Proceedings

for

Historic Opportunity on a Historic Landscape

American Water Resources Association Montana Section 2022 Conference

October 12 - October 14, 2022
Copper King Hotel, Butte, MT

Contents

**Link to oral and poster presentation abstracts on MT AWRA website*

THANKS TO ALL WHO MAKE THIS EVENT POSSIBLE!

- **The AWRA Officers**
  Brent Zundel, President -- Montana Dept of Natural Resources and Conservation, Bozeman, MT
  Tom Michalek, Vice President -- RESPEC, Butte, MT
  Lou Volpe, Treasurer -- Montana Dept of Environmental Quality, Helena, MT
  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.

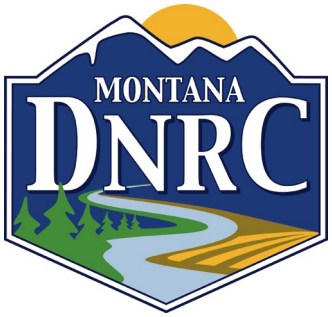

Brent Zundel


Tom Michalek


Lou Volpe


Nancy Hystad

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



WEDNESDAY, OCTOBER 12, 2022

REGISTRATION

8:00 am – 6:00 pm - Registration available at the Copper King. Preconference registration is preferable and is available through the MT AWRA website.

MORNING WORKSHOP

9:30 – 11:30 am **CRITICAL ISSUES TOPICAL WORKSHOPS** (*concurrent; please register; coffee provided*)

Drought Management: Where Science Meets Action
Moderator: Kristal Jones, JG Research and Evaluation

Groundwater-Surface Water Interactions and Related Adaptation Strategies
Moderator: Karen Filipovich, Bozeman, MT

LUNCH, FIELD TRIP, HYDROPHILE RUN, and PINT NIGHT

12:00 pm Sack **LUNCH** provided to all field trip attendees

12:00 pm – 5:00 pm **FIELD TRIP** - Depart Copper King promptly at 12 PM noon. (*Please register; space is limited. If you have a personal hard hat, bring it.*) A behind-the-scenes look at active mining operations and water treatment in the Continental Pit, a trip to Butte's Basin Creek Dam to hear about Butte's drinking water system and the planned dam safety rehabilitation, and a tour of the unique Basin Creek water treatment plant

5:30 pm **HYDROPHILE 5K WALK/RUN** - departs and finishes at the Copper King Hotel; route map here

6:00 pm **PINT NIGHT** at Slainte Butte America Pub (8 S Montana St, in Uptown)

THURSDAY, OCTOBER 13, 2022

REGISTRATION

7:30 am REGISTRATION, COFFEE, AND CONVERSATION

OPENING DAY PLENARY SESSION

8:00 am WELCOME WITH INTRODUCTIONS, LOGISTICS, AND ANNOUNCEMENTS
Brent Zundel - *AWRA Montana Section President*

8:10 A MESSAGE FROM THE MONTANA WATER CENTER
Stephanie Ewing - *Montana Water Center, Director*

8:25 LEGISLATIVE UPDATE
Jason Mohr - *Research Analyst, Montana Legislative Environmental Policy Office*

8:45 PLENARY SESSION 1: Communicating Clean-up: Engaging the Public in Technical Decision-making
Julia Crain - *Department of Reclamation and Environmental Services, City and County of Butte Silver Bow*

9:30 BREAK with light refreshments

9:45 PLENARY SESSION 2:The Unique Aspects of Hydrology for Dams
Michele Lemieux*, P.E. - MT Department of Natural Resources and Conservation, Dam Safety Program*

10:30 BREAK

10:45 PLENARY SESSION 3: Natural Resource Damages in the Upper Clark Fork River Basin and the Effort(s) to Restore the Injuries
Doug Martin - *Restoration Program Chief, Natural Resource Damage Program*

11:30 WATER LEGEND ANNOUNCEMENT

12:00 LUNCH (p*rovided to all conference attendees)* and FLASH TALKS

LUNCH FLASH TALKS - Eat and learn!

Sara Eldridge, *US Geological Survey*, Microbiological Applications for Water Resource Investigations in Montana

Ashley Bussell, *US Geological Survey WY-MT Water Science Center*, Aquatic-terrestrial linkages of the Upper Columbia River Basin watershed

Jeff Dunn, *WGM Group*, Contemplating Management of Riparian Areas as a Public Resource

TECHNICAL SESSIONS: ORAL PRESENTATIONS (**Blue text indicates student presenters**)

SESSION 1 (Concurrent)
GROUNDWATER

Moderator: Nick Banish, *Gallatin Local Water Quality District*

1:00 pm ***Nicholas Dugan***, *Environmental Protection Agency,* Microbial Characterization of Shallow Well and Spring Water Collection Systems in Yellowstone National Park

1:25 ***Andrew Bobst***, *Montana Bureau of Mines and Geology*, Thickness of the Deep Aquifer and Character of the Underlying Sediments in the Flathead Valley

1:50 ***Todd Myse***, *Montana Bureau of Mines and Geology.* Hydrogeologic Investigation of the Hamilton, Montana Area: Some Preliminary Results

2:15 ***Skye Keeshin***, *Montana State University,* Geochemical Signals of Solute Loading and Mixing below a Reclaimed Surface Coal Mine

2:40 ***James Swierc***, *Aaniiih Nakoda College*, North Helena Valley Groundwater Conditions, 2021

3:00 ***BREAK*** *with light refreshments*

SESSION 2 (Concurrent)
WATER QUALITY

Moderator: Daniel March, *HDR Engineering*

1:00 pm ***Ann Hanson***, *Montana Bureau of Mines and Geology*. Is Manganese in Montana's Groundwater a Concern? – An Evaluation of Manganese in Montana's Basin-Fill and Alluvial Aquifers

1:25 ***Claire Kirk***, *Monitoring Montana Waters*. Year Two of Monitoring Montana Waters (MMW): About Us and How to Get Involved

1:50 ***Kylie Bodle***, *Montana State University,* Pharmaceutical effects on aerobic granular sludge: morphology and treatment capacity

2:15 ***Abbie Ebert***, *Montana Dept of Environmental Quality,* The prevalence and magnitude of per- and polyfluoroalkyl substances (PFAS) in surface water in at-risk areas of Montana

2:40 ***Christopher Ellison***, *US Geological Survey,* Application of Surrogate Technology to Predict Real-Time Metallic-Contaminant Concentrations and Loads in the Clark Fork during Superfund Remediation Activities at Grant-Kohrs Ranch National Historic Site near Deer Lodge, Montana

3:00 ***BREAK*** *with light refreshments*

THURSDAY, OCTOBER 13, 2022 (continued)

SESSION 3 (Concurrent)
MANAGEMENT & RESTORATION

Moderator: Elena Evans, *Missoula Valley Water Quality District*

3:25 pm — ***Sharon Brodie**, Four Corners Foundation,* Gilly: Software for Processing Permits and Mapping Data for River Conservation

3:50 — ***Sarah Church & Adam Sigler**, Montana State University,* Social Outcomes from Community/Volunteer Collected Water Data in Montana

4:15 — ***Wendy Weaver**, Montana Freshwater Partners,* Thinking Outside the Box: Watershed Solutions for Wetland and Stream Mitigation in Montana

4:40 — ***Daniel March**, HDR Engineering,* The Nelson Dam Removal Project: Improving Reliability and Resiliency of Public Infrastructure, Water Supply, and Ecological Habitat Restoration

5:05 — ***Jamie McEvoy**, Montana State University,* Murky Waters: Divergent Ways Scientists, Practitioners, and Landowners Evaluate Beaver Mimicry

5:30 — ***BREAK & POSTER SET UP***

SESSION 4 (Concurrent)
WATER QUALITY *(continued)*

Moderator: Amos Taiswa, *Montana Tech*

3:25 pm — ***Meryl Storb**, USGS WY-MT Water Science Center,* Trends in concentrations and loads of Selenium, Nitrate, and Sulfate for the two major tributaries and the outflow of Koocanusa Reservoir

3:50 — ***Tasnim Sultana Ritu**, Montana State University,* Analyzing the performance of aerobic granular sludge to reduce PFAS and conventional nutrients from wastewater in sequencing batch reactors

4:15 — ***Riley Logan**, Montana State University,* UAV-Based Hyperspectral Imaging for Algal Bloom Identification and Pigment Estimation in the Upper Clark Fork River

4:40 — ***Joe Griffin**, Montana Technological University,* What can Salish oral history and thirty years of intense environmental water quality monitoring tell us about the current health of Silver Bow Creek?

5:05 — ***Ronald Breitmeyer**, Montana Bureau of Mines and Geology,* Changes to Groundwater and Surface-water Nitrate Concentration in the Upper Gallatin River Corridor, Big Sky, MT

5:30 — ***BREAK & POSTER SET UP***

6:00 - 9:00 PM **POSTER SESSION & EVENING SOCIAL**: Heavy appetizers and drinks

7:00 PM **HENDERSON AWARD PRESENTATION & TREASURER NOMINATIONS**

AQUATIC BIOLOGY

***Matt Deyoe**, Montana State University,* Carbon and Nitrogen Isotopes of Aquatic Invertebrates: A New Biological Assessment and Monitoring Tool

***Weslyn Schilling**, Aaniiih Nakoda College,* Using Bioassessments to Collect and Identify Macroinvertebrates in the Milk River on the Fort Belknap Indian Reservation

CLIMATE

***Theodore Barnhart**, US Geological Survey,* Tongue River 2100: Future Tongue River streamflow estimates to enable Northern Cheyenne data-driven water management and planning

COLLABORATION & COMMUNICATION

***Madison Boone**, Montana State University,* Understanding Social Learning in Interdisciplinary Water Quality Research: Case Studies of the Montana Consortium for Research on Environmental Water Systems

***Jennifer Harrington**, Native American Natural Resource Program,* Tribal Consultation Policy And Practice: A Case Study Of The Confederated Salish And Kootenai Tribes And Nmisuletk (The Middle Fork Of The Clark Fork River) As A Tribal Trust Resource

ECOLOGY

***William Hamilton**, US Geological Survey,* Mapping Optimal Restoration Sites for Persistence of Greenback and Colorado River Cutthroat Trout

***Nate Heili**, Montana State University,* Towards quantifying the magnitude and importance of aquatic insect emergence in irrigation canals in Gallatin Valley, MT

GROUNDWATER

***Daniel Buckley**, Montana Technological University,* Comparative analysis of long-term groundwater levels and the Standardized Precipitation Index

***Nick Banish**, Gallatin Local Water Quality District,* Aquifer Chemistry Reveals Patterns in Wastewater Indicators

***David Baude**, University of Montana* Discerning bedrock recharge spatial variability of mountainous watersheds in Montana and relating bedrock recharge to topographic and lithologic characteristics

***Joshua Harris**, MT Department of Natural Resources and Conservation*, Improving State of Montana Groundwater Withdrawal Estimates

***Harrison McGillen**, University of Montana,* The Effect of Evapotranspiration on Fluvial Islands

***James Madison**, Montana Bureau of Mines and Geology*, A high total-dissolved-solid zone in the Tobacco Valley aquifer system, Northwestern Montana

***Sara Edinberg**, Montana Bureau of Mines and Geology*, Hydrogeologic Framework of the Upper Yellowstone River Valley, Park County, Montana

***Joshua Harris**, Montana Technological University,* Groundwater Control Structures of the Flathead Valley, Montana

HYDROLOGY

***David Selkowitz**, US Geological Survey, WY-MT Water Science Center,* A New Machine Learning Approach for Automated Mapping of Irrigation Channel Networks Using High Spatial Resolution Remote Sensing

***Aaron Heldmyer**, US Geological Survey,* Prediction of hydrologic drought conditions for ungaged basins across CONUS using a novel donor-based approach

***Claire Rawlings-Gilder**, University of Montana,* Modeling variable critical shear stress in sediment transport using FastMECH

MANAGEMENT & RESTORATION *(continued)*

Jason Alexander, *US Geological Survey,WY-MT Water Science Center,* Using stakeholder-designed experiments to re-operate a large irrigation diversion dam for the benefit of a trout fishery on the Shoshone River, Park County,Wyoming.

***Katie Fogg**, Montana State University,* Effects of floodplain shading on hyporheic and stream channel temperatures: a restoration case study

***Morgan Suddreth**, Montana State University,* Ecosystem Service Assessment in Rocky Mountain Wetlands

WATER QUALITY

***Ingrid Peters**, Montana State University,* Yellowstone Watershed Cumulative Health Risk Analysis of Drinking Water Contaminants

***Madison Torrey**, Montana State University,* Upper Clark Fork River Remote Sensing and Extinction Spectra

***Sarah Warnke**, Montana State University,* Cumulative Risk Assessment of Drinking Water in Cascade and Lewis and Clark Counties, MT

***Meghan Robinson**, Montana State University,* Community/Volunteer Collected Water Data – A Diamond in the Rough?

***Mari Eggers**, Montana State University,* Human health risk with private well water consumption, Montana

***Sonny Gray**, Aaniiih Nakoda College,* Investigation of Groundwater Resources on the Southern End of the Reservation

***Mace Mangold**, WGM Group,* Manhattan Wetland Restoration And Nutrient Reduction Project

***Madison Foster**, Montana State University,* Hydrologic connectivity and instream nitrate uptake mediate the influence of agricultural stream corridors on stream nitrate loads and concentrations

***Karen Marts**, Stillwater Valley Watershed Council*,The Stillwater Rosebud Water Quality Initiative – Citizen Hydrology in Stillwater and Carbon Counties, MT

***Amos Taiswa**, Montana Technological University,* Electrospun Controlled Release Anti-Quorum Sensing Filter Attachments Prevent Biofouling in MCE Membranes

***Kerri Mueller**, Missoula Valley Water Quality District (Big Sky Watershed Corps)*, Investigating the Source of Bacterial Contamination in the Groundwater of Frenchtown, Montana

FRIDAY, OCTOBER 14, 2022

7:30 am GATHER FOR COFFEE AND CONVERSATION WITH COLLEAGUES

TECHNICAL SESSIONS: ORAL PRESENTATIONS

SESSION 5 (Concurrent)

MANAGEMENT & RESTORATION *(continued)*

and HYDROLOGY

Moderator: Hayley Oakland, *Montana State University*

8:00 am ***Bill Kleindl**, Montana State University,* Which Wetland Assessment Tool is the Best? A sensitivity test of the six dominant Montana assessment tools

8:25 ***Elena Evans**, Missoula Valley Water Quality District,* Smurfit-stone: Is it leaking?

8:50 ***Seth Siefken**, US Geological Survey,* Floods in the Yellowstone River Basin – 140 Years of History

9:15 ***Dan Armstrong**, US Geological Survey,* The US Geological Survey response to June 2022 flooding in Montana and Wyoming

9:40 ***David Ketchum**, University of Montana/MT Department of Resources and Conservation,* Sustainability of Irrigation and Streamflow in the Western United States.

10:00 ***BREAK** with light refreshments*

SESSION 6 (Concurrent) WATER

QUALITY *(continued)*

and CLIMATE

Moderator: Abbie Ebert, *Montana Department of Environmental Quality*

8:00 am ***Marisa Sowles**, Geum Environmental Consulting,* The search for nitrogen sources and solutions in the Lost Creek/ Dutchman Complex

8:25 ***Caitlin Mayernik**, Montana State University,* Riparian corridors control stream concentrations of nitrate and sulfate in semiarid dryland agricultural landscapes of the Judith River Watershed

8:50 ***Amos Taiswa**, Montana Technological University,* Electrospun Controlled Release Anti-Quorum Sensing Filter Attachments Prevent Biofouling in MCE Membranes

9:15 ***Kelsey Jencso**, Montana Climate Office, Navigating the waters ahead – Climate change in MT and monitoring for the seasonal extremes*

9:40 ***Camela Carstarphen**, Montana Bureau of Mines and Geology,* Montana Precipitation Isotope Network (MTPIN): report of pilot network data

10:00 ***BREAK** with light refreshments*

FRIDAY, OCTOBER 14, 2022 (continued)

SESSION 7 (Concurrent)

HYDROLOGY *(continued)*

Moderator: Torie Haraldson, *Gallatin Local Water Quality District*

10:25 ***Roy Sando**, US Geological Survey, WY-MT Water Science Center,* Modeling thirty years of high-resolution annual streamflow permanence in the upper Missouri River basin with PROSPER

10:50 ***Hayley Oakland**, Montana State University,* Net-Spinning Caddisfly Effects on Hyporheic Hydrology in Experimental Stream Mesocosms

11:15 ***Kayla Jamerson**, Montana Climate Office/University of Montan,* Thresholds of Ecosystem Health along the Soil-Plant- Atmosphere-Continuum

11:40 ***Megan Heath**, Montana Bureau of Mines and Geology,* Wye is the groundwater rising? - A Conceptual Exercise in the Hydrogeologic Framework of the Wye/O'Keefe Area

12:05 ***Fin Malone**, Montana Climate Office,* Landscape controls on the soil-plant-atmosphere continuum and spatial patterns of forest growth

SESSION 8 (Concurrent)

COLLABORATION & COMMUNICATION and MODELING

Moderator: Marisa Sowles, *Geum Environmental Consulting*

10:25 ***Sheree Watson**, US Geological Survey, WY-MT Water Science Center,* Collaborations with Indigenous Nations in Water Resources

10:50 ***Chris Kangas**, MT Department of Environmental Quality,* Using GIS to Promote Transparency, Accountability, and Collaboration for Montana DEQ Water Quality

11:15 ***Theodore Barnhart**, U.S. Geological Survey WY-MT Water Science Center,* Multi-Objective Calibration of SnowModel for Water Resources Forecasting, Lake Sherburne Watershed, MT

11:40 ***Shannon Hamp**, Montana State University,* Multispectral imager for detecting algal blooms in rivers

12:05 ***Ali Gebril**, Montana Bureau of Mines and Geology,* Modeling surface and groundwater interaction to study dewatering of the end reaches of Lolo Creek, Montana

12:25 ***Kathy Chase**, U.S. Geological Survey WY-MT Water Science Center,* The International St. Mary and Milk Rivers Study Climate and Hydrology: Past, Present, and Future

12:55 ***CLOSING PLENARY: New Officer, Student Awards, Next Year's Location***

KEYNOTE SPEAKER 1

COMMUNICATING CLEAN-UP: ENGAGING THE PUBLIC IN TECHNICAL DECISION-MAKING

Julia Crain, Department of Reclamation and Environmental Services, City and County of Butte-Silver Bow

As practitioners whose work shapes communities, how can we engage the public in decision making and keep them informed about progress and outcomes throughout a project's duration? In Butte, the recently finalized Consent Decree outlines a body of remedial objectives occurring in residential and commercial neighborhoods throughout the community. Executing remedial design relies on the innovation and creativity of the technical team, and public engagement ensures their work occurring in the places we live and work reflects their interests.This presentation will discuss the Butte Priority Soils Operable Unit Community Engagement Plan and the methodology for public engagement associated with the BPSOU cleanup.

Julia, a Butte native, is a professional planner. Since joining Butte-Silver Bow in 2011, Julia has worked alongside col- leagues and partners to understand the relationship between the technical work of reclamation and restoration and its impact on community quality of life. Her work includes program-related planning, grant writing and project implementa- tion, and administration of the County's redevelopment trust fund which fund local projects that provide public benefits to current and future generations. Julia brings a Master of Urban and Regional Planning from Portland State University (2011) and a Bachelor of Public Affairs from Seattle University (2006) to her work at Butte-Silver Bow.

KEYNOTE SPEAKER 2

THE UNIQUE ASPECTS OF HYDROLOGY FOR DAMS

Michele Lemieux, P.E., MT Department of Natural Resources and Conservation, Dam Safety Program

Ground water hydrology and surface water hydrology take on a different focus when dealing with dams.When talking a storm event, in dams we are often referring to a 10,000+ year storm event.When talking ground-water flow, in dams we focus heavily on the movement of soil particles. With both groundwater and surface water, there is large uncertainty, which plays a significant role in decision making.

This high-level overview of dam hydrology will review several dam failures, noting the hydrologic factors that contributed to the dam failure. The presentation will also summarize approaches in use in the industry to simulate extreme storms, estimate groundwater gradients and the biggest challenge of all - deal with large uncertainty.

Michele Lemieux manages the Montana Dam Safety Program. She has a Master's degree in Civil Engineering and a Bachelors degree in Geological Engineering, both from the University of Utah. She is a registered Professional Engineer. Her expertise is geotechnical engineering, however after 25 years of working with dams, she also has a solid background in extreme storm event hydrology. Michele co-chairs the National Dam Safety Program Research Work Group and the Association of State Dam Safety Officials Dam Design and Construction Committee. On the lighter side, she strives to get in at least 60 ski days a year. She also loves to backpack, bike ride and garden.

KEYNOTE SPEAKER 3

NATURAL RESOURCE DAMAGES IN THE UPPER CLARK FORK RIVER BASIN AND THE EFFORT(S) TO RESTORE THE INJURIES

Doug Martin, Restoration Program Chief, Natural Resource Damage Program

In 1983, the State of Montana (State) filed a lawsuit against the Atlantic Richfield Co. (BP-AR) for injuries to the State's natural resources in the Upper Clark Fork River Basin (UCFRB) which extends from Butte to Milltown. Natural resources injured included aquatic, terrestrial and groundwater resources as well as the lost services associated with these resources.The lawsuit was brought under federal and state Superfund laws and sought damages from BP-AR or these injured natural resources. Decades of mining and smelting by BP-AR and its predecessors in the Butte and Anaconda areas released hazardous substances that injured natural resources and deprived Montanans of their use.The Natural Resource Damage Program (NRDP) pursued the natural resource damage (NRD) litigation against BP-AR on behalf of the Governor, the trustee of natural resources for the State.The State settled this lawsuit through a series of settlement agreements completed in 1999, 2005, and 2008 for approximately $230 million.The NRDP developed seven restoration plans to address the injuries and specific sites within the UCFRB, with public input, that were approved by the Governor following public review and comment.

This talk will provide an overview of the injured natural resources, the restoration plans developed, and the efforts being implemented throughout the UCFRB to restore, replace, or acquire the equivalent of the injured natural resources.

Doug Martin has been with Montana Natural Resource Damage Program (NRDP) since 2001 and the Restoration Program Chief since 2014. Doug has had the opportunity to be involved with the Upper Clark Fork River Basin, Yellowstone River, East Helena, and Upper Blackfoot Mining Complex natural resource damage injury assessments, settlement negotiations, restoration planning and implementation. Doug was also fortunate to be assigned the State's Project Manager for the Milltown Dam removal negotiations to integrate remediation and restoration, where he has worked on the design and implementation of the Milltown restoration actions since 2002. Doug received a B.S. from MSU in Fish and Wildlife Management, 1986 and a M.S. in Environmental Engineering from Montana Tech, 1992. He strongly believes that "WE" implement successful restoration projects, there is no "I" in restore.

SPECIAL SPEAKERS

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 Laboratory 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.

LEGISLATIVE UPDATE
Jason Mohr, Research Analyst, Legislative Environmental Policy Office

Jason Mohr is a research analyst for the nonpartisan Montana Legislative Environmental Policy Office (LEPO). He also serves as staff for the Water Policy Interim Committee. Mr. Mohr has worked for the Montana Legislature 13 ½ years. He has previously worked as a newspaper reporter and editor in Minnesota and Montana, and has degrees in chemistry and journalism.

WATER LEGEND

MIKE ROBERTS, Hydrologist, Montana Department of Natural Resources and Conservation

Mike Roberts was honored as a Montana AWRA Water Legend on October 13, 2022, in Butte, Montana. Mike dedicated 33 years of private and public-sector work to water resources, retiring in 2019. Mike earned a B.S. degree in Geology from Montana State University, and an M.S. degree in Forest Hydrology from the University of Montana.

He began his professional career in Helena in 1987, working as a geologist for Systems Technology for a year, then OEA Research from 1988 – 1998. This work focused primarily on riparian, fluvial geomorphic, and water quality data collection and analysis on streams throughout Montana and neighboring states. He worked on many projects, but one stood out: surveying over 100 Montana streams for 319 non-point source pollution for the (then) Water Quality Bureau in the Montana Department of Health and Environmental Services

Mike began working for the Montana Department of Natural Resources and Conservation (DNRC) as a hydrologist in 1999. He spent the next 20 years of his career working throughout the state, focusing on the Big Hole, Bitterroot, and Blackfoot basins, with additional projects in the Smith and Yellowstone.

He has authored and co-authored several applied articles and technical memoranda relating to agricultural water use, canal conveyance efficiency, hydrologic assessments and studies of various streams, quantification of evapotranspiration, and other topics focusing on water use in Montana.

Mike significantly advanced the Water Commissioner Training Program with excellent presentations and hands-on

instruction which, in turn, has positively affected how water is effectively managed throughout the agricultural community in Montana.

It is fitting that Mike is recognized at a conference in Butte. As perhaps his most recognized contribution, Mike devoted nearly 20 years to streamflow management and monitoring in support of fluvial Arctic Grayling conservation on the Big Hole River. Mike worked directly with Big Hole landowners on strategies that met target flows needed by the fish – especially during low water years – while also enabling ranchers to meet their agricultural needs. Streamflow gaging, water use and availability modeling, and improving irrigation efficiency were some of the tools Mike employed to meet these goals. In 2014, the fluvial Arctic Grayling was removed from the list of potential endangered species candidates, and DNRC was recognized by the US Fish and Wildlife Service for its outstanding contributions to that species' recovery.

In their nomination for Mike, a colleague said, "Mike is a diligent and enthusiastic ambassador of hydrology, water use, and watershed science. He is a great teacher, instructor, and mentor…. He is a dedicated, hard-working field scientist, but also a great presenter and effective mentor and teacher. He is a thorough researcher and technical writer. One of Mike's most important talents is building positive connections between his professional work and the water users, ranchers, and general public in a project area."

Mike has been very active in Montana AWRA, serving as President in 2008. Mike and others introduced the Hydrophile 5K as an annual event. Additionally, he has conducted several plenary sessions and delivered several informative technical presentations at the annual conference.

His volunteer activities include teaching stream hydrology and water measurement for local high schools, Trout Unlimited, and water commissioner trainings. He's a board member of the Tiny Seed Project and volunteer manager for Lewis & Clark County's Vaccination and Testing Clinics.

Post-retirement, Mike says his days are still filled with wading streams and kicking dirt clods across the prairie, but now in pursuit of checking off many Montana outdoor bucket list endeavors. His friends and colleagues said that, "Outside of hydrology, Mike is a talented athlete, great guitar player, and good guy in general." If you're in Helena, make sure to catch one of Mike's gigs with Darkhorse or Uncle Cousin.