Welcome!

- Using your **3 sticky notes**, please write down your **top 3 natural hazards** of concern in Emmet County
  - Use 1 sticky note per hazard
  - Place your sticky note on the wall, grouping similar responses together

Winter Storm/ Blizzard	**Heavy Snow**	**Ice Storm**	**Extreme Cold**	**Extreme Heat**	**Invasive Species**
High Winds	**Tornado**	**Severe T-Storm**	**Lightning**	**Drought**	**Wildfire**
Hail	**High Winds**	**Shoreline Erosion**	**Shoreline Flooding**	**Seiche**	**Inland Flooding**

Emmet County Community Meeting

Natural Hazards Concerns

March 14, 2023

Networks Northwest

Talent / Business / Community

Introductions

- Networks Northwest - Community Planners
  - Jennifer Neal, AICP
  - Stephanie Marchbanks

- Community Partners
  - Matthew Blythe, Emmet County Emergency Management Coordinator
  - Emmet County Local Emergency Planning Committee

Agenda

- Thank you for joining us!
- We will be discussing the following:
  - Purpose of the Natural Hazard Mitigation Plan
  - Community Survey Results
  - Your Community Vulnerabilities
  - Your Specific Natural Hazard Concerns in Emmet County

Purpose

Hazard Mitigation Planning

“The effort to reduce loss of life and property by lessening the impact of disasters”

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Billion-Dollar Disasters Shattered U.S. Record in 2020

The 22 events that each caused at least $1 billion in damage show the increasing costs of climate change

By Thomas Frank, E&E News on January 11, 2021

An aerial view of flood waters from Hurricane Delta surrounding structures destroyed by Hurricane Laura on October 10, 2020 in Creole, Louisiana. Credit: Mario Tama *Getty Images*

Presidential and Governor Declared Emergencies/Disasters

Date of Incident	Type of Incident	Affected Area	Type of Declaration/Federal ID #	Notes
March 2020	COVID-19; COVID-19 Pandemic	Statewide & National	State of Emergency, National Emergency (3455), and Governor and Presidential Declared Major Disaster (4494)	
1/29/2019	Extreme Cold	Statewide	Governor Declared Emergency	
9/4/2005 and 9/7/2005	Hurricane (Katrina) Evacuation	Statewide	Governor Declared Disaster and Presidential Declared Emergency (3225)	Declared due to the emergency conditions in the State of Michigan, resulting from the influx of evacuees from states impacted by Hurricane Katrina beginning on August 29, 2005.
2/3/2014	Deep Frost	Emmet County and Cheboygan, Chippewa, Delta, Charlevoix, Gogebic, Luce, Mackinac & Marquette Counties.	Governor Declared Emergency	
12/29/2001	Heavy Snow	Emmet County	Governor Declared Emergency	
1/26-27/1978	Blizzard, Snowstorm	Statewide	Presidential Declared Emergency (3057); Governor Declared Disaster	
3/2/1977	Drought	44 Counties, including Emmet.	Presidential Declared Emergency (3035)	

Historic Events

- 235 events with an event were reported between 01/01/1950 and 11/30/2022 (26,632 days), according to NOAA's National Centers for Environmental Information Storm Events Database.

* Presidential and/or Governor Declared Emergencies/Disasters ** Great Lakes Current Incident Database

Type of Event	# of Events	Event Location	Year Event Recorded
Wildfire	377	MDNR Lands	1981-2018
Extreme Winter Weather	126	Statewide; Region	1978*, 1996-2022, 2001*, 2014*
Thunderstorm/Wind; High/Strong Wind	73	County and Region	1967-2021; 1 injury in 2001
Hail	18	Countywide	1983-2019
Extreme Temperatures (Heat / Cold)	6	Region; Statewide	2001, 2007, 2015 (2), 2018, 2019*
Shoreline Hazards (lakeshore flood, waterspouts, rip current, coastal erosion)	6	Lake MI Coast - County/Region	1999 (waterspouts on LTB); 2005 & 2010 (rip current rescues at Petoskey State Beach**); 2012 (1 rip current death at Good Hart); 2020 (2 lakeshore floods; LTW washout due to coastal erosion)
Tornadoes	5	Countywide; F0 to F1	1953, 1955, 1957, 1987, 1996
Drought	3	Countywide and Region	1977*, 2007(2)
Flood/Flash Flood	3	Countywide and Region; Good Hart & Oden; City of Harbor Springs	2011, 2020, 2022
Lightning	1	Petoskey	2011
Public Health Emergency	1	Statewide/National	2020* (COVID-19 Pandemic)

Survey Results

Community Representation

58 responses (answered at least 42% of questions) from Nov 9, 2022 to Jan 4, 2023

All Cities, Village, and Townships have at least two responses

Role/Organization Role

Resident
Property or Business Owner
Appointed or Elected Official
Local Government Employee
Chamber of Commerce
Environmental Non-Profit
Other organization stakeholder

Survey Results

Q4: Are you familiar with the County's 2016 Hazard Mitigation Plan?

Yes: 22%

No: 78%

Q5: Does the community you represent have an adopted Master Plan?

Yes: 49%

Unknown, No or N/A: 51%

Q6: Does the community you represent have an adopted Capital Improvement Plan?

Yes: 42%

Unknown or N/A: 58%

Survey Results

Q7: Please rate your level of concern regarding each type of potential Natural Hazard affecting your community.
(Not Concerned = 1, Somewhat Concerned =2, Very Concerned =3)

Rank	Hazard	Mean Score
1	Severe Winter Weather (blizzard, snowstorm, ice, sleet, etc.)	2.38
2	High Winds/Straight-line Winds	2.36
3	Lake MI Shoreline Hazards (fluctuating water levels, rip current, erosion, seiche, landslide, flooding)	2.17
4	Severe T-storm (lightning, hail, wind, intense rainfall)	2.12
5	Invasive Species (aquatic or terrestrial)	1.97
6	Plant and Animal Diseases	1.91
7	Extreme Cold	1.88
8	Excessive Rainfall/Flooding	1.83
9	Tornado or Waterspout	1.81
10	Wildfire	1.72
11	Dense Fog	1.53
12	Extreme Heat	1.52
13	Drought	1.52
14	Subsidence (i.e., sinkholes)	1.36
15	Space Weather (i.e., solar-geomagnetic storm, solar flare)	1.17
16	Meteorites & Other Impacting Objects from Space	1.09
17	Earthquakes	1.07

Survey Results

Q8: Please describe your concerns regarding impacts from the above Natural Hazards.

AVAILABLE RESOURCES TO ENSURE HEALTH AND SAFETY
• I believe Emmet County fairgrounds is designated as a major disaster shelter particularly for housing animals in our barns.
• Resources available in the community to respond to such events
• Whether we can sustain one of these events.
• Ensuring the safety & health of our constituents (food, heat, shelter, medical) and ensuring our ability to collect & distribute tax money to continue operations in the case of a long term service outage.
• Lack of goods
• Concerns about how to handle widespread severe weather, and other Natural Hazards in order to keep people safe.
• What is the plan for each one. As there is really unknown information
• Human injury or loss of life.
• Severe weather concerns as related to health and safety
ELECTRICITY
• Ensuring that local power grid resources are available to operate our facility or support prompt response to our facility in the event of a natural disaster impacting our operation.
• Trimming of trees around power lines. Higher winds this year showed how vulnerable our grid system is to Northern Michigan tree density.
• Loss of power for extended periods of time. Lack of resource such as food and clean water.
• Inconvenience of no electricity for a period of time.
• safety of residents and visitors, utility services availability
• Business interruption
• Rural areas are quickly isolated and inaccessible after storms and power outages

Survey Results

Q8: Please describe your concerns regarding impacts from the above Natural Hazards.

PROPERTY DAMAGE

- home damage
- Damage to home and county structures
- Generalized damage
- Severe property damage
- Wildfire and Drought - Effect on farming and potential loss of property/life.
- Wildfires with the number of trees that have come down from the winds we have had.
- Living in a forested area and near the Great Lakes, fire and storm impacts from the lake are always in my thinking when I think of natural disasters.

TRANSPORTATION

- The impacts on air travel & the Airport
- In my role as a judge, I am concerned to the extent these hazards impact the ability of the court to provide services to county residents (i.e., unexpected closures) and the safety of residents in relation to their attendance at or access to the courts.
- Keeping the road network and bridges open for travel

STORM CLEAN UP

- Who cleans up after natural disasters and where does the material go?
- July of 2020's big storm that blew thru Petoskey and HS in a matter of hours, downed thousands of trees on private and public lands. Emmet County DPW managed the majority of the wood waste and was inundated with over 10,000 cubic yards of wood waste that we stockpiled then had ground and hauled to CMS energy's co-gen facility @ the cost of $6 per yard. Wood debris needs to be sustainably managed and burying it in a pit (like city of Gaylord) is not the BMP. Emmet County DPW is willing and able to provide consultation and BMP's for managing all storm debris including waste to landfill, recycling, reuse and recovery of materials to their highest and best use.

Survey Results

Q8: Please describe your concerns regarding impacts from the above Natural Hazards.

NATURAL RESOURCES
• Impacts from climate change are detrimental to our infrastructure, water quality, and public health - flooding, extreme storm events, unprecedented lake level fluctuations (record lows to record highs in record time), erosion, sewage and septic contamination, spread of invasive species, etc.
• Invasive Species impact on our water,
• Continued erosion along Lake Michigan shoreline.
• Shoreline erosion, rip current, plant and animal diseases
GENERAL CONCERNS
• Severe weather especially winter
• Winter months are unavoidable and create hazardous conditions for all.
• Damage to public infrastructure, damage to the economy
• The above natural hazards may cause disruption of the economy and threaten life in Emmet County.

Survey Results

Q13: Please describe any disruptive or damaging hazard event that have occurred within your community in the last ten years.

Event Type	# of Times Mentioned	Description
Winter Weather	12	Winter storms, blizzard, ice, snow, severe cold, heavy snowfalls with reduced visibility, impact on roads, closure of the county court due to severe weather conditions
Shoreline Erosion/Flooding	10	Lake MI shoreline; high lake water events causing damage to public investment/infrastructure; collapse of LTW due to erosion in 2020; road and trail closures due to erosion; snowmelt and rainfall resulting in landslides causing significant property damage; hardening of the shoreline which causes further erosion and other ecological problems for the waters
High Winds	10	Straight line winds damage; July 2020 storm and clean up of it; the storms that have occurred with high winds and power outages have caused the most problems but thankfully it's only been a temporary inconvenience…It would be much more concerning if these events happened in the winter.
Power Outages	10	Caused by storms. There are still pockets of Emmet County that occasionally go 3-4 days without power following even a mild inclement weather event; Not able to perform county government work functions due to communication and power disruptions.
Thunderstorms	8	July 2020 severe thunderstorm caused significant damage in and around Petoskey
COVID Pandemic	7	
Tornado	3	Gaylord tornado in May 2022 showed there is a possibility of damaging tornadoes in our area as well. Tornado touchdown in downtown Petoskey a couple of years ago.
Inland Flooding	3	Roads flooded after a storm; excessive flooding and stormwater overflow. Septic failures due to high water tables or failure to maintain systems. Tannery Creek flooding on US-31.
Invasive Species	1	Invading many inland lakes and streams and the Great Lakes shoreline.
Other	2	Road crumbling; Dead and falling trees on our roads appear to be a serious potential problem.

Survey Results

Q29: Has your community considered mitigation strategies for potential or current hazards? If so, please identify potential strategies you would like to explore in the future.

• Feasibility studies for shoreline restoration and native plantings, rerouting bike path to Highway, a suspension bridge as a replacement for bike path etc...	County employee/City of Petoskey Council member
• It continues to dumbfound me that Emmet County WILL NOT embrace a comprehensive, sustainably-financed, countywide public transit system. For hazards where masses of people need to be efficiently moved and/or traffic congestion is not ideal, public transit is a critical piece of infrastructure.	City of Petoskey resident/business owner
• Our emergency operations plan includes risk mitigation strategies for many types of events.	County Medical Care Facility Administrator
• I would like to work with you on creating a plan for disaster debris clean up. I know this is a part of planning that is generally overlooked or assumed that someone else will take care of it but we (the transfer station) likely doesn't have capacity for large scale clean up efforts.	Emmet County DPW Director
• Green Infrastructure Flooding Management Shoreline Bioengineering	Tip of the Mitt Watershed Council
• Tannery Creek flooding study started. Need property owner cooperation and grant funding to correct the issues.	Emmet County Planning & Zoning
• Flood mitigation.	City of Harbor Springs
• Update emergency preparedness plan and hold emergency response exercises.	Little Traverse Township Supervisor
• PFAS contamination	Emmet County BOC
• Removal of hazardous and dead trees along road rights of way.	Harbor Springs Outdoor Club

Vulnerabilities in Your Community

People

Economy

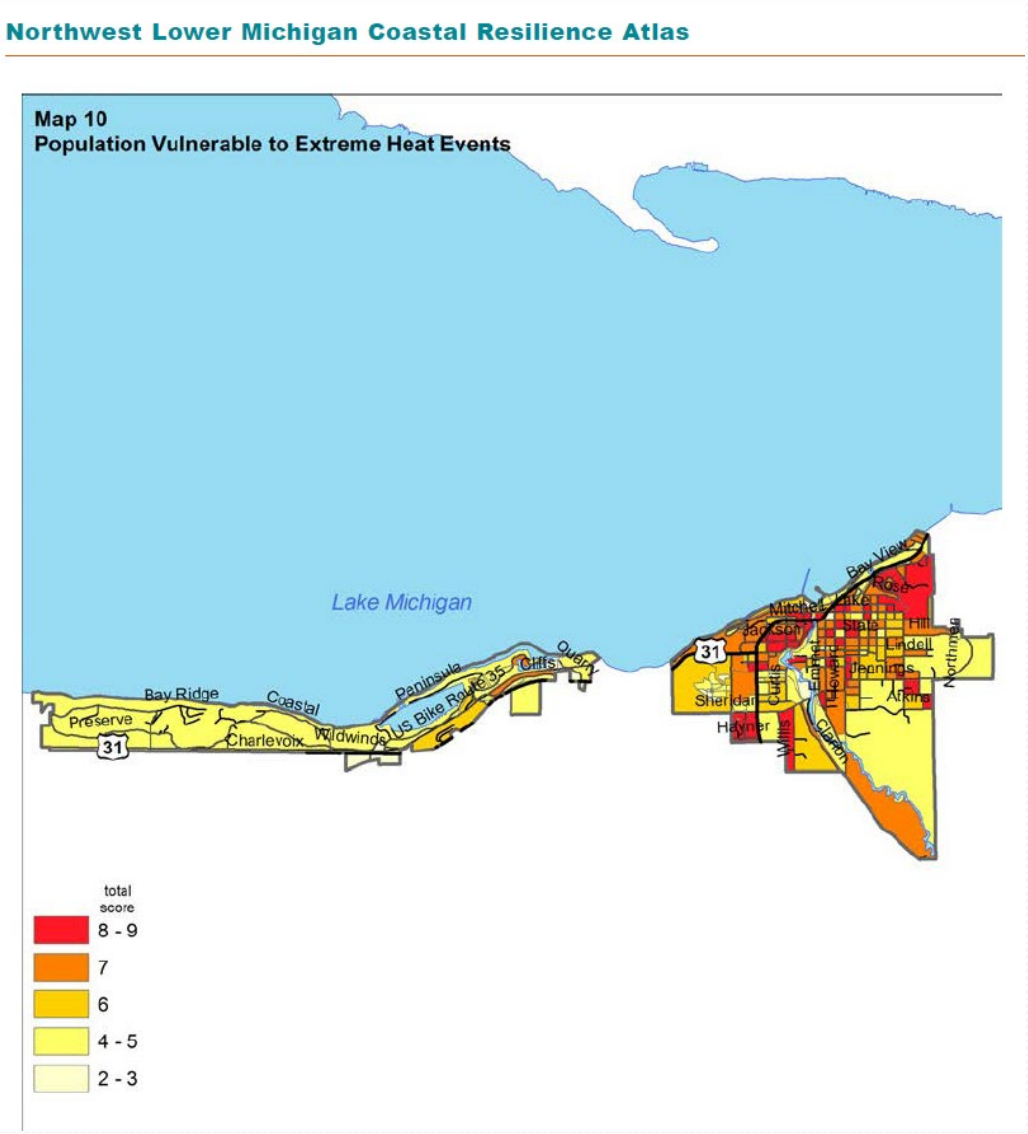
Built Environment

Natural Environment

Vulnerable Populations

LIAA's NW MI Coastal Resilience Atlas – Heat Vulnerability Assessment

- Vulnerability = Exposure to the hazard (tree canopy and impervious surface) + Sensitivity
- Population Characteristics of Sensitivity:
  - Persons > age 65
  - Persons living alone
  - Minority (non-white) persons
  - Persons living below the poverty threshold
  - People > age 25 with less than a high school education
  - Disability status (i.e., ambulatory difficulty, mental disability)



Vulnerable Populations
Full Group Discussion

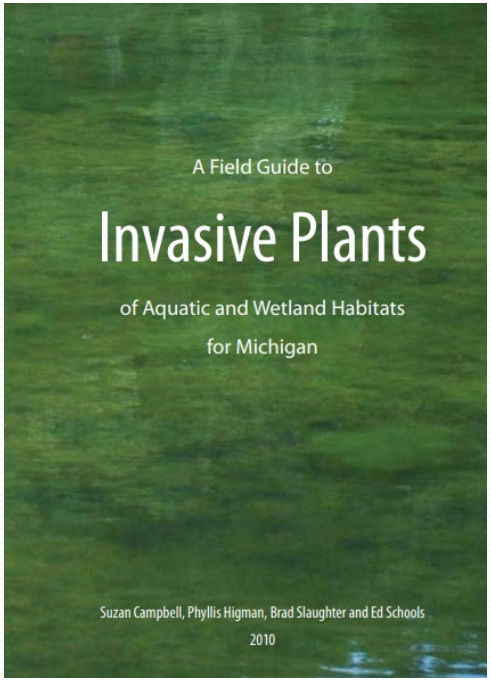
- Who are your primary vulnerable populations?
- Where are they located?
- What mechanisms are in place to aid these populations in the event of a natural hazard?

Vulnerable Natural Resources Full Group Discussion

- What are your primary natural resources?
- What role do they play in the economy, quality of life, natural habitat?
- What mechanisms are in place to manage or restore natural features in the event of a natural hazard?

Invasive Species

- An invasive is a species that is **non-native to the ecosystem** under consideration AND whose introduction causes or is likely to cause **economic or environmental harm**
- Only a small fraction of non-native plants are invasive
- Lake-moderated climates along Lake Michigan, Lake Erie, Saginaw Bay, Thumb, and Lake St. Clair are milder and have high potential to harbor species typically found to the south.



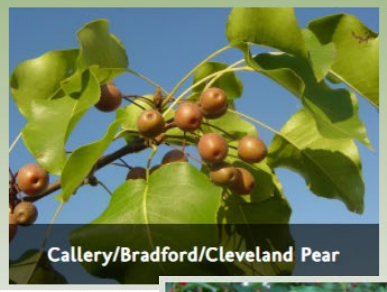
Invasive Species

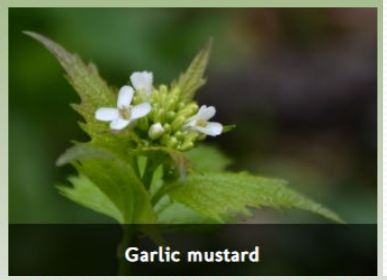

Baby's breath


Japanese and common barberry


Blue lyme grass


Glossy and common buckthorn


Callery/Bradford/Cleveland Pear


Garlic mustard


Invasive honeysuckles


*Knotweeds

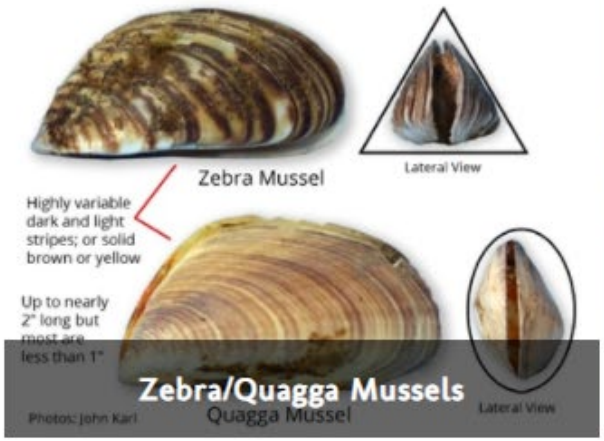

Invasive bittersweet


*Invasive Phragmites


*Purple loosestrife


Tree-of-Heaven

Invasive Species



Zebra/Quagga Mussels


Round goby


Rusty crayfish

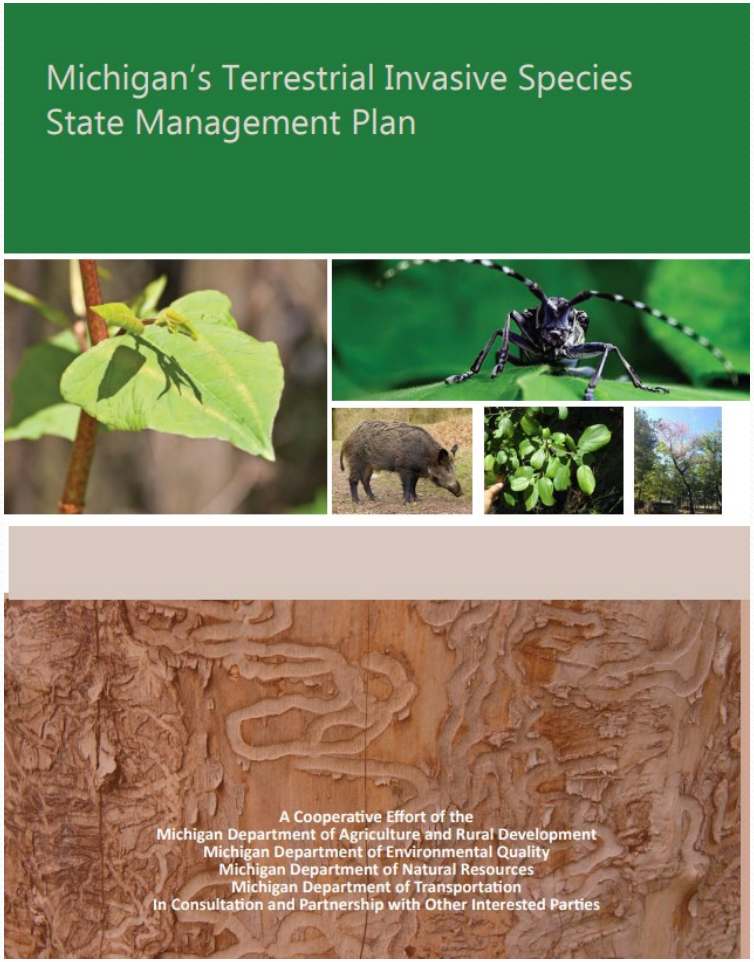

Eurasian Ruffe


Sea Lamprey

Asian Carp

Invasive Species

- The State of Michigan estimates 42% of threatened or endangered species are considered at risk due to non-native species.
- Visitors spent over $22 billion dollars in Michigan in 2014, supporting nearly 327,000 jobs (Tourism Economics 2014). Invasive species impact the use and beauty of Michigan's shorelines, trails and parks, which may result in a reduction in visitor spending and citizen enjoyment
- Michigan's Forest Products Industry supports 96,000 jobs and contributes more than $20 billion to the state's economy each year (Michigan DNR 2015). Invasive forest pests including emerald ash borer, oak wilt and beech bark disease kill trees and significantly impact the value of urban properties, forests and timber resources. The estimated cost of treating or removing dead ash within developed land in Michigan's communities due to emerald ash borer was $230 million in 2009.



Source: Kovacs, K.F., R.G. Haight, D.G. McCullough, R.J. Mercader, N.W. Siegert and A.M. Liebhold. 2010. Cost of potential emerald ash borer damage in U.S. communities, 2009–2019. Ecological Economics 69: 569-578.

Invasive Species – Small Group Discussion

- In groups of 5-6, discuss how invasive species affects your community. What are your **greatest concerns** pertaining to **invasive species?**
  - Think of forests, rivers, Great Lakes, hunting, agriculture, etc.
  - **Choose 1 person in your group to be the recorder**; this person will write each person's responses and will report key findings to the whole group.

Winter Storms, Thunderstorms/Wind, Tornado

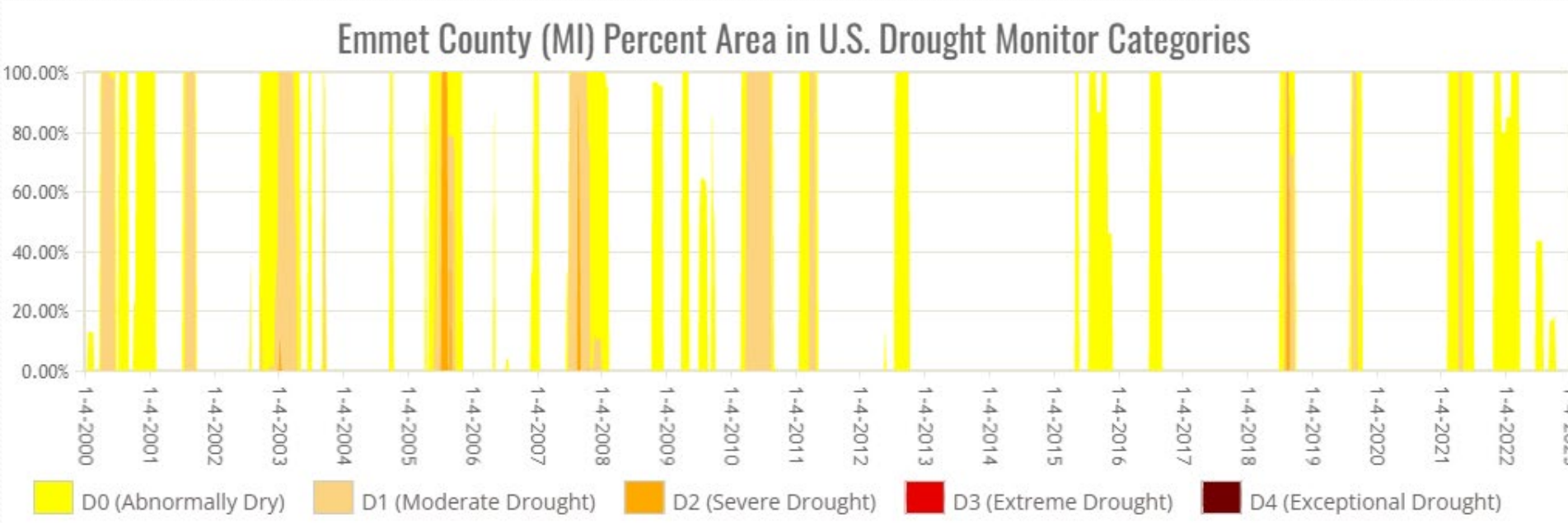
- Winter weather events include: Winter weather, winter storms, lake-effect snow, ice storm, heavy snow, frost/freeze, blizzard
- Most common type of hazard (excluding wildfire): 126 events total
- Caused $204,000 in property damages and $5,000,000 in crop damages
- Largely due to March 2012 heavy snow event and April 2012 frost/freeze event

- Thunderstorms and Severe Winds includes thunderstorm events and high wind events
- Second most common type of hazard (excluding wildfire): 73 events total
- Caused $623,000 in property damages $0 in crop damages
- Also, one lightning strike event in Petoskey in 2011 caused $4,000 in property damage to a home

- Tornado events (5) 1953, 1955, 1957, 1987, 1996 - No deaths or injuries; $52,500 in property damages.

Drought

- Definition: Drought is a consequence of a natural reduction in the amount of expected precipitation over an extended period of time, usually a season or more in length.
- There have been three major drought in the past - Presidential declared emergency in 1977 and two drought events in 2007
- Emmet County drought fluctuations



Drought – Key Issues

Agricultural Production Losses

The primary direct economic impact of drought in the agricultural sector is crop failure and pasture losses. These costs are often passed on to consumers through increased prices and/or they may be offset through government disaster assistance programs. Indirect impacts of drought in the sector can include reduced supplies to downstream industries, such as food processors, and reduced demand for inputs, such as fertilizer and farm labor. The non-market impacts of production losses include mental health strain on farmers.

Pests and Diseases

Drought, coupled with high temperatures, may expand the distribution and incidence of pests and diseases that affect crops, forage, and livestock.

Decreased Water Availability for Agriculture

The depletion of water availability in soils causes significant declines in crops and livestock productivity. In addition, surface and groundwater supplies may decline during drought, affecting water availability and increasing costs to access water for crop or forage irrigation and watering livestock. With a return to normal precipitation, soil moisture typically recovers long before surface and groundwater supplies are replenished.

Specialty Crops

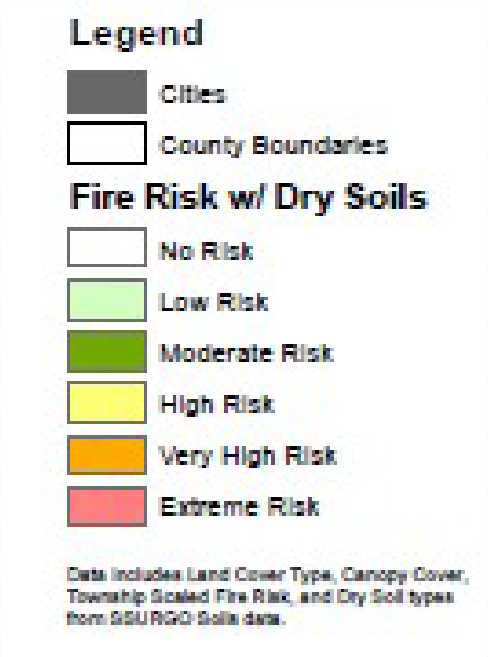
Most specialty crops (such as fruits, vegetables, tree nuts, and medicinal herbs) are more vulnerable to drought than field crops and have a higher value per unit of land/water. They may therefore represent a higher risk for experiencing economic loss in drought if the crop water demand exceeds water supply.

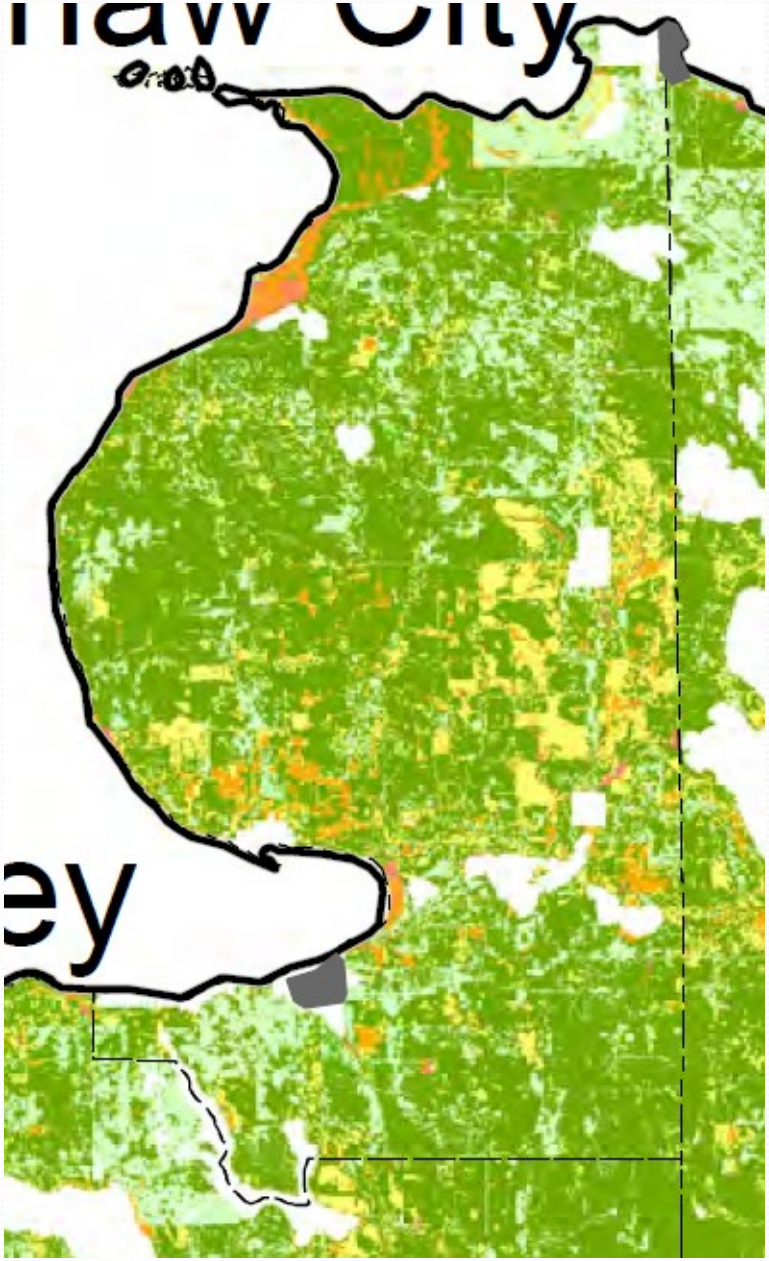
Wildfire

- A wildfire is an **unplanned, uncontrolled fire** in grassland, brushland, or forested areas.
- **377 wildfires occurred on lands under MDNR jurisdiction within Emmet County** from 1981-2018, resulting in 649.6 acres burned.
- **= average of 17.1 acres burned and 9.9 wildfires per year**

Wildfire

- High fire risk corresponds with certain vegetation types (pine, dune grass, etc.)





Source: Wildfire Risk Map - MDNR Forest Resources Division

Small Group Discussions – Thunderstorms, Wind, Winter Storms, Tornado, Drought, Wildfire

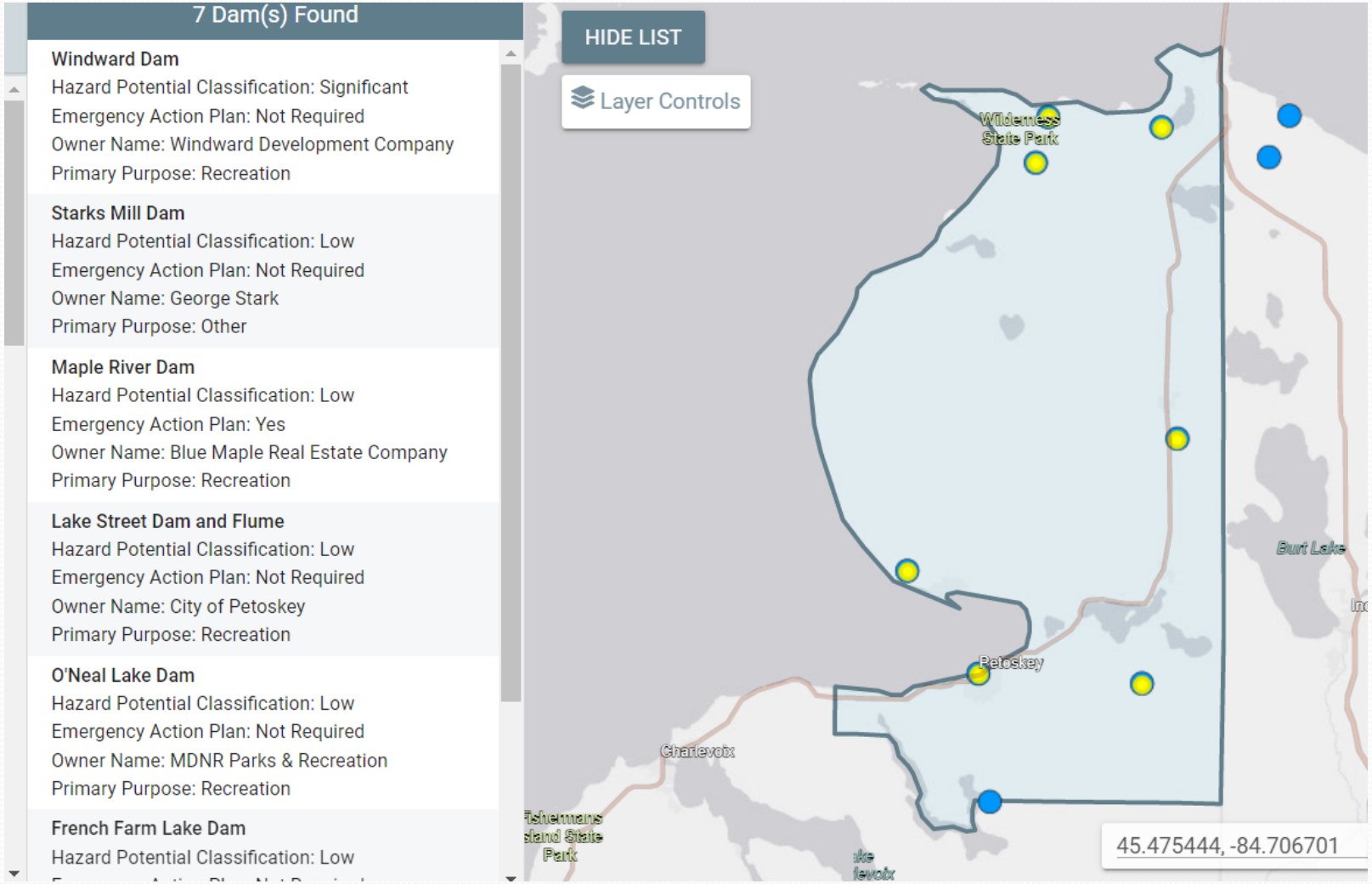
- In groups of 5-6, discuss how these hazards affect your community
- What is the potential for this hazard to affect your **economy, natural environment, built environment or population**?
- Please answer this question for the following hazards
  - Severe Thunderstorm – wind, tornado, hail, lightning
  - Winter Weather – wind, ice, heavy snow, extreme cold
  - Wildfire, extreme heat, and drought
- Spend **5-7 minutes** on each hazard

Inland Flooding

Date	Location	Property Damage	Episode Narrative	Event Narrative
6/21/2011	GOOD HART	$18,000	A culvert was washed out along Levering Road (C-66) a few miles east of Cross Village. Substantial soil erosion occurred in the yards of some homes. The co-operative observer, one mile east of Cross Village, measured 4.79 inches of rain in 12 hours, most of which fell in a four hour period either side of midnight.	Bands of training thunderstorms affected parts of Northwest and North Central Lower Michigan. Locally very heavy rain occurred in a few spots, including between Manistee and Cadillac. The only flooding occurred in the Cross Village area of Emmet County.
7/18/2020	MENONAQUA BEACH (Start); ALANSON (End)	$98,000	Thunderstorms moved repeatedly over the same area on the afternoon of the 18th. Rainfall amounts of 2 to 4 inches were estimated to fall from just northeast of Petoskey, on toward Indian River. Measured rainfall amounts by the next morning were as high as 5.25 inches near Afton, though this occurred over multiple rounds of thunderstorms, not just this late afternoon batch. Flash flooding was reported in the community of Oden in Emmet County, where knee-high water flooded homes along Pingree Avenue, on the east side of town.	Thunderstorm activity earlier in the day laid down an outflow boundary across far northern lower Michigan. Severe thunderstorms reignited along that boundary by mid afternoon. Damaging winds and excessive rainfall were the primary hazards.
9/3/2022	HARBOR POINT	$5,000	M-119 (Bluff Dr) closed at Harrison St due to significant erosion of shoulder of highway. Time estimated.	A line of strong thunderstorms formed along an advancing cold front early in the morning on 9/3, eventually tracking into northern lower Michigan and producing heavy rainfall. Additional storms initiated just behind the line and continued to produce heavy rainfall in the vicinity of Little Traverse Bay, leading to significant erosion of the shoulder of M-119. A 24 hour rainfall total of 2.80 inches was measured 1 mile NNE of Harbor Springs at 9:30 AM EST with the majority of that falling in a 3 hour period that morning.

Emmet County Dams (7)

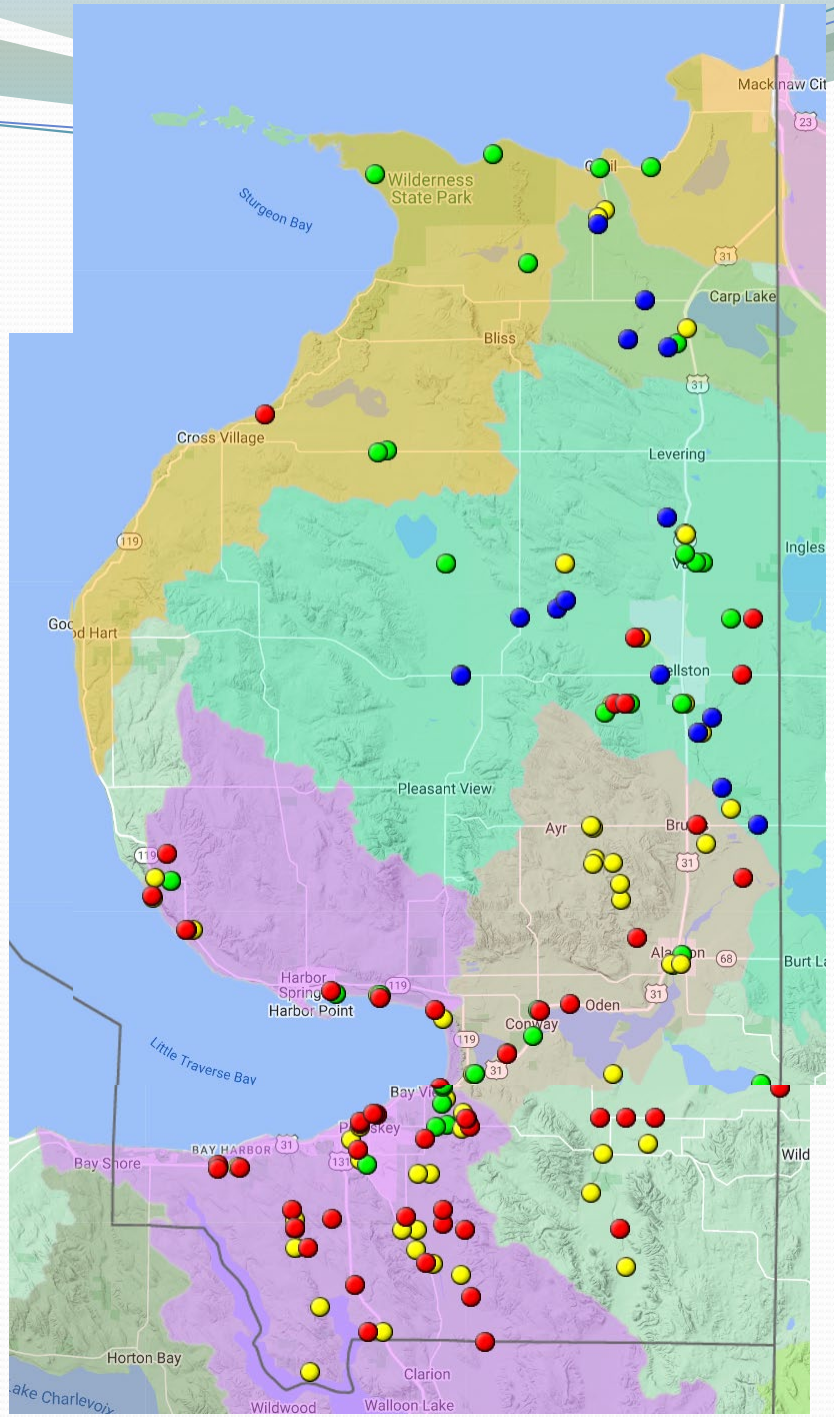
Listed on the National Inventory of Dams



Road-Stream Crossing Conditions

Five Watersheds - Frontal Lake Michigan, Carp River, Maple River, Crooked River, Little Traverse Bay.

Yellow = Moderate
Red = Severe
Green = Minor
Blue = Restored



http://www.northernmichiganstreams.org/emmetcorsx.asp Map updated as of 5/5/2021.

Coastal Hazards

- $155,000 in property damages; 1 death

Event Type	Date	Location	Episode Narrative	Event Narrative
Lakeshore Flood	4/13/2020	Lake MI coastal communities		Strong low pressure passed just north of eastern upper Michigan on the morning of the 13th. Gusty west to northwest winds developed during the day, in the wake of the low. Gusts of 40 to 50 mph were common across northern Michigan, especially during the afternoon. Some localized power outages resulted. Lakeshore flooding also occurred along portions of the Lake Michigan coastline of northwest lower Michigan. Severe coastal erosion destroyed a portion of the Little Traverse Wheelway between Petoskey and Charlevoix. $150,000 in property damage was reported to NOAA for Emmet County.
Lakeshore Flood	10/23/2020	Lake MI Coastal Communities; Wawatam Twp.	Wilderness Park Drive was closed between Headlands Rd and Straits View Dr for five hours due to lakeshore flooding.	Low pressure lifted across northern lower Michigan early in the morning of the 23rd. Very heavy rain fell just in advance of this low, late on the 22nd and early on the 23rd. 24 hour rainfall totals were 5.00 in Suttons Bay, 4.98 in Lake Ann, and 4.73 in Gaylord. Following a period of relatively dry weather, most flooding issues were minor. However, more significant road flooding occurred in and near Traverse City. In addition, gusty northwest winds in the wake of the low contributed to lakeshore flooding along the Lake Michigan coast on the 23rd. $5,000 in property damage was reported to NOAA for Emmet County.

Coastal Hazards

Event Type	Date	Location	Episode Narrative	Event Narrative
Waterspout	8/4/1999	Little Traverse Bay	Unseasonably cold air over the warmer waters of Lake Michigan triggered numerous cold air funnel clouds over Little Traverse Bay; three of which developed into waterspouts.	-
Rip Current	7/18/2005	Petoskey State Park Beach	16 people were rescued; classic rip current.	SW wind 10-20 mph; 3-4 ft. waves
Rip Current	8/17/2010	Petoskey State Park Beach	Two people were rescued; classic rip current	W wind 15-25 mph ; 5-6 ft. waves.
Rip Current	7/11/2012	Good Hart	A teenaged male from Portage, Michigan, drowned off of Cross Village Beach. Dive teams were called in, and found the body about 40 feet from shore.	West winds gusting to 20 mph produced considerable wave action on Northern Lake Michigan, and provided a favorable environment for rip currents.

Coastal Flooding & Shoreline Erosion

- **Land Information Access Association (LIAA)** – Traverse City-Based Non-Profit
- **Northwest Lower Michigan Coastal Resilience Atlas** http://www.resilientmichigan.org/nw_atlas.asp

Coastal Dynamics

- Decadal variability of lake water levels – Record highs in 2020 and 1986
- Wave Energy and Height
  - Erosion
  - Changing conditions
- Climate change on the Great Lakes
  - Increased precipitation events and storminess
  - Water temperature increasing

Coastal Flooding Scenarios

- **"Lucky" Future**: Under the Lucky Climate Future, **Great Lakes water levels will continue to stay relatively low**. Although there will be wave and wind action, major storm events and wave impacts will not encroach on properties landward of current beaches. A Lucky Future projection, indicating the land areas that would be affected by high-energy waves along the shorefront and/or adjacent riverine flooding under these conditions, is shown in green on the maps.

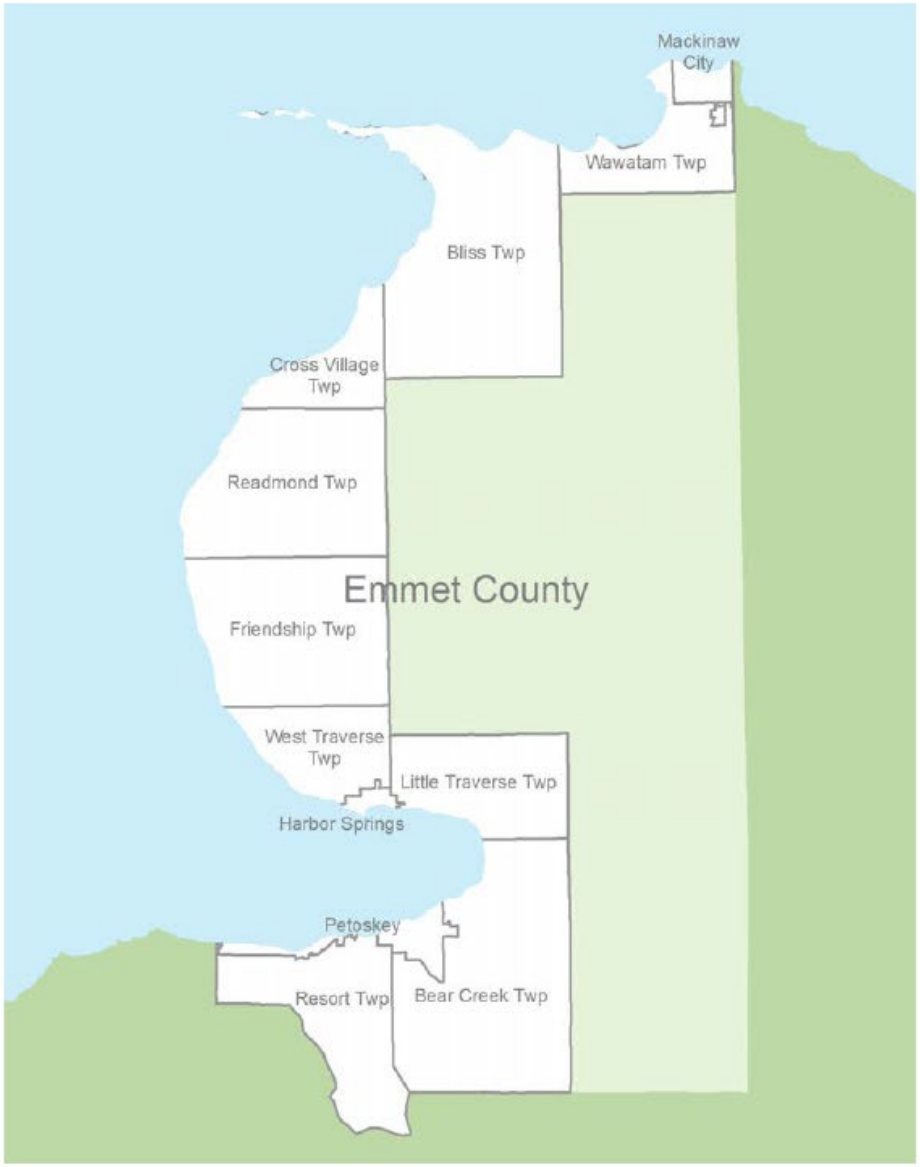
- **"Expected" Future**: Under the Expected Climate Future, Great Lakes water levels will continue to fluctuate according to long-term decadal patterns, including recent extreme storm events incorporated into the ongoing Great Lakes Coast Flood Study being conducted by the Federal Emergency Management Agency (FEMA). Given those ongoing fluctuations, this Climate Future accounts for periods **when Great Lakes still-water elevations are closer to the long-term average. In addition, this Climate Future anticipates the so-called "100-year storm event" (or 1% storm) becoming more like a 20- or 50-year storm event** (i.e., an expected storm within the normal community planning time horizon) because of increased storminess.

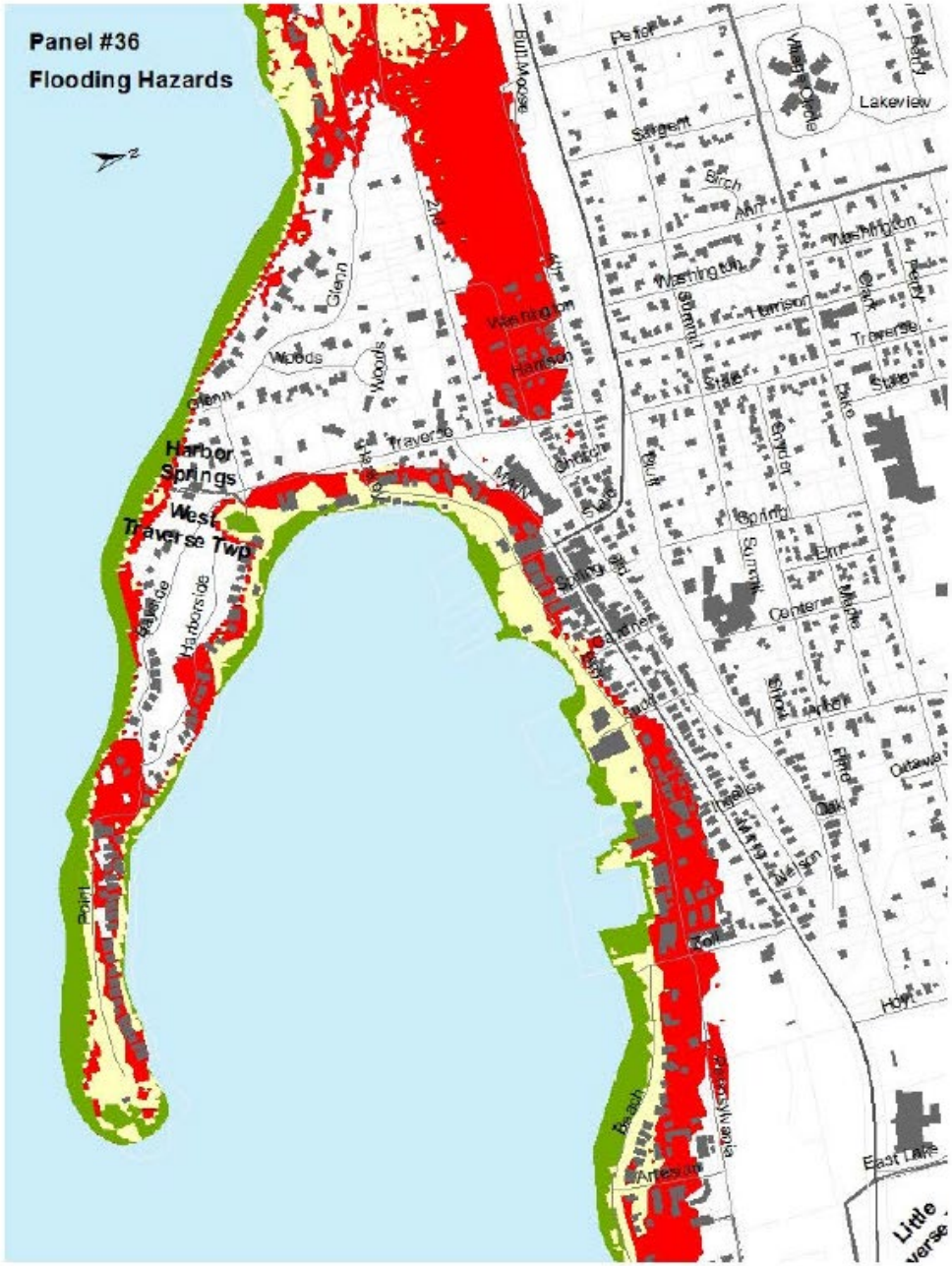
- **"Perfect Storm" Future**: Under the Perfect Storm Climate Future, Great Lakes water levels will continue to fluctuate according to decadal patterns, consistent with assumptions made for the Expected Future. However, for this Perfect Storm Climate Future, **the estimated still-water elevation is set higher than the long-term average and closer to the long-term high (583 feet). In addition, this Climate Future anticipates the occurrence of a so-called "500-year storm event" (or 0.2% storm) occurring within the planning time horizon while lake levels are high.**

Emmet County

Coastal Flooding Scenario Impacts

Emmet County			
Total SEV	Lucky	Expected	Perfect Storm
$ 3,091,651,050.00	$ 31,044,900.00	$ 259,598,400.00	$ 577,459,700.00



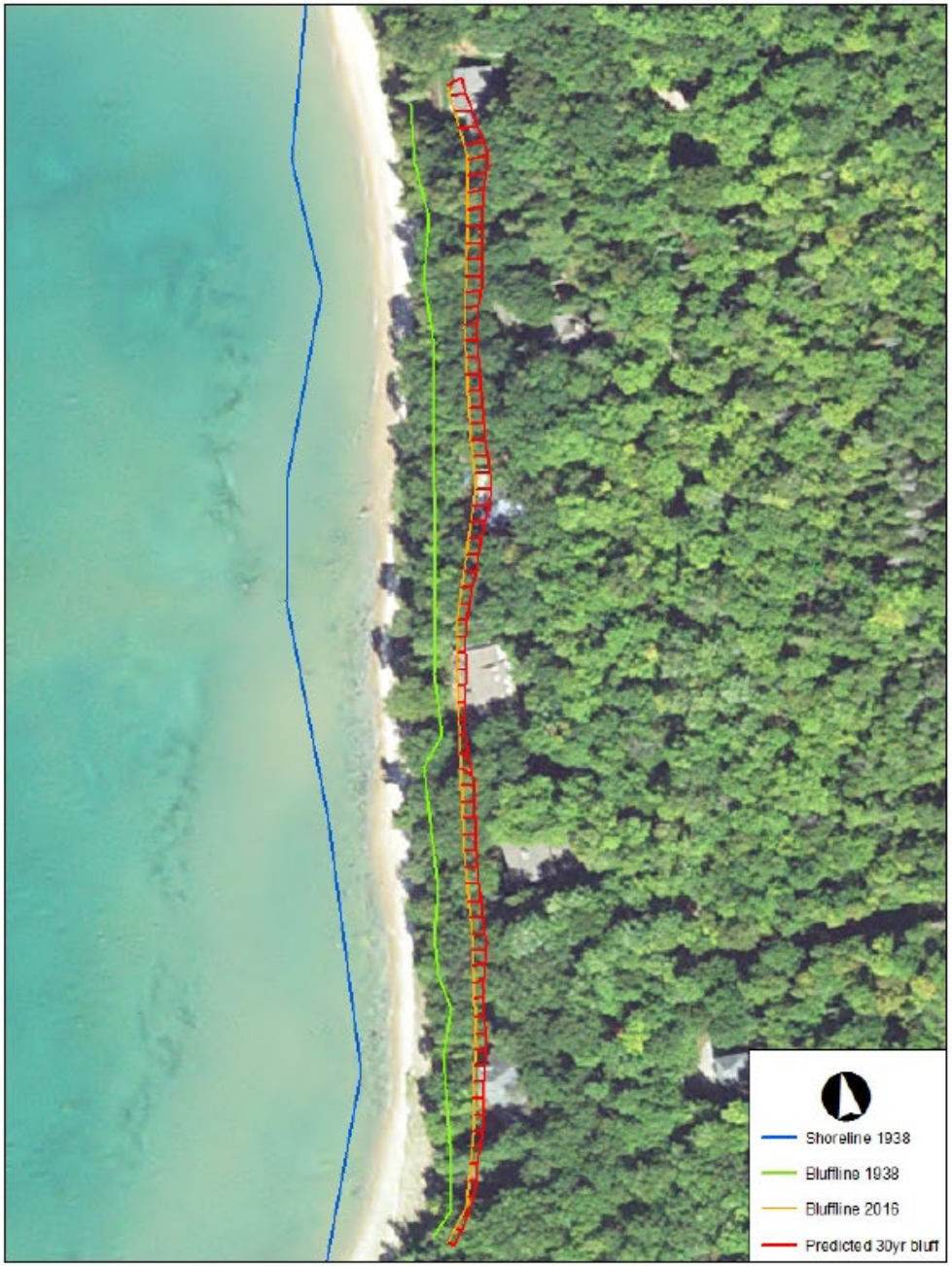


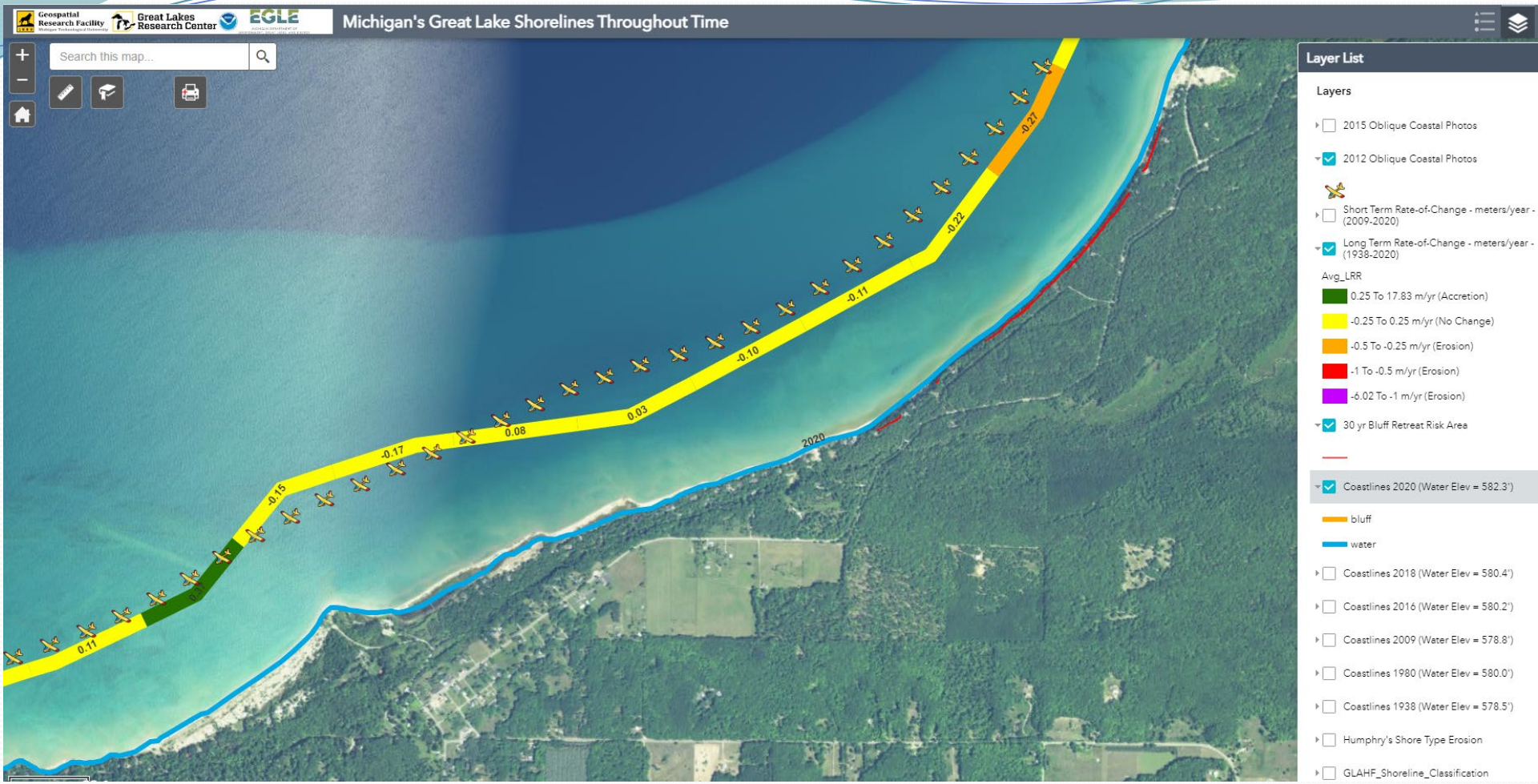
Lucky Flooding Scenario
Expected Flooding Scenario
Perfect Storm Flooding Scenario

BLUFF RECESSION DETAIL

At least one "zoomed in" detail example of historic bluffline recession and future projections is provided at the beginning of each county section of this chapter. Shoreline and bluffline recession data can be viewed in greater detail online at http://geospatialresearch.mtu.edu/czmp.

Bluff Detail, Panel 27, Readmond Twp.





https://portal1-geo.sabu.mtu.edu/mtuarcgis/apps/webappviewer/index.html?id=d75880obb18e460ab39aa66631051156

OR search “Michigan Tech shoreline mapping site”

Pros and Cons of Short-Term Coastal Mitigation Options

	Armor	Nourish	Relocate
Pros	Slows erosional processes	Slows erosional processes	Conserve natural Public Trust beach and shoreline
Cons	Loss of natural shoreline and Public Trust beach; damage to neighboring shoreline	Short-term solution (e.g. one storm may destroy the investment)	Cost of relocation, loss of land
Owner's Interest	Safeguarding infrastructure prioritized over the cost of armor, loss of Public Trust beach, and damage elsewhere	Safeguarding property and structures prioritized over cost and feasibility	Preservation of infrastructure and natural shoreline prioritized over cost of relocation
Public Interest	Owner's interest prioritized over loss of natural beach and potential future public cost of cleanup when armor fails	Safeguarding property and structures prioritized over cost and feasibility	Preservation of natural beach prioritized over cost of relocation and loss of land

Mapping Activity

- Using the map provided, mark the following:
  - Inland flooding - riverine and urban (blue marker)
    - Locations where floods have occurred in the past
    - Locations where floods have a higher probability of occurring
    - Potential for dam failure
  - Coastal flooding and recession (purple marker)
    - Locations of particular concern along the community's shoreline and bluffs
  - Wildfires (red marker)
    - Locations where wildfires have occurred in the past
    - Locations where wildfires have a higher probability of occurring
  - Invasive Species (orange marker)
    - Locations where invasive species are occurring; if unknown…
    - Locations where invasive species have a higher probability of occurring or may cause significant damage

Next Public Input Session
Wednesday April 5, 10 am
Emmet County EMS Building
Technological and Human-Induced Hazards

Lunch provided! Please RSVP to Matt Blythe.