structural fires can occur on any parcel in which a structure is present. Structural development in Oakland County is more concentrated in the southern portion of the County. Therefore, a higher frequency of structural fires can be expected in southern Oakland County.

Figure 21: Structural Fire Hazard Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Economic Impact

Property loss from structural fires can be very high. From 2012 through 2016, Oakland County experienced a total of \$146,004,642 in property and content loss from structural fires, an average of \$29,200,928 per year.

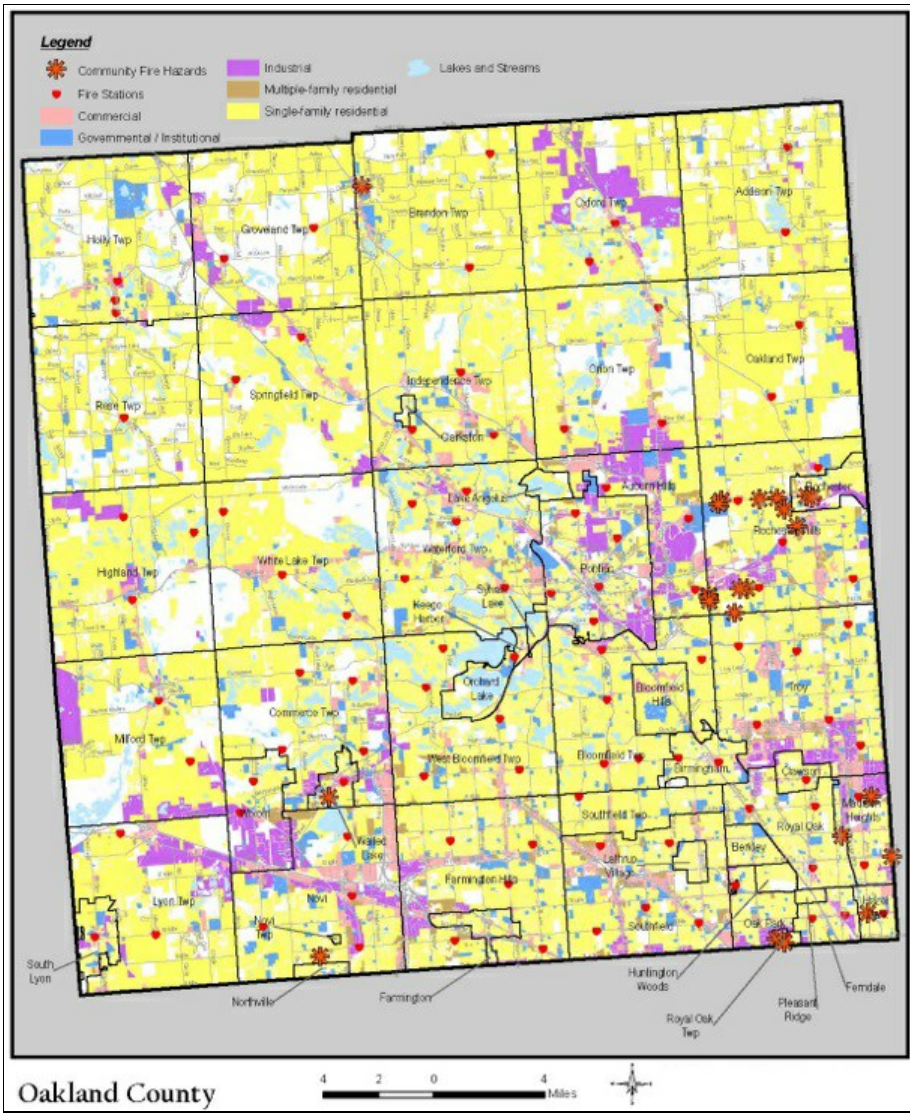
Critical Facilities/Services

There are over 40 fire departments/fire stations which respond to structural fires within Oakland County. During 2012 through 2016, there were no firefighter deaths from structural fires; however, an average of nearly 21 firefighters are injured each year from responding to structural fires. Almost 90% of all firefighter injuries in Oakland County result from responding to structural fires. Emergency response assistance is provided to fire departments through mutual aid agreements. For all types of fire department responses, mutual aid is given amongst many of the fire departments in Oakland County an average of 100 times each year.

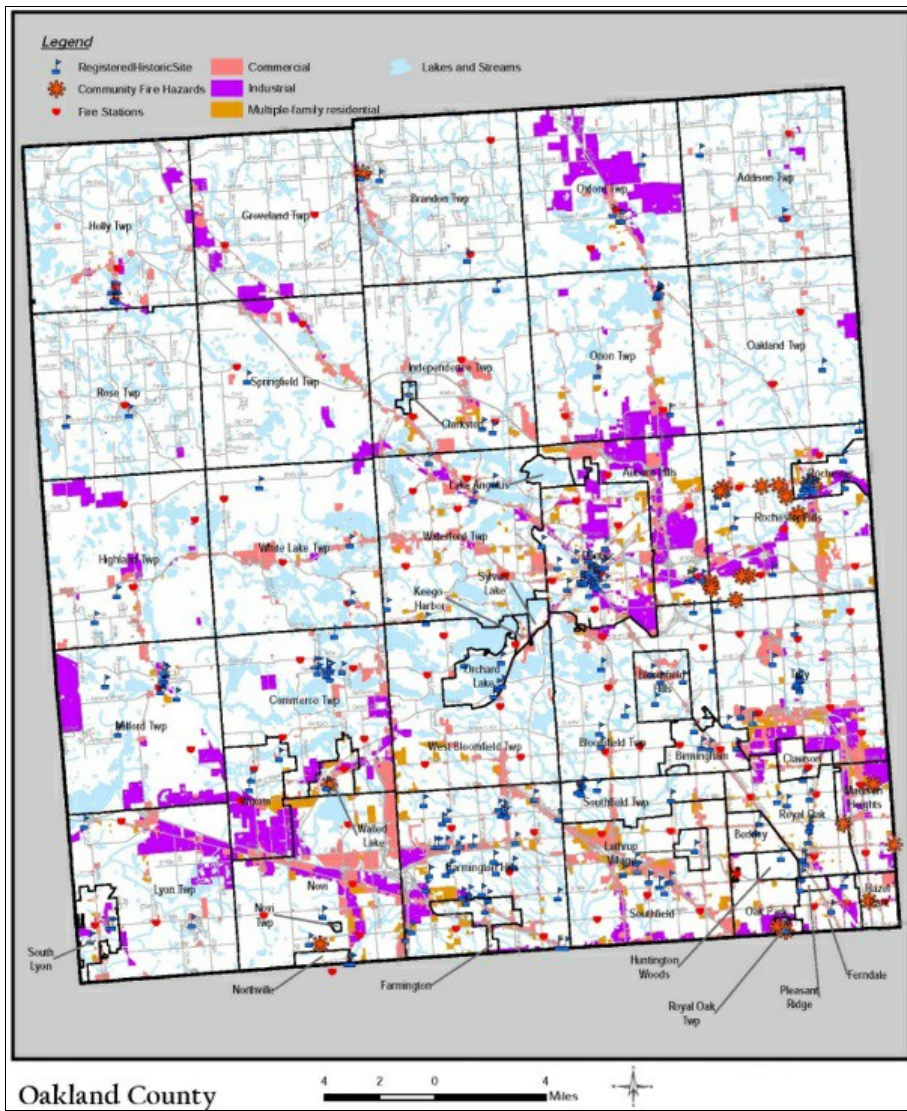
Structural Fire Risk & Vulnerability Assessment

Structural hazards are commonly known as the “universal hazard” because they can occur anywhere. There are over 600 structural fires per year in Oakland County. Historic sites and hi-rise structures present unique challenges as it relates to this hazard. Structural development in Oakland County is more concentrated in the southern portion of the County. The 40 fire stations in the County are a vulnerable asset in response to a structural fire. Almost 90% of all firefighter injuries in Oakland County result from responding to structural fires. The location of registered historic sites and fire stations are provided on Figure 22. Also shown are the areas of multiple-family residential development, industrial development, and commercial development.

Figure 22: Structural Fire Vulnerability Maps



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Table 30: Structural Fire Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	50
Potential Magnitude and Scale ¹	31
Physical Vulnerability Hazard Impact ¹	58
Social Vulnerability Hazard Impact ¹	40
Community Conditions Hazard Impact ¹	21
Overall Capability and Capacity ²	79
Mitigation ²	100
Hazard Consequence & Impact Score ¹	34
Overall Risk Rating ³	41

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, page 66.

National Climatic Data Center, <https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=379163>, viewed June 20, 2017.

Michigan State University, firewise.msu.edu, viewed June 20, 2017

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 245.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 232.

SEMCOG, *Land Use in Southeast Michigan 2000-2008, Specific to Oakland County*, viewed June 20, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 66-71.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 242

Michigan Department of Environmental Quality, http://www.michigan.gov/deq/0,4561,7-135-3312_4123_4122_4346-235851--,00.html, June 20, 2017.

Michigan Department of Environmental Quality, Scrap Tire Program, Staff Telephone Interview, August 30, 2004.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 313-314.

1.6.7 Flooding

Published 7/5/2018 18:03 by Nathaniel Marlette

Dam Failure

Definition

The failure of an impoundment located in a river, stream, lake or other waterway resulting in downstream flooding.

Historical Events

Dam failure can result in loss of property, life and natural resources for miles downstream of a dam. Dam failures not only occur during flood events, but also can be caused by poor operation, lack of maintenance and vandalism.

Examples of significant dam failures in Michigan include: 1) Marquette in 2003 when an earthen dam failed causing over \$10 million in property damages and 2) in September 1986, an intense rainfall caused 11 dams to fail in the Lower Peninsula of Michigan. Currently, there are over 2,500 dams identified statewide. From 1988 to 2013 the Michigan Department of Environmental Quality (MDEQ) has documented approximately 287 dam failures (none catastrophic).

Table 31: High and Significant Hazard Dams in Oakland County

Name	Hazard	H8	Head
Clarkston	High	34	30
Clintonville	Significant	14	30
Loon Lake	Significant	8	6
Ford Dam #3 (Hubbell Pond)	Significant	25	15
Gehrke	Significant	18	10
Holly	Significant	12	9
Lake Louse	Significant	12	11
Lake Orion	Significant	18	13
Oxbow	High	15	8
Pontiac Lake	High	21	15
Quarton	Significant	19	15
Waterford Multi-Lakes Level	Significant	12	11
Wildwood Lake	High	22	6
Winkler Pond	Significant	13	9
Lake Neva	High	17	13
Lake Sherwood	Significant	22	15
Endicott	Significant	14	11
Heron	High	26	20
Davisburg Trout Farm	Significant	12	7
Dawson Millpond	High	9	8
Wolverine Lake	Significant	14	11
Pontiac Motor Division Detention Area	Significant	12	12
Wau-Me-Gah Lake	Significant	8	3

Source: State of Michigan Department of Environmental Quality Geological and Land Management Division.

Frequency & Probability

Oakland County has 8 high and 15 significant dam hazards. Based on the number of high and significant dam hazards, it is very probable that a dam failure will occur in the future within the County.

Figure 23: Dam in Oakland County



Health & Safety

No deaths or major injuries have been reported as a result of dam failure in the state. The risk to human life as a result of dam hazards is moderate to high.

Area Impacted

Areas located downstream from a dam, within a floodplain, are at greatest risk for impact from a dam failure. Approximately 5,784 structures are located within FEMA-mapped 100-year floodplains in Oakland County.

Economic Impact

The risk for property damage as a result of dam hazards is moderate to high. Property loss and content loss can be very high as a result of a dam failure. Variable costs to repair a damaged dam are anticipated.

Critical Facilities/Services

Flooding events can require a substantial amount of resources and assistance from multiple agencies and departments including local emergency response departments and state and federal departments such as the MDEQ Water Resources Division, Dam Safety Unit and FEMA. If flooding from a dam resulted in significant damage to homes, the American Red Cross may also provide assistance.

Dam Failure Risk & Vulnerability Assessment

Oakland County currently has 8 high and 15 significant dam hazards.

Table 31: Dam Failure Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹		13
Potential Magnitude and Scale ¹		29
Physical Vulnerability Hazard Impact ¹		65
Social Vulnerability Hazard Impact ¹		66
Community Conditions Hazard Impact ¹		60
Overall Capability and Capacity ²		68
Mitigation ²		67
Hazard Consequence & Impact Score ¹		53
Overall Risk Rating ³		26

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Riverine Flooding

Definition
The periodic occurrence of overbank flows of rivers, streams, drains, and lakes resulting in partial or complete inundation of the adjacent floodplain.

Historical Events
According to NOAA data, there were 23 flood/flash flood events in Oakland County from 1996 through 2016, resulting in 1 death and approximately \$402 million worth of damage. Some historical floods are listed below.

In September 2008, heavy rainfall led to flooding of roads and basements. Roads were closed, people were evacuated from their homes and a woman had to be rescued when her car became submerged on a flooded road.

A historic rainfall event unfolded over Southeast Michigan on August 11, 2014, leading to major flooding and road closures. This event was caused by a strengthening low pressure system moving over the area, focusing the tropical moisture which came up from the south. The hardest hit areas included Metro Detroit and surrounding communities. Southern Oakland, Wayne, and Macomb counties saw the worst of the flooding as 4 to 6 inches of rain fell over a 4 hour period. Around 75,000 homes and businesses suffered damage, with over 3000 suffering major damage. There was also damage to the roads and bridges, along with the city sewer pumps which were overwhelmed by the torrential rainfall. Total estimated dollar loss from the Detroit Metro area was 1.8 billion dollars. Oakland County suffered an estimated 400 million in property damage.

In September, 2016, Heavy rain fell across the Detroit Metro Area during the morning hours (2 to 5 inches). Widespread urban flooding was reported, with many roads and interstates closed. Many basements were also flooded. The flooding resulted in approximately 2 million dollars in damages in the Detroit Metro Area, with \$500,000 coming specifically from damages in Oakland County.

Frequency & Probability
From 1975 through 2014, 14 major floods in Michigan resulted in Presidential Major Disaster Declarations. Two (2) of Oakland County's major rivers, the Clinton and Rouge Rivers, are likely to flood again. Portions of the Huron River also exhibit flooding, but less frequently. Smaller tributaries of these river systems are also likely to flood in the future. It is highly probable that riverine flooding will continue to be a hazard in Oakland County.

Health & Safety
In Oakland County, there has been 1 death from riverine flooding since 1996. The risk to human life is low.

Area Impacted
Riverine floods in Oakland County primarily affect streets and infrastructure located in or near floodplains and in areas with inadequate drainage. Approximately 6,000 structures are located within the FEMA 100-year floodplain within Oakland County.

Figure 24: 100-year Floodplain Map

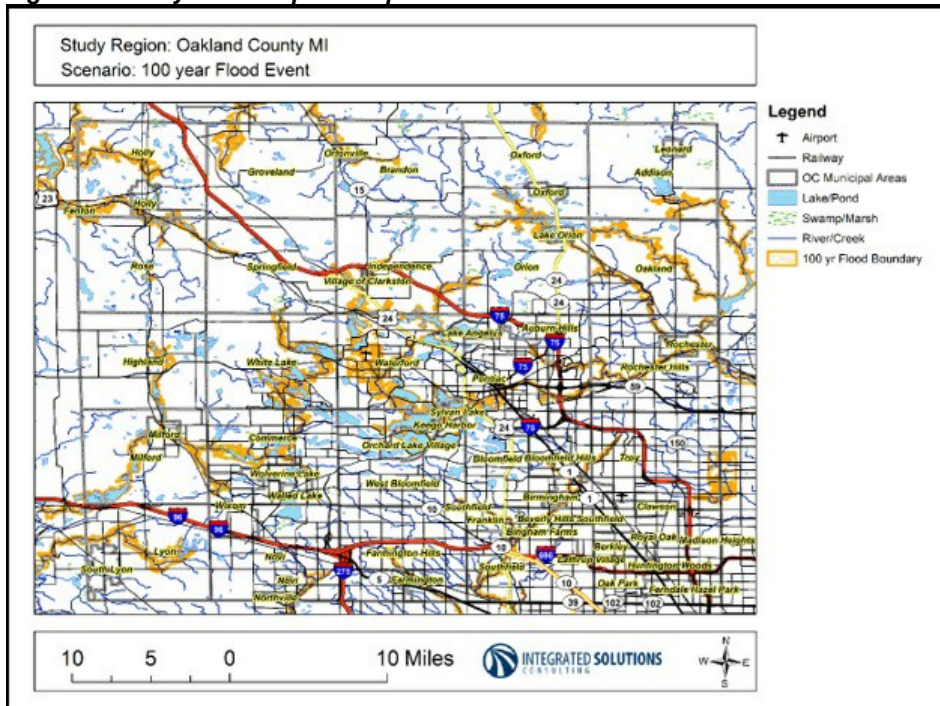
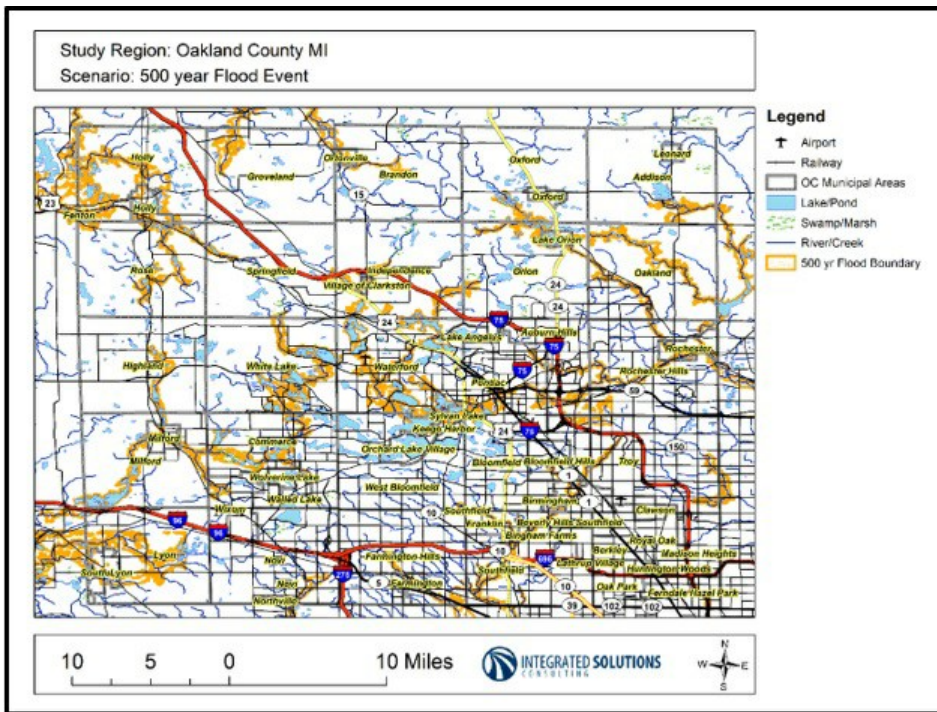


Figure 25: 500-year Floodplain Map



Economic Impact

Property loss from flood events can be very high. Property damage from flooding in Michigan is estimated at \$60 million to \$100 million annually. Flood insurance coverage for Oakland County was estimated at \$335,119,600 in March 2017. The risk of property damage resulting from riverine flooding hazards is high. From 2012 to 2017, the number of active flood insurance policies dropped 14.0% nationally and 18.0% in the state of Michigan. In Oakland County, however, the number of people with flood insurance grew slightly.

Critical Facilities/Services

Flooding events can require a substantial amount of resources and assistance from multiple agencies and departments including local emergency response departments, as well as state, federal and nongovernmental agencies such as the American Red Cross. Significant crop yield losses may result from flood events. Agricultural services such as the U.S. Department of Agriculture may provide assistance. The National Weather Service issues flood watch and warnings to give advanced warning of potential flooding to areas.

National Flood Insurance Program (NFIP) Participation

The majority of Oakland County communities participate in the National Flood Insurance Program.

All 62 Oakland County communities, with the exceptions of the Cities of Berkley, Hazel Park and Lake Angelus are known to have adopted local ordinances and/or site plan review standards that regulate construction and land uses within designated floodplains.

In addition, Part 31, Water Resources Protection, Act 451 of 1994, as amended, regulates activities that result in occupation, fill or grade lands within floodplains along watercourses with a drainage area in excess of 2 square miles. Such activities require an application, review and permit issuance from the MDEQ prior to disturbance.

Policies In-Force

According to FEMA, Oakland County communities had 1,385 insurance policies in-force totaling \$330,694,100.

Table 33: NFIP Policies In-Force

Community Name	Policies In-Force	Insurance In-force Whole \$	Written Premium In-Force
AUBURN HILLS, CITY OF	9	3,077,900	18,439
BERKLEY, CITY OF	10	2,268,000	3,427
BEVERLY HILLS, VILLAGE OF	13	2,750,700	11,807
BINGHAM FARMS, VILLAGE OF	2	700,000	830
BIRMINGHAM, CITY OF	71	13,536,400	56,969
BLOOMFIELD HILLS, CITY OF	24	9,258,100	124,725
BLOOMFIELD, TOWNSHIP OF	82	25,919,500	63,624
BRANDON, TOWNSHIP OF	16	3,352,900	20,837
CLARKSTON, CITY OF	1	132,000	1,454
CLAWSON, CITY OF	7	2,128,000	2,647
COMMERCE, TOWNSHIP OF	30	8,509,000	19,479
FARMINGTON HILLS, CITY OF	203	31,926,700	156,115

FARMINGTON, CITY OF	97	15,619,000	46,570
FERNDALE, CITY OF	8	2,399,600	6,254
FRANKLIN, VILLAGE OF	13	3,955,000	4,964
GROVELAND, TOWNSHIP OF	2	485,000	1,753
HAZEL PARK, CITY OF	4	280,000	708
HIGHLAND, TOWNSHIP OF	6	1,840,000	5,206
HOLLY, TOWNSHIP OF	7	878,700	7,152
HOLLY, VILLAGE OF	8	1,203,900	6,974
HUNTINGTON WOODS, CITY OF	11	2,632,000	3,818
INDEPENDENCE, TOWNSHIP OF	23	5,910,100	19,329
KEEGO HARBOR, CITY OF	23	4,565,800	19,437
LAKE ANGELUS, CITY OF	2	292,000	779
LAKE ORION, VILLAGE OF	30	6,043,100	28,014
LATHRUP VILLAGE, CITY OF	5	1,440,000	1,786
LYON, TOWNSHIP OF	12	2,710,300	11,606
MADISON HEIGHTS, CITY OF	4	1,000,000	2,771
MILFORD, TOWNSHIP OF	1	105,000	256
MILFORD, VILLAGE OF	3	1,130,000	1,585
NORTHVILLE, CITY OF	35	8,576,700	67,361
NOVI, CITY OF	47	16,533,300	41,135
OAK PARK, CITY OF	14	2,434,000	4,179
OAKLAND, TOWNSHIP OF	21	5,431,400	17,342
ORCHARD LAKE VILLAGE, CITY OF	11	3,740,000	5,602
ORION, TOWNSHIP OF	12	2,910,000	7,790
ORTONVILLE, VILLAGE OF	3	486,000	2,583
PONTIAC, CITY OF	10	2,327,000	9,754
ROCHESTER HILLS, CITY OF	38	9,249,600	22,838
ROCHESTER, CITY OF	10	3,886,700	18,698
ROSE, TOWNSHIP OF	2	487,700	1,932
ROYAL OAK, CITY OF	36	7,840,000	11,623
SOUTHFIELD, CITY OF	61	14,716,800	51,053
SPRINGFIELD, TOWNSHIP OF	3	1,050,000	1,245
SYLVAN LAKE, CITY OF	3	1,050,000	1,203
TROY, CITY OF	136	40,422,900	184,552
WALLED LAKE, CITY OF	1	70,000	239
WATERFORD, CHARTER TOWNSHIP OF	77	20,235,500	65,738
WEST BLOOMFIELD, TOWNSHIP OF	110	27,222,900	90,711
WHITE LAKE, TOWNSHIP OF	21	4,261,900	11,409
WIXOM, CITY OF	5	1,083,000	2,361
WOLVERINE LAKE, VILLAGE OF	2	630,000	766
TOTAL	1,385	330,694,100	1,269,429

Source: FEMA as of 10/31/2017

Table 34: CRS Eligible Communities

Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
Commerce, Township of	05/1/03	10/1/14	9	5	5	C
Farmington Hills, City of	10/1/94	10/1/95	10	0	0	R
Novi, City of	10/1/99	10/1/99	7	15	5	C

Source: FEMA as of 10/1/2017

Oakland County has 18 properties that were designated as having suffered repetitive flood claims, according to an official list maintained by FEMA

and the National Flood Insurance Program. Eleven of these eighteen properties are located within the City of Farmington Hills, four are in Waterford Township, two are in the City of Birmingham, and one is in the City of Troy. All of these properties are listed as not yet having fully benefited from flood mitigation activities, and they should be prioritized for future projects that might alleviate their flood risks. FEMA funds are available through HMGP, PDMP, and FMAP in order to help subsidize these types of flood mitigation activities. Although most of FEMA's hazard mitigation grants are provided with a 75/25 cost-share agreement, repetitive loss properties can enjoy an even more favorable cost-share ratio, with 90% and sometimes even 100% of the flood mitigation costs potentially able to be paid through these federal programs.

Of the eleven repetitive loss properties in the City of Farmington Hills, eight are of a single-family residential type, and three are classified as 'other residential' (i.e. not single-family occupancy). Although some of these properties have experienced 4 or 5 damaging events during the past several decades, others have only two or three events listed within the space of just a few years, before which or after which the property might not have been covered by insurance. For example, one property reported four insurance claims for flood damages throughout the 1980s and 1990s, and is currently still insured. A few other properties have four or five claims reported between the late 1990s and the present day, and are currently insured. But the remaining properties listed for the city all tend to have had just a couple of reported flood claims within the space of one decade, along with at least one reported lapse in their insurance coverage. In other words, additional damages are likely to have occurred to these homes, but were not reported during the periods in which no insurance was being carried under the NFIP. Average claim payments for some of these properties have even exceeded \$100,000, although the average damages per event tend to be in the \$10,000 to \$20,000 range, when all these listed properties in the city are being considered. These are more severe flood damages than has been documented for the other Oakland County communities, so these properties in the city seem to merit being heavily prioritized for flood mitigation activities.

Waterford Township's four identified repetitive loss properties are all of the single-family residential type. Their claim history shows a pattern similar to those described in Farmington Hills, in which only a couple of damaging events occur within a single decade, but some lapse in insurance coverage is also indicated in the records. The current list of Waterford's repetitive loss properties all had just two claims reported, with the longest accompanying time period ranging from the years 2004 to 2013, while the shortest range of time involved a period of only a year and a half. Average damages to each property, per event, came out to less than \$10,000.

The City of Birmingham had two identified properties which were classified as 'other non-residential properties' and these were the only non-residential properties to appear in the Oakland County listings. One of the properties only had a couple of claims in 1997, followed by an uninsured period, while the other identified property reported four claims over a 15-year period, and hasn't had any listed flood events since 1996 although the property is designated as currently insured. The average claim amounts were a few thousand dollars lower, on average, than those reported for Waterford Township.

Finally, the City of Troy had one single-family residential property listed as suffering three damaging events during the early 1980s, followed by some lapse in insurance coverage, and an average damage amount that is comparable to that reported for Waterford Township. The prioritization of these properties may ultimately be determined at the household level, but this general planning analysis must protect the confidentiality of insurance and claim information for all specific addresses. Therefore, the general prioritization suggested here would be to emphasize the larger number of more heavily damaged properties found within Farmington Hills, then the moderately damaged properties located in Waterford Township and the City of Troy, and finally the properties listed for the City of Birmingham. Since the level of interest, activity, and motivation will naturally vary among individual property owners, however, any opportunity to implement flood mitigation activities at any of these properties should be sought and followed up on, as each property on this list has already been defined as meriting high priority. It is recommended that all of the NFIP-identified repetitive loss properties maintain flood insurance coverage, while funding is sought to alleviate their risks.

Another interesting pattern found within the information from the NFIP is that regarding the dates of damaging flood events. Sorting all reports by date reveals a total of some 21 events between April 1979 and September 2013, for which claims were paid. Ten of these 21 flood events only involved a single property from the county's list, but the following events affected multiple properties (the number of listed properties affected by each event is provided in parentheses): October 1, 1981 (5), March 13 to 16, 1982 (3), May 1 to 2, 1983 (5), June 20 to 21, 1989 (4), June 18 to 19, 1996 (3), July 2, 1997 (2), August 6 to 9, 1998 (5), June 24, 2000 (3), May 22 to 23, 2004 (3), September 13, 2008 (3), and September 3, 2013 (3). Some of the event dates correspond with declared flood disasters, such as an event on September 11, 2000 (affecting one of the listed properties), which was when widespread basement flooding occurred and eventually resulted in federal disaster 1346 being declared—Michigan's most damaging disaster to date.

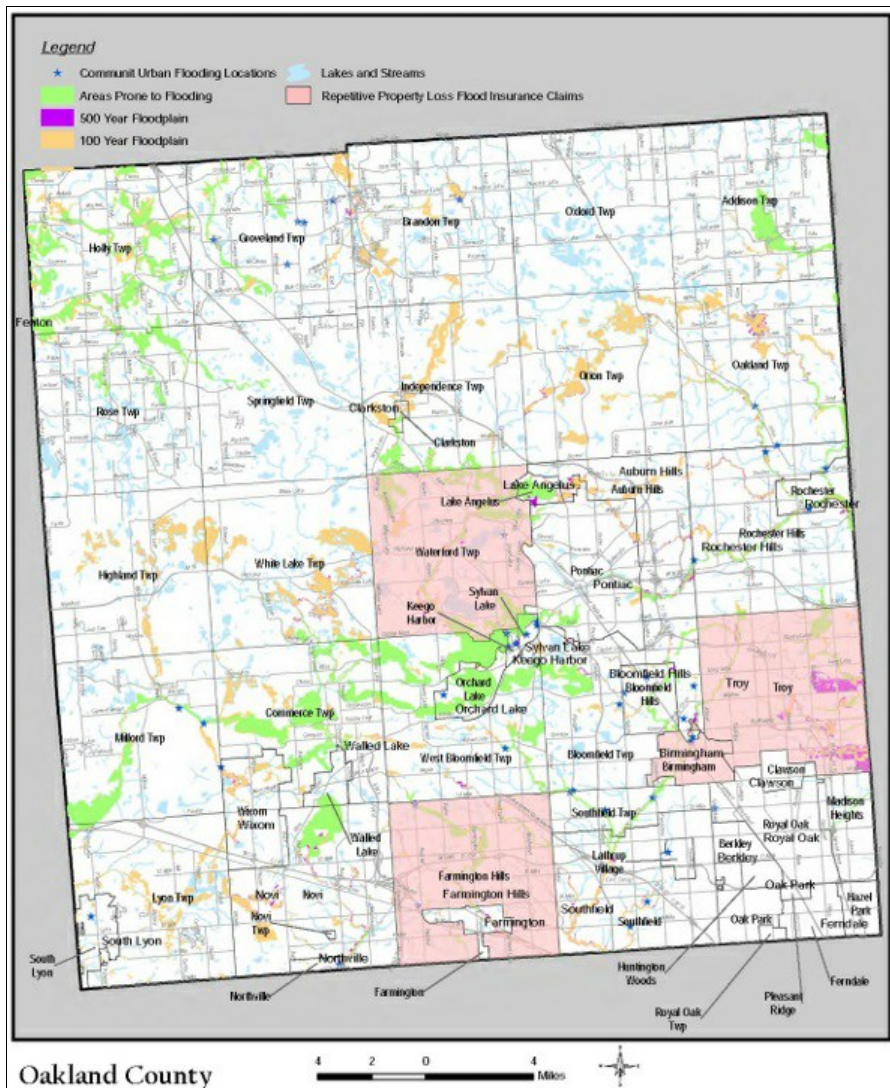
Riverine Flooding Risk & Vulnerability Assessment

Riverine flooding is dependent on seasonal weather patterns. There is 1 major riverine flooding event in Michigan every 2 years.

Vulnerable areas to flooding are those locations and populations within floodplains and flood prone areas, primarily those downstream of an event. Vulnerabilities include Infrastructure (bridges and structures) and populated areas. Approximately 5,784 structures are located within the FEMA 100-year floodplain in Oakland County. Figure 26 shows specific areas in the County which have a high occurrence of flooding.

Repetitive loss properties are those that have reported a certain number and amount of flood damages to the National Flood Insurance Program (NFIP), and therefore have been prioritized for flood mitigation activities because of the greater needs and cost-effectiveness that those properties seem to exhibit for potential flood mitigation projects. Oakland County has 18 properties that were designated as having suffered repetitive flood claims, according to an official list maintained by FEMA and the National Flood Insurance Program. Eleven of these eighteen properties are located within the City of Farmington Hills, four are in Waterford Township, two are in the City of Birmingham, and one is in the City of Troy. All of these properties are listed as not yet having fully benefited from flood mitigation activities, and they should be prioritized for future projects that might alleviate their flood risks. FEMA funds are available through HMGP, PDMP, and FMAP in order to help subsidize these types of flood mitigation activities. Although most of FEMA's hazard mitigation grants are provided with a 75/25 cost-share agreement, repetitive loss properties can enjoy an even more favorable cost-share ratio, with 90% and sometimes even 100% of the flood mitigation costs potentially able to be paid through these federal programs.

Figure 26: Riverine Flooding Vulnerability Map



Source: Oakland County, MI, USDA, SMECOG | Created by: ASTI

HAZUS (100-year Flood)

HAZUS estimates that about 1,391 buildings will be at least moderately damaged. This is over 60% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed.

Of the 55 fire stations analyzed, one will experience moderate damages. No hospitals will experience damages in this scenario, two of the 44 police stations will experience moderate damages, and seven of the 535 schools will experience moderate damages.

Building-Related Losses

The total building-related losses were 697.15 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 43.87% of the total loss.

HAZUS (500-year Flood)

HAZUS estimates that about 2,823 buildings will be at least moderately damaged. This is over 65% of the total number of buildings in the scenario. There are an estimated 40 buildings that will be completely destroyed.

Of the 55 fire stations analyzed, one will experience moderate damages and a total of two will experience loss of use. One hospital will experience moderate damages in this scenario; one of the 44 police stations will experience moderate damages and another will experience loss of use; and five of the 535 schools will experience moderate damages and another seven will experience loss of use.

Building-Related Losses

The total building-related losses were 1,056.16 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 46.60% of the total loss.

Table 35: Riverine Flooding Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	44
Potential Magnitude and Scale ¹	41
Physical Vulnerability Hazard Impact ¹	73
Social Vulnerability Hazard Impact ¹	63
Community Conditions Hazard Impact ¹	53
Overall Capability and Capacity ²	68
Mitigation ²	61
Hazard Consequence & Impact Score ¹	55
Overall Risk Rating ³	49

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Urban Flooding

Definition

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

Historical Events

Urban flooding is typically the result of intense rainfall, snowmelt, ice jams, dam failures (considered separately above) or a combination of these factors. Secondary hazards associated with urban flooding include infrastructure damage, dam failure, riverine flooding and shoreline flooding and erosion.

According to NOAA data, there were 23 flood/flash flood events in Oakland County from 1996 through 2016. Of these, 14 were flash flood events.

Between April 4 and 11, 1947, flooding resulted in significant damage in Northville, where floodwaters filled basements and inundated the first floors of numerous residences.

On August 6 1998, flooded roads impacted the morning commute in Southfield, Troy, Livonia, Novi and other cities. Parts of I-75, I-696 and Woodward Avenue were closed. Basements were flooded in Farmington and Royal Oak and several businesses in Farmington Hills experienced water damage. In Northville, a train derailed when it attempted to cross tracks that were washed out. Nineteen hundred (1,900) gallons of diesel fuel were spilled.

On June 28, 1999, runoff caused flash flooding in northern Oakland County with several gravel roads washed out in rural areas and some street flooding in the towns of Holly and Ortonville.

On June 25, 2000, flash flooding in Auburn Hills washed out the entrance ramp from southbound Lapeer Road to Interstate I-75 and a creek in Rochester Hills flooded a parking lot that damaged 5 cars. Some low-lying roads were closed for much of the day, including Walnut Lake Road in West Bloomfield and Halstead Road in Farmington Hills.

In September 2000, a Presidential Major Disaster Declaration was granted to Wayne and Oakland Counties for urban flooding and sewer backups caused by an intense rainfall on September 10 and 11, 2000.

One (1) man drowned in West Bloomfield Township on June 18, 1996, when he drove his car across a flooded parking lot into a pond that was obscured by the flood waters.

During July 2000, a stranded family was rescued by a boat in Novi after their car stalled in floodwaters.

In May 2004, portions of Dixie Highway were closed due to flooding from heavy rains that exceeded a foot of standing water.

A historic rainfall event unfolded over Southeast Michigan on August 11, 2014, leading to major flooding and road closures. This event was caused by a strengthening low-pressure system moving over the area, focusing the tropical moisture which came up from the south. The hardest hit areas included Metro Detroit and surrounding communities. Southern Oakland, Wayne, and Macomb counties saw the worst of the flooding as 4 to 6 inches of rain fell over a 4-hour period. Around 75,000 homes and businesses suffered damage, with over 3000 suffering major damage. There was also damage to the roads and bridges, along with the city sewer pumps which were overwhelmed by the torrential rainfall. Total estimated dollar loss from the Detroit Metro area was 1.8 billion dollars. Oakland County suffered an estimated 400 million in property damage.

In September 2016, Heavy rain fell across the Detroit Metro Area during the morning hours (2 to 5 inches). Widespread urban flooding was reported, with many roads and interstates closed. Many basements were also flooded. The flooding resulted in approximately 2 million dollars in damages in the Detroit Metro Area, with \$500,000 coming specifically from damages in Oakland County.

Frequency & Probability

There have been 14 flash flood events in Oakland County since 1996. The frequency of urban flooding is dependent on seasonal weather patterns. Urban flooding is usually caused by inadequate drainage following heavy rainfall or rapid snowmelt. Urban flooding is more likely to occur during the spring when thunderstorms and snow melt are more prominent. Many areas of Oakland County are moderately to heavily populated. Most of these areas are connected to a municipal sewer system (storm water and/or sanitary sewer), therefore, it is highly probable that urban flooding will occur in

the future within the County. As development continues within the County, an increase in urban flooding may occur.

Health & Safety

Possible loss of life would be primarily from drowning incidents. Other potential health-related problems could be from sewer back-ups and increased pollutant concentrations.

Area Impacted

An urban flood in Oakland County would primarily affect streets and infrastructure located in and near floodplains and in areas with inadequate drainage.

Economic Impact

Current flood damages in Michigan are estimated between \$60 million to \$100 million per year. Twenty-three (23) flood events were reported in Oakland County between 1996 and 2016, resulting in property damage totaling an estimated \$402.236 million.

From 1975 through 2014, 14 major floods in Michigan resulted in Presidential Major Disaster Declarations. These flood disasters have damaged homes, businesses, personal property and agriculture resulting in hundreds of millions of dollars' worth of damage.

Critical Facilities/Services

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

Urban Flooding Risk & Vulnerability Assessment

Urban flooding is dependent on seasonal weather patterns. Urban flooding is normally restricted to areas with high volumes impervious materials. These would include major cities, industrial parks, and downtown districts.

Vulnerabilities include Infrastructure (bridges and structures) and populated areas (Commercial and Residential).

- See Infrastructure (Water/Sewer) Vulnerability Map in Appendix A

Table 36: Urban Flooding Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹		38	
Potential Magnitude and Scale ¹		41	
Physical Vulnerability Hazard Impact ¹		68	
Social Vulnerability Hazard Impact ¹		71	
Community Conditions Hazard Impact ¹		53	
Overall Capability and Capacity ²		73	
Mitigation ²		67	
Hazard Consequence & Impact Score ¹		55	
Overall Risk Rating ³		46	
Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Shoreline Flooding & Erosion

Definition

Shoreline erosion hazards typically involve the loss of property as sand or soil is removed by water action and is carried away over time.

Historical Events

Shoreline flooding and erosion typically occurs along the Great Lakes shoreline and is caused by high water levels. A significant high water period in Michigan was in 1997 through 1998. During this period, the Great Lakes were at or near record levels set in the mid-1980s. In 1985 through 1986, record high lake levels resulted in a Governor's Disaster Declaration for 17 shoreline counties. During 1972 through 1973, high water levels caused flooding in 30 counties in Michigan.

Oakland County does not have any Great Lakes shoreline; therefore, this hazard is not included further within this Plan.

Michigan Department of State Police, Emergency Management Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 208.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, page 79.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 77-81.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=133285>, *Standard Query for Severe Weather*, June 20, 2017.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=660647>, *Standard Query for Severe Weather*, June 20, 2017.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=538946>, *Standard Query for Severe Weather*, June 20, 2017.

FEMA, <https://www.fema.gov/disasters/>, June 20, 2017.

National Climatic Data Sponsored Website, <https://www.ncdc.noaa.gov/stormevents/listevents.jsp?>, *Standard Query for Severe Weather*, June 20, 2017.

Ibid.

Michigan Department of State Police, Emergency Management Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 168.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, *Standard Query for Severe Weather*, viewed June 20, 2017.

Michigan Department of State Police, Emergency Management Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 171.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, *Standard Query for Severe Weather*, viewed June 20, 2017.

Ibid.

Ibid.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, *Standard Query for Severe Weather*, viewed June 20, 2017.

Ibid.

Ibid.

Ibid.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 82-101.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, *Standard Query for Severe Weather*, viewed June 20, 2017.

FEMA, Natural Disaster Reports, viewed June 20, 2017.

Michigan Department of State Police, Emergency Management Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 179.

1.6.8 Fog

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Definition

Fog is condensed water vapor in a cloudlike mass that is located close to the ground and limits visibility.

Historical Events

In 2005, up to 200 cars collided during a heavy fog in Ingham County. Two (2) people were killed, 37 were injured and both lanes of I-96 were closed for hours. In 1995, dense fog lasted for over 24 hours resulting in numerous traffic accidents and 4 fatalities. Schools were delayed and flights were delayed, cancelled or diverted.

Frequency & Probability

Michigan has approximately one major fog event every two years. NOAA lists one major fog event for Oakland County since 1950.

Health & Safety

Low visibility can cause large multi-car accidents resulting in personal injury and death. No records of death or injury from fog events were found for Oakland County.

Area Impacted

Fog is usually limited to low lying areas and valleys; however, during significant events, large portions of the County may be affected. The areas of most concern would be highways, freeways, areas of high traffic volumes and airports.

Economic Impact

Fog is normally limited to the early morning hours which may delay the morning commute. Low visibility may lead to accidents, property damage and injury. The economic impacts are typically short term and localized.

Critical Facilities/Services

Critical facilities and services that depend on transportation are most affected by fog. School buses and emergency response vehicles may be significantly delayed. The affect should be temporary and limited to the duration of the fog event or shortly thereafter.

Fog Risk & Vulnerability Assessment

Michigan has approximately 1 major event every 2 years. NOAA had 1 major fog event listed for Oakland County since 1950. Fog is normally limited to the early morning hours and would therefore, be constrained to the early morning commute. The most dangerous accidents tend to be on highways/freeways, high traffic roads, airports, and railroad crossings. Heavy fog can lengthen the time it takes for emergency response vehicles to respond to an emergency. Heavy fog also puts school buses and other public buses at increased chance of accident.

Table 37: Fog Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹			25
Potential Magnitude and Scale ¹			11
Physical Vulnerability Hazard Impact ¹			28
Social Vulnerability Hazard Impact ¹			29
Community Conditions Hazard Impact ¹			16
Overall Capability and Capacity ²			79
Mitigation ²			72
Hazard Consequence & Impact Score ¹			21
Overall Risk Rating ³			23
Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police, Emergency Management Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 161.

Ibid.

1.6.9 Gas/Oil Shortages or Supply Disruption

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Definition

A gas/oil shortage is when demand for gas/oil exceeds the available supply.

Historical Events

In 2005, Hurricane Katrina disrupted oil refinery stations that affected Michigan's supply of fuel. Cold temperatures in 1976, 1977 and 2000 lead to a fall in propane inventories. The propane industry found it difficult to maintain deliveries causing the price of propane to hit record highs. During the 1970s, the Middle East Oil Embargo halted the flow of oil causing an energy crisis followed by the eruption of the Iranian Civil War this resulted in gas shortages and a significant increase in the cost of gasoline.

Frequency & Probability

Since 1965, there have been 7 major gas/oil shortages that impacted Oakland County. The conflicts in the Middle East as well as increased demand around the globe can be expected to lead to additional shortages in the future.

Health & Safety

Although no information could be found regarding specific injuries or deaths caused by gas/oil shortages, they are possible. Shortages in heating fuels and increased cost may lead some individuals to be unable to heat their homes and result in a number of health issues attributed to cold weather (e.g., hypothermia, chilblains, etc.) collectively referred to as cold stress. Long term shortages in gasoline and fuel may lead to violent outburst. Overall the risk to health and safety is low.

Area Impacted

All of Oakland County would be impacted by a gas/oil shortage. Depending on the type of fuel, certain areas may be more impacted than others. Propane shortages would impact rural areas while gasoline shortages would have a larger impact on commuters and businesses.

Economic Impact

Economic impact includes increased prices of gas/oil, reduction in spending on other items and less driving. Long-term widespread shortages may lead to job loss, high inflation, recession and social unrest. Propane or natural gas shortages may affect the ability of people to heat their homes and may lead to damage to personal property.

Critical Facilities/Services

Critical facilities and services are impacted by gas/oil disruptions and shortages. Critical facilities such as emergency response and schools rely on transportation fleets with relatively poor mileage. Generators run on diesel fuel. Most critical facilities are limited to fixed finances such as schools, emergency response and nursing homes that find it difficult to make up the increased cost of heating and transportation.

Gas/Oil Shortage Risk & Vulnerability Assessment

Since 1965, there have been 7 major gas/oil shortages that impacted Oakland County. Gas and oil shortages cover a wide range of fuels used for different purposes from fueling vehicles to heating homes or making plastics. The type of gas/oil shortage will dictate what/who is most vulnerable. For example, gasoline shortages will affect commuters, which in turn will affect the businesses where they work (increase in absenteeism). Oakland County has limited public transportation available, without gasoline many residents would find it difficult to make it into work. If there was a shortage of propane or natural gas, that would affect the ability to heat homes, hospitals, and nursing homes. It would also affect some ability to cook. Shortages in diesel would affect commercial and industrial facilities, places with generators, emergency response, and schools.

Table 38: Gas/Oil Shortage Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹		13	
Potential Magnitude and Scale ¹		5	
Physical Vulnerability Hazard Impact ¹		47	
Social Vulnerability Hazard Impact ¹		66	
Community Conditions Hazard Impact ¹		28	
Overall Capability and Capacity ²		73	
Mitigation ²		67	
Hazard Consequence & Impact Score ¹		36	
Overall Risk Rating ³		21	
Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

1.6.10 Hazmat Incidents

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Fixed Site

Definition

Hazardous Material (Hazmat) Incident – Fixed Site is defined as an uncontrolled release of a hazardous material originating from a building, structure or fixed equipment which is capable of posing a risk to life, health, safety, property or the environment.

Historical Events

According to Oakland County's 2015 SARA Title III reports, Oakland County had 225 Extremely Hazardous Substance (EHS) facilities and over 500 active hazardous substance facilities. Oakland County has an average of 25 reported hazmat incidents per year. Although most hazmat incidents occur at industrial facilities, this is not always the case. For example, on May 29, 2004, a tank containing ethylene glycol for a refrigeration system ruptured at a fish market in Birmingham. Approximately 180 gallons of the material were released, with a portion entering the storm drain system. The spill required evacuation of the building and several people were exposed to the spilled material, 6 people required hospitalization.

Table 39: Fixed Site Hazmat Releases in Oakland County

Community Name	Number of Releases
Pontiac	59
New Hudson	15
Troy	46
Novi	11
Farmington Hills	28
Rochester and Rochester Hills	30
Waterford	21
Royal Oak	19
Southfield	27
Auburn Hills	11
Hazel Park	9
Oxford	13
West Bloomfield	7
Birmingham	5
Bloomsfield Hills	3
Clarkston	9
Clawson	6
Ferndale	13
Holly	11
Lake Orion	8
Leonard	3
Oak Park	11
Ortonville	1
South Lyon	7
Springfield	2
Farmington	8
Franklin Village	1
Keego Harbor	2
Madison H8s	18
Milford	23
Northville	1

Source: U.S. Coast Guard, National Response Center website, www.nrc.uscg.mil/foia.html, Standard Query Report for Oakland County, Fixed Incidents, January 1, 1990 through December 21, 2011.

Frequency & Probability

From 1990 through December 2011, there were a total of 547 reported fixed site hazmat incidents in Oakland County, an average of 25 incidents per year. As the County continues to develop and attract new business and industry, it is anticipated that the probability of occurrence for this hazard will increase.

While recent fixed-site hazmat was not available, the following data demonstrates that hazmat issues, albeit many of them were small, occur often in Oakland County.

Table 40: All Hazmat-related Incidents in Oakland County

Year	Frequency	Fatalities	Casualties	Total Loss (Property and Content Loss)
2012	2,962	0	0	4,901
2013	4,102	0	0	33,730
2014	4,389	0	0	36,860
2015	3,227	0	0	107,988
2016	3,752	0	0	19,225

Source: Michigan Bureau of Fire Services

Table 41: Chemical Spill or Leaks in Oakland County

Year	Frequency	Fatalities	Casualties	Total Loss (Property and Content Loss)
2012	20	0	0	0
2013	13	0	0	0
2014	20	0	0	0
2015	18	0	0	0
2016	27	0	0	0

Source: Michigan Bureau of Fire Services

Health & Safety

Given the frequency of hazmat incidents in Oakland County, the number of deaths and injuries from this event is relatively low.

Area Impacted

In Oakland County, fixed site hazmat incidents have rarely required an evacuation. The majority of hazmat material releases in Oakland County are releases to water, followed by land/soil and air. Environmental contamination which results from this hazard can extend to off-site locations.

Economic Impact

The economic impact due to this hazard can be highly variable, especially when including the costs of environmental remediation. According to the U.S. EPA Hazmat Response Team, costs for responding to a hazmat incident can range from \$1,000-\$100,000. Some property damage from this type of event can be expected, especially if the release results in a fire or explosion. Additional impact in the form of lost business revenue, can result if the incident causes a business to close.

Although major fixed site hazmat incidents are not common in Oakland County, there is a potential for such an incident. A significant incident would likely involve response efforts from multiple agencies and departments. Additional impact could result from environmental remediation and restoring public confidence in the environmental health of the County.

HAZMAT Fixed-Site Risk & Vulnerability Assessment

Vulnerable locations are the Superfund Amendments and Reauthorization Act (SARA) Title III sites (sites that store hazardous substances) in the County and those areas within an approximate 1-mile radius of these sites. In 2010, there were 195 Extremely Hazardous Substance (EHS) facilities and 502 Active Hazardous Substance facilities within the County.

About half of the County's 62 municipalities have had at least 1 fixed site hazmat release between 1999 and 2011. Police and fire stations are vulnerable assets in response to a hazmat fixed site release. Areas with greater population are more at risk for secondary health-related incidents resulting from a fixed site hazmat release. The location of the listed SARA Title III sites, which include SARA Section 302 and Section 312 facilities, is shown on the HAZMAT Fixed-Facility Vulnerability Map, along with the locations of police and fire stations in the County. Also displayed on the map are the census blocks within a 1-mile radius of the listed sites. Approximately 1,442,426 people are located within 1 mile of at least 1 SARA Section 302 or Section 312 facility.

- See HAZMAT Fixed-Facility Vulnerability Map in Appendix A

Table 42: Hazardous Materials: Fixed Facility Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	31
Potential Magnitude and Scale ¹	16
Physical Vulnerability Hazard Impact ¹	53
Social Vulnerability Hazard Impact ¹	54
Community Conditions Hazard Impact ¹	32
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	38
Overall Risk Rating ³	38

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Transportation Incident

Definition

Hazardous Material (Hazmat) Incident – Transportation is defined as an uncontrolled release of a hazardous material during transport which is capable of posing a risk to life, health, safety, property or the environment.

Historical Events

One of the most significant responses required for a hazmat incident in Oakland County occurred on November 15, 2001. The incident involved the head-on collision of 2 trains near Clarkston. As a result of the collision, 2 of the rail crew members were killed and 2 more were injured. In addition, a car carrying 4,000 gallons of fuel oil was derailed. The derailment required the response of local fire departments and hazmat teams, the Michigan Department of Environmental Quality, Michigan Department of Natural Resources and the U.S. Environmental Protection Agency. A 1-mile radius around the incident site was evacuated, impacting approximately 719 people. Fortunately, after investigation by the hazmat team, it was determined that there was no release from the rail car.

Table 43: Transportation Related Hazmat Releases in Oakland County January 1, 1990 through 2011

Community Name	Number of Releases
Pontiac	18
Novi	5
Milford	5
Holly	1
Lake Orion	9
Sylvan Lake	2
Auburn Hills	4
Farmington Hills	4
Hazel Park	4
Highland	3
Northville	1
Rochester Hills	3
Sylvan Lake	2
Waterford	3
Wixom	3
Wood Lake	1

Source: U.S. Coast Guard, National Response Center website, www.nrc.uscg.mil/foia.html, Standard Query Report for Oakland County, Mobile and Transportation Incidents, January 1, 1990 through December 31, 2011

Frequency & Probability

Since 1978, there have been 4 significant hazardous material transportation incidents in Oakland County. Three involved train derailments and 1 involved a cargo van transporting radioactive materials. There have been 111 reported incidents involving mobile transport and 43 railroad incidents in Oakland County since 1992. The State of Michigan averages a reportable incident every 9.1 days. As the County continues to develop and attract new business and industry, it is anticipated that the probability of occurrence for this hazard will increase.

Health & Safety

Compared to fixed site hazmat incidents in Oakland County, transportation related incidents are more likely to result in death or injury. Oakland County experiences 1 death every 3 years and 1 injury each year, on average, as a result of transportation related hazmat accidents. Deaths and injuries are typically limited to the operators of the transportation vessel.

Area Impacted

There are 134 miles of freight railroads and approximately 62 miles of interstate and major state highway in Oakland County. Although large-scale, off-site impacts are not common with hazmat transportation incidents, they are certainly possible within Oakland County. Off-site impacts can include evacuation, closure of roadways and environmental contamination.

Economic Impact

The economic impact due to this hazard can be highly variable, especially when including the costs of environmental remediation. According to the U.S. EPA HazMat Response Team, costs for responding to a hazmat incident can range from \$1,000-\$100,000. Damage to transportation equipment is expected with this event, however, these costs are the responsibility of the transporter. Costs to the public can include response efforts, commuter delays and damage to transportation infrastructure.

Critical Facilities/Services

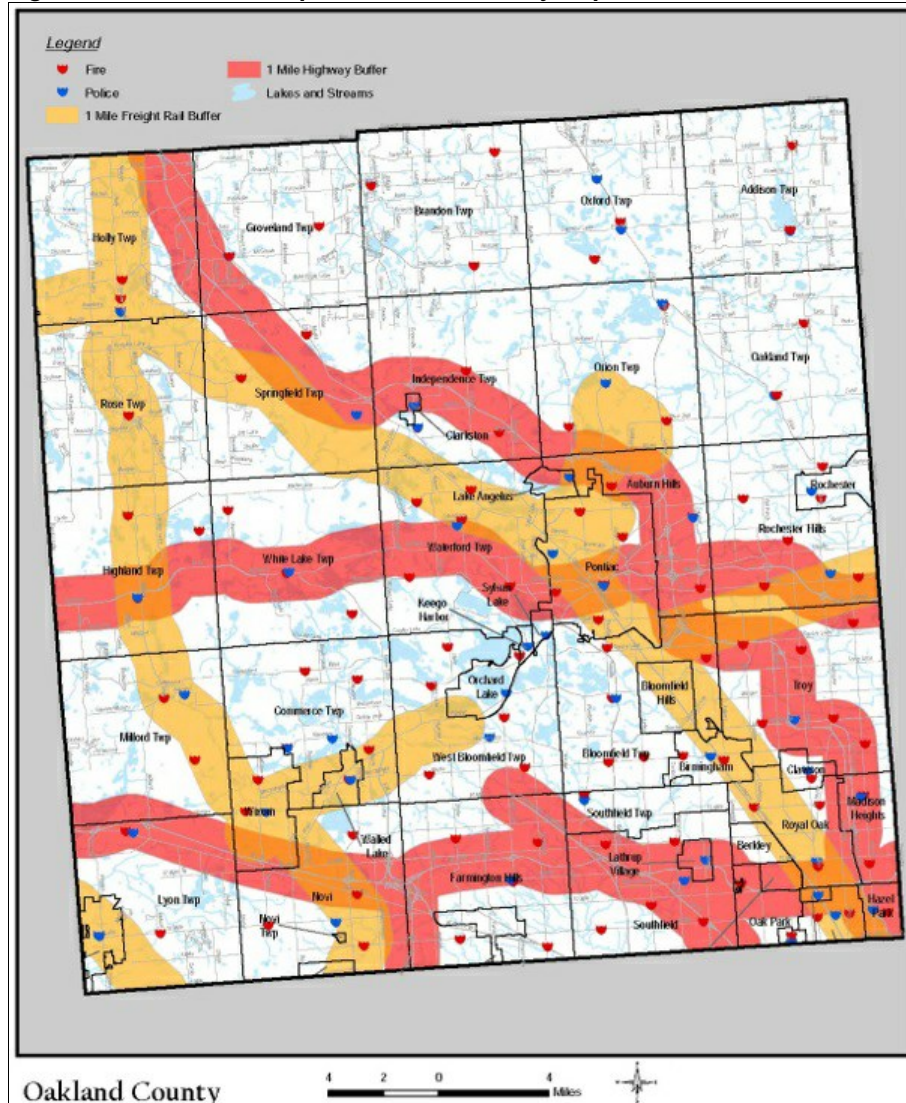
Although transportation related hazmat incidents are not common in Oakland County, such an incident is very possible. As demonstrated by the November 15, 2001, incident, a significant incident can involve response efforts from multiple agencies and departments. Additional impact could result from environmental remediation and restoring public confidence in the environmental health of the County.

HAZMAT Transportation Risk & Vulnerability Assessment

There have been 4 significant hazmat transportation incidents in Oakland County since 1978. There were a total of 111 automobile/truck accidents and 43 railroad accidents. Pontiac, Lake Orion, Novi, and Milford had the highest number of releases in the County; however, 16 communities had at least 1 incident reported.

Vulnerable locations to a transportation hazmat incident are the areas within a 1-mile radius of the railroads and major roadways, particularly I-75, I-696, I-96, I-275, and M-59. Areas of greater population are more vulnerable to these incidents. Police and fire stations are vulnerable assets in response to a hazmat fixed site release including activities such as evacuation assistant and cleanup assistance. The locations of the railroads, major highways, and police and fire station locations are included on Figure 27. Census block groups within a 1-mile radius of major highways and freight rail are also included on Figure 27. Approximately 767,222 people are located in these census blocks within 1 mile of the selected highways.

Figure 27: HAZMAT Transportation Vulnerability Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Table 44: HAZMAT Transportation Incident Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	38
Potential Magnitude and Scale ¹	14
Physical Vulnerability Hazard Impact ¹	53
Social Vulnerability Hazard Impact ¹	54
Community Conditions Hazard Impact ¹	35
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	38
Overall Risk Rating ³	38

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Oakland County LEPC webpage, https://www.oakgov.com/homelandsecurity/Pages/program_service/lepc.aspx, June 21, 2017.

U.S. Coast Guard, National Response Center website, www.nrc.uscg.mil/foia.html, Standard Query Report for Oakland County, Fixed Incidents, January 11, 2012.

Ibid.

Ibid.

Federal Railroad Administration, Safety Data Reports for 2001, <http://safetydata.fra.gov>, filtered for Oakland County, June 27, 2017.

U.S. Coast Guard, National Response Center website, www.nrc.uscg.mil/foia.html, Standard Query Report for Oakland County, Rail Incidents, January 11, 2012.

Ibid.

U.S. Coast Guard, National Response Center website, www.nrc.uscg.mil/foia.html, Standard Query Report for Oakland County, Rail Incidents, January 11, 2012.

1.6.11 Infrastructure Disruption

Published 7/5/2018 21:30 by Nathaniel Marlette

Definition

An infrastructure disruption is the disruption of a critical public or private utility infrastructure which results in a short-term loss of service.

- See Infrastructure Map in **Appendix A**

Water System

Historical Events

On June 7, 1999, a water main break in the City of Auburn Hills resulted in a week-long loss of water service to over 44,000 households in Auburn Hills, Orion Township, Lake Orion and Rochester Hills. The break was caused when a drilling company accidentally struck a water main. The water emergency forced the temporary closures of hundreds of schools and businesses, including major industries within the affected area. Local officials estimated the water emergency resulted in economic losses in the tens of millions of dollars.

On October 23, 2017, a 48-inch water main broke in Farmington Hills, causing at least 50,000 people to completely lose water service and impacting over 300,000 people. Impacted areas of the County were placed on a water boil until the break could be fixed and water pressure restored. The water boil lasted for up to nine days in the hardest hit areas.

Frequency & Probability

Water system disruptions can be attributed to causes such as construction/excavation activities, underground freezing, power outages and system blockages. Two (2) significant water main breaks have occurred in Oakland County since 1999.

In 2003, there were 257 water line breaks, including service line breaks. The vast majority of water line breaks do not create a water crisis situation. It is estimated that this hazard will be somewhat more likely to occur in the future as the water system structures age and countywide development continues.

Health & Safety

The availability of clean drinking water is crucial to the health and safety of the public. Water service interruptions can cause untreated or poorly treated drinking water to enter the water supply, resulting in boil water advisories.

Area Impacted

The Oakland County Water Resources Commissioner's Office (OCWRC) operates and maintains the water system for many of the communities of Oakland County. The OCWRC's water system has been designed to minimize the number of people impacted from service interruption. The goal of planning is to limit impacts to no more than 28 customers with each break. However, the impact of each line break is highly variable.

Economic Impact

Water is a vital component in operating schools, hospitals, businesses and in maintaining public health. Information regarding the economic impact of water system failures is not available. It is anticipated that an interruption in service can be extremely costly, depending upon the number of affected customers and duration of the event.

Critical Facilities/Services

Maintaining a functional water system is a critical service of the OCWRC in portions of Oakland County. Loss of water service can make it difficult to operate other critical facilities such as schools, hospitals, businesses and sport/entertainment venues.

Water Disruption Risk & Vulnerability Assessment

The Oakland County Water Resources Commissioner's Office (OCWRC) operates and maintains storm drains throughout the County. As shown on the Infrastructure (Water/Sewer) Vulnerability Map, the OCWRC operates and/or maintains portions of the water and sanitary sewer systems within the County. Interruptions in the water system are common; in 2003, for example, there were 257 water line breaks. The primary consequence of this hazard is potential public health impacts. As a result, schools, hospitals and elderly care facilities have been identified as the most vulnerable.

- See Infrastructure (Water/Sewer) Vulnerability Map in **Appendix A**

Table 45: Infrastructure Disruption Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	25
Potential Magnitude and Scale ¹	19
Physical Vulnerability Hazard Impact ¹	62
Social Vulnerability Hazard Impact ¹	59
Community Conditions Hazard Impact ¹	45
Overall Capability and Capacity ²	73
Mitigation ²	61
Hazard Consequence & Impact Score ¹	45
Overall Risk Rating ³	33

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Electrical System

Historical Events

The largest, and arguably most infamous, electrical system failure in the United States occurred on August 14, 2003. This system failure started at 4:10 p.m. in southern Ohio and within seconds, 50 million people in North America were left without electricity. The blackout affected millions of customers in southeast Michigan, including Oakland County. In many ways, this event was a worst-case scenario electrical failure.

About 1 million Michigan residents lost power on March 8, 2017. Gov. Rick Snyder, in a press briefing with officials from the state’s two biggest utilities, called the windstorm “the largest combined statewide” power outage event in Michigan history. At one point, approximately one-third of Michigan residents were affected by the power outage. More than 800,000 DTE customers were affected by the storm and more than 4,000 wires were downed by falling trees. 320,000 Consumers Energy customers lost power because of the storm. The outages were caused by near-hurricane force winds, which pounded the area for more than 12 hours. A warmer than normal winter created softer ground, making it easier for trees to uproot and knock down more power lines.

Frequency & Probability

Electrical service for the majority of Oakland County is provided by DTE Energy, with the exception of a small area in the northwest portion of the County which is serviced by Consumers Energy. It is estimated that a significant power failure occurs in Oakland County once per year. Electrical failures, like the August 2003 blackout, although rare, can occur due to problems within the electrical system and from secondary causes such as weather and human/animal interference. Ice storms have an established history of causing electrical service interruptions. Electrical outages are often related to severe weather events, which occur 30-40 times per year within Oakland County.

Electrical service problem areas exist within the County. Problem areas are those areas that experience a power outage more than twice each year. When a problem area is identified, the cause is determined and remedied as quickly as possible. As a result, the identified problem areas are always changing.

As the County continues to grow and demand for electrical service increases, it is possible that this hazard will occur more frequently and with greater consequence.

Health & Safety

Electrical service is incredibly important in maintaining the health and safety of the public. Electricity is required to heat and cool homes, operate traffic signals and operate hospitals and emergency services. Power outages can be particularly dangerous during times of extreme heat or cold. In addition, power outages can have a negative impact on the infirm. The number of people impacted by a power outage is highly variable with each event.

Economic Impact

Electricity is a vital component to operating businesses and County services. Information regarding the economic impact of electrical outages is not available. It is anticipated that an outage can be extremely costly, depending of the number of affected customers and duration of the event.

Critical Facilities/Services

As demonstrated by the August 2003 blackout, electricity is an integral part of every service the County provides to its residents. The blackout caused traffic backups, loss of water service and gasoline shortages making it difficult to provide even the most common services. Fortunately, large-scale electrical failures are not common. However, the blackout was a good “test” for the County’s systems to determine effectiveness under disaster conditions.

Electrical Disruption Risk & Vulnerability Assessment

Electrical service is provided to Oakland County by Consumers Energy and DTE Energy. Failures of the electrical system are also more likely to occur during severe storm events. Populations in schools, hospitals and elderly care facilities have been identified as being at increased vulnerability to this hazard. Locations of these facilities are shown in the Electrical/Communication System Vulnerability Map.

- See Electrical/Communication System Vulnerability Map in **Appendix A**

Table 46: Electrical System Infrastructure Failure Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	31
Potential Magnitude and Scale ¹	12
Physical Vulnerability Hazard Impact ¹	47
Social Vulnerability Hazard Impact ¹	66
Community Conditions Hazard Impact ¹	35
Overall Capability and Capacity ²	75
Mitigation ²	61
Hazard Consequence & Impact Score ¹	39
Overall Risk Rating ³	35

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Communications System

Historical Events

Oakland County operates internal communications systems such as a 9-1-1 Public Safety, Answering Point (PSAP), and an emergency public radio system. There are an additional 29 PSAPs within the County that are operated by local cities, townships and villages. Telephone service for Oakland County residents is available from numerous service providers. In April 2003, a significant ice storm affected Oakland County. The ice downed phone lines cutting service to numerous customers throughout the County. Since 1987, construction projects within the County have caused at least 2 service interruptions in the 9-1-1 system.

Frequency & Probability

Communications failures are most frequently a result of severe weather events or other interferences that affect phone lines, such as animals or automobiles striking utility poles. Very rarely does a communications failure result from a problem with the communications system itself. Communications failures, both public and private systems, are possible with any major storm event such as ice storms, lightning or high winds which occur an average of 30-40 times each year. Power outages can also interrupt operation of the 9-1-1 PSAP. As the County continues to grow and demand for communications services increase, it is anticipated that this hazard will occur more frequently and which greater consequence.

Health & Safety

Communications systems are a vital link between the public and emergency response services. As a result, a failure of the system can have secondary impacts to the health and safety of the affected public. The number of people that experience a loss of service due to a communications failure is directly related to the severity of the event. However, people requiring emergency services during a failure are at greater risk for impact.

Area Impacted

A failure of private telephone communications is limited to the service area network. However, a failure of the emergency communications system can impact the entire County.

Economic Impact

The majority of economic impact from this hazard would result to loss of productivity for affected businesses.

Critical Facilities/Services

The 9-1-1 PSAP and emergency dispatch systems are vital services provided to Oakland County residents. Power outages and downed lines can greatly impact the County's ability to operate these systems. Backup generators are utilized to maintain emergency communications during power outages. If phone lines to the 9-1-1 PSAPs are downed, the calls are automatically re-routed to an alternate PSAP to maintain 9-1-1 phone services.

Communication Disruption Risk & Vulnerability Assessment

Private communications services are provided by a number of companies. With growing dependency on wireless networks, this specific asset represents a significant vulnerability. Oakland County also operates a 9-1-1/communications center. The public safety radio system currently in place in the County will be replaced with a system that allows for greater interoperability across multiple jurisdictions, including the State of Michigan.

Failures of the communication system are more likely to occur during severe storm events. Populations in schools, hospitals and elderly care facilities have been identified as being at increased vulnerability to this hazard. Locations of these facilities are shown in the Electrical/Communication System Vulnerability Map.

- See Electrical/Communication System Vulnerability Map in **Appendix A**

Table 47: Communication System Incidents Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	25
Potential Magnitude and Scale ¹	2
Physical Vulnerability Hazard Impact ¹	47
Social Vulnerability Hazard Impact ¹	59
Community Conditions Hazard Impact ¹	28
Overall Capability and Capacity ²	76
Mitigation ²	72
Hazard Consequence & Impact Score ¹	33
Overall Risk Rating ³	29

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Storm Water System

Historical Events

In September 2000, extensive rains in southeast Michigan flooded municipal storm sewers causing sewer backups in thousands of Oakland County homes and businesses. The major cause of the sewer backups was a temporary loss of power at pumping stations and insufficient capacity of the storm sewer system due to the high rains, which exceeded the design capacity. The flooding caused extensive damage to affected homes and businesses and created a public health hazard due to potential exposure to untreated sewage. On October 27, 2000, Oakland County was granted a Presidential Disaster Declaration to provide disaster assistance to affected businesses and individuals.

A historic rainfall event unfolded over Southeast Michigan on August 11, 2014, leading to major flooding and road closures. This event was caused by a strengthening low-pressure system moving over the area, focusing the tropical moisture which came up from the south. The hardest hit areas included Metro Detroit and surrounding communities. Southern Oakland, Wayne, and Macomb counties saw the worst of the flooding as 4 to 6 inches of rain fell over a 4-hour period. Around 75,000 homes and businesses suffered damage, with over 3000 suffering major damage. There was also damage to the roads and bridges, along with the city sewer pumps which were overwhelmed by the torrential rainfall. Total estimated dollar loss from the Detroit Metro area was 1.8 billion dollars. Oakland County suffered an estimated 400 million in property damage.

In September 2016, Heavy rain fell across the Detroit Metro Area during the morning hours (2 to 5 inches). Widespread urban flooding was reported, with many roads and interstates closed. Many basements were also flooded. The flooding resulted in approximately 2 million dollars in damages in the Detroit Metro Area, with \$500,000 coming specifically from damages in Oakland County.

Frequency & Probability

There are 2 primary types of storm water systems in Oakland County – open drains and enclosed, underground systems. The primary problems associated with open drains are log jams, plugged drains and siltation and bank erosion. The major dilemma with the County's storm water systems, both open drains and enclosed systems, is that the County's drainage needs exceed system capacity when rainfall amounts exceed the design capacity. The open storm water system was originally designed to manage storm water for a specific design event. However, when the design event is exceeded flooding often occurs.

Capacity limitations of the storm water system are evident during periods of high rain or snowmelt. Some degree of storm water system flooding can be expected with any major rain or snowmelt event. It is anticipated that this hazard will become more frequent and more severe as future rainfall amounts increase as projected.

Health & Safety

The storm water system is of great importance to protecting human health and safety. Flooding which results during system failures, or capacity exceedances, can create safety problems and sewer backups in both combined storm water systems (sanitary and storm water flow) and separated storm water systems, presenting a health concern.

Area Impacted

County drains are found throughout Oakland County. The Oakland County Water Resources Commissioner's Office (OCWRC) is charged with the responsibility of maintaining the County storm water system's under their jurisdiction. The storm water systems for the remaining portions of Oakland County is operated and/or maintained by the Road Commission of Oakland County, the Michigan Department of Transportation and/or local municipalities. The area impacted by flooding is dependent upon the drainage area for the storm water system. Areas with combined storm water systems (sanitary and storm water flow) are more frequently found in the southern portions of the County. These areas can be at increased risk for sewer backups and basement flooding.

Economic Impact

As demonstrated by the September 2000 system failure, flooding can result in major property damage costs. Storm water system upgrades can also be very costly to implement. Funding is available for maintaining many Oakland County drains; however, maintenance funding is limited for approximately 200 County drains which were established under the 1956 Drain Code. Each year claims are filed with OCWRC for property damage due to flooding caused by system backups and capacity exceedances.

Critical Facilities/Services

Maintaining a functional storm water system is a critical service provided by the OCWRC to many Oakland County Communities. The storm water

system is important to protect property, both public and private, and to maintain public health.

Storm Water System Disruption Risk & Vulnerability Assessment

Capacity limitations of the storm water system are evident during periods of high rain or snowmelt. Some degree of storm water system flooding can be expected with any major rain or snowmelt event. It is anticipated that this hazard will become more frequent and more severe as future rainfall amounts increase as projected.

- See Infrastructure (Water/Sewer) Vulnerability Map in **Appendix A**

Table 48: Storm Water System Incident Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	25		
Potential Magnitude and Scale ¹	13		
Physical Vulnerability Hazard Impact ¹	58		
Social Vulnerability Hazard Impact ¹	54		
Community Conditions Hazard Impact ¹	40		
Overall Capability and Capacity ²	73		
Mitigation ²	61		
Hazard Consequence & Impact Score ¹	40		
Overall Risk Rating ³	32		
Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Sewer System

Historical Events

Disruptions of the sanitary sewer system can result in significant risks to public health and safety. A system disruption can result in sewer backups in homes or businesses and discharges of untreated sewage to rivers and lakes.

In September 2010, a sanitary sewer pipe failed and resulted in a large sinkhole on a high traffic road. The sinkhole also affected nearby utilities such as gas and water. The sewer and sinkhole repairs caused road closures for an extended period of time. The road closures were a major disruption to residents, businesses and the general public for many months.

A historic rainfall event unfolded over Southeast Michigan on August 11, 2014, leading to major flooding and road closures. This event was caused by a strengthening low-pressure system moving over the area, focusing the tropical moisture which came up from the south. The hardest hit areas included Metro Detroit and surrounding communities. Southern Oakland, Wayne, and Macomb counties saw the worst of the flooding as 4 to 6 inches of rain fell over a 4-hour period. Around 75,000 homes and businesses suffered damage, with over 3000 suffering major damage. There was also damage to the roads and bridges, along with the city sewer pumps which were overwhelmed by the torrential rainfall. Total estimated dollar loss from the Detroit Metro area was 1.8 billion dollars. Oakland County suffered an estimated 400 million in property damage.

Frequency & Probability

A major system failure occurs within the County approximately once every 20 to 25 years. Smaller problems are more frequent. During major storm events, it is highly possible for a loss of power to occur at certain pump stations. This can create the potential for an overflow discharge to local rivers or lakes. It is expected that problems will become more frequent as the system structures age.

Health & Safety

Human exposure to untreated sewage presents a major health and safety threat. Discharges of untreated sewage to lakes or rivers can also significantly impact the environmental health of local waterways.

Area Impacted

OCWRC operates or maintains sanitary sewer systems most of the communities of Oakland County. Rural areas of the County have no municipal sewer service available. The sanitary sewer systems in the communities of Beverly Hills and Franklin Village have been identified as areas with the most frequent maintenance needs. The oldest parts of the system are in the Pontiac area, with the average construction date in the 1920's. The number of sewer users impacted by each failure is dependent upon the severity of the event. Lakes or rivers could also be impacted due to sewer overflow discharges, making them temporarily unsafe for recreational activity.

Economic Impact

Information regarding the economic impact of sanitary sewer system failures is not available. The sanitary sewer system is a vital part of the operations system for a wide range of businesses. It is anticipated that a failure could be extremely costly, depending upon the number of affected customers and duration of the event.

Critical Facilities/Services

Maintaining a functional sanitary sewer system is a critical service provided by the OCWRC to portions of Oakland County. It is OCWRC's policy to respond to all maintenance needs within 1 hour. Loss of sanitary sewer service can make it difficult to operate other critical facilities such as schools,

hospitals, businesses and sport/entertainment venues.

Recent construction projects have increased the capacity of the system to decrease the likelihood of the system being overwhelmed. The improvements help protect against sewage backing up into homes and businesses or being discharged directly to lakes and streams during a major storm event.

Sewer System Disruption Risk & Vulnerability Assessment

A major system failure occurs within the County approximately once every 20 to 25 years. Smaller problems are more frequent. During major storm events, it is highly possible for a loss of power to occur at certain pump stations. This can create the potential for an overflow discharge to local rivers or lakes. It is expected that problems will become more frequent as the system structures age.

- See Infrastructure (Water/Sewer) Vulnerability Map in **Appendix A**

Table 49: Sewer System Incident Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	19		
Potential Magnitude and Scale ¹	9		
Physical Vulnerability Hazard Impact ¹	53		
Social Vulnerability Hazard Impact ¹	40		
Community Conditions Hazard Impact ¹	38		
Overall Capability and Capacity ²	73		
Mitigation ²	61		
Hazard Consequence & Impact Score ¹	35		
Overall Risk Rating ³	25		
Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Bridges, Roads, and Overpasses

Historical Events

There have been 85 significant bridge failures in the United States since 1940. In 2009, a tanker explosion in Hazel Park caused a bridge to collapse onto I-75.

Frequency & Probability

Although there has only been 1 bridge collapse, it is possible for other bridge/overpass failures in the future. According to 2010 data from SEMCOG, Oakland County has 7,343 miles of public roads. Of these, 12% are in good condition, 42% are in fair condition and 46% are rated as being in poor condition. In 2010, there were 703 bridges in Oakland County; 670 of those are open, 32 are open with restrictions and 1 was closed. As of 2010, 22.9% (161) of the County's bridges were determined to be deficient.

Health & Safety

Hundreds of people have been killed or injured due to bridge failure in the United States. Falls, debris and drowning are the biggest threats from bridge failures. Sink holes rarely injure people, however.

Economic Impact

Economic impact is dependent on the size and type of failure. Significant failures can cost hundreds of millions of dollars to clean up and repair. Property damage to passing vehicles and nearby buildings may also result from failure. Re-routing of traffic can cause traffic congestion and reduce revenue for area businesses.

Critical Facilities/Services

Damage to roads and bridges can lead to congested roads or severely limit the ability of emergency personnel to respond to emergency situations. Depending on the severity of the failure and location of a transportation infrastructure failure, critical facilities such as hospitals, schools and nursing homes may be isolated.

Bridges, Roads, Overpasses Risk & Vulnerability Assessment

There have been 85 significant bridge failures in the U.S. since 1940; and one occurred in Michigan. In 2010, there were 703 bridges in Oakland County

Table 50: Structural Failure Infrastructure Failure Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	13
Potential Magnitude and Scale ¹	13
Physical Vulnerability Hazard Impact ¹	53
Social Vulnerability Hazard Impact ¹	29
Community Conditions Hazard Impact ¹	35
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	32
Overall Risk Rating ³	20

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Invasive Species

Definition

An invasive species is a species that is not native to the ecosystem and whose introduction causes, or is likely to cause, harm to the economy, environment and/or human health.

Historical Events

Some of the most notable invasive species include emerald ash borer, Asian carp, gypsy moth, zebra mussels, Phragmite, and Japanese beetles. Each of these species have significantly impacted the environment and resulted in decreased revenue and profits.

Frequency & Probability

At least 200 high-impact invasive species occur in the United States. A new invasive species is established every 2 to 5 years. The probability of new invasive species to become established in Oakland County is relatively high.

Health & Safety

While most invasive species do not pose a direct significant threat to a person's health or safety, they can make life less enjoyable. Certain plant species, such as glossy buckthorn and multiflorarose, have thorns that can cause injuries. Certain insects can bite and sting which can lead to allergic reactions. Certain diseases may affect herd populations such as deer or cattle. Diseases such as Chronic Wasting Disease and Foot and Mouth Disease are of most concern.

Economic Impact

The economic impact of invasive species can be rather high. It is estimated that the cost of invasive species is over 120 billion annually in the U.S. Invasive species can kill desirable plant and animal species, cause disease, reduce crop production, kill fish, decrease biodiversity, change hydrology, reduce aesthetic value and hurt tourism. Removal or control of invasive species is very costly and can be ineffective in certain species.

Critical Facilities/Services

Impact to critical facilities is relatively low. Invasive species tend to be located in natural areas and open spaces.

Invasive Species Risk & Vulnerability Assessment

New invasive species are introduced into the State of Michigan on average every 2 to 5 years. Invasive species threaten biodiversity, cause disease and death, diminish food supplies, and may alter the macro-climate and hydrology of an area. Parks, recreational lands, open spaces, area lakes and streams, and agricultural lands are the most vulnerable to invasive species. Oakland County has over 60,000 acres of parks, recreational land, and open space; Almost 30,000 acres of water; and approximately 20,000 acres of agricultural land.

Table 51: Invasive Species Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	31
Potential Magnitude and Scale ¹	10
Physical Vulnerability Hazard Impact ¹	28
Social Vulnerability Hazard Impact ¹	29
Community Conditions Hazard Impact ¹	24
Overall Capability and Capacity ²	73
Mitigation ²	56
Hazard Consequence & Impact Score ¹	24
Overall Risk Rating ³	28

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 137-148.

Ibid.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 383.

DTE Energy Media Relations, November 2011.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 137-148.

Oakland County Homeland Security Division, November 2011.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 382.

Daniel Imhof. BridgeForum, [Bridge Collapse Database](#), Accessed June, 2017

SEMCOG, <http://www.semco.org/Data/Apps/comprof/transportation.cfm?cpid=2999>, June 17, 2017.

Michigan State Police, *Michigan Hazard Analysis*, March 2006.

1.6.12 Nuclear Power Plant Accidents

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Definition

A nuclear power plant accident would involve an actual or potential release of radioactive material at a nuclear facility in a quantity sufficient to constitute a threat to the health and safety of off-site populations.

Historic Events

In Michigan, there are 3 nuclear power plants in operation. The operation of these facilities is heavily regulated by the Federal Nuclear Regulatory Commission. There has never been an off-site release of radioactive material from a nuclear power plant in Michigan. However, an onsite release did occur on October 5, 1966, at the Enrico Fermi-1 Atomic Power Plant in Monroe County, Michigan. The release was a result of fuel meltdown; however, the radioactive material was contained within the reactor containment building. The Fermi-1 plant was shut down in 1972. In 1998, the Enrico Fermi-2 plant was opened next to the site of the Fermi-1.

Frequency & Probability

The southern portion of Oakland County is within the Secondary Emergency Planning Zone of the Fermi-2 Atomic Power Plant. The Secondary Emergency Planning Zone consists of a 50-mile radius around the plant. Although there has never been an off-site release from the plant, it is possible for a release from the plant to impact Oakland County.

Health & Safety

An accident at a nuclear power plant could result in radioactive materials becoming airborne or in direct impact to areas adjacent to the plant. The severity of radiological contamination from such an event is directly proportionate to the type and amount of radioactive material released, weather conditions at the time of the release and the location relative to wind direction following the release. Although the southern portion of Oakland County is within the Secondary Emergency Planning Zone of the Fermi-2 Atomic Power Plant in Monroe County, prevailing wind patterns generally place the plant downwind of Oakland County. For areas within this zone, the primary concern is radiological contamination of food sources. Procedures have been developed by the plant and emergency response agencies to prevent radiation from contaminating food supplies and to prevent contaminated foods from being consumed, indicating that the risk to human health is considered low.

Area Impacted

Approximately 460 square miles in the southern portion of Oakland County is within the Secondary Emergency Planning Zone of the Enrico Fermi-2 plant. However, the actual area impacted by a release would depend greatly on the type and amount of radioactive material released, weather conditions at the time of the release and the location relative to wind direction following the release.

- See Nuclear Power Plant Map in **Appendix A**

Economic Impact

Due to the low frequency of this event in the United States, it is difficult to establish the economic impacts. It is anticipated that the impact could be very high, depending on the severity of the event.

Critical Facilities/Services

Nuclear power plant owners/operators work closely with emergency planners to develop response plans in the event of a release of radioactive materials. In Michigan, the responsibility to respond to such events is shared by the plant owner/operator and all levels of government. Response to an off-site release would likely involve multiple agencies and departments from all levels of government.

Nuclear Power Plant Accident Risk & Vulnerability Assessment

There are 3 nuclear power plants in Michigan. One active plant, Enrico Fermi-2 was opened in Monroe County in 1998, next to the Enrico Fermi-1 plant that was shut down in 1972. The southern portion of Oakland County is within the 50-mile radius Secondary Emergency Planning Zone of the Enrico Fermi-2 plant.

The primary vulnerability to a nuclear power plant incident is radiological contamination of food sources. Restaurants and grocery stores are most vulnerable, as well as active agricultural lands. Approximately 460 square miles in the southern portion of Oakland County is located within the Secondary Emergency Planning Zone and is shown in the Nuclear Power Plant Accident Vulnerability Map. Also shown on the map are areas of active agriculture land use in the County that are within the planning zone.

- See Nuclear Power Plant Accident Vulnerability Map in **Appendix A**

Table 52: Nuclear Power Plant Accidents Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	13
Potential Magnitude and Scale ¹	13
Physical Vulnerability Hazard Impact ¹	53
Social Vulnerability Hazard Impact ¹	54
Community Conditions Hazard Impact ¹	40
Overall Capability and Capacity ²	63
Mitigation ²	67
Hazard Consequence & Impact Score ¹	40
Overall Risk Rating ³	22

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

1.6.13 Oil and Gas Well Accidents

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Definition

An oil or gas well incident is an uncontrolled release of oil, natural gas or a release of hydrogen sulfide gas, a by-product of production wells.

Historic Events

As of 2012, there were 19 active or producing wells within Oakland County. The last significant oil/gas well accident in Michigan was in 2013 in Jackson County. An explosion at an oil well placed a man in extremely critical condition and he was airlifted to University of Michigan hospital. Investigators believed that a truck had struck some piping in the oil well, causing an explosion and natural gas fire.

Table 53: Major Causes of Transmission Pipeline Accidents in the United States in 2016

Cause	% Of Total Accidents
Material/Weld/Equipment Failure	34%
Corrosion	20%
Excavation Damage	14%
Incorrect Operation	7%
Natural Force Damage	6%
Other Outside Force Damage	9%
All Other Causes	9%

Source: U.S. Department of Transportation, Office of Pipeline Safety, Transmission Pipeline, Incident Summary by Cause, June 21 2017

Frequency & Probability

Since 1973, there have been 11 significant oil or natural gas well accidents in Michigan. The probability of an accident in Oakland County is relatively low. According to the MDEQ, the most common problems associated with oil and gas wells in Oakland County are small spills and odor complaints.

Health & Safety

There are several hazards related to oil and gas wells. Producing wells can generate hydrogen sulfide gas as a by-product. Hydrogen sulfide gas is extremely poisonous and presents a number of chemical safety hazards to responders and adjacent populations. Accidental releases, fire and explosion can also result from such an event.

In Michigan, death and injury rates associated with oil and gas well accidents are very low. To date, there has been 1 death and 1 injury from accidents since 1973. In those cases, death and injury resulted to the employees servicing the wells.

Area Impacted

Lands with oil and gas wells and surrounding areas are most at risk for impact from well accidents. The location of wells is concentrated in the southwestern portion of the County.

Oil and gas well accidents often result in a release, or potential release, of hazardous gases. As a result, areas adjacent to the site of the incident may be evacuated as a precaution. In Michigan, there have been no oil or gas well accidents which have resulted in off-site property damage. However, areas of evacuation have been large enough to include residents within a one-half mile radius.

- See Oil and Gas Well Map in **Appendix A**

Economic Impact

Accidents of this nature are not common in Michigan and have not resulted in significant property damage or other loss. Therefore, information regarding the economic impact of oil and gas wells is limited and further investigation is not warranted at this time.

Critical Facilities/Services

Oil and gas wells in Oakland County are owned and operated by private companies; however, response to an accident would involve public agencies. The level of public response would depend upon the severity of the accident. Due to the possibility of evacuation with this type of accident, involvement from multiple emergency response agencies would likely be required.

Oil and Gas Well Accident Risk & Vulnerability Assessment

Residential areas, schools, churches, and hospitals are the most vulnerable areas for this type of event. Local fire and police departments would respond to an incident. Populations located within a 1-mile radius of a well are most vulnerable and urbanized areas are more vulnerable than rural areas based solely on population densities.

Census block groups within a 1-mile radius of the wells are included in the Pipeline and Well Vulnerability Map. The map also shows the locations of schools, hospitals, police stations, and fire stations in the County.

- See Pipeline and Well Vulnerability Map in **Appendix A**

Table 21: Oil and Gas Well Incident Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	13
Potential Magnitude and Scale ¹	2
Physical Vulnerability Hazard Impact ¹	47
Social Vulnerability Hazard Impact ¹	54
Community Conditions Hazard Impact ¹	32
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	33
Overall Risk Rating ³	20

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Source: Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 369.

Source: Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 366.

Source: Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 363.

Source: Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 365.

1.6.14 Petroleum and Natural Gas Pipeline Accidents

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Definition

A petroleum or natural gas pipeline incident would involve an uncontrolled release of petroleum, natural gas or hydrogen sulfide gas from a pipeline.

Historical Events

Michigan is a major producer and consumer of petroleum and natural gas products; therefore, transmission and distribution pipelines are commonly found throughout the State of Michigan. One of the most injurious pipeline accidents in Oakland County occurred on May 20, 1992, when contractors were excavating a sidewalk and caused a service line to rupture. The gas ignited causing an explosion which killed 2 people and injured 17 others.

On November 20, 2017, a ruptured gas line caused an explosion and massive fire that left an 18-foot-deep crater in an area of Orion Township near the Great Lakes Crossing Outlets mall. The fire — which occurred in an area north of Brown Road near Joslyn Road, near the border with Auburn Hills — had flames 100- to 150-feet wide and up to 200-feet high. The flames could be seen from downtown Detroit, more than 30 miles away.

Figure 28: Gas Line Explosion (November 20, 2017)



Frequency & Probability

Since 1990, there have been 33 pipeline incidents in Oakland County. Two of the accidents occurred to transmission lines, the remainder involved distribution lines which are more commonly found in the County. It is anticipated that this hazard will be more likely to occur in the future as the pipeline structures age.

Health & Safety

Pipeline accidents can pose a significant threat to the public due to the potential for fires, explosions and ruptures. Since 1990, 2 pipeline accident-related deaths and 14 injuries have occurred in Oakland County.

Area Impacted

There are over 110,000 miles of natural gas transmission pipelines in Michigan, with a large percentage centered in or around Oakland County. Additionally, there are approximately 1,300 miles of refined petroleum product pipeline in Michigan.

Oakland County has 4 pipeline terminals that could be impacted. In addition, natural gas processing plants and compression facilities can also be at risk of an incident. Smaller natural gas distribution lines can be found throughout the County with Consumers Energy, DTE Gas, and SEMCO providing natural gas service to the majority the County.

Natural gas or petroleum pipelines can be found throughout the County, which means that pipeline accidents can occur anywhere. Typically, pipeline accidents only impact the immediate area. However, evacuations of adjacent buildings can be required as a precaution.

- See Natural Gas and Petroleum Pipeline Map in **Appendix A**

Economic Impact

In the United States since 1991, the property damage caused by transmission pipeline accidents is over \$1 billion. These costs are largely due to damage to the pipeline structures. Other impacts may result due to a decrease in product availability.

Critical Facilities/Services

Local fire and police departments would respond to pipeline accidents. This type of hazard may also require response from hazmat teams. Oakland County fire departments frequently respond to gas leaks in the County.

Petroleum and Natural Gas Pipeline Accident Risk & Vulnerability Assessment

There have been 6 natural gas explosions in Oakland County. From 1990 through 2017, there have been over 30 pipeline incidents in Oakland County, an average of over 1 event per year in Oakland County. Consumers Energy provides natural gas service to the majority of the County and DTE provides service to approximately 36 square miles.

Pipelines can pose a significant threat to the public due to the threat of fires, explosions, and ruptures. Residential areas, schools, churches, and hospitals are the most vulnerable areas for this type of event. Local fire and police departments would respond to a pipeline incident. Gas leaks are a frequent call for service for Oakland County fire departments. Populations located within a 1-mile radius of a well or pipeline are most vulnerable and urbanized areas are more vulnerable than rural areas based solely on population densities.

The locations of natural gas distribution pipelines, natural gas transmission lines, petroleum gas pipelines, oil/gas bottom wells, and oil/gas surface wells are shown on the Pipeline and Well Vulnerability Map. There are approximately 120 miles of natural gas distribution pipelines, 363 miles of natural gas transmission lines, and 107 miles of petroleum gas pipelines in the County. Census block groups within a 1-mile radius of the pipelines and wells are included on the map. Approximately 1,028,514 people are located within the census blocks identified. Also on the map are the locations of schools, hospitals, police stations, and fire stations in the County.

- See Pipeline and Well Vulnerability Map in **Appendix A**

Table 55: Petroleum and Natural Gas Pipeline Accidents Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	38		
Potential Magnitude and Scale ¹	11		
Physical Vulnerability Hazard Impact ¹	53		
Social Vulnerability Hazard Impact ¹	54		
Community Conditions Hazard Impact ¹	43		
Overall Capability and Capacity ²	73		
Mitigation ²	67		
Hazard Consequence & Impact Score ¹	39		
Overall Risk Rating ³	38		
Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Source: Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 354.

U.S. Coast Guard, National Response Center, www.nrc.uscg.mil/foia.html. Standard Query Report, Pipelines, Oakland County Michigan, report generated on January 5, 2012.

Watershed Council, *Pipelines in Michigan*, <https://www.watershedcouncil.org/pipelines-in-michigan.html>, viewed June 21, 2017.

U.S. Department of Transportation, Office of Pipeline Safety, Incident Summary by Cause, January 25, 2012.

1.6.15 Public Health Emergencies

Published 7/5/2018 22:00 by Nathaniel Marlette

Definition

A public health emergency is 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.

Historical Events

Public health emergencies can result from a number of causes such as food borne illness, waterborne pathogens, loss of sewer/water service and epidemics of communicable diseases. In recent years, the risk of a public health emergency resulting from an intentional release of a chemical, biological or radiological agent has become more apparent.

The largest botulism epidemic in U.S. history originated in Oakland County in March 1977. The cause was traced to home-canned peppers which were served at a Pontiac restaurant. The restaurant used home-canned peppers because of a shortage of commercially prepared peppers following a crop failure. Although no one died from the poisoning, 59 people became ill, many of which required intensive medical treatment.

In September 2002, a Legionnaire's Disease outbreak originated from an air conditioning unit at a Farmington grocery store. The Legionnaire's outbreak resulted in 4 deaths and 30 illnesses.

Frequency & Probability

Public health emergencies can arise from a wide range of causes and may result in varying levels of severity, thus making it difficult to establish a frequency of occurrence. Since 1973, there have been 14 major public health emergencies in Michigan, an average of 1 emergency almost every 3 years.

It is important to note that some of the same causes of a public health emergency (i.e. food borne illness, etc.) do occur with regularity within Oakland County. However, these cases are isolated to a few individuals with limited impact to the general public.

It is anticipated that this hazard will become more likely to occur in the future as the County population ages and increases.

Health & Safety

Public health emergencies are an obvious threat to human health and safety. A public health emergency can take many forms and spread by various means. As a result, it is not feasible to determine a death or injury rate for this hazard.

Public health emergencies are of particular concern for populations with weakened or undeveloped immune systems. According to the 2010 Census, nearly 6% of the population within Oakland County is under the age of 5 and over 13% are over the age of 65. Collectively, almost 19% of the Oakland County population is at risk for greater impact from a public health emergency based solely upon age.

Area Impacted

Due to the nature of public health emergencies, impacts from this event tend to be more widespread rather than confined to a specific location. It is important to note that a public health emergency may originate outside of Oakland County, yet impact communities within the County.

Economic Impact

Economic impacts from this hazard can be severe if the source is infrastructure related (i.e., if improvements are needed to the public water supply system). However, it is more likely that economic impacts will result through lost wages and medical expenses for impacted persons. Additional impact may result if a business is determined to be the source of the emergency, (i.e., a restaurant must close). Due to the low frequency of this hazard, additional investigation of the economic impact is not recommended at this time.

Critical Facilities/Services

A major public health emergency would likely involve varying degrees of response from local, state and possibly federal public health agencies.

Table 56: Reportable Disease and Conditions in Michigan 2005-2009

Disease or Condition	Average Number of Cases (per year)
Amebiasis (Amoebiasis)	45.2
Campylobacteriosis	918.4
Cryptosporidiosis	209
Dengue Fever	9.2
E. Coli 0157:H7	88.6
Giardiasis	677.2
Hepatitis A	12.4
Hepatitis C	89.6
HIV/AIDS	828.4
Influenza	200,000
Legionellosis	169
Listeriosis	23.6
Lyme Disease	73.4
Malaria	23.4
Pertussis	492.4
Q Fever	2.2
Salmonellosis	962.6
Shigellosis	188.4
Streptococcal Disease	195
Tuberculosis	28.8
Yersiniosis	22.6

Public Health Risk & Vulnerability Assessment

Public Health Emergencies can arise from a wide range of causes and can result in varying levels of severity. Persons most susceptible to public health emergencies are those persons with weakened or undeveloped immune systems. Almost 19% of the Oakland County population is highly vulnerable to a public health emergency, based solely on age. Therefore, adult care and day care are most vulnerable, as well as schools. The locations of public safety facilities, adult/child care facilities, day care facilities, and schools are shown on the Public Health Emergency Vulnerability Map.

Vulnerable assets involved with public health emergencies are medical service facilities and include the County's Health Division facilities, clinics, and hospitals. The Oakland County Health Division operates 2 locations within the County. The County's health facilities and hospitals are also shown on the map.

- See Public Health Emergency Vulnerability Map in **Appendix A**

Table 57: Public Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹		38
Potential Magnitude and Scale ¹		24
Physical Vulnerability Hazard Impact ¹		28
Social Vulnerability Hazard Impact ¹		59
Community Conditions Hazard Impact ¹		38
Overall Capability and Capacity ²		68
Mitigation ²		67
Hazard Consequence & Impact Score ¹		37
Overall Risk Rating ³		37
Legend		
Score	1: Vulnerability Rating	2: Capability and Capacity Rating
0 – 25	Minimally Vulnerable	Minimally Capable
26 – 50	Somewhat Vulnerable	Somewhat Capable
51 – 75	Vulnerable	Capable
76 - 100	Very Vulnerable	Very Capable
N/A	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, pages 456 - 467.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 183-190.

1.6.16 Subsidence

Published 7/5/2018 22:02 by Nathaniel Marlette

Natural Subsidence

Definition

Lowering or collapse of the land surface due to loss of subsurface support.

Historical Events

No natural subsidence events are known to have been recorded in Oakland County. There are no natural subsidence hazards in Oakland County according to the Geological and Survey Division of the MDEQ.

Frequency & Probability

No known natural subsidence events have been recorded in Oakland County. Therefore, the frequency of events cannot be adequately determined. The only known potential incident of natural subsidence in the County would be sink holes most likely caused from water main breaks. Based on the amount of underground utilities (specifically water mains) within in the County, there is probability that a sinkhole event can occur from this non-natural source. The probability of this occurrence increases as water systems age.

Health & Safety

In the event of a sinkhole, potential health and safety issues are dependent on the location and size of the sink hole. A sink hole occurring near or within a street or public access area could potentially cause injury. Injury could also occur if a sink hole occurred beneath a building causing structural damage or, if severe enough, collapse. Following the event, the sink hole could pose a risk to the health and safety of people within the area if it is not properly marked and barricaded. Workers are at risk for cave-ins or confined space entry concerns if entering the sink hole is required to correct the problem.

Area Impacted

The area impacted would be the area immediately surrounding the sink hole.

Economic Impact

Economic impacts incurred from the occurrence of a sink hole could include a disturbance in transportation and costs incurred to fill the sink hole. If a sink hole were to occur beneath a building foundation, potential cost to stabilize, repair or rebuild could be substantial, dependent on the size of the sink hole.

Critical Facilities/Services

Response would be primarily localized police and fire departments, utility services and potentially road services such as the local road commission or MDOT.

Mining Related Subsidence

Definition

Lowering or collapse of the land surface due to loss of subsurface support in mining areas.

Historical Events

No known mining subsidence events are recorded for Oakland County. There are no mining subsidence hazards in Oakland County according to the Geological and Survey Division of the MDEQ.

Subsidence Risk & Vulnerability Assessment

The only known potential for natural subsidence in the County is from sink holes, most likely caused from water main breaks. The probability of this occurrence increases with older water systems. The water system and sanitary sewer services areas are depicted in a map in Appendix A.

- See Infrastructure Systems (Water/Sewer) Vulnerability Map in **Appendix A**

Table 58: Natural Subsidence Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	6
Potential Magnitude and Scale ¹	0
Physical Vulnerability Hazard Impact ¹	28
Social Vulnerability Hazard Impact ¹	29
Community Conditions Hazard Impact ¹	16
Overall Capability and Capacity ²	79
Mitigation ²	100
Hazard Consequence & Impact Score ¹	17
Overall Risk Rating ³	10

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, July 2012, page 175.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, July 2012, page 179 - 180.

1.6.17 Thunderstorm Hazards

Published 7/5/2018 22:25 by Nathaniel Marlette

Hail

Definition

Conditions where atmospheric water particles from thunderstorms form into rounded or irregular lumps of ice that fall to the earth.

Historical Events

In Oakland County, 164 hail events have been reported since 1960. In July 2014, a powerful upper-level low pressure system dropped southward into the Great Lakes, sparking a good deal of severe thunderstorms in the warm, moist, and unstable air in advance of the system. A particularly strong storm moved across Oakland County between around 4:30 and 5:15 pm, dropping hail up to 2.50-inch diameter (tennis ball size) near the Highland/White Lake area, with wind damage reported over central and eastern portions of the county. The storms produced heavy rainfall as well, with a swath of 1-2 inches recorded over southern Oakland County. Wyandotte, in southern Wayne County, picked up 2.67 inches in 4 hours. Total damage across Southeast Michigan was estimated to be 100 million dollars from the severe wind and hail.

On June 24, 1998, 2 tracks of severe thunderstorms crossed the state moving east to west. One stretched across central Michigan, while the other moved across the southern portion of the state. The more northerly thunderstorms produced large amounts of hail in several counties, ranging from dime-size to baseball-size hail.

On June 26, 1995, a severe thunderstorm caused nickel-sized hail and ground lightning that resulted in 3 injuries.

Frequency & Probability

In Michigan, there is 1 intense hailstorm every 2 to 3 years that causes significant damage to property. Hail events are highly likely to occur in the County.

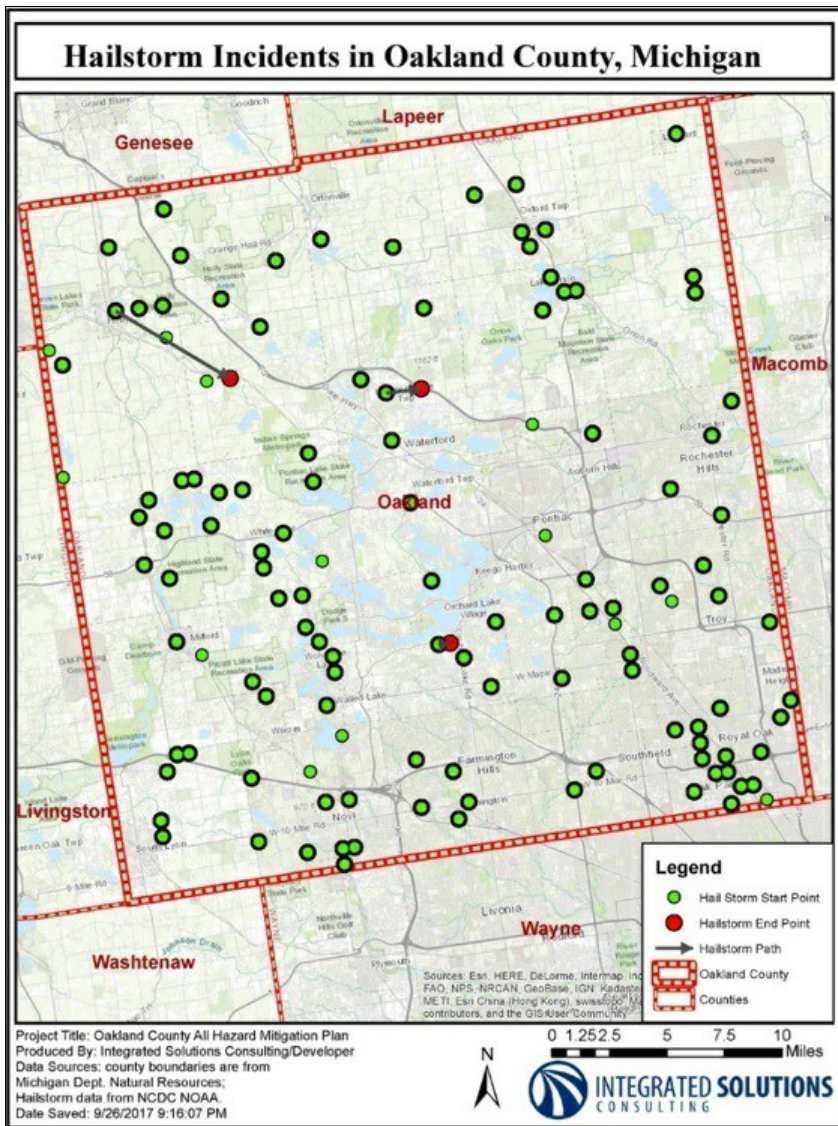
Health & Safety

The human health and safety risk associated with hail is low. However, hail is often associated with tornado activity.

Area Impacted

Hail storms are typically localized as they move through Michigan. The entire County could be affected; however, impacts will more likely be localized to residents directly under the center of the storm.

Figure 29: Hailstorm Incident Map



Source: NCDC NOAA

Economic Impact

Nationally, property damage from hail exceeds \$3.1 million annually. Hail storms can impact infrastructure, power lines, roads, businesses and personal property. Property damage, loss of business revenues and response costs can result from hail events. Hail is especially damaging to crops, property and automobiles.

Critical Facilities/Services

Response to a hail related emergency would be localized. Utilities may require repair and maintenance resulting from hail.

The National Weather Service and local media can alert the public of severe storms capable of producing large hail, high winds and lightning. Storms are detected using radar, weather data, spotters and, in the event of high winds or tornadoes, outdoor warning sirens can alert those not near a radio or television of an approaching storm. There are 275 outdoor warning sirens located throughout the County.

Hail Risk & Vulnerability Assessment

Oakland County receives 30-40 thunderstorm events per year. Vulnerabilities associated with thunderstorm hazards (hail, lightning, and severe wind) and tornadoes are the warning siren systems, communications/electrical infrastructure, police and fire facilities, manufactured home sites, and people.

Oakland County has approximately 60,623 acres of transportation, communication, and utility land use. There is also over 13,000 manufactured homes. Southfield, Pontiac, and Orion Township are most vulnerable to communication, utility, and electrical transmission line failure based on total acreage for land use, respectively. Communication/utility land use and manufactured home park land use are shown on the Severe Weather (Thunderstorms, Severe Winds, Tornado) Vulnerability Map, which also includes the locations of the County's outdoor warning sirens and police and fire stations. Communications and electrical companies within the County include local utility companies, cable and satellite providers, local television networks, local radio networks and communication towers, including local emergency and cell phone towers.

Oakland County has a funded program in place to replace outdoor warning sirens that are in disrepair or outdated. Many of the old outdoor warning sirens in the County were recently replaced. Although the County has the most warning sirens of any county in Michigan, there is still a need to expand the outdoor warning siren coverage.

- See Severe Weather (Thunderstorms, Severe Winds, Tornado) Vulnerability Map in **Appendix A**

Table 56: Hail Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	44
Potential Magnitude and Scale ¹	23
Physical Vulnerability Hazard Impact ¹	58
Social Vulnerability Hazard Impact ¹	48
Community Conditions Hazard Impact ¹	40
Overall Capability and Capacity ²	75
Mitigation ²	67
Hazard Consequence & Impact Score ¹	41
Overall Risk Rating ³	42

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Lightning**Definition**

The discharge of electricity from within a thunderstorm.

Historical Events

On July 29, 1996, a 38-year old woman was struck by lightning and killed in Milford Township while standing near a tree on the patio of her parent's home.

On August 25, 1998, lightning struck an apartment building in Southfield causing a fire that destroyed 2 units and damaged the administrative office.

In July 2000, Oakland County suffered a lightning strike which affected the County's public safety radio system.

On September 11, 2000, the 9-1-1 phone system at the Milford Police Department was struck by lightning causing substantial damage to electronic equipment.

On April 7, 2001, lightning struck a satellite dish outside a Brandon Township residence. The strike followed the outside wiring and entered the home. A fire resulted and the contents of the basement were lost.

On August 1, 2003, a boy in Troy was struck by lightning and was revived by CPR. Four days later on August 5, 2003, lightning struck the Oxford Village Dispatch Center's 110-foot tower causing widespread equipment failure and damage. Four (4) days later on August 5, 2003, lightning struck the Oxford Village Dispatch Center's 110-foot tower causing widespread equipment failure and damage.

On April 6, 2010, a lightning strike caused a house fire causing extensive electrical and roof damage exceeding \$150,000.

Frequency & Probability

There have been 39 major lightning events (resulting in fire, injury, death, etc.) reported in Oakland County since 1996. Over 50% of lightning casualties occur in the months of June and July, and another 22% of deaths occur in August. Lightning occurrences happen every year; therefore, lightning events will continue to occur in the future within the County.

Location of Lightning Strikes

- 40% are at unspecified locations
- 27% occur in open fields and recreation areas (not golf courses)
- 14% occur to someone under a tree (not on golf course)
- 8% are water-related (boating, fishing, swimming, etc.)
- 5% are golf-related (on golf course or under tree at golf course)
- 3% are related to heavy equipment and machinery
- 2.4% are telephone-related
- 0.7% are radio, transmitter, and antenna-related

Months of Most Strikes

- July - 30%
- August - 22%
- June - 21%

Time of Most Strikes

2:00 p.m. - 6:00 p.m.

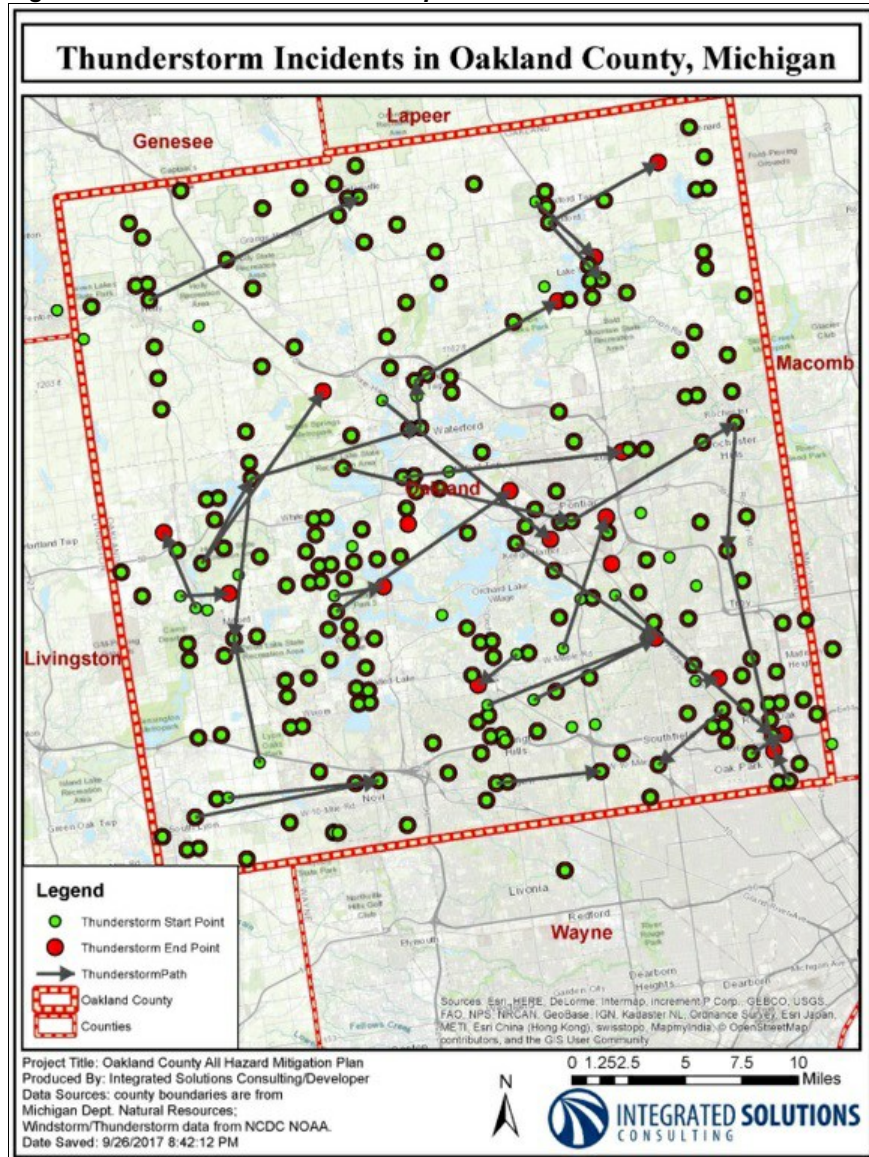
Health & Safety

During the 39 storms, 1 death and 5 injuries were reported. Lightning deaths are usually caused by the electrical force shocking the heart into cardiac arrest or throwing the heartbeat out of rhythm. Lightning can also cause severe skin burns that can lead to death if complications from infections ensue. Lightning strikes impact 1 person 91% of the time and 2 or more victims 9% of the time. Approximately 20% of lightning strike victims die and 70% of survivors suffer serious long-term after effects, such as memory and attention deficits, sleep disturbance, fatigue, dizziness and numbness.

Area Impacted

The effects of lightning are very localized; however, thunderstorms can cover a large area.

Figure 30: Thunderstorm Incident Map



Source: NCDC NOAA

Economic Impact

Property damage estimates from lightning strikes in Oakland County since 1996 equal \$2.318 million.

On July 26, 1997, lightning started a fire that caused \$750,000 of damage to a 2-story apartment building in Farmington Hills.

Because lightning-related damage information is compiled by a number of different sources, it is difficult to accurately determine collective damage figures resulting from lightning strikes.

Critical Facilities/Services

Initial response to a lightning strike would be local emergency responders (fire, police, emergency medical care, etc.). Power outages as a result of a lightning strike may impede emergency response. Local utility companies across the County estimate as much as \$1 billion per year in damaged equipment and lost revenue from lightning. The Federal Aviation Administration (FAA) reports approximately \$2 billion per year in airline industry operating costs and passenger delays from lightning.

Communication services can be damaged and destroyed (cell and communication towers, computer systems, phone services, etc.). Local utility companies and the services they offer are often affected from lightning strikes.

Lightning is associated directly with severe thunderstorms. The National Weather Service and local media can alert the public of the severe storms capable of producing large hail and lightning.

Lightning Risk & Vulnerability Assessment

Oakland County receives 30-40 thunderstorm events per year. Vulnerabilities associated with thunderstorm hazards (hail, lightning, and severe wind) and tornadoes are the warning siren systems, communications/electrical infrastructure, police and fire facilities, manufactured home sites, and people.

- See Severe Weather (Thunderstorms, Severe Winds, Tornado) Vulnerability Map in **Appendix A**

Table 60: Lightning Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	50
Potential Magnitude and Scale ¹	9
Physical Vulnerability Hazard Impact ¹	53
Social Vulnerability Hazard Impact ¹	40
Community Conditions Hazard Impact ¹	24
Overall Capability and Capacity ²	79
Mitigation ²	89
Hazard Consequence & Impact Score ¹	30
Overall Risk Rating ³	39

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Severe Wind

Definition

Winds greater than 50 miles per hour (mph), not including tornadoes, are classified as high winds.

Historical Events

From January, 2000, to April, 2017, there have been 108 days with a thunderstorm wind event and 131 days with both a thunderstorm and high wind event reported in Oakland County.

On March 13, 2006, a storm produced sustained winds of 30-40 mph with gusts to 50 mph. The high winds caused a tree to fall and land on a vehicle, killing 1 and injuring 2 others.

On June 8, 2008, a thunderstorm with high winds resulted in over \$1.2 million in damages. Wind gusts exceeded 85 mph, downing trees and power lines and damaging roofs/siding and vehicles.

On August 19, 2010, a thunderstorm with high winds resulted in \$100,000 worth of damage in Oxford. The storm uprooted trees and damaged roofs and siding.

On March 8, 2017, high winds brought wind gusts in excess of 60 mph in Oakland County. The high winds took out power lines and trees, along with numerous reports of structural damage to buildings. There were also reports of brush fires and tractor-trailers flipped over around the area. Due to the extensive damage, many areas were without power for several days. Approximately 800,000 DTE customers and approximately 300,000 Consumers Energy customers were affected. The highest wind gust reported across Southeast Michigan was 68 mph at both Saginaw and Detroit Metro Airport. Total property damage was 35 million.

Frequency & Probability

Oakland County receives 30-40 thunderstorms per year. On average, wind events can be expected 5-7 times a year in the southern Lower Peninsula. Therefore, it is probable that wind events will occur every year with in the County.

Health & Safety

From 2000 - 2016, there was 1 death and 3 injuries reported in Oakland County from high winds. The public is most at risk from falling trees and electrical lines, blowing debris and collapsed buildings or roofs. High winds can be a direct effect of tornadoes which are discussed in this section.

Area Impacted

High winds affect entire populations, but the greatest risk is to those housed in mobile homes.

Economic Impact

Since 2000, approximately \$57.7 million in property damage has resulted from high wind events in Oakland County. Property damage is the greatest contributor to economic loss. Power outages resulting from high winds can also have an economic impact due to costs to restore and repair power lines and loss of revenues from prolonged outages to businesses.

Critical Facilities/Services

The National Weather Service and local media can alert the public of severe storms capable of producing large hail, high winds and lightning. Outdoor warning sirens can alert those not near a radio or television of approaching high winds (>70 mph) or tornadoes. There are 275 outdoor warning sirens located throughout the County.

Initial response activities due to emergencies from high winds would primarily be associated with local response from police, fire and medical emergency services. Local utility companies are essential in repairing lines and shutting down power or gas services that represent a threat to safety. Private or governmental tree removal services (urban forestry services) are also essential in providing preventive measures and are often involved clearing downed trees from power lines, roadways and buildings following severe wind incidents. Following the initial response, regional, state and local agencies may assist in cleanup and aid.

The following table demonstrates the many instances when down power lines have been reported and necessitated a response.

Table 61: Down Power Line Incidents in Oakland County

Year	Frequency	Fatalities	Casualties	Total Loss (Property and Content Loss)
2012	1,401	0	0	1,226
2013	2,168	0	0	5,500
2014	2,382	0	0	0
2015	1,335	0	0	0
2016	1,344	0	0	6,000

Source: Michigan Bureau of Fire Services

Severe Wind Risk & Vulnerability Assessment

Oakland County receives 30-40 thunderstorm events per year. Vulnerabilities associated with thunderstorm hazards (hail, lightning, and severe wind) and tornadoes are the warning siren systems, communications/electrical infrastructure, police and fire facilities, manufactured home sites, and people. Also, private or public urban tree removal services are also vulnerable to wind hazards.

- See Severe Weather (Thunderstorms, Severe Winds, Tornado) Vulnerability Map in **Appendix A**

Table 59: Severe Wind Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	44
Potential Magnitude and Scale ¹	32
Physical Vulnerability Hazard Impact ¹	65
Social Vulnerability Hazard Impact ¹	59
Community Conditions Hazard Impact ¹	43
Overall Capability and Capacity ²	73
Mitigation ²	39
Hazard Consequence & Impact Score ¹	49
Overall Risk Rating ³	46

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

National Climatic Data Sponsored Website, www.ncdc.noaa.gov, Standard Query for Severe Weather, June 21, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 227-229

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, July 2012, page 30.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov, Standard Query for Severe Weather, June 21, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 230-234.

Oakland County Executive, Special Projects Staff, September 15, 2004.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov, Standard Query for Severe Weather, June 21, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov, Standard Query for Severe Weather, June 21, 2017.

Ibid.

Ibid.

Ibid.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated, 2014)*, March 2014, page 77.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov, Standard Query for Severe Weather, June 21, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated, 2014)*, March 2014, page 78.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated, 2014)*, March 2014, page 78.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov, *Standard Query for Severe Weather*, June 21, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov, *Standard Query for Severe Weather*, June 21, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, *Standard Query for Severe Weather*, June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, *Standard Query for Severe Weather*, June 22, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated, 2014)*, March 2014, page 65.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated, 2014)*, March 2014, page 73.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, *Standard Query for Severe Weather*, June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov, *Standard Query for Severe Weather*, June 22, 2017.

1.6.18 Tornadoes

Published 7/5/2018 22:17 by Nathaniel Marlette

Definition

A violently rotating column of air extending downward to the ground from a cumulonimbus cloud.

Historical Events

According to the National Weather Service, the first recorded tornado in Oakland County occurred on April 6, 1882. Since 1950, approximately 4% of tornadoes in Michigan have been classified as violent tornadoes (EF4 or EF5 intensity). However, these few violent tornadoes have been responsible for 88% of Michigan's tornado-related deaths.

On March 20, 1976, a Category F4 tornado with winds in excess of 200 mph destroyed homes from Farmington Hills to West Bloomfield Township. Homes and businesses collapsed or were ripped off their foundations. A 15-year old girl died when the car she was in was hurled across Maple Road. Fifty-five injuries were reported and the cleanup afterward cost an estimated \$25 million.

On July 2, 1997, a series of thunderstorms went through south-central and southeast Michigan spawning 16 tornadoes, 13 of which occurred in southeastern Michigan counties.

On September 21, 2014, an EF1 tornado touched down in Rochester Hills, Michigan. With a maximum wind speed of 90 mph, the twister cut a one and a quarter mile (1.25 mi.) path of destruction that was 150 yards wide (one and a half football fields) in just 2 minutes. The tornado formed at 5:57 am EST and was gone by 5:59 am EST. Trees were uprooted, large branches were knocked down, and significant roof damage occurred on homes on and near Grand View Drive. Thirty-seven homes were affected (minimal damage; mostly cosmetic); five homes had minor damage (<50% damaged; damaged windows and doors); and four homes suffered major damage (>50% damage; involves structural features affecting strength/safety). Overall, 46 homes were impacted by the storm.

Table 63: Tornado Magnitude in Oakland County

Magnitude	Number	Deaths/Injuries	Property Damage
F0	6	0/0	\$82,000
F1	14	1/10	\$10.32 Million
F2	7	1/7	\$3.52 Million
F3	3	0/4	\$7.5 Million
F4	2	1/57	\$25.25 Million

Source: National Climatic Data Center, www.ncdc.noaa.gov, Oakland County, January 1, 1950 through 2016

Frequency & Probability

The months of April through June have historically been the period of greatest tornado frequency. Tornadoes in Michigan are most frequent in the spring and early summer when warm, moist air from the Gulf of Mexico collides with cold air from the Polar Regions to generate severe thunderstorms. Most tornadoes in Michigan occur in the southern Lower Peninsula.

Oakland County has had 7 tornadoes from 1996 to 2017. It is very probable that tornadoes will continue to represent a hazard to the County.

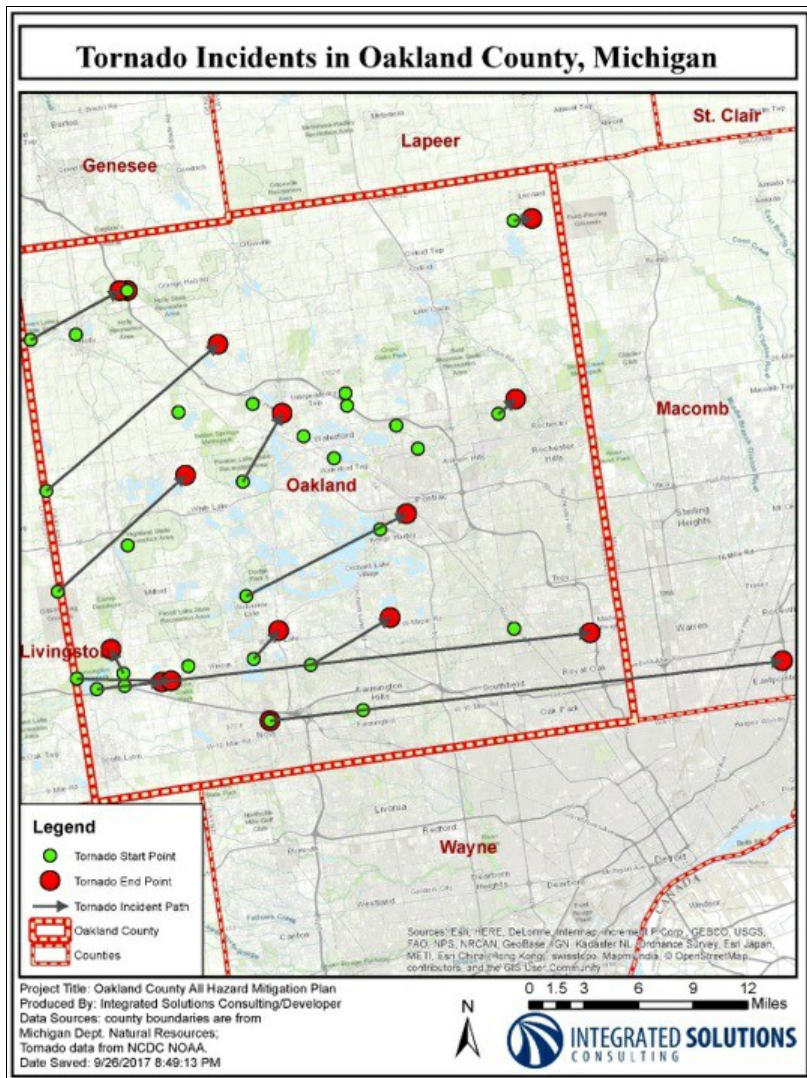
Health & Safety

Michigan's tornadoes have resulted in more deaths than in many other tornado-prone states. Michigan ranks in the top 10 states for single killer tornadoes, deaths per 10,000 square miles, and killer tornadoes as a percent of all tornadoes. Between 1950 and 2017, 3 tornado-related deaths and 78 injuries have occurred in Oakland County.

Area Impacted

A tornado would affect an entire population in the tornado's path. The most vulnerable populations would be mobile home residents. According to the 2016 5-year American Community Survey, there are approximately 13,000 mobile home/manufactured housing units in the County. Novi and White Lake Township have the highest number of mobile home establishments, with approximately 300 acres each.

Figure 31: Tornado Incident Map



Source: NCDC NOAA

The average tornado track is 16 miles long. The longest tracks have been reported at 200 miles long. The tornado path width is typically less than one-quarter mile, but can be over 1 mile.

Economic Impact

Property damage is the greatest contributor to economic loss. The amount of damage varies greatly with the severity of the tornado. Also, damage or destruction to utility lines (primarily overhead) can result in the loss of power and other utilities lasting a few moments to several days. Tornadoes can also destroy or damage agricultural fields, trees and other flora and disrupt transportation services due to debris and/or downed power lines.

Since 1950, Michigan has averaged over \$15 million per year in tornado-related damage. Between January 1, 1950 and 2011, property damage by tornadoes totaled over \$46.6 million in Oakland County.

A series of 13 tornadoes that swept through southeast Michigan on July 2, 1997, resulted in 2,900 damaged or destroyed homes, 200 damaged or destroyed businesses, over \$25 million in public damage and nearly \$30 million in private damage. Two deaths were caused directly by tornadoes and 120 injuries were reported. Approximately 350,000 electrical customers lost electrical power as a result.

A tornado that occurred on May 21, 2001, resulted in \$5.5 million in property damages and \$400,000 in agricultural damages primarily in Kalamazoo, Livingston and Oakland Counties.

Critical Facilities/Services

Tornado warnings systems play a major role in limiting the number of deaths and injuries related to tornadoes. Outdoor warning sirens are located throughout the County. The National Weather Service and local television and radio also provide advanced warning notice to communities. Outdoor warning sirens can be heard in most areas throughout the County.

Initial response activities due to tornadoes would primarily be associated with local response from fire, police and emergency medical care.

Local utility companies would be essential in repairing lines and shutting down power or gas services that represent a threat to safety. Following the initial response, regional, state and local agencies may also assist in cleanup and aid.

Tornado Risk & Vulnerability Assessment

Vulnerabilities associated with tornadoes are the warning siren systems, communications/ electrical infrastructure, police and fire facilities, manufactured home sites, and people. Also, private or public urban tree removal services are also vulnerable to tornadoes.

Oakland County has approximately 60,623 acres of transportation, communication, and utility land use. There are over 13,000 manufactured homes. Southfield, Pontiac, and Orion Township are most vulnerable to communication, utility, and electrical transmission line failure based on total acreage for land use, respectively. Novi has the highest total acreage for manufactured home park land use. Communication/utility land use and manufactured home park land use are shown on the Severe Weather (Thunderstorms, Severe Winds, Tornado) Vulnerability Map, which also includes the locations of the County's outdoor warning sirens and police and fire stations. Communications and electrical companies within the County include local utility companies, cable and satellite providers, local television networks, local radio networks and communication towers, including local emergency and cell phone towers.

- See Severe Weather (Thunderstorms, Severe Winds, Tornado) Vulnerability Map in **Appendix A**

Table 64: Tornadoes Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	31		
Potential Magnitude and Scale ¹	50		
Physical Vulnerability Hazard Impact ¹	65		
Social Vulnerability Hazard Impact ¹	59		
Community Conditions Hazard Impact ¹	43		
Overall Capability and Capacity ²	72		
Mitigation ²	56		
Hazard Consequence & Impact Score ¹	52		
Overall Risk Rating ³	40		
Legend			
<i>Score</i>	<i>1: Vulnerability Rating</i>	<i>2: Capability and Capacity Rating</i>	<i>3: Overall Risk Rating</i>
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Oakland County Michigan Emergency Management, *Hazard Study*, August 1998, page 20.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, July 2012, page 60.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 121.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, *Standard Query for Severe Weather*, June 22, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 244-256.

Oakland County Michigan Emergency Management, *Hazard Study*, August 1998, page 20.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 244-256.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, *Standard Query for Severe Weather*, June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, *Standard Query for Severe Weather*, June 22, 2017.

SEMCOG, Community Profiles, Land Use in Oakland County according to 2010 5 year American Community Survey, viewed June 22, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, July 2012, page 59.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, July 2012, page 62.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, *Standard Query for Severe Weather*, June 22, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, pages 244-256.

Ibid.

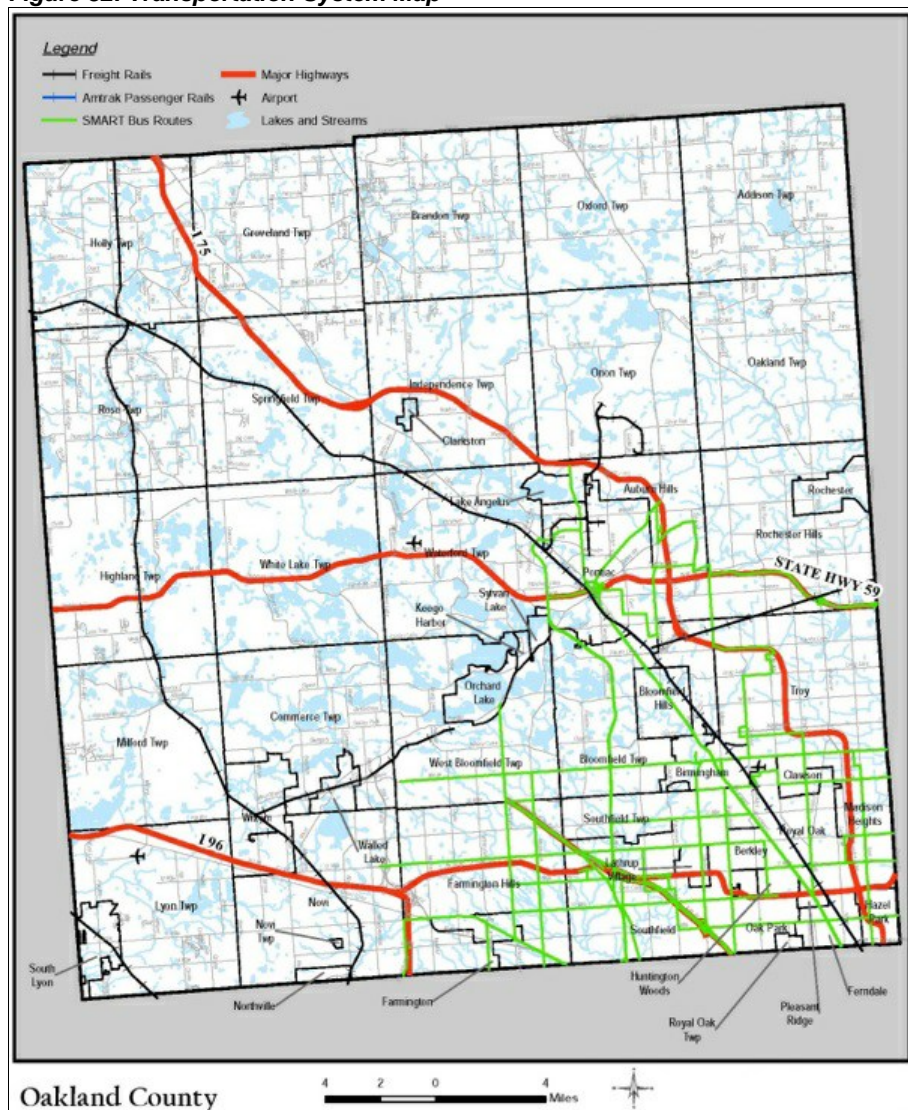
1.6.19 Transportation Accidents

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Definition

A transportation accident is a crash or other accident involving an air, land or water-based passenger carrier. (Note: Transportation accidents involving hazardous materials are addressed in Hazmat Incidents – Transportation.)

Figure 32: Transportation System Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Air

There are 3 public airports, 3 private airports, 1 sea plane base, and 20 private heliports in Oakland County. Air transportation accidents result from 4 major causes.

- In-air collision between 2 aircraft.
- A crash during in-air cruising due to mechanical failure, sabotage, etc.
- A crash during takeoff or landing.
- A collision between 2 aircraft during taxi or staging.

The majority of air transportation accidents occur during takeoff or landing and, therefore, impacted areas that are typically located near airports or runways. Response to air transportation accidents may involve fire control, survivor rescue/first aid, site security and crowd/traffic control.

Historical Events

The deadliest airplane accident in Oakland County history occurred on March 2, 1973, in Pontiac, when a small, private aircraft stalled in flight and crashed, killing all 4 people on board. The National Transportation Safety Board determined the probable cause of the crash was pilot error.

The deadliest single-survivor air transportation accident in U.S. aviation history occurred nearby in Romulus, Michigan (Wayne County). Northwest Airlines Flight 255 crashed after takeoff on August 16, 1987, killing 6 crew members and 149 passengers, except for a 4-year-old girl who sustained serious injuries. The crash killed 2 others on the ground.

In September 2009, a plane was forced to make an emergency landing in a store parking lot resulting in minor injuries to the pilot.

Frequency & Probability

There are 3 public airports within Oakland County. In addition, there are 20 private heliports, 3 private airports and a private seaplane base within Oakland County. The airports provide facilities for smaller, private aircraft such as corporate jets and charter planes.

All 3 of the public airports (Oakland County International, Oakland Troy, and Oakland Southwest Airport) are owned by Oakland County. The 3 private airports within the County are Ed Schultes Place Airport and Willie Run Airport in Ortonville and Handleman Sky Ranch Airport in Oxford. Of the 20 heliports, 3 are owned by hospitals (William Beaumont, Huron Valley Sinai, and Providence Hospitals), 8 are owned by private corporations and 9 are owned by private citizens. The seaplane base is located in Pontiac. Since 2010, 9 reportable air transportation incidents have occurred in the County. The aircraft involved in these incidents were all small aircraft with a limited number of passengers.

To date, there have been no air incidents involving large, commercial passenger aircraft in Oakland County. Commercial passenger air transportation is available through airports in Wayne and Genesee Counties and at Oakland County International Airport in Waterford.

Air transportation accidents in Oakland County will continue to occur in the future. It is anticipated that the probability for air transportation accidents to occur will fluctuate with air traffic volume.

Health & Safety

Aircraft accidents can be deadly to passengers. However, given the type of aircraft most common in Oakland County, death and injury are limited. Since 2010, there have been five (5) deaths from air transportation incidents in Oakland County.

Area Impacted

Due to the fact that the majority of aircraft accidents occur during landing or takeoff, the area most at risk for impact is the airport (or heliport) and immediately adjacent areas.

Economic Impact

Economic impact would result from damage to the aircraft and to any structures or improvements on the ground at the site of the accident. Damages to aircraft would typically be the responsibility of the private owner. Because the airports are owned by Oakland County, any damages to the airport infrastructure may be the responsibility of the County. Additional economic impact to the County may result if an accident causes disruption of services at the airport.

Reportable airplane crashes result in substantial damage to the aircraft including damage to the prop, nose, wings, fuselage, landing gear, tail and engine.

Critical Facilities/Services

Response to air transportation accidents is provided by local fire and police departments. Emergency response assistance is available through mutual aid agreements.

Airports within Oakland County provide an important service to area businesses. A significant accident at an airport could temporarily impede the County's ability to provide this service.

Air Transportation Risk & Vulnerability Assessment

There are 3 public airports, 3 private airports, a sea plane base, and 20 private heliports within Oakland County. Since 2010, 9 reportable air transportation incidents have occurred in the County. The aircraft involved in these incidents were all small aircraft with a limited number of passengers. The majority of transportation accidents occur during takeoff or landing, and therefore, impacted areas are typically those areas located near the airports or runways. The locations of the airports within the County are provided on the Transportation System Vulnerability Map, along with census blocks within a 5-mile radius of the airports. There are approximately 362,749 people located within 5 miles of at least 1 airport in the County.

- See Transportation System Vulnerability Map in **Appendix A**

Table 65: Air Transportation Accidents Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	13
Potential Magnitude and Scale ¹	22
Physical Vulnerability Hazard Impact ¹	58
Social Vulnerability Hazard Impact ¹	29
Community Conditions Hazard Impact ¹	32
Overall Capability and Capacity ²	79
Mitigation ²	67
Hazard Consequence & Impact Score ¹	34
Overall Risk Rating ³	21

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Highway

Historical Events

Vehicle accidents are common to all communities and can happen along any roadway. Most accidents are due to driver error and/or inclement weather conditions. Accidents involving modes of mass public transportation are of particular concern due to the high number of passengers which could be impacted.

An accident in Wixom on September 14, 2000, involved a collision between a Northville High School bus and an automobile. The school bus was carrying 48 students and several coaches. The accident killed the driver of the car and injured 1 car passenger and 10 bus passengers.

Frequency & Probability

Automobile accidents occur several times daily in Oakland County. In 2016, there were 42,660 reported crashes in Oakland County, of those 78 were fatal and 8,218 resulted in injuries. Alcohol was involved in 33.3% of the fatal crashes. However, the impact to the public from private automobile accidents is limited. Therefore, the analysis of highway hazards is limited to public highway transportation such as mass transit buses and school buses.

In 2016, there were 1,492 truck/bus over 10,000 lbs. accidents in Oakland County according to the Michigan State Police.

Bus accidents will continue to occur in Oakland County. The frequency of this hazard will likely increase with increased motor traffic.

Based on the 2011 - 2015 annual average crash statistics from the Southeast Michigan Council of Governments, the following intersections have the highest frequency of crashes in Oakland County:

1. Southfield Road at 11 Mile Road W
2. 12 Mile Road W at Orchard Lake Road
3. Maple Road W at Orchard Lake Road
4. 12 Mile Road W at Telegraph Road
5. N M 5 at Pontiac Trl N
6. 12 Mile Road at Dequindre Road
7. Commerce Road at Commerce Road
8. Highland Road at Airport Road
9. Southfield Road at 10 Mile Road W
10. 12 Mile Road W at Southfield Road

Health & Safety

Automobile accidents occur several times daily in Oakland County. In 2016, there were 42,660 reported crashes in Oakland County, of those 78 were fatal and 8,218 resulted in injuries.

Economic Impact

The National Highway Traffic Safety Administration estimated the total economic cost of traffic accidents in Michigan at approximately \$9.5 billion for the year 2010. This total includes all types of accidents and accounts for costs associated with lost productivity, medical costs, legal costs, emergency services costs, insurance costs, travel delays, property damage, workplace losses and human capital losses.

For the U.S. in 2016, the average auto liability claim for property damage was \$3,683; the average auto liability claim for bodily injury was \$16,110. It is anticipated that this rate of economic loss would be higher for public passenger transportation given that more passengers are present and the higher cost of a bus versus a private automobile.

Critical Facilities/Service

The highway transportation system in Oakland County plays a vital part in the County's ability to provide services to the public. Traffic accidents are notorious for causing temporary traffic delays which complicate the County's ability to maintain a well operating transportation network.

Highway Transportation Risk & Vulnerability Assessment

Automobile accidents occur several times daily in the County and can occur anywhere in the County. The impact to the public from private automobile accidents is limited; therefore, vulnerabilities were assessed based on analysis of public highway transportation.

From 2001 through 2003, there were 469 school bus accidents in Oakland County. Therefore, bus stations and bus routes, such as the SMART bus routes are vulnerabilities to highway transportation accidents. Also vulnerable are those locations identified as having frequent accidents, which are also provided on the Transportation System Vulnerability Map, along with SMART bus routes and schools.

- See Transportation System Vulnerability Map in **Appendix A**

Table 66: Highway Transportation Accidents Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	63
Potential Magnitude and Scale ¹	23
Physical Vulnerability Hazard Impact ¹	28
Social Vulnerability Hazard Impact ¹	29
Community Conditions Hazard Impact ¹	24
Overall Capability and Capacity ²	79
Mitigation ²	72
Hazard Consequence & Impact Score ¹	26
Overall Risk Rating ³	40

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Rail

Historical Events

Passenger rail accidents are typically associated with derailments or collision with motor vehicles attempting to cross railroad tracks. On January 13, 2004, in Bloomfield Hills, a school bus driver ignored the warning signals at a railroad crossing and attempted to cross the tracks. An approaching passenger train struck the school bus at a speed of 22 miles per hour causing injury to the driver of the bus.

Frequency & Probability

There are 109 miles of freight rail lines and 62 miles of passenger rail lines in Oakland County. Passenger rail service is provided by Amtrak with service between Pontiac and Detroit.

From 2008 through 2016, there were 68 railroad accidents/incidents in Oakland County, an average of 7.5 accidents/incidents each year. Seventeen of these incidents occurred at public railroad crossings. It is anticipated that the likelihood of occurrence for this hazard will fluctuate with the rate of rail traffic within the County.

Health & Safety

Death and injury to passengers involved in railroad accidents/incidents are rare in Oakland County. From 2008 through 2016, there were 4 deaths and 45 nonfatal conditions as a result of train accidents/incidents in Oakland County. There was 2 highway railroad death and 6 highway railroad injuries in Oakland County during that same time frame.

Area Impacted

Areas adjacent to a railroad are most at risk for impact from this hazard due to the potential for derailment. The majority of accidents occur at public railroad crossings. Secondary impact may result if railroad crossings are blocked resulting in traffic delays. If the train is transporting hazardous materials, an evacuation zone may need to be implemented. If an accident or derailment leads to the release of hazardous materials, the area may need to be evacuated for an extended period of time while environmental cleanup is performed.

Economic Impact

The greatest economic loss is property damage to the train equipment and railroad tracks. This loss is the responsibility of the owner/operator of the equipment and railroad.

Critical Facilities/Services

Given the frequency of this event, it is not anticipated that County services or facilities will be greatly impacted. Impact to County services may result if an accident blocks a railroad crossing, thus causing traffic problems. If the train is transporting hazardous materials, an evacuation area may need to be implemented. Police and fire services would be required to direct traffic and establish an exclusion zone.

Rail Transportation Risk & Vulnerability Assessment

From 2008 through 2016, there were 68 railroad accidents/incidents in Oakland County, an average of 7.5 accidents/incidents each year. Seventeen of these incidents occurred at public railroad crossings. Areas adjacent to railroads are most vulnerable to a railroad accident. The locations of railroads, police stations, fire stations, and critical vulnerable assets in the County are included on the Transportation System Vulnerability Map.

- See Transportation System Vulnerability Map in **Appendix A**

Table 67: Rail Transportation Accident/Incident Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	38
Potential Magnitude and Scale ¹	15
Physical Vulnerability Hazard Impact ¹	39
Social Vulnerability Hazard Impact ¹	29
Community Conditions Hazard Impact ¹	24
Overall Capability and Capacity ²	75
Mitigation ²	67
Hazard Consequence & Impact Score ¹	27
Overall Risk Rating ³	32

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Marine

Historical Events

Twenty routes of ferry service operate in Michigan's waterways. Public marine passenger ferries are heavily regulated and inspected by the U.S. Coast Guard to ensure public safety. To date, no significant accidents involving public marine transportation have been recorded in Michigan. Response to marine accidents differ significantly from air and land transportation accidents in that they can require an underwater search and rescue. There is no marine transportation service operating in Oakland County. As such, marine transportation accidents do not present a hazard to the County.

Marine Transportation Risk & Vulnerability Assessment

There is no marine transportation service operating in Oakland County. As such, marine transportation accidents do not present a hazard to the County.

National Transportation Safety Board, www.nts.gov. Aviation Database Query, Michigan, report generated June 22, 2017.

National Transportation Safety Board, www.nts.gov. Aviation Database Query, Michigan, report generated June 22, 2017.

National Transportation Safety Board, www.nts.gov. Aviation Database Query, Michigan, report generated June 22, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan*, July 2014, page 411.

State of Michigan, Office of Highway Safety Planning, [2016 Michigan Traffic accident Facts, Oakland County](#).

Ibid.

Ibid.

U.S. Department of Transportation, National Highway Traffic Safety Administration, www.nhtsa.dot.gov. The Economic and Societal Impact of Motor Vehicle Crashes 2010, State Costs, viewed June 22, 2017.

Rocky Mountain Insurance Information Association, *Cost of Auto Crashes and Statistics*. viewed June 22, 2017.

Federal Railroad Administration, <http://safetydata.fra.dot.gov>. all reports for all railroads in Oakland County, 2008 through 2016, reports generated in June, 2017.

Ibid.

1.6.20 Winter Hazards

Published 7/5/2018 22:35 by Nathaniel Marlette

Ice and Sleet Storms

Definition

Freezing rain is rain that freezes on contact with surfaces causing a coating of ice on exposed surfaces.

Historical Events

From March 1, 1950 through March 31, 2017, 5 ice storm events have been recorded in Oakland County.

On February 24, 2001, a wintry mix of precipitation broke out north of a warm front, with freezing rain being the dominant precipitation type. One power line in Waterford was damaged.

In April 2003, Oakland County had an intense ice storm, Thick Ice accumulations led to considerable damage and widespread power outages across the entire area. Tree damage was so severe that dozens of roads were blocked by trees and damage occurred to hundreds of homes, businesses and automobiles as tree limbs, or in many cases large trees themselves, were brought to the ground under the weight of the ice. It was estimated that 450,000 homes and businesses lost power during the storm. Nearly 50,000 people were without power for up to a week as persistent cold temperatures keep the heavy ice on the trees for 4 days after the storm. A 74-year old man in Troy was killed when he was struck in the head by a falling tree branch. Three other people died due to carbon monoxide poisoning as a result of poorly ventilated generators. Two woman were injured in Orion when a large tree fell onto the car they were in. Five house fires were said to have started by electrical lines being brought down onto the homes. Hundreds of traffic accidents were reported during the storm as well. Total damage in Oakland County was approximately 100 million.

On February 20, 2011, a winter storm impacted southeast Michigan, with 5 to 10 inches of snow falling across the majority of the area. Snow turned to ice leading to downed trees and power lines (most of which occurred over Lenawee and Monroe Counties). Power outages lasted 4 to 5 days. The resulting damage was estimated at \$1.5 million.

In late December 2013, an anticyclone over Ontario provided a supply of low-level cold air, causing the surface temperature to be near or below freezing for much of southeast Michigan. The result was a swath of freezing rain roughly between M-59 to M-46 which continued into Saturday night and early Sunday. The I-69 corridor was especially hard-hit, with ice accumulations of half an inch to three quarters of an inch, causing over 200,000 homes and businesses to lose power. Numerous trees and wires were downed, and a state of emergency was declared in Shiawassee County due to unsafe traveling conditions. South of M-59, much of the precipitation occurred as rain, with some locations receiving over 1.50 rain. North of M-46, much of the precipitation occurred as snow, with up to 4 inches reported. Total property damage in Oakland County was approximately 3 million.

Frequency & Probability

Michigan averages 15 significant storm events per year. The majority of sleet and ice storms occur during the months of January through April. The probability for ice and sleet storms to occur in Oakland County is high.

Health & Safety

Deaths and injury caused directly from an ice or sleet storm are difficult to determine. Deaths and injury are usually caused by secondary effects such as auto accidents, downed power lines and heart attacks from overexertion. According to the National Weather Service, 1 death and 2 injuries have been attributed to ice storms in Oakland County since 1993. These occurred during a storm in 2003 and were the result of falling tree limbs.

Area Impacted

Due to the widespread nature of ice and sleet storms, the entire population could be impacted either directly or secondarily (i.e. power outages, etc.). According to 2008 SEMCOG Land Use Data, Oakland County has approximately 60,623 acres of transportation, communication and utility land use.

Economic Impact

Economic loss would include property damage and costs of response (clearing roadways, downed power lines or trees, etc.).

From 2000 to 2016, ice storms have caused approximately \$103.45 million in property damage in Oakland County.

Critical Facilities/Services

Response to an ice and/or sleet storm related emergency would primarily be localized. Initial response activities due to emergencies from ice and sleet would primarily be associated with local response from police, fire and medical emergency services.

Utilities (power lines, telephone lines, cable, etc.) may require repair and maintenance resulting from ice and sleet. Regional or out-of-state services may be required to assist in cleanup and repair activities. Also, private or governmental tree removal services are often involved following ice and sleet incidents in order to remove trees from roadways, yards and away from power lines.

The National Weather Service and local media can alert the public of severe storms capable of producing ice and sleet.

Ice and Sleet Storm Risk & Vulnerability Assessment

Oakland County has had 5 major ice storm events since 1990. Communications and utilities are vulnerable to winter hazard events. Bridges and major roadways are vulnerable in that most incidents related to winter hazards are secondary effects such as auto accidents. Public facilities such as road yards (road commission and MDOT) are vulnerable assets in snow removal and road salt services. During major events, schools are likely to close and hospitals are likely to see an increase in patients with ailments such as heart attacks from overexertion and auto accident injuries. Over 85% of deaths related to ice storms are traffic related.

Police and fire stations are vulnerable to emergency response activities related to winter hazard incidents. The locations of major highways, schools,

hospitals, and police and fire stations, are included on the Winter Hazard Vulnerability Map, along with transportation, communication, and utility land use locations.

- See Winter Hazard Vulnerability Map in **Appendix A**

Table 65: Ice and/or Sleet Storm Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	25
Potential Magnitude and Scale ¹	26
Physical Vulnerability Hazard Impact ¹	53
Social Vulnerability Hazard Impact ¹	54
Community Conditions Hazard Impact ¹	43
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	42
Overall Risk Rating ³	33

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Snow Storms

Definition

A period of rapid accumulation of snow accompanied by high winds and cold temperatures.

Historical Events

According to the NOAA, Oakland County has had 19 significant winter storm events from 1950 to 2016. In 2011, Oakland County had 1 blizzard warning.

From 1950 through 2016, 23 heavy snow events were reported in Oakland County.

On January 26, 1977, a Presidential Disaster Declaration was issued for 15 counties in the southern part of the state. Many residents were isolated in rural residences or stranded in public shelters.

On March 12 through 14, 1993, a snowstorm, now called “The Storm of the Century,” struck the Eastern U.S. dumping 56 inches of snow in some areas and causing \$2 billion in property damage. The storm impacted 26 states and approximately 50% on the nation’s population. A total of 270 deaths and over 600 injuries were attributed to the storm.

On January 2 and 3, 1999, heavy snow produced 15 inches in Royal Oak; 14 inches in Ferndale; 13 inches in South Lyon; 12 inches in Milford, Clarkston and White Lake; 11 inches in West Bloomfield; 10 inches in Rochester Hills, Farmington and Waterford and 8 inches in Holly and Oxford. The weight of the snow tore a gash in the roof of the Pontiac Silverdome. Full operations at Detroit Metropolitan Airport did not resume until January 6, 1999.

On December 11, 2000, a heavy snow event over several counties produced 12 inches in Royal Oak; 12 to 14 inches in Oxford; 14 inches in White Lake; 11 to 12 inches in Farmington and Farmington Hills; 11 inches in West Bloomfield, 8.8 inches in Milford and 11 to 12 inches in South Lyon. Many schools were closed for two to four days after the storm. Mail delivery the next day was spotty at best, and many businesses and government offices were closed. Several communities declared snow emergencies, forbidding all non-emergency travel until crews could clear roads. Presidential Emergency Declarations were made for all counties in southeast Michigan except Wayne, Lenawee, and Monroe.

Frequency & Probability

Oakland County has had 49 snow storm events from 1996 - 2017. The annual average snowfall in Michigan is 60.66 inches of snow per year. The annual average snowfall in Oakland County is 36.02 inches. It is probable that snow storms will occur in the future in Oakland County.

Health & Safety

Deaths caused directly from the event are difficult to determine. Deaths related to snowstorms are usually caused by secondary effects such as delays in emergency vehicle response, auto accidents, downed power lines and heart attacks from overexertion. The direct risk to human life from snowstorms is low.

Area Impacted

Blizzards are the most dramatic of all snowstorms, bearing strong winds and an enormous amount of snowfall. Snowstorms can impact a large area of a community, especially if it results in heavy accumulations of snow. Due to the widespread nature of snow storms, the entire population could be impacted either directly or indirectly (i.e. power outages, etc.). Oakland County has approximately 7,343 miles of public roadway that could be affected.

Economic Impact

Primary costs would include property damage and snow removal. Economic losses are dependent upon the degree of storm severity. Schools and businesses may be closed if snowfall is heavy, deep or if a snow emergency is declared that prohibits traffic on roadways. From 1996 through 2016,

Oakland County has recorded \$400,000 in damages as a result of snow storm events.

Critical Facilities/Services

Response to a snow related emergency would primarily be localized. Initial response activities due to emergencies from snow storms would primarily be associated with local response from emergency medical services, public works departments and facilities such as MDOT. Municipalities would have increased costs in snow removal activities.

Transportation would be effected as roads and airports could see delays or short-term to long- term closures. Schools and businesses may be closed for a day to several days.

The National Weather Service and local media are critical in alerting the public of severe storms capable of producing snow storms and blizzard conditions.

Snow Storm Risk & Vulnerability Assessment

Oakland County has had multiple significant winter snow storm incidents. Communications and utilities are vulnerable to winter hazard events. Bridges and major roadways are vulnerable in that most incidents related to winter hazards are secondary effects such as auto accidents. Public facilities such as road yards (road commission and MDOT) are vulnerable assets in snow removal. During major events, schools are likely to close and hospitals are likely to see an increase in patients with ailments such as heart attacks from overexertion and auto accident injuries.

Police and fire stations are vulnerable to emergency response activities related to winter hazard incidents. Private or governmental tree removal services are also vulnerable to winter hazards. The locations of major highways, schools, hospitals, and police and fire stations, are included on the Winter Hazard Vulnerability Map, along with transportation, communication, and utility land use locations.

- See Winter Hazard Vulnerability Map in **Appendix A**

Table 69: Winter Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	56		
Potential Magnitude and Scale ¹	41		
Physical Vulnerability Hazard Impact ¹	58		
Social Vulnerability Hazard Impact ¹	59		
Community Conditions Hazard Impact ¹	45		
Overall Capability and Capacity ²	73		
Mitigation ²	67		
Hazard Consequence & Impact Score ¹	48		
Overall Risk Rating ³	52		
Legend			
Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, Standard Query for Severe Weather, June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, Standard Query for Severe Weather, June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, Standard Query for Severe Weather, June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, Standard Query for Severe Weather, June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, Standard Query for Severe Weather, June 22, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 90.

SEMCOG, Community Profiles, Land Use in Oakland County, viewed June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storm, Standard Query for Severe Weather, June 22, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, Standard Query for Severe Weather, January 5, 2012.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)*, March 2014, page 90.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, July 2012, page 48.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, Standard Query for Severe Weather, June 23, 2017.

National Climatic Data Sponsored Website, www.ncdc.noaa.gov/, Standard Query for Severe Weather, June 23, 2017.

USA Travel Website Oakland County Data, <http://www.usa.com/oakland-county-mi-weather.htm>, viewed June 23, 2017.

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Analysis*, March 2006, page 280.

1.6.21 Terrorism and Sabotage

Published 7/6/2018 08:16 by Nathaniel Marlette

Definition

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.

Historical Events

The most recognized forms of terrorism include assassination, bombings and extortion. These acts are often identified with particular groups or organizations. The Middle East and portions of Europe, South America and Asia have been greatly impacted for many years by acts of terrorism and sabotage. In more recent years, the United States has been victim to acts of terrorism.

Of increasing concern, is sabotage of computer systems also known as hacking. Organized hacking groups, such as "Anonymous," target specific organizations, corporations and governmental agencies to bring down websites for a stated purpose. Other groups hack into and retrieve sensitive and confidential information to make a profit or expose it on the internet. Individual hackers may steal identities or personal credit card information. Other forms of sabotage to computer systems include the introduction of viruses, malware or spyware that can cripple a computer network or steal private information.

Unfortunately, Oakland County has experienced acts of terrorism. On August 30, 1971, members of the Ku Klux Klan gained access to the school bus depot in Pontiac and used dynamite to bomb the buses. The crime was carried out in response to court actions requiring a busing plan to integrate local schools.

Frequency & Probability

It is difficult to establish a frequency for terrorist activity in Oakland County based on historical events. Acts of terrorism in Michigan have included bombings, shootings, and arson. From 1970 - 2015, there have been 48 significant terrorist attacks in the State of Michigan. This has been at a rate of roughly one every 2 - 3 years. Despite the unpredictable nature of this hazard, it is likely to occur in the future.

Sabotage of computer systems is a growing trend in the world. Governmental sites and private corporations have been targeted. The increased use and dependency on computer systems, technology and networks will lead to an increase in these types of crimes.

Health & Safety

Due to the nature of terrorist attacks, it is difficult to establish a death or injury rate from historical events. Not all acts of terrorism are intended to cause death or injury, as demonstrated in the 1971 bus bombings. However, terrorist events in Michigan from 1970 to 2015 have resulted in 5 deaths and 7 injuries.

While sabotage to computer systems normally would not lead to harm to health and safety, it is possible. As technology becomes more integrated into society, the more access hackers will have to sensitive systems. Integration of systems such as electrical grids, nuclear power plants, air traffic control centers, traffic lights, etc., can leave these systems vulnerable to attack. If these systems are compromised, it is possible that people may be injured or killed.

Area Impacted

Terrorism can take many forms and the aim of terrorist attacks can vary from destruction of property to harming people to disrupting quality of life. Depending on the type of terrorist attack, property damage can be extensive.

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

Economic Impact

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

Critical Facilities/Services

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

Special Consideration

Homeland security is addressed under a separate needs and threat assessment, therefore, terrorist acts are not considered in this Plan.

Terrorism and Sabotage Risk & Vulnerability Assessment

These hazards and vulnerabilities thereof are confidential in nature and are addressed in a separate plan that is available to view for those that are deemed necessary.

Table 70: Terrorism and Sabotage Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	25
Potential Magnitude and Scale ¹	9
Physical Vulnerability Hazard Impact ¹	62
Social Vulnerability Hazard Impact ¹	63
Community Conditions Hazard Impact ¹	47
Overall Capability and Capacity ²	73
Mitigation ²	67
Hazard Consequence & Impact Score ¹	44
Overall Risk Rating ³	33

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

Michigan Department of State Police Emergency Management and Homeland Security Division, *Michigan Hazard Mitigation Plan (Updated March, 2014)* March 2014, page 480.

Global Terrorism Database. [Search Query for Michigan](#). viewed June 23, 2017.

Global Terrorism Database. [Search Query for Michigan](#). viewed June 23, 2017.

1.6.22 Weapons of Mass Destruction

Published 7/6/2018 08:18 by Nathaniel Marlette

Definition

Weapons intended to cause widespread damage and high number of casualties.

Historical Events

Weapons of mass destruction typically fall into 4 categories: 1) missiles, 2) biological weapons, 3) nuclear weapons or 4) chemical weapons. In 2008, 9 countries were known to possess, or be able to obtain 1 or more types of weapons of mass destruction. There are 9 countries known to have nuclear weapons as of June 2017.

Frequency & Probability

Weapons of mass destruction have never been used to carry out an attack in Oakland County. Globally, there have been approximately 25 known WMD attacks from 1985 - November, 2016. Although Oakland County does not have a history of attacks from weapons of mass destruction, the possibility of such an event does exist.

Although the actual number of nuclear weapons a country has is classified, there are estimates based on leaked information. It is estimated that there are currently approximately 14,900 nuclear weapons in the world. Of those, roughly 3,960 are deployed strategic missiles (ready to fire on short notice). This number does not include retired warheads waiting to be dismantled.

Health & Safety

On March 8, 2016, Islamic State militants struck the town of Taza, Kirkuk, Iraq with a blistering agent – killing a 3-year-old child and injuring 600 others.

Given the nature of weapons of mass destruction, a successful use of these weapons would cause great loss of life and injury. Death and injury rates are highly variable with each attack and the form of weapon used. The greatest loss of life from such an attack occurred in Iraq on February 16, 1988, when Iraqi warplanes attacked a Kurdish city with mustard gas and nerve agents, killing up to 5,000 people, mostly civilians.

In March 1995, a Japanese cult released sarin nerve gas within the Tokyo subway system during morning rush hour, killing 12, severely injuring 50, and inflicting more limited health effects on over 1,000 people.

Depending on the type of weapon used, the effects on human health can linger for years, continuing to present a hazard.

Area Impacted

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

Economic Impact

It is difficult to estimate the economic impact of a successful attack using weapons of mass destruction. It is anticipated that such an event would be incredibly damaging to life, property and infrastructure, as well as the local, state and possibly federal economy.

Critical Facilities/Services

An attack using weapons of mass destruction against public infrastructure can directly impact the County's ability to operate essential facilities and provide services. Successful attacks would require large-scale response from all levels of government. As stated above, the County has identified and evaluated locations within the County which are potential targets for weapons of mass destruction.

Special Consideration

Homeland security is addressed under a separate needs and threat assessment. Therefore, weapons of mass destruction may have a separate assessment.

Weapons of Mass Destruction Risk & Vulnerability Assessment

These hazards and vulnerabilities thereof are confidential in nature and are addressed in a separate plan that is available to view for those that are deemed necessary.

Table 68: Weapons of Mass Destruction Hazard Evaluation and Impact/Consequence Assessment

Frequency & Probability ¹	6
Potential Magnitude and Scale ¹	40
Physical Vulnerability Hazard Impact ¹	73
Social Vulnerability Hazard Impact ¹	66
Community Conditions Hazard Impact ¹	55
Overall Capability and Capacity ²	63
Mitigation ²	61
Hazard Consequence & Impact Score ¹	56
Overall Risk Rating ³	19

Legend

Score	1: Vulnerability Rating	2: Capability and Capacity Rating	3: Overall Risk Rating
0 – 25	Minimally Vulnerable	Minimally Capable	Low
26 – 50	Somewhat Vulnerable	Somewhat Capable	Medium
51 – 75	Vulnerable	Capable	High
76 - 100	Very Vulnerable	Very Capable	Extreme
N/A	Not Applicable/Unknown	Not Applicable/Unknown	Not Applicable/Unknown

James Martin Center for Nonproliferation Studies (CNS), [Chemical and Biological Weapons: Possession and Programs Past and Present](#). Last updated March, 2008. viewed on June 23, 2017.

Johnstonsarchive.net. [Summary of Historical Attacks Using Chemical or Biological Weapons](#). Accessed June 23, 2017.

Federation of American Scientists, <http://www.fas.org/programs/ssp/nukes/nuclearweapons/nukestatus.html>, June 23, 2017.

Johnstonsarchive.net. [Summary of Historical Attacks Using Chemical or Biological Weapons](#). Accessed June 23, 2017.

Ibid

Michigan State Police, *Michigan Hazard Analysis*, July 2012, page 371.

1.7 Hazard Assessment & Analysis

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Oakland County recognizes that a community's All Hazard Risk Assessment is the fundamental building block of the four core functions of emergency management: prepare, respond, recover, and mitigate. In today's hazard environment, emergency management is the crux of solving the complex challenges that face our communities during an emergency or following a disaster. The disaster activity over the past several years has re-emphasized the importance for communities to invest in creating thorough strategies to develop comprehensive emergency plans and to test, train, and exercise all emergency operations.

1.7.1 Hazard Assessment Methodology and Process

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The objective of the risk methodology is to devise a process to compare and evaluate which hazards are the greatest threats to the County and where mitigation actions should be focused to provide the best value to County. The All-Hazard Risk Assessment describes, analyzes, and assesses the risks facing the County from four categories of hazards: Natural, Technological/Manmade, Political, and Public Health. Natural hazards are those events that are a result of our surrounding environment, such as tornadoes and flooding. Technological hazards are events that are a result of the failure of infrastructure and systems that we have become dependent on for daily activities, such as transportation networks or utilities. Politically-motivated hazards are those events that are a result of local, national, or international societal interactions, such as terrorism.

Disasters Are Not Isolated Events

Past disaster events, both natural and manmade, indicate that disasters cannot be viewed or solved as isolated instances. In other words, the rising number of disasters and ensuing damages, including human losses, can be viewed as “symptoms of broader and more basic problems”. These problems stem from the intricate relationships society shares with both the natural and constructed environments.

According to Dr. Denis Mileti:

“Many disaster losses – rather than stemming from unexpected events – are the predictable result of interactions among three major systems: the physical environment, which includes hazardous events; the social and demographic characteristics of the communities that experience them; and the buildings, roads, bridges, and other components of the constructed environment”.

Source: Mileti, Denis (1999). *Disasters by Design*. Joseph Henry Press: Washington DC.

Dr. Mileti’s findings demonstrate that these destructive events must be understood and assessed from a holistic point of view, and that current and future solutions for reducing damages and human losses must acknowledge that disasters occur at the intersection between the physical environment, social community characteristics, and the constructed environment. While the escalating losses from disasters will continue to result in part from the continuing expansion of the constructed environment, it can also be attributed to the fact that “all these systems – and their interactions – are becoming more complex with each passing year”.

Therefore, the County All Hazard Risk Assessment update assumed that hazard events exacerbate pre-existing conditions of a community, and that a community’s hazard risk is a function of its vulnerability and potential hazard impact. To mitigate against these risks and hazards, capacities and capabilities of managing potential impacts are evaluated as well as a disaster’s cascading impacts on communities, residents, essential services, and critical assets. The figure below provides a general illustration of this relationship between the pre-existing conditions in a community (i.e. pre-disaster vulnerability and efforts to mitigate and build capabilities) and the potential impact from various hazards.

Figure 33: Community Conditions, Vulnerabilities and Hazard Impacts



Source: Integrated Solutions Consulting

Although incorporating vulnerability, capability, and cascading impacts in a risk assessment is complex, it is imperative to include these relationships in the methodology to the best ability possible to ensure the usefulness of the outputs. Understanding these interdependent relationships can assist in operational, hazard, agency, and community planning.

Many of the hazards in the Risk Assessment do not pose a significant risk because of their low-probability of occurring or minimal impact; however, these hazards are still addressed in this Plan. Hazards that were determined to not occur in Michigan were removed from the Risk Assessment.

Community Vulnerability Risk and Resiliency (CVR2)

Using the CVR2 process, each hazard is evaluated based on the probability of a hazard occurring, the potential magnitude of the hazard, and potential impacts. The CVR2 hazard assessment also provides consideration to the community’s efforts to mitigate and build capacity to manage each hazard threat. The CVR2 hazard risk analysis incorporates the outputs provided by the vulnerability and capability/capacity indices to provide an overall hazard risk score that can be prioritized. The following table identifies the indicators and measurements, describes why these are important, and presents the key used to evaluate each indicator.

Building off the theoretical finding that disasters are not isolated events, the CVR2 process analyzes a series of vulnerability indices to evaluate the different types of impacts that may be possible by the hazard. Categories are areas of potential vulnerability (example: social vulnerability). This is further evaluated based on a series of scientific indicators such as special population types such as the elderly. Each indicator is assessed to provide a complete picture of the potential impact that each hazard poses on the community. The following table identifies the indicators and measurements, describes why these are important, and presents the key used to evaluate each indicator.

Table 72: Hazard Assessment





















Indicators & Measurements	Description	Rating Key	
Hazard-Specific Frequency & Probability	Frequency of past occurrences and probability of future occurrences based on predictive modeling or scientific research.	Extreme	
		High	
		Medium	
		Low	
Hazard-Specific Magnitude & Scale	The potential magnitude of the hazard and scale or size of the hazard.	Extreme	
		High	
		Medium	
		Low	
Capability & Capacity	The community's capability and capacity to manage the hazard, such as floodplain management programs or anti-terrorism surveillance	Very Capable	
		Capable	
		Somewhat Capable	
		Minimally Capable	
Mitigation Assessment	The community's efforts to mitigate the hazard such as a buying out flood-prone properties, building codes, etc.	Very Capable	
		Capable	
		Somewhat Capable	
		Minimally Capable	
Consequence & Impact Assessment	The potential severity of the impacts and consequences of the event. This assessment provides consideration to the Hazard Impact Analysis.	Extreme	
		High	
		Medium	
		Low	

Table 73: Hazard Impact Analysis

Categories and Indicators	Rating Key	Physical Vulnerabilities Hazard Impact Analysis								
<p>Physical Vulnerabilities Hazard Impact Analysis</p> <ul style="list-style-type: none"> Critical Infrastructure Key Resources Building Stock 	<p>The built environment provides the setting for human activity, ranging in scale from personal residential structures and buildings to neighborhoods and cities that often includes supporting infrastructure, such as transportation networks, energy and water systems. The CVR2's Physical Vulnerability Index (PVI) evaluates critical infrastructure, key resource assets, and building stock risk exposure to hazards using a series of indicators and measurements.</p>	<table border="1"> <tr> <td>Very Vulnerable</td> <td style="background-color: red;"></td> </tr> <tr> <td>Vulnerable</td> <td style="background-color: orange;"></td> </tr> <tr> <td>Somewhat Vulnerable</td> <td style="background-color: yellow;"></td> </tr> <tr> <td>Minimally Vulnerable</td> <td style="background-color: lightgreen;"></td> </tr> </table>	Very Vulnerable		Vulnerable		Somewhat Vulnerable		Minimally Vulnerable	
Very Vulnerable										
Vulnerable										
Somewhat Vulnerable										
Minimally Vulnerable										
<p>Social Vulnerabilities Index (SVI) Hazard Impact Analysis</p> <ul style="list-style-type: none"> Special Populations Cultural Conditions Socio-Economic Conditions 	<p>Social vulnerability can be broadly viewed as the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recovery from the impact of a hazard or threat. Social vulnerability can also be looked at as the susceptibility of community groups (elderly, children, etc.) to the impacts of hazards, as well as their resiliency or ability to adequately recover from them. It should be noted that susceptibility is not only a function of demographic characteristics, but also more complex factors such as health care provision, social capital, and access to lifelines. The CVR2's Social Vulnerability Index (SVI) evaluates the hazard risk exposure of special population types, socio-economic conditions, and cultural conditions using a series of open-source data measurements.</p> <p>There are a number of potential special populations that may be used in the descriptions below including:</p> <ul style="list-style-type: none"> Children: Those under 18 years old Dialysis Patients: Patients who are reliant on dialysis to survive Disabled: Those who have a mental or cognitive disability Elderly: Those over 65 Low-Income/Poor: Those who do not make a living wage or are below the poverty line Pet Owners: Those who live with and/or take care of animals Transient: Tourists, commuters, and homeless University Students: Those who attend a college or university, often between ages 18 & 23 Vehicle Ownership: Those who do not have access to a vehicle 	<table border="1"> <tr> <td>Very Vulnerable</td> <td style="background-color: red;"></td> </tr> <tr> <td>Vulnerable</td> <td style="background-color: orange;"></td> </tr> <tr> <td>Somewhat Vulnerable</td> <td style="background-color: yellow;"></td> </tr> <tr> <td>Minimally Vulnerable</td> <td style="background-color: lightgreen;"></td> </tr> </table>	Very Vulnerable		Vulnerable		Somewhat Vulnerable		Minimally Vulnerable	
Very Vulnerable										
Vulnerable										
Somewhat Vulnerable										
Minimally Vulnerable										
<p>Community Conditions Vulnerability Index (CVI) Hazard Impact Analysis</p> <ul style="list-style-type: none"> Community Organizations Economic Conditions Environmental Conditions Government Conditions Special Properties 	<p>Community-level indicators are measures of conditions that consider how the area may be impacted during a hazard event. A community is a complex system of many interconnected components. This assessment is not meant to capture this system in its entirety, but rather to focus on specific categories of indicators. The CVR2's Community Conditions Vulnerability Index focuses specifically on four broad categories (economic, environmental, community organizations, governmental conditions), comprised of a series of evidence-based indicators and measurements of community vulnerability.</p>	<table border="1"> <tr> <td>Very Vulnerable</td> <td style="background-color: red;"></td> </tr> <tr> <td>Vulnerable</td> <td style="background-color: orange;"></td> </tr> <tr> <td>Somewhat Vulnerable</td> <td style="background-color: yellow;"></td> </tr> <tr> <td>Minimally Vulnerable</td> <td style="background-color: lightgreen;"></td> </tr> </table>	Very Vulnerable		Vulnerable		Somewhat Vulnerable		Minimally Vulnerable	
Very Vulnerable										
Vulnerable										
Somewhat Vulnerable										
Minimally Vulnerable										

The true value of the CVR2 assessment is the ability to compare a wide variety of hazards and threats, from floods to acts of terrorism, using the same format for each hazard type. The scoring mechanism enables the community to identify areas of strength and weakness, as well as support the case for further mitigation and planning projects to build up the resilience of the area.

Limitations

The analysis of hazards is complicated by a number of factors including laws, customs, ethics, values, attitudes, political preferences, complex infrastructures and the built environment. The hazard analysis developed for the County's Hazard Mitigation Plan should be considered an initial step to evaluate the community's hazards. A hazard analysis, however, does provide a wealth of valuable information that is essential for identifying goals, prioritizing actions, planning and preparedness, and recovering and mitigating future hazards.

The assessment of data and identifying the risk to a community is not a hard science. It is not possible to predict hazards or their impacts. Hazard analysis data and conclusions are not absolute. The perception of what constitutes a risk and a judgment of its impact can differ from individual to individual. The changing natural, built, or societal environments can have a significant effect on each hazard assessment. For this reason, it is important to periodically update this document. A hazard risk assessment does provide a guide to evaluate Oakland County's risks and guide the mission of protecting their members and interests.

Hazard Risk Determination

The determination of the risks associated with each hazard were not based on empirical values, but instead based on a function of the probability of the event occurring and its potential impact. This approach was necessary due to the complexities of a uniformed all-hazard approach and the numerous direct and indirect factors for a unique community like Oakland County.

At the most fundamental level, both DHS and FEMA recognize that risk is equal to frequency (and/or probability) multiplied by consequence ($R = F \times C$). More specifically, in order to have a certain level of risk, there must be a probability or likelihood for that event to occur. Likewise, if the event does occur but there is no impact or consequence, the level of risk is negated or substantially reduced.

Whereas measuring frequency/probability of a hazard is often straightforward, defining and measuring the consequence is more complex. At the most basic level, consequence is an assessment of the potential impact(s) if the attack or hazard incident actually occurs. In this assessment, the consequence of an event (or the impact) will be interdependent on the following factors: vulnerabilities (i.e. social, physical, and community conditions), capabilities and capacities, mitigation, and the characteristics (i.e. magnitude, scale, etc.) of the hazard event or attack itself. Again, the frequency/probability of the hazard is not included in assessing the consequence because without the event, there is no consequence or impact.

The algebraic conceptual framework that drives the CVR2 tool is based on the overarching premise that the impacts of a disaster are a direct correlation to the pre-existing conditions and vulnerabilities of the community; and secondly, although risk exposure can be reduced, a community can never completely eliminate disaster impacts by implementing mitigation projects or by building capabilities and capacities.

It is important to recognize that the greater the rigor used in the methodology, the more reliable the output and the more effective the jurisdiction's preparedness efforts will be. For this reason, the CVR2 relies on a large spectrum of evidence-based categories, indicators and measurements all of which are important in understanding a community's hazard risk potential. The algorithm of the CVR2 allows for the systematic analysis of these categories, indicators and measurements and provides the consistency needed to uniformly evaluate the hazard risk potential across all hazards.

Figure 34: Risk Assessment Methodology and Formula

$$\left[\begin{array}{c} \text{Probability} \\ \text{and} \\ \text{Frequency} \end{array} \right] \times \left[\begin{array}{c} \text{Potential} \\ \text{Magnitude \&} \\ \text{Scale} \end{array} \right] = \left[\begin{array}{c} fV \left[\begin{array}{c} \text{Average Social} \\ \text{Vulnerability-} \\ \text{Impact Score} \end{array} \right] + \left[\begin{array}{c} \text{Average Physical} \\ \text{Vulnerability-} \\ \text{Impact Score} \end{array} \right] + \left[\begin{array}{c} \text{Average Community} \\ \text{Conditions Vulnerability-} \\ \text{Impact Score} \end{array} \right] \\ fX \left[\begin{array}{c} \text{Average Capabilities \&} \\ \text{Capacities Score} \end{array} \right] + \left[\begin{array}{c} \text{Average Mitigation} \\ \text{Score} \end{array} \right] \end{array} \right] \wedge \left(\frac{fV2}{fX2} \right)$$

The algorithm above recognizes that the potential impact from a hazard is a function of the pre-existing vulnerabilities in a community. Additionally, the algorithm recognizes that although you can reduce your potential impact and vulnerability to hazards by increasing your capability and implementing mitigation, vulnerability cannot be eliminated. Communities cannot achieve absolute resiliency to any hazard.

More specifically, the variable fV represents the numeric relationship that although there is a direct correlation between a community's vulnerability and potential impacts; the extent of the vulnerability exposure varies from hazard to hazard. Similarly, fX represents the numeric relationship that recognizes that capabilities, capacities and ability to mitigate cannot eliminate a threat and, therefore, cannot be absolute. In simple terms, vulnerability, capability and mitigation will never be more than 100% or less than 0% (both of which would be practically and theoretically impossible).

Finally, the algorithm recognizes that communities can have vulnerabilities, capabilities, capacities, and ability to mitigate that are specific to the community and therefore should be considered all hazards. This is represented in the $fV1$ and $fX1$ variables. An example of this would be a community's overall level of preparedness or trust in government. Additionally, communities may also have hazard-specific vulnerabilities or taken hazard specific measures to mitigate or build capabilities to manage a specific hazard. This is represented by the $fV2$ and $fX2$ variables. An example of this would be a community participating in FEMA's National Flood Insurance Program.

1.7.2 Hazard Ranking

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Table 74: Oakland County Hazard Ranking

Natural Hazards		Score
1	Winter Storm and Blizzards	52
2	Riverine Flooding	49
3	Urban Flooding	46
4	High Winds/Severe Winds	46
5	Hail	42
6	Tornadoes	40
7	Extreme Cold	40
8	Thunderstorms (Lightning)	39
9	Ice and/or Sleet Storms	33
10	Extreme Heat	30
11	Drought	25
12	Fog	23
13	Earthquake	21
14	Wildfire	19
15	Natural Subsidence	10
Manmade/Technological Hazards		Score
1	Structural Fire	41
2	Transportation Accidents: Highway	40
3	Hazardous Materials Incidents: Transportation	38
4	Hazardous Materials Incidents: Fixed Facility	38
5	Petroleum and Natural Gas Pipeline Accidents	38
6	Infrastructure Failure: Electrical System Failure Incident	35
7	Infrastructure Failure: Water System Disruption	33
8	Transportation Accidents: Rail	32
9	Criminal Acts: Vandalism	32
10	Infrastructure Failure: Storm Water System Incident	32
11	Criminal Acts: Arson	31
12	Infrastructure Failure: Communication System Failure Incident	29
13	Invasive Species	28
14	Dam Failure	26
15	Criminal Acts: Mass Shootings/Active Assailant	25
16	Infrastructure Failure: Sewer System Incident	25
17	Nuclear Power Plant Accidents	22
18	Transportation Accidents: Air	21
19	Gas/Oil Shortage	21
20	Oil and Gas Well Incident	20
21	Infrastructure Failure: Transportation (Bridges, Roads, Overpasses) Infrastructure System Failure Incident	20
22	Scrap Tire Fire	17
Political Hazards		Score
1	Terrorism and Sabotage	33
2	Civil Disturbances	23
3	Weapons of Mass Destruction	19
Public Health Hazards		Score
1	Public Health Emergencies	37

1.8 Mitigation Goals and Objectives

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Mitigation goals describe the broad direction that Oakland County and participating jurisdictions and school districts will take to select mitigating projects which are designed specifically to address risks posed by natural and manmade hazards. The goals are stepping-stones between the mission statement and the specific objectives developed for the individual mitigation projects.

As stated in this Plan, the purpose of the hazard mitigation planning process is to identify hazard areas, to assess the risks, to analyze the potential for mitigation and to recommend mitigation strategies, where appropriate. Potential mitigation projects will be reviewed using criteria that stress the intrinsic value of the increased safety for people and property in relation to the monetary costs to achieve this (i.e., a cost-benefit analysis). With that in mind, the planning goals for this entire Plan were reassessed and updated.

The analysis of the Risk Assessment identified areas where mitigation improvements could be made, providing the framework for the committee to readdress and formulate planning goals.

1.8.1 Goals and Objectives

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During the 2017 update process, the 2012 goals were reviewed and updated according to the Advisory Committee's feedback. The Advisory Committee agreed that the 2012 goals provided a concise set of parameters to guide the hazard mitigation process, and that no changes were warranted. Therefore, the 2017 Plan goals are:

- Protection of public health and safety and prevention and reduction of loss of life and injury due to all hazards.
- Improve and support public and private organizational response capabilities.
- Prevention and reduction of damage to public and private property and infrastructure.
- Protection of critical assets, including, but not limited to: hospitals, nursing homes, and schools.
- Increasing awareness, education and preparedness of public, business, non-profit, government, etc. about hazards.
- Encourage personal responsibility.

1.9 Mitigation Strategies and Actions

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The heart of the mitigation plan is the mitigation strategy, which serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The mitigation strategy describes how the community will accomplish the overall purpose, or mission, of the planning process. In this section, mitigation actions/projects were updated/amended, identified, evaluated, and prioritized.

Plan participants assessed over 300 hazard mitigation strategies, including strategies from FEMA documents, strategies from the 2012 Oakland County Plan and suggestions from the communities, Advisory Committee members and school districts. These strategies were evaluated by the Advisory Committee during the third meeting held on November 3, 2017, resulting in a prioritized list of 147 new strategies, in addition to 229 ongoing/updated mitigation strategies from the 2012 Plan, and 126 completed strategies. Fifteen were removed or considered not relevant.

Major categories that represented the identified mitigation strategies, included (in order of priority as identified by the Advisory Committee):

1. Emergency Planning
2. Emergency Training for First Responders
3. Infrastructure work
4. Culverts/General Flood/Water System
5. Personal Preparedness Encouragement
6. Radio/Communication/Notification System
7. Security Improvements
8. Emergency Supplies/Small Equipment
9. Generator
10. Warning Sirens/Loud Speakers
11. Hire/Train Staff
12. Large Response Equipment or Construction Project
13. Emergency Shelters

The Mitigation Actions and Projects from the County, Municipalities and School Districts are included in the following Volumes:

Volume II:

- County Mitigation Actions (County Departments and Mitigation Actions that Apply to the County and All Participating Municipalities)
- Municipal Mitigation Actions (Cities, Townships, and Villages)

Volume III:

- School District-Level Mitigation Actions

Each entities' Mitigation Actions are organized as follows:

- **New Mitigation Actions** - New actions identified during this 2017 update process
- **Ongoing Mitigation Actions** - These ongoing actions were included in the previous update, and have yet to be completed. Some of these actions have no definitive end. During the 2017 update, these "ongoing" mitigation actions and projects were modified and/or amended, as needed, to better define the action/project.
- **Completed Mitigation Actions** - Completed actions since 2012

The Action Plan for each mitigation project is presented in a table format. The table is designed to capture important details intended to support the implementation of the project. It is also designed to facilitate and encourage the annual review and maintenance of each mitigation action by allowing the Lead Agency/Organization to document the yearly status of the project prior to and/or during the Annual Advisory Committee meeting.

Table 75: Action Plan

1.	(INSERT MITIGATION ACTION TITLE)	
<i>(INSERT DESCRIPTION)</i>		
Year Initiated		
Applicable Jurisdiction		
Lead Agency/ Organization		
Supporting Agencies/ Organizations		
Applicable Goal(s)		
Potential Funding Source		
Estimated Cost		
Benefits (Loss Avoided)		
Projected Completion Date		
Actual Completion Date		
Priority		
Status	2017	
	2018	
	2019	
	2020	
	2021	
Applicable Hazards		

The parameters for the timeline (Projected Completion Date) are as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years
- Ongoing = currently being funded and implemented under existing programs.

1.9.1 Prioritization Process

Published 7/6/2018 08:33 by Nathaniel Marlette

The mitigation action must be prioritized according to a benefit/cost analysis of the proposed projects and their associated costs (44 CFR, Section 201.6(c)(3)(iii)). The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. The projects were prioritized and evaluated as shown on the individual worksheets for each recommended mitigation initiative.

The estimated costs for the mitigation initiatives were identified as high, medium, or low, using the following ranges:

- Low – less than \$10,000
- Medium – from \$10,000 to \$100,000
- High – greater than \$100,000

Furthermore, prioritization was based on a scale of High, Medium and Low. The contributing prioritization factors for the Advisory Committee were:

- Technical Feasibility
- Cost Effectiveness
- Ability to Accomplish, Fund, Measure, and Sustain
- Protection of Critical Resources
- Community and Public Acceptance - socially equitable, etc.
- Environmentally Sound

Priority was assessed by requesting that every new mitigation action submitted by County departments, municipalities and school districts go through a ranking process (for each of the aforementioned prioritization factors), which was a numbering system from 1 to 5 with 1 being much less important and 5 being much more important.

Municipalities and School Districts were also asked to consider the following when identifying mitigation strategies: 1) benefit to the County or City/School in relation to the hazards mitigated and 2) number of hazards that would be mitigated.

The following form “New Mitigation Action Projects Form” and the online equivalent (<https://integratedsolutions.wufoo.com/forms/qo0ndg617ys5lw/>) was created to facilitate the prioritization process described above.

Figure 35: New Mitigation Action Projects Form

Name:
 Organization/Department:
 E-mail:
 Phone:

New Mitigation Action (Please Describe):

Year Initiated	2017 (New Mitigation Action)
Applicable Jurisdiction or School District	
Lead Agency/Organization	
Supporting Agencies/Organizations	
Potential Funding Source	
Estimated Cost	
Benefits (loss avoided)	
Projected Completion Date	
PRIORITY (High, Medium, Low)	

Please indicate if the mitigation goals are applicable to the new mitigation action/project. Check All That Apply.

- Protection of public health and safety and prevention and reduction of loss of life and injury.
- Improve and support public and private organizational response capabilities.
- Prevention and reduction of damage to public and private property and infrastructure.
- Protect critical assets (example: hospitals, nursing homes, schools).
- Increase awareness and preparedness of public, business, non-profit, government, etc. about hazards.
- Encourage personal responsibility.

This mitigation action:

Instructions: Circle the best option

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
	(1)	(2)	(3)	(4)	(5)
Is technically feasible	1	2	3	4	5
Is cost effective	1	2	3	4	5
Can be easily accomplished, funded, measured, and sustained	1	2	3	4	5
Protects critical resources and property	1	2	3	4	5
Will be accepted by the community and public	1	2	3	4	5
Is environmentally sound	1	2	3	4	5

Part 100 of the General Education Regulations will require

Multiple Choice

All words	Correct Answer
1. The word "multiple" means:	more than one
2. The word "choice" means:	to select from several
3. The word "require" means:	to demand or need
4. The word "regulation" means:	a rule or law
5. The word "general" means:	including all or most
6. The word "education" means:	the process of learning
7. The word "part" means:	a portion or section
8. The word "of" means:	possessive or relationship
9. The word "the" means:	definite article
10. The word "will" means:	future tense or desire
11. The word "require" means:	to demand or need
12. The word "regulation" means:	a rule or law
13. The word "general" means:	including all or most
14. The word "education" means:	the process of learning
15. The word "part" means:	a portion or section
16. The word "of" means:	possessive or relationship
17. The word "the" means:	definite article
18. The word "will" means:	future tense or desire
19. The word "require" means:	to demand or need
20. The word "regulation" means:	a rule or law
21. The word "general" means:	including all or most
22. The word "education" means:	the process of learning
23. The word "part" means:	a portion or section
24. The word "of" means:	possessive or relationship
25. The word "the" means:	definite article
26. The word "will" means:	future tense or desire
27. The word "require" means:	to demand or need
28. The word "regulation" means:	a rule or law
29. The word "general" means:	including all or most
30. The word "education" means:	the process of learning
31. The word "part" means:	a portion or section
32. The word "of" means:	possessive or relationship
33. The word "the" means:	definite article
34. The word "will" means:	future tense or desire
35. The word "require" means:	to demand or need
36. The word "regulation" means:	a rule or law
37. The word "general" means:	including all or most
38. The word "education" means:	the process of learning
39. The word "part" means:	a portion or section
40. The word "of" means:	possessive or relationship
41. The word "the" means:	definite article
42. The word "will" means:	future tense or desire
43. The word "require" means:	to demand or need
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48. The word "of" means:	possessive or relationship
49. The word "the" means:	definite article
50. The word "will" means:	future tense or desire
51. The word "require" means:	to demand or need
52. The word "regulation" means:	a rule or law
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55. The word "part" means:	a portion or section
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57. The word "the" means:	definite article
58. The word "will" means:	future tense or desire
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64. The word "of" means:	possessive or relationship
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81. The word "the" means:	definite article
82. The word "will" means:	future tense or desire
83. The word "require" means:	to demand or need
84. The word "regulation" means:	a rule or law
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86. The word "education" means:	the process of learning
87. The word "part" means:	a portion or section
88. The word "of" means:	possessive or relationship
89. The word "the" means:	definite article
90. The word "will" means:	future tense or desire
91. The word "require" means:	to demand or need
92. The word "regulation" means:	a rule or law
93. The word "general" means:	including all or most
94. The word "education" means:	the process of learning
95. The word "part" means:	a portion or section
96. The word "of" means:	possessive or relationship
97. The word "the" means:	definite article
98. The word "will" means:	future tense or desire
99. The word "require" means:	to demand or need
100. The word "regulation" means:	a rule or law

1.10 Plan Maintenance Process

Published 7/6/2018 08:34 by Nathaniel Marlette

The Oakland County Hazard Mitigation Plan (Plan) maintenance process includes a schedule for annual monitoring and evaluation of the programmatic outcomes established in the Plan and for producing a formal Plan revision every five years.

1.10.1 Formal Review Process

Published 7/6/2018 08:34 by Nathaniel Marlette

The Plan may be reviewed on an annual basis by Oakland County Homeland Security and reviewed and revised every five years by the committee to determine the effectiveness of programs and to reflect changes that may affect mitigation priorities. Oakland County Homeland Security will be responsible for contacting the Mitigation Advisory Committee members (LEPC) and organizing the review. Committee members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan. The Committee will review the goals and action items to determine their relevance to changing situations in the County as well as changes in Federal policy, and to ensure they are addressing current and expected conditions. The Committee will also review the risk assessment portion of the Plan to determine if this information should be updated or modified, given any new available data. The organizations responsible for the various action items will report on the status of the projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised or removed.

Oakland County Homeland Security will be responsible for ensuring the updating of the Plan. Oakland County Homeland Security will also notify all holders of the Plan and affected stakeholders when changes have been made. Every five years the updated Plan will be submitted to the Michigan State Police, Emergency Management and Homeland Security Division's (MSP/EMHSD) Mitigation Program and to the Federal Emergency Management Agency for review.

1.10.2 Continued Public Involvement

Published 7/6/2018 08:35 by Nathaniel Marlette

Oakland County Homeland Security is dedicated to involving the public directly in the review and updates of the Plan. The public will also have the opportunity to provide input into Plan revisions and updates. Copies of the Plan will be kept by appropriate County departments, municipalities, school districts, and outside agencies, as appropriate.

Public meeting(s) will be held when deemed necessary by Oakland County Homeland Security. The meetings will provide a forum where the public can express concerns, opinions, or new alternatives that can then be included in the Plan. Oakland County Homeland Security will be responsible for using County resources to publicize the public meetings and maintain public involvement.

To further facilitate continued public involvement in the planning process, Oakland County will ensure that:

- Oakland County Homeland Security will keep a copy of the plan on hand at their office for review and comment by the public.
- Oakland County Homeland Security will conduct outreach after a disaster event to remind members of the importance of mitigation and to solicit mitigation ideas to be included in the plan.
- A public meeting will be held annually to provide the public with a forum for discussing concerns, opinions, and ideas with the Mitigation Advisory Committee (LEPC).

1.10.3 Monitoring, Evaluation, and Updating the Plan

Published 7/6/2018 08:36 by Nathaniel Marlette

To ensure the Plan continues to provide an appropriate path for risk reduction throughout the County, it is necessary to regularly evaluate and update it. Oakland County Homeland Security will be responsible for monitoring the status of the Plan and gathering appropriate parties to report of the status of Mitigation Actions. The County Mitigation Advisory Committee (LEPC) will convene on an annual basis to determine the progress of the identified mitigation actions. The Mitigation Advisory Committee will also be an active participant in the next plan update. As the Plan matures, new stakeholders will be identified and encouraged to join the existing Mitigation Advisory Committee.

Oakland County Homeland Security is responsible for contacting committee members and organizing the annual meeting. The Committee's responsibilities include:

- Annually reviewing each goal and objective to determine its relevance and appropriateness.
- Monitor and evaluate the mitigation strategies in this Plan to ensure the document reflects current hazard analyses, development trends, code changes and risk analyses and perceptions.
- Ensure the appropriate implementation of annual status reports and regular maintenance of the Plan. The committee will hear progress reports from the parties responsible for the various implementation actions to monitor progress.
- Create future action plans and mitigation strategies. These should be carefully assessed and prioritized using benefit-cost analysis (BCA) methodology that FEMA has developed.
- Ensure the public is invited to comment and be involved in mitigation plan updates.
- Ensure that the County complies with all applicable Federal statutes and regulations during the periods for which it receives grant funding, in compliance with 44 CFR.
- Reassess the Plan in light of any major hazard event. The committee will convene within 90 days of any major event to review all applicable data and to consider the risk assessment, plan goals, objectives, and action items given the impact of the hazard event.
- Review the hazard mitigation plan in connection to other plans, projects, developments, and other significant initiatives.
- Coordinate with appropriate municipalities and authorities to incorporate regional initiatives that transcend the boundaries of the County.
- Update the plan every five years and submit for FEMA approval.
- Amend the plan whenever necessary to reflect changes in State or Federal laws and statutes required in 44 CFR.

1.10.4 The Five-Year Action Plan

Published 7/6/2018 08:37 by Nathaniel Marlette

This section outlines the implementation agenda that the Mitigation Advisory Committee should follow five years following adoption of this plan, and then every five years thereafter. The Mitigation Advisory Committee, led by Oakland County Homeland Security, is responsible to ensure the Plan is updated every five years.

The Committee will consider the following an action plan for the first 5-year planning cycle. It should be noted that the schedule below can be modified as necessary and does not include any meetings and/or activities that would be necessary following a disaster event (which would include reconvening the Mitigation Advisory Committee within 90 days of a disaster or emergency to determine what mitigation projects should be prioritized during the community recovery). If an emergency meeting of the Mitigation Advisory Committee occurs, this proposed schedule may be altered to fit any new needs.

Year 0:

- **2017:** Update Hazard Mitigation Plan, including a series of Mitigation Steering Committee meetings & Public meetings. Submit Hazard Mitigation Plan for FEMA approval.
- **January 2018 – July 2018:** Work on Mitigation Actions, Oakland County Homeland Security to stay in contact with lead departments/municipalities to keep tabs on project status.

Year 1:

- **June – July, 2018:** Prepare for and promote first annual Plan Review and Public meetings.
- **August 2018:** Reconvene Committee for first annual Mitigation Advisory Committee meeting. Introduce the concept of Mitigation Plan Integration with other planning documents. Host first annual Public meeting.
- **September 2018 – July 2019:** Work on Mitigation Actions, Oakland County Homeland Security to stay in contact with lead departments/municipalities to keep tabs on project status. Encourage plan integration efforts.

Year 2:

- **June – July 2019:** Prepare for and promote second annual Plan Review and Public meetings.
- **August, 2019:** Reconvene Committee for second annual Mitigation Steering Committee meeting. Review plan integration efforts. Host second annual Public meeting.
- **September 2019 – July 2020:** Work on Mitigation Actions, Oakland County Homeland Security to stay in contact with lead departments/municipalities to keep tabs on project status. Encourage plan integration efforts.

Year 3:

- **June – July 2020:** Prepare for and promote third annual Plan Review and Public meetings.
- **August 2020:** Reconvene Committee for third annual Mitigation Steering Committee meeting. Review plan integration efforts. Host second annual Public meeting.
- **September 2020 – July 2021:** Work on Mitigation Actions, Oakland County Homeland Security to stay in contact with lead departments/municipalities to keep tabs on project status. Encourage plan integration efforts.

Year 4:

- **June – July 2021:** Prepare for and promote fourth annual Plan Review and Public meetings.
- **August 2021:** Reconvene Committee for fourth annual Mitigation Steering Committee meeting. Review plan integration efforts. Host fourth annual Public meeting.
- **September 2021 – July 2022:** Work on Mitigation Actions, Oakland County Homeland Security to stay in contact with lead departments/municipalities to keep tabs on project status. Encourage plan integration efforts.

Year 5:

- **January - December 2022:** Update 2017 Hazard Mitigation Plan, including a series of Mitigation Advisory Committee meetings & Public meetings.
- **January 2023:** Submit 2023 Hazards Mitigation Plan for FEMA approval. Repeat.

1.10.5 Annual Mitigation Advisory Committee Meetings

Published 7/6/2018 08:38 by Nathaniel Marlette

During each annual Mitigation Advisory Committee meeting, the Committee will be responsible for a brief evaluation of the 2017 Hazard Mitigation Plan and to review the progress on Mitigation Actions.

Plan Evaluation

To evaluate the plan, the Mitigation Advisory Committee should answer the following questions:

- Are the goals and objectives still relevant?
- Is the risk assessment still appropriate, or has the nature of the hazard and/or vulnerability changed over time?
- Are current resources appropriate for implementing this plan?
- Have lead agencies participated as originally proposed?
- Has the public been adequately involved in the process? Are their comments being heard?
- Have departments/municipalities been integrating mitigation into their planning documents?

If the answer to each of the above questions is “yes,” the plan evaluation is complete. If any questions are answered with a “no,” the identified gap must be addressed.

Review of Mitigation Actions

Once the plan evaluation is complete, the Committee must review the status of the Mitigation Actions. To do so, the Mitigation Advisory Committee should answer the following questions:

- Have the Mitigation Actions been implemented as planned?
- Have outcomes been adequate?
- What problems have occurred in the implementation process?

Meeting Documentation

Each annual Mitigation Advisory Committee meeting must be documented, including the plan evaluation and review of Mitigation Actions. Mitigation Actions have been formatted to facilitate the annual review process.

1.11 Appendices

Published 3/7/2016 11:35 by Dan Martin

1.11.1 Appendix A: Figures (Not included in Public Version - FOUO)

Published 12/28/2017 15:36 by Nathaniel Marlette

Figure 37: Earthquake Vulnerability Map

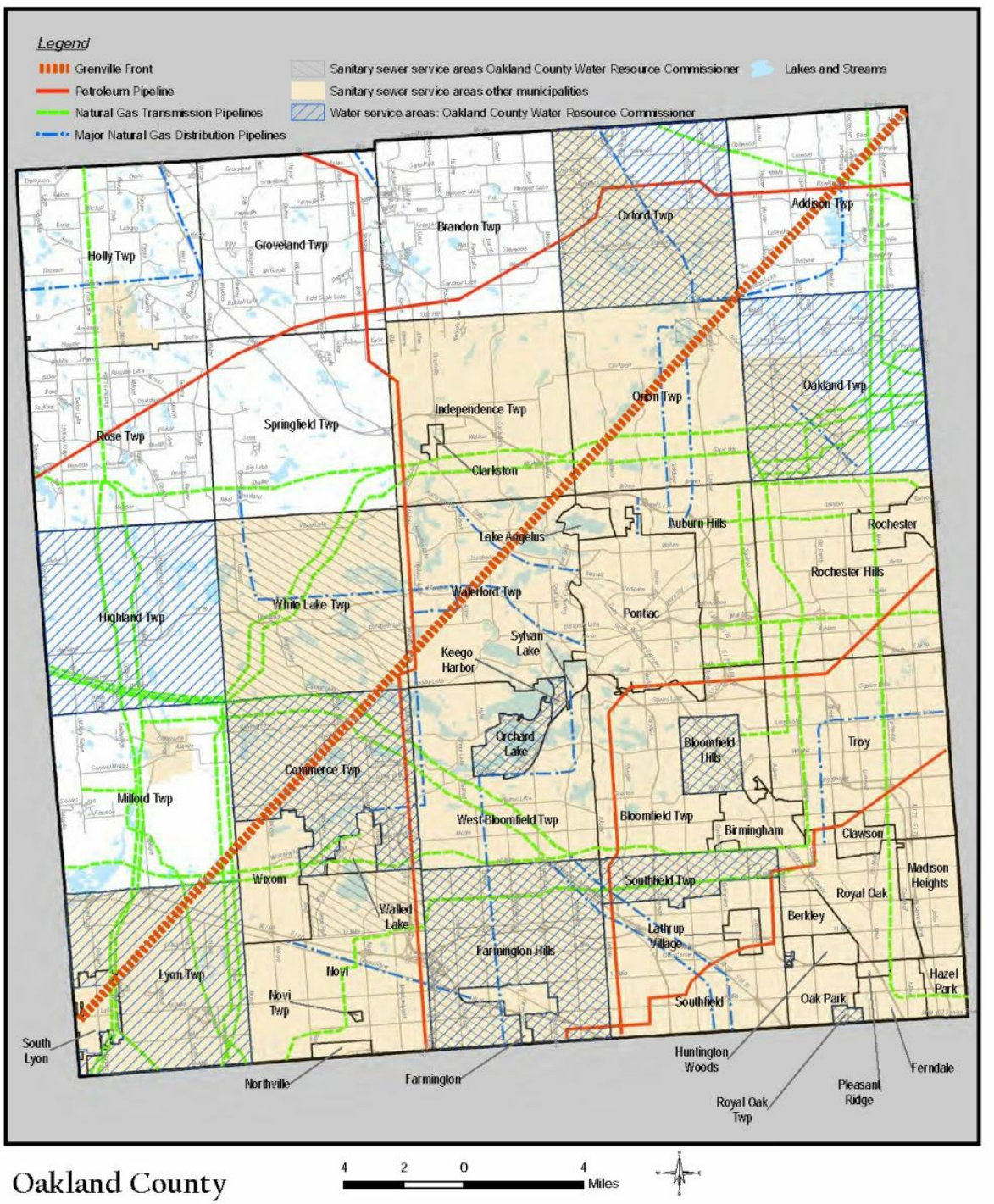
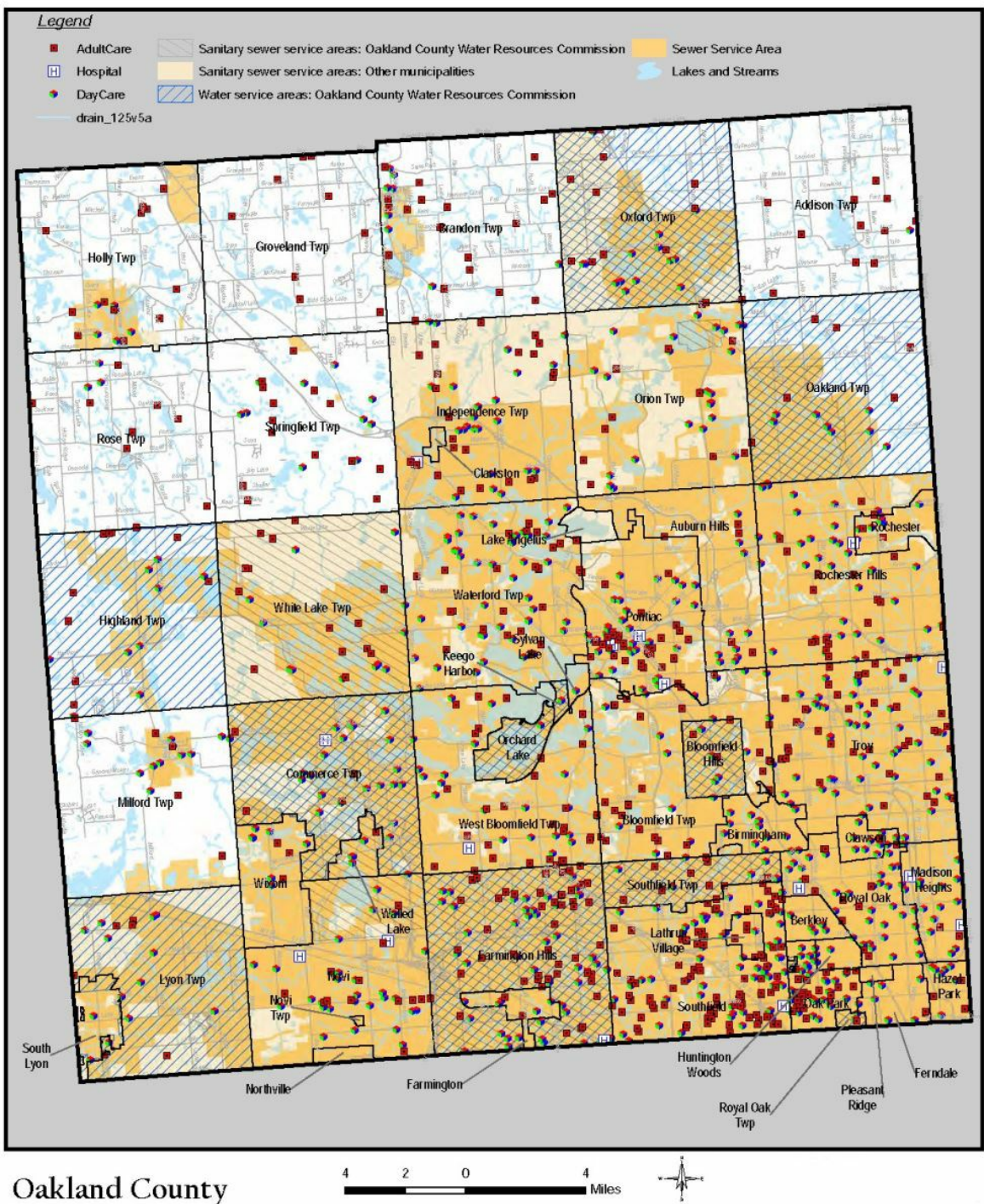


Figure 38: Extreme Temperature Vulnerability Map

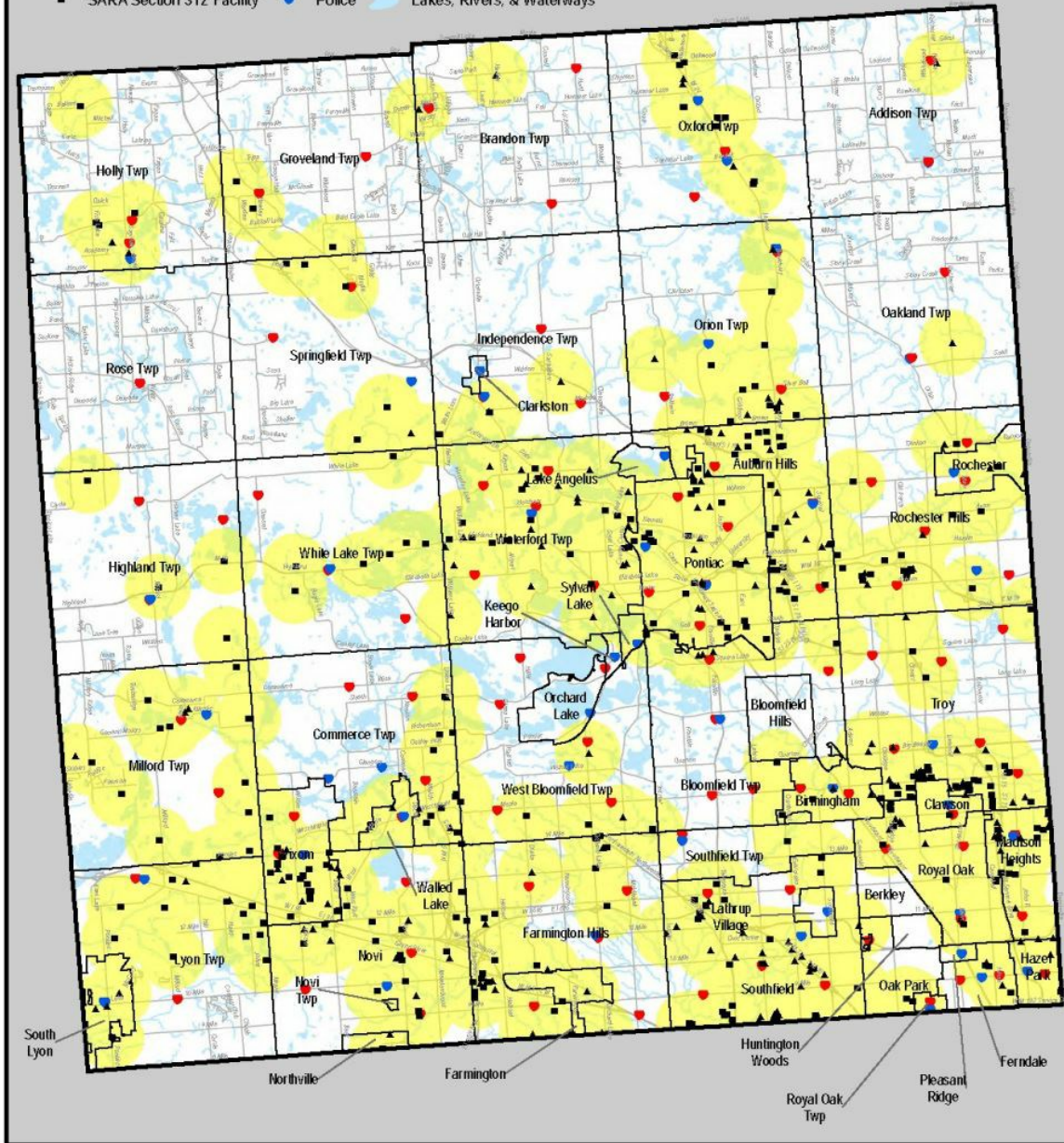


Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Figure 39: HAZMAT Fixed-Site Vulnerability Map

Legend

- ▲ SARA Section 302 Facility
- SARA Section 312 Facility
- Fire
- Police
- SARA Title III sites 1 mile Buffer
- Lakes, Rivers, & Waterways



Oakland County



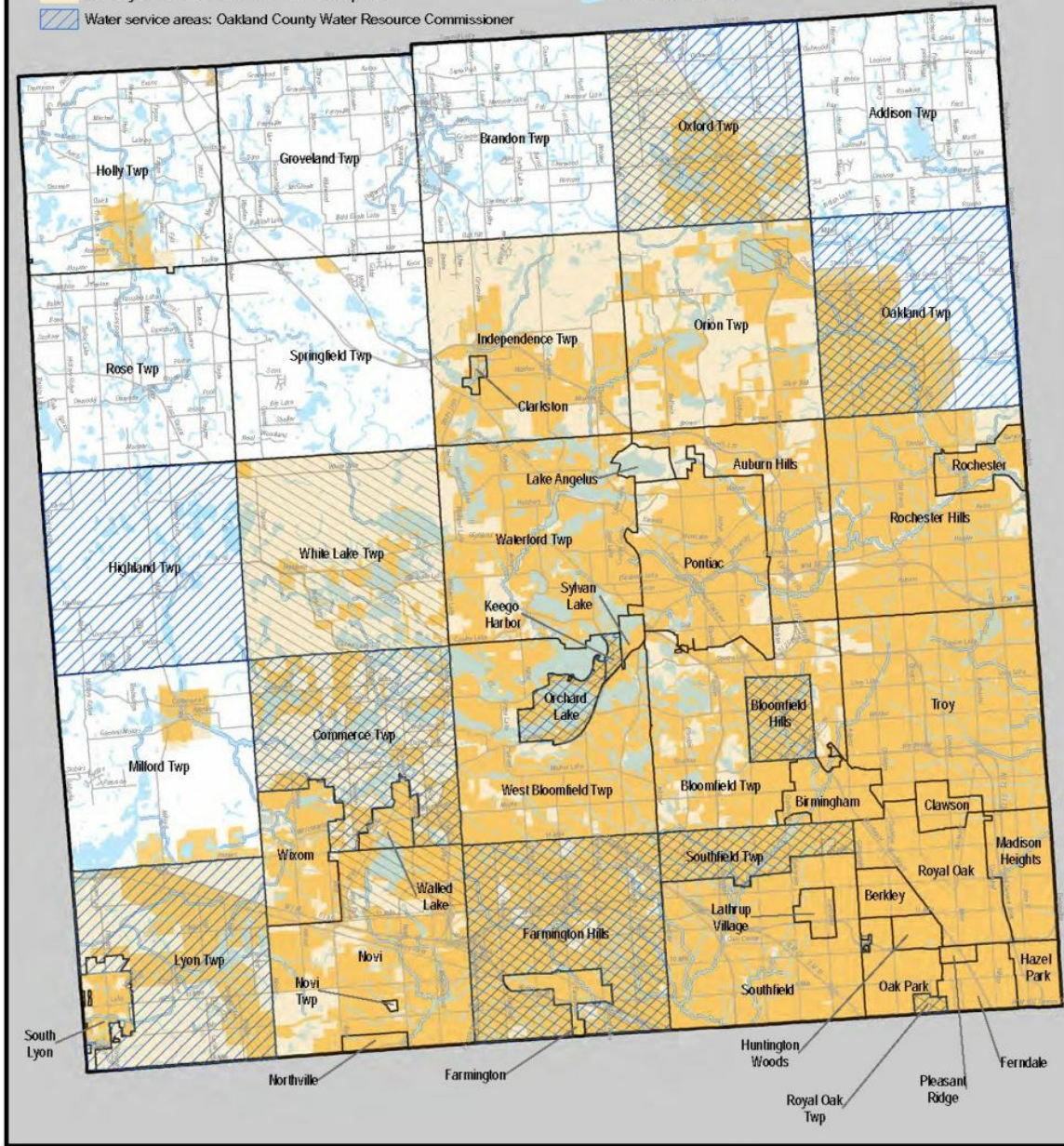
Source: Oakland County, MI, USDA,

SEMCOG | Created by: ASTI

Figure 40: Infrastructure Map

Legend

- Sanitary sewer service areas: Oakland County Water Resource Commissioner
- Sanitary sewer service areas: Other municipalities
- Water service areas: Oakland County Water Resource Commissioner
- Sewer Service Area
- Lakes and Streams



Oakland County









4 2 0 4 Miles

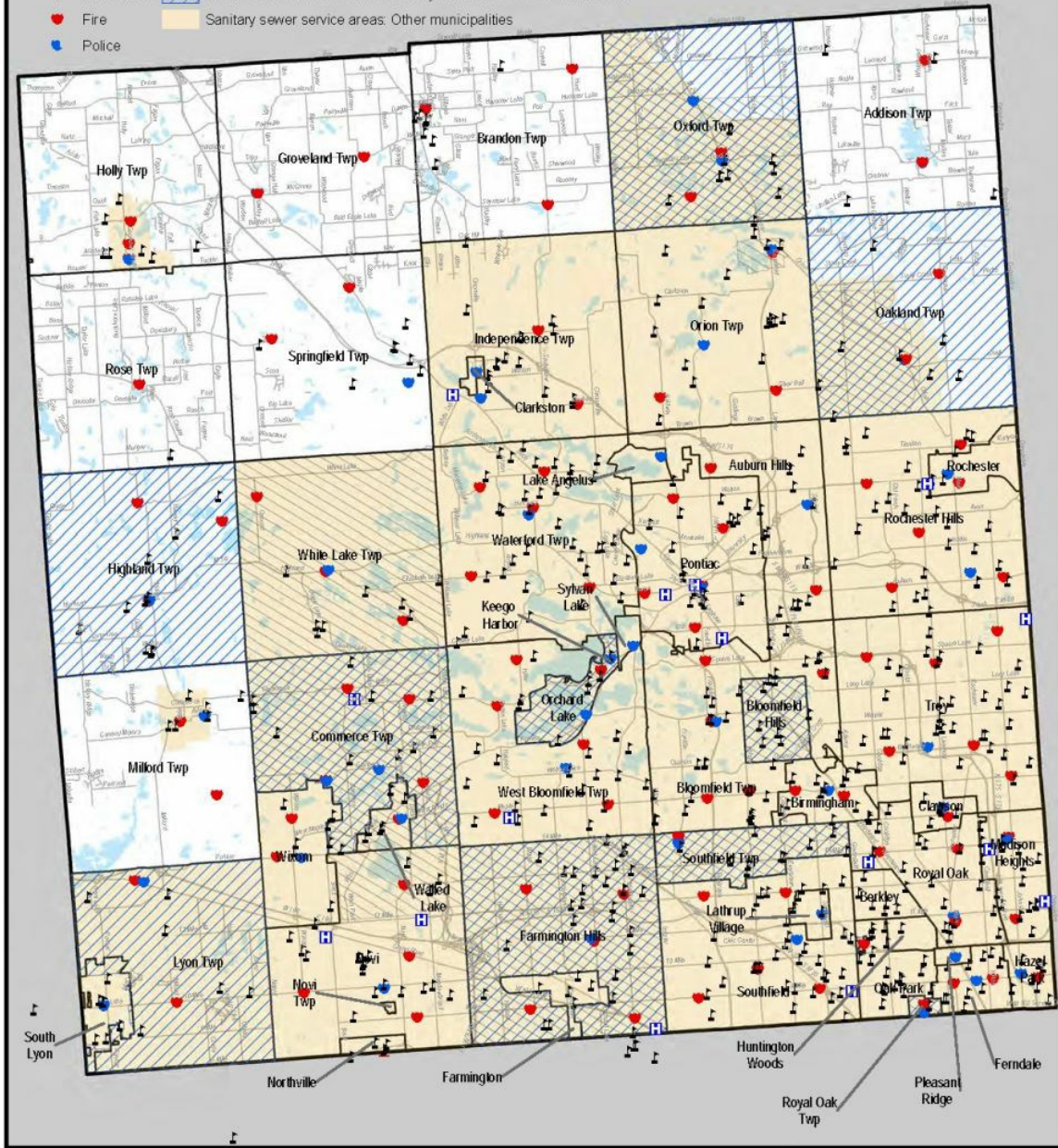


Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Figure 41: Infrastructure (Water/Sewer) Vulnerability Map

Legend

-  Hospital
-  Educational
-  Fire
-  Police
-  Sanitary sewer service areas: Oakland County Water Resources Commission
-  Water service areas: Oakland County Water Resources Commission
-  Sanitary sewer service areas: Other municipalities
-  Lakes and Streams



Oakland County

4 2 0 4 Miles



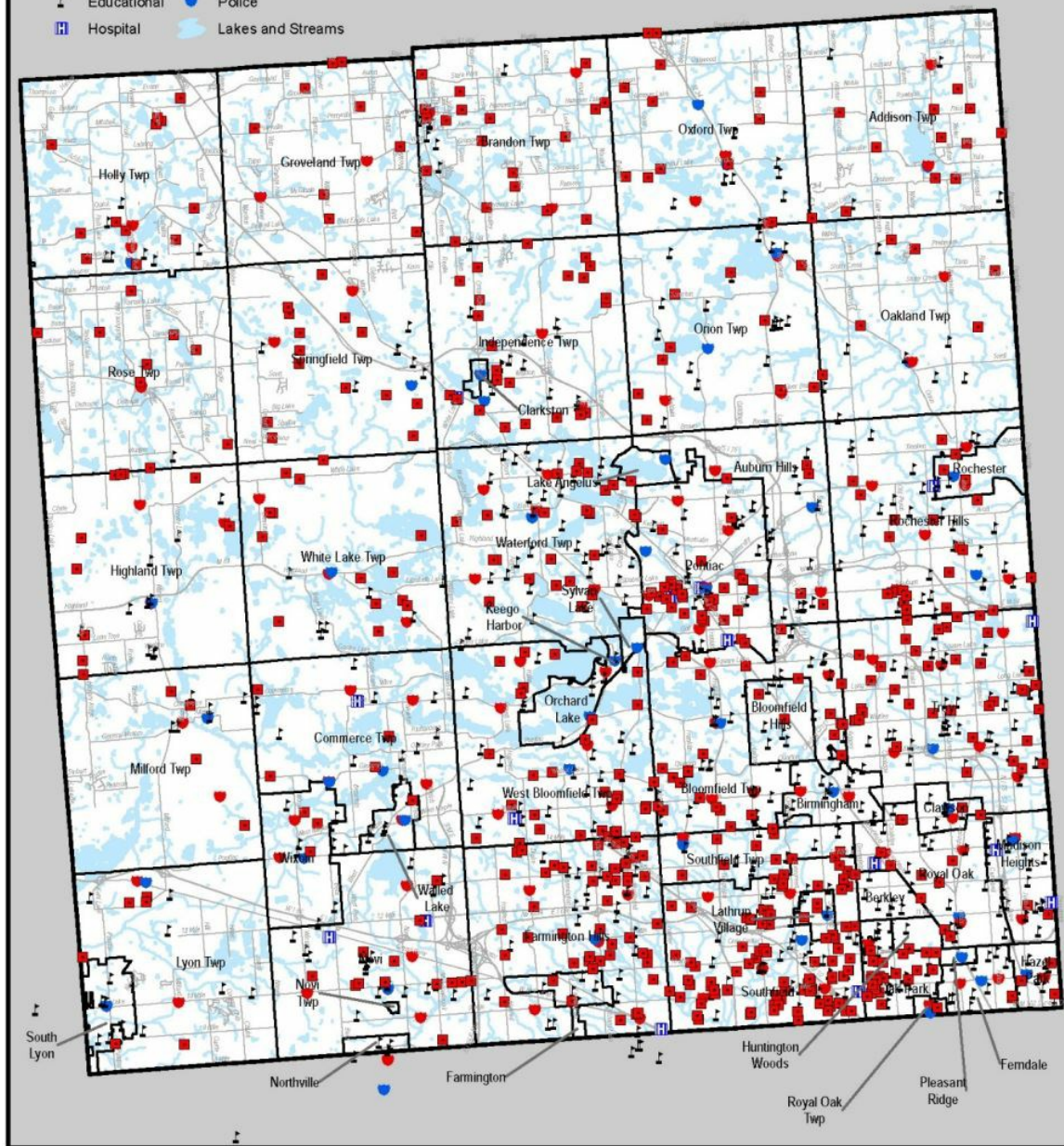
Source: Oakland County, MI, USDA,

SEMCOG | Created by: ASTI

Figure 42: Electrical/Communication System Vulnerability Map

Legend

- AdultCare
- Fire
- ⚡ Educational
- Police
- 🏥 Hospital
- 🌊 Lakes and Streams



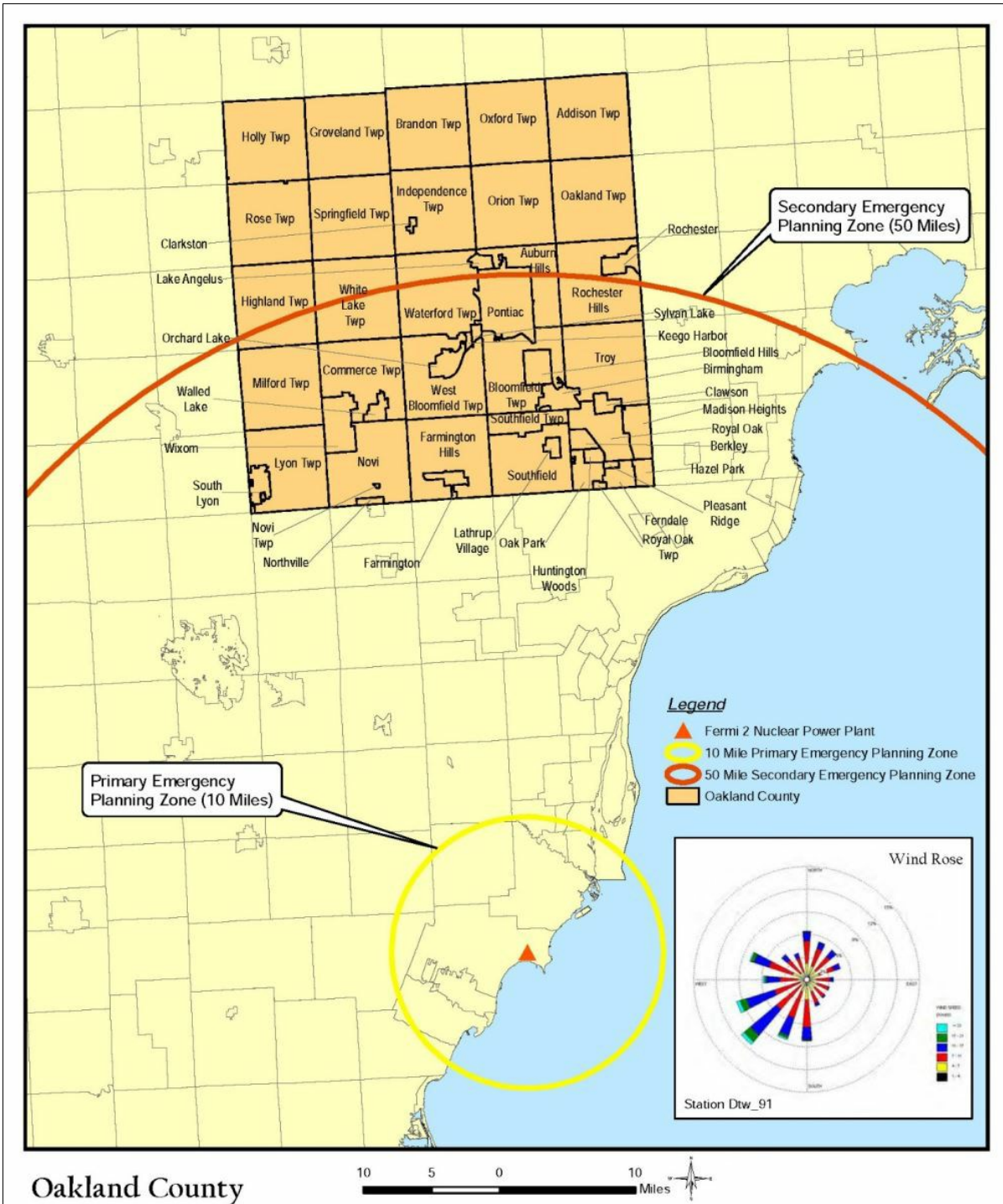
Oakland County



Source: Oakland County, MI, USDA,

SEMCOG | Created by: ASTI

Figure 43: Nuclear Power Plant Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Figure 44: Nuclear Power Plant Accident Vulnerability Map

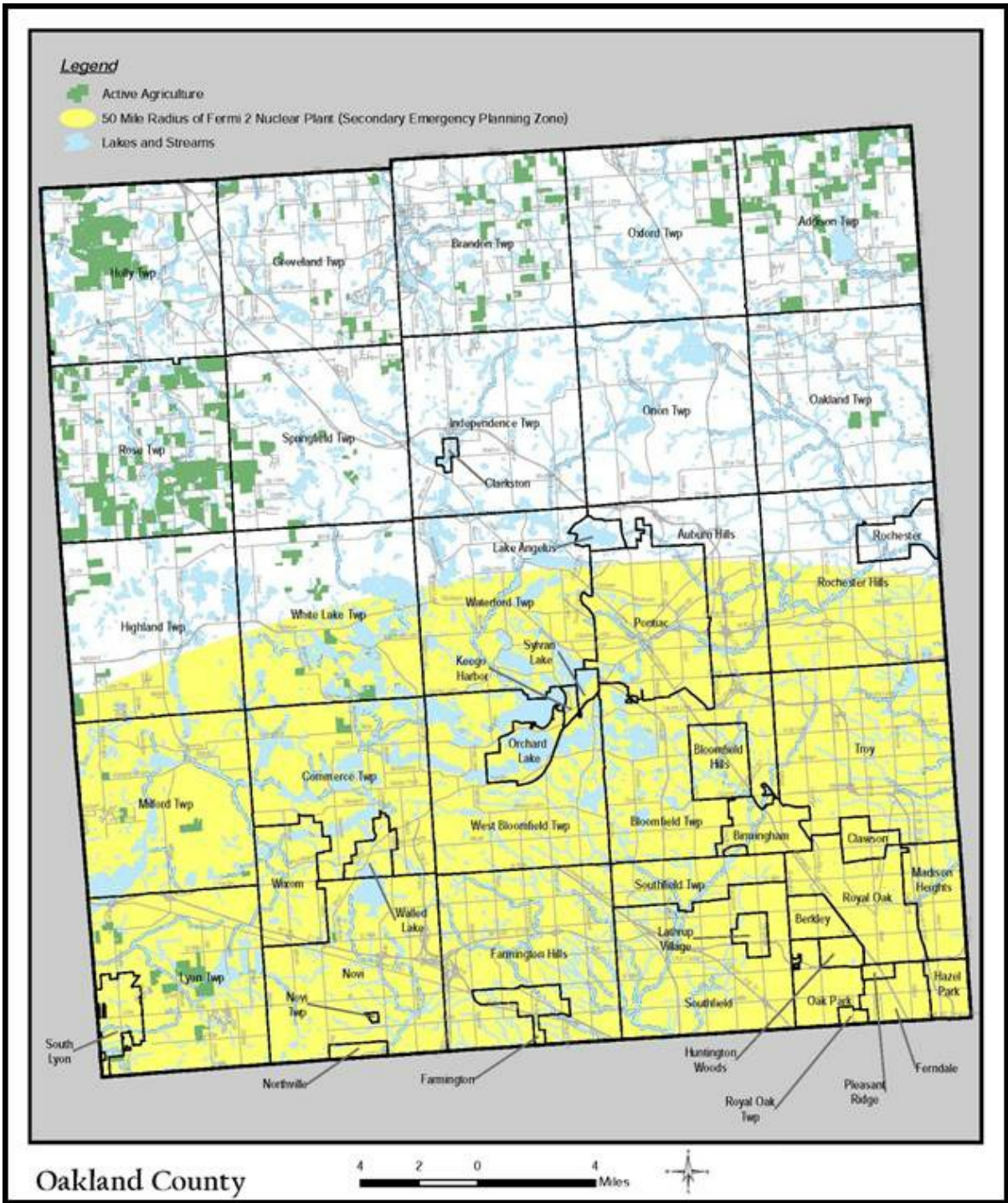
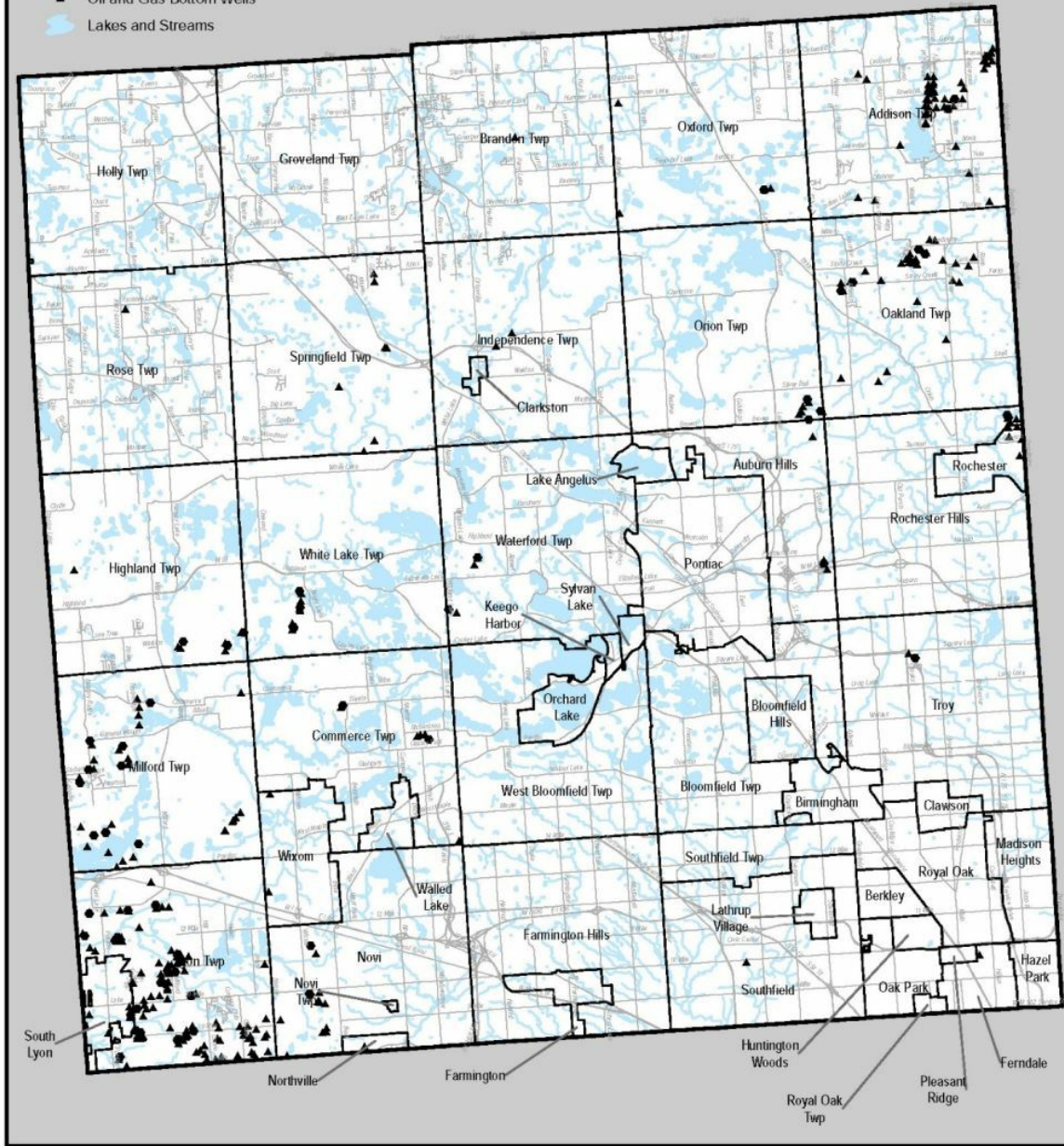


Figure 45: Oil and Gas Well Map

Legend

- Oil and Gas Surface Wells
- ▲ Oil and Gas Bottom Wells
- ☁ Lakes and Streams



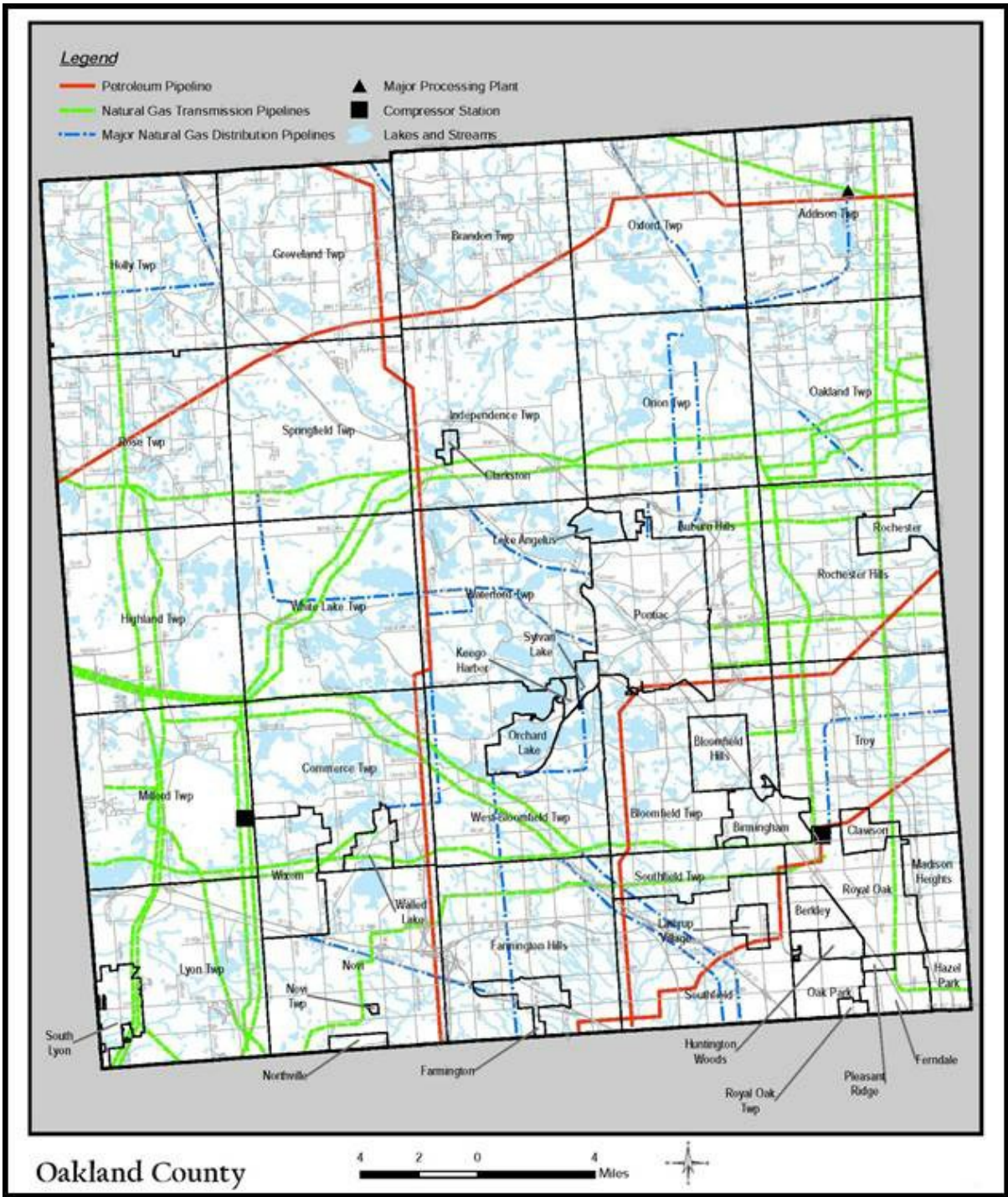
Oakland County



SEMCOG | Created by: ASTI

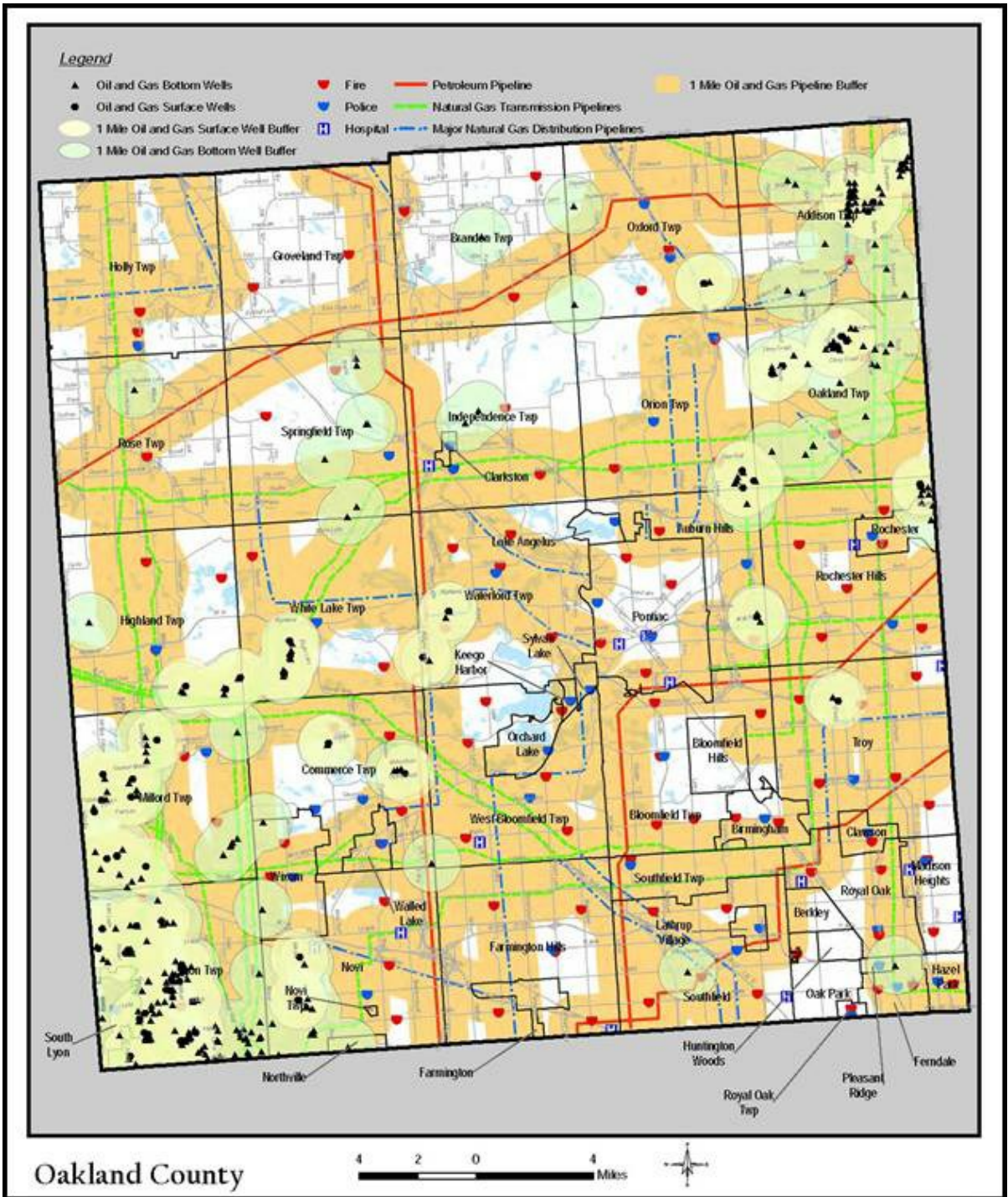
Source: Oakland County, MI, USDA,

Figure 46: Natural Gas and Petroleum Pipeline Map



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Figure 47: Pipeline and Well Vulnerability Map

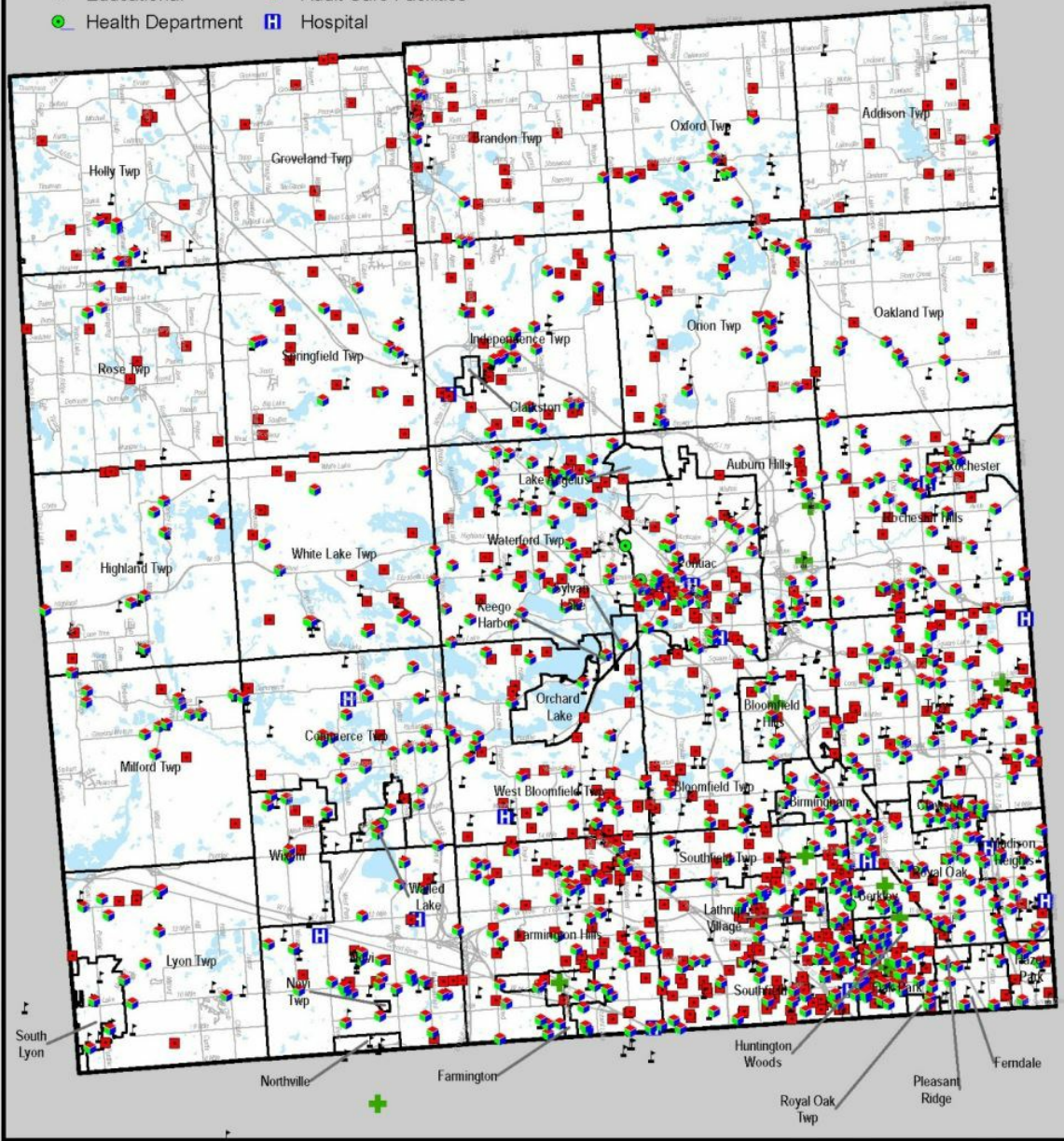


Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Figure 48: Public Health Emergency Vulnerability Map

Legend

-  Day Care Facilities
-  Public Safety
-  Lakes and Streams
-  Educational
-  Adult Care Facilities
-  Health Department
-  Hospital



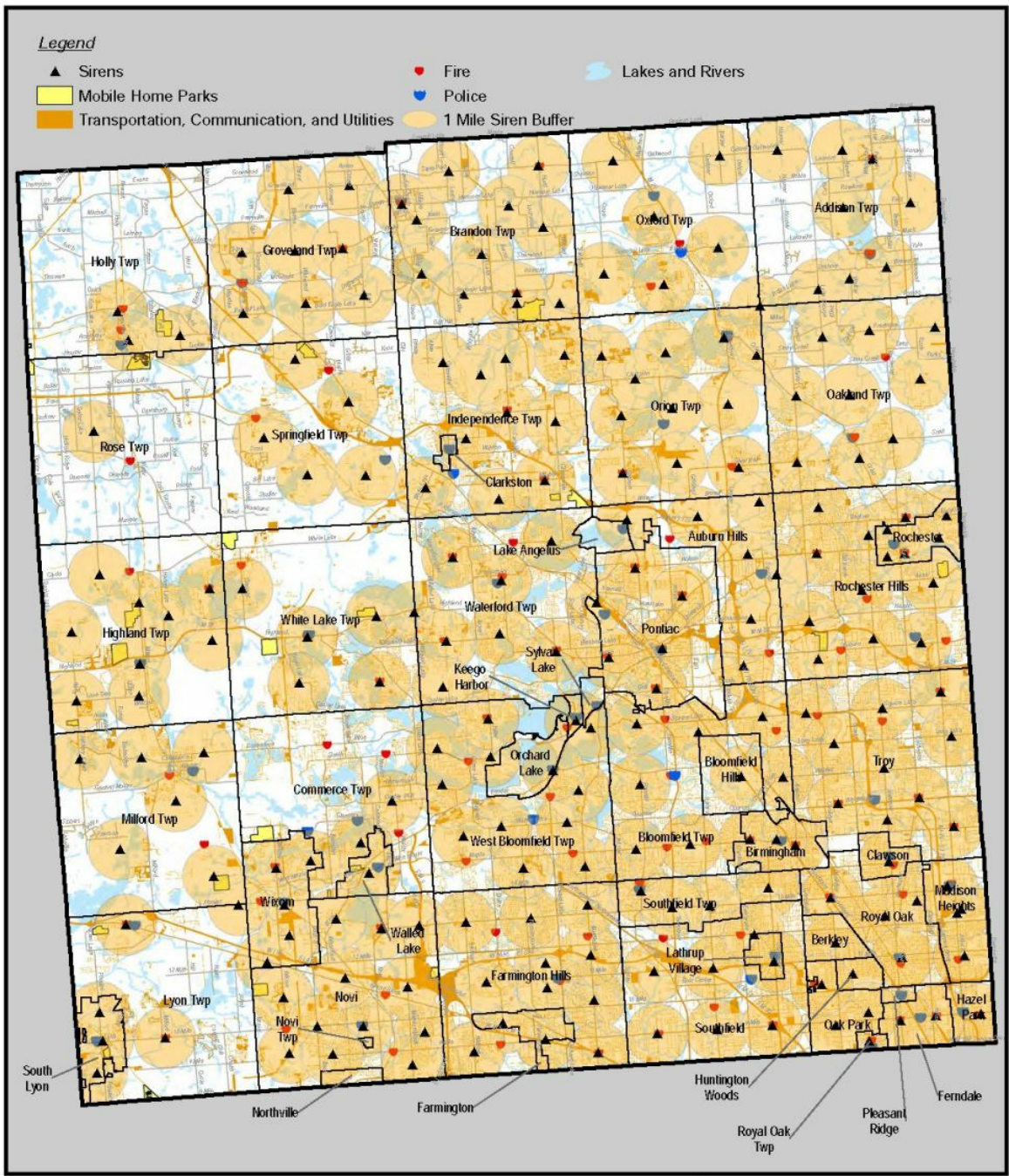
Oakland County

4 2 0 4 Miles



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Figure 49: Severe Weather (Thunderstorms, Severe Winds, Tornado) Vulnerability Map



Oakland County



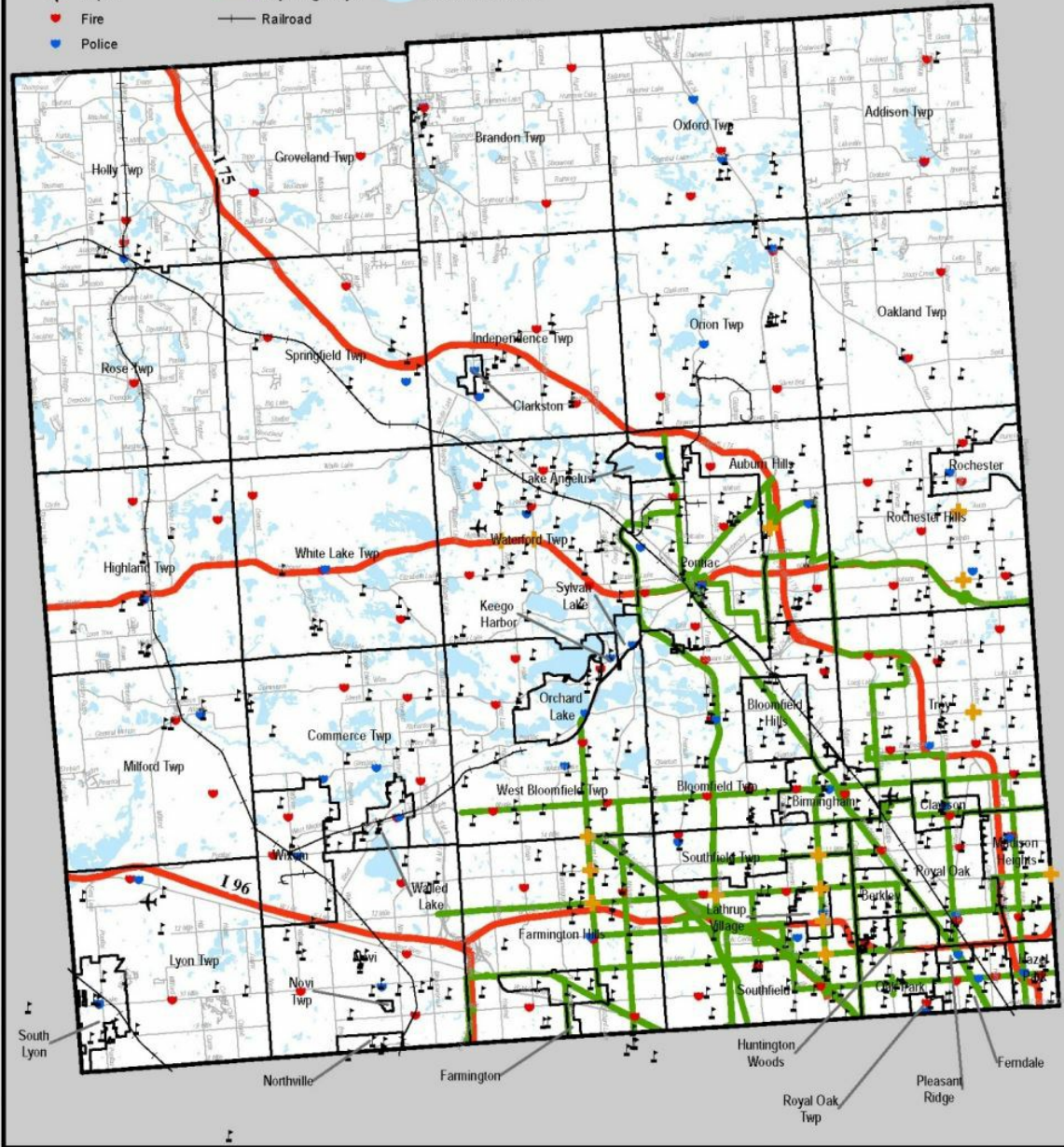
Source: Oakland County, MI, USDA,

SEMCOG | Created by: ASTI

Figure 50: Transportation System Vulnerability Map

Legend

- 🏫 Educational Facilities
- ✈️ Airport
- 🚒 Fire
- 👮 Police
- 🚌 Smart Bus Routes
- 🛣️ Major Highways
- 🚊 Railroad
- ⚡ High Crash Intersections
- 🌊 Lakes and Streams



Oakland County

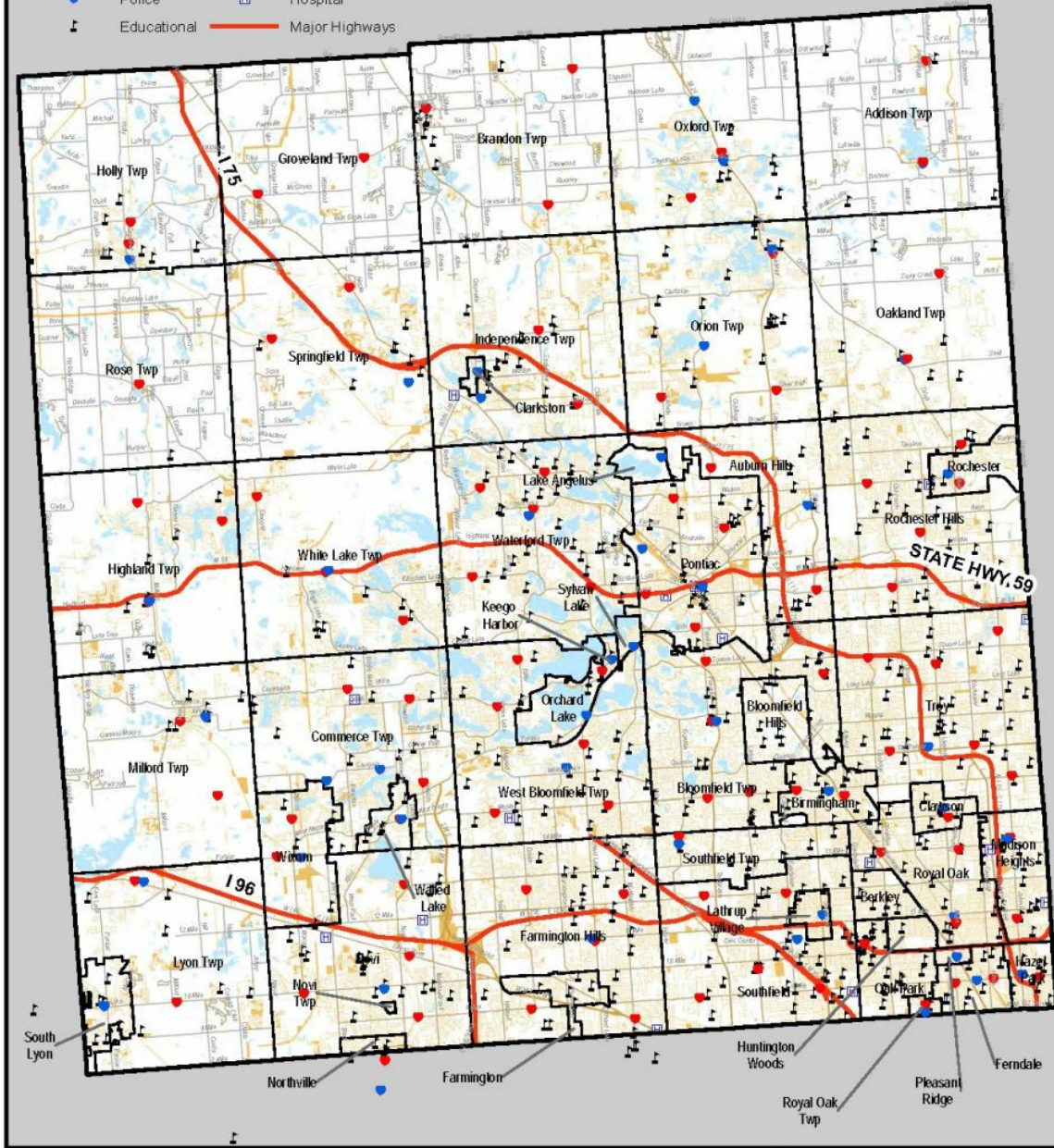


Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

Figure 51: Winter Hazards Vulnerability Map

Legend

- Fire
- Police
- ⚡ Educational
- Transportation, Communication, & Utility
- Hospital
- Major Highways
- ☁ Lakes and Streams



Oakland County



Source: Oakland County, MI, USDA, SEMCOG | Created by: ASTI

1.11.2 Appendix B: Meetings and Outreach Materials

Published 7/6/2018 08:46 by Nathaniel Marlette

Steering Committee Meetings

5/5/2017

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan: Project Kickoff Meeting
Oakland County, MI

Hazard Mitigation Planning Meeting - Project Kickoff
Date: 5/5/2017

Name	Organization	Phone	E-mail
Jack Blanchard	Berkley Public Safety	248-930-9687	jblanchard@berkeleymi.net
Mike Crum	Berkley DPS	248-658-3393	micrume@berkeleypublicsafety.net
Bill Coker	Rochester Hills Fire Dept.	(248) 650-4720	Cokerb@rochesterhills.org
John Bernard	FT MARINE	586-209-9586	Jbernard@nmasresources.com
Tom Ambrose	Franklin Township (PA)	281-480-4902	Tambrose@franklinpa.gov
Bill Johns	City of Southfield	248-796-5912	wjohns@cityofsouthfield.com
Tim Roberts	MI - EMSA	517-202-5593	timroberts@emsa-mi.gov
James Newells	FHEO-	248-334-7710	jnewells@fheo.com
Michael Bastianelli	Franklin Td	248-626-9670	bastianelli.ma@franklinpa.gov
Sharon Stahl	Gage Products	248-761-8511	sshahl@gageproducts.com
Connie Sims	WRC	248-858-1441	simscc@oakgov.com
Ron Marie	Warren PD	248-624-6114	RMarie@warrenmi.gov
Paul Tombaugh	Oakland Univ		ptombaugh@oakland.edu
Don McEllan	Lake Angelus IA	248-343-0374	mcellan@lakeangelusmi.net
Tom Hardesty	Oakland County Health Services	248-453-9578	thardesty@oakgov.com
Mike Kuzila	Oakland County Hazardous Materials	(248) 858-1598	kuzilame@oakgov.com

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan: Project Kickoff Meeting
Oakland County, MI

Hazard Mitigation Planning Meeting - Project Kickoff
Date: 5/5/2017

Name	Organization	Phone	E-mail
DAVE ROSS	Westland Hill FD	248-409-1514	dross@westlandhillmi.gov
Scott McKee	Lathrop Village PD	248-663-6031	smckee@lathropvillage.org
Jim Goetzweck	Green Lakes Crossing	248-454-5015	jgoetzweck@glcusa.com
Joe Wilkin	HUSH	248-937-3334	jwilkin@hush.org
Les Goodman	Lake Orion Schools	248-521-7178	lrgoodman@charter.k12.mi.us
John B. Martin	NOVI FIRE	248-939-0593	jmartin@cityofnovi.org
Chori Marics	OCHSD	248-452-9879	maricsg@comcast.net
Kevin Sullivan	Farmdale Fire	248-632-2093	ksullivan@farmdalefire.com
JOHN CIUSCIT	Rochester Fire	248-651-4470	jciscit@rochesterhills.org
TONY DRAITZ	OAKLAND CO HEALTH	248-858-1320	drautzto@oakgov.com
DAVID ALK	ISC	248-390-2121	
Don Martin	ISC	847-477-6342	

8/4/2017

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan: Hazard Identification and Risk Analysis
Oakland County, MI

Hazard Mitigation Planning Meeting - Hazard Identification and Risk Analysis			
Date: 8/4/2017			
Name	Organization	Phone	E-mail
THOM HANSEN	DLHSD	248-458-9576	hansth@oakgov.com
MIKE KUZIO	OCHSD	(248) 858-1598	KUZIO@oakgov.com
James Newell	FHEI	248-337-7716	jnewell@fhgov.com
Stan Barnes	FHPD	248-871-2820	sbarnes@fhgov.com
John Busmann	T/T MARINE INC	586-207-9586	JBUSMAN@TTCMARINEACADEMY.COM
Glori Macias	OCHSD	248 452 9879	maciasg@oakgov.com
Jack Blanchard	Berkley	248-930-7667	jblanchard@berkleypub.net
Todd Strobel	Boehle Chemicals	248-844-9010	todds@boehlechem.com
MICHAEL KAPLAN	WATERLOO	516-567-4909	michael@kayak.com
PAUL TOMBOULAKIS	Oakland Univ	248-651-8740	tombouli@comcast.net
Gara Stoddard	OC Health	248-869-6288	stoddard@oakgov.com
Jim Goetzinger	GLCO	248-454-5015	jgoetzinger@comcast.net
Dave DeBoer	WBSD	248 401-1514	deboer@wbsd.com
MIKE CRUM	Berkley DPS	248 658-3393	mcrum@berkeleypublicsafety.com
Melanie Benzene	OCHD	248-858-1318	Benezame@oakgov.com
Sharon Stahl	Gage Products	248-761-8511	sstahl@gageproducts.com

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Planning Meeting - Hazard Identification and Risk Analysis			
Date: 8/4/2017			
Name	Organization	Phone	E-mail
JOHN REARDON	LEPC	2485051423	REARDON1655@ATT.NET
Kerwin Schio	OCHSD	248-858-1724	SCHIOK@oakgov.com
Lauren Martin	ISC	224-432-7607	lauren.martin@i-s-consulting.com
Dale Abe	ISC	208-390-2021	dale.abe@i-s-consulting.com

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan: Mitigation Actions and Strategies
Oakland County, MI

Hazard Mitigation Planning Meeting Date: 11/2/2017			
Name	Organization	Phone	E-mail
Dale Ak	ISC	248-370-2021	dak@okc.org
MIKE KUZILO	OCHSD	(248) 858-1518	KUZILO@OCHSD.COM
Don McLean	Large Angels	248/343-0374	MCLEAN@ST@LargeAngels.net
Jack Blanchard	Berkley	248-930-9607	jblanchard@berkleymi.net
Marcus Wiegert	OCHO	248-558-1357	wiegert@ocho.org
LEE Graham	DE 324	734-347-3382	lee.graham@de324.com
TOM DRATZ	OCHD	248-878-1320	tdratz@ocho.org
Sharon Stahl	Gage Products	248-761-8511	sstahl@gageproducts.com
Paul Tombooni	Oakland University	248-651-8740	tombooni@oakland.edu
Tina Katarista	MI-PHED	67-202-5577	katarista@mi-phed.org
Sara Stoddard	Hueph	918-898-1288	stoddard@hueph.com
John Gieslik	Rockstar Fire	248-651-4470	JGIESLIK@ROCKSTAR.MI.ORG
Peter Bell	Rockstar FD	248-651-4470	PBELL@ROCKSTAR.MI.ORG
Dave DeBon	West Branch	248-409-1514	ddebond@westbranchmi.org
James Newell	FHED	248-331-7716	jnewell@fhed.com
Jim Wilkin	HVST	248-937-3334	jwilkin@hvs.org

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Planning Meeting Date: 11/2/2017			
Name	Organization	Phone	E-mail
Connie Sims	WAC	248-858-1441	Sims@wac.org
Michael Cron	Becky DBS	248-658-3853	cron@beckydb.com
Leah Kahn	ISC	731-818-3324	leah.kahn@iscmi.org



12/8/2017

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan: Review Meeting
Oakland County, MI

Hazard Mitigation Planning Meeting
Date: 12/8/2017

Name	Organization	Phone	E-mail
Jack Blanchard	Berkley	248-730-7667	jblanchard@berkeleymi.net
Tim Kotovik	M&P Enclis	517-202-5697	kotovik@multipurpose.com
Thom Hurley	Delia Cook	248-450-4576	thom@deliacook.com
Jim Wilton	HUS/IT	248-937-3334	jimwilton@ocmi.org
BRIAN CRANE	FRANKLIN	916/26-7672	bcrane@villagepd.org
Tony Anderson	FRANKLIN	248-526-9176	tony@franklinmi.com
Sharon Stahl	Gage Products Co.	248-761-8511	sstahl@gageproducts.com
Connie Sims	TWC	248-858-1441	csims@twc.org
Michael Cima	Oakland University	248-721-1200	mcima@oakland.edu
Dean Scholz	OC Risk	248-830-9375	scholz@ocmi.org
James Neufeld	FHFD	248-331-7716	jneufeld@fhfd.com
JOHN OLESZAK	RFD	248-651-4470	oleszak@ocmi.org
MIKE KOSKA	OCPSD	248-858-1598	mkoska@ocpsd.com
Danko Jec	ZIC	208-790-2021	danko@zic.com
Kevin Sullivan	Fennelle Fire	248-632-2093	ksullivan@fennellefirerescue.org
Sara Stoddard	Health Division	248-858-1288	stoddards@ocmi.org
Leah Kahn	ISC	831-818-3324	Leah.Kahn@i-sc.com



Stakeholder Webinars

Table 76: Stakeholder Webinar Participation

Name	Position/Title	Jurisdiction	Webinar Date
Tony Averbuch	Fire Chief	Southfield Township	Aug. 29, 2017
Tom Lindberg	Police Chief	Village of Milford	Aug. 29, 2017
Peter Scholz	Fire Chief	Oxford Township	Aug. 30, 2017
James Neufeld	EMC	City of Farmington Hills	Aug. 30, 2017
Steve King		Birmingham Schools	Aug. 31, 2017
Matthew Hess		Birmingham Schools	Aug. 31, 2017
Sam Barna		Oxford Schools	Aug. 31, 2017
Marshall Johnson	EMC	City of Novi	Sept 5, 2017
Andrew Pazuchowski	EMC	City of Huntington Woods	Sept 5, 2017

Stakeholder/Municipal Workshops

August 22, 2011

Dear Emergency Management Coordinators:

As I had indicated last year we will be holding a series of Mitigation Workshops throughout the County on October 17th, 18th, 23rd and 24th. During these workshops we will review the hazard risk assessment and ongoing mitigation actions with each community, as well as identify new mitigation actions.

We strongly recommend that each jurisdiction or school district attend one of the workshops. In preparation for the meeting, please review the Mitigation Plan and your jurisdiction's current plan's Ongoing Mitigation Actions and think about new mitigation actions you would like to include in the updated plan. It is beneficial to identify a planning team from your jurisdiction that can help to identify and implement mitigation within your community. Provided below is a list of agencies you might consider:

- Building Code Enforcement
- City Managers/County Administrators
- Emergency Management
- Fire Department/District
- Floodplain Administration
- Geographic Information Systems
- Public Works
- Stormwater Management
- Transportation/Highway Department
- City Council/Town or Commission
- Planning Commission
- Planning/Community Development
- Regional/Mitigation Planning Organizations
- City/County Advisory Office
- Economic Development Agency
- Local Emergency Planning Committee
- Police/Sheriff's Department
- Sanitation Department
- Tax Assessor's Office
- Special Districts/Authorities
- Airport Security Operations
- Fire Control District
- Flood Control District
- School District(s)
- Health Authority
- Utility District

The Workshop schedule is below:

Date	Location	Time
Tuesday, October 17th	Oakland International Airport 6500 Highland Rd Warrens MI 48092	Local/School Emergency Management Team 2pm to 4 pm Public Meeting 6pm to 8 pm
Wednesday, October 18th	Independence Twp Fire Station #1 6500 Citation Dr. Livonia MI 48140	Local/School Emergency Management Team 2 pm to 4 pm
Monday, October 22nd	Farmington Hills Fire Station 5 31455 W. 11 Mile Rd Farmington Hills MI 48335	Local/School Emergency Management Team 2 pm to 4 pm Public Meeting 6pm to 8 pm
Tuesday, October 24th	Bakeria of Milford 2832 56th Mile Rd Milford MI 48361	Local/School Emergency Management Team 2 pm to 4 pm

Again, please feel free to contact myself or Mike Kuzig at 248-656-5000 if you have any questions. We look forward to seeing you at one of the upcoming workshops. Thank you.

Gratefully,



Thomas G. Heidealy
Manager, Homeland Security Division

Oakland County Mitigation Meetings

Please use this form to identify what Oakland County Mitigation Meeting you and others from your jurisdiction or organization will attend.

Name *

First Last

Jurisdiction/Organization *

Email *

Phone Number

 - -

####

Number of Potential Attendees (Including Yourself) *

Please select the meeting your jurisdiction/organization will attend. *

Please select your meeting

Please select your meeting

- Tuesday, October 17th, 2 pm to 4 pm (Oakland International Airport, 6500 Highland Road, Waterford MI 48327)
- Wednesday, October 18th, 2 pm to 4 pm (Independence Twp Fire Station 1 6500 Citation Dr. Clarkston MI 48346)
- Monday, October 23rd, 2 pm to 4 pm (Farmington Hills Fire Station 5 31455 W. 11 Mile Rd Farmington Hills MI 48336)
- Tuesday, October 24th, 2 pm to 4 pm (Baker's of Milford 2923 S. Milford Rd. Milford MI 48381)

10/17/2017

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan: Workshops
Oakland County, MI

Hazard Mitigation Planning Meeting - Workshops
Date: 10/17/2017

Name	Organization	Phone	E-mail
Steve King	Birmingham P/S	248-223-3983	SKING@birmingham-12-MI.us
Jenny Morawski	Addison Twp Fire	248 628 5600	SMORAWSKI@AFFD@CMAA.I.ca
BRUCE PEARSON	Addison Twp. Spins	248 628 5409	bpearson@AddisonTwp.org
Victor Cardenas	City of Novi	347-0450	vcardenas@cityofnovi.org
JOHN B. MARTIN	CITY OF NOVI	248-939-0553	jbmartin@cityofnovi.org
MARSHALL JOHNSON	CITY OF NOVI	248 347-0558	mjohnson@cityofnovi.org
Teri Stinson	W.B. Schools	248 520-1680	thorstee.stinson@wbsd.org
BILL CHAFFIELD	WALLED LAKE SCHOOLS	248-956-3060	williamchaffield@wlsd.org
Greg LeLito	MADISON HEIGHTS	248-588-3605	greglelito@madison-heights.org
Alan Weber	Novi	248-568-3080	aweber@CityofNovi.org
Bill Cooke	Rochester Hills FD	243-656-4717	Cookebr@rochesterhills.org
Mike Drago	Novi Community Schools	248-255-1210	michael.drago@novi.k12.org
JOE RAONIA	LampHERE Schools	248-589-1990	RaoniaJ@LampHEREschools.org
MAU COVEY	Waterford Region	248-518-6607	MCovey@WaterfordMI.org
JOHN GRESK	ROCHESTER FIRE	248-651-4770	JGRESK@ROCHESTERMI.org
Jarrod Hart	City of Novi Police	248-735-5609	Jhart@cityofnovi.org

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Continues →

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan Workshops
Oakland County, MI

Hazard Mitigation Planning Meeting - Workshops
Date: 10/17/2017

Name	Organization	Phone	E-mail
Mike Kuzin	OCHSD	248-858-1598	Kuzinm@ocgov.com
Leah Kahn	Isc	831-88-3324	leah.kahn@i-s-consulting.com
Danko Abe	Isc	208-390-2021	danko.abe@i-s-consulting.com
Thom Woodruff	OCHSD	248-452-9576	woodruff@ocgov.com





10/18/2017 Workshop

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan: Workshops
Oakland County, MI

Hazard Mitigation Planning Meeting - Workshops
Date: 10/18/2017

Name	Organization	Phone	E-mail
DAVID KWAPIS	BRANDON Township	248-627-4000	DKWAPIS@BRANDONFIRE.ORG
LARRY WESTLEY	AVONDALE SCHOOLS	248-229-5513	larry.westley@avondale.k12.mi.us
Antonio Macias	AVONDALE HILLS	248-496-8774	amacias@avondalehills.org
HARRY ANDERSON	CLAWSON PD	248-655-4450	hander@cityofclawson.com
Jeremy Lintz	Holly Twp./Rose Twp.	248-459-8316	jlintz@noctu.com
Jon Firth	Berkley Schools	248-857-8049	jfirth@berkleyschools.org
Mark Brown	Independence Twp.	248.519.4422	mbrown@independencefire.org
Ugo Clason	Bloomfield Hills	248 701-0777	uclason@bloomfieldhills.org
Sam Barna	Oxford Comm Schools	248 969 5208	sam.barna@oxfordschools.org
Leah Kahn	ISC	831-818-3324	leah.kahn@i-s-consulting.com
Danko Abe	ISC	208-390-2021	danko.abe@i-s-consulting.com
Micko Kuzila	OCLUSD	248 858 1598	KUZILAM@OCLUSD.COM
Tom Winters	Ox HSN	248 452 9576	twinters@oxfordhsn.com



10/23/2017 Workshop

-SIGN-IN SHEET: Hazard Mitigation Plan Update-

Hazard Mitigation Plan Workshops
 01/24/2017

Hazard Mitigation Planning Meeting - Workshops
 Dec. 11/2017

Name	Organization	Phone	Email
James Nechold	FHEO	248-34-7116	jnechold@fheo.net
Mike Gorn	Berkley	248-658-3593	mike.gorn@berkley.mi.us
Matt Koehn	Berkley	248-658-3589	mkoehn@berkley.mi.us
Erin Craine	Franklin PD	2-626-9672	ecraine@franklin.mi.us
Dan Forbis	Franklin PD	" "	dforbis@franklin.mi.us
HAROLD ROSSMAN	Lake Orion	248-693-8326	rossmanh@lakeorionmi.org
Reginald Madelico	Farmington DPS	248-474-4700	rmadelico@farmingtonmi.org
Kenneth Kirby	Oakland Univ Police	248-802-4326	k Kirby@oaklandmi.edu
Ted Westman	Farmington	248-774-4200	twestman@farmingtonmi.org
Chad Leedy	Farmington	248/473-7250	cleedy@farmingtonmi.org
Mike Koloski	Ferris State	248-336-4201	m.koloski@ferris.edu
Frank Demers	Farmington	248-474-5500 x 2735 248-516-6166	fdemers@farmingtonmi.org FRANK.DEMERS@MI
Ray Arnold	Franklin	" "	" "
Karen Mondon	Farmington Hills	248-871-2330	kmondon@farmingtonhillsmi.org
Jason Gonzalez	Waterford Fire	248-604-2088	jgonzalez@waterfordmi.org
Brandy Siedkezel	Southfield	248-76-4806	bsiedkezel@southfieldmi.com

-SIGN-IN SHEET: Hazard Mitigation Plan Update-

Hazard Mitigation Planning Meeting - Workshops
 Dec. 11/2017

Name	Organization	Phone	Email
John Murrer	Farmington Hills PD	248 489 3124	murrerjohn@farmingtonhillsmi.org
George Metzger	Farm Hills CMO	248 87-2500	gmetzger@farmingtonhillsmi.org
Steve Brown	Warren	248-624-0804	sbrown@warrenmi.org
Brian Brown	Ferris State Fire	248 632 2096	bbrown@ferris.edu
Kevin P. Sullivan	Ferris State City Fire	248-632-2093	ksullivan@ferris.edu
Dave Abe	ISC	208-390-2021	dave.abe@isc.org
Leah Kuban	ISC	831-818-2224	leah.kuban@isc.org
Mike Kuzner	OCHSD	248 858 1578	kuzner@ochsd.com
Thom Hackstaff	OCHSD	248 457 9578	thom.hackstaff@ochsd.com



10/24/2017 Workshop

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Plan Workshops
Oakland County, MI

Hazard Mitigation Planning Meeting - Workshops
Date: 10/24/2017

Name	Organization	Phone	E-mail
Kevin Knauiss	Milford Police	248 684 1815	kknauiss@milfordpolice.com
Scott McKee	Lathrup Village	248-663-6032	Policechief@lathrupvillage.com
Michael Carlson	Northrup	248-449-7721	micarison@northrup.com
Tom Lindberg	Milford	248 684-1815	tlindberg@milfordpolice.com
Don Green	MILFORD TWP	248 685 8731	supervisor@milfordtownship.com
CHARL SOVIK	SOUTH LYON	248-437-4193	sovik@southlyonpolice.com
Lloyd Collins	South Lyon	248 437 1777	chief@southlyonpolice.com
John Elsbirth	Wolverine Lake	248-926-6060	John.elsbirth@wolverinelake.com
Bill Johns	Southfield	248-796-5992	Wjohns@cityofsouthfield.com
David Feichner	Springfield Twp	248 625 6699	feichner@springfieldwp.com
Harvey Stark	Beverly Hills	248 540 3410	hstark@beverlyhillspolice.com
Chad Trussler	Beverly Hills	248 540 3416	ctrussler@beverlyhillspolice.com
Thomas Goan	Milford Fire	248-684-1000	goan@milfordfiredept.com
Amy Goan	Milford Fire	248-684-1000	goan@milfordfiredept.com
Melissa Baker	South Lyon Schools	248 866 1626	mbaker@slcs-usd.org
PAUL SHEPCH	Clarencville School District	248 919-0250	Paul.Shepich@clarencville-schools.org

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- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Planning Meeting - Workshops			
Date: 10/24/2017			
Name	Organization	Phone	E-mail
Joe George	Orchard Lk Police	278-682-2100	Policechief@cityoforchardla.com
Peter Scholz	Oxford Fire Dept	248-769-9483	pscholz@oxfordfiredept.com
Leah Kahn	ISC	831-818-3224	leah.kahn@i-s-consilting.com
Dako Ave	ISC	208-370-2021	dakos@i-s-consilting.com





OAKLAND COUNTY EXECUTIVE L. BROOKS PATTERSON

Bill Mullan, Media & Communications Officer
Office: (248) 858-1048 | Cell: (248) 202-9868 | mullanw@oakgov.com

NEWS RELEASE

Oakland County seeks public input for disaster plan

Oct. 3, 2017, Pontiac, Mich. – Oakland County residents and businesses can help the county update its emergency preparedness plan by attending a voluntary public meeting, County Executive L. Brooks Patterson announced today.

There will be two informational and planning sessions open to members of the public who wish to inform the county about their emergency preparedness needs in the event of a natural or manmade disaster:

- Tuesday, Oct. 17 from 6-8 p.m. at Oakland County International Airport Main Terminal, J. David VanderVeen Conference Center, 6500 Patterson Parkway, Waterford
- Monday, Oct. 23 from 6-8 p.m. at Farmington Hills Fire Station No. 5, 21455 W. 11 Mile Road, Farmington Hills

"With the public's involvement, we will work together to identify ways to improve our emergency preparedness," Patterson said. "That is why we encourage residents and business owners to attend."

Oakland County updates its hazard mitigation plans every five years to keep residents, businesses, and organizations well prepared and vigilant in compliance with federal requirements.

"Emergency preparedness planning helps to identify policies and actions that can be implemented over the long term to reduce risk and mitigate future losses," said Thomas Hardesty, manager of Oakland County Homeland Security Division.

About Oakland County Homeland Security Division

The Oakland County Homeland Security Division is dedicated to supporting Oakland County cities, villages, and townships through a coordination of effort for logistical support during emergency operations by enhancing all-hazard preparedness along with comprehensive homeland security initiatives and first responder training. It develops and coordinates programs for natural, technological, national security, and nuclear/chemical/biological emergencies/disasters affecting Oakland County. For more information, go to OakGov.com/HomelandSecurity.

For media inquiries only, please contact Bill Mullan, Oakland County media and communications officer, at 248-858-1048.

###

PUBLIC MEETING TO PROVIDE INPUT INTO OAKLAND COUNTY'S DISASTER & EMERGENCY PLANS

OAKLAND COUNTY will be hosting two public information and planning sessions to gather input from Oakland County residents regarding the All-Hazard Mitigation Plan, which is undergoing a mandatory 5-year update. The plan addresses the County's key hazards and ways to mitigate their risks. The public is invited to attend either meeting. The first public meeting will be held Tuesday, October 17th at the Oakland International Airport (6500 Highland Rd., Waterford MI 48327) from 6 p.m. to 8 p.m. The second meeting will be held Monday, October 23rd at the Farmington Hills Fire Station 5 (31455 W. 11 Mile Rd., Farmington Hills, MI 48336) from 6 p.m. to 8 p.m.

10/17/2017

- SIGN-IN SHEET: Hazard Mitigation Plan Update - *Public Meetings*

Hazard Mitigation Planning Meeting - Workshops
Date: 10/17/2017

Name	Organization	Phone	E-mail
<i>Leah Kahn</i>	<i>ISC</i>	<i>831-88-3324</i>	<i>leah.kahn@i-sc.com</i>
<i>Dako Abe</i>	<i>ISC</i>	<i>208-390-7021</i>	<i>dako.abe@i-sc.com</i>
<i>Mike Lewis</i>	<i>OCHSD</i>	<i>(248) 858-1598</i>	<i>kl@ochsd.com</i>
<i>Thom Hurdoff</i>	<i>OCHSD</i>	<i>248 452-9576</i>	<i>thurdoff@ochsd.com</i>

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10/23/2017

- SIGN-IN SHEET: Hazard Mitigation Plan Update -

Hazard Mitigation Planning Meeting - Public Meeting
Date: 10/22/20

Name	Organization	Phone	E-mail
TIMOTHY TUTTLE	FAY RICE/CORVT	248-417-0970	TIM.TUTTLE@LIVE.COM
Jack Lewin	Municipality of Milford	734-417-4379	jlwin@milfordmi.gov
Leah Kahan	ISC	831-818-3324	leah.kahan@isc-consulting.com
Tom Hedges	OSHA	248-453-9578	hedges@oas.gov
MIKE KUZILO	OSHS	248-558-1598	Kuzilo@oas.gov
Daike Abe	ISC	208-390-2021	daike.abe@isc-consulting.com



Dil Mullan, Media & Communications Officer
Office (248) 858-1044 | Cell (248) 202-6882 | dil.mullan@oakgov.com

NEWS RELEASE

Public invited to review and comment on County's disaster plan

January 12, 2016, Pontiac, Mich. – Oakland County residents and businesses are invited to review and comment on the County's Hazard Mitigation Plan. The plan can be accessed at OakGov.com/HomelandSecurity.

Comments and questions about the plan can be sent to Oakland County Homeland Security Division by email OakGov.com/HomelandSecurity or phone 248-858-6300. The comment period will close January 26, 2016.

Oakland County adheres to federal requirements to update its emergency preparedness plans every five years in an effort to keep residents, businesses, and organizations well prepared and vigilant. The purpose of emergency preparedness planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses. This planning effort represents the dedicated participation of the County and all municipalities within Oakland County.

About Oakland County Homeland Security Division

Oakland County Homeland Security Division is dedicated to supporting Oakland County cities, villages and townships through a combination of effort for logistical support during emergency operations by enhancing all-hazard preparedness along with comprehensive homeland security initiatives and first responder training. Oakland County Homeland Security Division develops and coordinates programs for natural, technological, national security, and nuclear/chemical/biological emergencies/disasters affecting Oakland County. For more information, go to OakGov.com/HomelandSecurity.

For media inquiries only, please contact Dil Mullan, Oakland County media and communications officer, at 248-858-1044.

###

1.11.3 Appendix C: Workshop Materials

Published 7/6/2018 08:46 by Nathaniel Marlette



Hazard Mitigation Plan Update 2017

Oakland County, Michigan

Workshop Agenda

Meeting Date: 10/23-24/2017

Introductions
Mitigation Overview
Questionnaire Findings
Risk Summary/Risk Assessment Findings
Jurisdiction/District Hazard Summary Worksheet
Review Ongoing Mitigation Actions/Projects
Identify New Mitigation Actions
Oakland County Knowledge Management System

Jurisdiction-Specific Hazard Concerns
Oakland County, MI Hazards

Name: _____; E-mail: _____;

Jurisdiction/District: _____

Natural Hazards	
Hazards	Please describe any specific and/or unique concerns/risks that this hazard poses to your jurisdiction and/or school district. Include any vulnerable properties that are at risk of repetitive damages from this hazard, as applicable.
Drought	
Earthquake	
Extreme Cold	
Extreme Heat	
Fog	
Hailstorm	
High Winds	
Ice/Sleet Storms	
Flood (Riverine)	
Flood (Shoreline Flooding and Erosion)	

Environment-Specific Hazard Events

Flood (Urban/Fresh Flooding)	
Subsidence	
Thunderstorm and Lightning	
Tornado	
Wildfire	
Winter Storm/Blizzard	

Technological/Humanmade Hazards

Hazards	Classify the primary event to determine if this hazard poses a risk to you or your organization. LOW = low risk; MED = medium risk; HIGH = high risk. REPEATITIVE = damage from this hazard is cumulative.
Criminal Acts: Arson	
Criminal Acts: Mass Shootings/Active Assault	
Criminal Acts: Vandalism	
Power Failure	
Gas/Oil Spillage or Supply Disruption	
Hazardous Materials: Incidents, Filled Site	

(Jurisdiction-Specific Hazard) Examples

Hazardous Materials Incidents: Transportation Incident	
Infrastructure Failure: Communication System Failure Incident	
Infrastructure Failure: Electrical System Failure Incident	
Infrastructure Failure: Sewer System Failure Incident	
Infrastructure Failure: Storm Water System Failure Incident	
Infrastructure Failure: Transportation (Bridges, Roads, Overpasses) Infrastructure System Failure Incident Infrastructure Failure: Water System Failure Incident	
Invasive Species	
Nuclear Power Plant Accidents	
Oil and Gas Well Accidents	
Pipeline and Natural Gas Pipeline Accidents	
Scrap Tire Fire	

(Division Specific Hazard) Examples

Structural Fire	
Transportation Accidents: Air	
Transportation Accidents: Highway	
Transportation Accidents: Marine	
Transportation Accidents: Rail	
Civil Disturbances	
Structural Fire	
Terrorism and Sabotage	
Weapons of Mass Destruction	
Pandemic/Epidemic	

Name:

Organization/Department:

E-mail:

Phone:

New Mitigation Action (Please Describe):

Year Initiated	2017 (New Mitigation Action)
Applicable Jurisdiction or School District	
Lead Agency/Organization	
Supporting Agencies/Organizations	
Potential Funding Source	
Estimated Cost	
Benefits (loss avoided)	
Projected Completion Date	
PRIORITY (High, Medium, Low)	

Please indicate if the mitigation goals are applicable to the new mitigation action/project. Check All That Apply.

- Protection of public health and safety and prevention and reduction of loss of life and injury.
- Improve and support public and private organizational response capabilities.
- Prevention and reduction of damage to public and private property and infrastructure.
- Protect critical assets (example: hospitals, nursing homes, schools).
- Increase awareness and preparedness of public, business, non-profit, government, etc. about hazards.
- Encourage personal responsibility.

This mitigation action:

Instructions: Circle the description.

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
	(1)	(2)	(3)	(4)	(5)
Is financially feasible	-	-	-	-	-
Is cost effective	-	-	-	-	-
Can be easily accomplished, funded, measured, and sustained	-	-	-	-	-
Protects critical resources and property	-	-	-	-	-
Will be accepted by the community and public	-	-	-	-	-
Is environmentally sound	-	-	-	-	-

Place an "X" by the hazard(s) this action/project will mitigate:

Mitigated Hazards	
All Hazard	
Natural Hazards	
Drought	
Earthquake	
Extreme Cold	
Extreme Heat	
Fog	
Faulting	
High Wind	
Ice/Sleet/Storms	
Flood (River/Sea)	
Flood (Shallow Aquifer/Deep Fracture)	
Flood (Urban/Coastal/Leaking)	
Subsidence	
Thunderstorm/Lightning	
Tornado	
Wildfire	
Winter Storm/Blizzard	
Technological Hazards	
Cybermalicious/Insider	
Drilled Zone Waste Recovery/Water Issue/Inc.	
Criminal Acts/Vandalism	
Dam Failure	
Gas/Oil Storage or Supply Disruption	
Hazardous Materials Incident - Radio Site	
Hazardous Materials Incident - Transportation Incident	
Infrastructure Failure - Communication System Failure Incident	
Infrastructure Failure - Electrical System Failure Incident	
Infrastructure Failure - Sewer System Failure Incident	
Infrastructure Failure - Steam/Water System Failure Incident	
Infrastructure Failure - Transportation (Bridges, Roads, Overpasses) Infrastructure System Failure Incident	
Infrastructure Failure - Water System Failure Incident	
Invasive Species	
Nuclear Power Plant Accidents	
Oil and Gas Well Accidents	
Hydrogen and Natural Gas Pipeline Accidents	
Scrap Tire Fire	
Structural Fire	
Transportation Accidents - Air	
Transportation Accidents - Highway	
Transportation Accidents - Marine	
Transportation Accidents - Rail	
Civil Disturbances	
Spill/Leak Fire	
Terrorism/ Bomb Scenarios	
Weapons of Mass Destruction	
Pandemic/Epidemic	

1.11.4 Appendix D: Questionnaire

Published 12/28/2017 16:40 by Nathaniel Marlette

To Whom It May Concern:

Oakland County is conducting a study to better understand the preparedness needs and risk perceptions of its residents as part of the County's Hazard Mitigation Plan update process. To do so, a questionnaire has been distributed throughout the county, and you have been selected to participate. Your feedback is greatly needed and appreciated!

The questionnaire should only take about **10** minutes to complete. All responses will be kept confidential, and your participation is strictly voluntary. Your input will enable the County to better serve you.

Thank you for your participation.

If you have any questions, please contact: Oakland County Homeland Security Division (248.858.5300)

DEFINITIONS

Hazard Mitigation: The purpose of hazard mitigation planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses. Mitigation forms the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage.

1 Do you live and/or work in Oakland County? Please select the best answer that applies to your current situation.

- Yes, I live in Oakland County
- Yes, I live and work in Oakland County
- Yes, I live in Oakland County, but work in another county
- Yes, I work in Oakland County, but live in another county
- No, I do not live or work in Oakland County
- Not Applicable
- Do Not Know
- Other: _____

2 Approximately how many years have you lived in Oakland County, Michigan (IF APPLICABLE)?

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- 11 - 20 years
- 21 or more years
- Not Applicable
- Do not know

3 Approximately how many years have you worked in Oakland County, Michigan (IF APPLICABLE)?

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- 11 - 20 years
- 21 or more years
- Not Applicable
- Do not know

4 Please indicate which community in Oakland County you live in (IF APPLICABLE).

- | | | | |
|---|---|--|--|
| <input type="checkbox"/> Addison Township | <input type="checkbox"/> City of Ferndale | <input type="checkbox"/> Milford Township | <input type="checkbox"/> Rose Township |
| <input type="checkbox"/> City of Auburn Hills | <input type="checkbox"/> Village of Franklin | <input type="checkbox"/> Village of Milford | <input type="checkbox"/> City of Royal Oak |
| <input type="checkbox"/> City of Berkley | <input type="checkbox"/> Groveland Township | <input type="checkbox"/> City of Northville | <input type="checkbox"/> Royal Oak Township |
| <input type="checkbox"/> Village of Beverly Hills | <input type="checkbox"/> City of Hazel Park | <input type="checkbox"/> Novi Township | <input type="checkbox"/> City of South Lyon |
| <input type="checkbox"/> Village of Bingham Farms | <input type="checkbox"/> Highland Township | <input type="checkbox"/> City of Novi | <input type="checkbox"/> City of Southfield |
| <input type="checkbox"/> City of Birmingham | <input type="checkbox"/> Holly Township | <input type="checkbox"/> City of Oak Park | <input type="checkbox"/> Southfield Township |
| <input type="checkbox"/> Village of Bloomfield | <input type="checkbox"/> Village of Holly | <input type="checkbox"/> Oakland Township | <input type="checkbox"/> Springfield Township |
| <input type="checkbox"/> City of Bloomfield Hills | <input type="checkbox"/> City of Huntington Woods | <input type="checkbox"/> City of Orchard Lake | <input type="checkbox"/> City of Sylvan Lake |
| <input type="checkbox"/> Bloomfield Township | <input type="checkbox"/> Independence Township | <input type="checkbox"/> Orion Township | <input type="checkbox"/> City of Troy |
| <input type="checkbox"/> Brandon Township | <input type="checkbox"/> City of Keego Harbor | <input type="checkbox"/> Village of Ortonville | <input type="checkbox"/> City of Walled Lake |
| <input type="checkbox"/> City of Clarkston | <input type="checkbox"/> City of Lake Angelus | <input type="checkbox"/> Oxford Township | <input type="checkbox"/> Waterford Township |
| <input type="checkbox"/> City of Clawson | <input type="checkbox"/> Village of Lake Orion | <input type="checkbox"/> Village of Oxford | <input type="checkbox"/> West Bloomfield Township |
| <input type="checkbox"/> Commerce Township | <input type="checkbox"/> City of Lathrup Village | <input type="checkbox"/> City of Pleasant Ridge | <input type="checkbox"/> White Lake Township |
| <input type="checkbox"/> City of Farmington Hills | <input type="checkbox"/> Village of Leorsard | <input type="checkbox"/> City of Pontiac | <input type="checkbox"/> City of Wixom |
| <input type="checkbox"/> City of Farmington | <input type="checkbox"/> Lyon Township | <input type="checkbox"/> City of Rochester Hills | <input type="checkbox"/> Village of Wolverine Lake |
| <input type="checkbox"/> City of Fenton | <input type="checkbox"/> City of Madison Heights | <input type="checkbox"/> City of Rochester | <input type="checkbox"/> Other: _____ |

5 Please indicate which community in Oakland County you work in (IF APPLICABLE).

- | | | | |
|---|--|---|---|
| <input type="checkbox"/> Addison Township | <input type="checkbox"/> City of Ferndale | <input type="checkbox"/> Milford Township | <input type="checkbox"/> Rose Township |
| <input type="checkbox"/> City of Auburn Hills | <input type="checkbox"/> Village of Franklin | <input type="checkbox"/> Village of Milford | <input type="checkbox"/> City of Royal Oak |
| <input type="checkbox"/> City of Berkley | <input type="checkbox"/> Groveland Township | <input type="checkbox"/> City of Northville | <input type="checkbox"/> Royal Oak Township |
| <input type="checkbox"/> Village of Beverly Hills | <input type="checkbox"/> City of Hazel Park | <input type="checkbox"/> Novi Township | <input type="checkbox"/> City of South Lyon |
| <input type="checkbox"/> Village of Bingham Farms | <input type="checkbox"/> Highland Township | <input type="checkbox"/> City of Novi | <input type="checkbox"/> City of Southfield |

- 1. West Birmingham
- 2. Village of Ashford
- 3. City of Birmingham
- 4. Bessemer Township
- 5. Kanhawha Township
- 6. Prattville
- 7. City of Wetumpka
- 8. Wetumpka Township
- 9. City of Carverton, AL
- 10. City of Phenix
- 11. City of Enterprise
- 12. City of Wetumpka
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- 96. City of Wetumpka
- 97. City of Wetumpka
- 98. City of Wetumpka
- 99. City of Wetumpka
- 100. City of Wetumpka

6 Please indicate what type of device(s) you use to access the internet. None, ALL that apply.

- 1. Computer/laptop/desktop
- 2. Smart phone
- 3. Tablet
- 4. Other (please specify)
- 5. None

7 Please indicate these activities you have done to prepare for emergencies and disasters. Please select ALL that apply. I have...

- A. Attended preparedness classes
- B. Home inspection
- C. Used to disaster supply kit
- D. Visited local government website for emergency preparedness information
- E. Attended fire drill
- F. Read fire drills in the manual
- G. Other (please specify)
- H. None

8 Please indicate where you go to obtain emergency and disaster related information? Please select ALL that apply.

- 1. Local government website
- 2. Local emergency services
- 3. Local newspaper
- 4. Local television
- 5. Local radio
- 6. Local community center
- 7. Local church
- 8. Local library
- 9. Local school
- 10. Local business
- 11. Local government office
- 12. Local emergency services
- 13. Local newspaper
- 14. Local television
- 15. Local radio
- 16. Local community center
- 17. Local church
- 18. Local library
- 19. Local school
- 20. Local business
- 21. Other (please specify)
- 22. None

9 Would you agree or disagree with the following statements?

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Do Not Know
Oakland County is providing the services necessary to help prepare me for a disaster.	0	0	0	0	11	89
I can find the web site of Oakland County's web site and can easily obtain information about emergencies and disasters.	0	11	0	11	11	57
During times of emergency, information is provided in a language or format I can understand.	0	0	0	0	0	100
I can seek obtain emergency information in times of crisis.	0	0	0	11	11	78

10 Please indicate here (Oakland County) has been most helpful in preparing for emergencies and disasters (example: provide preparedness materials in my language).

11 If a disaster (i.e. one or more) impacted Oakland County, knocking out electricity and running water, would your household be able to manage on its own for at least three (3) days?

Yes No Maybe Other

12 Do you believe that your household and/or place of business might ever be threatened by the following hazards? Please rate what hazards present the greatest risk to your household.

Low Risk - Low impact on lives and property damage	Medium Risk - Moderate impact on lives and property damage	High Risk - High impact on lives and property damage	All Applicable
Earthquake/Blot	0	0	0
Criminal Activity (example: Active Shooter/Assault, Arson, Vandalism)	0	0	0
Item Failure	0	0	0
Drought	0	0	0
Earthquake	0	0	0
Extreme Cold Incident	0	0	0
Extreme Heat Incident	0	0	0
Flooding	0	0	0
Fog	0	0	0
Gas/Oil Shortages	0	0	0
Hazardous Material Release (example: Chemical Spill)	0	0	0
Infrastructure Failure (example: Bridge Collapse)	0	0	0
Major Transportation Accident Incident	0	0	0
Major Water Accident	0	0	0
Public Health Emergency (example: Pandemic)	0	0	0
Biological Incident	0	0	0
Severe Winter Storm/Heavy Snow/Ice Storm	0	0	0
Substance Abuse/Intoxication	0	0	0
Terrorist Incident	0	0	0
Thunderstorms	0	0	0
Tornado and High Winds	0	0	0
Utility Failure	0	0	0
Wildfires	0	0	0

13 Please select the answer that best describes your past experience.

- I have never experienced any type of damage or injury from a disaster.
- I have experienced minor property damage and/or injuries from a disaster.
- I have experienced major property damage and/or injuries from a disaster.
- I have experienced catastrophic property damage and/or injuries from a disaster.

14 If you have experienced any damage(s) or injury(ies) from a disaster, please list the hazard(s) that caused the damage/losses and/or injuries. (Example: flooding, wind, winter storms).

15 If you have experienced any damage(s) or injury(ies) from a disaster, please indicate where this occurred. (Example: my home, on a roadway or intersection, at work, on vacation, etc.).

16 If you have experienced any damage(s) or injury(ies) from a disaster, please describe the damage(s) and/or injury(ies). (Example: basement flooded, roof was damaged, vehicle was damaged, broken limbs, lacerations, etc.).

17 Based on YOUR PERCEPTION of your jurisdiction's hazards, to what degree of emphasis would you expect your jurisdiction to mitigate the following hazards?

Mitigation definition: The purpose of mitigation planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses. Mitigation forms the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage.

No Mitigation Needed = No mitigation on this hazard is expected or needed.	Low Priority = This hazard should be mitigated, but is not a high priority compared to other hazards.	Medium Priority = It is important to mitigate this hazard.	High Priority = It is a high priority to emphasize mitigation for this hazard.	
			Medium Priority	High Priority
No Mitigation Needed				
	Low Priority	Medium Priority	High Priority	
Civil Disorder/Riot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Criminal Acts (example: Active Shooter/Assault, Arson, Vandalism)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dam Failure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Drought	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Earthquake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme Cold Incident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme Heat Incident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flooding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fog	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gas/Oil Shortages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hazardous Materials Release (example: Chemical Spill)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Infrastructure Failure (example: Bridge Collapse)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Major Transportation Accident/Incident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oil/Gas Well Accident(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public Health Emergency (example: Pandemic)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Radiological Incident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Severe Winter Storms/Heavy Snowfall/Ice Storm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Subsidence (Sinkhole)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Terrorism Incident	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thunderstorms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tornado and High Winds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utility Failure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wildfires	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18 If an evacuation was ordered for your area, please indicate how likely you would be to do the following.

	Somewhat		Do Not Know	Not Applicable
	Very Likely	Likely		
Immediately evacuate as instructed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would first consult with family and friends outside my household before making a decision to evacuate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wait and see how bad the situation is going to be before deciding to evacuate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Refuse to evacuate no matter what.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19 What might prevent you from leaving your place of residence if there was an evacuation order? Select ALL that apply.

- Pet
- Livestock
- Job
- Need to care for another person
- Spouse/significant other won't leave
- Need to stay and protect property
- Lack of money
- No place to go
- No transportation
- Traffic
- Lack of gas/fuel for vehicle
- Disability/health issues
- No obstacles would prevent me from evacuating
- I would refuse to evacuate no matter what
- Other (please specify): _____

20 If you were to evacuate, where would you most likely stay? Please select the best answer.

- Shelter/evacuate center
- Church or place of worship
- Workplace
- Home of a friend or relative
- Hotel/motel
- Do not know
- Other (please specify): _____

21 In an evacuation, would you or anyone in your household require special assistance in order to evacuate?
 Yes (answer Questions 21a, 21b) No (Skip to Question 22) Not applicable
 Maybe (answer Questions 21a, 21b) Do not know Other: _____

21a Would that assistance be provided by someone within your household, by an outside agency, or by a friend or relative outside your household?
 Within household Outside Agency Not Applicable
 Friend/Relative (outside household) Do not know Other: _____

21b If applicable, please indicate what kind of outside assistance your household may need during an evacuation (i.e. Transportation, Medical, etc.)

22 What type of structure do you live in?
 Detached single family home Recreational vehicle (RV)
 Duplex, triplex, quadruple home Some other type of structure
 Multi-family building – 2 stories or less (apartment/condo) Do not know
 Mobile home Not applicable
 Manufactured home Other (please specify): _____

23 How many persons, including yourself, are currently living in your household?
Under age 5: _____ Ages 11-19: _____ Ages 45-64: _____ Ages 80+: _____
Ages 6-10: _____ Ages 20-44: _____ Ages 65-79: _____

24 Which of the following best describes your race/ethnicity? Select ALL that apply.
 American Indian or Alaska Native Hispanic or Latino
 Hawaiian or Other Pacific Islander Non-Hispanic White
 Asian or Asian American Other (please specify): _____
 Black or African American

25 Please indicate the language(s) spoken in your household. Select ALL that apply.
 English Asian or Pacific Island language Other (please specify): _____
 Spanish Other Indo-European language

26 Please indicate your sex.
 Female Male Not Applicable

27 (OPTIONAL) If you would like someone to contact you regarding emergency preparedness in Oakland County, please leave your contact information below, and a representative will contact you. We will ensure your information is kept confidential.
Name: _____ Phone Number: _____ Email: _____

This concludes the survey. Thank you for your time!

PLEASE MAIL COMPLETED SURVEYS TO:
Oakland County Homeland Security Division
1200 N Telegraph Rd, Bldg 47W
Pontiac, MI 48341

NEED MORE INFORMATION?



To learn more about us, contact our important information about emergency notification or preparation/pursuit call: <http://www.oakcountymichigan.com/forindividuals>

Sign Up for OakAlert: Oakland County Emergency Notification System

In the event of an emergency, it is critically important for you to be prepared and for you to be informed. Oakland County is taking a proactive approach to ensure our residents to be most aware of emergency situations that may impact individuals and businesses in Oakland County. By implementing the Oakland County Emergency Notification System (OakAlert), OakAlert is an emergency notification system enabling and empowering essential personnel be aware of various incidents in Oakland County.

- <http://www.oakgov.com/humanandcommunity/oakalert>
- Or contact the Information Security Division at (248) 278-7000.

Do I Thing: Emergency Preparedness

Being prepared for disasters and emergencies can seem like a big job. Many people don't know where to start, so they never start at all. With Do I Things you can take small steps that make a big difference in an emergency.

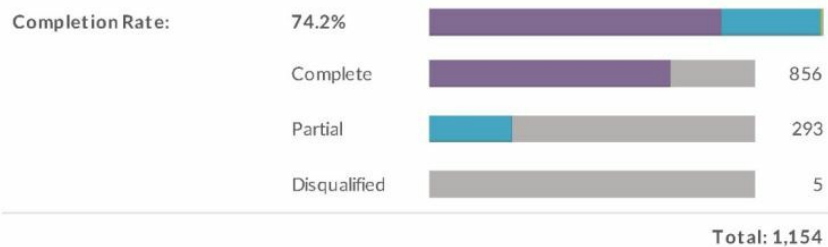
- For more information about do I thing, see <http://doi1thing.com>.

1.11.5 Appendix E: Questionnaire Results and Findings

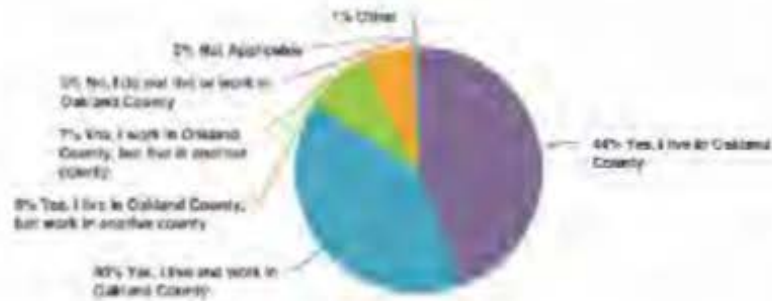
Published 12/28/2017 17:06 by Nathaniel Marlette

Report for 2017 Oakland County and Municipality Hazard Mitigation Questionnaire

Response Counts

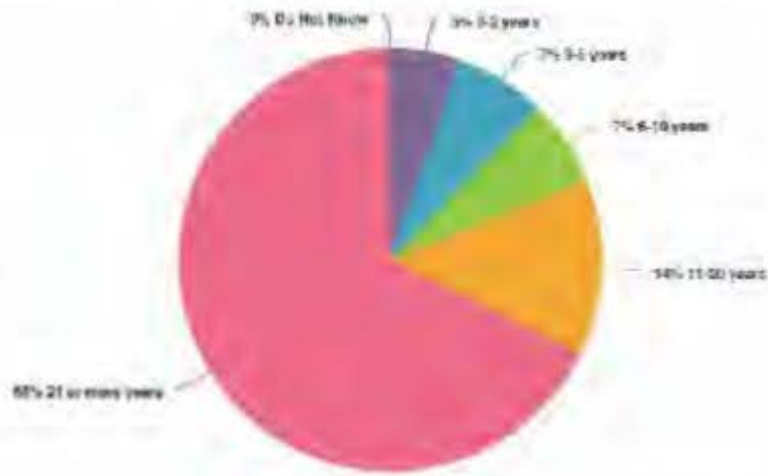


1. Do you live and/or work in Oakland County? Please select the best answer that applies to your current situation.



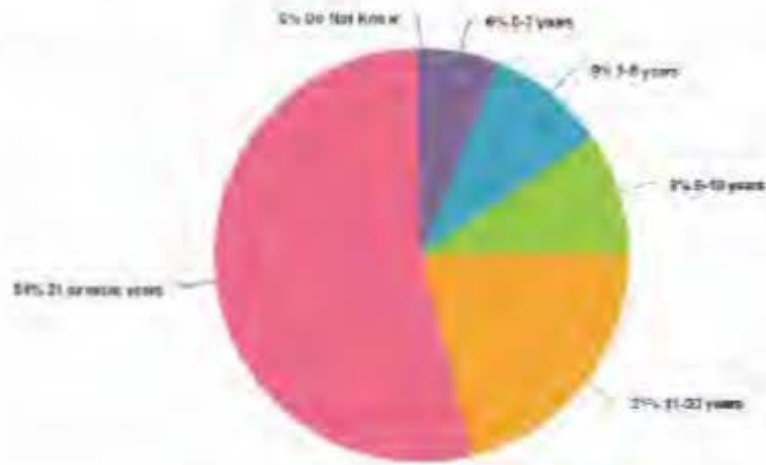
Value	Percent	Responses
Yes, I live in Oakland County	44.19%	482
Yes, I live and work in Oakland County	30.26%	324
Yes, I live in Oakland County, but work in another county	8.56%	92
Yes, I work in Oakland County, but live in another county	6.61%	72
No, I do not live or work in Oakland County	0.43%	4
Not Applicable	0.74%	8
Other	0.55%	6
		Total: 5,093

2. Approximately how many years have you lived in Oakland County, Michigan?



Value	Percent	Responses
0-2 years	5.4%	34
3-5 years	5.0%	33
6-10 years	6.0%	40
11-20 years	17.5%	104
21 or more years	65.0%	449
Do Not Know	10.4%	7
		Total: 691

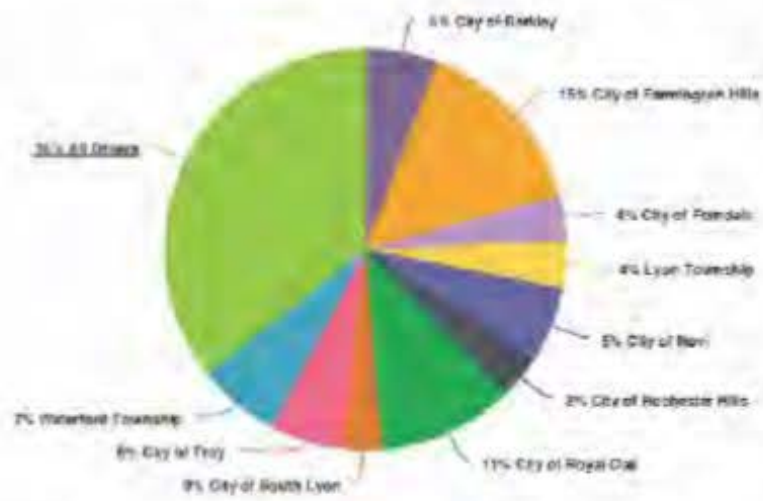
3. Approximately how many years have you worked in Oakland County, Michigan?



Value	Percent	Responses
0-2 years	3.2%	31
3-5 years	5.2%	46
6-10 years	9.4%	87
11-20 years	22.5%	107
21 or more years	59.8%	270
Do Not Know	0.2%	1

Total: 502

4. Please indicate which community in Oakland County you live in.



Value	Percent	Responses
City of Berkeley	5%	35
City of Farmington Hills	14%	101
City of Farmdale	3%	33
Lyon Township	3%	33
City of Novi	6%	66
City of Rochester Hills	3%	31
City of Royal Oak	11%	99
City of South Lyon	6%	69
		Total: 304

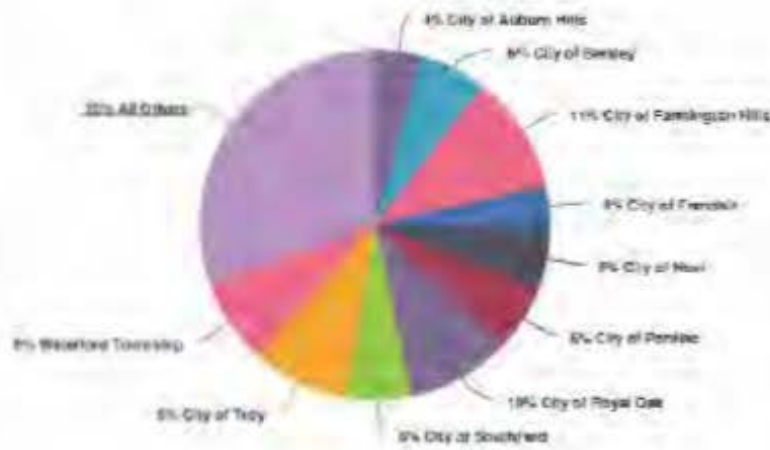
Value		Percent	Responses
City of Troy		50%	52
Williamston Township		47%	51
Adrian Township		0.16	1
City of Auburn Hills		0.7%	7
Village of Beverly Hills		0%	0
Village of Westland Farms		12%	13
City of Birmingham		17%	18
Blairsville Township		0.5%	5
Brighton Township		0.9%	9
City of Dearborn		0.7%	7
City of Dearborn		0.2%	2
Commerce Township		1.9%	20
City of Farmington		0.9%	9
Village of Franklin		0.1%	1
Crookland Township		0.2%	2
City of Hazel Park		0.2%	2
Highland Township		1.7%	18
Italy Township		0.7%	7
Village of Livonia		0.5%	5
City of Livingston Woods		0.5%	5
			Total 204

Value	Percent	Responses
Independent Township	2.0%	18
City of Eagle Harbor	0.2%	2
Village of Lake Orion	0.2%	2
Village of Livonia	0.1%	1
City of Madison Heights	2.5%	25
Mill Creek Township	1.1%	10
Village of Westland	1.0%	9
West Township	0.1%	1
City of Oak Park	0.0%	1
Oakley Township	1.3%	13
City of Orchard Lake	0.4%	4
Orion Township	1.1%	10
Village of Ortonville	0.1%	1
Oxford Township	1.1%	10
Village of Oxford	0.3%	3
City of Pleasanton	0.2%	2
City of Pontiac	0.6%	6
City of Royal Oak	1.7%	16
Rose Township	0.3%	3
Royal Oak Township	0.3%	3
		Total 254





















Value		Percent	Responses
City of Southfield		0.9%	1
Spring Lake Township		0.0%	0
City of Taylor		0.3%	1
West Bloomfield Township		1.5%	10
White Lake Township		2.4%	10
City of Warren		0.6%	4
Village of Westland		0.1%	1
Other		0.4%	3

Total: 104

5. Please indicate which community in Oakland County you work in.








Value	Percent	Responses
City of Auburn Hills	4%	21
City of Berkeley	5%	25
City of Farmington Hills	10%	51
City of Farmdale	3%	13
City of Novi	3%	21
City of Pontiac	6%	28
City of Royal Oak	10%	48
City of Southfield	3%	20
		Total: 473

Value		Percent	Responses
City of Troy		3.9%	42
Walworth Township		7.8%	87
Adrian Township		0.4%	5
Village of Dowsley Park		0.2%	3
Village of Reister Farms		1.3%	14
City of Genoa		0.2%	3
City of Bloomhick Hills		1.3%	14
Bloomfield Township		2.1%	23
Granite Township		0.2%	3
City of Dawson		0.2%	3
Cameron Township		1.9%	21
City of Farmington		0.4%	5
Village of Franklin		0.2%	3
City of Farm Park		0.2%	3
Richland Township		0.05%	1
Irby Township		0.4%	5
Village of Holly		0.2%	3
Beaufort Township		0.2%	3
City of Lake Angelus		0.2%	3
Village of Lake Orion		0.2%	3

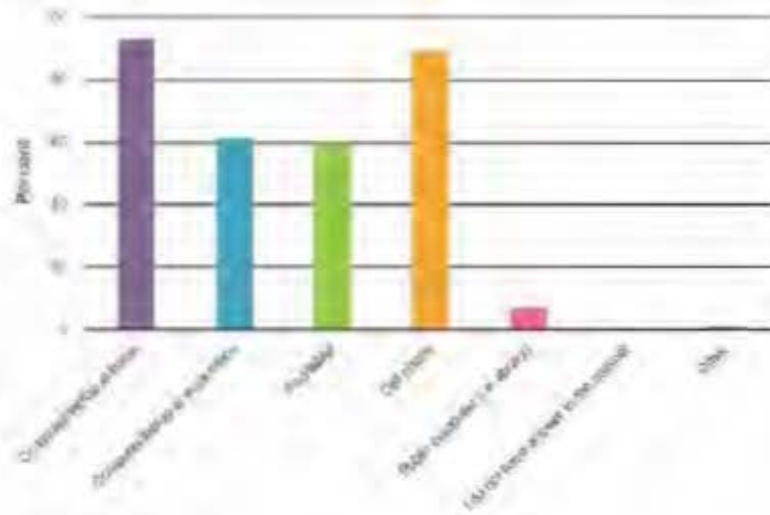
Total: 473

Value		Percent	Responses
City of Ladino Village		0.4%	2
East Township		1.3%	3
City of Madison Heights		1.9%	3
Adrian Township		1.2%	3
Village of Milford		1.1%	3
City of Livonia		0.8%	4
Royal Township		0.4%	2
City of Oak Park		0.2%	1
Oakland Township		0.4%	1
City of Okemos		0.4%	3
Oron Township		0.2%	4
Oxford Township		0.2%	1
City of Pleasant Ridge		0.2%	1
City of Rochester Hills		1.4%	3
City of Rochester		1.1%	2
City of South Lyon		0.7%	4
Southfield Township		0.4%	3
Spring Hill Township		0.2%	3
City of Sylvan Lake		0.2%	1
City of Westland		0.4%	2

Total: 479

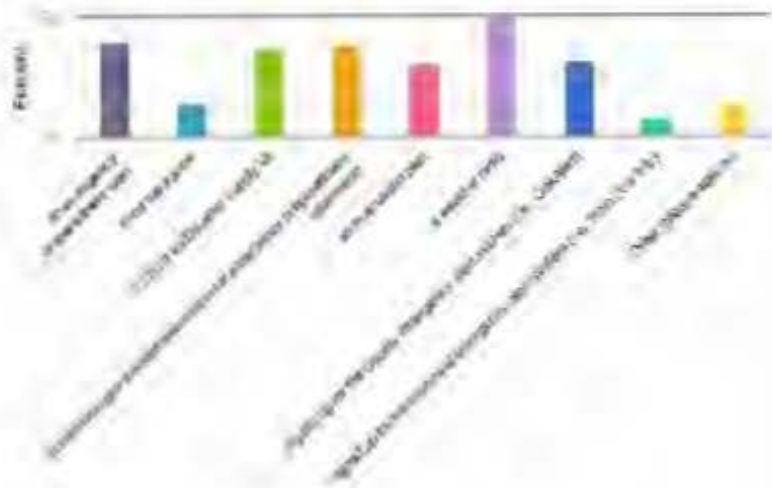
Value		Percent	Responses
West Bendure IT Services		100%	1
W&B Ink. Printing		100%	1
Calym/Moran		100%	1
Virginia-Missouri, LLC		100%	1
None		100%	1
			Total(7)

6. Please indicate what type of device(s) you use to access the internet. Select ALL that apply.



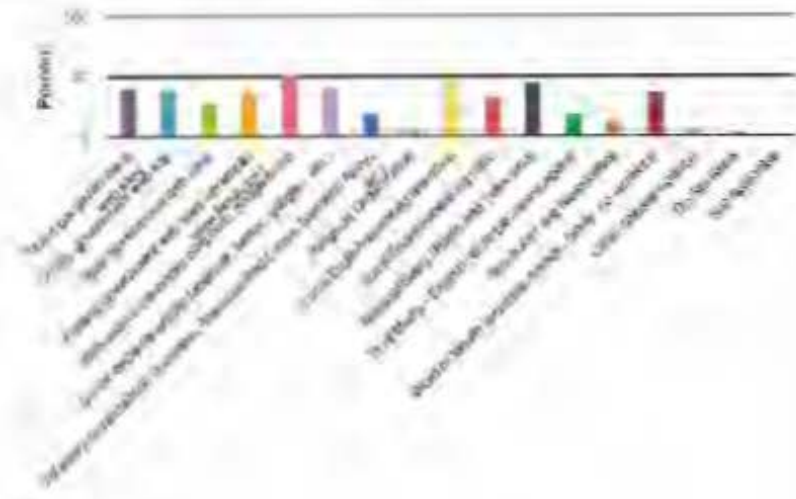
Value	Percent	Responses
Computer/Smartphone	93.2%	915
Tablet	61.3%	600
Cell phone	50.1%	491
Other (includes PDA, etc.)	3.4%	33
Other (includes smart TV, etc.)	1.2%	12
Other	0.8%	8

7. Please indicate those activities you have done to prepare for emergencies and disasters. Please select ALL that apply. (1 row)



Value	Percent	Responses
an emergency preparedness plan	35.73%	328
Basic Insurance	14.05%	113
21 hour kit/disaster supply kit	3.03%	29
know local government or fire department emergency preparedness information	27.56%	257
an evacuation plan	20.12%	241
an internet radio	4.72%	43
signed up for the County emergency alert system (i.e., DuAlert)	34.27%	297
signed up for the Nevada Statewide Emergency Alert System (i.e., NevadaAlert)	7.11%	58
Other (please specify)	13.61%	112

18. Please indicate where you go to obtain emergency and disaster-related information? Please select ALL that apply.



Value	Percent	Responses
Municipal government websites	40.5%	597
County government websites	39.0%	582
State government websites	27.9%	413
Federal government websites (example: www.fda.gov)	16.9%	253
Web search engines (bing.com, google.com)	51.9%	508
Social media (example: facebook, twitter, google+, etc.)	39.5%	387
Voluntary organizations (example: American Red Cross, Salvation Army, etc.)	18.5%	181
Religious Organizations	5.8%	48
Local English speaking community	45.8%	445
Local English speaking organizations	33.8%	325
Walk and Bikes (Bike and Tricycle)	44.5%	432
Food Meats - English language newspapers	28.0%	175
Brochures and Newsletters	12.0%	118
Word of Mouth (social friends, family, co-workers)	36.3%	355
Other (please specify)	9.0%	89
Do not know	3.5%	31
Not Applicable	0.4%	4

9. Would you agree or disagree with the following statements?

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Do Not Know	Responses
<p>Quilley County is growing the fastest in the state.</p> <p>Quilley County is the most beautiful in the state.</p> <p>Quilley County is the best place to live.</p>	95 9.2%	224 20.9%	304 28.6%	50 4.7%	12 1.1%	231 21.5%	930
<p>Quilley County will prosper in the future.</p> <p>Quilley County will attract new businesses.</p> <p>Quilley County will be a better place to live in the future.</p>	96 9.1%	222 20.7%	317 29.7%	160 15.0%	48 4.5%	151 14.2%	1047

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Do Not Know	Responses
During times of emergency, information flow is timely and accurate	294 30.1%	570 57.6%	183 18.4%	0 0.0%	3 0.3%	172 17.6%	983
During times of emergency, information flow is timely and accurate	157 12.4%	359 28.0%	235 18.8%	44 3.5%	12 1.0%	197 15.6%	995
Total							988

10. Would you agree or disagree with the following statements?

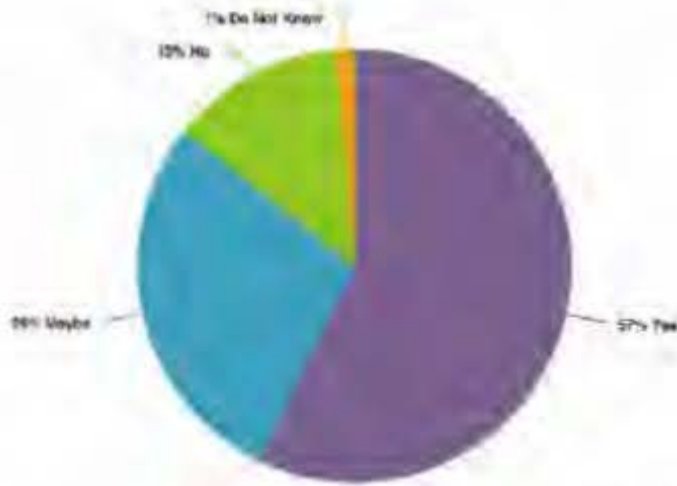
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Do Not Know	Responses
The City of Boca Raton provides the services necessary to provide the best education for students living in Boca	3 1.0%	14 22.6%	15 23.0%	0 0.0%	4 6.5%	16 25.0%	42
Encouraging walkability in Boca City web site and can easily obtain information about important events and services through the City website	4 7.9%	26 50.2%	15 28.0%	0 0.0%	3 4.8%	6 12.7%	51

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Do Not Know	Responses
Having time of emergency information available to the City of Royal Oak is needed in a long-term cultural can...	7 11.5%	25 37.7%	10 15.4%	1 1.5%	0 0.0%	20 32.8%	63
Emergency information available to the City of Royal Oak is needed in a long-term cultural can...	4 6.3%	41 63.6%	11 17.2%	3 4.7%	1 1.6%	20 32.8%	64
Total							
Total							
Response							

11. Please indicate how Oak and County, your city, and/or your township can better assist you in preparing for emergencies and disasters (example: provide preparedness materials in my language).



12. If a disaster (i.e. snow storm) impacted Gasland County, knocking out electricity and running water, would your household be able to manage on its own for at least three (3) days?



Value	Percent	Responses
Yes	57.2%	508
Maybe	28.8%	253
No	11.0%	97
Do Not Know	1.0%	10
		Total 977

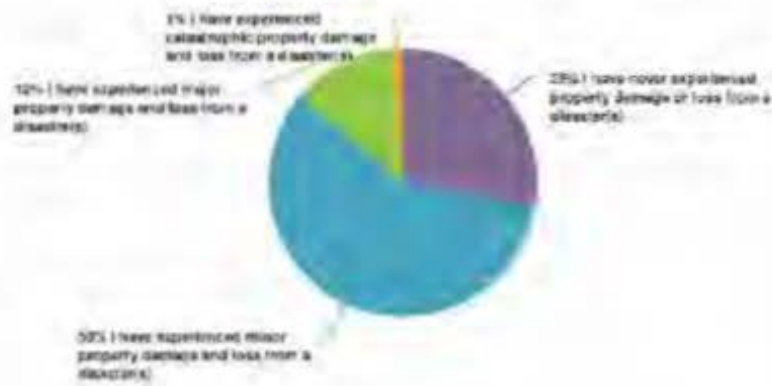
13. Do you believe that your household and/or place of business might ever be threatened by the following hazards? Please rate what hazards present the greatest risk. Low Risk = Low impact on threat to life and property damage
 Medium Risk = Medium impact on threat to life and property damage High Risk = High impact on threat to life and property damage

	Low Risk	Medium Risk	High Risk	Not Applicable	Responses
Car Disasters/Inj					
House	194	210	68	13	885
Business	16.5%	24.9%	8.0%	1.5%	
Chemical Accidents (Asbestos, Air Pollution, Lead, Radon)					
House	306	110	125	5	853
Business	36.2%	13.1%	14.8%	0.6%	
Demolition					
House	100	35	7	241	863
Business	11.2%	4.2%	0.8%	27.9%	
Earthquake					
House	190	271	30	57	858
Business	22.3%	25.6%	3.7%	5.1%	
Explosion					
House	194	65	9	79	858
Business	22.7%	7.6%	1.0%	9.2%	
Extreme Cold Incident					
House	129	163	252	9	963
Business	15.3%	20.3%	29.5%	1.1%	
Extreme Heat Incident					
House	207	172	172	9	869
Business	24.2%	21.9%	20.0%	0.9%	
Floods					
House	164	348	119	22	853
Business	19.2%	40.8%	14.0%	2.6%	

	Low Risk	Medium Risk	High Risk	Not Applicable	Responses
Fog					
Count	368	169	128	17	652
Risk %	40.2%	42.9%	15.0%	1.0%	
Gas/Oil Spill/Leak					
Count	362	361	138	9	850
Risk %	42.6%	42.5%	13.9%	1.0%	
Gasoline/Motor Oil/Leak/Spill (except Chemical Spill)					
Count	341	342	150	19	852
Risk %	40.0%	40.1%	17.6%	2.2%	
Infrastructure Failure (except Bridge Collapse)					
Count	419	264	127	39	859
Risk %	49.1%	31.1%	15.0%	4.6%	
Main Transportation Accident/Incident					
Count	231	335	238	21	851
Risk %	27.1%	42.9%	27.5%	2.5%	
Oil/Gas Well Accident/Spill					
Count	518	162	49	79	808
Risk %	63.9%	21.5%	5.0%	9.8%	
Public Health Emergency (example: Pandemic)					
Count	304	472	164	11	851
Risk %	35.7%	43.7%	19.3%	1.3%	
Ecological Incident					
Count	332	201	90	29	652
Risk %	45.0%	25.9%	9.5%	3.6%	
Severe Winter Storm/Heavy Snowfall/ice Storm					
Count	48	306	406	5	850
Risk %	5.6%	42.7%	51.2%	0.6%	

	Low Risk	Medium Risk	High Risk	Not Applicable	Responses
Sustainable (Sustainable)					
Count	464	291	70	22	857
Percent	54.2%	34.6%	8.2%	2.6%	
Therapeutic (Therapeutic)					
Count	390	297	149	11	847
Percent	46.0%	35.7%	17.6%	1.3%	
Therapeutic (Therapeutic)					
Count	90	335	407	2	834
Percent	10.5%	41.0%	49.7%	0.2%	
Travel and High Waste					
Count	61	445	351	3	860
Percent	7.1%	52.8%	40.8%	0.4%	
Utility (Utility)					
Count	84	295	370	2	751
Percent	11.2%	39.3%	49.3%	0.2%	
Waters					
Count	100	94	20	1	215
Percent	46.0%	43.7%	9.3%	0.5%	
Total					
Total Responses					863

14. Please select the answer that best describes your experience:



Value	Percent	Responses
Have never experienced property damage or loss from a disaster	27.9%	142
Have experienced minor property damage and loss from a disaster	32.3%	165
Have experienced major property damage and loss from a disaster	12.8%	109
Have experienced catastrophic property damage and loss from a disaster	12%	61
		Total: 504

15. If you have experienced any damage(s) or injury(ies) from a disaster, please list the hazard(s) that caused the damage(s)/losses and/or injury(ies) (example: flooding, wind, winter storm)



16. If you have experienced any damage(s) or injury(ies) from a disaster please indicate where this occurred (example: my home, on a roadway or in intersection, at work, or vacation, etc.)



17. If you have experienced any damage(s) or injury(ies) from a disaster, please describe the damage(s) and/or injury(ies). (example: basement flooded, roof was damaged, vehicle was damaged, broken bones, abrasions, etc.)



A word cloud of disaster-related terms. The most prominent word is 'damage' in large orange letters at the top. Below it, 'roof' is the largest word in blue. Other significant words include 'trees' in green, 'siding' in blue, 'vehicle' in purple, 'flooding' in orange, and 'fallen' in orange. Smaller words include 'power', 'tree', 'house', 'loss', 'food', 'home', 'downed', 'minor', 'water', 'due', 'lost', 'fell', 'cat', and 'water'.

18. Based on YOUR PERCEPTION of your jurisdiction's hazards, to what degree of emphasis would you expect your jurisdiction to mitigate the following hazards? Mitigation definition: The purpose of mitigation planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses. Mitigation forms the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. No Mitigation Needed = No mitigation on this hazard is expected or needed Low Priority = This hazard should be mitigated, but is not a high priority compared to other hazards Medium Priority = It is important to mitigate this hazard High Priority = It is a high priority to emphasize mitigation for this hazard

	No Mitigation Needed	Low Priority	Medium Priority	High Priority	Responses
SMO (SLO) (99)					
Strong	145	281	191	235	852
Weak	10.3%	22.1%	22.7%	27.7%	
General Occurrence					
Active Shooter/Extortion	52	153	284	357	846
Active Violence	6.2%	18.2%	33.8%	41.8%	
Cloud					
Strong					
Weak					
Dam Failure					
Strong	84	220	52	69	342
Weak	24.3%	26.1%	7.4%	8.2%	
Drought					
Strong	319	375	102	35	831
Weak	39.7%	44.2%	12.0%	3.9%	
Disruptive					
Strong	337	325	70	60	792
Weak	42.7%	39.7%	8.2%	7.4%	
Evacuation					
Strong	93	234	340	182	849
Weak	10.9%	27.4%	40.3%	21.5%	

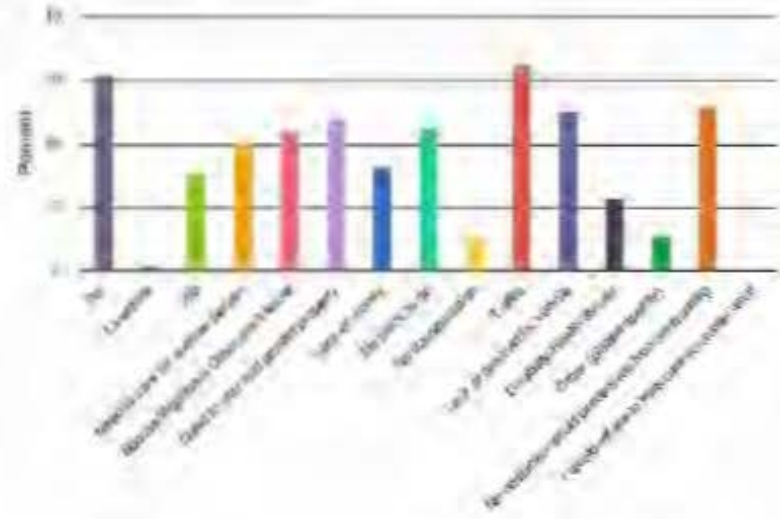
	No Mitigation Needed	Low Priority	Medium Priority	High Priority	Responses
Extreme Heat Index					
Count	103	264	333	143	843
Share %	12.2%	31.2%	39.6%	17.0%	
Flooding					
Count	94	255	267	205	851
Share %	11.0%	30.0%	31.9%	24.1%	
Fog					
Count	380	329	127	29	865
Share %	43.4%	38.2%	12.6%	2.6%	
Gas/Oil Spillages					
Count	145	333	247	55	840
Share %	17.0%	39.6%	29.4%	6.3%	
Hazardous Materials Release (example: Chemical Spill)					
Count	84	225	236	258	844
Share %	10.0%	26.8%	28.0%	30.3%	
Infrastructure Failure (example: Bridge Collapse)					
Count	120	214	282	255	851
Share %	14.2%	25.7%	33.5%	30.3%	
Major Transportation Accidents (example)					
Count	31	175	318	263	849
Share %	3.6%	20.9%	37.7%	31.3%	
Oil/Gas Well Accidents					
Count	220	292	180	157	849
Share %	27.2%	35.0%	21.4%	18.9%	
Public Health Emergency (example: Pandemic)					
Count	54	173	245	357	843
Share %	6.3%	20.4%	29.1%	42.3%	

	No Mitigation Needed	Low Priority	Medium Priority	High Priority	Responses
Blizzard/ Icefall					
Count	142	247	177	254	842
Rate %	19.2%	29.2%	21.0%	30.4%	
Severe Winter Storm/Windy Snowfall/ Ice Storm					
Count	30	136	313	367	846
Rate %	3.5%	16.1%	37.0%	43.4%	
Subzero (Dry)					
Count	141	307	185	212	845
Rate %	17.2%	36.7%	22.4%	25.3%	
Thunderstorms					
Count	87	183	207	263	840
Rate %	10.4%	21.8%	24.6%	31.2%	
Thunderstorm					
Count	108	255	265	251	883
Rate %	12.0%	28.7%	29.9%	28.3%	
Tornado and High Winds					
Count	45	177	341	352	845
Rate %	5.3%	20.9%	40.4%	41.4%	
Utility Failure					
Count	37	130	301	364	841
Rate %	4.4%	15.5%	35.8%	43.3%	
Wildfire					
Count	69	100	94	76	600
Rate %	11.5%	16.7%	15.4%	12.6%	
Total					863

10. 11. 2023

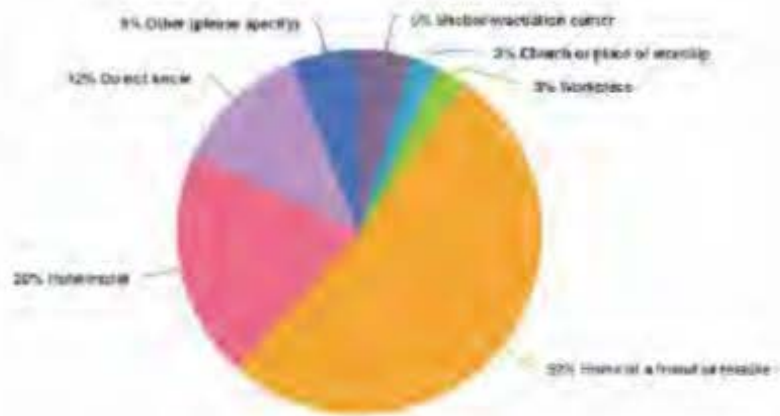
	Very Likely	Somewhat Likely	No. Very Likely	No. Likely at All	Do Not Know	Not Applicable	Responses
Immediately execute as instructed.	385 45.0%	359 39.2%	66 5.0%	30 5.8%	26 3.1%	6 0.7%	853
Would first consult with state and federal wildlife agencies before making a strike or removal.	272 35.2%	275 33.0%	242 17.1%	96 11.0%	10 1.2%	14 1.7%	769
Wait until we have the situation going to be before deciding to execute.	140 16.9%	280 33.8%	247 29.0%	60 7.2%	16 1.9%	5 0.7%	848
Refuse to execute regardless.	2 0.2%	32 3.8%	151 18.2%	225 27.0%	40 4.8%	55 6.6%	465
Other							101

20. What might prevent you from leaving your place of residence if there was an evacuation order? Please select ALL that apply:



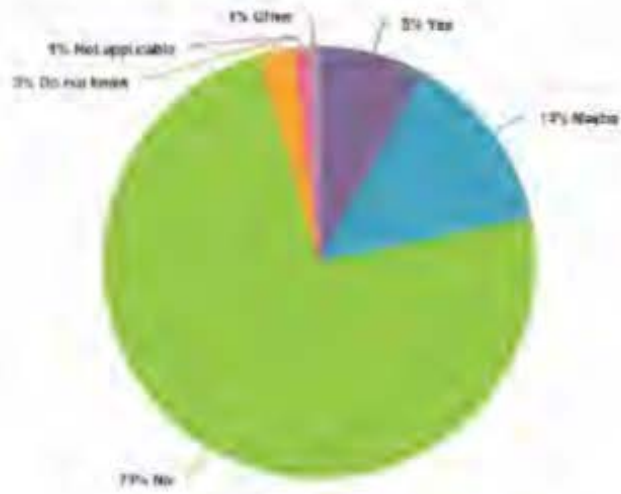
Value	Percent	Responses
Full	30.5%	260
Unstock	0.0%	0
Job	15.4%	130
Need to care for another person	20.9%	173
Spec. Occ./Significant Other - work issues	22.0%	185
Need to care and protect property	20.8%	177
Lack of training	16.4%	137
No place to go	22.7%	192
No (re)education	3.4%	29
Tuition	32.5%	273
Lack of quality of the vehicle	20.5%	172
Disability/Health Issues	11.6%	98
Other (please specify)	3.4%	29
Multiplying workload; prevent me from exercising	23.9%	200
Would refuse to exercise no matter what	0.1%	1

21. If you were to evacuate, where would you most likely stay? Please select the best answer.



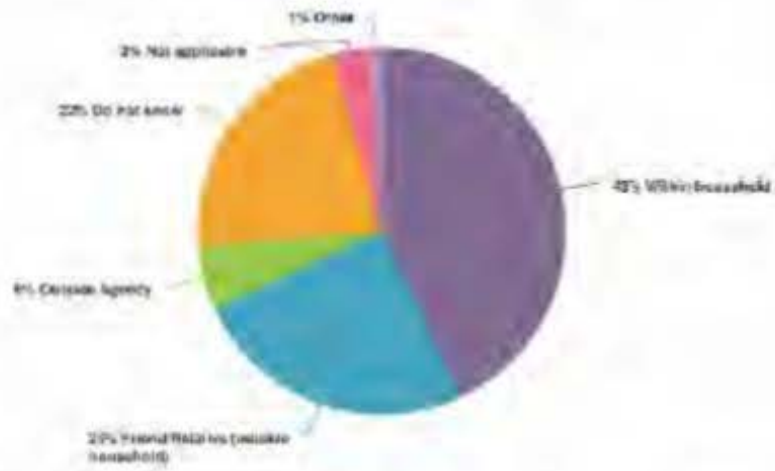
Value	Percent	Responses
Shelter/vacation center	2.5%	40
Church or place of worship	2.4%	38
Workplace	2.4%	37
Home of a friend or relative	54.7%	841
Hotel/motel	20.4%	314
Do not know	12.3%	193
Other (please specify)	3.0%	47
		Total: 859

22. In an evacuation, would you or anyone in your household require special assistance?



Value	Percent	Responses
Yes	5.5%	59
Maybe	13.6%	143
No	73.7%	629
Do not know	2.7%	29
Not applicable	1.4%	15
Other	0.8%	7
		Total: 854

23. If yes, would that assistance be provided by someone within your household, by an outside agency, or by a friend or relative outside your household?

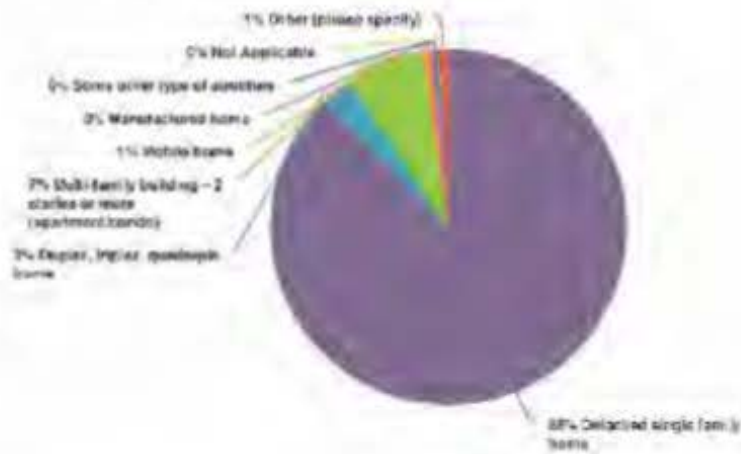


Value	Percent	Responses
Within household	42.9%	78
Friend/Relative (outside household)	25.0%	46
Outside Agency	5.8%	10
Do not know	22.0%	40
Not applicable	2.2%	4
Other	1.1%	2
		Total: 182

24. If applicable, please indicate what kind of outside assistance your household may need during an evacuation (i.e., transportation, Medical, etc.)

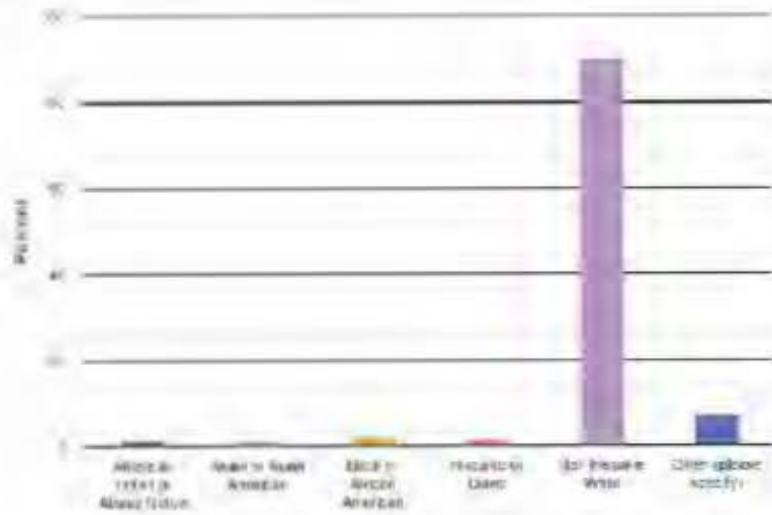


25. What type of structure do you live in?



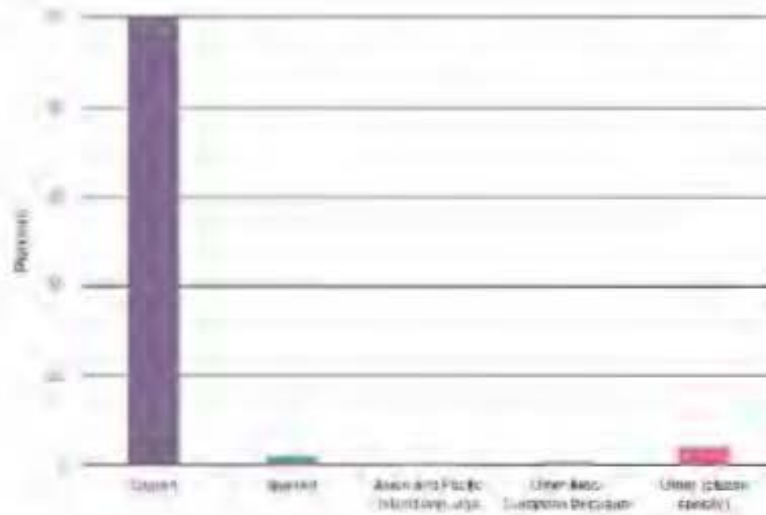
Value	Percent	Responses
Detached single family home	87.7%	746
Duplex, triplex, quad rental home	2.6%	23
Multi-family building - 2 stories or more (apartment building)	7.1%	60
Mobile home	0.7%	5
Manufactured home	0.9%	7
Some other type of structure	0.9%	8
Not Applicable	0.1%	1
Other (please specify)	0.9%	7
		Total: 851

26. Which of the following best describes your race/ethnicity? Please select ALL that apply.



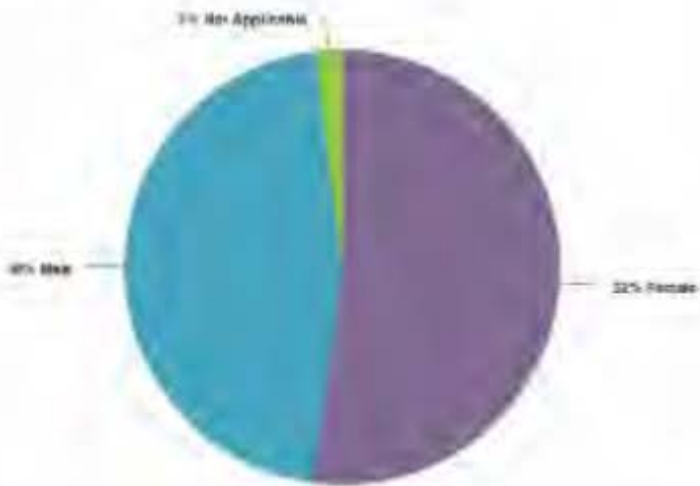
Value	Percent	Responses
American Indian or Alaska Native	1.4%	11
Asian or Asian American	1.2%	10
Black or African American	2.3%	19
Hispanic or Latino	1.4%	12
Not Hispanic or Latino	81.3%	756
Other (please specify)	7.0%	59

29. Please indicate the language(s) spoken in your household. Please select ALL that apply.



Value	Percent	Responses
English	100.0%	168
Spanish	2.2%	4
American Sign Language	0.2%	0
Other Indo-European languages	0.3%	0
Other (world's family)	0.3%	0

30. Please indicate your sex.



Value	Percent	Responses
Female	35.9%	445
Male	52.2%	691
Not Applicable	2.0%	17

Total: 1153

1.11.6 Appendix F: Example Community Resolution for Plan Adoption

Published 12/28/2017 17:09 by Nathaniel Marlette

SAMPLE Resolution No. _____

ADOPTION OF THE OAKLAND COUNTY HAZARD MITIGATION PLAN

WHEREAS, the mission of (insert community name here) includes the charge to protect the health, safety, and general welfare of the people of (insert name of community here), and

WHEREAS, (insert community name), Michigan is subject to flooding, tornadoes, winter storms, and other natural, technological, and human hazards, and

WHEREAS, and the Oakland County Homeland Security Division and the Oakland County Local Emergency Planning Committee, comprised of representatives from the County, municipalities, and stakeholder organizations, have prepared a recommended Hazard Mitigation Plan that reviews the options to protect people and reduce damage from these hazards; and

WHEREAS, (insert community name) has participated in the planning process for development of this Plan, providing information specific to local hazard priorities, encouraging public participation, identifying desired hazard mitigation strategies, and reviewing the draft Plan; and

WHEREAS, the Oakland County Homeland Security Division (HSD), with the Oakland County Local Emergency Planning Committee (LEPC), has developed the OAKLAND COUNTY HAZARD MITIGATION PLAN (the "Plan") as an official document of the County and establishing a County Hazard Mitigation Coordinating Committee, pursuant to the Disaster Mitigation Act of 2000 (PL-106-590) and associated regulations (44 CFR 210.6); and

WHEREAS, the Plan has been widely circulated for review by the County's residents, municipal officials, and state, federal, and local review agencies and has been revised to reflect their concerns, and

NOW THEREFORE BE IT RESOLVED by the (insert community name and governing body here) that:

1. The Oakland County Hazard Mitigation Plan (or section(s) of the Plan specific to the affected community) is/are hereby adopted as an official plan of (insert Community name here)
2. The (insert name of position) is charged with supervising the implementation of the Plan's recommendations, as they pertain to (insert community name here) and within the funding limitations as provided by the (insert community governing body) or other sources
3. The (insert name of position) shall give priority attention to the following action items recommended in portions of the Plan specific to (insert community name):
 - a. _____ (Recommendation _____, Section _____, page _____)
 - b. _____ (Recommendation _____, Section _____, page _____)
 - c. _____ (Recommendation _____, Section _____, page _____)

Passed by the (insert community name and governing body here) on (insert date).

Signature

Signature

Vote:

Yes _____

No _____

1.11.7 Appendix G: Notice of Endorsement & Adoption

Published 7/6/2018 08:53 by Nathaniel Marlette

Notices of Endorsement and Adoption from each jurisdiction will be included in this section upon receiving FEMA's conditional approval of the plan.

U.S. Department of Homeland Security
Region V
536 N. Clark St., 6th Floor
Chicago, IL 60610-1507



FEMA

April 2, 2018

Mr. Matt Schnepf
State Hazard Mitigation Officer
Michigan State Police
Emergency Management and
Homeland Security Division
P.O. Box 30634
Lansing, MI 48909

Dear Mr. Schnepf:

Thank you for submitting the Oakland County Hazard Mitigation Plan for our review. The plan was reviewed based on the local plan criteria contained in 44 CFR Part 201, as authorized by the Disaster Mitigation Act of 2000. Oakland County met the required criteria for a multi-jurisdiction hazard mitigation plan. Formal approval of this plan is contingent upon the adoption of the plan by the jurisdictions. Once FEMA Region V receives documentation of adoption we will send a letter of official approval to your office.

We look forward to receiving the adoption documentation and completing the approval process for the Oakland County Hazard Mitigation Plan.

If you or the community has any questions, please contact Christine Meissner at (312) 408-4460 or christine.meissner@fema.dhs.gov.

Sincerely,

A handwritten signature in cursive script that reads "Melissa A. Janssen".

Melissa A. Janssen
Chief, Risk Analysis Branch
Mitigation Division

Attachment: Local Plan Review Sheets

www.fema.gov

1.11.8 Appendix H: Federal Funding Sources and Programs

Published 7/6/2018 08:59 by Nathaniel Marlette

Many local governments are in a quandary to implement measures to secure and protect property with today's economic constraints. Many programs, including FEMA's Pre-Disaster Mitigation Program and the Hazard Mitigation Grant Program, are the victims of budget cuts. DHS' 2006 Emergency Management Performance Grants – Program Guidance and Application Kit states that “emergency managers at all levels should leverage all available funding and resources from multiple sources wherever possible...(and)...should not restrict their activities to only Federal funding to achieve the goals outlined within their strategies. Rather, special attention should be given to leveraging relevant funding sources and resources that support”... mitigation activities. In addition to federal programs, the State homeland security and preparedness programs and resources may be available to meet the objectives outlined in the All-Hazard Mitigation Plan. This section outlines potential funding sources.

FEDERAL PROGRAMS AND FUNDING

DHS: FEMA

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) administered by the Federal Emergency Management Agency (FEMA) provides grants to State, tribal, and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

Pre-Disaster Mitigation Program

Funding for the Pre-Disaster Mitigation (PDM) program is provided through the National Pre-Disaster Mitigation Fund to assist State, tribal, territorial and local governments in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. The PDM program was allocated \$30,000,000 in FY 2015. Project priorities are:

Mitigation planning and project sub-applications

Flood Mitigation Assistance Grant Program

The Flood Mitigation Assistance (FMA) Grant Program provides funding to assist States and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFIP). According to the FY 2015 Flood Mitigation Assistance (FMA) Grant Program Fact Sheet, \$150,000,000 is available to States, Tribal, Territorial, and local governments. FEMA will prioritize eligible planning and project sub-applications as follows:

Mitigation planning sub-applications consistent with 44 CFR Part 201 up to a maximum of \$100,000 federal share per applicant.

Projects that mitigate at least 50 percent of structures that meet definition part (b)(ii) of a Severe Repetitive Loss (SRL) property: At least 2 separate NFIP claim payments have been made with the cumulative amount of such claims exceeding the market value of the insured structure.

Project sub-applications that mitigate at least 50 percent of structures that meet the definition of a Repetitive Loss (RL) property: Have incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event.

Projects that mitigate at least 50 percent of structures meet definition part (b)(i) of a SRL property: 4 or more separate NFIP claims payments have been made with the amount of each claim exceeding \$5,000, and with the cumulative amount of claims payments exceeding \$20,000.

Projects that will reduce the risk profile in communities through mitigation of the largest number of contiguous NFIP-insured properties.

Repetitive Flood Claims and Severe Repetitive Loss Grant Program

The Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) grant programs were authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108–264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al). According to FEMA, “The SRL Grant Program makes funding available for a variety of flood mitigation activities. Under this program, FEMA provides funds to state and local governments to make offers of assistance to NFIP-insured SRL residential property owners for mitigation projects that reduce future flood losses through:

Acquisition or relocation of at-risk structures and conversion of the property to open space;

Elevation of existing structures; or Dry floodproofing of historic properties.

SRL mitigation grants are provided to eligible applicant states/tribes/territories that, in turn, provide subgrants to local governments or communities. The applicant must have a FEMA-approved mitigation program in place that includes SRL properties” (Guidance for Severe Repetitive Loss Properties, 2011). According to FEMA, “RFC funds may only be used to mitigate structures that are located within a state or community that is participating in the NFIP that cannot meet the requirements of the Flood Mitigation Assistance (FMA) program because they cannot provide the non-federal cost share, or do not have the capacity to manage the activities” (fema.gov).

Mitigation Technical Assistance Program

There are three major mitigation technical assistance programs that provide technical support to state/local communities, FEMA Regional and

Headquarters Mitigation staff in support of mitigation initiatives. These programs include the Hazard Mitigation Technical Assistance Program, the National Earthquake Technical Assistance Program, and the Wind and Water Technical Assistance Program.

They provide the technical support that is necessary to mitigate against potential loss of lives and minimize the amount of damage as a result of a natural disaster.

Staffing for Adequate Fire and Emergency Response Grant Program

The goal of the Staffing for Adequate Fire and Emergency Response (SAFER) Grant Program is to assist local fire departments with staffing and deployment capabilities in order to respond to emergencies, and assure that communities have adequate protection from fire and fire-related hazards. For FY 2015, an estimated \$340,000,000 is set aside to assist fire departments in achieving the SAFER goal. There are two program priorities: to hire firefighters, and to recruit and retain volunteer firefighters.

Fire Prevention and Safety Grant Program

The Fire Prevention and Safety (FP&S) Grant Program had \$34,000,000 available in FY 2014 in support of two activities: fire prevention and safety (including general education/awareness, code enforcement/awareness, fire & arson investigation, and national/state/regional programs and studies) and research and development (including clinical studies, technology and product development, database system development, dissemination and implementation research, and preliminary studies).

Homeland Security Grant Program

Comprised of three interconnected grant programs, the Homeland Security Grant Program (HSGP) seeks to support the building, sustainment, and delivery of core capabilities essential to achieving the National Preparedness Goal, which is "A secure a resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that post the greatest risk." The HSGP grant programs are the State Homeland Security Program (SHSP), the Urban Areas Security Initiative (UASI), and Operation Stonegarden (OPSG).

State Homeland Security Program

In FY 2015, \$402,000,000 was allocated to the State Homeland Security Program (SHSP). Although only states and territories can apply for SHSP funds, the program is directed at supporting States, Tribes, and local governments to address high-priority preparedness gaps identified in the Threat and Hazard Identification and Risk Assessment (THIRA) with relation to terrorism. Award methodology is based on the minimum amounts as legislatively mandated (0.35% of total funds for states, Washington D.C., and Puerto Rico and 0.08% of total funds for American Samoa, Guam, the Northern Mariana Islands and the U.S. Virgin Islands), DHS' risk methodology, and the anticipated effectiveness of proposed projects.

Operation Stonegarden

Operation Stonegarden (OPSG) is designed to support cooperation and coordination between Customs and Border Protection (CBP), the United States Border Patrol (USBP), and local, Tribal, territorial, State, and Federal law enforcement agencies. In FY 2015, \$55,000,000 is allocated to this program. States and territories that border Canada, Mexico, or international waters are eligible. Counties and federally-recognized Tribal governments within those states are eligible to apply for funds through their State Administrative Agency (SAA).

Cooperating Technical Partners Program

The Cooperating Technical Partners (CTP) Program seeks to strengthen and increase the effectiveness of the National Flood Insurance Program (NFIP) through fostering relationships among all levels of government to reduce flood losses and promote community resiliency. The total funding for Region 4 in FY 2015 was \$12,973,272. The main focus in FY 2015 for the CTP program is to support the mission and objectives of FEMA's Risk MAP (Mapping, Assessment, and Planning) program.

Emergency Management Performance Grant

In FY 2015, \$350,100,000 was allocated to the Emergency Management Performance Grant (EMPG). This program is designed to assist state, local, territorial, and tribal governments to prepare for all hazards. The State Administrative Agency (SAA) or Emergency Management Agency (EMA) can apply for the funding. All 50 states, Washington D.C., and Puerto Rico will receive at least 0.75% of total funding. American Samoa, Guam Northern Mariana Island and the U.S. Virgin Island will each receive at least 0.25% of total funding. The balance will be distributed on a population-share basis.

Homeland Security National Training Program Continuing Training Grants Program

The Homeland Security National Training Program Continuing Training Grants Program (HSNTP/CTG) had \$11,521,000 for FY 2015 to be used for training focused on cybersecurity, hazardous materials, countering violent extremism, and rural training. Eligible entities (including state, local, tribal, and territorial entities) must have existing programs or demonstrate expertise relevant to the focus areas.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Immunization Research, Demonstration, Public Information and Education Grants

The Immunization Research, Demonstration, Public Information and Education Grant program assists States, political subdivisions of States, and other public and private nonprofit entities to conduct research, demonstration projects, and provide public information on vaccine-preventable diseases and conditions. Project funds may be used for the costs associated with organizing and conducting these projects, and in certain circumstances, for purchasing vaccine. Requests for direct assistance (i.e., "in lieu of cash") for personnel, vaccines, and other forms of direct assistance will be considered. Funds may not be used to supplant existing immunization program activities.

Immunization Grants

Immunization Grants assist States and communities in establishing and maintaining preventive health service programs to immunize individuals against vaccine-preventable diseases (including measles, rubella, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B, hepatitis A, varicella, mumps, haemophilus influenzae type b, influenza, and pneumococcal pneumonia). Grant funds may be used for costs associated with planning, organizing, and conducting immunization programs directed toward vaccine-preventable diseases and for the purchase of vaccine; and for the implementation of other program elements, such as assessment of the problem; surveillance and outbreak control; information and education; adequate notification of the risks and benefits of immunization; compliance with compulsory school immunization laws; vaccine storage, supply, and delivery; citizen participation; and use of volunteers. Vaccine will be available "in lieu of cash" if requested by the applicants. Requests for personnel and other items "in lieu of cash" will also be considered. Vaccine purchased with grant funds may be provided to private practitioners who agree not to charge for vaccine. Grant funds may be used to supplement (not substitute for) existing immunization services and operations provided by a State or locality.

DEPARTMENT OF THE INTERIOR

River, Trail, and Conservation Assistance Program

The goal of this program is to work with community groups and local and State governments to conserve rivers, preserve open space, and develop trails and greenways; with the goal of helping communities achieve on-the-ground conservation successes for their projects.

ENVIRONMENTAL PROTECTION AGENCY

Wetland Program Development Grants

The Wetland Program Development Grants are designed to assist state, tribal, and local government agencies in building their wetland management programs. Grant funds can be used to develop new or refine existing wetland protection, management or restoration programs. The types of projects funded through this program are very diverse. In the past, states, tribes and local governments have pursued a wide range of activities from very broad policy or regulatory projects, to development of specific technical approaches/methods for wetland health or restoration.

Nonpoint Source Implementation Grants – 319 Program

Through its 319 program, EPA provides formula grants to the states and tribes to implement nonpoint source projects and programs in accordance with section 319 of the Clean Water Act (CWA). Nonpoint source pollution reduction projects can be used to protect source water areas and the general quality of water resources in a watershed.

Examples of previously funded projects include installation of best management practices (BMPs) for animal waste; design and implementation of BMP systems for stream, lake, and estuary watersheds; basinwide landowner education programs; and lake projects previously funded under the CWA section 314 Clean Lakes Program. For FY 2014, tribal base grants were from \$30,000 to \$50,000, and competitive grant awards could be up to \$100,000.

Watershed Organizations

EPA recognizes that strong and committed watershed organizations and local governments are necessary partners to achieve the goals of the Clean Water Act and improve our nation's water quality. To support these local efforts, the EPA is working to: build the capacity of watershed organizations to develop and implement sustainable funding plans to obtain achieve environmental results; and, build the capacity of private and public funders to channel their resources towards good watershed initiatives.

US DEPARTMENT OF AGRICULTURE

Emergency Watershed Protection Program

The USDA Natural Resources Conservation Service's (NRCS) Emergency Watershed Protection (EWP) Program helps protect lives and property threatened by natural disasters such as floods, hurricanes, tornadoes, droughts, and wildfires. There are two parts of the program: EWP - Recovery and EWP - Floodplain Easement (FPE).

EWP – Recovery: The EWP Program is a recovery effort program aimed at relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. Public and private landowners are eligible for assistance, but must be represented by a project sponsor that must be a legal subdivision of the State, such as a city, county, township or conservation district, and Native American Tribes or Tribal governments. NRCS may pay up to 75 percent of the construction cost of emergency measures. The remaining 25 percent must come from local sources and can be in the form of cash or in-kind services.

EWP – Floodplain Easement: Privately-owned lands or lands owned by local and state governments may be eligible for participation in EWP-FPE. To be eligible, lands must meet one of the following criteria:

Lands that have been damaged by flooding at least once within the previous calendar year or have been subject to flood damage at least twice within the previous 10 years.

Other lands within the floodplain are eligible, provided the lands would contribute to the restoration of the flood storage and flow, provide for control of erosion, or that would improve the practical management of the floodplain easement Lands that would be inundated or adversely impacted as a result of a dam breach.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Community Development Block Grant Program

The Department of Housing and Urban Development sponsors this program, intended to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities primarily for persons of low and moderate income. Recipients, which include principal cities of Metropolitan Statistical Areas (MSAs), other metropolitan cities with populations of at least 50,000, and qualified urban counties with populations of at least 200,000 (excluding the population of entitled cities), may initiate activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services. Specific activities may include public services, acquisition of real property, relocation and demolition, rehabilitation of structures, and provision of public facilities and improvements, such as new or improved water and sewer facilities.

1.11.9 Appendix I: Acronyms and Definitions

Published 12/28/2017 17:11 by Nathaniel Marlette

ADA - American Disabilities Act
ASFPM - Association of State Floodplain Managers
BCA - Benefit Cost Analysis
BCR - Benefit Cost Ratio
BMPs - Best Management Practices
CBP - Customs and Border Protection
CDBG - Community Development Block Grant
CFR - Code of Federal Regulations
CRS - Community Rating System
CTP - Cooperating Technical Partners
DFO - Disaster Field Office
DMA2K - Disaster Mitigation Act of 2000
DNR - Department of Natural Resources
DOT - Department of Transportation
EA - Environmental Assessment
EMPG - Emergency Management Performance Grant
EOC - Emergency Operations Center
EPA - Environmental Protection Agency
EWP - Emergency Watershed Protection
FCO - Federal Coordinating Officer
FEMA - Federal Emergency Management Agency
FIA - Flood Insurance Administration
FIRM - Flood Insurance Rate Map
FIS - Flood Insurance Study
FMA - Flood Mitigation Assistance
FP&S - Fire Prevention and Safety
GIS - Geographic Information System
HAZUS
HMPG - Hazard Mitigation Grant Program
HMTAP - Hazard Mitigation Technical Assistance Program
HSGP - Homeland Security Grant Program
HUD - Housing and Urban Development
IA - Individual Assistance
IAP - Incident Action Plan
IBC - International Building Code
ICC - Increased Cost of Compliance
ICS - Incident Command System
LCA - Local Capability Assessment
MOU - Memorandum of Understanding
MSAs - Metropolitan Statistical Areas
NEPA - National Environmental Policy Act
NFIP - National Flood Insurance Program
NFIRA - National Flood Insurance Reform Act
NRCS - Natural Resources Conservation Service
OMB - Office of Management and Budget
OPSG - Operation Stonegarden
PA - Public Assistance
PAO - Public Assistance Officer
PDA - Preliminary Damage Assessment
PDM - Pre-Disaster Mitigation
PDM-C - Pre-Disaster Mitigation Competitive
RFC - Repetitive Flood Claims
RL - Repetitive Loss
RLP - Repetitive Loss Property
RLR - Repetitive Loss Report
SAFER - Staffing for Adequate Fire and Emergency Response
SFHA - Special Flood Hazard Area
SHMO - State Hazard Mitigation Officer
SHMP - State Hazard Mitigation Plan
SHS - State Historical Society
SHSP - State Homeland Security Program
SRL - Severe Repetitive Loss
THIRA - Threat and Hazard Identification and Risk Assessment
UASI - Urban Areas Security Initiative
UDC - Uniform Dwelling Code
USBP - United States Border Patrol
USDA - U. S. Department of Agriculture

1.11.10 Appendix J: FEMA Crosswalk

Published 7/6/2018 09:30 by Nathaniel Marlette

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

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

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

Jurisdiction: Oakland County, MI	Title of Plan: Multi-Jurisdictional All Hazard Mitigation Plan	Date of Plan: Feb. 15, 2018
Local Point of Contact: Thomas Hardesty	Address:	
Title: Manager	Oakland County Homeland Security Division	
Agency: Oakland County Homeland Security Division	1200 N Telegraph Road	
	Pontiac, MI 48341	
Phone Number: 248-452-9578	E-Mail: hardestyt@oakgov.com	

State Reviewer:	Title:	Date:
------------------------	---------------	--------------

FEMA Reviewer:	Title:	Date:
Date Received in FEMA Region <i>(insert #)</i>		
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved		

1.11.10.1 Section 1: Regulation Checklist

Published 7/6/2018 10:29 by Nathaniel Marlette

SECTION 1: REGULATION CHECKLIST

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

1. REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	1.4 Hazard Mitigation Plan Process		
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	1.4.3 Plan Participation		
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	1.4.3 Plan Participation 1.4.4 Plan Activities 1.11.2 Appendix B: Meetings and Outreach Materials 1.11.3 Appendix C: Workshop Materials 1.11.4 Appendix D: Questionnaire 1.11.5 Appendix E: Questionnaire Results and Findings		
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	1.4.2 Planning Process 1.10.6 Implementation through Existing Programs		
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	1.10.2 Continued Public Involvement		
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	1.10 Plan Maintenance Process		
ELEMENT A: REQUIRED REVISIONS			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			

1. REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	1.6 Hazard Profile & Risk Assessment 2 Municipalities (2017 Hazard Mitigation Plan Update)		
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	1.6 Hazard Profile & Risk Assessment 2 Municipalities (2017 Hazard Mitigation Plan Update)		
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	1.6 Hazard Profile & Risk Assessment 2 Municipalities (2017 Hazard Mitigation Plan Update)		
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	1.6.7 Flooding		
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	1.5 Community Profile 1.10.6 Implementation through Existing Programs		
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	1.6.7 Flooding		
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	1.8 Mitigation Goals and Objectives		
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	1.9 Mitigation Strategies and Actions 2 Municipalities (2017 Hazard Mitigation Plan Update) 3 School Districts & Universities (2017 Hazard Mitigation Plan Update)		
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	1.9 Mitigation Strategies and Actions 2 Municipalities (2017 Hazard Mitigation Plan Update) 3 School Districts & Universities (2017 Hazard Mitigation Plan Update)		
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	1.10 Plan Maintenance Process 1.10.6 Implementation through Existing Programs		

1. REGULATION CHECKLIST Regulation (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
<u>ELEMENT C: REQUIRED REVISIONS</u>			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	1.5 Community Profile		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	2 Municipalities (2017 Hazard Mitigation Plan Update) 3 School Districts & Universities (2017 Hazard Mitigation Plan Update)		
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	2 Municipalities (2017 Hazard Mitigation Plan Update) 3 School Districts & Universities (2017 Hazard Mitigation Plan Update)		
<u>ELEMENT D: REQUIRED REVISIONS</u>			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	1.4.5 Plan Adoption 1.11.7 Appendix G: Notice of Endorsement & Adoption (Will be fulfilled upon FEMA approval)		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	1.4.5 Plan Adoption 1.11.7 Appendix G: Notice of Endorsement & Adoption (Will be fulfilled upon FEMA approval)		
<u>ELEMENT E: REQUIRED REVISIONS</u>			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
<u>ELEMENT F: REQUIRED REVISIONS</u>			

1.11.10.2 Section 2: Plan Assessment

Published 7/6/2018 10:32 by Nathaniel Marlette

SECTION 2: PLAN ASSESSMENT

INSTRUCTIONS: The purpose of the Plan Assessment is to offer the local community more comprehensive feedback to the community on the quality and utility of the plan in a narrative format. The audience for the Plan Assessment is not only the plan developer/local community planner, but also elected officials, local departments and agencies, and others involved in implementing the Local Mitigation Plan. The Plan Assessment must be completed by FEMA. The Assessment is an opportunity for FEMA to provide feedback and information to the community on: 1) suggested improvements to the Plan; 2) specific sections in the Plan where the community has gone above and beyond minimum requirements; 3) recommendations for plan implementation; and 4) ongoing partnership(s) and information on other FEMA programs, specifically RiskMAP and Hazard Mitigation Assistance programs. The Plan Assessment is divided into two sections:

1. Plan Strengths and Opportunities for Improvement
2. Resources for Implementing Your Approved Plan

Plan Strengths and Opportunities for Improvement is organized according to the plan Elements listed in the Regulation Checklist. Each Element includes a series of italicized bulleted items that are suggested topics for consideration while evaluating plans, but it is not intended to be a comprehensive list. FEMA Mitigation Planners are not required to answer each bullet item, and should use them as a guide to paraphrase their own written assessment (2-3 sentences) of each Element.

The Plan Assessment must not reiterate the required revisions from the Regulation Checklist or be regulatory in nature, and should be open-ended and to provide the community with suggestions for improvements or recommended revisions. The recommended revisions are suggestions for improvement and are not required to be made for the Plan to meet Federal regulatory requirements. The italicized text should be deleted once FEMA has added comments regarding strengths of the plan and potential improvements for future plan revisions. It is recommended that the Plan Assessment be a short synopsis of the overall strengths and weaknesses of the Plan (no longer than two pages), rather than a complete recap section by section.

Resources for Implementing Your Approved Plan provides a place for FEMA to offer information, data sources and general suggestions on the overall plan implementation and maintenance process. Information on other possible sources of assistance including, but not limited to, existing publications, grant funding or training opportunities, can be provided. States may add state and local resources, if available.

1.11.10.2.1 A. Plan Strengths and Opportunities for Improvement

Published 7/6/2018 10:32 by Nathaniel Marlette

A. Plan Strengths and Opportunities for Improvement

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

1.11.10.2.1.1 Element A: Planning Process

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Element A: Planning Process

How does the Plan go above and beyond minimum requirements to document the planning process with respect to:

- Involvement of stakeholders (elected officials/decision makers, plan implementers, business owners, academic institutions, utility companies, water/sanitation districts, etc.);*
- Involvement of Planning, Emergency Management, Public Works Departments or other planning agencies (i.e., regional planning councils);*
- Diverse methods of participation (meetings, surveys, online, etc.); and*
- Reflective of an open and inclusive public involvement process.*

Comments:

1.11.10.2.1.2 Element B: Hazard Identification and Risk Assessment

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Element B: Hazard Identification and Risk Assessment

In addition to the requirements listed in the Regulation Checklist, 44 CFR 201.6 Local Mitigation Plans identifies additional elements that should be included as part of a plan's risk assessment. The plan should describe vulnerability in terms of:

- 1) A general description of land uses and future development trends within the community so that mitigation options can be considered in future land use decisions;*
- 2) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; and*
- 3) A description of potential dollar losses to vulnerable structures, and a description of the methodology used to prepare the estimate.*

- How does the Plan go above and beyond minimum requirements to document the Hazard Identification and Risk Assessment with respect to:

- Use of best available data (flood maps, HAZUS, flood studies) to describe significant hazards;

- Communication of risk on people, property, and infrastructure to the public (through tables, charts, maps, photos, etc.);

- Incorporation of techniques and methodologies to estimate dollar losses to vulnerable structures;

- Incorporation of Risk MAP products (i.e., depth grids, Flood Risk Report, Changes Since Last FIRM, Areas of Mitigation Interest, etc.); and

- Identification of any data gaps that can be filled as new data became available.

Comments:

1.11.10.2.1.3 Element C: Mitigation Strategy

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Element C: Mitigation Strategy

How does the Plan go above and beyond minimum requirements to document the Mitigation Strategy with respect to:

- Key problems identified in, and linkages to, the vulnerability assessment;*
- Serving as a blueprint for reducing potential losses identified in the Hazard Identification and Risk Assessment;*
- Plan content flow from the risk assessment (problem identification) to goal setting to mitigation action development;*
- An understanding of mitigation principles (diversity of actions that include structural projects, preventative measures, outreach activities, property protection measures, post-disaster actions, etc);*
- Specific mitigation actions for each participating jurisdictions that reflects their unique risks and capabilities;*
- Integration of mitigation actions with existing local authorities, policies, programs, and resources; and*
- Discussion of existing programs (including the NFIP), plans, and policies that could be used to implement mitigation, as well as document past projects.*

Comments:

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

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

How does the Plan go above and beyond minimum requirements to document the 5-year Evaluation and Implementation measures with respect to:

- *Status of previously recommended mitigation actions;*
- *Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk;*
- *Documentation of annual reviews and committee involvement;*
- *Identification of a lead person to take ownership of, and champion the Plan;*
- *Reducing risks from natural hazards and serving as a guide for decisions makers as they commit resources to reducing the effects of natural hazards;*
- *An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.);*
- *Discussion of how changing conditions and opportunities could impact community resilience in the long term; and*
- *Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience.*

Comments:

1.11.10.2.2 B. Resources for Implementing Your Approved Plan

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B. Resources for Implementing Your Approved Plan

Ideas may be offered on moving the mitigation plan forward and continuing the relationship with key mitigation stakeholders such as the following:

- *What FEMA assistance (funding) programs are available (for example, Hazard Mitigation Assistance (HMA)) to the jurisdiction(s) to assist with implementing the mitigation actions?*
- *What other Federal programs (National Flood Insurance Program (NFIP), Community Rating System (CRS), Risk MAP, etc.) may provide assistance for mitigation activities?*
- *What publications, technical guidance or other resources are available to the jurisdiction(s) relevant to the identified mitigation actions?*
- *Are there upcoming trainings/workshops (Benefit-Cost Analysis (BCA), HMA, etc.) to assist the jurisdictions(s)?*
- *What mitigation actions can be funded by other Federal agencies (for example, U.S. Forest Service, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA) Smart Growth, Housing and Urban Development (HUD) Sustainable Communities, etc.) and/or state and local agencies?*

Comments:

