CLIMATE READY MISSOULA

EXECUTIVE SUMMARY

DRAFT

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CLIMATE CHANGE IMPACTS ALL OF US.

LET'S GET

CLIMATE READY, MISSOULA.

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Executive Summary

The science is clear: our climate is changing. In Missoula County, we can expect hotter, drier summers; warmer, wetter springs; more frequent and intense wildfires and floods; and more wildfire smoke. These changes will have far-reaching impacts on public health and safety, our economy, and our natural environment. The purpose of the Climate Ready Missoula planning effort has been to identify the greatest risks that Missoula County faces as a result of climate change, and to develop strategies to address those risks.

The plan has been developed over 18 months with the participation of hundreds of local organizations and individuals via two large stakeholder workshops, online surveys, and numerous public meetings. Climate Ready Missoula was inspired by the Climate Ready Communities program developed by the Geos Institute.

> **"The science is clear: our climate is changing. In Missoula County, we are facing hotter, drier summers; warmer, wetter springs; and more frequent and intense wildfires and floods."**

This Executive Summary includes an abbreviated version of the main components of the full plan, including climate projections and scenarios, the vulnerability assessment, climate adaptation goals and strategies, and next steps. Please see the full plan for the guiding principles which frame this effort and for additional details on all of these topics.

Climate Projections and Scenarios

The Climate Ready Missoula project started by gathering and summarizing climate change projections specific to Missoula County. Data sources included the Montana Climate Assessment and the U.S. Climate Resilience Toolkit developed by the National Oceanic and Atmospheric Administration in partnership with twelve other federal agencies.

Any effort to predict the future is accompanied by uncertainty. In climate modeling, this uncertainty stems from the fact that the models themselves are by necessity simplifications of reality, as well as uncertainty about whether and how quickly greenhouse gas emissions will be reduced worldwide. The Climate Ready Missoula projections are based on the results of twenty different climate models in order to account for the uncertainty that accompanies any one model. We also present results for two greenhouse gas emissions trajectories, one in which emissions are reduced substantially in the coming decades ("stabilization scenario"), and another in which they continue to increase ("business-as-usual scenario").

Temperature

Missoula County's average annual temperature is projected to increase 4-5°F by midcentury and 5-8°F by the end of the century (Figure ES-1). The greatest temperature increases are projected in July, August, and September.

As temperatures rise, the average number of hot days (> 90°F) per year is projected to increase 12-20 days by the middle of the century and 18-39 days by the end of the century. In contrast, the average number of frost days per year is projected to decrease 36-46 days by the middle of the century and 45-73 days by the end of the century.

Precipitation

Average annual precipitation for Missoula County is projected to increase by 2-3% by mid-century and by 3-6% by the end of the century. However, the change in precipitation is not expected to be uniform across all seasons. Winter and spring (and, to a lesser extent, fall)

are expected to receive more precipitation, while summers are expected to be drier (Figure ES-2).

Warmer temperatures are likely to result in more precipitation falling as rain rather than snow in western Montana, especially at low elevations.

Figure ES-1 Projected change in annual and seasonal average temperature for Missoula County by mid-century and the end of the century.

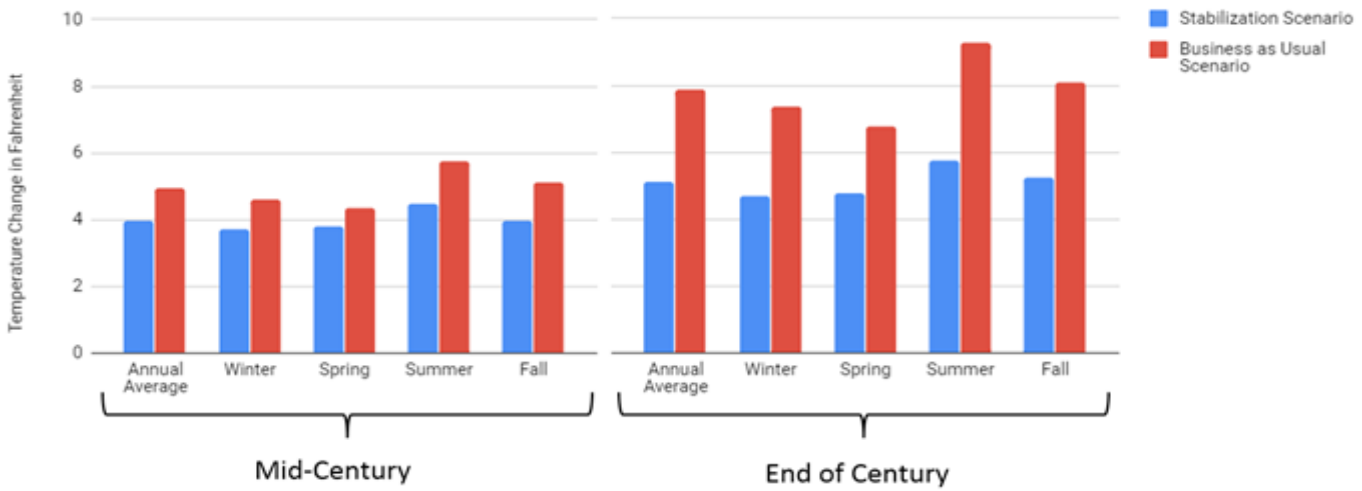
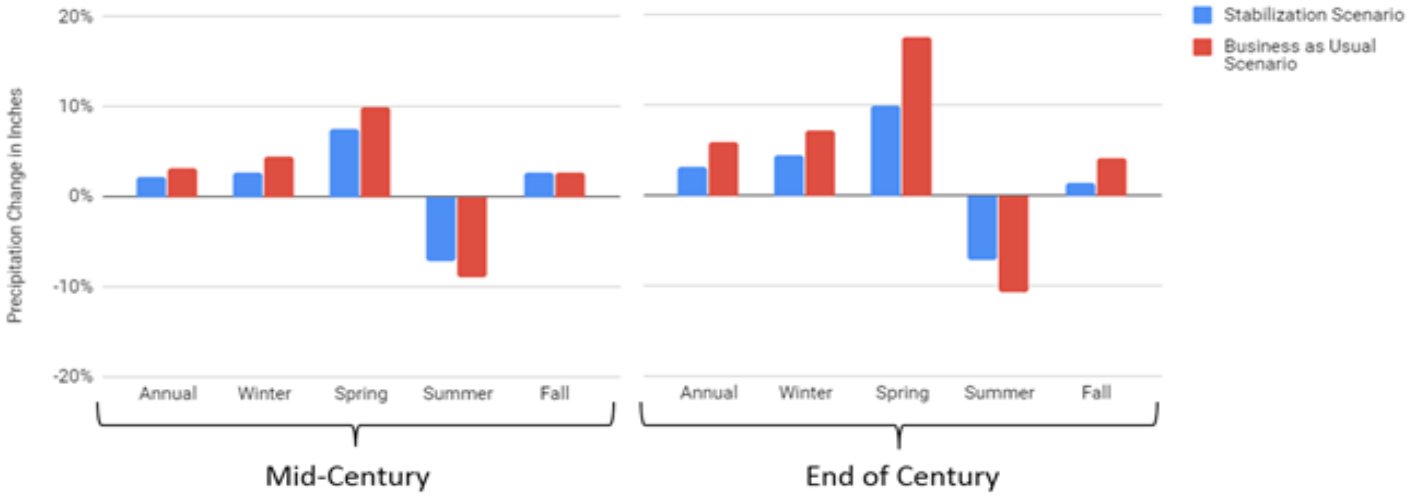


Figure ES-2 Projected change in annual and seasonal average precipitation for Missoula County by mid-century and the end of the century.



Mid-Century Climate Scenarios

The following three scenarios describe plausible futures for Missoula County in the next 30 years based on current trends, recent events, scientific research, and the climate projections presented above. Scenarios enable us to envision the range of futures that climate change might bring to Missoula County.

Scenario 1 | Turn Up the Heat

In this scenario, the annual average temperature increases by approximately 6°F by mid-century, with the greatest temperature increase in the summer. Average summer temperatures will be hotter than the summer of 2017, when we experienced a prolonged heat wave. We'll experience 2-3 additional weeks per year with daily high temperatures above 90°F. Average annual precipitation will remain about the same, but the timing of precipitation will change: summers will be drier and the rest of the year slightly wetter.

With higher temperatures and less precipitation in the summer and early fall, fire seasons will last an average of 12 days longer than they do today, and the total land area burned each year will increase about 50% on average. Over time, increases in the size and severity of fires will reduce the extent of low elevation forests, converting forested areas to shrublands or grasslands.

Longer and more intense fire seasons in Missoula County and throughout the region will mean longer periods of unhealthy air quality due to wildfire smoke, increasing the incidence and severity of respiratory and cardiovascular disease among county residents. Outdoor recreation and tourism will decline during periods of wildfire smoke and thousands of jobs will be lost in the tourism industry statewide.

Warmer winters will lead to a decline in mountain snowpack, and that snowpack will melt earlier due to warmer spring temperatures. Late summer streamflows will be much lower than they are now, and stream temperatures will be higher, stressing fish and riparian vegetation.

Due to a later fall freeze and earlier spring thaw, the growing season will increase in length by about 2 months. However, less summer precipitation and lower August streamflows will mean that less water is available for agriculture during the growing season.

Reduced snowpack and earlier snowmelt will impact winter recreation. Ski hills will face shorter seasons and more frequent closures of low-elevation terrain, and opportunities for low-elevation nordic skiing and backyard ice skating will be reduced or eliminated. Seasons for other recreational sports such as mountain biking may be extended due to warmer springs and falls, but will also be affected by wildfire smoke.

Scenario 1 Snapshot:

- Average annual temperature increases by ~ 6°F by 2050, more in the summer
- 2 - 3 additional weeks/year with daily highs above 90°F
- Average annual precipitation will remain the same, but summer rainfall will decrease by about 30%
- Longer fire seasons, more wildfire smoke.

Scenario 2 | Here Comes the Rain Again

In this scenario, average annual temperatures increase by about 3°F by mid-century, and average annual precipitation increases by 15%. This additional precipitation falls in the winter, spring, and fall; summer precipitation does not change. We also experience several more days per year of intense rainfall. There will be an increase in the number and intensity of droughts and wildfires in this scenario, but not as pronounced as the increase in Scenario 1. On the other hand, flooding will be a much bigger issue in this scenario than in Scenario 1.

While summer precipitation does not change in this scenario, hotter summers increase evaporation rates, reducing water available for plant growth in the summer and resulting in a greater contrast between wet and dry seasons. Early but short spring rains promote rapid green-

ups, followed by prolonged dry summers and brown landscapes. The growing season increases in length by 2-3 weeks due to increased fall and spring temperatures.

Elk and other wildlife will benefit from the availability of ample forage in early spring, but may be forced to change their normal winter ranges due to warmer winters and deeper mountain snowpack.

Warmer temperatures and wetter winters and springs will lead to more frequent and severe flooding. By mid-century, the average winter and spring will be even warmer and wetter than 2018, when severe flooding damaged houses and tipped power poles. In the urban area, more severe rain events will challenge our stormwater system, and greater volumes of stormwater runoff that flow to the aquifer will increase the potential for contamination of our drinking water supply. Flooding will impact populations of fall spawning fishes, such as bull trout, whose eggs and young are vulnerable to spring floods.

Scenario 2 Snapshot:

- Average annual temperature increases by ~ 3°F by 2050, more in the summer
- ~ 1 additional week/year with daily highs above 90°F
- Average annual precipitation increases by 15%, falling in winter, spring, and fall - summer precipitation does not change
- More flooding.

Scenario 3 | Feast or Famine

In this scenario, average temperatures will increase 4-5°F by mid-century. Average annual precipitation will not change, but there will be much greater variability in precipitation from year to year, with some very wet years and some intense drought years. A “normal” year will be a thing of the past.

Increased year-to-year variability in precipitation will result in increased variability in fire season length and area burned. The timing of season-ending events, in particular, will be highly variable among years.

In dry years, we will experience low late-summer streamflows and reduced water available for plant growth, with impacts on aquatic ecosystems, river recreation, and agriculture similar to Scenario 1. In wet years we will experience flood events similar to those described in Scenario 2. Flooding will be exacerbated by the increase in wildfires in dry years, since rainfall runoff over burned areas can cause flash flooding. Burned hillsides are also vulnerable to landslides when it rains, resulting in soil loss which degrades land, slows regrowth, and leads to excessive sedimentation in streams and rivers.

From year to year, the season and conditions for outdoor activities like skiing and fishing will vary dramatically. Businesses involved in outdoor recreation and those that cater to tourists will be particularly challenged to prepare for this unpredictability. Increased variability will also be difficult for farmers and ranchers, as the strategies for drought years may be very different from wet years.

Scenario 3 Snapshot:

- Average annual temperature increases by 4 - 5°F by 2050, more in the summer
- 2 additional weeks/year with daily highs above 90°F
- Average annual precipitation will remain the same, but there will be much greater variability in precipitation from year to year
- A “normal” year will be a thing of the past.

Vulnerability Assessment

These climate projections and scenarios served as the foundation for our first stakeholder workshop, at which more than 100 participants worked in 11 sector groups to complete an exercise that involved identifying and prioritizing climate change risks based on the seven climate impacts described below.

The Vulnerability Assessment summarizes the information gathered at the workshop, as well as public input that was gathered through a subsequent online survey and public meetings. Altogether, the sector groups identified more than 100 specific risks that are described on page 29 - 59 of this plan. Figure 3 depicts the sectors in which risks were identified related to each of the seven climate impacts.

Wildfires

In Missoula County, wildfire is a naturally occurring phenomenon that is important to forest ecosystems. Over the last century, the policy of attempting to suppress wildfires has, in some areas, resulted in denser forests that, when they burn, do so much more intensely and destructively than they might have in the past. At the same time, expansion of the Wildland-Urban Interface (WUI) and increased development in the WUI put more people and structures at risk from wildfire. As Missoula County's climate warms and as summers become drier, wildfires are likely to increase in size and frequency and the fire season is likely to become longer relative to what we're accustomed to today.

Wildfire Smoke

More wildfires in Montana and the west, and a longer wildfire season, will mean more days of unhealthy air quality for Missoula County residents. Most Missoula County residents live in mountain valleys, where trapped smoke can create unhealthy conditions that last for hours or days. Exposure to wildfire smoke is associated with a range of negative health consequences including increased respiratory and cardiovascular problems.

Higher Temperatures

By mid-century, Missoula County's average annual temperature is projected to increase by about 3-5°F, with the greatest temperature increases projected to occur in summer. The average number of hot days (> 90°F) per year is projected to increase 12-20 days by the middle of the century.

Wetter Winters/Springs and Flooding

Climate projections indicate that Missoula County is likely to experience increased year-round precipitation. However, the change in precipitation is not expected to be uniform across all seasons. Winter and spring (and, to a lesser extent, fall) are expected to receive more precipitation, while summers are expected to be drier. Because year-round temperatures will be higher, more precipitation will fall as rain rather than snow, especially at low elevations.

Throughout Montana's history, "rain-on-snow" events have caused the most severe and destructive floods. Some evidence suggests that warm and wet winter storms originating in the Pacific Ocean will become more severe in the future, likely bringing more rain-on-snow events to Missoula County. Intense rain is another common cause of flooding in Montana, and climate models project increases in the frequency and magnitude of the most intense precipitation events.

Climate Variability

One plausible future scenario for Missoula County includes a significant increase in year-to-year climate variability. We may experience some very wet years and other intense drought years, with the concept of a "typical" year simply no longer being meaningful. While variability and unpredictability will affect all sectors, agriculture, recreation and tourism will find it particularly difficult to adapt to these conditions.

Climate Migration and Population Change

Missoula County's population is increasing. From 2010-2017 the county grew by 7.3%, and it is projected to grow an additional 21.8% by 2043. These estimates are independent of the impacts of climate change on the flow of migrants to and from Missoula County. To support the Climate Ready Missoula process, Adaptive Hydrology, LLC performed a preliminary analysis of the impacts of climate change on Missoula County's population. The bottom line: Missoula County will likely experience an increase in population due to climate change.

Drier Summers and Drought

Climate projections suggest that while winters and springs in Missoula County are likely to see an increase in precipitation, summers will become drier. In addition, higher temperatures are projected to lead to reduced low-elevation snowpack, early snowmelt, and an earlier peak in spring runoff. Earlier snowmelt and decreased summer precipitation are expected to reduce late-summer streamflows across the county. Although there is uncertainty about the impacts of climate change on the frequency of long-term (multi-year) drought, there is widespread agreement that such droughts will be more severe when and where they do occur.

Climate + Equity

The impacts we face have the potential to increase inequity, erode community ties and cultural identities, and divert local funding and resources. It will be essential that we address these threats to our social fabric and the most vulnerable among us during implementation, frequently referencing the guiding principles for this effort (p. 17), which emphasize equity, inclusiveness, and cultural values.

Figure ES-3 Sectors Affected by Climate Impacts

	Wildfire	Wildfire smoke	Higher temperatures	Wetter winters and springs (flooding)	Drier summers and drought	Climate variability	Climate migration and population changes
Agriculture	X	X	X	X	X	X	
Buildings + Land Use	X	X	X	X			X
Business, Recreation + Tourism	X	X		X	X	X	X
Ecosystems + Wildfire	X		X	X	X		X
Emergency Response	X	X	X	X			
Energy	X		X	X	X		X
Water	X		X	X	X		X
Wildfire Smoke, Heat, + Health	X	X	X	X	X		

Climate Adaptation Goals and Strategies

At the second stakeholder workshop, participants worked in cross-sector groups to develop strategies to address the risks identified in the Vulnerability Assessment. Following the workshop, these strategies were refined into the list of adaptation goals and actions, presented on the following pages, which forms the heart of this plan. The list is organized by sector. Each sector contains multiple adaptation goals (in green) and one or more strategies to forward each goal (in black).

Next Steps

Given the far-reaching impacts of climate change, it is no surprise that the strategies presented in this plan touch on nearly every aspect of Missoula County: our health, our economy, our built environment, our natural environment, and our social cohesion. Implementation of the plan will thus, by necessity, involve dozens of organizations, individuals, city and county departments, and other government agencies that are active in these areas. It will take all of us.

Implementation of many of these strategies will not be easy. We will confront numerous barriers—policy, economic, technological, and social—that will need to be overcome. Identifying these barriers and addressing them strategically will be essential to allow for the successful implementation of the plan.

An Implementation Task Force and dedicated staff capacity will be necessary to coordinate and monitor implementation of this plan as a whole, report on progress, redirect actions that are not achieving the desired results, update the plan as needed, and continue engaging the community.

It will be important for the Implementation Task Force to refer frequently to the guiding principles of this effort as strategies are prioritized and implemented. For example, equity and inclusiveness should be key considerations in all steps of implementation. Adaptiveness and flexibility will be critical as strategies are implemented and evaluated and as climate conditions continue to change.

Recommended Next Steps:

- Form an Implementation Task Force with dedicated staff capacity
- Report annually on progress to the community, the Missoula Board of County Commissioners, and the Missoula City Council
- Review and update the Climate Resiliency Plan every 5 years, or as needed

Diana Maneta Photo

	Goal + Strategy
wildfire smoke, heat, and health	Improve indoor air quality in homes during wildfire smoke events.
	Educate homeowners about options to create safe indoor air (MERV 13 air filters, portable air cleaners).
	Make portable air cleaners more accessible.
	Improve indoor air quality in (and access to) public and commercial buildings during wildfire smoke and heat events.
	Develop voluntary measures and incentives, such as a certification program for clean air buildings, to encourage safe indoor air in public buildings, schools, and businesses.
	Find, develop and promote indoor recreation, exercise and creative activity spaces that are available to individuals and recreational programs (youth and adult) that are accessible to all income levels.
	Improve health and safety of outdoor workers during heat and smoke events.
	Encourage employers to change workplace environment to reduce wildfire smoke and heat exposure, for example by adapting work hours, following Cal/OSHA guidance and/or providing pop-up clean air shelters and/or appropriate safety equipment (e.g., Personal Protective Equipment - PPE) for employees.
	Increase awareness of physical health impacts of wildfire smoke.
	Educational campaign about air quality data, health risks of wildfire smoke, connection between smoke and heat, and activity guidelines.
	Collaborate with healthcare providers to develop and promote wildfire smoke exposure checklist; educate providers who are unaware.
	Encourage healthcare providers to work with sensitive subgroups to reduce controllable exposures (smoking, radon) and have a plan in place before wildfire smoke arrives.
	Increase awareness of mental health impacts of climate change.
	Educate the public and healthcare providers about the mental health impacts of wildfire smoke and other climate vulnerabilities, including those specific to agricultural community.
	Increase healthcare system capacity to respond to the mental health impacts of wildfire smoke events, wildfires, floods, and other climate impacts.
	Assess existing mental health resources and increase as needed, such as network of providers, integration with general practitioners and emergency responders, screenings, and capacity of inpatient and outpatient care, scalable to smoke events.
	Increase awareness of health impacts of heat.
	Educational campaign about the prevention of and signs of heat related illness for the most vulnerable populations.
	Educational campaign for healthcare, public safety, and emergency response communities about the connection between heat and aggression.
buildings + land use	Balance competing land use needs in the context of population growth.
	Incorporate climate migration in population growth projections in growth policy and other planning efforts.
	Ensure that city and county land use plans adequately protect habitat, open space, and agricultural land.
	Encourage urban gardens and small-scale agriculture to preserve the ability to grow food in Missoula County.
	Reduce development in floodplain.
	Prevent or restrict new development in floodplain.
	Work with federal partners on education and buy-out programs in floodplain areas where there is a history of repetitive loss.

	Goal + Strategy
buildings + land use	Reduce cooling costs by increasing efficiency of building stock.
	Develop programs to implement and incentivize more energy efficient building practices (new and retrofits) that are accessible to all socio-economic groups, including weatherization and cool roofs.
	Develop an educational campaign to increase consumers' energy efficiency, with a focus on cooling.
	Reduce vulnerability of buildings to wildfire.
	Adopt regulations and programs to address the home ignition zone (structure and surroundings), such as neighborhood ambassadors, WUI building codes, WUI zoning codes, and WUI standards in building, zoning, and subdivision codes.
	Restrict and regulate new development in high wildfire hazard areas.
	Address urban heat island effect and maintain and grow healthy, diverse urban forests that account for social equity considerations.
	Create incentives and programs to decrease urban heat island effect, for example through building siting, shade and vegetation.
	Develop and promote an educational campaign to build shared understanding of value of urban forests and encourage planting appropriate species, watering, and care.
water	Conserve water through water conservation plans, practices, regulations and strategic/guided growth.
	Implement Missoula Water's plan to reduce infrastructure water loss (leaks, losses, theft, aging meters).
	Take water availability into account in county growth policy and zoning.
	Develop educational materials and incentives to increase water use efficiency during drought and flood conditions.
	Articulate water use best practices in real time, across user groups (ag producers, outfitters), based on drought conditions.
	Create community-wide water systems (rather than individual wells) in developed or developing areas.
	Enhance water storage opportunities and infrastructure to reduce incidence and impact of flooding and low-streamflow events.
	Expand storage (natural and human created, e.g. reservoirs, wetlands, beavers, and beaver mimicry).
	Preserve water quality through improved stormwater management, prioritizing green infrastructure over traditional methods.
	Develop a funding mechanism to support green infrastructure.
	Implement low-impact development standards to encourage fewer impervious surfaces.
	Improve and expand stormwater facilities, via new land use regulations or other methods.
	Preserve water quality through efficient wastewater treatment, water delivery systems, education and regulation.
	Create and support community-wide wastewater systems (rather than septic) in developed or developing areas.
	Create, fund, and implement a well contamination response plan (identify at-risk wells, potential contaminants, places to restrict new well construction).
	Balance competing water needs in the context of population growth.
	Enhance/incentivize more effective, multi-stakeholder (recreation and agriculture) approach to drought response planning.
	Advocate for state water policies that provide innovation and flexibility in encouraging water conservation and resiliency.

	Goal + Strategy
ecosystems (aquatic + terrestrial) + wildfire	Build understanding of forest, terrestrial and aquatic ecosystems and appropriate, site/landscape-specific management options that account for climate change.
	Analyze current and departure from historical conditions to identify and prioritize where to resist, accept, or facilitate site or ecosystem change, considering cultural values.
	Create and implement watershed management plans based on climate projections that prioritize habitats to protect (include restoration strategies, human access considerations, and agricultural best management practices).
	Maintain and enhance connected habitat corridors.
	Reduce high severity wildfires and their impact in high risk areas/landscapes.
	Increase prescribed fire and/or thinning where appropriate.
	Implement best practices such as prescribed fire, streamside buffers, and support of beavers to increase watershed resilience to fire.
	Build a shared understanding of the realities of wildfire and our expectations of wildfire response.
	Grow educational and outreach efforts within and between agencies, community partners, and public to build support for forest management options (including allowing natural fires to burn), considering divergent values (for example, Wildfire Adapted Missoula).
	Ensure ecological integrity during and after fire and/or fire suppression activities.
	Create a watershed reinvestment fund to support restoration after wildfire.
agriculture	Increase adoption of ecologically sound and climate smart practices for Missoula County agriculture.
	Identify and promote ecologically sound agricultural best practices in a 1-stop shop, considering pests, pathogens, heat, drought, smoke.
	Promote regenerative soil building to revitalize soil quality.
	Develop and communicate water-use best practices for agricultural producers in real time to inform plant and animal water needs, improve efficiency, and reduce water loss.
	Increase economic resilience of Missoula County agriculture given climate change.
	Promote diversification of farm income sources.
	Increase access to locally sourced food through aggregation, storage and distribution of agricultural products.
	Increase support for locally sourced food through education and outreach, economic incentives, and other programs.
	Strengthen social connectivity between farmers, ranchers, and community members.
	Create a farmer and rancher support network at regional or sub-regional level, considering economic and mental health needs of agricultural community.
emergency preparedness + response	Ensure “hard” infrastructure (roads, bridges, power lines, telecommunications, etc.) is resilient to climate change.
	Assess infrastructure needs and vulnerabilities to inform infrastructure strategic plan (protect, enhance, develop redundancies).
	Ensure “soft” infrastructure (systems, people, partnerships, communication, plans, etc.) is resilient to climate change.
	Enhance emergency communication capabilities and evacuation strategies, routes, and safety zones.
	Connect with and support Invest Health, Missoula College, Missoula Emergency Services Inc., Missoula City-County Health Dept. and partners regarding preventative health measures (upstream health response).
	Ensure public safety and emergency response communities have the necessary tools to provide care, outreach and/or referrals.
	Ensure sufficient emergency response personnel within rural areas of Missoula County.

	Goal + Strategy
business, recreation, + tourism	Prepare tourism and recreational industries for changing climate.
	Increase agility of existing tourism and recreational businesses to adapt to changing conditions (timing and location of activities).
	Diversify tourism and recreational industries by identifying, investing in, and promoting new, sustainable-oriented opportunities.
	Develop and market flexible indoor recreation and tourism opportunities.
	Develop recreational resource plan, including a comprehensive map of resources, to adapt uses and types of recreation, as well as protect assets and promote access.
	Strengthen and diversify local economy (aside from tourism and recreation) in a changing climate.
	Partner with economic development organizations and universities to develop a certification program and knowledge sharing for climate resilient businesses.
	Enhance energy efficiency and weatherization workforce and business opportunities.
	Expand and diversify value-added timber market, for example small diameter mass timber.
energy	Ensure a clean, reliable, affordable energy system in the context of increased heat, drought, extreme weather, wildfire, and population growth.
	Collaborate statewide to facilitate and advocate for policy, regulatory, and utility program change that accelerates development of renewable energy, energy storage, energy efficiency, and load flexibility.
	Develop local energy savings programs to reduce energy cost burden and exposure to energy price volatility.
	Accelerate adoption of distributed renewable energy systems, electrification and microgrids.
	Manage vegetation near utility infrastructure to reduce the risk of igniting fires in very hot/dry periods.
	Bury overhead power lines.