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## **Comparative evaluation of the material of the artificial levees: a case study along the Tisza and Maros Rivers, Hungary**

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Artificial levees are important in protecting human lives and infrastructure as they are essential to flood protection measures. Nevertheless, lacking information about their structure and internal composition might cause high risks. To monitor their stability, integrated surveys are needed, including geophysical and geotechnical methods. Levees along the rivers in Hungary were constructed more than 150 years ago and were heightened several times; therefore, investigations are required to assure their performance in flood risk mitigation. Our investigation aimed to utilise non-invasive geophysical techniques, primarily electrical resistivity imaging, and Ground Penetrating Radar with the validation of a geotechnical method to map and compare the compositional and structural variations of two very different levee sections and check the levee health along River Tisza and River Maros. Integrating the analysed drilling data with ERT and GPR profiles enabled to provide information about the structure of the levees and the interfaces between different layers and also showed that the main composition of the investigated Tisza levee section is fine and medium silt with an average resistivity 30  $\Omega\text{m}$ ; however, the investigated section of Maros levee was built of not only of fine and medium silt but also of medium and coarse sand exhibiting higher resistivity values reaching up to 2200  $\Omega\text{m}$ . Several physical parameters were measured to study the nature of constituting levee materials, like moisture content, grain size, porosity, bulk density, saturated hydraulic conductivity, and resistivity. It was found that most of them show a connection with resistivity, but the hydraulic conductivity did not show a direct connection; however, the latter could exhibit the aquitard nature of Tisza levee materials and the non-aquitard nature of Maros levee materials.