PUBLIC HEALTH & SAFETY

The 2006 Study did not provide a direct, in-depth discussion of the impacts of climate change to public health and safety, but general assertions made, such as the danger of wildfires to human health, still hold true. This 2014 report provides a preliminary assessment of potential impacts to human health and safety in the Aspen area as a result of climate change, though more detailed assessment based on site specific conditions and vulnerabilities is still needed.

Aspen's elevation and geographic location will likely serve as an important source of protection against some anticipated health impacts associated with climate change. Aspen is not immune to all potential risks, however. Some risks, such as wildfires, landslides, or deterioration of air quality, may have direct impacts on the health and safety of visitors and residents of Aspen. Other threats may be more indirect, such as increased anxiety about the state of the environment or altered mobility or economic stability of potential visitors to Aspen[85].

Visitors and locals alike would both be at risk in the case of catastrophic events, such as landslides or fires. While fires are an important natural cycle for ecosystems, they also pose serious threats to human health: loss of property and risk of direct physical harm and increase potential for related floods or landslides. With a large proportion of Aspen's population living and recreating in or near forested areas, potential health and safety consequences for Aspen from wildfires are considerable. In the western United States, the active wildfire season has increased by 78 days over the last century, and the odds of increasingly large or intense wildfires are anticipated to rise in the future.[86]

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[85] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds. 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program: 841. doi: 10.7930/J0Z31WJ2.

[86] Running, Steven W. 2006. Is Global Warming Causing More, Larger Wildfires? *Science* 313 (5789): 927-928. doi:10.1126/science.1130370

Decreased air quality

Recent findings suggest that in addition to increased fire risk, the warmer temperatures associated with climate change may also have impacts on air quality. The early onset and greater duration of the growing season may increase the length of the allergy season, while CO_2 fertilization may increase pollen and spore production, worsening allergies for those with hay fever.[87]

Additionally, hot days often correlate with higher levels of ground-level ozone, so an increasing number of warm days could mean more frequent days with ozone levels above those considered healthy. Ozone is an oxidant and at high concentrations reacts with human tissue. High levels of ozone can irritate lung tissue, aggravate pre-existing respiratory conditions, and may contribute to increased likelihood of respiratory infections.[88]

Changes in temperature and precipitation regimes could have a significant impact on the spread of disease, even for high altitude locations.

Aspen's recent ozone levels (2013) have been below the EPA standard of 75 parts per billion, but high temperatures correlate with higher levels of ground-level ozone, so as temperatures rise, ozone levels throughout the summer months may also increase. [89]

Fine airborne particulate matter can also pose respiratory risks. Impacts of climate change on aerosols and particulate matter are still not fully understood, but increased incidence of fires would increase both. Further, changes in wind or weather patterns could change global distribution of pollution from transportation and industry as well as wind borne mineral dust from mining, fossil fuel extraction and recreation particularly from upwind desert areas to the west — all important source of particulates. Particulate pollution from combustion is released by high-temperature industrial processes, wildfires, gasoline and diesel engines, and during the production of fossil-based power.[90] Although the City of Aspen Electric system is on its way to

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[87] Frumkin, Howard, Jeremy Hess, George Luber, Josephine Malilay, and Michael McGeehin. 2008. Climate Change: The Public Health Response. *American Journal of Public Health* 98 (3): 435-445. doi: 10.2105/AJPH.2007.119362

[88] Climate Impacts on Human Health. Human Health Web Page. Last updated Sept. 2013. Environmental Protection Agency. Available at http://www.epa.gov/climatechange/impacts-adaptation/health.html

[89] Aspen/Pitkin County Website. Data available at: http://www.aspenpitkin.com/Departments/Environmental-Health/Air-Quality-Outdoors/Ozone/Historical-Ozone-Levels/

[90] Climate Impacts on Human Health 2013

achieving 100 percent of its electricity from renewables, pollution from far away sources and, locally, its busy streets will continue to affect Aspen air quality.[91]

Figure 4.3 Projected probability of presence of West Nile Virus

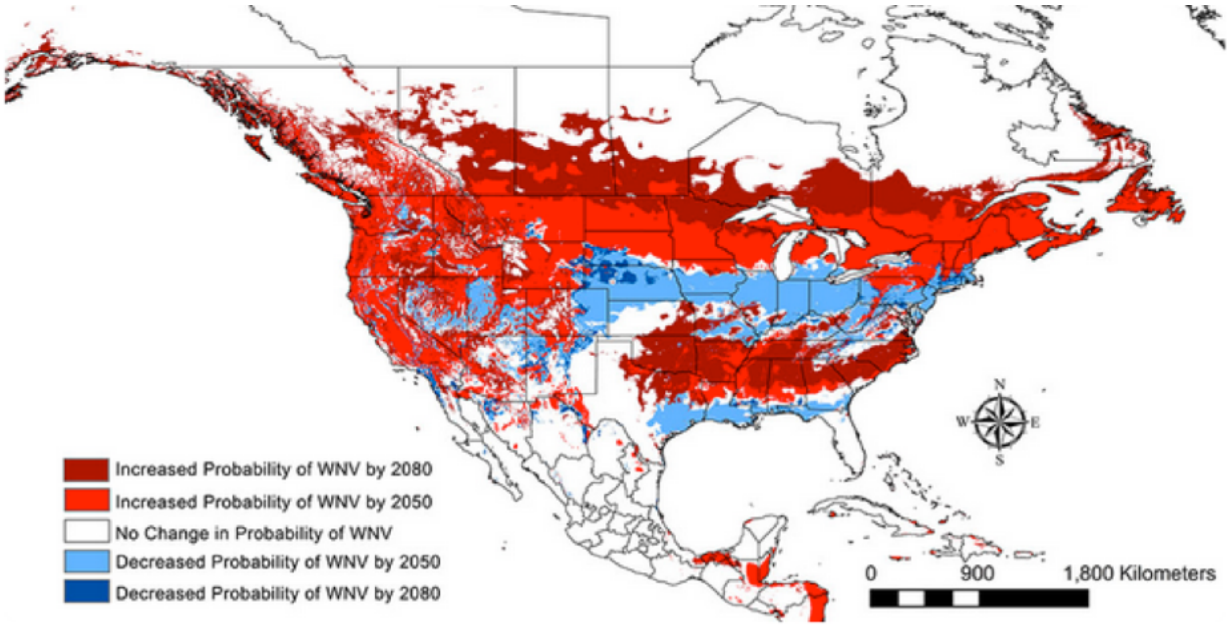

Figure 4.3 Probability of presence of West Nile virus (WNV) projected for the years 2050 and 2080 under the A1B middle emissions climate scenario. Areas in red indicate increased probability of WNV presence by at least 10% compared to current incidence. Areas in blue represent decreased predicted prevalence. Source: Harrigan et al. 2014.

Vector borne disease

As temperatures shift across the United States, so too will the range of animal species that are vectors for disease. As temperature and moisture regimes change, so too might the prevalence of carrier species, such as the birds and insects spreading vector borne diseases such as West Nile Virus (WNV).

The Center for Disease Control reports that there were 318 cases of WNV and 7 WNV-related deaths reported for Colorado in 2013.[92] A recent study by Harrigan and colleagues found a strong correlation between prevalence of West Nile Virus and higher temperature/lower

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[91] Frumkin, Howard, Jeremy Hess, George Luber, Josephine Malilay, and Michael McGeehin. 2008. Climate Change: The Public Health Response. *American Journal of Public Health*. 98(3), 435-445. doi: 10.2105/AJPH.2007.119362

[92] Data available at: http://www.cdc.gov/westnile/statsMaps/preliminaryMapsData/histatedate.html

precipitation regimes.[93] As a result, climate variables can be used to project the probability of the presence of West Nile Virus (WNV), where higher maximum temperatures in the warmest month lead to higher probability of virus presence. Seasonal drying and lower annual precipitation were also associated with higher likelihood of outbreaks over the next 50-80 years. Harrigan et al also found that the geographic distribution of WNV was expected to shift northward and up in altitude with climate change, increasing probability of WNV by 2050 for the Rocky Mountain Region of Colorado, including high altitude locations (see Figure 4.3).[66]

The shift to warmer temperatures may also lead to an upward movement in the distribution of invasive mosquito species, including those typically associated with tropical habitats and tropical disease. Changes in land use, socio-economic conditions, human behavior, population density, and water use all may additionally play a role in prevalence and spread of transmission of vector borne diseases.[94] The presence of a disease such as WNV in the Aspen area could have significant negative impact on local bird populations and could pose a direct threat to human health.

Other potential threats to public health and safety include: mental health concerns, changes in food and water supply stability, and increased pressure on resources as a consequence of population increase. For example, climate change may impact mental health in the form of anxiety over associated environmental degradation or stress in relation to a climate driven disaster, such as a wildfire.[95] Additionally, both local and non-local food production may shift in relation to changes in climate patterns, water availability, and disruptions to global food markets.

Response strategies

Outreach, development of appropriate codes, increasing response capacity, identification of high risk locations, and structural changes are all potential strategies for adaptively managing climate-related risks to public health and safety. Building codes and conscientious development planning are key to helping prevent disasters such as fires or flooding and can assist in avoiding development of mosquito-prone areas.

Distribution of information can also help to ameliorate the health risks associated with climate change. Public education and outreach, particularly for tourists, can help to prevent illnesses

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[93] Harrigan, Ryan J., Henri A. Thomassen, Wolfgang Buermann, and Thomas B. Smith. 2014. A continental risk assessment of West Nile virus under climate change. *Global Change Biology*. John Wiley and Sons, Ltd. doi: 10.1111/gcb.12534

[94] Harrigan, Ryan J., Henri A. Thomassen, Wolfgang Buermann, and Thomas B. Smith. 2014. A continental risk assessment of West Nile virus under climate change. *Global Change Biology*. John Wiley and Sons, Ltd. doi: 10.1111/gcb.12534

[95] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds. 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program: 841. doi: 10.7930/J0Z31WJ2.

such as heat stress. Education can also play a role in disaster readiness. It can help to build compliance with laws and regulations and can encourage preparedness at a family level. For example, the Center for Disease Control promotes creation of escape plans and disaster kits in every home.[96]

Finally, promoting enhanced response capacity can improve community ability to meet a variety of as-of-yet uncertain health concerns. For example, health care providers may evaluate the

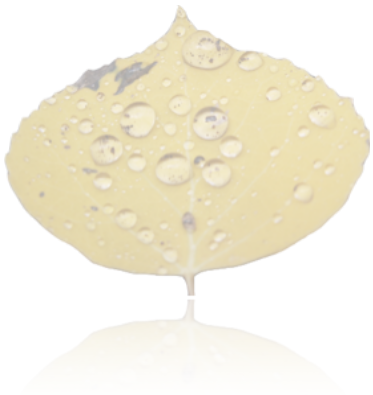
Box 4.4 Health and safety summary

Climate-related Changes
- Increased frequency of extreme high temperatures
- Increased risk of extreme events (e.g. drought, fire, flood, landslide)
- Increased presence of particulate matter and tropospheric ozone
- Changing ranges of disease-carrying species
- Changing climate conditions affecting food supply

Future Potential Impacts
- Environmental stress-related mental illnesses
- Increased respiratory illnesses as a result of air quality impairment
- Increased incidence of vector borne diseases
- Loss of property or injury related to disaster events
- Lengthened and intensified allergy season

Potential Responses
- Assessment of high risk populations
- Address pre-existing local health concerns
- Prioritize potential threats to public health and safety in relation to existing capacities
- Assess and improve building codes and regulations in relation to changing hazards
- Public education and outreach
- Assess and improve early warning systems

Lingering Uncertainties
- Exposure of Aspen to vector borne diseases and other climate-related health risks
- Management impacts on wildfires
- Public response to changes
- Alteration of prevailing wind patterns
- Alteration of air quality from regional fossil energy extraction and production

[96] CDC's Building Resilience Against Climate Effects (BRACE) Framework. Climate and Health Program Webpage. Last updated 2012. Centers for Disease Control and Prevention. Available at http://www.cdc.gov/climateandhealth

vulnerability of local populations to respiratory illnesses or illnesses such as WNV and create plans accordingly. Outreach and education may also promote health and safety by improving compliance with regulations and creating a sense of community involvement, leading to empowerment and diminishing stress and uncertainty.