

**UNIVERSITY OF NAIROBI**

**COLLEGE OF BIOLOGICAL AND PHYSICAL SCIENCES**

**SCHOOL OF PHYSICAL SCIENCES**

**DEPARTMENT OF GEOLOGY**

**GEOLOGICAL, GEOPHYSICAL AND GEOTECHNICAL EVALUATION OF  
EARTH'S SUBSURFACE SUITABILITY FOR DAM CONSTRUCTION**

**A CASE STUDY OF MAIRA DAMSITE, NAMBALE AREA BUSIA COUNTY**

**GITHINJI TABITHA WAMBUI**

**I56/68395/2011**

**A dissertation submitted in partial fulfilment of the requirement for the award of  
degree of masters of Science in Geology (Engineering Geology)**

**NOVEMBER, 2013**

## Abstract

The adaptation of geophysical methods for engineering geology purposes represents a significant contribution to the development of geotechnical site investigation methodology. Prior to construction of any engineering structure, proper geotechnical site investigations should be carried out. This helps refine a conceptual geological model as well as to provide a model of geotechnical design parameters. This dissertation focuses on both geophysical and geotechnical investigations for a dam site in Nambale area, Busia County. The principal goal of this exercise was to characterize the geological formation by using geophysical and geotechnical properties, so as to evaluate and determine their competence for dam construction.

The bedrock mainly consists of stratigraphic rock units of the Nambale formation which is part of Yala group belonging to the Nyanzian super-group. The geophysical results revealed three distinct layers. These are basically top soil, fractured rocks and bedrock. The top soils generally consist of arable loam soils, mixed with stiff clays, silts and sands. The second layer is composed of fractured shale, mudstone and sandstone which are mixed with sands and stiff clays. This is underlain by the third layer comprising of dense, hard and compact shale which forms part of the bedrock in some sections. However, the igneous granitic rocks form the main bedrock of the area.

The depth to the bedrock ranges from 13 metres to 30 metres with an irregular morphology and has resistivity ranging from 120 Ohm.m to 500 Ohm.m. Seismic velocities of this layer range from 2500 m/sec to 7000 m/sec. The area has a shallow water table with the aquifer forming at the depths between 10 metres to 15 metres, with a resistivity range 54 Ohm.m to 100 Ohm.m. The Multi-Channel Analysis of Surface Wave (MASW) gave clear variations in the velocities even those occurring within short ranges: therefore it came handy in delineating and mapping of the subsurface soil formation. The geotechnical results show that the consistency limits of the soils within the area had moderate to high plasticity; hence, the soils are expected to exhibit moderate to high swelling potential.

The overall assessments show that the subsurface formation is competent and appropriate for a dam structure. It is therefore recommended based on the results of this study that the foundation of the embankment set up at depth of about 4 metres, where the rock are strong and that grouting should be done on weak zones.