

# CONCEPTUAL PATHWAYS FOR CLIMATE CHANGE HAZARDS AND HEALTH

CLIMATE DRIVERS	HAZARD	EXPOSURES	VULNERABLE GROUPS	HEALTH RISKS
Heat <i>All Regions</i>	Heat Events: <ul style="list-style-type: none"><li>• More frequent</li><li>• Longer duration</li><li>• More extreme</li></ul>	Elevated temperatures	<ul style="list-style-type: none"><li>• People over age 65</li><li>• People over age 65 and living alone</li><li>• Children under age 5</li><li>• People with preexisting conditions:<ul style="list-style-type: none"><li>◦ Diabetes</li><li>◦ Cardiovascular disease</li><li>◦ Renal system disease</li></ul></li><li>• People of color<sup>1</sup></li><li>• People working or exercising outdoors</li><li>• People with limited English proficiency</li></ul>	<ul style="list-style-type: none"><li>• Heat Exhaustion</li><li>• Heat Stroke</li><li>• Illness or death due to cardiovascular disease</li><li>• Illness or death due to renal system failure</li></ul>
	Poor Outdoor Air Quality: <ul style="list-style-type: none"><li>• Increases in ozone</li><li>• Increases in particulate matter</li><li>• Increased pollen production</li><li>• Longer pollen season</li></ul>	Ozone, Particulate Matter	<ul style="list-style-type: none"><li>• People over age 65</li><li>• Children under age 5</li><li>• People with pre-existing conditions: asthma, COPD, respiratory allergies, cardiovascular disease</li><li>• People working or exercising outdoors</li><li>• People with limited English proficiency</li></ul>	<ul style="list-style-type: none"><li>• Respiratory arrest</li><li>• Exacerbation of asthma and other lung disease</li><li>• Exacerbation of allergies and respiratory infections</li><li>• Reduction in childhood lung function development<sup>2</sup></li></ul>
		Pollen	<ul style="list-style-type: none"><li>• People with allergies</li><li>• People with asthma</li></ul>	<ul style="list-style-type: none"><li>• Exacerbation of asthma</li><li>• Allergy symptoms</li></ul>
	Food-borne Illness	Spoiled food from refrigeration failure in transport/storage	<ul style="list-style-type: none"><li>• People over age 65</li><li>• Children under age 5</li><li>• Pregnant women</li><li>• People with compromised immune systems</li></ul>	<ul style="list-style-type: none"><li>• Gastrointestinal illness</li></ul>
		Changes in patterns of <i>salmonella</i> growth	<ul style="list-style-type: none"><li>• People over age 65</li><li>• Children under age 5</li><li>• Pregnant women</li><li>• People with compromised immune systems</li></ul>	<ul style="list-style-type: none"><li>• <i>Salmonella</i> infection</li></ul>
	Drought	Water quality degradation	<ul style="list-style-type: none"><li>• People over age 65</li><li>• Children under age 5</li><li>• Pregnant women</li><li>• People with compromised immune systems</li></ul>	<ul style="list-style-type: none"><li>• Gastrointestinal illness</li><li>• Nitrate exposure</li><li>• Naturally occurring arsenic and uranium exposure<sup>3</sup></li></ul>
Heat and Increased Precipitation <i>All Regions</i>	Vectorborne Disease: <ul style="list-style-type: none"><li>• Longer seasons</li><li>• Expanding ranges</li><li>• Increased habitat</li><li>• Higher breeding rates</li></ul>	Ticks	<ul style="list-style-type: none"><li>• People working or exercising outdoors</li><li>• People with pets that go outdoors</li></ul>	<ul style="list-style-type: none"><li>• Tick-borne illnesses (e.g. Lyme, Babesiosis, Anaplasmosis)</li></ul>
		Mosquitoes	<ul style="list-style-type: none"><li>• People working or exercising outdoors</li></ul>	<ul style="list-style-type: none"><li>• West Nile Virus</li><li>• Eastern Equine Encephalitis</li></ul>
	Biological Contamination of Water	Contact with water contaminated with fecal bacteria (e.g. <i>E. Coli</i> or <i>salmonella</i> ) from runoff, flooding, or sewer overflow discharge <sup>4</sup>	<ul style="list-style-type: none"><li>• People over age 65</li><li>• Children under age 5</li><li>• Pregnant women</li><li>• People with compromised immune systems</li></ul>	<ul style="list-style-type: none"><li>• Skin infections</li><li>• Eye infections</li><li>• Wound infections</li><li>• Gastrointestinal illness</li></ul>
		Water or shellfish contaminated with Vibrio bacteria (e.g. <i>Vibrio vulnificus</i> , <i>Vibrio parahaemolyticus</i> ) <sup>5</sup>	<ul style="list-style-type: none"><li>• People over age 65</li><li>• Children under age 5</li><li>• Pregnant women</li><li>• People with compromised immune systems</li><li>• People with liver disease or Thalassemia</li><li>• People who consume raw shellfish</li><li>• People who take medications that decrease stomach acid levels</li></ul>	<ul style="list-style-type: none"><li>• Gastrointestinal illness</li><li>• Wound infection</li><li>• Septicemia (bloodstream infection)</li></ul>
		Contact with Algae Blooms (Cyanobacteria) <sup>6</sup>	<ul style="list-style-type: none"><li>• Children under age 5</li><li>• People who boat or swim in fresh water lakes, ponds, and rivers</li><li>• Pets</li></ul>	<ul style="list-style-type: none"><li>• Gastrointestinal symptoms</li><li>• Skin and eye irritation</li><li>• Neurological damage</li><li>• Liver damage</li></ul>
	Chemical Contamination of Water	Contact with chemically contaminated water from flooding and runoff	<ul style="list-style-type: none"><li>• People over age 65</li><li>• Children under age 5</li><li>• Pregnant women</li></ul>	<ul style="list-style-type: none"><li>• Skin reactions</li><li>• Chronic illness</li></ul>

For more information about the health impacts of climate change in Massachusetts contact:

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CLIMATE DRIVERS	HAZARD	EXPOSURES	VULNERABLE GROUPS	HEALTH RISKS
Flooding (inland and coastal)  All Regions	All Flooding	Contaminated flood water (direct contact or flood-contaminated drinking water)	<ul style="list-style-type: none"> <li>• People over age 65</li> <li>• Children under age 5</li> <li>• Pregnant women</li> <li>• People with compromised immune systems</li> <li>• People with limited English proficiency</li> </ul>	<ul style="list-style-type: none"> <li>• Skin infections</li> <li>• Eye infections</li> <li>• Wound infections</li> <li>• Trench foot</li> <li>• Gastrointestinal illness</li> </ul>
		Debris/Physical hazards	<ul style="list-style-type: none"> <li>• Adolescents and Young Adults<sup>7</sup></li> <li>• Utility workers</li> <li>• Rescue workers</li> </ul>	<ul style="list-style-type: none"> <li>• Injury or death from debris, downed wires, drowning, falls, and motor vehicle crashes</li> </ul>
		Loss of electricity, heat	<ul style="list-style-type: none"> <li>• People over age 65</li> <li>• People living alone</li> <li>• Children under age 5</li> <li>• People using medical equipment that requires electrical power or medications that require refrigeration</li> </ul>	<ul style="list-style-type: none"> <li>• Carbon Monoxide (CO) Poisoning</li> <li>• Falls and injuries in the home</li> <li>• Medical emergencies due to loss of medical equipment function</li> <li>• Medical emergencies due to spoiled medications</li> </ul>
		Relocation/Displacement	<ul style="list-style-type: none"> <li>• People over age 65</li> <li>• People with limited mobility</li> <li>• People under age 18</li> <li>• People with low socioeconomic status</li> <li>• People who rent their homes</li> <li>• People with limited English proficiency</li> <li>• People of color</li> </ul>	<ul style="list-style-type: none"> <li>• Psychological stress</li> <li>• Financial loss stress</li> <li>• Loss of employment</li> <li>• Substance abuse</li> </ul>
		Mold	<ul style="list-style-type: none"> <li>• Children under age 5</li> <li>• People with compromised immune systems or respiratory disease</li> <li>• People with Allergies</li> <li>• People with Asthma</li> </ul>	<ul style="list-style-type: none"> <li>• Allergic reactions</li> <li>• Respiratory illness</li> </ul>
	Tidal Flooding	Salinization of land leading to loss of shade cover and green space	<ul style="list-style-type: none"> <li>• People susceptible to heat-related illness (see groups vulnerable to heat events, page 1)</li> </ul>	<ul style="list-style-type: none"> <li>• Heat-related illnesses (see heat related health risks, page 1)</li> </ul>
		Salt intrusion into drinking water supplies	<ul style="list-style-type: none"> <li>• People with hypertension or other salt-sensitive illnesses/medications</li> </ul>	<ul style="list-style-type: none"> <li>• Hypertension</li> <li>• Medication interactions</li> </ul>
Extreme Weather  All Regions	Damage to critical infrastructure	Loss of electricity, heat	<ul style="list-style-type: none"> <li>• People over age 65</li> <li>• People living alone</li> <li>• Children under age 5</li> <li>• People using medical equipment that requires electrical power or medications that require refrigeration</li> </ul>	<ul style="list-style-type: none"> <li>• Hypothermia</li> <li>• Carbon Monoxide (CO) Poisoning</li> <li>• Falls and injuries in the home</li> <li>• Medical emergencies due to loss of medical equipment function</li> <li>• Medical emergencies due to spoiled medications</li> </ul>
		Loss of water and sewer/septic utilities	<ul style="list-style-type: none"> <li>• People over age 65</li> <li>• Children under age 5</li> <li>• Pregnant women</li> <li>• People with compromised immune systems</li> <li>• People with limited English fluency</li> </ul>	<ul style="list-style-type: none"> <li>• Gastrointestinal illness</li> <li>• Dehydration</li> </ul>
		Damage to roadways	<ul style="list-style-type: none"> <li>• People over age 65</li> <li>• People living alone</li> <li>• Children under age 5</li> <li>• Pregnant women</li> <li>• People with limited mobility</li> <li>• People with chronic medical conditions requiring frequent care</li> </ul>	<ul style="list-style-type: none"> <li>• Death or injury due to delayed emergency response</li> <li>• Motor vehicle accidents/injuries</li> </ul>
	Direct storm impacts	Debris/Physical hazards	<ul style="list-style-type: none"> <li>• Adolescents and Young Adults<sup>7</sup></li> <li>• Utility workers</li> <li>• Rescue workers</li> </ul>	<ul style="list-style-type: none"> <li>• Injury or death from debris, downed wires, falling trees, falls, and motor vehicle crashes</li> </ul>

1. Hattis D, Ogneva-Himmelberger Y, Ratck S. The spatial variability of heat-related mortality in Massachusetts. Applied Geography 33 (2012) 45-52.
2. Gauderman WJ, Avol E, Gilliland F, Vora H, Thomas D, Berhane K, McConnell R, Kuenzli N, Lurmann F, Rappaport E, Margolis H, Bates D, Peters J. The effect of air pollution on lung development from 10 to 18 years of age. N Engl J Med. 2004 Sep 9;351(11):1057-67.
3. USGS Uranium and Arsenic Bedrock Well Study for Massachusetts on Mass.gov: <https://www.mass.gov/service-details/arsenic-uranium-bedrock-well-study-location-lookup-for-arsenic-and-uranium>
4. Flood Waters or Standing Waters: Health Risks. Available from the US Centers for Disease Control: <https://www.cdc.gov/healthywater/emergency/extreme-weather/floods-standingwater.html>
5. Vibrio vulnificus Infections and Disasters: Disaster Recovery Fact Sheet. Available from the US Centers for Disease Control: <https://www.cdc.gov/disasters/vibriovulnificus.html>
6. Harmful algal blooms in fresh water bodies (Massachusetts DPH fact sheet). Available at Mass.gov: <https://www.mass.gov/files/documents/2016/08/ww/algae-fresh-water-english.pdf>
7. Lowe D, Ebi KL, Forsberg B. Factors Increasing Vulnerability to Health Effects before, during and after Floods. Int. J. Environ. Res. Public Health 2013, 10, 7015-7067.

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