

MONTANA CLIMATE SOLUTIONS COUNCIL: CLIMATE ADAPTATION, INFORMATION, AND DECISION COMMITTEE

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MONTANA CLIMATE SOLUTIONS COUNCIL

COMMITTEE: ADAPTATION, INFORMATION AND DECISION SUPPORT

WHITE PAPER: MONTANA ADAPTATION PRINCIPLES AND ACTIVITIES

1.19.20

PRIMARY AUTHORS: SALLY ERICSSON, LAURIE YUNG, AND AMY CILIMBURG

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

Yes. These principles underlie all of the other white papers from the Climate Adaptation, Information, and Decision-Support Committee and many of other committees' recommendations.

KEY ISSUE

Montana agencies, communities and stakeholders should approach climate change and its impacts with an understanding of the state's geography, culture, history, economy, and resources. Addressing the impacts of climate change requires robust, bottom-up processes based on an understanding of climate projections and the specific vulnerabilities and risks that different sectors and communities will experience, and a focus on explicit goals and effective actions to build resilience. Recommendations should build on and be integrated into existing programs wherever possible. Mitigation, innovation, and adaptation efforts should be coordinated whenever possible to maximize co-benefits and synergies.

Adaptation should proceed in ways that are commensurate with the urgency of climate change. As Governor Bullock's 2019 Executive Order states: "the widespread and potentially irreversible impacts of a changing climate require an urgent effort to both reduce emissions and build resilience for communities." The principles below lay out guidelines to advance adaptation across the state.

RECOMMENDATIONS

RECOMMENDATION 1: ADOPT GUIDING PRINCIPLES FOR EFFECTIVE ADAPTATION

RECOGNIZE AND INVEST IN THE LEADERSHIP PROVIDED BY MONTANA'S NATIVE NATIONS.

- Learn from and integrate traditional and indigenous knowledge into adaptation efforts.
- Build on the climate adaptation work already happening on tribal lands throughout the state.
- Recognize the leadership provided by Montana's sovereign Native Nations.

EMPHASIZE CO-BENEFITS

- Prioritize adaptation actions that also assist with mitigation.
- Prioritize adaptation actions that offer other co-benefits (e.g., human and ecosystem health).
- Pay attention to the interaction of non-climate stressors and climate impacts.

- Support nature-based solutions. Redesign planning processes to fully consider ecological integrity and blue/green infrastructure.
- Coordinate adaptation, mitigation, and multi-hazard interactions to maximize the co-benefits of climate planning.

PRIORITIZE COMMUNITIES AND SOCIAL EQUITY

- Emphasize community-based solutions that function at scales relevant to Montanans, where appropriate (e.g. watershed or landscape-scale strategies).
- Develop solutions that are tailored to the unique needs of different communities.
- Evaluate all projects and policies through a social equity lens. Avoid maladaptive planning that shifts existing vulnerabilities in time or place.

DEVELOP EFFECTIVE POLICY AND CROSS-SECTOR MECHANISMS

- Facilitate local and regional action. Use the state's coordinating and convening capacity to support collaboration across sectors and levels of government.
- Mainstream climate adaptation policy and practices by integrating them into existing agencies and relevant decisions.
- Develop lasting authority and enforcement capacity. Where possible, create a statutory authority for guidelines, approvals, and funding.
- Prioritize frameworks for state guidance and community-based solutions.

BUILD ON EXISTING SUCCESSES AND MODELS

- Invest in existing efforts wherever possible, to build on Montana's strengths and successes.
- Build on existing successful models of regional collaboration.
- Borrow from previous executive orders, task forces, and councils to avoid re-inventing processes.

LINK SCIENCE AND ACTION

- Prioritize climate information and tools that meet the needs of decision-makers.
- Prioritize solutions-focused research that can advance adaptation.
- Focus on science-based decision-making and prioritize actions that are evidence-based.

INCREASE CAPACITY TO ACT

- Emphasize resources for planning and implementation.
- Build capacity for adaptation throughout the state, in all sectors, across all communities, for all Montanans.
- Build horizontal learning networks so that landowners, businesses, and communities can share strategies and successes.
- Collaborate with other states on regional adaptation strategies.
- Address barriers to implementation.

INNOVATE AND LOOK TO THE FUTURE

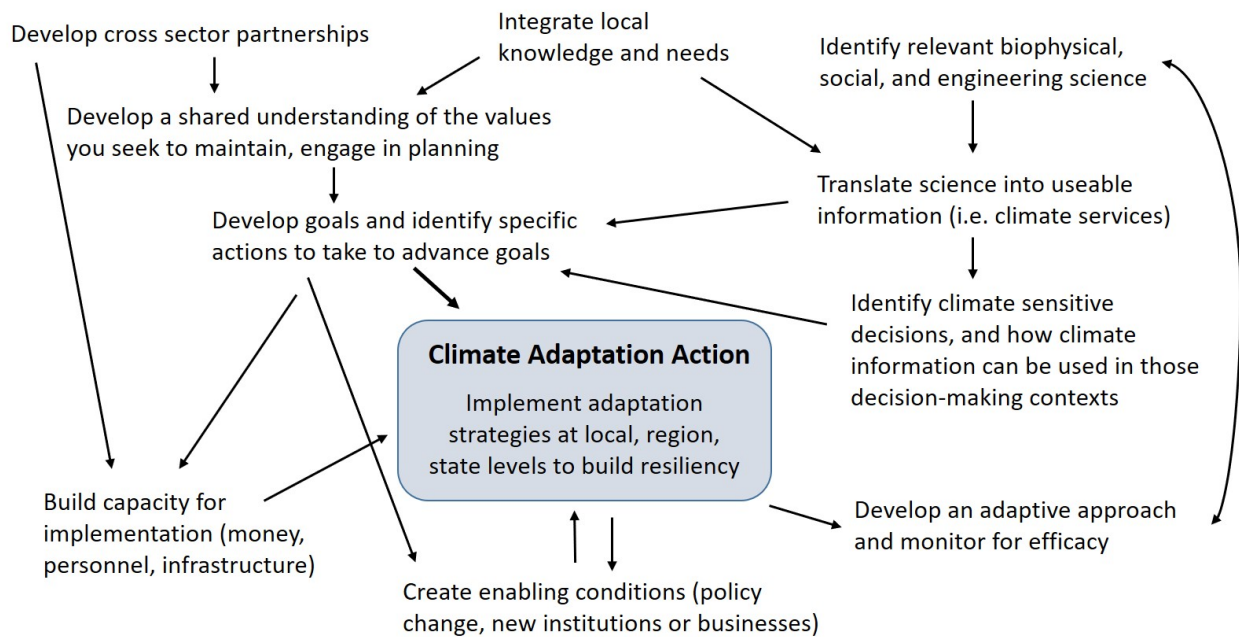
- Pilot emerging innovations and monitor for success.
- Incentivize proactive planning for communities and encourage preparedness for rebuilding more resilient communities if disasters occur.
- Build capacity for flexible decision-making that works in the context of uncertainty and can respond to changing conditions, including surprises.

Some of these principles are based on a recent letter to the U.S. House Select Committee on the Climate Crisis from the Association of Adaptation Professionals (ASAP), a group of professionals working on climate adaptation across the country. While these cross-cutting themes may also relate to Federal policy, they resonate for Montana and are based on years of experience. See:

https://gallery.mailchimp.com/e03c0defd82501b6766c012e4/files/c02eb525-dfc5-4725-8ed0-6967eb6a617b/ASAP_Policy_Recommendations_House_Select_Committee_on_the_Climate_Crisis_2019.pdf

RECOMMENDATION 2: PROMOTE A FULL UNDERSTANDING OF WHAT ADAPTATION ENTAILS

Climate action knits together a range of activities from translating science into usable information to building the partnerships required for implementation. The figure below depicts the activities that may be involved in adaptation; a suite of similar activities can be applied to climate mitigation. Not all of these activities are always part of the process. For example, if there is agreement on the action necessary, it’s possible that only funding is needed for implementation (e.g. providing HEPA filters for vulnerable groups during wildfire smoke events). In contrast, if we don’t know how to respond to forests transitioning into shrubland after wildfire, we’ll likely need more engagement with science and mechanisms for experimentation. An understanding of the full suite of activities that might be involved is important for building capacity for the full cycle of action, from research to planning to implementation.





NOTE: THIS IS JUST A DISCUSSION DRAFT AND NOT A FINAL RECOMMENDATION

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DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

KEY ISSUE

Effective climate adaptation--and mitigation--require acting on scientific information and local knowledge to reduce harm from climate change. One of the assumptions inherent in discussions of adaptation is that more scientific information leads to action. Scientific information is critical to understanding how climate change is currently impacting specific resources and communities and what impacts are projected for the future. Without this knowledge, adaptation actions cannot respond to specific climate impacts and thus may not be effective. For example, without an understanding of how spring flooding may change in a particular area, communities and landowners cannot adequately prepare for the future impacts of flooding.

Montana is experiencing rapid changes in its climate and weather patterns, water availability, and natural and managed resources that affect the sustainability of its communities. As a result of climate change, there has been a trend toward rising temperatures in recent decades, and warming has led to a loss of snowpack in our mountains and summer conditions that start sooner and last longer. Earlier snowmelt and peak streamflow have been associated with unusual flooding, spring and summer drought, large wildfires, and a longer wildfire season. Climate and water shortages have also stressed the health of our forests, agricultural lands and rivers, bringing new diseases and pests that affect timber production, cropping strategies and recreational activities. The current climate trends are expected to continue into the coming decades. Given the magnitude of the threat, statewide adaptation strategies need to incorporate a commensurate scale of scientific analysis and technical assessment; scenario planning and development; and information integration, synthesis, conveyance and translation for the purpose of decision support.

In total, these elements are known as *Climate Services*. State-of-the-art science linked to meaningful and sustained stakeholder engagement are essential to maximize the success and efficiency of any and all adaptation actions, many mitigation actions, as well as those actions that are aimed at increasing the resilience of both natural and built systems.

The following recommendations provide guidelines regarding how to connect science to knowledge to action and ultimately to more efficient and effective decision-making.

Build Montana-specific climate services

Montana-specific climate services can help bridge the gap between information and action. The International Climate Services Partnership defines climate services as:

Climate services involve the production, translation, transfer, and ultimately the decision support of knowledge for climate-informed decision making and climate-smart policy and planning. Climate services ensure that the best available and relevant science is effectively acquired, synthesized, translated, communicated and utilized by decision-makers and related stakeholders within Montana's key sectors, in order to develop, enhance and evaluate both mitigation and adaptation strategies, as well as other forms of decision making that also enhance the resilience of the State's built and natural systems to the impacts and effects of a changing climate. Easily accessible, timely, and decision-relevant knowledge provided through the climate service can help society better cope with natural changes that occur under the rubric of climate variability while also limiting the economic and social damage caused by climate-change related disasters (e.g. drought, flood, wildfire). Climate services also allow society to build resilience to future change and take advantage of the opportunities provided by favorable conditions. Effective climate services require established technical capacities and active as well as iterative communication and exchange between information producers, translators, and user communities.

[\(http://www.climate-services.org/about-us/what-are-climate-services/\)](http://www.climate-services.org/about-us/what-are-climate-services/)

Climate Services facilitate the evolutionary process of progressing from science to knowledge to action, in order to find solutions to some of Montana's pressing environmental challenges. Climate Services brings together scientists and stakeholders in Montana to seek solutions related to climate change adaptation and other environmental and social-economic challenges. Its overarching, strategic goal is to build a partnership, knowledge base, and process that enables informed, timely and responsive decision-making by Montanans adapting to changes underway in the region. Consequently, Climate Services also promotes the development and use of decision support services that can transform newly found knowledge into actionable outcomes and outputs. These outcomes and outputs are intended to support all forms and scales of decision-making, from individuals and local organizations to Montana's political infrastructure and agencies to the leadership in federal agencies, the Executive Office, and Congress.

The process of beginning with science and moving through to decision-making is complex and does not end with better informed actionable measures. In fact, the process requires continuous evaluation and feedback, so that the consequences of decisions and actions can inform ideas for new research and knowledge exchange in an iterative manner. The feedback is often the most difficult part of the process to complete and requires very active and engaged stakeholders who have keen interest in the mission and success of Climate Services.

The role of stakeholders in a Climate Service

Climate information is more likely to be trusted by and relevant to end-users if they are involved in the production and dissemination of such information. Climate services in Montana need to be guided by the needs of various stakeholders to ensure that the specific information, decision-support tools, and communication methods meet the needs of those groups. Too often, climate information reflects the assumptions of scientists and isn't field tested with end-users to determine whether it is relevant, useful, or how it can be used. Further, local knowledge provides a source of information about how conditions are changing and which adaptation actions are needed. In addition to the scientific assessment, robust stakeholder engagement is needed to guide development of adaptation and mitigation planning and address the needs of end-users. We also need to test the efficacy of various information, services, and decision support tools. The activities of a climate service go in both directions, with the scientific assessment providing the best-available information in terms that are understandable to stakeholders, and the stakeholders identifying on-the-ground needs for more information and investment. To the extent that specific climate services can be co-produced between scientists and relevant end-users (e.g. farmers, tourism businesses, local government staff, homeowners who live within the WUI: Wildland Urban Interface), these services are more likely to be integrated into decisions about adaptation.

Invest strategically in Climate Services

The white papers below describe a large variety of existing and ongoing efforts by state agencies, NGOs, and universities, to provide climate information to decision makers throughout the state. Many of the white papers request additional resources to continue or expand these vital efforts. Investments in climate services for Montana should carefully consider how to build the capacity of existing efforts, the appropriate role of local and state agencies, effective models for delivering climate services utilized in other states, and how to coordinate across efforts to limit duplication and enhance synergies. Such investments should be coordinated and strategic, building on existing programs where appropriate and developing new initiatives as needed. Linking to regional or national efforts and programs will be important for accessing additional information and resources.

PROGRESS TO DATE

IN A FEW SENTENCES DESCRIBE PROGRESS TO DATE. THIS COULD INCLUDE KEY SUCCESSES, CASE STUDIES, COMPLETED RESEARCH, ACTIONS TAKEN IN OTHER STATES THAT COULD BE REPLICATED, SUPPORTED OR BUILT UPON IN MONTANA.

Elements of Climate Services are currently provided by a diverse set of organizations in Montana, including the universities, state and federal agencies, tribal colleges, NGOs, and private businesses. This recommendation is built on the assumption that we should leverage and invest in our current climate service capacity, while also building new initiatives, expertise and capacities where needed. Here are just a few examples of the organizations that are currently involved in climate services in Montana and who could collaborate in this effort:

Montana Climate Assessment (MCA): The first ever Montana Climate Assessment was completed in 2017 and serves as an important benchmark of the state’s changing climate and the historic and future consequences for water, forests, and agriculture. It gives us a baseline for better understanding of future impacts and rates of change. Thus, the MCA also serves as a state wide indicator of the relative and actual health of the environment and can be used as a model for future endeavors towards the existing legislative mandate for a bi-annual report on the “State of the Environment” (Enacted by the Montana State Legislature). The MCA was coordinated by the Montana University System’s Institute on Ecosystems and brought together climate service providers and researchers from the universities, state and federal agencies, tribal colleges, and non-governmental organizations to benchmark Montana’s climate future.

Montana Climate Office: The Montana Climate Office is a state-designated center with the central goal of providing the most accurate climate information to the citizens of Montana to increase public awareness of variations in Montana’s climate and environment. The MCO assists state agencies in climate-environment interaction issues and related applications. In recent years it has established, operated and maintained an extensive weather and soil moisture early warning network across Montana. This network and existing climate data are used to assist decision making in applications such as agricultural and water resource models. Research by the MCO focuses on Montana’s climate and its interaction with the environment - the MCO investigates the effects of climate variations on agriculture and natural resources and develops forecasts that assist in resource management during periods of drought or flood. Finally, the MCO interacts with K-12, community colleges, teachers and students, and with other community organizations on different aspects of MTs climate and environment.

Climate Smart Missoula: is a local non-profit organization working to catalyze efforts to build resiliency and reduce Missoula’s carbon footprint. They are currently partnering with local government and other organizations and entities to better prepare and adapt to relevant climate impacts via their [Climate Ready Missoula](#) project. They also work collaboratively to set mitigation goals and develop activities to meet those goals. They have a variety of adaptation and mitigation resources and programs available here: missoulaclimate.org.

Climate Smart Montana: is a non-partisan, non-profit network with the goal of sharing information and resources to better coordinate community-based climate solutions and resiliency efforts in Montana. Launched in 2019, this network is run through MSU Extension’s Community Development Program. More [here](#):
<http://www.msucommunitydevelopment.org/ClimateSmartMontana.html>

GAPS

IDENTIFY KNOWN GAPS THAT EXIST AND REPRESENT BARRIERS TO MAKING PROGRESS ON THIS ISSUE. GAPS COULD BE RELATED TO DATA, RESEARCH, TECHNOLOGY, HUMAN RESOURCES, FINANCIAL RESOURCES. IDENTIFY

WHAT RESEARCH CAN BE ACCOMPLISHED AS PART OF THE COUNCIL'S DELIBERATIONS, AND WHAT MUST BE UNDERTAKEN ON A LONGER TIME HORIZON.

There are several important gaps or barriers to delivering effective climate services in Montana. These include:

1. Lack of structure for connecting scientific information to end-user needs to ensure that information and tools meet the planning needs of Montanans.
2. Lack of coordination across diverse efforts, limiting capacity to take advantage of shared data needs and opportunities to create tools and products that work across sectors.
3. Lack of resources to continue and expand existing efforts and to invest in new initiatives. For example:
 - DEQ currently monitors air quality but needs resources to expand monitoring capacity. Counties need resources to ensure that staff can interpret local air quality data and communicate with local communities about health impacts and actions that can be taken to reduce harm.
 - The Montana Climate Assessment provides a baseline understanding of past, present and projected climate-related impacts and effects that serve as a foundation to an effective climate service. The knowledge base of the service needs to be updated regularly to reflect the new science information and expanded to cover all relevant sectors (e.g. human health, fish and wildlife, and outdoor recreation and tourism).
 - The Montana Climate Office and state agencies are working on translating climate data into early-warning systems for drought and flooding but need resources to put these systems into place.

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION.

RECOMMENDATIONS

RECOMMENDATION 1: ESTABLISH A MUS CLIMATE COUNCIL THAT PRIORITIZES CLIMATE SERVICE NEEDS AND ADMINISTERS FUNDING FOR CLIMATE INFORMATION, ADAPTATION AND MITIGATION PROJECTS

Establish a multi-organizational Montana Climate Services Council to be located within the Montana University System (MUS) to guide the development and translation of climate information and decision-relevant tools, based on the needs of end-users. The Advisory Committee will be composed of climate information providers (i.e. scientists, agency staff) and

end-users (e.g. businesses, communities, agencies, landowners) and would be a collaborative effort by the two research universities (the University of Montana and Montana State University). The Advisory Committee will facilitate a dialogue between end-users and climate information providers, prioritize climate services needed in the state, and identify synergies and resources. Importantly, this CAC should have authority to help guide climate-related efforts of state agencies, budgetary authority for prioritized climate-related research and services, and the ability to organize efforts across the state. The actual work of developing climate services will be completed through grants awarded by the CSC to Montana universities, federal and state agencies, NGOs, and private businesses.

Structure of the Advisory Committee

The Advisory Committee will be composed of approximately half end-users - businesses, agencies, tribes, local government, and landowners across key sectors (e.g. agriculture, water, forestry, health, outdoor recreation and tourism) – and half climate information providers (e.g. scientists and extension-like professionals in universities, agencies, NGOs, and businesses). The structure could be modeled after the Governor’s Drought and Water Supply Advisory Committee or the Montana Land Information Advisory Council to prioritize the needs of both end-users and decision-makers.

Tasks of the Advisory Committee

Facilitate dialogue between end-users and climate information providers to ensure that priorities are guided by the needs of stakeholders and decision makers. This is particularly important because climate information providers (e.g. scientists) are not always aware of the on-the-ground challenges related to mitigation and adaptation. This kind of dialogue can ensure that the climate services developed meet the needs of different decision-makers.

Prioritize climate services that are most needed in Montana. Priorities will help climate service providers set agendas and secure resources, and providers will also have access to additional resources to identify climate services that are important but not highlighted as top priorities by the CAC.

Identify synergies across climate services and across sectors. This will enable different groups to capitalize on data and products that are relevant across sectors and pool resources where appropriate to advance shared goals. This will also help limit redundancies and ensure resources are efficiently utilized.

Identify resources (funding, expertise, partnerships). While long-term funding is envisioned as coming from federal agencies and from new sources of funds stemming from state legislative actions, short-term funding (1 to 3 years) should be pursued from a wide array of sources, including philanthropic organizations, private donors, and non-profit foundations. The majority

of the budget would be in the form of grants that are administered on an annual basis by the CAC to climate service providers across the state. The CAC would be responsible for regular assessments, prioritizing needs, and seeking a range of new funding sources for climate services. Further, the Council will be able to connect expertise across the state, across public and private sectors, and across disciplines to facilitate new partnerships to develop climate services. Other elements of the Council and services infrastructure that would be supported by these funds include- CAC travel, outreach and staff to coordinate efforts.

Development of the Climate Services

The Advisory Council will not be responsible for the development of specific climate services. Instead specific climate services will be developed by participating agencies, universities, NGOs, businesses, and others, including but not limited to those organizations who are currently providing climate services.

Advantages of this Model

- Integrates a range of sectors to enable synergies across different efforts
- Leverages the strengths of existing capacity and efforts in the climate services arena

Communities

Community Resilience

Built Environment

Human/Public Health

Parks, Recreation, and Tourism

Urban and Community Forests



MONTANA CLIMATE SOLUTIONS COUNCIL

ADAPTATION

DRAFT WHITE PAPER: BUILDING COMMUNITY RESILIENCE TO CLIMATE CHANGE

DATE 1.20.20

PRIMARY AUTHORS:

- Amy Cilimburg, Climate Smart Missoula
- Laurie Yung, University of Montana

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

KEY ISSUE

Montana communities and counties are strongly encouraged to embrace planning processes that build local climate resilience. Here we focus on adaptation planning; mitigation can occur simultaneously, or before or after the planning described herein. These process recommendations can also be applied to mitigation planning.

Although there are myriad resources that communities and counties can draw upon to develop a planning process and build capacity for implementation, from available programs to web resources to advice from similar communities who have undertaken resilience planning (see below), state agencies, universities, and other climate services should build the capacity to assist communities in this process.

Planning efforts should start by bringing community leaders and interested parties together and identifying the relevant climate impacts and vulnerabilities (who and what is most at risk, given up-to-date climate projections) so that adaptation strategies can be designed specifically to limit harm from these impacts. In other words, communities and counties need to understand how climate change will impact their locale so that they can develop appropriate and efficient responses. For example, communities in Montana will not be responding to sea level rise because that particular climate impact is not relevant here; but they do need to develop strategies to limit harm from wildfire smoke. Efforts should focus on actions that fit with local needs and goals and can be implemented at the local level. Some actions may integrate with or align with larger regional strategies.

This paper will focus on local planning processes, while specific actions can be found in the other papers in this Climate Plan. Tribal communities may find these recommendations helpful but a separate paper will discuss approaches, options, and best practices from tribal perspectives.

Different communities in Montana will build resilience in ways that respond to local strengths and needs, recognizing their unique vulnerabilities and opportunities. Local climate resilience processes will vary depending on the size of the community, whether they are municipalities or counties, and the specific climate risks they face. Effective planning requires meaningful involvement and buy-in from a diverse group of relevant decision-makers, stakeholders, and community members.

PROGRESS TO DATE

Many Montana communities have developed climate resilience plans that include adaptation strategies, including the City of Missoula and Missoula County, Confederated Salish and Kootenai Tribes, the Blackfeet Nation, Bozeman, and Whitefish. In addition, many Montana communities have disaster mitigation plans, wildfire plans, drought and flood plans, growth plans, and other plans that can support resilience planning and facilitate implementation. Some communities also have mitigation plans (e.g., 100% clean electricity goals, municipal greenhouse gas emission reduction plans).

GAPS

- A straightforward and publicly available process for climate resilience planning that can be adapted to local needs.
- Community learning network for knowledge exchange between Montana communities.
- Resources that communities with limited capacity can use to develop and implement plans.
- Updated climate projections and associated impacts that are accessible to communities at relevant spatial and temporal scales.
- Accessible science advisors who can help translate climate impacts into local vulnerabilities.

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION. This will vary greatly, depending on community size, resources, and work to date.

- Elected officials: county commissioners and/or city council members
- Local government staff: health department, emergency service providers, planners, etc.
- Local businesses including financial institutions
- Representatives from specific sectors: Health professionals, low income groups, social service organizations, farmers and ranchers, forest managers, water managers, non-profit organizations, and scientists.
- State or federal agency representatives, ideally based in or near the community/county.

RECOMMENDATIONS

RECOMMENDATION 1: OUTLINE PROCESS FOR COMMUNITY RESILIENCE PLANNING

EVERY COMMUNITY IN MONTANA IS UNIQUE AND WILL ADDRESS CLIMATE ADAPTATION IN WAYS THAT RECOGNIZE ITS OWN VULNERABILITIES AND OPPORTUNITIES. WHILE THERE ARE SOME SIMILARITIES, COMMUNITY PROCESSES AND PLANS WILL VARY DEPENDING ON COMMUNITY SIZE AND RESOURCES, AND WHETHER THEY ARE MUNICIPALITIES, TRIBAL NATIONS OR COUNTIES. RESILIENCE PLANNING PROCESSES NEED TO SECURE BUY-IN FROM COMMUNITY MEMBERS, BUILD ON EXISTING PROGRAMS, AND USE UP-TO-DATE ANALYSES OF CLIMATE IMPACTS. RECOMMENDATIONS SHOULD FOLLOW BEST PRACTICES FOR EFFECTIVE ADAPTATION PLANNING (SEE “ADAPTATION PRINCIPLES”), WITH STRONG CONSIDERATION FOR EQUITY AND CO-BENEFITS, INCLUDING STRATEGIES THAT BUILD RESILIENCE AND REDUCE GREENHOUSE GAS EMISSIONS. FOR EXAMPLE, IMPROVING THE EFFICIENCY OF BUILDINGS AND INFRASTRUCTURE AND DEVELOPING DISTRIBUTED RENEWABLE ENERGY SYSTEMS CAN HELP BUFFER THE IMPACTS AND UNCERTAINTIES TIED TO MORE VOLATILE WEATHER EVENTS, TEMPERATURE EXTREMES, AND GRID DISRUPTION. WHEREVER POSSIBLE OTHER MONTANA COMMUNITIES CAN BE USED AS MODELS OR REFERENCE.

TO ENABLE LOCAL-LEVEL RESILIENCE PLANNING, WE NEED TO OUTLINE A PROCESS THAT IS SPECIFIC, STRAIGHTFORWARD, AND ADAPTABLE TO DIFFERENT COMMUNITY CONTEXTS.

SOME COMMUNITIES MAY CHOSE TO INITIATE MITIGATION PLANNING SIMULTANEOUSLY. NOTE THAT THE STAKEHOLDERS, EXPERTS, AND PLAYERS MAY BE DIFFERENT BETWEEN THESE TWO REALMS.

More specifically, we recommend:

- ✓ Investment in the Climate Smart Montana network as a platform for communities to share ideas, processes, lessons learned, and resilience plans, so that no community needs to reinvent the wheel. This will enable planning that is specific to local contexts that also builds on what has been done elsewhere, thus leveraging existing experience and plans.
 - ✓ Identification of useful planning resources and guidelines (e.g. [Climate Ready Communities](#) guide, the US Climate Resilience Toolkit, and others).
 - ✓ Outlining the basic steps in the resilience planning process and key decisions that communities need to consider.
 - ✓ Building a network or community of practice (this could be accomplished through Climate Smart Montana).
 - ✓ Promoting planning that encompasses both climate adaptation and mitigation to help communities anticipate and bounce forward from stresses and shocks while seizing opportunities to strengthen local and regional economic independence and pursue economic development tied to the clean energy transition.
 - ✓ For mitigation, consider the need to set overarching and specific energy goals, establish baseline greenhouse gas (GHG) emissions data for the locale, utilize a carbon accounting system (e.g., *ClearPath* available via ICLEI), and the need for stronger state and federal rules and policies to enable more local and regional GHG emissions reduction options.
 - ✓ Depending on the community, consult with tribal nations in development and implementation of recommendations. Recognize tribal sovereignty and right to self-determination.
- **Who could implement the recommendation?** Climate Smart Montana and Montana State University Extension with assistance from Montana communities who have already developed resilience plans and from university researchers studying the process of community adaptation planning.
 - **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Actions will enable communities to leverage existing resources and experience, and build on ongoing efforts (rather than reinvent the wheel). Identifying mitigation co-benefits is part of this process.
 - **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** These actions will make resilience planning much more effective and thus limit harm to communities and across sectors.
 - **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** No adverse impacts.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Need to ask relevant parties to provide an estimate here.
- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?** 1-2 years. Planning processes address short to long-term goals.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?** If this recommendation is successful, communities and counties will have access to adaptable, relevant planning processes and be able to easily share expertise across the state. They will be inspired to initiate climate planning efforts, understanding the necessity and opportunities.

RECOMMENDATION 2: IDENTIFY/BUILD SCIENTIFIC TOOLKIT FOR COMMUNITY RESILIENCE PLANNING

IDENTIFY ACCESSIBLE SCIENCE THAT COMMUNITIES CAN USE TO UNDERSTAND HOW CLIMATE CHANGE WILL IMPACT THEM. IN PARTICULAR, COMMUNITIES NEED INFORMATION ABOUT CLIMATE IMPACTS AT A LEVEL OF SPECIFICITY AS WELL AS SPATIAL AND TEMPORAL SCALE THAT IS RELEVANT TO THEM, WITH INFORMATION ABOUT THE CRITICAL UNCERTAINTIES THAT THEY SHOULD CONSIDER. THIS WILL ALSO ENTAIL DEVELOPING STRATEGIES TO FILL KNOWLEDGE GAPS WHERE USABLE SCIENCE IS NOT AVAILABLE.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

Many tools and resources are already available for communities, including the Montana Climate Assessment, the Montana Climate Office, and the National Climate Assessment, along with myriad peer-reviewed science publications. However, moving from these resources to a specific set of climate impacts and vulnerabilities requires time and expertise. Without the relevant science, communities might not plan for key climate impacts and thus miss opportunities to mitigate harm to livelihoods and the environment. We recommend that the state fund two new MSU extension agents to be housed in the Montana Climate Office to work directly with communities to identify and translate climate science resources. We recommend updating the Montana Climate Assessment as new information becomes available on current sectors (water, agriculture, and forests) and to expand coverage to include new sectors, such as recreation and tourism, fish and wildlife, and human health. We also recommend building the capacity of the Montana Climate Office to provide sector-specific climate information and forecasts as they currently do for agriculture through the Montana Drought and Climate project (<https://climate.umt.edu/mtdrought/>).

- **Who could implement the recommendation?** Montana State University and University of Montana, specifically the Montana Institute on Ecosystems and the Montana Climate Office. The Montana Energy Corps program provides communities with affordable access to motivated AmeriCorps service members to help coordinate and support community-based working groups.
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Building climate resilience and limiting harm from climate change absolutely requires

relevant, accessible climate information. This is critical to local-level planning as well as sector-specific planning (e.g. agriculture, forestry, tourism, health).

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** These resources will make resilience planning much more effective and efficient, thus limiting harm to communities and across sectors.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** No adverse impacts.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Need to ask relevant parties to provide an estimate here.
- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?** Two years.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?** If this recommendation is successful, communities, local governments, businesses, non-profits and land managers will have access to relevant information about climate impacts from which to build adaptation strategies.

RECOMMENDATION 3: IDENTIFY/ESTABLISH RESOURCES FOR COMMUNITY RESILIENCE PLANNING

IDENTIFY FUNDING AND OTHER RESOURCES TO SUPPORT PLANNING AND IMPLEMENTATION IN MONTANA COMMUNITIES. THE STATE (AND OTHERS) SHOULD IDENTIFY AND MAKE AVAILABLE RESOURCES TO BUILD COMMUNITY CAPACITY.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation?** The Governor's Office in collaboration with MSU and UM, including MSU Extension. Other state agencies (DEQ, DPHHS, Commerce, etc.)
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Smaller communities and counties around the state need resources to build their capacity for local-level resilience planning.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** These resources will make resilience planning more effective and thus limit harm to communities and across sectors.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies**

could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider? No adverse impacts.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Need to ask relevant parties to provide an estimate here.
- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?** One year.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?** If this recommendation is successful, all Montana communities will have the ability to build resilience in the face of climate change, regardless of size or financial resources.

RECOMMENDATION 4: IMPLEMENT COMMUNITY RESILIENCE PLANNING

IMPLEMENT LOCAL-LEVEL STAKEHOLDER-DRIVEN RESILIENCE PLANNING ALL ACROSS THE STATE TO ENSURE THAT MONTANA IS PREPARED FOR CLIMATE CHANGE AND CAN LIMIT HARM FROM SPECIFIC CLIMATE IMPACTS. DO THIS COMMENSURATE WITH THE URGENCY AT HAND.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation?** Plans would be developed and implemented by a range of stakeholders, including individuals, businesses, local officials, state and federal agencies, and more. The specific stakeholders will vary depending on the community.
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** In developing resilience plans and adaptation strategies, communities will integrate climate change impacts into their planning processes to limit harm to property and infrastructure, improve health and safety, and reduce economic losses. Adaptation actions that limit harm from specific climate impacts, such as wildfire smoke or drought, save money in the long-term (and often in the short-medium term). Adaptation also ensures that communities are prepared for extreme events, such as flooding, which reduces harm and stress during emergencies. Many adaptation strategies have co-benefits, which means that they have benefits beyond responding to climate impacts (e.g. investing in urban forests to limit heat island effect also provides social benefits associated with increased tree cover; water planning conserves water resources and maximizes the predictability of supply).
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** Planning processes that are stakeholder-driven, educate communities about the risks and vulnerabilities they face, and spur action by local governments, business, and residents. There is no downside as, at minimum, the process will result in community education about risks and actions to take, and if done well, will build long-lasting community cohesion and reduce harm from climate change.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to**

consider? Resilience planning is specifically designed to be inclusive and explicitly address equity, through careful thinking about who and what specifically is vulnerable to different climate impacts. As a result, the process and the strategies should benefit both communities and the environment.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Some funding and capacity for planning are needed and the exact dollar amount will vary by community. Although some communities may be able to provide financial or staffing support or obtain grant funding, others may need to initiate the process using volunteers and accessible, free guidelines and resources. We strongly recommend funding be made available from the State of Montana to support local-level resilience planning.
- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?** Communities can incorporate climate adaptation planning into other local planning efforts immediately. Similarly, there may be some activities (especially if offered by a particular agency or non-profit) that are either ongoing or could be launched right away. These can be used to demonstrate the value of resilience planning. In general, planning processes can be completed in one to two years. Implementation is ongoing.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?** A local working group that commits to updating this planning processes periodically (3-5 years) would be a success. Overall, success will be determined local evaluation, updates, and implementation.

RECOMMENDATION 5: SUPPORT RESEARCH ON THE EFFICACY OF COMMUNITY RESILIENCE PLANNING

SUPPORT RESEARCH TO UNDERSTAND THE FOLLOWING: THE CONDITIONS THAT ENABLE PLANNING AND IMPLEMENTATION IN DIFFERENT COMMUNITIES, HOW COMMUNITIES NAVIGATE BARRIERS TO PLANNING AND IMPLEMENTATION, WHAT PROCESSES HELP COMMUNITIES PLAN UNDER UNCERTAINTY, WHICH MECHANISMS WORK TO CREATE FLEXIBILITY AND RESPOND TO CHANGING SCIENCE, HOW TO EFFECTIVELY INTEGRATE LOCAL AND TRADITIONAL KNOWLEDGE, WHAT PROCESSES WILL WORK TO UPDATE PLANS OVER TIME, AND WHICH LESSONS ARE TRANSFERRABLE FROM ONE COMMUNITY TO ANOTHER.



MONTANA CLIMATE SOLUTIONS COUNCIL

ADAPTATION

WHITE PAPER: CLIMATE ADAPTATION IN THE BUILT ENVIRONMENT

January 21, 2020

PRIMARY AUTHORS:

- Sally Ericsson
- Amy Cilimburg
- Sara Hartley
- Ann Schwend

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

MANY OF THESE RECOMMENDATIONS NEED TO BE CROSSWALKED WITH THE RECOMMENDATIONS OF THE MITIGATION AND INNOVATION COMMITTEES. ANALYTIC RESOURCES ALSO NEED TO BE IDENTIFIED.

KEY ISSUE

Montana's built environment – both public and private – will be increasingly affected by the changing climate. Wildfires, avalanches, flooding, and extreme weather events will affect housing, cultural resources, commercial buildings, roads, rail and other transportation infrastructure, schools, hospitals, community and tribal health centers, water and energy infrastructure. Policies and programs should assess the climate risks to the built environment and communicate those risks and vulnerabilities to stakeholders.

Although much of the planning, strategy development and actions will happen at the community or county level, there is a strong need to address and coordinate across counties and at regional and state levels, depending on specific issue and recommendation. For example, what happens in one area along a river impacts downstream property owners. Transportation and energy issues are often addressed statewide. It will be crucial to work with a variety of public and private partners to better prepare our built environment.

A yearlong collaboration convened by the Hoover Institution lays out seven strategies to develop more climate resilient infrastructure:

- make better decisions in the face of uncertainty;
- view infrastructure systemically;
- take an iterative, multi-hazard approach;
- improve and inform cost-benefit analysis;
- mainstream nature-based infrastructure;
- jump-start resilience with immediate actions; and
- plan now to build back better.

PROGRESS TO DATE

Many processes are on-going that dovetail with protecting the built environment from the impacts of climate change, including the Montana Ready Communities Initiative (MRCI) and the 2018 Update Multi-Hazard Mitigation Plan.

Many of the following recommendations are from Montana community climate plans. Some communities have developed plans that assess local climate impacts, conduct vulnerability assessments, and prioritize recommendations. These plans are beginning to be implemented. Obviously not all recommendations will be relevant to all communities, counties or tribal nations and prioritization will be key.

GAPS

- Some communities do not take action because they are not aware of the climate risk and vulnerabilities that they face.
- Resilience planning and adaption takes financial resources. Building resilience into private and public planning processes saves money in the long run.
- Communities need to build capacity and assistance to assess their vulnerabilities and develop possible actions to take to address them
- Some local leaders do not take action because they lack the political ability to do so, especially given strong opposition to landuse and other planning and building codes.

STAKEHOLDERS

All Montana residents
 Local elected officials: mayors, City council members, County commissioners, etc.
 Tribal leaders
 Local transportation, economic development and planning officials
 State agencies: DOT, Commerce, etc.
 Business leaders including energy utilities and railroad companies
 Residential and commercial developers
 Home and business owners
 Insurance companies

RECOMMENDATIONS

RECOMMENDATION 1: REDUCE DEVELOPMENT IN FLOODPLAINS TO REDUCE RISK

Communities should prevent or restrict new development in floodplains. There may be need and opportunity to assist with the moving of buildings or infrastructure out of the floodplain as changing conditions and predictions warrant. These actions would be made primarily by local governments and FEMA.

Local planning officials should work at a watershed scale to understand how their communities' water resources are related to the ecosystem. Interagency and regional watershed management is essential to water storage, supply, quality and habitat. Local officials should recognize the value of functioning floodplains and riparian areas for all members in the community and consider creating green areas with little infrastructure (e.g., trails and soft infrastructure) to allow rivers to naturally flood and attenuate the risks downstream. Communities should

consider areas where flooding can occur rather than channeling rivers or “firehosing” through leveed areas, which only increases the flooding potential downstream. Growth policies should protect river corridors to allow rivers room to move around and up out of their banks

Local officials should recognize that there may be economic and safety consequences of development in floodplains. Officials should work with Federal and private sector partners (e.g., insurance companies) to educate the public, especially developers and builders about the risks. Where necessary, buy-out programs in floodplain areas should be implemented. Green infrastructure strategies should be used to minimize costs, provide environmental co-benefits, and increase preparedness over the long-term. The latest analyses of floodplains should be used for decision-making.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?** Local governments would be the primary implementor. Financial incentives/disincentives through financial institutions and insurance companies could be used as well.
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Floodplains in urban areas could be used for parks and other nature-based purpose, if not developed.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** Going through a local planning process on floodplain management would educate residents and businesses in communities that are facing increased flood risk.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Developers and realtors often oppose restrictions on development as believe it reduces business activity.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Unknown.
- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long term goals?** Implementing local planning processes could take 1-5 years. The benefits are long-term.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?**

RECOMMENDATION 2: REDUCE ENERGY COSTS BY INCREASING EFFICIENCY OF BUILDING STOCK

Reduce increasing energy cost burdens due to more extreme weather. Federal, state and local governments can all develop programs to incentivize or require more energy efficient building practices for both new and remodeled

structures. Strategies may include “cool roofs” and building placement (e.g., set back requirements, allowance for built or tree shade). State and local governments can lead by example.

Working with energy providers or others, the state should develop a campaign to increase energy efficiency and conservation for residential, commercial and industrial buildings. Energy use disclosure requirements can be considered, and new financing models and opportunities developed and shared.

This will overlap with strategies developed by the Mitigation Group.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?** Local building codes could increase energy efficiency. Federal low-income energy assistance programs can support the work. Utilities could support energy efficiency programs of their business model (and regulations) decouple their bottom line from the increased use of energy.
- **Describe the pros and cons of the recommendation. including any co-benefits for mitigation and adaptation to climate change.** Increasing energy efficient building lowers energy costs for consumers and reduces ghg emissions
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** Increasing energy efficiency is simply good conservative policy that is effective in reducing emissions and cost-effective to energy consumers incusing governments.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** No adverse impacts except reduced revenues for energy providers.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** The upfront costs (with long term-benefits) will depend on the amount of aggressiveness.
- **Provide an estimate of a reasonable timeframe to implement this recommendation.**
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?** Does this recommendation address short, medium, or long term goals? Integrate this recommendation with the ghg mitigation team. Identify resources from State and Federal programs that can be used.

RECOMMENDATION 3: REDUCE VULNERABILTY OF BUILDINGS AND COMMUNITIES TO WILDFIRE

In coordination with other forest health programs, communities should work to prevent and reduce development in the WUI through education programs and adoption of codes and standards including new construction standards addressing structure hardening and vegetation management.

Encourage communities to become Firewise communities.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?** State incentives and education programs through agencies working with counties and local communities. Counties and local communities can work through community-based stakeholder processes to develop code. Developers and real estate professionals should work with communities to address risks in their communities.
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Less development will allow firefighting teams to be able to better target activities. Wildlife habitat will be conserved with less development. Lower firefighting costs if a significant amount of development is curtailed.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** TBD
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Developers and homebuilders will argue there will be adverse economic impacts in their businesses.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** TBD
- **Provide an estimate of a reasonable timeframe to implement this recommendation.** Planning processes will take 2 plus years.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?** Dissemination of existing resources to communities and business leaders to focus their attention on risks to their communities and cost-effective solutions.

RECOMMENDATION 4: ADDRESS URBAN HEAT ISLAND EFFECTS AND MAINTAIN AND GROW HEALTHY, DIVERSE URBAN FORESTS

Create incentives and programs for communities to decrease urban heat island effect through building siting, shade and vegetation.

Develop and educational campaigns to build shared understanding of value of urban forests and encourage planting appropriate species, watering, and care. Enhance local government programs (and develop where don't exist) to plant and care for trees and consider stronger requirements for developers or building owners.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?** Local communities work with non-profits to identify resources for increased tree canopy in their communities.
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** These actions would have co-benefits including better water management in communities and enhanced wildlife habitat. Cooler communities will assist in energy load reduction and peak load management.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**
- **Provide an estimate of a reasonable timeframe to implement this recommendation.**
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?**

RECOMMENDATION 5: ENSURE “HARD” INFRASTRUCTURE (ROADS, BRIDGES, POWER LINES, TELECOMMUNICATIONS, ETC.) IS RESILIENT TO THE IMPACTS OF CLIMATE CHANGE

Climate resiliency planning should be integrated into existing and upcoming policy and planning efforts at all levels of government. In assessing infrastructure needs and vulnerabilities, the state and communities should incorporate the best available climate projections to inform the strategic planning process and project development to protect capital investments for decades, enhance communities and local economies and develop redundancies to address climate risk.

Hazard mitigation strategies should be incorporated into facility and infrastructure planning at the local level using the resources of MT DES and FEMA.

Communities should work with local stakeholders to build resiliency in their communities and increase the understanding of the vulnerabilities to their built environment now and in the future.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?** All levels of government as they plan capital investments.

- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Planning processes based on the best available climate science can result in infrastructure investments that mitigate ghg emissions and adapt to the impacts of climate change. Roads and buildings sited with the most accurate floodplain data, for example, will save resources over the long run because they will not have to be repaired or relocated in 20 years because of increased flood risk.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**
- **Provide an estimate of a reasonable timeframe to implement this recommendation.** Statewide standards for decision making can be developed and disseminated within 2 years with input from communities and experts across the state.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?**

RECOMMENDATION 6: ENHANCE WATER INFRASTRUCTURE TO REDUCE THE INCIDENCE AND IMPACT OF FLOODING AND PRESERVE WATER QUALITY THROUGH IMPROVED STORMWATER MANAGEMENT

The following are examples of strategies that support enhancing water infrastructure, given climate projections:

- Prioritize “green” water infrastructure solutions over traditional “gray” methods. Green infrastructure may be less costly and provide co-benefits including riparian and wetland restoration.
- Take a watershed/landscape scale view of water infrastructure in communities to understand the hydrological science of the local water systems during flooding and drought events.
- Develop funding mechanisms to support green infrastructure. Identify Federal and other resources to support green infrastructure projects.
- Implement low-impact development standards to encourage fewer impervious surfaces.
- Improve and expand stormwater facilities (potential for new land use regulations).

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

- Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.
- Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?
- Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?
- What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?
- Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long term goals?
- What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?

RECOMMENDATION 7: CONSERVE WATER THROUGH WATER CONSERVATION PLANS, PRACTICES, REGULATIONS AND STRATEGIC/GUIDED GROWTH

The following are examples of strategies that support water conservation, given climate projections:

- Develop and implement plans to reduce unaccounted for water (leaks, losses, theft, aging meters).
- Take water availability into account in county growth policy and zoning.
- Consider cumulative water use impacts over the entire build out of developments
- Develop educational materials and incentives to increase water use efficiency. Increased water efficiency also increases energy efficiency.
- Develop water audit programs and incentives for reduced water use
- Create community-wide water (rather than individual wells) in developed or developing areas.
- Balance competing water needs in the context of population growth.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)? DNRC and local communities.
- Describe the pros and cons of the recommendation. including any co-benefits for mitigation and adaptation to climate change.
- Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**
- **Provide an estimate of a reasonable timeframe to implement this recommendation.**
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?**

RECOMMENDATION 8: BUILD ADAPTATION ACTIONS UPON THE DES HAZARD MITIGATION PROGRAMS WORKING WITH COMMUNITIES TO IDENTIFY THEIR HIGHEST PRIORITY RISKS AND VULNERABILITIES AND CREATE AND IMPLEMENT HAZARD MITIGATION PLANS THAT INCORPORATE CLIMATE IMPACTS

The 2018 Multi-hazard Mitigation Plan assumes that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. For example,

“as flooding is generally associated with precipitation frequency and quantity, the frequency of flooding will not remain constant if broad precipitation patterns change over time. Specifically, as hydrology changes, storms currently considered to be a 1 percent annual chance event (100-year flood) might strike more often, leaving many communities at greater risk. The risks of landslide, severe storms, extreme heat and wildfire are all affected by climate patterns as well. For this reason, an understanding of climate change is pertinent to efforts to mitigate natural hazards.”

Regional hazard profiles include potential climate change impacts.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?** Local communities in their hazard mitigation planning, with support from DES and FEMA.
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Identifying the economic impact of previous natural disasters on the local economies and then factoring in climate change and predicting the economic impact of similar natural disasters in the future due to climate change, can garner the attention of community members and officials on the importance of climate adaptation and mitigation actions (similar to Colorado’s current study). Understanding how climate change can directly impact to a community’s economic heart may lead to increased support when wanting to incorporate climate impact considerations into hazard mitigation planning.

This process will allow communities to analyze the cost of mitigation compared to predicted cost of disasters in the future, showing a direct benefit of dollars spent

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** If explained in the context of economic impact, the recommendation would be fairly effective

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Adverse impact is the cost and time associated with developing mitigation plans at a local level combined. In addition to that, when it comes to identifying projects within the hazard mitigation plan, there may be a perception of increased project costs if they are to be designed and implemented to address the climate impact considerations on the hazard.

This is where it is imperative to educate local communities on the FEMA Hazard Mitigation Assistance Grant Programs (PDM, FMA, HMGP) where funding can be obtained to offset 75% of project costs (funding can be used for planning and implementation projects).

MT DES is also looking into the possibility of the State taking on the role of local hazard mitigation plans

State would apply for FEMA funds to draft regional hazard mitigation plans that would be approved by FEMA and then adopted by local communities within that region

- a) 3 Regional Plans
 - b) State would pay the required 25% match
 - c) State would ensure that the plans are adopted and current which means that all local jurisdictions (who adopt the plans) will always be eligible for FEMA HMA funding.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** TBD
 - **Provide an estimate of a reasonable timeframe to implement this recommendation.** 2-5 years.
 - **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?**

RECOMMENDATION 9: UPDATE THE MONTANA WILDLAND URBAN INTERFACE (WUI) BUILDING CODE TO ENSURE HOMES ARE CONSTRUCTED USING WILDFIRE-RESISTANT MATERIALS AND DESIGN FEATURES.



MONTANA CLIMATE SOLUTIONS COUNCIL

ADAPTATION

WHITE PAPER: ADDRESSING CLIMATE AND HUMAN/PUBLIC HEALTH

DATE

PRIMARY AUTHORS:

- Cathy Whitlock, Montana State University
- Amy Cilimburg, Climate Smart Missoula
- Robert Byron, Bighorn Valley Health Center, Hardin
- Others are invited to contribute

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?
THIS PAPER WILL BE COORDINATED WITH THE OTHER ADAPTATION WHITE PAPERS IN BOTH BUCKETS, AND, POSSIBLY, WITH THE INNOVATIONS GROUP

KEY ISSUE

Climate change is global, and the anticipated impacts to human health and well-being affect all of humankind to some degree. In Montana, harms may include increased mortality rates related to cardiovascular and respiratory conditions and heat stress, increased premature births, spread of infectious disease, higher morbidity, and elevated gastrointestinal diseases, to name a few. Particular aspects of climate change may be positive in some regions initially (i.e., longer growing seasons and less killing frosts), but the consequences of warming are less positive and of great concern over the long term. Impacts on groups and individuals vary based on where they live, as well as on their age, gender, occupation, underlying medical conditions, and socioeconomic status. The most vulnerable populations to climate change are the elderly, the sick, children, individuals working outdoors, isolated populations far from services, low-income groups, and those with inadequate health coverage

Montana, given its northern and interior location, will avoid many of the health impacts of climate change facing other parts of the US and the world. Nonetheless, some of the health consequences experienced here will be more serious than elsewhere. Those of immediate concern are related to temperature and wildfires, including heat- and smoke-related illness and cardiopulmonary illness. Other conditions are not out of the question: Projected increases in floods, early snowmelt, and intense precipitation events can lead to more gastrointestinal disease due to contamination of water supplies and increases in opportunities for food-, water-, and vector-borne diseases. Mold contamination of homes in water-saturated regions may increase. Late-summer drought can pose challenges to food security and public water supplies, especially those relying on surface-water. Projected higher temperatures, extreme weather and general uncertainty in livelihoods related to agriculture, forestry and tourism also may have consequences for stress and mental illness. Montana already has high rates of depression, ranking near the top of the national suicide rate for several decades. People on certain medications to treat mental illness may be at increased risk for side effects with higher temperatures. Projected changes in water resources may impact the availability of traditional subsistence, medicinal and ceremonial plants, which, in turn, threatens food security, community health and cultural well-being for tribal communities.

The vulnerabilities and impacts to health from climate change are increasingly recognized. Understanding who is most at risk and developing statewide and localized strategies to mitigate harm and increase health outcomes is critical. A November 2019 report in the *Lancet* highlights this public health imperative:

“The life of every child born today will be profoundly affected by climate change, with populations around the world increasingly facing extremes of weather, food and water insecurity, changing patterns of infectious disease, and a less certain future. Without accelerated intervention, this new era will come to define the health of people at every stage of their lives.” <http://www.lancetcountdown.org/2019-report/>

PROGRESS TO DATE

There are a number of resources that the state, communities and counties can already draw upon to understand climate health risks and build capacity for implementation.

Information linking climate change and human health in Montana is currently being summarized in “Assessing Climate Change and Human Health in Montana” (C2H2), a special report of the Montana Climate Assessment to be released in Fall 2020. C2H2 is product of a diverse partnership from the universities, state agencies, nongovernmental organizations, healthcare community, and tribes. Support for C2H2 comes from the Montana Healthcare Foundation, MSU’s Center for American Indian and Rural Health Inequities and the Montana Institute on Ecosystems. This assessment of human health impacts is intended to be a sustained effort, one that will be updated and expanded on a regular basis as part of the overall Montana Climate Assessment.

The objective of C2H2 is to bring scientifically based information to the people of Montana in an organized and understandable manner. This assessment is directed to the needs of communities, healthcare professionals and other decision makers to help understand the climate-health connection and evaluate different strategies for responding to climate change and its impacts in Montana. The flow of information also goes in the opposite direction, with the hope that C2H2 will help decision makers identify critical information gaps that require new scientific investigation, tool development, and future assessment. Strategies and activities developed and implemented can readily be shared with others to increase health outcomes across the state. C2H2 highlights key information that can improve understanding of complex issues and identify knowledge gaps where more information is needed. The report draws on key findings from MCA (2017) that are or will likely be important factors for human health. By summarizing the current state of knowledge about human-health impacts in Montana now and in the future, C2H2 contributes to the flow of information from the national level to the regional, state, and local levels.

C2H2 covers the topic by describing: health-related aspects of recent and projected climate change in Montana; linkages between climate change and human health; current health landscape of Montana; the health consequences and uncertainties posed by climate projections for mid- and end-of-century; and recommended actions, research needs and policy changes to ensure positive health outcomes.

Part of C2H2's objective is to work with Montana Department of Public Health and Human Services (DPHHS) and partnership organizations to maintain an active website describing national, state, and local activities that center on the impacts of human health and climate change and how best to respond.

Some communities in Montana are already considering the health impacts from climate change. For example, Missoula County's Climate Resiliency Planning effort specifically addresses public health and builds on collaborative efforts between Climate Smart Missoula and the Missoula City-County Health Department.

At the state level, a new statewide non-profit: Montana Health Professionals for a Healthy Climate is being formed to address this issue.

Montanan's Department of Environmental Quality (MTDEQ) provides resources on air quality throughout the year and is particularly crucial during wildfire smoke season, a significant health threat exacerbated by climate change.

Nationally, the Center for Disease Control has developed the BRACE Framework: Building Resilience Against Climate Effects. The BRACE Framework is a five-step process that allows health officials to develop strategies and programs to help communities prepare for the health effects of climate change. <https://www.cdc.gov/climateandhealth/BRACE.htm>.

Two influential reports are available at the national level: (1) The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment by US Global Change Research Program and (2) Human Health. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment (see end for full citations).

GAPS

INFORMATION: MCA (2017) provided the first detailed analysis of expected impacts to water, agriculture and forests from climate change in Montana, but its limited scope was not able to address the topic of human health. National-level studies have outlined a number of linkages between climate change, exposure, health outcome, with projected health impacts that have direct implications for Montana (USGCRP 2016). The certainty of changes in the region's climate in the decades ahead calls for a deeper understanding of the potential impacts on people as well as the capacity of the region's healthcare community to respond to emerging climate-related challenges.

PEOPLE and CAPACITY: Collaboration among climate, health, and environmental scientists, and healthcare professionals is needed to gather data on climate and health trends, examine potential health impacts of projected climate changes, and communicate the need for monitoring and action to the broader healthcare community, the public, and policy makers.

This knowledge leads to the development of on-the-ground actions. Localized planning and implementation needs funding and support. Communities and healthcare providers need specific guidance to engage in the development of localized climate and health action plans. This coordination involves a wide variety of stakeholders.

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION. This will vary greatly, depending on community size, resources, and work to date.

- State of Montana DHPPS, DEQ
- UM and MSU researchers
- Local and county staff: health department, emergency service providers, etc.
- Healthcare professionals, hospitals, and health clinics
- Tribal service health groups
- Health-related non-governmental organizations
- Representatives from low income groups and social service organizations

RECOMMENDATIONS

RECOMMENDATION 1: VIA THE C2H2, PROVIDE REGULAR ASSESSMENT OF CLIMATE-RELATED HEALTH RISKS AND MONITORING OF CLIMATE-RELATED ILLNESSES. THIS INFORMATION WILL BE FOUNDATIONAL FOR PLANNING AND MONITORING EFFORTS FOR THE STATE AS WELL AS COUNTIES, COMMUNITIES, HEALTHCARE PROFESSIONALS

C2H2 discusses eight topics as areas of health concern for Montana now and in the future, given climate projections. They are described in more detail below:

- Extreme climate events
- Extreme heat
- Vector-borne diseases
- Water-related illnesses
- Food safety and nutrition
- Wildfires
- Allergens/Air Quality
- Mental Health

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation?** The State of Montana Department of Health and Human Services, DEQ, local public health departments, local and county governments, healthcare professionals and hospitals would implement the recommendations of C2H2.
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** These actions will enable the state and communities to align climate/health activities and outcomes with other health efforts to leverage existing resources and experience. Identifying mitigation co-benefits is part of this process.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** Over the long term, effectiveness is high. Identifying and addressing health risks and health/climate impacts builds support for addressing climate impacts more broadly as health professionals are trusted community leaders.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Health planning should intentionally identify health disparities, related to economics and location, for the benefit of all.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Funding and resources for implementation of the recommendations in C2H2 are needed and the exact dollar amount has not been calculated. However, it's well known that health prevention measures save money in the long run. We recommend funding be made available from the State of Montana for continued monitoring and reporting on health-related issues, and delivery of services where most needed.
- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?** A statewide planning effort is needed to routinely collect and store necessary data, better train professionals to make connections between health conditions and climate change, and update the findings of C2H2 on a regular basis. Planning should occur over the next three to five years as a follow-up to the release of the report.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?** A statewide health and climate task force committed to updating the science and recommendations of C2H2 on a regular basis (3-5 years) would be a success. Overall, success will be determined by whether the state, county, local communities, and healthcare professionals continue to discuss, evaluate and implement the specific strategies.

RISK 1 – EXTREME EVENTS

Climate models project increased numbers of extreme weather events, including precipitation events, droughts, storm surges, and floods, as well as events with more complex origins, such as wildfires (Bell, et al, 2016) (Westerling, 2006). In inland regions, like Montana where average annual precipitation is projected to show minimal change, precipitation may be more concentrated in spring, winter and fall, with a high likelihood of precipitation and flooding events (Whitlock, et al, 2017). When extreme weather events occur, people face the risk of injury and death, exposure to diseases from contaminated waters, potential displacement if homes are destroyed or damaged, and a markedly heightened jeopardy for mental health issues.

RISK 2 - EXTREME HEAT

Multiple studies demonstrated increased mortality associated with heat waves (Knowlton et al. 2009; Ostro et al. 2009; Isaksen et al. 2016), which is the major cause of weather-related deaths in the United States (<https://www.weather.gov/hazstat/>). Across the country, fatalities from heat related illness are highest in the agriculture, forestry, fishing, and hunting sectors, reflecting this particular vulnerability to high heat days. The highest risk occupations for heat-related deaths occur in men in construction or agriculture jobs, especially with very small businesses (Gubernot et al. 2015). National data also indicate the impacts of advancing heat on mental health and heat stroke. Those living in areas without access to shade, air conditioning, and cooling places are at much more risk. In addition, pregnancy carries with it the risk of premature births and birth defects from heat exposure during pregnancy. This issue is potentially worse for migrant workers, those living in inadequate housing, poverty, cultural and linguistic isolation, and without insurance.

RISK 3 – INFECTIOUS AND VECTOR-BORNE DISEASE

Vectors are organisms, such as ticks, mosquitoes and fleas, that transmit diseases from one host to another. The number of vector-borne diseases tripled in the United States between 2004-2016, with over 100,000 cases reported in 2016 (Rosenberg et al. 2018). Globally, vector-borne diseases include malaria, Chagas disease, yellow fever, dengue, Zika, plague, and Chikungunya, among others. In the

United States, Lyme disease, Rocky Mountain Spotted Fever, and anaplasmosis, all carried by ticks, and West Nile Virus, transmitted by mosquitoes, are most prominent, though Zika, dengue, Eastern Equine Encephalitis, and Chikungunya are also of concern. Climate change is expected to increase the range of vectors, primarily ticks and mosquitoes in the United States, thereby increasing the number of people exposed to the diseases they transmit (Beard et al. 2016; Sonenshine 2018). The interactions between climate, vectors and pathogens, however, is complex and not well understood.

RISK 4 – WATER-RELATED ILLNESS

Extreme precipitation events, earlier snowmelt, and flooding can affect people's health in a variety of ways. Immediate impacts include injury and death from drowning, hypothermia, exposure to toxic substances released as a result of flooding, and exacerbation of underlying conditions, such as cardiovascular or pulmonary disease, due either to the event itself, or cleaning up afterwards. Later complications include respiratory and skin infections, vector-borne illnesses, and mental health conditions (Du et al. 2010; Ryan et al. 2015; Paterson et al. 2018). Harmful algal blooms (HABs) have increased from approximately 100 reported in the media in 2013, to over 500 in 2019 (https://www.ewg.org/interactive-maps/2019_algal_blooms/map/). Depending on the causative organism and type of exposure, HABs can result in skin rashes, gastrointestinal symptoms, muscle cramps, liver damage, even death.

RISK 5 – FOOD SAFETY AND NUTRITION

Climate change impacts of food supply, safety and nutritional content may be more profound than other health impacts on a global basis. Elevated CO₂ levels reduce the protein and micronutrient content of grains, and increased temperatures, both modest and extreme, lower crop yields (Zhao et al. 2017; Vogel et al. 2019). Heat and water stress, both expected to increase with climate change, can induce production of aflatoxins, fungal produced toxins that are known carcinogens (Medina et al. 2014).

RISK 6 – WILDFIRE SMOKE

The smoke produced by wildfires exposes large numbers of people over broad geographic areas to air contaminated with a wide variety of substances in the form of PM, carbon monoxide, nitrous oxide, benzene, polyaromatic hydrocarbons, and aldehydes, to name a few (Naeher et al. 2010; Reisen et al. 2015). The most consistent relationships across studies are between wildfire smoke exposure and flares of asthma or COPD, less so relative to cardiovascular outcomes. Individual actions suggested for minimizing the health impacts of wildfire smoke exposure, include avoiding strenuous outside activities, staying indoors, turning air conditioning to recirculation mode to avoid drawing in outside air, using masks (N95), and using portable or in-line HEPA filters indoors. Further study regarding the efficacy of each of these recommendations is needed.

RISK 7 – ALLERGENS/AIR QUALITY

Particulate matter (PM) from wildfires has been associated with multiple health effects, including cardiovascular, respiratory and infectious, the latter with increased risk for pneumonia (Rappold et al. 2011; Reid, Jerrett, et al. 2016; Tinling et al. 2016). Additionally, PM has been found to cross the placenta in pregnant women (Bové et al. 2019) and in separate studies to be associated with preterm birth (DeFranco et al. 2016; Trasande et al. 2016) and low birth weight (Fleischer et al. 2014). Ground level ozone, formed primarily when sunlight acts on nitrous oxides and volatile organic compounds, has been associated with asthma exacerbations, increased hospitalizations, and premature mortality (Bell et

al. 2004; Zanobetti and Schwartz 2008; Di et al. 2017), as well as with preterm birth (Olsson et al. 2013). Both are expected to increase with climate change.

RISK 8 - MENTAL HEALTH

The mental health impacts of climate change range from immediate impacts from extreme weather events (Lamond et al. 2015), storms or wildfires, to more sustained, but slower occurrences such as drought. The former can lead to increases in post-traumatic stress disorder (PTSD), anxiety, depression, suicidal ideation, and substance abuse, whereas the latter include all of those plus a sense of loss of community and, in many cases, displacement (Hayes et al. 2018; Palinkas and Wong 2019). Even small increases in temperature can lead to significant increases in mental illness (Obradovich et al. 2018). Heat has been associated with increased interpersonal aggression in the form of domestic violence, abuse and rape, as well as intergroup conflicts (Hsiang et al. 2013). Montana with its high suicide rates and the limited access to mental health professionals in most rural areas may be at risk for many of these mental health impacts, thus raising the importance of preparedness planning.

RECOMMENDATIONS

RECOMMENDATION 2: USING THE C2H2 ASSESSMENT, COMMUNITIES DEVELOP LOCALIZED ACTION PLANS AND IMPLEMENT STRATEGIES APPROPRIATE TO THE PLANNING AREA.

Montana will face specific health/climate challenges, given climate projections, our geography, and diverse rural, tribal and urban issues. Every community in Montana is unique and approaches to addressing climate and health risks will vary across the state. Healthcare professionals are trusted messengers in any community and county health departments are invaluable. Health adaptation recommendations should follow pre-determined guiding principles, with strong consideration for equity and the co-benefits that allow for mitigating emissions.

Climate/health planning can be accomplished by bringing community leaders and health experts together to understand state-wide and local health vulnerabilities (who and what is most at risk, given up-to-date regional climate projections) and to identify the adaptation strategies that will improve public health and limit harm from these impacts. This recommendation encourages stakeholders to put the information presented in the C2H2 to work for Montana Citizens.

The Community Planning whitepaper provided overall guidance.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation?** The State of Montana DPHHS and DEQ, local public health departments, local and county governments, healthcare professionals and hospitals together with social service agencies, non-profit organizations.
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Planning can be done within a broader climate resiliency planning effort and some strategies may overlap with other community adaptation strategies. Identifying mitigation co-benefits is part of this process.

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** Over the long term, effectiveness is high. Planning ahead and improving health builds support for addressing climate impacts more broadly as health professionals are trusted community leaders.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Health planning should intentionally identify health disparities, related to economics and location, for the benefit of all.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Funding and resources for implementation of the recommendations in C2H2 and via localized planning efforts are needed. Again, health prevention measures save money over time. We recommend funding be made available from the State of Montana for planning and for delivery of prioritized services.
- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?** Local and regional planning should commence following the release of C2H2 and the launch of a statewide planning effort.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?** This recommendation will be successful if county, local communities, and healthcare professionals continue to plan, evaluate, implement the specific strategies and adapt these as the future unfolds.

CITATIONS/RESOURCES

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MONTANA CLIMATE SOLUTIONS COUNCIL

COMMITTEE NAME: ADAPTATION

WHITE PAPER: OUTDOOR RECREATION AND TOURISM DRAFT

JANUARY 17, 2020

PRIMARY AUTHORS:

- Kyan Bishop, Montana State Parks Planner, FWP
- Renee Lemon, Planner, FWP
- Elizabeth Covelli Metcalf, Associate Professor, University of Montana
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DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

-

KEY ISSUE

Climate change poses a serious threat to outdoor recreation, as well as to the ecosystems on which it depends, to the communities that provide important recreational amenities and access, and for residents who overwhelmingly view outdoor recreation as a part of their legacy, and even identity. Protection of these resources and systems is vital to maintaining a diverse and healthy economy, positive mental and physical health outcomes, and a resilient, high quality of life for residents as well as out of state visitors.

PROGRESS TO DATE

IN A FEW SENTENCES DESCRIBE PROGRESS TO DATE. THIS COULD INCLUDE KEY SUCCESSES, CASE STUDIES, COMPLETED RESEARCH, ACTIONS TAKEN IN OTHER STATES THAT COULD BE REPLICATED, SUPPORTED OR BUILT UPON IN MONTANA.

Relevant research and reports

- One of the key goals articulated in the draft [2020-2024 Statewide Comprehensive Outdoor Recreation Plan](#), or SCORP, describes the need to adapt outdoor recreation in Montana for a changing environment.
- [Impacts of climate change on outdoor recreation participation: Outlook to 2060](#) is a longer-term forecast that provides insightful projections on how recreational activities and participation may change.
- Montana [planning tools](#) to reduce wildfire risk for communities could provide a helpful start
- [Report](#) on costs and impacts of the 2017 fire season in Montana highlights some of the key challenges and opportunities related to wildfires

Studies that could be replicated and actions that could be taken

- Develop a drought assessment for outdoor recreation and tourism, such as this [study](#) for Southwestern Colorado

- Develop a statewide resiliency plan, potentially utilizing information gathered as part of the Montana Department of Commerce’s [Montana Ready Communities Initiative](#), or adapting information from the [Colorado Resiliency Framework](#) or [Vermont’s Roadmap to Resilience](#).
- Identify opportunities for greater coordination, collaboration, and communication in planning, research and evaluation efforts.

GAPS

IDENTIFY KNOWN GAPS THAT EXIST AND REPRESENT BARRIERS TO MAKING PROGRESS ON THIS ISSUE. GAPS COULD BE RELATED TO DATA, RESEARCH, TECHNOLOGY, HUMAN RESOURCES, FINANCIAL RESOURCES. IDENTIFY WHAT RESEARCH CAN BE ACCOMPLISHED AS PART OF THE COUNCIL’S DELIBERATIONS, AND WHAT MUST BE UNDERTAKEN ON A LONGER TIME HORIZON.

There is a high need in Montana for more capacity and funding to conduct recreation-related research, assess vulnerabilities, develop well-coordinated plans, and drive ideas toward implementation. Efforts would be valuable both at a regional level, as well as at a very localized level such as in smaller communities that are often resource challenged. Undertaking some of the data and analysis efforts could enable key stakeholders to better prioritize work, projects, and financial resources, not to mention inform policy, programs and even legislation.

- **Overall Challenges and Opportunities:** Conduct a literature review and assessment to identify and examine the core challenges and opportunities for outdoor recreation and tourism in Montana related to climate adaptation. This can include looking at recreational facilities and amenities, in other words, as well as access to natural or open spaces. This analysis can help to identify what places, recreational assets, and activities are most vulnerable or ‘at risk’ for the state.
- **Visitor Participation, Preferences, and Experiences in Recreation:** Conduct a statewide study stratified by county to better understand visitor participation, preferences, and experiences in outdoor recreation, and how trends may change or be impacted by climate adaptation. In time, consider amplifying this effort to a small consortium of western states that neighbor Montana to undertake a holistic view.
- **Education and Outreach:** Conduct a literature review and assessment of outreach and educational programs that promote awareness of climate change, conservation, and stewardship to identify successful models, promising practices, and approaches for delivering information to the public.
- **Economic Impacts:** Conduct research to better understand the economic impacts of climate change on specific recreation sectors (e.g., fishing, rafting, skiing). Use this information to project the ‘costs’ of climate-related impacts and to develop adaptation strategies.
- **Health Impacts:** Conduct research to better understand the relationship between outdoor recreation and mental and physical health in Montana. Use this information to identify the key health impacts on that may be caused by a potential lack of, or diminishing level of, outdoor recreation. Collaborate with public health and school officials to use the results to develop strategies and action plans. Include predicted increases in health-care costs due to sedentary lifestyles, etc.
- **Training:** Train outdoor recreation professionals on climate adaptation strategies specific to parks, recreation, and tourism.

- **Data and Tools:** Derive a set of data measures and tools for climate adaptation strategies that outdoor recreation managers, planners, economic developers, and others can utilize. Use emerging technologies and consider the involvement of the public both for engagement and education purposes.

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION.

- Montana state agencies including DEQ, DNRC, MDT, DPHHS, Commerce, OPI, and FWP
- Governor's offices including OOR, OED, OIA, OCS
- Federal Agencies
- Tribes
- Montana Universities
- Private landowners
- Local governments and key local elected officials
- NGOs (e.g., local land trusts, sports groups, conservation, and civic groups)

RECOMMENDATIONS

RECOMMENDATION 1: DEVELOP AN INVENTORY OF OUTDOOR RECREATION AND TOURISM RESOURCES IN MONTANA AND ASSESS WHICH OF THESE RESOURCES ARE MOST VULNERABLE TO CLIMATE CHANGE

Montana lacks a holistic inventory of outdoor recreation resources, opportunities, assets, and access points. Once an inventory is complete, partners can conduct research and vulnerability assessments to determine which outdoor recreation resources are most vulnerable to climate change. For example, a reduction in overall snowpack impacts opportunities to both fish and ski, two hugely popular recreational activities. This assessment would help partners prioritize outdoor recreation resources for adaptation strategies.

Based on existing literature, impacts on water resources and the changing trends in temperature changes across seasons can be presumed to be the two areas of most concern for our state. With respect to water resources, we can anticipate impacts on angling in the form of less predictability related to good fishing locations, abundance of fish stock/supply, and increasing crowding. We can also anticipate changes in conditions and behaviors for boating, rafting, swimming and other water recreation. Flooding and changes in spring melt-off both in terms of timing and volume are already being experienced, which requires additional resources for mitigation, emergency response, and recovery activities.

With projected warming there appear to be three main areas of concern. First, it is still unclear how warming temperatures will impact snowpack and the many types of winter recreation that depend on reliable snow. Second is the change in what we think of as peak and non-peak seasons. Montana's shoulder seasons are expanding yet the resources to support or provide for staff during those busier times has not kept up. Similarly, recreational facilities and amenities are now being used with more frequency as a result of these seasonal participation changes. A last consideration is the different array of amenities in the future that we may need as temperatures warm and weather becomes more extreme. Amenities that offer more shade and/or thermal protection, and more indoor recreational options may be necessary as time goes on.

RECOMMENDATION 2: CONDUCT RESEARCH TO UNDERSTAND HOW THE IMPACTS OF CLIMATE CHANGE ON OUTDOOR RECREATION AND TOURISM RESOURCES WILL AFFECT PHYSICAL AND MENTAL HEALTH

Conduct research on the relationship between climate change, outdoor recreation, and physical and mental health at the local scale. This research should include and assess state and federal parks and recreation opportunities. Include research that focuses on low-income communities and communities of color, which may be particularly vulnerable to adverse physical and mental health impacts from fewer outdoor recreation opportunities.

It is also important to recognize that for individuals and communities that are economically vulnerable further challenges exist. Evidence suggests that low-income communities and communities of color are less likely to have the resources and capacity to prepare for and recover from extreme climate events. Additionally, they are more likely to have chronic health conditions and live in or be exposed to poor air quality and pollutants. As such, having ready access in terms of convenience, affordability, and ease to recreational opportunities can be even more important for these groups. It is generally accepted that access to the outdoors, open spaces, and natural places all have positive physical and mental health benefits. For low- and moderate-income individuals, however, specific impacts of climate adaptation that result in less recreational access could have disproportionate impacts and cascading effects.

In addition, developing strategies to address specific challenges for Montana's tribal communities, whose livelihoods, economies, health, and cultural identities are uniquely disrupted by climate change will be critical. Amongst other measures, recognizing the importance of having or creating shared communal places where people can gather safely and securely and where social ties can be fostered and developed will assist in efforts.

RECOMMENDATION 3: DEVELOP AND STRENGTHEN NETWORKS OF OUTDOOR RECREATION AND TOURISM PROFESSIONALS ACROSS AGENCIES, JURISDICTIONS AND THE PRIVATE SECTOR TO IMPROVE COORDINATION, COLLABORATION AND ENSURE UNDERSTANDING OF ROLES, RESPONSIBILITIES, AND PROTOCOLS IN ADAPTING TO CLIMATE CHANGE

Strengthen existing partnerships and build new connections across organizations. Review existing protocols and identify opportunities to coordinate on climate adaptation for outdoor recreation.

When wildfires or other natural disasters occur, there are often direct impacts on already limited staffing and resources available. Improving coordination and communication between recreation providers and emergency management personnel is needed. Similarly, ensuring that outdoor recreation organizations and agencies have up-to-date rapid response plans in place and that they are well communicated across stakeholders is critical. Such collaboration could lead to improved coordination around policies such as dispersing visitors when needed, carrying out emergency and evacuation plans, as well as other efforts.

RECOMMENDATION 4: INCLUDE CLIMATE ADAPTATION STRATEGIES RELATED TO OUTDOOR RECREATION AND TOURISM IN LOCAL PLANS AND POLICIES, SUCH AS PARKS AND RECREATION PLANS, CLIMATE RESILIENCY PLANS, GROWTH POLICIES, AND HAZARD MITIGATION PLANS

Local government's plans and policies should include climate adaptation strategies for parks and outdoor recreation. Additionally, reduce non-climate stressors to help sustain and make recreational opportunities more resilient to the effects of climate change. This could include the impacts of population growth and increased vehicle traffic and congestion on recreational resources.

RECOMMENDATION 5: DEVELOP CLIMATE INFORMATION AND TOOLS SPECIFIC TO THE OUTDOOR RECREATION AND TOURISM SECTORS PRODUCED BY THE STATEWIDE CLIMATE SERVICES

Climate information on the most vulnerable recreational opportunities, assets and infrastructure should be shared via public outreach and education efforts. This could include developing a handbook or fact sheet that explains climate change effects on recreational opportunities, ecosystems; adaptation and mitigation options; training and educational opportunities; and key points of contacts. Public input and engagement in the delivery and content of these tools should be integrated, and ongoing dialogues should help to inform adaptation strategies.

RECOMMENDATION 6: EMPOWER LOCAL PARTNERS TO WORK TOGETHER ON CLIMATE ADAPTATION STRATEGIES AND SOLUTIONS TO PROTECT AND RESTORE THE OUTDOOR RECREATION AND TOURISM RESOURCES THAT ARE MOST VULNERABLE TO CLIMATE CHANGE

Agencies, universities, and non-governmental organizations should support local climate adaptation strategies and solutions. Climate adaptation for outdoor recreation will be most effective if it is driven and supported by local partners.

RECOMMENDATION 7: DEVELOP FUNDING STRATEGIES TO SUPPORT THE COSTS OF CLIMATE ADAPTATION FOR OUTDOOR RECREATION AND TOURISM PROVIDERS

Partners should develop funding strategies for local communities, both urban and rural, as well as state recreational resources. For example, funding is needed to undertake facility improvements, maintenance, and repair to create amenities that are more 'climate-durable'.

When natural disasters strike, resources tend to be funneled away from other pressing needs or geographical areas, concentrated and expended in short periods of time, and focused on a set of specific geographies, often which were unplanned or unanticipated. In other words, there is a cascade of trade-off decisions that can have immediate consequences for other resources, in turn bearing further burdens where there is already a limited level of staffing and resources. As such, there is a strong need to ensure that there is funding available to cover the costs of preparedness, mitigation, and recovery measures, such as:

- Covering the increased expenses of staffing and personnel
- Undertaking facility improvements, maintenance and repair
- Developing or upgrading amenities that are more 'climate-durable'
- Conducting training and workshops for key stakeholders; and,

- Stabilizing recreational assets and infrastructure with a longer-term view.

Funding is also needed to support the costs of planning, evaluation, and monitoring efforts, so as to allow for a more responsive and pro-active approach in the creation and development of policies, programs, and other key decisions.



MONTANA CLIMATE SOLUTIONS COUNCIL

WHITE PAPER: URBAN AND COMMUNITY FORESTS

DATE: DECEMBER 2, 2019

PRIMARY AUTHORS:

STAFF, FORESTRY ASSISTANCE BUREAU, DNRC

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

COMMITTEE NAME (YES, WATER RESOURCES, COMMUNITIES, PUBLIC HEALTH)

KEY ISSUE INCREASE IN FOREST CANOPY COVER TO INCREASE CARBON COLLECTION/STORAGE, PROVIDE COOLING SHADE, REDUCE ENERGY CONSUMPTION, AND SUSTAIN PUBLIC HEALTH.

IN A FEW SENTENCES DESCRIBE THE ISSUE, GOAL, QUESTION TO BE ANSWERED, OR PROBLEM STATEMENT.

Rising temperatures, altered moisture patterns, and extreme weather events will impact the health and quality of living of Montana’s rural and urban residents. The projected 4.5 to 6 degree increase in temperatures and increased smoke from widespread wildfires will cause uncomfortable, potentially unbearable living conditions in towns and cities. These changes are expected to result in substantial impacts to trees, plants, water, fish and wildlife, and humans. Insects and disease, fire, floods are expected to increase as well as illnesses from heat, allergies, stress, anxiety. An aggressive urban and community forestry program with extensive tree planting and maintenance of healthy trees can mitigate temperature and flooding impacts in towns and cities.

PROGRESS TO DATE

IN A FEW SENTENCES DESCRIBE PROGRESS TO DATE. THIS COULD INCLUDE KEY SUCCESSES, CASE STUDIES, COMPLETED RESEARCH, ACTIONS TAKEN IN OTHER STATES THAT COULD BE REPLICATED, SUPPORTED OR BUILT UPON IN MONTANA.

State and federal agencies and partners are working extensively to plant trees and maintain healthy urban and community forests with limited financial resources.

GAPS

- IDENTIFY KNOWN GAPS THAT EXIST AND REPRESENT BARRIERS TO MAKING PROGRESS ON THIS ISSUE. GAPS COULD BE RELATED TO DATA, RESEARCH, TECHNOLOGY, HUMAN RESOURCES, FINANCIAL RESOURCES. IDENTIFY WHAT RESEARCH CAN BE ACCOMPLISHED AS PART OF THE COUNCIL’S DELIBERATIONS, AND WHAT MUST BE UNDERTAKEN ON A LONGER TIME HORIZON.

Gaps include: additional funds, staff, and infrastructure are needed for an expansive urban and community planting and tree maintenance program. The current program needs to be scaled up significantly to develop shade to mitigate temperature increase and flooding.

STAKEHOLDERS

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION.

Includes local, state, federal agencies (including fire managers and departments), landowners, groups, citizens, and partners including researchers and funding organizations

Partner with cities, towns, agencies, and organizations, including:

- City Parks and Recreation and Urban Forestry Departments
- City Officials
- DNRC
- Forest Service
- BLM
- Public
- Legislature
- County Officials
- Universities
- Volunteers
- Schools
- Urban & community organizations, including Montana Urban and Community Forestry Association; Arbor Day Foundation; Sustainable Urban Forest Coalition Montana League of Cities and Towns; Montana Nursery and Landscape Association; Association of Montana Turf Ornamental and Pest Professionals; MSU-Extension Resources; Western States Coordinators Network; Western Forestry Leadership Coalition; International Society of Arboriculture; MT Universities, Colleges, and educational institutions.

RECOMMENDATIONS

RECOMMENDATION 1: Increase the extent of forest cover within urban areas and rural communities.
DESCRIBE THE RECOMMENDATION.

- Accelerate planting and care of trees in urban and community locations. Promote planting climate hardy, adaptable, tolerant species for urban spaces. Utilize trees as green infrastructure to use in improvements for any or all ecosystem services.

Benefits in addition to carbon storage and cooling include stormwater interception and filtration, bioswales and water retention, air quality and dust/smoke/wind abatement and human health.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

Cities, towns, counties, state and federal agencies, landowners, homeowners.

- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.**

Pros: Significant tree cover will keep temperatures cooler and mitigate flooding.

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**

Highly effective in mitigating temperature increases and flooding impacts.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**

No significant adverse impacts

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**

Significant additional funding and staff resources will be needed as well as an increase in volunteers. Significant build-up of nursery infrastructure would be needed.

- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?**

Work in progress would continue but would need to accelerate through the next decade and beyond.

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?**

Further develop partnerships. Use grant programs, financial incentives, assessments, etc. Monitoring and follow-up with additional action. Additional research addressing the question “Are we planting the right trees in the right places, in the right geographies” is needed.

RECOMMENDATION 2:

DESCRIBE THE RECOMMENDATION.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
- **Describe the pros and cons of the recommendation. including any co-benefits for mitigation and adaptation to climate change.**
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**
- **Provide an estimate of a reasonable timeframe to implement this recommendation.**
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?**

Natural Resources

Air Quality

Agriculture

Ecosystems, Species, and Habitats

Fire Adapted Forests and Communities

Forest Health

Forest Products Utilization

Rangelands

Water Quality and Quantity



MONTANA CLIMATE SOLUTIONS COUNCIL

COMMITTEE NAME (ADAPTATION)

WHITE PAPER: ADAPTATION NEEDS FOR AIR QUALITY IMPACTS

DATE: NOVEMBER 20, 2019

PRIMARY AUTHORS:

- Staff, Montana DEQ, Air Quality Bureau
- NAME, AFFILIATION

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

COMMITTEE NAME (YES, GHG MITIGATION BUT ALSO WITHIN THE ADAPTATION COMMITTEE SECTORS OF FORESTS AND PUBLIC HEALTH)

KEY ISSUE

IN A FEW SENTENCES DESCRIBE THE ISSUE, GOAL, QUESTION TO BE ANSWERED, OR PROBLEM STATEMENT.

The Montana Climate Assessment Report (MCAR) has concluded that each of the seven climate divisions have shown temperature increases from 1950 through 2015 with the prediction of continued warming. The MCAR also predicted that more extreme heat days (above 90°F) are projected to occur more frequently. Although the report concluded that the number of consecutive dry days would change very little, there is expected to be more variation in precipitation, leading to longer, more severe periods of drought. Any additional precipitation predicted to occur would not be expected during the wildfire season. Together, warmer days and lack of increased precipitation work to increase the risk of wildfires in Montana. Combined with past fire suppression practices, an increase in fire risk including size, frequency and severity is projected by the MCAR. To help manage the risks associated with warmer conditions during the summer, forest management practices, such as prescribed burning, will need to change. Doing so will require that airsheds be managed to avoid unhealthy concentrations of particulate matter (smoke) yet provide opportunity for expanded prescribed burning to help reduce extreme wildfire events. These impacts are also largely identified and included in the Montana Forest Action Plan. The impacts on air quality will need to be considered as the need for the year-round management of forest fuels, including the practice of expanding the use of prescribed fire, become a way to mitigate impacts from more frequent wildfire events in Montana.

PROGRESS TO DATE

IN A FEW SENTENCES DESCRIBE PROGRESS TO DATE. THIS COULD INCLUDE KEY SUCCESSES, CASE STUDIES, COMPLETED RESEARCH, ACTIONS TAKEN IN OTHER STATES THAT COULD BE REPLICATED, SUPPORTED OR BUILT UPON IN MONTANA.

The Air Quality Bureau's Smoke Management program is designed to work closely with all entities interested in conducting burning in the State of Montana. Specific requirements in the Administrative Rules of Montana (ARM) 17.8 Subchapter6 describe the process to authorize burns, from both major and minor sources, that seeks to limit

air quality impacts from burning and directs all burners to follow best smoke management practices. A key component of the program is the understanding of adequate dispersion and meteorological conditions and the resultant impacts realized from smoke. Historically, the Smoke Management program has been associated with a message that burning is 'closed' or restricted, or 'open' during certain seasons. Implementation of the program has changed significantly over the past 5 years, with more effort placed on the messaging that burning can be accomplished throughout the year, under the right conditions. The education and outreach portion of the program has increased and centered on informing the burners, both major and minor, on the process to find opportunities to burn. This is a critical component of successfully integrating air quality impacts to allow for more prescribed burning, with the intention of mitigating increased wildfire risks.

The Air Quality Bureau attempts to balance the emissions impacts from burning with industrial sources and smaller, residential sources. The State of Montana's ambient air quality monitoring network provides the data necessary to evaluate air quality impacts geographically. Air dispersion and meteorological modeling can help air quality scientists evaluate anticipated impacts over large regions. Additionally, data tracking tools that consider burn proposals and completions, meteorology, and measured, modeled, and reported air quality impacts are needed to better track progress and inform future decisions. These are examples of the tools necessary to assist the State Air Quality Meteorologist and other staff to make informed decisions regarding the 'where, when, and how much' of open burning.

GAPS

- IDENTIFY KNOWN GAPS THAT EXIST AND REPRESENT BARRIERS TO MAKING PROGRESS ON THIS ISSUE. GAPS COULD BE RELATED TO DATA, RESEARCH, TECHNOLOGY, HUMAN RESOURCES, FINANCIAL RESOURCES. IDENTIFY WHAT RESEARCH CAN BE ACCOMPLISHED AS PART OF THE COUNCIL'S DELIBERATIONS, AND WHAT MUST BE UNDERTAKEN ON A LONGER TIME HORIZON.

Although the Air Quality Bureau has been working to advance a message of cooperation regarding smoke impacts and prescribed fire, there is a misunderstanding that burning is restricted during certain seasons. Therefore, more stakeholder engagement is needed to advance the message of cooperation, and what the air quality goals are for prescribed fire. It is not uncommon for burners to find different messaging between DEQ's Air Quality Bureau and local county authorities, fire officials, public health officials and forest management officers throughout the various forest districts. Often, a message of 'restrictions on burning due to fire safety' vs 'air quality impacts' get muddled together. A large portion of the effort to allow more prescribed fire needs to be focused on finding adequate ways to communicate the varying messages.

Additionally, various governmental agencies have different data systems for tracking open burning. The burners wishing to conduct prescribed burning must navigate a maze of websites and data entry systems to gain permission to burn. More resources are needed to link information systems, as appropriate, to succinctly coordinate the message.

Currently the Air Quality Bureau receives state special revenue of approximately \$100,000 from those major sources that conduct burning, which is used to fund staff managing the open burning program. There is not a dedicated revenue stream for the forecasting of smoke impacts during wildfires. To make informed open burning decisions the smoke management team works to analyze websites, data systems, meteorological tools and monitoring data. Certain parts of the state, namely the Northwest, are difficult to forecast yet are often the areas that propose the most prescribed fire. Additional ambient air quality monitors/sensors in these areas would greatly improve prescribed fire forecasting and decision making on burn requests.

The current funding for the Smoke Management Program coupled with the smoke forecasting during wildfire season is inadequate to provide the necessary “forward” looking forecasting, additional stakeholder engagement, ambient air quality monitoring enhancements and data collection that will be necessary to support the expanded use of prescribed fire and the forecasting during wildfire season.

STAKEHOLDERS

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION.

- Forest Service
- Trade Associations (Montana Logging Assoc., Wood Products Association, etc.)
- DNRC
- BLM
- Private Major Open Burners
- Minor burners conducting forestland and environmental management
- Public
- Board of Environmental Review
- Legislature
- County Officials

RECOMMENDATIONS

RECOMMENDATION 1: STAKEHOLDER ENGAGEMENT ON THE SMOKE MANAGEMENT PROGRAM

DESCRIBE THE RECOMMENDATION.

Implement an engagement process to educate and inform stakeholders on the Smoke Management Program and the ability to use prescribed fire for forest fuel reduction on a year-round basis. Bring forward a funding request through the 2021 Legislative Session to obtain additional general fund dollars to provide the necessary services for smoke forecasting.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

The Air Quality Bureau would engage stakeholders to educate and assist those interested in conducting prescribed burning

- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.**

Any messaging and education campaign would emphasize the existing flexibility to manage these forest fuels. Managing fuels provides a co-benefit for mitigation and adaptation.

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**

Effective messaging and education would have a high impact on the ability to increase the use of prescribed fire.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**

This would impact both governmental agencies which use prescribed fire as well as private major burners who use or would expand the use of prescribed fire. It also would benefit minor burners from both an adaptive approach as well as mitigation for catastrophic fire.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**

The costs to engage stakeholders on prescribed burning would be absorbed into the existing Smoke Management Program budget. The Air Quality Bureau will be seeking additional general fund during the 2021 Legislative Session to continue the staffing and implementation of a smoke forecasting program during wildfires.

- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?**

Engagement with stakeholders occurred during CY2019 and will continue into the foreseeable future.

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?**

The metric for this would be two-fold; first, the calculated increase in acreage treated with prescribed fire, and secondly, the number of minor burners utilizing the ability for additional burning opportunities. This data is normally collected as part of the Open Burning program and does not require additional data collection. There would be an ongoing analysis of any change in air quality concentrations at monitoring sites compared to the increased use of prescribed fires.



MONTANA CLIMATE SOLUTIONS COUNCIL

ADAPTATION

WHITE PAPER: AGRICULTURAL WORKING LANDS

DATE JANUARY 20, 2020

PRIMARY AUTHORS:

Ben Thomas

Bruce Maxwell

Laurie Yung

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

Not necessarily, though would work well with the innovations in technology for monitoring, verifying

KEY ISSUE

Climate model projections show a warmer Montana in the future, with mixed changes in precipitation and more extreme temperature events (Whitlock et al. 2017). Agricultural productivity is highly vulnerable to extreme weather events, such as flooding, blizzards, hailstorms, and drought (Melillo et al. 2014). An assessment of climate effects on Montana agriculture and therefore opportunities for solutions is complex because of uncertainties inherent in the timing and manifestation of climate change, and because of complexity in how natural systems, agricultural producers, and market processes will react (Whitlock et al. 2017). Agricultural decision support must be focused on reducing uncertainty by building tools that explicitly consider the complex interactions between climate, market processes and policy.

PROGRESS TO DATE

Agricultural production decisions are driven by complex factors including growing conditions, prices, pest pressure, available markets, etc. Decisions that maximize the efficiency of inputs generally reduce the cost paid for the inputs and increase producer resilience. Montana crop producers have shown a willingness to adopt agricultural practices that offer potentially beneficial climate resilient solutions including reduced tillage, increasing certified organic acres, and adoption of non-traditional crops (e.g. pulse crops, oil seeds and hemp). Montana livestock producers have responded to recent droughts by capturing spring runoff water, but with little attention to hydrologic consequences.

GAPS

Land conversion from native ecosystems to agriculture production are generally reported as a major contributor to carbon emissions. For acreage that has already been converted to agriculture production (crops or rangeland), these systems offer multiple opportunities to mitigate climate impacts and sequester carbon. A robust system of incentives for agricultural producers could maximize the climate benefits of the 18

million acres of cropland and 38 million acres of pasture and range within Montana. The agriculture industry can offer solutions in the arenas of “carbon farming” and regenerative agriculture.

Additionally, there is a well-documented gap between the climate information and decision support tools that are produced and the needs of farmers and ranchers. To be useful, the developers of decision support systems need to engage directly with farmers and ranchers to ensure that tools are relevant and actionable in the desired contexts.

STAKEHOLDERS

Crop producers, livestock producers, industry and trade organizations, technology companies, energy companies, private for-profit entities, NGO's, land and water managers, governmental agencies representing federal, state, local and tribal industries.

RECOMMENDATIONS

RECOMMENDATION 1: IMPROVE CLIMATE INFORMATION SERVICES AND INFRASTRUCTURE

Develop infrastructure to deliver climate information services to the agricultural community

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- Through coordination with federal, state, local, and private entities, Montana should improve on the current infrastructure of climate information services.
- The growing use of precision agriculture is an opportunity to help producers adapt to changing climate by maximizing efficiency of input applications, maximizing irrigation and stock water efficiency, making site-specific crop selection, and selection of livestock behavior optimization.
- The current infrastructure of capturing and delivering climate information to the agricultural community can be further invested in:
 - Montana Mesonet that produces data from which agricultural decision tools can be derived including real-time updated weather patterns and quarterly updated climate projections.
 - Analysis of historic data to determine site-specific, temporal and spatial climate patterns and trends.
 - Agricultural Draught Early Warning
 - Water availability projections for irrigation dependent agriculture
 - New technology solutions
- This recommendation does not promote one specific tool; rather, it recognizes that this is an emerging field with new technologies, companies, and entities engaging in innovative ways.
- A dedicated committee could be formed and appointed with leaders in agriculture to coordinate, through a variety of funding sources, improved information services. That committee could also serve as a clearing house for information related to adaptation strategies and tools for producers to access.

RECOMMENDATION 2: DIRECT RESEARCH

RESEARCH FOCUS ON CLIMATE RESILIENT AGRICULTURAL STRATEGIES:

- Between state, federal, and private funds, there are a multitude of research channels in agriculture:
 - State checkoff funds (Wheat and Barley, Pulse, etc)

- Federal research funds (Specialty Crops, ARS, etc.)
- State University System projects (MSU)
- Industry
- What is lacking is meaningful coordination of existing research funds to address climate resilient ag strategies. This could include minimum funding levels in a number of these programs for resiliency; leveraging private funds; creating additional funds (raising checkoff or additional general funds dollars; recycling funds from increased profits resulting from employing resilience tools.
- Some areas of focus could include:
 - Crop and livestock variety improvements
 - Further development of precision ag based bioeconomic decision tools that contribute to resilience
 - Dryland and draught tolerant crop varieties
 - Crop rotation diversification
 - Crop response under variable conditions
 - Forage production models under variable conditions
 - Determining the potential for locally grown and processed bison to substitute for cattle under extreme conditions
 - Biological soil amendments
 - Response to new pests including weeds
 - Social science to better understand what types of stakeholder and co-production processes lead to information and decision support tools that are useful to producers.
 - Social science to better understand how producers perceive and utilize climate information and decision support tools, to build knowledge of how to make information/tools more useful.

RECOMMENDATION 3: PRODUCER INCENTIVES TO RESILIENT STRATEGIES

DEVELOP SYSTEM OF INCENTIVES FOR CLIMATE RESILIENT AGRICULTURAL STRATEGIES AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- Changing climate conditions have sometimes disastrous impacts on agriculture. A long-term strategy should include incentive-based programs to help producers improve the resiliency of their operations.
- Various production practices and technologies improve resiliency
 - Site-specific optimized input management for crops and livestock production
 - Planting crops and forage species that increase carbon sequestration
 - Planting diversified multispecies cover crops
 - Improved soil health
 - Promote woody perennial plantings
 - Promote local food processing and added value to agricultural products
- This recommendation is to develop a comprehensive approach to provide incentives to producers to adopt these practices. That approach must include:
 - Existing or additional state programs; federal sources of funding; public/private partnerships; etc.
- One possible source of funding could include “checkoff” funds from the Montana Agriculture Climate Committee, which would be funded by having the Committee act as a carbon credit aggregator for producers. Those funds would then be used for research or economic development related to climate adaptation.
 - This Committee is proposed as part of the GHG Mitigation Subcommittee.



MONTANA CLIMATE SOLUTIONS COUNCIL

COMMITTEE NAME: ADAPTATION

WHITE PAPER: ECOSYSTEMS, SPECIES, AND HABITATS DRAFT

JANUARY 17, 2020

PRIMARY AUTHORS:

- Stephen Begley, Water Conservation Specialist, Fisheries Division, FWP
- Renee Lemon, Planner, FWP
- Linnaea Schroeder, MEPA Coordinator, FWP
- Mike Thompson, Region 3 Wildlife Manager, Wildlife Division, FWP

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

Greenhouse Gas Mitigation Strategies Committee

KEY ISSUE

Climate change impacts Montana's fish, wildlife, habitats, and ecosystems and adds to non-climate stressors, such as habitat loss, fragmentation, and degradation. Conserving these resources and systems is vital to maintaining a healthy economy, diverse outdoor recreation opportunities, and a high quality of life for present and future generations.

PROGRESS TO DATE

IN A FEW SENTENCES DESCRIBE PROGRESS TO DATE. THIS COULD INCLUDE KEY SUCCESSES, CASE STUDIES, COMPLETED RESEARCH, ACTIONS TAKEN IN OTHER STATES THAT COULD BE REPLICATED, SUPPORTED OR BUILT UPON IN MONTANA.

Montana has a long history of habitat conservation and restoration that involves a variety of stakeholders. Examples include restoring streams through the Future Fisheries Program; administering the State's instream flow water rights while encouraging water-saving measures for municipalities and irrigators through water leases; acquiring, protecting, and restoring habitat through programs like Habitat Montana; taking aggressive action on existing and potential invasive species and wildlife diseases; and promoting the value of functional floodplains and beneficial fires.

GAPS

IDENTIFY KNOWN GAPS THAT EXIST AND REPRESENT BARRIERS TO MAKING PROGRESS ON THIS ISSUE. GAPS COULD BE RELATED TO DATA, RESEARCH, TECHNOLOGY, HUMAN RESOURCES, FINANCIAL RESOURCES. IDENTIFY WHAT RESEARCH CAN BE ACCOMPLISHED AS PART OF THE COUNCIL'S DELIBERATIONS, AND WHAT MUST BE UNDERTAKEN ON A LONGER TIME HORIZON.

- Capacity and funding for research to identify the most vulnerable ecosystems, species, and habitats.
- Increased funding for SNOTEL, USGS Stream Gages, Montana Mesonet, and SCAN sites to expand soil, water, and climate monitoring.
- Develop more cost-effective climate modeling and monitoring systems and techniques.
- Capacity and funding to train state agency staff on how to integrate climate science in their work.

STAKEHOLDERS

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION.

- Montana state agencies including DEQ, DNRC, MDT, DES, Commerce, and FWP
- Federal Agencies including USDA, USFS, NRCS, USGS
- Tribes
- Private landowners
- Local governments
- NGOs (e.g., local land trusts, sports groups, conservation, and civic groups)

RECOMMENDATIONS

RECOMMENDATION 1: STRENGTHEN EXISTING PARTNERSHIPS AND BUILD NEW COLLABORATIONS ACROSS AGENCIES, DISCIPLINES, AND JURISDICTIONS TO SHARE KNOWLEDGE AND ENSURE THE NEEDS OF SPECIES, HABITATS, AND ECOSYSTEMS ARE CONSIDERED IN ALL ASPECTS OF CLIMATE CHANGE ADAPTATION

Encourage and enable state agency staff to attend climate change conferences and other opportunities where they can network with other states and learn from their efforts. Provide opportunities for collaboration among stakeholders on existing ideas and approaches to climate adaptation, and to avoid duplicating work.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
 - Governor's Office
 - State agency staff
 - Montana University System
 - Federal agency staff
 - Tribes
 - Conservation organizations
 - Local government
 - Landowners and interested citizens
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** The pros are that state agency staff would develop more knowledge and contacts about climate as it relates to ecosystems, species, and habitats. The cons would be cost to attend conferences and staff time, which is already constrained.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** This recommendation would have a high effectiveness and is a key first step in addressing this issue.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** No significant adverse impacts anticipated.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Travel costs, conference costs, staff time
- **Provide an estimate of a reasonable timeframe to implement this recommendation.** Ongoing
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?** There is a network of people with the knowledge and expertise needed to work collaboratively to apply climate science and adaptation strategies to conserve Montana’s ecosystems, species, and habitats.

RECOMMENDATION 2: CONDUCT RESEARCH AND VULNERABILITY ASSESSMENTS TO IDENTIFY MONTANA’S SPECIES, HABITATS, AND ECOSYSTEM FUNCTIONS THAT ARE MOST VULNERABLE TO CLIMATE CHANGE

Use existing research on climate change and input from end users and decision-makers to guide additional research projects. Prioritize the additional research and vulnerability assessments that will have the greatest impact on climate adaptation strategies and decisions for species, habitats, and ecosystems.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
 - Universities
 - Agency biologists
 - Conservation organizations
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** New research that is focused on Montana will help identify priority ecosystems, species, and habitats. However, research takes time and is costly. There should be an effort to catalogue and use existing data and research as much as possible.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** High – understanding which resources are most vulnerable will help Montana prioritize climate adaptation strategies and projects.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Few adverse impacts are anticipated.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Research costs, staff time

- **Provide an estimate of a reasonable timeframe to implement this recommendation.** Conducting original research can be time-consuming and extend over many years depending on the study. However, developing vulnerability assessments could have shorter timeframes and start being developed using existing information.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?** The research and vulnerability assessments would result in a list of the most vulnerable ecosystems, species, and habitats in Montana. This list would help stakeholders develop and prioritize climate adaptation strategies and projects.

RECOMMENDATION 3: INCLUDE INFORMATION ON THE SPECIES, HABITATS, AND ECOSYSTEM FUNCTIONS THAT ARE MOST VULNERABLE TO CLIMATE CHANGE IN STATEWIDE CLIMATE SERVICES

Provide end users and decision-makers with information about climate change effects on fish, wildlife, habitats, and ecosystems; adaptation and mitigation options; training opportunities; case studies; recommended peer-reviewed research; and contacts in a user-friendly format.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
 - Montana Universities
 - State agency staff (e.g., biologists to help with content, communication staff to create products)
 - Local government
 - Conservation organizations
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** The benefits are increased public awareness of how climate change is impacting ecosystems, species, and habitats, and adaptation options.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** Medium – early public education and outreach efforts can help build understanding of the key issues and terminology, so the public is prepared to provide input on future adaptation strategies and projects. This outreach can also provide baseline information to support consideration of ecosystems, species, and habitats in local land use, climate, and hazard mitigation planning.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Few adverse impacts anticipated.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Staff time, potential contract costs to help with developing information
- **Provide an estimate of a reasonable timeframe to implement this recommendation.** This could be accomplished in the short-term.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?** There is increased public awareness of how climate change is affecting ecosystems, species, and habitats and

adaptation options, and increased consideration of these resources in local land use, climate, and hazard mitigation planning.

RECOMMENDATION 4: INTEGRATE CLIMATE CONSIDERATIONS FOR SPECIES, HABITATS, AND ECOSYSTEMS INTO STATE AGENCY PROJECTS, ENVIRONMENTAL REVIEWS, PROGRAMS, PLANS, COMMUNICATION, AND TRAINING

Develop climate information training programs for state agency staff that includes how to consider the species, habitats, and ecosystem functions that are most vulnerable to climate change in projects. Develop guidance and performance measures to assess state agency progress on integrating this information into programs.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
 - State agencies
 - Montana Natural Heritage Program
 - Agency MEPA Coordinators and Public Information Officers
- **Describe the pros and cons of the recommendation. including any co-benefits for mitigation and adaptation to climate change.** Integrating climate information in state agency projects will raise awareness and move climate change work from a peripheral to a mainstream issue. This will require increasing staff knowledge and training on how to integrate climate science into state agency plans and projects.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** Medium – It will take time to integrate climate science and adaptation in state agency plans and projects. While this would increase the consideration of ecosystems, species, and habitats in state decision-making, it may not affect decision-making by other levels of government.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Few adverse impacts are anticipated.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Staff time
- **Provide an estimate of a reasonable timeframe to implement this recommendation.** This could be started in the short-term but may take time to be fully integrated.
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?** State agency decision-making, work products, and discussions consider climate impacts and adaptations to vulnerable ecosystems, species, and habitats.

RECOMMENDATION 5: CONSERVE AND RESTORE HABITATS NECESSARY TO SUPPORT HEALTHY FISH, WILDLIFE, PLANT POPULATIONS AND ECOSYSTEM FUNCTIONS IN A CHANGING CLIMATE, INCLUDING CONNECTIVITY BETWEEN HABITATS TO ALLOW FOR SPECIES MOVEMENT

Strengthen partnerships between local, state, federal, and tribal government; private landowners; and conservation organizations to implement landscape-scale conservation. Protect, enhance, and restore large, connected, intact areas capable of supporting self-sustaining populations of wildlife, while also providing for the needs of people. Consider the habitat needs of all species from large predators and game animals to smaller species like wetland birds and pollinators. Protect, enhance, and restore rivers, streams, lakes, reservoirs, wetlands, and riparian areas that are critical to fish, wildlife, and plant populations. Provide for aquatic organism passage, where appropriate. There are multiple co-benefits to habitat conservation, including the opportunity to enhance carbon sequestration.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
 - FWP – Habitat Montana and Future Fisheries Program, seek opportunities for additional instream flow protection through water reservations, water leases with private landowners, and permanent conversions of existing water rights to instream flow purposes.
 - Land trusts – conservation easements
 - Local government – open space programs, land use planning (e.g., growth policies)
 - State agencies
 - Federal agencies
 - Tribes
 - Private landowners – land stewardship
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** This would continue to build on Montana’s successful efforts to conserve high priority habitats, such as big game winter range and riparian areas. Montana could expand on this success by also conserving habitats and ecosystems that are most vulnerable to climate change. Land conservation is already challenging, and prioritizing lands can be difficult with many stakeholders and competing interests.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** High – identifying and conserving high priority habitats and ecosystems is a critical factor in ensuring Montana’s fish, wildlife, habitats, and ecosystems are intact for future generations. This is especially important as Montana’s population increases, exacerbating habitat loss, degradation, and fragmentation.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Land use planning, conservation, and stewardship affect everyone. Involving key stakeholders, such as communities and landowners, is critical to reducing adverse effects.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?** Staff time, financial resources for land conservation and stewardship
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?** Montana currently has a connected network of healthy habitats, both land and water, that can support fish and wildlife species. However, non-climate stressors (e.g., human population growth) combined with climate change will

likely disrupt many of those networks. There is a need to continually monitoring of species and habitats and apply adaptive management.

RECOMMENDATION 6: REDUCE NON-CLIMATE STRESSORS TO HELP FISH, WILDLIFE, PLANTS, AND ECOSYSTEMS BE MORE RESILIENT TO THE EFFECTS OF CLIMATE CHANGE

A non-climate stressor is a change unrelated to climate that can exacerbate the impacts of climate change. Examples are land use change and human population growth. Stakeholders should continue to work together to avoid, minimize, and mitigate the impacts of non-climate stressors to optimize ecosystem function and increase the health and resilience of fish and wildlife populations.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
 - State agencies
 - Federal agencies
 - Tribes
 - Local government
 - Landowners
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Agencies can build on the work already happening to reduce non-climate stressors. In addition, this could be an area to engage citizens and landowners.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** Non-climate stressors exacerbate the effects of climate change so reducing these impacts would have a high impact.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** It is likely that implementing this recommendation would cause a wide range of impacts to the human environment, both positive and negative. However, many if not all potentially negative impacts could be mitigated with collaborative planning and innovation.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**
- **Provide an estimate of a reasonable timeframe to implement this recommendation.**
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?**

RECOMMENDATION 7: DEVELOP AND MAINTAIN POLICIES AND REGULATIONS THAT PROTECT FISH AND WILDLIFE DURING DROUGHT, WILDFIRE, AND OTHER NATURAL DISASTERS

Continue to implement angling restrictions/closures and administer Montana Fish, Wildlife, and Parks' water rights and water reservations to protect instream flows during drought and reduce impacts on fish and wildlife.

 AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
 - Legislature
 - State agencies - FWP, DNRC
- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.** Maintaining minimum instream flow in rivers and streams of all sizes provides critical thermal refugia, increases dissolved oxygen levels, and keeps sections from being de-watered so fish and other aquatic organisms can move as needed in search of better conditions in times of stress.
- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?** This recommendation is likely to have a high impact on addressing the issue.
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?** Any move to increase instream flow should correspond to efforts to improve efficiency of irrigation methods and water delivery so the agricultural sector is supported.
- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**
- **Provide an estimate of a reasonable timeframe to implement this recommendation.**
- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?**

RECOMMENDATION 8: CONTINUE TO PREVENT AND MINIMIZE THE SPREAD OF AQUATIC INVASIVE SPECIES, AND FISH AND WILDLIFE DISEASES, WHICH CAN BE EXACERBATED BY CLIMATE CHANGE

Continue to implement Montana's AIS Program through monitoring, watercraft inspection stations, and communication and education. Continue conducting surveillance and disease investigations for reportable diseases in fish and wildlife. Map the presence and spread of fish and wildlife disease to prioritize prevention efforts, surveillance, and public education. Maintain policies and regulations that prevent and minimize the spread of fish and wildlife disease, and have rapid response plans ready.

 AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
 - State agencies – FWP, DNRC, Department of Agriculture
 - Local government and conservation districts
 - Recreationists
 - Landowners

- Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.
- Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?
- Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?
- What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?
- Provide an estimate of a reasonable timeframe to implement this recommendation.
- What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?

RECOMMENDATION 9: MONITOR, EVALUATE, AND REPORT ON SPECIES, HABITATS, AND ECOSYSTEM FUNCTIONS THAT ARE MOST VULNERABLE TO CLIMATE CHANGE

In order to respond to the fast-changing environment with both climate and non-climate stressors, stakeholders must monitor, evaluate, and report on the species, habitats, and ecosystem functions that are most vulnerable to climate change. This will allow stakeholders to adapt strategies and actions to address the latest conditions.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?
- Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.
- Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?
- Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?
- What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?
- Provide an estimate of a reasonable timeframe to implement this recommendation.

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long-term goals?**



MONTANA CLIMATE SOLUTIONS COUNCIL

WHITE PAPER: FIRE-ADAPTED FORESTS AND COMMUNITIES

DATE: DECEMBER 4, 2019

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

COMMITTEE NAME

YES, WATER RESOURCE, COMMUNITIES, AND PUBLIC HEALTH)

PRIMARY AUTHORS:

STAFF, FORESTRY ASSISTANCE BUREAU, DNRC

KEY ISSUE: ESTABLISHING AND MAINTAINING FIRE-ADAPTED FORESTS AND COMMUNITIES WILL INCREASE CARBON CAPTURE AND STORAGE AND PROTECT COMMUNITIES

IN A FEW SENTENCES DESCRIBE THE ISSUE, GOAL, QUESTION TO BE ANSWERED, OR PROBLEM STATEMENT.

Montana ranks first in the nation with the highest percentage of homes in high wildfire hazard areas. 64% of Montanans live in the Wildland Urban Interface, with projected growth to continue, placing more communities and homes in fire-prone landscapes at risk of catastrophic loss due to wildfire. Investment and actions are needed to adapt forests and communities to more severe and expansive wildfires projected to accompany rising temperatures and increased drought. Fire has always been integral to Montana's forests and grasslands. Aggressive fire suppression the past century has withheld ecological disturbance and altered vegetation across Montana and the Northern Rockies. Forests and grasslands are at increasing risk for severe, large-scale fires that will greatly reduce carbon storage, degrade habitat and water, and threaten public health and safety. Large, rapidly moving wildfires will impact people with fire behavior and smoke that will destroy homes and cause illness and possibly death. Collaborative planning and coordinated actions to treat fuels and prepare communities will reduce impacts, including loss of property and threats to public health and safety.

Progress to Date

IN A FEW SENTENCES DESCRIBE PROGRESS TO DATE. THIS COULD INCLUDE KEY SUCCESSES, CASE STUDIES, COMPLETED RESEARCH, ACTIONS TAKEN IN OTHER STATES THAT COULD BE REPLICATED, SUPPORTED OR BUILT UPON IN MONTANA.

The State of Montana's Forest in Focus 2.0 and the Forest Service's Shared Stewardship initiatives are serving as frameworks for improving forest health and wildfire risk. State and federal agencies are working across boundaries with local governments, private landowners, and partner groups to implement the national Cohesive Strategy which focuses on resilient landscapes, community protection, and effective fire response. Montana has an active Forest Action Council working with partners across the state to develop a Forest Action Plan (FAP). The FAP, to be completed in fall, 2020, will include an assessment of forest conditions, priority areas for restoration, and an implementation strategy. It is focused heavily on creating and maintaining fire-adapted forests and communities. The BLM and Forest Service are updating their Land Management Plans to better address management of wildfire and wildfire risk. State and federal agencies and private landowners are aggressively working on projects on all three arms of the Cohesive Strategy. Twenty-three collaborative groups in Montana are actively working with state and federal agencies on projects and actions to strengthen resiliency of forests and communities to wildfire impacts. In the spring of 2019 the DNRC, in partnership with watershed groups, local, state, tribal and federal governments, launched the Fire Adapted Montana Learning Network. This learning network was formed to connect people across the state as they develop new ideas and share strategies to help Montanans become more resilient to wildfire. The Fire Adapted Montana Learning Network works collaboratively to amplify existing and new efforts across Montana to support fire adapted communities.

GAPS: IDENTIFY KNOWN GAPS THAT EXIST AND REPRESENT BARRIERS TO MAKING PROGRESS ON THIS ISSUE. GAPS COULD BE RELATED TO DATA, RESEARCH, TECHNOLOGY, HUMAN RESOURCES, FINANCIAL RESOURCES. IDENTIFY WHAT RESEARCH CAN BE ACCOMPLISHED AS PART OF THE COUNCIL'S DELIBERATIONS, AND WHAT MUST BE UNDERTAKEN ON A LONGER TIME HORIZON.

Additional funds and personnel are needed to raise awareness, educate, and encourage Montanans living in high wildfire hazard areas to act to manage their risk. Persistent rapid population growth will continue to present the greatest challenge to reducing wildfire risk and creating fire adapted communities in Montana's Wildland Urban Interface. The large geographic area combined with limited community preparedness and fire prevention resources also highlights the need to deliberately engage and educate landowners and local fire protection services on defensible space, home ignition zones, fuel reduction tools, smoke preparedness, and evacuation safety. Everyone has a responsibility in creating a fire-adapted Montana.

To be effective with landowner outreach and awareness there needs to be stronger communication and coordination, clear contacts, pathways, and accountability for landowner participation with incentives and resources for actions to prepare their land and property for wildfire. Incentives and regulation should be explored to propel landowners to prepare for wildfires, particularly within and adjacent to the home ignition zone. Information is needed about effect of smoke to public health.

STAKEHOLDERS

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION.

Includes local, state, federal agencies (including fire managers and departments), landowners, groups, citizens, and partners including researchers and funding organizations. Forest Service

- DNRC
- USFS
- BLM
- County Officials
- RC&D
- Rural Fire Departments
- Landowners
- Public
- Legislature

RECOMMENDATIONS

RECOMMENDATION 1: AGENCIES AND PARTNERS WORK TOGETHER TO IMPLEMENT THE NATIONAL COHESIVE STRATEGY. WORK IN PARTNERSHIP ACROSS BOUNDARIES.

DESCRIBE THE RECOMMENDATION.

Manage forests to reduce carbon losses from wildfire. Implement treatments to improve safety and effectiveness of wildfire suppression and management. Retain fire in forest systems through prescribed burning and controlled management of wildfires.

- Establish fuel breaks to facilitate safe, effective management of wildfires.

- Manage forest structure and composition to reduce the risk, severity, and extent of wildfire.
- Strengthen coordination of agency and landowner work on all three arms of the national Cohesive Strategy.
- Establish Incentives and regulations and procure funding to enhance landowner action in preparing for wildfires, particularly within and adjacent to the home ignition zone and WUI.
- Conduct information and collect information on the effect of smoke to public health.
- Montana's Forest Action Plan can provide the framework for implementing the cohesive strategy across boundaries.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

All of the stakeholders listed are currently active in this work. Continue developing coordinated plans and implementation of projects.

- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.**

Pro: Increase effective actions to improve landscape resiliency, community protection, and wildfire response.

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**

High effectiveness in modifying risk to large, uncharacteristic wildfires.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**

No significant adverse ecological or social impacts. There will likely be some opposition from groups and individuals philosophically opposed to logging.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**

Significant additional funds and staff resources will be needed.

- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?**

Work is in progress and will continue for decades as forests and communities are dynamic and growth into the Wildland Urban Interface and forest growth will continue.

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?**

Monitoring and adaptive management.

RECOMMENDATION 2: UPDATE THE MONTANA WILDLAND URBAN INTERFACE (WUI) BUILDING CODE

DESCRIBE THE RECOMMENDATION.

Decades of research and post-fire assessments have provided clear evidence that building materials and design, coupled with landscaping on the property, are the most important factors influencing home survivability during a wildfire. With one-third of all U.S. homes in the wildland-urban interface and more than 35,000 structures lost to wildfire in the last decade, more communities should consider adopting building codes that require new home construction to meet wildfire-resistant standards. This study finds negligible cost differences between a typical home and a home constructed using wildfire-resistant materials and design features. <https://headwaterseconomics.org/wildfire/homes-risk/building-costs-codes/>

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

Legislature and/or local government could implement this recommendation.

- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.**

Pro: Increase effective actions to support fire adapted communities in Montana.

Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?

High impacts.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**

No significant adverse impacts.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**

Costs and resources would be invested in educating diverse stakeholders about the benefits of a WUI building code. As findings indicate the cost of building to WUI code with a newly constructed home is negligible.

- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?**

An updated WUI code could be addressed during the 2021 legislative session and improved upon at future legislative sessions.

What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?

Monitoring of code compliance in counties across Montana.

RECOMMENDATION 3: PRESCRIBED FIRE AND AIR QUALITY

DESCRIBE THE RECOMMENDATION

The combination of a warming climate and the accumulation of dense forest fuels ensures a future with increasingly large fires and abundant smoke in Montana. Satellite mapping illustrates that dense areas of smoke can span county and state scales. Historic and current forest management practices affect wildfire smoke impacts on downwind human populations. Recent research findings and modeling results indicate that proactive fire management - prescribed fires and resource objective fires – conducted in the spring and fall during cooler weather conditions, substantially reduced emissions (by as much as half) compared to emissions in hot, dry, midsummer conditions. Working with air quality personnel across the state to address current burning limitations could greatly improve future air quality by increasing proactive fire management in Montana.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

(See Recommendation 1 with the following additions:)

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

Legislature, local government

- **Describe the pros and cons of the recommendation. including any co-benefits for mitigation and adaptation to climate change.**

Pros: Improved forest health air quality for residents across the state.

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**

Highly effective at addressing air quality and forest health challenges.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**

Costs would be associated with educating air quality partners about the needs of forest managers to actively manage.

- **Provide an estimate of a reasonable timeframe to implement this recommendation.**

This issue could be addressed in the year ahead.

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?**

Engaging with local air quality and forest management agencies will determine how changes in air quality restrictions effect active forest management.

RECOMMENDATION 4: CULTURAL CHANGE- TRANSFORMATIVE ADOPTION TO WILDFIRES

DESCRIBE THE RECOMMENDATION

Move to new levels of social-ecological resilience by adopting new approaches to living with wildfire as co-existence. For example, increased acceptance and support of prescribed fires and more refined approaches of managing with the full range of response for wildfires. Also, redefining where it is acceptable to build homes, planning for more significant and effective wildfire protection approaches such as much larger community defensible zones and fuel breaks for ingress-egress.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

(See Recommendation 1 with the following additions:)

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**
- **Describe the pros and cons of the recommendation. including any co-benefits for mitigation and adaptation to climate change.**

Pros: Lower costs and less displacement of homeowners.

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**
- **High effectiveness as people to adjust to living with fire rather than reacting to fire.**
- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**

Restricting home locations and materials may impact those who value unconstrained living.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**
- **Provide an estimate of a reasonable timeframe to implement this recommendation.**

Implement immediately and over the next several decades.

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?**

Monitoring and evaluation of fire effects and losses. Adjustments and adaptation based on effectiveness of actions and results..



MONTANA CLIMATE SOLUTIONS COUNCIL

WHITE PAPER: FOREST HEALTH

DATE: DECEMBER 2, 2019

PRIMARY AUTHORS:

STAFF, FORESTRY ASSISTANCE BUREAU, DNRC

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

COMMITTEE NAME (YES, WATER RESOURCES, COMMUNITIES, PUBLIC HEALTH)

KEY ISSUE: MANAGING FORESTS FOR VIGOR AND RESILIENCE TO INSECTS, DISEASE, AND WILDFIRE WILL INCREASE CARBON CAPTURE AND STORAGE

IN A FEW SENTENCES DESCRIBE THE ISSUE, GOAL, QUESTION TO BE ANSWERED, OR PROBLEM STATEMENT.

Healthy forests across landscapes are essential for carbon sequestration and storage. Forests capture carbon rapidly, in great capacity and for long periods of time, storing it in tree stems, leaves, branches, roots, and soil. Montana's forested landscapes should be stocked to optimize growth and vigor of trees and plants. Forests should be managed to maintain composition, density, and structure that occupy the site but preclude tree stress. This will provide for high sequestration of carbon and resiliency to uncharacteristic insect and disease and reduce risk of uncharacteristic large, stand-replacing wildfires and associated loss of carbon. In addition to carbon storage, healthy forests provide quality habitat for fish and wildlife, clean and abundant water, forest products, recreation, and other ecological, social, and economic benefits.

PROGRESS TO DATE

IN A FEW SENTENCES DESCRIBE PROGRESS TO DATE. THIS COULD INCLUDE KEY SUCCESSES, CASE STUDIES, COMPLETED RESEARCH, ACTIONS TAKEN IN OTHER STATES THAT COULD BE REPLICATED, SUPPORTED OR BUILT UPON IN MONTANA.

The State of Montana's Forest in Focus 2.0 and the Forest Service's Shared Stewardship initiatives are serving as frameworks for improving forest health and wildfire risk. State and federal agencies are working across boundaries with local governments, private landowners, and partner groups to increase the pace and scale of forest restoration to enhance forest health across the state. Montana has an active Forest Action Council working with partners across the state to develop a Forest Action Plan (FAP). The FAP, to be completed in fall, 2020, will include an assessment of forest conditions, priority areas for restoration, and an implementation strategy. The BLM and Forest Service are updating their Land Management Plans to better address management of forest health across landscapes. State and federal agencies and private landowners are aggressively working on projects to increase the pace and scale of restoration. Twenty-three collaborative groups in Montana are actively working with state and federal agencies on forest restoration. With leadership and support from the Montana Forest Collaboration Network, these diverse groups of local citizens are working with the agencies to design and support actions to move forests to healthier conditions and reduce wildfire risk.

GAPS: IDENTIFY KNOWN GAPS THAT EXIST AND REPRESENT BARRIERS TO MAKING PROGRESS ON THIS ISSUE. GAPS COULD BE RELATED TO DATA, RESEARCH, TECHNOLOGY, HUMAN RESOURCES, FINANCIAL RESOURCES. IDENTIFY WHAT RESEARCH CAN BE ACCOMPLISHED AS PART OF THE COUNCIL'S DELIBERATIONS, AND WHAT MUST BE UNDERTAKEN ON A LONGER TIME HORIZON.

A large percentage of forests in Montana are either overstocked or understocked, and not meeting their potential to capture and store carbon. The Montana Opportunity Assessment developed for the US Climate Alliance states that

Forest Restocking (reforestation) offers the highest potential gain for carbon in Montana. A significant amount of the forested acres in Montana have large proportions of dead and dying trees and decay of carbon exceeds growth in many areas. Many other forests are overstocked, with tree densities causing stress to trees and are increasingly at risk to insect and disease mortality and uncharacteristic wildfire.

More inventory information on stand conditions and existing and potential carbon gain is needed to inform management decisions and actions to manage for forest health. In some areas tree stocking should be increased to move towards higher utilization of forested areas with healthy forests capturing and storing carbon near their potential. In other areas forests should be thinned to reduce tree stress and increase resiliency to insects, disease, and drought.

Additional funds, staff capacity, and nursery infrastructure is needed for greatly enhanced reforestation and stand treatment programs in Montana.

STAKEHOLDERS

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION.

Includes local, state, federal agencies, landowners, groups, citizens, and partners including researchers and funding organizations. Working groups within the Montana Forest Collaboration Network and Montana Watershed Coordination Council.

Specifically:

- Forest Service
- DNRC
- BLM
- Public
- Legislature
- County Officials
- Montana Forest Collaboration Network and Affiliated Collaborative Groups
- Montana Watershed Coordination Council

RECOMMENDATIONS

RECOMMENDATION 1: MAINTAIN AND INCREASE EFFECTIVE FOREST ECOSYSTEMS

DESCRIBE THE RECOMMENDATION.

- Avoid forest conversion to non-forest land uses.
- Increase extent of forest cover. Reforest lands that have been deforested and create growing space and plant trees in understocked forests.
- Manage forests to reduce carbon losses from wildfire. Implement treatments to improve safety and effectiveness of wildfire suppression and management. Retain fire in forest systems through prescribed burning and controlled management of wildfires.
- Establish fuel breaks to facilitate safe, effective management of wildfires.
- Manage forest structure and composition to reduce the risk, severity, and extent of wildfire.
 - Prevent the introduction and establishment of invasive plant species and severe outbreaks of insects and disease. Thinning stands releases individual trees from competition and makes them more resilient to insects and diseases.
- Promptly regenerate and revegetate forests after disturbances using species that are adapted to future conditions.
- Add trees to increase stocking of understocked stands using species that are adapted to future conditions.

- Complete vegetation treatments throughout the develop of stands to alter composition, structure, and density to maintain and increase vigor and growth and reduce risk and extent of loss to disturbance.
- Prioritize management and investments in locations that provide high carbon across landscapes throughout the state.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

State. Federal, local agencies, landowners, industry, universities.

- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change.**

Pros: Managing forests for forest health will provide high carbon sequestration and storage.

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**

Forest health investment and implementation would have a high impact on carbon sequestration. Reforestation and stand improvement treatments such as thinning would likely have a medium-high impact on reducing tree mortality attributes to insects, disease and drought.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**

Without infrastructure or markets to offset cost of thinning, the burden of cost would be on governments and individuals to complete the recommended work. And slash material that remains after thinning would need to be treated through prescribed fire (broadcast and burn piles), chipping, or removal. Each of these slash treatment options create their own impacts: fire contributes particulate matter to airshed, chipping may alter surface fuel characteristic and impact nutrient cycling, and removal is costly. Untreated slash will likely create habitat for bark beetle species (particularly engraver beetles in pine) to build up.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**

A significant increase in agency and landowner funding and capacity would be needed. Costs for reforestation and thinning and other stand treatments vary widely according to number of entries, terrain, access to markets, and techniques used.

- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?**

Forest Health treatments are in progress and will continue. Acceleration of pace and scale can continue to the level of funding and capacity

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?**

Monitoring to track forest conditions and success of treatments and adaptive actions to continue work to improve forest health.

RECOMMENDATION 2: INCREASE INFORMATION BASE FOR FOREST HEALTH THROUGH RESEARCH, INVENTORY, MONITORING

DESCRIBE THE RECOMMENDATION.

Expanded inventory of stand conditions across landscapes. Increase knowledge of forest health threats and constraint, such as barriers to stocking and reforestation and currently lesser known “secondary” insects and diseases that could potentially act as primary agents of mortality under drier climate scenarios or in a landscape of drought-stressed or fire-scorched trees.

Numerous organisms currently impact trees on an incidental scale, known as “secondary” agents, and primarily affect trees that have decreased vigor due to moisture deficit, overstocking, windthrow, fire, etc. These organisms are not well understood in their ecology and behavior, nor are

they readily identified by taxonomic keys and resources, but they could become an increasingly common mortality agent in forests under future climate conditions.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

(Include the same here as stated above for Recommendation No. 1).

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

State and federal agencies could continue and enhance forest inventories and interpretation of the results. Insect and disease diagnosticians (and the organizations that support them) should focus funding and resources on understanding the organisms.

- **Describe the pros and cons of the recommendation. including any co-benefits for mitigation and adaptation to climate change.**

Inventory, interpretation, training and collecting institutional knowledge require time and funding.

Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?

Expanded inventory and information, including on insects and disease, would likely have a high impact in addressing forest health. Action to increase knowledge of secondary insects and disease may have a low-medium impact on the overall issue of declining tree vigor, depending on the organism and scale of impact.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?**

No adverse impact other than expenditure of funds and staff capacity and any impacts to other work that becomes lower priority.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**

This should be done as soon as possible to capture institutional knowledge of specialists doing inventory and interpretation, including taxonomists and field specialists that have observed these organisms over the course of their careers.

- **Provide an estimate of a reasonable timeframe to implement this recommendation.**

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?**

Evaluate response to treatment, including response time and management tactics during outbreak of insect or disease. Were we able to catch it in a timely manner? What percentage of the landscape was impacted? This action achieves long-term goals.



MONTANA CLIMATE SOLUTIONS COUNCIL

WHITE PAPER: FOREST PRODUCTS UTILIZATION FOR CARBON CAPTURE AND STORAGE

DATE: DECEMBER 2, 2019

PRIMARY AUTHORS:

STAFF, FORESTRY ASSISTANCE BUREAU, DNRC

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

COMMITTEE NAME (YES, COMMUNITIES)

KEY ISSUE: INCREASE FOREST PRODUCTS UTILIZATION FOR CARBON STORAGE, AND TO MITIGATE CARBON LOSS THROUGH EMISSIONS FROM BURNING WOOD MATERIAL

IN A FEW SENTENCES DESCRIBE THE ISSUE, GOAL, QUESTION TO BE ANSWERED, OR PROBLEM STATEMENT.

Forest Products store carbon and provide products from treatments completed for forest health and wildfire risk reduction. Action is needed to retain and expand the infrastructure and operator capacity for a strong forest products industry in Montana. Investment and innovation is needed to develop expanded markets and processing of mass timber ,lumber, plywood, biomass, biochar, and other forest products beneficial for carbon storage.

Without infrastructure or markets to offset cost of thinning, the burden of cost of stand treatments would be on governments and individuals to complete the recommended work. Slash material that remains after thinning would need to be treated through prescribed fire (broadcast and burn piles), chipping, or removal. Each of these slash treatment options create their own impacts: fire contributes particulate matter to airshed, chipping may alter surface fuel characteristic and impact nutrient cycling, and removal is costly. Untreated slash will likely create habitat for bark beetle species (particularly engraver beetles in pine) to build up.

Currently, fuel treatments and early stand treatments (pre-commercial thinning) incur a net cost or financial loss, often up to \$1000/acre. Technologies proven in other regions provide high value outlets for the material removed in these treatments shifting the economic paradigm from a cost to a profit or break-even outcome. This increases the capacity to treat more acres and move forests to a more climate adapted position while increasing the capacity to store more carbon in the built environment through strategy one (1) above. Requires incentives rewarding carbon storage in building materials and displacing fossil carbon. Requires entrepreneurship and capital investment.

PROGRESS TO DATE

IN A FEW SENTENCES DESCRIBE PROGRESS TO DATE. THIS COULD INCLUDE KEY SUCCESSES, CASE STUDIES, COMPLETED RESEARCH, ACTIONS TAKEN IN OTHER STATES THAT COULD BE REPLICATED, SUPPORTED OR BUILT UPON IN MONTANA.

Montana has active forest products organizations and agencies working to retain and expand the forest infrastructure and industry in Montana. Retention of forest industry is an emphasis of Montana's Forest in Focus 2.0 and the State Forest Action Plan.

GAPS

- IDENTIFY KNOWN GAPS THAT EXIST AND REPRESENT BARRIERS TO MAKING PROGRESS ON THIS ISSUE. GAPS COULD BE RELATED TO DATA, RESEARCH, TECHNOLOGY, HUMAN RESOURCES, FINANCIA Additional funds, staff, and infrastructure are needed to retain and expand current operator and manufacturing capacity and diversification and marketing of wood products.

Consistency and reliability of federal timber supply needs to be improved.

Research and solutions are needed to establish economically feasible delivery and manufacturing for small wood, biomass, and biochar products. Research and development is needed for greater use of mass timber products.

- RESOURCES. IDENTIFY WHAT RESEARCH CAN BE ACCOMPLISHED AS PART OF THE COUNCIL'S DELIBERATIONS, AND WHAT MUST BE UNDERTAKEN ON A LONGER TIME HORIZON.

STAKEHOLDERS

IDENTIFY STAKEHOLDERS WHO NEED TO BE ENGAGED IN EITHER DEVELOPMENT OF RECOMMENDATIONS OR THEIR IMPLEMENTATION.

Forest industry groups, state and federal agencies, including:

- Forest product and marketing associations (Montana Logging Association, Montana Wood Products Association, Roundwood Association. etc)
- Wood processing and delivery businesses, including small mills and operators
- DNRC
- Forest Service
- BLM
- County Officials
- Legislature

RECOMMENDATIONS

RECOMMENDATION 1: Expand operator and manufacturing capacity and diversification of uses of wood products. Includes increase use of wood products in construction.

DESCRIBE THE RECOMMENDATION.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

All stakeholders listed above. Government could aid implementation by off-setting expenses through grants and establishing sustainable markets for small diameter biomass.

- **Describe the pros and cons of the recommendation, including any co-benefits for mitigation and adaptation to climate change**

Pro: Increase carbon storage and utilize wood materials removed from actions to increase forest health and reduce wildfire risk. Provides opportunities to sink carbon in the built environment while simultaneously offsetting costs of forest management and increasing rate of carbon sequestration in forests through density management.

- **Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?**

High effectiveness in addressing the need to increase carbon storage. Wood utilization retains carbon rather than emitting it as when it is burned for disposal.

- **Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider.**

No significant adverse impacts.

- **What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?**

Significant investments in infrastructure, equipment, and operator capacity would be needed.

- **Provide an estimate of a reasonable timeframe to implement this recommendation. Does this recommendation address short, medium, or long-term goals?**

Current efforts would need to be expanded upon for the next decade and beyond. Requires incentives rewarding carbon storage in building materials and displacing fossil carbon. Requires entrepreneurship and capital investment. Additional efforts are needed to adopt tall wood building codes (IBC 2020); training builders, and providing either incentives for wood construction or disincentives for carbon intensive materials such as concrete and steel (or both).

- **What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals?**

Monitoring and evaluation.

RECOMMENDATION 2: Develop and promote new markets for small diameter biomass. Increase use of wood energy at both residential and commercial scale.

DESCRIBE THE RECOMMENDATION. New biomass markets would provide outlets for low-value wood removed in necessary forest density management while offsetting use of fossil-based carbon for heat (displaces coal, propane, liquid natural gas, heating oil with biomass from the current carbon cycle). Creates another mechanism to pay for forest vegetation management necessary to meet forest adaption goals while providing a practical renewable energy source. Requires revisions to current air quality regulations and standards that are outdated, and do not account for the superior emission controls of modern wood burning technologies. Requires significant capital investment for commercial scale facilities.

AS APPROPRIATE, CONSIDER THE FOLLOWING RELEVANT TO THE RECOMMENDATION:

- **Who could implement the recommendation (legislature, Governor, local government, utility/co-ops, homeowners, businesses, agriculture, landowners, industry etc.)?**

Businesses, entrepreneurs, commissioners, foresters, government agencies, etc. could continue their collaboration to make this happen. Increased funding from federal government could satisfy this objective along with promoting economic growth and fulfilling intent of the USFS “Shared Stewardship”

We need markets in Montana not just for forest treatments but also for the economy and natural resource independence.

High impact

[No obvious detrimental impacts.]

Dedication to biomass utilization and wood product industry diversification from businesses, entrepreneurs, commissioners, foresters, government agencies, etc.

Describe the pros and cons of the recommendation. including any co-benefits for mitigation and adaptation to climate change.

Pro: Increase carbon storage and utilize wood materials removed from actions to increase forest health and reduce wildfire risk. Provides opportunities to sink carbon in the built environment while simultaneously offsetting costs of forest management and increasing rate of carbon sequestration in forests through density management.

Identify whether this recommendation would likely have a high, medium or low effectiveness or impact in addressing the issue and why. How does the recommendation advance the guiding principles or theory of change identified by the committee?

High impact due to increasing sequestration and offsetting costs of managing forest density, structure, and composition to improve forest health and reduce risk to severe wildfires.

Identify whether this recommendation would have any significant adverse impacts on specific groups of people, industries, businesses or others. If there are significant adverse impacts, what mitigation strategies could be used to reduce those impacts? Similarly, are there adverse impacts to the environment to consider?

[No obvious detrimental impacts.]

What are the estimated costs or resources (both public and private) needed to implement this recommendation (if possible)?

Significant increase in funding, infrastructure and capacity is needed (public and private).

Provide an estimate of a reasonable timeframe to implement this recommendation.

Current efforts would need to be expanded upon for the next decade and beyond.

What needs to happen to determine whether this recommendation, if implemented, is successful in achieving its goals? Does this recommendation address short, medium, or long term goals?

Dedication to biomass utilization and wood product industry diversification from businesses, entrepreneurs, commissioners, foresters, government agencies, etc. Requires a continuous and long-term commitment of a sustained yield of forest biomass from our federally managed public lands to ensure a consistent supply of raw material. Requires revisions to current air quality regulations and standards that are outdated, and do not account for the superior emission controls of modern wood burning technologies. Requires significant capital investment for commercial scale facilities.



MONTANA CLIMATE SOLUTIONS COUNCIL

CLIMATE CHANGE ADAPTATION, INFORMATION, AND DECISION SUPPORT

WHITE PAPER: NATURAL RESOURCES ADAPTATION - RANGELANDS

JANUARY 2020

PRIMARY AUTHORS:

- John Tubbs, DNRC
- Stacey Barta, DNRC
- Dr. Rachel Frost, Montana State University
- Chris Mehus, Western Sustainability Exchange
- Dr. Clayton Marlow, Montana State University

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

Rangelands and Forestry may benefit from being coordinated with GHG Mitigation and possibly innovations.

KEY ISSUE

Climate variability has impacts on Montana's rangeland ecosystems. Conserving these resources and systems is vital to maintaining a healthy economy, soil health, water infiltration, wildlife habitats, livestock systems, outdoor recreation opportunities, and a high quality of life for present and future generations.

Climate change and the uncertainty it creates cross economic and ecological sectors require an integrated response. Recognizing the interrelationship among natural resources sectors and types, adaptive solutions must identify opportunities to build resilience throughout the natural and human communities. Land, water, air, agriculture, forest, rangelands or prairie landscapes cannot be managed as separate systems. Working at a watershed scale, adaptive strategies to build resilience across the natural and human environments need to be identified and coordinated at the community level and integrated across jurisdictions to reduce future impacts to Montana's economy, environment and its communities. Monitoring data and clear communication about the benefits of monitoring and sharing data, and the use of data to make informed decisions on land management practices that mitigate climate change.

PROGRESS TO DATE

Rangelands in Montana have been quietly providing a variety of ecosystem good and services. Montana is 62% rangeland and is an undervalued resource. Private, state and federal land managers have been responsible for the health of rangelands and making strides for improved rangeland health over the last 50 years. Each individual management strategy may represent deep understanding of the specific issues related to a single resource. The challenge is to broaden the decision space to bring a comprehensive and integrated approach to adaptive management necessary to address a changing climate. Montana has a few entities working on soil/rangelands

monitoring- Rangelands Monitoring Group, and a pilot carbon credit program for rangelands- Western Substantiality Exchange. These types of project and the information generated need to be shared across jurisdictional boundaries and ownership to provide a broader knowledge base of the project benefit and outcomes.

GAPS

Natural resource adaptation strategies addressing climate changes emphasize resilience. Key to this is resilience across resources and the natural and human communities dependent upon their condition. The uncertainty of how the climate is changing and the on the ground effect of those changes makes adaptation difficult. Fundamental to filling gaps is continued investment in data collection and monitoring, analysis and forecasting, and analysis to provide decision makers the best available information. Further, institutions and laws bifurcate and distribute key decisions by separating resources and communities into distinct groups. This division of resources and associated economies and ecosystems is often necessary to direct regulation and management. However, the divisions cause gaps in understanding and analysis themselves. A focused effort of integration is necessary to address an overall change in climate. Only an integrated resource management approach at the appropriate scale will drive effective adaptation strategies. Gaps in information on Rangelands in Montana are broad. There are many unknowns as to what role rangelands can play, specifically in Montana to mitigate GHG and strategies for adaptations and resiliency. Many other western states have already begun to address similar gaps in their regions.

Public and private rangelands lack the funding and personnel to access pertinent information to do adequate planning for drought mitigation, interpret historic range condition assessments, and conduct restoration projects to rehabilitate degraded rangeland. Those who own private rangelands generally need to remain economically viable through grazing and recreation operations to avoid cultivating rangelands or possible development. Remaining economically viable in times of market uncertainty is difficult enough without an ever-changing climate that compounds the risk of escalating wildfire with the effects of higher temperatures and drought on forage production and seasonal availability Objective ecological baseline information coupled with trained staffing for local technical assistance and coordination of local natural resource planning groups is needed to manage the effects of climate change on rangeland sustainability.

STAKEHOLDERS

All Montana citizens are important stakeholders in the identification and development of appropriate adaptive strategies. Private rangeland and water managers, governmental agencies representing local, state, tribal and federal interests are key stakeholders. It is critically important for community-based climate adaption efforts to recognize the goals and directives of private for-profit entities and non-governmental organizations with a broader view of resource conservation and management, wildlife and fisheries management especially in Montana where large expanses of public and private lands are co-mingled. The Montana Rangeland Resources Committee, and locally led Conservation Districts can bring these disparate groups together to address natural resource challenges specific to the issue of climate change and engage these groups in developing adaptive strategies to further enhance resiliency in our rangelands.

RECOMMENDATION: RANGELANDS/GRASSLANDS

1. Conservation and promotion of diverse rangeland ecosystem that supports livestock agriculture, industry, non-developed recreation, wildlife, soil biology/function, pollinators and wildfire risk mitigation.
2. Promote and incentivize best management practices for building resiliency in rangelands that lower the risk of wildfire, increase soil carbon and enhance soil water holding capacity.
3. Formalize a carbon credit program for grazing systems that build soil carbon and soil water holding capacity and incentivizing grazing strategies and infrastructure that have led to improved soil and ecological conditions.
4. Expand funding for qualified range and soil technician positions in FS, BLM, NRCS and DNRC to gather, synthesize and summarize existing range and riparian monitoring data so that trends and patterns can be documented, and information can help form future decisions and monitoring protocols.
 - a. melding existing state and federal range monitoring data bases into a single, comprehensive historic baseline for evaluating current Montana rangeland ecological condition and then collate these records into long term trends in soil erosion, vegetation community composition and habitat size/distribution;
 - b. parallel efforts to use the historic evaluations to identify range community types and the larger habitats that have undergone the most change over the past three decades;
5. Capacity and funding to conduct research and assess vulnerabilities to enable managers to better prioritize resources:
 - a. Specified research include identification of habitats, ecosystems, and species most vulnerable to climate change, and approaches that managers could take to adapt those resources.
 - b. publishing the complete analyses so managers can better prioritize field work, projects, and financial resources. This synthesis can also be used to target areas for more intensive weather/climate monitoring.

RECOMMENDATION 1: CONSERVATION OF DIVERSE RANGELAND ECOSYSTEM THAT SUPPORTS AGRICULTURE, RECREATION, WILDLIFE AND POLLINATORS.

Montana Rangelands are inherently diverse due to geological, soil, climate, elevation, and aspect differences. This diversity is expressed through unique plant communities that support an equally unique assemblage of species. Conversion of grasslands to improved pastures or croplands increases carbon emissions, reduces biodiversity and poses one of the greatest threats to wildlife habitat according to the World Wildlife Fund Plowprint. Equally threatening to biodiversity is the conversion of rangeland to housing sub-divisions. Slowing the conversion of rangeland to cropland or development preserves the landscape's ability to capture and store carbon in perennial vegetation. Embedded within this recognition is the conjoined effort to link grazing and historic fire return intervals to achieve resilient rangelands in the face of climate change. Strategies are needed that encourage the conservation of the physical and biological processes that support intact rangeland ecosystems, and the restoration of degraded systems while still sustaining industry and cultural values.

STRATEGY: SUPPORT INCENTIVES TO CONSERVE NATIVE RANGELAND IN PERPETUITY

Conservation easements are a powerful tool to conserve the integrity of intact, native rangelands for all future generations. Additional support, both financially for the purchase of easements, and in capacity for the processing of easements and outreach to landowners is needed to protect these vital lands from further loss to cultivation or development. Current easement programs focus on the value of land for aesthetics or wildlife habitat with little consideration given to the carbon sequestration potential of the land. Expansion of existing programs, or

development of a permanent easement program that focuses on lands with the greatest potential to sequester carbon should be considered.

STRATEGY: SUPPORT INCENTIVES FOR TERM EASEMENTS OR LEASES FOR RANGELAND

A *term lease* is another option to increase enrollment in programs that conserve intact rangeland. These term leases can be used to protect lands at the greatest risk of conversion or sub-division. Term leases are effective to provide capital for rangeland restoration, installation of rangeland improvements that increase management capability, and financial stability to prevent development. The Montana Sage Grouse Habitat Improvement Program has initiated a pilot project for term leases to protect vital sage grouse habitat. Existing term leases should be monitored for effectiveness, improvement to the landscape, and economic feasibility to determine their potential to positively affect conservation of rangeland to mitigate climate change. Term leases should be awarded in preference to landowners who plan to restore converted cropland to native rangeland, or perennial vegetation.

STRATEGY: SUPPORT RANGELAND EDUCATION AND COORDINATION ACROSS LOCAL, STATE AND FEDERAL BOUNDARIES

Rangelands are a complex and diverse ecosystem that spans private, state, and federal ownership, as well as the sovereign lands of tribes. Developing an outreach and education program that highlights the benefits of intact rangeland for carbon mitigation will help stakeholders understand the need to protect and improve rangeland ecosystems. Increased capacity, both financially and through personnel, is needed to accomplish this suggestion. Support for an intern, or another FTE within the MT DNRC Rangeland Resources Program would be one way to increase capacity for a statewide rangeland education effort. Teaming up with Montana State University, and other public and private partners to demonstrate the benefits of rangeland for carbon sequestration through research and monitoring is another avenue for effective outreach on the value of rangelands for carbon sequestration. Sharing the stories of Montana landowners who are documenting the ability of their soil to hold carbon under different management and grazing strategies. To be effective, outreach should be focused on landowners to encourage adoption of monitoring as well as effective management strategies; and to the public to demonstrate that effective management, including grazing, can improve the soil's ability to mitigate climate change.

STRATEGY: SUPPORT USE OF LINKED FIRE-GRAZING MANAGEMENT TO RE-ESTABLISH THE ECOLOGICAL PROCESSES THAT ADD RESILIENCY TO RANGELAND COMMUNITY TYPES AND HABITATS.

The interaction between historic wildfire patterns and large herbivore grazing forms the Northern Mixed Grass Biome. This single rangeland community type makes up 1/3 to 1/2 of Montana's rangelands. Private, state and federal land managers must have reasonable protection from predatory lawsuits to implement combinations of prescribed fire and grazing necessary to revitalize the Northern Mixed Grass biome AND limit catastrophic wildfire risk in other rangeland types. Support should come in terms of 1) incentives to insurance companies to provide low cost coverage for private landowners using prescribed fire as part of their range management strategy, 2) prioritization of fire protection for subdivisions and communities with documented FIREWISE plans and 3) closure of legal loopholes e.g. Access to Equal Justice Act, that enable NGO's to block actions on federal lands without incurring any expense.

RECOMMENDATION 2: PROMOTE BEST MANAGEMENT PRACTICES FOR BUILDING RESILIENCY IN RANGELANDS TO INCREASE SOIL CARBON AND SOIL WATER HOLDING CAPACITY.

Grasslands are tremendous carbon reserves. Proper management improves carbon sequestration and promotes soil health that improves nutrient cycling and water retention capacity. Implementing these best management practices requires financial and technical support for landowners.

STRATEGY: SUPPORT ESTABLISHMENT OR ENHANCEMENT OF INFRASTRUCTURE THAT IMPROVES GRAZING MANAGEMENT ON RANGELAND

Sometimes the difference in the land being kept rangeland and converted to some other use is simply the funds to implement needed improvements to fencing and water infrastructure that keep the land economically viable as rangeland. The Natural Resources Conservation Service provides cost-share for many needed improvements, however, there are gaps in their programming that could be addressed at the state level. Funding and capacity are needed to explore where federally funded conservation programs fail to meet the needs of local communities, ecosystems, or species of concern. Appropriate state programs could be developed to provide additional cost-share, or to cover improvements that do not qualify for funding at the Federal level.

STRATEGY: PROVIDE TECHNICAL SUPPORT FOR RANGELAND MONITORING, ESTABLISHING GRAZING BEST MANAGEMENT PRACTICES

Technical support is limited to NRCS, MSU Extension, and private rangeland consultants. NRCS does not have the capacity to do technical support as their field staff is limited by budgets, federal hiring freezes, and contract administration. Most MSU Extension agents are not experts in rangeland, and the lone Extension Rangeland Specialist has many other duties and is responsible for the entire state. Regional expertise in rangeland management, planning and monitoring is needed to provide technical assistance to landowners, and the continued support to help them implement management changes. These positions need to be permanently funded to allow the technicians to establish relationships with landowners. Trust and a personal relationship greatly enhances the ability to work with landowners in collecting and interpreting monitoring data, evaluating grazing decisions and grassland conditions, and offer technical assistance in developing personalized drought mitigation plans for landowners. Education, monitoring, data interpretation and planning should be done by certified professional range managers at federal, state and local levels. Certification will enhance trust among range managers and user groups and establish credibility in the political and judicial systems.

RECOMMENDATION 3: CARBON CREDIT PROGRAM FOR GRAZING SYSTEMS THAT BUILD SOIL CARBON AND INCREASE SOIL WATER HOLDING CAPACITY.

Rangeland has a unique ability to sequester carbon and lessen the impacts of climate change. 50 percent of Montana's rangelands are in poor to moderate condition (stored soil carbon in the 1-2% range). Through adaptive management intensive grazing practices combined with extensive rest periods, this level can be increased significantly (5%-7%) and sequestered to deeper levels in a relatively short time frame.

STRATEGY: ESTABLISHING A CARBON CREDIT SYSTEM

Establishing a system that rewards landowners / managers for good decisions will increase adoption of best management practices to improve soil carbon sequestration and water retention capabilities. There is a large sustainability movement quickly gaining momentum in corporate America, motivated by companies that want to brand themselves as greener and wishing to offset their environmental footprint. These companies are looking for ways to purchase carbon credits. The grazing offset is still being developed, but has tremendous potential to meet this expanding demand. Once the Montana Grasslands Carbon Project has been validated by the appropriate carbon registry, many more companies will be compelled to purchase credits from this market which will hopefully create great expansion opportunities for ranchers across Montana and eventually the entire western US. They will

benefit from a strong network of partners from the private sector, government, and non-government organizations for education, technical assistance, additional research, marketing, and implementation.

RECOMMENDATION 4: FUND THE DEVELOPMENT OF A STATE-WIDE TEAM TO ASSEMBLE RANGE, RIPARIAN AND SOIL MONITORING DATA ARCHIVED BY PRIVATE, STATE AND FEDERAL AGENCIES.

STRATEGY: ESTABLISHING MONTANA RANGELAND ECOLOGICAL BASELINE

The Forest Service and Bureau of Land Management have been collecting vegetation data on grazing allotments throughout Montana since the late 1950's. The NRCS has collected soils information along with vegetation data on adjoining private lands over the same period. Most often this information has been used to amend grazing management or create restoration plans. While some of the vegetation and soils data became part of ecological site descriptions, the majority of this data resides unedited in file cabinets, agency computer data bases or on CDs. Generated over 50 years and across the entire state this range and riparian inventory can be mined to create a detailed record of soil and vegetation trends under ongoing climate change. As already outlined there are too few staff in either state or federal offices to undertake this task and fulfill their current tasks. The state legislature and governor's office should negotiate with ALL THREE federal agencies to create a 5-year plan to hire and support certified range management professionals to locate, summarize and publish the long term ecological trend for Montana. The ecological trend data then forms a base for 1) identifying those community types and habitats most vulnerable to climate change and 2) highlight those regions and sub-regions within the state where more detailed climate monitoring will be useful.

RECOMMENDATION 5: CAPACITY AND FUNDING TO CONDUCT RESEARCH AND ASSESS VULNERABILITIES. DATA AND ANALYSIS WOULD ENABLE MANAGERS TO PRIORITIZE FIELD WORK, PROJECTS, AND FINANCIAL RESOURCES. SPECIFIC RESEARCH NEEDS INCLUDE IDENTIFICATION OF HABITATS, ECOSYSTEMS, AND SPECIES MOST VULNERABLE TO CLIMATE CHANGE, AND APPROACHES THAT MANAGERS COULD TAKE TO ADAPT THOSE RESOURCES.

STRATEGY: EFFECTIVE ASSESSMENT OF ECOSYSTEM/SPECIES VULNERABILITY TO CLIMATE CHANGE WILL INCLUDE MEASURES BEYOND AIR TEMPERATURE, PRECIPITATION AND SOIL MOISTURE

A host of livestock and land management strategies developed since the 1950's produce externalities that appear to limit rangeland resiliency. The growing use of "pour-on" insecticides in the range livestock industry is one such example. There is a strong but limited data base indicating that insecticide residues in manure have negative effects on soil health through reduction of important dung beetle populations. Research into alternative livestock pest controls is necessary to recover rangeland soil health and protect livestock health. The Governor's Office and state legislature could encourage funding for alternative research through business (pesticide) tax incentives focused on RANGELAND (not cropping) investigations.

Another immediate line of investigation is the effect of grazing strategies aimed at producing a mosaic of vegetation community types rather than the traditional livestock centric single species community. Historic grazing management strategies have prioritized high ecological condition across a broad landscape. This homogenous landscape may constrain range ecosystem response to climate change. Management experience since the early 2000's indicates landscapes with little species/structural diversity are counterproductive to sage grouse brood and chick survival, exacerbate wildfire spread and reduce species and functional group survival under ongoing climate change. More research into the role of landscape diversity on both rangeland resiliency and economic productivity is crucially important to a state-wide response to climate change.



MONTANA CLIMATE SOLUTIONS COUNCIL

ADAPTATION AND DECISION-MAKING SUPPORT SUBCOMMITTEE

WHITE PAPER: WATER QUALITY AND QUANTITY IN NATURAL SYSTEMS

PRIMARY AUTHORS:

- Hannah Riedl, DEQ
- Ann Schwend, DNRC

KEY ISSUE

Montana depends on cold, clean, and abundant water to maintain our economy, ecosystems, and lifestyle. As noted in the Montana Climate Assessment, increased temperatures, decreased snowpack, earlier snowmelt, and rain on snow events will likely intensify floods and droughts and directly impact the timing of water availability, quality and quantity. Rivers and streams are magnets for development but are dynamic systems that need space to transport water and sediment. Coordinated, dedicated support for monitoring and assessment of Montana's water resources is critical. To prepare for the future requires a comprehensive approach to integrating land and water management and sustaining natural systems that are adaptive to change and resilient to extreme events.

RECOMMENDATION: PROTECT AND PROMOTE NATURAL STREAM AND WETLAND FUNCTIONS

Healthy river corridors, floodplains and wetlands function as sponges to slow snowmelt and high spring flows, which reduces downstream flood risks. They also temporarily store water in shallow aquifers, slowly releasing water to augment late summer return flows. Native riparian vegetation protects stream banks from erosion and downcutting, maintains floodplain connectivity, attenuates nutrients to protect water quality, and provides shade to reduce water temperatures and increase habitat diversity.

STRATEGY: RESTORE AND PROTECT RIVER CORRIDORS, FLOODPLAINS AND WETLANDS

The current system of requiring flood insurance to protect homeowners against the risks of living in floodplains is important for homeowners but does not recognize the cost to the ecosystem. Local governments should establish a comprehensive review process for all development that infringes on rivers, floodplains, and wetlands. Laws that discourage development in the floodplain, or establish setbacks for development from wetlands, likely will be needed. Such proactive regulations could help protect floodplain and wetland functions more comprehensively than the current ad hoc, piecemeal restoration approach.

STRATEGY: EDUCATE THE PUBLIC ON THE VALUE OF FLOODPLAINS AND WETLANDS

Extensive education and outreach is required to ensure public understanding and acceptance about the intrinsic value of healthy floodplains, wetlands and riparian corridors for community benefits. Rather than mitigating loss from development, floodplains and wetlands must be valued so that they are proactively protected.

RECOMMENDATION: INTEGRATE LAND USE AND WATER RESOURCE PLANNING

Land use has a direct impact on hydrologic systems, by changing the ability to manage supply, or by increasing demands on a finite resource. Since water does not follow traditional land management jurisdictions, local

planning should occur at the watershed scale. To create more resilient communities, it is important to integrate land and water planning to consider the cumulative hydrologic and water quality impacts of land development on surface and groundwater resources.

STRATEGY: SUPPORT LOCAL DROUGHT AND WATER QUALITY PLANNING

- Watershed water supply and drought management plans provide flexibility to adapt during times of drought and share the water shortage across many users. Agency rulemaking should be initiated to encourage and protect these types of adaptive approaches.
- Water Quality Restoration Plans (WQRPs) outline targeted implementation methods to address non-point source water quality issues and engage local stakeholders

STRATEGY: IDENTIFY ADAPTIVE WATER MANAGEMENT AREAS

Identify agricultural or undeveloped areas that have the adaptive capacity to allow flooding to occur and reduce flood risks for downstream urban communities. Developing mechanisms to compensate these landowners, either through land conservation or flooding easements, may increase the areas where flooding can occur and reduce the “firehose” impacts of channelized stream and river systems.

STRATEGY: INCORPORATE GREEN INFRASTRUCTURE IN STORMWATER MANAGEMENT

Many permitted industries, subdivisions, towns, and municipalities are required to capture and treat stormwater. Green infrastructure, such as wetland cells, gravel ponds and ditches, should be encouraged for stormwater capture and treatment.

STRATEGY: INVEST IN TOOLS TO IMPROVE STATEWIDE MONITORING AND ASSESSMENT OF WATER RESOURCES

- Dedicate funding to support a well-coordinated and sustainable stream gage monitoring system.
- Encourage local planning jurisdictions to incorporate channel migration zone mapping in their public outreach and decision making.
- Support further analysis and mapping of groundwater resources.
- Support and expand Montana Mesonet and other soil moisture monitoring.

RECOMMENDATION: INVEST IN RESOURCES TO PREVENT HARMFUL ALGAL BLOOMS

Warming temperature is a major factor influencing the increased proliferation of harmful algal blooms, and the issue raises concern about human health, recreation, drinking water, and livestock operations. Investing in projects, such as riparian revegetation and floodplain restoration, that will protect and restore stream and wetland function will also help reduce factors that promote the formation of harmful algal blooms. Additionally, this issue provides an excellent education and outreach platform to unify multiple stakeholders with varying interests and motivate a call to action.



MONTANA CLIMATE SOLUTIONS COUNCIL

MONTANA CLIMATE OFFICE: CLIMATE INFORMATION AND SERVICES FOR MONTANA

WHITE PAPER: MONTANA CLIMATE INFORMATION AND SERVICES

DECEMBER 27, 2019

PRIMARY AUTHORS:

- Kelsey Jencso, Kyle Bocinsky, Laurie Yung and Amy Cilimburg

DOES THE WHITE PAPER NEED TO BE COORDINATED WITH OTHER COMMITTEES?

Yes. These principles underlie many of the other committees' recommendations.

KEY ISSUE: DEVELOP MONTANA CLIMATE INFORMATION AND SERVICES THAT SUPPORT CLIMATE, DROUGHT AND FLOOD RISK ADAPTATION AND MITIGATION

Montana's environment and economy will be increasingly impacted by climate change (Whitlock et al., 2017).¹ A key to mitigating climate impacts and capitalizing on knowledge of the future is policy and management decisions that are based upon the best available science and observations. Climate change impacts decision making across the state at a variety of scales; from long term planning for increases in aridity due to changes in the temperature and precipitation regionally, to seasonal responses to variability and extremes that contribute to drought, floods or wildfires across counties and tribal lands in any given year (Jencso et al., 2019).²

To adapt and build resilience we must take a three pronged approach to climate information delivery and services:

- 1) We need to understand where changes are likely to occur in future decades for planning and adaptation.
- 2) We need to develop early warning systems that characterize seasonal conditions at locally relevant scales and across our important economic sectors, to take advantage of year to year variability now and into the future.
- 3) We need to communicate current and predicted conditions effectively to all Montana stakeholders. These data need to be tailored to inform effective decision making, adaptation and mitigation.

Page 70 of the 2016 Montana State water plan recommended "support for Montana Climate Office's involvement in monitoring and forecasting in order to increase the lead-time for Montana water users

¹ <https://montanaclimate.org>

² https://www.drought.gov/drought/sites/drought.gov.drought/files/NIDIS_LL_FlashDrought_2017_high-res_Final_6.6.2019.pdf

and managers to prepare for times of water scarcity.” We reiterate this recommendation here in the form of sustained support of the Montana Climate Office that would provide climate services to state agencies and the public for climate change planning.³

PROGRESS TO DATE

In 2006 Governor Schweitzer approved⁴ the Montana Climate Office⁵ as the official steward of climate information for Montana, with anticipated service to the Governor’s Drought and Water Supply Advisory Committee. Across the US, state climate offices and the American Association of State Climatologists⁶ provide climate services at the state and local level in partnership with NOAA and other federal agencies, including the Regional Climate Centers (RCC), Regionally Integrated Sciences and Assessments (RISA) program, the National Climatic Data Center (NCDC), the National Weather Service (NWS), and the USDA’s Natural Resource Conservation Service (NRCS). State climate offices (SCO) provide a vital and nationally recognized connection between federal climate partners, University scientists and state and local entities. SCOs serve on a variety of federal, state, or local boards, commissions, task forces, and other groups, providing a direct conduit of information and expertise into planning and operations within the state.

Montana Climate Office Mission:

- Assimilate, organize, and disseminate climate information from recognized Federal, State, and local sources for the benefit of a large and diverse stakeholder community in Montana.
- Be a credible and expert source of information for decision makers that rely on the most current information on climate to make important policy decisions.
- Assist stakeholders in interpreting climate information or adapting climate products to their needs for incorporation into the planning process.

Since 2012, the MCO and its partners have moved towards providing climate information and services for the state. These activities have included:

1. **Montana Climate Atlas⁷:** annually updated maps and data resources that characterize trends in climate, water and economically important climate indices across Montana. The Climate Atlas formed the basis for the approval of the Climate Spatial Data Infrastructure layer by the Montana Library Commission and the Montana Land Information Advisory Committee; Montana Code Annotated 90-1-404⁸.
2. **Montana Climate Assessment⁹:** The MCO characterized historical and projected climate trends and performed modeling, analysis and write-up of the Climate Chapter of the Montana Climate

³ http://dnrc.mt.gov/divisions/water/management/docs/state-water-plan/2015_mt_water_plan.pdf

⁴ <https://climate.umt.edu/files/schweitzer20060119.pdf>

⁵ <https://climate.umt.edu>

⁶ <https://www.stateclimate.org>

⁷ <https://climate.umt.edu/atlas/>

⁸ https://leg.mt.gov/bills/mca/title_0900/chapter_0010/part_0040/section_0040/0900-0010-0040-0040.html

⁹ <https://montanaclimate.org>

Assessment in partnership with the Institute on Ecosystems, University of Montana and Montana State University.

3. **Climate and Drought Early Warning¹⁰**: Daily online modeling and assessments of drought severity and moisture conditions for the Upper Missouri River Basin in collaboration with the Governor’s Drought and Water Supply Committee — Monitoring Subcommittee. This is an ongoing project that is being developed by members of MCO, DNRC, MT State Library, USFS, USGS, NRCS and MT DOA. The NOAA National Integrated Drought Information System is funding this initiative as a pilot for the development of early warning systems in other regions.
4. **Montana Mesonet¹¹**: The Montana Mesonet is a cooperative statewide soil moisture and meteorological information system designed to support decision-making in agriculture, range and forested watershed contexts, and to serve as a drought and flood early warning system for the state. The Montana Mesonet is supported by federal and local partners including NOAA National Mesonet Program, Department of the Interior Bureau of Land Management, United States Forest Service, U.S. Army Corps of Engineers, MT Department of Natural Resources and Conservation, MT Department of Agriculture, Montana Bureau of Mines and Geology, MT Institute on Ecosystems, Montana State University, Crow Agency, Fort Belknap Reservation, Fort Peck Reservation and private farmers and ranchers. The mesonet currently consists of 74 weather and soil moisture stations that report conditions every 15 minutes.
5. **MT Community Collaborative Rain, Hail and Snow Network (CoCoRAHs)¹² - Education and Extension**: The MCO leads and funds the MT CoCoRAHs as part of its education and extension efforts in partnership with NWS Glasgow, NWS Great Falls, NWS Missoula and NWS Billings. CoCoRAHs is a long standing and internationally recognized NOAA program that conducts community & K–12 education and daily measurements of rainfall, snowpack and hail.
6. **Workforce Development**: Offered new curricula, training opportunities, and internships in climate and water analysis to pipeline advanced undergraduate (15) and graduate students (7) into the workforce.
7. **Climate Communication**: The MCO produces seasonal newsletters for agricultural producers¹³ that highlight current agricultural weather conditions, seasonal outlooks, drought predictions and future climate projections with estimates of uncertainty.
8. **MT Drought Management Plan**: The MCO is assisting the DNRC and Governor’s Drought and Water Supply Committee with an update of the state’s 1995 Drought Response Plan.

¹⁰ <https://climate.umt.edu/drought/>

¹¹ <https://climate.umt.edu/mesonet>

¹² https://www.cocorahs.org/Content.aspx?page=coord_MT

¹³ <https://climate.umt.edu/mtdrought/newsletters.php>

9. **Research on the Information Needs of End-Users from Different Stakeholder Groups:** MCO conducts research with University Social Scientists to better understand the climate information needs of agricultural producers, tourism and recreation businesses, and other stakeholders in Montana, to improve the efficacy of climate information. This work looks at different needs relative to type of information, spatial and temporal scale, uncertainty, and delivery medium, and examines how people use climate information in decision-making.

GAPS: FUNDING FOR THE MONTANA CLIMATE OFFICE

The primary gap in developing, maintaining and providing “boots on the ground” climate services is the lack of sustained funding for permanent personnel. Most successful state climate offices in the U.S. typically employ between 4-8 full time employees as part of the University System.¹⁴¹⁵¹⁶ In 2018, the MCO lost its support for 0.5 FTE when the former Information Specialist retired. The State Climatologist position is supported by 0.10 FTE and approximately \$10,000 per year is contributed for travel and outreach by the Forest Conservation Experiment Station’s budget. Currently, funding for MCO staff (Letters of Appointment; 3.0 FTE) is through soft money from grants by federal entities such as NOAA, NSF, USDA, DOI BLM or cooperative agreements for specific projects with state agencies (e.g., DNRC). Uncertain funding limits the MCO’s ability to provide climate services and extension beyond the boundaries of specific projects funded by short term grants.

It is imperative to establish a durable Montana Climate Office to ensure that critical services are ongoing and expanded. At a minimum, funding is necessary to support the State Climatologist position and for the hire of 1.0 FTE Service Climatologist (with skill-sets in hydrology and computational climate science; similar to other states), 1.0 FTE of a Computational Scientist and Web Developer and 1.0 FTE for a Mesonet Coordinator. In addition, we recommend between 2–5 FTE for Climate Extension Specialists with possible shared appointments between the Montana Climate Office, Tribal Colleges, MSU Agricultural Experiment Stations, MSU Extension, the Montana Forest and Conservation Experiment Station or agencies with climate relevant workflows such as the DNRC, DEQ and FWP.

Long-term funding is envisioned as coming from federal agencies, the Montana University System, and/or the State of Montana, either in the form of existing direct program funding, or new sources of funds from legislative action. The Montana Climate Office could be jointly shared between University of Montana and Montana State University; similar to MSU Extension Forestry.¹⁷ This partnership would connect the well established climate expertise at the University of Montana with the statewide footprint of extension and agriculture science of Montana State University.

Funding would also be supplemented by revenue generating sales of climate service information to relevant stakeholders. As one example, the MCO currently receives a monthly stipend for provision of

¹⁴ <https://nsco.unl.edu/about>

¹⁵ <https://climate.ncsu.edu/office/staff>

¹⁶ http://climate.atmos.colostate.edu/ccs_info.html

¹⁷ <http://forestry.msueextension.org/>

Montana Mesonet data (74 weather and soil moisture stations) to the U.S. Army Corps of Engineers and NOAA for use in daily flood early warning and reservoir management models — information used to protect life and property in the Upper Missouri River Basin.

Funding would support continuity of existing efforts as outlined in the section above (progress to date) as well as the recommendations described below.

RECOMMENDATION 1: CREATE A MUS CLIMATE COUNCIL THAT COORDINATES CLIMATE SERVICE NEEDS FOR ADAPTATION AND MITIGATION

Creating a plan for climate adaptation, mitigation and resilience across the state will take time and must evolve as stakeholder needs are assessed; beyond what can be anticipated by the Climate Solution Council in a short time period. The Montana Climate Office in conjunction with a countless groups have taken important first steps towards addressing the challenges and opportunities associated with Climate Change in Montana. To leverage existing efforts and sustain this process into the future, we suggest the development of a standing Climate Advisory Council (CAC) that would be housed within the Montana University System. Importantly, this CAC should have authority to determine climate related efforts of state agencies, budgetary discretion for identified climate related research and services, and the ability to organize efforts across the state. Governor Brian Schweitzer proposed a Climate Council during his administration in 2005.¹⁸ This committee could be similar to concepts proposed in the Montana Adaptation Knowledge Exchange (MAKE) and would serve to connect science and applied efforts of the MCO and other MUS entities with recognized climate needs on an annual basis.

The direction, objectives, and immediate goals of the MCO will be reviewed by the CAC. The CAC will provide guidance on matters related to climate modeling priorities, information dissemination, technology application for resource management and service to state agencies and tribes, service activities involving workshops and training programs, undergraduate, high school, citizen outreach, agricultural and economic policy elucidation, and local climate information and products. Membership in the CAC will be cross-disciplinary and represent the various climate related interests (e.g., representing industry, environmental concerns, local and tribal governments, transportation, agriculture, state agencies, university extension, university scientists, citizen groups). The CAC will meet at least twice a year to assess the accomplishments and to provide guidance on future activities.

RECOMMENDATION 2: CONTINUE ASSESSMENTS OF CLIMATE TRENDS IN CONJUNCTION WITH IMPACT AND ADAPTATION PLANNING

Uncertainties in the scale and location of climate impacts can make decision making difficult. Climate change projections have inherent uncertainties, although the climate models are becoming increasingly more accurate with new data and will continue to be improved into the future. The 2017 Montana Climate Assessment served as an important benchmark of statewide climate trends and potential impacts to Forestry, Water and Agricultural sectors. Moving forward it is important to develop, refine,

¹⁸ <http://deq.mt.gov/Energy/climatechange/data/AddressingClimateIssues>

and deploy tools and integrated approaches that enable iterative decision making and increase the flexibility and robustness of climate change responses.

We recommend continued climate modeling to be conducted on a multi-year basis. To guide modeling efforts the CAC could conduct a request for proposals and surveys on to identify specific community needs (e.g., agency relevant climate issues, town or city specific analyses). Once specific projects are determined the MCO will work in partnership with the CAC and MUS entities to select the best available climate models - based upon established science. Models will be downscaled to locally relevant scales such as tribal lands, watersheds and counties as stakeholder needs are identified by the steering committee. Similar to the first MCA, these projections will be conveyed with estimates of uncertainty and coupled with impact assessments and adaptation strategies for new sectors of interest by university, agency and community experts.

Importantly, CAC will set priorities for the sectors where additional analysis is required and seek out experts within the MUS system to connect climate model outputs with impact assessments and adaptation strategies. The results of these studies will be used as a foundation for Climate Extension Specialists and stakeholders to pursue funding from state programs (e.g., DNRC, DEQ, MT DOA, MT RDGP) and federal programs (e.g., NRCS, USDA AFRI, NSF, NOAA SARP, BIA, DHS-FEMA) that support projects to enhance climate resiliency.

RECOMMENDATION 3: FURTHER DEVELOP AND SUPPORT THE MONTANA CLIMATE DATA LAYER UNDER THE MONTANA SPATIAL DATA INFRASTRUCTURE AND MONTANA LIBRARY

We recommend further development and support of the Montana Climate Data Layer. Montana climate data and metadata are provided for Montana and basins that intersect with Montana's borders (Figure 1) through the Montana Spatial Data Infrastructure (MSDI) at the State Library.¹⁹ MSDI datasets are generally accepted as the best available, standardized, statewide data that meet the essential, digital geographic information needs of Montana's citizens, its government, commerce, legislature, area researchers, and more. This provides a pipeline for access to scientifically sound climate data for use in planning and adaptation activities. The collection includes climate station data and trends in statewide meteorology and terrestrial products. The data are provided by the Montana Climate Office and updated in coordination with the Montana State Library and Montana Land Information Advisory Council on an annual basis. The Climate Office provides overview information on each published dataset and the status of development. Complete documentation for each dataset is provided in metadata that accompanies each product. The Montana Climate Office maintains a climate station mapping application as an interface for those seeking information on specific climate stations. Each station is linked to a web page with more detailed information and includes a link to download data. The mapping application can be viewed on most desktop and mobile devices. In the future, peer reviewed climate projections (Recommendation 2) would be hosted under the climate data theme at the state library.

¹⁹ <http://geoinfo.msl.mt.gov/home/msdi/climate.aspx>



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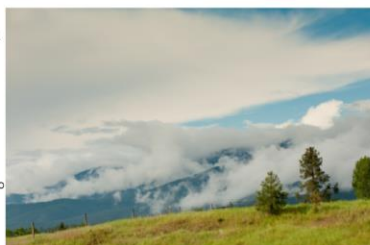
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Climate

Data and Documentation

Montana climate data and metadata are provided for Montana and basins that intersect with Montana's borders. The collection includes climate station data, statewide meteorology, and terrestrial products. The data are provided by the **Montana Climate Office**. The Climate Office provides overview information on each published dataset and the status of development. Complete documentation for each dataset is provided in metadata that accompanies each product. Please use the Data Products sidebar on the **Data Products page** for access to the data.



Theme Lead

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- Climate Home
- Data Construction
- Publishing and Archiving
- Cross-MSDI Relationships
- Data Outreach
- Success Stories
- Projects
- Research and Development

Figure 1: Montana climate information and data services are hosted by the Montana State Library. The data are provided by the Montana Climate Office and updated in coordination with the Montana State Library and Montana Land Information Advisory Council on an annual basis.

RECOMMENDATION 4: FURTHER DEVELOP DROUGHT AND FLOOD EARLY WARNING SYSTEMS TO SUPPORT COMMUNITY, TRIBAL, STATE AND FEDERAL RESPONSES

We recommend funding for existing and new drought, flood and agricultural weather networks. Measurements of precipitation (rain and snow), weather conditions, soil moisture, groundwater, and streamflow are critical for planning and response during both wet and dry time periods. This information is useful to inform policy, planning, risk assessment, and decision-making at multiple levels of government (e.g., national, regional, tribal, state, county, and local), and across many time scales. Timely, accurate, and actionable observations of water availability are needed to prepare communities for drought and floods, mitigate impacts, and enhance post event recovery.

There is a need for increased and sustainable levels of investment for critical drought and flood monitoring infrastructure, such as the DNRC-USGS Cooperative Water Program, DEQ's PM2.5 Air Quality Program, Montana Bureau of Mines and Department of Agriculture groundwater monitoring, NRCS snow survey, Remote Automated Weather Station (RAWS) networks, NOAA Cooperative Observer Program (COOP), CoCoRAHs and web based delivery of NASA/USGS satellite data. Most of these programs have developed extensive data-rich observations for more than 30 years. These important records enable climatologists to place current conditions in the context of past events and help to determine the presence of absence of drought conditions for a given area.

New and expanded monitoring networks are also needed and the 2017 flash drought illustrated a need to accelerate these initiatives (Jencso et al., 2019). Similar to many other states, Montana (as part of NOAA's National Mesonet Program²⁰) has recognized the need for monitoring systems to better

²⁰ <https://nationalmesonet.us/nmp-partners/>

characterize moisture conditions and the potential for local drought impacts to agriculture, rangelands, and water resources. The MCO began the Montana Mesonet as an automated weather and environmental monitoring network designed to observe phenomena such as precipitation, temperature, wind speed, relative humidity, evapotranspiration and soil moisture as indicators for agricultural and rangeland conditions.²¹

Mesonet stations fill monitoring gaps from federal weather station networks in sparsely populated areas of Montana. They also provide data for the development of more continuous gridded weather and drought data sets, and seasonal predictive models of drought for in support of the Governor's Drought and Water Supply Committee and U.S. Drought Monitor. Since 2015 the mesonet has expanded from 6 stations to 74 (Figure 2) as a result of collaborations amongst the MCO, NOAA, the Montana Agricultural Experiment Stations, the Department of the Interior Bureau of Land Management, Montana Department of Agriculture, Montana Bureau of Mines and Geology, The Institute on Ecosystems, Stillwater County, the Blackfoot Challenge, the Governor's Drought and Water Supply Committee - Monitoring Sub-Committee, Montana Department of Natural Resources and Conservation and private farmers and ranchers across the state.

Beyond improvements in traditional forecasts of precipitation or temperature, the development of new web based products will help to translate this information into terms that stakeholders care more directly about. Example derived products include cattle comfort indices, plant water stress and irrigation tools, productivity monitoring, inversion modeling for pesticide and fertilizer applications, indices for pest and disease monitoring, evapotranspiration estimates, degree day monitoring for different crops, and fire danger monitoring in rangelands and forests. These concepts are not new. For example, the Oklahoma Mesonet consists of a network of 120 meteorological stations that are used for agricultural decision making (planting, irrigation and chemical applications), drought monitoring, public health, and emergency warning in partnership with the University System.²² Since its inception in 1996, it is estimated that the Oklahoma Mesonet has contributed to cost savings of \$2.8–\$5.4 million annually (Klockow et al., 2010).

²¹ <https://climate.umt.edu/mesonet>

²² <https://www.mesonet.org/index.php/agriculture/monitor>

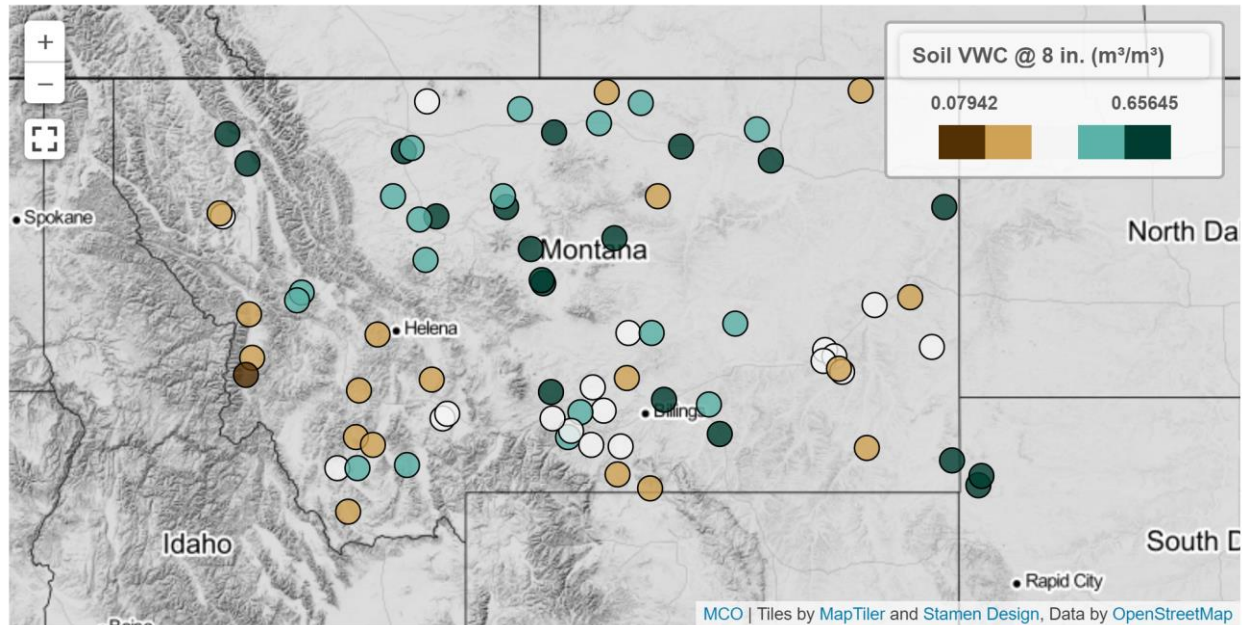


Figure 2: Online map of Montana Mesonet station locations. 74 stations report 15 minute measurements of precipitation, wind speed, wind direction, relative humidity, temperature, lightning strikes, solar radiation, barometric pressure, soil moisture, soil temperature and soil water conductivity.

RECOMMENDATION 5: FACILITATE EXTENSION OF CLIMATE DATA AND SERVICES TO MONTANANS

Many communities are experiencing increasing awareness of climate change and interest in comprehensive adaptation planning. Lack of human resources, access to information, training, and expertise provide significant barriers to this process in Montana. Across the U.S., the majority of State Climate Offices have designated personnel and extension budgets (travel, workshops, etc.) to connect climate data to constituents (e.g., tribes, agriculture, water resources, private landowners). Climate information and adaptive programs are irrelevant if they are not conveyed to the end users who can make use of it. Planning personnel are required to translate current science and connect it to end users — these positions would provide a vital link to impacted communities and landowners, and would aid in the co-production of climate information and adaptation activities as new needs are recognized.

We recommend between 2–5 FTE for Climate Extension Specialists with possible shared appointments between the Montana Climate Office, Tribal Colleges, MSU Agricultural Experiment Stations, MSU Extension, the Montana Forest and Conservation Experiment Station or agencies with climate relevant workflows such as the DNRC, DEQ and FWP. These positions and their respective themes (e.g. tribal, agriculture, natural resources, forestry) could be prioritized by the Climate Advisory Council (Recommendation 1).

Responsibilities of the Climate Extension Specialists would include:

- providing climate information via newsletters and websites that are tailored to end user needs and developed iteratively through feedback.

- traveling the state to provide workshops and trainings.
- communicating climate information (e.g., seasonal forecasts) through a variety of mediums including radio broadcasts, social media and newsletters.
- advising communities and landowners on planning and adaptation strategies (recommendation 6).
- facilitating community grant writing to state and federal programs that support infrastructure improvement for adaptation and resilience. Projects would be conducted as new needs arise and sector specific climate assessments are performed in partnership with stakeholders (recommendation 2).

Prokopy et al. (2008) found that, in studies related to the adoption of best management practices, access to information was positively associated with adoption rates. Climate Extension Specialists may play an important role by helping communities in their decision-making as it relates to climate change and will provide information and engagement related to potential effects and adaptation strategies.

RECOMMENDATION 6: CO-DEVELOPMENT AND SCIENTIFIC FIELD-TESTING OF CLIMATE INFORMATION TO ENSURE END-USER NEEDS ARE MET

The majority of climate information is often not utilized in decision-making, because the information and/or the way it is delivered is not credible or relevant to the intended audience (Prokopy et al., 2008). To ensure that the climate information provided by MCO and others is not only useful but actually used in adaptation decisions, we recommend investment in social science research to better understand the needs of different groups across the state, from grain farmers to ranchers, and from tribes to tourism operators. MCO is currently piloting this kind of research with Montana farmers and ranchers, and has a proposal to work with tourism and recreation managers and businesses, but additional work is needed to ensure that climate information and services meet the needs of end-users (and not just what scientists assume those end-users need).

STAKEHOLDERS

Over the past eight years the Montana Climate Office has responded to requests for specific climate information from businesses, private landowners, agencies, research groups and policy makers. In addition to those requests the Montana Climate Office has interacted with organizations or public entities interested in applied climate metrics or in advancing our understanding of Montana's climate. Examples of these entities are as follows:

Local: Teton County, Musselshell County, Red Lodge, City of Missoula, City of Bozeman, City of Whitefish, Town of Martinsdale, Town of Lakeview, Town of Augusta, Montana Grape and Winery Association, Missoula Valley Water Quality District, Montana Arboretum, Montana Natural History Center, Montana Association of Counties

Non-Governmental Organizations American Association of State Climatologists, Center for Research on the Changing Earth System, National Drought Mitigation Center, National Geographic, Turner

Foundation, Trust for Public Land, Union of Concerned Scientists, Wildlife Society, Climate Smart Missoula

Tribal: Montana Tribal Colleges, Confederated Salish and Kootenai Tribe, Crow Agency, Fort Belknap Reservation

Private: WGM Engineering, Climate Central, GeoData Services CDM, TetraTech, Northwestern Energy, AdaptiveHydro, Billings Gazette, Prairie Star, Valley Journal, Farm Journal Television, Tri-State Livestock News

State or Local Non-Governmental Organizations: One Montana, Missoula Climate Action, Clark Fork Task Force, Lolo Watershed Group, Blackfoot Challenge, MT American Water Resources Association, Montana Watershed Coordination Council, Montana Association of Geographic Information Professionals, Montana Association of Conservation Districts, Center for Large Landscape Conservation, Montana Association of Conservation Districts, Montana Association of Planners, Montana Farmers Union, Montana Farm Bureau Federation, Montana Stockgrowers Association, Great Northern Landscape Conservation Cooperative

Montana University System: Institute on Ecosystems, Institute for Tourism & Recreation Research, National Center for Landscape Fire Analysis, Montana State University Extension (Agriculture, Forestry, and Economics), Montana Bureau of Mines and Geology, Montana Water Center, University of Montana (multiple departments) Montana State University (multiple departments) Carroll College

Other Universities University of Lethbridge University of Idaho Idaho State University University of Oregon Oregon State University, University of Washington, South Dakota State University, North Dakota State University, University of Nebraska, University of Colorado

State of Montana: Governor's Office, State Library & Library Commission, Montana Board of Regents, Dept. of Fish, Wildlife and Parks Dept. of Natural Resources (Water Resources and Forestry Divisions), Dept. of Environmental Quality, Dept. of Agriculture, Dept. of Health and Human Services, Dept. of Revenue, Water Information System, Montana Land Information Advisory Council, Montana Bureau of Mines and Geology,

Regional Washington Climate Office, Idaho Climate Office, North Dakota Climate Office, South Dakota Climate Office, Wyoming Climate Office, Nebraska Climate Office, Crown of the Continent, Greater Yellowstone Area Clean Air Partnership, University of Washington Climate Impacts Group, Great Lakes Regional Water Program, Central Region Climate Services, Environment Canada, Desert Research Institute

Federal: Montana Congressional Delegation, U.S. Global Change Research Program, Department of Energy - Oak Ridge National Laboratory, National Park Service, National Science Foundation, National Center for Atmospheric Research, Dept. of Commerce/National Oceanic and Atmospheric Administration National Weather Service, National Centers for Environmental Information - Climate

Impacts Group, Climate Impacts Research Consortium, National Climate Data Center, Climate Prediction Center, National Integrated Drought Information System, United States Forest Service, U.S. Department of Agriculture, Natural Resources and Conservation Service

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