Salem Climate Action Plan - Vulnerability Assessment Table

A. Climate Impact	B. Summary of Climate Impacts	C. Summary of how climate impacts may be felt in the community	D. Likelihood	E. Consequences	F. Risk	G. Adaptive Capacity	H. Vulnerability level
			See D. Likelihood tab for scale	*See E1. Intersections and E2. Assessment of Intersections tabs*	*See F. Risk tab*	*See G. Adaptive Capacity tab*	*See H. Vulnerability level tab for scale*
Warming temperatures	Average summer temperatures will increase from 66°F (1990s) to 71°F (2055s).	As temperatures become warmer on average throughout the summer, potential for drought conditions increases. For context: The 2015 drought occurred when air temperatures were 5 to 10 °F above normal in the early months of 2015. Additionally, June 2015 was the warmest it had ever been on record (7.7 °F above normal). Warming temperatures will also likely lead to sustained or increased frequency of cyanotoxin/harmful algal blooms in Salem's drinking water.	Likely	Minor	Moderate	3.22	Moderate
	Average high summer temperature will increase from 79°F (1990s) to 86°F (2055s).	More heat-related illnesses, especially for those who work outside (e.g., farmworkers and construction workers) who have vulnerable health status, or who are unsheltered.	Likely				
	Extreme heat days (days >90°F) are projected to increase from 7 per year (1990s) to 33 per year (2055s). Days >100°F will increase from 1 (1990s) to 6 (2055s).	Increased risk of heat stroke to small children, the elderly, people with chronic diseases, low-income populations and outdoor workers. Increase in repiratory problems.	Likely				
	Growing season will lengthen from 227 days (1990s) to 295 days (2055s).	Longer growing seasons may provide benefits to agricultural producers, such as ability to grow and sell crops that were previously not suitable for the area. This could create the possibility of an agricultural production boom in coming decades; however, this benefit may be offset by increasing pests and weeds that will also occur from warming temperatures.	About as Likely as Not				
	Average winter temperatures will increase from 41°F (1990s) to 46 °F (2055s).	Warmer winter temperatures may lead to a precipitation shift where the area experiences less snow and more rain in winter. Heating needs may be slightly less demanding of the energy system.	Likely				
	Average low winter temperature will go from 35°F (1990s) to 39°F (2055s).	Precipitation shift: less snow/ice to more rain. Focus on mitigation potentially turns towards flood risk reduction rather than winter storm risk mitigation. Potentially slight decrease in demand for heating with average winter temperatures going up by about 4°F by mid-century and 7°F by end of century.	Likely				

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Changes in precipitation patterns	Annual Precipitation will go from 40 (1990s) to 41 (2055s) inches per year.	Though quantity of precipitation is not projected to change significantly by mid-century, the type and timing of precipitation is likely to shift from winter snow to winter rain. Changes in the timing of precipitation temperature compounded with changes in wind and precipitation patterns may cause unpredictable cloudburst events, which lead to flash flooding/flooding in areas not designated as "high risk." Impacts from flooding include: Loss of vehicles, loss of vehicle fuel, street closures and home and business damage (source: Marion County Emergency Operations Plan, pg. 60). Increased evapotranspiration rates, coupled with warming temperatures, may increase likelihood of drought.	Likely	Minor	Moderate	3.78	Low
	Water deficit will change from +3 inches (1990s) to -0.7 inches (2055s).	Increased likelihood of drought; increased needs for water for irrigation.	Likely				
	Willamette River January streamflow will increase from 48,863 cfs (historic) to 54,982 cfs (by 2069).	Corps of Engineers may adjust management actions to conserve water in winter/spring for drought conditions in summer/fall.	TBD				
	Increasing rain on snow events.	Increasing number of events where rain is combined with snow/snowmelt may create increased number of flooding events.	About as Likely as Not				
Increased fire risk	Extreme fire danger days will increase from 11 per year (1990s) to 20 pear year (2055s) - with a majority of increase in extreme fire danger days occurring in the summer (18.3 days by mid-century compared to 10.1 days historically) - and a very slight increase expected in the fall (0.8 days by mid-century compared to 0.6 historically) and spring (0.5 days by mid-century compared to 0.3 days historically) - no change in extreme fire danger days is expected in the winter (0 days projected by mid-century and 0 days historically) Modeling from Portland State University researchers shows that in Western Oregon: - "wildfire hazard will likely increase by mid-century as a result of larger, more frequent fires" - "annual burn probabilities were similar to those found in higher frequency fire regimes" - "All climate and baseline scenarios illustrate that extremely large, intense fires are plausible, and that they will become more plausible under hotter and drier climate scenarios"	With increased risk of fire comes the increased risk of fire damage to public and private properties, smoke inhalation, evacuation of residents, economic losses, landslides, and transportation disruption. Potential impacts to major national rail lines. Unhealthy and hazardous air quality related to wildfire smoke can also take a mental health toll on residents in addition to physical harm. Wildfires release great amounts of carbon dioxide, which may work against global efforts to reduce GHG emissions. In burned areas, increased risk of landslides, potential negative environmental impacts from firefighting materials on soil and water resources. Drinking water is currently dependent on surface water; quality of surface water is at risk of degraded quality due to post-fire debris and soil movement.	Likely	Moderate	High	3.19	Moderate
Reduced number of chilling hours	Will go from 2,408 hours (1990s) to 1,553 hours (2055s)	Some fruit tree species may be adversely affected	Likely	Negligible	Low	N/A	N/A

D. Likelihood Rating Scale

Level of Evidence	Term	Likelihood	Examples of Common Phrasing by Community Members
High	*Very Likely*	*95–99%*	*"Beyond a reasonable doubt"*
	Likely	*65–94%*	*"Pretty much convinced, clear and convincing evidence"*
Some	*About as Likely as Not*	*34–66%*	*"Increasingly supporting evidence (possible/probable)"*
	Unlikely	*5–33%*	*"Unlikely, not a lot of supporting evidence"*
Low	*Improbable*	*1–5%*	*"Pretty much not gonna happen, little evidence*

Projected Intersections Between Non-Climate and Climate Stressors

This worksheet shows the ways that certain changes, or stressors, to the Salem community may intersect with the ways that Salem's climate is projected to change. Understanding the potential intersections between overlapping dynamics is key to obtaining a clear understanding of Salem's vulnerabilities.

Definitions:

Non-climate Stressor: A broad category containing multiple impacts to your community that are not related to climate (Example: population growth is a non-climate stressor associated with multiple non-climate impacts, including land-use changes and changes to the tax base)
Non-climate Impact: An effect on human communities and natural systems that results from stressors other than climate (e.g., land-use changes, economic recessions, pandemics)
Climate Stressor: A broad category containing multiple climate impacts (Example: a projected future increase in temperature is a climate stressor that contains several climate impacts, including a rise in heat-related illnesses, droughts, and increased wildfire risk)

1 Non-climate Stressor	2 Non-climate Impact (+/-)	3. Intersection with Climate Stressors			
		3a. Warming temperatures	3b. Changes in precipitation patterns	3c. Increased fire risk	3d. Reduced number of chilling hours
Population changes: Marion and Polk counties are “growing, aging, and becoming more diverse” (MWVHA, 2020, pg. 15). Possibility of population growth due to climate migration.	Increased demand for housing New housing and road construction Increased VMT Higher housing costs Land use changes New Salem residents Need for more school capacity Need for more energy, water, natural gas, food, etc. Impact on jobs/economy? Potential for a divided community which could lead to ineffective politics and governance	Increased demand for air conditioning/ energy Increased demand for irrigation/ water Increased demand for drinking water treated for cyanotoxins More forested land being converted to developments (+) New agricultural opportunities (+) Less demand for heating/ natural gas	Increased risk of flooding Unpredictable precipitation patterns may lead to flood events in areas outside the historical high-risk floodplain where new development is occurring Increased pressure to build housing in floodplains More impervious surfaces and runoff, which puts stress on stormwater treatment facilities Potential harm to railroads, bridges, overpasses from flooding Increaeses in population will may increase demand for water and could put pressure on potentially strained water sources	Population growth rate could be higher than expected if people choose to leave higher risk areas, e.g. California Increased pressure to build housing in fire risk zones More people = more potential sources of fire As development occurs further from the urban core, people living on the edges of Salem may experience greater impacts related to wildfires (e.g., disruption in telecommunications and natural resource services). Increased health risks due to poor air quality from smoke	N/A
Increased demand for and access to affordable housing	Increased financial pressure for residents Increased rate of homelessness Increased wealth for property owners Higher housing costs Increased demand for housing New housing and road construction	Heat-related health impacts to unsheltered populations	Increased pressure to build housing in floodplains Unsheltered people are more vulnerable to flood risk	Increased need to retrofit existing and build new homes with higher grade air filters and fire resistant materials	N/A

Vulnerable populations (unsheltered, elderly, young, medically fragile, speak English less-than-very-well)	Specialized care and outreach	Warming temperatures and extreme heat days disproportionately affect vulnerable populations Could be beneficial in that vulnerable populations might experience less adverse health impacts related to colder temperatures During hot summer days, residents tend to visit local waterways to cool off. If harmful algal blooms increase, access to waterways as cooling opportunities may be denied	Unsheltered populations at risk for flood-related harm due to living in flood-prone areas Evacuation during a flood event of the young, elderly, medically fragile, and people who speak English less-than-very-well could be challenging	Poor to hazardous air quality resulting from wildfires would greatly impact vulnerable populations	N/A
Emerging health trends and risks (increased rates of diabetes, obesity, depression, and sexually-transmitted infections, persons with disabilities)	Increased costs associated with healthcare; more people at risk for climate-related health impacts due to underlying conditions	Warming temperatures and extreme heat days disproportionately affect vulnerable populations	Water intrusion in homes can create mold issues, respiratory issues, psychological stress	Poor to hazardous air quality resulting from wildfires could greatly impact people with underlying health issues such as asthma, diabetes and obesity Increased risk of negative mental health impacts	N/A
Earthquake (Cascadia)	Catastrophic disruption of life in the area	If the earthquake were to occur during extreme heat days, more people, not just vulnerable populations, are at risk for heat-related illnesses (all become vulnerable) If the earthquake were to occur during winter months, a benefit could be that warmer temperatures would prevent negative health impacts related to cold temperatures	If the earthquake were to occur during a flood event, more damage, displacement, and bodily harm would likely occur	If the earthquake were to occur during wildfire season, more damage, displacement, and bodily harm would likely occur Earthquakes have the potential to generate wildfires (e.g., causing breaks in natural gas lines and downing power lines). Such destruction would lead to disastrous increases in fire risk if a major earthquake were to occur during fire season	N/A
Local economy	Climate impacts may affect local and regional economic activity in addition to acute economic loss resulting from extreme weather events such as flooding and wildfires	Local food producers may be able to grow a wider variety of crops Increasing algal blooms in lakes may inhibit recreational activities Warming temperatures may allow for new pests to infiltrate the area; invasive pests may have the ability to negatively impact Salem's tree canopy.	Possibility of property damage from nuisance flooding Drought may negatively impact food producers	Fire-damaged forests and trails may reduce number of visitors Wine industry may experience negative consequences from smoke	Some flowering fruit and nut crop varieties may be adversely affected

Assessment of Interactions

This worksheet assesses the consequence level of the given impact by deciding the cumulative impact of each climate stress (from tab E1. Intersections) and assigning an assessed consequence level using the following scale:

- Catastrophic: Community will cease to exist or have functions permanently altered
- Major: Functions of the community may be dramatically altered, such that value is undermined
- Moderate: Function of the community may be diminished, such that it is degraded but still present
- Minor: Community will continue to function but specific activities may be impaired
- Negligible: Community will not be visibly or functionally affected

	3a. Warming temperatures	3b. Changes in precipitation patterns	3c. Increased fire risk	3d. Reduced number of chilling hours
Synthesis statement	While higher summer temperatures may have health impacts on vulnerable populations, the temperature increase is not projected to be extreme and will be offset by potential benefits to agriculture. The issue of increasing cyanotoxins in drinking water due to algal blooms would be a significant risk if not for the important water treatment efforts already underway.	Though overall precipitation amounts are expected to remain consistent, hotter days will lead to a water deficit which may impact agricultural producers. Precipitation patterns may change, leading to increased frequency of heavy downpour events and nuisance flooding.	Hotter and drier conditions will lead to increased fire risk in forested areas outside of Salem. Main impacts to Salem include health risks due to poor air quality, increased emergency operations and evacuations, and reduction in tourism. Salem could also experience higher than expected population growth as people from more southern locations relocate due to their own fire risk.	The reduction in the number of cool nights may have adverse effects on some flowering fruit and nut tree species, which could have negative economic consequences for agricultural producers in and around Salem.
Assessed consequence level	**Minor**	**Minor**	**Moderate**	**Negligible**

F. Risk Rating Scale

This table uses the likelihood and consequences previously assessed (Columns D and E) and uses the table below to combine the two values of likelihood and consequence. Where the likelihood row and the consequences column meet is the assessed risk value. This step is repeated for each climate stressor.

Likelihood	Consequences				
	Negligible	Minor	Moderate	Major	Catastrophic
Improbable	Low	Low	Low	Low	Low
Unlikely	Low	Low	Moderate	Moderate	Moderate
About as Likely as Not	Low	Moderate	Moderate	High	High
Likely	Low	Moderate	High	High	Extreme
Very Likely	Low	Moderate	High	Extreme	Extreme

G. Adaptive Capacity Rating

Adaptive capacity of a system combines community adaptation potential with social constructs, shining a light on a community's strengths and areas needing improvement. To determine vulnerability, it is critical to determine what capacities exist in a community, where weaknesses might be, and how well the community is poised to respond to change from multiple stressors and impacts. The goal of this exercise is to assess your community's adaptive capacity in relation to your identified climate stressors (identify where you are already strong and where you might improve).

Advisory Group Members were asked to assess the community's capacity to adapt to climate impacts. The following scale was used:

5 = Superior (This is the ideal condition)
4 = Good (Better than adequate, but could use improvement)
3 = Fair (Could easily be improved)
2 = Poor (Not adequate, but provides modest function)
1 = Nonexistent (Not functional or does not exist)

Community Adaptation Capacity to Climate Impact	Warming Temperatures	Changes in precipitation patterns	Increased fire risk	Notes
Social Potential				
Extent, distribution and connectivity of social networks	3.33	3.33	2.89	Generally, I think our social potential for most things is "fair" because we have had some experience with each albeit in limited scenarios. "Good" for both high temps (short term) and "Fair" for high temps (long term). "Good" for flooding owing to relatively recent experiences. [Warning: I'm generally an optimist in most things....]
Past evidence of responsiveness to disasters	3.78	3.80	3.20	Recent wildfire events caused mass confusion and panic within the community. It seemed clear that community expertise and connectivity was lacking.
Community expertise	3.50	3.90	3.30	
Community participation and collaboration	3.20	3.00	3.00	I feel as though Salem Residents are capable of managing all of these. I do feel there is a lack of experience and expertise in some of the categories that residents as well as most people will have a hard time dealing with.
Average Social Potential	3.45	3.51	3.10	

Definitions:

Community Adaptation Potential — connections in a community based on existing relationships as well as evidence of past collaborative efforts and actions. This information is typically something you can learn about in news stories or by soliciting input from local residents with experience in the region.
Social Constructs — social rules and governance structures that a community operates within. These are usually unspoken and unwritten, although most everyone understands them through training, experience, and time in the community.
Adaptive Capacity — ability (or lack thereof) of the community to utilize social relations, social constructs, and knowledge to adapt to changing conditions in the community and/or larger world.
Social Potential — relationships between people that allow them to make collective decisions about the future.
Organizational Capacity — individual employee capacity combined with others in the organization and the community to make organizational choices in the face of change.
Management Potential — rules, regulations, and management styles that allow the organization and its employees to adapt to changing conditions.

Organization Capacity				
Staff capacity (training/time)	3.09	3.83	3.27	Stormwater Operations staff seem to be at full capacity with existing conditions. Changes in precipitation and storm events will likely require more staff and funding.
Responsiveness	2.83	3.75	3.18	Generally, we're well organized with good relationships and reasonably good responsiveness to issues related to flooding and droughts. Fire risks and warming, less so, and are ranked a little less because we have less experience with these.
Relationships	3.25	3.75	3.64	
Stability/Longevity	3.36	4.08	3.45	I believe the organization will take some additional training and efforts to be able to respond to some of these changes as a whole. I feel as though some people don't use a long term/longevity view on the actions they take as part of the organization.
Average Organization Capacity	3.13	3.85	3.39	
Management Potential				
Existing mandates	2.60	4.00	2.60	
Monitoring and evaluation capacity	2.92	4.00	2.83	
Ability to learn and change	3.42	4.25	3.33	I believe a lot of the organization has struggle adapting to changes in the community and environment, but could improve over time.
Proactive management	2.92	3.58	3.08	
Partner relationships	3.58	4.33	3.80	Our partnerships with other agencies is quite good, particularly with respect to flooding/drought. We are most prepared for drought and flooding with our regulations (including curtailment plans) and floodplain management regulations. The wildfires last year were lessons learned factories.
Science and technical support	3.08	3.67	2.91	
Average Management Potential	3.09	3.97	3.09	
(Average Social + Organization + Management Potential) /3	3.22	3.78	3.19	

Conversion to Adaptive Capacity Rating:	1 - 2.3	**Low**
	2.4 - 3.6	**Moderate**
	3.7 - 5	**High**

H. Vulnerability Level Rating Scale

This table uses the risk and adaptive capacity values previously assessed to determine a Vulnerability Level Rating.

Risk	Adaptive Capacity		
	Low	Moderate	High
Low	Low	Low	Low
Moderate	Moderate	Moderate	Low
High	High	Moderate	Moderate
Extreme	High	High	Moderate

Sources

American Public Health Association and Centers for Disease Control and Prevention. “Extreme Heat Can Impact Our Health in Many Ways.” Accessed March 30, 2021. https://www.cdc.gov/climateandhealth/pubs/extreme-heat-final_508.pdf.

Consultation with Dr. Erica Fleishman, Director, Oregon Climate Change Research Institute.

'Future Climate Dashboard,' 'Climate Mapper,' and "Future Streamflows" web tools. Climate Toolbox. https://climatetoolbox.org/.

Marion County Emergency Operations Plan, 2020-2024. Marion County Emergency Management.

McEvoy, Andy, Max Nielsen-Pincus, Andrés Holz, Arielle J. Catalano, and Kelly E. Gleason 2020. "Projected Impact of Mid-21st Century Climate Change on Wildfire Hazard in a Major Urban Watershed outside Portland, Oregon USA" *Fire* 3, no. 4: 70.

Salem Climate Action Plan Advisory Committee meeting and survey, February 2, 2021.