STUART R. JENNINGS

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Principal Scientist
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Fields of Competence

- Land Reclamation
- Soil and Water Chemistry
- Mine Closure
- Soil Remediation
- Storm Water Management
- Technical Writing and Editing
- Multi-disciplinary Project Management
- Environmental Soil Science
- Native plant restoration
- Vadose zone analysis and instrumentation

Education

- **M.S. in Land Rehabilitation** – (1995) Montana State University, Reclamation Research Unit. Emphasis in mine land reclamation, geochemistry of sulfide mineral oxidation.

- **B.S. in Geology** – (1984) Montana State University

Professional Summary

Stuart Jennings is a geologist and land reclamation scientist with 25 years of experience. Stuart's technical strengths are in soil geochemistry, land reclamation, soil remediation, surface water protection, and environmental problem solving. He has particular expertise in the management of acid-sulfate soils systems resulting from mining of sulfide-bearing ore materials. Mr. Jennings is recognized as an expert in the treatment and management of mine waste in the Rocky Mountain region. He is credited with developing an innovative approach for reestablishment of native plants through reprocessing mine tailings to remove sulfide minerals, for reestablishment of wildlife habitat in smelter-affected uplands, for developing geochemical controls for inhibition of weeds and promotion of native plant communities. As a technical writer and editor, Mr. Jennings has participated in the preparation of technical articles, book chapters, technical reports for the U.S. government, and numerous technical project reports. In addition to his technical skills, Mr. Jennings has a passion for building partnerships between private, public and non-profit entities to accomplish landscape scale conservation and restoration. In companion, Stuart is known for supporting students, building organizational bridges and recruiting high-caliber talent to KCHarvey.

Representative Projects

East Side Road Revegetation Project, Montana Department of Environmental Quality. Historical discharges of contaminated irrigation water into upland pastures has resulted in metal enriched soil, sparse vegetation and recurring wind erosion impacting rural residential properties near Deer Lodge, Montana. The subject pastures have been reclaimed twice previously without success. The current project will assess the causative factors leading to the prior problematic outcome and then develop and install effective revegetation measures. The initial work will implement an emergency soil stabilization effort in 2014.

Mt Haggin Wildlife Management Area Restoration Project, Montana Fish Wildlife and Parks. Restoration of wildlife habitat in smelter impacted uplands near Anaconda, Montana has been initiated in partnership with EPA, Montana DEQ and the Natural Resource Damage Trustee (MDOJ). Thousands of acres of upland big game habitat exhibits barren, sparsely vegetated and erosive condition. Innovative reclamation practices are under development to accelerate natural recovery and return these degraded areas into improved wildlife habitat.

Assessment and Repair of a Mine Waste Repository, Colorado Department of Public Health and Environment. The Church Placer mine site was used as a local repository for mine waste in Gilpin County, Colorado. The repository cover was constructed using blasted rock from a nearby road widening project and included organic amendment and reseeding. Project work included assessment of revegetation success, recommendations for maintenance and design of repair actions. One area of the cover had rapidly acidified due to movement of acidity from mine waste upward into the soil cover resulting in failed vegetation and accelerated erosion. Lime amendment prescriptions were developed and implemented in 2013.

Abandoned Mine Closure Design and Evaluation of In-Situ Treatment, Colorado Division of Reclamation Mining and Safety. Central Colorado has many abandoned mines requiring clean-up actions. These actions will be implemented by both State and federal agencies and often involve mixed land ownership with both public and private land. Many of these sites are in remote, high elevation locations with limited access. Conventional closure techniques are often not applicable or excessively costly at these remote locations. In-situ treatment closure options are being developed employing soil amendments to immobilize metals and allow for revegetation.

Landform Reconstruction, Alberta Oil Sands (private client). Vast areas of the boreal forests of northern Alberta are being disturbed to recover bitumen for processing into fuel. Progressively tightening reclamation standards require companion innovation and adaptation of new reclamation practices to return large disturbed areas to productivity. Several projects have been completed including updating closure and reclamation plans that emphasize hydrological and ecological function as well as geomorphic designs for landform reconstruction.

Camelina Meal Evaluation as a Soil Amendment In 2009 the Montana Departments of Transportation and Environmental Quality commissioned a research study evaluating the effectiveness of waste camelina meal as a soil amendment for road cuts where topsoil was not replaced. Replicated greenhouse and field research plots were constructed using varying rates of camelina addition followed by seeding with native grasses. First year monitoring was performed in 2009. Qualitative subsequent evaluation suggests these treatments have improved over time and test plots show healthy vegetation growing 5 years after treatment.

Anaconda AWRR&S Operable Unit, 1996-present, CDM and EPA. During the ten year period of 1996-2006 Mr. Jennings served as EPA's chief ecological advisor at the Anaconda Regional Water, Waste and Soil Operable Unit near Anaconda, Montana. During that period of time Mr. Jennings led EPA through a process of delineating areas within the 300 square mile site requiring remedial action through development of an innovative protocol. The Land Reclamation Evaluation System (LRES) utilizes a landscape scale assessment of soil and vegetation conditions coupled with habitat types and patterns of land use creating a process for the responsible party (ARCO) to develop engineering designs, implement actions and subsequently monitor effectiveness. The habitats and designs spanned the spectrum from south-facing shrub-grasslands with noxious weed issues to riparian wetlands with discontinuous deposits of fluvial mine tailings. Implementation and monitoring of this work is expected to last more than 20 years. Key stream restoration components of this work include Warm Springs Creek, Silver Bow Creek, Lost Creek, Dutchman Creek and Mill Creek utilizing approaches ranging from grazing modifications to total reconstruction.

Clark Fork River Flood Plain Evaluation Study, 2005-present, CH2M Hill and EPA. An ecological evaluation protocol was developed by the Reclamation Research Unit (Stuart Jennings and Dennis Neuman) and Bitterroot Restoration (Paul Hansen) for assessment of the ecological health of the Clark Fork River floodplain where impacted by historic mine waste (2000-2003). The Riparian Evaluation System (RipES) is an objective, data predicated land assessment tool integrating vegetation, soil and streambank condition to determine whether the identified polygons require remedial action. Data collected includes GPS delineation of habitat polygons based on mine waste impacts to the landscape, weed mapping, wetland delineation and streambank condition evaluations. Mr. Jennings has served as a field team member and advisor to this on-going mapping effort encompassing 40 miles of privately owned ranch land along the Clark Fork River near Deer Lodge, MT.

Abandoned Mine Reclamation Evaluation Handbook, 2003-2006, USDA Forest Service and the Bureau of Land Management. The legacy of hardrock mining in the headwaters of Montana watersheds has imparted an indelible signature of metals and a challenging problem for federal land managers. Many actions have been taken to mitigate the impacts of historic mining, yet the effectiveness of these actions was unknown to the land managers. Mr. Jennings led an effort initiated by University scientists to develop an assessment protocol for remediated mine sites located in diverse habitats managed by the Forest Service and BLM. Polygons were mapped using GPS and

aerial photography and protocols developed for characterizing the landforms and their associated management prescriptions with emphasis on public safety and ecological integrity. Emphasis was placed on assessment of previously restored streambanks to assure remedy protectiveness.

Restoration of the Clark Fork River Floodplain at Bonner, Montana. 2004-present, Montana Department of Justice, Natural Resource Damage Program. Restoration of the floodplain of the Clark Fork River is required after removal of the contaminated sediments behind Milltown Dam. Mr. Jennings led an investigation of the soil suitability and sources of borrow material for use in floodplain reconstruction. Multiple sampling events were conducted to progressively resolve the location, distribution, characteristics and quality of available soil materials. Metal contamination was delineated leading to development of a grading plan maximizing contamination removal and minimizing cost by leaving uncontaminated historic floodplain sediments in the floodplain.

Hydrologic Monitoring of Cow and Pony Creeks, Rosebud County, Montana. 1990-present. Battelle-Pacific Northwest Laboratories. Power generation near Colstrip Montana creates nearly 1 million tons of ash annually that is slurried to disposal ponds at the headwaters of Cow Creek. Long-term monitoring initiated in the early 1980's has been conducted to protect groundwater, surface water and springs on private ranch land down gradient of the ash disposal ponds. Mr. Jennings has participated in water quality monitoring over a 16 year period in an effort to assure the perpetuation of livestock grazing and access of clean water. This study emphasized long-term trend monitoring of the shallow alluvial and coal aquifers.

Keating Mine Reclamation Project, Radersburg, Montana. 2001-2006. U.S. BLM. Demonstration of in-place treatment of acidic mine tailings was requested by the BLM as a demonstration of the effectiveness of chemical amelioration of formerly phytotoxic mine tailings. Mr. Jennings performed the baseline vegetation inventory at this project site and developed the seed mix reflecting the management prescription and native species represented.

Arkansas River Remedial Action, Leadville, CO, 2005-2012, URS Operating Services and EPA. Mine tailings deposited within the floodplain of the Arkansas River and on ranch land down gradient of Leadville, Colorado have been remediated under actions initiated by EPA under the Superfund statute. Mr. Jennings served as EPA's technical advisor on soil treatment, amendment specifications, streambank reconstruction, construction practices and revegetation prescriptions. Contamination was irregularly distributed across several landforms and habitat types. Using GPS and aerial photography the specific treatment areas were mapped and unique treatment prescriptions developed reflecting habitat type, soil quality and construction considerations. Work on this project was completed in 2009. Stream restoration included bank stabilization and complete streambank reconstruction through the 11 mile reach. A total of 18 acres of fluvial mine tailings and 153 acres of contaminated meadows were treated during the 2008-2009 construction seasons.

Implementing Construction Site BMPs in the Northern Rocky Mountains, 2005-2006, EPA. Stormwater control at construction sites is a regional problem. Revegetation is the ultimate form of soil stabilization of disturbed sites reflecting the adjacent undisturbed habitats. Mr. Jennings led the development of a training CD and website for regulators, engineers, land owners and construction site operators. Current practices employed across the region were evaluated, analyzed and synthesized into a graphic guide and training protocol for optimized effectiveness.

Evaluation of Organic Matter Addition and Incorporation on Steep Slopes. 2004-2007. Montana Department of Transportation. Stabilization of steep slopes along transportation corridors is ineffective when topsoil cannot be replaced and the underlying parent material does not support plant growth. Mr. Jennings was principal investigator in a research project funded by the Montana Department of Transportation to evaluate the feasibility and effectiveness of compost addition on steep slopes. Test plots were constructed in northwest and southeast Montana and monitored for a three year period to assess plant community development and erosion control.

Water Balance Monitoring through Constructed Caps at Colstrip Montana, 1996-present. PPL Montana. Research plots were constructed on coal fly ash disposal ponds in the mid-1990's leading to selection of a cap design to maximize evapotranspiration of meteoric water while providing for establishment and persistence of native grass plant communities. Monitoring of the research plots for soil water content and water balance was initiated using neutron probes and shifting to datalogger based TDR waveguides in 2005 once the entire ash disposal cap was constructed. This research is on-going.

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