KANE COUNTY, ILLINOIS

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Kane County
Climate Vulnerability Assessment

February 2023

Prepared by:

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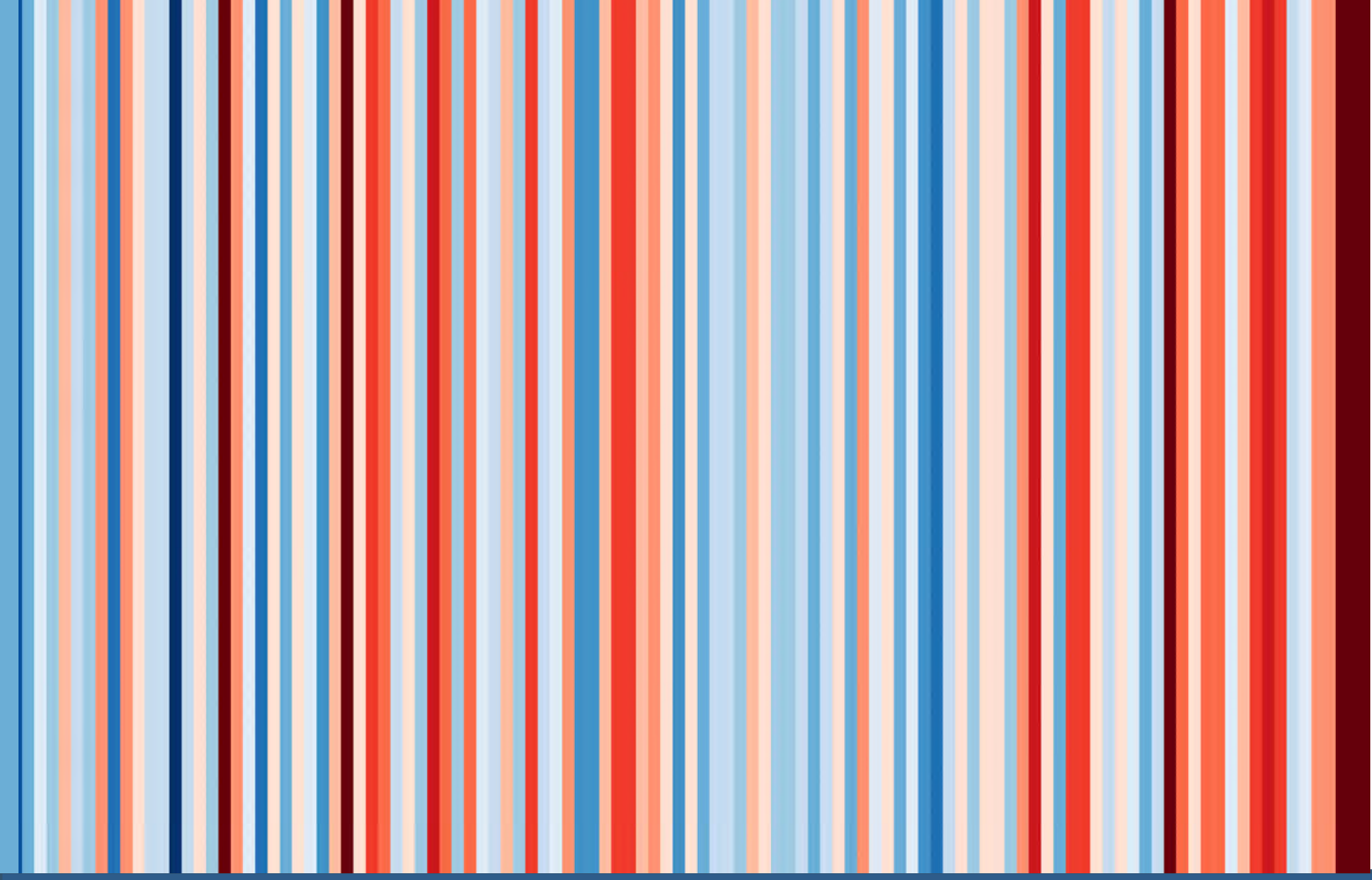
Table of Contents



← 1895 **Illinois's Annual Temperature Trends** 2021 →

Each stripe represents the temperature Illinois averaged over a year. Blue = Below Average Red = Above Average

The County's Future Climate

By 2050, without successfully reducing global GHG emissions, Kane County's climate can be expected to be:

+4-5°F
warmer average annual temperature than now.

+15% higher
Annual average rainfall than now

+12-17 more days
annually with a high temperature over 95°F.

+30% more
Heavy precipitation events annually

+60% more
air conditioning demand and energy needed than now.

+20 days longer
Growing, allergy, and mosquito season

SECTION **01**

Introduction

Click here to return to TOC

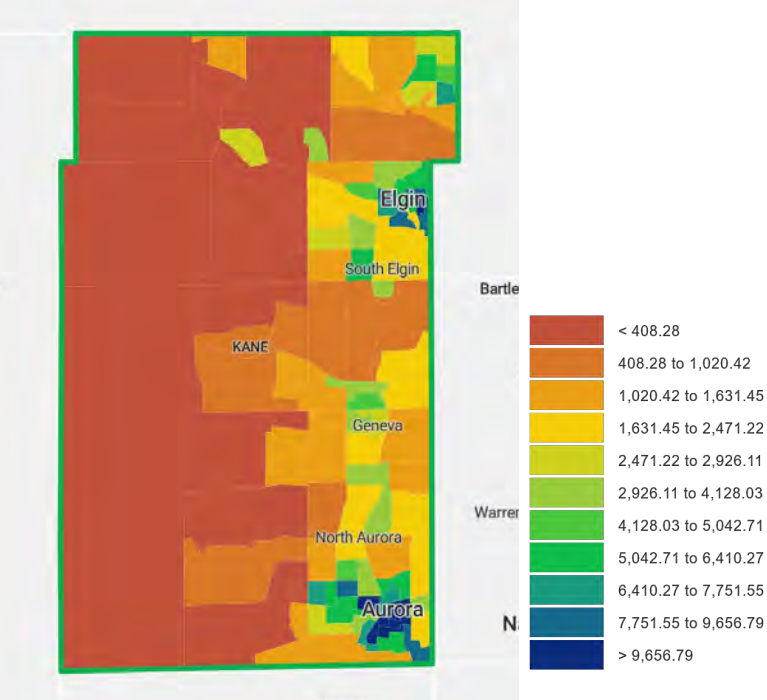
Introduction

Climate change is a global phenomenon driven by human made emissions of Greenhouse Gases (GHG) that creates local impacts. Three changes to Illinois's climate are occurring already: shorter winters with fewer cold extremes; more heavy and extreme precipitation; and an increase in annual average temperatures. In the future, there is high confidence that these changes will continue to increase in frequency and intensity, and also that Illinois will begin to experience heat extremes beyond the historical variability of the climate. There is somewhat lower confidence that drought, and also tornadoes, hail and straight-line wind will increase in frequency and/or intensity as a result of climate change in the future.

While the science behind climate change is complex, many of the solutions to reducing impacts are already a part of Kane County's local government expertise. In many instances, responding to climate change does not require large scale changes to local government operations, but simply requires adapting existing plans and polices to incorporate knowledge about changing levels of risk across key areas such as public health, infrastructure planning and emergency management.

Incorporating this knowledge not only protects our communities from growing risk, but climate adaptation strategies can also increase jobs, improve public health and the overall livability of our communities. Strategies which strengthen resilience in time of emergency also help communities thrive even more during good times.

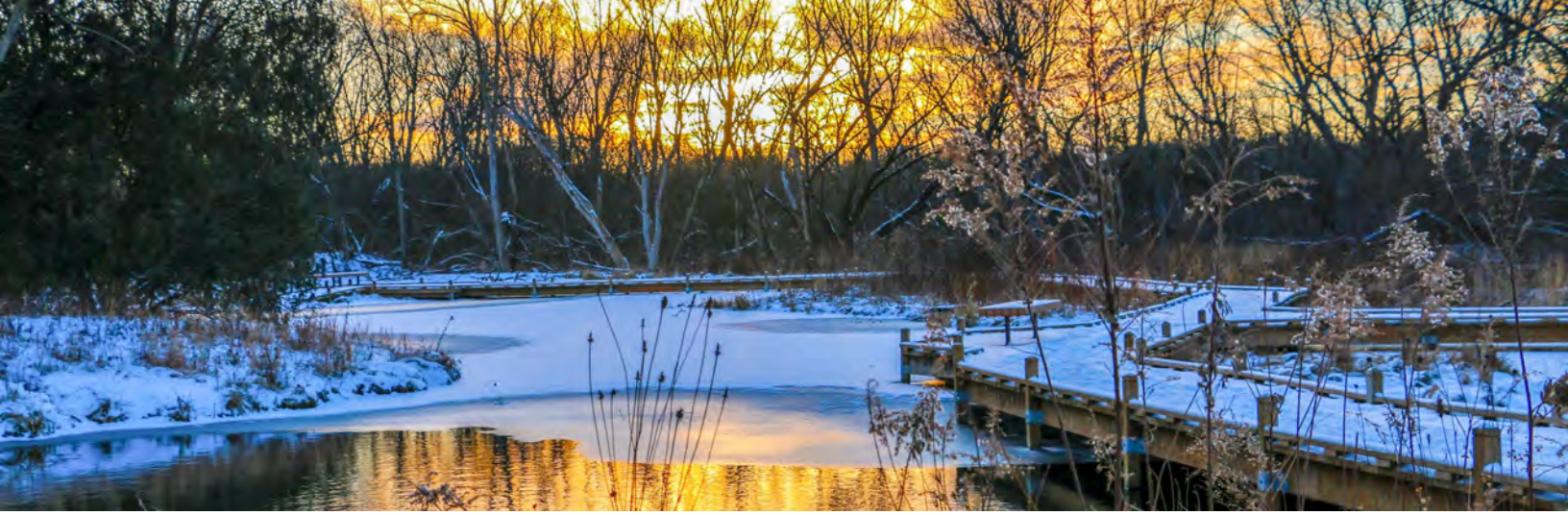
Population Density by Census Tract
(Source: US Census Bureau)



Kane County Characteristics

Land area (square miles)	**519.36**
Population	**531,756**
Density (people/sq mi)	**1,023.9**
Jobs	**218,068**
Households	**181,845**
Agricultural area*	**41%**
Tree coverage*	**16.9%**
Manicured lawn coverage*	**16.2%**
Prairie grass coverage*	**10.3%**
Impervious surface coverage*	**13.8%**
Water coverage*	**1.8%**

*percent of land area



What is Climate Change Vulnerability?

According to the Intergovernmental Panel on Climate Change (IPCC), vulnerability is "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes". Vulnerability is a function of both impacts (the effects of climate change and variability on a given system or resource) as well as adaptive capacity (the ability of the economy, infrastructure, resources, or population to effectively adapt to such events and changes).

Why Study Climate Change Vulnerability?

Increases in the global surface temperature and changes in precipitation levels and patterns are expected to continue and intensify for decades, regardless of mitigation strategies currently being implemented. In turn, these changes in climate have impacts on the economy and health of local communities.

Weather and climate shape our economy. Temperature impacts everything from the amount of energy consumed to heat and cool homes and offices to the ability for some workers to work outside. Temperature and precipitation levels not only determine how much water we have to drink, but also the performance of entire economic sectors, from agriculture to recreation and tourism. Extreme weather events, like tornadoes, hail storms, droughts, and inland flooding can be particularly damaging. In the last ten years alone, extreme weather events have cost Illinois and the Midwest $96 billion in damage and resulted in 440 deaths. (NOAA National Centers for Environmental Information).

In addition, climate conditions effect the quality of life and life safety of communities – particularly those populations especially sensitive to climate impacts. Extreme weather events linked to climate change have the potential to harm community member health in numerous ways. Rising temperatures, for example, can result in a longer-than-average allergy season, erode air quality. Longer growing seasons can prolong the stay and increase the population of insects increasing the risk of vector-borne diseases. Climate impacts also exacerbate additional economic challenges that can directly impact the ability of at-risk populations to cope with the additional risks exacerbated by climate conditions while creating more exposure to dangerous living/working conditions and poor nutrition.

Strengthening community resilience is rooted in an on-going assessment of potential vulnerabilities, and anticipating potential climate impacts. Climate adaptation focuses on development and implementation of strategies to address those vulnerabilities, and communication and outreach to the members of the community.

Weather vs Climate

The difference between weather and climate is a measure of time. Weather is what conditions of the atmosphere are over a short period of time, and climate is how the atmosphere "behaves" over relatively long periods of time. (NASA)

SECTION 02

Climate Change
Trends + Projections

Click here to return to TOC

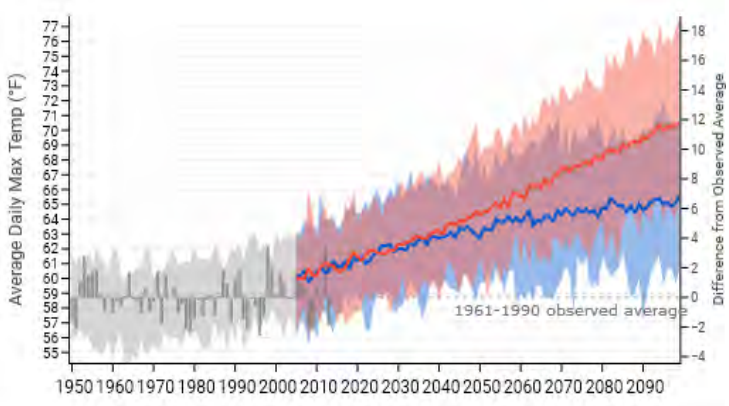
Climate Trends and Projections for Kane County

To evaluate vulnerability to climate change, we first look to understand the changes that have already occurred as well as those that the County is likely experience over the next 30–80 years. The following information summarizes historical trends and future projections in climate factors that are likely to impact the community, which include air temperature, extreme heat, precipitation (rain and snow), extreme precipitation, storms, flooding, and drought.

Air Temperature

Temperatures in Illinois have risen 1-2°F over the last 100 years. Seasonal changes in temperature have been more extreme. Winter and spring average temperature trends are five and three times larger than summer, respectively. And much larger changes have also observed in winter low temperatures (i.e., minimum daily temperature averaged) and less change observed in summer high temperatures (i.e., average maximum daily temperatures). Summer warming has been more concentrated in an increase in nighttime temperatures, with the coolest nights of summer becoming warmer.

Kane County Average Daily Maximum Temperature Projections



Statewide Temperature Changes for 1990-2019 Relative to 1895-1924

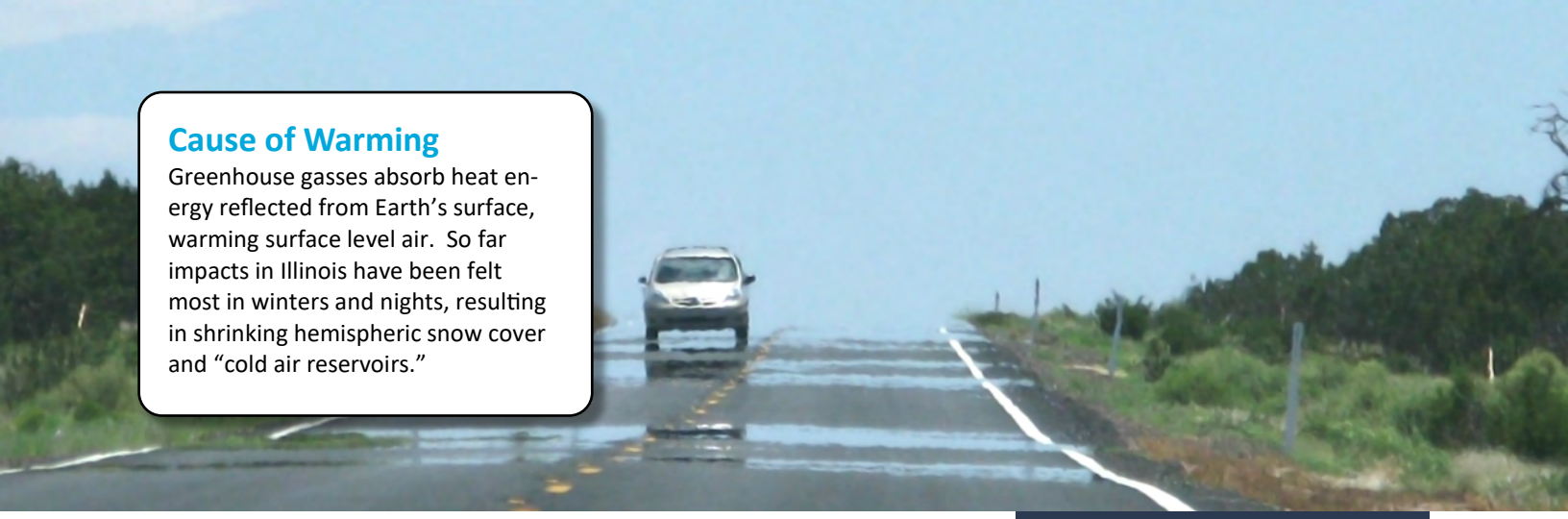
Season	Overnight Minimum Temperature	Average Daily Temperature	Daytime Maximum Temperature
Winter	+3.0	+2.5	+2.2
Spring	+1.8	+1.6	+1.4
Summer	+1.7	+0.5	-0.7
Fall	+1.3	+0.8	+0.4

In Kane County

Since 1950:
+0.3°F increase in annual temperatures

By 2060:
+4-6°F increase in annual temperatures
18% decrease in frost-free nights (24 nights)

By 2100:
+10°F increase in annual temperatures
35% decrease in frost-free nights (45 nights)



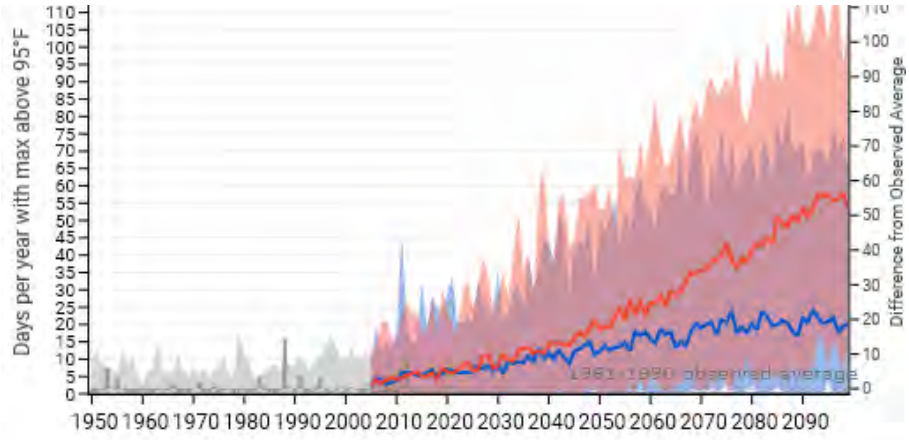
Cause of Warming

Greenhouse gasses absorb heat energy reflected from Earth's surface, warming surface level air. So far impacts in Illinois have been felt most in winters and nights, resulting in shrinking hemispheric snow cover and "cold air reservoirs."

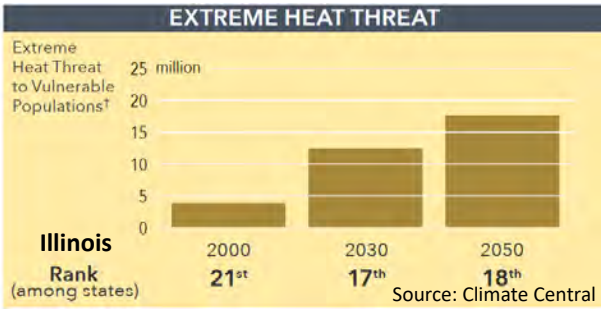
Extreme Heat

Extreme heat events are likely to increase significantly over the coming decades. The number of days in Illinois with maximum temperatures over 95°F are likely to increase from an average of 2–3 per year from 1984–2013 to 20–30 days per year by mid-century. By the end of the century, the majority of the state will experience an average of 50-55 days per year with high temperatures over 95°F, representing a 2000% increase in extreme heat days annually.

Kane County Days Above 95°



By 2050, Illinois is projected to see an increase in the Extreme Heat Threat of six fold. With this increase, by 2050, Illinois is projected to be ranked 18th for extreme heat threat within the United States.



Source: Climate Central

In Kane County

By 2050:

20-30 days over 95°F
(250-400% increase)

By 2100:

50-55 days over 95°F
(650-800% increase)

Road buckling caused by extreme heat June 2017 (photo: Illinois DOT via Flickr)

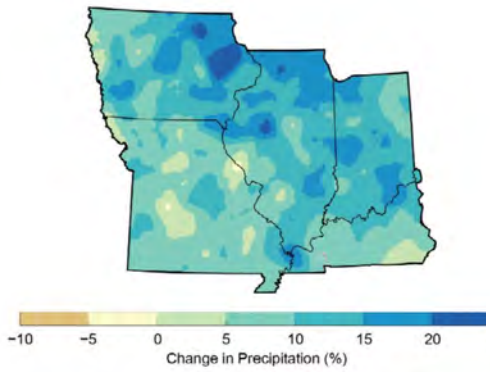
Annual Rainfall

In Illinois, annual precipitation has increased over the past 120 years. The state's total annual precipitation has increased by 5 inches, equivalent to a 12 to 15% increase in annual precipitation. In northern and central Illinois, most of the change has come in summer (June to August). The number of very heavy precipitation events over the last 120 years has increased by 40%.

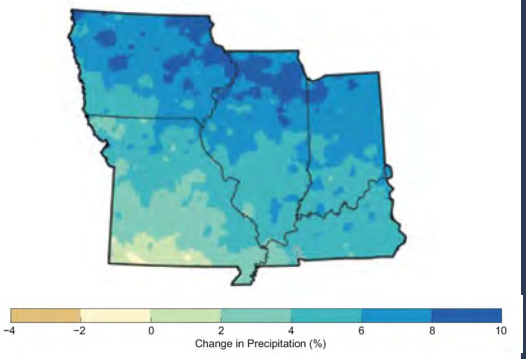
Statewide Precipitation Changes for 1990-2019 Relative to 1895-1924

Season	Precipitation (inches)	Precipitation (% Change)
Winter	+0.54	8.5%
Spring	+1.33	12.5%
Summer	+1.55	14.3%
Fall	+1.33	15.9%

Observed Annual Precipitation Changes for 1990-2019 Relative to 1895-1924

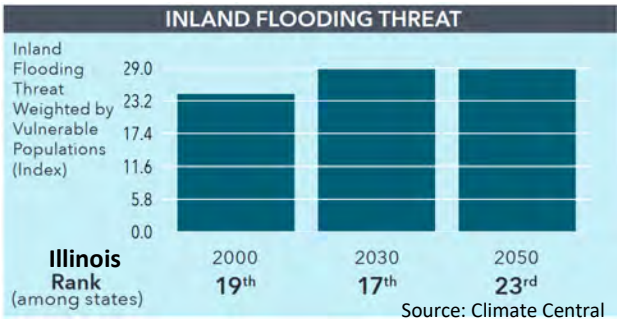


Projected Annual Precipitation Changes for 2070-2100 Relative to 1990-2019



Projected Annual Precipitation

Illinois is expected to see an increase in precipitation with larger increases in the north than in the south. Climate models show a change in the distribution of precipitation across the seasons. This increasing variability of precipitation results in projected increases in both heavy rain and length of dry spells.



Inland Flooding Threat in Illinois

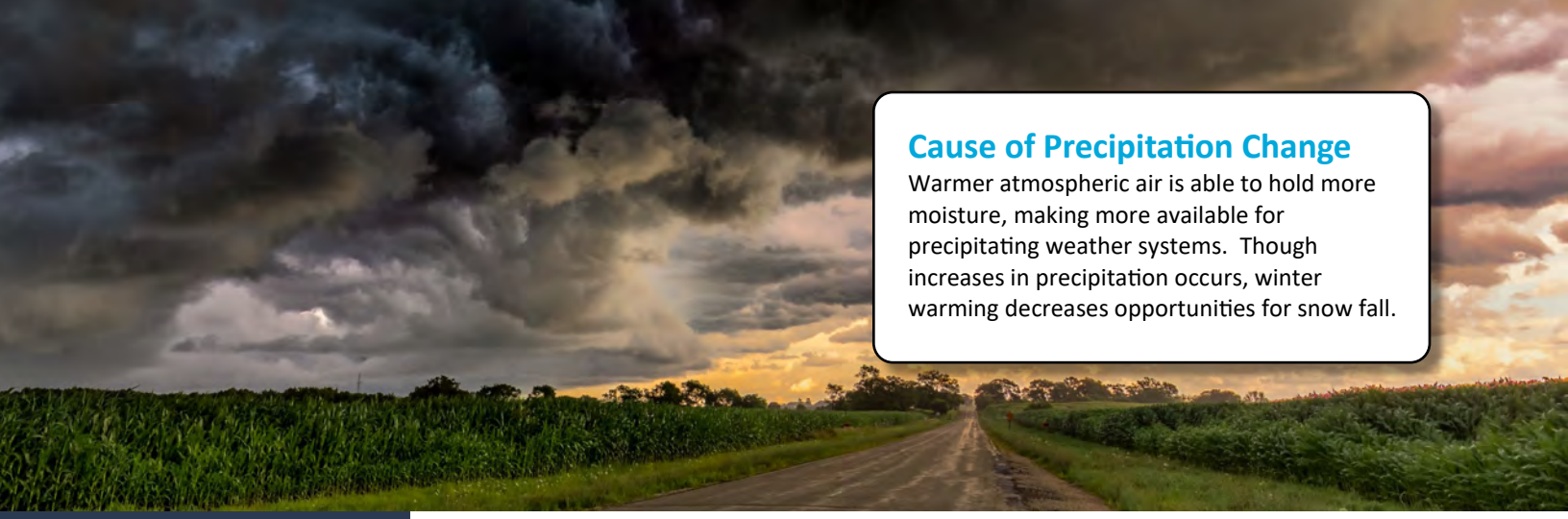
By 2050, Illinois is projected to see an increase of inland flooding threat of 25 percent—with threat being calculated by severity of flooding weighted by the State's estimated flood vulnerable population. With this increase, by 2050, Illinois is projected to be ranked 23rd for inland flooding threat within the United States—a decrease from its current ranking as 19th.

In Kane County

Since 1950:
+10% increase in annual precipitation

By 2050:
+5% increase in annual precipitation

By 2100:
+10% increase in annual precipitation



Cause of Precipitation Change

Warmer atmospheric air is able to hold more moisture, making more available for precipitating weather systems. Though increases in precipitation occurs, winter warming decreases opportunities for snow fall.

In Kane County

By 2050:

15-25% increase in days with precipitation over 2”

As much as 100% increase in days with precipitation over 4”

By 2100:

Up to 50% increase in days with precipitation over 2”

Up to 400% increase in days with precipitation

Extreme Precipitation, Storms, and Flooding

Extreme precipitation, which is strongly associated with severe flooding events, has been increasing over the last several decades. Since 2000, Illinois has seen a significant uptick in devastating, large-area extreme rainstorms as well as increases in 1-inch rains, 3-inch rains, and the size of the heaviest rainfall of the year.

Storm Weather Events

Number of Events Reported In Kane County:

From January 2003 to Dec 2022: **645 events**

Storm Weather Damage 2002-2022: **$14,602,000 + 3 deaths**

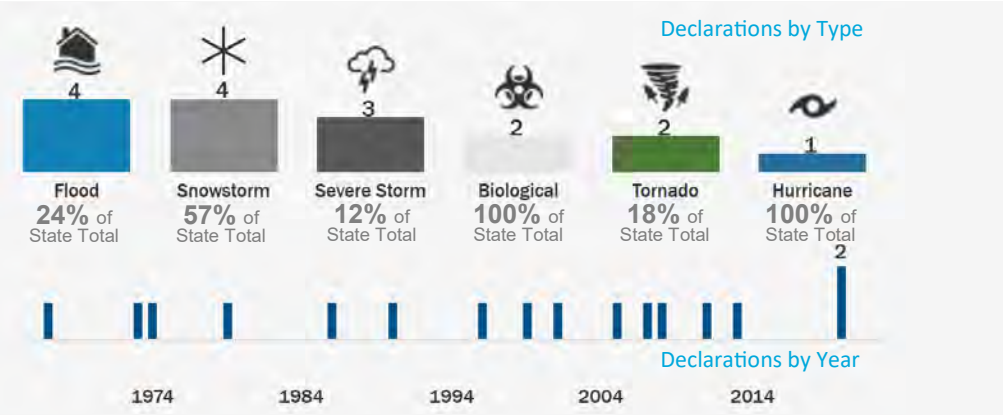
(source: NOAA National Centers for Environmental Information)

There are few detailed projections for storm activity because the complex forces involved in storm processes are difficult for scientists to model. However, according to the Nature Communications study “More frequent intense and long-lived storms dominate the spring-time trend in central US rainfall” by Feng, L. R. et al, the amount of precipitation associated with spring storms increased by 25% per decade from 1979 to 2014.

Illinois already suffers from annual flooding. The increase in heavy precipitation events over the last decades has coincided with an increase in flood disaster declarations in the State. The projected increase in the frequency of heavy precipitation events is likely to result in increasing risks from flooding and flash flooding.

All Disaster Declarations in Kane County Since 1950

16 Disasters Declared
In Kane County, Illinois
(Jan 1, 1950 - Feb 12, 2023)
25% of State Total
Source: FEMA



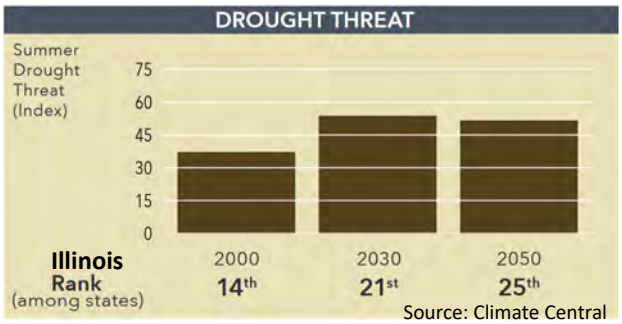
Cause of Drought

Wet trends have decreased drought over the last 50 years in Illinois, but future precipitation increases projected to occur over fewer days, meaning longer dry spells.

Drought

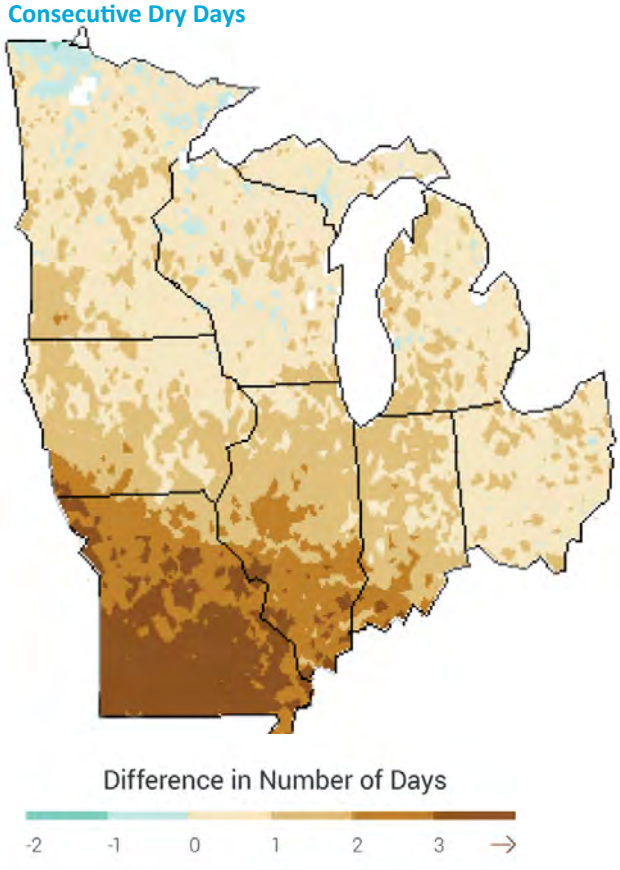
Although annual precipitation is projected to increase in Illinois over the coming century, summer rainfall is expected to remain relatively consistent. However, projections anticipate a greater proportion of that rainfall to occur during increasingly heavy rainfall events. This means that the swings between wet periods and dry periods will become more extreme and the number of dry days between rainfall events will increase. In addition, because warmer temperatures increase the amount of water that is lost to the atmosphere through evaporation, there may be an overall net loss of water in the ecosystem during these periods of time. Consequently, it is likely that droughts will become more common in the County, even as overall annual precipitation increases.

By 2050, the severity of widespread summer drought is projected to see an increase of 40 percent—with threat being calculated by severity of drought weighted by the State's estimated drought vulnerable population. With this increase, by 2050, Illinois is projected to be ranked 25th for drought severity threat within the United States—a decrease from its current ranking as 14th.



Source: Climate Central

Consecutive Dry Days



SECTION 03

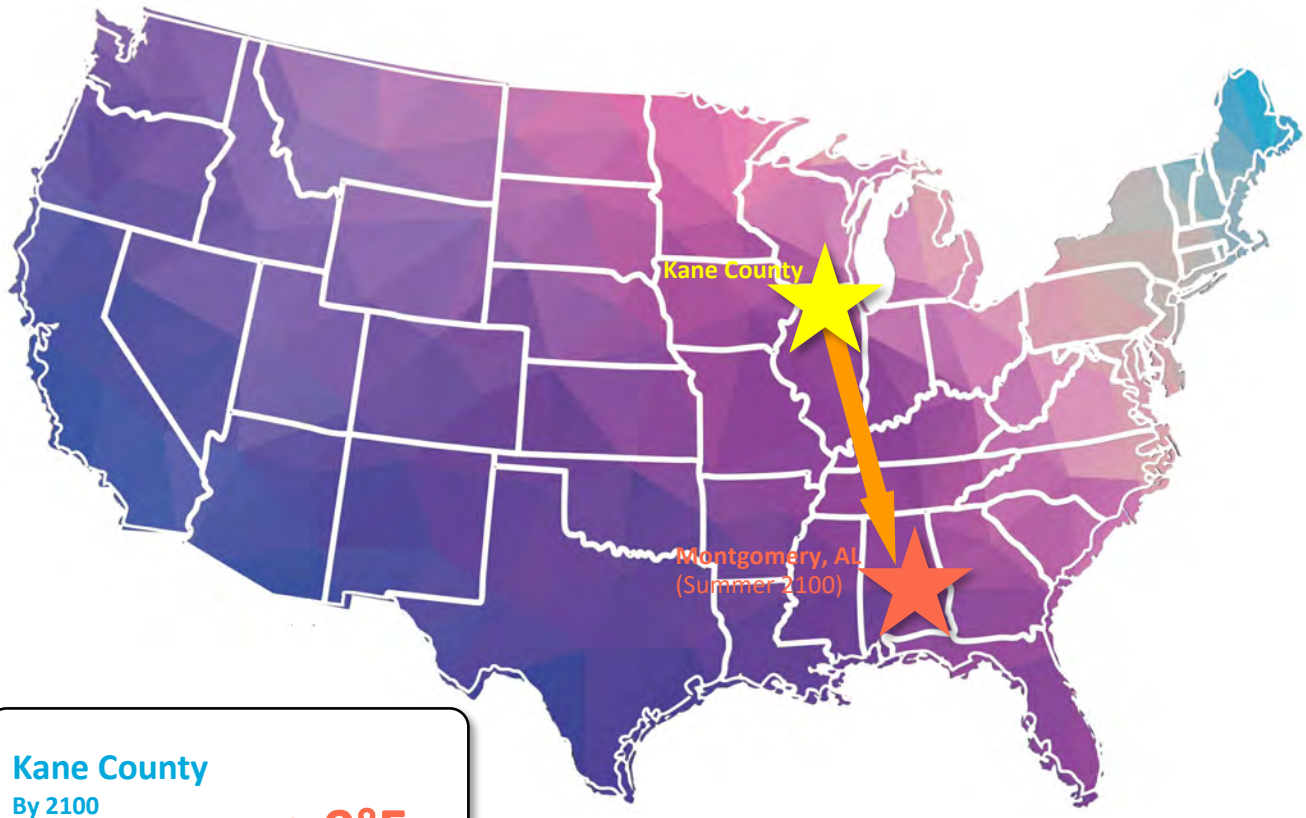
County On The Move

Click here to return to TOC

Projected changes in annual average temperatures and growing seasons will result in a change in the overall climate of Kane County. Summertime conditions for mid-twenty first century in Kane County are projected to be similar to the conditions currently felt 300-360 miles or further to the South. By the end of the century, summertime temperatures in Kane County will be similar to those felt 700-800 miles further to the South.

10 Miles Distance southward Kane County's climate experience moves every year.

Which is equal to moving **145 Feet** every day



Kane County
By 2100
Average Summer High: **+ 9°F**

(Source US Climate Assessment, Climate Central)

SECTION 04

Climate Risks To The Population

Click here to return to TOC

The projected changes to the community's climate in the coming decades represent potential risks to residents. These risks are particularly acute in populations especially vulnerable to them such as children under 5, seniors over 65, and those with disabilities – see Vulnerable Populations section for more information. Below are some of the more significant risks to the community's population:

Extreme Weather / Temperature

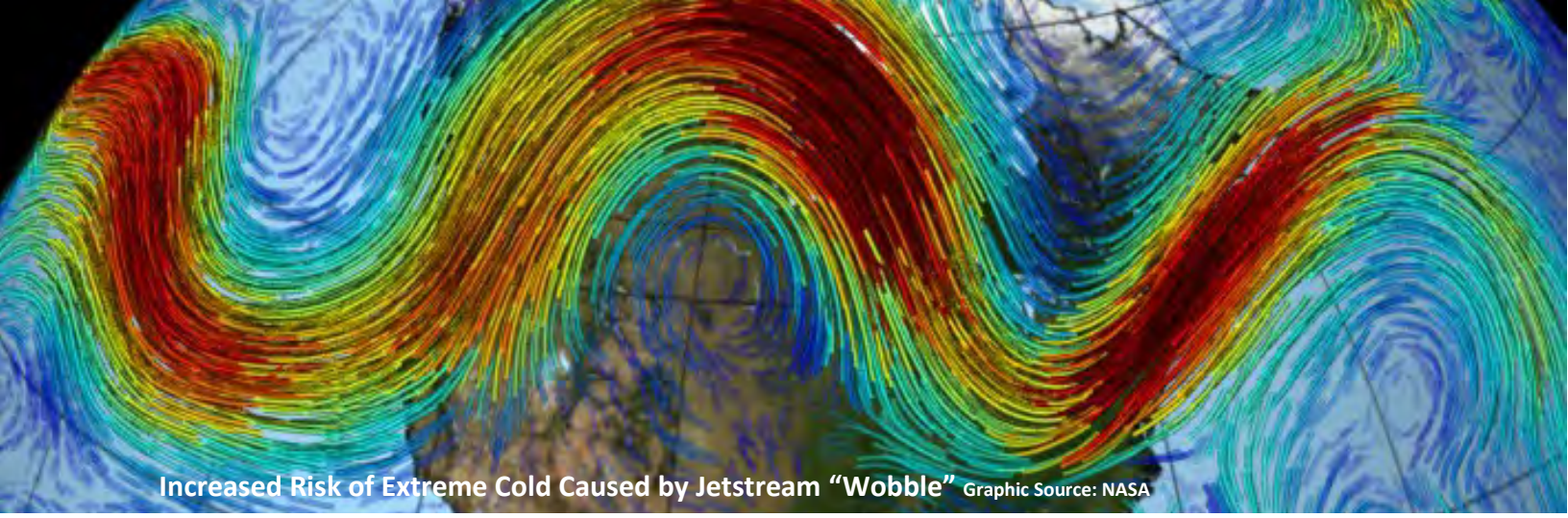
Certain groups of people are more at risk of stress, health impacts, or death related to Extreme Weather events including heat stress, tornadoes, wind storms, lightning, wildfires, winter storms, hail storms, and cold waves. The risks related to extreme weather events include traumatic personal injury (tornadoes, storms), carbon monoxide poisoning (related to power outages), asthma exacerbations (wildfires, heat stress), hypothermia/ frostbite (cold waves, winter storms), and mental health impacts.

Vulnerability to heat stress can be increased by certain variables including the presence of health conditions like diabetes and heart conditions; demographic and socioeconomic factors (e.g. aged 65 years and older living alone); and land cover (e.g. Low percentage tree canopy cover). Studies of heat waves and mortality in the United States demonstrate that increased temperatures or periods of extended high temperatures have increased heat-related deaths.* During heat waves, calls to emergency medical services and hospital admissions have also increased.

According to the US National Climate and Health Assessment:

> "While it is intuitive that extremes can have health impacts such as death or injury during an event (for example, drowning during floods), health impacts can also occur before or after an extreme event as individuals may be involved in activities that put their health at risk, such as disaster preparation and post-event cleanup. Health risks may also arise long after the event, or in places outside the area where the event took place, as a result of damage to property, destruction of assets, loss of infrastructure and public services, social and economic impacts, environmental degradation, and other factors. Extreme events also pose unique health risks if multiple events occur simultaneously or in succession in a given location, but these issues of cumulative or compounding impacts are still emerging in the literature."

In addition, extreme weather can cause economic stress. Property damage, business closure, crop loss, job loss, and employment "down time" can all be caused by extreme storms, weather, and temperatures. These economic impacts can affect individuals, families, businesses, and communities at large. According to the North American Electric Reliability Corporation, the leading cause of electric transmission outages (in terms of electric outage count) in Illinois is "Severe Weather - Thunderstorm".



Increased Risk of Extreme Cold Caused by Jetstream "Wobble" Graphic Source: NASA

Increased Risk of Extreme Cold

Though global temperatures are rising, there is evidence that the County is at risk of increased likelihood of extreme cold temperatures during winter "cold snaps" due to variations in the jet stream caused by warming ocean temperatures and a warming Arctic County. The jet stream—a powerful river of wind high in the atmosphere—shapes the Northern Hemisphere's weather, and it plays a key role in weather extremes. This powerful river of wind transports moisture and moves masses of cold and warm air and storm systems along its path.

The jet stream is driven partly by the temperature contrast between masses of cold air over the North Pole and warmer air near the equator. Climate change has led to faster warming in the Arctic than in the temperate zones, reducing the temperature differences between the two Countys and weakening the jet stream. As the jet stream becomes weaker, it has periods of "wobble" in which it coils much more significantly dipping far to the South. As the jet stream coils southward it brings bitter cold arctic air southward along with it. Studies indicate that as arctic temperatures continue to rise, increases in jet stream "wobble" and extreme winter cold snaps may increase in occurrence.

Flood and Drought Vulnerability

According to the latest National Climate Assessment, the frequency of heavy precipitation events has already increased for the nation as a whole as well as for Illinois specifically. These heavy rain events are projected to increase throughout Illinois. Increases in both extreme precipitation and total precipitation have contributed to increases in severe flooding events in certain Countys. Floods are the second deadliest of all weather-related hazards in the United States.

In addition to the immediate health hazards associated with extreme precipitation events when flooding occurs, other hazards can often appear once a storm has passed. Elevated waterborne disease outbreaks have been reported in the weeks following heavy rainfall, although other variables may affect these associations. Water intrusion into buildings can result in mold contamination that manifests later, leading to indoor air quality problems. Populations living in damp indoor environments experience increased prevalence of asthma and other upper respiratory tract symptoms, such as coughing and wheezing, as well as lower respiratory tract infections such as pneumonia, respiratory syncytial virus, and pneumonia.

By 2050, Illinois will see:

- An increase of flood risk by more than **20%**
- As well as a **40%** increase in its index of the severity of widespread drought.

(Source: US Climate Resilience Toolkit, Climate Central; Graphic Source: Climate Central)

Flooding causes economic stress. Property damage, business closure, crop loss, job loss, and employment "down time" can all be caused by extreme storms, weather, and temperatures. These economic impacts can affect individuals, families, businesses, and communities at large.

Air Quality Impacts

According to the published literature, air pollution is associated with premature death, increased rates of hospitalization for respiratory and cardiovascular conditions, adverse birth outcomes, and lung cancer. Air quality is indexed (AQI) by the U.S. Environmental Protection Agency (EPA) and Illinois Pollution Control Board to provide a simple, uniform way to report daily air quality conditions. Illinois AQI numbers are determined by hourly measurements of five pollutants: fine particles (PM2.5), ground-level ozone (O3), sulfur dioxide (SO2), nitrogen dioxide (NO2), and carbon monoxide (CO). The levels of all of these pollutants can be effected by climate impacts as well as the greenhouse gas emissions which are driving Illinois' changing climate impacts.

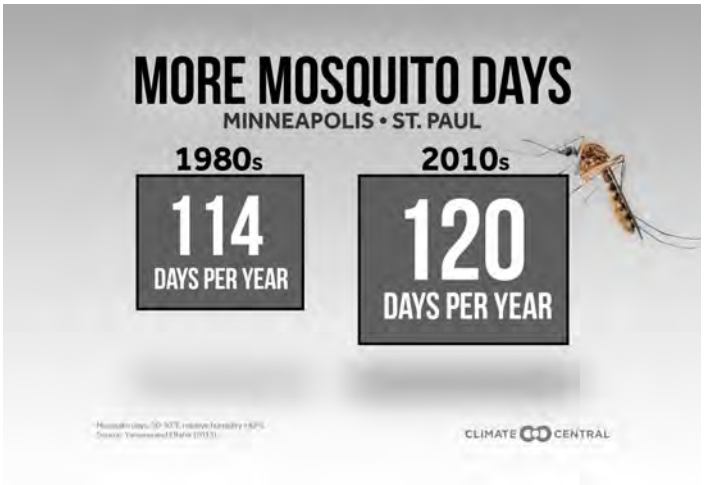
These pollutants have a range of potential health impacts. Ozone exposure may lead to a number of adverse health effects such as shortness of breath, chest pain when inhaling deeply, wheezing and coughing, temporary decreases in lung function, and lower respiratory tract infections. Long-term exposure to fine particulate matter (also known as $PM_{2.5}$) is correlated with a number of adverse health effects. In fact, each 10 µg/m³ elevation in $PM_{2.5}$ is associated with an 8% increase in lung cancer mortality, a 6% increase in cardiopulmonary mortality, and a 4% increase in death from general causes. The annual average of $PM_{2.5}$ provides an indication of the long-term trends in overall burden, relevant to the long-term health effects. Increased surface temperatures are known to increase ground level ozone levels. The projected Illinois climate change impacts of extreme heat, changes in precipitation, drought and wild fires can all cause increases in fine particulate matter, which in turn, can contribute to respiratory illness particularly in populations vulnerable to them.

The US EPA designates counties with unhealthy levels of air pollution as "Non attainment" areas and areas which are on the edge of unhealthy levels "maintenance" areas. The State of Illinois has had multiple jurisdictions designated as "non attainment" areas. However some of these areas have re-met federal air quality requirements and are now maintenance areas. Air quality issues currently being addressed in State of Illinois implementation plans include Carbon Monoxide, Sulfur Dioxide, and Particulate Matter. For current and forecasted air quality throughout the state visit: https://cfpub.epa.gov/airnow. You can also download Plume Lab's free mobile phone air quality monitoring app: https://plumelabs.com/en/air/

Climate change is expected to affect air quality through several pathways, including production and potency of allergens and increase Countyal concentrations of ozone, fine particles, and dust. Some of these pollutants can directly cause respiratory disease or exacerbate existing conditions in susceptible populations, such as children or the elderly. Other air quality issues with health considerations include allergens, pollen, and smoke from wildfires (traces sufficient to cause respiratory impacts are capable of traveling great distances). Each of these are anticipated to be increased with climate change.

Vector-Borne Diseases

Vector-Borne diseases are diseases spread by agents such as ticks and mosquitoes. The projected climate change impacts in this County are anticipated to increase the spread of vector borne diseases such as West Nile virus, and Lyme disease by altering conditions that affect the development and dynamics of the disease vectors and the pathogens they carry. Rising global temperatures can increase the geographic range of disease-carrying insects, while increased rainfall, flooding and humidity creates more viable areas for vector breeding and allows breeding to occur more quickly. In addition, Illinois' lengthening growing season and warming winters will increase the population of vector carrying insects as well as open the County up to new species.



Food Insecurity and Food-borne Diseases

According to former U.S. agriculture secretary Tom Vilsack, climate change is likely to destabilize cropping systems, interrupt transportation networks and trigger food shortages and spikes in food cost. According to the US National Climate Assessment for the Midwestern states: "In the next few decades, longer growing seasons and rising carbon dioxide levels will increase yields of some crops, though those benefits will be progressively offset by extreme weather events. Though adaptation options can reduce some of the detrimental effects, in the long term, the combined stresses associated with climate change are expected to decrease agricultural productivity."

While malnutrition and hunger are typically problems in the developing world, the United States still has significant populations affected by insufficient food resources and under-nutrition. Some of the climate impacts which may increase food insecurity and food-borne diseases in Illinois include:

- Extreme weather events and changes in temperature and precipitation can damage or destroy crops and interrupt the transportation and delivery of food
- Changes in agricultural ranges, practices and changing environmental conditions can reduce the availability and nutritional content of food supplies. For example, an increase in the use of pesticides leads to a decrease in nutritional content of food.
- Extreme weather events, such as flooding, drought, and wildfires can contaminate crops and fisheries with metals, chemicals, and toxicants released into the environment.
- Degraded soil health and soil erosion, exacerbated by increasing drought/flood cycles and increasing storm intensities.

Water Quality/Quantity

Water risks consist of both water quality as well as water quantity issues. Water quantity issues are clearly linked to precipitation levels and timing, water variability, as well as changes in water demand. Water demand itself can be increased not only by population changes but also as a result of climate changes such as increased temperatures and time frames between rain events which increase demands on water consumption. In addition, water withdraw from ground water sources deplete aquifer capacities. Indirectly, the lack of water can cause pressure on agricultural productivity, increase crop failure, and cause reductions in food supply and increases in food prices and food insecurity. As a highly precious resource, all communities should look to increase water conservation regardless of the projected water stress levels of their immediate County, while communities in Countys with a projected increase in water stress should view water conservation as a major long-term priority.

Water quality issues can be affected by climate impacts in a number of ways:

- Increased precipitation and rapid snow melt can result in flooding, which in turn increases the likelihood of water contamination from sources such as sewage as well as contaminants such as chloride, gasoline, oil, chemicals, fertilizers, and pesticides.
- Increased air and water temperatures can increase toxic algae blooms, decrease water oxygen levels, and cause changes in fish populations as well as increases in mercury concentrations in fish.
- Increased heavy rain events can result in increases in sediment, diminishing water quality.

Waterborne Illness

Waterborne diseases are caused by a variety of microorganisms, biotoxins, and toxic contaminants, which lead to devastating illnesses such as cholera, schistosomiasis and other gastrointestinal problems. Outbreaks of waterborne diseases often occur after a severe precipitation event (rainfall, snowfall). Because climate change increases the severity and frequency of some major precipitation events, communities could be faced with elevated disease burden from waterborne diseases. Increased frequency of intense extreme weather events can cause flooding of water and sewage treatment facilities, increasing the risk of waterborne diseases.

Infrastructure Failure

Extreme weather events, flooding and flash flooding, as well as increasing daily stresses caused by increasing climate variability all represent potential causes of failure of our aging infrastructure. Power outages, road damage, bridge collapse, water infrastructure failure - each of these represent significant physical climate risks to the community, especially individuals who are climate vulnerable.

SECTION 05

Climate Risks To Infrastructure

Click here to return to TOC

The projected changes to the community's climate in the coming decades represent potential risks to the community's infrastructure. Many of the risks have the potential of co-occurring, such as extreme heat and drought immediately followed by extreme precipitation events. Potential risks to infrastructure include:

Housing
Warming temperatures will increase demand for air conditioning. Although most homes have air conditioning currently, the increased demand will mean increased costs. Over 10% of households in the County already live under high energy burden (households spending 6% or more of total income on energy). Rising energy costs may be very difficult for these and other households to bear, increasing their vulnerability to extreme weather events. Heavier rains may cause more local flooding, which could cause damage and limit mobility for some neighborhoods in more flood-prone areas of the city.

Stormwater Management
Increasing precipitation will increase demands on stormwater infrastructure and increase flash flooding risks. The County's stormwater infrastructure may not be able to handle the amount of runoff that is expected in the future, and considerable resources would be needed to make needed upgrades.

Transportation
Flooding is not a significant concern for Kane County now, but increasing likelihood of heavy-precipitation events in the future may increase the risk of local flooding, potentially blocking roadways and trails. Increasing temperatures and more days with maximum temperatures over 95° may increase damage to transportation infrastructure including buckling and cracking of road pavement and warping of rail lines. The high reliance on personal vehicles and limited transit services within portions of the county limits residents' options, especially during times of extreme events.

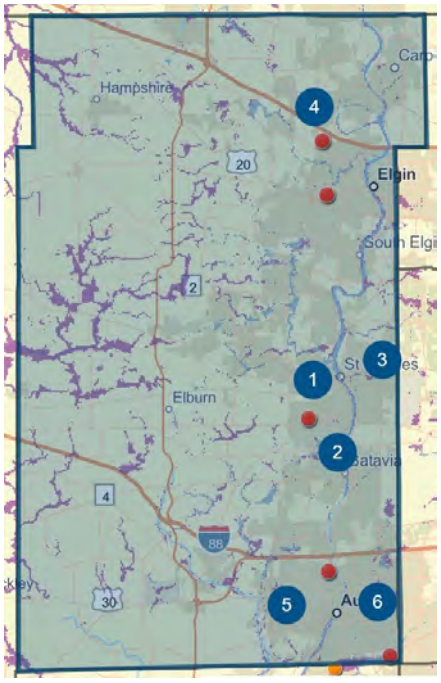
Power Distribution
Increased extreme temperature events are likely to increase demand on power generation and distribution systems and may increase potential for power failure. Increased potential for drought combined with increased risk of heavy rain events pose an increased risk of fallen trees. In tun, this may increase the risk of damage to power lines, particularly during extreme weather events when power demand may be highest.

Critical Facilities
Critical facilities in the community include hospitals, first responder facilities like police and fire, emergency communications facilities, nursing homes, power plants, water and wastewater treatment facilities, schools, and security facilities. Increased risk of extreme temperatures may place increased stress on heating and cooling systems critical facilities and increase potential of system failure during times of highest demand. Increased potential of extreme weather events may pose an increased risk to facilities from high winds, falling trees, sleet/hail, or other impacts. The projected increase of heavy precipitation may pose increased risk to facilities from flooding and flash flooding, even in areas without history of flooding.

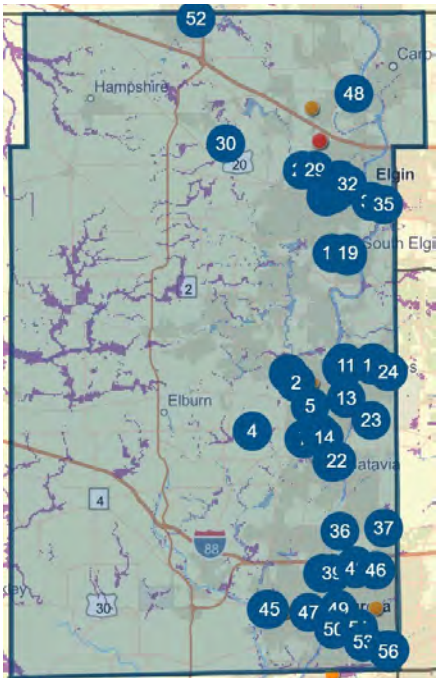
Critical Facilities

Below is a preliminary survey of potential critical facility locations in the community:
(Source FEMA)

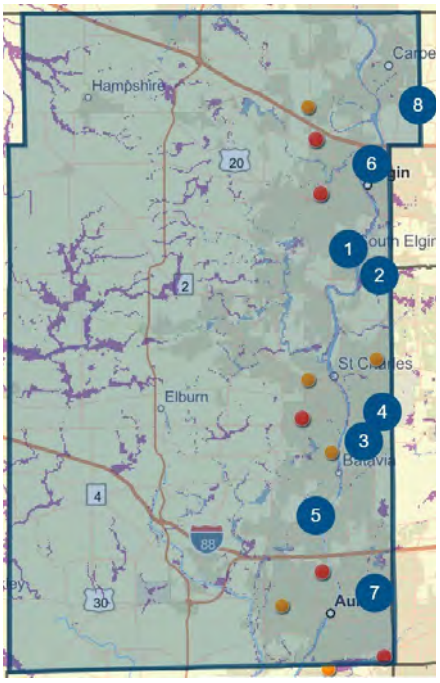
(6) Urgent Care Facilities



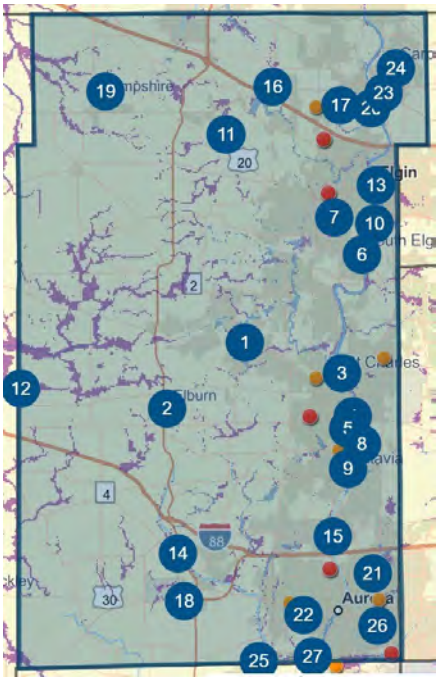
(56) Nursing Care Facilities



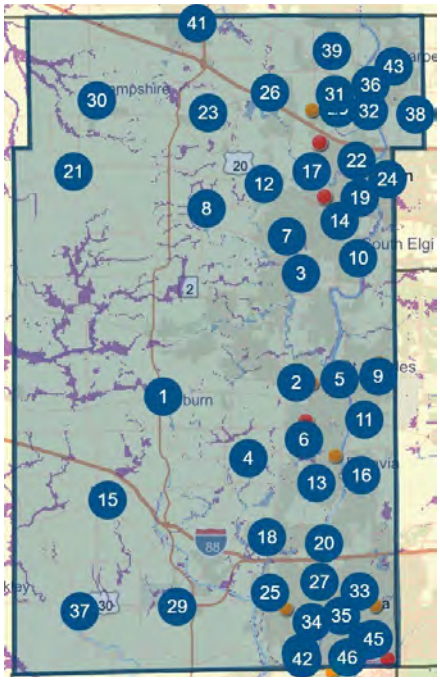
(8) Power Plant Facilities



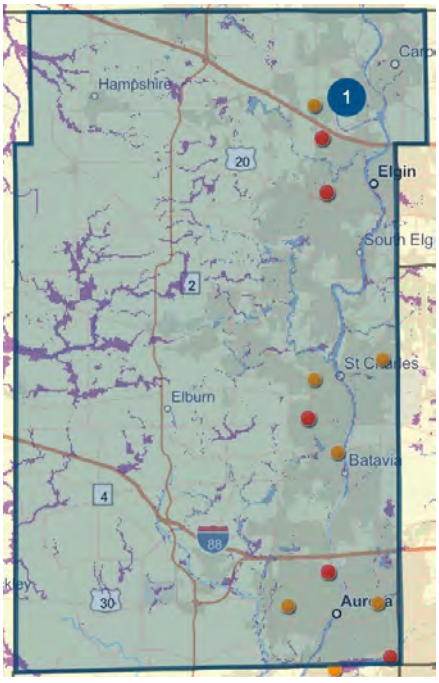
(27) Law Enforcement Facilities



(46) Fire Stations



(1) High Hazard Dam Line



Facilities Preliminarily Identified Potential Increased Risk of Flooding

East Dundee
East Dundee Police Department
Rutland Dundee Fire Protection District Station 2

Gilberts
Gilberts Elem School

Saint Charles
Saint Charles Police Department
Saint Charles Fire Department Station 1

Sleepy Hollow
Sleepy Hollow Police Department

South Elgin
South Elgin Police Department

Marywood
Aurora Rehab & Living Center

Montgomery
Fox Valley Park District Police

North Aurora
North Aurora Police Department

(Source FEMA)

Kane County Flood Risk Factor: Moderate

Residential **Minor Risk**
12,101 out of 142,836 homes

Road **Minor Risk**
927 out of 3,804 miles of roads

Commercial **Moderate Risk**
2,347 out of 9,986 commercial properties

Critical Infrastructure **Moderate Risk**
28 out of 113 infrastructure facilities

Social Facilities **Major Risk**
95 out of 478 social facilities

(Source: First Street Foundation)

Kane County Heat Risk Factor: Moderate

180,293
Total properties at risk

Heat Factor distribution of properties

- Minimal - 1
- Minor - 57.6K
- Moderate - 122.7K
- Major - 0
- Severe - 0
- Extreme - 0

(Source: First Street Foundation)

Kane County Wildfire Risk Factor: Minor

Residential **Minor Risk**
1,440 out of 142,866 homes

Commercial **Minor Risk**
82 out of 9,990 commercial properties

Critical Infrastructure **Minor Risk**
5 out of 357 infrastructure facilities

Social Facilities **Minor Risk**
2 out of 478 social facilities

(Source: First Street Foundation)


ONLY
ONLY

SECTION 06

Climate Risks To Agriculture

Click here to return to TOC

Share of Kane County Crops

Corn for grain	51%
Soybeans	43%
Forage	4%
Wheat	1%
Nursery stock	1%

Source: Census of Agriculture, 2017

As with infrastructure, the projected changes to the community's climate in the coming decades represent potential risks to the region's agriculture and food security. Potential risks to agriculture include:

Shifting Seasons

The projected change to the growing season may seem like a positive development, however, this shift in seasons can be problematic for farmers. Not only will planting and harvesting periods be adjusted, the potential for increased variability of the region's weather may increase risks such as frost damage or delayed planting or harvesting due to flooding. Crop selections may eventually require change as the environment becomes suitable for different plants. In turn, these changes pose the risk of disrupting food supplies or destabilizing Kane County's agricultural business model. The effect may be more severe on local ecology as plant and animal species may no longer be suited to climate conditions and also unable to move due to habitat fragmentation and man-made barriers such as highways.

Flooding

Kane County has over 600 farms with over $180,000,000 in annual production. Uncaptured small agriculture production brings that number even higher. Crop production is a key component to the agriculture industry making up 85% of agricultural revenue in Kane County. Illinois is now experiencing a climate that is already significantly warmer and wetter than at any time in the last 120 years. Wetter winters and springs, drier summers and longer stretches of dry days between more intense rain events are likely to impact agriculture and increase risk of flood damage to crops.

Crop Yield

Heat and water stress are likely to reduce corn yields over the next couple decades. By 2055, yields of rainfed corn in central Illinois are projected to decline by 23-34% according to some estimates. Although soybean yields may benefit from increased atmospheric carbon dioxide in the near-term, this crop is also expected to have yield declines as heat and water stress intensify later in the century.

Weeds, Pests, and Diseases:
Warmer winters, increased spring precipitation, and higher temperatures will increase populations of pests and diseases. These increases may have significant negative effects on crops and livestock in Kane County. Resistance to pest and disease control methods may compound climate change risks while increasing management costs.

Livestock:
By 2050, Illinois could see an increase of 40 to 55 days each year where the daily temperature exceeds 86 degrees, which triggers heat stress in numerous livestock species. Increased heat stress severely impacts farmers, farm workers, and animals. Among livestock, high heat can decrease meat and milk quality and quantity by up to 25%, as well as egg production. Livestock will are likely to also face growing threats related to reduced forage quality and increased exposure to disease vectors.

Kane County Livestock

- 4,631 Cows
- 51,093 Hogs
- 3,699 Chickens
- 800 Sheep
- 140 Goats
- 1,476 Horses
- 77 Turkey

Source: Census of Agriculture, 2017

SECTION 07

Vulnerable Populations
In Kane County

Click here to return to TOC

According to the study "Estimating economic damage from climate change in the United States", climate change economic impacts will increase the unpredictability and inequity of future economic outcomes.

Some groups face a number of stressors related to both climate and non-climate factors. For example, people living in impoverished urban or isolated rural areas, floodplains, and other at-risk locations such as areas of current or historically high levels of toxic chemical pollution are more vulnerable not only to extreme weather and persistent climate change but also to social and economic stressors. Many of these stressors can occur simultaneously or consecutively.

People or communities can have greater or lesser vulnerability to health risks depending on age, social, political, and economic factors that are collectively known as social determinants of health. Some groups are disproportionately disadvantaged by social determinants of health that limit resources and opportunities for health-promoting behaviors and conditions of daily life, such as living/working circumstances and access to healthcare services. Populations of concern are particularly vulnerable to climate change impacts. Heightened vulnerability to existing and projected climate impacts can be due to a sector of the population's exposure, sensitivity, or adaptive capacity to a climate impact.

Who is Most Vulnerable?

Across the United States, people and communities differ in their exposures, their inherent sensitivity, and their capacity to respond to and cope with climate change related threats. The following sections summarize factors that may contribute to the disproportionate impacts of climate change likely to be felt by each group. They also provide maps to illustrate the density of these populations within the County's census tracts, which can be used by government officials and the climate action planning team to aid recognition of the potential for inequities as well as the conditions that contribute to them.

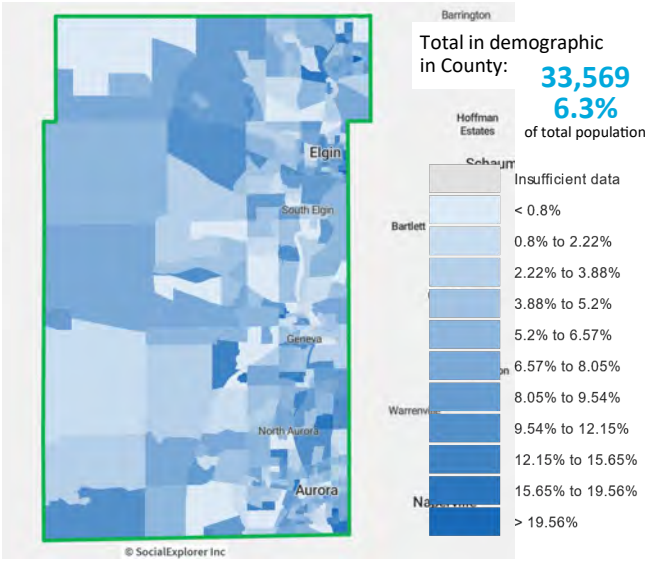
This information may be used as a preliminary guide and indicator of areas where special attention may need to be paid to potential disparities in climate-related hazards (e.g., flooding, extreme heat, air pollution) and/or to ensuring just distribution of the benefits of actions designed to address these climate impacts.

Community members who are most vulnerable include:

Children Under 5

According to the US Global Change Research Program "Children are vulnerable to adverse health effects associated with environmental exposures due to factors related to their immature physiology and metabolism, their unique exposure pathways, their biological sensitivities, and limits to their adaptive capacity. Children have a proportionately higher intake of air, food, and water relative to their body weight compared to adults. They also share unique behaviors and interactions with their environment that may increase their exposure to environmental contaminants such as dust and other contaminants, such as pesticides, mold spores, and allergens."

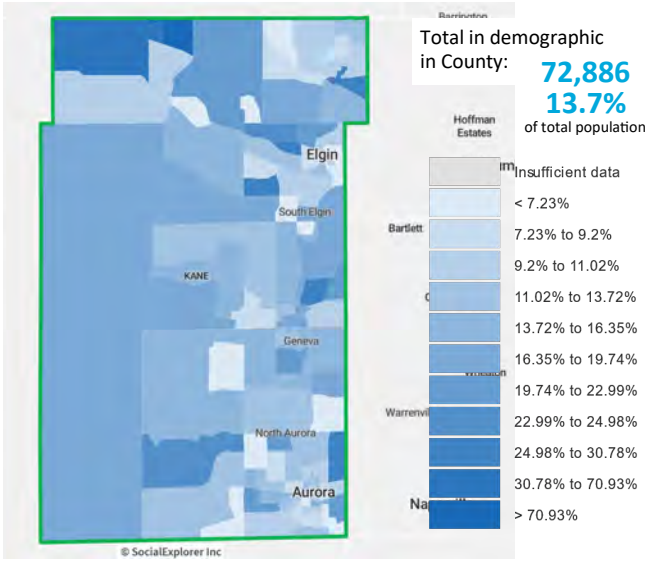
Children are particularly sensitive to the following Climate Risks (see Section 4 for Climate Risk information):

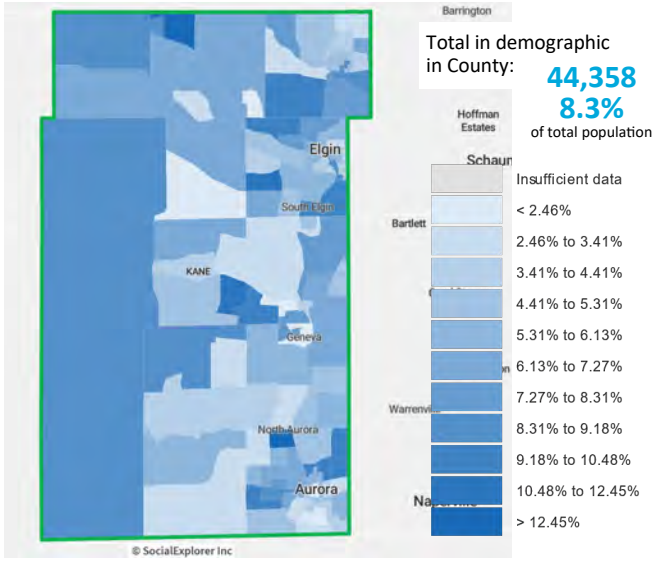


Seniors Over 65

Older adults are also vulnerable to the health impacts associated with climate change and weather extremes. Vulnerabilities within older adults are not uniform due to the fact that this demographic is a diverse group with distinct sub-populations that can be identified not only by age but also by race, educational attainment, socioeconomic status, social support networks, overall physical and mental health, and disability status. According to the US Global Change Research Program "the potential climate change related health impacts for older adults include rising temperatures and heat waves; increased risk of more intense floods, droughts, and wildfires; degraded air quality; exposure to infectious diseases; and other climate-related hazards."

Older Adults are particularly sensitive to the following Climate Risks (see Section 4 for Climate Risk information):





Total in demographic in County: **44,358**
8.3%
of total population

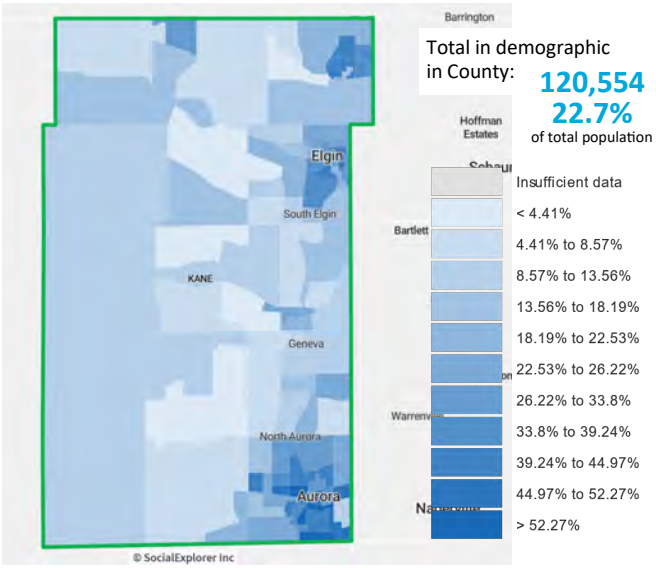
- Insufficient data
- < 2.46%
- 2.46% to 3.41%
- 3.41% to 4.41%
- 4.41% to 5.31%
- 5.31% to 6.13%
- 6.13% to 7.27%
- 7.27% to 8.31%
- 8.31% to 9.18%
- 9.18% to 10.48%
- 10.48% to 12.45%
- > 12.45%

Individuals with Disabilities

People with disabilities experience disproportionately higher rates of social risk factors, such as poverty and lower educational attainment, that contribute to poorer health outcomes during extreme events or climate-related emergencies. These factors compound the risks posed by functional impairments and disrupt planning and emergency response. Disability refers to any condition or impairment of the body or mind that limits a person's ability to do certain activities or restricts a person's participation in normal life activities, such as school, work, or recreation.

Individuals with disabilities are particularly sensitive to the following Risks (see Section 4 for Climate Risk information):

Extreme Weather / Temp · Flood · Air Quality · Food Insecurity · Power Failure



Total in demographic in County: **120,554**
22.7%
of total population

- Insufficient data
- < 4.41%
- 4.41% to 8.57%
- 8.57% to 13.56%
- 13.56% to 18.19%
- 18.19% to 22.53%
- 22.53% to 26.22%
- 26.22% to 33.8%
- 33.8% to 39.24%
- 39.24% to 44.97%
- 44.97% to 52.27%
- > 52.27%

Individuals in Economic Stress

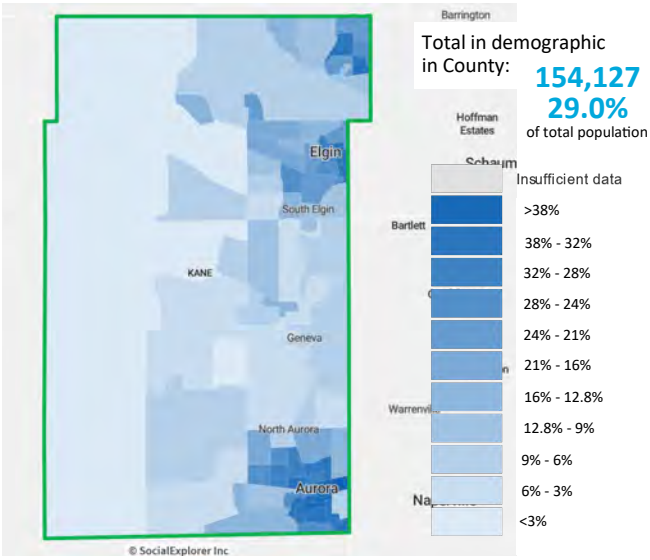
Individuals and families living under economic stress, defined here as "low income" individuals (200% poverty level), are frequently the most adaptive demographic group in our communities. Those living under economic stress exhibit on-going adaptation capabilities simply navigating day-to-day challenges with less than needed resources. This adaptive capacity, however, is overwhelmed in times of emergency as lack of sufficient economic resources greatly reduce the range of options available in response to crisis. For those in poverty, weather-related disasters or family members falling ill can facilitate crippling economic shocks.

Individuals experiencing economic stress, defined as those at 200% poverty level (the common definition of "Low Income") are particularly sensitive to the following Climate Risks (see Section 4 for Climate Risk information):

Extreme Weather / Temp · Flood · Air Quality · Vector-Borne · Food Insecurity · Water Quality · Waterborne · Power Failure

People of Color

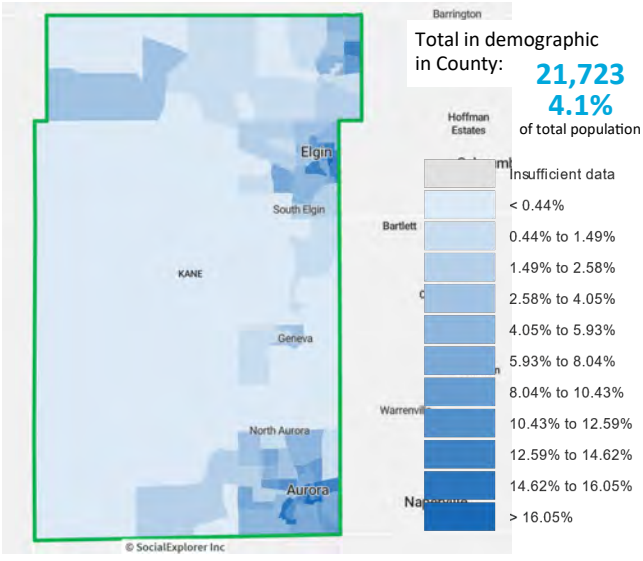
These populations are at increased risk of exposure given their higher likelihood of living in risk-prone areas, areas with older or poorly maintained infrastructure, or areas with an increased burden of pollution. In addition, according to the Center for Disease Control and the National Health Interview Survey these portions of our population also experience higher incidence of chronic medical conditions which can be exacerbated by climate change impacts. These populations may also be impeded from preparing, responding, and coping with climate related health risks due to socioeconomic and education factors, limited transportation, limited access to health education, and social isolation related to language barriers. People of Color may be particularly sensitive to the following Climate Risks (see Section 4 for Climate Risk information):

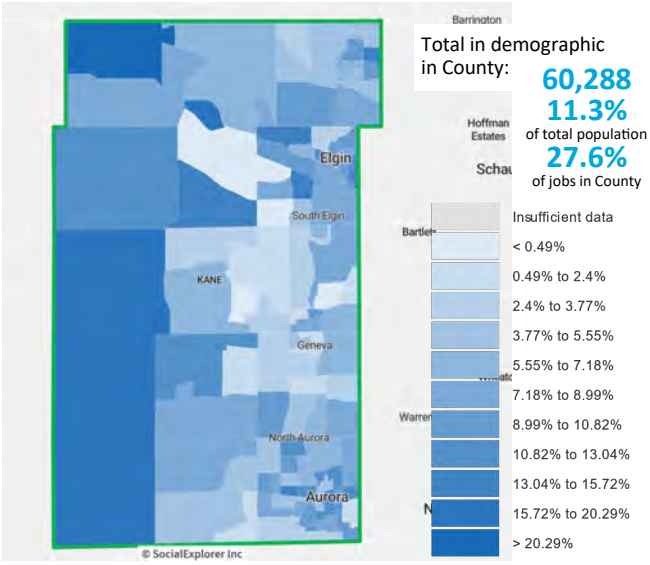


Limited English Speakers

Individuals with limited English language skills may be more socially isolated. Their limited English also likely limits their access to public information and notifications, potentially resulting in a knowledge gap related to community resources, programs, or education which may be relevant in preparing for and recovering from climate impacts. In addition, communication barriers may create challenges for limited English speakers in understanding critical information or instructions given in public address during an extreme weather event. Though not specifically a “person of color” category, individuals with limited English frequently overlap with populations of color, making this group potentially doubly vulnerable.

Limited English Speakers may be particularly sensitive to the following Climate Risks (see Section 4 for Climate Risk information):

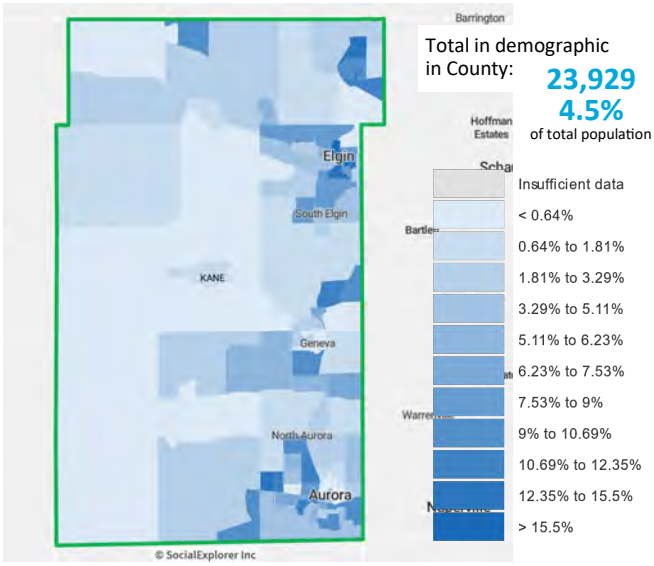




At Risk Workers

Climate change will increase the prevalence and severity of occupational hazards related to environmental exposure. As our climate changes, we may also experience the emergence of new work related risks. Climate change can be expected to affect the health of outdoor workers through increases in ambient temperature, more prevalent and longer-lasting heat waves, degraded air quality, extreme weather, vector-borne diseases, and industrial exposures. Workers affected by climate change include farmers and other agricultural workers; laborers exposed to hot indoor work environments; construction workers; paramedics and other first responders; and transportation workers.

Individuals employed in at-risk occupations may be particularly sensitive to the following Climate Risks (see Section 4 for Climate Risk information):



Individuals with Possible Limited Mobility

In general, climate action looks to advance reduction of single occupant vehicles and increase use of public transit and other alternative transportation modes. From the perspective of climate adaptation for vulnerable populations, limited mobility due to lack of access to effective and sufficient public transit combined with elevated levels of households without vehicle access may present challenges during emergency evacuation situations, especially for individuals in high-risk areas. In addition, limited mobility can inhibit access to cooling stations (public facilities with air conditioning) during extreme heat events and/or access to hospitals or clinics. Individuals with limited vehicle access may also be individuals in economic stress or older adults—populations for which mobility challenges may exacerbate climate vulnerabilities.

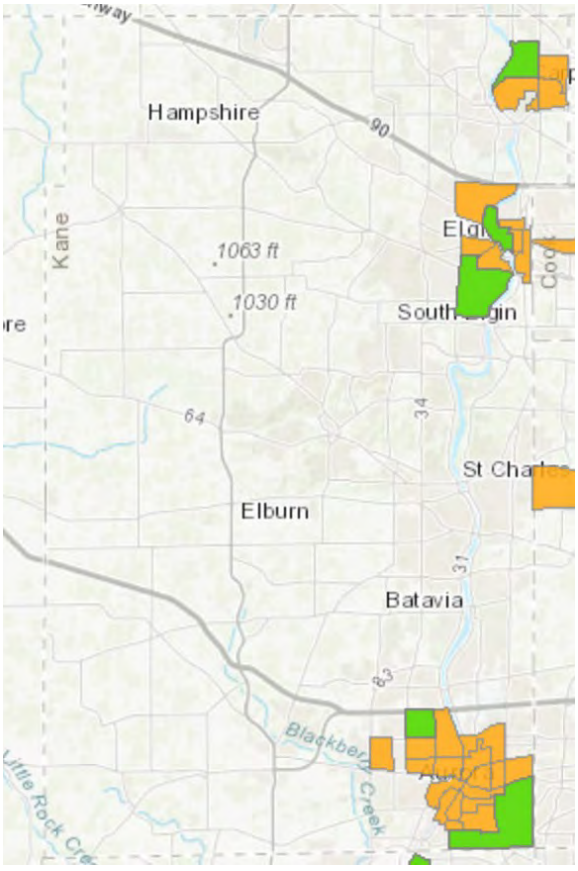
Individuals with limited mobility may be particularly sensitive to the following Climate Risks (see Section 4 for Climate Risk information):

Individuals With Possible Food Insecurity

Those in economic stress are also frequently food insecure. In Illinois, food insecurity affects 1 in 12 adults and 1 in 8 children. Many of the projected climate change impacts are likely to affect agricultural production and distribution, which in turn, may cause spikes in food costs and increase food and nutrition insecurity among those in economic stress. Climate change affects agriculture in a number of ways such as through changes in average temperatures, rainfall, and extreme weather events. As the food distribution system becomes more stressed, individuals with less readily available access are more likely to be negatively impacted by the resulting cycles of food shortages and food price increases.

Individuals experiencing food insecurity may be particularly sensitive to the following Climate Risks (see Section 4 for Climate Risk information):

On the map to the right, highlighted sections represent low-income census tracts (tracts where 20% or more of the population is at or below poverty, or where family median incomes are 80% or less of State median) where a significant number (at least 500 people) or share (at least 33 percent) of residents are distant from the nearest supermarket. In sections which are green, residents are more than 1 mile (urban) or 10 miles (rural), while in orange sections residents are more than ½ mile (urban) or 10 miles (rural) from nearest supermarket.



Climate Migrant Populations

In the United States alone, within just a few decades, hundreds of thousands of homes on US coasts will be chronically flooded. According to a study by the Union of Concerned Scientists, over 170 communities in the United States will be chronically inundated from sea level rise by the end of this decade. More than half of these 170 communities are currently home to socioeconomically vulnerable neighborhoods.

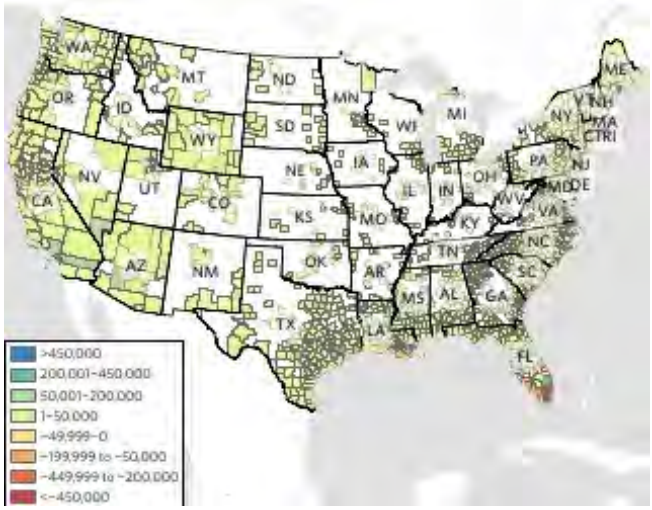
By 2060 the number may more than double to 360 communities and by 2100 double yet again to over 670 communities chronically inundated. By that time more than 50 heavily populated areas—including Oakland, California; Miami and St. Petersburg, Florida; and four of the five boroughs of New York City—will face chronic inundation. These effects of sea level rise could displace 13,000,000 people within the United States by the end of this century. In addition to these internal-US climate migrants, the UN forecasts estimate that there could be anywhere between 25 million and 1 billion environmental migrants by 2050.

Human migration is a natural response to these climate change pressures, and is one of many adaptation measures that people will take in response to climate change. Understating how human migration will be affected by climate change is therefore a critical input in the decision making process of many governments and organizations. In particular, it is important to understand how climate change driven migration will differ from "business as usual" forms and motivations humans have to migrate, increasing the volume rate of migration brining with it indirect impacts on the communities likely to receive migrants.

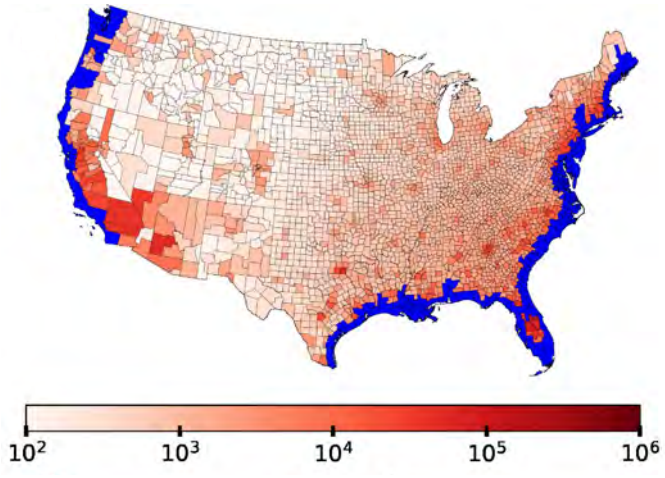
The impacts of climate migration will cause accelerated changes for inland areas that will observe much higher levels of incoming migrants than they would have without climate impacts. It is projected that 86% of all communities with populations of over 10,000 will be impacted with climate migration this century. These changes can in turn take the form of tighter labor markets and increased housing prices, and impacts on income inequality. This climate migration can also have positive impacts such as improved productivity, broadened skillsets within the labor force, and expanded human capital.

Below are two modeled projections for US climate migration induced by sea level rise (SLR) only through 2100:

Hauer Projection
Migration induced by sea-level rise in US



Robinson Projection
Migration induced by sea-level rise in US



(Sources: School of Computational Science and Engineering, Georgia Institute of Technology, United Nations International Organization on Migration; Hauer, M. Migration induced by sea-level rise could reshape the US population landscape; Robinson C, Dilkina B, Moreno-Cruz J (2020) Modeling migration patterns in the USA under sea level rise.

SECTION 08

Findings

Click here to return to TOC

Based on the total estimated population count for each vulnerable population and considering the risks each demographic is most sensitive to, the population vulnerabilities can be considered from highest sensitivity (more vulnerable individuals) to lowest (fewer vulnerable individuals) sensitivity. It should be noted that risks which appear to have lower sensitivity levels should not be considered irrelevant for the community.

The Vulnerable Population Risk Sensitivity Chart tabulates the instances of vulnerable population which are particularly sensitive to each of the Climate Risks to the Population as outlined in Section 4 and calculated in Section 7. The left side of the chart includes all of the primary climate risks while the right side includes the economic climate risks.

Vulnerable Populations Risk Sensitivity Chart

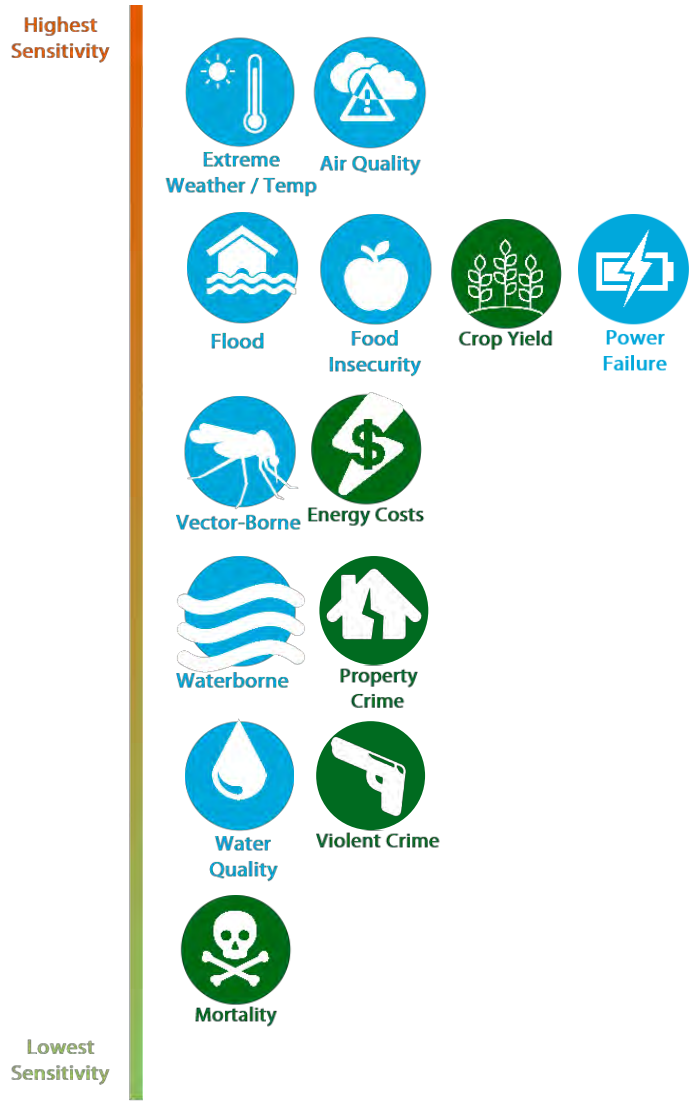
		Primary Risks to The Population								Economic Vulnerabilities				
Vulnerable Demographic	Population	Extreme Weather / Temp	Flood	Air Quality	Vector-Borne	Food Insecurity	Water Quality	Waterborne	Power Failure	Crop Yield	Mortality	Energy Costs	Property Crime	Violent Crime
Children Under 5	33,569	**33,569**		**33,569**	**33,569**	**33,569**		**33,569**	**33,569**	**33,569**	**33,569**	**33,569**		
Seniors Over 65	72,886	**72,886**	**72,886**	**72,886**	**72,886**	**72,886**			**72,886**	**72,886**	**72,886**	**72,886**	**72,886**	
Individuals with Disabilities	44,358	**44,358**	**44,358**	**44,358**		**44,358**			**44,358**		**44,358**	**44,358**	**44,358**	
Est Total Low Income	120,554	**120,554**	**120,554**	**120,554**	**120,554**	**120,554**	**120,554**	**120,554**	**120,554**	**120,554**		**120,554**	**120,554**	**120,554**
People of Color	154,127	**154,127**	**154,127**	**154,127**	**154,127**	**154,127**	**154,127**	**154,127**	**154,127**	**154,127**		**154,127**	**154,127**	**154,127**
Limited English	21,723	**21,723**	**21,723**	**21,723**	**21,723**	**21,723**		**21,723**	**21,723**	**21,723**		**21,723**	**21,723**	**21,723**
At-Risk Workers	60,288	**60,288**	**60,288**	**60,288**	**60,288**			**60,288**						**60,288**
Limited Mobility	23,929	**23,929**	**23,929**			**23,929**			**23,929**	**23,929**				
Total by category		**531,434**	**497,865**	**507,505**	**463,147**	**471,146**	**274,681**	**390,261**	**471,146**	**426,788**	**150,813**	**447,217**	**413,648**	**356,692**
percentage of Vuln pop		100%	94%	95%	87%	89%	52%	73%	89%	80%	28%	84%	78%	67%
Rank by Vulnerability		1	2	1	3	2	5	4	2	2	6	3	4	5
Percentage of Tot Pop		99.9%	93.6%	95.4%	87.1%	88.6%	51.7%	73.4%	88.6%	80.3%	28.4%	84.1%	77.8%	67.1%

Prioritizing Risk and Vulnerabilities

Climate change impacts affect everyone and policies and actions should consider climate adaptive needs of SMSC. As with all planning efforts, climate adaptation benefits from analysis in order to assist in establishing priorities for initial efforts. An effort to structure a prioritization should not be seen as an attempt to discard the need to address climate impacts for any population within the community - whether or not it is defined as one of the "vulnerable" populations . Prioritization, however, is necessary to ensure the greatest impact and effectiveness of limited resources.

Based on the above review Kane County adaptive efforts may be most effective by prioritizing strategies which address the climate risks of **Extreme Heat, Air Quality, Flooding, Food Security, Crop Yeild, and Power/ Infrastructure Failure**. Particular attention should be paid to strategies which are most effective for **People of Color, Individuals in Economic Stress, and Seniors Over 65**.

Kane County Climate Risk Sensitivity Ranking Summary



Projected Economic Impacts of Climate Change

"Estimating economic damage from climate change in the United States", a 2017 study completed by Solomon Hsiang and others from the University of California at Berkeley assessed the economic impact of current climate projections throughout the United States. The sectors assessed, and the findings for Kane County counties is below:

Agricultural Yields Through 2100 (Graphic A)

Agricultural yields are projected to decline with the increase of Global Mean Surface Temperature in addition to impacts related to precipitation changes. Although increased CO2 levels are anticipated to offset a portion of these yield loses, the impact for much of the United States will be a net negative.

Energy Expenditures Through 2100 (Graphic C)

As average annual temperatures increase, demand for energy will increase, resulting in increased energy expenditures.

Reduced Labor Productivity Through 2100 (Graphics D & E)

Labor productivity declines with the instance of increased temperature. Rates vary for "low-risk" workers who are predominantly not exposed to exterior conditions and for "high-risk" workers (those identified as "At Risk Workers" in Section 4).

Increases in Crime Rates Through 2100 (Graphics G & H)

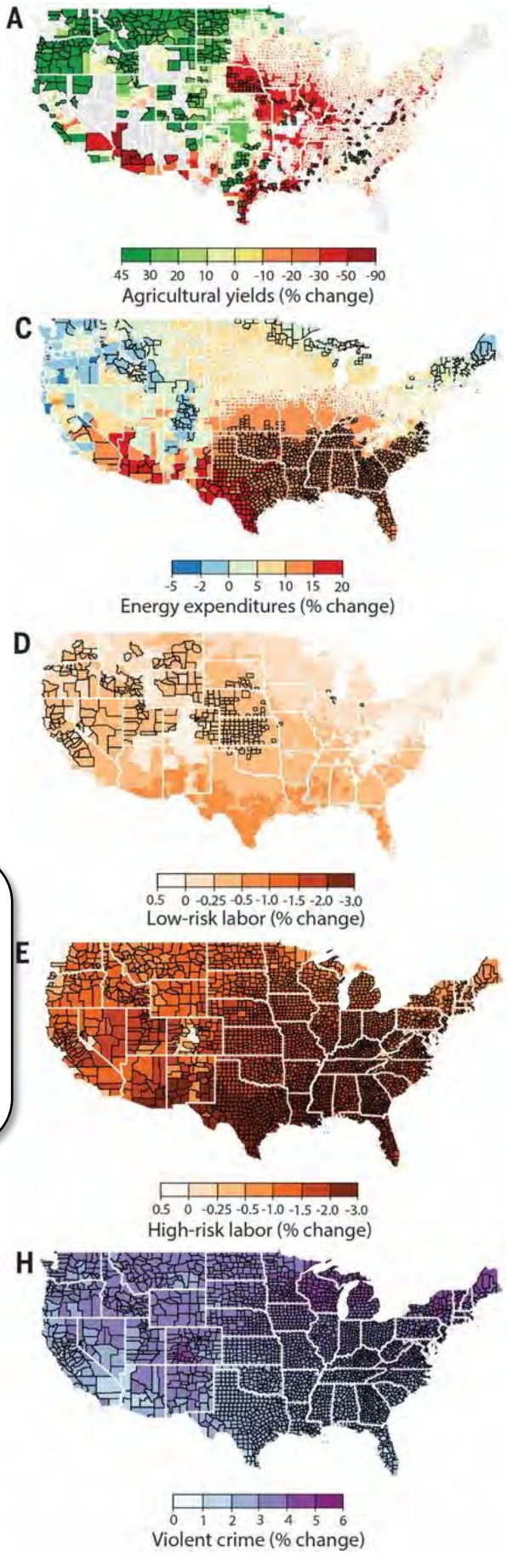
Studies indicate property crime increases as the number of cold days decrease due to the property crime suppression effect cold days have. Violent crime rates have been shown to increase linearly at a relatively precise 0.88% per 1°C.

Total Projected Economic Impacts Through 2100

According to research completed for "Estimating economic damage from climate change in the United States", the total annual economic costs for Counties in Kane County by 2100 will be:

$408,000,00 annually (2019 dollars)*

* Value does not include potential increased property damage nor increased healthcare costs due to extreme weather events.

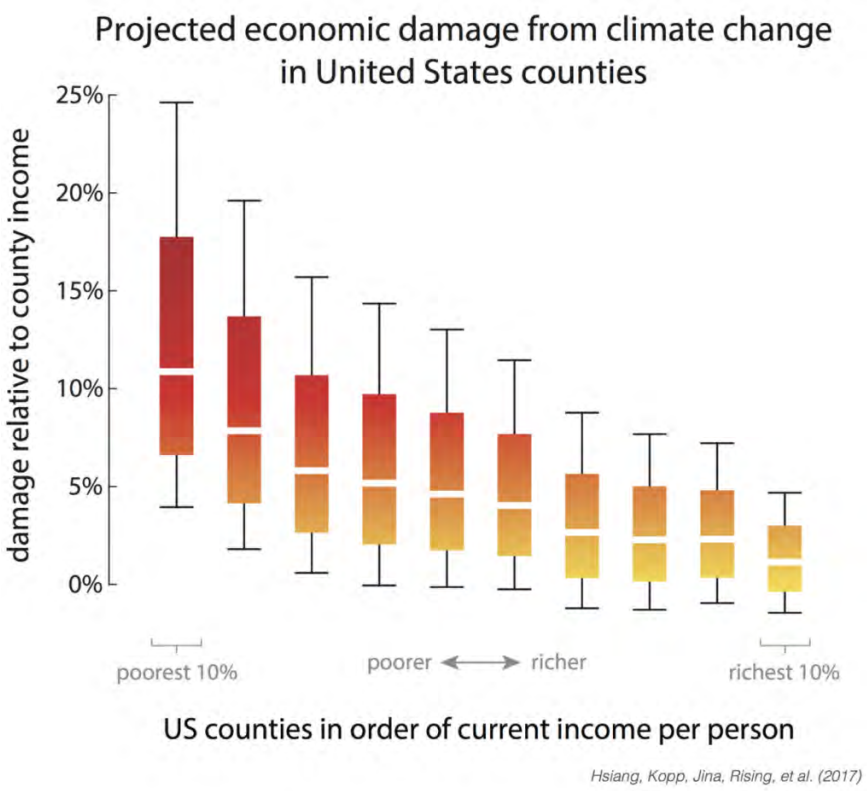


Graphic Source: "Estimating economic damage from climate change in the United States"

Inequity of Economic Impacts Through 2100

According to the study "Estimating economic damage from climate change in the United States", climate change economic impacts will increase the unpredictability and inequity of future economic outcomes. The projected economic effects are unequally borne. As the graphic to the left illustrates, the poorest 10% are likely to receive 5 to 10 times the negative economic impacts of the wealthiest 10% in the community.

Graphic Source: "Estimating economic damage from climate change in the United States" Muir-Wood, Paul Wilson, Michael Oppenheimer, Kate Larsen and Trevor Houser Solomon Hsiang, Robert Kopp, Amir Jina, James Rising, Michael Delgado, Shashank Mohan, D. J. Rasmussen, Robert DOI: 10.1126/science.aal4369
Science 356 (6345), 1362-1369.



Estimating Social Cost of Carbon

"Social Cost of Carbon" (also known as "Avoided Cost of Carbon") is effort to properly account for the damages caused by greenhouse gas emissions and the resulting climate change impacts. By including the social cost of carbon in planning efforts, agencies and businesses can properly evaluate policies and decisions that affect greenhouse gas emissions. The "Social Cost of Carbon" is measure of the share of climate change economic harm and impacts from emitting one ton of carbon dioxide into the atmosphere.

The "Total Projected Economic Impacts" calculated on the previous page can be used to establish a reasonable localized social cost of carbon for the County. The methodology is to simply take the projected annual climate impact value and divide by the current County-wide GHG emissions:

Estimating the total annual economic impact for Kane County ÷ **Current Total County-Wide GHG Emissions** = **Localized Social Cost of Carbon**

Using this formula for Kane County, an estimated localized social cost of carbon can be calculated as:

$408 Million in estimated annual economic impact ÷ **7,015,103 Metric Tons GHG Emissions** = **$58 / MT CO2 Localized Social Cost of Carbon**

The measure of a country's greatness should be based on how well it cares for its most vulnerable populations.

Mahatma Gandhi

SECTION 09

Potential Climate Change Impacts By Sector

Click here to return to TOC

The vulnerability assessment for Kane County was conducted through a process that included a review of relevant scientific literature, regional planning documents, and local, regional, and national climate assessments.

During the first step of the process, paleBLUEdot compiled a list of climate vulnerabilities for nine different sectors of interest based on existing resources and our experience with other communities as well as regional planning documents and studies. The list of vulnerabilities generated for each sector included both direct impacts of climate change (e.g., increased risk of illness or injury as a result of heat stress) as well as ways that existing stressors in the community might interact with climate changes, either by exacerbating the impacts of climate change (e.g., greater risk of flood damage where aging infrastructure is inadequate to deal with increased stormwater volume) or being exacerbated by climate change (e.g., loss of usable riverfront area due to frequent flooding is likely to magnify existing challenges related to the limited supply of vacant land for development in the region).

The likelihood, consequence, and adaptive capacity was ranked for each key vulnerability, resulting in risk and vulnerability evaluations for the impacts that were identified as being of particular concern for each sector.

Likelihood is the degree to which a sector is exposed to significant changes in climate. For this ranking, likelihood was assigned based on whether effects/impacts are anticipated to occur within a 30–80-year time frame (i.e., between 2050 and 2100).
The following scale was used:

Very High: >75% probability
High: 25-75% probability
Moderate: <25% probability
Low: Probability zero or close to it

Consequence is the degree to which a sector is affected by exposure to a changing climate. Consequence rankings were assigned based on the degree of consequence that the anticipated effect/impact would have on the functioning of that sector in the community as a whole rather than on the individuals directly experiencing the impact (e.g., the scale of flood damage or heat-related illnesses was considered at the community level rather than the severity of consequences for a given individual who might have suffered damage or illness).
The following scale was used:

Very High: Service to community ceases to exist
High: Service significantly impacted
Moderate: Service diminished
Low: Service not visibly or functionally affected

Adaptive capacity is the degree to which a sector may be able to cope with or respond to a given impact of climate change. Adaptive capacity rankings were assigned based on likely ability to establish policies or regulations that would support climate-informed actions, likely availability of partnerships and stakeholder relationships that would support robust collaborative action, ability to be flexible or respond quickly to changing conditions, and likely community willingness/desire to make changes, among other considerations.
A scale of Low/Moderate/High was used for this ranking.

Buildings and Energy

This sector focuses specifically on climate change vulnerability of publicly- and privately-owned **buildings** within the community, including those that provide critical services such as health care facilities, police/fire/rescue facilities, libraries, schools, community centers, and other governmental and public facilities. It also includes factors related to **energy** production and maintenance, energy demand, and diversification of energy services.

Vulnerability: Energy Cost and Power Outages

High energy demand due to hotter summers and more extreme heat, increasing costs and the risk of power outages (with potentially significant impacts on vulnerable residents such as those who are already under financial stress)

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	Moderate	High

Vulnerability: Flood Damage

Increased damage or loss of buildings due to flooding or related impacts

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	Moderate	High

Vulnerability: Infrastructure Damage

Increased damage or loss of buildings and infrastructure due to extreme weather events or related impacts

Likelihood	Consequence	Capacity	Vulnerability
High	High	Moderate	Moderate

Vulnerability: Energy Cost and Power Outages

High energy demand due to hotter summers and more extreme heat, increasing costs and the risk of power outages (with potentially significant impacts on vulnerable residents such as those who are already under financial stress)

Likelihood	Consequence	Capacity	Vulnerability
Very High	Moderate	High	High

Vulnerability: Isolation Due to Flooding

Reduced access to more isolated residential areas due to road flooding (e.g., mobile home parks with only one road in and out), potentially hindering evacuation efforts or emergency response

Likelihood	Consequence	Capacity	Vulnerability
Moderate	Very High	Low	Moderate

Vulnerability: Housing Damage

Increased risk of flood and extreme weather damage along waterways, floodplains and areas susceptible to extreme weather (naturally or due to built conditions), with disproportionate impacts on vulnerable communities more likely to reside in those areas

Likelihood	Consequence	Capacity	Vulnerability
High	Very High	Moderate	Moderate

Land Use & Housing

Land use refers to the pattern of development and redevelopment of public and private property within a community for all uses. This includes factors related to the supply and demand of land, price of land, costs associated with development, opportunities redevelopment, and existing or potential land-use conflicts. **Housing** refers more specifically to the availability of residential units within the community (including affordablity), as well as the quality and condition of housing units, access, and maintenance of necessary utilities and conditions in and around housing units.

Potential Climate Change Impacts by Sector

Vulnerability: Increased Car Use

Reduced interest in walking/biking or using public transportation on hot days, increasing dependence on cars with air conditioning.

Likelihood	Consequence	Capacity	Vulnerability
High	Moderate	High	Moderate

Vulnerability: Flood Damage to Infrastructure

Increased flooding and associated damage to streets, sidewalks/trails, and parking lots during heavy rain events, particularly in low-lying areas or where stormwater infrastructure is inadequate

Likelihood	Consequence	Capacity	Vulnerability
Moderate	Very High	Moderate	High

Vulnerability: Resistance to Change

Historical investment in car-focused and lower density development resulting in reduced walkability, complicating future changes to increase the use of public and alternative mobility.

Likelihood	Consequence	Capacity	Vulnerability
Moderate	High	Moderate	Moderate

Transportation, Equipment & Mobility

Transportation and **mobility** focuses on motorized and non-motorized modes of transportation and associated infrastructure. This includes consideration of public transportation systems, bicycle and pedestrian routes, and parking infrastructure. **Equipment** refers to off-road equipment which consume fuels (like lawn and construction equipment) as well as alternative fuel equipment (like electric vehicle charging).

Open Space & Ecosystems

This topic area includes community **open space**, including parks, conservation lands, and other open space resources, as well as the **ecosystems** including urban tree canopy, grasses and land cover plants and the species that depend on them. Important aspects include the condition and management needs of these natural systems, which are associated with groundwater and surface water resources, recreation, native plants and wildlife .

Vulnerability: Invasive Species

Expansion of non-native invasive plants and insect pests as temperatures increase (particularly winter temperatures), likely resulting in the introduction of new invasive species into the area.

Likelihood	Consequence	Capacity	Vulnerability
Very High	Moderate	Moderate	Moderate

Vulnerability: Flooding Impacts

Increased flooding and erosion, impacting native plant communities (e.g., can result in loss of species such as ash) as well as access to and condition of parks and conservation.

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	Moderate	Moderate

Vulnerability: Tree Canopy Stress

Increased stress and potential loss of tree canopy due to invasive pests (i.e. Emerald Ash Borer), changing temperature and precipitation patterns, extreme weather events, and invasive species impacts.

Likelihood	Consequence	Capacity	Vulnerability
Very High	Very High	Moderate	High

Potential Climate Change Impacts by Sector

Waste Management

Waste management refers to both municipal solid waste, recycling, and organics recycling (composting, etc). This sector includes consideration of volume, demand and service capacity, and infrastructure associated with collection and disposal.

Vulnerability: Energy Cost and Power Outages

Increased leakage and run-off, potentially impacting local water quality.

Likelihood	Consequence	Capacity	Vulnerability
Moderate	Very High	High	Low

Vulnerability: Increased Waste Generation

Increased waste generation due to debris and other damage (including organic debris from vegetation damage), which is likely to be exacerbated by illegal dumping.

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	Moderate	High

Vulnerability: Resistance to Change

Historical precedence for solid waste collection frequency, complexity of encouraging behavior change required to reduce solid waste generated and/or increase effective diversion to recycling and organics composting results in complications in reducing solid waste impacts.

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	Moderate	High

Vulnerability: Increased Flooding

Increased flooding during periods of heavy rain, particularly where the City's stormwater infrastructure is inadequate for increased volumes or impermeable surfaces prevent infiltration.

Likelihood	Consequence	Capacity	Vulnerability
Very High	Very High	Moderate	High

Vulnerability: Groundwater Infiltration

Elevated groundwater tables due to frequent large storms, infiltrating the sanitary sewer system and increasing the cost of treatment.

Likelihood	Consequence	Capacity	Vulnerability
Very High	Moderate	High	Moderate

Vulnerability: Resistance to Change

Water consumption behaviors and infrastructure investments (i.e. landscape sprinklers, non-native plantings, etc) as well as perception of a water rich region result in complications in reducing water consumption patterns.

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	Moderate	High

Water & Wastewater

This topic area includes **drinking water**, in terms of water quality and quantity and timing of supply, and **wastewater**, including stormwater runoff as well as municipal wastewater. Both drinking water and wastewater/stormwater require infrastructure for processing and distribution, which includes source water, underground water and sewer lines, culverts and stormwater management systems. This topic area must also consider **natural water resources** that supply drinking water for the City and wetlands that provide water filtration and floodwater storage.

Potential Climate Change Impacts by Sector

Local Food and Agriculture

This topic area considers **food systems**, including food processing and distribution systems, local food production including urban agriculture, and community food security.

Vulnerability: Agricultural Production Impacts

Current crops may not be suited for new conditions, increased flooding and climate change impacts on agricultural lands result in crop failures and impact food costs, availability, or security in community.

Likelihood	Consequence	Capacity	Vulnerability
High	Very High	Low	High

Vulnerability: Local Food System Impacts

Extreme weather events such as flooding result in damage or interruption to food distribution and retail operations impacting food costs availability, or security in community.

Likelihood	Consequence	Capacity	Vulnerability
Moderate	Very High	Moderate	Moderate

Vulnerability: Extreme Temperature Health Impacts

Increase in heat- or cold-related illness and death, which may be exacerbated by pre-existing medical conditions, age, occupation, and/or socioeconomic variables (e.g., access to a vehicle or regular health care).

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	High	Moderate

Vulnerability: Emergency Shelter Demand

Increased demand for public shelter, emergency, and medical services.

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	High	Moderate

Vulnerability: Interruption to Services

Increased flooding and extreme weather events causing associated damage or interruption to health and emergency services.

Likelihood	Consequence	Capacity	Vulnerability
High	Very High	Moderate	High

Public Health & Wellness

Public health and **wellness** include potential hazards that directly or indirectly impact public health by exacerbating chronic health conditions, causing illness or disease, and increasing the risk of injury or death. This topic also considers emergency services (e.g., fire, rescue), social services, and public health programming.

Potential Climate Change Impacts by Sector

Vulnerability: Utility Interruptions due to Extreme Weather

Increased demand and extreme weather impacts on utilities (electric, natural gas) and communications infrastructure which increase costs or potential for service interruption impacting local businesses and industry.

Likelihood	Consequence	Capacity	Vulnerability
Very High	Moderate	Moderate	Moderate

Vulnerability: Local Business Damage due to Extreme Weather

Extreme weather events, flooding, and other climate change impacts result in service interruption or economic damage for local businesses and industry.

Likelihood	Consequence	Capacity	Vulnerability
High	Very High	High	High

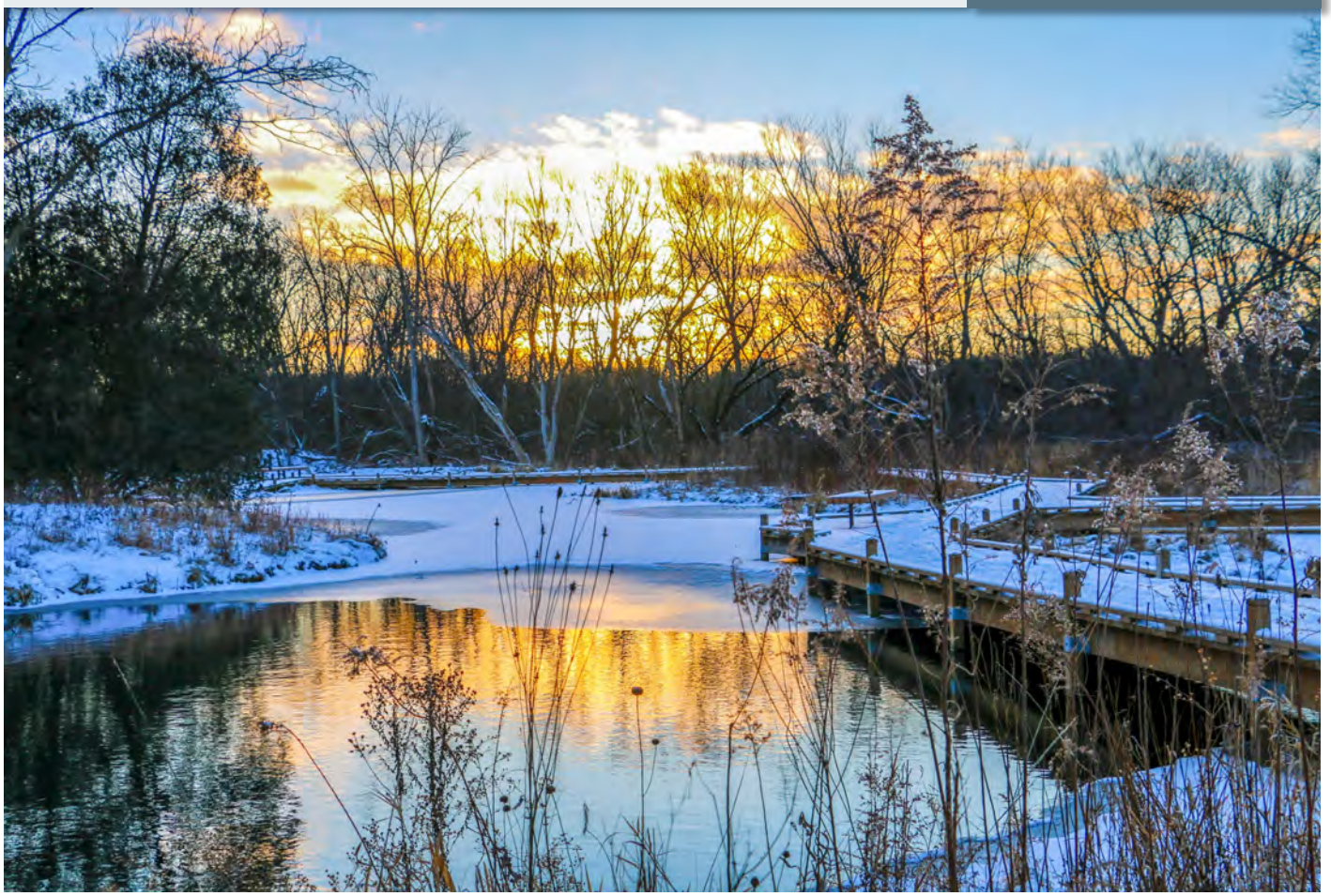
Vulnerability: Impacts on At-Risk Workers

Increased risks for outdoor and other at-risk workers who are more exposed to heat, potentially reducing labor productivity.

Likelihood	Consequence	Capacity	Vulnerability
Very High	High	Moderate	High

Sustainable Economy

This topic area includes various indicators of **economic activity and opportunities** within the community, including employment, ability to attract and retain businesses and local industries, and community support for the local economy. This sector also represents the overall supportiveness of the local economy for the goals and objectives of increasing overall **community sustainability.**



Section

A1

Appendix 1
Local Climate Risks to the Environment

Click to Return to TOC

Local Climate Risks To The Environment

Climate change projections for the Community represent potential risks. The types of risks can be organized into risks to the environment and ecosystems and risks to the population. The following is an overview of the potential risks posed by climate change for the region:

Warmer summers

Pollution control risks:

Wildfires may lead to soil erosion

Habitat risks:

Greater evaporation
Lower groundwater tables
Switching public water supply between surface and groundwater sources may affect the integrity of water bodies

Fish Wildlife and Plant risks:

Species that won't tolerate warmer summers may die/migrate
Biota at the southern limit of their range may disappear from ecosystems
Species may be weakened by heat and become outcompeted
Essential food sources may die off or disappear, affecting the food web
Species may need to consume more water as temperature rises

Recreation and Public Water Supply Risks:

More people using water for recreation may raise the potential for pathogen exposure
Warmer temperatures may drive greater water demand
Evaporation losses from reservoirs and groundwater may increase

Warmer winters

Pollution Control risks:

Increased fertilizer and pesticide use due to longer growing season.
Warmer winters result in more ice and freeze thaw resulting in greater chloride application and more permanent damage to local water bodies due to increased salt concentrations.

Habitat risks:

Less snow, more rain may change the runoff/infiltration balance; base flow in streams may change
Changing spring runoff with varying snow.

Fish Wildlife and Plant risks:

Species that used to migrate away may stay all winter and species that once migrated through may stop and stay
Pests may survive winters that used to kill them and invasive species may move into places that used to be too cold
Some plants need a "setting" cold temperature and may not receive it consistently
A longer growing season may lead to an extra reproductive cycle
Food supplies and bird migrations may be mistimed

Recreation and Public Water Supply Risks:

Summer water supplies that depend on winter snow pack may be reduced or disappear
Cold places may see more freeze/thaw cycles that can affect infrastructure

Warmer water

Pollution Control risks:

Temperature criteria for discharges may be exceeded (thermal pollution)
Warmer temperatures may increase toxicity of pollutants
Higher solubility may lead to higher concentration of pollutants
Water may hold less dissolved oxygen
Higher surface temperatures may lead to stratification
Greater algae growth may occur
Parasites, bacteria may have greater survival or transmission

Habitat risks:

Warmer water may lead to greater likelihood of stratification
Desired fish may no longer be present
Warmer water may promote invasive species or disease

Fish Wildlife and Plant risks:

Newly invasive species may appear
Habitat may become unsuitably warm, for a species or its food
Heat may stress immobile biota
Oxygen capacity of water may drop

Local Climate Risks To The Environment

Some fish reproduction may require cold temperatures; other reproductive cycles are tied to water temperature
Parasites and diseases are enhanced by warmer water

Fish resource food harvesting, Recreation, and Public Water Supply Risks:
Harmful algal blooms may be more likely
Fishing seasons and fish may become misaligned
Desired recreational fish may no longer be present
Invasive plants may clog creeks and waterways
Changes in treatment processes may be required
Increased growth of algae and microbes may affect drinking water quality

Increased drought

Pollution Control risks:
Critical-low-flow criteria for discharging may not be met
Pollutant concentrations may increase if sources stay the same and flow diminishes
Pollution sources may build up on land, followed by high-intensity flushes

Habitat risks:
Groundwater tables may drop
Base flow in streams may decrease
Stream water may become warmer
Increased human use of groundwater during drought may reduce stream baseflow
New water supply reservoirs may affect the integrity of freshwater streams

Fish Wildlife and Plant risks:
Species may not tolerate a new drought regime (birch family)
Native habitat may be affected if freshwater flow in streams is diminished or eliminated

Recreation and Public Water Supply Risks:
Freshwater flows in streams may not support recreational uses
Groundwater tables may drop
Maintaining passing flows at diversions may be difficult

Increased storminess

Pollution Control risks:
Combined sewer overflows may increase
Treatment plants may go offline during intense floods
Streams may see greater erosion and scour
Urban areas may be subject to more floods
Flood control facilities (e.g., detention basins, manure management) may be inadequate
High rainfall may cause septic systems to fail

Habitat risks:
The number of storms reaching an intensity that causes significant problems may increase
Stronger storms may cause more intense flooding and runoff
Turbidity of surface waters may increase
Increased intensity of precipitation may yield less infiltration
Stream erosion may lead to high turbidity and greater sedimentation
Lower pH from NPS pollution may affect target species

Fish Wildlife and Plant risks:
Greater soil erosion may increase turbidity and decrease water clarity
Greater soil erosion may increase sediment deposition in estuaries, with consequences for benthic species

Recreation and Public Water Supply Risks:
More frequent or more intense storms may decrease recreational opportunities
Greater nonpoint source pollution may impair recreation
Water infrastructure may be vulnerable to flooding
Flood waters may raise downstream turbidity and affect water quality

(Source: USEPA “Being Prepared for Climate Change A Workbook for Developing Risk-Based Adaptation Plans”)

Section

A2

Appendix 2
Glossary of Climate Adaptation and Vulnerability Terms

Click to Return to TOC

Abbreviations

BAU	Business as usual
BEV	Battery electric vehicle
BIPOC	Black, Indigenous, People of Color
C&D	Construction and demolition
CAP	Climate Action Plan
CE	Carbon Equivalent
CDP	Carbon Disclosure Project
CFC	Chlorofluorocarbons
CH_4	Methane
CHP	Combined Heat and Power
CO2	Carbon dioxide
CO2e	Carbon dioxide equivalent
CSG	Community Solar Garden
DOE	U.S. Department of Energy
EMS	Emergency medical services
EPA	U.S. Environmental Protection Agency
EV	Electric vehicle
EVSE	Electric vehicle supply equipment
FEMA	Federal Emergency Management Agency
FTE	Full-time equivalent
GCoM	Global Covenant of Mayors
GDP	Gross Domestic Product
GHG	Greenhouse gas
GWP	Global warming potential
HFC	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt-hour
LEV	Low emission vehicle
MWH	Megawatt hour – 1,000 Kilowatt-hours
MSW	Municipal Solid Waste
MT	Metric ton equivalent to 1,000 kg (also known as Metric Tonne)
MMT	Million Metric tons
MTCO2e	Metric tons of carbon dioxide equivalent
N_2O	Nitrous Oxide
NO_x	Nitrogen Oxides
NZE	Net-Zero Emissions
O_3	Ozone
ODS	Ozone Depleting Substances
PACE	Property Assessed Clean Energy
PFC	Perfluorocarbons
PHEV	Plug-in hybrid electric vehicle
PM2.5	Particulate matter of 2.5 micrometer diameter or less
POC	People of Color
PPA	Power Purchase Agreement
PUB	Public Utilities Board
REC	Renewable Energy Credit
SO_2	Sulfur Dioxide
SF_6	Sulfur Hexafluoride
SULEV	Super ultra-low emission vehicle
t	Ton equivalent to 2,000 lbs (United States)
TOG	Total Organic Gasses
USGS	U.S. Geological Survey
VMT	Vehicle miles traveled
VHT	Vehicle hours traveled
ZEV	Zero emission vehicle

A

Action
Actions are detailed items that should be completed to carry out the vision and strategies identified in the plan.

Activity Data
Data on the magnitude of a human activity resulting in emissions or removals taking place during a given period of time. Data on energy use, metal production, land areas, management systems, lime and fertilizer use and waste arisings are examples of activity data. (IPCC)

Adaptation
See "Climate Adaptation or Resilience"

Adaptive Capacity
The social, technical skills, and financial capacities of individuals and groups to implement and maintain climate actions.

Aerosols
A collection of airborne solid or liquid particles, with a typical size between 0.01 and 10 micrometer that reside in the atmosphere for at least several hours. Aerosols may be of either natural or anthropogenic origin. Aerosols may influence climate in several ways: directly through scattering and absorbing radiation, and indirectly by acting as cloud condensation nuclei or modifying the optical properties and lifetime of clouds. (IPCC2)

Afforestation
Planting of new forests on lands that historically have not contained forests. (IPCC2)

Air Pollutant
Any man-made and/or natural substance occurring in the atmosphere that may result in adverse effects to humans, animals, vegetation, and/or materials. (CARB)

Anthropogenic
The term "anthropogenic", in the context of greenhouse gas inventories, refers to greenhouse gas emissions and removals that are a direct result of human activities or are the result of natural processes that have been affected by human activities. (USEPA2)

Atmosphere
The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium and radiatively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio) and ozone. In addition, the atmosphere contains the greenhouse gas water vapor, whose amounts are highly variable but typically around 1% volume mixing ratio. The atmosphere also contains clouds and aerosols. (IPCC2)

B

Baseline Emissions
A baseline is a measurement, calculation, or time used as a basis for comparison. Baseline emissions are the level of emissions that would occur without policy intervention or without implementation of a project. Baseline estimates are needed to determine the effectiveness of emission reduction programs (also called mitigation strategies).

Base Year
The starting year for the inventory. Targets for reducing GHG emissions are often defined in relation to the base year.

BAU
See "Business As Usual Forecast"

Biogenic
Produced by the biological processes of living organisms. Note that we use the term "biogenic" to refer only to recently produced (that is non-fossil) material of biological origin. IPCC guidelines recommend that peat be treated as a fossil carbon because it takes a long time to replace harvested peat.

Biogeochemical Cycle
Movements through the Earth system of key chemical constituents essential to life, such as carbon, nitrogen, oxygen, and phosphorus. (NASA)

Biomass
Either (1) the total mass of living organisms in a given area or of a given species usually expressed as dry weight; or (2) Organic matter consisting of or recently derived from living organisms (especially

regarded as fuel) excluding peat. Includes products, by-products and waste derived from such material. (IPCC1)

Biomass Waste
Organic non-fossil material of biological origin that is a byproduct or a discarded product. "Biomass waste" includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw, and other biomass solids, liquids, and gases; but excludes wood and wood-derived fuels (including black liquor), biofuels feedstock, biodiesel, and fuel ethanol. Note: EIA "biomass waste" data also include energy crops grown specifically for energy production, which would not normally constitute waste. (EIA)

BIPOC
“Black, Indigenous, and People of Color” this is a term specific to the United States, intended to center the experiences of Black and Indigenous groups as representative of or shaping the socio-economic dynamics experienced by all people of color.

Black Carbon
Operationally defined aerosol species based on measurement of light absorption and chemical reactivity and/or thermal stability; consists of soot, charcoal and/or possible light absorbing refractory organic matter (Charlson and Heintzenberg, 1995, p. 401). (IPCC2)

Blue Carbon
Carbon sequestered and stored by wetlands and other coastal ecosystems helping to mitigate the effectsof climate change.

Business As Usual Forecast
The Intergovernmental Panel on Climate Change (IPCC) defines a
“business-as-usual” forecast as the level of emissions that would result if future development trends follow those of the past and no changes in policies take place. A BAU forecast assumes that no emission-reduction actions will be undertaken beyond those already in place, mandated by State or Federal policy, or committed to in the base year.

C

Carbon Cycle
All parts (reservoirs) and fluxes of carbon. The cycle is usually thought of as four main reservoirs of carbon interconnected by pathways of exchange. The reservoirs are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans, and sediments (includes fossil fuels). The annual movements of carbon, the carbon exchanges between reservoirs, occur because of various chemical, physical, geological, and biological processes. The ocean contains the largest pool of carbon near the surface of the Earth, but most of that pool is not involved with rapid exchange with the atmosphere. (NASA)

Carbon Dioxide (CO_2)
A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1. (IPCC2)

Carbon Dioxide Equivalent (CO_2e)
A metric used to compare emissions of various greenhouse gases. It is the mass of carbon dioxide that would produce the same estimated radiative forcing as a given mass of another greenhouse gas. Carbon dioxide equivalents are computed by multiplying the mass of the gas emitted by its global warming potential.

Carbon Disclosure Project (CDP)
An international organization that administers a platform for organizations and cities to publicly disclose their environmental impacts, such as climate risk. CDP is one of the approved disclosure platforms utilized by GCoM.

Carbon Emissions
The release of carbon dioxide into the atmosphere. Primary human sources of the release of carbon dioxide occur from burning oil, coal, and gas for energy use.

Carbon Equivalent (CE)
A metric measure used to compare the emissions of the different greenhouse gases based upon their global warming potential. Carbon equivalents can be

calculated from to carbon dioxide equivalents by multiplying the carbon dioxide equivalents by 12/44 (the ratio of the molecular weight of carbon to that of carbon dioxide). The use of carbon equivalent is declining in GHG inventories.

Carbon Intensity
The amount of carbon by weight emitted per unit of energy consumed. A common measure of carbon intensity is weight of carbon per British thermal unit (Btu) of energy. When there is only one fossil fuel under consideration, the carbon intensity and the emissions coefficient are identical. When there are several fuels, carbon intensity is based on their combined emissions coefficients weighted by their energy consumption levels. (EIA)

Carbon Neutrality
"Carbon neutrality" means annual zero net anthropogenic (human caused or influenced) CO2 emissions by a certain date. By definition, carbon neutrality means every ton of anthropogenic CO2 emitted is compensated with an equivalent amount of CO2 removed (e.g. via carbon sequestration).

Carbon Offsets
A carbon offset is a reduction or removal of emissions of carbon dioxide or other greenhouse gases made to compensate for emissions made elsewhere. Offsets are measured in metric tonnes of carbon dioxide-equivalent. Offsets are bought and sold to address direct and indirect emissions associated with an organization's operations.

Carbon Sinks
A forest, ocean, or other natural environment viewed in terms of its ability to absorb carbon dioxide from the atmosphere.

Carbon Sequestration
This refers to the capture of CO_2 from the atmosphere and its long term storage in oceans (oceanic carbon sequestration), in biomass and soils (terrestrial carbon sequestration) or in underground reservoirs (geologic carbon sequestration).

Chlorofluorocarbons (CFCs)
Greenhouse gases covered under the 1987 Montreal Protocol and used for refrigeration, air conditioning, packaging, insulation, solvents, or aerosol propellants. Because they are not destroyed in the lower atmosphere, CFCs drift into the upper atmosphere where, given suitable conditions, they break down ozone. These gases are being replaced by other compounds, including hydrochlorofluorocarbons and hydrofluorocarbons, which are greenhouse gases covered under the Kyoto Protocol. (IPCC3)

Circular Economy
An alternative to a traditional linear economy (make, use, dispose) in which an economy is a regenerative system where resource input and waste are minimized. This is achieved through long-lasting product design, repair, reuse, remanufacturing, and recycling. Circular economy strategies are often cited as systems level approaches to reducing waste generation through product and system design.

Climate
Climate in a narrow sense is usually defined as the "average weather" or more rigorously as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These relevant quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. (IPCC2)

Climate Adaptation or Resilience
The capacity of a natural environment to prevent, withstand, respond to, and recover from a disruption. The process of adjusting to new climate conditions to reduce risks to valued assets. Adaptation is achieved through actions taken to increase resilience to climate change impacts by reducing vulnerability.

Climate Change
Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. (IPCC2)

Climate Hazard
An extreme climate event or condition that can harm human health, livelihoods, or natural resources. It can include abrupt changes to the climate system such as extreme precipitation, storms, droughts, and heat waves.

Climate Migration
Movement of people due to the impacts of climate change on their livelihoods or erosion of quality of life, such as shifts in water availability and crop productivity, or to factors such as sea level rise or storm surge.

Climate Model
A quantitative method to simulate interactions of the important drivers of climate—including atmosphere, oceans, land, and ice—to develop projections of future climate.

Climate Scenario
A coherent, internally consistent, plausible description of possible climatic conditions

Climate Risk
The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability and hazard. (IPCC):

Climate Vulnerability
Is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its capacity to adapt.
Vulnerability = potential impact (sensitivity x exposure) – adaptive capacity (IPCC):

Climate Vulnerability Assessment
A report used to identify and define the risks posed by climate change and inform adaptation measures needed to combat climate change. Reports can be about a wide range of fields including food security, poverty analysis, and extreme weather events.

Co-Benefit
Indirect benefits to the community (e.g., public health, economic, equity) caused by climate adaptation and mitigation strategies, actions, and policies.

Co-generation
Co-generation is an industrial structure, installation, plant, building, or self-generating facility that has sequential or simultaneous generation of multiple forms of useful energy (usually mechanical and thermal) in a single, integrated system. (CARB)

Community Choice Aggregation (CCA)
CCA programs, also known as "Municipal Power Aggregation" or "Community Power Aggregation", allow local governments to procure power on behalf of their residents, businesses, and municipal accounts from an alternative supplier while still receiving transmission and distribution service from their existing utility provider. Typically, enabling legislation at the State level is required in order to assemble a CCA program for a community. See EPA's CCA webpage for more: https://www.epa.gov/green-power-markets/community-choice-aggregation

Combined Heat and Power (CHP)
Combined heat and power is the simultaneous production of both electricity and useful heat for application by the producer or to be sold to other users with the aim of better utilization of the energy used. Public utilities may utilize part of the heat produced in power plants and sell it for public heating purposes. Industries as auto-producers may sell part of the excess electricity produced to other industries or to electric utilities. (IPCC)

Community Power Aggregation
See "Community Choice Aggregation"

Community Solar / Community Solar Garden (CSG)
Solar facilities shared by multiple community subscribers who receive credit on their electricity bills for their share of the power produced. Community solar allows members of a community to share the benefits of solar power on their property without installing it on their own property. Electricity generated by the community solar farm typically costs less than the price from utility companies.

Complete Streets
A "complete street" is a design approach that requires streets to be designed to support safe, convenient and comfortable travel and access for users of all ages and abilities regardless of their mode of transportation.

Consistency
Consistency means that an inventory should be internally consistent in all its elements over a period of years. An inventory is consistent if the same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. (IPCC)

Continuous Emission Monitor (CEM)
A type of air emission monitoring system installed to operate continuously inside of a smokestack or other emission source. (CARB)

Cool Roof
Roof surfaces designed to reflect radiation from the sun, reducing heat transfer into the building or the building's surrounding area.

Cool Pavement
Pavement surfaces designed to reflect radiation from the sun, reducing heat transfer into the road's surrounding area.

Criteria Air Pollutant
An air pollutant for which acceptable levels of exposure can be determined and for which an ambient air quality standard has been set. Examples include: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM10 and PM2.5. The term "criteria air pollutants" derives from the requirement that the U.S. EPA must describe the characteristics and potential health and welfare effects of these pollutants. The U.S. EPA and CARB periodically review new scientific data and may propose revisions to the standards as a result. (CARB)

D
Deforestation
Those practices or processes that result in the change of forested lands to non-forest uses. This is often cited as one of the major causes of the enhanced greenhouse effect for two reasons: 1) the burning or decomposition of the wood releases carbon dioxide; and 2) trees that once removed carbon dioxide from the atmosphere in the process of photosynthesis are no longer present and contributing to carbon storage. (UNFCC)

Distillate Fuel Oil
A general classification for one of the petroleum fractions produced in conventional distillation operations. It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation. (EIA)

District Heating
District heating is a system for distributing heat generated in a centralized location through a system of pipes for residential and/and commercial heating within a district of a community.

E
Eco-System Services
Contributions of ecosystems to human well-being. For example, ecosystems produce resources used by humans such as clean air, water, food, open space, flood control, climate mitigation, and other benefits**.**

Emissions
The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere. (USEPA1)

Emission Factor
A coefficient that quantifies the emissions or removals of a gas per unit activity. Emission factors are often based on a sample of measurement data, averaged to develop a representative rate of emission for a given activity level under a given set of operating conditions. (IPCC)

Emission Inventory
An estimate of the amount of pollutants emitted into the atmosphere from major mobile, stationary, area-wide, and natural source categories over a specific period of time such as a day or a year. (CARB)

Emission Rate
The weight of a pollutant emitted per unit of time (e.g., tons / year). (CARB)

Energy Tariff
An Energy Tariff, or utility tariff, governs how an energy provider (electric or natural gas) charges the customer for their energy and natural gas usage. Electric and natural gas vendors must submit their tariffs to the government for approval.

Environmental Justice
The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies

Equity
The state or quality of being just and fair in the way people are treated. Equity recognizes that each person has different circumstances and allocates the exact resources and opportunities needed to reach an equal outcome. According to the World Health Organization, Equity is "the absence of avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically or geographically" while the US Center for Disease Control defines Equity as "when everyone has the opportunity to be as healthy as possible." Within the context of climate change, climate equity means both protection from climate change and environmental hazards as well as access to climate resilience and environmental benefits for all, regardless of income, race, and other characteristics.

Estimation
Estimation is the assessment of the value of an unmeasurable quantity using available data and knowledge within stated computational formulas or mathematical models.

F
Fluorocarbons
Carbon-fluorine compounds that often contain other elements such as hydrogen, chlorine, or bromine. Common fluorocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). (UNFCC)

Flux
Either (1) Raw materials, such as limestone, dolomite, lime, and silica sand, which are used to reduce the heat or other energy requirements of thermal processing of minerals (such as the smelting of metals). Fluxes also may serve a dual function as a slagging agent. (2) The rate of flow of any liquid or gas, across a given area; the amount of this crossing a given area in a given time. (e.g., "Flux of CO2 absorbed by forests"). (IPCC)

Fossil Fuel
Geologic deposits of hydrocarbons from ancient biological origin, such as coal, petroleum and natural gas.

Fuel Combustion
Fuel combustion is the intentional oxidation of materials within an apparatus that is designed to provide heat or mechanical work to a process, or for use away from the apparatus. (IPCC)

Fugitive Emissions
Fugitive emissions are unintentional leaks emitted from sealed surfaces, such as packings and gaskets, or leaks from underground pipelines resulting from corrosion or faulty connections.

G
Geologic Carbon Sequestration
It is the process of injecting CO_2 from a source, such as coal-fired electric generating power plant, through a well into the deep subsurface. With proper site selection and management, geologic sequestration could play a major role in reducing emissions of CO_2. Research efforts to evaluate the technical aspects of CO_2 geologic sequestration are underway. (USEPA4)

GHG
See "Greenhouse Gas"

Global Warming
Global warming is an average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes,

both natural and human induced. In common usage, "global warming" often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities. Also see Climate Change (USEPA1)

Global Warming Potential (GWP)
An index, based upon radiative properties of well-mixed greenhouse gases, measuring the radiative forcing of a unit mass of a given well-mixed greenhouse gas in the present-day atmosphere integrated over a chosen time horizon, relative to that of carbon dioxide. The GWP represents the combined effect of the differing times these gases remain in the atmosphere and their relative effectiveness in absorbing outgoing thermal infrared radiation. The Kyoto Protocol is based on GWPs from pulse emissions over a 100-year time frame. (IPCC2)

GCoM Global Covenant of Mayors:
GCoM is the largest global alliance for city climate leadership, built upon the commitment of over 10,000 cities and local governments. The alliance's mission is to mobilize and support climate and energy action in communities across the world.

Green Streets
A "green street" is a stormwater management approach that incorporates vegetation, soil, and engineered systems to slow, filter, and cleanse stormwater runoff from impervious surfaces.

Greenhouse Effect
Trapping and build-up of heat in the atmosphere (troposphere) near the earth's surface. Some of the heat flowing back toward space from the earth's surface is absorbed by water vapor, carbon dioxide, ozone, and several other gases in the atmosphere and then reradiated back toward the earth's surface. If the atmospheric concentrations of these greenhouse gases rise, the average temperature of the lower atmosphere will gradually increase. (UNFCC)

Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories:
A robust, transparent and globally-accepted framework that cities and local governments can use to consistently identify, calculate and report on city greenhouse gas emissions.

Greenhouse Gas
Greenhouse Gas (GHG) is any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). (UNFCC)

Greenhouse Gas Reduction
Actions taken to reduce the number and severity of potential future climate impacts compared to un-checked greenhouse gas emissions.

Green Infrastructure
An approach to managing precipitation by reducing and treating stormwater at its source while delivering environmental, social, and economic benefits. Stormwater runoff can carry trash, bacteria, and other pollutants and is a major cause of water pollution in urban areas.

Green Roof
A green roof is a layer of vegetation planted over a waterproofing system that is installed on top of a flat or slightly–sloped roof. Green roofs are also known as vegetative or eco–roofs. They fall into three main categories—extensive, intensive, and semi–intensive. Green roofs have been shown to decrease heat island contributions of buildings and decrease stormwater runoff while increasing overall vegetative land coverage.

Green wall
A green wall is similar to a green roof but applied to exterior wall surfaces.

Gross Domestic Product (GDP)
The sum of gross value added, at purchasers' prices, by all resident and non-resident producers in the economy, plus any taxes and minus any subsidies not included in the value of the products in a country or a geographic region for a given period, normally one year. It is calculated without deducting for depreciation of fabricated assets or depletion and degradation of natural resources. (IPCC3)

Groundwater
Water that occurs beneath the water table in soils and geologic formations that are fully saturated.

H

Halocarbons
A collective term for the group of partially halogenated organic species, including the chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), halons, methyl chloride, methyl bromide, etc. Many of the halocarbons have large Global Warming Potentials. The chlorine and bromine-containing halocarbons are also involved in the depletion of the ozone layer. (IPCC2)

Hazard
The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury,or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.

Heat Island
A heat island is an urban or large-scale area characterized by temperatures higher than those of the surrounding due to human activities. The difference in temperature between urban and less-developed rural areas has to do with how well the surfaces in each environment absorb and hold heat. See also "Micro Heat Island"

Hydrocarbons
Strictly defined as molecules containing only hydrogen and carbon. The term is often used more broadly to include any molecules in petroleum which also contains molecules with S, N, or O An unsaturated hydrocarbon is any hydrocarbon containing olefinic or aromatic structures. (IPCC)

Hydrofluorocarbons (HFCs)
Compounds containing only hydrogen, fluorine, and carbon atoms. They were introduced as alternatives to ozone depleting substances in serving many industrial, commercial, and personal needs. HFCs are emitted as by-products of industrial processes and are also used in manufacturing. They do not significantly deplete the stratospheric ozone layer, but they are powerful greenhouse gases with global warming potentials ranging from 140 (HFC-152a) to 11,700 (HFC-23). (USEPA1)

I

ICLEI Local Governments for Sustainability:
A membership organization for local governments to pursue reductions in carbon pollution and improvements in advancing sustainable urban development. ICLEI's members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

Impact
An effect of climate change on the structure or function of a system: for example, environmental consequences of climate change, such as extreme heat waves, rising sea levels, or changes in precipitation resulting in flooding and droughts.

Intergovernmental Panel on Climate Change
The IPCC was established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988. The purpose of the IPCC is to assess information in the scientific and technical literature related to all significant components of the issue of climate change. The IPCC draws upon hundreds of the world's expert scientists as authors and thousands as expert reviewers. Leading experts on climate change and environmental, social, and economic sciences from some 60 nations have helped the IPCC to prepare periodic assessments of the scientific underpinnings for understanding global climate change and its consequences. With its capacity for reporting on climate change, its consequences, and the viability of adaptation and mitigation measures, the IPCC is also looked to as the official advisory body to the world's governments on the state of the science of the climate change issue. For example, the IPCC organized the development of internationally accepted methods for conducting national greenhouse gas emission inventories. (USEPA1)

K

Kilowatt Hour (kWh):
A measure of electrical energy equivalent to a power consumption of 1,000 watts for one hour.

Kyoto Protocol
The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1997 in Kyoto, Japan, at the Third Session of the Conference of the Parties (COP) to the UNFCCC. It contains legally binding commitments, in

addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (most Organisation for Economic Cooperation and Development countries and countries with economies in transition) agreed to reduce their anthropogenic greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride) by at least 5% below 1990 levels in the commitment period 2008 to 2012. The Kyoto Protocol entered into force on 16 February 2005. (IPCC2)

L

Land Use and Land Use Change
Land use refers to the total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The term land use is also used in the sense of the social and economic purposes for which land is managed (e.g., grazing, timber extraction and conservation). Land use change refers to a change in the use or management of land by humans, which may lead to a change in land cover. Land cover and land use change may have an impact on the surface albedo, evapotranspiration, sources and sinks of greenhouse gases, or other properties of the climate system and may thus have a radiative forcing and/or other impacts on climate, locally or globally. (IPCC2)

Living Streets
A "living street" combines the concepts of complete streets and green streets while putting additional focus on quality of life aspects for City residents.

LULUCF
Acronym for "Land Use, Land Use Change and Forestry", a category of activities in GHG inventories.

M

Megawatt Hour (MWH):
A measure of electrical energy equivalent to a power consumption of 1,000,000 watts for one hour.

Methane (CH_4)
A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 25 times that of carbon dioxide (CO_2). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, flooded rice fields, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion. The GWP is from the IPCC's Fourth Assessment Report (AR4).

Metric Ton
The tonne (t) or metric ton (MT), sometimes referred to as a metric tonne, is an international unit of mass. A metric ton is equal to a Megagram (Mg), 1000 kilograms, 2204.6 pounds, or 1.1023 short tons.

Micro Heat Island
Micro heat islands are smaller scale hot spots within developed areas which experience higher temperatures than surrounding areas due to how well the surfaces in the location absorb, reflect, and hold heat. These occur in areas such as poorly vegetated parking lots, non-reflective roofs and asphalt roads. Micro urban heat islands are strongly affected by micro climate factors and localized conditions of the built environment. See also "Heat Island"

Million Metric Tons (MMT)
Common measurement used in GHG inventories. It is equal to a Teragram (Tg).

Mitigation:
Actions taken to limit the magnitude or rate of long-term global warming and its related effects. Climate change mitigation generally involves reductions in human emissions of greenhouse gases.

Mobile Sources
Sources of air pollution such as automobiles, motorcycles, trucks, off-road vehicles, boats, and airplanes. (CARB)

Mode Share
The percentage of travelers using a particular type of transportation. Modal share is an important component in developing sustainable transport within a city or region because it reveals the level of utilization of various transportation methods. The percentage reflects how well infrastructure, policies, investments, and land-use patterns support different types of travel.

Model
A model is a quantitatively-based abstraction of a real-world situation which may simplify or neglect certain features to better focus on its more important elements. (IPCC)

Municipal Power Aggregation
See "Community Choice Aggregation"

Municipal Solid Waste (MSW)
Residential solid waste and some non-hazardous commercial, institutional, and industrial wastes. This material is generally sent to municipal landfills for disposal. (USEPA1)

N

Natural Sources
Non-manmade emission sources, including biological and geological sources, wildfires, and windblown dust. (CARB)

Net Energy Metering, (NEM)
Net Energy Metering (NEM), also known as Net Metering, allows residential and commercial customers who generate their own electricity from solar power to sell the electricity they aren't using back into the grid. The NEM rate schedule (energy tariff) determines how much you are paid for the electricity you sold to the grid. Many states have passed net metering laws. In other states, utilities may offer net metering programs voluntarily or as a result of regulatory decisions. Differences between state legislation, regulatory decisions and implementation policies mean that the mechanism for compensating solar customers varies widely across the country.

Net Zero Emissions (NZE)
Refers to a community, business, institution, or building for which, on an annual basis, all greenhouse gas emissions resulting from operations are offset by carbon-free energy production. An NZE building or property is one which generates or offsets all energy consumed. If a City develops a NZE building code, this definition will have to be refined to provide additional guidance on calculating emissions and offsets to achieve net-zero emissions.

Nitrogen Fixation
Conversion of atmospheric nitrogen gas into forms useful to plants and other organisms by lightning, bacteria, and blue-green algae; it is part of the nitrogen cycle. (UNFCC)

Nitrogen Oxides (NO_x)
Gases consisting of one molecule of nitrogen and varying numbers of oxygen molecules. Nitrogen oxides are produced in the emissions of vehicle exhausts and from power stations. In the atmosphere, nitrogen oxides can contribute to formation of photochemical ozone (smog), can impair visibility, and have health consequences; they are thus considered pollutants. (NASA)

Nitrous Oxide (N_2O)
A powerful greenhouse gas with a global warming potential of 298 times that of carbon dioxide (CO_2). Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, manure management, fossil fuel combustion, nitric acid production, and biomass burning. The GWP is from the IPCC's Fourth Assessment Report (AR4).

O

Ozone (O_3)
Ozone, the triatomic form of oxygen (O_3), is a gaseous atmospheric constituent. In the troposphere, it is created both naturally and by photochemical reactions involving gases resulting from human activities (smog). Tropospheric ozone acts as a greenhouse gas. In the stratosphere, it is created by the interaction between solar ultraviolet radiation and molecular oxygen (O_2). Stratospheric ozone plays a dominant role in the stratospheric radiative balance. Its concentration is highest in the ozone layer. (IPCC2)

Ozone Depleting Substances (ODS)
A compound that contributes to stratospheric ozone depletion. Ozone-depleting substances (ODS) include CFCs, HCFCs, halons, methyl bromide, carbon tetrachloride, and methyl chloroform. ODS are generally very stable in the troposphere and only degrade under intense ultraviolet light in the stratosphere. When they break down, they release chlorine or bromine atoms, which then deplete ozone. (IPCC)

P

Perfluorocarbons (PFCs)
A group of human-made chemicals composed of

carbon and fluorine only. These chemicals (predominantly CF_4 and C_2F_6) were introduced as alternatives, along with hydrofluorocarbons, to the ozone depleting substances. In addition, PFCs are emitted as by-products of industrial processes and are also used in manufacturing. PFCs do not harm the stratospheric ozone layer, but they are powerful greenhouse gases: CF_4 has a global warming potential (GWP) of 7,390 and C_2F_6 has a GWP of 12,200. The GWP is from the IPCC's Fourth Assessment Report (AR4).

Phantom Load
Phantom load refers to the energy used by any appliance or electronic device (such as televisions, DVD players, microwaves and personal computers) that still uses electricity or "standby power" when turned off. An appliances that draws "phantom loads" means it is constantly drawing electricity.

Photosynthesis
The process by which plants take carbon dioxide from the air (or bicarbonate in water) to build carbohydrates, releasing oxygen in the process. There are several pathways of photosynthesis with different responses to atmospheric carbon dioxide concentrations. (IPCC2)

Plug Load
Plug loads refer to energy used by equipment that is plugged into an outlet. In an office, key plug loads include computer and monitors, printers, and copiers. Plug loads as a share of overall building energy use is higher in energy efficient buildings.

POC
"People of Color" or "Person of Color" is a general umbrella term that collectively refers to all non-white demographic groups.

Point Sources
Specific points of origin where pollutants are emitted into the atmosphere such as factory smokestacks. (CARB)

Power Purchase Agreement (PPA)
A power purchase agreement (PPA), or electricity power agreement, is a contract between two parties; one party generates electricity (the seller) and the other party looks to purchase electricity (the buyer). Individual customers and organizations may enter into PPAs with individual developers or may join together to seek better prices as a group. PPAs can allow longer term commitments to renewable energy as well as a form of "direct" investing in new renewable energy generation.

Property-Assessed Clean Energy (PACE)
A program created for financing energy efficiency and renewable improvements on private property. Private property can include residential, commercial or industrial properties. Improvements can include energy efficiency, renewable energy and water conservation upgrades to a building.

Process Emissions
Emissions from industrial processes involving chemical transformations other than combustion. (IPCC)

R

Radiative Forcing
A change in the balance between incoming solar radiation and outgoing infrared (i.e., thermal) radiation. Without any radiative forcing, solar radiation coming to the Earth would continue to be approximately equal to the infrared radiation emitted from the Earth. The addition of greenhouse gases to the atmosphere traps an increased fraction of the infrared radiation, reradiating it back toward the surface of the Earth and thereby creates a warming influence. (UNFCC)

Reforestation
Planting of forests on lands that have previously contained forests but that have been converted to some other use. (IPCC2)

Regeneration
The act of renewing tree cover by establishing young trees, naturally or artificially - note regeneration usually maintains the same forest type and is done promptly after the previous stand or forest was removed. (CSU)

Renewable Energy
Energy resources that are naturally replenishing such as solar, wind, hydro and geothermal energy.

Renewable Energy Credits (RECs)

A market-based instrument that represents the property rights to the environmental, social and other non-power attributes of renewable electricity generation. RECs are issued when one megawatt-hour (MWh) of electricity is generated and delivered to the electricity grid from a renewable energy resource. The single largest category of reductions in Evanston's emissions has been through the purchase of RECs.

Residence Time
Average time spent in a reservoir by an individual atom or molecule. Also, this term is used to define the age of a molecule when it leaves the reservoir. With respect to greenhouse gases, residence time usually refers to how long a particular molecule remains in the atmosphere. (UNFCC)

Resilience
The ability to anticipate, prepare for, respond to, and recover quickly from climate change hazards with minimum damage to social well-being, the economy, and the environment.

Reservoir
Either (1) a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored; or (2) Water bodies regulated for human activities (energy production, irrigation, navigation, recreation etc.) where substantial changes in water area due to water level regulation may occur. (IPCC)

Respiration
The process whereby living organisms convert organic matter to carbon dioxide, releasing energy and consuming molecular oxygen. (IPCC2)

Retro-commissioning
The systematic process to improve an existing building's performance ensuring the building controls are running efficiently and balancing the designed use and the actual use of the building.

Ride-share
The practice of sharing transportation in the form of carpooling or vanpooling. It is typically an arrangement made through a ride-matching service that connects drivers with riders.

S

Scope 1:
Scope 1 includes emissions being released within the city limits resulting from combustion of fossil fuels and from waste decomposition in the landfill and wastewater treatment plant.

Scope 2:
Scope 2 includes emissions produced outside the city that are induced by consumption of electrical energy within the city limits.

Scope 3:
Scope 3 includes emissions of potential policy relevance to local government operations that can be measured and reported but do not qualify as Scope 1 or 2. This includes, but is not limited to, outsourced operations and employee commute.

Short Ton
Common measurement for a ton in the United States. A short ton is equal to 2,000 lbs or 0.907 metric tons. (USEPA1)

Sink
Any process, activity or mechanism that removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol from the atmosphere. (IPCC2)

Social Cost of Carbon
The social cost of carbon is a measure of the economic harm from climate change impacts, expressed as the dollar value of the total damages from emitting one ton of carbon dioxide into the atmosphere.

Solar Radiation
Electromagnetic radiation emitted by the Sun. It is also referred to as shortwave radiation. Solar radiation has a distinctive range of wavelengths (spectrum) determined by the temperature of the Sun, peaking in visible wavelengths. (IPCC2)

Source
Any process, activity or mechanism that releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol into the atmosphere. (IPCC2)

Stationary Sources
Non-mobile sources such as power plants, refineries,

and manufacturing facilities which emit air pollutants. (CARB)

Strategy / Strategic Goal
Specific statements of direction that expand on the sustainability vision and GHG reduction goals and guide decisions about future public policy, community investment, and actions.

Sulfur Dioxide (SO_2)
A compound composed of one sulfur and two oxygen molecules. Sulfur dioxide emitted into the atmosphere through natural and anthropogenic processes is changed in a complex series of chemical reactions in the atmosphere to sulfate aerosols. These aerosols are believed to result in negative radiative forcing (i.e., tending to cool the Earth's surface) and do result in acid deposition (e.g., acid rain). (UNFCC)

Sulfur Hexafluoride (SF_6)
A colorless gas soluble in alcohol and ether, slightly soluble in water. A very powerful greenhouse gas with a global warming potential most recently estimated at 22,800 times that of carbon dioxide (CO_2). SF_6 is used primarily in electrical transmission and distribution systems and as a dielectric in electronics. This GWP is from the IPCC's Fourth Assessment Report (AR4).

T
Terrestrial Carbon Sequestration
It is the process through which carbon dioxide (CO_2) from the atmosphere is absorbed by trees, plants and crops through photosynthesis, and stored as carbon in biomass (tree trunks, branches, foliage and roots) and soils. The term "sinks" is also used to refer to forests, croplands, and grazing lands, and their ability to sequester carbon. Agriculture and forestry activities can also release CO_2 to the atmosphere. Therefore, a carbon sink occurs when carbon sequestration is greater than carbon releases over some time period. (USEPA3)

Therm:
A unit of measure for energy that is equivalent to 100,000 British Thermal units, or roughly the energy in 100 cubic feet of natural gas. Often used for measuring natural gas usage for billing purposes.

Total Organic Gases (TOG)
Gaseous organic compounds, including reactive organic gases and the relatively unreactive organic gases such as methane. (CARB)

Transparency
Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information. (IPCC)

Trend
The trend of a quantity measures its change over a time period, with a positive trend value indicating growth in the quantity, and a negative value indicating a decrease. It is defined as the ratio of the change in the quantity over the time period, divided by the initial value of the quantity, and is usually expressed either as a percentage or a fraction. (IPCC)

U
Urban Tree Canopy
Describes the makeup and characteristics of trees within the urban environment.

V
VMT Vehicle Miles Traveled:
A unit used to measure vehicle travel made by private vehicles, including passenger vehicles, truck, vans and motorcycles. Each mile traveled is counted as one vehicle mile regardless of the number of persons in the vehicle.

Vision Zero:
Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all.
https://visionzeronetwork.org/

Vulnerability
The degree to which a system is susceptible to or unable to cope with, adverse effects of climate change. Vulnerability consists of the following:

- Exposure: The presence of people, ecosystems, or assets in places and settings that could be adversely affected by climate change impacts
- Sensitivity: The degree to which people,

ecosystems, or assets are affected by climate change
- Adaptive capacity: The ability of assets, systems or people to adjust to an adverse impact

W

Water Vapor

The most abundant greenhouse gas; it is the water present in the atmosphere in gaseous form. Water vapor is an important part of the natural greenhouse effect. While humans are not significantly increasing its concentration, it contributes to the enhanced greenhouse effect because the warming influence of greenhouse gases leads to a positive water vapor feedback. In addition to its role as a natural greenhouse gas, water vapor plays an important role in regulating the temperature of the planet because clouds form when excess water vapor in the atmosphere condenses to form ice and water droplets and precipitation. (UNFCC)

Weather

Atmospheric condition at any given time or place. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to-hour, day-to-day, and season-to-season. Climate in a narrow sense is usually defined as the "average weather", or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. A simple way of remembering the difference is that climate is what you expect (e.g. cold winters) and 'weather' is what you get (e.g. a blizzard). (USEPA1)

Z

Zero Emission Vehicles (ZEV)

A vehicle that does not emit harmful emissions during operation. Harmful emissions can have a negative impact on human health and the environment. Electric (battery-powered) cars, electric trains, hydrogen-fueled vehicles, bicycles, and carriages are considered to produce zero emissions.

Zero Waste

The conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health.

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