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Congrats Graduates and Happy Holidays to All!

Please enjoy perusing this fall's departmental newsletter highlighting some of LRES' many research, teaching, and service pursuits. Our graduating seniors did an incredible job on their Fall Capstone Project; they explored the environmental effects of rapid development in Gallatin County and the local water supply (see more on page 10). The department extends its deepest congratulations to our graduates for your remarkable accomplishments in graduating this semester! Our best wishes to you in your future endeavors. Please keep asking questions, stay in touch, and be well.

- Tracy Sterling, Professor & Department Head, LRES

New Faculty



Adam Sigler, Assistant Professor & Water Quality Extension Specialist



Manbir Rakkar, Assistant Research Professor, Soil Acidification

Frank Dougher, Environmental & Geopatial Sciences Instructor

Manbir Rakkar

I grew up in a small village of India. As far as I can recall, during my childhood I used to explore my surroundings using scientific principles that I was learning in the school. My teachers were happy to see my potential to become a scientist whereas my siblings were always annoyed with me because of all the scientific details that I use to bombard on them. Anyhow, my career goals during childhood varied from aspiring to be a science teacher, a fighter pilot, and an astronaut. But as I was growing, I started noticing the hardships of farmers and communities experiencing setbacks from soil and water exploitation. Therefore, I chose to pursue a bachelor's degree in agriculture to better understand our agriculture systems and serve the farm community.

I thought that adding fertilizers in appropriate amount was the most important question of growers, leading me to pursue my master's in soil sciences with a focus in nutrient management at North Dakota State University. During my master's program, I realized that soils are complex and learning only about soil chemistry won't be sufficient. Luckily, I got involved in an integrated crop livestock project for my PhD which widened my vision to utilize interdisciplinary approaches to improve soil productivity. I got hands-on experience on soil chemistry, physics and microbiology. Due to my academic background, now I use a combination of field, lab, and modeling techniques to correlate soil processes under a given set of management scenarios. Due to my research background in soil physics, chemistry and biology, I evaluate all these components of soil to develop best management practices that holistically take into account crop-soil systems. During my postdoc, I utilized my soil research experience to evaluate the soil health benefits of a novel perennial grain crop-Kernza.

I moved to Bozeman as an Assistant Research Professor in September 2021. Growing up in the plains region of India and working in the Midwest US for eight years, you can probably imagine my excitement after seeing the landscape beauty of this region. I have been enjoying my long field trips to sample soil in Montana. In this position, I will be working to mitigate, prevent and adapt to soil acidification. The overarching goal of my research will be to improve soils using multi-disciplinary approaches, serve the farm community and create a healthy agro-ecosystem.

In my spare time, I like to spend time with my family and do outdoor activities with my toddler. My hobbies include traveling and watching movies. I like to do thrilling activities (e.g., sky diving), whenever and wherever possible. This winter, I am looking forward to learning to ski.

Adam Sigler

I did most of my growing up in Logan Utah, just down the hill from Utah State University where my dad had gone to school and my grandfather had been a professor. I moved to Texas with my family while in high school and my grandfather passed away back in Logan during that time. So, after graduation it made sense for me to move back to Logan, live with my grandma and attend USU. This gave me the opportunity to learn what an incredible woman my 85 year-old grandmother was and to live in a house filled with 50 years-worth of tools, books, and gadgets my grandfather had accumulated.

I started at USU in Environmental Engineering, but transferred into the Watershed Science degree two years later after being captivated by an elective Watershed Science course. The transfer landed me in the College of Natural Resources where my grandfather had been



a department head, prompting some to say I had "come back from the dark side" due to a historic rivalry between the colleges. I think the Watershed Science degree was relatively new and didn't have a lot of enrolled students yet. During my senior year, I was informed I would be awarded the "Outstanding Senior in Watershed Science" award. "That's awesome!" I exclaimed, "... wait, are there any other seniors this year?" "Well no, but we wouldn't have awarded it, if you weren't outstanding." Ha, OK, well, I'll take what I can get!

During my senior year at USU, I got a job working for Extension, writing water related factsheets and doing modeling work. This was my first introduction to Extension, and the discovery that there was a whole branch of the university dedicated to sharing information with the public struck me as very romantic.

After wandering the world for a few years post-bachelor's degree, I came to MSU in 2004 to work for my predecessor Dr. Jim Bauder in the Extension Water Quality Program and to pursue a master's degree. I finished my master's in LRES in 2008, working on a livestock water quality project under Jim. That same year I developed and taught a junior-level water quality course and then traveled to Kenya with the MSU chapter of Engineers Without Borders to work on water quality testing and mapping. When Jim retired in 2009, I moved into a position as the Extension Associate Water Quality Specialist. In 2011, I started a PhD in LRES under Dr. Stephanie Ewing characterizing nitrogen movement from dryland wheat farm fields to groundwater and streams. I finished the PhD in April of 2020 and it was exciting to have the project featured on the cover of *Mountains and Minds* magazine in Spring 2021.

Since starting at MSU in 2004, I've worked on a breadth of topics including private well owner testing/ education, citizen water monitoring, livestock water quality, water monitoring for the National Park Service, water quality education support for tribal colleges, and landscape nitrogen dynamics. The last 16 years at MSU has been highly fulfilling and I'm thrilled to build on past work as I transition to this new chapter as a tenure-track professor in LRES.

Frank Dougher

I'm thrilled to be back at Montana State University, working with the students, staff, and faculty of the LRES department! I originally come from northern Illinois, playing around in the rivers and lakes of the Upper Midwest. I attended Southern Illinois University, earning a Bachelor of Science in Geology, studying Geomorphology and Petroleum Geology. I went on to study Fluvial Geomorphology at Utah State University, eventually earning a Master of Science in Geography with a thesis on Geomorphometry and Landform Classification; and was first hired as a professional Geospatial Analyst for the RS/GIS Laboratory there at USU. Utah is also where my two children were born, as well as where I learned how to snowboard, while somehow never actually getting good at it.

I moved to Montana in 2001, working with Drs. Rew, Maxwell, and Lawrence on geospatial analysis, field mapping, and predictive modelling in wildland and agricultural plant communities. I moved on to serve Gallatin County, first as a GIS Analyst and later as the GIS Supervisor for 13 years, before being invited to return to MSU as an instructor in Environmental and Geospatial Sciences. I enjoy spending time outside year-round, and working with volunteer organizations in Bozeman, such as the Friends of Regional Parks, the Big Sky Wind Drinkers, and Scouting, having been a volunteer leader of various scout units for 20 years. I also occasionally find time to spend with my wife Tracy, and our two kids, and to get up to Bridger to work on my next snowboarding injury.

I'll be teaching courses in GPS Mapping, Geographical Information Systems, and Environmental Sciences, as well as helping to enable the students and faculty researchers of MSU to collect and analyze and communicate geo-enabled data. Feel free to swing on by the Geospatial Lab, Leon Johnson 245, any time. I'm always up for helping out with your mapping questions!

New LRES Grants Awarded from Dec. 2020 - Nov. 2021

These funds fuel our research and teaching mission-to discover new knowledge, to engage and train students using laboratory and field studies across local to global scales, and to enrich the lives of Montanans

Federal Grants

National Science Foundation- SITS	
Ewing, Payn, and Reinhold	Using continuous soil solute signals to infer transport and reaction
	dynamics that regulate water quality
National Science Foundation- RAPID	
Ewing, Dixon	NSF RAPID: Geomorphic controls on sediment age, ice
	preservation, and carbon storage in arctic permafrost systems
National Science Foundation- EPSC	oR
Payn, Ewing	CREWS YR4
National Aeronautics And Space Adr	ninistration
McDermott, Bothner	Environmental distribution and evolutionary history of non- methanogen methane synthesis
US Environmental Protection Agence	y .
Ebel, Menalled, Seipel	Converting household food scraps into biofertilizer using small biodigesters
National Institutes of Health	
Peterson, Cornish	My home, my health: place-based public health resources for public educators

Federal Grants cont.

USDA National Institute of Food and Agriculture

Ebel, Seipel	Improving efficacy of Puccinia punctiformis as an integrated weed management tool for Canada Thistle (Cirsium arvense)
Seipel, Chichinsky, Eberly, Menalled Maxwell	Integrating thistle rust into organic management of Canada thistle Improving the economic and ecological sustainability of US crop production through on-farm precision experimentation (with the
Miller	University of Illinois) Winter canola cultivar deployment project for the southern Great Plains and Montana (with Kansas State University)
National Park Service	
Brookshire	Aquatics program review, data analysis and reporting for Parks in the Southern Colorado Plateau Network
Bureau of Land Management	
Mangold, Frame-Martin Weaver	Montana noxious weed education campaign Weed Biocontrol with Insects
US Department of Agriculture	
Mangold, Seipel	Montana State University's Extension implementation plan for integrated pest management
USDA- Natural Resources Conserva	tion Service
Ewing	Regional cooperative soil survey (NCSS) conference
USDA APHIS	
Littlefield	Rearing and release of the hoary cress gall mite Aceria drabae within Montana and the Western region.
USDA Agricultural Research Service	e- Plains Area
Miller, Jones, Koeshall, Powell	Understanding soil spatial and micro-climate effects on grain protein formation in field pea
USDA Forest Service	1
Mangold, Frame-Martin	Montana noxious weed education campaign
Weaver	Field scale demonstration of semiochemical directed orientation of a biological control agent in riparian habitat
Seipel, Rew	Improving efficacy of Puccinia punctiformis as an integrated weed management tool for Canada Thistle (Cirsium arvense)
Peterson	Connecting Great Plains and Rocky Mountain ecoregions through improved understanding of Army Cutworm migrations and grizzly bear interactions
Montana Wheat & Barley Committ	ee
Weaver	Integrated pest management of Wheat Stem Sawfly - host plant resistance and biological control
Miller, Ewing, Jones	Soil carbon accrual in progressive montana crop rotations
Menalled, Seipel	Integrated management of cheatgrass and Fusarium crown rot

Montana Grants

Montana Noxious Weed Trust Fund

Seipel, Eberly	Development and assessment thistle rust (Pucinina punctiformis) to reduce Canada thistle (Cirsium arvense) in Montana's rangelands
Mangold, Frame-Martin	Montana noxious weed education campaign
Mangold, Powell	Multi-spatial analysis of ventenata control treatments on the Crow Reservation
Weaver	Continued mass rearing, release, and monitoring of the northern tamarisk leaf beetle: a biocontrol agent for saltcedar.
Weaver	New solutions for old problems: identifying the best available biological control options for the integrated management of invasive toadflaxes.
Weaver	Continuing development of candidate agents for biological control of Russian olive
Littlefield	Rearing and release of the hoary cress gall mite and continued screening of agents by CABI
Littlefield	Continued screening of biocontrol agents for Oxeye daisy and common
	tansy
Littlefield	Continued host testing and release of biocontrol agents for invasive hawk weeds
Littlefield	Continued host testing of a flea weevil on Russian knapweed
Montana Department of Environme	ental Quality
Sigler	2021 - 2020 volunteer water quality monitoring support
Montana Fertilizer Tax Fund	
Miller, Jones, Ewing	Long-term N management in alternative crop rotations (ongoing)
Jones, Miller	Enhancing nitrogen fixation in pea and lentil through breeding and management (ongoing)
Ewing, Brookshire, Jones, Payn	Research analytical chemist, environmental analytical laboratory
Ewing, Koffman	Replacement of combustion analyzer for dissolved carbon and nitrogen
Maxwell, Hegedus	On-farm experiments to optimizing site-specific application of nitrogen
U U	fertilizer rates to maximize producer profits
Montana Department of Agriculture	2
Menalled	Weed management in dryland chickpea and fava beans in Montana

Private, University, Regional and Other State Grants

tes of Health
Larval mosquito management and risks to people and aquatic ecosystems
Assessing the effects of insecticide-contaminated soil on nectar and pollen provisioned to solitary bee larvae
Indian Reservation
Modeling shade influence on hyporheic temperature
Grassland restoration and pollinator conservation on Tribal lands degraded by anual invasive grasses

College of Agriculture Distinguished Faculty Award



Dr. Bob Peterson has a prolific research record in comparative risk assessment emphasizing insect ecology, plant-stress ecophysiology and integrated pest management. Coupled with his high publication rate, Dr. Peterson's excellent teaching skills and rapport with his students have garnered him many well-deserved honors. He also directs the Online Professional Master of Science program in LRES, a popular program celebrating its 10th year and reaching around the globe. In the nearly twenty years since Dr. Peterson arrived at MSU, he has spent time not only in the classroom, in the field and in his research lab, but also in service on many local and national committees. His service to his students, his department, and MSU are only some of the many reasons he received this distinguished faculty award.

Excellence in Research and Discovery Award

This award recognizes scientists who are national leaders in their area of research and whose research has made substantial contributions in moving forward their profession and improving the economy, society, and quality of life beyond the contribution to academia

Dr. Lisa Rew, a professor LRES department, has established an internationally renowned research program in weed ecology and mountain invasion ecosystems. Her combination of basic and applied research



demonstrates her ecological aptitude as a scientist as well as her ability to recognize relevant needs in weed management and formulate research questions that further the management of invasive plants across a variety of agricultural and ecological systems. Her 78 journal articles span research on butterfly habitat, biology of *Bromus sterilis*, spatial pattern of nonindigenous plants, invasion process and susceptibility to invasion. Representing a culmination of her combined research efforts, the sampling strategy she proposed has become the backbone to the Mountain Invasion Research Network (MIREN) plant surveys that has been repeated three times over ten years in ten mountain regions of the world. The data collected provide the basis of seven MIREN publications, including one in Proceedings of the National Academy of Sciences. Dr. Rew's work is well respected, and she is recognized as a national and international leader in her field.

NACTA Teaching Award of Merit for Graduate Students

This award recognizes excellence in on-campus teaching that aims to transform lives through innovation in teaching, discovery-driven education experiences, exceptional student engagement, and imparting skills relevant to the workforce. Justin Gay and Bryce Currey, PhD students in the LRES department, were announced as recepients of this 2021 College of Agriculture award in Inside Ag.





Justin served as TA for three years in ENSC 353 Environmental Biogeochemistry. He formalized the greenhouse experiment of the lab, developing a poster session for students to share results and synthesize the material.

Bryce developed and managed the labs for GPHY 426 and 429R Remote Sensing, integrating his PhD work to introduce the students to advanced and open-source remote sensing software and putting the proprietary software into perspective.

LRES Recognition



Bill Kleindl was named president-elect of the Society of Wetland Scientists.

Jane Mangold and Noelle Orloff were featured in The New York Times



discussing herbacide fundamentals and offering advice to homeowners who are considering using them as part of their weed control practices.



John Priscu was interviewed by Netflix 'Atypical' about polar science. https://youtu.be/zHiHV4ZZZRM



Bruce Maxwell is taking part in a \$4 million nationwide precision agriculture research grant by developing a user-friendly system for on-farm experimentation, data collection,

and analysis, as well as a framework to help farmers make the most costeffective and ecologically sustainable management decisions. Erik Norderud, Scott Powell, and Bob Peterson published a paper in the Journal of Insect Science outlining the risk of Asian giant hornets establishing populations in the Pacific Northwest, including Montana.



Lisa Rew Received an Editors' Choice award from the Arctic, Antarctic, and

Alpine Research Journal for her paper "Moving up and over: redistribution of plants in Alpine, Arctic, and Antarctic ecosystems under global change".



Catherine

AMBER Burnarhiner Burnarhiner Burnarhiner Wird Magaru Wardes Bartes Bartes Bartes Bartes

Zabinski's book, Amber Waves: The Extraordinary Biography of Wheat, from Wild Grass to World Megacrop, was named to the longlist for an AAAS/Subaru SB&F Prize for

Excellence in Science Books in the Young Adult Science Book category.



An interdisciplinary LRES research team including Stephanie Ewing, Rob Payn, and Ann Marie Reinhold received a \$944,000 National Science Foundation grant to study the efficiency of nitrogen fertilizers and their impact on soil health and water quality, with a focus on central Montana.



John Priscu identified a Antarctica *Chlamydomonas* species (UWO 241) in 1995, and a recently accepted *Photosynthesis Research* arcticle

suggested that UWO 241's unique biochemistry confirms it is a unique strain of Antarctic alga. It proposed that the algae be officially renamed to *C. priscuii* to recognize John Priscu, the investigator who originally isolated the strain.



Rick Engel is enjoying his retirement!

We'd love to hear from you! To share your research and/or professional accomplishments in an upcoming newsletter, please contact: Tracy Sterling, Department Head, tracy.sterling@montana.edu Reilly Tunby, Administrative Associate, lresfrontdesk@montana.edu



Groundbreaking Methane Systhesis Discovery

An interdisciplinary team of scientists from Montana State University's College of Agriculture and College of Letters and Science recently published research casting new light on a previously unknown element of the carbon cycle, thanks to data collected from Yellowstone National Park over more than a decade.

Tim McDermott, a professor in MSU's Department of Land Resources and Environmental Sciences, began studying the microbiology of Yellowstone Lake in 2007. While collecting data to analyze the lake's chemistry and the interaction of various microbes in the lake with the park's underlying thermal features, McDermott noticed something seemed off.

"We came across some lake water gas chemistries that didn't make a lick of sense," said McDermott. "We were seeing a lot of methane in places we didn't expect and wondering, 'what's going on here?"

Through a series of microbial experiments and extensive analysis of the wider biological community present in the lake samples, the team identified a known gene that seemed to be catalyzing the methane synthesis.

The magnitude of the discovery cannot be overstated. The fact that aerobic methane synthesis can happen at all is a seismic shift in the field of biogeochemistry. Since methane is a much more potent greenhouse gas than carbon dioxide, scientists are interested in identifying where in the biosphere it is created and where it goes. This project creates a springboard for extensive further research in Yellowstone National Park and beyond. "This is a fundamentally different process from anaerobic methane synthesis," said McDermott. "In an ecological sense, it's logical to think that this is occurring throughout the biosphere, not just in Yellowstone Lake. It's conceivable to think that it's even occurring across the world's oceans and throughout the world."

Marni Rolston, you are Pure Gold!

Marni Rolston is a staff member in the Department of Land Resources and Environmental Sciences on the MSU Bozeman campus. The following is her Pure Gold Award nomination submitted by her colleagues Scott Powell, Bob Peterson and Tracy Sterling.

Marni Rolston exemplifies the spirit of the Pure Gold Award! She is the Program Manager for the Professional M.S. program in Land Resources and Environmental Sciences. She began serving in this role in 2018 and has made a tremendous impact in a relatively short time frame.

Thanks to Marni's incredible responsiveness and guidance to students, enrollment has rapidly doubled in size to nearly 100 students from across the United States. Marni is the first line of contact for both prospective



and current students in the program, and her positive, "can-do" disposition deserves recognition for the program's growth. Students in the program routinely comment on Marni's effectiveness and helpful attitude as one of the overall strengths of the program.

For example, 2020 graduate, Erin Monty, commented that "Marni was vital to my success of completing my master's degree. She always provided information and encouragement when I needed it in a timely and supportive way with genuine enthusiasm. The program is extremely lucky to have her." Kyla Gupta, another 2020 graduate, commented that "As a former student, I quickly learned that I could depend on Ms. Rolston's help for any issues that came up, which greatly contributed to my personal success in the program."

Beyond her excellent people skills, Marni is highly organized and keeps track of the innumerable organizational tasks required by her position. Her talents and expertise are incredible assets to our students and to Montana State University, making her very deserving of the Pure Gold Award.

SALSA-Antarctica Film

John Priscu and John Dore worked as part of a 50-person team to drill 4,000 feet into the ice to sample from Mercer Subglacial Lake in Antarctica. The project had the goal of learning more about the unexplored biome and the potential for it to support life. Located roughly 500 miles from the South Pole, team members used specialized tractors and ski equipped aircraft to conduct their research.

John Priscu, John Dore, and their team worked to better understand the hydrology, geology, and geomicrobiology of subglacier lakes through water samples, setiment cores, and microbial samples.

The team produced a feature-length film

documenting the trip and research, which has already been garnering awards. The hope is for the film to be picked up by National Geographic, NOVA or BBC. A trailer for the film can be found at:

www.antarcticlakefilm.com/

Fall LRES Event

The LRES Community Committee planned a fall event at Story Mill Park, but early snow and power outages the morning of the event led to it being cancelled for safety. The committee supplied homemade soup, cornbread and cookies later that week to the LRES department.



- Food (chili, vegetable soup, bread, seltzer water)
- Yard Games (cornhole, bocci, crocket, badminton)
- Trick or Treat (faculty will have candy bars for students that introduce themselves)

Stay tuned for future LRES events hosted by the Community Committee!

LRES 593: Challenges in Ecology and Environmental Science

antarctic

This course provided a common starting point and cohort-building experience for students in the Ecology & Environmental Sciences crosscollege PhD program. In a welcoming and convivial learning environment, students worked to develop the vocabulary, peer group, and core professional skills necessary to support an interdisciplinary approach to grand challenges in ecology and environmental sciences.

Many of the issues that we confront in today's society related to ecology and environmental issues are multifaceted, with scientific, social, political, and economic ramifications. To further explore these issues the course focused on the following topics: climate change, water quantity and quality issues, managing landscapes for multiple objectives, and systems thinking tradeoffs and optimization. Students attended local excursions to meet with researchers, land managers, non-governmental organization representatives, and land owners who have been tackling "grand challenges" within this ecosystem and to witness many of the core geological and ecological attributes of the Greater Yellowstone region.

Instructors: T. Sterling, D. Debinski, J. Haggerty



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Adopt a Trailhead

MSU Weed Ecology professionals and volunteers installed a new Adopt a Trailhead Montana kiosk and held a weed pull at the Painted Hills Trailhead to celebrate Montana's 2021 Noxious Weed Awareness Week.

"Some noxious weeds are detrimental to agriculture, some are poisonous to livestock," Montana Noxious Weed Education Campaign project coordinator Shantell Frame-Martin said. "All of them degrade wildlife habitat and forage. Some degrade water quality if they are occurring on the banks of streams and rivers."

Trailhead adopters are responsible for weed control and host an annual weed pull event. Weed pullers at the Painted Hills Trails pulled hoary alyssum, spotted knapweed, musk thistle and houndstongue from the popular trail.

LRES Capstone: ENSC 499R

The LRES Capstone Class presented their final project, "Running on Empty: Environmental Effects of Rapid Development in Gallatin County", on November 15 to both an in person and online audience through a hybrid seminar.

Bozeman's rapid population increases and rising global temperatures threaten water security not only for us, but to support the quality of the natural resources that urged many of us to move to this scenic valley. The severity of the consequences are only enhanced by the arid climate of Bozeman and the significant toll climate change takes on the snowpack that drives our water storage. We gathered data from a variety of sources, from USDA drought and snow maps to research papers on the forefront of sustainable solutions. With this presentation we aim to address these issues, and pose an array of potential solutions. Additionally, the objective

is to present a broad overview of the origins of the city's water, water use, distribution of water usage, challenges of water cycling in urban environments, and solutions that could help our growing city address the approaching water deficit we will face. As we address land use changes and water demand, we will illustrate the full picture of these challenges by identifying our role and responsibility in the consequences of rapid growth on precious natural resources.

- Cathy Zabinski, Instructor





loe Bobrowsk

Hetta William

Running on Empty: The Environmental Effects of Rapid Development in Gallatin County

> LRES Capstone Class Fall 2021







Meghan Robin



LRES Degrees Awarded Fall 2021

Bachelor of Science

Environmental Sciences

Joseph Thomas Bobrowski Cecelia McAfee Francine Patricia Mullen Isabella Pritchard Malcolm Lewis Purinton Kevin Tarnowski

Professional Master of Science

Land Resources & Environmental Sciences

Sarah Beard Chris Edward Bilbrey Emily Branum (Su) Willa C. Fouts (Su) Virginia Hamilton Lauren Ellen Hillmer Drew T. Howing Katelynn Rae Little Isaac Todhunter Newell Rebecca L. Oliver Zachary F. Rittner (Su) Edward Wilmans Sprigg Kendall M. Wojcik

Master of Science

Land Resources & Environmental Sciences

Sydney Christine Atencio (Su) Simon Fordyce Laura Tindall Ouverson (Su)

Latrice Tatsey

Entomology

John L. Bowley Land Rehabilitation Molly C. Haviland

Doctor of Philosophy

Ecology & Environmental Sciences

David Jonathan Adrian Wood



Opportunities to Support LRES

A gift to the department is a great way to support student and faculty endeavors. Donations can be earmarked for student scholarships or internships, graduate fellowships, undergraduate and graduate student programs, endowed professionals, and more.

For information about making a domation to the Department, please contact Jesse Tufte, MSU Alumni Foundation, College of Agriculture, Director of Development (406-994-4815 or jesse.tufte@msuaf.org).



Department of Land Resources & Environmental Sciences