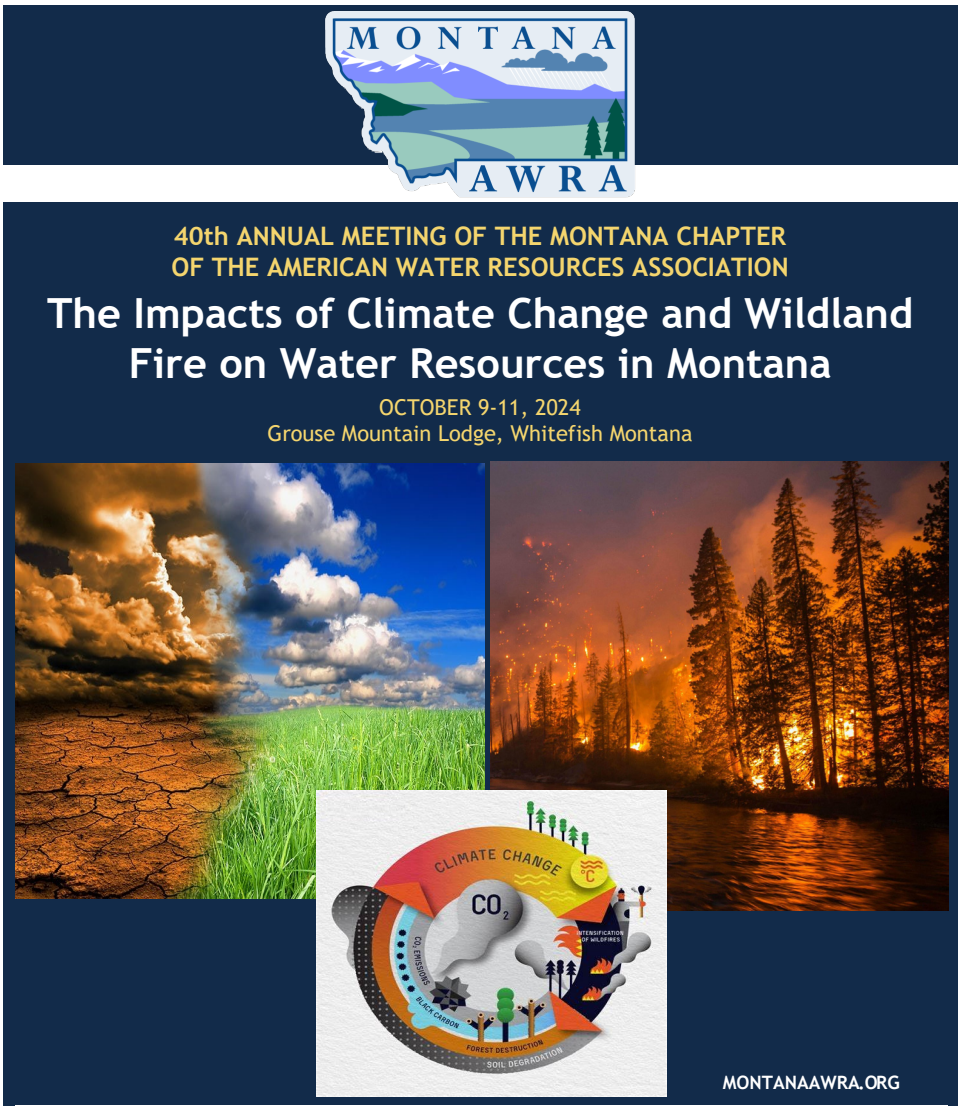


PROCEEDINGS

for

"Impacts of Climate Change and Wildland Fire on Water Resources Across Montana"

MT AWRA 2024 Conference
October 9 - October 11, 2024
Grouse Mountain Lodge
Whitefish MT

Contents

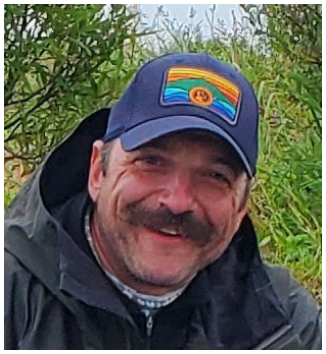
SCAN ME

THANKS TO ALL WHO MAKE THIS EVENT POSSIBLE!

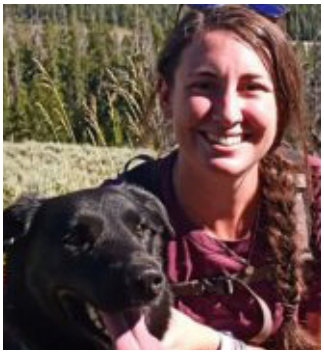
- **The AWRA Officers**
  Lou Volpe, President—Hydrologist, US Forest Service, Helena-Lewis & Clark National Forest
  Sara Edinberg, Vice President— Assistant Research Hydrogeologist, Montana Bureau of Mines and Geology
  Ron Breitmeyer, Treasurer— Ronald J. Breitmeyer, Ph.D., PE, Assoc. Professor, Civil Engineering, Carroll College
  Danika Holmes, Secretary—Regional Water Planner - Upper Missouri River Basin, Montana DNRC
  Nancy Hystad, Executive Secretary—Montana State University, Bozeman, MT

- **Montana Water Center**
  Stephanie Ewing, Director, and Whitney Lonsdale, Assistant Director

And especially the conference presenters, field trip leaders, moderators, student judges, and volunteers.



Lou Volpe



Sara Edinberg

Ron Breitmeyer

Danika Holmes

Nancy Hystad

The Montana Section of the American Water Resources Association would like to thank our 2024 sponsors.

WEDNESDAY, OCTOBER 9

REGISTRATION

9:00 AM - 6:00 PM	Registration at the Grouse Mountain Lodge

MORNING WORKSHOP

9:30 AM - 11:30 AM	Data Collection Expose, Streamlining Data Collection

AFTERNOON

12:00 PM - 5:00 PM attendees	Field Trip - Depart Grouse Mountain Lodge promptly at 12 PM noon. Sack lunch provided to field trip
5:30 PM	Hydrophile 5k Walk/Run - route map on page 15
6:00 PM	Jeremiah Johnson Brewing Co. (2 Central Ave, Whitefish) Dinner on your own

THURSDAY, OCTOBER 10

OPENING DAY PLENARY

7:30 AM **REGISTRATION OPENS** - Gather early for coffee and conversation with colleagues. Continental breakfast free at hotel.

8:00 AM Welcome! Introductions, logistics, and announcements - Lou Volpe, MT AWRA President

8:10 AM A message from the Montana Water Center - Stephanie Ewing, Director

8:25 AM **PLENARY SESSION 1:** Charles Luce, Climate Change Influences on Fire and Water in Montana: Understanding the Physical Drivers of Change

9:00 AM **PLENARY SESSION 2:** Sheila Murphy, Wildfires in watersheds: What determines the water-quality response?

9:35 AM **PLENARY SESSION 3:** Amanda Hohner; Wildfire Implications for Drinking Water

10:10 AM BREAK

10:25 AM **PLENARY SESSION 4:** Kelsey Jencso, Building climate preparedness through enhanced soil moisture monitoring

11:00 AM Q and A Session

11:30 AM Water Legend: Congratulations Vicki Watson!

12:00 PM LUNCH (provided to all registered conference attendees.)

THURSDAY, OCTOBER 10 (continued)

TECHNICAL SESSIONS (Blue text indicates student presenters.)

Session 1
Climate

Moderator: Mary Sutherland, MBMG

1:00 PM ***Theodore Barnhart,*** *U.S. Geological Survey, Wyoming-Montana Water Science Center.* Hydrologic and River System Modeling to Support End-of-Century, Future-Climate Water Availability in the Tongue River, Montana and Wyoming

5 min transition

1:25 PM ***Patrick Wurster,*** *U.S. Geological Survey.* SWIPe: A Surface-Water Index of Permanence and Its Relation to Atmospheric Water Supply and Demand in the Upper Missouri River Basin (1989-2021)

5 min transition

1:50 PM ***Colin Brust,*** *Montana Climate Office.* Montana Mesonet Tools: Open-Source Software for Accessing and Visualizing Montana's Weather

Session 2
Water Quality

Moderator: Abbie Ebert, DEQ

1:00 PM ***Samanthi K. Wijerathna,*** *Montana State University.* Exploring the Impact of the Cedar Creek Fire on Source Water Quality and Treatment

5 min transition

1:25 PM ***Brooke Bain-White,*** *University of Montana.* Old McDonald had a fire…but did it affect water quality?

5 min transition

1:50 PM ***Rachel Suhs,*** *Missoula Valley Water Quality.* District Examination of Long Term Nitrate Trends in the Missoula Aquifer

Session 3
Restoration and Management

Moderator: Ginette Abdo, MBMG and Casey Ryan, CSKT

2:15 PM ***Ann Hanson,*** *Montana Bureau of Mines and Geology.* Statewide Suitability Analysis for Managed Aquifer Recharge (MAR) using Surface Infiltration Methods

5 min transition

2:40 PM ***Sara Eldridge,*** *U.S. Geological Survey.* Assessing Restoration Effectiveness of the Vermilion River in Northwestern Montana: a collaboration between the USFS and USGS

3:05 PM **BREAK** - ***Poster presenters may set up now***

3:20 PM ***Samantha Tappenbeck,*** *Flathead Conservation District.* Impacts of Recreational Boating and Corresponding Wave Energy on the Lake-Influenced Flathead River

5 min transition

Session 4
Water Quality (continued)

Moderator: Cam Carstarphen, MBMG and Seth Siefken, USGS

2:15 PM ***Brianna Elizondo,*** *Flathead Biological Station.* Year Four of Monitoring Montana Waters (MMW): A Flathead Lake Biological Station program supporting watershed monitoring.

5 min transition

2:40 PM ***Gregory Clark,*** *U.S. Geological Survey.* Post-fire Sediment Connectivity and Phosphorus Response in Two Central Montana Watersheds.

3:05 PM **BREAK** - ***Poster presenters may set up now***

3:20 PM ***Jack Poole,*** *Montana State University.* Understanding nitrate processing in agricultural stream corridors using electrical resistivity tomography (ERT) and salt tracer experiments in riparian aquifers.

5 min transition

TECHNICAL SESSIONS (Blue text indicates student presenters.)

3:45 PM ***Andy Efta,*** *USDA Forest Service.* Wildfire risk to municipal water supplies sourced from National Forest System lands in Montana: Planning status overview, future approaches, and key takeaways for informed decision making.

5 min transition

4:10 PM ***David Busby,*** *River Design Group.* Impairments to Fluvial Processes and Development of Restoration Strategies on a Dam-Influenced Reach of the Madison River, Montana

5 min transition

Session 5
Pollution Ecology

Moderator: Atilla Folnagy, DNRC

4:35 PM ***Benjamin Coleman,*** *University of Montana, Forestry.* The influence of submicron particles on metal and metalloid accumulation by periphyton and benthic macroinvertebrates

5 min transition

5:00 PM ***Rachel Malison,*** *Flathead Biological Station.* Linking research to conservation actions to help improve efforts to reduce pesticide pollution in surface waters

5 min transition

3:45 PM ***Joe Griffin,*** *Montana Technological University.* Using 30 years of water quality and biological monitoring data to gauge the success and limitations of the Superfund cleanup of mining damaged Silver Bow Creek, Butte, Montana

5 min transition

4:10 PM ***Mary Sutherland,*** *Montana Bureau of Mines and Geology.* Exploring Groundwater and Surface-Water Connections Using Temperature and Water Supply in the Big Hole River Near Glen, MT

5 min transition

Session 6
Water Quality (continued)

Moderator: Andy Bobst, MBMG

4:35 PM ***Caitlin Mayernik,*** *Montana State University* Pathways of sulfate mobilization, production, and loss across stream corridors draining cultivated soils in central Montana

5 min transition

5:00 PM ***Meghan Robinson,*** *Montana State University.* Soil texture and seasonal changes in soil structure control deep percolation and nitrate leaching risk in an irrigated cropping system

5 min transition

5:30 - 8:00 PM **Social Hour + Poster Session: Heavy hors d'oeuvre, Beer and Wine**

POSTER SESSION

Aquatic Biology

Jonathan Shikany, *Montana State University.* Characterizing the colonization of pathogenic free-living amoeba and associated microbial communities in the Greater Yellowstone Ecosystem

Climate

Karin Hilding, *City of Whitefish.* Climate Resiliency Planning: an EPA Whitefish Case Study

Ecology

Bryanna Angood-Hardy, *National Ecological Observatory Network, Battelle.* NEON in the Northern Rockies: Aquatic Data and Resources to Understand Changing Ecosystems

Michelle Fillion, *USGS.* Exploring metal/metalloid transfer across aquatic-terrestrial interfaces: impacts of mining activities on macroinvertebrates and ecosystem health in the Clark Fork River and Kootenai River/Lake Koocanusa basins, Montana.

Jacob McArtor, *University of Montana.* Wildfire Effects on Heavy Metal Concentrations in Streams and Benthic Macroinvertebrate Communities

Emma Tate, *Montana State University.* Microbial mediation of water quality in a central Montana agricultural landscape

Geomorphology

Riley Henson, *University of Montana.* Extreme Flood Response in East Rosebud Creek and Global Fluvial Geomorphic Resilience

Groundwater

Shawn Kuzara, *MBMG.* Quantification of groundwater recharge from flood- and pivot-irrigated fields

Caroline Martin, *Montana State University.* Evaluating Wildfire Effects on Groundwater Quality

Evan Norman, *DNRC.* Basin Studies and Groundwater Monitoring; Providing Evidence Based Solutions for Water Resource Issues

Rachel Suhs, *Missoula Valley Water Quality District.* Long-term Nitrate Trends in the Target Range Area of the Missoula Aquifer

Hydrology

Katherine Chase, *USGS.* Climate and Hydrology for The International St. Mary and Milk Rivers Study in Montana, US and Alberta and Saskatchewan, Canada

Raeya Gordon, *Montana State University/DNRC.* Quantifying Deep Percolation and Soil Water Storage on Irrigated Fields

Management and Restoration

Jake Atkinson, *DEQ.* Clean Water Act Section 319 Restoration Project Effectiveness Reviews - Lessons Learned

Kaitlin Boren, *DNRC.* Effects of CCAA streamflow management and riparian ecosystem restoration on water temperatures and species abundance in Steel Creek, a major spawning and rearing tributary of the Big Hole River for Montana Arctic grayling.

Tera Ryan, *Montana Salinity Control Association.* Planting for a Change: Land Use, Saline Seeps and Shallow Groundwater Interactions

Audrey Wright, *Montana Conservation Corps.* How Montana Conservation Corps Is Working to Mitigate the Impacts of Climate Change on the Region's Water Resources

Modeling

Bruce Boles, *Montana State University.* Unique Challenges and Potential Solutions for Surface Water Models in High Relief, Mountainous Catchments with Vulnerable Alpine Glaciers

Harrison McGillen, *University of Montana.* 3D Modeling of Changing Precipitation Type and its Impact on Mountainous Groundwater at a Watershed Scale

Monitoring

Rodney Caldwell, *USGS.* U.S. Geological Survey National Groundwater Climate Response Network

Camela Carstarphen, *MBMG.* Delivering Montana Bureau of Mines and Geology's Ground Water Characterization Data within an Interactive Map Environment, Lincoln and Sanders Study Area Data Map

Sara Edinberg, *MBMG.* 30 Years of Groundwater Monitoring at Montana Bureau of Mines and Geology

POSTER SESSION

Ann Hanson, *MBMG.* Exploring 30 Years of Montana Groundwater Quality Data with Censored Statistics

Brian Hogenson, *CSKT Tribes.* CSKT Groundwater Monitoring Network

Ashley Peterson, *DNRC.* Montana Stream Gage Network

Drew Shafer, *Gallatin Local Water Quality District.* The State of the GLWQD's Surface Water Monitoring Network

W. Adam Sigler, *Montana State University.* Linking datasets and partners to characterize increasing nitrate in Gallatin Valley groundwater

Water Quality

Haylie Brown, *USGS.* Conceptual approach for identifying drainages of co-located legacy mine sites and possible future burn areas as compounding risk factors to water quality in Montana

Jack Buban, *Gallatin River Task Force.* Analysis of Long Term Water Quality Trends in the Upper Gallatin River Watershed near Big Sky, Montana

Madisan Chavez, *Montana State University.* Investigating water quality at Chief Plenty Coups Spring near Pryor, Montana: A fifty-year legacy of wastewater management and cultural significance

Russell Conti, *Montana State University.* Tracking a Watershed's Nutrients Across Time and Space in a Quickly Developing Mountain West Community

Sonny Gray, *Aaniiih Nakoda College.* Impacts to Water Quality from the Mining in the Little Rocky Mountains in streams on the Fort Belknap Reservation, Montana

Michelle Hornberger, *USGS.*

Nicklas Kiekover, *Montana State University.* Characterizing Risk for Contaminants of Emerging Concern in Montana Water Supplies

Hannah Riedl, *DEQ.* Fresh plan for freshwaters: Updating the Nonpoint Source Pollution Management Plan

Weslyn Schilling, *Aaniiih Nakoda College.* Source Water Assessment for Snake Butte Spring as Drinking Water Source for Fort Belknap Community

Matthew Smith, *MBMG.* Geochemical Evidence Against Oil Brine Contamination in North Willow Creek, Fergus, Petroleum and Musselshell County Montana

Vicki Watson, *University of Montana.* Long term trends in nutrients and attached algae levels in the Clark Fork River

FRIDAY, OCTOBER 11

TECHNICAL SESSIONS (Blue text indicates student presenters.)

7:30 AM Registration Opens - Gather early for Coffee and Conversation with Colleagues

Session 7
Hydrology

Moderator: Rachel Malison, Flathead Biological Station

8:00 AM ***Jeremy Crowley,*** *University of Montana.* UAS Research for Water Resources

5 min transition

8:25 AM ***James Swierc,*** *Aaniiih Nakoda College.* Preliminary Isotope Hydrology of Water Resources of the Little Rocky Mountains and Fort Belknap Reservation, Montana.

5 min transition

8:50 AM ***Casey Ryan,*** *Confederated Salish & Kootenai Tribes.* Adaptive Water Management on the Flathead Reservation: Balancing Instream Flows and Irrigation in a Changing Climate

9:15 AM **BREAK**

Session 8
Ecology

Moderator: John LaFave, MBMG

8:00 AM ***Nate Heili,*** *Montana State University.* Irrigation ditches as novel intermittent stream networks that provide energetic subsidies to terrestrial ecosystems via aquatic insect emergence

5 min transition

8:25 AM ***Matt Trentman,*** *University of Montana.* How should we quantify and measure fine woody debris in streams?

5 min transition

8:50 AM ***Dylan White,*** *University of Montana* Elevated nutrient concentrations affect the accumulation of metals in periphyton and invertebrates in artificial streams

9:15 AM **BREAK**

Session 9
Hydrology (continued)

Moderator: Dave Saba, DNRC

9:30 AM ***Zachary Holyman,*** *Montana Climate Office.* Identifying Future Hydrologic Changes to Montana's Rivers and Creeks

5 min transition

9:55 AM ***Seth Siefken,*** *U.S. Geological Survey.* 1964 Northwest Montana Flood 60th Anniversary – Study of an Extreme Flood Event

5 min transition

10:20 AM ***David Ketchum,*** *U.S. Geological Survey.* Increasing irrigation water use affects sustainability of streamflow in the western United States

5 min transition

10:45 AM ***Sam Carlson,*** *Clark Fork Coalition.* Interactions between streamflow and air temperature drive spatial and temporal stream temperature patterns

Session 10
Groundwater

Moderator: Melissa Schaar, USGS

9:30 AM ***Zachary Holden,*** *USDA Forest Service.* Potential drivers of groundwater declines and increasing vulnerability in the wildland urban interface of western Montana

5 min transition

9:55 AM ***Elizabeth Meredith,*** *Montana Bureau of Mines and Geology.* MBMG GWIP Study of the Billings Aquifer

5 min transition

10:20 AM ***Brett Oliver,*** *Montana Bureau of Mines and Geology.* A Groundwater Budget for the West Billings Aquifer System

5 min transition

10:45 AM ***Adam Sigler,*** *Montana State University.* Cumulative Human Health Risk from 19 Contaminants in Montana Groundwater

TECHNICAL SESSIONS (Blue text indicates student presenters.)

5 min transition

11:10 AM **John Lunzer,** *Montana Department of Natural Resources and Conservation*. Who gives a flux about the vadose zone?

11:35 AM **BREAK**

Session 11
Collaboration and Communication

Moderator: Tom Michalek, Alpine Engineering

11:50 AM ***Kevin Krogstad,*** *Montana Department of Environmental Quality*. Presenting Science: Effective Technical Presentations

5 min transition

12:15 PM ***Ty Williams,*** *Wildlands Engineering, Inc.* From Big Sky to Coastal Shores: Navigating Water Resources Across Diverse Landscapes

5 min transition

12:40 PM ***Stephanie Murphy,*** *Western Montana Conservation Commission*. Western Montana Conservation Commission: Collaboration & Education for Water Resource Protection

5 min transition

1:05 PM ***Jared Glass,*** *Flathead Lake Biological Station*. Developing the Montana Pesticide Stewardship Partnership Program (PSPP)

5 min transition

11:10 AM ***Daniel Buckley,*** *Montana Bureau of Mines and Geology*. On declining groundwater levels in the Bitterroot Valley

11:35 AM **BREAK**

Session 12
Modeling

Moderator: Matthew Trentman, University of Montana

11:50 AM ***Andrew Bobst,*** *Montana Bureau of Mines and Geology*. Developing a Numerical Groundwater Flow Model for the East Flathead Valley

5 min transition

12:15 AM ***David Saba,*** *Montana Department of Natural Resources and Conservation*. 2D Or Not 2D? Use of a 2-Dimensional Hydraulic Model for Indirect Discharge Estimation and Other Applications in Stream Gaging

5 min transition

12:40 PM ***Kurt Zeiler,*** *Montana Bureau of Mines and Geology*. Application of the USGS Soil-Water Balance (SWB) Model to Estimate Groundwater Recharge in Western and Eastern Montana

5 min transition

1:05 PM ***Joshua Erickson,*** *USDA Forest Service* How much dirt is in the creek? A probabilistic approach to assessing sediment delivery risk to waterbodies on National Forest System lands in western Montana

1:30 PM **Closing Plenary:** New Officer, Student Awards, Next Year's Location

KEYNOTE SPEAKER 1

CLIMATE CHANGE INFLUENCES ON FIRE AND WATER IN MONTANA: UNDERSTANDING THE PHYSICAL DRIVERS OF CHANGE

Charles Luce, Research Hydrologist for the US Forest Service Rocky Mountain Research Station

The effects of climate change are often felt most strongly through changes in water. Across the Northern Rockies and Plains, the pathways through which climate change affects water resources are diverse and complex, which can make it challenging to interpret climate services that provide planners and decision-makers with projections of expected changes for ecosystems and water. In this context, it helps to see and understand the physical processes underlying the expected changes, such as whether they are thermodynamic, dynamic/circulatory, or cascading in nature, to shape a sense of certainty around the projections, and devise adaptive approaches. The most certain effects of a changing climate are warming temperatures, which in turn drive changes to snowpacks, precipitation intensity, and evaporative demand. Precipitation changes are broadly, less certain in General Circulation Models, but because precipitation changes are fundamental to hydrologic outcomes, understanding the processes can help identify what projections are robust, and where surprises should be considered. Changing summer precipitation regimes and warming temperatures are fundamental to worsening fire seasons, which in turn drive further changes to streamflow and water quality. This presentation steps through different climatic and hydrological processes that are evolving under a changing climate to increase the understanding and utility of hydrological climate services in the Northern Rockies.

Charlie Luce is a Research Hydrologist for the US Forest Service Rocky Mountain Research Station in Boise, Idaho. He works on a wide range of issues related to forest-water relations and aquatic ecosystems in forests, including climate change, snow hydrology, drought, wildfire occurrence and effects, forest roads, stream temperature, and groundwater-surface water interactions. He has authored or co-authored more than 95 refereed journal articles along with more than 45 book chapters, agency reports, and books. He is a former Editor of Water Resources Research and a Fellow of the American Geophysical Union.

KEYNOTE SPEAKER 2

WILDFIRES IN WATERSHEDS: WHAT DETERMINES THE WATER-QUALITY RESPONSE?

Sheila Murphy, Research Hydrologist with the USGS Water Mission Area

Wildfires are a natural process in many ecosystems, but in recent decades have increased substantially in size, severity, and frequency in the western U.S. and many other parts of the world. After a wildfire, loss of canopy vegetation and changes to soil properties can lead to increased overland flow during rainfall. As a result, flooding, erosion, and the movement of sediment, ash, and debris into surface water can damage infrastructure, increase treatment costs for drinking water providers, and impair stream ecosystems. The nature and extent of post-wildfire water quality effects vary widely, from no observable change to massive increases in the concentrations and loads of sediment, nutrients, and metals in downstream receiving waters. Post-fire water quality depends on many factors, including wildfire characteristics (burn severity, size), post-fire precipitation regime (snow or rain; short, high intensity vs. long, low intensity); and watershed characteristics (slope, geology, vegetation). In addition, land use (both historical and current), can contribute to impacts associated with post-wildfire water quality. Critical gaps in our understanding of drivers and processes that determine post-wildfire impacts on water supplies must be resolved and incorporated into models and assessments. This presentation will describe recent advances in understanding critical drivers of post-fire water quality, with a focus on the intersection of wildfire and legacy mining waste. Given the wide range of potential post-wildfire effects on water supplies, water providers and land managers need accurate guidance on what to expect in their watersheds to enable plans for minimizing impacts on water supplies.

Sheila Murphy is a Research Hydrologist with the USGS Water Mission Area, in boulder CO. Sheila's research focuses on how disturbances (such as wildfire, floods, and land use change) alter watershed response, water quality, and water quantity. Her recent research has evaluated the effects of wildfire on water quality in the western U.S., and the hydrologic and geochemical responses to land cover change and hurricanes in a tropical forest in Puerto Rico. In 2023 Sheila received a Superior Service Award from the Department of the Interior for making fundamental advancements in the understanding of water quality impairment following wildfires.

KEYNOTE SPEAKER 3

WILDLAND FIRE IMPLICATIONS FOR DRINKING WATER

Amanda Hohner, Assistant Professor in the Department of Civil Engineering at Montana State University

The rise in wildfire activity in municipal watersheds has created new uncertainties, unprecedented challenges, and substantial costs for drinking water utilities. Wildfires generate natural benefits to ecosystems, however, severe fires quickly transform forest floors, char vegetation and soils, and create a landscape susceptible to post-fire erosion and runoff to nearby surface waters serving as drinking water supplies. Consequently, source water quality can be highly variable and drastically altered following fire. For instance, increases in turbidity, nutrients, and dissolved organic matter (DOM) have been observed, all of which challenge water treatment process performance and the delivery of safe drinking water to consumers. Large municipalities have experienced wildfires near source waters, while small, single source water systems in fire-prone areas also face substantial risks, but may lack treatment flexibility and watershed monitoring programs, and may have fewer staff and operational resources. The goals of this research aim to connect post-fire source water quality to drinking water consequences, including the impacts on treatment processes (e.g., design upgrades, chemical dosing) and finished water quality. The key takeaways from several projects conducted in collaboration with water utilities that have experienced wildfires in their source watersheds will be summarized. Areas of emphasis include post-fire alterations to DOM quantity and quality, DOM removal by coagulation treatment, and regulated and unregulated disinfection byproduct (DBP) formation. In addition, more recent work has focused on investigating wildfire ash physicochemical properties, particle stability, and turbidity treatability. Lastly, a transdisciplinary project with the overarching goal of increasing the resiliency of water systems to wildfire will be discussed. Collectively, our research aims to inform decision making by drinking water utilities as they prepare for and respond to wildfire.

Amanda Hohner is an assistant professor in the Department of Civil Engineering at Montana State University. She completed her M.S. and Ph.D. degrees in Environmental Engineering at the University of Colorado-Boulder and received her B.S from Washington State University. Her primary area of expertise focuses on the characterization of source water quality and drinking water treatment processes. Within this area, she evaluates the effects of climatic disturbances on watersheds and drinking water system resiliency.

KEYNOTE SPEAKER 4

BUILDING CLIMATE PREPAREDNESS THROUGH ENHANCED SOIL MOISTURE MONITORING

Kelsy Jencso, State Climatologist and is the W.A. Franke Endowed Chair in Watershed Hydrology

Climate change and the increasing frequency of droughts and floods accentuate the need to accurately characterize soil moisture for early warning and optimization of decisions across scales. Accessible soil moisture information plays a critical role in drought and flood forecasting, agricultural monitoring, forest fire prediction, water supply management and other natural resource activities. Here, I'll discuss the Montana Climate Office's work to build new soil moisture monitoring infrastructure, validate existing soil moisture models, and to develop new high-resolution models for more accurate predictions of water supply. At the point scale, the Montana Mesonet reports soil water content and potential at 5, 10, 20, 50, 100 cm depths every five minutes at 161 weather stations. By 2027 this network will be expanded to ~300 stations. These new point data provide critical information for operational forecasting as well as validation and selection of the best soil moisture models for drought assessment (e.g., SPoRT, SMAP L4 and Topofire). Further, new data assimilation approaches and artificial intelligence models show promise for resolving soil moisture dynamics at unprecedented scales. Leveraging in-situ point data from the Mesonet, satellite data and improved meteorological information, we are taking critical steps towards improved decision making when soil moisture is of concern.

Kelsy is the W.A. Franke Endowed Chair in Watershed Hydrology and State Climatologist. His basic research focuses on factors impacting water movement from uplands to streams in mountain watersheds and characterizing how forests respond to water limitations. At the Montana Climate Office, Jencso directs a team that builds science-based tools, observations, models and education designed to bolster Montana's ability to respond to climate change.

SPECIAL SPEAKER

MONTANA WATER CENTER UPDATE

Stephanie Ewing, Director, Montana Water Center

Stephanie Ewing is the Director of the Montana Water Center, and a professor in the Department of Land Resources and Environmental Sciences at Montana State University. She directs the Soil Biogeochemistry Lab- oratory and Environmental Analytical Laboratory and is broadly interested in soil-groundwater-surface water connections with an emphasis on water quality related to land use. As Montana Water Center Director, she is interested in championing collaborative approaches to water related research across the Montana University System and Montana's diverse network of water resource professionals.

WATER LEGEND

Vicki Watson, Professor Emeritus, Environmental Studies University of Montana

If there was a single individual that best reflects Missoula's recent decades of success in stewardship, conservation and community, Vicki Watson is someone who should come to all of our minds. Born and raised on a creek in a Texas blackland prairie farm, she earned a B.A. in Biology at the University of Houston, and an M.S. and PhD in Aquatic Systems Ecology at the University of Wisconsin, studying the lakes & rivers of Wisconsin.

Dr. Watson served as a professor at the University of Montana for 35 years where she taught over 20 different courses, including environmental science, applied & pollution ecology, impact assessment, watershed conservation and sustainability science. She has directed over 90 MS graduate committees and served on over 100 other graduate committees. Advised over 50 undergraduates, directed hundreds of internships, senior honors theses, and independent study projects. Her former students have gone on to make waves as public interest scientists, educators, stewards, policymakers, and non-profit organizers throughout the US.

Vicki assisted Montana's Department of Environmental Quality in characterizing Montana lakes and streams, while also working with other scientists to develop nutrient criteria guidance documents for the EPA and nutrient standards for Montana – some of the first in the US. And she served on state and local task forces where she advocated for watershed CPR (conservation, preservation & restoration). With grants from the USEPA, Forest Service and Geological Survey, Vicki researched the fate of heavy metals and cyanide leaching from abandoned mines and environmental fate of herbicides used in roadside weed control.

Now 'retired', Vicki continues to serve her Missoula community – leading community dances, producing newsletters & jobs notices for UM Environmental Studies students, organizing volunteers for service days, and continuing studies of the Clark Fork River and other streams. Her generosity and kindness extends beyond the planet to people, often offering housing or needed equipment to current and former students, providing local events with home-baked goods or produce from her garden, and contributing regularly to local fundraising.

Vicki's efforts have not gone unnoticed. During her time at UM, she received UM's Distinguished Teaching Award (1992), Service Learning Fellowship (1998), Greening UM award (2006), and Outstanding Service to Students Award (2015). Other accolades for her service include the Clark Fork Coalition's Dedicated Conservationist Award (1988), Missoula YWCA's Professional Woman of the Year (1991), Missoula Conservation Roundtable's Arnold Bolle Conservation Professional Award (1996), MT Natural History Center's Environmental Educator of the Year (2007), Missoula Sustainable Business Council's Sustainability Advocate of the Year (2011), Western Montana Conservation Commission's Water Steward (2024) and Montana chapter of American Water Resources Association's Water Legend (2024)!

In her own words: "I retired from the university but not from watershed keeping. I thank all these rivers for helping satisfy my thirst for life." Those that benefit from the watersheds she has helped conserve for decades, have her to thank.

HYDROPHILE 3-Mile run

Feel free to join us on Wednesday after the field trip at 6 p.m. for the annual AWRA Hydrophile 3-mile run or casual run/walk that will start and end in front of the Grouse Mountain Lodge. The course map can be found below and a description of the course can be found on the MapMyRun link here: https://www.mapmyrun.com/routes/view/6254422234/. The route will not be marked but it's pretty easy to follow. This year's first place finisher will receive a "Major Award"! Cold refreshments (beers!) will be available after the run for all that participate.