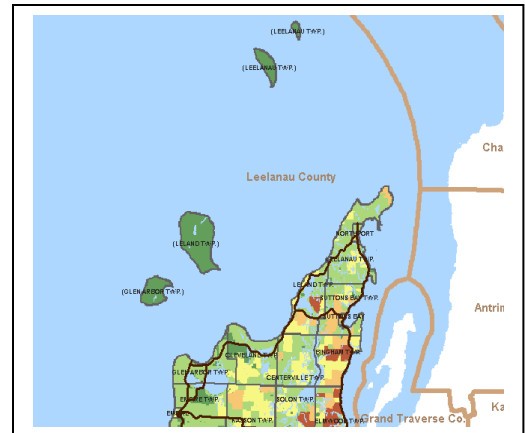


2006



**Produced by:
Northwest Michigan Council of Governments
2194 Dendrinios Drive
PO Box 506
Traverse City MI 49685
231-929-5000
fax: 231-929-5012
www.nwm.org**

TABLE OF CONTENTS

I.	Acknowledgements	Page 3
II.	Letter of Transmittal	Page 4
III.	Preface	Page 5
IV.	Executive Summary	Page 6
V.	Purpose of the Plan	Page 9
VI.	Community Profile	Page 11
VII.	The Development of the Plan	Page 13
	A. Data Methodology	
	B. Natural Hazards Information	
	1. Natural Hazards and Climate Change	
	2. Natural Hazards Recorded Events	
	3. Probability of Natural Hazards	
	C. Leelanau County Natural Hazards Task Force and Public Input	
	D. Emergency Warning System Coverage	
	E. Economic Impact Analysis	
VIII.	Natural Hazards Mitigation Goals and Objectives	Page 22
IX.	Identification and Selection of Mitigation Strategies	Page 23
	A. Climate Change Solutions	
	B. Selection of Feasible Mitigation Strategies	
X.	Participation in the Development of the Leelanau County Natural Hazards Mitigation Plan	Page 26
XI.	Implementation of the Leelanau County Natural Hazards Mitigation Plan	Page 29
	1. Natural Hazards Mitigation Plan Managers and Technical Assistance	
	2. Funding the Implementation of the Plan	
	3. Action Agenda	
	4. Monitoring and Evaluation	
XII.	Natural Hazards Mitigation Plan Adoption Resolution	Page 34
XIII.	Appendices	Page 35
	A. Glossary	
	B. Detailed Maps	
	1. Full County	
	2. Priority Areas	
	C. Population Density Map	
	D. Risk Assessment Work Sheet	
	E. Examples of Past Mitigation Projects	
	F. Task Force Meetings	
	G. Resources	

I. ACKNOWLEDGEMENTS

The Plan is the culmination of the interdisciplinary and interagency planning effort that required the assistance and expertise of numerous agencies, organizations, and individuals. Without the technical assistance and contributions of time and ideas of these agencies, organizations, and individuals, this plan could not have been completed.

Following is a list of the key contributors to the Plan who participated in the development of the Leelanau County Hazards Mitigation Plan:

Leelanau County Board of Commissioners

Jean Watkoski

Leelanau County Administrator

David W. Gill

Leelanau County Drain Commissioner

Steven R. Christensen

Leelanau County Emergency Management Coordinator

Tom Skowronski

Leelanau County Equalization Department

Pam Zientek

Leelanau County Planning Commission

Leelanau County Planning Department

Trudy Galla

Leelanau County Sheriff Office

Mike Oltersdorf

Grand Traverse Band of Ottawa and Chippewa Indians

Jolanda Murphy

Local Government

Cleveland Township

Leelanau Township

Others

Leelanau Conservation District

Michigan Department of Environmental Quality

Michigan Department of Natural Resources

II. LETTER OF TRANSMITTAL

LEELANAU COUNTY BOARD of COMMISSIONERS

301 CEDAR ST.

P.O. BOX 1107

LELAND, MI 49654-1107

PHONE: (231) 256-9711 or toll free 1-866-256-9711 FAX: (231) 256-0120

JEAN I. WATKOSKI, DISTRICT #1

MARK WALTER, DISTRICT #2,

DAVID W. SHIFLETT, DISTRICT #3

MARY P. TONNEBERGER, DISTRICT #4

WILLIAM J. BUNEK, DISTRICT #5

ROBERT L. HAWLEY, DISTRICT #6

MELINDA C. LAUTNER, DISTRICT #7

David W Gill, County Administrator

January 7, 2005

Mike Sobocinski

Michigan State Police Emergency Management Division

4000 Collins Road

PO Box 30636

Lansing MI 49809-8136

Dear Mr. Sobocinski:

Enclosed, please find the Leelanau County Natural Hazards Mitigation Plan. This Plan has been developed in conjunction with the County Emergency Management Coordinator, County Planners, County Planning Commission, Task Force Members, the public, and the State of Michigan. The Plan lays out the process of evaluating the potential natural hazards, land use, and mitigation strategies to protect lives and property in the County.

This transmittal letter serves notice that all future development decisions in Leelanau County will consider hazard vulnerability reduction as a standard practice. The intent of the Natural Hazards Mitigation Plan is not to limit development, but to ensure that all development occurs in a manner that minimizes the possibility of damage from potential natural hazards to the greatest extent possible.

Thank you for your time and consideration. If you have any questions, please feel free to contact the Leelanau County Emergency Management Coordinator, Tom Skowronski at 231.256.8775.

Sincerely,

Robert Hawley

Leelanau County Board Chair

III. PREFACE

Hazard mitigation is any action taken before, during, or after a disaster to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards. This procedure is an essential element of emergency management, along with preparedness, response, and recovery. Emergency management includes four phases: a community prepares for a disaster; responds when it occurs; and then there is a transition into the recovery process, during which mitigation measures are evaluated and adopted. The evaluation improves the preparedness posture of the County for the next incident, and so on. When successful, mitigation will lessen the impacts of natural hazards to such a degree that succeeding incidents will remain incidents and not become disasters.

Reducing the impact of hazards on people and property through the coordination of resources, programs, and authorities prevents communities from contributing to the increasing severity of the problems. Mitigation allows repairs and reconstruction to be completed after an incident occurs in such a way that does not just restore the damaged property as quickly as possible to pre-disaster conditions. This process is needed to ensure that such cycles are broken, that post-disaster repairs and reconstruction take place after damages are analyzed, and that sounder, less vulnerable conditions are produced. Through a combination of regulatory, administrative, and engineering approaches, losses can be limited by reducing susceptibility to damage.

Recognizing the importance of reducing community vulnerability to natural hazards, Leelanau County is actively addressing the issue through the development and implementation of this plan. The many benefits to be realized from this effort are:

1. Protection of the public health and safety;
2. Preservation of essential services;
3. Prevention of property damage; and
4. Preservation of the local economic base.

This process will help ensure that Leelanau County remains a vibrant, safe, enjoyable place in which to live, raise a family, preserve the local agricultural and economic base and maintain a tourist base.

IV. EXECUTIVE SUMMARY

In 2000, the Disaster Mitigation Act shifted the Federal Emergency Management Agency's (FEMA) scope of work to promoting and supporting prevention, or what is called hazard mitigation planning. FEMA now requires government entities to have natural hazards mitigation plans in place as a condition for receiving grant money, such as hazard mitigation grant program funds, in the future.

To meet this requirement, the Michigan State Police provided funding to regional planning agencies throughout the State of Michigan to work with individual counties in developing their Hazard Mitigation Plans. For northwest, lower Michigan the ***Northwest Michigan Hazard Mitigation Planning Project*** was coordinated by the Northwest Michigan Council of Governments (NWMCOG) and included the ten county area of Emmet, Charlevoix, Antrim, Kalkaska, Missaukee, Wexford, Grand Traverse, Leelanau, Benzie, and Manistee. NWMCOG worked with the Task Forces and developed plans for the counties. These plans included a general community profile, a comprehensive inventory of existing hazards, a hazard analysis, goals and objectives, and feasible mitigation strategies to address the prioritized hazards.

The Leelanau County Natural Hazards Mitigation Plan focuses on natural hazards such as drought, flooding, shoreline erosion, thunderstorms and high winds, and severe winter weather, and was created to protect the health, safety, and economic interests of the residents and businesses by reducing the impacts of natural hazards through planning, awareness, and implementation. Through this Plan, a broad perspective was taken in examining multiple natural hazards mitigation activities and opportunities in Leelanau County. Each natural hazard was analyzed from a historical perspective, evaluated for potential risk, and considered for possible mitigative action.

The Plan serves as the foundation for natural hazard mitigation activities and actions within Leelanau County, and will be a resource for building coordination and cooperation within the community for local control of future mitigation and community preparedness around the following:

Natural Hazards Mitigation Planning Goals for Leelanau County:

- Goal 1: Increase local participation in hazards mitigation*
- Goal 2: Integrate hazard mitigation considerations into the County's comprehensive planning process*
- Goal 3: Utilize available resources and apply for others for hazard mitigation projects*
- Goal 4: Develop and complete hazard mitigation projects in a timely manner*

The Leelanau County Task Force participants designated the following top Natural Hazards Mitigation Priority Areas:

1. *County: Severe Winter Weather - heavy snow, extreme temperatures, and concerns about major power and energy loss, agriculture*
2. *County: Severe High Winds and Tornadoes; highlighting the seasonal population influx and festivals held in Greillickville, Northport, Cedar, Leland, Glen Arbor, Suttons Bay, Peshawbestown, Empire, Maple City, Lake Leelanau; and agriculture*

3. *Lake Michigan: Erosion of Slopes and Bluffs*
4. *County: Erosion (Inland) and Stormwater Concerns – wetland loss*
5. *Dams and Bridges: Failure and Localized Flooding*

And, recommended the following mitigation strategies:

Priority 1. County: Severe Winter Weather - heavy snow, extreme temperatures, and concerns about major power and energy loss; and agricultural damage

Snow load Mitigation Strategies:

- a. Snow load design standards – develop planning grant for a study of snowfall patterns and occurrence of damage
- b. Public education and awareness
- c. Enforcement of building codes for new construction – state code is 60 lbs. per sq. ft.

Priority 2. County: Severe High Winds and Tornadoes highlighting the seasonal influx and festivals/events held in Greillickville, Northport, Cedar, Leland, Glen Arbor, Suttons Bay, Peshawbestown, Empire, Maple City, Lake Leelanau; and agricultural damage

High Winds and Tornado Mitigation Strategies:

- a. Develop and implement mutual support and aid practices with surrounding communities
- b. Tree management by power companies on power line easements
- c. Public education
- d. Suggest that events have an evacuation plan
- e. Building Code enforcement for new construction

Priority 3. Lake Michigan: Erosion of Slopes and Bluffs

Erosion and Debris Flow Mitigation Strategies:

- a. Inventory shoreline erosion sites
- b. More detailed soil erosion permits: slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement
- c. Zoning administration and enforcement of ordinances: development setbacks, lot sizes, driveways, relocation of structures, Lake Michigan coastal zoning ordinances – U.S. Army Corps of Engineers and Michigan Department of Environmental Quality
- d. Open space designations: acquisition or conservation easements by land conservancies, county, townships
- e. Public education
- f. Building code enforcement through permits

Priority 4. County: Erosion (Inland) and Stormwater Concerns – wetland loss

Erosion and Debris Flow Mitigation Strategies:

- a. Inventory erosion sites

- b. More detailed soil erosion permits: slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement
- c. Zoning administration and enforcement of ordinances: development setbacks, lot sizes, driveways, relocation of structures, Lake Michigan coastal zoning ordinances – U.S. Army Corps of Engineers and Michigan Department of Environmental Quality
- d. Open space designations: acquisition or conservation easements by land conservancies, county, townships
- e. Public education
- f. Building code enforcement through permits

Priority 5. Dams and Bridges: Failure and Localized Flooding

Flood Mitigation Strategies:

- a. Assessment of flood threat and dam inspections results
- b. Research a flood warning system
- c. Public education
- d. Building code enforcement

Additional Mitigation Strategies:

- ***Work with other governmental entities such as townships, villages, and the Grand Traverse Band of Ottawa and Chippewa Indians; organizations; businesses; and the public***
- ***Work on a multi-hazard warning plan and strategies for festivals/events***
- ***Develop mutual support and aid from surrounding communities***
- ***Incorporate the Plan's hazard mitigation concepts, strategies, and policies into existing elements of Leelanau General Plan***

The Leelanau County Hazards Mitigation Plan was recommended by the Leelanau County Planning Commission on November 23, 2004 to the Leelanau County Board of Commissioners for adoption. The Leelanau County Board of Commissions adopted the Plan on December 21, 2004.

V. PURPOSE OF THE PLAN

The Disaster Mitigation Act of 2000 shifted the Federal Emergency Management Agency's (FEMA) scope of work to promoting and supporting prevention, or what is called Hazard Mitigation Planning. FEMA has now required government entities to create mitigation plans as a condition of receiving grant money, such as hazard mitigation grant program funds. To meet this requirement, the Michigan State Police funded regional planning agencies to work with individual counties to develop the Natural Hazards Mitigation Plans. The Northwest Michigan Council of Governments was the agency to develop this Plan.

The **purpose of the Leelanau County Natural Hazards Mitigation Plan** is to find solutions to existing problems; anticipate future problems; prevent wasteful public and private expenditures; protect property values; and allocate land resources. The implementation of the Plan is to prevent injury, loss of life, property damage, breakdown in vital services like transportation and infrastructure, economic slumps, diminished tourist activity, liability issues, and damage to a community's reputation. For Leelanau County in the northwest region of the lower peninsula of Michigan, the **planning process** utilized the following steps in the development of the Plan. Emphasis was placed on natural hazards that have had significant impact on the community in the past.

1. Identification of natural hazards and risks
2. Preparation of draft plan
3. Identification of natural hazards mitigation goals and objectives for emergency management programs
4. Selection of evaluation criteria
5. Selection of mitigation strategies using locally chosen criteria
6. Public Comment
7. Completion of the final plan

The Plan also lays out the implementation of the plan, and the monitoring and periodic revision of the plan.

What is a Hazard?

A **hazard** is an event or physical condition that has potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss. This plan focuses on natural hazards such as drought, earthquakes, extreme temperatures, wildfires, urban and riverine flooding, high or wind driven waters that cause shoreline flooding and erosion, ground subsidence/landslides, thunderstorms and high winds, tornadoes, and winter weather hazards. This Plan is intended to be a resource for building coordination and cooperation within a community for local control of future mitigation and community preparedness.

In the State of Michigan, the **principle natural hazards** are:

- ☐ Tornadoes
- ☐ Flooding
- ☐ Lightning
- ☐ Severe winds
- ☐ Severe winter weather (snow, ice, sleet)

These principle natural hazards events have caused the top impacts to be erosion/debris flow, frozen pipes, and floods.

Governor Declarations for major disasters around the State of Michigan that occurred from 1977 to 2001 include:

- Thirteen (13) severe storms
- Eleven (11) floods
- Eight (8) winter storms
- Six (6) tornadoes
- Five (5) technical disasters
- Three (3) fires

What is Mitigation?

Mitigation is the sustained action taken to lessen the impact from natural hazards and to work to reduce the long-term risk to human life and property, and their effects. This long-term planning distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery. This Plan can be used to lessen the impact; to support and be compatible with community goals; to lay out considerations in choosing and evaluating methods; and to look at the feasibility of mitigation strategies.

VI. COMMUNITY PROFILE

Leelanau County offers its residents and visitors access to some magnificent natural features including excellent access to Great Lakes shoreline and inland lakes such as Lake Leelanau, Glen Lake, Platte Lake, and many more.

The following community data located below is provided to describe Leelanau County for planning and implementing the mitigation strategies.

Major Geographic Features of Leelanau County

Area in Water	16,000 acres
Miles of Great Lakes shoreline	151 miles
Forest Lands	126,900 acres 57.0% of total land area
Wetlands	27,412 acres 12.3% of total land area
Operating Farms (2002)	429
Farmland (2002)	62,406 acres

The total County population is **21,119**. The projected growth for 2010 is 23,419 and for 2020 it is 25,977. The population numbers from the 2000 Census for the **11 Townships, 3 Villages, and part of 1 City** covered by this plan are:

Townships/Villages/Cities	Population
Bingham Township	2,425
Centerville Township	1,095
Cleveland Township	1,040
Elmwood Township	4,264
Empire Township	1,085
Glen Arbor Township	788
Kasson Township	1,577
Leelanau Township	2,139
Leland Township	2,033
Solon Township	1,542
Suttons Bay Township	2,982
City of Traverse City (part)	149
Village of Empire	378
Village of Northport	648
Village of Suttons Bay	589

Please see Attachment C. Population Density Map

County Resident Profile

1. There are 13,960 *Housing Units* in Leelanau County with an average household size of 2.48 people per household. 42.3% of households have 2 persons.
2. The number of residents 65 years and over is 3,669, or 17.4% of the population.
3. The number of residents 19 years and under is 5,623, or 27% of the population.
4. The number of residents over 65 with a disability is 1,215, or 6% of the population.
5. The total Number of residents with disability is 3,104, or 15% of the population.
6. The number of residents that have a language barrier or are linguistically isolated is 123, or less than 1% of the population.
7. Percent below poverty level:
February 2004 Poverty level: \$15,670 Family of 3 and \$9,310 Family of 1
 - Families in poverty with children: 157
 - Income less than \$15,000: 9.7%
 - Individuals in poverty: 1,128

1997/2002 Economic Census

Industry Description	Number of Establishments	Number of Employees
Wholesale trade	16	18
Retail trade	117	607
Information	4	20-99
Real estate, rental, leasing	27	62
Professional, scientific, technical services	54	124
Administrative, support, waste management, remediation services	36	105
Educational services	1	0-19
Health care, social assistance	37	250-499
Arts, entertainment, recreation	25	453
Accommodation and food services	65	641
Other services (except public administration)	30	73
Merchant Wholesalers		
Wholesale trade	15	86
Agents, Brokers, and Commission Merchants		
Wholesale trade	3	4

Information provided above was retrieved from the Northwest Michigan Council of Governments' *Benchmarks 2004*, *Northwest Lower Michigan County Profiles 2000*, and reports on the Northwest Michigan Council of Governments' website.

VII. THE DEVELOPMENT OF THE PLAN

A. Data Methodology and Map Development

Leelanau County staff identified the critical facilities and infrastructure on the base map with the Northwest Michigan Council of Governments' GIS staff then digitizing the facilities as point files. Natural hazards points, polygons, and population centers data were then added to the base maps utilizing the following data:

Critical Infrastructure

5	Airports
6	Banks
7	Bridges
20	Churches
7	Communications Facilities
5	Dams
6	Emergency Management Services Facilities
3	Emergency Operations Centers
1	Ferry Dock
10	Fire Stations
10	Government Buildings
6	Historic Sites
1	Hospital Facilities (closing)
9	Industrial Facilities
6	Medical Facilities <ul style="list-style-type: none">• Primary physicians per 100,000 population 1998 is 37.3
2	Nursing Home/Assisted Living Facilities
3	Police Stations
11	Resort/Recreational Facilities
11	Schools
5	Water and Sewage Treatment Facilities <ul style="list-style-type: none">• Water: 12.6% public system or private company; 85.6% individual wells;• Sewer: 12.6% public sewer; 84.7% individual septic/cesspool; 2.7% other
1	Water Tower

Flood Data

In order to delineate potential flood plain areas (seasonal floodplains) for each county, NWMCOG overlaid wetland, soils, and elevation data to determine the most likely flood prone areas. Once overlaid, isolated polygons (areas) were deleted in order to show a more accurate representation of potential flood prone areas along lakes, rivers, and streams. Sources: Temporary/Seasonally Flooded Areas data are from the National Wetland Inventory of the US Fish and Wildlife Service; Hydric soils data are from the county digital soil surveys (where available); and Digital Elevation Model data are from the Center for Geographic Information, Michigan Department of Information Technology.

Fire Data

Modern forest fire data was obtained from the USDA forest service and the Departments of Natural Resources in Minnesota, Wisconsin, and Michigan. Fire regimes data (fire prone areas) were provided by the USDA Forest Service, North Central Research Station in Wisconsin. Land type associations, and historical and modern fire rotations were used to identify the fire prone areas.

Tornadoes - National Weather Service

Damaging Winds - National Weather Service

Large Hail - National Weather Service

Winter Weather - National Weather Service

Landslide/Erosion

Shoreline erosion and landslide incident zones delineated by the US Geological Service. Digital Elevation Model data from the Center for Geographic Information, Michigan Department of Information Technology.

Other hazards such as earthquakes may occur in northwest Michigan communities, but are not considered to be substantial risks.

The detailed Leelanau County Map is presented in Appendix B. #1.

B. Natural Hazards Information**1. Natural Hazards and Climate Change**

Scientists are now convinced that human activity, primarily the burning of fossil fuels to produce electricity and drive cars, is changing the climate. These activities emit gases, primarily carbon dioxide, that blanket the planet and trap heat. Some of the signs of climate changes we are seeing already throughout the Great Lakes region are average annual temperatures are increasing; severe rainstorms have become more frequent; winters are getting shorter; and the duration of lake ice cover is decreasing. In general, Michigan's climate will grow considerably warmer and probably drier during this century, especially in the summer.

Potential Impacts from Climate Change

Northwest, lower Michigan depends heavily on groundwater, on freshwater from Lake Michigan, and on rainfall for agriculture, drinking, and industrial uses. As the population in this region continues to grow, the demand for water for all the needs increases. The projected changes in rainfall, evaporation, and groundwater recharge rates from climate changes will affect ecosystems and all freshwater users. *Please note that these are predictions from the most recent data available regarding climate change and that many feel that any natural hazard events cannot be predicted on a yearly basis.*

- Reduced summer water levels are likely to diminish the recharge of groundwater, cause small streams to dry up, and reduce the area of wetlands, resulting in poorer water quality and less habitat for wildlife.
- Lake levels are expected to decline in both inland lakes and the Great Lakes, as more moisture evaporates due to warmer temperatures and less ice cover.
- Pressure to increase water extraction from the Great Lakes will grow, exacerbating an already contentious debate in the region.
- Development and climate change will degrade the flood-absorbing capacities of wetlands and floodplains, resulting in increased erosion, flooding, and runoff polluted with nutrients, pesticides, and other toxins.

2. *Natural Hazards Recorded Events*

Data for weather events was compiled from the National Oceanic and Atmospheric Administration's (NOAA) website utilizing the following sections:

- Weather/Climate Events, Information, Assessments
- Climatology and Extreme Events
- U.S. Storm Events Data Base: 1950 to present, local storm reports, damage reports, etc. from various sources – events checked for Leelanau County included drought, flooding, funnel clouds, hail, lightning, snow and ice, thunderstorms and high winds, tornadoes, wild/forest fires.

The most severe events recorded for Leelanau County are listed below, including the number of events, followed by the dates and descriptions.

1. Drought: - 2 events
 - August 2001 (county): The stress on the crops was most noted for corn, but also hit hay crops to a lesser extent.
 - July 1 to August 17, 2004
2. Flooding – 6 events
 - April 1993: (region) \$5 million property damage
 - July 1999: flash flood; (county); several secondary roads throughout the county were washed out from up to 4 inches of rainfall within a few hours, specifically Cherry Bend Road, Trumbull Road, and Cottonwood Road were washed out
 - September 2000: flash flood; (county); flooding and washouts of secondary roads and area basements from 4 to 8 inches of rainfall, specifically sections of M-22 near Suttons Bay damaged due to the force of running water, several businesses within the town of Glen Arbor were flooded
 - April 2004
3. Hail – 10 events
 - May 2001: (Suttons Bay) 1.75 inches
4. Snow and Ice – 51 events (12 inches or more of snow)
 - Winter 1978: blizzard
 - April 1993: heavy snow; \$50,000 property damage (region)

- December 1993: heavy snow (county); 13 inches of snow plus 5 to 12 more inches within 5 days with 54 mph winds and considerable blowing and drifting closing of many secondary roads with main highways barely passable; numerous accidents
- January 1994: heavy snow/freezing rain; \$5 million property damage; (region)
- November 1996: heavy snow (county); 6 to 14 inches across the county
- December 1998: heavy snow (region); 8 to 18 inches
- December 2002: ice storm (region); quarter of an inch of ice had accumulated
- January 2004: heavy snow (region); heavy lake effect around 20 inches with 5 to 6 foot drifts across M-72

5. Thunderstorm and High Wind – 22 events

- July 1995: thunderstorm/wind (county – Northport to Glen Haven \$10,000, Suttons Bay \$10,000, Empire \$2,000, Glen Arbor \$2,000); trees and power lines down
- June 1999: thunderstorm/wind (Cedar); trees down
- August 2001: thunderstorm/wind (Northport); trees down
- September 2001: strong wind (region); gusts as high as 40 mph that caused waves in excess of 10 feet on Lake Michigan
- October 2001: high wind (region); 30 to 40 mph with a few gusts of 60 mph; numerous trees and power lines down with power outages impacting more than 20,000 customers
- December 2001: thunderstorm/wind; \$1,000 property damage (county); damage to a satellite dish at a television station; non-convective wind gusts of 40 to 50 mph causing some power outages
- April 2002: thunderstorm/wind (Suttons Bay); trees and power lines down
- July 2002: thunderstorm/wind (Suttons Bay); trees on roadways, trees and power lines down
- August 2003: thunderstorm/wind (Northport); trees down
- November 2003: high wind; \$155,000 property damage (region); trees and power lines down; a utility company called it the worst windstorm in 20 years since the Edmund Fitzgerald storm
- April 2004

6. Tornadoes – 2 events

- April 1956: Cedar Run to Ruthardt Road to Suttons Bay
- July 1956: Cedar Run to Ruthardt Road to Suttons Bay
- July 1977: F1; Path was 8 miles long, 167 yards wide; \$25,000 property damage; (county)
- August 1978: F; Path was 2 miles long, 160 yards wide; \$250,000 property damage (county)

Other

7. Shoreline Erosion

The Michigan Hazard Analysis of 2006 identifies the south half of Leelanau County as a High Risk Erosion Area with the Lake Michigan shoreline at risk. The National Climatic Data Center indicates that there have been no lake surf erosion events reported in Leelanau County since 1950. While there were Governor's Disaster Declarations for shoreline problems in the state in 1985 and 1986, these declarations did not include Leelanau County.

8. Wildfires
The Michigan Hazard Analysis of 2006 identified around 35 wildfires occurred in Leelanau County from 1981 to 2005, all of relatively small size. Therefore, after evaluation of the hazards map by the Task Force where it showed that the forests are made up of mostly fire resistant hardwoods, they did not list wildfires as a priority area.
9. Earthquakes
There has been no occurrence of earthquakes in the county in recent history and the closest ones have been in Ohio and Indiana which are about six hours from Leelanau County.
10. Subsidence
The Michigan Hazard Analysis of 2006 and local information indicate that there have been no significant subsidence events in the county. Given the geological structure below the county, no significance subsidence issues are expected in the future.

3. *Probability of Hazards:*

The possibility that a natural hazard such as hail, thunderstorm and high wind, tornadoes, and snow and ice will affect this area of Michigan occurs on an annual basis. The magnitude and severity depends on the season, which determines temperature, moisture in the air, ice cover on the lakes, etc. Also, the severity of harm and damage from natural hazard events can be connected with tourist activity, the increased pace of second home development, and a general increase in the base population in northwest, lower Michigan. The geographic impact of the natural hazards' impact has remained the same in Leelanau County.

The areas where natural hazards overlap in Leelanau County can include heavy snow that causes trees and power lines down, and then melting, rain and flooding. Rising water levels with high winds can cause coastal landslides/debris flow/erosion.

Please see Appendix C: Risk Assessment Summary Table.

C. Leelanau County Natural Hazards Task Force and Public Input

To create the Leelanau County Natural Hazards Task Force, invitations for the meetings were sent to the following entities requesting their participation:

County Administrator/Coordinator
County Board of Commissioners
County Sheriff/Emergency Services (911 Services Coordinators, Public Safety)
County Emergency Manager/Coordinator
County Public Works Director
County Health Department Director
County Planning or Community Development Director
County Drain Commissioner/Soil Erosion Officers
County Road Commission Director
County Conservation District Director/Soil Erosion Officers
Township elected and appointed officials
Township Supervisors

Township Clerks
Michigan State Police
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Michigan Department of Transportation
U.S. Coast Guard
Hospitals
City/Village Maintenance/Utilities
Tribes
Environmental/Conservation Groups/Organizations
American Red Cross
Groundwater Protection Organizations
Housing Associations
Chambers of Commerce
National Weather Service (Gaylord)
Michigan Family Independence Agencies

The first Task Force meeting was held on **May 13th, 2004** to identify the natural hazards priority areas and the second Task Force meeting was held on **July 20th, 2004** to develop the mitigation strategies for the priority issues. The following organizations/individuals participated in these meetings:

Leelanau County Board of Commissioners
Leelanau County Administrator
Leelanau County Drain Commissioner
Leelanau County Emergency Management Coordinator
Leelanau County Equalization Department
Leelanau County Planning Commission
Leelanau County Planning Department
Leelanau County Sheriff Office
Grand Traverse Band of Ottawa and Chippewa Indians
Cleveland Township
Leelanau Conservation District
Michigan Department of Environmental Quality
Michigan Department of Natural Resources

At the first Task Force meeting, the NWMCOG staff presented the background of the required project; the principle natural hazards in Michigan; what is mitigation planning; the purpose of the plan; suggested goals; and the political process. A full county hazards map was available for review with four separate quadrant maps. These sectional maps were for the participants to review the areas of the county they were most familiar with. The Emergency Management Coordinator and Planners reviewed all the maps to give input on the entire county.

The group analyzed the map areas for the top hazard priority areas by documenting the most threatening. They did a qualitative assessment of points and concerns of potential conflicts with the population centers and the relationship to critical facilities. The general list created included:

1. Severe winter weather – energy loss (power)

2. Slopes and bluffs along Lake Michigan – homes lost near Leland
3. Festivals/events and seasonal population – Northport, Cedar, Leland, Glen Arbor, Dune Fest, Suttons Bay, Peshawbestown, Empire, Maple City, Lake Leelanau
4. Tornadoes and high winds
5. Greillickville – population, gasoline storage tanks, gas tanker deliveries during (Cherry Festival and Blue Angels)
6. Cedar area – wetlands, not a lot of people, buildings; can release water at Leland dam for Lake Leelanau
7. Stormwater and soil erosion
8. Dams/Bridges in the county
9. Wetlands – environmentally important to slow storm surges; protect the small ones, too.

The participants then took the complete list above and developed their Top Five Natural Hazards Priority Areas. Due to the rural nature of the county, there has not been a lot of property damage, injuries, or deaths due to natural hazards. Please refer to Figure 1.

1. **County: Severe Winter Weather - heavy snow, extreme temperatures, and concerns about power and energy loss; agriculture**
Snowstorms can be very dangerous for a community for short periods of time. Heavy snows can shut down towns and businesses for a period of a few days if the snow is falling faster than it can be cleared in a timely fashion. Blowing and drifting with blizzard conditions cause driving hazards.
2. **County: Severe High Winds and Tornadoes highlighting the seasonal influx and festivals in Greillickville, Northport, Cedar, Leland, Glen Arbor, Suttons Bay, Peshawbestown, Empire, Maple City, Lake Leelanau; and agriculture**
There is a historical record of high wind events and tornadoes on the Leelanau Peninsula over the years. Severe winds, or straight line winds that sometimes occur during severe thunderstorms can be very damaging to a community. Severe winds have the potential to cause loss of life from property damage and flying debris. Damage from straight line winds is more widespread than tornadoes and usually affects multiple counties. There is also risk of infrastructure damage from downed power lines due to falling trees and limbs.

There is a historical record of severe thunderstorm events in the county with some concerns regarding the influx of tourists. Thunderstorms are hazards that bring a variety of problems during the spring, summer, and fall seasons. They can bring potential lightning, flash flooding, hail, strong winds, and even tornadoes.
3. **Lake Michigan: Erosion of Slopes and Bluffs**
Shoreline erosion hazards involve the loss of property as sand or soil is removed by water action and carried away over time. This can cause structures to stand perilously close to waters or bluffs. The foundation of a structure, or underground utility pipes in the area, may become fully exposed and vulnerable to weather, extreme temperatures, water damage, or other sources of risk.

Shoreline roadways whose banks erode and cause the road surface to crack, become unstable, or more prone to deposits of sand, snow, water, and ice from nearby beaches and water bodies.

4. County: Erosion (Inland) and Stormwater Concerns – wetland loss

Soil erosion and stormwater runoff hazards can involve the loss of property along waterways and natural drainage areas as sand or soil is removed by water action and carried away over time. The foundation of a structure, or underground utility pipes in the area, may become fully exposed and vulnerable to weather, extreme temperatures, water damage, or other sources of risk. Roadways can also be washed away by stormwater and can cause the road surface to crack, become unstable, or more prone to deposits of sand, snow, water, and ice.

5. Dams and Bridges: Failure and Localized Flooding

There are four major dams in the County and four major bridges. Major bridges include the Narrows Bridge between Big and Little Glen Lakes, and bridges in Leland, Lake Leelanau, and Cedar. Damages will be greater from flash flood types of events than they would from gradual floodplain inundation.

In addition to “regular” flooding in a riverine floodplain, other flooding may involve low-lying areas that collect runoff waters; flaws or shortcomings in existing sewer infrastructure; undersized or poorly designed stormwater control practices; collective effects of land use and development trends; illegal diversion of water, or actions that interfere with system function.

Please refer to Appendix B. #2 Priority Area Maps.

D. Emergency Warning System Coverage

There is one warning siren located in Leland at this time. And, there is one warning siren located in Peshawbestown at the Pow Wow Grounds on Stallman Road for the Grand Traverse Band of Ottawa and Chippewa Indians.

E. Economic Impact Analysis

The total Damaging Events’ Costs recorded since 1950 with the National Oceanic and Atmospheric Administration for Leelanau County, the region, and the state are as follows:

1.	Snow and Ice -	\$5,050,000
2.	Thunderstorm and High Wind -	\$180,000
3.	Tornadoes -	\$275,000

NWMCOG staff worked with the Leelanau County Equalization Department to calculate each Priority Area’s economic value through the State Equalized Values (SEV) for real and personal property (residential and commercial). The following includes the 2000 Census data for the priority area and the SEV dollar amount times two (estimated fair market values) for each priority area.

1. *County: Severe Winter Weather - heavy snow, extreme temperatures, and concerns about power and energy loss; agriculture*
Population: 21,119
Total: \$6,794,260,658
2. *County: Severe High Winds and Tornadoes highlighting the seasonal influx and festivals/events held in Greillickville/Elmwood Township, Northport/Leelanau Township, Cedar and Maple City/Solon Township, Leland and Lake Leelanau/Leland Township, Glen Arbor/Glen Arbor Township, Suttons Bay and Peshawbestown/Suttons Bay Township, Empire Township, and agriculture*

Population: 21,119
Total: \$6,794,260,658
3. *Lake Michigan: Erosion of Slopes and Bluffs*

Population: 8,180 (estimated)
Total: \$1,686,682,438
4. *County: Erosion and Stormwater Concerns – wetland loss*
Population: 21,119
Total: \$6,794,260,658
5. *Dams and Bridges: Failure and Localized Flooding*
Population: 7,285 plus seasonal influx during the summer
Total: \$695,124,040

VIII. NATURAL HAZARDS MITIGATION GOALS AND OBJECTIVES

The mission of the Leelanau County Natural Hazards Mitigation Plan is to protect the health and safety of the public and property in the County which includes prevention of injury, loss of life, property damage, breakdown in vital services like transportation and infrastructure, economic slumps, maintain tourist base, and liability issues. This is done by taking action to permanently eliminate or reduce the long-term risks from natural hazards.

Specific goals and objectives have been established based upon the community's natural hazards analysis, as well as input from the Task Force participants and the public through meetings, posting of the draft plan with a request for comments in the local newspaper and on the NWMCOG website, and the presentation of the plan to the Leelanau County Planning Commission.

Goal 1: Increase local awareness and participation in natural hazards mitigation strategies

- A. Encourage cooperation and communication between planning and emergency management officials
- B. Encourage additional local governmental agencies to participate in the hazard mitigation process
- C. Encourage public and private organizations to participate

Goal 2: Integrate hazard mitigation considerations into the community's comprehensive planning process

- A. Enforce and/or incorporate hazard mitigation provisions in building code standards, ordinances, and procedures; and into the county's comprehensive master plan
- B. Create or update zoning ordinances to reflect any new building codes, shoreline protection rules, etc.
- C. Incorporate hazard mitigation into basic land use regulation mechanisms
- D. Incorporate hazard area classifications into standard zoning classifications
- E. Develop community education and warning systems
- F. Strengthen the role of the Local Emergency Planning Committee in the land development process
- G. Integrate hazard mitigation into the capital improvement planning process so that public infrastructure does not lead to development in hazard areas
- H. Encourage county agencies to review local roads, bridges, dams, and related transportation infrastructure for hazard vulnerability

Goal 3: Utilize available resources and apply for additional funding for hazard mitigation

- A. Provide a list of desired community mitigation measures to the State for possible future funding
- B. Encourage the application for project funding from diverse entities

Goal 4: Develop and complete hazard mitigation projects in a timely manner

- A. Encourage public and business involvement in hazard mitigation projects

IX. IDENTIFICATION AND SELECTION OF MITIGATION STRATEGIES

A. Climate Change Solutions

Regional residents, business leaders, and policymakers can help reduce the potential impacts from climate change by pursuing three necessary and complementary strategies:

- Reducing heat-trapping gas emissions will help curb the threat from a changing climate. This can be achieved, for example, by increasing energy efficiency, switching to renewable energy sources such as wind and biomass, increasing the fuel economy of vehicles, and investing in clean transportation choices.
- Minimizing pressures on the environment by improving air quality, protecting the quality and supply of water resources, protecting habitat, and limiting sprawl.
- Preparing for those impacts from global warming that cannot be avoided through better planning and emergency preparedness, adaptations in agriculture, strengthening public health response and warning systems, and adjusting flood control infrastructure based on projected precipitation trends.

B. Selection of Feasible Mitigation Strategies

A set of evaluation criteria was developed to determine which mitigation strategies were best suited to address the identified problems in Leelanau County.

1. The measure must be technically feasible.
2. The measure must be financially feasible.
3. The measure must be environmentally sound and not cause any permanent, significant environmental concerns.
4. The measure must be acceptable to those participating in the strategy and/or primarily impacted by the strategy.

By anticipating future problems, the County can reduce potential injury, structure losses, loss of power such as electric and gas, and prevent wasteful public and private expenditures.

At the second Task Force meeting in **July 2004** the participants reviewed the suggested list of strategies, matched them with each of the natural hazard priority areas, and also suggested others to create a list of the most desired strategies for each. Please refer to Appendix B. #2.

Priority 1. County: Severe Winter Weather - heavy snow, extreme temperatures, and concerns about major power and energy loss; and agricultural damage

Snow load Mitigation Strategies:

- a. Snow load design standards – develop planning grant for a study of snowfall patterns and occurrence of damage
- b. Public education and awareness
- c. Enforcement of building codes for new construction – state code is 60 lbs. per sq. ft.

Priority 2. County: Severe High Winds and Tornadoes highlighting the seasonal influx and festivals/events held in Greillickville, Northport, Cedar, Leland, Glen

**Arbor, Suttons Bay, Peshawbestown, Empire, Maple City, Lake Leelanau;
and agricultural damage**

High Winds and Tornado Mitigation Strategies:

- a. Develop and implement mutual support and aid practices with surrounding communities
- b. Tree management by power companies on power line easements
- c. Public education
- d. Suggest that events have an evacuation plan
- e. Building Code enforcement for new construction

Priority 3. Lake Michigan: Erosion of Slopes and Bluffs

Erosion and Debris Flow Mitigation Strategies:

- a. Inventory shoreline erosion sites
- b. More detailed soil erosion permits: slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement
- c. Zoning administration and enforcement of ordinances: development setbacks, lot sizes, driveways, relocation of structures, Lake Michigan coastal zoning ordinances – U.S. Army Corps of Engineers and Michigan Department of Environmental Quality
- d. Open space designations: acquisition or conservation easements by land conservancies, county, townships
- e. Public education
- f. Building code enforcement through permits

Priority 4. County: Erosion (Inland) and Stormwater Concerns – wetland loss

Erosion and Debris Flow Mitigation Strategies:

- a. Inventory erosion sites
- b. More detailed soil erosion permits: slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement
- c. Zoning administration and enforcement of ordinances: development setbacks, lot sizes, driveways, relocation of structures, Lake Michigan coastal zoning ordinances – U.S. Army Corps of Engineers and Michigan Department of Environmental Quality
- d. Open space designations: acquisition or conservation easements by land conservancies, county, townships
- e. Public education
- f. Building code enforcement through permits

Priority 5. Dams and Bridges: Failure and Localized Flooding

NFIP Status – Leelanau County; Bingham, Centerville, Cleveland, Elmwood, Empire, Glen Arbor, Leelanau, Leland, Suttons Bay Townships, Villages of Suttons Bay, Northport, Empire

Flood Mitigation Strategies:

- a. Assessment of flood threat and dam inspections results
- b. Research a flood warning system
- c. Public education
- d. Building code enforcement

Additional Mitigation Strategies:

- *Work with other governmental entities such as townships, villages, and the Grand Traverse Band of Ottawa and Chippewa Indians; organizations; businesses; and the public*
- *Work on a multi-hazard warning plan and strategies for festivals/events*
- *Develop mutual support and aid from surrounding communities*
- *Incorporate the Plan's hazard mitigation concepts, strategies, and policies into existing elements of Leelanau General Plan*

X. Participation in the Development of the Leelanau County Natural Hazards Mitigation Plan

The opportunities for review by other governmental entities and the public included the following:

- A. Quarterly reports were given to the Northwest Michigan Council of Governments' Board of Directors for neighboring counties' review.
- B. Public Notices were published in the Leelanau Enterprise – no comments were received.

Public Notice

The Northwest Michigan Council of Governments is requesting public comment on the Natural Hazards Mitigation Plan draft for Leelanau County. The Plan is available for review at the Leelanau County Planning Department, County Building, Leland or at nwm.org, Community Resources, Community and Economic Development, Hazard Mitigation Planning Program, Leelanau County Plan. Please send comments by September 17, 2004 to: Hazard Mitigation Plans, NWMCOG, PO Box 506, Traverse City MI 49685-0506.

- C. Postcards that gave notice of the draft plan to review were sent to all the Township Supervisors - no comments were received.
- D. The Natural Hazards Mitigation Plan was presented to the Leelanau County Planning Commission where the meetings are posted in the newspaper and are open to the public. Commission members gave their input and there was a comment from a township appointed official.
- E. The Natural Hazards Mitigation Plan was presented to the Leelanau County Board of Commissioners where the meetings are posted in the newspaper and are open to the public. Commissioners gave their input and there were no comments from the public.
- F. During development of the plan, all townships and villages were provided the opportunity to formally comment on plan drafts and other related materials. They were given the opportunity via mailings of both meeting notices and draft copies of the plan for comment. Notification was also provided to them that the plans were

posted on the NWMCOG website and could be reviewed there. While no jurisdictions (other than the county) provided formal written comments, they did provide county staff (particularly the county emergency manager) with feedback via other informal means. This feedback took the form of phone calls, emails and conversations that occurred at various non-mitigation related meetings throughout the county. This information was provided back to NWMCOG staff by the county staff and used in development of the plan, including the risk assessment and community profile sections.

In addition, the townships and villages (whether or not they have their own zoning) have indicated to NWMCOG and the county emergency manager that they will follow the county's lead in identifying mitigation projects and developing grant applications to fund those projects. Land use issues associated with those projects (where applicable) will be handled by each jurisdiction that controls zoning in the project area.

The Townships/Villages in the priority areas include:

1. Bingham Township – Zoning
2. Centerville Township – Zoning
3. Cleveland Township – Zoning
4. Elmwood Township – Zoning
5. Empire Township – Zoning
6. Village of Empire – Zoning
7. Glen Arbor Township – Zoning
8. Kasson Township – Zoning
9. Leelanau Township – Zoning
10. Village of Northport – Zoning
11. Leland Township – Zoning
12. Solon Township – Zoning
13. Suttons Bay Township – Zoning
14. Village of Suttons Bay – Zoning
15. City of Traverse City – Zoning

County/Township/Others	Zoning	Participation
Leelanau County	No	Task Force meetings, review of draft plans, approval to submit plan: County Commissioners County Administrator Drain Commissioner Emergency Management Coordinator Equalization Department Planning Commission Planning Department Sheriff Department
Bingham	Yes	See paragraph F, above
Centerville	Yes	See paragraph F, above
Cleveland	Yes	Task Force meetings, review of draft plans
Elmwood	Yes	See paragraph F, above
Empire	Yes	See paragraph F, above
Village of Empire	Yes	See paragraph F, above
Glen Arbor	Yes	See paragraph F, above
Kasson	Yes	See paragraph F, above
Leelanau	Yes	Task Force meetings, review of draft plans
Village of Northport	Yes	See paragraph F, above
Leland	Yes	See paragraph F, above
Solon	Yes	See paragraph F, above
Suttons Bay	Yes	See paragraph F, above
Village of Suttons Bay	Yes	See paragraph F, above
Traverse City	Yes	See paragraph F, above
Grand Traverse Band of Ottawa and Chippewa Indians	Yes	Task Force meetings, review of draft plans
Leelanau Conservation District	N/A	Task Force meetings, review of draft plans
Michigan Department of Environmental Quality	N/A	Task Force meetings, review of draft plans
Michigan Department of Natural Resources	N/A	Task Force meetings, review of draft plans

**The Grand Traverse Band has their own planning authority over lands they own that have been put in trust with the Federal Government. The County Natural Hazards Mitigation Plan would not cover the Tribe/lands, but the Tribes may adopt the approved County plan as their own.

N/A = Not applicable; these are non-governmental authority entities

XI. IMPLEMENTATION OF THE LEELANAU COUNTY NATURAL HAZARDS MITIGATION PLAN

1. *Natural Hazards Mitigation Plan Managers and Technical Assistance*

The leader for implementing the Natural Hazards Mitigation Plan is the Leelanau County Board of Commissioners, with the staff leaders being the Emergency Management Coordinator and the Planning Department. Working partnerships can be established with the following to provide technical assistance to accomplish the goals and objectives of the Plan.

Leelanau County Government
Townships, cities, and villages
Leelanau County Conservation District
Leelanau County Drain Commissioner
Leelanau County Road Commission
Grand Traverse Band of Ottawa and Chippewa Indians
Conservation Resource Alliance
Watershed Center Grand Traverse Bay
Michigan State University Extension
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
U.S. Environmental Protection Agency
U.S. Army Corps of Engineers
U.S. Department of Agriculture Natural Resources Conservation Service
U.S. National Park Service
Insurance Companies
Real Estate Companies
Architects
Engineers

All natural hazards mitigation planning could be pursued with the new tool available to the local governments which is Michigan Public Act 226 of 2003, the Joint Municipal Planning Act. This Act provides for joint land use planning by cities, villages, and townships and allows two or more municipalities' legislative bodies to create a single joint planning commission to address planning issues. This tool helps with planning for the "big picture" issues such as natural hazards that cross jurisdictional boundaries.

- ☞ Individual units of government modifying their ordinances simultaneously to include language that would incorporate aspects of protection
- ☞ Developing an overlay zoning district that would cross jurisdictional boundaries that would be incorporated into existing independent units of government's zoning ordinances
- ☞ Forming a new joint (multi-jurisdictional) planning commission or zoning board
- ☞ Sharing zoning administration
- ☞ Sharing enforcement activities

2. Funding the Implementation of the Plan

To assist with the funding of the proposed natural hazards mitigation strategies, here is a list of potential financial assistance entities to help fund the implementation projects of the Plan.

Federal Emergency Management Administration – Hazard Mitigation Grant Program

U.S. Environmental Protection Agency

U.S. Department of Agriculture Natural Resources Conservation Service

U.S. Department of Agriculture Rural Development: Rural broadband opportunity – high speed telecommunication funding from the Public Telecommunications Facilities Planning and Construction grants

U.S. Department of Housing and Urban Development

Michigan Department of Environmental Quality

Michigan Department of Natural Resources

National Oceanic and Atmospheric Administration

Community, Regional Foundations

Businesses: Home Depot (local store and Foundation) The Home Depot Foundation assists with educational initiatives that provide developers and the general public with the information they need to make homes more disaster resistant.

3. Action Agenda

Following is summary for accomplishing the **recommended natural hazards mitigation actions** for Leelanau County. The townships in the priority areas have their own zoning, but there are not zoning changes recommended.

Action Agenda Layout:

Priority and Action Strategies	Responsible Parties	Timeframe
Priority Area 1 Snow Load Mitigation Strategies:		
a. Snow load design standards – develop planning grant for a study of snowfall patterns and occurrence of damage	County Planning Department Emergency Management Coordinator Building Inspector	1-3 years from adoption of the plan
b. Public education and awareness	County Building Inspector County Planning Department Emergency Management Coordinator Townships, Villages, City	1-3 years from adoption of the plan
c. Enforcement of building codes for new construction	County Building Inspector	Ongoing
Priority Area 2 High Winds and Tornado Mitigation Strategies:		
a. Develop and implement mutual support and aid practices with surrounding communities	County Planning Emergency Management Coordinator County Building Inspector Townships, Villages, City	1-3 years from adoption of the plan
b. Tree management by power companies on power line easements	Emergency Management Coordinator Building Inspector	Ongoing
c. Public education	County Building Inspector County Planning Emergency Management Coordinator	1-3 years from adoption of the plan

	Townships, Villages	
d. Suggest that events have an evacuation plan	County Planning Emergency Management Coordinator	1-3 years from adoption of the plan
e. Building Code enforcement for new construction	Building Inspector	Ongoing
Priority Area 3 <i>Lake Michigan: Erosion and Debris Flow Mitigation Strategies:</i>		
a. Inventory of shoreline erosion sites	County Planning Emergency Management Coordinator Drain Commissioner County Soil Conservation District	1-3 years from adoption of the plan
b. More detailed soil erosion permits – slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement	County Soil Conservation District Emergency Management Coordinator MI Department of Environmental Quality	Ongoing
c. Zoning administration and enforcement of ordinances/permits	County Planning County Building Inspector Emergency Management Coordinator Drain Commissioner County Soil Conservation District MI Department of Environmental Quality U.S. Army Corps of Engineers	Ongoing
d. Open space designations: acquisition or conservation easements by land conservancies, county, townships	County Planning Townships, Villages Land Conservancies	1-5 years from adoption of the plan
e. Public education	County Planning Emergency Management Coordinator County Soil Conservation District Drain Commissioner Townships, Villages	1-3 year from adoption of the plan
f. Building code enforcement through permits	Building Inspector	Ongoing
Priority Area 4 <i>Erosion (Inland) and Debris Flow (wetland loss) Mitigation Strategies:</i>		
a. Inventory of erosion sites	County Planning Emergency Management Coordinator Drain Commissioner County Soil Conservation District	1-3 years from adoption of the plan
b. More detailed soil erosion permits – slide areas, drainage control, grading, debris flow measures, vegetation (native species) placement	County Soil Conservation District Emergency Management Coordinator MI Department of Environmental Quality	Ongoing
c. Zoning administration and enforcement of ordinances/permits	County Planning County Building Inspector Emergency Management Coordinator Drain Commissioner County Soil Conservation District MI Department of Environmental Quality U.S. Army Corps of Engineers	Ongoing
d. Open space designations: protection of wetlands, acquisition or conservation easements by land	County Planning Townships, Villages Land Conservancies	1-5 years from adoption of the plan

conservancies, county, townships		
e. Public education	County Planning Emergency Management Coordinator County Soil Conservation District Drain Commissioner Townships, Villages	1-3 years from adoption of the plan
f. Building code enforcement through permits	Building Inspector	Ongoing
Priority Area 5 Flood Mitigation Strategies:		
a. Assessment of flood threat and dam inspections results	Emergency Management Coordinator County Planning Drain Commissioner	1-3 years from adoption of the plan
b. Research a flood warning system	Emergency Management Coordinator	1-3 years from adoption of the plan
c. Public education	Emergency Management Coordinator County Planning Drain Commissioner County Soil Conservation District Townships, Villages	
d. Building code enforcement		

Additional Mitigation Strategies:

- ***Work with other governmental entities such as townships, villages, and the Grand Traverse Band of Ottawa and Chippewa Indians; organizations; businesses; and the public***
- ***Work on a multi-hazard warning plan and strategies for festivals/events***
- ***Develop mutual support and aid from surrounding communities***
- ***Incorporate the Plan's hazard mitigation concepts, strategies, and policies into existing elements of Leelanau General Plan***

Leelanau County can also utilize watershed management plans and data that have been developed within the county boundaries. Proposed mitigation strategies that have been laid out in the Grand Traverse Bay Watershed Management Plans include:

- Inventory shoreline erosion sites
- Reduce the magnitude of overland stormwater runoff to streams
- Minimize the change of terrestrial vegetation types from forest/shrub species to turf species
- Utilize maps for potential flood areas and wetlands
- Work to stop wetland and other types of lowland filling
- Protect critical riparian areas
- Limit habitat fragmentation by maintaining compact communities
- Adequate setbacks for buildings
- Minimize development clearings by landowners
- Establish riparian buffers along waterway
- Establish and support stormwater best management practices
- Reduce the amount of impervious surfaces in the watershed, especially in areas of high groundwater recharge
- Regularly inform public about the watershed, activities, study findings, success/example projects, and opportunities for contribution (organization to public)

- Provide focused information to residents, visitors, local governments, and other target groups on priority topics (organization to individual)
- Involve the citizens, public agencies, user groups and landowners in implementation of the watershed plan through meetings and workshops with individuals or groups.

The County should consider the following key land use issues and the relationship to hazard mitigation:

- Safe, beneficial uses for hazard prone areas
- Concentration issues
- Proximity issues
- Location of public facilities and infrastructure
- Development standards for public facilities and infrastructure
- Effect of accumulated development on community systems and facilities

4. *Monitoring and Evaluation*

The Leelanau County Natural Hazards Mitigation Plan will be monitored on a regular basis by the Emergency Management Coordinator and the Planning Department. Because Leelanau County is a dynamic, changing county with population growth, it is expected that the plan should be reviewed on an annual basis.

To assess the effectiveness of the Plan, some questions to ask in the review include: 1) How many and which mitigation strategies were developed? Implemented? 2) Did any new natural hazards events take place the past year to report? This review will be administered by the Emergency Management Coordinator with the Local Emergency Planning Committee, the County Planning Commission and Department, and the public. If changes are needed, the plan will be presented to the Task Force participants for revisions.

Although review of the plan will occur annually, and a formal revision may not be needed each year, a new edition of the plan will be expected within every five year period. New additions of the plan will be based on annual reviews, monitoring, evaluation, and an accumulation of official feedback and public input. When it is appropriate to publish a revised version of the plan, the Task Force participants shall again be involved in the revision process. Each new edition of the plan will again be officially adopted by the Leelanau County Board of Commissioners.

XII. NATURAL HAZARDS MITIGATION ADOPTION RESOLUTION

To be inserted after adoption by the Leelanau County Board of Commissioners

XIII. APPENDICES

Appendix A

Glossary of Mitigation Planning Terms

Alluvial fan: A gently sloping fan-shaped landform created over time by the deposition of eroded sediment and debris.

Base Flood: A flood having a one percent chance of being equaled or exceeded in any given year.

Coastal high hazard area: An area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms.

Disaster: A major detrimental impact of a hazard upon the population and economic, social, and built environment of an affected area.

Exposure: The number, types, qualities, and monetary values of various types of property or infrastructure and life that may be subject to an undesirable or injurious hazard event.

Flood Insurance Rate Map: As defined under the National Flood Insurance Program, an official map of the community on which the administrator of the Flood Insurance Administration has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

Floodplain or flood prone area: Any land area susceptible to being inundated by water from any source.

Floodplain management: The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works, and floodplain management regulations.

Fuel: Combustible plant material, both living and dead, that is capable of burning in a wildland situation; any other flammable material in the built environment that feeds a wildfire.

Hazard: An event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.

Hazard identification: The process of defining and describing a hazard, including its physical characteristics, magnitude and severity, probability and frequency, causative factors, and locations or areas affected.

Lifeline systems: Public works and utilities such as electrical power, gas and liquid fuels, telecommunications, transportation, and water and sewer systems.

Major disaster: As defined in the Stafford Act, “any natural catastrophe or, regardless of cause, any fire, flood, or explosion in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.”

Mitigation: Sustained action taken to reduce or eliminate the long-term risk to human life and property from natural hazards and their effects. Note that this emphasis on long-term risk distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery.

Multiple-objective management: A holistic approach to floodplain management (or the management of other hazards) that emphasizes the involvement of multiple distinct interest in solving land use problems related to the hazardous area.

Natural hazard: Hurricanes, tornadoes, storms, floods, tidal wave, tsunamis, high or wind-driven waters, volcanic eruptions, earthquakes, snowstorms, wildfires, droughts, landslides, and mudslides.

One hundred year flood: The flooding event that has a one percent chance of occurring in a particular location in any given year. While this is the most common reference point statistically because it is used for regulatory purposes in the National Flood Insurance Program, the same language applies in referring to other actual or hypothetical events in terms of their statistical probabilities.

Risk: The potential losses associated with a hazard, defined in terms of expected probability and frequency, exposure, and consequences.

Risk assessment: A process or method for evaluating risk associated with a specific hazard and defined in terms of probability and frequency of occurrence, magnitude and severity, exposure, and consequences.

Special flood hazard area: Land in the floodplain within a community subject to one percent or greater chance of flooding in any given year.

Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act (P.L. 93-288, as amended by P.L. 100-707), which provides the greatest single source of federal disaster assistance.

Structure: A walled and roofed building, including a storage tank for gas or liquid, that is mostly above ground, as well as a manufactured home.

Tornado Classifications:

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not

			<p>be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies</p>
--	--	--	--

Urban Wildfire: A fire moving from a wildland environment, consuming vegetation as fuel, to an environment where the fuel consists primarily of buildings and other structures.

Urban/wildland interface: A developed area, also known as the “I-zone,” occupying the boundary between an urban or settled area and a wildland characterized by vegetation that can serve as fuel for a forest fire.

Vulnerability: The level of exposure of human life and property to damage from natural hazards.

Watershed management: The implementation of a plan or plans for managing the quality of flow of water within a watershed, the naturally defined area within which water flows into a particular lake or river or its tributary. The aims of watershed management are holistic and concern the maintenance of water quality, the minimization of stormwater runoff, the preservation of natural flood controls such as wetlands and pervious surface, and the preservation of natural drainage patterns. Watershed management is, in many ways, an enlargement of most of the concerns that underlie floodplain management.

Wildland: An area in which development has not occurred with the exception of some minimal transportation infrastructure such as highways and railroads, and any structures that are widely spaced and serve largely recreational purposes.

Appendix B

Detailed Maps

- 1. 11 x 17 Full Map**
- 2. 11 x 17 Zoom in of Priority Areas**

Appendix C

Population Density Map

APPENDIX D

Risk Assessment Summary Table: LEELANAU COUNTY

HAZARD	How Frequently has the Hazard Occurred in the Past?	How Likely is the Hazard to Occur in the Future?	Potential Geographic Size of the Affected Area	Potential Population Impacted	Priority of Mitigation Activities for this Hazard	Detailed Damaged and Estimated Costs (Population, Economic, Environment)
Drought	2 events	37% chance	County	21,119		\$0.00
Earthquakes	No recorded events	5% chance	County	21,119	0	
Lake Surf Erosion and Severe Erosion	Lost homes near Leland	Cyclical water level chance	Lake Michigan shoreline	8,180	3	\$0.00
			Soil Erosion county-wide	21,119	4	
Flooding			Wetland loss - county	21,119	4	\$0.00
	6 events	11% chance	Dams/Bridges Low areas – secondary roads	7,285	5	
Hail	10 events	19% chance	Some severe	County		\$0.00
Snow and Ice			County	21,119	1	Property damage \$5,050,000
	52 events	96% chance	County			
Subsidence	No recorded events	5% chance	Unknown	Unknown	0	
Thunderstorms/Winds			Elmwood	4,264 + seasonal	2	Property damage \$180,000
			Northport	648 + seasonal		
			Cedar	1,095 + seasonal		
			Leland	2,033 + seasonal		
			Glen Arbor	788 + seasonal		
			Suttons Bay	589 + seasonal		
			Peshawbestown	500 + seasonal		
	23 events	43% chance	County			
Tornadoes			Elmwood	4,264 + seasonal	2	\$0.00
			Northport	648 + seasonal		
			Cedar	1,095 + seasonal		
			Leland	2,033 + seasonal		
			Glen Arbor	788 + seasonal		
			Suttons Bay	589 + seasonal		
			Peshawbestown	500 + seasonal		

	2 events	37% chance	County	21,119		Population, Economic, Environment
--	----------	------------	--------	--------	--	--------------------------------------

Appendix E

Examples of Past Mitigation Projects

Flood Projects	Tornado/Wind Projects	Extreme Cold/Winter/Infrastructure Failure Projects
Replace culvert with bridge	Modify roof ballast system on airport	Insulate municipal water tower
Install stormwater relief drain	Construct storm shelters in public buildings	Insulate city infrastructure
Upgrade road culvert	Construct storm shelters for homes, facilities	Insulate sanitary/storm sewer mains
Elevate floors of homes	Wind bracing for microwave/radio towers	Insulate water mains
Acquire of floodway properties	Construct mobile home park storm shelter	Bury utility lines
Create retention basin	Wind retrofitting for municipal buildings	Relocate sewer mains
Construct new dike	Wind bracing for school facilities	Reroute power lines under a river
Upgrade bridge over a creek (for greater stream flow)	Upgrade warning sirens**	Install plumbing devices to prevent sewer backup
Install sea wall	Install warning sirens**	Elevate and build casing for generator for EOC
Install rip rap to protect roadway	Purchase/Distribute NOAA radios**	Living snow fences for highways and roadways
Re-route various county drains	Severe weather monitoring systems**	
Purchase back-flow prevention valves	Implement long-term community outreach**	
Construct new drains for flood relief		
Flood study for home acquisition		
Flood study of community's flood risk	T-storm/Lightning Projects	Wildfire Projects
Flood study for stream, roadways		
Elevate electrical equipment in basements	Lightning protection (grounding/phasing)	Vegetation management for roadways
Floodproof wastewater treatment plant	Purchase/Distribute NOAA radios**	Vegetation mgmt. for urban interface areas of city
Warning sensor for creek/river	Install weather alert monitors**	Vegetation mgmt. for homes in fire prone areas
Warning sensor for dam		Urban Interface Education Program**
Raise manholes above 100-Yr floodplain		
Expand storm sewer network for subdivision		
Excavate floodway channel bypass		
Establish permanent flood elevation benchmarks**		
Increase pump capacity for pump stations		
Remove abandoned dam		
Construct emergency floodway		
Install plumbing devices to prevent sewer backup		

**Denotes Hazard Mitigation Grant Program State
Discretionary projects (only 5-10% set aside of HMGP funding)

Appendix F

The first Task Force meeting was held on **May 13th, 2004** to identify the natural hazards priority areas and the second Task Force meeting was held on **July 20th, 2004** to develop the mitigation strategies for the priority areas.

AGENDA May 13, 2004

- I. Welcome
 - a. Introductions
- II. Hazard Mitigation Planning Overview
- III. Data Sources
- IV. Hazard Mitigation Maps
- V. Breakout into Small Groups by Region
 - a. Analyze the maps for the top five potential hazard areas
 - b. List out the top five potential hazard areas
- VI. Report Out from Each Group and Develop the Top Five Potential Hazard Areas for the Entire County
- VII. Next Steps

AGENDA July 20, 2004

- I. Welcome and Introductions
- II. List out Recommended Mitigation Strategies

The following is the list of participants:

Leelanau County Board of Commissioners
Jean Watkoski

Leelanau County Administrator
David W. Gill

Leelanau County Drain Commissioner
Steven R. Christensen

Leelanau County Emergency Management Coordinator
Tom Skowronski

Leelanau County Equalization Department
Pam Zientek

Leelanau County Planning Commission

Leelanau County Planning Department
Trudy Galla

Leelanau County Sheriff Office

Mike Oltersdorf

Grand Traverse Band of Ottawa and Chippewa Indians

Jolanda Murphy

Local Government

Cleveland Township

Leelanau Township

Others

Leelanau Conservation District

Michigan Department of Environmental Quality

Michigan Department of Natural Resources

Appendix G

Resources

Benchmarks 2004, Northwest Michigan Council of Governments

Confronting Climate Change in the Great Lakes Region, Michigan fact sheet, Union of Concerned Scientists and the Ecological Society of America, April 2003.

Grand Traverse Bay Watershed Protection Plan, Watershed Center Grand Traverse Bay, December 2003, www.gtbay.org.

Integrating Human-Caused Hazards Into Mitigation Planning, State and Local Mitigation Planning how-to guide: Federal Emergency Management Agency, September 2002, FEMA 386-7 CD.

Local Hazard Mitigation Planning Workbook: EMD-PUB 207, February 2003, Emergency Management Division, Michigan Department of State Police.

Michigan Hazard Analysis: EMD PUB-103, December 2001, Emergency Management Division, Michigan Department of State Police.

Michigan Hazard Analysis 2006, EMD-PUB 103, March 2006, Emergency Management and Homeland, Security Division / Michigan Department of State Police

National Oceanic and Atmospheric Administration: Weather/Climate Events, Information, Assessments; Climatology and Extreme Events; U.S. Storm Events Data Base; 1950-present, local storm reports, damage reports, etc. from various sources. www.ncdc.noaa.gov

Northwest Michigan County Profiles 2000, Northwest Michigan Council of Governments, November 2002.

Northwest Michigan Council of Governments Website Data, nwm.org.

Planning for a Disaster-Resistant Community: A One-Day Workshop for City and County Planners, Planning Officials, and Consultants: American Planning Association Research Department, American Planning Association, 2002 in cooperation with the Federal Emergency Management Agency, Planning and Mitigation Branch (materials only).

State and Local Mitigation Planning how to guide: Understanding Your Risks, identifying hazards and estimating losses: Federal Emergency Management Agency, August 2001, FEMA 386-2.