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Geological and Geotechnical Investigations of Axum Dam Site, Tigray, Northern Ethiopia

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A geological and geotechnical study was conducted for a concrete gravity dam which is planned to be constructed in the Maychew River 40 km south of Axum town for the purpose of water supply for the town. The objectives of this research were: to map geology of the area, to characterize geological defects within and around dam site, to evaluate the water tightness of the dam site, and to determine the bearing capacity of the dam foundation. The research involved: review of different literature, lithological and structural mapping, characterizing rock masses by using different rock mass classification methods and interpretation of subsurface data (geophysical, core drilled data, test pit data etc.). Results of the study indicate that the area is underlain by Quaternary sediments, metasedimentary and metavolcanic rocks. The Quaternary sediments are characterized by low permeability, low plasticity and are poorly graded nature. Metasedimentary rocks are found covering the right abutment of the dam whereas in the reservoir area they are intercalated with metavolcanic rocks. These rocks are moderately jointed and sheared with faulting and folding observed; due to these they have a relatively high permeability. Metavolcanic rocks which are found covering the left abutment are strong, less permeable and fractured. Most of the discontinuities such as fractures, bedding and foliation in the study area are oriented E-W, NNW-SSE and NNE-SSW. The investigation revealed that the potential problems (seepage/leakage) could occur due to presence of faults, joints, karstified black limestone, lithological variations, groundwater depth and topography at right abutment. Differential settlements may also occur because empirically estimated moduli of deformation (E_d) of rock masses on the right abutment are much less than the left abutment and different geological defects cross the dam axis. To minimize these problems contact grouting and consolidation grouting are recommended as mitigation measurements.

