

## Removal and Retention of Copper and Zinc in a Constructed Wetland Over 20 Years

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The A-01 constructed wetland treatment system (CWTS) was designed to remove metals (primarily copper) from the effluent of the A-01 National Pollution Discharge Elimination System (NPDES) outfall at the Savannah River Site, Aiken, SC. This research investigated metal removal, distribution and retention in the A-01 CWTS over a period of 20 years. The findings are important for ensuring continued metal sequestration in the A-01 CWTS over time, providing management guidance for constructed wetlands, and investigating changes in metal remediation effectiveness as a wetland ages. During 20 years of operation, systematic water and sediment sampling validated the wetlands' performance. After passage through the treatment cells, Cu concentrations were well below permit limits during all years of operation, often falling below  $10 \mu\text{g L}^{-1}$ . Cu removal has been consistent over time, averaging about 80% despite large changes in influent Cu concentrations. Copper and Zn were rapidly removed from the water and held in the sediments shortly after the water entered the treatment wetland. Average removal of Zn from water by the wetland system was 52 and 65% in 2004 and 2020, respectively.

Generally, the highest concentrations of Cu and Zn were found in the sediment from the first cell in each pair of cells suggesting that most of the Cu and Zn in the A-01 effluent were bound to the sediment quickly. Diffusive gradients in thin films (DGT) measurements of Cu and Zn in the sediments were much lower than bulk sediment concentrations. These results suggest that most of the Cu and Zn in the A-01 CWTS sediments were not bioavailable, hence not toxic to aquatic organisms, as a likely consequence of adsorption to sediment particles and complexation with organic and inorganic substances.