

Marquette Area  
Climate and Health  
Adaptation Guidebook

Volume II:  
Policy and Metric  
Recommendations

Marquette County, MI



Michigan State University  
December 2018



**MICHIGAN STATE**  
UNIVERSITY



# Table of Contents

- Preface — 2
- Acknowledgments — 3

## 1 Introduction — 4

- Overview — 5
- Project Background — 6
- Project Partners — 7
- Climate and Health — 8

## 3 Methods — 12

- Process — 13
- Phase I and II Quick Summary — 14
- Volume I Overview — 15

## 3 Policy Recommendations — 16

- The Policy Charts — 17
- Vector Awareness — 18
- Air Quality—22
- Emergency Response/Extreme Events—31
- Water Related—41

## 4 Lessons Learned—49

## 5 Appendices—51

- Appendix A: Full Stakeholder Response Summary — 52
- Appendix B: References — 53
- Appendix C: Expert Resources/Further Information — 57

# Preface

## Volume I of III

### Purpose

The Marquette Area Climate and Health Adaptation Guidebook (the Guidebook) is the result of a pilot project to build climate adaptive capacity at the local level by integrating public health considerations into existing community and climate adaptation planning initiatives. Though the Guidebook is focused on Marquette, the innovative process was developed with the goal to be usable or replicable by other communities from small to large, wholly or in part, depending on their resources and needs.

The Guidebook is structured in three volumes. Each is intended to stand alone as a resource but also build upon each other to provide a detailed accounting of the process and results.

### Volume Structure

#### **Volume I:** Stakeholder Engagement and Visual Design Imaging

Establishes the community's concerns and priorities related to climate and health as expressed by community stakeholder groups. Uses current and potential future images of vulnerable locations in Marquette and surrounding areas to visualize how the built environment could be redesigned to address these climate-related public health concerns.

#### **Volume II:** Policy Recommendations for Enacting Adaptive Built Environment Changes

A comprehensive reference guide for community leaders and technical decision makers describing potential policy tools that could stimulate adaptive community planning and the implementation of the built environment design changes developed in Volume I. Includes health-related metrics associated with each policy tool for users to track and evaluate their own planning activities.

#### **Volume III:** Prioritizing and Implementing Recommendations

Outlines further stakeholder engagement to prioritize the recommendations from Volume II and establish ownership for implementation. Provides further refined guidance for implementing priority policies and built environment design changes.

# Acknowledgements

## Centers for Disease Control and Prevention

The Centers for Disease Control and Prevention (CDC)'s Climate and Health Program is helping state and city health departments prepare for the specific health impacts of climate change that their communities will face. This publication was supported by Cooperative Agreement Number 1NUE1EH1324, funded by the Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention or the US Department of Health and Human Services.

## Michigan Department of Health and Human Services

The Michigan Climate and Health Program (MICHAP) of the Michigan Department of Health and Human Services (MDHHS) is led by principal investigator Lorraine Cameron, with support from program manager Aaron Ferguson and epidemiologist Yonathan Kefelegen. MICHAP provided funding for this project through their CDC grant while also providing oversight and technical guidance. This report does not necessarily represent the official views of MDHHS.

## Michigan State University School of Planning, Design and Construction

### Michigan State University Extension

The project team at Michigan State University (MSU) and the School of Planning, Design and Construction (SPDC) is led by co-principal investigators Wayne Beyea and Pat Crawford, MSU Extension Educator Brad Neumann, Design Assistants Amal Shabaan and Wei Li and Research Assistants Elena Cangelosi and Joel Arnold.

## Local Partners

Marquette County, including the Marquette County Health Department, the Marquette County Climate Adaptation Task Force (CATF), and numerous community stakeholder groups all held vital roles in the MICHAP and MSU process to examine Marquette area climate and health impacts.

## Special Thanks

The MSU Project Team would like to express their gratitude to the various stakeholders who attended the community stakeholder meetings, Community Visioning Meeting, Preliminary Design Meeting and/or provided feedback during this process to make this project possible.





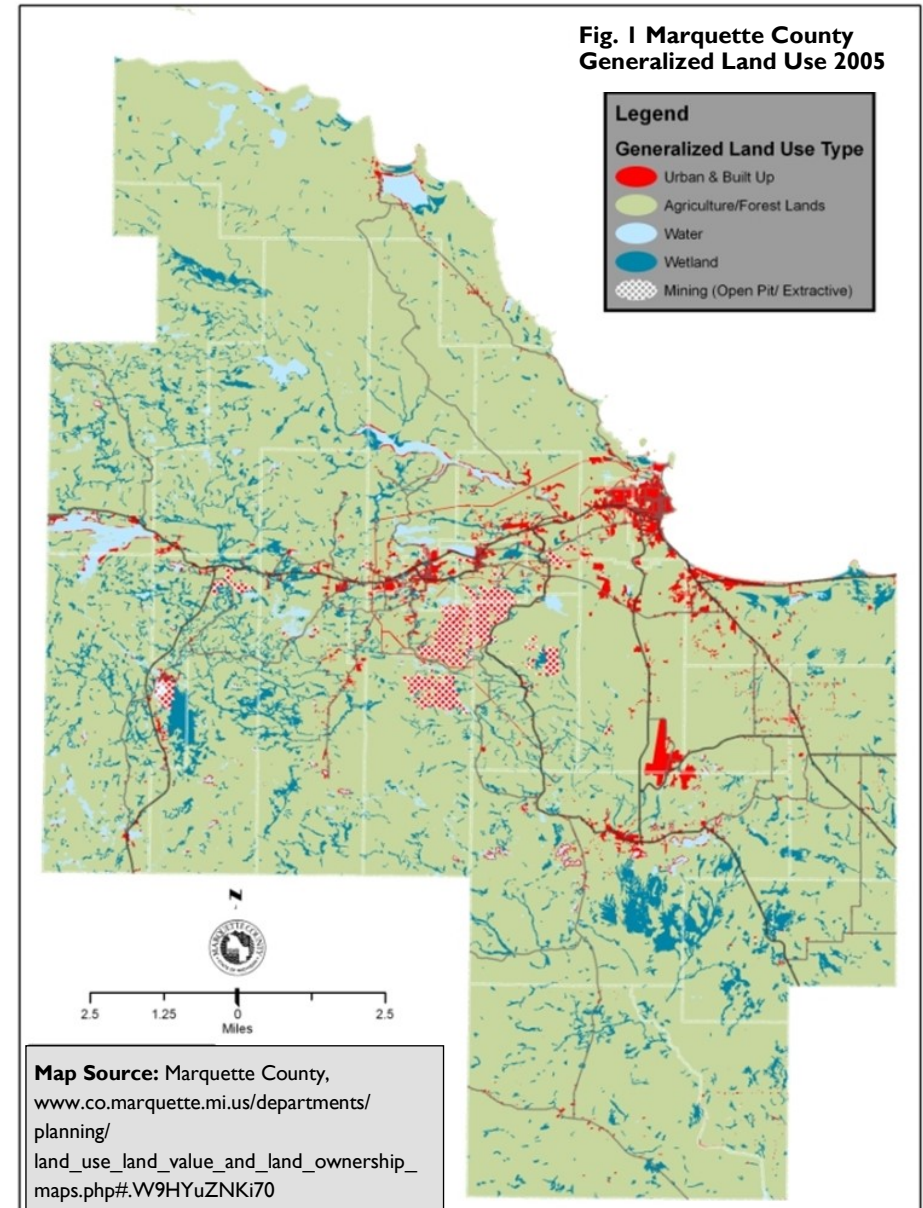
# Introduction

# Overview

The Marquette Area Climate & Health Adaptation Guidebook (the Guidebook) is the product of a pilot project demonstrating how local adaptive capacity can be built to reduce or prevent the health impacts from climate change. The project is novel in the field of climate and health adaptation in that it utilizes a multi-disciplinary approach to conduct stakeholder education and engagement through a health and equity lens, provides experts and the public an opportunity to establish their vision of a climate adapted community, and then connects the health and built environment components through policy analysis and community planning. Although Marquette is the primary audience for this Guidebook, it is intended that the process, some of the results, and lessons learned can be applied to other communities across the state and region.

Being the largest county in Michigan covering 1,873 square miles of land area, and sitting along the shores of Lake Superior, Marquette boasts urban, rural, and wilderness settings as shown in Figure I. Each area faces unique, though not always exclusive, challenges from climate change such as increased extreme precipitation events and periods of drought. Fortunately, community leaders are addressing many of the issues through multiple climate adaptation initiatives across varying scales from the city to Lake Superior watershed level.

Though these plans are extensive in their assessment of environmental and economic impacts from climate change, a gap was identified concerning health. This was recognized by community leaders and became a catalyst for their involvement to develop this Guidebook. It examines the health impacts from climate change and how built environment adaptations could address them.

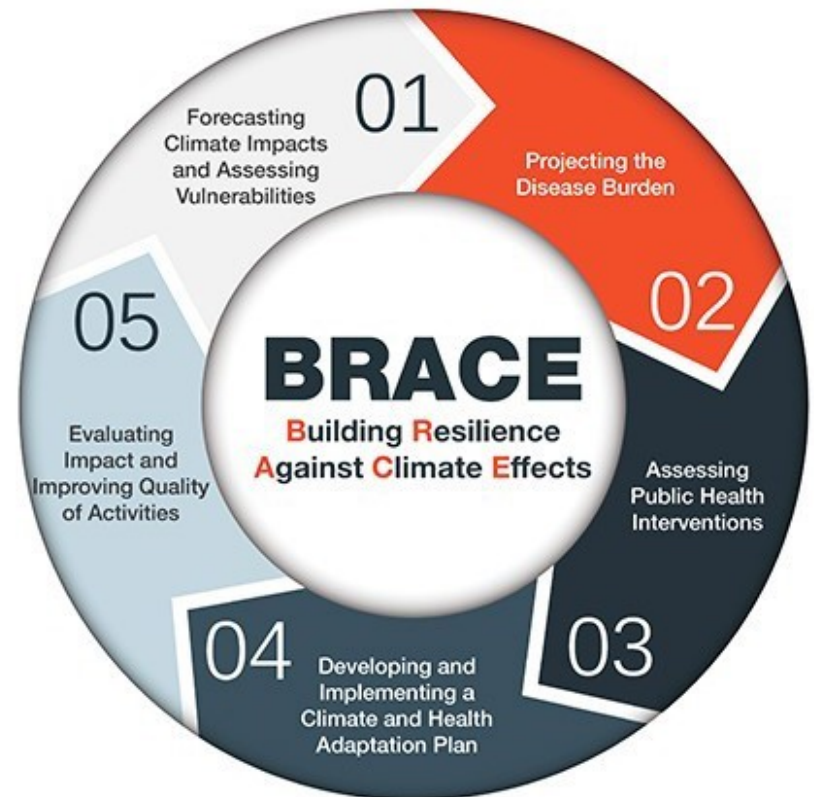


# Project Background

Following the CDC’s Building Resilience Against Climate Effects framework (BRACE), shown in Figure 2, MICHAP is building a climate-resilient public health system for Michigan at the state and local levels by following three main principles: 1. Climate change is recognized as a public health issue and is integrated into public health practice, 2. Public health agencies and stakeholder organizations have the tools, resources and activities to respond to climate change impacts within existing programs, and 3. Vulnerable populations are explicitly considered in programs and policies addressing climate change impacts.

This Guidebook project is part of MICHAP’s larger state-wide Climate and Health Adaptation Plan (MDHHS, 2016) to develop, pilot, and evaluate activities that increase the adaptive capacity of communities to prevent or reduce the health effects of climate change. Four types of adaptive strategies were identified in the state-wide plan and used to frame the Guidebook development process and its recommendations. Those are: 1. Education and inclusion: Ensure diverse stakeholders including representatives of vulnerable populations and social service providers are engaged when identifying issues and developing solutions. 2. Landscape actions: Work with land use and built environment decision makers to consider the climate and health impacts and benefits of the action. 3. Policy: Coordinate climate adaptation and public health best practices and metrics by tying them into a community’s existing planning initiatives or ordinances. 4. Surveillance and tracking: Increase capacity for collection and analysis of local environmental health and climate related data. Develop local indicators for a community to track impacts over time and incorporate into cost/benefit risk analyses or health impact assessments.

Fig. 2. Centers for Disease Control and Prevention- Climate and



The BRACE framework is a five-step process laid out by the CDC to help states and community health departments address the public health concerns of climate change in their communities. As part of the CDC’s Climate-Ready States and Cities Initiative (CRSCI) MICHAP uses this framework to address climate health concerns in Michigan.



# Project Partners

Developing this Guidebook was a collaborative effort requiring diverse perspectives from the technical to local. The project was led by the Michigan Climate and Health Adaptation Program (MICHAP), the Michigan State University (MSU) School of Planning, Design and Construction (SPDC), and the MSU Extension (MSUE) program. However, the success of the project was largely dependent upon the existing capacity, knowledge, and networks of several local groups including the Marquette County Health Department (MCHD) and the Marquette Climate Adaptation Task Force (CATF). Through this process a diverse group of stakeholders, including vulnerable populations, had multiple opportunities to indicate their priority climate related health concerns and a chance to visualize potential adaptive built environment design changes. That feedback led to four major themes which guided further engagement and recommendation development: 1. Vector Awareness, 2. Air Quality, 3. Emergency Response/Extreme Events, and 4. Water Related issues.

## MSU School of Planning, Design and Construction and MSU Extension

To address the built environment concerns related to climate change, the Michigan State University (MSU) School of Planning, Design and Construction (SPDC) offers the Sustainable Built Environment Initiative (SBEI) in partnership with MSU Extension (MSUE). The SBEI provides planning and design assistance to communities within a sustainability framework focused on resiliency and climate adaptation. The program helps build local consensus and generate physical design plans to address challenging sustainability concerns. The partnership allows for an integrated approach to solving complex community problems through the diverse expertise found within the SPDC along with MSUE's institutes and Extension educators.

## Marquette County Health Department

The MCHD is Marquette's local health authority. It works to enrich lives in the community by preventing disease, promoting healthy lifestyles, and protecting the environment. Its vision is a community where people achieve the highest quality of life through healthy living by caring for themselves, one another and the environment. MCHD worked with the local MSUE office to bring key local representatives from the medical/health field and from vulnerable populations into the project discussions, as well as contributing its own expertise.

## Marquette Climate Adaptation Task Force

The CATF based in Marquette was created to help local leaders and the public think proactively about the effects of climate change and develop strategies that will make the Upper Peninsula more resilient. The seventeen members are drawn from a diverse group of current and former elected and appointed city, township and county leaders, representatives of energy and industry, university officials and environmental groups. CATF proceeds on the assumption that climate change and extreme weather events are occurring and that they will have an impact on the local area. Its members help to coordinate ongoing assessments of how climate change will affect their communities and have a focus on implantation of recommendations from the various climate planning initiatives that are ongoing in the area.

# Climate and Health

Climate change can affect public health in numerous ways. With changing temperature and precipitation patterns also come changes to extreme weather such as increases in heavy precipitation and higher temperatures. Combined, they can lead directly to several negative health impacts including injury, waterborne diseases and heat related illnesses. Indirectly, health can be impacted by increases in drought, flooding, wildfires, expansion of vector borne disease habitats and more, as shown in Figure 3. Extreme weather caused by climate change is especially impactful to the health of vulnerable populations. Figure 4 summarizes how the changes in precipitation patterns and extreme weather can directly and indirectly lead to several negative health outcomes.

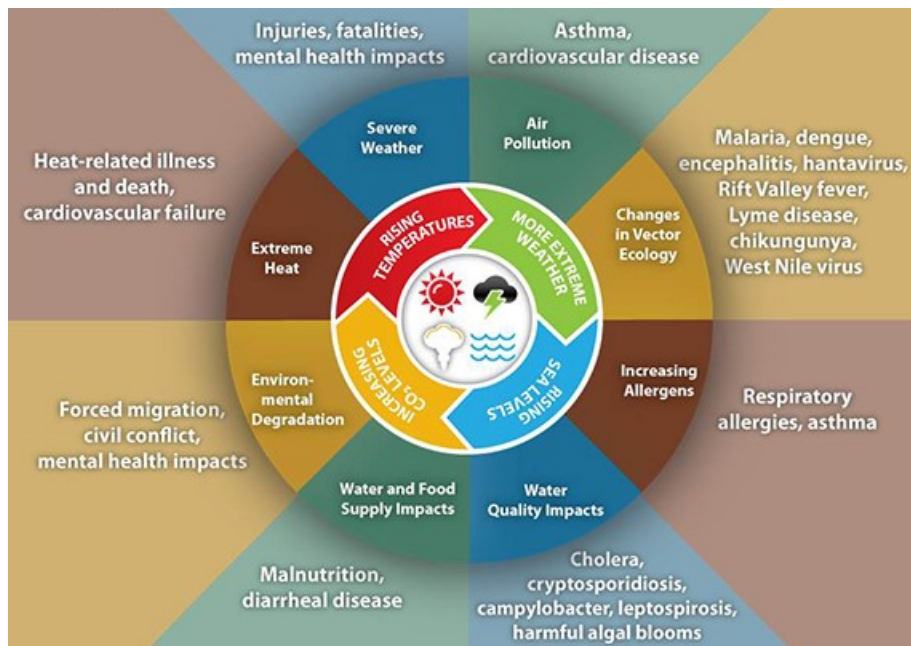
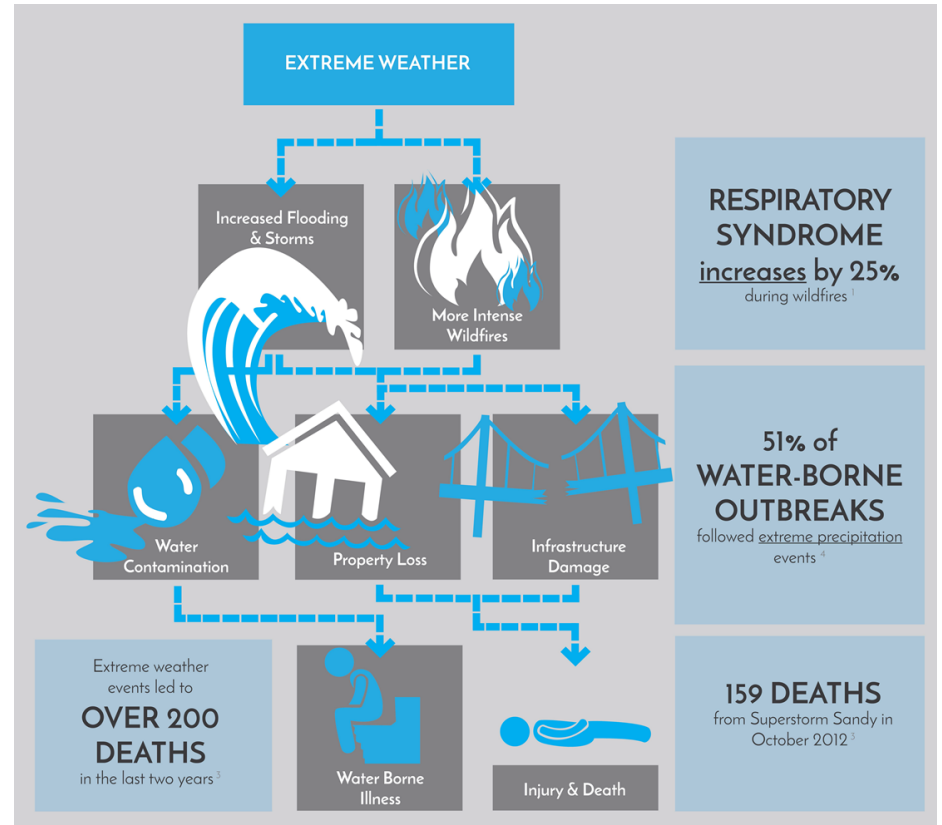


Fig. 3. Climate related health outcomes causal pathway diagram

Fig. 4. Causal pathway from extreme weather to disease, injury and death



**Above Source:** American Public Health Association (2012), <https://www.apha.org/news-and-media/multimedia/infographics/how-climate-change-affects-your-health>  
**Sources** used in the graphic from top to bottom and left to right:  
<https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5727a2.htm>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1446745/>  
[www.ncdc.noaa.gov/billions/events/US/1980-2018](http://www.ncdc.noaa.gov/billions/events/US/1980-2018)  
[www.ncdc.noaa.gov/billions/events/US/1980-2018](http://www.ncdc.noaa.gov/billions/events/US/1980-2018)

**Left Image Source:** Centers for Disease Control and Prevention, <http://www.cdc.gov/climateandhealth/effects/default.htm>

# A Changing Climate in the Marquette Area

Compared to average temperature and precipitation levels of the early to mid-20th century, the Midwest region and Michigan have both warmed and received more precipitation overall as shown in Figures 5 and 6.

Marquette’s climate has undergone similar though not completely identical changes. Residents are experiencing higher overall temperatures, with most dramatic increases occurring in the winter, as displayed in Table 1. However, unlike most of the region Marquette has seen decreased levels of annual precipitation driven primarily by drier springs and summers as shown in Table 2.

At the same time the Great Lakes region has experienced more frequent and intense extreme weather events like heavy rains and periods of drought (Great Lakes Integrated Sciences and Assessments (GLISA), n.d.). Those events have contributed to damaging infrastructure and impacting health. Examples include: floods impacting roads and water treatment plants; wildfires cutting off power and access to services; cold snaps freezing pipes; stream and beach contamination from storm water runoff; and diminishing aquifer recharge leading to water shortage.

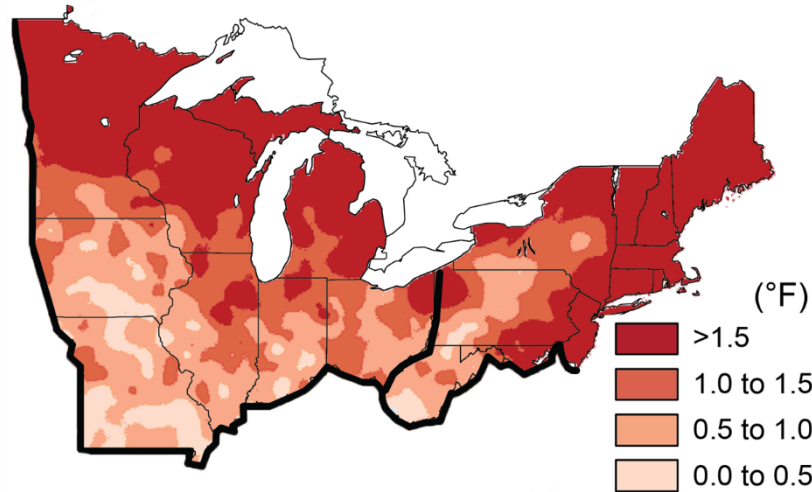


Fig. 5. Midwest temperature changes, 1991-2012 average compared to the 1901-1960 average.

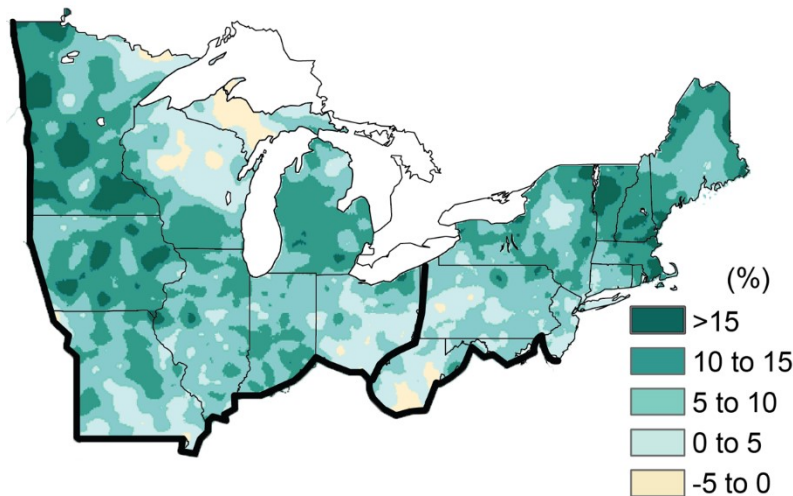


Fig. 6. Midwest annual total precipitation changes, 1991-2012 average compared to the 1901-1960 average.

Table 1: Change in Temperature from 1951 to 2017 (°F) in Western Upper	
Annual	+2.7
Winter	+3.9
Spring	+2.5
Summer	+2.1
Fall	+2.5
<b>Western Upper Peninsula</b> includes: Baraga, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Marquette, Menominee, and Ontonagon Counties. climate data source: GLISA, <a href="http://glisa.umich.edu/division/mi01">http://glisa.umich.edu/division/mi01</a>	

Table 2: Change in Precipitation from 1951 to 2017 in Western Upper		
	in.	%
Annual	-0.4	-1.21
Winter	+0.5	10.11
Spring	-0.4	-4.95
Summer	-1.7	-15.70
Fall	+1.3	14.95
<b>Western Upper Peninsula</b> includes: Baraga, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Marquette, Menominee, and Ontonagon Counties. climate data source: GLISA, <a href="http://glisa.umich.edu/division/mi01">http://glisa.umich.edu/division/mi01</a>		

# Vulnerability and Readiness of the Marquette Area

Climate vulnerability is a measure of a community’s risk of being negatively impacted by climate change. The degree to which it is vulnerable depends on three variables, as shown in Figure 7. Exposure is the severity and types of changes to an area’s climate. Marquette’s is discussed on the previous page. Sensitivity considers the population and their health and living conditions. Adaptive capacity is the expertise, plans, programs, or resources a community has in place to prevent or reduce negative impacts.

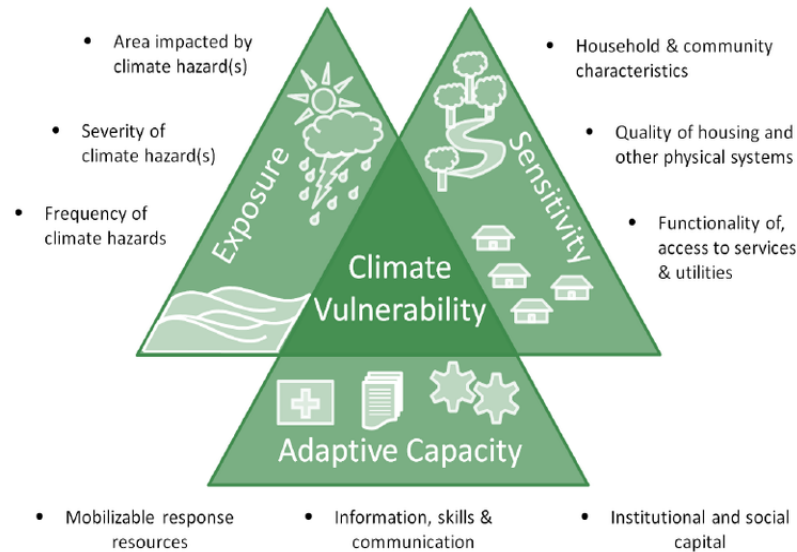


Fig. 7. Components of Climate Vulnerability

Source: Trundle & Mcevoy, 2015, [www.researchgate.net/publication/](http://www.researchgate.net/publication/)

In Marquette the groups considered particularly sensitive include the aging, young children, those in poverty, the homeless, those without access to health care or other essential services, people with chronic diseases and mental stress, and socially isolated individuals and towns. Table 3 lists a subset of key socio-economic and health related indicators of vulnerability for Marquette County compared to the rest of the state.

<b>Table 3: Socio-economic Vulnerability Factors</b> (from U.S. Census 2016 estimates)		
	<b>Marquette County (%)</b>	<b>State of Michigan (%)</b>
Age under 5 yrs.	4.8	5.8
Age 65 yrs. and over	18.0	16.2
Population in Poverty	15.0	15.8
<b>Elevated Rates of Chronic Health Conditions in Marquette County vs. Michigan</b> (from Behavioral Risk Factor Survey: <a href="http://www.michigan.gov/brfs">http://www.michigan.gov/brfs</a> )		
Disability	30.3	25.2
Asthma (Still)	14.6	10.9
Asthma (Ever)	26.3*	15.9
Obesity	36.5	31.1
Arthritis	34.8	31.1
*significantly elevated		

**Marquette’s existing adaptive capacity was a key indicator of community readiness to take on this project.**

Marquette is unique in comparison to other communities of its size, and even those much larger, in terms of the number and sophistication of climate adaptation activities already under way and the breadth of stakeholders who are participating. Climate plans have been created and are being implemented for the Lake Superior Watershed (Superior Watershed Partnership, 2012) Marquette County (Superior Watershed Partnership, 2013) and the City of Marquette (MSUE & MSUSPDC, 2013). Groups such as CATF and the Superior Watershed Partnership & Land Trust (SWP) have been instrumental in laying the foundation of climate change awareness and understanding while also building a broad network.

Along with demonstrated health related vulnerabilities, Marquette was selected due to that existing adaptive capacity. With assessments of the environment and infrastructure completed and access to local expertise, this project focused on building relationships with vulnerable populations and exploring the complex connections between climate, health, and the built environment. This Guidebook supplements the existing adaptation efforts by recommending policies and metrics that are supportive of health as well as economic and environmental goals.

# Adaptation

## What is adaptation and how do we use it to build resilience?

**Definition** – Actions that build the capacity of the community to address and interrupt climate change from impacting people’s health.

*Examples of adaptive actions from MICHAP Strategic Plan Update: 2016-2022:*

**Education and inclusion:** Develop communication plans and messaging about community wide resources and protective personal behaviors that particularly target those most vulnerable.

**Landscape and built environment:** Promote land-use and infrastructure solutions that sustainably address climate impacts while also benefiting community health.

**Policy:** Coordinate adaptations with ongoing community development and public health activities by tying them into the community’s existing decision-making processes such as the master plan or health improvement plan.

**Surveillance and Tracking:** Increase capacity for collection, analysis, and sharing of environmental and health related data.

Adaptation planning allows the community to strategically address the climate concerns of the community in a measured and collaborative manner.

## What can we adopt?

**1. Green Infrastructure** is the network of green spaces and water systems that delivers multiple environmental, social and economic values and services to urban communities. This living network strengthens the resilience of urban environments to respond to the major current and future challenges of climate change, growth, health and biodiversity loss, as well as water, energy and food security.



**2. Low Impact Development (LID)** encompasses alternative construction techniques that try to minimize or replicate natural landscape features that allow stormwater to infiltrate, rather than run off, developed properties. LID projects can mitigate both water quantity extremes such as drought and flooding and the degradation in water quality caused by alterations in land use and climate change.

By mimicking the natural environment, LID techniques, which include pervious pavement, rain gardens, vegetated swales and green roofs, allow stormwater to be retained and naturally treated on site and infiltrate into groundwater or gently runoff to surface waters.



Green Infrastructure and low impact development are landscape and built environment adaptations that can be used to build resilience. This poster was presented to the community at the kickoff meeting in November 2017. **Source:** Amal Shabaan, PhD Student, MSU SPDC, adapted from the City of Philadelphia Green Streets Design Manual



# Methods

# Process

This multi-year project is being executed in three phases. Each phase has different objectives that move the project toward the larger goal of preventing or reducing human health impacts from climate change in Marquette County.

## Phase I

**2017** Identify potential partner communities and establish a foundation for intervention by engaging stakeholders and understanding concerns

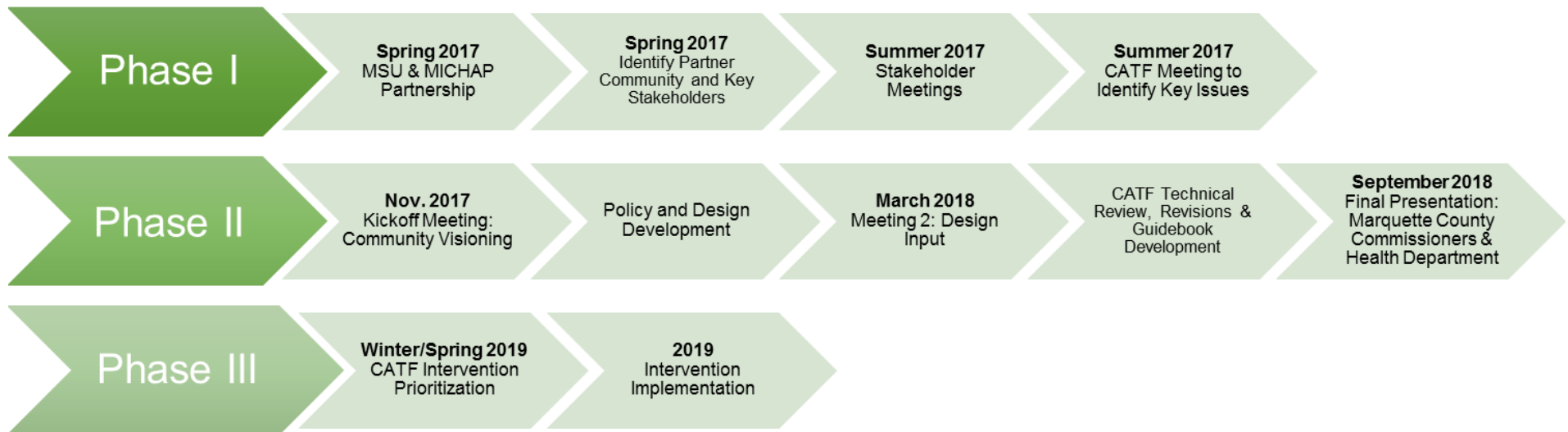
## Phase II

**2018** Develop interventions, recommendations, and metrics; obtain feedback; and develop guidebook

## Phase III

**2019** Engage community to prioritize recommendations and establish ownership for implementing the recommendations

## Project Timeline



## Phase I and II Quick Summary



The team met stakeholders at various locations throughout the county, in the field when possible.



Community members listen to stakeholder input and provide further input at Meeting I.



Community members engage with adaptation designs at Meeting 2.

To develop recommendations that accurately address the climate related public health concerns of the community, the team conducted an iterative input and feedback process including a series of focus groups followed by two community meetings and a final presentation held over the first two phases of the project. A detailed description of this process can be found in Volume I.

During Phase I, beginning in July of 2017, the project team conducted focus groups with nearly 25 stakeholder groups representing a range of perspectives. The information gathered at the meetings was synthesized and presented to CATF to identify the priority climate and health issues of the community. A list of examples sites around Marquette identified as having been impacted by climate related events was also generated from those meetings. The sites were photographed and used to develop before and after design renderings of potential built environment adaptations.

On November 2, 2017, kicking off Phase II, the first community meeting was held as an initial opportunity for the residents to review the priority issues and discuss their vision for climate adaptation in the area. At the second community meeting on March 26, 2018, the team presented the before and after design renderings along with preliminary policy and health metric recommendations. With feedback from those meetings and further interaction with CATF the design images were finalized, and Volume I was developed. From there a literature review of climate and health adaptation policies, best practices, and evaluation metrics was conducted and Volume II was drafted. After additional technical review from CATF Volume II was prepared for a final presentation to stakeholders. During that final meeting the goals and steps for Phase III were outlined.



# Volume I Overview

**Volume I: Stakeholder Engagement and Visual Design Imaging** includes the project overview and background, also presented here in Volume II, but provides greater detail about the stakeholder engagement process, the identification of the four overarching health categories (Vector Awareness, Air Quality, Emergency Response/Extreme Events, and Water Related issues), the development of each category’s causal pathway, and the utilization of original imagery to create the before and after design renderings of potential built environment adaptations. Volume I aims to help community residents and leaders visualize and better connect with potential climate adaptations that could address the climate related public health concerns they previously identified.

The *Design Recommendations* portion of Volume I includes two different sets of before and after imagery. The first set, as demonstrated by Figure 8, incorporates a list of the physical adaptations displayed in the image, symbology that indicates which of the four overarching health categories that adaptation is meant to address, sample policies that could enable the adaptive design concept to be implemented, and health measures that could be adopted as metrics in the various stakeholders’ plans and evaluations. The second set of images, as shown in Figure 9, offer a more detailed explanation of how the adaptation concepts pictured in the after images address the climate and health concerns presented in the before image. Additional information is also provided in pop-out boxes containing tips, case studies, and quotes from the community stakeholders.

Fig. 8 Design and Policy Sample Page

**Physical Intervention**

1. Educational Signage
2. Low-fire risk vegetation
3. Vegetated Swale

**Sample Policies**

- Increase educational signage in public places on tick awareness and prevention.
- Enhance countywide wildland urban interface (WUI) codes and ordinances based on Firewise USA standards.
- Set green infrastructure standards for public spaces that ensure the use of native, low-water-dependent landscaping on public properties.

**Sample Health Measures**

- Number of tick-specific educational signs in public places
- Number of new developments in WUI
- Change in the number of municipal properties with LID practices

**Health Categories:** Flooding, Water Quantity, Wildfires, Ticks

Fig. 9. Design and Adaptation Explanation Page

**ISPEMING SENIOR CENTER**

**Water Quality** **Air Quality**

While native plants, trees, and vegetated landscaping can all help absorb storm water to improve water quality, community gardens can accomplish similar goals with the added bonuses of improving social well-being in communities and increasing sources for local fresh produce.<sup>1</sup> Additionally, gardening encourages healthy activity and eating habits. Plants also not only improve air quality by absorbing harmful particulates from the air, but local community gardens reduce residents’ need to drive long distances for fresh produce, limiting car emissions released into the air.<sup>2</sup>

**Community Gardens and Social Cohesion**

A concern voiced by the Marquette area community that did not fit neatly into a health category was that of social cohesion in relation to future population increases believed to be predicted. Community gardens, while useful for built environment adaptations, can also be used as a means for building community. Research indicates that community gardens bring together people of diverse backgrounds to share one common interest, and promote interactions that build social capital (Firth et al, 2011).

**Tip**

<sup>1</sup> Centers for Disease Control and Prevention (CDC), 2010  
<sup>2</sup> European Climate Adaptation Platform (Climate-ADAPT), 2015



# Policy Recommendations

# The Policy Charts

## How they were developed

The sample policies from Volume I provided a means for broad education and engagement of stakeholders around climate impacts and adaptation in Marquette. However, decision makers indicated they needed a more comprehensive guide for folding the climate and health related built environment adaptations into the ongoing planning and development efforts in their respective jurisdictions. In response the project team developed this series of charts as a menu of tools that municipalities and organizations throughout Marquette can consider when looking to formally adopt, implement, and measure the success of the actions or policies.

The following 140 policy options with associated measures are organized by the four overarching health issues and further framed by the sample adaptations and measures displayed in the design renderings developed for Volume I. The policy options were developed after reviewing many of the existing plans and reports for the Marquette area as well as climate adaptation best practices from around the country and world. A list of these plans and guides is available in Appendix B of this guidebook. Though the project team does not recommend any one of the actions or policies for a given jurisdiction, they have been synthesized to align with or build onto the current climate adaptation work in Marquette where possible. Community leaders including CATF reviewed these charts to ensure community concerns were appropriately addressed.

Readers will see four separate charts addressing the overarching health issues of Vector Awareness, Air Quality, Emergency Response/Extreme Events, and Water Related concerns. Within each chart, the topic is broken down into the climate driver, its impact, the category and goal of each intervention, policy recommendations, and suggested metrics. Table 4 explains each of these categories in greater detail.

Table 4. Description of each section of the policy recommendation charts and how the sections are related.

Climate Driver	Impact	Interventions	Recommendations	Metrics
Describes one of the initial components of the causal pathway for that overarching health issue. Some represent actual changes in the climate like increased extreme precipitation while others are a result of those changes, like flooding.	The exposure variable or change in the environment based on the climate driver that could directly and/or indirectly impact health. Examples range from damaged infrastructure, to emerging diseases like Lyme, to degraded water quality.	One of four broad categories of recommendations (landscape actions, policies and ordinances, education and inclusion concepts, and surveillance and tracking techniques) with specific health related goals.	Policies or actions relating to the intervention. There are two types: “ <b>public</b> ”, action taken by a public agency regarding public facilities, site, infrastructure, etc., and “ <b>private</b> ”, action taken by private entities or action taken by public agencies that are targeted at citizens or businesses.	Ways by which the community can measure the results of the recommendation over time. Should be incorporated into planning and evaluation efforts.

# Vector Awareness

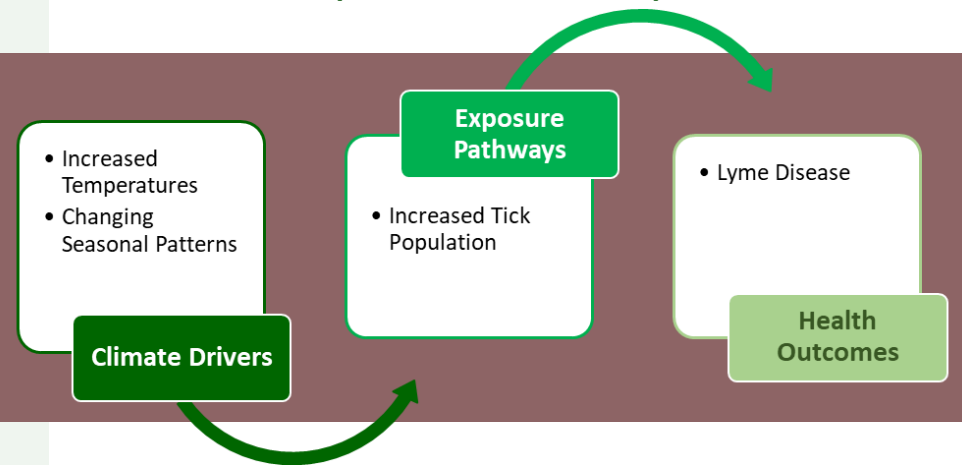


## Vector Awareness

Issues relating to the increased prevalence of vectors (specifically ticks) and vector-borne diseases throughout Marquette County due to a changing climate.



## Vector-borne Disease Exposure Pathway (Vector Awareness)



Stakeholder groups and community members voiced concerns about how the lasting increased temperatures seen with climate change have begun to expand the habitats of vector-borne disease carrying insects to the Marquette area. While mosquitos and mosquito-borne viruses were brought up a few times as a concern, ticks, and tick-borne illnesses were the main issue voiced by the community.

To address these concerns and limit the increased risk of human exposure to ticks, policies focus broadly on enhancing and maintaining buffers between humans and tick habitats, educating the public on tick-exposure risk and prevention, and expanding vector management and monitoring.



Ticks



Vector Awareness

# Policy Recommendations Vector Awareness



Climate Driver	Impact	Interventions	Recommendations	Metrics
Ticks	Lyme Disease and other emerging tick-borne diseases	<p><b><u>Landscape Actions</u></b> Green Infrastructure/ Low-impact-development</p> <p><b>Goal:</b> Reduce human exposure to ticks</p>	<p><b>Public</b></p> <p>I. Adopt integrated pest management strategies for public spaces such as parks and schools that include strategies for:</p> <ul style="list-style-type: none"> <li>– landscape management (ex. widened walking trails and regularly mowed grass);</li> <li>– best management organic land care practices; and</li> <li>– environmentally friendly lawns and backyard wildlife programs.</li> </ul>	Number of sites with integrated pest management strategies
		<p><b><u>Policy</u></b> Local regulations</p> <p><b>Goal:</b> Reduce human exposure to ticks</p>	<p><b>Private</b></p> <p>I. Encourage “Tick-Safe” landscaping in the development process through<sup>(1)</sup>:</p> <ul style="list-style-type: none"> <li>– site plan reviews and/or</li> <li>– permitting incentives (including fast-tracked permitting, technical assistance, site bonuses, etc.).</li> </ul> <p><b>Public</b></p> <p>I. Include “Tick Safe” language in zoning laws. Ensure zoning in reference to urban agriculture includes reference to “tick-safe” landscaping.</p>	<p>Number of sites developed with tick preventative measures</p> <p>Number of relevant ordinances updated with “Tick Safe” language</p>

(1) See CDC website on “Preventing Ticks in the Yard” ([https://www.cdc.gov/lyme/prev/in\\_the\\_yard.html](https://www.cdc.gov/lyme/prev/in_the_yard.html))

# Policy Recommendations Vector Awareness



Climate Driver	Impact	Interventions	Recommendations	Metrics
Ticks	Lyme Disease and other emerging tick-borne diseases	<p><b><u>Education and Inclusion</u></b></p> <p>Outreach</p> <p><b>Goal:</b> Increased awareness of tick exposure risk and prevention measures</p>	<p><b>Public/Private</b></p> <p>1. Develop communication plan on tick exposure risk and prevention measures. Include:</p> <ul style="list-style-type: none"> <li>– coordination with public schools,<sup>(2)</sup> local nonprofits, and local media partners for public education;</li> <li>– education on tick barriers between wooded areas and lawns;</li> <li>– encouragement of “Tick-Safe-Yards” practices such as short mown grass and debris free yards; and</li> <li>– ensured inclusion of diverse stakeholders such as representatives of vulnerable populations and social service providers.</li> </ul> <p>2. Develop tick education materials and make them available at parks, visitor areas, hotels, etc. (flyers, leaflets, posters).</p> <p>3. Ensure training for human and veterinary clinics and health care providers on recognition and treatment of tick-borne diseases.</p> <p><b>Public</b></p> <p>1. Increase educational signage in public places on tick awareness and prevention.</p> <p>2. Encourage property owner participation in vector communication and management plan by developing a localized website to house tick education materials and, through the communication plan, promotion of existing websites housing tick education material such as the Centers for Disease Control (CDC) and Michigan Department of Health and Human Services (MDHHS).</p>	<p>Number of sites with integrated pest management strategies</p> <p>Number of individuals reached by public education campaign</p> <p>Number of trainings for clinic and health care providers</p> <p>Number of tick-specific educational signs in public places</p> <p>Number of people participating in new vector communication and management plan via website</p>

(2) See Strategic Plan for School Integrated Pest Management, EPA

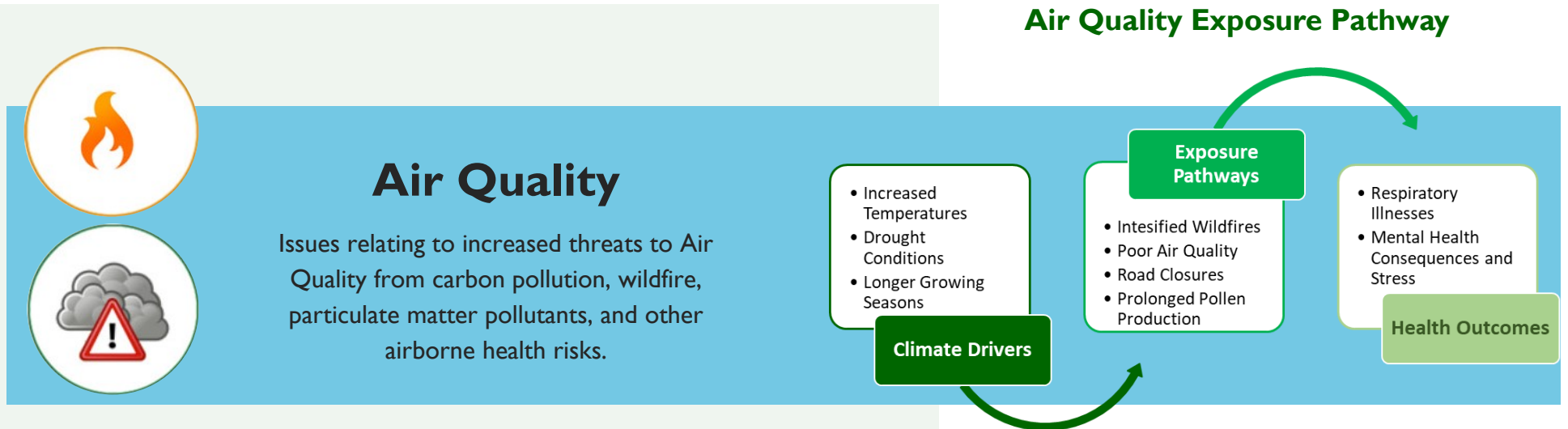
# Policy Recommendations

## Vector Awareness



Climate Driver	Impact	Interventions	Recommendations	Metrics
Ticks	Lyme Disease and other emerging tick-borne diseases	<p><b><u>Surveillance and Tracking</u></b></p> <p>Data collection and monitoring</p> <p><b>Goal:</b> Improve understanding of the risk and ability to coordinate a response.</p>	<p><b>Public</b></p> <p>1. Enhance existing countywide tick-monitoring efforts coordinated by the Michigan Disease Surveillance System (MDSS) database and MDHHS via the MiTracking data portal to include localized, area wide coordination between local infrastructure and health authorities, and relevant local groups (veterinarians, outdoor enthusiasts, etc.) to monitor insect breeding and vector disease spread using existing statewide data sources and by developing localized data.</p> <p>2. Build local capacity to monitor ticks by using existing state resources to train local health department staff and other specialized authorities in tick ecology, how to conduct tick drags, identify tick species and submit live ticks to MDHHS for disease testing.</p> <p><b>Private</b></p> <p>1. Encourage public reporting of ticks to Michigan Department of Health and Human Services (MDHHS) or local health department.</p>	<p>Number of cases of tick borne diseases</p> <p>Number and species of ticks counted by using tick drags</p> <p>Number of local trainings completed</p> <p>Number of ticks sent by citizens and identified and/or tested by MDHHS</p>

# Air Quality



Stakeholder groups and community members voiced concerns about wildfires and the smoke caused by wildfires as well as worsening air quality from increased pollen and harmful particulates. Increasing average annual temperatures and shifting seasonal precipitation patterns that have at times led to drought conditions can lead to intensified wildfires, poorer air quality, and increased pollen counts. This can impact health by causing or exacerbating respiratory illnesses as well as mental health and stress consequences.

To address these concerns and limit the increased risk of wildfires and poor air quality, policies focus broadly on preventing wildfires, expanding clean energy, encouraging low-pollen and high pollutant-absorptive vegetation use, and enhancing air quality monitoring and communication.





# Policy Recommendations Air Quality

Climate Driver	Impact	Interventions	Recommendations	Metrics
Wildfire	Smoke	<p><b><u>Education and Inclusion</u></b> Public Outreach</p> <p><b>Goal:</b> Prevent wildfires at campsites</p>	<p><b>Public</b></p> <p>1. Develop communication plan to address campfire safety through:</p> <ul style="list-style-type: none"> <li>- signage;</li> <li>- leaflets; and</li> <li>- incorporation of campfire education in online camp registration process.</li> </ul>	<p>Number of people registered for campsites that receive campfire safety education</p> <p>Number of fires caused by campfires</p>
		<p><b><u>Education and Inclusion</u></b> Public Outreach</p> <p><b>Goal:</b> Promote education on smoke danger precautions</p>	<p><b>Public</b></p> <p>1. Develop wildfire communication plan based on CDC wildfire smoke fact sheet and Firewise USA public education techniques. Use:</p> <ul style="list-style-type: none"> <li>- PSAs;</li> <li>- local news interviews;</li> <li>- mobile device messaging;</li> <li>- flyers and leaflets;</li> <li>- social media advertising; and</li> <li>- community engagement sessions.</li> </ul> <p>2. Develop localized air quality communication plan which includes smoke forecasting of EPA Air Resource Advisory (ARA) program.</p>	<p>Number of people reached by wildfire communication plan</p> <p>Number of people reached by air quality communication plan</p>
		<p><b><u>Education and Inclusion</u></b> Thinning/Pruning/Tree Removal/Brush Clearing on Private Property</p> <p><b>Goal:</b> Engage residents' participation in wildfire prevention</p>	<p><b>Private</b></p> <p>1. Encourage large landowners to complete a forest management plan through the U.S. Forest Service's Northern Institute of Applied Climate Science.</p> <p>2. Encourage residential adoption of Firewise standards through<sup>(3)</sup>:</p> <ul style="list-style-type: none"> <li>- public information campaigns and</li> <li>- grant programs.</li> </ul>	<p>Number of large landowners who have completed a forest management plan</p> <p>Number of sites in Marquette County listed on the Firewise USA map</p>

(3) See Marquette County Community Wildfire Protection Plan

# Policy Recommendations

Air Quality



Climate Driver	Impact	Interventions	Recommendations	Metrics
Wildfire	Smoke	<p><b><u>Landscape Actions</u></b> Modernize Infrastructure</p> <p><b>Goal:</b> Ensure infrastructure safety to prevent electrical fires</p>	<p><b>Public</b></p> <p>1. Work with utilities to ensure power line and infrastructure design and construction standards are appropriate for high wind and in high wildfire hazard areas. Include:</p> <ul style="list-style-type: none"> <li>– increased clearances between vegetation and power lines throughout the high wildfire hazard areas;</li> <li>– stringent wire-to-wire clearances for new and reconstructed facilities in high wildfire hazard areas; and</li> <li>– burial of power lines in high-risk areas.</li> </ul>	<p>Acres of power lines made fire safe</p> <p>Number of electrical fires</p>
		<p><b><u>Education and Inclusion</u></b> Modernize Operational Practices</p> <p><b>Goal:</b> Maintain fire safe infrastructure</p>	<p><b>Public</b></p> <p>1. Conduct annual patrol inspections of overhead distribution facilities in high and medium wildfire hazard areas.</p>	<p>Number of power lines that pass inspections</p>
		<p><b><u>Policy</u></b> Ordinance Update</p> <p><b>Goal:</b> Reduce the number of human caused wildfires</p>	<p><b>Public</b></p> <p>1. Enhance rural burn and motorized vehicle regulations through:</p> <ul style="list-style-type: none"> <li>– local ordinance amendments and</li> <li>– countywide ordinance amendments</li> </ul> <p>2. Enhance countywide wildland urban interface (WUI) codes and ordinances based on Firewise USA standards. Include:</p> <ul style="list-style-type: none"> <li>– defined best practices for construction and location of new development in WUI with resilient materials outlined and</li> <li>– restrictions on new development in high risk areas.</li> </ul>	<p>Number of wildfires started through rural burn practices</p> <p>Number of new developments in WUI</p>

# Policy Recommendations Air Quality

Climate Driver	Impact	Interventions	Recommendations	Metrics
Air Pollutants	O <sub>3</sub> (ozone) and PM <sub>2.5</sub> (particulate matter)	<p><b><u>Education and Inclusion</u></b> Public Outreach</p> <p><b>Goal:</b> Promote protective behaviors</p>	<p><b>Public</b></p> <p>1. Develop air quality communication plan. Include:</p> <ul style="list-style-type: none"> <li>– PSAs via radio, TV, and mobile device messages on protective personal behaviors during poor air quality days;</li> <li>– factsheets and staff training on protective behaviors at medical facilities;</li> <li>– grade school level lessons on protective personal behaviors to reduce exposure to poor air quality;</li> <li>– development of asthma control plan for schools;</li> <li>– promotion of use of the AirNow app by those with asthma and other respiratory conditions;</li> <li>– promotion of Ozone Action Days.</li> </ul>	<p>Number of residents contacted by outreach programs</p> <p>Number of students who participated in lessons</p> <p>Number of trainings conducted</p> <p>Number of people with AirNow app</p>
		<p><b><u>Policy</u></b> Urban Tree Canopy Investments</p> <p><b>Goal:</b> Remove pollutants from county air</p>	<p><b>Public</b></p> <p>1. Use master plans and zoning ordinances to encourage diverse and high-pollutant-absorption tree plantings in all communities, such as ordinances to ensure that each tree taken down will be replaced with another tree, ensuring widespread co-benefits.</p> <p>2. Encourage the planting of trees that maximize absorption of air pollutants. Do so by:</p> <ul style="list-style-type: none"> <li>– utilizing the assistance of the Michigan Department of Natural Resources Urban &amp; Community Forestry Program and other community partners;</li> <li>– incorporating the use of i-Tree Species tool<sup>(4)</sup> to quantify pollutant reduction and maximize planting benefits; and</li> <li>– incorporating the principles of the EPA Green Street Design Guide, in high traffic areas, into local planning decisions and the local capital improvements plan.</li> </ul> <p>3. Expand urban canopy cover in City of Marquette to high traffic areas throughout the county. <sup>(5)</sup></p>	<p>Number of new trees planted per year on private property</p> <p>Number of trees the City of Marquette plants per year in high traffic areas</p>

# Policy Recommendations Air Quality

Climate Driver	Impact	Interventions	Recommendations	Metrics
Air Pollutants	O <sub>3</sub> (ozone) and PM <sub>2.5</sub> (particulate matter)	<p><b><i>Surveillance and Tracking</i></b> Data Collection</p> <p><b>Goal:</b> Increase capacity for collection and analysis of local air quality and respiratory disease data</p>	<p><b>Public</b></p> <p>1. Install and maintain Michigan Department of Environmental Quality (MDEQ) monitor and create Air Action! Day program for Marquette County.</p> <p>2. Monitor Air Quality, especially in low-income neighborhoods. Do so by:</p> <ul style="list-style-type: none"> <li>- installing air quality monitors in each fire response zone and</li> <li>- identifying entity for ongoing maintenance and data collection.</li> </ul> <p>3. Expand upon particular air pollutants to be measured annually within Marquette County. Specifically measure:</p> <ul style="list-style-type: none"> <li>- CO (carbon monoxide);</li> <li>- NO<sub>2</sub> (nitrogen dioxide);</li> <li>- O<sub>3</sub> (ozone);</li> <li>- PM<sub>10</sub> (particulate matter); and</li> <li>- SO<sub>2</sub> (sulfur dioxide).</li> </ul> <p>4. Adopt specific air pollutant reduction targets resulting from implementation of green infrastructure recommendations.</p>	<p>Percent of county covered by localized air quality tracking</p> <p>Long-term trends of air pollutant concentration.</p> <p>Number of days with elevated Air Quality Index (AQI)</p> <p>Number of air pollutants measured annually</p> <p>Degree to which air pollutant reduction targets are met</p>
		<p><b><i>Policy</i></b> Coordination</p> <p><b>Goal:</b> Develop regional strategy with cross-sectoral partners to address air pollution</p>	<p><b>Public</b></p> <p>1. Coordinate adaptations with ongoing community development and public health activities by:</p> <ul style="list-style-type: none"> <li>- tying them into a community’s master planning and health improvement planning processes and</li> <li>- formally implanting a vision of resilience for business and residential districts to guide long-term investment in infrastructure and health and social service programming.</li> </ul>	<p>Number of residents provided with subsidies for asthma treatment</p>

(4) i-Tree Species is a free tool assisting urban foresters in selecting tree species that address specific area concerns, such as removing air pollutants (<https://species.itreetools.org>)

(5) Following objective 4.2 of the Marquette County Climate Action Plan

# Policy Recommendations Air Quality

Climate Driver	Impact	Interventions	Recommendations	Metrics
Air Pollutants	O <sub>3</sub> (ozone) and PM <sub>2.5</sub> (particulate matter)	<p><b><u>Policy</u></b> Coordination</p> <p><b>Goal:</b> Develop regional strategy with cross-sectoral partners to address air pollution</p>	<p>2. Provide assistance to reduce asthma triggers particularly in homes of those with existing asthma and who are low income. Do so by:</p> <ul style="list-style-type: none"> <li>– promoting local air monitoring assistance programs;</li> <li>– amending rental codes and inspection requirements that look to fix leaks that cause mold;</li> <li>– connecting homeowners or renters with resources for controlling pests using Integrated Pest Management (IPM) strategies; and</li> <li>– identifying resources for installing window air conditioner units.</li> </ul>	Number of residents provided with subsidies for asthma treatment
		<p><b><u>Policy</u></b> Support Smart Growth</p> <p><b>Goal:</b> Reduce pollutant emissions throughout region</p>	<p><b>Public</b></p> <p>1. Promote Placemaking and incentivize market-supported, mixed-use development in every community which include businesses that meet the basic needs of the community residents (e.g. grocery stores, health centers, etc.) within walking distance. Achieve this by:</p> <ul style="list-style-type: none"> <li>– providing financial incentives to developers and</li> <li>– amending local community ordinances to allow implementation.</li> </ul> <p>2. Expand the development of walkable and bikeable options throughout county. Do so by:</p> <ul style="list-style-type: none"> <li>– encouraging Safe Routes to School Audits throughout county;</li> <li>– partnering with area trail-building groups; and</li> <li>– including these priorities each community’s master plan and promoted in zoning ordinances.</li> </ul>	<p>Number of residents within one-mile of vital-needs businesses</p> <p>Miles of bike lanes and safely bikeable and walkable routes throughout county</p>

# Policy Recommendations

Air Quality



Climate Driver	Impact	Interventions	Recommendations	Metrics
Air Pollutants	Energy	<p><b>Policy</b> Clean Energy</p> <p><b>Goal:</b> Reduce greenhouse gas emissions through encouragement of renewable energy sources and energy efficiency</p>	<ol style="list-style-type: none"> <li>1. Build onsite renewable energy systems at emergency centers. <sup>(6)</sup></li> <li>2. Invest in wind energy harvesting for smaller communities as a means for reducing reliance on conventional energy.</li> <li>3. Use community planning process to realize on-site, community-based energy systems.</li> <li>4. Assess housing stock and municipal buildings for energy efficiency and renewable energy adaptation through adoption of new local codes and inclusion in master plan goals.</li> </ol>	<p>Number of emergency centers with onsite renewable energy systems</p> <p>Number of new wind energy installations</p> <p>Number of properties with onsite community-based energy systems</p> <p>Number of structures assessed for energy efficiency and renewable energy adaptation</p>

(6) Following Objective 3.2 of the Climate Adaptation Plan for Marquette County

# Policy Recommendations Air Quality

Climate Driver	Impact	Interventions	Recommendations	Metrics
Allergens	Pollen	<p><b><u>Landscape Actions</u></b> Urban Landscape</p> <p><b>Goal:</b> Manage for low-pollen production where possible</p>	<p><b>Public</b></p> <ol style="list-style-type: none"> <li>1. Incorporate pollen reduction into Urban Tree Canopy and county tree planting plans. Include:                             <ul style="list-style-type: none"> <li>– pollen reduction strategy to ensure that municipal tree-plantings and landscaping use low-pollen-producing species and</li> <li>– strategies for removing and replacing high-pollen-producing plant and tree species.</li> </ul> </li> <li>2. Develop ragweed control plan for public and undeveloped properties.</li> <li>3. Adopt guidelines to ensure that municipal tree-plantings and landscaping use low-pollen-producing species. Include list of allergy friendly trees for developers.<sup>(7)</sup></li> </ol>	<p>Number of low-pollen-producing tree species planted</p> <p>Number of asthma related hospitalizations</p> <p>Number of properties with ragweed</p>
		<p><b><u>Education and Inclusion</u></b> Awareness</p> <p><b>Goal:</b> Raise awareness of low-pollen alternatives and protective behaviors</p>	<p><b>Private</b></p> <ol style="list-style-type: none"> <li>1. Discourage planting of pollen producing plants on new developments. Do so via developer incentives such as expedited permitting for landscape plans including low-pollen landscaping.</li> <li>2. Discourage pollen producing plants and tree species on residential properties. Do so through:                             <ul style="list-style-type: none"> <li>– flyers and leaflets on identifying and removing high pollen plants and low pollen replacements and</li> <li>– grants for the replacement of high pollen landscaping with low pollen alternatives.</li> </ul> </li> </ol>	<p>Number of low-pollen-producing plants and tree species planted</p>

(7) i-Tree Species is a free tool assisting urban foresters in selecting tree species that address specific area concerns, such as removing air pollutants (<https://species.itreetools.org>)

# Policy Recommendations Air Quality

Climate Driver	Impact	Interventions	Recommendations	Metrics
Allergens	Pollen	<p><b><u>Education and Inclusion</u></b> Awareness</p> <p><b>Goal:</b> Raise awareness of low-pollen alternatives and protective behaviors</p>	<p><b>Public</b></p> <p>1. Develop allergen communication plan. Include:</p> <ul style="list-style-type: none"> <li>– PSAs via radio and TV to communicate an early onset of pollen season and protective actions such as planting low-pollen species on private residential properties that citizens can take; and</li> <li>– factsheets and staff training on protective behaviors at local hospitals and clinics.</li> </ul>	<p>Number of residents contacted by allergen communication plan</p> <p>Number of trainings conducted</p>
		<p><b><u>Surveillance and Tracking</u></b> Tracking Systems</p> <p><b>Goal:</b> Track and communicate pollen levels</p>	<p><b>Public</b></p> <p>1. Install pollen monitors and institute pollen tracking system.</p> <p>2. Communicate pollen levels to local clinics, hospitals, patients, and the general public.</p>	<p>Number of high pollen days</p>
		<p><b><u>Policy</u></b> Ordinance Changes</p> <p><b>Goal:</b> Ensure ordinances reflect changes in pollen and allergen risk due to changing climate</p>	<p><b>Public</b></p> <p>1. Consider pollen ordinances specifying non-allowable, pollen-producing tree and plant species in communities.</p> <p>2. Include plant species requirements in site plan review process.</p> <p><b>Private</b></p> <p>1. Amend local ordinances for lawn length, particularly during pollen season.</p>	<p>Number of ordinances updated and adopted</p> <p>Number of site plans including new pollen species requirements</p> <p>Annual number of violations for lawn length code enforcements</p>






# Emergency Response/Extreme Events



Stakeholder groups and community members voiced concerns about how the increasingly frequent extreme weather events and wildfires seen with climate change coupled with insufficient infrastructure, inadequate transportation networks, isolated residents, and other challenges can lead to increased health dangers in the community, such as injury, respiratory illnesses, cold-related illness, and mental health consequences.

To address these concerns and limit the increased risks to humans posed by extreme weather and emergency events, policies focus broadly on enhancing green and gray infrastructure, promoting extreme weather preparedness and caution, promoting accessible living patterns and improved transportation networks, and limiting people’s exposure to the dangers of extreme weather.

-  **Energy**
-  **Road Access**
-  **Wildfires**

# Policy Recommendations

## Emergency Response/Extreme Events



Climate Driver	Impact	Interventions	Recommendations	Metrics
Storm Surge	Shoreline Flooding	<p><b><u>Policy</u></b> Ordinance</p> <p><b>Goal:</b> Reduce road access barriers and property damage along Lake Superior</p>	<p><b>Public</b></p> <p>1. Implement a countywide Beach Overlay or Shoreline Protection Zone. Require:</p> <ul style="list-style-type: none"> <li>– enhanced building standards and</li> <li>– further setbacks in coastal areas, including for roads.<sup>(8)</sup></li> </ul> <p>2. Develop an asset management plan that includes an assessment and phased approach to increasing resilience of assets in these overlay zones.</p>	<p>Number of road closures due to flooding</p> <p>Number of new or enhanced setbacks or other installations to protect beach or shoreline</p>
		<p><b><u>Landscape Actions</u></b> Green Infrastructure/ LID</p> <p><b>Goal:</b> Reduce shoreline flooding through green infrastructure development</p>	<p><b>Public</b></p> <p>1. Prioritize projects that offer protection from wave action, changing water levels, and storm surge while also helping manage runoff and creating habitat. Emphasize the incorporation of green infrastructure and natural shoreline restoration in any coastal zone development.<sup>(9)</sup> Do so through:</p> <ul style="list-style-type: none"> <li>– site plan reviews and/or</li> <li>– permitting incentives (including fast-tracked permitting, technical assistance, site bonuses, etc.).<sup>(10)</sup></li> </ul>	<p>Number of road closures, other damage due to flooding</p>
		<p><b><u>Surveillance and Tracking</u></b> Infrastructure Mapping</p> <p><b>Goal:</b> Use flooding data to guide infrastructure investments</p>	<p><b>Public</b></p> <p>1. Map and inventory the infrastructure damages caused by extreme weather. Identify areas subject to repeated damages. In doing so:</p> <ul style="list-style-type: none"> <li>– utilize existing FEMA data as a baseline;</li> <li>– Supplement or update FEMA dataset by utilizing tools like the Great Lakes Shoreviewer; and</li> <li>– track damages using shared information technology such as Superior Watershed Partnership Coastal Reporting Tool</li> </ul> <p>2. Update design standards to match forecasted need based on critical infrastructure inventory. Include:</p> <ul style="list-style-type: none"> <li>– elevation and</li> <li>– flood proofing.</li> </ul>	<p>Percentage of critical infrastructure mapped and inventoried</p> <p>Number of design standards updated to match forecasted need</p>

# Policy Recommendations

## Emergency Response/Extreme Events



Climate Driver	Impact	Interventions	Recommendations	Metrics
Storm Surge	Shoreline Erosion	<p><b><u>Landscape Actions</u></b></p> <p>Infrastructure Resiliency</p> <p><b>Goal:</b> Reduce the risk to property and residents of shoreline erosion from changing lake levels.</p>	<p>Public</p> <ol style="list-style-type: none"> <li>1. Develop an asset management plan that includes an assessment and phased approach to increasing resilience of assets in overlay zones.</li> <li>2. Strategically acquire property easements along the waterfront to prevent inappropriate development along the shoreline. Include:                             <ul style="list-style-type: none"> <li>– focusing property acquisition on high risk areas and</li> <li>– land acquisitions via a land conservancy or trust such as the Superior Watershed Partnership.</li> </ul> </li> <li>3. Encourage dune restoration by local community groups such as the Superior Watershed Partnership through mechanisms such as grant funding.</li> </ol>	<p>Percentage of coastal land owned by local public entities</p> <p>Number of dune restoration projects completed through local partnerships</p>

- (8) Following Objective 1.4 of the 2013 Climate Adaptation Plan for Marquette County
- (9) Built off recommendation in Village of Sebawaing Resilience Plan
- (10) Following the actions listed in the Lake Superior Climate Adaptation and Implementation Plan

# Policy Recommendations

## Emergency Response/Extreme Events



Climate Drive	Impact	Interventions	Recommendations	Metrics
Wildfire	Access	<p><b><u>Policy</u></b> Support Smart Growth</p> <p><b>Goal:</b> Encourage more accessible living patterns to ensure access to residences in cases of major wildfires</p>	<p><b>Public</b></p> <p>1. Increase redundancy in the street network to emergency vehicle access and evacuation ability. Address:</p> <ul style="list-style-type: none"> <li>– isolated residents;</li> <li>– long, narrow driveways.</li> <li>– cul de sacs;</li> <li>– long curvilinear streets; and</li> <li>– dead end streets.</li> </ul>	Number of isolated, hard-to-reach homes
		<p><b><u>Policy</u></b> Zoning and Ordinances</p> <p><b>Goal:</b> Reduce the risk present to homeowners from the growth in wildfire activities</p>	<p><b>Public</b></p> <p>1. Adopt a fire hazard overlay district for remote, poorly accessed, high-risk wildfire areas.</p> <p>2. Adopt zoning regulations to encourage market-supported, mixed use development that is the appropriate density and scale for the location and community.</p> <p>3. Pursue development of microgrids for local areas to enhance grid redundancy.</p> <p>4. Consider burial of power lines for protection in major weather events and plan for the life cycle of energy infrastructure investments to better display the full-life savings of green infrastructure.</p>	<p>Number of isolated, hard-to-reach homes</p> <p>Percentage of local dense, developed area covered by zoning which encourages mixed uses</p> <p>Extent of development of microgrids in local areas</p> <p>Percentage of local power lines buried by the utility</p>
		<p><b><u>Surveillance and Tracking</u></b> Warning Systems</p> <p><b>Goal:</b> Track wildfires and assess wildfire risk across the county</p>	<p><b>Public</b></p> <p>1. Develop Wildfire Warning System, operated by responding units, to communicate the spread of wildfires and evacuation procedures when necessary.</p> <p>2. Update wildfire hazard maps and designate high, medium, and low wildfire hazard areas.</p>	<p>Number of people reached by warning system</p> <p>Number of people evacuated</p>

# Policy Recommendations

## Emergency Response/Extreme Events



Climate Driver	Impact	Interventions	Recommendations	Metrics
Wildfire	Access	<p><b><u>Education and Inclusion</u></b> Public Outreach</p> <p><b>Goal:</b> Prepare residents for wildfires</p>	<p><b>Public</b></p> <p>1. Develop and communicate evacuation plans for high fire hazard communities. Do so via:</p> <ul style="list-style-type: none"> <li>- public information campaigns;</li> <li>- signage;</li> <li>- flyers; and</li> <li>- leaflets.</li> </ul>	Number of people evacuated during wildfires
	Property Damage	<p><b><u>Education and Inclusion</u></b> Private property maintenance</p> <p><b>Goal:</b> Reduce the risk present to homeowners from the increasing number of wildfires</p>	<p><b>Private</b></p> <p>1. Encourage large landowners to complete a forest management plan through the U.S. Forest Service’s Northern Institute of Applied Climate Science of the Marquette County Soil and Water Conservation District (SWCD).</p> <p>2. Encourage residential adoption of Firewise standards. Do so through:</p> <ul style="list-style-type: none"> <li>- public information campaigns;</li> <li>- the promotion of localized programs and resources; and</li> <li>- grant programs.<sup>(11)</sup></li> </ul>	<p>Number of large landowners who have completed a forest management plan</p> <p>Number of sites in Marquette County listed on the Firewise USA map</p>
		<p><b><u>Education and Inclusion</u></b> Public Outreach</p> <p><b>Goal:</b> Promote and incentivize fire safe practices and behaviors</p>	<p><b>Public</b></p> <p>1. Distribute educational materials on Firewise and safe equipment use with zoning compliance permits.</p> <p>2. Fast track zoning compliance permits for Firewise sites.</p>	<p>Number of sites in Marquette County listed on the Firewise USA map</p> <p>Number of fires caused from preventable causes<sup>(12)</sup></p>

(11) As listed in Marquette County Community Wildfire Protection Plan

(12) Equipment use, campfires, and electrical issues are the top 3 causes of wildfires in Marquette County

# Policy Recommendations

## Emergency Response/Extreme Events



Climate Driver	Impact	Interventions	Recommendations	Metrics
Flooding	Access	<p><b><u>Surveillance and Tracking</u></b> Track Vulnerabilities</p> <p><b>Goal:</b> Understand where greatest risk to transport networks exist and address vulnerabilities</p>	<p><b>Public</b></p> <p>1. Inventory critical infrastructure most vulnerable to damage by extreme weather. For flooding situations, enhance:</p> <ul style="list-style-type: none"> <li>- height;</li> <li>- drainage;</li> <li>- culverts; and</li> <li>- surrounding low-impact-development (LID) on roads subject to repeated flooding.<sup>(13)</sup></li> </ul>	<p>Number of road closures due to extreme events</p>
		<p><b><u>Landscape Actions</u></b> Green Infrastructure/Low Impact Design</p> <p><b>Goal:</b> Reduce road use and development along coast</p>	<p><b>Public</b></p> <p>1. Utilize Great Lakes Shoreviewer technology to identify coastal areas at risk for flooding and assess flooded areas for potential adaptive measures such as:</p> <ul style="list-style-type: none"> <li>- use of pervious pavement in trail network upgrades and</li> <li>- alternative routes for key coastal arteries (partner with the Michigan Department of Transportation (MDOT), the County Road Commissioner, or the Army Corps of Engineers).</li> </ul>	<p>Percent of publicly owned land cover dedicated to greenspaces</p> <p>Square footage of pervious pavement added on trail networks</p>
		<p><b><u>Landscape Actions</u></b> Green Infrastructure/Low Impact Design</p> <p><b>Goal:</b> Ensure road construction appropriately manages floodwater to allow for road access</p>	<p><b>Public</b></p> <p>1. Identify routes at risk for flooding and assess flooded areas for potential adaptive measures such as:</p> <ul style="list-style-type: none"> <li>- enhanced height, drainage, culverts, and surrounding LID on road subject to repeated flooding;</li> <li>- use of pervious pavement in trail network upgrades and</li> <li>- alternative routes for key arteries (partner with the Michigan Department of Transportation (MDOT), the County Road Commissioner, or the Army Corps of Engineers).</li> </ul> <p>2. Develop enhanced Floodplain Overlay Zone with updated floodplain maps to require enhanced construction standards for roads to ensure accessibility of roadways. Include enhanced height, drainage, culverts, and surrounding LID.</p>	<p>Number of road closures due to extreme events</p>

<sup>(13)</sup> At minimum, those identified in the 2015 Marquette County Hazard Mitigation Plan

# Policy Recommendations

## Emergency Response/Extreme Events



Climate Driver	Impact	Interventions	Recommendations	Metrics
Flooding	Access	<p><b><u>Policy/Ordinances</u></b> Countywide planning</p> <p><b>Goal:</b> Reduce coastal development to protect properties from flood damage</p>	<p><b>Public</b></p> <p>1. Develop Beach Overlay Zone or Shoreline Protection Zone to require enhanced building standards and further setbacks in coastal areas, including for roads to ensure accessibility of roadways.</p>	Percent of waterfront covered by a protective zone
		<p><b><u>Landscape Action</u></b> Countywide Planning</p> <p><b>Goal:</b> Ensure road construction appropriately manages storm water to allow for road access</p>	<p><b>Public</b></p> <p>1. Create a region-wide storm water management plan, coordinating between all agencies. Include:</p> <ul style="list-style-type: none"> <li>– map and inventory of repeat road flooding and</li> <li>– enhanced height, drainage, culverts, and surrounding LID on road subject to repeated flooding.<sup>(14)</sup></li> </ul>	Number and location of repeated road closures due to flooding
		<p><b><u>Landscape Actions</u></b> Green Infrastructure/Low Impact Design (GI/LID)</p> <p><b>Goal:</b> Reduce the increased risk of roads flooding due to runoff</p>	<p><b>Public</b></p> <p>1. Adopt developer incentives (monetary, fast-track permitting, technical assistance, etc.) to encourage LID in new developments and retrofits to reduce runoff and potential flooding.</p> <p>2. Develop policies that facilitate increased implementation of GI and LID. Include:</p> <ul style="list-style-type: none"> <li>– amended landscaping requirements to require permeable surfaces in all developments and increased vegetative cover;</li> <li>– use of Land Division Alternatives to preserve natural landscape; and</li> <li>– zoning code amendments such as storm water management, natural features and drain setbacks, etc.<sup>(15)</sup></li> </ul> <p>3. “Lead-by-example” in municipal development.<sup>(16)</sup> Include:</p> <ul style="list-style-type: none"> <li>– retrofitting all municipal buildings with LID measures (e.g. rain barrels, green roofs, pervious surfaces, rain gardens, etc.) and</li> <li>– installing storm water controls on public properties (such as grey water storage, rain barrels, green roofs, rain gardens, and bioswales) through routine updates and retrofits as demonstration projects.</li> </ul>	<p>Number of new developments using LID</p> <p>Number of LID practices on publicly-owned properties</p> <p>Gallons of runoff diverted by GI/LID</p>

# Policy Recommendations

## Emergency Response/Extreme Events



Climate Driver	Impact	Interventions	Recommendations	Metrics
Flooding	Access	<p><b><u>Policy/Ordinances</u></b> Mapping/Local Codes</p> <p><b>Goal:</b> Reduce the increased risk of road flooding due to runoff</p>	<p>Public</p> <ol style="list-style-type: none"> <li>1. Ensure new development manages storm water on site without contributing to adjacent properties or municipal sewers. Include:                             <ul style="list-style-type: none"> <li>– wording in master plan goals and objectives for the control of storm water, including developers participation;<sup>(17)</sup> and</li> <li>– zoning ordinance amendments requiring all new development manages storm water runoff without contributing to adjacent properties and municipal sewers,<sup>(18)</sup> including clearly written design standards.</li> </ul> </li> <li>2. Include life-cycle costs of infrastructure in Capital Improvement planning to capture cost savings of green infrastructure.</li> <li>3. Adopt countywide coordinated permitting to avoid noncompliant and potentially harmful development. Include enabling language in community master plans to allow for coordinated permitting.<sup>(19)</sup></li> </ol>	<p>Number of new sites managing storm water onsite through LID</p> <p>Number of public investment projects incorporating life-cycle costs</p> <p>Number of noncompliant new builds</p>
	Property Damage	<p><b><u>Policy/Ordinances</u></b> Updated Mapping</p> <p><b>Goal:</b> Maintain accurate flood-risk information</p>	<p>Public</p> <ol style="list-style-type: none"> <li>1. Update countywide floodplain maps.</li> <li>2. Adopt enhanced countywide floodplain ordinances beyond those meeting National Flood Insurance Program (NFIP) standards with differing levels of requirements for 10-year, 100-year, and 500-year floods.</li> </ol>	<p>Percent of countywide floodplain maps meeting these standards</p> <p>Number of countywide floodplain ordinances meeting new updated standards</p>

(14) At minimum, those identified in the 2015 Marquette County Hazard Mitigation Plan

(15) Follow Land Policy Institute (LPI) Rural Water Quality Protection Guidebook Standards of “best approach” ([http://www.canr.msu.edu/resources/rural\\_water\\_quality\\_protection\\_a\\_planning\\_zoning\\_guidebook\\_for\\_local\\_offici](http://www.canr.msu.edu/resources/rural_water_quality_protection_a_planning_zoning_guidebook_for_local_offici))

(16) As suggested in the Lake Superior Climate Adaptation, Mitigation, and Implementation Plan

(17) Adopt language recommendations from LPI Rural Water Quality Protection Guidebook, A-9

(18) Adopt language recommendations from LPI Rural Water Quality Protection Guidebook, A-10

(19) Follow language recommendations from LPI Rural Water Quality Protection Guidebook, A-4



# Policy Recommendations

## Emergency Response/Extreme Events



Climate Driver	Impact	Interventions	Recommendations	Metrics
Flooding	Injury and Death	<p><b><u>Education and Inclusion</u></b> Outreach</p> <p><b>Goal:</b> Increase awareness of dangers of flooding</p>	<p><b>Private</b></p> <p>1. Develop communication plan on the dangers of floodwaters in rural communities. Do so via:</p> <ul style="list-style-type: none"> <li>- coordination with public schools;</li> <li>- public information campaigns; and</li> <li>- flyers and leaflets.</li> </ul> <p>2. Develop and communicate evacuation plans for flood hazard communities. Do so via:</p> <ul style="list-style-type: none"> <li>- public information campaigns;</li> <li>- signage; and</li> <li>- flyers and leaflets.</li> </ul> <p>3. Inventory countywide critical service buildings (public and private) in floodplains and make these buildings more resilient.</p>	<p>Number of county residents reached by outreach campaigns</p> <p>Number of critical service buildings that undertake resilience measures</p>
Extreme Cold	Frozen Pipes	<p><b><u>Education and Inclusion</u></b> Awareness Campaign</p> <p><b>Goal:</b> Increase residential awareness of the risk of pipes freezing</p>	<p><b>Public</b></p> <p>1. Develop communication and messaging plans to encourage resident action “weatherizing” techniques. Include:</p> <ul style="list-style-type: none"> <li>- public information campaigns;</li> <li>- preparedness documents accessible via municipal websites; and</li> <li>- encouragement of resident participation in free home energy audits through the local energy provider and other local organizations.</li> </ul>	<p>Number of residents reached by weatherization awareness efforts</p> <p>Number of sites weatherized</p>

# Policy Recommendations

## Emergency Response/Extreme Events



Climate Driver	Impact	Interventions	Recommendations	Metrics
Extreme Cold	Cold Illness	<p><b><u>Education and Inclusion</u></b> Awareness Campaign</p> <p><b>Goal:</b> Increase awareness of impacts of extreme cold events on resident health</p>	<p><b>Public</b></p> <p>1. Develop communication plans and messaging on extreme cold recognition and protective personal behaviors. Do so by:</p> <ul style="list-style-type: none"> <li>- improving inter-agency discussion, coordination, and communication utilizing partners and working groups;</li> <li>- ensuring inclusion of diverse stakeholders such as representatives of the vulnerable populations and social service providers; and</li> <li>- incorporating efforts into TV and radio PSA campaign.</li> </ul>	Number of county residents reached by outreach campaigns
		<p><b><u>Landscape Actions</u></b> Energy System Enhancements</p> <p><b>Goal:</b> Enhance stability of energy service during cold weather</p>	<p><b>Public</b></p> <p>1. Pursue development of microgrids for local areas to enhance grid redundancy.</p> <p>2. Consider burial of power lines for protection in major weather events and plan for the life cycle of energy infrastructure investments to better display the full-life savings of green infrastructure.</p>	<p>Extent of development of microgrids in local areas</p> <p>Percentage of local power lines buried by the utility</p>
		<p><b><u>Landscape Actions</u></b> Warming Centers</p> <p><b>Goal:</b> Increase availability of warming centers from extreme cold events</p>	<p><b>Public</b></p> <p>1. Develop “Warming Centers” in each community and provide residents information on where to access them.</p>	Number of warming centers established
		<p><b><u>Policy</u></b> Weatherization</p> <p><b>Goal:</b> Reduce exposure to extreme cold temperatures inside homes</p>	<p><b>Public</b></p> <p>1. Develop minimum weatherization standards for rental properties and new construction.</p> <p>2. Adopt energy efficiency practices amongst municipal buildings. Use cost savings to provide weatherization services for vulnerable populations.</p>	Number of homes, new builds, and municipal buildings weatherized

# Water Related



## Water Related

Issues relating to challenges brought by more frequent intense precipitation events, more frequent periods of drought, and overall community changes brought by flooding, aquifer depletion, and other water issues.

- Climate Drivers**
- Increased Precipitation
  - Drought Conditions

- Exposure Pathways**
- Flooding
  - Intensified Wildfires
  - Road Closures
  - Mold
  - Contaminated Wells

- Health Outcomes**
- Waterborne Diseases
  - Respiratory Illness
  - Mental Health Consequences and Stress

## Water Related Issues Exposure Pathway

Stakeholder groups and community members voiced concerns about increased flooding events and resulting damage and runoff, drought conditions, concerns over water sources, and contaminated water. Increased extreme rain events as well as increased drought conditions and lasting increased temperatures seen with climate change that can lead to intensified flooding, road closures, mold, contaminated water, and intensified wildfires, among other dangers. This can impact health by limiting road access, increasing chances for waterborne disease, causing respiratory illnesses, and leading to mental health consequences and stress.

To address these concerns and limit the increased risk of contaminated surface and groundwater, reduced groundwater access, and flooding consequences, policies focused broadly on reducing runoff, enhancing green and gray infrastructure, encouraging conservation practices, and reducing risks of contamination.

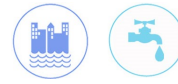


**Flooding**



**Water Quality**

# Policy Recommendations Water Related



Climate Driver	Impact	Interventions	Recommendations	Metrics
Flooding	Water Quality	<p><b><u>Landscape Actions</u></b> Green Infrastructure/ Low Impact Design</p> <p><b>Goal:</b> Protect water quality by reducing concentration of runoff pollutants</p>	<p><b>Public</b></p> <p>I. Encourage homeowners and developers countywide to retrofit existing sites to include LID and GI through:</p> <ul style="list-style-type: none"> <li>- developer incentives (including fast-tracked permitting, technical assistance, site bonuses, etc.);</li> <li>- improved storm water management credits;</li> <li>- GI storm water management grants; and</li> <li>- development standards (zoning ordinances, building plans, site plan reviews, etc.<sup>(20)</sup>).</li> </ul> <p><b>Public</b></p> <p>I. “Lead-by-example” in municipal development. Include:</p> <ul style="list-style-type: none"> <li>- local specialized organization such as SWP assistance in process;</li> <li>- retrofitting all municipal buildings with LID measures (e.g. rain barrels, green roofs, pervious surfaces, rain gardens, etc.) and</li> <li>- installing storm water controls on public properties (such as grey water storage, rain barrels, green roofs, rain gardens, and bioswales) through routine updates and retrofits as demonstration projects.</li> </ul>	<p>Number of people utilizing LID/GI incentives for their private properties</p> <p>Gallons of runoff diverted by GI/LID</p>
		<p><b><u>Policy/Ordinances</u></b> Mapping/Local Codes</p> <p><b>Goal:</b> Protect well-sourced drinking water from increased risk of groundwater contamination</p>	<p><b>Public</b></p> <p>I. Adopt a Wellhead Protection Zone Overlay for community water systems that use groundwater as a source.</p> <p>2. Use master plans and zoning ordinances to identify and adopt<sup>(21)</sup>:</p> <ul style="list-style-type: none"> <li>- well inspection and abandoned well capping ordinances;</li> <li>- septic inspection ordinances; and</li> <li>- identification, management, handling, and proper containment of hazardous materials.<sup>(22)</sup></li> </ul> <p>3. Identify and require storm water and wastewater management plans for existing and proposed local facilities that may pollute drinking water.</p>	<p>Percent of county covered by countywide Wellhead Protection Zone Overlay</p> <p>Number of ordinances amended to comply with new groundwater contamination reduction principles</p> <p>Number of existing and proposed local facilities with such plans</p>

(20) See the Oregon Drinking Water Protection Current Practices for clear language

# Policy Recommendations

## Water Related



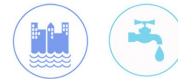
Climate Driver	Impact	Interventions	Recommendations	Metrics
Flooding	Water Quality	<p><b><u>Policy/Ordinances</u></b> Mapping/Local Codes</p> <p><b>Goal:</b> Protect well-sourced drinking water from increased risk of groundwater contamination</p>	<p><b>Private</b></p> <p>1. Educate and encourage property owners and contractors through technical or financial incentives to implement well improvements for existing private water wells located within 100-year floodplains.</p> <p>2. Include permitting requirements for well design for new wells that may be installed within a 100-year floodplain or other vulnerable locations.</p>	<p>Number of properties utilizing incentives to improve wells within the 100-year flood plain</p> <p>Percent of communities adopting protective permitting requirements for new wells in a 100-year floodplain.</p>
		<p><b><u>Education and Inclusion</u></b> Groundwater Protection</p> <p><b>Goal:</b> Increase awareness of groundwater protection measures</p>	<p><b>Private</b></p> <p>1. Work with MDHHS, MSU and other partners to develop private well communication and messaging plans including educational materials<sup>(23)</sup> on:</p> <ul style="list-style-type: none"> <li>– health risks of contamination and testing options;</li> <li>– measures homeowners can take to protect groundwater;</li> <li>– proper toxic waste disposal; and</li> <li>– how farmers can develop buffer strips.</li> </ul> <p>2. Create a list of environmental permits, grants, and loans for businesses to reference for water conservation and protection assistance on Marquette County Health Department website.</p> <p>3. Provide educational materials on LID techniques available to developers. Include guides such as the SEMCOG Low Impact Development Manual for Michigan.</p> <p>4. Conduct educational campaign for public on proper septic design and maintenance.</p>	<p>Number of homeowners receiving educational materials</p> <p>Number of Marquette County businesses taking advantage of listed environmental permits, grants, and loans</p> <p>Number of developers implementing LID practices</p> <p>Number of people contacted by outreach programs</p>

(21) Follow Land Policy Institute (LPI) Rural Water Quality Protection Guidebook Standards of “best approach”

(22) Use language from Land Policy Institute (LPI) Rural Water Quality Protection Guidebook, p. A-7

(23) Available on Marquette County Health Department website

# Policy Recommendations Water Related



Climate Driver	Impact	Interventions	Recommendations	Metrics
Flooding	Water Quality	<p><b><u>Policy/Ordinances</u></b> Countywide planning</p> <p><b>Goal:</b> Reduce beach contamination by addressing contamination sources upstream</p>	<p><b>Public</b></p> <p>1. Incorporate Lake Superior Watershed Partnership Watershed Management plans into each community’s master plan and zoning ordinance language to ensure protection and ability of wetlands.</p> <p>Consider:</p> <ul style="list-style-type: none"> <li>– expanding any floodplain overlay zones to include tributary overlay zones to protect from contamination;</li> <li>– designating a Natural Rivers District to apply to area rivers;</li> <li>– conducting targeted wetland restoration; and</li> <li>– “Identify, map and prioritize wetland areas most vulnerable to flooding, erosion, siltation, degradation and invasive species”.<sup>(24)</sup></li> </ul> <p>2. Conduct a countywide Environmental Inventory to include in all communities’ master plans to facilitate understanding of how watershed and sub-watersheds interact.</p> <p>3. Amend master plans and zoning ordinances to include:</p> <ul style="list-style-type: none"> <li>– Protection of natural features and drain setbacks<sup>(25)</sup> and</li> <li>– buffer requirements of natural features of varying distances in zoning ordinances.<sup>(26)</sup></li> </ul> <p>4. Provide tax incentive for:</p> <ul style="list-style-type: none"> <li>– farmers who develop buffer strips between agricultural land and surface water<sup>(27)</sup> and</li> <li>– homeowners that replace impervious surfaces with pervious surfaces.</li> </ul>	<p>Percent of waterfront covered by a protective zone</p> <p>Number of beach closures due to contamination</p> <p>E. Coli levels at Lake Superior outfalls</p> <p>Number of toxic algal blooms per year</p> <p>Number of community master plans incorporating countywide environmental inventory</p> <p>Number of master plans and zoning ordinances incorporating such features</p> <p>Number of farmers and homeowners taking advantage of incentive programs</p>

(24) As listed in Lake Superior Climate Adaptation and Implementation Plan

(25) Adopt precise language recommendations from Land Policy Institute (LPI) Rural Water Quality Protection Guidebook

(26) A minimum of 25ft is recommended

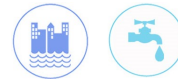
(27) Financial incentives are also available through USDA conservation programs

# Policy Recommendations Water Related



Climate Driver	Impact	Interventions	Recommendations	Metrics
Flooding	Water Quality	<p><b><u>Policy/Ordinances</u></b> Strengthening Septic Systems</p> <p><b>Goal:</b> Protect surface and groundwater from septic contamination</p>	<p><b>Public</b></p> <p>1. Encourage septic maintenance, inspections, and where feasible, replacements outside the flood zones and wetlands. To do so, use:</p> <ul style="list-style-type: none"> <li>- triple bottom line cost-benefit analysis;</li> <li>- low interest home loans; and</li> <li>- grants.</li> </ul> <p>2. Conduct educational campaign for public on proper septic design and maintenance.</p> <p>3. Within 100-year flood zone, conduct feasibility studies of:</p> <ul style="list-style-type: none"> <li>- connecting isolated standalone systems to municipal or regional systems and</li> <li>- the reconstruction or relocation of existing on-site wastewater treatment systems.</li> </ul>	<p>Number of septic inspections</p> <p>Number of residents contacted by educational campaign</p> <p>Area of county covered by feasibility study</p>
		<p><b><u>Policy/Ordinances</u></b> Countywide coordination</p> <p><b>Goal:</b> Protect groundwater from septic contamination</p>	<p><b>Public</b></p> <p>1. Conduct comprehensive septic study and adopt countywide septic ordinance to protect groundwater from contamination.</p>	<p>Number of operational and rotating septic inspections performed and complied with</p>
	Environmental Exposures	<p><b><u>Education and Inclusion</u></b> Outreach</p> <p><b>Goal:</b> Educate public on how to avoid exposure to mold and waterborne diseases</p>	<p><b>Public</b></p> <p>1. Develop flood-related health risk communication plan. Use:</p> <ul style="list-style-type: none"> <li>- PSAs via radio and TV on protective personal behaviors (ex. flood cleanup) against mold and waterborne diseases after flooding events; and</li> <li>- factsheets; and</li> <li>- provide staff training on protective behaviors and potential exposures at local hospitals and clinics.</li> </ul>	<p>Number of county residents reached by outreach campaigns</p> <p>Number of trainings conducted</p>

# Policy Recommendations Water Related



Climate Driver	Impact	Interventions	Recommendations	Metrics
Drought	Depleting Aquifers	<p><b><u>Policy</u></b></p> <p>Water Conservation</p> <p><b>Goal:</b> Discourage water waste and encourage conservation among property owners</p>	<p><b>Public</b></p> <ol style="list-style-type: none"> <li>1. Develop countywide Water Conservation Plan based on EPA and American Water Works Association (AWWA) guidelines. Include actions to take based on drought severity.</li> <li>2. Limit municipal water use for nonessential functions during dry periods in communities dependent on groundwater as water source.</li> <li>3. Adopt regular aquifer monitoring countywide.</li> </ol> <p><b>Private</b></p> <ol style="list-style-type: none"> <li>1. Discourage use through dry periods through: <ul style="list-style-type: none"> <li>– tiered rates based on rainfall (consider rate incentives/credits such as reductions in rates based on participation in community classes on smart water usage) and</li> <li>– maximum usage mandates during dry periods.</li> </ul> </li> <li>2. Adopt rental inspections for water conservation strategies (leaks, insulation, etc.).</li> <li>3. Require state-of-the-art water saving technologies in all new developments.</li> <li>4. Limit impervious surface in new developments to under 10% through site ratios.</li> </ol>	<p>Volume of municipal water usage during dry periods</p> <p>Change in aquifer levels</p> <p>Number of rental inspections completed with water conservation strategies</p> <p>Number of new developments incorporating state-of-the-art water saving technologies</p> <p>Number of new developments with limited impervious surfaces to site ratios</p>



# Policy Recommendations Water Related



Climate Driver	Impact	Interventions	Recommendations	Metrics
Drought	Depleting Aquifers	<p><b><u>Surveillance and Tracking</u></b> Studies and Tracking Systems</p> <p><b>Goal:</b> Amass information needed to craft policies to address depleted aquifers from drought conditions</p>	<p><b>Public</b></p> <ol style="list-style-type: none"> <li>1. Use U.S. Drought Monitor to evaluate drought severity and tie into countywide Water Conservation Plan.</li> <li>2. Conduct study on the feasibility of the extension of municipal water infrastructure to private well dependent and drought-vulnerable homes.</li> <li>3. Conduct study on the feasibility of changing the water supply source of currently groundwater dependent communities to Lake Superior.</li> <li>4. Conduct study on the feasibility of combining region-wide water supply systems in order to increase water security through sourcing from both groundwater and surface water.</li> </ol>	<p>Percentage of local drinking water sources covered by drought monitoring infrastructure</p> <p>Number of private well dependent homes</p> <p>Number of communities sourcing from Lake Superior</p> <p>Number of municipalities sharing water infrastructure</p>
		<p><b><u>Education and Inclusion</u></b> Water Conservation</p> <p><b>Goal:</b> Increase water conservation behaviors among residents, local government and businesses</p>	<p><b>Private</b></p> <ol style="list-style-type: none"> <li>1. Develop communication and messaging plans to encourage resident action on water conservation. Use:                             <ul style="list-style-type: none"> <li>– PSAs, flyers, leaflets, mobile device messaging, local news interviews, social media advertising, and community engagement sessions and</li> <li>– coordination with area schools to incorporate lessons on the importance of water conservation for personal water security.</li> <li>– Include:                                     <ul style="list-style-type: none"> <li>– encouragement of resident participation in free home efficiency audits (including water leakage) through the local water or energy provider and</li> <li>– messaging to residents on the importance of water conservation including how to identify water leaks on their property.</li> </ul> </li> </ul> </li> </ol>	<p>Number of households contacted via new communication outreach plans</p> <p>Number of audits completed</p> <p>Number of households that took action following audits</p>

# Policy Recommendations Water Related



Climate Driver	Impact	Interventions	Recommendations	Metrics
Drought	Depleting Aquifers	<p><b><u>Landscape Actions</u></b> Green Infrastructure/ Low Impact Design</p> <p><b>Goal:</b> Utilize low cost infrastructure measures to reduce loss of water in drinking water sources</p>	<p><b>Public</b></p> <ol style="list-style-type: none"> <li>1. Set green infrastructure standards for public spaces that ensure the use of native, low-water-dependent landscaping on public properties.</li> <li>2. Review existing Department of Environmental Quality (DEQ) designated Wellhead Protection Areas and develop local ordinance to codify the protection of those areas.</li> </ol> <p><b>Private</b></p> <ol style="list-style-type: none"> <li>1. Encourage LID practices, greywater reuse, and low-water dependent landscaping by private owners and developers through:                             <ul style="list-style-type: none"> <li>– developer incentives such as expedited permitting;</li> <li>– storm water credits; and</li> <li>– performance standards (ex. limit impervious surface in new developments to under 10% through site ratios).</li> </ul> </li> </ol>	<p>Change in the number of municipal properties with LID practices</p> <p>Number of DEQ Wellhead Protection Areas protected</p> <p>Number of LID adoptions by private property owners</p> <p>Acres of impervious area in the county</p> <p>Number of days and instances of low or no water provision</p>
		<p><b><u>Landscape Actions</u></b> Support Smart Growth</p> <p><b>Goal:</b> Increase higher density living options</p>	<p><b>Private</b></p> <ol style="list-style-type: none"> <li>1. Adopt zoning regulations to encourage market-supported, mixed use development that is the appropriate density and scale for the location and community.</li> </ol>	<p>Number of mixed-use, high efficiency units developed</p>
		<p><b><u>Education and Inclusion</u></b> Support Smart Growth</p> <p><b>Goal:</b> Promote benefits of higher density living</p>	<p><b>Private</b></p> <ol style="list-style-type: none"> <li>1. Use placemaking in communication plan to educate residents on the benefits of mixed-use, higher-density living and potential dangers of isolation.</li> </ol>	<p>Number of residents contacted by outreach program</p>

# Lessons Learned

The lessons reported here share what our team has discovered both through the Marquette Area Climate and Health Adaptation Project and through the research upon which this project builds (Crawford et al., 2018). We hope they are useful to community leaders, health officials, planners, and others who choose to follow the process recorded here and in Volume I for adaptation action in their own communities.

- **Climate change is a public health threat, but many solutions to reduce or prevent the impacts require resources from outside of the public health sector.** The negative health effects from climate change are becoming clearer and more widely accepted as a major threat by public health agencies. While some health impacts are direct, many are indirectly a result of climate's impacts on the built environment. Public health agencies are critical in identifying health impacts and vulnerable populations in need of intervention, but solutions often require working with groups that can adapt a community's infrastructure like transportation, water, buildings, etc.
- **Offering a 'menu' of policy tools that enable built environment adaptations allows decision-makers to choose those most suitable for their jurisdiction based on its unique needs.** There are many ways a community could adapt to reduce climate related public health impacts, but not all options are appropriate for each community. The project team created 140 unique built environment adaptation recommendations that address a wide range of climate and health issues. Local decision-makers will be able to review them and select the ones most feasible and beneficial to their jurisdiction.
- **Creating policy tools that align with ongoing planning efforts is important to getting broad buy-in for climate adaptation.** Local jurisdictions are often limited in resources and required to deliver many services and benefits to the community. Therefore, presenting climate adaptation as an additional task on top of those services can be a barrier to implementing the recommendations. In Marquette, local decision makers were consulted early and often to craft recommendations that could meet their communities' unique needs and be integrated into their existing initiatives.
- **Environmental or socio-economic metrics can be used as indirect indicators of likely positive health outcomes.** Measuring the health benefits of climate adaptation is important for ensuring equitable and effective allocation of resources. However, it can be challenging and, in some cases, directly measuring changes in health is not possible. In those scenarios metrics tracking environmental or behavior changes are recommended. For instance, it may not be possible to collect data showing that installing green infrastructure (GI) leads directly to less waterborne disease. But comparing measures of water quality before and after the GI is installed could show cleaner water which indicates a reduced potential for waterborne pathogen exposure.

# Index



## Vector-borne disease

pgs. 8, 15, 17, 18-21



## Air Quality

pgs. 8, 9, 15, 17, 22-30



## Emergency Response/Extreme Events

pgs. 8, 9, 15, 17, 31-40



## Water Related

pgs. 8, 9, 15, 17, 41-48



# Appendices

# Appendix A: Full Stakeholder Response Summary

**Figure 1: Common Climate Change Concerns Raised by Stakeholders Categorized into Four Focus Group Meetings**

Climate Change	Public Health	Emergency Preparedness	Local Government
Wildfires		Wildfires	
Aging Population/ Stress of Change			Stress of Change/ Long Winters
Vector Borne Disease through Ticks	Vector Borne Disease through Ticks	Vector Borne Disease through Ticks	Vector Borne Disease through Ticks
Rising Temperature		Rising Temperature/ Extremes	
Climate Migration	Climate Migration		Climate Migration
Flooding	Flooding	Flooding	Flooding
Energy Outages	Energy Outages	Energy Outages	
Resource Allocation			
Economic Impact			
	Air Quality		Air Quality
	Water Shortages		Water Shortages
	Road Access		
	Emergency Preparedness		
		Evacuation	
			Opioids Epidemic
			Water Quality/ Lake Contamination

**Figure 2: Common Climate Change Concerns Raised by Stakeholders Categorized by exposure, infrastructure, social/economic issues, and health outcomes**

Identified Climate Health Issues	Stakeholder Groups				
	Climate Change	Public Health	Emergency Preparedness/ Underserved	Local Government	Economic Development
<b>Exposure</b>					
Wildfires	X		X	X	
Flooding	X	X	X	X	
Water Shortage	X	X		X	X
Air Quality		X		X	X
Ticks	X	X		X	
Lake Contamination				X	
Extreme Weather			X	X	X
<b>Infrastructure</b>					
Access	X	X	X	X	
Energy	X	X	X		X
<b>Social/Economic</b>					
Migration	X	X		X	X
Social Conflict	X				
Economic Impact	X				X
Resource Allocation	X				
<b>Health Outcomes</b>					
Mental Health	X		X	X	
Respiratory Illness		X		X	
Substance Abuse				X	
Vector Borne Disease	X	X		X	

Primary Priorities
Flooding
Water Shortage
Access
Wildfires

Secondary Priorities
Ticks
Air Quality

# Appendix B: References

Throughout the development of this document, the following publicly available local plans, current practices guides, comparable community plans, and national guidelines were referenced in order to create the recommendations and policy interventions noted in this guidebook.

## **Nationwide**

- American Planning Association (APA) (Healthy Plan Making, American Planning Association (APA) (n.d.) *Healthy Plan Making*. Washington, D.C.: American Planning Association. Available at [https://planning-org-uploaded-media.s3.amazonaws.com/publication/download\\_pdf/Healthy-Plan-Making.pdf](https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Healthy-Plan-Making.pdf) (Accessed 27 July 2018).
- Anderson H, Brown C, Cameron LL, Christenson M, Conlon KC, Dorevitch S, Dumas J, Eidson M, Ferguson A, Grossman E, Hanson A, Hess JJ, Hoppe B, Horton J, Jagger M, Krueger S, Largo TW, Losurdo GM, Mack SR, Moran C, Mutnansky C, Raab K, Saha S, Schramm PJ, Shipp-Hilts A, Smith SJ, Thelen M, Thie L, Walker R. BRACE Midwest and Southeast Community of Practice. (2017) *Climate and Health Intervention Assessment: Evidence on Public Health Interventions to Prevent the Negative Health Effects of Climate Change*. *Climate and Health Technical Report Series*. *Climate and Health Program*, Centers for Disease Control and Prevention. Available at [https://www.cdc.gov/climateandhealth/docs/ClimateAndHealthInterventionAssessment\\_508.pdf](https://www.cdc.gov/climateandhealth/docs/ClimateAndHealthInterventionAssessment_508.pdf) (Accessed 27 July 2018).
- Brown, I. Martin-Ortega, J., Waylen, K. & Blackstock, K. (2016) Participatory scenario planning for developing innovation in community adaptation responses: three contrasting examples from Latin America. *Regional Environmental Change*, 16, 1685-1700
- Centers for Disease Control and Prevention (CDC) (2010) *Community Gardens*. Available at <https://www.cdc.gov/healthyplaces/healthtopics/healthyfood/community.htm> (Accessed 25 August 2018).
- Centers for Disease Control and Prevention (CDC) (2018) *Ticks: Preventing Ticks in the Yard*. Available at [https://www.cdc.gov/ticks/avoid/in\\_the\\_yard.html](https://www.cdc.gov/ticks/avoid/in_the_yard.html) (Accessed 27 July 2018).
- City of Philadelphia (2014) *Green Streets Design Manual*. Available at [http://www.phillywatersheds.org/img/GSDM/GSDM\\_FINAL\\_20140211.pdf](http://www.phillywatersheds.org/img/GSDM/GSDM_FINAL_20140211.pdf) (Accessed 16 August 2018).
- The Connecticut Agricultural Experiment Station (2007) *Tick Management Handbook*. New Haven: Connecticut Agricultural Experiment Station. Available at <http://www.ct.gov/caes/lib/caes/documents/publications/bulletins/b1010.pdf> (Accessed 27 July 2018).
- Crawford, P., Beyea, W., Bode, C., Doll, C. & Menon, R. (2018) 'Creating climate change adaptation plans for rural coastal communities using Deliberation and Analysis as public participation for social learning', *The Town Planning Review*, 89(3), 283-304.
- European Climate Adaptation Platform (Climate-ADAPT) (2018) *Urban Farming and Gardening*. Available at <https://climate-adapt.eea.europa.eu/metadata/adaptation-options/urban-farming-and-gardening> (Accessed 17 August 2018).
- Few, R., Brown, K., & Tompkins, E. (2007) 'Public Participation and climate change adaptation: avoiding the illusion of inclusion', *Climate Policy*, 7, 46-59
- Firth, C., Maye, D. & Pearson, D. (2011) 'Developing "community" in community gardens', *Local Environment*, 16(6), 555-568.
- Gray, S., Jordan, R., Crall, A., Newman, G., Hmelo-Silver, C., Huang, J., Novak, W., Mellor, D., Frensley, T., Prysby, M., & Singer, A. (2017) 'Combining participatory modelling and citizen science to support volunteer conservation action', *Biological Conservation*, 2008, 76-86
- Henly-Shepard, S. Gray, S., & Cox, L. (2015) 'The use of participatory modeling to promote social learning and facilitate community disaster planning', *Environmental Science and Policy*, 45, 109-122
- International Renewable Energy Agency (2017). *Renewable Power: Sharply Falling Generation Cost*. Available at [https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Nov/2017IRENA\\_Sharply\\_falling\\_costs\\_2017.pdf](https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Nov/2017IRENA_Sharply_falling_costs_2017.pdf) (Accessed August 15, 2018).
- National Association of City Transportation Officials (NACTO)(n.d.) *Urban Bikeway Design Guide*. Available at <https://nacto.org/publication/urban-street-design-guide/> (Accessed 28 July 2018).
- National Association of City Transportation Officials (NACTO)(n.d.) *Urban Street Design Guide: Speed Management*. Available at <https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/speed-management/> (Accessed 17 August 2018).

# Appendix B: References

## Nationwide

- National Association of City Transportation Officials (NACTO)(n.d.) *Urban Street Storm water Guide: Hybrid Bioretention Planter* Available at <https://nacto.org/publication/urban-street-stormwater-guide/stormwater-elements/green-stormwater-elements/hybrid-bioretention-planter/> (Accessed 17 August 2018).
- National Fire Protection Association (2018) *Firewise USA*. Available at <https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA> (Accessed 17 August 2018).
- National Oceanic and Atmospheric Administration (NOAA) (2018) *Storm Events Database*. Available at <https://www.ncdc.noaa.gov/stormevents/> (Accessed 29 August 2018).
- Roseen, R, Ballesteros, P, Houle, K, Heath, D, & Houle, J. (2014) 'Assessment of Winter Maintenance of Porous Asphalt and Its Function for Chloride Source Control', *Journal of Transportation Engineering*, 140. (Accessed August 15, 2018).
- State of Oregon Department of Environmental Quality (2017) *Drinking Water Protection: Using an Ordinance or Overlay*. Available at <http://www.oregon.gov/deq/FilterDocs/DWPOrdinanceOverlay.pdf> (Accessed 26 August 2018).
- Trundle, Alexei & Mcevoy, Darryn. (2015). Greater Port Vila Climate Vulnerability Assessment - Full Report. 10.13140/RG.2.1.3930.4404. Available at [https://www.researchgate.net/publication/283243489\\_Greater\\_Port\\_Vila\\_Climate\\_Vulnerability\\_Assessment\\_-\\_Full\\_Report](https://www.researchgate.net/publication/283243489_Greater_Port_Vila_Climate_Vulnerability_Assessment_-_Full_Report) (Accessed 30 November, 2018)
- U.S. Department of Energy Better Buildings Solution Center (2017) *On-Site Energy Storage Decision Guide*. Available at <https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/BB%20Energy%20Storage%20Guide.pdf> (Accessed August 17, 2018).
- United States Environmental Protection Agency (USEPA) (2009) *Managing Stormwater with Low Impact Development Practices: Addressing Barriers to LID*. New England: USEPA. Available at <https://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/AddressingBarrier2LID.pdf> (Accessed 26 July 2018).
- United States Environmental Protection Agency (USEPA) (2012a) *Benefits of Low Impact Development: LID can protect your community's resources*. Washington, D.C.: USEPA. Available at <https://www.epa.gov/sites/production/files/2015-09/documents/bbfs1benefits.pdf> (Accessed 16 August 2018).
- United States Environmental Protection Agency (USEPA) (2012b) *Costs of Low Impact Development: LID saves money and protects your community's resources*. Washington, D.C.: USEPA. Available at <https://www.epa.gov/sites/production/files/2015-09/documents/bbfs3cost.pdf> (Accessed 30 July 2018).
- United States Environmental Protection Agency (USEPA) (2012c) *Encouraging Low Impact Development*. Washington, D.C.: USEPA. Available at <https://www.epa.gov/sites/production/files/2015-09/documents/bbfs7encouraging.pdf> (Accessed 26 July 2018).
- United States Green Building Council (2016) *Benefits of Green Building*. Available at <https://www.usgbc.org/articles/green-building-facts> (Accessed 17 August 2018).
- United States Environmental Protection Agency (USEPA) (2016) *Strategic Plan for School Integrated Pest Management*. Available at [https://www.epa.gov/sites/production/files/2016-02/documents/2016-2017\\_school\\_ipm\\_strategic\\_plan.pdf](https://www.epa.gov/sites/production/files/2016-02/documents/2016-2017_school_ipm_strategic_plan.pdf) (Accessed 27 July 2018).
- United States Environmental Protection Agency (USEPA) (2018a) *Green Infrastructure*. Available at <https://www.epa.gov/green-infrastructure>. (Accessed August 17, 2018).
- United States Environmental Protection Agency (USEPA) (2018b) *Smart Growth and Climate Change*. Available at <https://www.epa.gov/smartgrowth/smart-growth-and-climate-change> (Accessed 27 July 2018).
- United States Office of Energy Efficiency & Renewable Energy (EERE) (2017). *Let it Snow: How Solar Panels Can Thrive in Winter Weather*. Available at <https://www.energy.gov/eere/articles/let-it-snow-how-solar-panels-can-thrive-winter-weather> (Accessed August 15, 2018).
- Washington State Department of Ecology (2005). *Critical Aquifer Recharge Areas Guidance Document*. Available at <https://fortress.wa.gov/ecy/publications/documents/0510028.pdf> Accessed August 31, 2018).
- Wyckoff, M. A., Neumann, B., Pape, G., Schindler, K., Michigan State University., & Mlplace (Organization) (2015). *Placemaking as an economic development tool: A placemaking guidebook*. Available at <http://www.canr.msu.edu/resources/pmedtguidebook> (Accessed August 15, 2018).



# Appendix B: References

## Regional/Statewide/Michigan Case Studies

- Adamus, Anne (2008) 'The A. Alfred Taubman Student Services Center at Lawrence Technological University', *The Review* (Michigan Municipal League) 81(3). May/June, p. 23.
- City of Bay City (2017) *City of Bay City, Michigan Master Plan 2017*. Available at <https://www.baycitymi.org/DocumentCenter/View/1639/Bay-City-Master-Plan> (Accessed 27 July 2018).
- City of Flint (2013) *Imagine Flint: Master Plan for a Sustainable Flint*. Flint: City of Flint. Available at <http://imagineflint.com/Documents.aspx> (Accessed 27 July 2018).
- City of Hancock (2017) *Hancock Master Plan*. Available at [http://www.cityofhancock.com/docs/City\\_of\\_Hancock\\_Master\\_Plan.pdf](http://www.cityofhancock.com/docs/City_of_Hancock_Master_Plan.pdf) (Accessed 27 July 2018).
- City of Trenton (2017) *Trenton Coast Resiliency Master Plan*. Available at [http://www.trentoncoast.bria2.net/wp-content/uploads/2018/01/Trenton-Coast-Resiliency-Master-Plan-FINAL-DRAFT-09112017\\_small.pdf](http://www.trentoncoast.bria2.net/wp-content/uploads/2018/01/Trenton-Coast-Resiliency-Master-Plan-FINAL-DRAFT-09112017_small.pdf) (Accessed 27 July 2018).
- Delta Institute (2017) *Muskegon Lake Resiliency Plan*. Available at [https://muskegonlake.org/documents/Muskegon-Lake\\_Resiliency-Plan.pdf](https://muskegonlake.org/documents/Muskegon-Lake_Resiliency-Plan.pdf) (Accessed 27 July 2018).
- Fair, David (Host). (August 28, 2015). Issues Of The Environment: Ecological Benefits Of Washtenaw County Rain Gardens [Radio Broadcast Episode]. Available at <http://www.wemu.org/post/issues-environment-ecological-benefits-washtenaw-county-rain-gardens> (Accessed 17 August 2018).
- Great Lakes Integrated Sciences and Assessments (GLISA), Extreme Precipitation. Available at <http://glisa.umich.edu/climate/extreme-precipitation> (Accessed 30 November 2018).
- Great Lakes Integrated Sciences and Assessments (GLISA) (Great Lakes Climate Divisions), Western Upper Michigan. Available at <http://glisa.umich.edu/division/mi01> (Accessed 19 September 2018).
- Land Information Access Association (LIAA) and Beckett & Raeder, Inc. (2017) *Planning for Community Resilience in Michigan: A Comprehensive Handbook*. Available at [http://www.resilientmichigan.org/downloads/michigan\\_resiliency\\_handbook\\_web.pdf](http://www.resilientmichigan.org/downloads/michigan_resiliency_handbook_web.pdf) (Accessed 28 July 2018).
- Land Policy Institute (2012) *Rural Water Quality Protection Guidebook: A Planning & Zoning Guidebook for Local Officials*. East Lansing: Michigan State University. Available at [http://www.canr.msu.edu/landpolicy/uploads/files/Resources/Publications\\_Presentations/Books/GLRI/2012/Rural\\_Water\\_Quality\\_Protection\\_Guidebook/ruralwaterqualityprotection\\_grigdbk\\_lpi\\_december2012\\_chapter1intro.pdf](http://www.canr.msu.edu/landpolicy/uploads/files/Resources/Publications_Presentations/Books/GLRI/2012/Rural_Water_Quality_Protection_Guidebook/ruralwaterqualityprotection_grigdbk_lpi_december2012_chapter1intro.pdf) (Accessed 27 July 2018).
- Michigan Department of Health and Human Services (MDHHS) (2018) Michigan Behavioral Risk Factor Surveillance System. Available at <http://www.michigan.gov/bfrs> (Accessed August 28, 2018)
- Michigan Department of Health and Human Services (MDHHS) (2016) Michigan Climate and Health Adaptation Program (MICHAP) Strategic Plan Update: 2016-2021. Available at [https://www.michigan.gov/documents/mdhhs/MICHAP\\_Strategic\\_Plan\\_update\\_final\\_10\\_4\\_537461\\_7.pdf](https://www.michigan.gov/documents/mdhhs/MICHAP_Strategic_Plan_update_final_10_4_537461_7.pdf) (Accessed 7 December 2018).
- Michigan Department of Health and Human Services (MDHHS) & Great Lakes Integrated Sciences Assessment Program (GLISA) (2015) *Michigan Climate and Health Profile Report 2015: Building Resilience Against Climate Effects on Michigan Health*. Available at [https://www.michigan.gov/documents/mdhhs/MI\\_Climate\\_and\\_Health\\_Profile\\_517517\\_7.pdf](https://www.michigan.gov/documents/mdhhs/MI_Climate_and_Health_Profile_517517_7.pdf) (Accessed 27 July 2018).
- National Oceanic and Atmospheric Administration (NOAA) (2013) *Great Lakes Coastal Resilience Planning Guide*. Available at <http://greatlakesresilience.org/> (Accessed 27 July 2018).
- Office of the Washtenaw County Water Resources Commissioner (2018) *Rain Gardens*. Available at <https://www.washtenaw.org/647/Rain-Gardens> (Accessed 17 August 2018).
- Southeast Michigan Council of Governments (2008) *Low Impact Development: A Design Guide for Implementers and Reviewers*. Available at <https://semcog.org/Reports/LID/files/assets/basic-html/page-1.html> (Accessed August 17, 2018),
- Village of Sebewaing (2017) *Village of Sebewaing Resiliency Plan*. Sebewaing: Village of Sebewaing

# Appendix B: References

## Marquette Area (Local)

- Central Upper Peninsula Planning and Development (n.d.) *Priorities in Climate Adaptation Plans 2011-2016*. Available at <http://www.centralupdashboard.org/wp-content/uploads/2017/04/ClimateAdaptationCentralUP.pdf> (Accessed 28 July 2018).
- City of Marquette, MI (2015) *City of Marquette Community Master Plan*. Available at [https://marquettetmi.gov/wp-content/uploads/2017/07/master\\_plan.pdf](https://marquettetmi.gov/wp-content/uploads/2017/07/master_plan.pdf) (Accessed 28 July 2018).
- County of Marquette (n.d.) *Marquette County Hazard Mitigation Plan*. Available at [http://www.co.marquette.mi.us/departments/planning/hazard\\_mitigation\\_plan.php](http://www.co.marquette.mi.us/departments/planning/hazard_mitigation_plan.php) (Accessed 28 July 2018).
- King, H., & Thaler, T., Griffith, G., Crossett, T., Rasker, R. (Eds.). (2013) *Forest and Water Climate Adaptation: A Plan for Marquette County, Michigan*. Sagle: Model Forest Policy Program in association with Common Waters Partnership, Pinchot Institute for Conservation the Cumberland River Compact and Headwaters Economics. Available at [http://www.superiorwatersheds.org/images/Marquette\\_CAP.pdf](http://www.superiorwatersheds.org/images/Marquette_CAP.pdf) (Accessed 28 July 2018).
- Marquette County Community Health Assessment Team (2012) *Marquette County Community Health Assessment & Improvement Process*. Available at [http://www.co.marquette.mi.us/departments/health\\_department/community\\_health/docs/Comm\\_Health\\_Assessment\\_Improvement\\_Process.pdf](http://www.co.marquette.mi.us/departments/health_department/community_health/docs/Comm_Health_Assessment_Improvement_Process.pdf) (Accessed 28 July 2018).
- Marquette County Forestry Commission (2011) *Marquette County Forest Management Plan*. Available at [http://www.co.marquette.mi.us/departments/planning/docs/FMP\\_adopted\\_10\\_05\\_11.pdf](http://www.co.marquette.mi.us/departments/planning/docs/FMP_adopted_10_05_11.pdf) (Accessed 28 July 2018).
- Marquette County Health Department (2013) *Health Department*. Available at [http://www.co.marquette.mi.us/departments/health\\_department/index.php](http://www.co.marquette.mi.us/departments/health_department/index.php) (Accessed 28 July 2018).
- Marquette County Health Department (2013) *Maternal/Infant Health Program*. Available at [http://www.co.marquette.mi.us/departments/health\\_department/community\\_health/family\\_support\\_services/maternal\\_infant\\_health\\_program.php](http://www.co.marquette.mi.us/departments/health_department/community_health/family_support_services/maternal_infant_health_program.php) (Accessed 28 July 2018).
- Marquette County Resource Management Department, Planning Division (2014) *Marquette County Community Wildfire Protection Plan*. Available at [http://www.co.marquette.mi.us/departments/planning/docs/Marquette\\_County\\_Community\\_Wildfire\\_Protection\\_Plan\\_revised.pdf](http://www.co.marquette.mi.us/departments/planning/docs/Marquette_County_Community_Wildfire_Protection_Plan_revised.pdf) (Accessed 28 July 2018).
- Michigan State University Extension (2013) *Adaption to Climate Change and Variability*. Available at [http://www.superiorwatersheds.org/images/City\\_Marquette\\_Climate\\_Plan.pdf](http://www.superiorwatersheds.org/images/City_Marquette_Climate_Plan.pdf) (Accessed 31 July 2018).
- Resource Management and Development Department, Planning, Community Development, Forestry, & Recreation Division, Marquette County, MI. (2010) *Zoning Plan: Chapter of the Marquette County Comprehensive Plan*. Available at [http://www.co.marquette.mi.us/departments/planning/docs/Local\\_Zoning\\_Analysis.pdf](http://www.co.marquette.mi.us/departments/planning/docs/Local_Zoning_Analysis.pdf) (Accessed 28 July 2018).
- Superior Watershed Partnership (2013) *Climate Adaptation Plan for Marquette County, Michigan*. Available at [http://www.superiorwatersheds.org/images/Marquette\\_CAP.pdf](http://www.superiorwatersheds.org/images/Marquette_CAP.pdf) Accessed 31 July 2018).
- Superior Watershed Partnership (2012) *Lake Superior Climate Adaptation Mitigation and Implementation Plan*. Available at <http://www.superiorwatersheds.org/images/climate-jan.pdf> (Accessed 28 July 2018).

# Appendix C: Expert Resources for Further Information

## Overall

- Planning for Community Resilience in Michigan: A Comprehensive Handbook - [http://www.resilientmichigan.org/downloads/michigan\\_resiliency\\_handbook\\_web.pdf](http://www.resilientmichigan.org/downloads/michigan_resiliency_handbook_web.pdf)
- NOAA: Great Lakes Coastal Resilience Planning Guide - <http://greatlakesresilience.org/>

## Regional Climate Change Predictions

- Great Lakes Integrated Science and Assessment Center (GLISA)—<http://glisa.umich.edu/>
- National Oceanic and Atmospheric Administration (NOAA)—<http://www.noaa.gov/>

## Vector-Borne Disease

- Center for Disease Control and Prevention (CDC) National Center for Emerging and Zoonotic Infectious Disease (NCEZID) Division of Vector-Borne Diseases (DVBD)—<https://www.cdc.gov/ncezid/dvbd/index.html>

## Wildfires

- National Fire Protection Association - Firewise - <https://www.nfpa.org/Public-Education/By-topic/Wildfire/Firewise-USA>
- US Forest Service - <https://www.fs.fed.us/>

## Air Quality

- Michigan Department of Environmental Quality - Air Quality - <https://www.michigan.gov/deq/0,4561,7-135-3310---,00.html>

## Extreme Rainfall

- Naturally Resilient Communities - [http://nrcsolutions.org/strategies/?fwp\\_hazards=coastal#solutions](http://nrcsolutions.org/strategies/?fwp_hazards=coastal#solutions)
- USEPA Green Infrastructure - <https://www.epa.gov/green-infrastructure>

## Extreme Heat

- USEPA Reduce Urban Heat Island Effect - <https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect#resources>
- USEPA Green Infrastructure - <https://www.epa.gov/green-infrastructure>

## Water Quality

- USEPA Green Infrastructure - <https://www.epa.gov/green-infrastructure>
- NACTO Urban Street Stormwater Guide - <https://nacto.org/publication/urban-street-stormwater-guide/stormwater-elements/green-infrastructure-configurations/>
- MSU Land Policy Institute: Rural Water Quality Protection, A Planning and Zoning Guide for Local Officials - [http://www.canr.msu.edu/landpolicy/uploads/files/Resources/Publications\\_Presentations/Books/GLRI/2012/Rural\\_Water\\_Quality\\_Protection\\_Guidebook/ruralwaterqualityprotection\\_glrigdbk\\_lpi\\_december2012\\_chapter1intro.pdf](http://www.canr.msu.edu/landpolicy/uploads/files/Resources/Publications_Presentations/Books/GLRI/2012/Rural_Water_Quality_Protection_Guidebook/ruralwaterqualityprotection_glrigdbk_lpi_december2012_chapter1intro.pdf)

## Energy

- Planning for Community Resilience in Michigan: A Comprehensive Handbook - [http://www.resilientmichigan.org/downloads/michigan\\_resiliency\\_handbook\\_web.pdf](http://www.resilientmichigan.org/downloads/michigan_resiliency_handbook_web.pdf)

## Placemaking

- Michigan Municipal League - <http://placemaking.mml.org/>
- Project for Public Spaces - <https://www.pps.org/>