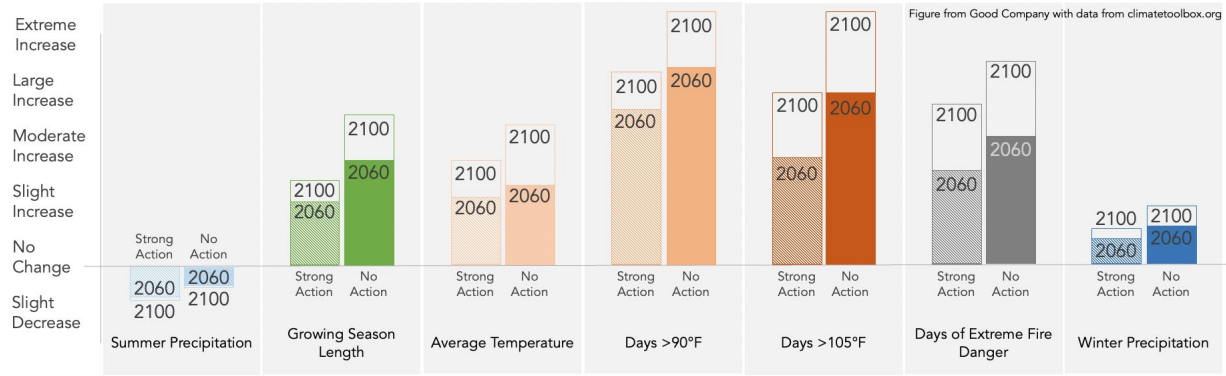
Future Physical Conditions - How will Climate Change affect Gresham?

The intention of this document is to help the people of Gresham to understand the choice between continuing as we have been or working hard to ensure that Gresham can continue to be a prosperous, just, and beautiful place to live. Where possible, we share what the differences in future physical conditions will be with and without action to reduce emissions. We also suggest possible actions to mitigate or adapt to the changing conditions.

Figure 1: Scale of climate change in years 2060 and 2100, depending on global climate action

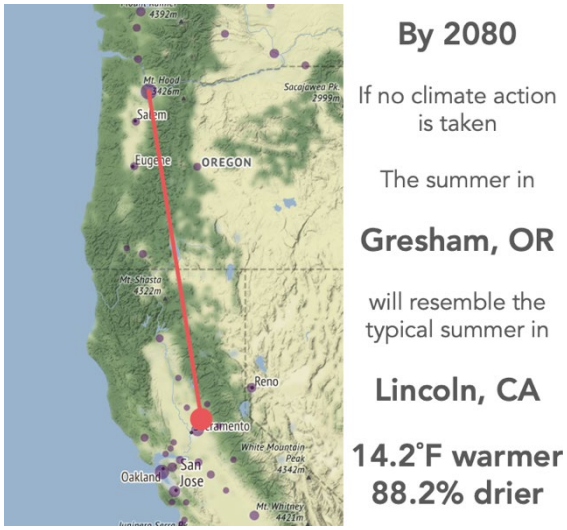


Snapshot: Hotter Summers, More Intense Rain Events in Winter

Figure 1 compares the scale of change in key factors by mid-century and by the end of the century under strong climate action and no climate action scenarios. In both scenarios, we will feel the impacts of climate change and will need to adapt but if we act quickly, we can avoid the worst of the impacts.

By the end of the century, without climate action, Gresham *can expect to experience a summer climate much like California's Sacramento Valley.*[1] (Figure 2) The number of days over 90 degrees every summer are expected to increase dramatically: ***from a historical average of 7 to nearly 65 by the end of the century.*** In contrast, if we take substantive action, ***we can constrain***

Figure 2: Gresham will have summers like the Sacramento Valley



[1] From University of Maryland Center for Environmental Science. https://fitzlab.shinyapps.io/cityapp/

the number of hot days to under 34. Water wise, Gresham will have *mostly unchanged total rainfall with an increase in big storm events. But that doesn't mean that water will be unaffected.* The Columbia and Sandy River watersheds are heavily reliant on snowpack and that is expected to decrease substantially, leading to an increase in winter flows and decrease in summer flows. The snowpack loss has been happening for the past century (Figure 3[2]), and it will continue in the future. As an example, the current snowpack on Mt. Hood on May 1 averages 75.4 inches of snow water equivalent. Without strong climate action, that will decrease to 37.1 inches by the end of the century. Strong climate action can keep the snowpack at 54.1 inches[3]. Figure 4[4] shows the expected snowpack at various points on Mount Hood at the end of the season (May 1). Note that while snow is likely to remain on the top of the mountain, sites farther down will experience losses that could mean the difference between snow and bare ground.

Figure 3: Snowpack loss in the Western US

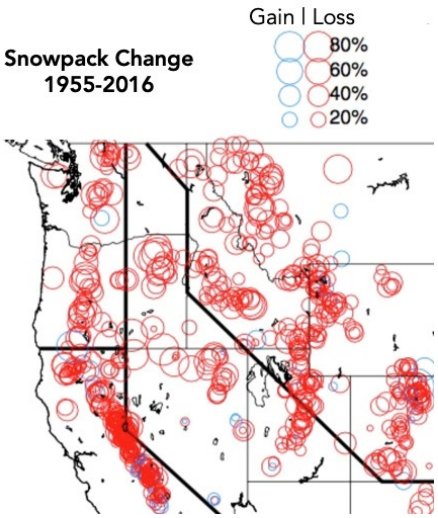
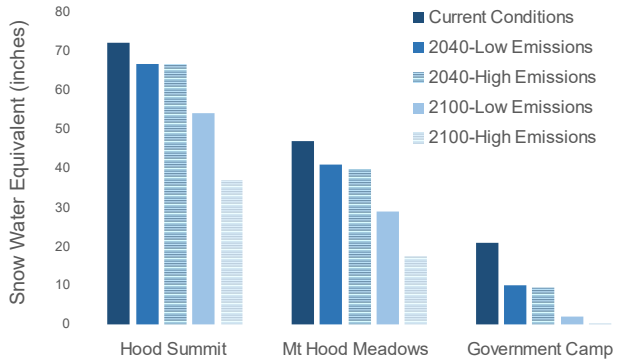


Figure 4: Forecasted Snowpack Loss on Mt. Hood, May 1 Snowpack



Wet Season

Increased intensity of winter storms

Overall rainfall quantities will remain nearly unchanged for Gresham, but the overall increase in temperature will change the pattern of precipitation. The most noticeable change will be an increase ***in "atmospheric rivers", weather systems that bring large storms with heavy precipitation.*** Expect more true rain and less gentle Oregon mist. In addition, the ***increase in storms during the colder months is likely to lead to more ice and snowstorms.***

[2] Adapted from Mote, P.W., Li, S., Lettenmaier, D.P. et al. Dramatic declines in snowpack in the western US. npj Clim Atmos Sci 1, 2 (2018). https://doi.org/10.1038/s41612-018-0012-1

[3] From climatetoolbox.org

[4] From climatetoolbox.org

Potential Hazard

Severe storms have the potential to knock out power and services, whether snow and ice is involved. They can also impact the ability of people to get to work and to school, disrupting daily life.

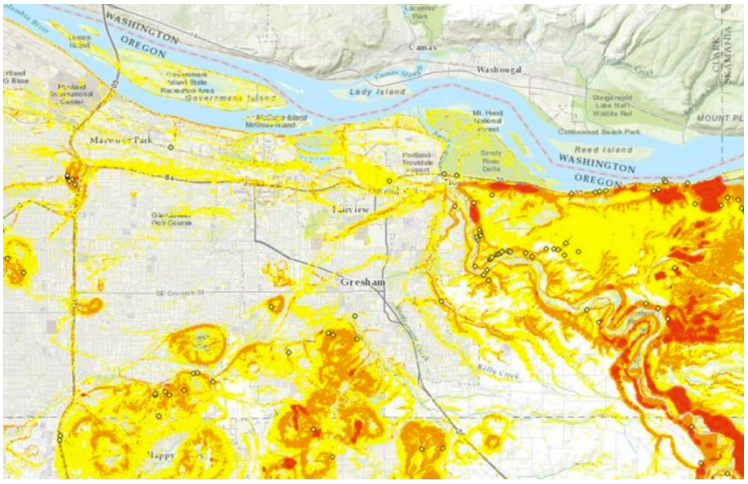
Actions to Take

To prepare for storm events, the city should ensure that it has sufficient ability to clear roads and repair broken power lines. Existing trees should be trimmed to minimize the risk of limb falls breaking lines, and when planting new trees their ability to withstand strong winds and heavy ice should be considered along with other characteristics such as drought and heat tolerance. Wherever possible powerlines should be placed underground.

Landslides

Increased severity of storm events will likely increase the risk from Gresham's greatest natural hazard, landslides.

Figure 5: Gresham area landslide hazards



Potential Hazards

The most severe hazard is for neighborhoods near steep slopes, such as on the buttes. Figure 5[5] shows the areas that are most likely to be affected by landslides. The landslides are most likely to be triggered by seismic activity (not climate change) but intense storm events that saturate the soil can increase the risk. The Southwest neighborhood is likely to be affected with Powell Valley elementary school in particular danger. In addition, neighboring communities of Pleasant Valley and Springwater are at elevated landslide risk.

Actions to Take

DOGAMI has produced a comprehensive LIDAR map of all areas that have experienced or are susceptible to landslides. Gresham should incorporate this information into their building codes, ensuring that properties take appropriate actions and disclose the landslide hazard status to potential buyers upon sale.

In addition to restricting development and ensuring code compliance in landslide-prone areas, risk can be mitigated with plants that have strong and resilient root systems (or with artificial reinforcement of root systems), limiting the prevalence of impermeable surfaces, and appropriate stormwater management.

Dry Season

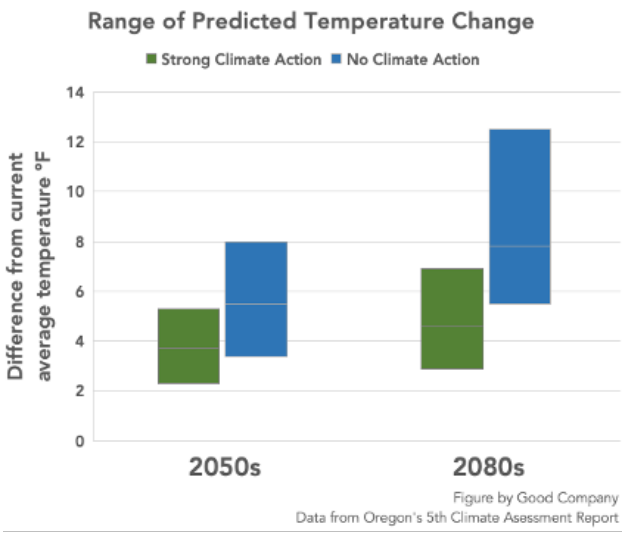
Heat

As mentioned before, an increase in mean temperatures are expected in all scenarios – whether we reduce emissions or not. This increase will also expand the growing season in the region. Under a strong

[5] From Multnomah County Multi-Jurisdictional Natural Hazards Mitigation Plan

climate action scenario, ***Gresham can expect an increase in growing season from 258 days a year to 306 days a year. Without climate action, the growing season will be nearly the whole year at 340 days.*** This change in growing season presents an opportunity for agricultural production, an increase in growing season can lead to an increase in production with appropriate crop choices. The decrease in summer stream flows, however, increases the potential for drought, possibly counteracting any agricultural benefits from increased growing season. Increasing water storage in the Columbia, Sandy, and Willamette basins will be critical to taking advantage of the expanded growing season.

Figure 6: Expected range of yearly average temperature change by mid and late century



Potential Hazards

During the 3-day heat wave in late June 2021, 54 Multnomah County residents died from heat-related causes. ***More people died of extreme heat in these 3 days in Multnomah County than in the past decade in the entire state[6].*** This heat wave was well beyond anything that had previously been experienced, but it is likely to occur again in the future.

In addition to the tragic loss of human life, intense heat waves can disrupt infrastructure and daily life in various ways: powerlines can sag, asphalt can buckle, outdoor activity can become hazardous, and agricultural crops can be spoiled.

Actions to Take

Switch home heating systems to heat pumps. These systems provide energy efficient cooling as well as heating. This action has a dual benefit of reducing home heating emissions in the winter as well as providing cooling in the summer. Planting trees, especially in neighborhoods that have a high social vulnerability index score can protect against heatwaves. In addition, parks should increase the availability

[6] Preliminary Review on Excessive Heat Deaths, Multnomah County Public Health

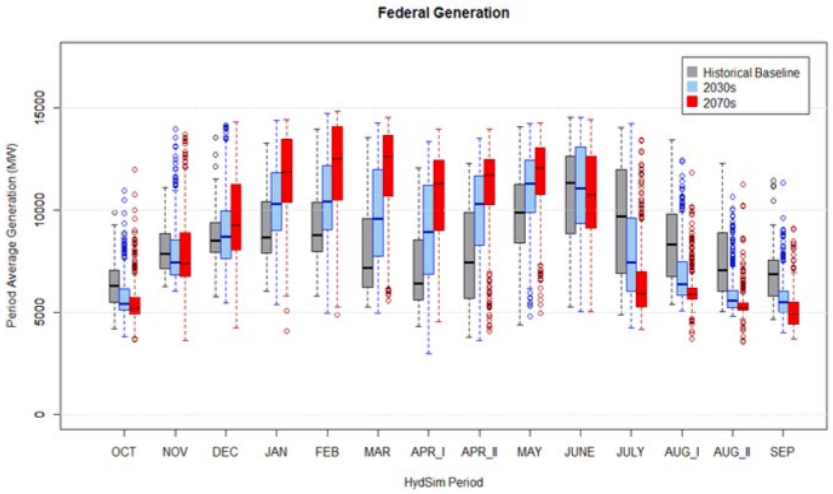
of water play areas in playgrounds to provide cooling outdoor activities. Finally, like warming shelters in the winter, the city should provide heat refuges for those that are most vulnerable.

In planning and new infrastructure work, the city should consider the effects of extreme heat on surfaces and infrastructure.

Decreased Stream Flow

The lack of change in overall precipitation should not be interpreted as proof against drought in the summer. Winter rain is quickly lost to winter streamflow and summer streamflow in the Columbia and Sandy Rivers is dependent on mountain snowpack, which is expected to decrease (Figure 4). The soil itself has a finite water holding capacity, and the expected increase in summer temperatures will more quickly deplete the soil's water.

Figure 7: Columbia Basin dams' power generation capacity will dip below historical levels in the summer and exceed historical levels in the winter



Potential Hazard

Decreasing flow and increasing water temperature can favor the growth of toxic cyanobacteria, poisoning supply and requiring costly treatment.

Hydroelectricity is a major power source for the region, and in the summer, snowmelt is critical to power generation. The Bonneville Power Authority reports[7] that its summer power generating capacity will decrease in the future (Figure 7).

Actions to Take

The City of Gresham is already taking steps to fortify its own water supply. Storing the increased winter precipitation for summer months will be crucial to meeting future water needs.

For power supply, winter water storage is again crucial, and innovations that store winter power generation for the summer can help even out the power capacity. On the demand side, a city wide electricity efficiency program to weatherize buildings could decrease the need for summer cooling and electricity demand.

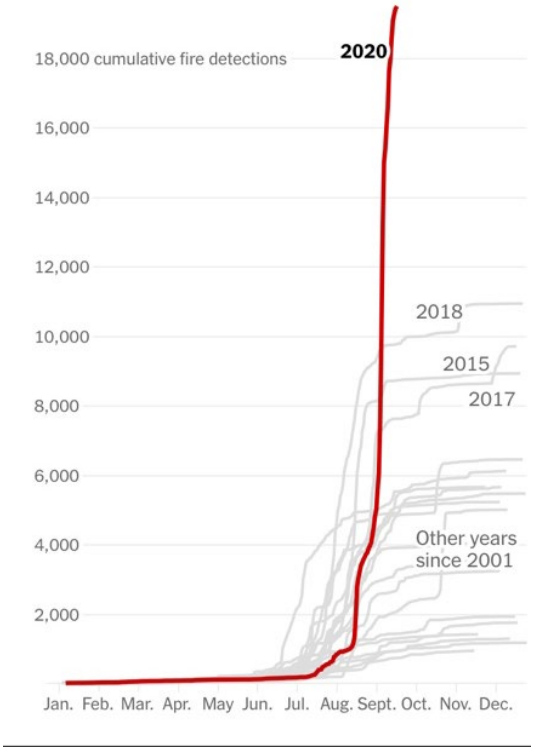
Fire

The fire pattern of the forests of the Cascade Range to the east of Gresham is characterized by frequent, low severity fires. The combination of dense Douglas fir regrowth after logging combined with an increase

[7] Climate and Hydrology Datasets for RMJOC Long-Term Planning Studies: Second Edition (RMJOC-II) Part II: Columbia River Reservoir Regulation and Operations—Modeling and Analyses, Bonneville Power Administration 2020

in summer heat is likely to intensify the fires, more severe fires that will leave mostly dead forest and increase the burned area. We are already seeing the devastating effects, as shown in Figure 8[8], with 2020 being the worst fire year on record for the West Coast, with 2021 nearly as bad.[9] ***Without action, the current average of 11 days of extreme fire danger will nearly double to 21 by the middle of the century. Robust climate action can decrease those day to 18.***

Figure 8: 2020's record-breaking fire season



Potential Hazards

Neighborhoods in South Central Gresham are at elevated risk for fire because they have lower density and higher tree cover. Properties adjacent to Gresham and Gabbart Buttes may be vulnerable to wildfire in the nature area.

Recently burned areas are also at increased risk of landslides, as was seen along the Columbia Gorge after the devastating 2017 fires.

Actions to Take

Community-wide firewise programs can raise awareness of the causes, ways to prevent, and strategies to mitigate wildfires.

Properties near large wooded areas should include a 50 foot firebreak between structures and the woods. Stragegic pruning can help prevent wildfires as well as storm damage.

Intense heat and wildfires can kill existing trees. Replanting efforts, done in consultation with forestry experts, should take into account future climate conditions to ensure fire-resistant forests that also can handle winter storms as well as maintain native trees and wildlife.

To prevent fire-related landslides, the city should take steps to harden recently burned slopes or revegetate with supporting structure.

Air Pollution

Pollen levels are expected to increase with the increase in growing season, worsening seasonal allergies. Ozone levels are also expected to climb as temperatures increase. Wildfire smoke is expected to increase with wildfires, not just those in nearby forests, but across the West.

[8] From the New York Times, "Record Wildfires on the West Coast Are Capping a Disastrous Decade" By Blacki Migliozzi, Scott Reinhard, Nadja Popovich, Tim Wallace and Allison McCann Sept. 24, 2020

[9] Source: NASA'S Fire information for Resource Management System and National Interagency Fire Center

Potential Hazards

Smoke, ozone, and seasonal allergies can cause and exacerbate numerous health conditions including acute respiratory disorders like asthma, but also cardiovascular disease. Outdoor workers are particularly susceptible to these hazards. Smoky days also disrupt normal life, closing services and making outdoor recreation impossible.

Actions to Take

A community-wide air purifier distribution systems will help to protect those most vulnerable from the worst of the smoke. The city should also make plans for smoke refuge areas where people without clean air can come for relief, especially in the daytime when smoke tends to be worst.

Ozone is produced by common polluting activities, such as cars and trucks burning gasoline and diesel fuel. Encouraging a switch to electric vehicles will decrease ozone pollution especially for communities along busy transport routes, often the most historically marginalized.

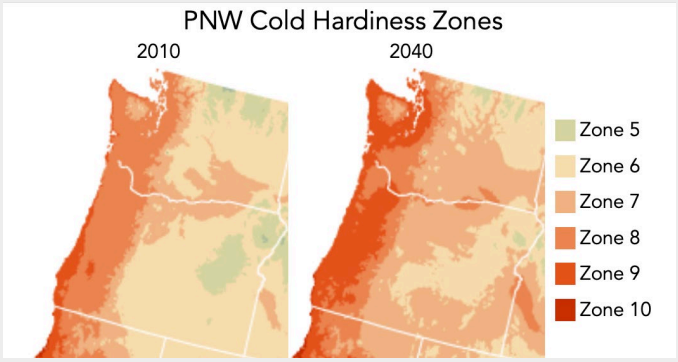
Arborists and planners can also consider pollen loads as they select trees and other plants. Wind pollinated plants produce large amounts of airborne pollen, while insect pollinated plants produce less, and provide food for pollinating insects.

Year Round

Plant and Animal ranges change

The ability of plants and animals to thrive is affected by a combination of water availability and temperature. Changing either of those factors will result in a change in which plants and animals can live around Gresham. Although living things have some capacity to adapt to changes in their environment, the rate of climate change generally exceeds the rate of adaptation observed in the wild or in fossil records.

Make lemonade? The USDA defines cold hardiness zones to help gardeners choose plants that will be able to survive the winter in their area. Gresham's cold hardiness zone will shift from 8b to 9a (Chico, CA) under strong climate action and to 9b (Napa, CA) under no climate action. This means more lemons and oranges but fewer apples and pears.



Potential Hazards

The changing climate means changes to the species that can survive in Gresham (See Box[10]). For example, habitat for native trout and salmon is expected to decrease by 50% to 100% by 2100 under a no action scenario[11]. In addition, changing conditions can also change the range of diseases. The range of the mosquito that carries malaria is predicted to shift all the way up to Alaska without climate action (Figure 9[12]).

Actions to Take

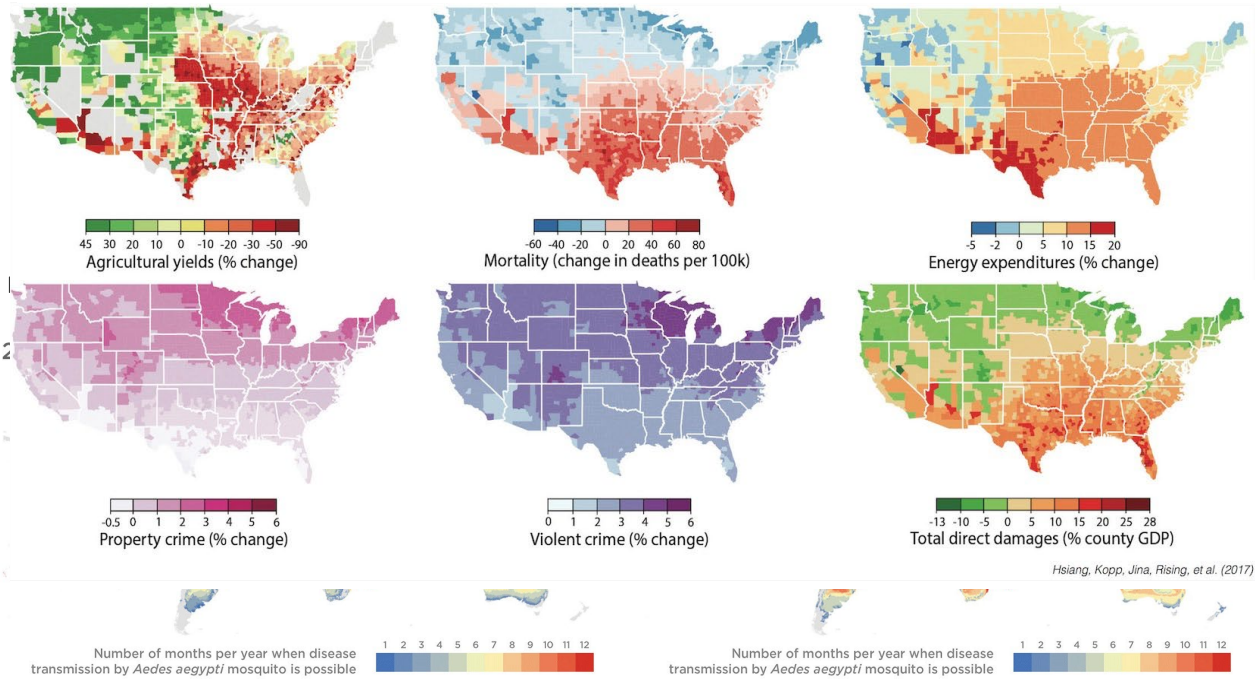
We cannot prevent substantial changes to the climate, but actions to reduce other threats faced by species can help them to survive. For example, setting aside greater wildlands and planting native species in our gardens can bolster native populations, giving them more time to adapt.

In addition, when planting forests or wildlands, it is important to consider which species will thrive under future conditions. This way, the essential services of the forests and wild spaces for maintaining habitats, clean water, and shade can be preserved even if the species of trees changes.

Increasing Population

The United States will experience changes across an array of sectors. Overall, the Pacific Northwest will remain one of the best places to live in the country. Figure 10 shows decreasing affordability and comfort in the southern and midwestern states and more moderate changes to the northwest. This will likely lead to people moving to more comfortable and less difficult conditions in the northern states. As other parts

Figure 10: Social, economic, and health changes due to climate change



Ruesch, A. et al *Conservation Biology* "Projected Climate-Induced Habitat Loss for Salmonids in the John Day River Network, Oregon, U.S.A." 2012

[12] Figure adapted from Ryan, S.J., Carlson, C.J., Mordecai, E.A., Johnson, L.R. 2019. Global expansion and redistribution of Aedes-borne virus transmission risk with climate change. PLOS Negl Trop Dis. 13(3): e0007213

of the country suffer through droughts, hurricanes and intolerable heat waves, it is likely that the increasing population trend in the Pacific Northwest will continue.

Potential Hazards

Increased population, especially accounting for people fleeing climate change, could exacerbate the current housing crisis and increase pressure on social services.

Actions to Take

The city should plan to incorporate the newcomers in thoughtful and innovative growth plans, to ensure that they can use the growth as an opportunity to strengthen the economy, increase justice, and improve the lives of all Greshamites.

Meanwhile, the city should strengthen the social safety net and homelessness prevention programs.

Health Effects

The Oregon Health Authority has put together a comprehensive assessment of how climate change will affect Oregonians' health (Figure 11).

Potential Hazards

We can expect many of the above-mentioned effects along with an increase in heat-related conditions, such as heat exhaustion, and infectious diseases such as West Nile, Lyme, and fungal diseases. Furthermore, heat effects human health through increasing stress and increasing violence. Pregnant people, people who work outdoors, the elderly, and people without access to air conditioning are at particularly increased risk.

Actions to Take

Institute city-wide programs to distribute air filters and ensure people have clean air to breathe.

Institute policies that cap outdoor work in extreme heat.

Strengthen the public health response to prepare for future infectious disease outbreaks.

Figure 11: OHA's Climate Related Health Risk Table

<table>
<tr><th>Climate-related drivers of health: environmental hazards</th><th>Stress factors: inequities in social, physical environment, cultural, and economic supports</th></tr>
<tr><td>Heat</td><td rowspan="2">Systemic inequities in policies</td></tr>
<tr><td>Infectious disease vectors</td></tr>
<tr><td>Wildfire</td><td rowspan="3">Inequities and unequal investment in social determinants of health (e.g., housing, education, income, wealth, transportation access, food security, income security, access to health care)</td></tr>
<tr><td>Air quality (e.g., pollen, wildfire smoke, smog, ozone)</td></tr>
<tr><td>Storms, floods, landslides</td></tr>
<tr><td rowspan="2">Sea level rise</td><td rowspan="2">Capacity and adaptive capacity of infrastructure, institutions, and systems to support human health (e.g., culturally specific services, surge capacity of hospitals)</td></tr>
<tr><td>Drought, water insecurity</td></tr>
<tr><th colspan="2">Effects on human health</th></tr>
<tr><td colspan="2">Hazard-related acute conditions (e.g., heat stroke, asthma attack)</td></tr>
<tr><td colspan="2">Hazard-related chronic conditions (e.g., heart disease, diabetes, respiratory illness)</td></tr>
<tr><td colspan="2">Infectious diseases (e.g., Lyme disease)</td></tr>
<tr><td colspan="2">Mental health conditions</td></tr>
<tr><td colspan="2">Adverse pregnancy outcomes</td></tr>
</table>