Implementation of a Two-Year Phytoextraction Pilot Study at a Wood Treatment, Chromated Copper Arsenate Site

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Background/Objectives. Historical use of chromated copper arsenate (CCA) as a wood preservative for lumber treatment occurred in the United States from the mid-1930s to 2003. Legacy CCA sites are regulated due primarily to the presence of elevated soil arsenic (As). The Columbia Wood Preserving Site, located in Columbia, South Carolina, is a vacant 37-acre parcel which formerly occupied approximately nine acres of wood treatment operations. Sustained As concentrations in site soils have been documented between approximately 100 to 1,000 milligrams per kilogram (mg/kg). Target, state-level imposed regulatory As standards for residential exposure scenarios have been established at 39 mg/kg. The prescribed remedy for the site, so far, has been focused source area soil removal.

Phytoremediation is also being evaluated in a pilot study as a potential cooperative remedy in portions of the site with lower soil As concentrations. The objective of the pilot study was to evaluate potential alternative phytoremediation mechanisms, including phytoextraction and phytostabilization that could be used in concert with interim targeted soil excavation and disposal efforts implemented at the site. Long-term site goals include sustainable remediation and establishment of dedicated greenspace.

Approach/Activities. A 2-year field pilot study was initiated from May 2017 through November 2018 in an area historically used for staging and drying treated wood products. A randomized block design was used to test four separate plant plots distributed randomly in each of six replicates or blocks (24 plots total). Test plants included *Pteris vittata* Edenfern™, *Equisetum hyemale* (Rough Horsetail), *Amaranthus gangeticus* (Carnival Amaranth), and a native grass/forb control mix. Non-destructive mid-season and final harvests were conducted in August 2017 and October 2017, respectively, to assess overall As uptake, soil As concentrations, overall biomass production, and regeneration efficiency of previously harvested portions of the plots. Year 2 included addition of *Pteris cretica* (Cretan Brake fern) and *Pteris multifidi* (Spider Brake fern) as alternative temperate weather tolerant species.

Results/Lessons Learned. Year 1 results indicated that *Pteris vittata* outperformed all other plant treatments at accumulating As, with bioconcentration factors (BCF) ranging from 14 to 49. Mass balance calculations and assumptions to meet a 50% reduction of soil arsenic concentration of 100 mg/kg suggest approximately 10 year timeframe to achieve remedial cleanup goal. Approximately 60% of the *P. vittata* population died after the first growing season after a record-low Columbia, South Carolina winter. Mid-season Year 2 results suggest that a mix of *Pteris* species is a feasible long-term remedy for portions of the site. Limiting factors include sun exposure, nutritionally poor soils, and 10-year frost kill likelihood.