ENVIRONMENTAL IMPLICATIONS OF PHOSPHATE-BASED AMENDMENTS IN 
HEAVY METAL CONTAMINATED ALLUVIAL SOIL

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ABSTRACT

A suite of research has focused on the immobilization of lead (Pb) compounds in soil through 
the application of phosphate-based amendments that induce formation of pyromorphites 
[Pb₅(PO₄)₃OH,Cl,F]. However, water quality threats associated with the phosphorus (P) 
remediation are a concern, particularly in riparian areas. This study investigated the effects 
of P fertilizer application rates on metals and P loss via surface water runoff at different time 
intervals following P application to a lead contaminated alluvial soil. Soil collected from a 
contaminated floodplain was treated with Triple Super Phosphate (TSP) fertilizer at differing 
molar ratios of P to Pb: 0:1 (control); 4:1; 8:1; and 16:1. At elevated P treatment levels, P 
and total Pb concentrations in runoff were significantly greater (p < 0.05) than the control 
during the first round of rainfall simulation when the treatment units were un-vegetated. 
After one year and the establishment of tall fescue (*Festuca arundinacea*), total P content in 
effluents from the second RFS decreased by an order of magnitude and total Pb decreased by 
two to three orders of magnitude. Analysis of metal uptake into tall fescue revealed a 
significant reduction in Pb that was most pronounced for the 16:1 P:Pb treatment. Statistical 
analysis with linear combination fitting (LCF) applied to XANES data of soil samples 
indicated that pyromorphite concentration ranged from 0% (control soil) to 32% (16:1 P:Pb, 
1 year post-treatment) of the total Pb concentration. The findings of this study suggest that P 
application required to achieve a 4:1 P:Pb molar ratio may be a viable means of reducing Pb 
bioavailability in contaminated alluvial soils while minimizing concerns related to P loss 
from soils treated with this remediation strategy.