

5 Conclusion and recommendations

5.1 Conclusion

Dolomite is a sedimentary rock composed of $\text{CaMg}(\text{CO}_3)$, and is prone to the development of sinkholes and subsidences. Dolomite in South Africa is found in the Malmani and Campbellrand Subgroups. Within these subgroups, the Eccles and Monte Christo Formations are the formations most prone to development of sinkholes and subsidences. In South Africa, 96% of sinkhole and subsidence related incidents are related to human activities. The main mechanisms for sinkhole formation are 1) ingress of water – ponding water, leaking wet infrastructure, change of drainage patterns; and 2) groundwater level drawdown – dewatering for mining, over extraction of water. In order to identify the various zones with related dolomite stability, a dolomite stability investigation (DSI) needs to be conducted.

This study concluded that a Dolomite Stability Investigation is a (geo-) investigation conducted to determine the geotechnical risk associated with the metastable dolomite underlying a future or existing development. This is based on the Inherent Hazard Class risk rating as described in section 2.7.6.

The structure of such a report is formulated as follows:

- Introduction – specifying the background to the study and previous investigations and information that is available;
- Geo-environmental setting including the location and extend of the study area, the drainage and topography/contours and the vegetation and climate;

A full outline of the project is then given, detailing the fieldwork and data evaluation procedures that will be followed.

- Geological assessment of the regional and local geological setting of the study area, including an assessment of all existing instability features in the area and all possible structural information such as faults and folds in the area.;
- Geophysical surveys of the area;
- Percussion borehole drilling, based on evaluation of the structural geological setting of the area and the geophysical surveys of the area;
- Geohydrological assessment of the area on a regional and local scale so as to determine the geohydrological regime of the area, including groundwater fluctuation and water uses of the site and surrounding area. Geohydrological monitoring and modelling may also play a very important role.

- Final zonation based on the hazard characterisation and evaluation procedures. These are based on a) receptacle development, b) mobilisation agencies, c) potential surface manifestation development space, d) nature and mobilisation potential of the blanketing layer and e) the bedrock morphology. This is evaluated in conjunction with the geophysical data and the geohydrological regime of the area;
- This is finalised by conclusions and recommendations based on the NHBRC classification and allowable land uses of the area.

In order to determine the exact parameters that are gathered from a DSI, a DSI was done at Sarafina, Ikageng, within the Tlokwe City Council. From this study it was determined that the process and the various parameters acquired from the investigation must be evaluated based on specific criteria related to decision making of each parameter. This decision making process is based on at least the following input parameters:

Geo-environmental site conditions:

- Drainage
- Topography
- Geophysical conditions
- Regional geological conditions
- Local geological conditions
- Regional groundwater conditions
- Local groundwater conditions

Geotechnical stability of the dolomite based on the hazard characterisation and evaluation procedures

- Percussion drilling data
- Receptacle development
- Mobilisation agencies
- Potential surface manifestation development space
- Nature and mobilisation potential of the blanketing layer
- The bedrock morphology

From these parameters a decision support system (DSS) is developed in section 4.5.3 of this document, which integrates and aligns the various parameters in such a way that the effect thereof on the dolomite risk of an area may clearly be seen and quantified by means of Inherent Hazard Characterisation.

5.2 Recommendation of additional parameters

The following additional parameters that have not been addressed during this study have been identified and may also be regarded as potential future research:

- Infrastructure surveys including at least:
 - Evaluation of the storm water systems;
 - Manholes and conditions;
 - Water supply networks;
- Bulk water meters on critical pipe lines to identify water losses and leaks;
- Survey of the road structures – paved, tarred, gravel roads and slope and condition of the roads.

5.3 Potential future research

During this study, various potential future research subjects have been identified:

- Detail geological mapping in all areas underlain by dolomite in South Africa so as to identify the type of dolomite and therefore the risks associated with those specific formations;
- Surface water modelling to identify possible surface ponding areas;
- Groundwater modelling to identify possible influences on groundwater;
- Evaluation of the effectivity of correlation between surface geophysical methods such as resistivity, gravity, GPR and magnetics in order to identify possible cavities below the ground surface;
- The identification and quantification of artificial recharge from municipal infrastructure and related water sources;
- Identification and correlation between the water flow properties within dolomite and the cavity areas that have been identified;
- Seasonal fluctuation of water levels in dolomite in relation to the effect of global climate change;
- Evaluation of the correlation between water levels and change in water levels with time in relation to highly weathered dolomite and chert zones and cavities.