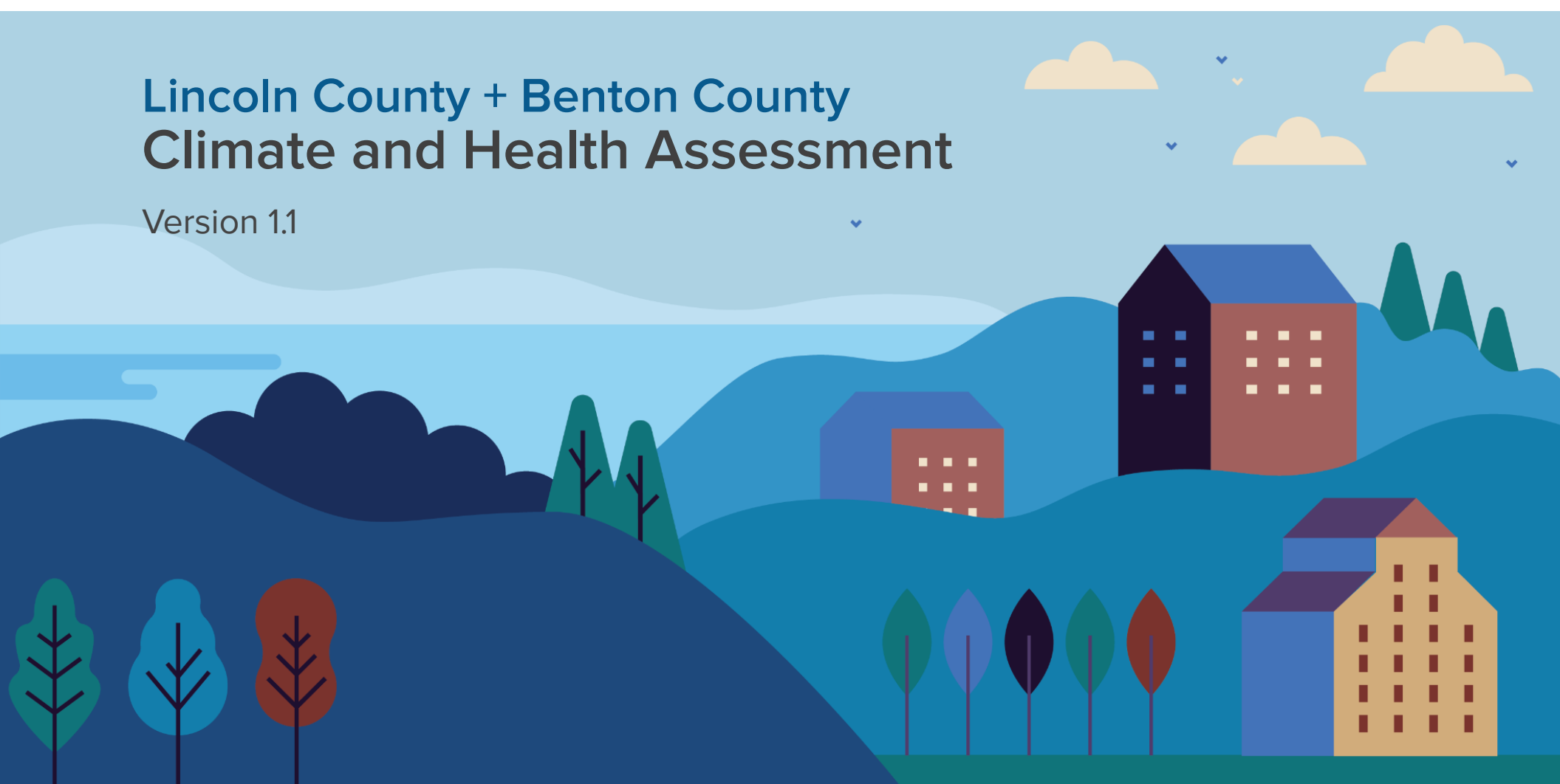




# Lincoln County + Benton County Climate and Health Assessment

Version 1.1



## Acknowledgements

This report was produced by Rede Group on behalf of Lincoln County Health and Human Services and Benton County Health Services (hereafter, “Lincoln and Benton counties”). Rede Group would like to thank the communities of Lincoln and Benton Counties for their time spent contributing to this assessment and ongoing analysis and planning efforts. This assessment would not be possible without the sincere and insightful input we received from both Lincoln County and Benton County community members.

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# Executive Summary

## What is this Climate and Health Assessment?

Climate change is affecting the health of our communities. An increase in natural disasters such as wildfires, heatwaves, and floods also means an increase in breathing issues (from inhaling smoke), heat stroke, injury, mental health issues, and many other conditions.

Lincoln and Benton County Health Departments have formed a partnership to figure out which climate events and health issues they should prioritize, and make a plan to address them over the next few years. To do that, they hired Rede Group to ask community members about their concerns and to study data from other climate change experts. All of the information we collected is in this assessment report. Lincoln and Benton County are going to use this information to make their plan and share this work with their communities.

## People in Lincoln and Benton Counties are most worried about...

**Heatwaves and heat domes** causing more people to suffer from heat stroke, especially infants, elderly, and people who work outside, like farmers.

**Wildfires** that put peoples' lives and homes in danger and create a lot of smoke that makes it harder to breathe. This is especially concerning for people who already have breathing issues (like asthma), people who work outside, and people who live in rural areas who may have a harder time evacuating or accessing emergency resources.

**Droughts** and other events that harm crops, making it harder for people to access fresh food and drinkable water. This also puts peoples' livelihoods at risk, especially fishers and farmers.

**Mental health impacts** like anxiety and depression, especially for youth.

The table in Figure 8 of the Climate and Health Risk Summary section of this assessment explains these climate events, the health issues they cause, and the most vulnerable people in more detail.

### What is already being done about this?

- Some city governments are already thinking about how to prepare for future climate emergencies and working with their partners in government and community organizations to prepare.
- Local environmental groups are advocating for policies and programs that help prevent or lessen climate disasters.
- Emergency response teams at the county level are working on emergency drills and prevention.
- Some local government agencies are working with farmers and fishers in their area to help them adopt more sustainable practices and protect their livelihoods.

### How is the information in this assessment going to be used?

**Prioritize:** Lincoln and Benton Counties will use this data to determine the top climate and health concerns to focus on.

**Plan:** Rede will work with both counties to draft a regional plan with specific goals and strategies to prepare for these climate and health impacts.

**Act:** The counties will use the plan over the next 5-10 years to address climate-related health issues, and involve community members in other efforts to reduce the impacts of climate disasters.

**Assess:** Lincoln and Benton counties will assess their progress on their goals and adjust their plan as needed.

# Introduction

## Background + purpose

Rede Group, in partnership with Lincoln and Benton counties, conducted a regional<sup>1</sup> climate and health assessment to inform the creation of a climate and health implementation and adaptation plan. The purpose of this assessment was to explore climate events and their related health outcomes that were most concerning or top-of-mind for community members in the Lincoln-Benton area. Included with this data is a preliminary analysis of available secondary data from the Oregon Climate Change Research Institute (OCCRI), including a climate and health risk assessment for the region (see *climate + health risk summary* section and Appendix C). During primary data collection, Rede also sought opportunities for climate resilience, asking participants to share about community strengths and possible points of collaboration as the counties plan to put these findings into action.

## Methods + analysis

### Data collection

The assessment consisted of an organizational readiness survey; individual interviews, group interviews, focus groups, and a survey with community members.

The organizational readiness assessment survey was directly adapted from OHA's Climate Change: Resilience Planning Toolkit.<sup>2</sup> See a summary of findings from this survey in the *Next steps* section.

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<sup>1</sup> For the purposes of this assessment, “regional” refers to the area covered by Lincoln and Benton Counties.

<sup>2</sup> <https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/TOOLKIT/Pages/Capacity.aspx>

Rede conducted interviews and focus groups with a diverse array of community organizations and government agencies. Rede collaborated with the client team to identify priority populations in the region that would be most impacted by the health impacts of climate change based on existing state and national vulnerability indices.<sup>3</sup> This list of priority populations included:

- Organizations serving Black, Indigenous, and People of Color
- The Confederated Tribes of Siletz Indians
- The elderly and organizations serving them
- Families with children and organizations serving them
- People with disabilities and organizations serving them
- Youth / students
- The unhoused / houseless and organizations serving them
- Outdoor recreation groups
- Fishers and organizations serving them
- Farmers, agricultural workers, and organizations serving them

Rede and the client team also engaged community members and organizations that are actively involved in environmental advocacy, and those who provide health services to the region. Additionally, city, county, and state government representatives, who will be important sources of buy-in when the client team moves on to the planning and action phases of their implementation and adaptation plan, were also invited to participate. By including these officials in the assessment, there was a co-benefit of educating them on the climate and health work being led by Lincoln and Benton Counties. This list of additional participants included:

- Representatives from local climate change groups

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<sup>3</sup> OHA Social Vulnerability Index.

<https://www.oregon.gov/oha/ph/HealthyEnvironments/climatechange/Documents/Social-Vulnerability-Assessment.pdf>

- Regional health equity coalitions + advisory groups
- Local and regional hospital and healthcare systems
- Mental health providers
- County and city representatives for transportation, tourism, land use planning, and infrastructure
- County commissioners
- City managers + administrators
- Emergency managers

Once the list of data collection participants was finalized, Rede recruited community leaders, organizations, and members for one of the three data collection options. *Community leaders* were defined as city, county, tribal, or state government officials and were offered participation in an individual interview. *Community members and organizations* were any community-based organization or members of these organizations, students, and others who live and work in Lincoln or Benton County. Every contact was first invited to participate in an interview or focus group, and then if they could not attend or wished to provide their feedback another way, they were invited to take a survey with nearly identical questions.

Figure 1 shows the number of responses for each data collection method and the overall response rate for the assessment. Figures 2 and 3 show the percentage of participants from Lincoln and Benton counties, and the perspectives captured across data collection methods, respectively.



Figure 1. Total number of assessment participants

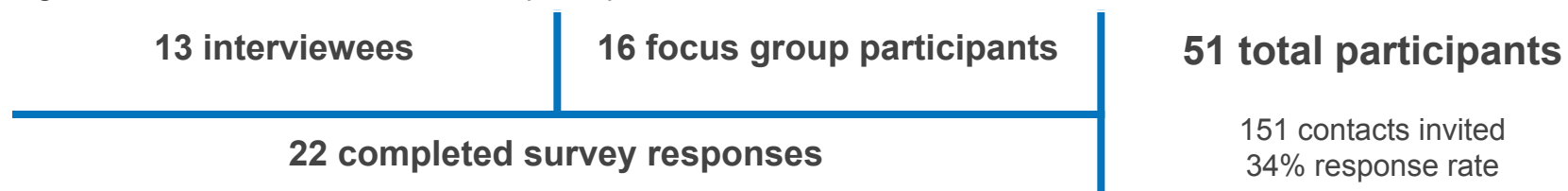


Figure 2. % of participants from each county across data collection methods (N=51)

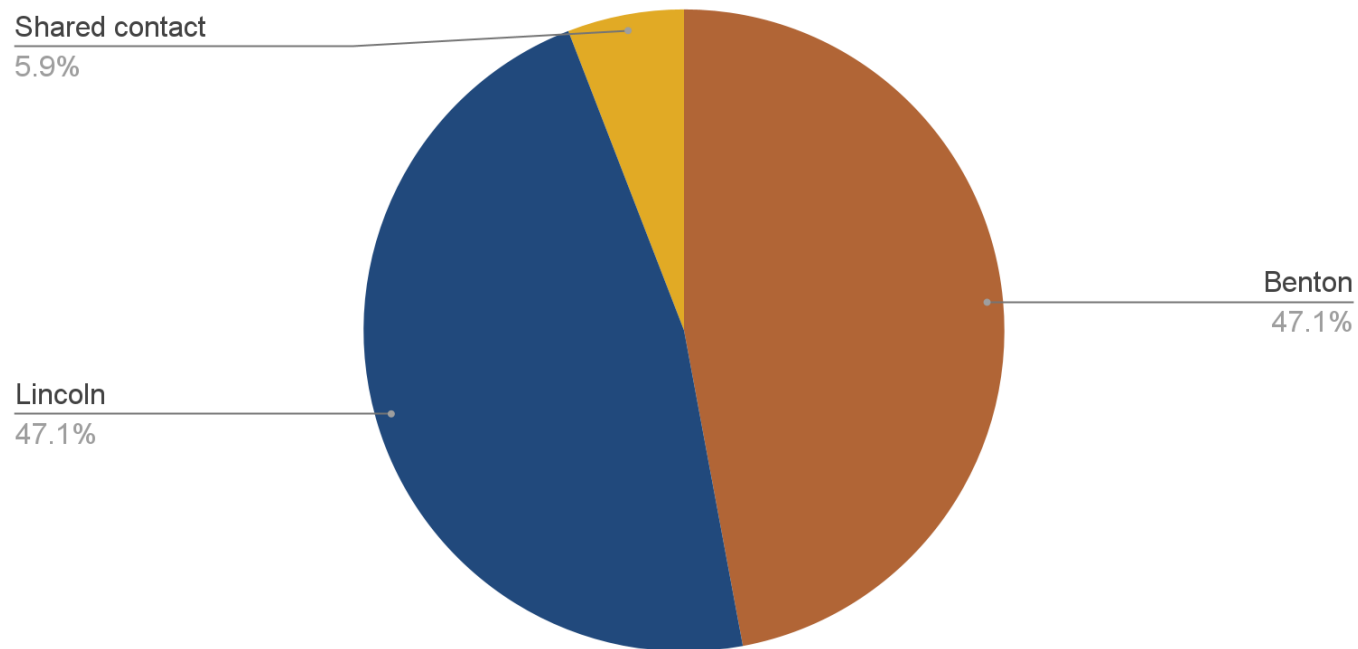
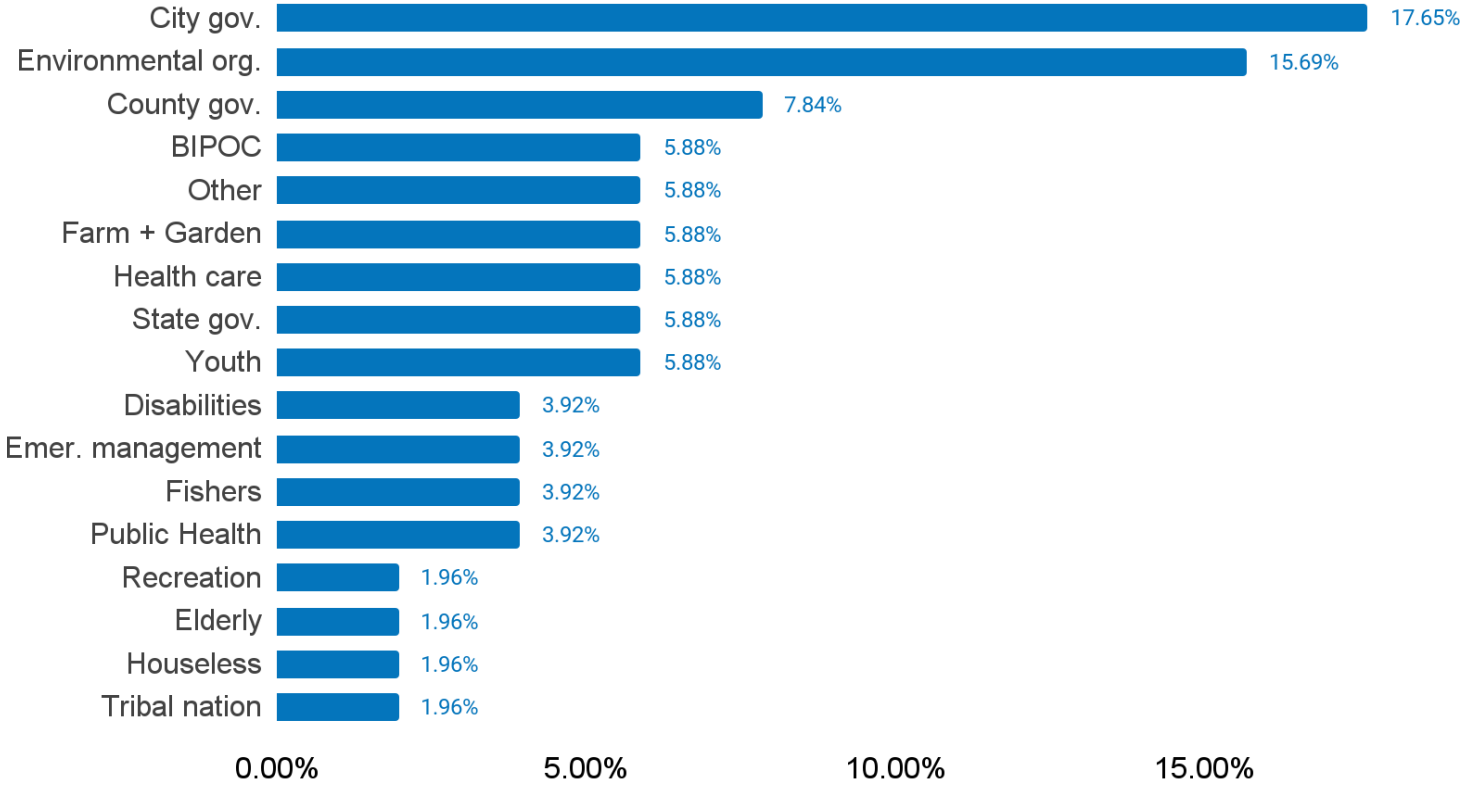


Figure 3. Perspectives captured in assessment (N=51)



Participants were able to receive a gift card for their participation if they 1) responded “yes” to a survey screening question asking if they would like to be compensated for their time and 2) if they were not employed by/representing a city, county, or state government.

### Analysis of interview and focus groups

Surveys were collected via Survey Monkey and analyzed in Microsoft Excel. Interviews and focus groups were recorded via Zoom and audio files were transcribed by Rev, a third-party transcription service. Transcripts were then analyzed in Dedoose software, which Rede used to identify themes in climate and health concerns across data collection methods. These initial findings were presented in a virtual *data party* to the client team, others from Lincoln and Benton counties interested in the project, and a group of assessment participants. *Data parties* allow collaborators and interested individuals to reflect on findings and delve deeper into questions. This is a valuable step in community engagement, allowing attendees to ask Rede to further clarify findings and share how the information found can be best used to guide their work. Rede provided preliminary findings from the initial data analysis at the data party and facilitated a discussion among participants to answer questions and elevate key take-aways. All of the data analysis combined with the insights from the data party have informed the climate and health concerns presented in this report as the most pressing to the communities of Lincoln and Benton Counties.

### Analysis of surveys

Rede completed a climate hazards assessment using reports produced by OCCRI, the Oregon Fifth and Sixth Climate Assessments and Future Climate Projections for Lincoln, Lane, Linn, and Marion counties. OCCRI anticipates its projections for Benton County will be complete later in 2023. Lane, Linn and Marion county climate projections were analyzed as a proxy for Benton County given that all are located within the Willamette Valley. OCCRI’s Director also advised Rede to take this approach.

Rede also completed a climate and health profile report for Benton and Lincoln Counties which describes the health impacts and vulnerable populations associated with each climate hazard (e.g. wildfires, drought, etc.). The framework and health impacts draw from the Oregon Climate and Health Profile Report, which was developed based on multiple data indicators and academic research. The climate and health profile report includes a list of climate and health indicators for the region (see *Climate + health risk summary* section and Appendix C).

## Assessment considerations + limitations

### Climate + health expertise

Many of our study participants may not consider themselves to be experts in the linkage between climate events and impacts to human health. Wanting to acknowledge this reality and support participants in contributing to the regional implementation plan, Rede distributed two infographics and the executive summary from the OHA Climate and Health Resilience Plan<sup>456</sup> that demonstrated climate change's impacts on human health as a conversation primer.

Similarly, in addition to multiple open-ended response options, the survey included some questions with a preset list of climate and health concerns for respondents to rank. The lists on these ranking questions were adapted from the infographics and executive summary used by Rede in interviews and focus groups.

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<sup>4</sup> OHA. (2014). Oregon Climate and Health Profile Report. [infographic].  
[https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/Oregon\\_Climate\\_and\\_Health\\_Info-Graphic.pdf](https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/Oregon_Climate_and_Health_Info-Graphic.pdf)

<sup>5</sup> OHA. (2018). *Climate impacts on human health*. [infographic].  
<https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/2018/OHA-Climate-Impacts-on-Human-Body.pdf>

<sup>6</sup> OHA. (2014). Oregon Climate and Health Profile Report. *Executive Summary*.  
<https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/oregon-climate-health-exec-summary.pdf>

The combination of the infographics and prewritten questions guided respondents to answer questions with health impacts at the forefront of their minds instead of answering questions with complete open-mindedness. Rede's analysis team strongly believes that answers were truthful and insightful; however, Rede recognizes that answers may have been prompted by infographics or guided by a prewritten question. This is an important consideration when interpreting the findings of this assessment.

#### Data collection time period

Due to the time period of the project, data collection took place over December and January, when most community members were busy during the winter holiday season. It is likely that response rates may have been higher had data been collected at a different time of the year or for a longer time period.

#### Representation of priority populations

Rede experienced some difficulty recruiting community members from some priority populations, including elderly, youth, houseless, and tribal nation members, or organizations representing these populations. While we were able to capture at least one response from each of these populations, future assessments should focus on engaging these populations further for more robust commentary on their specific challenges and priorities related to climate change and health.

## Climate + Health Risk Summary

Overall, our assessment showed that community members' climate and health concerns generally align with the climate and health risks projected by the Oregon Climate Change Research Institute (OCCRI).

Projected climate changes in Lincoln and Benton Counties:

- Summers are getting hotter and drier.
- The last freeze of winter is occurring earlier, while the first freeze of fall is starting later.
- By mid-century, much of Oregon is projected to have 20 fewer days below freezing per year.
- More precipitation will fall as rain rather than snow, increasing the risk of floods and landslides.
- Oregon is likely to experience more extreme events like heat waves, wildfires and storms.
- Sea level rise and ocean acidification are expected to continue.

Reports from OCCRI conclude that the climate risks for both counties that are most likely to increase in both number of occurrences and intensity are heat waves, heavy rains, flooding, and wildfire; which were also highlighted as primary concerns from assessment participants. Both participants and data from OCCRI acknowledge that Lincoln County has a coastal border and therefore also needs to prepare for coastal hazards and ocean temperature and chemistry changes.

To identify the health risks posed by the climate events predicted by OCCRI data, Rede also reviewed OHA's 2020 report, Climate and Health in Oregon<sup>7</sup>, the Oregon Climate and Health Profile Report,<sup>8</sup> and the Oregon Climate and Health Vulnerability Assessment.<sup>9</sup>

Figure 8 shows the climate impacts considered in this assessment, the main concerns of assessment participants (all of which appear in the OHA Climate and Health in Oregon report), and additional health risks appearing in OHA's reports. The figure also includes vulnerable populations for each climate and health impact.

See Appendix C for a standalone climate and health risk profile created from OCCRI data and data from the Oregon Climate and Health Profile, and Appendix D for an in-depth summary of the data OCCRI used to create the Sixth Oregon Climate Assessment.<sup>10</sup>

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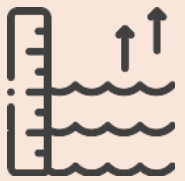
<sup>7</sup> OHA. (2020). Climate and Health in Oregon Report. <https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/2020/Climate%20and%20Health%20in%20Oregon%202020-%20Full%20Report.pdf>

<sup>8</sup> OHA. (2014). Oregon Climate and Health Profile. <https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/oregon-climate-and-health-profile-report.pdf>


<sup>9</sup> OHA. Climate and Health Vulnerability Assessment. <https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/Social-Vulnerability-Assessment.pdf>



<sup>10</sup> Oregon Climate Change Research Institute (OCCRI). (2023). <https://blogs.oregonstate.edu/occri/oregon-climate-assessments/>



Figure 8. Climate impacts, health outcomes, and vulnerable populations from primary and secondary data

| Climate Impact*  | Health Risks  | Vulnerable Groups  |
|--|---|--|
| <b>Indirect Impacts of All Climate Events</b><br> | <b>Economic instability + income loss</b><br>for forestry, fisheries, agriculture and tourism industries<br><br>Food insecurity, mental health, chronic disease | <ul style="list-style-type: none"> <li>● Low-income</li> <li>● Farm workers</li> <li>● Fishing industry workers</li> <li>● Rural residents</li> <li>● Economically dependent on tourism or forestry</li> <li>● Agricultural workers</li> <li>● Coastal communities</li> <li>● Native Americans/American Indians</li> <li>● Communities of color</li> </ul> |
|  | <b>Mental + behavioral health</b><br>Chronic stress, anxiety, depression, suicide   | <ul style="list-style-type: none"> <li>● Low-income</li> <li>● People who are economically dependent on climate stability</li> <li>● Parents</li> <li>● Youth</li> <li>● People with existing chronic diseases</li> <li>● People with existing mental health conditions</li> </ul>   |
|  | <b>Migration</b><br>Infectious disease  | Uncertain. The number of people migrating due to severe climate change in their home area is likely to increase  |
|  | <b>Displacement</b><br>Communicable disease in crowded evacuation centers, mental illness   | <ul style="list-style-type: none"> <li>● Low-income</li> <li>● People living in Low-lying/coastal/high-risk landslide areas</li> <li>● Native Americans/American Indians</li> <li>● Wildland/urban interface residents</li> </ul>  |
| <b>Sea Level Rise</b><br>                       | <b>Income loss</b><br>Food insecurity, chronic disease  | <ul style="list-style-type: none"> <li>● Coastal community at large</li> </ul>   |
|  | <b>Displacement</b><br>Anxiety, depression, suicide   | <ul style="list-style-type: none"> <li>● Coastal community at large</li> <li>● Native Americans/American Indians</li> </ul>  |
|  | <b>Mental and behavioral health</b><br>Anxiety, depression, suicide   | <ul style="list-style-type: none"> <li>● Coastal community at large</li> <li>● Native Americans/American Indians</li> </ul>  |



| Climate Impact*   | Health Risks  | Vulnerable Groups   |
|---|---|---|
| <b>Ocean Acidification</b>  | <b>Income Loss</b><br>Food insecurity, chronic disease  | <ul style="list-style-type: none"> <li>● Native Americans/American Indians</li> <li>● People who are economically dependent on fisheries</li> </ul>   |
| <b>Heatwaves + Heat dome</b><br><br> | <p><b>Heat related illness and death</b><br/>           Illness: Heat rash, heat cramps, heat exhaustion, heat syncope (fainting), heat stroke</p> <p><b>Death:</b> Cardiovascular disease, renal failure, heart attack, stroke, heat stroke, deaths from respiratory illness</p> <hr/> <p><b>Violence</b><br/>           Intentional injury, homicide</p> <hr/> <p><b>Air pollution (respiratory illness)</b><br/>           Chest pain, coughing, throat irritation, congestion, reduced lung function, exacerbation of emphysema, bronchitis and asthma, cancer deaths</p> <hr/> <p><b>Harmful algal blooms</b><br/>           Rash, paralytic shellfish poisoning, gastrointestinal illness, neurotoxic shellfish poisoning, food insecurity</p> <hr/> <p><b>Recreational risk</b><br/>           Drowning, dehydration</p> | <ul style="list-style-type: none"> <li>● Young children</li> <li>● Older adults</li> <li>● Low-income</li> <li>● Socially isolated</li> <li>● Outdoor workers (particularly migrant and immigrants, agriculture, forestry, construction and road workers)</li> <li>● People with chronic diseases</li> <li>● Pregnant women</li> <li>● Not used to hotter weather (coastal)</li> <li>● Communities of color</li> <li>● Urban residents</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● Children and young adults</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● People living near heavy traffic</li> <li>● People with existing chronic respiratory illness</li> <li>● Children and young adults</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● People who eat shellfish</li> <li>● Economically dependent on seafood or coastal tourism</li> <li>● Native Americans / American Indians</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● Children</li> <li>● Males</li> </ul> |

| Climate Impact*  | Health Risks  | Vulnerable Groups   |
|--|---|---|
| <p><b>Wildfire</b></p>  | <p><b>Air quality (respiratory illness + visibility)</b><br/>Cardiopulmonary disease, ischemic heart disease, asthma, bronchitis, pneumonia, cancer, motor vehicle crash injury due to low visibility</p> <hr/> <p><b>Water quality</b><br/>Increased flows of sediment, elevated temperatures<br/>Gastrointestinal illness, methemoglobinemia</p> <hr/> <p><b>Occupational Risks</b><br/>Heat stress, respiratory illness, heat-related illness, unintentional injury, hearing loss, rhabdomyolysis, death</p> | <ul style="list-style-type: none"> <li>● People with existing chronic illness</li> <li>● Children</li> <li>● Older adults</li> <li>● Outdoor workers (particularly migrant and immigrant workers)</li> <li>● Wildland firefighters</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● Infants</li> <li>● Private well users</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● Wildland firefighters</li> <li>● Outdoor workers (particularly migrant and immigrant workers)</li> </ul>   |
| <p><b>Drought</b></p>  | <p><b>Income loss</b><br/>Stress, chronic disease, premature death</p> <hr/> <p><b>Food insecurity</b><br/>(ex. Malnutrition, obesity, chronic diseases),</p> <hr/> <p><b>Water insecurity</b><br/>(ex. Water-borne disease (microorganisms, biotoxins and toxic contaminants), dehydration)</p> <hr/> <p><b>Mental and Behavioral health</b><br/>(ex. Stress, anxiety, depression, suicide)</p>  | <ul style="list-style-type: none"> <li>● Farmers, farm workers, economically dependent on agriculture</li> <li>● Rural residents</li> <li>● Native Americans / American Indians</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● Communities of color</li> <li>● Native Americans / American Indians</li> <li>● Rural residents</li> <li>● Pregnant women and children</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● Rural residents</li> <li>● Low-income</li> <li>● Private well users</li> <li>● Native Americans / American Indians</li> <li>● Infants</li> </ul> <hr/> <ul style="list-style-type: none"> <li>● Farmers</li> <li>● Rural residents</li> <li>● Low-income</li> </ul> |

| Climate Impact*  | Health Risks   | Vulnerable Groups  |
|--|--|--|
| <b>Heavy rain, flooding</b><br> | <b>Landslides</b><br>Stress, injury, death<br>Blockage/destruction of critical roadways, damage to infrastructure including drinking water/sewer systems | <ul style="list-style-type: none"> <li>● Buildings/residents near steep slopes</li> <li>● First responders</li> </ul>                                    |
|  | <b>Flooding</b><br>Injury, water-borne disease, respiratory illness, exposure to toxins, death   | <ul style="list-style-type: none"> <li>● Coastal communities</li> <li>● Low-lying areas</li> </ul>   |
| <b>Infectious Disease</b><br>   | <b>Vector-borne disease</b><br>(ex. West Nile virus, Lyme disease)   | <ul style="list-style-type: none"> <li>● Outdoor workers</li> <li>● People in routine contact with animals, people living in areas with ticks</li> </ul> |
|  | <b>Food-borne disease</b><br>(ex. gastroenteritis, campylobacteriosis, salmonellosis, V. parahaemolyticus)   | <ul style="list-style-type: none"> <li>● People who consume shellfish, possibly through improper food storage and handling during hot weather</li> </ul> |
|  | <b>Fungal disease</b><br>(ex. Cryptococcus gattii cryptococcosis)  | Research is still exploring this   |

**Particularly vulnerable populations in Lincoln and Benton Counties:**

- Tribal, Native American, communities\*\*
- Immigrant, migrant, and refugee communities\*\*
- Non-English-speaking communities\*\*
- People with existing illness, particularly mental health\*\* and/or chronic disease
- People with disabilities\*\*
- Low-income\*\*
- Communities of color
- Socially isolated individuals
- Unhoused
- Children and infants
- Pregnant women
- Older Adults
- Private well users
- Residents living in landslide prone areas
- Wildland firefighters
- Farmers, farm workers, and other outdoor workers
- Economically dependent on tourism, fishing/shellfish industry, forestry
- First responders, healthcare workers, public health/emergency management

\*\* These populations have been highlighted in Community Health Improvement Plans (CHIPs).

## Community Findings: Top Climate and Health Concerns

We asked everyone who participated in this assessment about:

- The climate events they were most concerned about;
- The climate-related health impacts they were most concerned about; and
- Which population groups in their community they thought were most vulnerable.

This section is divided into subsections highlighting the top five climate and health concerns across all data collection methods. Participants were also asked about strengths and resources for climate and health resilience, and findings from those questions are detailed later in this report (See *Climate + health resilience* section).

### Respiratory illness (breathing issues)

Concern about respiratory illness was a theme across all data collection methods. Nearly half of interviewees and focus group participants discussed the detrimental effects that wildfire smoke in particular can have on one's respiratory system, and over half of community survey respondents (54.5%, n=12) reported that they were “very concerned” about respiratory illness.

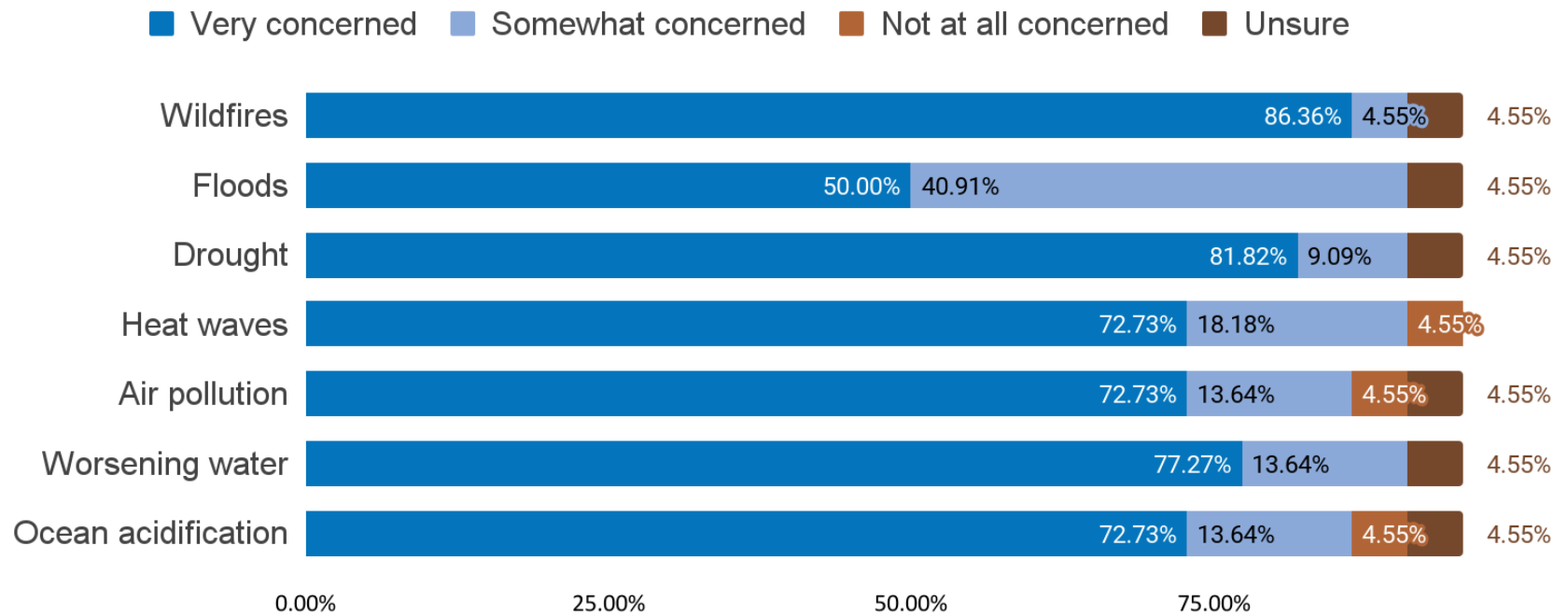
#### Climate events - Respiratory illness

##### *Wildfire*

Across data collection methods, participants elevated wildfires as a concern for respiratory illness. Most interview participants and most focus group participants responded that one of their main climate-related concerns is the growing plausibility of wildfires and the respiratory issues caused by wildfire smoke. Survey data also indicated that wildfires are a

top concern for Lincoln and Benton county residents, with 86.4% (n=19) of survey respondents marking that they were “very concerned” about wildfires.

Figure 4. Concerns about environmental impacts of climate change



A few participants from both Lincoln and Benton counties recalled feeling more concerned about wildfires after a recent fire struck their community.<sup>11</sup> Many respondents linked wildfires to other climate effects, such as extreme temperatures and droughts, which make wildfires more likely to happen.

*“One of our big concerns is going to be wildfire because it's happened already.” - Interviewee*

*“And a couple years ago we had the fire that was definitely heat-related. And we're more aware now of the danger of wildfires.” - Interviewee*

### Vulnerable populations - Respiratory illness

#### *People with existing respiratory conditions + elderly*

In addition to the impact to the general population, many participants expressed concern for the impact of wildfire smoke on those with existing respiratory illness, such as asthma, and elderly populations.

*“And when we had the wildfires, that was really a problem for a lot of people and we didn't seem prepared or equipped here to help people with that in their homes. And so that was a big deal for people with just underlying medical conditions or that are medically fragile because even though they come here, we don't have a lot of healthcare here.” - Interviewee*

*“And then I think the other one is just kind of the respiratory impacts of wildfires. We've had quite a few people that are sensitive to or have respiratory issues that are negatively impacted that way.” - Interviewee*

*“For instance, you've got allergens mentioned here. I think, I see seasonal allergies going up. People who didn't suffer before, now suddenly are developing allergies. You add that to a pandemic or some smoke in the air and*

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<sup>11</sup> Oregon faced one of its worst set of forest fires in years causing over 1 million acres burned, which is twice the 10-year average. 40,000 residents were forced to evacuate. (Oregon Office of Emergency Management, 2020)

*suddenly you've got major respiratory challenges, especially for older populations or other vulnerable populations.”*  
- Interviewee

### *Outdoor workers*

Other populations who may be especially affected by negative impacts to air quality include those who live or work outside and are therefore at higher risk of exposure to smoke and poor quality air.

*“I worry about the health of respiratory illnesses of our agricultural workers who are outdoors regardless, especially those who are contractors or subcontractors who are not mandated. And essentially you get the job done now and you finish faster rather than doing this hourly. And so I do worry that people's... the exposure that individuals who may not even have or are less likely to have health insurance or even qualify for health insurance. I worry about just for individuals and I have extended family members that have chronic conditions like asthma.”* - Interviewee

Other considerations:

A few participants also linked their concern for respiratory illness to COVID-19. The COVID-19, or Coronavirus, pandemic peaked between 2020 and 2022 in Oregon, but is still a present danger at the time of this assessment. “Long COVID” (aka “long haul COVID”), a term for symptoms that persist from anywhere to a few months to over a year after testing negative for the Coronavirus, is still being understood by health researchers, but research has shown that prolonged respiratory issues can be a symptom of Long COVID for some individuals.<sup>12</sup> This did not come up in detail in our assessment, but is an important consideration as Lincoln and Benton counties plan to address this health issue moving forward.

*“Yeah, I've seen the same sort of impacts. I think the most obvious one that comes to mind is related to the air quality. Because it's so direct, everybody's impacted. Even if you're not somebody that suffers from asthma or something like that, everybody's impacted. But then also recognizing the compounding factor of COVID too, and the*

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<sup>12</sup> CDC. (16 December 2022). Long COVID or Post-COVID conditions. <https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html>

*number of people that I know, I just think of our staff, people that are dealing with long haul symptoms.” - Interviewee*

## Temperature-related conditions

For this assessment, temperature-related conditions include heat exhaustion and other heat related illness, as well as health complications from freezing temperatures. Excessive heating and freezing temperatures are captured here as *extreme temperatures*. Across all data collection methods, heat-related illness was mentioned by participants far more often than health issues related to freezing temperatures.

### Climate events - Temperature-related conditions

#### *Extreme temperatures and unseasonal weather*

All interviewees and most focus group participants expressed concerns with extreme or unseasonal weather, and the community survey showed that 73% of respondents were “very concerned” about heat waves. Many participants said they felt like they were experiencing longer and hotter summers, with *heat waves* being a more familiar experience. Some participants also remembered that Oregon as a whole experienced a *heat dome*<sup>13 14</sup> about two years ago, increasing attention towards climate change's effects for some participants.

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<sup>13</sup> **Heat waves** specifically refer to extended periods of *unusually* hot weather outside of historical averages. A **heat dome** refers to an event of heat being trapped in the atmosphere in a dome like fashion. Heat waves: ([National Oceanic and Atmospheric Association](#), n.d.) Heat domes: ([National Oceanic and Atmospheric Association](#), January, 2023)

<sup>14</sup> In the summer of 2021, the Northwest (including Lincoln and Benton counties) experienced record high temperatures causing a heat dome event. ([United States Department of Agriculture](#), n.d.)



*“I mean, that heat dome that we had... Was that two summers ago? That was devastating. I mean, people are still talking about it, at least the people I hang out with are still talking about it.” - Focus group participant*

*“So heat is a risk for a lot of our folks. And especially, the last couple summers, we've had multiple 100-degree days, which is unusual.” - Focus group participant*

*“Thinking about that extreme weather, a lot of us will have heaters and things like that, but might not have air conditioned spaces. So I know one thing we've been struggling with a lot during our past two years, primarily during the heat waves, is finding long-term air conditioned spaces for folks who might need it. Not only unhoused, but also just the general population who just might not have air conditioning, and they can survive a 90 degree day once. But if we're getting over close to 100 degree, multiple days in a row, we start to have a lot more problems.” - Interviewee*

Participants also reported noticing unseasonal weather in the last few years. Unseasonal weather was commonly defined by participants as longer periods of rain or drought than would typically be expected. Some participants also described experiencing more “dumps” of rain versus a more steady precipitation throughout a typically rainy season for the region.

*“And just I would say not the constant rain but the rain that happens, it's heavier, that then brings on flooding as well.” - Interviewee*

*“As for work, we actually are seeing some interesting delays in projects, both because of the increase in precipitation during this time of year. For us, the winter is the ideal planting season. So we do try and get out, but especially this winter, we're facing a lot of heavy winds and increased high precipitation events that are making it difficult for us to actually get on site. We're just coming up to a lot of really saturated soils that we can't work in.  
- Focus group participant*

## Vulnerable populations - Temperature-related illness

### *Houseless / unhoused*

Around half of focus group participants and interviewees recognized that unhoused individuals are vulnerable to climate change without shelter or access to resources that could help them mitigate the effects of climate events. Participants expressed their concern that climate change will continue to bring on extreme weather that has already proven to be fatal to people experiencing houselessness, and houseless populations may not be able to access resources to mitigate the health impacts of extreme temperatures.

*“I’m worried about people on the streets in the winter too. We have had some deaths from exposure. Well, especially with our wet weather, (unhoused) are exposed to the elements more.” - Interviewee*

*“Well, the unhoused, because they have no roof over their heads, they have no way to shelter from extreme heat or extreme cold or respiratory challenges like wildfire smoke, or... And they are already more stressed just because they don't know necessarily where their next meal's going to come from or whether they're going to be safe sleeping or you name it.” - Interviewee*

*“but when we had that day that was 114 degrees here at my house, we just were able to come inside and put the air conditioning on, close everything up. Not everybody can do that. We have a growing homeless population problem in Lincoln County, and everywhere, and not everybody can get warm or cold when they need to. So I would suspect that we would see a lot of these things, whether that's respiratory illness, people that are having a difficult time with heat stroke and those kinds of things.” - Interviewee*

### *Elderly*

Interviewees and focus group participants shared that, in their mind, elderly populations are at greater risk of health complications due to extreme temperatures because of existing health challenges that many of them may face.

*“Far as the seniors right now, I guess I kind of just think about the changes in weather, primarily in terms of hotter summers and more erratic winters, and whether or not people of older age are prepared, with their housing and healthcare and resources, to stay healthy as a result.” - Focus group participant*

*“Because of recent history, elderly or if you have the extreme heats, the extreme cold, I would say it'd be the people that really can't go above and beyond for themselves.” - Interviewee*

*“And then the other thing that I think that's been a big impact that I have felt personally, well, not personally, but professionally through my work, is some of the really terrible, terrible hot days that we've had. And as you indicate in this very first document that I looked at, it affects the elderly really bad. And so we had some individuals that were in [a nearby city] that were senior citizens that were unable to get air conditioners and were virtually in their homes baking.” - Focus group participant*

#### *Agricultural workers + people who work outside*

Some participants discussed the dangers that outdoor workers face because of extreme temperatures. Different groups of outdoor workers have no option but to work outdoors regardless of temperature and may not have as many protections or opportunities to protect themselves from the heat.<sup>15</sup>

*“the farmworkers who are working under the heat, or the landscaping workers working under the heat, we can certainly assume that it's not only a risk of heart attack, but there's also a risk of anxiety derived from working under the heat.” - Interviewee*

*“And it was around requiring employers to provide a specific amount of shade and shelter during heat related, like heat waves, and specific temperatures, et cetera. Yet it only applies to employees, contractors and subcontractors*

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<sup>15</sup> It should be noted that in 2022, The Oregon Occupational Safety and Health Division (OR-OSHA) adopted rules to provide stronger protections for farmworkers against heat and smoke. <https://osha.oregon.gov/news/2022/Pages/nr2022-11.aspx>

*are not included. And I'm thinking about Benton County, I know that a lot of Christmas tree farm employers contract their work out. So they don't have employees, therefore they're not subject to these rules. And so we're thinking about now with the extreme temperature ranges and not just during the heat, but also in the cold, they're excluded from these protections.* - Interviewee

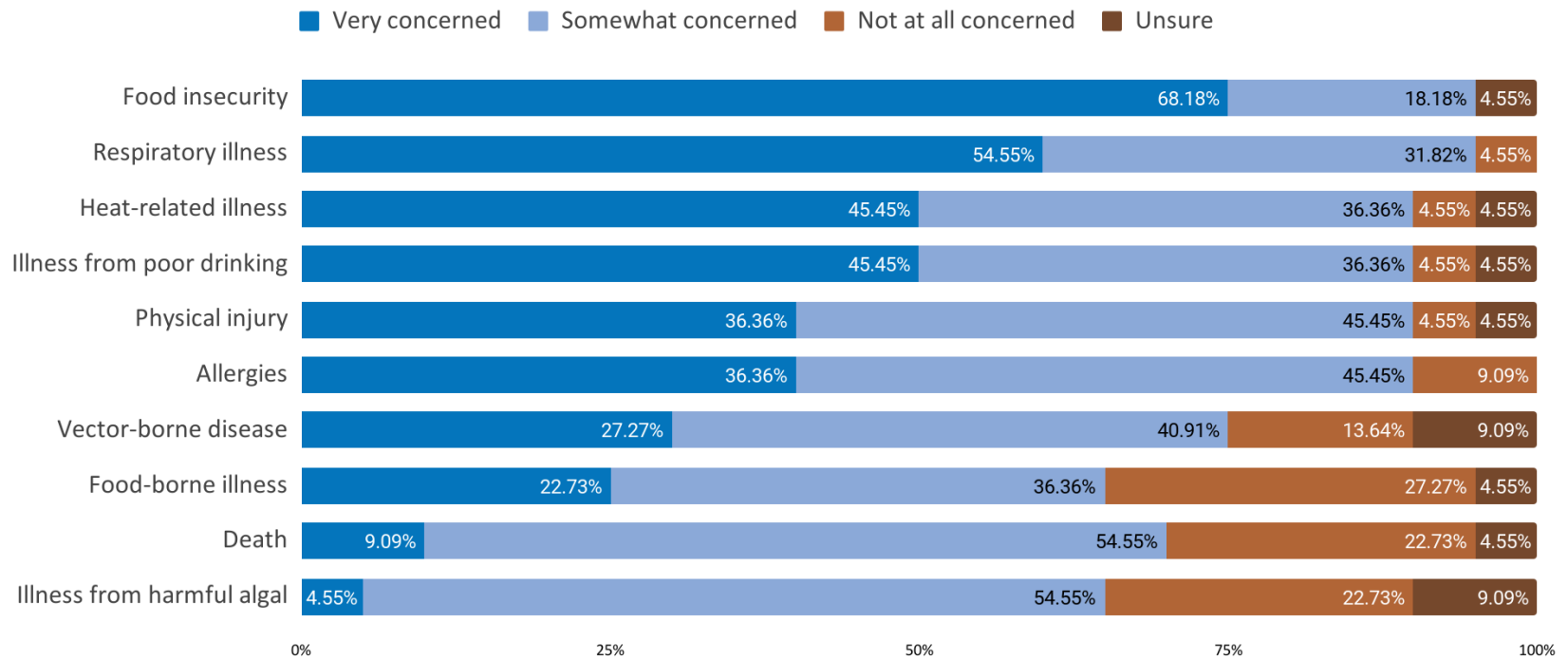
*“And so we're thinking about now with the extreme temperature ranges and not just during the heat, but also in the cold, [agricultural and migrant seasonal workers] excluded from [shade & shelter policy] protections.”* - Interviewee

*“A vulnerable population is people whose jobs are tied to working outside such as fishermen working in more dangerous waters and agricultural and forest workers who work outside even in hot/smoky conditions”* - Survey respondent

## **Food insecurity**

Fishing and farming are central to the economies, lifestyle, and food supply of Lincoln and Benton counties. When discussing consequences of climate change, food production was a near-unanimous social impact discussed by all data collection participants. According to survey respondents, food insecurity is by far the most concerning potential social impact of climate change, with 68.2% (n= 15) indicating that they are “Very Concerned”.

Figure 5. Concern for climate impacts to physical health



Climate events - Food insecurity

Ocean warming + acidification

Many participants discussed how rising ocean temperatures and increases in domoic acid would cause fishing harvests to be severely disrupted. Respondents, particularly those from Lincoln county, noted that the fishing industry is well aware of

these climate events and has already felt the impact, reporting that fish, crab, and shellfish have been diseased or dying in increased numbers.

*“Anyone who grows shellfish is talking about it. Anyone regarding the [research center], the fishermen are talking about climate change. I don't know if they're discussing it as such, but obviously they're catches are decreasing. So on all levels, look at salmon spawning, streams are too warm, okay, now you can't spawn salmon because they're going to die. Their streams are too warm. There's climate change, right?” - Interviewee*

“the levels of domoic acid in crab and, I believe, in other shellfish also, but I'm not sure of that. But that level, if it's too high, crabbing is suspended until it goes lower, so we lose days of fishing because of that. What happens is [domoic acid] reduces the size of the meat inside them, so they're not considered marketable.” - Interviewee

### *Drought + water quality*

The second most critical piece of participant feedback was water quality, water levels, and drought. Sixty-four percent of focus group respondents and 76% of interviewees discussed noticeable differences in precipitation over time and the effects on the community. Firstly, many respondents discussed the effects of long periods of drought on communities that rely on wells or groundwater that can be used for potable drinking water. Secondly, many respondents discussed how the drought has a crucial impact on agricultural work for reasons that most respondents felt were too obvious to explain. However, we can assume that crops cannot grow without water, and with more extended periods of drought, entire harvests can be eliminated.

Survey data tells us that drought is the second most significant concern for Lincoln and Benton communities, with 81.8% (n=18) of respondents labeling drought and water quality as “highly concerned.” The reasons given by community survey respondents are similar to those given by qualitative respondents.

Drought and unseasonal weather were overlapping concerns for participants; both too much rain and not enough rain can negatively impact crops and thus threaten the food supply that depends on farmers.

*“And the water issues as well. How do we grow food efficiently given changing water availability? Yeah, there's just going to have to be an awful lot of lifestyle change as people adapt.”- Interviewee*

*“And then like you said, with our salmon runs when the rivers are low, a couple years ago when we were going through the drought, it had a big impact on the salmon runs.” - Interviewee*

### *Unseasonal weather*

Unseasonal weather events such as storms, landslides, flooding, and heat waves can severely disrupt food production and harvest. Participants discussed periods of both unusually heavy rainfall and heat waves that they felt has become more frequent in recent years. Participants are familiar with rainfall in the Pacific northwest, however it seems that there is a perception that rainfall is increasing and precipitation is heavier at certain times, contrary to a more familiar pattern of light, constant precipitation throughout a typical rainy season.

*“And then I mentioned water resources and the hydrology. We're going to see changes in seasonality of rainfall, changes from snowfall to rainfall, less snow pack. That's going to have to affect agriculture and what we grow and when we grow it and where we grow it. And so yeah, that's clearly a strong local effect.” - Interviewee*

*“We had rain, rain, rain, rain. It would not stop raining far longer than it normally would for us here in Lincoln County. And I think that was true of most of Oregon. I know my friends in Eugene were experiencing the same thing, whereas we would normally have dryness at least some April, May, June. We just had rain April, May, June. I mean, I would assume that's a function of climate change.” - Interviewee*

*“I've lived here my whole life, so you can see the seasons are starting to shift a little bit, and we're going to see a little less of the snow, the freezing. It should mean more rain, could have impacts throughout the state.” - Interviewee*

## Vulnerable populations - Food insecurity

### *Lincoln and Benton counties*

Food insecurity is a threat to many populations in Lincoln and Benton counties, particularly those who have lower incomes or are unhoused. The Lincoln County Community Health Improvement Plan (CHIP)<sup>16</sup> lists their county's food insecurity rate as 14.2% of the population as of 2017, and access to healthy food has been listed as a priority in Benton County's CHIP as well. Participants of this assessment were cognizant of the fishers and farmers central to their local food supply, and concerned about sustainable food production for their communities.

*“Boy, the fishermen, certainly, because it's affecting when they can catch shellfish, and that's affecting their ability to feed their families. The shellfish from here, a lot is consumed locally” - Focus group participant*

## Mental health

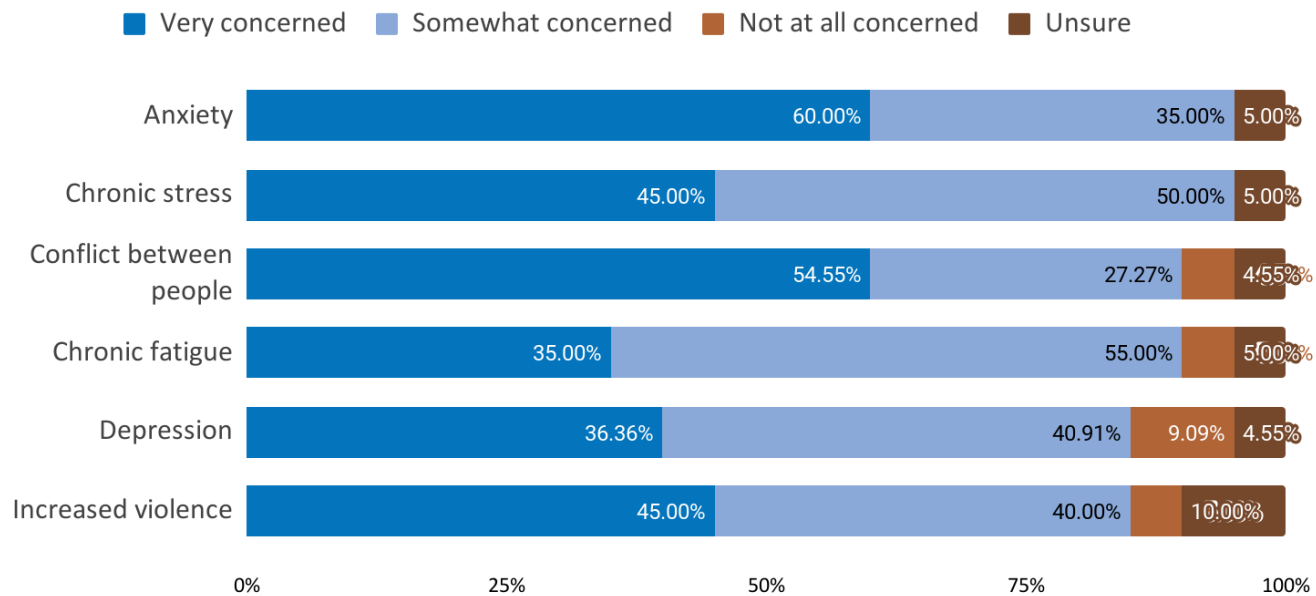
Concerns about the impact of climate events on mental health were highlighted across data collection methods. Participants called out mental health issues that can stem from the anxiety of potential future climate events, stress from the inability to mitigate climate change's effects, and depressive effects when considering an uncertain climate future. In surveys, anxiety and chronic stress emerged as the most pressing issues, with 95% (n=19) somewhat or very concerned about anxiety and 95% (n=19) somewhat or very concerned about chronic stress (see Figure 6).

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<sup>16</sup> A Community Health Improvement Plan (CHIP) is an assessment by county health departments. The county health departments collect data about health issues in their community and make a plan to improve these issues. This typically happens every 3-5 years. You can contact the Lincoln or Benton health departments, or visit their websites, to see their current CHIPs.



Figure 6. Concern for mental health impacts of climate change



Climate change causes a lot of unpredictability and uncertainty, as future climate events are difficult to forecast and often unpreventable. For instance, a fisherman or agriculture worker may be stressed from season to season not knowing if there will be a harvest that will keep them financially secure; or a houseless/unhoused person may be chronically stressed about staying safe and healthy in extreme temperatures. Data shows that youth are grappling with the inevitability of increased climate disasters. All of these mental health concerns were elevated by participants of this assessment.

*"Yes. Mental health is a big issue. And when the people from the community told us that they want to be prepared for a climate emergency, that is a reflection and expression of some level of anxiety they're going through. Saying "What do I do if there is a fire in my neighborhood or I lose my house?" So there is already a mental health effect*

*that I think is represented in terms of anxiety, to deal with the uncertain, with what would happen if there is an emergency in where I live. So that is why it's so important to start preparing now” - Interviewee*

#### Climate events - Mental health

Concern for mental health overall was a central theme in interviews, focus groups, and surveys. Some climate events that participants mentioned while discussing mental health impacts included ocean health that would affect food production, and extreme temperatures, especially heat.

*“Yeah, anytime the weather gets really severe, really cold, really hot, mental health impact is big. We see a lot of increased undesirable behaviors in lashing out. Or people using substances to try to survive again” - Focus group participant*

*“the delay in the crab season, again, down here, the Dungeness Crab season causes financial concerns, which manifests itself as certainly psychological issues and depression and things like that.” - Focus group participant*

*“So when the fire happened, for example, because we have one ingress in and out of the city, one highway, things got jammed up and people couldn't get out. So of course that's going to affect mental health. People are like, oh my god, I'm going to burn up, or the fire's coming our way, but I can't get out of town.” - Interviewee*

#### Vulnerable populations - Mental Health

##### *Farmers, fishers, and other food producers*

Impacts to food production are discussed in the *Food production and insecurity* section of this assessment report from the perspective of community members who are at risk of experiencing food insecurity due to rising costs or impacted harvests. However, some participants also considered the negative consequences of climate change on the livelihoods of fishers and farmers, and what impact that might have on their health (more specifically, their mental health).

*“The fishermen not being able to fish, these are people that have been fishermen for generations and you've affected their livelihood and their ability to be able to take care of their family. You've affected their sense of self-worth. They are tied, we all in some way, are tied to our careers, and our careers are part of our definition of ourselves.” - Focus group participant*

*“Wildfires are happening and I mean if a field gets burnt down when it wasn't intended to be, then of course there's going to be an impact on produce or anything that needs to be distributed throughout the country. So it's almost like a balance between worker safety and also just the outcome of their work because if they can't work, there's no food production. As far as lifestyle goes, I mean, I want to say yes, the slower effect might be even in mental health.” - Interviewee*

## Youth

Many interviewees and focus group participants brought up the anxiety that youth are experiencing while facing an uncertain and seemingly bleak climate reality.

*“The eco anxiety piece that kids now in Gen Z who were born in what, the middle or late '90s, I think, have lived their entire lives, knowing that the climate crisis is on us. So eco anxiety, being literally disabled by concern about the climate and the lack of significant, meaningful, effective action on the part of adults, is a very big deal.” - Focus group participant*

*“Younger people may be having more fears than us. I've thought about that before, too. I definitely feel it after being a lifelong Oregonian and seeing and feeling things change around me and listening to the hopelessness of young people that are in their 20s, which [my] daughter is, and conversations that I've had with her that make me incredibly sad and have been really surprising to me, about just the future and how it's hard for people to get motivated when they don't see a future, especially when it comes to the environment, maybe volunteering and*

*having children, all that kind of a thing. It's having this effect on people that is cutting off their ability to imagine the future.” - Focus group participant*

*“And the youth, kind of like I said, I think that they're most vulnerable because they're going to be the ones that kind of continue to see the negative impacts compound throughout their lives.” - Interviewee*

*“I'm concerned about future generations and what they're going to have to cope with.” - Interviewee*

## **Social determinants of health**

Social determinants of health<sup>17</sup> are not new to the field of public health, and it is becoming more widely understood by community members. Across data collection methods, participants highlighted their concerns about the social and economic impacts of climate change and how this will affect health. Food production, displacement (people being forced to leave) and migration (people choosing to leave), and recreation access were uplifted by participants as key considerations for climate and health resilience. While interventions in these areas might not always be squarely within the scope of a public health department's role, we believe these responses provide important context and guidance for shaping the priorities of the regional adaptation and implementation plan. The social determinants of health presented in this section also further highlight those with lower incomes as a priority population within climate and health resilience planning.

*“Human beings are stressed, it stresses every part of our system, mental health, cardiovascular health, everything else, food production is going to change. That'll also lead to cascading effects. So yeah, I don't think there's any system that we have that won't be affected, frankly.” - Focus group participant*

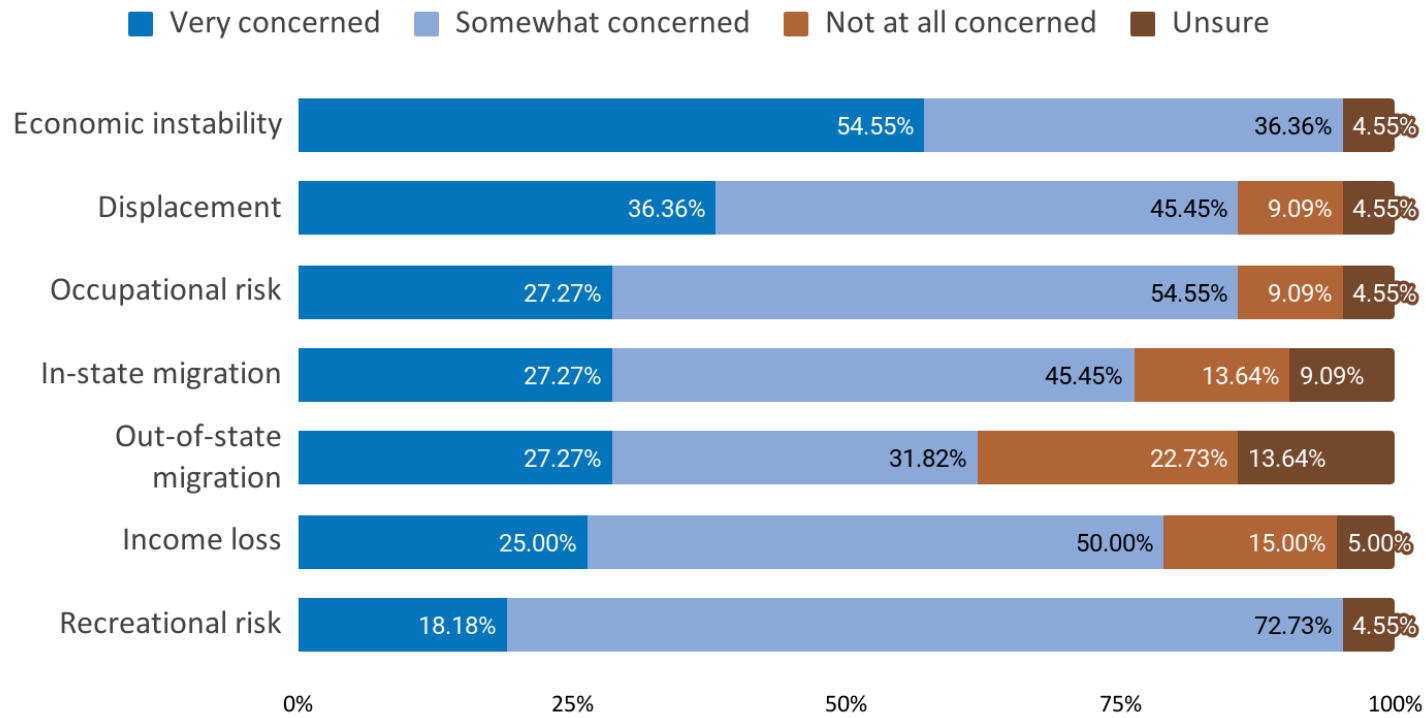
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<sup>17</sup> Social determinants of health are the living conditions that also affect your health. For example, living below the poverty line can cause stress over a long period of time, and cause health issues such as anxiety, depression, or chronic pain, depending on the person and the situation. Social determinants of health are addressed with policy, while other health conditions are addressed by medical professionals. Public health tries to improve social determinants of health, and physical and mental health conditions.

### Climate events - Social determinants

Similar to what we heard about mental health, participant concerns about the social determinants of health spanned many climate events and priority populations. Impacts to the livelihood of fishers and farmers; a lack of access to resources for individuals experiencing lower socioeconomic status (SES); and the complications that come with having your life disrupted by having to evacuate a climate-related emergency were highlighted by interviewees and focus group participants. Survey respondents demonstrated the most concern for economic instability (54.55%, n=12), displacement (36.36%, n=8), and occupational risk (e.g. working in a field in the hot sun) (27.27%, n=6) (see Figure 7)

Figure 7. Level of concern for social impacts of climate change



### Displacement + migration

Wildfires and extreme heat emerged as climate events that participants were most concerned about, and many of them connected these events to short-term displacement (i.e. emergency evacuations), as well as long-term migration.

*“And the displacement of the children, what they were trying to do in trying to figure out their schools when they were displaced from their homes, that was a big deal. Not only the stress of moving, but the stress of your community when your kid” - Focus group participant*

*“That fire was around that whole Otis area. And that whole area had to evacuate. So of course they needed to find housing for these people and Lincoln County doesn't have housing in general. It's just really an issue over there. And so trying to relocate people can be incredibly difficult. That was also true for the McKenzie area. And people were coming all the way into Eugene to find a place to stay.” - Focus group participant*

Rising housing prices and the growing number of folks experiencing housing insecurity was top-of-mind for participants who brought up concerns about folks needing emergency shelter, or who are relocating to escape the impacts of climate change in their environment.

*“You asked a minute ago about the slow impacts, and I was debating whether or not this is a slow impact or not, but we are seeing increasingly people who want to move to the Pacific Northwest or job applicants who are fleeing places like Southern California where either wildfires or heat or drought has them concerned about their future. And it's really interesting who responds... So we've pulled a few folks to Benton County from other parts of the country simply because they want to be in the Pacific Northwest where they perceive that there's still water available.” - Interviewee*

## Vulnerable populations- Social determinants

### *People experiencing lower socioeconomic status*

Participants expressed concerns about people with lower incomes being more vulnerable to climate events because they will not have equitable access to other resources. For example, interviewees and focus group participants discussed a possibility of difficulty accessing:

- Safe drinking water;
- Heat and air conditioning;
- Adequate food, especially during surge needs; and
- Virtual or cellular reception to receive emergency response communications.

*“So those that don't have enough financial money to be able to buy things at a more expensive rate for example, not having the ability to buy bottled water if that's what they need to be able to survive because it's expensive or maybe better quality foods because they're grown in better conditions or more plentifully available. So I think those that don't have access to funding as to sustain their daily life are the ones that are most impacted.” - Interviewee*

*“People living in generational poverty and/or unable to access assistance and those suffering from mental health issues. Generational trauma, bias, lack of access to health care, food, clean water, etc.” - Survey respondent*

*“So those who are already struggling to find housing and afford life in these communities that are the backbone of so many of the industries we have around here, including tourism, are just going to get more and more hardship. So I think that's a connect of a thread that affects all the health things that people are already struggling with.” - Interviewee*



### *Rural / isolated individuals*

Some participants linked many of the challenges described for people experiencing lower SES to rural populations. Financial insecurity is experienced by populations in urban and rural areas, and those in rural areas have additional challenges that may hinder their resilience to the health impacts of climate change, namely, isolation. Rural residents may have more barriers to accessing emergency services, and may be more impacted by drought and impacts to water quality.

*“And then because of the nature of a lot of the rural areas, a lot of them are, generally speaking, lower socioeconomic status, which adds again, another layer of access to not only health resources but all the logistical resources associated with it.” - Interviewee*

*“A large part of the population that we serve in Benton County are rural residents, and we're starting to see people's groundwater wells go dry or their landscapes dry up.” - Interviewee*

*“We live in a pretty rural area in both Lincoln and in Benton County, and so we have a lot of people that are very poor and have challenges with transportation. And are really living check to check in order to be able to survive. And when these kinds of things happen, it creates even more dire limitations to them. And they don't have the same kind of access to food that maybe somebody that lived in Corvallis as opposed to living in Alsea outside of Corvallis or in an area outside of Lincoln City do.” -Focus group participant*

### **Other climate + health concerns**

Participants discussed a wide array of climate and health concerns. For the purpose of prioritization and adaptation planning, this assessment provides detailed examination of the top climate and health concerns elevated by interviewees, focus group participants, and survey respondents. Other climate events of concern to participants included landslides and storms.

Other priority populations highlighted by participants included people whose primary language is not English; people with disabilities; and tribal nations (i.e. Confederated Tribe of Siletz Indians).

*“The winter storms have become much worse in my [lifetime], I think, so we're having bigger winter storms, more mudslides, landslides, longer rains.”* - Interviewee

A few participants also highlighted concerns about climate impacts to forests, and how this will affect heat domes, the timber industry, and future access to green space.

*“If you were to drive through Lincoln County in the last couple of years we had with the heat dome that occurred, and because our forest had already been stressed due to the summer of 2020 and the next summer we had corridors of trees that were already turning red, which is unusual for evergreens.”* - Focus group participant

*“I can't remember how many millions of dollars in worth of timber was destroyed. But the logging companies actually noticed a huge impact, where they had to go log areas a lot sooner than they would, where they're on a 70, 80 year timeline and they had to log these at year 30. So it was a huge impact to their production, and they had to replant. And so it changed a lot of their practices and their timelines for harvest, which impacted, of course, jobs and everything else.”* - Interviewee

## Climate + health resilience

### Current work

In interviews and focus groups, participants were asked if they knew of any existing plans or initiatives to address climate change in their communities. Participants working in city and county government generally did not discuss formal climate change adaptation plans, but some of them did mention that they are in the beginning stages of getting buy-in from leadership or working with the county to start strategizing. Other participants mentioned specific groups and coalitions that could be resources in climate and health resilience work, including:

- Concerned citizens for clean air in Lincoln County, working with the Oregon Department of Transportation on a pollinator protection corridor
- The Community Emergency Response Team in Benton County; one participant from an environmental organization said they have worked with them on wildfire evacuation drills and wildfire prevention
- The Corvallis Sustainability Coalition; which provides community education
- One participant representing fishers said they are working with the state of Oregon on “what they're calling now the blue economy,” and ways to support fishers

### Concerns + areas for improvement

Some participants raised their concerns about a perceived lack of resilience and community strengths. Overall, participants did not critique any specific actions taken by their community leaders related to climate and health, except to say that they feel that things are not moving quickly enough. Some participants noted that this assessment and plan is a key step, while others wondered if this effort will be sustained and impactful.

Although these comments do reflect frustration with climate and health actions that have, or have not, been taken thus far, they also communicate that some members of the community are ready to support the county in their climate and health resilience work.

*“So my experience of governments and agencies is that they're not really taking (climate resiliency) on. And that's why kids are so frustrated, and I'm frustrated too.” - Focus group participant*

*“And I think some of our local governments have blinders on. I mean, when one of our local fire stations is undergoing renovation and... instead of maximizing the amount of solar and solar batteries that could be included in this new fire station renovation, they chose to go with a lot more natural gas. And it just seemed rather foolish to me to be making that decision at this particular time. So I don't think the mindset is there for some of our decision makers.” - Focus group participant*

*“The bigger concern would be the health and wellness of future generations and whether or not our communities are preparing for the human race in years to come, and whether or not individuals and organizations and cities, municipalities, government agencies are doing enough” - Interviewee*

## Community strengths and resources

### Community culture, spaces, and collaboration

Interviewees, focus group participants, and survey respondents all shared community strengths and resources that they felt could support the counties' climate and health resilience work. Some of these resources included the current work aforementioned, and many participants considered the culture of Lincoln and Benton counties to be a resource in itself.

*“One of the things that attracted me to [this city in Lincoln County] in the first place is that there is a strong foundation of volunteerism. It's a fundamental concept that is shared by people in this community. I don't think that it would run as effectively without all of the volunteerism, which is really part of the contribution that most individuals make here.” - Interviewee*

*“Lincoln County community strengths are our diversity of people, cultures, compassionate service providers and all the caring community of partners that collaborate regularly to address the needs in our communities” - Survey respondent*

*“My community in Lincoln County can come together to deal with a crisis. The response to the Echo Mountain Fire is an example.” - Survey respondent*

Functional resources mentioned by participants included community spaces, such as libraries, that could be used in various emergencies and collaboration between farmers and the county to prepare for climate effects on crop production.

*“So one resource that comes to mind immediately is the library. I think folks always think of the Corvallis, Benton County Library system as a community resource for anything from high heat days to high smoke days, consistently providing that for the community as a sort of safe space to be.” - Interviewee*

*“I'll just say a couple things about food, because we work very closely with farmers in Benton County... We work a lot with ODA and NRCS (federal agencies) in particular on climate-smart agriculture, having workshops for farmers, doing a lot of regenerative soil management and all kinds of things. So there's a huge interest from the farmers that we work with.” - Focus group participant*

## Recreation

Lincoln and Benton counties are fortunate to host public beaches, winding bike trails, and ample green space. The natural environment of this region and the opportunities for recreation and play were among the things most valued by participants in this assessment. Strategies that protect these spaces have the potential to positively impact the region's climate and health resilience.

*“And just personally not being able to get outside because of the smoke, that's probably one of my biggest self-care things that I do is to go for walks. And so when I can't go for walks, I really love nature, it affects me physically. And then also I just feel drab, depressed.”* - Focus group participant

*“Yeah, I guess the only thing I would contribute would be on the recreation front... some issues that are exacerbated by climate change and really do limit the recreation opportunities for both locals and people visiting. Losing our beach access is a big thing as well. I was just at [the beach] this weekend enjoying the waves, but all the access points are now just 20 foot walls, heading straight down to the beach. We're losing our access, we're losing our recreation. In forested areas, [timber company] closes some of those down during the summer and the fall because of concerns about wildfires and recreation on deeper lands that are harder to get to, so I would just echo some of that stinks for those of us out here when you can't go to your favorite spots.”* - Focus group participant

*“So selfishly though, I think about the recreation, which is really important, I think, to Oregonians. And that's sort of one of those things that we're losing the public right of way on the coast a little bit by little bit. So one little seawall at a time, doesn't really notice it until it's all gone one day. And so that's a really slow snowballing sort of impact I feel like that we experience.”* - Focus group participant

## Science + education

Participants, especially those with proximity to Oregon State University (OSU) and Linn-Benton College, regarded knowledge of and familiarity with the natural environment as a community strength. This environmental awareness was noted as a key component of community-level buy-in for climate and health resiliency work.

*“I also think as an informational resource, we have Linn-Benton Community College as well as OSU and OSU Extension. I think they have consistently been providing resources to the community.” - Interviewee*

*“I think OSU extension service, I think they may already be a partner in this, but they seem like a natural fit to maybe providing more opportunities to educate or provide a platform to bring those trainings in to try and get a local elected officials up to speed, that general awareness, maybe facilitating some questions” - Interviewee*

*“We do have a caring community that is willing to step up and offer help to others and to comply with public health guidelines. We also have a great research institution that can help us develop policies and better understand and communicate the dangers that lie ahead.” - Survey respondent*

## Next steps

*“In this community, actually, there's all sorts of opportunity to collaborate. Once you tell people what you want to do, it's a community that really likes to volunteer, really likes to throw out things, really likes to chew it apart, but it needs to be focused. If we tell people, ‘this is the issue we want to do, what all can you do?’ You'll see private industry, you'll see nonprofits, you'll see all sorts of people jump in on that.” - Interviewee*

### Planning meetings

From March - May 2023, Rede and the client team will convene 3-5 planning meetings to prioritize next steps and discuss the role of Lincoln and Benton health departments and other governmental partners (ex. emergency management) in climate and health interventions. Another aim of these meetings will be to identify appropriate metrics for evaluation of the implementation plan. Through these conversations, Rede and the client team will identify:

- Overall goals of the climate and health adaptation and implementation plan;
- Appropriate, feasible, and actionable climate + health interventions;
- Strengths and opportunities for improvement within the team;
- Clear roles for implementation of interventions; and,
- Evaluation metrics



## Organizational capacity + community readiness

In order to assess organizational capacity and community readiness for climate and health interventions, Rede conducted a survey with Lincoln and Benton county health departments. Adapted from OHA's Climate Change Resilience Toolkit, the survey asks respondents to assess their capacity in numerous areas of climate and health resilience work, and the readiness of their communities for this work, as Low, Some, or Medium-to-High. The capacity and readiness levels are defined as follows:

**Low Capacity** – There is currently very little interest, support, or resources. The majority of our strategies should focus on training our public health officials and building awareness among our stakeholders.

**Some Capacity** – There is some interest and support within our organization and broader community. There may not be funding, but there are other forms of capital that could be used (such as existing partnerships, initiatives, collaborations, etc.). Our strategies may include a mix of targeted educational outreach with one or two priority public health interventions.

**Medium-to-High Capacity** - There is strong support within our organization and broader community to work on climate change. We are able to devote some staff time to this work and partners are ready to collaborate with us on these efforts. We have the interest and capacity to work on strategies that involve changes in our planning, policies, and systems.

Figure 9 shows the self-reported capacity levels of each county health department. Where capacity levels are identical or close, there may be opportunity for shared strategies in the adaptation and implementation plan. Where capacity levels are divergent, strategies in the plan may be more tailored to the county with the lower capacity.

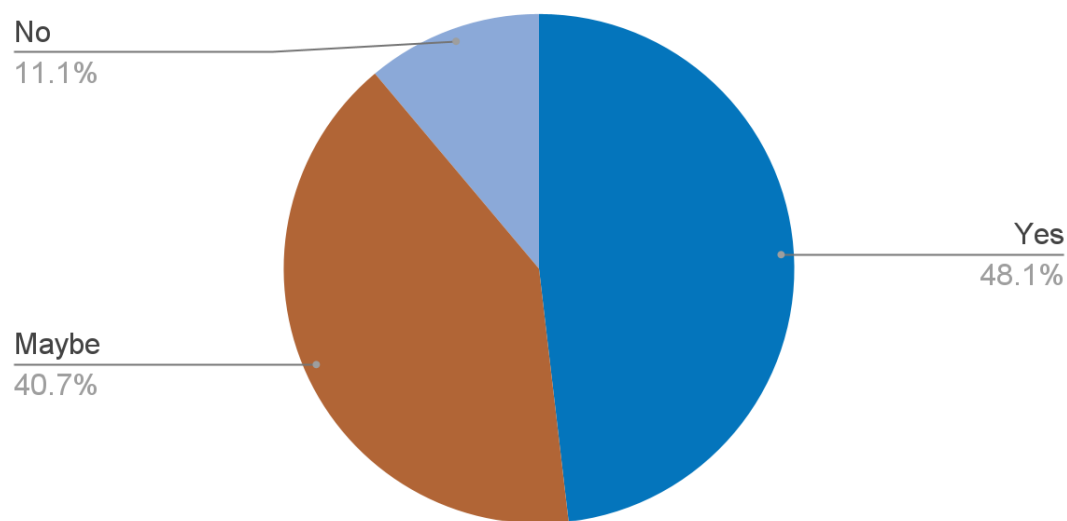
Figure 9. Self-assessed capacity and readiness in climate + health work

| Capacity Area  | Capacity level |               |
|--|----------------|---------------|
|  | Lincoln County | Benton County |
| Other agencies are planning and/or taking action                                   | Low            | Low           |
| Applicable funding   | Low            | Low           |
| Our dept. understands what other agencies have authority to do                     | Low            | Some          |
| Staff time can be allotted to the work   | Low            | Some          |
| Organizational culture of collaboration and creative problem-solving               | Low            | Some          |
| Interest among staff   | Some           | Some          |
| Knowledge among staff (or ability to gain expertise through training, etc.)        | Some           | Some          |
| Existing community partnerships  | Some           | Some          |
| Community partners are interested and ready to engage in climate-health resilience | Some           | Some          |
| General public readiness in climate-health resilience                              | Some           | Med - High    |
| Broader jurisdictional support (commissioners, other agency directors, etc.)       | Some           | Med - High    |
| Health dept. staff are interested and ready to engage                              | Some           | Med - High    |
| Health dept. staff are well-connected and already coordinating related efforts     | Some           | Med - High    |
| Leadership support   | Med-High       | Med - High    |

## Continued engagement

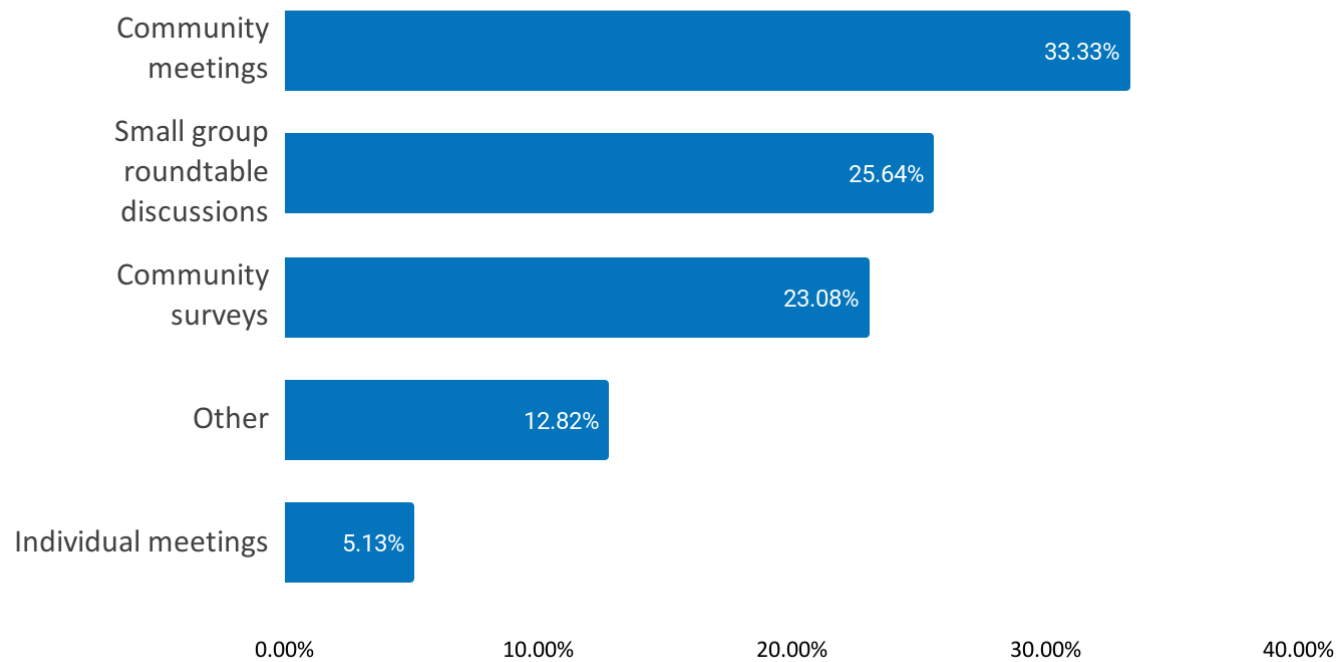
Many participants expressed interest in being continually engaged by Lincoln and Benton counties in climate and health adaptation work. Interviewees and focus group participants who expressed the most interest in continued participation were city and county government officials. As shown in Figure 9, 48.1% (n=13) of survey respondents also expressed interest in continuing to work with the county on climate and health adaptation work, and these respondents included a student, a few community-based organizations, and government officials at the city and county level. A full list of participants who wanted to be engaged in future assessments and planning process will be provided to the county as part of their planning process.

Figure 10. Would you like to continue working with the county on climate and health adaptation?



Survey respondents were also asked about the best ways for the county to engage them in this work. Figure 10 shows that community meetings and small roundtable discussions are the most preferred methods of engagement.

Figure 11. Best ways to engage community in future assessments and planning



# Appendix

## **Appendix Contents:**

Appendix A: Data collection instruments

A.1. Interview guide

A.2. Focus group guide

A.3. Community survey questions

Appendix B: Organizational capacity survey

Appendix C: Climate and health risk profile

Appendix D: OCCRI data summary

# APPENDIX A.1. INTERVIEW GUIDE

## Interview Guide base template

### Introduction

Thank you for joining us in this discussion of climate and health. I'm \_\_\_, a \_\_\_ at Rede Group. Rede Group is a public health consulting firm based in Oregon City and Lincoln and Benton county health departments hired us to learn about your concerns, ideas, and community strengths. We will use them to draft a plan with ways to better prepare for risks and protect health.

This discussion is being recorded for transcription. If there is something you would like to say during this interview but you don't want it to be attributed to you or your organization, please let us know.

The recording from this meeting, and the transcript, will be stored in Rede's Dropbox and will not be shared outside of this project.

One last thing - it is entirely normal for discussions of climate change to bring up strong feelings. Please feel free to take breaks, move around, eat, or care for yourself. .

Do you have any questions?

With that, let's get started.

1. First, can you please share your name, position, and county or city you are representing here today?
2. Prior to this interview, we sent out two infographics and the executive summary of the Oregon Climate and Health Profile Report [put in the chat]. Would you like a moment to look these over?
  - a. <https://www.oregon.gov/oha/ph/HealthyEnvironments/climatechange/Documents/oregon-climate-health-exec-summary.pdf>
    - i. Infographics:
      1. [Climate impacts on human body](#)
      2. [Climate and health](#)
3. After reviewing the infographics and report with your city, community or county in mind, do you have concerns related to climate change? If so, what are you most concerned about?
4. The infographic and report are specifically about climate impacts on human health. Do you have any concerns about climate impacts on health? If so, can you describe them?

## APPENDIX A.1. INTERVIEW GUIDE

5. In your community, who do you think is most vulnerable to the health impacts of climate change? Why they are most vulnerable?
  
6. Have you noticed or heard about the *slower* effects of climate change that impact food production, lifestyle, work  
Probe: how about quintessential Pacific Northwest icons, such as ocean acidification and warming temperatures, that affect salmon and forests?
  - a. Thinking of the residents of \_\_[city/area]\_\_, are you concerned about these types of changes?
  - b. What kind of health impacts are you most concerned about?
  - c. Are you concerned about the mental health impacts on residents due to these types of changes?
  
7. Do you think [city/area] are prepared for the public health challenges ahead?
  - a. Why or why not?
  
8. Adapting to climate change will be an ongoing process that requires planning and coordinating across government and community.
  - a. Does your city/organization have any climate adaptation plans in place already? Have you shared them with your county health department?
  - b. How can your local health department best engage with you or your agency in planning and executing climate and health adaptation plans?
  - c. Would you or your agency like to continue working with the health department on adaptation planning?
  
9. A key component of climate resilience is recognizing and bolstering community resources. Can you share what you most value about the community you serve?
  - a. Can you share about community strengths and resources that could support climate resilience?
  - b. What role, if any, do you think the health department could play in supporting and preserving what you most value?
  
10. Is there anything else you'd like to share related to climate change and health?

Closing statement.

APPENDIX A.1. INTERVIEW GUIDE



## APPENDIX A.2. FOCUS GROUP GUIDE

Focus group base template without prompts

- 1. First, I'd like us all to introduce ourselves**
- 2. Prior to this focus group**, everyone should have received two infographics about the health effects of climate change and the executive summary of the Oregon Climate and Health Profile Report
3. Have you seen any changes to the climate where you live, such as heat waves, wildfires, flooding or storms?
4. Have you noticed or heard about *slower* effects of climate change that impact food production, lifestyle, work, salmon, forests or other things?
5. Have you noticed health impacts related to these climate changes that you've just named? If so, what are they?
6. Based on your own experience and having reviewed the infographics, what are your top climate and health concerns?
7. Do you have any concerns about the effect of climate change on mental health – your own, your community's, or the people you serve?
8. Is your organization planning for these physical or mental health impacts?
9. Do you think that the people you serve are prepared for these incoming health challenges? Why or why not?
10. Communication about health risks is really important to protecting the health of communities. Where do you get information about upcoming or current emergencies?
11. A key component of climate resilience is recognizing and bolstering community resources. Are there resources you use to prepare for and/or deal with climate change and the related health impacts? (physical and mental health)
12. To better prepare for climate related health challenges in the next 5 years, what steps [policies, programs, campaigns, other...] could be taken by your...
13. Where are there opportunities for further collaboration?
  - Who should be engaged in this work of planning for climate change and health impacts?

## APPENDIX A.2. FOCUS GROUP GUIDE

**14.** Adapting to climate change is a long-term effort. Would you like to continue being involved with adaptation planning? Would you like to get a copy of the plan we draft based on your and others' thoughts?

**15.** What else do we need to discuss that hasn't come up already?

End of Focus group.

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

### Survey Introduction

**Rede Group is conducting this survey on behalf of Lincoln and Benton Counties. The purpose of this survey is to better understand your concerns and recommendations related to the health effects of climate change in your area.**

**Rede Group is a public health consulting firm based in Oregon City. Lincoln and Benton county health departments hired us to learn about your climate change related concerns, ideas, and community strengths. We will use them to draft a plan to better prepare for climate change and protect health.**

**The survey should take approximately 15 - 30 minutes to complete. At the end of the survey, you will be able to opt-in to receive a \$40 gift card that will be mailed to you. Participants who are eligible to receive an incentive are non-governmental entities, such as community-based organizations, and members of tribal nations.**

**Your responses to this survey are confidential, and will never be linked to you individually in any reporting or documents shared with Lincoln and Benton Counties. Findings will have no effect on any contract, staff resources, or other relationship you have with Lincoln and/or Benton County currently or in the future. If you have concerns about the confidentiality of your responses, or you have other questions about this assessment, please contact Makinna Miles at (503) 461-3595 or [makinna.miles@redegroup.co](mailto:makinna.miles@redegroup.co).**

**Your honest responses on this survey are truly valuable.**

**Thank you for your time!**

# APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

## Section 1: Introductory questions

1. Please enter your email address. This will help us track responses.

2. Which county do you live in?

Lincoln

Benton

>

Other (please specify)

The next question will ask you to select the perspective that you are representing in these survey responses. If you were contacted to participate through your work or official volunteer email or phone number, please take the survey as a representative of that organization.

If you are a student or youth/young adult and none of the other response options apply to you, please select option G. (Please also select this option if you were contacted to participate through a student organization).

If **none of the above** apply to you, please select "other" and tell us more. (for example, if you work on a farm)

For the purpose of this survey "representing" is not an official or legal term. By representing an organization, business, or government agency in this survey, you are providing your perspective as someone who works or participates in that organization.

3. Please select which perspective you are representing in these survey responses

A: I am taking this survey as a representative for my community-based and/or faith-based organization

B: I am taking this survey as a representative of a for-profit business

C: I am taking this survey as a representative of my city government

D: I am taking this survey as a representative of my county government

E: I am taking this survey as a representative of my state government

F: I am taking this survey as a member of a tribal nation

G: I am taking this survey as a student or youth/young adult

>

Other (tell us more)

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

4. Please tell us the community-based organization's name, the populations you serve, and the services/goods you provide.

APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

5. Please tell us the business name and the goods and/or services you provide.

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

6. Please tell us which city/county/state entity or department you work for, and your position.

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

7. If you are a member of a tribal nation, please specify which tribal nation:



## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

8. Please tell us which school you attend and if you are part of any student-led or youth-led organizations.

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

9. Please tell us if you work in any of the following fields:

- Commercial fishing
- Timber
- Forest management
- Farming and agriculture
- Fire or other emergency response
- General medical services
- Mental health services
- Tourism

>

- Other (please specify)

>

- None of the above

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

### Section 2: Climate concerns and health effects

10. In your city/county, have you noticed any effects of climate change, such as increased wildfires, warming ocean temperatures, decreased ocean or forest life, or others? If so, please describe.

Please take a moment to review these infographics. The executive summary of the OHA Climate and Health Report is also included if you wish to review it.

**Infographics:**

*Climate impacts on the human body -*

<https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/2018/OHA-Climate-Impacts-on-Human-Body.pdf>

*Climate and health -*

[https://www.oregon.gov/oha/ph/HealthyEnvironments/climatechange/Documents/Oregon\\_Climate\\_and\\_Health\\_Info-Graphic.pdf](https://www.oregon.gov/oha/ph/HealthyEnvironments/climatechange/Documents/Oregon_Climate_and_Health_Info-Graphic.pdf)

**Executive summary:**

*OHA Climate and Health Report*

<https://www.oregon.gov/oha/ph/HealthyEnvironments/climatechange/Documents/oregon-climate-health-exec-summary.pdf>

11. After reviewing these materials with your city or county in mind, do you have concerns related to climate change?

- Yes
- No
- Unsure

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

12. Please indicate how strongly you are concerned about the following effects of climate change:

|   | I am...              |
|---|----------------------|
| Income loss   | <input type="text"/> |
| Displacement<br>(urgently having to<br>leave where you live)  | <input type="text"/> |
| Economic instability  | <input type="text"/> |
| Migration from in the<br>state (example:<br>someone moving from<br>Bend to Lincoln City<br>because of climate<br>change impacts)        | <input type="text"/> |
| Migration from<br>outside the state<br>(example: someone<br>moving from<br>Singapore to Oregon<br>because of climate<br>change impacts) | <input type="text"/> |
| Recreational risk   | <input type="text"/> |
| Occupational risk   | <input type="text"/> |

13. Please indicate how strongly you are concerned about the following effects of climate change:

|                            | I am...              |
|----------------------------|----------------------|
| Increase in wildfires      | <input type="text"/> |
| Increase in floods         | <input type="text"/> |
| Drought                    | <input type="text"/> |
| Heat waves                 | <input type="text"/> |
| Air pollution              | <input type="text"/> |
| Worsening water<br>quality | <input type="text"/> |
| Ocean acidification        | <input type="text"/> |

14. Are there other effects of climate change that you are concerned about? If so, please describe. The next section of questions will talk more about health effects of climate change.

APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

15. Do you have any concerns about climate impacts on health?

- Yes
- No
- Unsure

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

16. Please indicate how strongly you are concerned about the following health effects of climate change:

|  | I am...              |
|--|----------------------|
| Injury from severe weather events or wildfire                              | <input type="text"/> |
| Worse or new allergies   | <input type="text"/> |
| Respiratory illness (trouble breathing) or asthma                          | <input type="text"/> |
| Vector-borne disease (ex. Zika from mosquitoes or Lyme disease from ticks) | <input type="text"/> |
| Illness from harmful algal blooms  | <input type="text"/> |
| Increase in food prices/food insecurity                                    | <input type="text"/> |
| Illness from drinking bad/contaminated water                               | <input type="text"/> |
| Food-borne disease or illness (food poisoning)                             | <input type="text"/> |
| Conflict between people  | <input type="text"/> |
| Heat-related illness   | <input type="text"/> |
| Death  | <input type="text"/> |

17. Please indicate how strongly you are concerned about the following mental health effects of climate change:

|                    | I am...              |
|--------------------|----------------------|
| Depression         | <input type="text"/> |
| Anxiety            | <input type="text"/> |
| Chronic stress     | <input type="text"/> |
| Chronic fatigue    | <input type="text"/> |
| Increased violence | <input type="text"/> |

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

18. Are there other thoughts, questions or concerns you'd like to share about the health impacts of climate change?

19. In your city or county, who do you think is most vulnerable to the health impacts of climate change? Why they are most vulnerable?



## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

### Section 3: Planning and preparedness

20. Do you think that your city/county is prepared for the health effects of climate change?  
Why or why not?

21. Adapting to climate change will be an ongoing process that requires planning and coordinating across government and community. Would you or your agency like to continue working with the health department on adaptation planning?

Yes

No

>

Other (please specify)

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

22. How can your local health department best involve you or your organization/agency in planning and executing climate and health adaptation plans? (select all that apply)

- Community surveys
- Community meetings
- Small group roundtable discussions
- Individual meetings

>

- Other (please specify)

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

### Section 4: Resilience and community resources

This assessment uses the U.S. Government's definitions of adaptation and resilience related to climate change.  
<https://toolkit.climate.gov/content/glossary>

For this assessment, "**climate resilience**" is the capacity of a community and natural environment to prevent, withstand, respond to, and recover from climate disruptions.

23. A key component of climate resilience is recognizing and bolstering community resources. Can you please share about community strengths and resources in the Lincoln-Benton County area that could support climate resilience?

24. What do you most value or appreciate about Lincoln or Benton County?

25. What role, if any, do you think the health department could play in supporting and preserving what you most value or appreciate about where you live?

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

26. Is there anything else you'd like to share related to climate change and health?

27. Would you like to receive an incentive for participating in this survey? This would be a \$40 gift card mailed to you.

Yes

No

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

28. Please provide your name, phone number, and complete mailing address. This information will ONLY be used for the purpose of mailing the incentive.

## APPENDIX A.3. COMMUNITY SURVEY QUESTIONS

29. Would you like to be contacted by the project team at Rede Group and Lincoln-Benton Counties to participate in a discussion about the findings from this climate and health assessment?

Yes

No

Thank you for taking this survey!

## Assess Organizational Capacity



Below is a checklist for assessing organizational capacity for climate and health work. Understanding current organizational capacity can help us decide what kinds of actions to undertake. Local health jurisdictions have varying levels of capacity determined by a number of factors including:

- Interest among staff
- Knowledge among staff (or ability to gain expertise through training, etc.)
- Leadership support
- Organizational culture of collaboration and creative problem-solving
- Other agencies are planning and/or taking action
- Broader jurisdictional support (commissioners, other agency directors, etc.)
- Our dept. understands what other agencies have authority to do
- Staff time can be allotted to the work
- Applicable funding
- Health dept. staff are interested and ready to engage
- Health dept. staff are well-connected and already coordinating related efforts
- Existing community partnerships
- Community partners are interested and ready to engage
- General public readiness (*see: Assessing community readiness tool*)

### **Weighing these types of factors, what is our current organizational capacity?**

**Low Capacity** – There is currently very little interest, support, or resources. The majority of our strategies should focus on training our public health officials and building awareness among our stakeholders.

**Some Capacity** – There is some interest and support within our organization and broader community. There may not be funding, but there are other forms of capital that could be used (such as existing partnerships, initiatives, collaborations, etc.). Our strategies may include a mix of targeted educational outreach with one or two priority public health interventions.

**Medium-to-High Capacity** - There is strong support within our organization and broader community to work on climate change. We are able to devote some staff time to this work and partners are ready to collaborate with us on these efforts. We have the interest and capacity to work on strategies that involve changes in our planning, policies, and systems.

# Lincoln & Benton Counties Climate and Health Profile

### Geography & Climate

Benton and Lincoln counties cover an area that extends from the Oregon coast to the Willamette River. They meet at the Coastal Mountain range. Highways 20 and 34 connect the two counties. One of Lincoln County's major rivers, the Alsea, begins in the Coastal Mountain Range in Benton County and terminates in Lincoln County at Alsea Bay.

#### Benton County Geography & Climate

Benton County occupies approximately 676 square miles in the heart of the Willamette Valley, in the mid-western part of Oregon. The Willamette Valley region begins east of the Oregon Coast Range and extends east to the Cascade Mountain Range and south to the Calapooya Mountains. In general, this region's geographical position results in a climate characterized by relatively mild temperatures, seasonal precipitation, mild winters, and dry summers. The Cascades serve as an effective moisture retainer for the majority of the Willamette Valley, causing storms to concentrate much of their moisture west of the peaks and leaving areas to the west fertile for agriculture.

Benton County is bordered on its north side by Polk County and on its south side by Lane County. To the west, Lincoln County separates Benton from the coast, and to the east are Linn County and the Willamette River. The 187-mile Willamette River connects to the Columbia River north of metropolitan Portland, which is the only fresh-water corridor for ocean-going commerce on the West Coast of North America, and the only water-grade route through the Cascade Range between Canada and California.

The Willamette and Mary's Rivers, and several small streams are subject to slow-rise flooding. The Willamette Valley is home to more than two-thirds of the Oregon population. Land elevations rise from 150 feet on the Willamette River and floodplains to greater than 3,000 feet in the Northern Oregon Coast Range. The western half of Benton County is known for its timber production, and once down from the mountains, the county is comprised of rolling hills and valleys that boast the largest concentration of wineries and vineyards in the State. Three major highways traverse the county: Highway 99W extends north and south through the county, and Highways 20 and 34 are oriented generally east and west from the Willamette River to the coast. The Willamette and Pacific Railroad also pass through the county.

\*Data from this table is drawn from the Oregon Climate and Health Profile Report, input from community members, and OCCRI County Projections



## APPENDIX C CLIMATE AND HEALTH RISK PROFILE

### **Lincoln County Geography & Climate**

Lincoln County is located on the central Oregon coast and occupies 992 square miles. The lands of the sovereign Confederated Tribes of Siletz are located within Lincoln County. Lincoln County's is bordered to the west by the Pacific Ocean and to the east by the Coastal Mountains. It is bordered on the northern coast by Tillamook County, inland to the east by Polk and Benton Counties and by Lane County on the south coast. It includes the cities of Lincoln City, Depoe Bay, Newport, Waldport and Yachats, all of which are located on the coast. Smaller communities are located in the inland portions of the county.

Lincoln County has multiple rivers including the Siletz, Alsea, Salmon, Yaquina, and Yachats. The Tum Tum River follows Hwy 20 and is a tributary of the Mary's River in Benton County. The Alsea River starts in Benton County in the Coastal Mountains.

Highway 101 runs north to south through the county, continuing north to Washington state and south to San Diego, California. Highways 34 and 20 connect Lincoln County to Benton County to the east.

The Pacific Ocean dominates the climate in the coastal region, creating a very temperate climate with a smaller range of temperatures than inland counties throughout the year. Lincoln County has a short, but productive growing season. Precipitation is significant, but seasonal, with nearly 72 inches per year falling autumn through spring with drier summers.

Lincoln County watersheds are rain dominated with peak flows occurring during the winter and low flows occurring during the summer.

### **Projected climate changes in Lincoln and Benton Counties:**

Although the climates of the two counties differ, reports compiled by the Oregon Climate Change Research Institute document that the types of changes they face are largely the same.

- Summers are getting hotter and drier.
- The last freeze of winter is occurring earlier, while the first freeze of fall is starting later.
- By mid-century, much of Oregon is projected to have 20 fewer days below freezing per year.
- More precipitation will fall as rain rather than snow, increasing the risk of floods and landslides.
- Both counties are likely to experience more extreme events like heat waves, wildfires and storms.

\*Data from this table is drawn from the Oregon Climate and Health Profile Report, input from community members, and OCCRI County Projections

## APPENDIX C CLIMATE AND HEALTH RISK PROFILE

- Sea level rise and ocean acidification are expected to continue.

### **Climate impacts and health risks in Lincoln & Benton Counties:**

- Climate change threatens our access to clean air, clean water and healthy food.
- Changes are likely to lead to health impacts from heat waves, wildfires, deteriorating air quality, drought, water-borne disease, increased allergens and diseases spread by ticks and mosquitoes
- Air pollution from increased ground-level ozone and wildfire smoke could worsen respiratory illness.
- Water sources can become contaminated from drought or flooding.
- Hospitalizations increase during extreme heat events.
- Drought, and on the coast changing ocean chemistry and temperature, threatens family incomes and quality of life.
- Changing ocean chemistry and temperature affect sea life, particularly shellfish, which can increase risk of foodborne illness and impact the shellfish industry
- Sea level rise threatens recreation and tourism as well as infrastructure and can exacerbate flooding of coastal rivers
- Uncertainty about the impacts of climate change, loss of beloved places, and threats to way of life are creating anxiety and depression for young people and many others in our community

## APPENDIX C CLIMATE AND HEALTH RISK PROFILE

| Climate Impact*      | Health Risks   | Vulnerable Groups   |
|----------------------|--|---|
| Heatwaves            | Heat related illness (ex: heat rash, heat cramps, heat exhaustion, heat syncope (fainting), heat stroke)   | People with chronic diseases, pregnant women, young children, older adults, low-income, socially isolated, outdoor workers (particularly migrant and immigrants, agriculture, forestry, construction and road workers), unacclimatized particularly on the coast, communities of color, urban residents |
|                      | Heat-related death (ex. cardiovascular disease, renal failure, heart attack, stroke, heat stroke, deaths from respiratory illness)   | People with chronic diseases, infants, children, older adults, low-income, socially isolated, outdoor workers, urban  |
|                      | Violence (ex. Intentional injury, homicide)  | Children and young adults   |
|                      | Air pollution (ex. Chest pain, coughing, throat irritation, congestion, reduced lung function, exacerbation of emphysema, bronchitis and asthma, cancer deaths, cardiopulmonary deaths), | People living near heavy traffic, people with existing chronic respiratory illness, children  |
|                      | Harmful algal blooms (ex. Rash, paralytic shellfish poisoning, gastrointestinal illness, neurotoxic shellfish poisoning, food insecurity, death),  | People who eat shellfish, those who are economically dependent on seafood or coastal tourism, American Indians  |
|                      | Recreational risk (drowning, dehydration)  | Children, males   |
| Heavy rain, flooding | Landslides (ex. stress, injury, death),<br>Indirect impacts: blockage/destruction of critical roadways, damage to infrastructure including drinking water and sewer systems              | responders, buildings near steep slopes   |
|                      | Flooding (ex. Injury, water-borne disease, respiratory illness, exposure to toxins, death)   | Coastal communities, low-lying areas  |
|                      | Displacement (ex. Communicable disease in crowded evacuation centers, anxiety, depression, suicide)  | Low-income, low-lying areas, coastal areas, high-risk landslide areas, Native Americans/American Indians  |

\*Data from this table is drawn from the Oregon Climate and Health Profile Report, input from community members, and OCCRI County Projections

## APPENDIX C CLIMATE AND HEALTH RISK PROFILE

| Climate Impact*     | Health Risks  | Vulnerable Groups  |
|---------------------|---|--|
|                     | Mental and behavioral health (ex. Anxiety, depression, suicide)   | Existing mental illness, low income  |
| Wildfire            | Air quality (ex. Cardiopulmonary disease, ischemic heart disease, asthma, bronchitis, pneumonia, cancer, motor vehicle crash injury due to low visibility), | people with existing chronic illness, children, older adults, outdoor workers particularly migrant and immigrant workers, wildland fire fighters   |
|                     | Water quality due to increased flows of sediment, nutrients and elevated temperatures (ex. Gastrointestinal illness, methemoglobinemia)                     | infants, private well users  |
|                     | Occupational Risks (ex. Heat stress, respiratory illness, heat-related illness, unintentional injury, hearing loss, rhabdomyolysis, death)                  | wildland fire fighters, outdoor workers particularly migrant and immigrant workers   |
|                     | Income Loss (ex. Mental health, Chronic disease, premature death)   | rural residents, American Indians, those economically dependent on tourism or forestry, fishing industry workers and agricultural workers (healthy forests protect these industries as well) |
|                     | Displacement (ex. Anxiety, depression, suicide)   | low-income, wildland/urban interface residents   |
| Sea Level Rise      | Income Loss (ex. food insecurity (malnutrition and obesity), chronic disease)   | Coastal community at large   |
|                     | Displacement (ex. Anxiety, depression, suicide)   | Coastal community at large, Tribal Communities, Native Americans/American Indians  |
|                     | Mental and Behavioral health (ex. Anxiety, depression, suicide)   | Coastal community at large, Tribal Communities, Native Americans/American Indians  |
| Ocean Acidification | Income Loss (ex. food insecurity (malnutrition and obesity), chronic disease)   | American Indians, people who are economically dependent on fisheries   |
| Drought             | Income loss (ex. Stress, chronic disease, premature death)  | Farmers, farm workers, others economically dependent on agriculture, rural residents, American Indians   |

\*Data from this table is drawn from the Oregon Climate and Health Profile Report, input from community members, and OCCRI County Projections

## APPENDIX C CLIMATE AND HEALTH RISK PROFILE

| Climate Impact*    | Health Risks   | Vulnerable Groups   |
|--------------------|--|---|
|                    | Food insecurity (ex. Malnutrition, obesity, chronic diseases),   | communities of color, American Indians, low-income households, pregnant women, children, rural residents        |
|                    | Water insecurity (ex. Water-borne disease (microorganisms, biotoxins and toxic contaminants), dehydration                              | rural residents, low-income, private well users, infants, American Indians                                      |
|                    | Mental and Behavioral health (ex. Stress, anxiety, depression, suicide)  | Farmers, rural residents, low-income  |
| Infectious Disease | Vector-borne disease (ex. West Nile virus, Lyme disease)   | Outdoor workers, people in routine contact with animals, people living in areas with ticks                      |
|                    | Food-borne disease (ex. gastroenteritis, campylobacteriosis, salmonellosis, V. parahaemolyticus)                                       | People who consume shellfish, possibly through improper food storage and handling during hot weather            |
|                    | Fungal disease (ex. Cryptococcus gattii cryptococcosis)  | Research is still exploring this.   |
| Indirect Impacts   | Economic instability for forestry, fisheries, agriculture and tourism industries (ex. Food insecurity, mental health, chronic disease) | Low-income, communities of color, farm workers, American Indians, fishing industry workers, coastal communities |
|                    | Chronic stress (ex. Chronic disease, mental illness)   | low-income, people who are economically dependent on climate stability, parents, youth                          |
|                    | Migration (ex. Infectious disease)   | Uncertain. The number of people migrating due to severe climate change in their home area is likely to increase |

\*Data from this table is drawn from the Oregon Climate and Health Profile Report, input from community members, and OCCRI County Projections

## APPENDIX C CLIMATE AND HEALTH RISK PROFILE

### Particularly vulnerable populations in Lincoln and Benton Counties:

- Tribal, Native American, communities\*\*
- Immigrant, migrant, and refugee communities\*\*
- Non-English-speaking communities\*\*
- Communities of color
- Socially isolated individuals
- Unhoused
- Children and infants
- Pregnant women
- Older Adults
- Private well users
- Residents living in landslide prone areas
- People with existing illness, particularly mental health\*\* and/or chronic disease
- People with disabilities\*\*
- Low-income\*\*
- Wildland firefighters
- Farmers, farm workers, and other outdoor workers
- Economically dependent on tourism, fishing/shellfish industry, forestry
- First responders, healthcare workers, public health/emergency management

\*\*These populations are highlighted in the Benton and Lincoln County Community Health Improvement Plans.

## APPENDIX D OCCRI DATA SUMMARY

### Summary of climate science and how it was used in the Sixth Oregon Climate Assessment

Climate change is a global phenomenon that is felt locally. Given the complexity of monitoring, assessing and predicting the effects of climate change, scientists from around the world have been collaborating for decades through international programs supported by many governments. This section is intended to give an overview of those programs, reports, and models which are used by climate scientists globally and in Oregon.

Climate scientists from around the world contribute to and rely on the [Coupled Model Intercomparison Project \(CMIP\)](#) (1), an initiative of the [World Climate Research Programme \(WCRP\)](#). The World Climate Research Programme was established in 1980 and aims to increase understanding of past, present, and future natural and human-caused changes in climate. WCRP-supported research provides the climate science that underpins the [United Nations Framework Convention on Climate Change](#), including national commitments under the Paris Agreement of 2015, and contributes to the knowledge that supports the [2030 Agenda for Sustainable Development](#), the [Sendai Framework for Disaster Risk Reduction](#), and multilateral environmental conventions (2).

Each CMIP forms the climate modeling foundation for the assessment reports of the Intergovernmental Panel on Climate Change (IPCC). The IPCC is the United Nations body for assessing the science related to climate change (3). CMIP5, published in 2013, was the basis for the IPCC's fifth assessment report (4). CMIP6 is the climate modeling foundation for the sixth assessment report of the IPCC published in 2021 (5).

Each CMIP contains climate scenarios called Representative Concentration Pathways or RCPs. CMIP6 contains all of the RCPs of CMIP5 and has several additional ones. This excerpt from the Sixth Oregon Climate Assessment describes RCPs and illustrates the complexity of predicting the effects of climate change:

“RCPs are concentrations of greenhouse gases, aerosols, and other factors that determine radiative forcings by 2100. Radiative forcing is the total amount of energy retained in the atmosphere after absorption of incoming solar radiation, which is affected by the reflectivity of Earth's surface, and emission of outgoing long-wave radiation, which is affected by the concentrations of heat-trapping or greenhouse gases. The four RCPs, 2.6, 4.5, 6.0, and 8.5, represent radiative forcings of 2.6, 4.5, 6.0, and 8.5 watts per square meter ( $W\ m^{-2}$ ) by 2100, respectively. The most commonly used RCPs, 4.5 and 8.5, are often described as representing moderate reductions and business-as-usual increases in greenhouse gas emissions, respectively. The RCPs do

## APPENDIX D OCCRI DATA SUMMARY

not specify a particular set of social and economic assumptions that would result in the radiative forcing by 2100. Multiple sets of social and economic assumptions could result in the same radiative forcing.”

Recognizing that Oregon was not exempt from the effects of climate change, Oregon lawmakers established the Oregon Climate Change Research Institute (OCCRI) in 2007 with House Bill 3543. One of OCCRI’s mandates is to assess the state of climate change science and the likely effects of climate change on the state at least once each biennium. It is mandated to submit the assessment to the Legislative Assembly and to the Governor. OCCRI’s Sixth Assessment was published in January 2023 (6).

The authors of the Sixth Oregon Climate Assessment used CMIP5 to develop their findings. However, knowing that CMIP6 was recently published, the assessment contains a detailed description of why CMIP5 remains the foundation of most climate assessments worldwide and in Oregon. Importantly, with regard to the latest IPCC report and CMIP6, the Sixth Oregon Climate Assessment states, “These differences notwithstanding, fundamental projections of future climate have not changed appreciably in the two years since publication of the fifth Oregon Climate Assessment (Dalton and Fleishman 2021).” (6)

The Oregon Sixth Assessment aligns with other governmental climate change assessments and is based on RCP 4.5 (moderate reductions in emissions) and RCP 8.5 (“business as usual” emissions).

### **CLIMATE RISKS FOR LINCOLN AND BENTON COUNTIES**

In addition to the mandated biennial assessment of the likely effects of climate change for the state, OCCRI has produced county level assessments for a number of counties. The Benton County assessment is projected for completion later in 2023 and is not currently available. However, OCCRI has completed assessments of Lincoln County as well as Lane, Linn, and Marion counties in the Willamette Valley.

OCCRI projects changes to climate hazards with respect to both direction of risk (rising or falling) and confidence. Very high confidence indicates that most models agree on the direction of change and there is strong evidence in the published literature. High confidence indicates most models agree on the direction of change and there is strong to medium evidence in the published literature. Medium confidence means that there is medium evidence and consensus on the direction of change with some caveats. Low confidence means the direction of change is small compared to the range of model responses or there is limited evidence in the published literature.



## APPENDIX D OCCRI DATA SUMMARY

Appendix 1 shows that the climate risks predicted with the highest confidence are the same for Lincoln, Lane, Linn, and Marion counties with the addition of coastal hazards and ocean temperature and chemistry changes for coastal counties. Therefore, it is prudent to conclude that Benton County should prepare for these same risks. Note that these climate hazards are the same as those identified in the Benton County Public Health Department 2013 climate adaptation plan.

The OCCRI county reports present future climate projections for the 2020s (2010–2039) and 2050s (2040–2069) relative to the 1971–2000 historical baseline. The climate risks described in the reports with very high or high confidence that both Benton and Lincoln counties will need to prepare for are heat waves (very high), heavy rains, flooding, and wildfire (high).

As a coastal community, there is high confidence that Lincoln County will have increased risk of loss of wetland ecosystems, coastal hazards, and ocean temperature and chemistry changes. The loss of wetlands in Benton County is projected with medium confidence.

The climate hazards depicted in these reports with medium confidence for both Lincoln and Benton are drought, expansion of non-native invasive species, and increased invasive species risk.

Reduced air quality is predicted with medium confidence for Willamette Valley counties but with low confidence in Lincoln county.

Cold waves are predicted as a decreasing risk with very high confidence. Windstorms are predicted to have unchanging risk with low confidence.

Medium confidence should not lead to the conclusion that a change in climate risk should not be considered in resilience planning. Drought, invasive species, and loss of wetlands can be drivers of other climate hazards such as wildfire and decreased air and water quality.

### **CLIMATE AND HEALTH DATA INDICATORS**

The Oregon Health Authority's (OHA) Climate and Health Program developed the Climate Change: Resilience Planning Toolkit. This toolkit provides an extensive list of sources for climate and health data. This assessment includes health information from the Oregon Climate and Health Profile report, the Sixth Oregon Climate Assessment, and the county Future Climate Projections reports completed by OCCRI. The climate

## APPENDIX D OCCRI DATA SUMMARY

risks reported by OCCRI below are for the higher emissions scenario, RCP 8.5. The risks do not decrease significantly under more moderate emissions scenarios.

The Oregon Climate and Health Profile report draws from academic research, national indicators, such as the Environmental Protection Agency's [Climate Change Indicators in the United States](#) as well as the Centers for Disease Control and Prevention [Regional Health Effects - Northwest Region](#).

Additional sources of climate and health information include:

- [Climate Toolbox](#).
- ESSENCE, Oregon's Syndromic Surveillance System
- [USGS](#) has tools and information on climate change and its impacts
- [Oregon Drought Monitor](#) shows current and past drought conditions
- [NOAA's Digital Coast](#) has multiple tools and information
- [Surging Seas](#) has multiple tools and maps, including a [GIS layering tool](#) with social vulnerability, population, ethnicity, income, property, and landmark layers
- [Oregon Wildfire Risk Explorer](#)
- [Yale Center on Climate Change and Health](#) has learning opportunities and information
- [APHA Center for Climate, Health, and Equity](#) has resources for public health practitioners

### **Extreme Heat**

Extreme heat events are defined as a day with temperatures at or above 90 degrees Fahrenheit. In Lincoln County, historically this number has been nearly zero. This number is expected to increase under both moderate and high emissions scenarios. Under a higher emissions scenario, the number of days at or above 90 degrees will increase by an average of 4 days per year, with a range of 1 to 8 days by the 2050s.

In Lincoln County, the temperature of the hottest day of the year is projected to increase on average by about 6°F, with a range of about 2 to 9°F, by the 2050s under the higher emissions scenario relative to the historical baselines.

An increase of four days per year may seem insignificant, but research by the Oregon Health Authority in 2011 demonstrated that hospital admissions for heat related reasons in the coastal region began to increase at temperatures as low as 80 degrees. This indicates that initial heat related affects may begin for coastal residents at even lower temperatures.

## APPENDIX D OCCRI DATA SUMMARY

In the Willamette Valley, the number of extremely hot days and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 17 days (range 5–29 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–10°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

### **Heavy Rains**

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor.

In the Lincoln and Benton counties, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially before 2050. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 13-14% (range 0–30% for Benton, 4%-28% for Lincoln) and 9-10% (range -1–21% for Benton and 3% to 22% for Lincoln), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

For both counties, the number of days per year on which a threshold for landslide risk is exceeded is not projected to change substantially. The threshold is based on prior 18-day precipitation accumulation (Benton) or 3-day and 15-day precipitation accumulation (Lincoln). However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

### **River Flooding**

Winter flood risk at mid- to low elevations in Willamette Valley counties, including Benton, where temperatures are near freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow.

Coastal rain-dominated watersheds, such as the Siletz River, may experience an increase in winter flood risk due to projected greater winter precipitation and warmer winter temperatures causing precipitation to fall more as rain and less as snow, in addition to increases in the frequency and intensity of flood--producing atmospheric river events.

## APPENDIX D OCCRI DATA SUMMARY

### **Wildfire**

Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Benton County by about 12 days (range -6–31) by the 2050s, relative to the historical baseline, under the higher emissions scenario.

The average number of days per year on which vapor pressure deficit is extreme is projected to increase by 28 days (range 10–43) by the 2050s, compared to the historical baseline, under the higher emissions scenario. Per the research cited by OCCRI (Sedano and Randerson, 2014; Williams et al., 2014; Seager et al., 2015; Rao et al., 2022), vapor pressure deficit is a measure of atmospheric dryness and it is more strongly associated with forest area burned than precipitation, drought indices, or temperature.

OCCRI reports on wildfire risk for Lincoln County as a percentage, rather than a number of days. Risk is expected to increase by about 37% with a range of -12 to +97% by the 2050s.

### **Coastal Erosion & Flooding**

The risk of coastal erosion and flooding hazards on the Oregon coast is expected to increase with climate change due to sea level rise and changing wave dynamics. In Lincoln County, local sea level is projected to rise by 1.7 to 5.7 feet by 2100. At these levels, the multi--year likelihood of a flood event reaching four feet above mean high tide is virtually certain to occur by 2100.

### **Ocean Temperature & Chemistry**

Ocean warming, ocean acidification, and decreasing dissolved oxygen levels are leading to alterations in marine ecosystems affecting coastal communities. The chemistry of the waters off the Oregon coast has already reached a threshold harmful to calcifying organisms and negative impacts are already evident. Reductions in calcifying organisms at the base of the marine food web could have cascading effects on higher trophic marine fish, birds, mammals, and the people who rely on this resource. In addition, warming ocean waters have altered marine species composition with greater prevalence of warm--water species expected during marine heat waves.

### **Loss of Wetlands and Coastal Wetland Ecosystems**

This climate hazard is predicted with high confidence for Lincoln County and medium confidence for Benton County. Coastal wetland ecosystems are sensitive to rising sea levels, increases in coastal storms and wave height, warming air and water temperatures, changing precipitation patterns and freshwater runoff, saltwater intrusion, and ocean acidification, which can lead to changes in biological, chemical, and physical

## APPENDIX D OCCRI DATA SUMMARY

processes; shifts in species and biodiversity loss; and altered location and spatial extent of tidal wetlands.

In the Willamette Valley, losses of wetlands in recent decades largely were caused by conversion to agriculture. Projected effects of climate change on wetlands in the Northwest include reductions in water levels and hydroperiod duration. If withdrawals of ground water do not increase, then wetlands that are fed by groundwater rather than surface water may be more resilient to climate change.

### **Drought**

Drought conditions, as represented by low summer soil moisture, low spring snowpack, low summer runoff, low summer precipitation, and high summer evaporation are projected to become more frequent in Benton and Lincoln Counties by the 2050s.

### **Air Quality**

[Research](#) indicates that exposure to wildfire smoke is the primary way that most people will experience fire as opposed to the fire itself (8). Under future climate change, the risk of wildfire smoke exposure is projected to increase in Lincoln County. The number of days with high concentrations of wildfire-specific particulate matter is projected to increase by 7% while the intensity of particulate matter concentrations is projected to increase by 89% by 2046–2051 under a medium emissions scenario compared with 2004–2009.

Air quality projections are more varied through the Willamette Valley than other climate hazards. OCCRI's report for Benton County will be more important with regard to this climate hazard. Projections for air quality are made under a medium emissions scenario.

The risk of wildfire smoke through the entire Willamette Valley is projected to increase. The number of days per year on which the concentration of wildfire-derived fine particulate matter results in poor air quality is projected to increase for most of the valley and the concentration of fine particulate matter will increase through the entire valley.

The number of days per year on which the concentration of wildfire-derived fine particulate matter results in poor air quality is projected to increase by 13% in Linn County and 19% in Marion County, but decrease by 5% in Lane County. However, the concentration of fine particulate matter is projected to increase in all counties: by 88%, from 2004–2009 to 2046–2051 in Linn, 58% in Lane, and 91% in Marion.

### **Expansion of Non-native Invasive Species**

## APPENDIX D OCCRI DATA SUMMARY

In general, non-native invasive insects and plants and diseases for forests and cropping systems in both counties are likely to become more prevalent in response to projected increases in temperature, especially minimum winter temperature, and the frequency, duration, and severity of drought. Invasive species populations are expected to expand in extent (northward in latitude, higher in elevation) with warmer temperatures. However, many of these responses are uncertain, are likely to vary locally, and may change over time.

### REFERENCES

1. World Climate Research Programme (WCRP). Coupled Model Intercomparison Project (CMIP). <https://www.wcrp-climate.org/wgcm-cmip>. Retrieved 11 March 2023.
2. World Climate Research Programme (WCRP). About Us. <https://www.wcrp-climate.org/about-wcrp/wcrp-overview>. Retrieved 11 March 2023.
3. Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/>. Retrieved 11 March 2023.
4. Intergovernmental Panel on Climate Change. Fifth Assessment Report. 2013. <https://www.ipcc.ch/assessment-report/ar5/>. Retrieved 11 March 2023.
5. Intergovernmental Panel on Climate Change. Sixth Assessment Report. 2021. <https://www.ipcc.ch/assessment-report/ar6/>. Retrieved 11 March 2023.
6. Fleishman, E., editor. 2023. Sixth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon. <https://blogs.oregonstate.edu/occri/oregon-climate-assessments>.
7. Rubado, D. 2011. Extreme Heat in Oregon. Presented at the Oregon Public Health Association Conference.
8. Navarro, Kathleen; Schweizer, Don; Balmes, John; Cisneros, Ricardo. 2018. A review of community smoke exposure from wildfire compared to prescribed fire in the United States. *Atmosphere*. 9(5): 185. <https://doi.org/10.3390/atmos9050185>.

# APPENDIX D OCCRI DATA SUMMARY

## APPENDIX 1

Future Climate Projections















Lincoln County

February 2020

A Report to the Oregon Department of Land Conservation and Development

Prepared by The Oregon Climate Change Research Institute

**Table 1 Summary of projected direction of change along with the level of confidence in climate change-related risk of natural hazard occurrence. Very high confidence means all models agree on the direction of change and there is strong evidence in the published literature. High confidence means most models agree on the direction of change and there is strong to medium evidence in the published literature. Medium confidence means that there is medium evidence and consensus on the direction of change with some caveats. Low confidence means the direction of change is small compared to the range of model responses or there is limited evidence in the published literature.**

|  | Low Confidence  | Medium Confidence   | High Confidence   | Very High Confidence  |
|--|---|---|---|---|
| Risk Increasing<br> | <br>Poor Air Quality | <br>Drought<br><br><br>Increased Invasive Species Risk |  Heavy Rains<br>Flooding <br>Wildfire <br>Loss of Wetland Ecosystems <br>Ocean Temp & Chemistry Changes <br>Coastal Hazards  | <br>Heat Waves |
| Risk Unchanging<br>=   | <br>Windstorms       |   |   |   |
| Risk Decreasing<br> |   |   |   | <br>Cold Waves |

# APPENDIX D OCCRI DATA SUMMARY













## Future Climate Projections

Lane County, Oregon

July 2022

Oregon Climate Change Research Institute

**Table 1 Summary of projected direction of change along with the level of confidence in climate change-related risk of natural hazard occurrence. Very high confidence means all models agree on the direction of change and there is strong evidence in the published literature. High confidence means most models agree on the direction of change and there is strong to medium evidence in the published literature. Medium confidence means that there is medium evidence and consensus on the direction of change with some caveats. Low confidence means the direction of change is small compared to the range of model responses or there is limited evidence in the published literature.**

|                      | Low Confidence   | Medium Confidence   | High Confidence  | Very High Confidence   |
|----------------------|--|---|--|--|
| Risk Increasing<br>↑ |  |  Drought<br> Expansion of Non-native Invasive Plants<br> Reduced Air Quality<br> Loss of Wetlands |  Heavy Rains<br> Flooding<br> Wildfire<br> Changes in Ocean Temperature and Chemistry<br> Coastal Hazards |  Heat Waves  |
| Risk Unchanging<br>= |  Windstorms |   |  |  |
| Risk Decreasing<br>↓ |  |   |  |  Cold Waves |



# APPENDIX D OCCRI DATA SUMMARY

Future Climate Projections

Marion County, Oregon

June 2022

Oregon Climate Change Research Institute

**Table 1 Summary of projected direction of change along with the level of confidence in climate change-related risk of natural hazard occurrence. Very high confidence means all models agree on the direction of change and there is strong evidence in the published literature. High confidence means most models agree on the direction of change and there is strong to medium evidence in the published literature. Medium confidence means that there is medium evidence and consensus on the direction of change with some caveats. Low confidence means the direction of change is small compared to the range of model responses or there is limited evidence in the published literature.**

|                      | Low Confidence | Medium Confidence   | High Confidence                            | Very High Confidence |
|----------------------|----------------|---|--|----------------------|
| Risk Increasing<br>↑ |                | ☐ Drought<br>🐛 Expansion of Non-native Invasive Species<br>⚠️ Reduced Air Quality<br>💧 Loss of Wetlands | ☁️ Heavy Rains<br>🏠 Flooding<br>🔥 Wildfire | ☀️ Heat Waves        |
| Risk Unchanging<br>= | 🌀 Windstorms   |   |  |                      |
| Risk Decreasing<br>↓ |                |   |  | ❄️ Cold Waves        |

# APPENDIX D OCCRI DATA SUMMARY











## Future Climate Projections

Linn County, Oregon

July 2022

Oregon Climate Change Research Institute

**Table 1 Summary of projected direction of change along with the level of confidence in climate change-related risk of natural hazard occurrence. Very high confidence means all models agree on the direction of change and there is strong evidence in the published literature. High confidence means most models agree on the direction of change and there is strong to medium evidence in the published literature. Medium confidence means that there is medium evidence and consensus on the direction of change with some caveats. Low confidence means the direction of change is small compared to the range of model responses or there is limited evidence in the published literature.**

|                      | Low Confidence   | Medium Confidence  | High Confidence  | Very High Confidence   |
|----------------------|--|--|--|--|
| Risk Increasing<br>↑ |  |  Drought<br> Expansion of Non-native Invasive Species<br> Reduced Air Quality<br> Loss of Wetlands |  Heavy Rains<br> Flooding<br> Wildfire |  Heat Waves  |
| Risk Unchanging<br>= |  Windstorms |  |  |  |
| Risk Decreasing<br>↓ |  |  |  |  Cold Waves |