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Building a GIS-based 3D seismic microzonation model for the City of Johannesburg

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The City of Johannesburg is South Africa's most populated city and is located along the gold-bearing reefs of the Witwatersrand. For the scientific component of the project, the Witwatersrand mining area was divided into four basins, namely the Eastern, Central, Western and the Far Western Basins.

For the purposes of this project, these basins were considered to be independent geological areas. After more than a century of mining in the Central Basin, several mines in the area eventually closed down and were subsequently flooded. Mines stopped pumping in 2008 and the rising of underground water levels has since triggered a series of seismic events. The Council for Geoscience (CGS), having taken note of these occurrences, has undertaken the monitoring of these events through a local network comprising 13 seismograph stations.

To assist in the mitigation of possible earthquake damages, the CGS was tasked with carrying out a seismic microzonation study for the City of Johannesburg in 2013. An essential part of the project was to undertake an overall assessment of the study area to obtain a better understanding of the surface and subsurface conditions of the Witwatersrand basins, specifically in and around the City of Johannesburg. GIS was utilised to collect up-to-date and relevant data, to produce a seismic database and to evaluate risks in a 3D environment. Spatially distributed data, such as local demographics, building footprints and infrastructure, combined with geological conditions and epicentre locations, were analysed in a 3D environment to simulate potential earthquake scenarios.

This paper will discuss the methods and techniques employed to develop the 3D model as well as the benefits derived from using the model. An online presentation of the model as a tool to assist the South African National Disaster Management Centre (NDMC) with the planning of emergency responses around seismic hotspots will also be demonstrated.