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# Guidelines for the stabilization of banks using the functional traits of roots

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## ABSTRACT

A decrease in riverbank stability results in accelerated changes in channel morphology, a loss of agricultural and natural lands, reduced water quality, possible movement of sediments and/or contaminants from surrounding lands into the river, and potential damage to property. Vegetation plays a critical role in stabilizing natural slopes. The purpose of this study was to determine the applicability of vegetation roots for the stabilization of South African riverbanks and quantify the effect of root reinforcement, specifically by means of root functional traits. The study focuses on South African riverbanks as there are limited studies on soil bioengineering for the South African environment. Further, there is a growing concern of riverbank failure in South Africa as expressed by the Water Research Commission. Numerical modelling using geotechnical software formed the method of research. A table was developed to provide scoping level guidance on the suitability of vegetation stabilization for various soil types, bank angles and bank heights for various flood conditions.

Results from transient finite element seepage analyses show that the input parameters are reliable within realistic ranges, but the saturated volumetric water content should be identified with accuracy in order for the guidelines presented to be used with greater confidence.

This report includes a thorough review of existing models that account for the effects of vegetation on bank stability. A limit equilibrium based model that accounts for the enhanced cohesion due to the presence of roots was proposed. A sensitivity analysis together with literature indicated that the most significant root functional traits are: root diameter, root density and root length. Results pertaining to the root functional traits that were able to stabilize appropriate banks were presented and the use demonstrated through hypothetical examples.

It was concluded that bank geometry, material permeability and material strength perform a significant role in riverbank stability and as a result loamy sand and gravel riverbanks are more suitable for vegetation stabilization.