

# Technology Innovation News Survey

Entries for May 16-31, 2021

## Market/Commercialization Information

### CALICO EARLY MAN REMEDIATION PROJECT

Bureau of Land Management, California State Office, Sacramento, CA.  
Contract Opportunities at SAM.gov, Solicitation 140L1221R0002, 2021

This is a total small business set-aside under NAICS code 237990 for a single-award, firm-fixed-price construction contract to provide the items of work required to remediate physical safety hazards associated with the Calico Early Man Mine, located in San Bernardino County, CA. The Bureau of Land Management's California State Office seeks contractors who are familiar with design, fabrication, and installation of remediation of physical safety hazards associated with abandoned mines because the features of this project are very similar and the same type of remedies are desired. Period of performance: 12/01/2021 to 02/28/2022. Offers are due by 6:00 PM PT on July 15, 2021. <https://sam.gov/opp/43e4afacd28648df813953b3189cd60e/view>

### FACILITATING A MULTI-ORGANIZATIONAL APPROACH TO FORMALIZING ARTISANAL AND SMALL-SCALE GOLD MINING

Dept of State, Office of Acquisitions Management, Funding Opportunity SFOP0008190, 2021

The Bureau of Oceans and International Environmental and Scientific Affairs' Office of Environmental Quality at the U.S. Department of State intends to fund a Cooperative Agreement of up to \$490,000 to facilitate a multi-organizational approach to formalizing artisanal and small-scale gold mining (ASGM) sectors. Shifting ASGM to a formal economic sector is critical for reducing mercury use and release. The agency seeks an organization with very strong facilitation and leadership skills that can work with international organizations, non-government organizations, local and national governments, and other stakeholders to develop one or more projects and, if funds allow, coordinate and launch the implementation of the project. Period of performance is two years. The closing date for applications is July 23, 2021. <https://www.grants.gov/web/grants/view-opportunity.html?oppId=333983>

### BUREAU OF LAND MANAGEMENT, NEVADA ENVIRONMENTAL QUALITY AND PROTECTION

Bureau of Land Management (BLM), Funding Opportunity L21AS00549, 2021

The BLM's Abandoned Mine Lands (AML) program and Orphan Well Project focus efforts in the following areas: (1) environmental compliance and the identification, inventory, cleanup, and remediation of legacy contaminated sites and features; (2) immediate response to releases of hazardous substances, wastes, and materials onto public lands; (3) mitigation of priority AML and Orphan Well contaminated and physical safety sites and features; (4) improving all BLM environmental programs via an environmental management system, including environmental audits; and (5) providing program training and awareness. Once funding has been secured, BLM anticipates awarding two Cooperative Agreements in support of these programs in the State of Nevada out of estimated total program funding of \$500,000. Agreement terms for funded projects are estimated to range between one and three years and are determined based on the period of performance as stated in the project proposal. All proposed projects submitted under this funding announcement must state a benefit to the public. Applications are due by 5:00 PM ET on July 20, 2021. <https://www.grants.gov/web/grants/view-opportunity.html?oppId=334222>

### SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM BROAD AGENCY ANNOUNCEMENT (PHASE I SOLICITATION)

Environmental Protection Agency, Cincinnati Acquisition Div., Cincinnati, OH.  
Contract Opportunities at SAM.gov, Solicitation 68HERC21R0144, 2021

EPA anticipates making about 20 Phase I SBIR awards of up to \$100,000 each, not to exceed a 6-month term of performance. These contracts will be awarded with a likely contract start date of December 1, 2021. The Phase I effort is for "proof of concept" of the proposed technology. All companies that successfully complete Phase I are eligible to compete for Phase II, which is to further develop and commercialize the technology. EPA SBIR topics for 2021-2022 encompass the following broad areas of interest: (1) clean and safe water; (2) air quality; (3) homeland security; (4) sustainable materials management; (5) safer chemicals; (6) and risk assessment. Each proposal must directly address just one of the specific topics described in the solicitation statement posted on FedConnect at <https://www.fedconnect.net/FedConnect/?doc=68HERC21R0144&agency=EPA>. The NAICS code is 541715. Each proposal must be submitted as a single PDF file via FedConnect by 12:00 noon ET on August 3, 2021.

<https://sam.gov/opp/3c41e30cc6c247c58b2710c91b44784b/view>

### CERCLA ENVIRONMENTAL SUPPORT SERVICES (ESS)

Bureau of Land Management, Nevada State Office, Reno, NV.  
Contract Opportunities at SAM.gov - Awards, 2021

The Nevada State Office of the Bureau of Land Management recently awarded several contracts to provide services for conducting preliminary assessment/site investigation (PA/SI) projects at mine sites in Nevada. These projects will consist of sampling programs to determine the presence and concentrations of various potential contaminants. Environmental Cost Management Inc. of Costa Mesa, CA, will provide PA/SI studies at the Leadville Mill site (total contract value: \$36,584.57) and the Hollingshead site (\$33,897.08). Water, Civil, and Environmental Inc. of Boise, ID, will conduct PA/SI studies at the Minnesota Mine (\$37,307.84) and the Wolff Mill Site (\$37,950.69).

## Cleanup News

### PIT LAKE TREATMENT AT THE RECLAIMED FORMER FARLEY MINE

Bonner, D., J. Forbort, J. Vogan, C. Leask, W. Nixdorf, O. Beruar, and R. Frost.  
2020 Mine Design, Operation & Closure Conference, 18-20 August, virtual, 26 minutes, 2020

The presentation details the reclamation, acid rock drainage management, and pit lake treatment approaches at a former mine in Manitoba. Reclamation involved consolidating sulfide mineral-bearing tailings and installing cover systems over the tailings, stormwater diversion systems, and an impermeable cover system over a waste rock stockpile. During reclamation activities, approximately 900 million gallons of ARD were treated using an interim ARD treatment system to create a freeboard for future ARD management and in situ treatment of ARD within the pit lake. The freeboard from this water treatment yielded storage for four years. A recent pit lake water treatment campaign was completed to create a freeboard, using an innovative approach to facilitate effective treatment by offloading quicklime directly from the bulk delivery trucks without the need for a slaker. **See times 1:25-1:51:** <https://www.youtube.com/watch?v=k3XVMIRLQgQ&list=UU1haRH1iNK0LYbYrtuTFROg&index=5>

### EFFECT OF AN EXTREME FLOOD EVENT ON SOLUTE TRANSPORT AND RESILIENCE OF A MINE WATER TREATMENT SYSTEM IN A MINERALISED CATCHMENT

Mayes, W.M., M.T. Perks, A.R.G. Large, J.E. Davis, C.J. Gandy, P.A.H. Orme, and A.P. Jarvis.  
Science of The Total Environment 750:141693(2021)

The Coledale Beck catchment contains the UK's first passive metal mine water treatment system. The catchment experienced an extreme rainfall event in December 2015 that equated to a 1 in 200-year event. The solute dynamics monitoring record for the site provided an opportunity to assess the effects of a major storm event on (1) catchment-scale solute transport and (2) the resilience of the new and novel passive treatment system to extreme events. Changes in system hydraulic efficiency explained a modest decline in treatment efficiency over time. There was no apparent flushing of the mine system during the storm event that could have compromised treatment system performance. Analysis of metal transport in the catchment downstream of the mine show the resilience of passive mine water treatment systems to extreme events and the importance of catchment-scale monitoring to ensure the continued effectiveness of treatment initiatives after major perturbation.

#### **TOWARD SUSTAINABILITY OF PASSIVE TREATMENT IN LEGACY MINING WATERSHEDS: OPERATIONAL PERFORMANCE AND SYSTEM MAINTENANCE**

Nairn, R.W., J.A. LaBar, L.R. Oxenford, N.L. Shepherd, B.K. Holzbauer-Schweitzer, J.G. Arango, Z. Tang, D.M. Dorman, C.A. Folz, J.I. McCann, J.D. Ingendorf, H.T. Stanfield, and R. C. Knox. | Proceedings from the postponed 14th IMWA Congress, "Mine Water Solutions," 2020

A 12-year regular performance evaluation was conducted for a large, multi-process unit passive treatment system (PTS) at the Tar Creek Superfund site, which receives  $\approx 1000$  m<sup>3</sup>/day artesian-flow lead-zinc mine water. Since 2008, the PTS has consistently retained >95% of targeted metal mass. Regular, periodic, and rehabilitative maintenance commitments were also documented. **See pages 123-128:**  
[https://www.imwa.info/docs/imwa\\_2020/IMWA\\_2020\\_proceedings.pdf](https://www.imwa.info/docs/imwa_2020/IMWA_2020_proceedings.pdf)

#### **INTEGRATED CLOSURE PLANNING FOR A HIGH ALTITUDE PIT LAKE IN THE PERUVIAN ANDES**

McCullough, C.D. and A. Diaz. | Proceedings from the postponed 14th IMWA Congress, "Mine Water Solutions," 2020

Pit lake highwalls extend up to 450 m above equilibrium water level at a high altitude copper mine in the Andes, presenting a surge wave risk due to regional seismic activity. A conceptual closure plan was developed incorporating a novel use of a waste rock dump in the valley downstream of the pit lake to provide surge wave protection to the communities located on the river below the mine site. **See pages 129-134:**  
[https://www.imwa.info/docs/imwa\\_2020/IMWA\\_2020\\_proceedings.pdf](https://www.imwa.info/docs/imwa_2020/IMWA_2020_proceedings.pdf)

#### **2020 NATIONAL OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT AWARD NOMINATION: THE EHRENFELD AML PILOT RECLAMATION/ RECREATION & WATERSHED IMPROVEMENT PROJECT**

Webb, P.M, 23 pp, 2020

The Ehrenfeld abandoned mine lands (AML) pilot reclamation and recreation and watershed improvement project was nominated for a 2020 award from the Office of Surface Mining and Reclamation and Enforcement. The reclamation project was a success story that included eliminating almost 70 acres of Priority 2 dangerous refuse pile areas as well as surface burning conditions and improving the acid mine drainage impacts on the Little Conemaugh River. Nearly 3.5 million cubic yards of acidic coal refuse materials were deposited in unreclaimed areas of the mine and covered with an alkaline material to neutralize the refuse and onsite spoil material. AML pilot funding was obtained to repurpose the reclaimed areas for the Johnstown Path of the Flood Trail parking lot and memorial park. This report describes the project in detail the AML issues and the innovative approach to reclamation, including difficulties encountered in achieving reclamation under the existing conditions.

<https://files.dep.state.pa.us/Mining/Abandoned%20Mine%20Reclamation/AbandonedMinePortalFiles/Award2020/2020Nomination.pdf>  
See national award video: [https://www.youtube.com/watch?v=vnDqUT9TSzk&list=PL-UVrc-RbMqQFq50FflhTVv1VNRq\\_4W&index=2](https://www.youtube.com/watch?v=vnDqUT9TSzk&list=PL-UVrc-RbMqQFq50FflhTVv1VNRq_4W&index=2)

## **Demonstrations / Feasibility Studies**

#### **BIOCHAR AND OTHER AMENDMENTS PROMOTE DOUGLAS FIR SURVIVAL AND GROWTH ON MINE TAILINGS**

Olszyk, D., M.G. Johnson, M. Bollman, M. Nash, K. Trippie, V. Manning, D. Watts, and J. Novak.  
Annual Meeting of Society of Environmental Toxicology and Chemistry, Virtual, 15-19 November, abstract only, 2020

A field study in mine spoils at the Formos mine Superfund site evaluated the effects of a mixture of lime, biosolids, biochar, and microbes on spoil pH; metal concentrations; and injury, growth, and needle elemental concentrations for Douglas fir. Two years after amendment application, pH increased, and metal availability decreased in the spoil, resulting in enhanced seedling survival, growth, and needle N contents while reducing needle heavy metal concentrations.

#### **PILOT TEST OF THE PERMEABLE REACTIVE BARRIER FOR REMOVING URANIUM FROM THE FLOODED GUNNAR PIT**

Kong, D., L. McGilp, A. Klyashtorin, I. Wilson, and L.D. Wilson.  
Journal of Geoscience and Environment Protection 8:155-176(2020)

Iron oxide coated sand (IOCS) media was applied in an experimental permeable reactive barrier to remove U contaminated floodwater from a mine pit. The mine pit contains  $\approx 3.2$  million m<sup>3</sup> of water contaminated by dissolved U (1.2 mg/L), Ra-226 (0.4 Bq/L), and minor concentrations of other contaminants that is seeping over the pit rim into Lake Athabasca. Hydrous ferric oxide sorbents and their supported forms onto silica sands were prepared, characterized, and tested in bench-scale adsorption kinetic experiments in a field trial. A pilot permeable reactive barrier was fabricated and field-tested to provide technical data to design a full-scale permeable barrier employing the IOCS media. [https://www.scrip.org/pdf/gep\\_2020072813585759.pdf](https://www.scrip.org/pdf/gep_2020072813585759.pdf)

#### **PHYSIO-BIOLOGICAL REMOVAL OF SELENIUM FROM MINING IMPACTED WATERS**

Witt, J., A. Prouty, D. Cunningham, and J. Aulbach.  
2020 Mine Design, Operation & Closure Conference, 18-20 August, virtual, 37 minutes, 2020

The Hoopes Selenium Treatability Study Pilot (Hoopes TSP) was constructed at Smoky Canyon Mine to evaluate the operational performance of physical and biological treatment of active selenium in mine-impacted waters. The treatments included ultrafiltration, reverse osmosis, anaerobic biological, and aerobic biological processes. The technologies were applied in an innovative arrangement that showed promise in removing selenium. Influent concentrations of total selenium fed to the Hoopes TSP averaged 0.144 mg/L and decreased to an average of 0.015 mg/L in the effluent during the study period. Details of the mine setting, influent water parameters, TSP configuration, and operational results are presented. **See times 1:53-2:30:**  
<https://www.youtube.com/watch?v=k3XVMIRL0qO&list=UU1haRH1iNKOLyBrtuTFROq&index=5>

#### **A VALIDATED METHOD FOR PIT LAKE WATER SAMPLING USING AERIAL DRONES AND SAMPLING DEVICES**

Castendyk, D., J. Voorhis, and B. Kucera.  
Mine Water and the Environment 39:440-454(2020)

The Matrice-HydraSleeve method has the potential to lower sampling costs, increase data acquisition, and improve the safety of water sampling in pit lakes by eliminating the need for lake access and boat-based sampling crews. The method combines a drone with a HydraSleeve water sample chamber to collect 1.75 L water samples from up to 122 m deep. Water samples were collected from similar depths in Dillon Reservoir using the Matrice-HydraSleeve method and traditional boat sampling methods to validate the method. Concentrations of Ca, Na, K, HCO<sub>3</sub>, SO<sub>4</sub>, Cl, and Zn showed less than 20% relative percent difference, and concentrations of Cd were within the detection limit, meeting the data quality objective for duplicate samples. The method was also used to collect water samples from the 101 m deep pit lake at the Thompson Creek Mine, including a sample from 92 m deep. Results provided confidence in the method. <https://link.springer.com/content/pdf/10.1007/s10230-020-00673-y.pdf>

#### **ENVIRONMENTAL BEHAVIOR OF METAL-RICH RESIDUES FROM THE PASSIVE TREATMENT OF ACID MINE DRAINAGE**

Jouini, M., C.M. Neculita, T. Genty, and M. Benzaazoua.

This study evaluated the potential mobility of metals and sulfates from acid mine drainage post-treatment residues to understand their fate and enable proper waste management. Samples from a field passive system at the reclaimed Lorraine Mine site consisting of two passive biochemical reactors (PBR1 and PBR2) separated by a wood ash reactor (WA) were collected from the inlet (In) and the outlet (Out) of each treatment unit. Physicochemical and mineralogical characterization was performed. The potential mobility of the metals was assessed via static and kinetic leaching tests. All residues had high metal contents (Fe content >29 g/kg in PBR1-In, > 76 g/kg in WA-In, and > 80 g/kg in PBR2-Out). A high residual neutralizing potential was also found in the WA residues (inorganic carbon 6.5%). Native and organic sulfur was found in the PBR2 residues, while Fe-oxyhydroxide, carbonate, and sulfate minerals were present in all residues. All residues were considered non-hazardous according to EPA regulations, but Quebec's provincial regulation for mining effluents classifies these residues as leachable for Fe, Al, Ni, Zn, and Mn. The PBR2 residues (In & Out) regenerated AMD rich in Fe and sulfates for PBR2-Out (1 g/L Fe and 6 g/L sulfates). All residues were proven to require stabilization before their landfill (co-)disposal with municipal waste.

## Research

**ASSESSMENT OF THE POSSIBLE REUSE OF EXTRACTIVE WASTE COMING FROM ABANDONED MINE SITES: CASE STUDY IN GORNO, ITALY**  
Mehta, N., G.A. Dino, I. Passarella, F. Ajmone-Marsan, P. Rossetti, and D.A. De Luca.  
Sustainability 12(6):2471(2020)

A shared methodology to recover raw materials from extractive wastes from abandoned mines was applied to a site in northwest Italy. The methods focused on: 1) analyzing the impact of tailings and fine fraction of waste rock (*Lepidium sativum*) to assess their viability as soil additives; and 2) recovering raw materials from tailings and coarse fraction (>2 mm) of waste rock using wet shaking table and froth flotation. The results indicated that the fine fraction of waste rock and tailings did not have detrimental effects on seed germination; however, plant growth markedly decreased. Crushing the coarse waste rock samples to This paper is **Open Access** at <https://www.mdpi.com/2071-1050/12/6/2471>

**LONG-TERM OPERATION OF A PERMEABLE REACTIVE BARRIER WITH DIFFUSIVE EXCHANGE**  
Schwarz, A. and N. Perez. | Journal of Environmental Management 284:112086(2021)

This study evaluated the long-term operation of a bench-scale reactor which simulated a permeable reactive barrier with sulfidic diffusive exchange (SDES-PRB) to treat acid mine drainage (AMD) over 591 days. Water amended with 200 mg/L Zn<sup>2+</sup> and 3300 mg/L SO<sub>4</sub><sup>2-</sup> at pH 4.9 was fed into the reactor followed by water with 450 mg/L Fe<sup>2+</sup>, 100 mg/L Zn<sup>2+</sup>, 10 mg/L Ni<sup>2+</sup>, 5 mg/L Cu<sup>2+</sup> and 3600 mg/L SO<sub>4</sub><sup>2-</sup> at pH 2.5. Biologically produced sulfide and alkalinity removed 99% of metals and acidity from moderately acidic water and up to 87% of Fe and 79% of Zn in highly acidic water. The sulfate reduction rates were similar, with no inhibitory effect apparent in either experiment. The SDES-PRB protected the microbial consortium from metal toxicity and acidity in the long term, indicating an extended operational range of biological PRBs.

**LEACHING AND PLANT UPTAKE OF TOXIC METALS IN ABANDONED MINE TAILINGS IN THE CAVE DEL PREDIL (I) MINING SITE AND RIO DEL LAGO VALLEY**

Contin, M., G. Fellet, D. Lizzi, B. Piani, M. De Nobili, and L. Marchiol.  
European Geosciences Union General Assembly, 4-8 May, Virtual, 17 slides, 2020

This study assessed the effect of metal immobilization treatments on mine tailings and the uptake and translocation of Pb, Zn, and Tl in *Biscutella laevigata* (L.) and *Silene vulgaris* (L.). Toxic metal mobility was evaluated either in batch extractions, by leaching columns in the native mine tailings, and in tailings treated with zero-valent Fe, Fe(II)+digestate, or biochar. Six specimens of each plant were collected upstream and downstream of the mining site in sediment banks. Composite bulk soil and rhizospheric soil samples were excavated along the 0-20 cm profile at each plant collection point. Plant specimens were divided into root apparatus and aboveground biomass fractions. Zero-valent Fe showed the strongest decrease of leached metals through the soil columns. Adding Fe(II) +digestate increased the concentration of metals in leachates, likely due to the acidification caused by Fe oxidation/precipitation. Pb concentration ranged between 0.01-669 mg/kg (roots) and 0.01-234 mg/kg (shoots) in *B. laevigata* and between 0.01-891 mg/kg (roots) and 0.01-208 mg/kg (shoots) in *S. vulgaris*. Zn concentrations ranged between 13.4-1461 mg/kg (roots) and 20.6-3390 mg/kg (shoots) in *B. laevigata* and 2.36-1829 mg/kg (roots) and 17.2-1590 mg/kg (shoots) in *S. vulgaris*.  
[https://presentations.copernicus.org/EGU2020/EGU2020-13346\\_presentation.pdf](https://presentations.copernicus.org/EGU2020/EGU2020-13346_presentation.pdf)

**ASSESSING HABITAT HETEROGENEITY AND VEGETATION OUTCOMES OF GEOMORPHIC AND TRADITIONAL LINEAR-SLOPE METHODS IN POST-MINE RECLAMATION**

FleisherKristina, P.R. and M. Hufford.  
Journal of Environmental Management 255:109854(2020)

Plant communities were sampled using line-point intercept transects at two reclaimed surface mines in Wyoming to compare vegetative diversity, composition, and structure between sites reclaimed using geomorphic and traditional methods. Greater species richness and Simpson's Diversity were observed in geomorphic reclamation at the first site but did not differ significantly at the second site, where geomorphic reclamation resembled undisturbed controls. Shrub abundance was up to 10 times greater based on the geomorphic reclamation method compared to traditional reclamation, but neither method achieved vegetation diversity levels observed on nearby, undisturbed rangeland.

**FORMULA AND BASIC GEOCHEMICAL RESEARCH TO CREATE NEW TECHNOLOGY FOR VEGETATION RESTORATION OF MINE SLAG HEAP (SLOPE)**

Zhao, W., Y. Zhou, and H. Xu.  
Environmental Science and Pollution 27:2464-2473(2020)

The ecological mechanism of vegetative restoration of mine slag piles treated with a mixed substrate of slag and soil was investigated through pot and field experiments. The study included physical and chemical analyses of various components and calculations of dosage and other parameters. Soil testing formula, plant selection, pot experiment, and ground planting experiment were selected as the key links. In addition to N, P, K, and organic matter, the content of fine particles was the main factor determining whether the soil-rock mixture could meet the growth and development requirements of plants. The content of fine particles significantly affected the water-supply water-holding capacities of the soil-rock mixture matrix. The higher the content of fine particles, the better the water supply and water-holding capacities. The mixture of artificial rocks and fine soil could be stirred evenly when 50-200% fine soil or fine soil + tailings were mixed into the mine waste residue, providing beneficial vegetation restoration effects.

**ECOLOGICAL SUCCESSION IN AREAS DEGRADED BY BAUXITE MINING INDICATES SUCCESSFUL USE OF TOPSOIL**

Onesimo, C.M.G., D.D. Dias, M. Vale Beirao, A.R. Kozovits, M.C.T.B. Messias  
Restoration Ecology 29(1): e13303(2021)

Plant succession was monitored for 40 months after topsoil transposition in an area of ironstone outcrops (or *cangas*) degraded by aluminum mining. Using a randomized design with 70 permanent 1x1-meter plots was used. Annual phytosociological surveys were carried out, and floristic and vegetational spectra were constructed using Raunkiaer life-forms. The floristic composition was compared with a reference site. Overall, 105 species were identified. Both flora and vegetation changed over time, increasing resemblance to the

reference areas. After 4 years of topsoil deposition, the floristic and vegetational spectra were similar to pristine ones. The vegetation spectrum showed increased dominance of phanerophyte and hemicryptophyte, while the proportion of therophytes was reduced. Weeds dominated the early successional stage, but the native species regeneration was not impeded.  
<https://onlinelibrary.wiley.com/doi/epdf/10.1111/rec.13303>

#### **ARUNDO DONAX L. STEM-DERIVED BIOCHAR INCREASES AS AND SB TOXICITIES FROM NONFERROUS METAL MINE TAILINGS**

Gu, J., J. Yao, G. Jordan, B. Roha, N. Min, H. Li, and C. Lu.  
Environmental Science and Pollution Research (27):2433-2443(2020)

Tailings were amended with increasing concentrations of *Arundo donax* L. stem-derived biochar (ASBC; at 0, 1, 3, and 5%) for 90 days. A 7-day wheat seed germination toxicity test assessed the bioavailability of toxicants in aqueous leachates of the biochar-amended tailing samples. Tailing leachates were phytotoxic, an effect that was partially decreased due to increasing concentrations of ASBC, with maximum effects (~47% of tailing phytotoxicity) occurring at 3% ASBC. Increasing concentrations of ASBC amendment decreased the mobile fractions of Cd, Cu, and Pb in tailing samples but increased the mobilities of As and Sb. The relative toxicity index indicated that the toxicity of the tailings decreased when As was not present since As decreased the biochar-reduced toxicity. Results suggest that use of biochar to decrease toxicity in tailings is limited by its inability to immobilize oxyanionic metalloids, such as As and Sb.

#### **TREATABILITY TRIALS TO REMOVE ZINC FROM ABBEY CONSOLS MINE WATER, WALES, UK**

Williams, T., J. Dent, T. Eckhardt, M. Riding, and D. Sapsford.  
Proceedings from the postponed 14th IMWA Congress, "Mine Water Solutions," 2020

Results of laboratory and field trials are presented to identify an effective method to remove zinc from Abbey Consols mine water. Sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) dosing to raise pH and facilitate precipitation offered an efficient and cost-effective treatment solution, achieving >90% reduction in dissolved zinc concentrations. **See pages 225-230:**  
[https://www.imwa.info/docs/imwa\\_2020/IMWA\\_2020\\_proceedings.pdf](https://www.imwa.info/docs/imwa_2020/IMWA_2020_proceedings.pdf)

## **General News**

#### **STATE-OF-KNOWLEDGE ON SELENIUM TREATMENT TECHNOLOGIES**

Golder Associates on behalf of the North American Metal Council-Selenium Working Group (NAMC-SWG), 63 pp, 2020

This report is a technical addendum to the original 2010 white paper and 2013 update published by the NAMC-SWG to include progress in installing full-scale selenium removal systems and the development of new removal technologies. A survey of end-users, vendors, and consultants was conducted to collect information on operating treatment plants. Results documenting the installation of 30 full-scale systems between 2007-2018 indicate that selenium treatment technologies have not reached full maturity and should be considered developmental. <https://www.namc.org/docs/00300393.pdf>  
2010 white paper: <https://www.namc.org/docs/00180231.pdf> 2013 white paper update: <https://www.namc.org/docs/00113597.pdf>

#### **MITIGATION OF URANIUM MINING IMPACTS—A REVIEW ON GROUNDWATER REMEDIATION TECHNOLOGIES**

de Lurdes Dinis, M. and A. Fiuzza. | Geosciences 11:250(2021)

This article provides an overview of available technologies to remediate groundwater contaminated with radionuclides, primarily from uranium mining. For each technology, the background, state of development, limitations, efficiency, potential adverse effects, and selection criteria are discussed, and examples of application and performance monitoring are provided. *This paper is Open Access at* <https://www.mdpi.com/2076-3263/11/6/250>

#### **REFERENCE SITE SELECTION PROTOCOLS FOR MINE SITE ECOSYSTEM RESTORATION**

Hernandez-Santin, L., M.L. Rudge, R.E. Bartolo, T.G. Whiteside, and P.D. Erskine.  
Restoration Ecology 29(1):e13278(2021)

A process is presented to select reference sites within a savanna ecosystem to develop and assess closure criteria and restoration guidelines for the Ranger Mine in Australia. Reference site selection followed five steps that involved both desktop and field methods: consider inclusion criteria; include randomly selected sites from areas matching the chosen criteria; conduct preliminary data analysis; estimate and update the sampling effort throughout the project; and obtain stakeholder feedback to calibrate ecological restoration outcomes. <https://onlinelibrary.wiley.com/doi/epdf/10.1111/rec.13278>

#### **HANDBOOK OF ECOLOGICAL AND ECOSYSTEM ENGINEERING**

Prasad, M.N.V (ed). Wiley Professional, Reference & Trade, ISBN 9781119678533, ISBN 9781119678595, 498 pp, 2021

This handbook provides an overview of the latest research and developments in ecological and ecosystem engineering, and includes issues central to the restoration and remediation of ecological environments. Case studies are provided to highlight practical applications of the concepts discussed. *See a list of chapters at*  
<https://www.wiley.com/en-us/Handbook+of+Ecological+and+Ecosystem+Engineering-p-9781119678533>

#### **A FRAMEWORK FOR DEVELOPING COMPLETION CRITERIA FOR MINE CLOSURE AND REHABILITATION**

Manero, A., M. Kragt, R. Standish, B. Miller, D. Jasper, G. Boggs, and R. Young.  
Journal of Environmental Management 273:111078(2020)

A systematic framework was developed to define completion criteria for mine closure and rehabilitation. The study was informed by a global review of the literature and collaborative research with mining stakeholders from Western Australia. The proposed framework consists of six fundamental steps: 1) select post-mining land use; 2) define aspects and closure objectives; 3) select reference(s); 4) select attributes; 5) define completion criteria; and 6) evaluate performance.

#### **A RESILIENCE-BASED APPROACH IN MANAGING THE CLOSURE AND ABANDONMENT OF LARGE MINE TAILING PONDS**

Komljenovic, D., L. Stojanovic, V. Malbasic, and A. Lukic.  
International Journal of Mining Science and Technology 30(5):737-746(2020)

In this paper, a holistic resilience-based approach is proposed to analyze closure and abandonment phases for mine tailing ponds. The proposed methodology is validated through a case study at an actual surface iron ore mine in Bosnia and Herzegovina.

#### **RESTORATION OF MINE DEGRADED LAND FOR SUSTAINABLE ENVIRONMENTAL DEVELOPMENT**

Ahirwal, J and V.C. Pandey | Restoration Ecology 29(4):e13268(2021)

This publication summarizes recent advances in restoring degraded mine lands and their role in the sustainable management of the post-mining ecosystem.

The Technology Innovation News Survey welcomes your comments and suggestions, as well as information about errors for correction. Please contact Michael Adam of the U.S. EPA Office of Superfund Remediation and Technology Innovation at [adam.michael@epa.gov](mailto:adam.michael@epa.gov) or (703) 603-9915 with any comments, suggestions, or corrections.

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