Technology Innovation News Survey

Entries for March 16-31, 2018

Market/Commercialization Information

GRANT PROJECTS: REDUCING MERCURY USE IN SMALL-SCALE GOLD MINING

The Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, is advertising four international grant projects aimed at preventing or minimizing the release of mercury to the environment during artisanal or small-scale gold mining. The estimated award ceilings vary, but a single award is anticipated for each grant, and the responses due date for all four is June 29, 2018.

- SFOP0005015: Reducing Mercury Use and Increasing Transparency in Ghana's Artisanal and Small-scale Gold Mining Sector - http://www.grants.gov/web/grants/view-opportunity.html?oppId=304761
- SFOP0005013: Responsible Recovery and Handling of Mercury from Contaminated Tailings and Riverbeds in Colombia - http://www.grants.gov/web/grants/view-opportunity.html?oppId=304781
- SFOP0005012: Reducing Mercury Use in Indonesia's Small-scale Gold Mining Sector - http://www.grants.gov/web/grants/view-opportunity.html?oppId=304763
- SFOP0005041: Abating Mercury Emissions Via Mobile Processing Units for Small-Scale Gold Processing in Suriname - http://www.grants.gov/web/grants/view-opportunity.html?oppId=304820

NOT-FOR-PROFIT ACID MINE DRAINAGE WATERSHED COOPERATIVE AGREEMENT PROGRAMS (WCAP)

Department of the Interior, Office of Surface Mining, Funding Opportunity S18AS00003, 2018

Funding is available to assist local 501(c)(3) status organizations and groups that undertake local acid mine drainage (AMD) reclamation projects to improve the water quality of AMD-affected streams. The priorities and technical focus for this announcement are to restore streams affected by AMD to a level that will support a diverse biological community and provide recreational opportunities for the public. WCAP is designed to be partnered with other funding sources to assist groups such as small watershed organizations to complete local AMD reclamation projects. Estimated total program funding is $1.5M, and about 25 awards are anticipated. The closing date for applications is August 31, 2018. http://www.grants.gov/web/grants/view-opportunity.html?oppId=300194

NATIONAL PRIORITIES: PER- AND POLYFLUOROALKYL SUBSTANCES

U.S. Environmental Protection Agency, Funding Opportunity EPA-G2018-ORD-A1, 2018

To better understand the impacts of per- and poly-fluoroalkyl substances (PFAS) on water quality and availability across the United States, U.S. EPA seeks proposals for obtaining new information on the following topics:

1. The fate and transport of short (C4 to C7) and long-chain (≥ C8) PFAS in the environment, including per- and poly-fluorinated carboxylic acids, sulfonic acids, and ethers, and associated precursor and transformation products.
2. Comprehensive human and ecosystem exposure to PFAS.
3. PFAS toxicity, modes of action, physiologically-based pharmacokinetics and pharmacodynamics, and other topics related to hazard assessment.

Proposals may address any or all of these topics in support of the development of robust risk assessments for human and ecological exposure to PFASs in water. Estimated total program funding is $3,968,800, and two awards are anticipated. The closing date for applications is June 18, 2018. **Grants.gov:** http://www.grants.gov/web/grants/view-opportunity.html?oppId=304740
EPA: http://www.epa.gov/research-grants/national-priorities-and-polyfluoroalkyl-substances

AQUEOUS FILM FORMING FOAM (AFFF) WASTE REMOVAL AND DISPOSAL

Defense Logistics Agency, Battle Creek, MI.
Federal Business Opportunities, FBO-5800, Solicitation 18BE087AFFF, 2018

The intent of this sources-sought notice is to identify the availability and interest of qualified firms in the following economic categories—8(a), HUBZone, woman-owned, and service-disabled veteran-owned small businesses—for the required services prior to determining the method of acquisition. The scope of work will consist largely of removal, transportation, treatment, and disposal of AFFF-related waste, characterized as non-hazardous, non-RCRA waste at the time of award of this contract. DLA Disposition Services will order the removal, transportation, and disposal of AFFF-related liquid and solid wastes, both containerized and bulk, from DoD and Department of Homeland Security installations located within the continental United States. The Government intends to solicit and award a firm-fixed-price IDIQ services contract under NAICS code 562211. The duration of the contract is anticipated to be one 30-month base period followed by one 30-month option period for a total contract life of 5 years. No solicitation is available at this time. Interested firms matching the categories referenced above are invited to submit a brief capabilities statement package by 2:00 PM ET on May 25, 2018. https://www.fbo.gov/spg/DLA/J3/DRMS/18BE087AFFF/listing.html

CONDUCT RA-O AT SITES SD024 & SS011 AT MOUNTAIN HOME AFB, IDAHO

Department of the Air Force, JBSA Lackland, Texas.
Federal Business Opportunities, FBO-5905, Solicitation FA8903-18-R-0025, 2018

This requirement is a 100% small business set-aside, NAICS code 562910 (Remediation Services), size standard 750 employees. The 772 ESS/PKS intends to award a single firm-fixed-price contract to conduct Remedial Action-Operations (RA-O) at sites SD024 and SS011 at Mountain Home AFB, Idaho. The period of performance will be 12 months, with two 12-month options. Site SD024 is affected by VOCs and petroleum hydrocarbons, and several large spills of JP-4 jet fuel have occurred at Site SS011. Soil vapor extraction is the remedy specified for both sites, with the addition at SS011 of in situ chemical oxidation for the groundwater. Post performance-based remediation actions include conducting annual RA-O and producing quarterly RA-O reports for sites SD024 and SS011. Proposals must be received by 2:00 PM CT on June 1, 2018. https://www.fbo.gov/notices/ca3af482f240288bac66f7ae31338322

SUPERFUND ENVIRONMENTAL REMEDIATION SERVICES

Federal Aviation Administration (FAA), W.J. Hughes Tech Center, Atlantic City, NJ.
Federal Business Opportunities, FBO-5911, Solicitation 30117, 2018

The FAA is seeking expressions of interest and capability from vendors able to provide Superfund environmental remediation services in accordance with CERCLA requirements to the FAA William J. Hughes Technical Center, located at the Atlantic City International Airport. The Center was listed on the NPL of Superfund sites in 1990, and a Federal Facility Agreement was signed between EPA and FAA for conduct of the Superfund remediation activities at the Technical Center in 1993. The requirement is for all aspects of remediation services related to Superfund cleanup only. Capabilities statements must be received by 3:00 PM ET on June 6, 2018. https://www.fbo.gov/spg/DOT/FAA/WJHTC/30117/listing.html

TRAINING SUPPORT WORKSHOP ACTIVITIES FOR THE STATE REVOLVING FUND (SRF) PROGRAMS

U.S. Environmental Protection Agency, Funding Opportunity EPA-OW-OWM-18-01, 2018

U.S. EPA is soliciting applications from eligible applicants to provide training workshop support activities for states and other practitioners implementing the State Revolving Fund (SRF) programs, the Clean Water SRF, program and the Drinking Water SRF programs. Support will include planning, preparing, and providing technical support for four annual National SRF Infrastructure Financing and Training Workshops. The workshops will target SRF program officials and other interested stakeholders. Funds awarded under this announcement may be used by recipients to promote participation and to support the travel expenses of non-federal personnel to attend. Estimated total program funding is $380,000, and a single award is anticipated. The closing date for applications is June 1, 2018. http://www.grants.gov/web/grants/view-opportunity.html?oppId=303293

Cleanup News

MINE TAILING DRAINAGE: A BOTTOMS UP APPROACH USING HDD DRILLING AND INSTALLATION METHODS

Bardsley, D.
Nevada Water Resources Association Annual Conference, 14-16 Feb 2017, Reno NV. 2017

At some historic mine sites, impoundment dewatering is the first step in remediation. At a site in Maine, horizontal wells were directed under, not through, a boulder/rubble tailings dam installed to dewater a tailings pond, remnant of an open-pit zinc/copper mine. Long distances to nearby utilities restricted the dewatering operations to a gravity-fed design, and the remote location and rugged terrain limited equipment access. The impoundment's embankments were constructed of mine waste, including boulder and cobble materials. Several controls were implemented at the Maine site to prevent uncontrolled release from the impoundment. Notably, casing was driven under the embankment, with the drilling going through the length of casing. The casing provided support to the overlying embankment and also focused any potential discharge through this one control point. A plug at the exit of the casing controlled tailings pond outflow. A gravity-fed bioreactor was constructed downgradient of the impoundment to treat the tailings drainage. **Slides:** https://cese.utulsa.edu/wp-content/uploads/2017/06/2016-IPEC-MINE-TAILING-DRAINAGE-A-BOTTOMS-UP-APPROACH-USING-HDD-DRILLING-AND-INSTALLATION-METHODS.pdf

HULING BRANCH AML RECLAMATION/ATV RECREATION AND WATERSHED IMPROVEMENT PROJECT

Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation, 117 slides, 2017

The Office of Surface Mining Reclamation and Enforcement recognized the Huling Branch abandoned mine land reclamation project with the national award for 2017 as the overall highest-rated reclamation project. Located in Clinton County, Pennsylvania, the AML reclamation project team eliminated dangerous highwalls, removed spoil piles, and reduced acid mine drainage impacts on surface water and groundwater. The site is now open to all-terrain vehicles for public recreation. The project team also used the Forestry Reclamation Approach to reforest the land. Descriptive information and media (the nomination, project slides, pictures, and video) are available at http://www.dep.pa.gov/Business/Land/Mining/AbandonedMineReclamation/ProgramAccomplishments/Pages/PA%27sAwardWinningReclamationProjects.aspx

UPDATE: PHOSPHATE MINE SITE INVESTIGATIONS AND CLEANUP IN SOUTHEAST IDAHO — SOUTHEAST IDAHO SELENIUM PROJECT

Idaho Department of Environmental Quality/U.S. EPA/U.S. Forest Service, 8 pp, 2017

Southeast Idaho is one of the world's major phosphate-producing regions, and phosphate mining has been an important industry in the area since the early 20th century. Phosphate mining has resulted in some negative ecological consequences, such as waste rock dumps and open pits that act as pathways to transport selenium and other contaminants to the environment through ground and surface water. Investigations and planning for cleanup at several sites described in this fact sheet are ongoing with the oversight of the U.S. EPA, U.S. Forest Service, and the Idaho Department of Environmental Quality. The Bureau of Land Management, Shoshone-Bannock Tribes, and U.S. Fish and Wildlife Service provide support. https://semspub.epa.gov/src/document/10/100072214

MINE WASTE REMEDIATION: UNITED STATES CASE STUDIES

Martino, L.E.
Bio-Geotechnologies for Mine Site Rehabilitation, Elsevier Inc. ISBN: 978-0-12-812986-9, Chapter 31:571-592(2018)

Depending on the commodity, the environmental consequences of elements in the commodity lifecycle downstream of the mine can be as significant and as resource-intensive (from a remediation standpoint) as the mining operation. This chapter presents case studies involving the remediation of wastes at coal-mining sites and at a site where commodity refractories (e.g., uranium mill tailings) accumulated after ore beneficiation. The remediation approaches discussed include creative strategies used to combine active and passive technologies in parallel and in series. Some remediation technology case studies focus only on individual mine facilities, while other case studies discuss watershed approaches crafted to address contamination impacts.

HENRY'S KNOB SITE CASE STUDY: REVITALIZING MINE TAILINGS IN CLOVER, SOUTH CAROLINA

U.S. EPA, Technology Innovation and Field Services Division, Washington, DC.
EPA 542-R-18-001, 10 pp, 2017

Working with state and federal regulatory agencies, a proactive responsible party is using an adaptive management approach to address environmental impacts from decades of kyanite mining at the Henry's Knob Superfund Alternative Approach site in York County, South Carolina. Open pit mining in a large pit quarry took place from 1947 to 1965 on top of the knob (mountain). Mined ore-grade rock was ground up, followed by a floatation process to liberate the kyanite from the other minerals in the ore. Leftover ground-up waste rock and spoils were dewatered in ponds, and the piles were left on site. Revegetation of the former mine tailings area is reducing tailings erosion and water infiltration, thus reducing the generation of acid mine drainage as a source of impact to groundwater and nearby streams. Ongoing monitoring will evaluate the effectiveness and other benefits associated with the revegetation. Based on the evaluation results, implementation of a groundwater remedy may or may not be necessary. The site's final cleanup plan is under development and will take at least two years to complete. https://semspub.epa.gov/work/HQ/100000929.pdf *** EPA sponsored a webinar on the Henry's Knob ecological revitalization on March 6, 2018, and the archived webinar materials—audio, video, and PowerPoint slides—are available at https://clu-in.org/conf/tio/mining-ecorev_030618/

Demonstrations / Feasibility Studies

TREATMENT OF MINE DRAINAGE WITH SIGNIFICANT TOPOGRAPHICAL CONSTRAINTS: CASE STUDY OF THE BODENNEC SITE (FRANCE)

Jacob, J.C., M. Save, and Y. Menard.
Mine Water and the Environment [Publication online 3 Mar 2018 prior to print]

The Bodennec lead and zinc mine site produces circumneutral mine drainage that contains 8 mg/L of dissolved iron, whereas the Fe water quality objective is 3 mg/L at the outlet. The water treatment installation in use, based on three settling ponds, could not reach this objective, and the site lacked sufficient surface area to build additional ponds or a passive treatment plant. A pilot-scale NaOH system comprising a pump controlled by a flow meter was built on site to assess the feasibility of a low-maintenance system to effect treatment via injection of a small volume of concentrated NaOH solution into the water. A solar panel connected to a battery supplied the system with electricity. Given the stability of the pH in the drainage no pH probe was needed. A final water treatment plant based on this pilot was built in 2017.

CLOSED LOOP FOR AMD TREATMENT WASTE

Zamzow, K. and G. Miller.
IMWA 2017: Mine Water & Circular Economy (Wolkersdorfer, C. et al., eds.). IMWA, Vol II:1103-1110(2017)

The Leviathan is an abandoned former copper and sulfur mine located in the Sierra Nevada of the Western United States. Acid mine water at the site is addressed in four compost-free, open-pond, alcohol-based bioreactors that have operated since 2003, treating 11.4 to 15.1 million liters of drainage annually. To take advantage of a local opportunity, a manufacturing waste product rich in alcohols from biodiesel (BD) production at a nearby agricultural farm was used in a 55-day pilot study as a replacement for the ethanol usually used in the bioreactor system. Final results showed that although sulfate reduction was not as high as previous years, most metals were removed below effluent discharge requirements, particularly when appropriate hydraulic residence time was achieved. The investigators observed that cold climates may challenge consistent delivery of the BD waste from storage tank to bioreactor. http://www.imwa.info/docs/imwa_2017/IMWA2017_Zamzow_1103.pdf

PASSIVE TREATMENT OF HIGHLY CONTAMINATED IRON-RICH ACID MINE DRAINAGE

Neculita, C.M., T.V. Rakotonimaro, B. Bussiere, T. Genty, and G.J. Zagury.

2017 National Meeting of the American Society of Mining and Reclamation, Morgantown, WV, 9-13 April. ASMR, Champaign, IL. 43 slides, 2017

An investigation of the effectiveness of acid mine drainage treatment systems—DAS (dispersed alkalinity substrate) units, consisting of coarse organic matrix (wood chips) and neutralizing materials (calcite, magnesia), and a mixed treatment system comprising passive biochemical reactors (PBRs: wood waste-based and constructed wetlands)—compared the performance of a 2-yr lab study and two field treatment installations. In the lab, DAS-calcite, DAS-dolomite, or DAS-wood ash for iron pretreatment, prior to sulfate removal by PBR, was followed by a final polishing unit. In the field, a pilot tri-unit (two PBRs separated by a wood-ash unit) system was installed on the Lorraine rehabilitated mine site and monitored over a 5-yr period. Up to 99% Fe removal occurred during lab testing (using two DAS-wood ash pretreatment units) relative to the field pilot (76% Fe removal). On East-Sullivan, a second rehabilitated mine site, a 14-yr monitoring dataset for a mixed treatment system showed the progressive improvement of water quality over time. Iron concentration declined 98%, and regulation requirements (Fe < 3 mg/L) were obtained in most of the discharge locations. **Slides:** http://www.asmr.us/Portals/0/Documents/Meetings/2017/04-22-Neculita-Slides.pdf

THE ECONOMIC PRE-TREATMENT OF COAL MINE DRAINAGE WATER WITH CAUSTIC AND OZONE
Boyden, B.H., L. Nador, S. Addleman, and L. Jeston.
Water Science and Technology 76(5):1022-1034(2017)

The Austar Coal Mine in NSW, Australia, sought alternatives to lime dosing for pretreatment before reverse osmosis downstream. A process of caustic and ozone for Mn(II) oxidation was pilot tested at up to 0.74 kL/hr at the mine site. Under proper conditions and no aeration, ~81% of Fe could be removed (initially at 156 mg/L) as green rust. Supplemental aeration followed first-order kinetics and allowed 99.9% Fe(II) oxidation and removal but only with a hydraulic residence time of about 47 min. The addition of supplemental Cu catalyst improved Fe removal. Ozone applied after caustic was effective in stoichiometrically oxidizing recalcitrant Mn(II) and any remaining Fe(II). Ozonation control was achieved using the oxidation reduction potential during oxidation of the Mn(II) species. The use of caustic, followed by ozone, proved economically comparable to lime pretreatment.

CHEMICAL MASS TRANSPORT BETWEEN FLUID FINE TAILINGS AND THE OVERLYING WATER COVER OF AN OIL SANDS END PIT LAKE
Dompierre, K.A., S.L. Barbour, R.L. North, S.K. Carey, and M.B.J. Lindsay
Water Resources Research 53(6):4725-4740(2017)

Fluid fine tailings (FFT) are a principal by-product of the bitumen extraction process at oil sand mines. The first full-scale demonstration oil sands end pit lake—Base Mine Lake (BML)—contains ~1.9 x 108 m^3 of FFT stored under a water cover within a decommissioned mine pit. The results from this study provide an initial assessment of the geochemical regime in the BML water cover that can be used as a baseline for future studies and assist in monitoring plan development at this demonstration site. http://limnology.missouri.edu/pdf/north/Dompierre_et_al-2017-Water_Resources_Research.pdf

AIDED PHYTOSTABILISATION REDUCES METAL TOXICITY, IMPROVES SOIL FERTILITY AND ENHANCES MICROBIAL ACTIVITY IN CU-RICH MINE TAILINGS
Touceda-Gonzalez, M., V. Alvarez-Lopez, A. Prieto-Fernandez, B. Rodriguez-Garrido, et al.
Journal of Environmental Management 186(2):301-313(2017)

A phytostabilization field trial was implemented in spring 2011 in Cu-rich mine tailings in NW Spain. The tailings were amended with composted municipal solids and planted with a grass (*Agrostis capillaris*) and with willow (*Salix* spp.) and poplar (*Populus nigra* L.) trees. Compost amendment improved soil properties, such as pH and fertility, and decreased soil Cu availability, leading to the establishment of a healthy vegetation cover. Both compost amendment and plant root activity stimulated soil enzyme activities and induced important shifts in the bacterial community structure over time. The beneficial effects of the phytostabilization process were maintained at least three years after treatment.

Research

STRATEGIES FOR REHABILITATING MERCURY-CONTAMINATED MINING LANDS IN COLOMBIA FOR RENEWABLE ENERGY AND OTHER SUSTAINABLE RE-USE
Rodriguez, A., P. Bardos, A. Cundy, E. Hall, T. Hutchings, W. Kovalick, F. de Leij, R. de Leij, B. Maco, and A. Rodriguez.
R3 Environmental Technology, 2017

Gold mining using mercury recovery techniques has resulted in severe health and environmental impacts in large areas of Colombia, South America. With ~4,200 active and abandoned gold mines and some 3,000 additional artisanal locations, 80,000 ha are estimated to be contaminated with Hg in Colombia, especially by artisanal methods. A project funded by the UK government and supported by the Colombian Ministries of Mining and Environment and Sustainable Development was conducted from June 2016 to March 2017 to evaluate a range of science-based gentle remediation strategies to rehabilitate land affected by soil Hg pollution in disadvantaged areas in Colombia and return it to productive use, with a focus on renewable energy generation. Technology evaluations and bench-scale testing included biochar for Hg stabilization as well as adaptation of international project decision-support tools (EU GREENLAND and HOMBRE Brownfields Opportunity matrix, and U.S. RE-Powering America) to conditions in Colombia. *Project output reports are available at* http://www.r3environmental.com.co/en/projects/76-estrategias-parastrategies-for-rehabilitating-mercury-contaminated-mining-lands-in-colombia-for-renewable-energy-and-other-sustainable-re-use.html

USING ORGANIC AMENDMENTS TO RESTORE SOIL PHYSICAL AND CHEMICAL PROPERTIES OF A MINE SITE IN NORTHEASTERN OREGON, USA
Page-Dumroese, D.S., M.R. Ott, D.G. Strawn, and J.M. Tirocke.
Applied Engineering in Agriculture 34(1):43-55(2018)

The U.S. Department of Agriculture, Forest Service, in cooperation with the City of Bend, Oregon, initiated a mine tailing reclamation project in the Umatilla National Forest in northeastern Oregon to determine the benefits of surface-applied organic amendments. Researchers established a field study using organic amendments applied to gold dredgings capped with 10 cm of loam and showing little evidence of regeneration. Study plot applications consisted of biochar, biosolids, or wood chips singly or in combination. Each plot was divided in half; one half was seeded with native grasses and forbs, and the other was planted with a combination of California brome and Jepson's blue wild rye. After two growing seasons, no significant differences were observed in plant cover between the planted or seeded plots, but soil properties were significantly altered by individual treatments. Combination treatments improved nutrient availability and soil moisture and grew up to twice as much plant cover as the control plots. https://www.fs.fed.us/rm/pubs_journals/2018/rmrs_2018_page_dumroese_d001.pdf

GIANT MINE STATE OF KNOWLEDGE REVIEW: ARSENIC DUST MANAGEMENT STRATEGIES
Giant Mine Oversight Board, 157 pp, 2017

The gold ore at the Giant Mine is collocated with arsenopyrite, an arsenic-bearing mineral. During ore processing, an arsenic trioxide (As_2O_3) dust mixture was generated, precipitated, and collected in baghouses. Beginning in 1951, the dust was stored on site in purpose-built vaults or in previously mined-out chambers (stopes). Over ~50 years of operation, 237,000 tonnes of As_2O_3 dust were generated and stored on site. The dust is, on average, ~60% As by weight. As $_2O_3$ is water soluble and therefore poses a risk to both people and the environment through transport to local water bodies. Long-term management of the dust is complicated by its large quantity, physical characteristics, and subsurface storage location. Integration of different technologies likely will be needed to provide effective treatment. Alternatives evaluated for this report included frozen block containment; vitrification with extraction, gold processing, and storage; cement stabilization and cement paste backfill with extraction and storage; and mineral precipitation with extraction and storage. Vitrification was the top-ranked dust stabilization and processing method identified in this report. https://www.gmob.ca/wp-content/uploads/2017/09/2017-08-Giant-Mine-State-of-Knowledge-Review_FINAL.pdf

MICROBIAL FUNCTIONAL CAPACITY IS PRESERVED WITHIN ENGINEERED SOIL FORMULATIONS USED IN MINE SITE RESTORATION
Kumaresan, D., A.T. Cross, B. Moreira-Grez, K. Kariman, P. Nevill, J. Stevens, R.J.N Allcock, et al.
Scientific Reports 7:564(2017)

Recycling of mining site substrates can be achieved by blending the waste materials with native soil to form a novel substrate that can be used in future landscape restoration; however, these post-mining substrate-based soils are likely to contain significant abiotic constraints for plant and microbial growth. Using both marker gene and shotgun metagenome sequencing, researchers showed that topsoil storage and the blending of soil and waste substrates to form planting substrates gave rise to variable bacterial and archaeal phylogenetic composition but a high degree of metabolic conservation at the community metagenome level. Their data indicated that whilst low phylogenetic conservation was apparent across substrate blends, high functional redundancy was observed in relation to key soil microbial pathways, allowing the potential for functional recovery of key belowground pathways under targeted management. https://www.nature.com/articles/s41598-017-00650-6

REVIEW OF PASSIVE SYSTEMS FOR ACID MINE DRAINAGE TREATMENT
Skousen, J., C.E. Zipper, A. Rose, P.F. Ziemkiewicz, R. Nairn, L.M. McDonald, and R.L. Kleinmann.
Mine Water Environment 36(1):133-153(2017)

This paper reviews the current state of passive system technology development for the treatment of acid mine drainage, provides results for various system types, and offers guidance for system sizing and effective operation. https://link.springer.com/content/pdf/10.1007/s10230-016-0417-1.pdf

MINING SITE RECLAMATION PLANNING BASED ON LAND SUITABILITY ANALYSIS AND ECOSYSTEM SERVICES EVALUATION: A CASE STUDY IN LIAONING PROVINCE, CHINA
Wang, J., F. Zhao, J. Yang, and X. Li.
Sustainability 9(6):890(2017)

A reclamation study that incorporated land suitability analysis and ecosystem service evaluation was conducted for a mining site in Liaoning Province, China. The team assessed the land suitability for three reclamation alternatives and identified suitable uses for each area. For areas that were comparably suitable for multiple land uses, an ecosystem services evaluation was conducted to determine the optimal reclamation strategy. Study results showed that forest could be restored throughout the entire mining site; agricultural uses were most suitable in the western and southern parts; and developed lands were suitable in northern areas that were closer to roads and city centers. https://www.mdpi.com/2071-1050/9/6/890/pdf

EFFECT OF EPISODIC RAINFALL ON AQUEOUS METAL MOBILITY FROM HISTORICAL MINE SITES
Valencia-Avellan, M., E.R. Slack, A. Stockdale, and R.J.G. Mortimer.
Environmental Chemistry 14(8):469-475(2018)

Episodic extreme rainfall events may affect metal dynamics in rivers flowing within historical metal mining areas. This study provides an analysis of the water chemistry and geochemical processes associated with metals mobilization during episodic rainfall events, specifically the behavior of Pb, colloidal Al, Fe oxides, and Zn. http://www.publish.csiro.au/en/pdf/EN17133

SYNOPTIC SAMPLING AND PRINCIPAL COMPONENTS ANALYSIS TO IDENTIFY SOURCES OF WATER AND METALS TO AN ACID MINE DRAINAGE STREAM
Byrne, P., R.L. Runkel, and K. Walton-Day.
Environmental Science and Pollution Research 24(20):17220-17240(2017)

A field-scale study was conducted in which synoptic sampling and principal components analysis (PCA) were employed in a mineralized watershed (Lion Creek, Colorado) under low-flow conditions to (a) quantify the impacts of mining activity on stream water quality; (b) quantify the spatial pattern of constituent loading; and (c) identify inflow sources most responsible for observed changes in stream chemistry and constituent loading. Several of the investigated constituents (Al, Cd, Cu, Fe, Mn, Zn) failed to meet chronic aquatic life standards along most of the study reach. The spatial pattern of constituent loading suggested four primary sources of contamination under low-flow conditions. Study data pointed to the complexity of contaminant mobilization processes and constituent loading in mining-affected watersheds, but the combined synoptic sampling and PCA approach enabled the development of a conceptual model of contaminant dynamics to inform remediation. *This paper is* ***Open Access*** *at* https://link.springer.com/article/10.1007/s11356-017-9038-y

POTENTIAL OF *EUCALYPTUS CAMALDULENSIS* FOR PHYTOSTABILIZATION AND BIOMONITORING OF TRACE-ELEMENT CONTAMINATED SOILS
Madejon, P., T. Maranon, C.M. Navarro-Fernandez, M.T. Dominguez, J.M. Alegre, B. Robinson, and J.M. Murillo. PLoS ONE 12(6):e0180240(2017)

In a study of the use of trees to immobilize trace metals (phytostabilization), researchers investigated the chemical composition of leaves and flower buds of *Eucalyptus camaldulensis* in seven sites along the Guadiamar River valley (SW Spain), an area contaminated by a mine spill in 1998. *E. camaldulensis* trees in the spill-affected area and adjacent non affected areas were growing on a variety of soils with pH from 5.6 to 8.1 at low concentration of plant nutrients. The spill-affected soils contained up to 1069 mg/kg As and 4086 mg/kg Pb. *E. camaldulensis* tolerated elevated trace metal concentrations in soil and had low trace metal concentrations in the aerial portions compared to other species growing in the same environment. Despite the relatively low concentration of trace metals in leaves, they were significantly correlated with the soil-extractable Cd, Mn, and Zn, but not Cu and Pb. This tree species generally is tolerant of impoverished and contaminated soils, grows fast, has a deep root system, and is suitable for phytostabilization of soils contaminated by trace metals owing to the low transfer of metals from soil to aboveground organs. Eucalyptus leaves also could be used for biomonitoring the soil extractability of Cd, Mn, and Zn (but not Cu or Pb). *This paper is* ***Open Access*** *at* http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0180240

A PRELIMINARY STUDY TO DESIGN A FLOATING TREATMENT WETLAND FOR REMEDIATING ACID MINE DRAINAGE-IMPACTED WATER USING VETIVER GRASS (*CHRYSOPOGON ZIZANIOIDES*)
Kiiskila, J.D., D. Sarkar, K.A. Feuerstein, and R. Datta.
Environmental Science and Pollution Research 24(36):27985-27993(2017)

A study is underway to develop a low-cost and sustainable floating wetland treatment (FWT) system for acid mine drainage (AMD) at the abandoned Tab-Simco coal mining site in Illinois using vetiver grass. Tab-Simco AMD is highly acidic (mean pH 2.64) and contains high levels of sulfate and metals. A 30-d greenhouse study conducted to screen and optimize the necessary parameters to design an FWT system showed significant sulfate removal, resulting in increased pH, particularly at higher planting densities. Vetiver also helped in metal removal: high amounts of Fe, Zn, and Cu were removed, with relatively lower amounts of Pb, Al, and Ni. Iron plaque formation on the root was observed, which increased metal stabilization in roots and lowered root-to-shoot metal translocation. Vetiver was tolerant of AMD, showing minimal change in biomass and plant growth. A large-scale mesocosm study is the next step in developing a vetiver-based FTW system for AMD treatment.

ROUGH WAVE-LIKE HEAPED OVERBURDEN PROMOTES ESTABLISHMENT OF WOODY VEGETATION WHILE LEVELING PROMOTES GRASSES DURING UNASSISTED POST MINING SITE DEVELOPMENT
Frouz, J., O. Mudrak, E. Reitschmiedova, A. Walmsley, P. Vachova, H. Simackova, J. Albrechtova, J. Moradi, and J. Kucera.
Journal of Environmental Management 205:50-58(2018)

At post-mining sites in the Czech Republic in 2003, researchers established plots in which the surface of the heaped overburden was either wave-like or leveled. In a detailed survey of the dominant species in 2015, both *Salix caprea* and *Betula pendu* trees occurred more often in wave-like plots than in leveled plots; this was particularly true for trees taller than 1 m, which were absent in leveled plots. In wave-like plots, both woody species occurred mainly on wave slopes while the grass *Calamagrostis epigejos* occurred mainly in the depressions. The authors speculated that trees were more abundant in wave-like plots than in leveled plots because the waves trapped tree seeds and snow and because the soil porosity was greater in wave-like than in leveled plots. Grasses might have preferred the leveled plots because soil porosity was lower and clay content was higher in leveled than in wave-like plots.

EVALUATION AND OPTIMIZATION OF A NEW MICROBIAL ENHANCEMENT PLUG-FLOW DITCH SYSTEM FOR THE PRETREATMENT OF ACID MINE DRAINAGE: SEMI-PILOT TEST
Song, Y., H. Wang, J. Yang, L. Zhou, J. Zhou, and Y. Cao.
RSC Advances 8:1039(2018)

A novel microbial enhanced plug-flow ditch reaction system was developed for pretreatment of AMD at semi-pilot scale. The pilot was used to examine system stability under different hydraulic retention times (HRTs) and to compare the effects of microbe-enhanced/lime-neutralization technology and direct lime neutralization. The bio-oxidation efficiency of Fe^{2+} (5 g/L) reached 100% in some parts of the system when HRT was 3 and 2 days, and the time taken to reach steady state was 6 and 4 days, respectively. When the HRT was 1 day, the reaction system operated for 4 days before equilibrium was lost. At the optimum HRT (2 days) and after the system was stable, the average precipitation rate of total Fe was 53.62% and the average removal rate of As(III) was 17.27%. Following microbial enhanced pretreatment, the amount of lime required and waste residues generated for AMD neutralization decreased by 75% and 85.25%, respectively. http://pubs.rsc.org/en/content/articlepdf/2018/ra/c7ra10765j

MULTI-SCALE INVESTIGATION OF URANIUM ATTENUATION BY ARSENIC AT AN ABANDONED URANIUM MINE, SOUTH TERRAS
Corkhill, C.L., D.E. Crean, D.J. Bailey, C. Makepeace, M.C. Stennett, R. Tappero, D. Grolimund, and N.C. Hyatt. Nature Materials Degradation 1:19(2017)

An international team led by the University of Sheffield has discovered that the toxic element arsenic prevents uranium at the abandoned South Terras uranium mine in Cornwall, England, from migrating into surface water and groundwater. Ore extraction processes and natural weathering of rock at the South Terras mine led to the proliferation of other elements during degradation, particularly arsenic and beryllium, which were found in significant concentrations. The arsenic and uranium have formed the highly insoluble secondary mineral metazeunerite. *This paper is* ***Open Access*** *at* https://www.nature.com/articles/s41529-017-0019-9.

WATER QUALITY IN THE FREIXEDA ABANDONED GOLD MINE AFTER REMEDIATION
Gosar, D. and M.R. Costa.
International Conference on Groundwater in Fractured Rocks, Chaves, Portugal, June 2017

At the Freixeda abandoned gold mine in Portugal NE, mine closure happened in 1955. Remediation processes of containment and control of tailings and phytoremediation with macrophytes in a wetland were carried out in 2007. Water samples collected in 2015, about 8 years after site remediation, showed that concentrations of heavy metals in the Freixeda stream had declined over time, and the Zn, Pb, Cd, and Cu concentrations in water were below the limit values for human consumption aside from the increased value of As. Higher As concentrations were attributed to acid mine drainage (AMD) inflow from the mine into the Freixeda stream and to the discharge from a confined aquifer. Treatment of AMD at the site is no longer effective due to lack of maintenance.

N-P FERTILIZATION STIMULATES ANAEROBIC SELENIUM REDUCTION IN AN END-PIT LAKE
Luek, A., D.J. Rowan, and J.B. Rasmussen.
Scientific Reports 7:10502(2017)

Fertilization of an end-pit lake with N and P increased primary production, creating a meromictic, anoxic layer, and enhanced the habitat for locally present anaerobic Se- and sulfur-reducing bacteria. Within two years, Se concentrations fell 10-fold, reaching water-quality guideline values. https://www.nature.com/articles/s41598-017-11095-2

General News

ARC CENTRE FOR MINE SITE RESTORATION

The Australian Research Council's Centre for Mine Site Restoration (CMSR) was officially launched on March 31, 2017. The CMSR, a joint research initiative of Curtin University and the University of Western Australia, is supported by the Botanic Gardens and Parks Authority, Sinosteel Midwest Corporation, BHP Billiton, Hanson Construction Materials, Karara Mining, Cliffs Natural Resources, Mineral Resources, and the Society for Ecological Restoration Australasia as industry partners. Restoration sits at the heart of Australia's ability to sustainably and responsibly exploit its mineral wealth. The CMSR is a major project connecting high-end science with on-ground practice in mining restoration. Its six thematic research areas are restoration genetics, seed technology and enablement, rare species management, restoration ecophysiology, restoration trajectory, and mining industry policy extension. The Centre aims to deliver a vast suite of integrated and focused research projects to underpin successful mine site restoration outcomes. http://arc-cmsr.org/index.php/en/

PRACTITIONER RESTORATION MANUAL
Commander, L., L. Merino-Martin, P. Golos, J. Stevens, C. Elliott, and B. Miller.
Botanic Gardens and Parks Authority/Sinosteel Midwest Corporation, Australia. 84 pp, 2017

This restoration manual is largely a synthesis of research findings from a 5-yr collaboration undertaken March 2012-March 2017 between Botanic Gardens and Parks Authority and Sinosteel Midwest Corporation (SMC). The project was carried out in the mid-west region of Western Australia on SMC holdings for post-mining restoration of a threatened ecological community in a banded iron formation landform that was mined for iron ore. While a large part of this restoration manual was developed for restoration works that might be carried out in the future on SMC holdings, secondary sources include relevant restoration research found in scientific journals and grey literature. Based on best current knowledge of restoration activities, the recommendations in this manual will be applicable to the broader restoration community, particularly to mining operations of similar style in areas of similar habitat or vegetation structure.
http://www.epa.wa.gov.au/sites/default/files/API_documents/Appendix%203%20-%20BGPA%20Sinosteel%20Restoration%20Manual%20March%202017.pdf

ANNUAL WORKSHOP PROCEEDINGS
British Columbia Mine Environment Neutral Drainage Metal Leaching/Acid Rock Drainage Annual Workshops.

The proceedings of the BC MEND ML/ARD workshops have been archived online since the first workshop in 1995. The online database allows access to every presentation delivered at the workshops. Browse by year or use the search functions to find a specific presentation. http://bc-mlard.ca/workshop-proceedings

SAN JUAN MINING AND RECLAMATION CONFERENCE
Mountain Studies Institute Website.

The primary goal of this annual conference is to educate the public and other stakeholders on the science and policy of mining, mine lands remediation, and water quality as it relates to non-point source pollution, improving mining practices, and addressing water quality impairments through workshops, field tours, and presentations. Each year the conference is hosted in a different San Juan community to highlight the host area's mining heritage and successes in conducting mine remediation and water quality improvement projects. The conference began posting presentation video and audio recordings in 2015 along with the meeting agenda and abstracts. The eighth annual conference took place May 2-4, 2018, in Creede, Colorado. http://www.mountainstudies.org/sjmrc/

IMWA 2017: MINE WATER & CIRCULAR ECONOMY, LAPPEENRANTA, FINLAND
Wolkersdorfer, C., L. Sartz, M. Sillanpaa, and A. Hakkinen (eds).
International Mine Water Association (IMWA), ISBN: 978-952-335-065-6, 2017

The theme of the IMWA 2017 Congress—"Mine Water & Circular Economy"—was represented in 243 oral and poster presentations. A circular economy "closes the loop" of product lifecycles by improving recycling and re-use; hence, valuable materials, such as metals, fertilizers, or adsorbents for wastewater purification, can potentially be extracted from mining wastes and mine water. The proceedings are published online at https://www.imwa.info/imwaconferencesandcongresses/proceedings/300-proceedings-2017.html.

BIO-GEOTECHNOLOGIES FOR MINE SITE REHABILITATION
Prasad, M.N.V., P.J. de Campos Favas, and S.K. Maiti (eds).
Elsevier, New York. ISBN: 9780128129869, 730 pp, 2018

This text identifies biological, physical, chemical, and engineering approaches useful to the reclamation of mine waste and acid mine drainage, providing coverage across different types of mining industries. Cost-effective strategies and remediation and rehabilitation methods are presented for contaminated sites, soils, and waste dumps. The papers in Section 1 refer to potential strategies and approaches for mine site rehabilitation, and those in Section 2 offer site restoration case studies. *See the table of contents and chapter abstracts at* https://www.sciencedirect.com/science/book/9780128129869.

APPROPRIATE ASPIRATIONS FOR EFFECTIVE POST-MINING RESTORATION AND REHABILITATION: A RESPONSE TO KAZMIERCZAK ET AL.
Cross, A.T., R. Young, P. Nevill, T. McDonald, K. Prach, J. Aronson, G.W. Wardell-Johnson, and K.W. Dixon.
Environmental Earth Sciences 77:256(2018)

The lack of clarity surrounding the definition and application of terminology in post-mining ecological repair is problematic for setting objectives, establishing goals, and assessing recovery trajectories. The authors present an outline of internationally applied definitions concerning the restoration and recovery process, followed by an invitation to both the mining industry and policy-makers to re-examine their terminology in the interests of attaining an internationally agreed nomenclature. The goal is to achieve sufficient clarity in the use and understanding of mine site reclamation terminology to align post-mining targets with community expectation, enhance the capacity of the mining industry to understand and meet these targets, and foster better analysis and more industry-relevant discussion of recovery methodologies by the scientific community and practitioners.
http://www.missouribotanicalgarden.org/Portals/0/staff/PDFs/aronson/CrossEetal2018AppropriateAspirations.pdf

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 or (703) 603-9915 with any comments, suggestions, or corrections.

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