



# SAN JUAN MINING & RECLAMATION CONFERENCE

May 23-26, 2017 - Ouray, Colorado

“Coming Full Circle: Making a Difference and Forging Ahead”



This conference was made possible by our generous sponsors & supporters:



ACE Geosciences • ACF West • ACZ Laboratories Inc. • ERTEC Environmental Systems  
Maser Consulting • Routescene Inc. • Trust for Land Restoration

# Conference Hosts

---



The Uncompahgre Watershed Partnership (UWP) was founded in 2007 by a coalition of citizens, nonprofits, local and regional governments, and federal and state agencies dedicated to understanding, restoring, and protecting land and natural resources within the Upper Uncompahgre Watershed. The UWP exists to help protect the economic, natural, and scenic values of the Upper Uncompahgre River Watershed. The Partnership works to inform and engage all stakeholders and solicits input from diverse interests to ensure collaborative restoration efforts in the watershed. We strive for a healthy river in a thriving community. For more information about the UWP and current projects, visit [www.uncompahgrewatershed.org](http://www.uncompahgrewatershed.org).



SAN JUAN MOUNTAINS COLORADO

grown to encompass fourteen counties in Southwest Colorado. Our mission is to enhance understanding and sustainable use of the San Juan Mountains through research and education. This mission has positioned MSI to identify and articulate information needs, facilitate and complete research and restoration initiatives, and most importantly to ensure that pertinent scientific information is made available to both decision makers and the general public. It is our belief that through science education, information is not only understood, but can be used to transform our communities into healthier, more sustainable places to live. More information available at [www.mountainstudies.org](http://www.mountainstudies.org).

Mountain Studies Institute (MSI) is a non-profit, non-advocacy, mountain research and education center. MSI was established in the heart of the San Juan Mountains, Silverton, CO, in 2002. MSI has developed a highly collaborative, dynamic, and unique approach to serving our region, which has



The San Miguel Watershed Coalition was formed in 1998 to enable a collaborative forum for all stakeholders to discuss and influence the future of the watershed. The San Miguel Watershed Coalition's purpose is to give the communities and stakeholders in the watershed a voice to direct the future management of watershed resources. Its mission is to advance the ecological health and promote the economic vitality of the watershed through the collaborative efforts of the entire community.

Our ultimate goal is to realize a watershed that is healthy in every respect, while offering a sustainable and quality lifestyle for all who live within it. [www.sanmiguelwatershed.org](http://www.sanmiguelwatershed.org)



**COLORADO**  
Division of Reclamation,  
Mining and Safety  
Department of Natural Resources

The Colorado Division of Reclamation, Mining and Safety (DRMS) is responsible for mineral and energy development, policy, regulation, and planning. The division is comprised of the Office of Mined Land Reclamation and the Office of Active and Inactive Mines. DRMS collaborates with citizen groups,

non-profits, and industry to conduct mine remediation projects at legacy sites to improve water quality and ecosystem function in the watersheds of San Juan Region. Learn more about DRMS' work at [mining.state.co.us](http://mining.state.co.us)



Animas River Stakeholders Group (ARSG) was founded in 1994 as a process to determine appropriate water quality standards for the Upper Animas River Basin. The Upper Animas Watershed has a long history of extensive metal mining as an economic mainstay dating back to the 1870s with major operations ending in 1991. The mission of ARSG is to improve water quality and habitats in the Animas River through collaborative process designed to encourage participation from all interested parties. Participants include mining companies, environmental organizations, and owners, local governments, and state and federal regulatory and land management agencies. [animasriverstakeholdersgroup.org](http://animasriverstakeholdersgroup.org)

## *Animas River Community Forum*

disseminating information related to the spill and its recovery. The forum works on issues that have agreement among Forum Partners. The group is looking to the future. Our purpose is to promote communication, coordination and collaborative action; foster public confidence; support resiliency in our communities; and enhance planning, improved public safety and health for the future; all while honoring the institutional authorities and decision making of governmental and community organizations. [animasrivercommunity.org](http://animasrivercommunity.org)

In response to the Gold King Mine spill incident, the Animas River Community Forum came together. The Forum's role is sharing and



The Willow Creek Reclamation Committee's mission is to improve water quality and habitat, reduce flood risks, reclaim areas impacted by mining, and preserve historic structures in the Willow Creek watershed in ways that are

practical, cost effective, and beneficial to the economic sustainability of the Creede community. The Willow Creek Project is a testimony to the grit and determination of a group of citizens who wanted to retain the independence and self-determination to decide how to clean up a small mountain stream that flows through their town. Their spirit and resolve have drawn a wealth of outside resources to their cause, and have allowed them to succeed beyond their wildest imagination. For more information, visit us at [www.willowcreede.org](http://www.willowcreede.org)



*Lake Fork Valley Conservancy*  
LAKE CITY COLORADO

Lake Fork Valley Conservancy has sustained and enhanced the environmental and rural character of the Lake Fork of the Gunnison River valley through education, restoration, and stewardship for more than a decade. Our team assessed the Lake Fork

watershed's water quality — particularly areas impacted by historic mining — with major synoptic sampling in 2005, 2006, 2009, and 2010. The Conservancy has cleaned up six mines to date, a feat the EPA recognized with an Achievement Award in 2008. In 2012 the Conservancy was given a Partners In Conservation award from the Department of the Interior for our role in land preservation. The Conservancy is now developing a program of educational and cultural events that promote environmental stewardship and a robust economy. More information available at [www.lfvc.org](http://www.lfvc.org).

## Conference Theme

---

### **“Coming Full Circle: Making a Difference and Forging Ahead”**

The San Juan Mining and Reclamation Conference made a full tour through the mining communities of southwestern Colorado over the past six years. After stops in Silverton, Lake City, Creede, Telluride, and Durango, the event returns to Ouray in 2017. The conference has featured presentations and discussions about the history and heritage of mining in the San Juan Mountains, contemporary hardrock mining practices, alternative remediation approaches to legacy mining impacts, and the regulatory frameworks for both. Now is the time to come full circle to examine lessons learned from reclamation projects across the region, how they are making a difference environmentally, and what reclamation will look like in the future. We have the opportunity to consider how industry in the region has utilized innovative mining technologies and environmental mitigation plans to energize hardrock mining in the San Juans.

In its seventh year, the conference will highlight projects and mining in the Uncompahgre Watershed. We will field-tour Uncompahgre Watershed Partnership’s tailings stabilization project, Ouray Silver Mine’s mining operations, and mitigation designs in the Canyon Creek sub-basin, as well as Idarado’s past and proposed remediation projects in the Red Mountain Creek sub-basin. Diverse stakeholders will have opportunities to examine and discuss successes of mining and reclamation to date, as well as contemplate their futures in this region.

# 2017 Conference Agenda

<b>May 23, 2017</b>	<b>OPENING RECEPTION</b>	<b>WRIGHT OPERA HOUSE</b>
6:30pm Doors 7:00pm Program	Mining Lore – A Community Reception featuring Tall Tales about Deep Subjects	Cash bar and tapas.
<b>May 24, 2017</b>	<b>PLENARY</b>	<b>OURAY COMMUNITY CENTER</b>
8:00am – 8:30am	Registration & Presentations Upload	Refreshments
8:30am – 8:50am	Welcome & Opening Remarks	Dennis Murphy, Uncompahgre Watershed Partnership, Pam Larson, Mayor City of Ouray
<b>SESSION I</b>	<b>Making a Difference</b>	<b>Tanya Ishikawa, Uncompahgre Watershed Partnership</b>
8:50am – 9:10am	Making a Difference in the Uncompahgre Watershed	Agnieszka Przeszlowska, Uncompahgre Watershed Partnership
9:10am – 9:30am	Reviving Upper Mineral Creek	Peter Butler, Animas River Stakeholders Group
9:30am – 9:50am	Successful Revegetation Techniques for Legacy and Active Mine Sites	Brent Hardy, ACF West
9:50am – 10:10am	Establishing Natural Background Levels in Historic Mining Districts: Technical and Legal Issues	Winfield G. Wright, Southwest Hydro-Logic and Paul Nazaryk, WestSky Environmental
10:10am – 10:40am	BREAK	Refreshments
<b>SESSION II</b>	<b>Mine Waste Management</b>	<b>Elizabeth Stuffings, San Miguel Watershed Coalition</b>
10:40am – 11:00am	Implementation and Early Performance of the Revenue Passive Treatment with Groundwater Infiltration	Briana Greer, Solid Solution Geosciences LLC
11:00am – 11:20am	Mine Waste Reclamation and Floodplain Development at the Akron Mine, Whitepine Colorado	Jason Willis, Trout Unlimited
11:20am – 11:40pm	Targeted Remediation: Mine Water Source Controls	Rory Cowie, Mountain Studies Institute
11:40pm – 12:00pm	Cost Effective Plans for Successful Mine Land Reclamation	Andy Jung, Profile Products
12:00pm – 1:30pm	LUNCH	On your own.
<b>SESSION III</b>	<b>Future of Reclamation</b>	<b>Peter Butler, Animas River Stakeholders Group</b>
1:30pm – 1:50pm	Good Samaritans – We didn't cause the problem, but we want to fix it.	Ty Churchwell, Trout Unlimited
1:50pm – 2:10pm	Unity as a Response to Disaster: the Animas River Community Forum	Shannon Manfredi, Animas River Community Forum
2:10pm – 2:30pm	Closing the Waste Loop - Waste Rock to Biomineral Fertilizer	Andrew Harley, Duraroot Environmental Consulting/H-2 Enterprises
2:30pm – 2:50pm	The San Juans and the Reshaping of CERCLA and Hard Rock Mining	Anthony D. Edwards, Sholler Edwards, LLC
2:50pm – 3:20pm	BREAK	Refreshments



# 2017 Conference Agenda

<b>May 24, 2017</b>	<b>PANEL &amp; EXHIBITS</b>	<b>OURAY COMMUNITY CENTER</b>
<b>SESSION IV</b>	<b>Future of Mining Panel</b>	<b>Rory Cowie, Mountain Studies Institute</b>
3:20pm – 4:20pm		Bob Larson, Monadnock Mineral Services, LLC David Beling, Bullfrog Gold Frank Filas, Filas Engineering and Environmental Services, LLC Pat Willits, Trust for Land Restoration Russ Means, CO Division of Reclamation, Mining & Safety
4:20pm – 4:30pm	Closing Remarks and Field Tour Logistics	Rory Cowie, Mountain Studies Institute
<b>POSTER &amp; EXHIBIT SESSION</b>		
4:30pm – 6:00pm	Posters, Exhibits and Networking Opportunities	Cash bar and tapas.
<b>May 25, 2017</b>	<b>IDARADO SPECIAL SESSION &amp; FREE FIELD TOURS</b>	<b>OURAY COMMUNITY CENTER &amp; FIELD</b>
8:30am – 8:40am	Welcome & Opening Remarks	Jeff Litteral, CO Division of Reclamation, Mining & Safety
8:40am – 10:30am	Water Quality Improvements Resulting from the Idarado Mine Remediation Project	Camille Price, CO Division of Reclamation, Mining & Safety
	Idarado Mine Remediation – A Discussion of Remedial Alternatives and Developing a Viable Path Forward	Devon Horntvedt, Worthington Miller Environmental
Tour 1: 11am – 1pm	Idarado Quick Tour, Red Mountain Creek	Camille Price, CO Division of Reclamation, Mining & Safety and Devon Horntvedt, Worthington Miller Environmental
Tour 2: 11am – 4pm	Ouray Silver Mines & Atlas Mill Sites, Sneffels Creek	Brian Briggs, Ouray Silver Mines; Briana Greer, Solid Solution Geosciences LLC; Jeff Litteral, CO Division of Reclamation, Mining & Safety; Bill Coughlin, Western Stream Works, Agnieszka Przeszlowska, Uncompahgre Watershed Partnership
<b>May 26, 2017</b>	<b>OURAY SILVER MINES SPECIAL TOURS</b>	
8:30 AM	Limited to 10 People: Underground tour of Revenue Mine and Mill	Meet in front of Ouray Community Center. On-line registration & shuttle ride are required.
10:00 AM	Limited to 10 People: Underground tour of Revenue Mine and Mill	Meet in front of Ouray Community Center. On-line registration & shuttle ride are required.
11:30 AM	Limited to 10 People: Underground tour of Revenue Mine and Mill	Meet in front of Ouray Community Center. On-line registration & shuttle ride are required.
1:00 PM	Limited to 10 People: Underground tour of Revenue Mine and Mill	Meet in front of Ouray Community Center. On-line registration & shuttle ride are required.

# Abstracts & Panel Bios

---

**WEDNESDAY, MAY 24, 2017**

## Welcome and Opening Remarks

### WELCOME

Dennis Murphy, Board of Directors  
Uncompahgre Watershed Partnership

### OPENING REMARKS

Pam Larson, Mayor  
City of Ouray

## Session I: Making a Difference

### MAKING A DIFFERENCE IN THE UNCOMPAHGRE WATERSHED

Agnieszka Przeszlowska, Project Manager, Uncompahgre Watershed Partnership  
*aprzysz@gmail.com*

The headwater region of the Uncompahgre River is on the northwest flank of the Silverton Caldera and is characterized by numerous large veins and smaller breccia pipes that are rich in ore-deposits, most importantly base-metal sulfides with silver tellurides and gold. The ore-deposits were discovered in the mid-1870s and hardrock mining commenced in four mining districts for principal commodities including silver, gold, lead, copper and zinc. The natural weathering of mineralized rock and heavy metal contamination from abandoned or inactive mines (mine drainage, waste rock leaching, tailings erosion) have impaired several streams in the Upper Uncompahgre Watershed. On-going, recent, and proposed mine remediation projects at mine lands in the watershed are focused on reducing metal loading, improving water quality and aquatic habitats in the impaired segments. This presentation will provide an overview of site characterization approaches and relevant mine remediation projects in the watershed. Partnerships will be highlighted to demonstrate that collaborative approaches are critical to making positive impacts on local resources, environment, and communities.

### REVIVING UPPER MINERAL CREEK

Peter Butler, Co-Coordinator, Animas River Stakeholders Group  
*butlerpeter2@gmail.com*

Twenty five years ago, Upper Mineral Creek was devoid of aquatic life. After remediation at a dozen mine sites in the basin over the last couple of decades, brook trout were found in the stream this past fall. The presentation will outline the projects completed and the changes in water quality. In addition, the discussion will include how to propose changes to use classifications and water quality standards to protect the improvements that have been accomplished.

### SUCCESSFUL REVEGETATION TECHNIQUES FOR LEGACY AND ACTIVE MINE SITES

Brent Hardy, Soil Scientist, ACF West  
*brent.hardy@acfwest.com*

Both historic and active mining has disturbed large areas throughout the U.S., which now require site reclamation and revegetation. Frequently, onsite or imported topsoil is unavailable, present in very limited quantities, or heavily impacted by pH, salts, metals or other materials that make native plant establishment and growth difficult to achieve. Stockpiling soils degrades the natural biological life, destroys soil structure, decreases organic matter,

and commonly mixes subsoils with surface soils. All of these factors make revegetation challenging and when combined with short growing seasons and arid climates push us to maximize our effectiveness. Today's technology in spray-applied amendments and stabilization products counteract these negative physical and chemical impacts. They also assist Mother Nature in speeding up the process of soil building, nutrient cycling, and stockpiling of organic matter using natural, biological, and manmade additives. This presentation will address several field techniques, design approaches, and soil amendments that have proven successful at different capping and closure sites across the arid west and mountain states. We will provide examples of lessons learned from both successes and failures on projects at multiple site installations and results from field testing sites. Attendees will be given knowledge and approaches that will help extend reclamation budgets through cost and time savings in the field.

ESTABLISHING NATURAL BACKGROUND LEVELS IN HISTORIC MINING DISTRICTS: TECHNICAL & LEGAL ISSUES  
Winfield G. Wright, P.E., C.P.H., Paul Nazaryk, J.D., and Robert A. Arnott, Ph.D., P.E., C.P.H.,  
Southwest Hydro-Logic, Westsky Environmental, Strategic Environmental Analysis  
*wgwright@frontier.net, paul.nazaryk@gmail.com*

The presence of naturally occurring dissolved-metal concentrations in waters draining from historic mining districts depends upon geologic setting. If the geologic setting consists of economic deposits within discrete vein systems, such as the Boulder River Basin in Montana, natural background metals generally will not contribute to elevated dissolved-metal concentrations in streams. However, if the geologic setting consists of widespread or disseminated mineralization, like many parts of the Upper Animas River Basin, natural background metals can contribute significant dissolved-metal concentrations to receiving streams.

The Upper Animas Watershed is located in the San Juan Mountains at the site of the former Silverton Caldera in a highly mineralized area with approximately 400 inactive and abandoned mines. The Upper Animas River and its major tributaries, Cement Creek and Mineral Creek, are heavily impacted by metals associated with both natural sources and historic mining activities. Characterization of the natural background metals in the area has been challenging, with studies beginning in the 1990s that focused on mass balance, stable isotopes, tracer-injection studies, and statistical approaches to describe natural background conditions. This information is important in determining how to remediate sites under statutory programs such as the Comprehensive Environmental Response, Compensation and Liability Act (Superfund).

This paper will explore technical and legal issues associated with establishing natural background and cleanup levels in surface and ground water in watersheds such as the Upper Animas River Basin.

## Session II: Mine Waste Management

IMPLEMENTATION AND EARLY PERFORMANCE OF THE REVENUE PASSIVE TREATMENT WITH GROUNDWATER INFILTRATION

Briana Greer, President, Solid Solution Geosciences LLC  
*briana@solidsolutiongeosciences.com*

In 2016 Ouray Silver Mines Inc permitted and installed a passive treatment system with subsequent groundwater infiltration at the Revenue Tunnel. This presentation will review the implementation of the project from pilot testing through recently collected groundwater data. The underground pilot testing revealed substantial reductions in metals of interest (cadmium, lead, and zinc). While it will take time to evaluate the overall performance of the system, early data from fall 2016 and spring 2017 suggest the system is functioning as expected. Results reveal groundwater quality well within the historic range and fully permit compliant. As the thaw commences, the mine continues to monitor groundwater metals of interest and water table elevation.



MINE WASTE RECLAMATION AND FLOODPLAIN DEVELOPMENT AT THE AKRON MINE, WHITE PINE COLORADO  
Jason Willis, Mine Restoration Project Manager, Trout Unlimited Inc.

*jwillis@tu.org*

Large-scale, abandoned mine land reclamation was completed at the Akron Mine and Mill site near the town of White Pine, Colorado during the 2015 and 2016 construction seasons. The site is located at the headwaters of Tomichi Creek, a tributary of the Gunnison River in the Grand Mesa, Uncompahgre, and Gunnison (GMUG) National Forests. This discussion will focus on north pile actions where Trout Unlimited worked with federal, state, and private partners to complete a non-time-critical removal action. Efforts focused on relocating and consolidating 127,000 cubic yards (CY) of contaminated mine tailings and waste rock containing high levels of lead and other heavy metals. These tailings and waste materials reached heights of 50 ft. and abutted Tomichi Creek for long stretches of 1,400 ft., thus historically confining the drainage without an accessible floodplain. Two large repositories were created to house 40,000 CY of tailings/waste, while the remaining 87,000 CY was consolidated and capped with two feet of clean fill at re-contoured slopes of 4.5:1 out of the floodplain. This action allowed for the creation of an accessible floodplain with widths ranging from 60 to 80 ft. based on historic 100-500 year flood return periods. On-site woody material, rock, and over 150 willow bulb transplants were used to stabilize the newly created floodplain, while a hummocking technique was performed to stimulate plant and seed growth across the site.

TARGETED REMEDIATION: MINE WATER SOURCE CONTROLS

Rory Cowie, PhD, Water Resources Program Director, Hydrologist, Mountain Studies Institute

*rorycowie@mountainstudies.org*

Can we effectively shut off Acid Mine Drainage (AMD)?

Given the high costs and perpetuity of handling AMD through traditional treatment technologies alternative approaches are warranted. The environmental impacts of AMD are primarily measured in terms of metals loading to surface waters, which is dependent on both the concentration of metals and amount (volume) of water transporting those pollutants.

One approach to reducing contaminant loading is to reduce or stop both the production of AMD and its release into surface waters through physical blocking of major pathways (i.e. mine tunnels). This talk will describe the engineering of bulkheads in mine workings to control water discharge. The installation of bulkheads help to control the amount, location, and timing of mine water release (blow out prevention). Bulkheads also help to restore pre-mining groundwater tables. Higher groundwater tables reduce the sub-surface oxidation potential which can slow the production of AMD.

Successful implementation of bulk heads requires sufficient understanding of the spatial and temporal sub surface hydrogeology in the area. This talk will also discuss what relevant background information and data needed to predict the hydrologic outcome of bulkheads in certain locations and how to monitor post installation.

COST EFFECTIVE PLANS FOR SUCCESSFUL MINE LAND RECLAMATION

Andy Jung, Global Mining Business Development Manager, Profile Products

*ajung@profileproducts.com*

Successful rehabilitation and reclamation of mining sites requires a comprehensive approach. Those overseeing rehabilitation efforts must assimilate and stage several considerations into a working relationship that integrates five fundamentals for successful mine closure. Employing the discipline to work through the discovery sequence of the first three fundamentals – to analyze soils and substrates, pick the right plant materials for the site, and select the most cost effective erosion and sediment control techniques, will undoubtedly head a project in the right direction.

These fundamentals must be followed by the development of clear construction plans and specifications that effectively communicate the project requirements to contractors and installers. Once construction commences, onsite oversight of acceptable installations must be conducted by qualified inspectors. Then, the active rehabilitation sites must be regularly inspected and maintained after each significant precipitation or other potentially damaging event. Failure to systematically execute any of these fundamentals can undermine the best laid plans of any mine closure project.

Successful restoration typically comes from carefully controlled onsite trials and iterative installations to assess efficacy of various treatment combinations. Such treatments must then be refined and customized to develop cost effective closure plans. Exhaustive research on suitable soil amendments, plant materials, and erosion control techniques should be planned and budgeted for as integral steps in the mine closure progression. Case studies using conditions found in the San Juans will be offered to illustrate the discovery and implementation of the five mine closure fundamentals for successful mine closure.

### Session III: Future of Reclamation

GOOD SAMARITANS – WE DIDN'T CAUSE THE PROBLEM, BUT WE WANT TO FIX IT.

Ty Churchwell, San Juan Mountains Coordinator, Trout Unlimited

*tchurchwell@tu.org*

The presenter will provide a basic update on the concepts, applications, and need for Good Samaritan legislation as a tool to combat acid mine drainage from abandoned and orphaned hardrock mines. This presentation will educate on the shortcomings of the Clean Water Act's (CWA) discharge permitting system and how this has stymied voluntary cleanups at mine sites across the west. You will learn exactly what Good Sam does, and does not do, in terms of 'liability relief' for those willing to voluntarily clean-up sites, and how this would apply in the event of an accidental spill. You will learn who are likely to be 'Good Sams' and who would be disallowed, what criteria would be used in permitting and what qualifications and safeguards would need to be in place. This concept will be put into context with how it could be employed in the San Juan Mountains, and what sites would qualify to be considered. We'll discuss CERCLA (the Superfund law) amendment alternatives to a traditional CWA amendment, and learn about what our U.S. delegation is doing to enact this vital legislation. Now that the upper Animas River basin is home to America's newest 48 Superfund sites, we'll explore what role Good Sam can have, if any, for the Animas, what the current status of the Animas' Superfund process is, and what role the regional San Juan Clean Water coalition has in all of this.

UNITY AS A RESPONSE TO DISASTER: THE ANIMAS RIVER COMMUNITY FORUM

Shannon Manfredi, Coordinator, Animas River Community Forum

*animasriverforum@gmail.com*

In response to the Gold King Mine spill incident, the Animas River Community Forum came together for the purpose of promoting communication, coordination and collaborative action; fostering public confidence; supporting resiliency in our communities; and enhancing planning, improved public safety and health for the future; all while honoring the institutional authorities and decision making of government and community organizations. The incident brought together government agencies, conservation organizations, and the education and business sectors, (i.e., Forum Partners)—all of which work in the Animas watershed, but for different purposes and often without interacting. Since forming, the Partners have met bi-monthly to hear updates about what they are doing in the watershed, and discuss trends, concerns, and opportunities. Partners have formed sub-groups to discuss common issues, compiled an inventory of monitoring data, developed and implemented an alert notification plan, and conducted a survey, among other accomplishments.

Moving beyond the GKM spill, Partners' aim to sustain the public's interest in the river and educate the public about other issues affecting water quality, in addition to providing information about the Superfund site. Not

unlike most “group efforts,” the Forum Partners grapple with what it means to collaborate (i.e., an internal struggle). Externally, there are parallel struggles coordinating efforts between the downstream community of Durango and the headwaters community of Silverton, which have different level of awareness, engagement, and issues of concern. This panel presentation will highlight the value of the Forum from Partner perspectives; lessons for other communities, and public engagement on the horizon.

#### CLOSING THE WASTE LOOP - WASTE ROCK TO BIOMINERAL FERTILIZER

Andrew Harley, Principal Scientist, Duraroot Environmental Consulting/H-2 Enterprises

*aharley@duraroot.com*

The large volumes of waste produced at mining operations are expensive to manage, and frequently cited as an obstacle in the environmental sustainability of mining. The majority of waste produced is still placed into storage facilities, and the reclamation and long-term management of these facilities has become an important part of modern mine development and mine closure. The applications of certain microorganisms have gained importance in the field of applied environmental microbiology. Among them, biomineral processing of metal mining from ores, concentrates, industrial wastes, overburdens with microorganisms and/or their metabolites. This process still produces waste material requiring management.

Remineralization is the process of adding ground up rock to agricultural land. Rock-forming minerals found in mine waste contain most of the nutrients required by higher plants for growth and development, and as such, provide a source of nutrients to depleted soil. Microbial activity enhances the release of these nutrients and supports additional beneficial outcomes in agricultural soils.

This paper describes a novel technique that combines the extraction of metals from mine waste using environmentally safe chemistry, followed by biodigestion of secondary waste from this process to generate a biomineral fertilizer. This process results in a zero-waste facility and multiple revenue streams. Bench-scale and pilot-test data will be presented, as well as a description of projects currently being permitted.

#### THE SAN JUANS AND THE RESHAPING OF CERCLA AND HARD ROCK MINING

Anthony D. Edwards, Owner, Sholler Edwards, LLC

*Anthony@ShollerEdwards.com*

It is undeniable that the Gold King Mine Spill focused international attention on the U.S. “Mineral Estate” and the acid mine drainage legacy of the mountain west. Unfortunately, we remain in the same eddy, a legal abyss, which we were churning in before the spill occurred. However, three lawsuits associated with the event and the subsequent Bonita Peak Mining District National Priority Listing are developing a foundation which will result in outcomes that will significantly impact the intersection of the Clean Water Act, CERCLA and Hard Rock Mining. These matters include New Mexico vs. Colorado in the United States Supreme Court, Sunnyside Gold Corp. vs. EPA in the U.S. Court of Appeals, D.C. Circuit and New Mexico and Navajo Nation vs. the EPA et al. (Consolidated Cases) in the District Court of New Mexico. The issues in question include the EPA’s “Responder” theory and agency liability, State sovereignty as it relates to CERCLA, and the efficacy of the EPA’s Hazard Ranking System as it relates to sites being placed on the NPL. The presenter will include a brief discussion of each of the matters outlining the issues at stake, the potential outcomes and consequences, and an update on where each case is procedurally.

## Session III: Future of Mining Panel

BOB LARSON

Mining and Geological Consultant – Professional Land Surveyor, Monadnock Mineral Services, LLC  
*larsouray@qwestoffice.net*

Bob is a continued proponent of mining resources in one of the most famous and prolific mining districts in the United States. He has worked in the Idarado, Camp Bird, Revenue-Virginus mines in addition to many prospects and exploration projects in the San Juan Mountains. He is engaged in continued research and activities on reclamation of tailings and waste rock, together with water discharge, to insure the least possible impacts to our naturally impaired mountain region.

DAVE BELLING

President & CEO  
Bullfrog Gold Corp.  
*dave@BullfrogGold.com*

David Beling, P.E. is a 1964 Mining Engineering graduate of the University of Arizona and has since been employed or consulted for Phelps Dodge, Union Oil, Fluor, United Technologies, Westinghouse, and 25 Canadian and US junior mining companies. Mr. Beling examined, significantly reviewed or was directly involved with 88 underground mines, 131 open pit mines and 164 process plants during the past 53 years. In addition to permitting, developing and managing several production operations, he initiated, closed or strongly contributed to debt and equity financings, commodity and asset sales, mergers, acquisitions and joint ventures.

FRANK FILAS

Partner, Filas Engineering and Environmental Services LLC  
*frankfilas@gmail.com*

Frank has a B.S. in Mining Engineering, an M.S. in Environmental Science and Engineering, and is a licensed professional engineer with 38 years of mining and construction experience. He started his career working primarily in mine operations and as a mine-site engineer in both underground coal and open-pit gold mining. For the last 28 years, he has worked both as an environmental manager for mining companies and as an environmental consultant to all sectors of the mining industry. Most recently, as Vice-President of Environmental Affairs for Energy Fuels Resources, he managed a team of environmental specialists responsible for permitting and compliance of uranium mines and processing facilities in five southwestern states including Colorado. He retired at the end of 2014 and is a Partner with his wife, Barb, in Filas Engineering and Environmental Services.

PAT WILLITS

Executive Director, Trust for Land Restoration  
*willits@independence.net*

Pat is executive director of the Trust for Land Restoration, a not-for-profit land trust, consultant group, and think tank, founded in 2000. The trust is dedicated to helping communities understand and manage a variety of environmental liability issues so that scenic vistas, historic landscapes, and critical native habitat in the San Juan Mountains of Southwest Colorado can be restored, conserved, and protected. Pat is a former San Miguel River Preserves Manager and former Southwest Colorado Program Manger for the Nature Conservancy. He is a former Board Member of Black Canyon Regional Land Trust, was a member of the Red Mountain Project Task Force,

and served as Mayor of the Town of Ridgway from 2000 to 2012. He is currently a member of the Uncompahgre Watershed Partnership's Mining Committee.

#### RUSS MEANS

Senior Environmental Protection Specialist, Colorado Division of Reclamation, Mining and Safety  
*russ.means@state.co.us*

Russ has worked for DRMS for 16 years out of the Grand Junction Field Office. He has been involved in uranium mine permitting, as well as other hard rock / metal prospecting and mining issues over the years. Russ leads the DRMS Field Office staff that covers Western Colorado. His past experience includes ten years as a miner in both underground and open pit copper mines.

### Poster Abstracts

#### UNCOMPAHGRE WATERSHED TOTAL MAXIMUM DAILY LOAD (TMDL)

Holly Brown, TMDL specialist, Colorado Department of Public Health and Environment - Water Quality Control Division  
*holly.brown@state.co.us*

Under Section 303(d) of the federal Clean Water Act, states are required to evaluate all available water quality-related data and information to develop a list of waters that do not meet established water quality standards (impaired). States then must develop a Total Maximum Daily Load (TMDL) for every pollutant/waterbody combination on the list.

A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that particular pollutant. A TMDL determines a pollutant reduction target based on this maximum allowable amount and allocates load reductions necessary to the source(s) of the pollutant.

Citizen information and participation can improve the quality of TMDLs that are developed and can ultimately speed cleanup of impaired waters. Public/stakeholder roles in the TMDL process can include: providing data and information; reviewing and commenting on the impaired waters list; assisting in the actual development of TMDLs; reviewing and commenting on draft TMDLs; and helping ensure TMDLs are implemented.

The Colorado Department of Public Health and Environment, Water Quality Control Division (CDPHE, WQCD) is currently developing TMDLs for several pollutant/waterbody combinations on Colorado's 303(d) list of impaired waters, including TMDLs that address metals impairments in a number of watersheds impacted by mining activities, either past or present. More information about CDPHE, WQCD TMDL development can be found at <https://www.colorado.gov/pacific/cdphe/total-maximum-daily-loads-tmdls>.

#### COLORADO ABANDONED MINE LAND INFORMATION HUB

Bonie B. Pate, Project Coordinator, Colorado Department of Public Health and Environment  
*bonie.pate@state.co.us*

In conjunction with the Colorado Department of Public Health and the Environment (CDPHE) and other state/federal agencies, the Colorado Geological Survey (CGS) has developed the Colorado Abandoned Mine Land (AML) information hub that provides access to statewide AML information from multiple agencies. The website brings existing AML inventories from state and federal agencies into a centralized, cloud-based GIS platform to facilitate the sharing of data with other agencies, drinking water suppliers, and the general public.

Participating agencies include: Bureau of Land Management; Department of Energy; Environmental Protection

Agency; National Park Service; United States Forest Service; Colorado Division of Reclamation Mining and Safety; Colorado Water Quality Control Division; and Colorado Geological Survey.

#### ENVIRONMENTAL MANAGEMENT

Crystal Fletcher, Environmental Engineer, Ouray Silver Mines Inc.  
*crystalfletcher@ouraysilvermines.com*

A brief exploration of the importance of Environmental Management in the Mining Industry that highlights the challenge of meeting the ever-increasing demand for raw materials while simultaneously minimizing harm to the environment, meeting regulatory standards/requirements, and improving relationships with regulatory agencies.

#### GOLCONDA PLACER MINE RECLAMATION; 25 YEARS LATER.

Corey Sue Hutchinson, Aquatic Biologist, Aqua-Hab, Inc  
*aquahab@bresnan.net*

Where two forks of the West Fork Mancos River join, gold-riddled cobble settled in the little valley. This was discovered and placer mining began. "Placer; a waterborne or glacial deposit of gravel containing heavy ore materials such as gold which have been eroded from their original bedrock and concentrated as small particles that can be washed out". The confluence was turned upside down with dozers and hydraulic blasting to remove the gold. The channels were diverted to the sides of the valley. In the late 1990's, the Forest Service directed funds to restore this area. Hydrologists and biologists developed a plan for re-contouring the valley, establishing stable channels, and vegetating the lunar-like landscape. Now, 25 years later, the little valley is full of trees, stable channels, and all that goes with a functioning ecosystem. Monitoring has consisted of one of those biologists (long gone from the Forest Service) going back every several years to document progress with photographs and general observation.

#### LESSONS FROM SANTIAGO: PARTNERSHIP APPROACHES TO ENHANCE REMEDIATION OF LEGACY MINES

Lauren Duncan, Abandoned Mine Restoration Project Manager, Trout Unlimited, Inc.  
*lduncan@tu.org*

Trout Unlimited (TU) has successfully completed extensive remedial work at the Santiago Mine and Mill, located seven miles south of Georgetown, CO. This site is on the State's Historic Register and is eligible for the National Historic Register, making it a popular destination for visitors. Tailings and mine waste containing high concentrations of heavy metals were present across the site and the material was readily accessible to humans and wildlife, making the site a priority for cleanup. TU's remedial work included consolidation of mine tailings and restoration, stabilization, and preservation of the site's historic buildings. The removal actions taken at the Santiago Mine will reduce contaminated sediment and metals loading in the main stem of Leavenworth Creek and improve the safety of the site for future visitors.

Critical to the success of the Leavenworth Creek project was the input of project partners, Federal/State agencies, and community groups. TU's partners provided essential technical and financial support, the State Historical Preservation Office guided restoration efforts on the historic Santiago Mill building, and local community groups detailed important site history. Partners and community members elevated this site from a standard removal action to an interpretative site that supports the needs of the community and the environment. The approach utilized at the Santiago Mine and Mill provides a positive example of how collaboration and partnerships enhance project results. TU hopes to use this project as a model that will help guide future reclamation efforts in the San Juan Mountain region and across the West.



RAPID REMEDIATION OF HEAVY METALS FROM MINE WASTE WATER  
Ryan Doeren, Fort Lewis College Research Assistant, Fort Lewis College  
*radoeren@fortlewis.edu*

The Gold King Mine Spill (2015 near Silverton, CO) heightened public awareness concerning the adverse effects associated with acid mine drainage in the San Juan Mountains. Challenges associated with remediation of contaminated mountain waters include remote locations, topography, high elevations, and dramatic diurnal temperature fluctuations. Few techniques that are rapid, efficient, and affordable with respect to cleaning acid mine waste waters have been published. We have recently developed a novel process that is efficient in the rapid remediation of heavy metals from polluted waters. This novel process involves the injection of Amagel polymer into mine water, causing rapid coagulation and flocculation followed by a rapid drying time of solids. Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) results show that our novel approach is capable of significantly reducing total heavy metal concentration. Preliminary data shows that, following treatment of acid mine drainage (pH=2.3) with Amagel, iron concentrations decreased by 99.6%, copper by 99.5%, and manganese by 99.2%. Laser diffraction studies showed that the rate at which suspended solids in mine waste water settled were nearly decades faster following treatment compared with untreated samples. In summary, our process leads to rapid settling of suspended solids combined with significant reductions in the concentration of heavy metals. Moreover, our method has the potential of facilitating the recycling of heavy metals obtained through separation.

CENTENNIAL MINE CENTENNIAL MINE CHANNEL RESTORATION PROJECT  
Bill Coughlin , Stream Restoration Specialist, Western Stream Works  
*billcoughlin@westernstreamworks.com*

The Centennial Mine Channel Restoration Project goals are to mitigate excessive erosion and sediment transfer through the ephemeral reach; to mitigate discharge interference with tailings; and to provide a monitoring and maintenance sediment basin to mitigate downgradient aggradation of tailings. Operations at the historic Centennial Mine, located in Disappointment Valley near Naturita, CO, had filled the ephemeral drainage and surrounding areas with uranium mine tailing waste. The approach to mitigating this problem is creating a channel by removing tailings and stabilizing the side slope. Then by creating a width to depth ratio and sinuosity ratio to replicate a reference reach upstream of tailings. The channel is built with a multi-stage floodplain and side slopes begin above the bankful stage capacity. Three feet of clean, imported fill underlie the entire project. Instream structures were installed to further mitigate sheer stress. As of spring 2017, the stream channel has functioned well and the sediment basin is ponding water at the base. This slow water condition will allow any transported fines to settle out and not migrate downstream. The channel stabilization project design is functioning as intended. Vegetation is just starting to develop root mass to further stabilize the 3:1 slopes. A significant discharge event has yet to occur, and when it does monitoring will follow.

THE LOWER WILLOW CREEK FLOODPLAIN PROJECT: A PROJECT TO CREATE COMMUNITY AND ECOLOGICAL RESILIENCE

Guinevere Nelson, Executive Director, Willow Creek Reclamation Committee  
*guineverenelson@gmail.com*

The merging of two restoration objectives was explored in the Lower Willow Creek Restoration Project. The project is in a community that relied on mining as the primary driver of the economy for almost 100 years. In that time, the project site was only used to store tailings and never integrated into the community. While emerging from the long history of mining, one of the project objectives was to connect the community to this site, and integrate it into the culture and memory of the community. The ecological restoration of the site included a simple cap to cover mine wastes and associated heavy metals. The major challenge of this project was to create opportunities that the community engaged with to participate in the restoration. The final outcome of these engagement efforts was identifying a stewardship opportunity that supported the restoration objectives.

**THURSDAY, MAY 25, 2017**

**WATER QUALITY IMPROVEMENTS RESULTING FROM THE IDARADO MINE REMEDIATION PROJECT**  
Camille Price, Environmental Protection Specialist, Colorado Division of Reclamation, Mining & Safety  
*camille.price@state.co.us*

The Idarado Mine Remediation Project completed construction of hydrologic controls above 12 mine waste rock piles and remediation of 5 mine tailings resulting from historic gold and silver mining in the upper Uncompahgre River watershed in 1997. Zinc loading in Red Mountain Creek has been reduced by 25% compared to pre-remediation water quality data thus far; the project's performance objective requires a 50% reduction, however. This presentation will discuss the project's remediation of mine waste and review the resulting water quality improvements to date. A complimentary presentation by Devon Horntvedt will discuss new technology Idarado is testing to address the remaining 25% reduction of zinc loading to achieve the performance objective.

**IDARADO MINE REMEDIATION – A DISCUSSION OF REMEDIAL ALTERNATIVES AND DEVELOPING A VIABLE PATH FORWARD**

Devon Horntvedt, Environmental Engineer PE, Worthington Miller Environmental, Consultant for Idarado Mining Company  
*devon.horntvedt@wm-env.com*

This presentation will outline the activities and remedial alternatives explored over the past several years by Idarado Mining Company as the company seeks to develop sustainable, long-term solutions to environmental impacts caused by metal loading sources and historic mining activities in the Uncompahgre River watershed. The discussion will dive into the specific challenges faced by engineers as work continues to be performed in developing viable solutions for managing these impacts, including Idarado's scientific evaluation of emerging technologies.

## **THANK YOU POSTER & EXHIBIT SESSION BEVERAGE SPONSORS**



**OURAY LIQUORS**

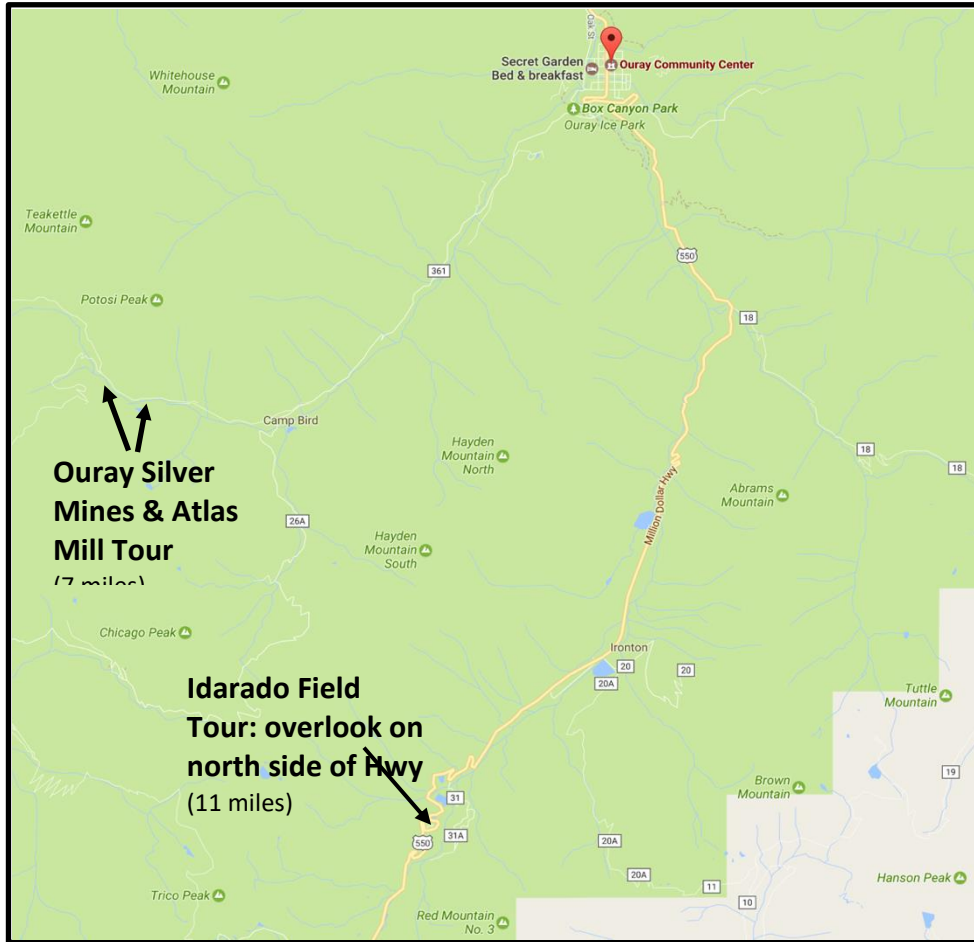


# Field Tours

All field tours will leave from the Ouray Community Center.

May 25, 2017 Idarado and Ouray Silver Mines/Atlas Mill tours will use private carpools.

May 26, 2017 Ouray Silver Mines belowground mine and mill tours will use jeep shuttles.



## THANK YOU TO OUR FIELD TOUR SPONSORS & CONTRIBUTORS



## Evaluation – *Please complete this survey*

---

Thank you for attending the fourth annual San Juan Mining Conference. We value your thoughts and feedback so we can continue to improve the conference and provide detailed reporting to our sponsors. We appreciate you taking a few moments to complete the following evaluation.

Name (optional): \_\_\_\_\_ Community Role: \_\_\_\_\_

Circle one:

Participant | Sponsor | Presenter

1. How did you find out about the conference?
2. How does this conference benefit you and/or your community?
3. What was the most useful workshop, tour and/or presentation for you? Why?
4. What was the least useful workshop, tour, and/or presentation for you? Why?
5. Are there audiences you think should participate in this conference that you didn't see this year? If so, who?
6. For 2018, what suggestions for improvement or recommendations for content do you have?
7. What topics would you like to see covered in future conferences?

Please rate the following facets of the conference (5=Very Good 1=Very Poor) and circle the number that corresponds to your opinion of the conference's ability to accomplish the following goals:

	Very Good	Good	Neutral	Poor	Very Poor
1) Educate participants on:					
a. the science and policy of mining	5	4	3	2	1
b. remediation of mine lands and activities addressing water quality impairments	5	4	3	2	1
2) Facilitate informed discussion among diverse presenters and stakeholders	5	4	3	2	1
3) Spark dialogue about the benefits legacy and operational mines can bring to communities	5	4	3	2	1
4) Expand knowledge and resources of stakeholders to actively participate in remediation/restoration of their mining communities	5	4	3	2	1

Please circle the number that represents your opinion of the conference's performance in the following areas:

	Very Good	Good	Neutral	Poor	Very Poor
Venue	5	4	3	2	1
Food	5	4	3	2	1
Field Tour	5	4	3	2	1
Presentation Topics	5	4	3	2	1
Length of Presentations	5	4	3	2	1
Quality of Panel Session	5	4	3	2	1
Posters & Exhibits Session	5	4	3	2	1

Additional Comments: