ECOLOGICAL ENGINEERING ALTERNATIVES FOR REMEDIATION AND RESTORATION OF A DRASTICALLY DISTURBED LANDSCAPE[1]

by

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Abstract: Ecological engineering or ecotechnology is defined as the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both. It is an emerging discipline that utilizes natural ecosystem-scale ecological and biogeochemical processes to help solve human-caused environmental problems. The approach applies a systems perspective based on the premise that sustainable solutions require working with natural processes, not against them. As part of a Fall 1998 Environmental Science graduate seminar in "Ecological Engineering" at the University of Oklahoma, students were asked to submit a proposal for the holistic and sustainable restoration of the Tar Creek Superfund Site, Ottawa County, Oklahoma. The Tar Creek site is a portion of an abandoned lead and zinc mining area known as the Tri-State Mining District (OK, KS and MO) and includes approximately 104 square kilometers of disturbed land surface and contaminated water resources in extreme northeastern Oklahoma. Approximately 94 million cubic meters of contaminated water currently exist in the underground voids. In 1979, acidic, metal-rich waters (pH 3.6-5.7, 80 ug Pb/L, 154,000 ug Zn/L, 80 ug Cd/L and 331,000 ug Fe/L) began to discharge into Tar Creek from natural springs, bore holes and mine shafts. In addition, approximately 37 million cubic meters of processed mine waste materials (chat) litter the surface in large piles. In general, the chat contains 750 mg Pb/kg; 8,300 mg Zn/kg; and 46 mg Cd/kg. Approximately 324 hectares of contaminated tailings settling ponds also exist on site. The site was listed on the National Priorities List (NPL) in 1983 and currently receives a Hazard Ranking System (HRS) score of 58.15, making Tar Creek the nation's number one NPL site. Student submitted proposals addressed the following four subject areas: passive treatment options for stream water quality improvement, surface reclamation and revegetation, stream habitat restoration and joint ecological and economic sustainability. Proposed designs for passive treatment of the contaminated mine drainage included unique constructed wetland designs that relied on a combination of biological and geochemical processes, use of microbial mats for luxury metal uptake, enhanced iron oxidation via windmill-based aeration and fly ash injection. Proposed surface reclamation methods included minimal regrading followed by biosolid, ash and other organic amendment applications and several phytoremediation techniques, especially the use of hyperaccumulators. The stream and riparian restoration portion of the proposals focused on chat removal, phytoremediation and species reintroduction. Proposed joint ecological and economic sustainability ventures included development of recreational facilities, mining-based tourism and an Ecotechnology Research Park.

Additional key words: mine waste, ecosystem restoration, sustainability

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