Phytoremediation and Rhizodegradation Pilot Studies at a 73-Acre Former Wastewater Pond in Northern California

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Background/Objectives. A former 73-acre waste water treatment pond is located adjacent to a coastal estuary with surrounding wetlands. The site contains a surficial layer of historically-discharged material composed of fine-grained material with total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), and metals as chemicals of concern (COCs). Due to the site setting and history, the waste sediment exhibits high salinity and sodicity. Site waste sediment and underlying soil has a low bearing capacity limiting the ability to place heavy equipment within the pond. Pilot studies have been conducted to evaluate the effectiveness of various remedial technologies including chemical oxidation, rhizodegradation, and enhanced monitored natural attenuation on the microbial community and COC concentrations and ability to scale up for full scale implementation. The results of the pilot studies were documented in a corrective measures study and used to develop the corrective measures implementation plan for the site. The end goal is the restoration of the pond as an estuarine tidal wetland that is similar to the surrounding area.

Approach/Activities. The pilot studies involved installation of a cofferdam and dewatering a 10-acre portion of the pond to construct irrigated test plots. Some of the plots were used to evaluate the influence of different native plants, compost, fertilizer, and gypsum on COC degradation and uptake. Other plots underwent mechanical soil aeration (i.e., rototilling) and amendment addition (mulch, compost, and spent mushroom compost). Plant survival and root zone characteristics were documented. Analysis of COCs in the waste sediment was conducted to evaluate microbial degradation processes/rates in the rhizosphere, and plant uptake. Molecular Biological Tools (MBTs) were employed to evaluate the effect the pilot study activities had on the indigenous microbial community. These analyses included NGS, QuantArray Petro©, and SIP analyses to collect the multiple lines of evidence on the ability of the pilot study activities to stimulate the indigenous microbial community to help degrade the site COCs. Additional bench testing and field studies evaluated chemical oxidation as a remedial alternative, dewatering methods and strategies, and the ability to utilize equipment of varying sizes within the pond for full scale implementation of the remedial plan. The results of the pilot study were used to evaluate the effectiveness, implementability, and sustainability of various remedial alternatives and ultimately develop the corrective measures implementation plan.

Results/Lessons Learned. The results of the pilot study demonstrated the ability to utilize cofferdams and dewatering techniques to effectively keep large portions of the pond dry, pneumatically apply compost, and establish native plants within the waste sediment. Analytical sampling results showed a reduction in TPH and PAH concentrations and that there is not an increased risk of metals accumulation in plants. MBT data showed changes in the microbial populations, enzymatic activity and isotope probing demonstrated direct evidence of biological degradation and microbial uptake of TPH and PAHs. Based on the results of the pilot study activities, an evaluation of potential remedial alternatives was conducted. A corrective measures implementation plan consisting of vegetation and managed recovery was selected for full-scale implementation based on effectiveness, implementability, and sustainability. Implementation of the full-scale remedy is expected to begin in 2019.