

Appendix G6 – Geohydrological Assessment



*Geohydrological assessment –Culcatta
Cemetery site. Stellenbosch Municipality*

REPORT:

GEOSS Report No: 2018/10-36

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23 October 2018

EXECUTIVE SUMMARY

Stellenbosch Municipality urgently requires additional burial sites (also known as Memorial Parks) to service the larger Stellenbosch Municipal area. Through a process of elimination, the municipality have identified Farm portion 29 (Culcatta) as a potential site. The site covers an area of 39.64 Ha portion. GEOSS was tasked to complete a preliminary geohydrological study of the potential site. The Memorial Park will be an expanded cemetery, which will allow significant leeway for walkways and landscaping (which could take the form of natural corridors).

The site is approximately 6 km north of Stellenbosch along the R305. The site is not developed and is heavily infested with alien vegetation and relatively flat in terms of relief. The Farm portion boundary is underlain by loam and sandy loam. These Cenozoic sediments are most likely underlain by greywacke, phyllite and quartzitic sandstone of the Tygerberg Formation (Malmesbury Group).

The proposed Memorial Park is located on an aquifer which is classified as a “fractured” aquifer i.e. fissured and fractured bedrock resulting from decompression and/or tectonic action of the bedrock. Groundwater occurs predominantly within fissures and fractures. If a borehole was drilled within this site, the borehole yield may be in the region of 0.5 to 2 L/s. The DWAF (1999) classification of the regional groundwater quality, as indicated by electrical conductivity (EC), has been classified as “marginal” to “good”. The EC of the area ranges from 70 – 300 mS/m.

There are a number of groundwater users in the area especially to the north and west of the site. The use of groundwater includes domestic, agricultural, livestock and town supply. Approximately 200 m from the northern boundary of the proposed Memorial park, two boreholes exist with good groundwater quality (used for domestic purposes).

The majority of the site is classified as having a “low/medium” groundwater vulnerability rating. The southern portion of the site has been classified as “medium” grading into a “very high” vulnerability classification.

From a groundwater perspective, the site is in close proximity to a number of groundwater users that depend on groundwater as a source. It is recommended that should the site be considered viable from all other perspectives then three to four exploration boreholes be drilled on site to bedrock to determine the groundwater level; aquifer thickness; nature of material of the surficial cover; and groundwater quality.

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ABBREVIATIONS

| | |
|------|------------------------------|
| ha | hectare |
| L/s | litres per second |
| m | metres |
| mS/m | milliSiemens per meter |
| NGA | National Groundwater Archive |

GLOSSARY OF TERMS

- Aquifer:** a geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)].
- Borehole:** includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)].
- Fractured aquifer:** Fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures.
- Groundwater:** water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.
- Intergranular Aquifer:** Generally unconsolidated but occasionally semi-consolidated aquifers. Groundwater occurs within intergranular interstices in porous medium. Typically occur as alluvial deposits along river terraces.
- Intergranular and fractured aquifers:** Largely medium to coarse grained granite, weathered to varying thicknesses, with groundwater contained in intergranular interstices in the saturated zone, and in jointed and occasionally fractured bedrock.

Suggested reference for this report:

GEOSS (2018). Geohydrological assessment – Culcatta Cemetery site. Stellenbosch Municipality. Report Number 2018/10-36. GEOSS - Geohydrological & Spatial Solutions International (Pty) Ltd. Stellenbosch, South Africa.

Cover photo:

Map of the proposed Culcatta cemetery site

GEOSS project number:

2015_07-1490.

1. INTRODUCTION

The Stellenbosch Municipality urgently requires additional burial sites (also known as Memorial Parks) to service the larger Stellenbosch Municipal area. Through a process of elimination, the municipality have identified Farm portion 29 (Culcatta) as a potential site. The area is 39.64 Ha in size. GEOSS was tasked to complete a preliminary geohydrological study of the potential site.

2. TERMS OF REFERENCE

The prime objective of the project is to determine the geohydrological setting of the proposed Memorial Park by means of a desktop site characterization using available geohydrological data as well as an on-site assessment.

3. THE “CULCATT” SITE

The site is approximately 6 km north of Stellenbosch along the R305 (**Map 1, Appendix A**). The site is not developed and is heavily infested with alien vegetation and relatively flat in terms of relief (**Map 2, Appendix A**).

3.1 Geology

The Geological Survey of South Africa (now the Council for Geoscience (CGS)) has mapped the area at 1:250 000 scale (3318 Cape Town). The geological setting is shown in **Error! Reference source not found. (Appendix A)** and the main geology of the area is listed in **Error! Reference source not found..**

Table 1: Geological formations within the study area

| Code | Formation | Group |
|------|-----------------------------------|------------|
| Qgg | Gravelly clay/loam soil | Quaternary |
| Qg | Loam and sandy loam | |
| Qs | Light-grey to pale-red sandy soil | |
| Nt | Tygerberg Formation | Malmesbury |

The Farm portion boundary is underlain by loam and sandy loam (Qg). These Cenozoic sediments are most likely underlain by greywacke, phyllite and quartzitic sandstone of the Tygerberg Formation (Nt) (Malmesbury Group).

3.2 Hydrogeology

The proposed Memorial Park is located on an aquifer which is classified as an “fractured” aquifer i.e. fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures. If a borehole was drilled within this site, the borehole yield may be in the region of 0.5 to 2 L/s. (**Map 4, Appendix A**).

Based on the DWAF (1999) classification the regional groundwater quality, as indicated by electrical conductivity (EC), has been classified as “marginal” to “good”. The EC of the area ranges from 70 – 300 mS/m (**Map 5, Appendix A**)

3.3 Hydrology

A small north-east / south-west water course, a tributary to the Plankenbrug River, flows to the east of the proposed memorial site. Flow within this watercourse will only occur during heavy rainfall events. Adjacent to the watercourse, to the north-east of the proposed Memorial Park, an agricultural dam is located.

3.4 Groundwater vulnerability and use

A national groundwater vulnerability map was developed using the DRASTIC methodology. The DRASTIC system is the most widely method used to evaluate intrinsic vulnerability for a wide range of potential contaminants. It is an overlay and index model designed to produce vulnerability scores by combining several thematic maps. It was originally developed in USA under cooperative agreement between the National Water Well Association (NWWA) and the US Environmental Protection Agency (EPA) for detail hydrogeological evaluation of pollution potential (Aller et al. 1987). The word DRASTIC is acronym for most important factors within the hydrogeological settings which control groundwater pollution. Hydrogeological setting is a composite description of all major geologic and hydrogeological factors which affect the groundwater movement into, though, and out of the area. These factors are:

- depth to water,
- net recharge,
- aquifer media,
- soil media,
- topography (slope),
- impact of vadose zone, and
- hydraulic conductivity.

The DRASTIC numerical ranking system contains three major parts: weights, ranges, and ratings.

The majority of the proposed study site is on an area classified as having a “low/medium” groundwater vulnerability rating. The southern portion of the property has been classified as “medium” grading into “very high” (**Map 6, Appendix A**).

3.5 Groundwater use

The proposed Memorial Park is located within a mostly agricultural region. Based on the number of agricultural dams in the region the agricultural sector utilizes mostly surface water to supply their needs.

The National Groundwater Achieve (NGA) database, which provides data on borehole positions, groundwater chemistry and yield, indicates that within the search radius there are no groundwater users in the area.

However four sites (to be considered as areas) were identified as groundwater users (**Map 2, Appendix A**). GEOSS has conducted a number of projects in the surrounding area ranging from hydrocensus's to groundwater exploration. Additional information for the area was obtained from borehole drilling companies.

3.6 Site 1 - Vrede:

Vrede is a wine farm located directly north of the Culcatta boundary. The wine farm has four boreholes but only use two. The boreholes were drilled to a depth of between 90 – 150 m and have yields ranging between 4 – 16 L/s. VBH1 and VBH2 are used for domestic and agricultural use. Drill chips located near the boreholes indicate they were drilled into granite. The farm manger reported the fracture depths of VBH2 to be between 120 -125 m. VBH3 and VBH4 are reported to have high iron concentrations and do not meet agricultural water quality parameters, therefore they are not used. The borehole are approximately 200 m north of the proposed Culcatta Memorial Park.

3.7 Site 2 – Wild Clover:

Wild Clover farm is located directly north-west of the Culcatta boundary and is a small holding. The estate has four boreholes (they were drilled back in the 90's and no drill records are available) of which only one is in use. The boreholes were drilled to a depth of between 60 –90 m and have yields ranging between 0.5 – 1.25 L/s. WCBH1 is the only borehole being used on the estate with a yield of 1.25 L/s. The field chemistry indicates the groundwater to be “marginal” as classified according to DWAF standards.

3.8 Site 3 - Mariendahl:

The Mariendahl area is located to the east of the Culcatta boundary. Five boreholes were drilled on the site in 2017 for drought relief. The boreholes were drilled to depths of 100 m. The main water strikes were intercepted at depths of 40 – 60 m below ground level.

The borehole blow yields ranged from 0.5 – 12.5 L/s. Water chemistry results were obtained from laboratory results. The groundwater is intended to be used for town supply.

3.9 Site 4 and 5:

No site access was granted to the farm portion directly west of the proposed Culcatta Memorial Park.

Table 2: Summary of boreholes within a 1 km search radius

| Farm | Site ID | Latitude | Longitude | Yield (L/s) | EC mS/m | pH |
|-------------|---------|------------|-----------|-------------|---------|-----|
| Vrede | VDBH1 | -33.847518 | 18.810327 | 9.7 | 91 | 7.3 |
| | VDBH2 | -33.848950 | 18.810692 | 16.0 | 78 | 7.4 |
| | VDBH3 | -33.845293 | 18.804203 | - | - | - |
| | VDBH4 | -33.846144 | 18.812234 | - | - | - |
| Wild Clover | WCBH1 | -33.848577 | 18.801397 | 1.3 | 292 | 6.5 |
| Mariendahl | MD_BH1 | -33.843792 | 18.824450 | - | 133 | 6.4 |
| | MD_BH3 | -33.847545 | 18.824960 | - | - | - |
| | MD_BH4 | -33.852770 | 18.825460 | - | 52 | 6.2 |
| | MD_BH5 | -33.843910 | 18.827410 | - | 73 | 6.5 |

4. DISCUSSION

The “Culcatta” site is located north of Stellenbosch along the R305. The surficial cover of the site comprises loam and sandy loam. These Cenozoic sediments are most likely underlain by greywacke, phyllite and quartzitic sandstone of the Tygerberg Formation (Malmesbury Group).

Groundwater users were identified to the north, east and south of the proposed memorial park. The uses of groundwater include domestic, agricultural, livestock and town supply. Site 1 has two boreholes ~200 m from the northern boundary of good groundwater quality which is used for domestic purposes.

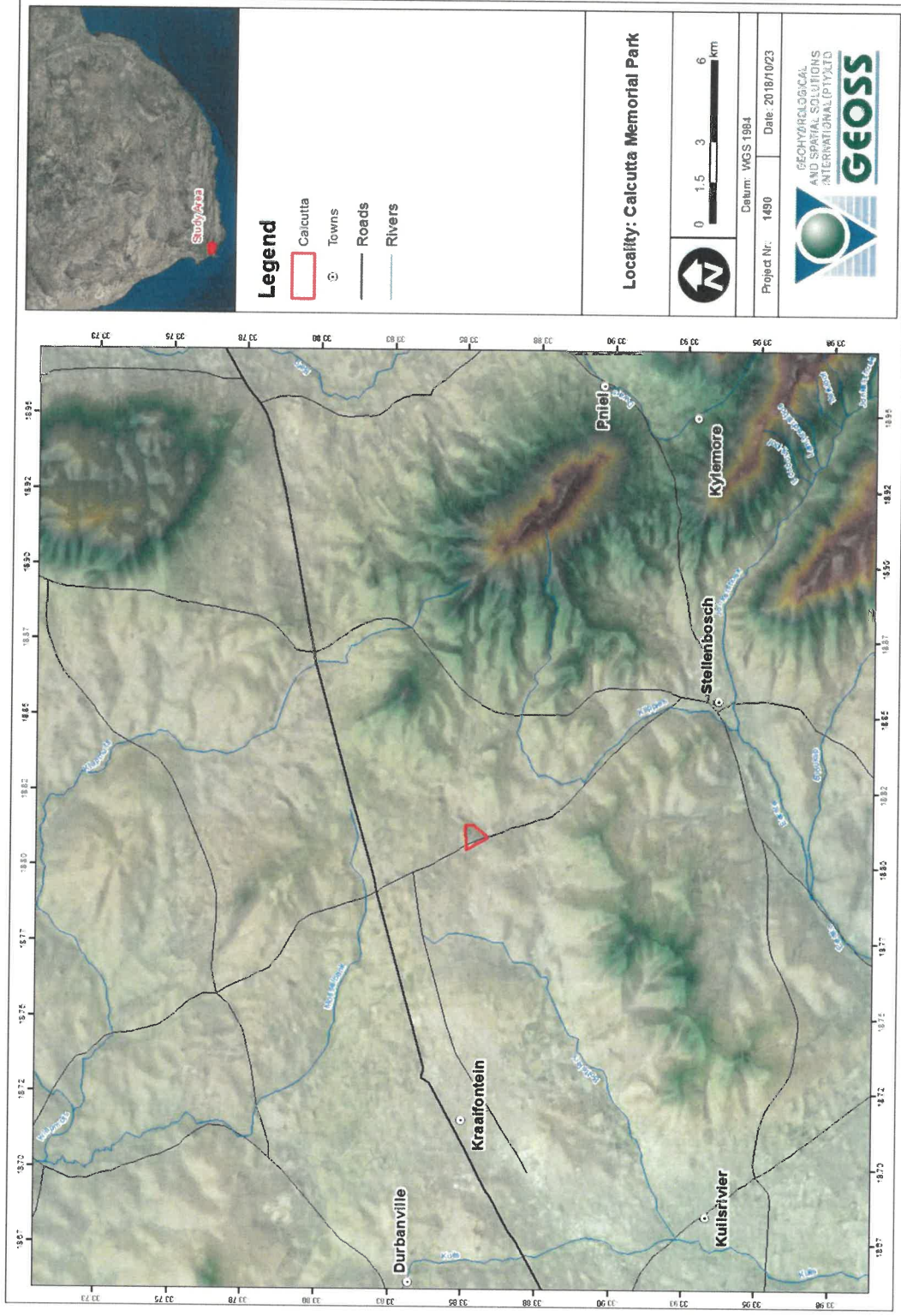
The site has a “medium” groundwater vulnerability rating, due to the argillaceous nature of the surficial cover. The thickness of the surficial cover is unknown as no drill records could be obtained.

From a groundwater perspective, the site is in close proximity to a number of groundwater users that depend on groundwater as a source. It is recommended that should the site be considered viable from all other perspectives, then three to four exploration boreholes be drilled on site to bedrock to determine the groundwater level; aquifer thickness; nature of material of the surficial cover; and groundwater quality. These boreholes can then also be used as monitoring boreholes if the site becomes operational.

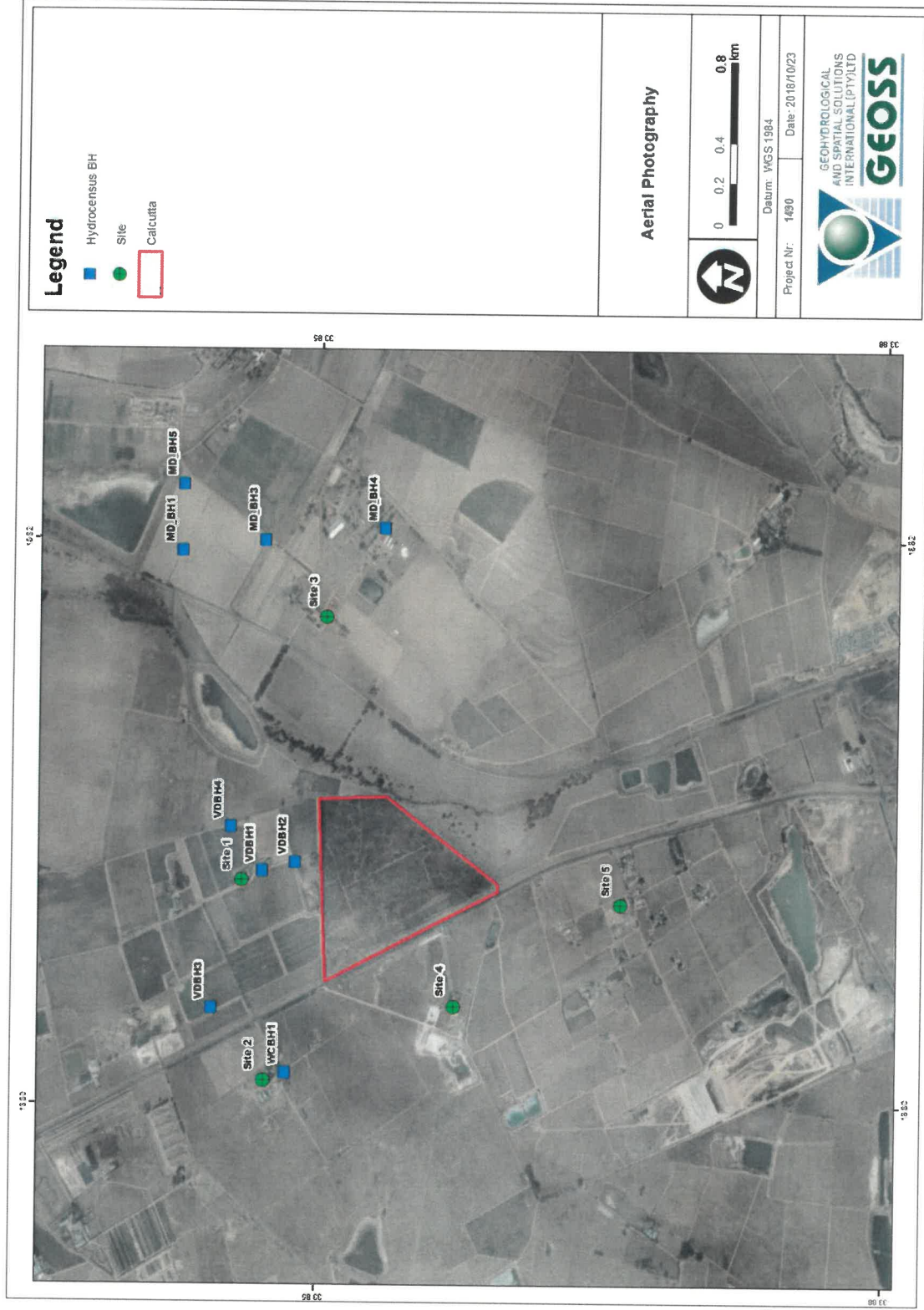
5. REFERENCES

- Aller L, Bennett T, Lehr J, Petty R, and Hackett G (1987) DRASTIC: A standardized system for evaluation ground water pollution potential using hydrogeological settings. National Water Well Association, Dublin, Ohio and Environmental Protection Agency, Ada, Ok.EPA-600/2-87-035.
- DWS, 2000. National scale mapping of groundwater conditions. Department of Water and Sanitation, Pretoria.
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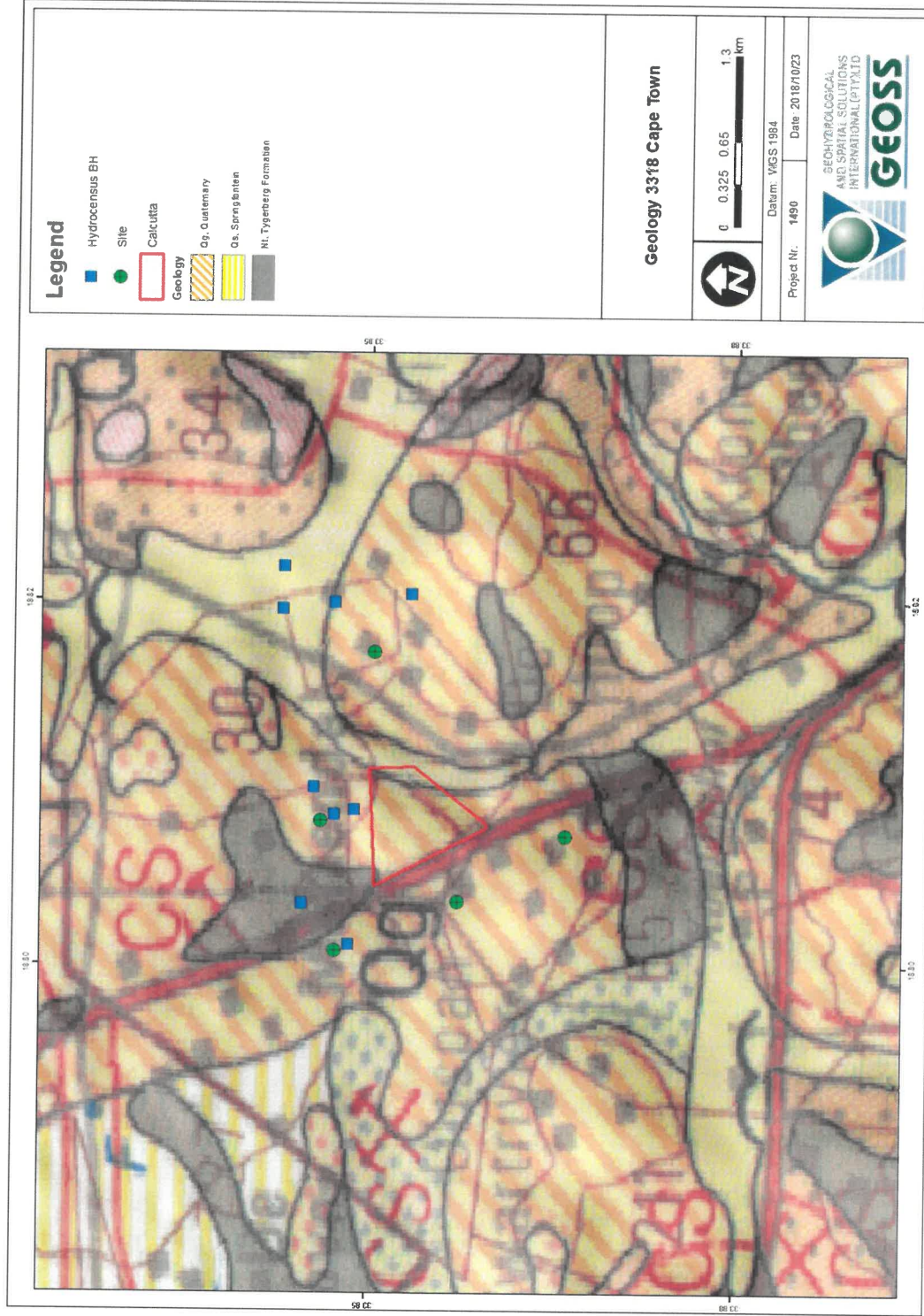
6. APPENDIX A: MAPS – CULCATT A



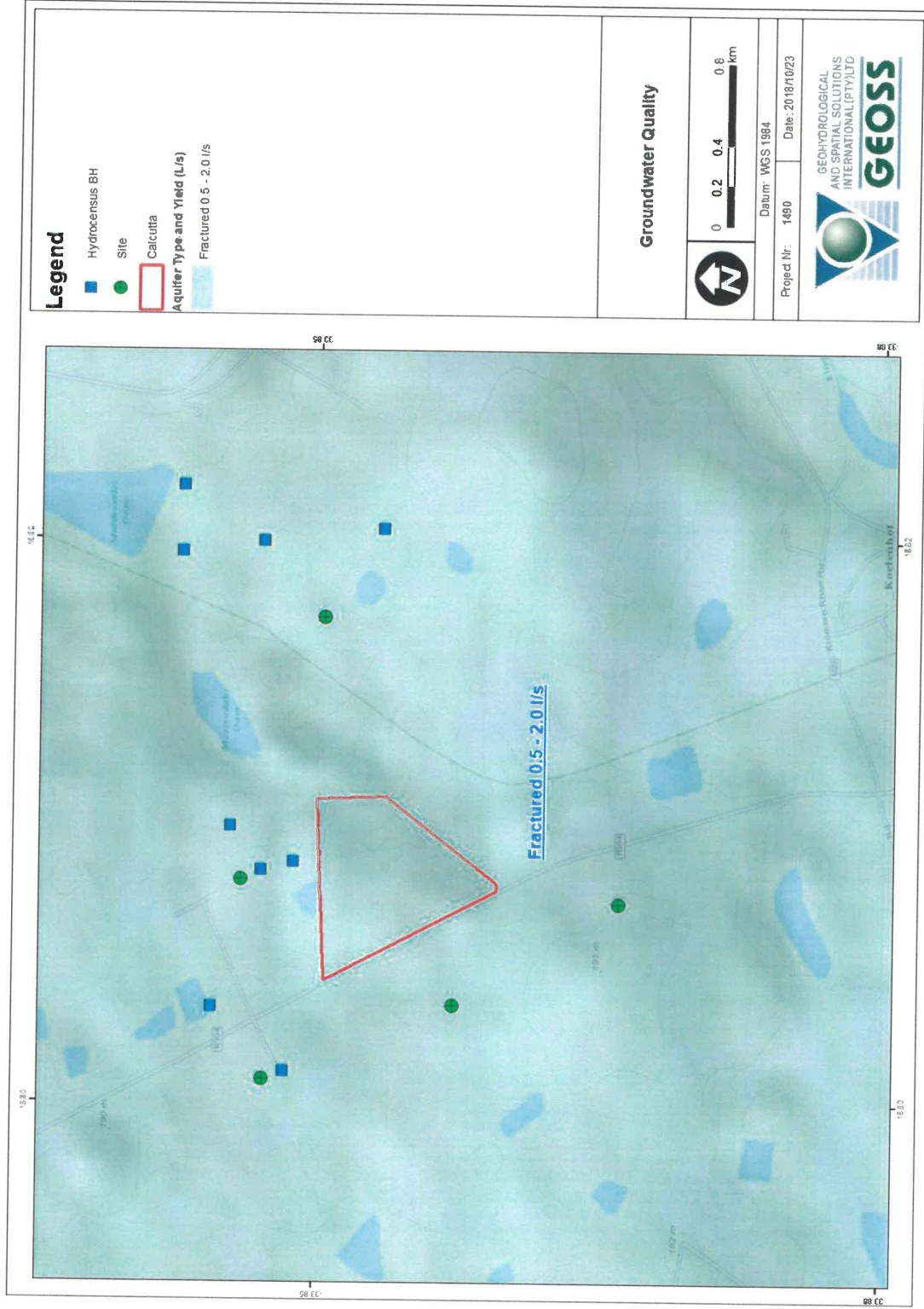
Map 1: Location of the Culcatta study area within a regional setting



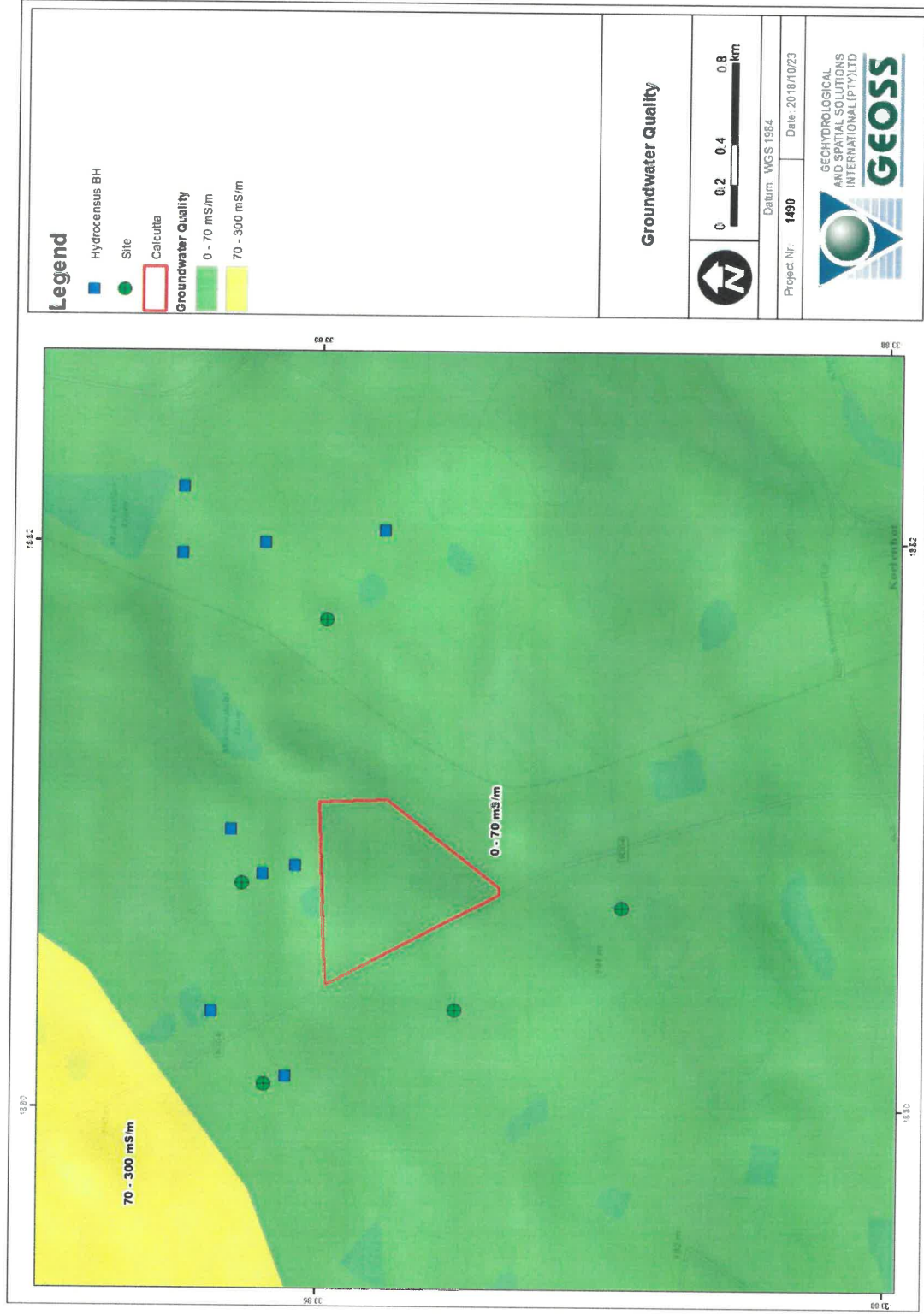
Map 2: The Culcatta study site superimposed on an aerial photograph



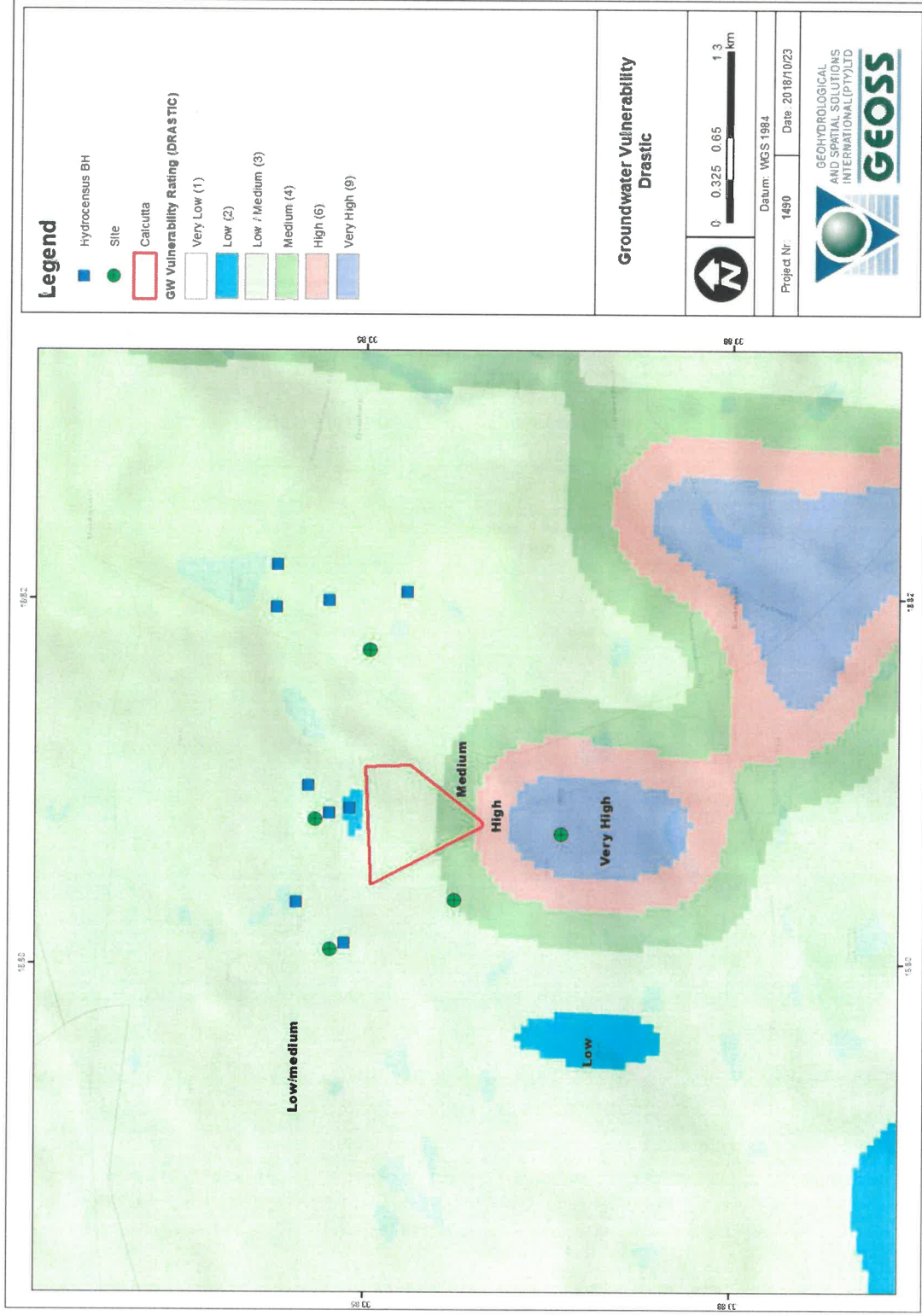
Map 3: The Culcatta study site and superimposed on a 1:250 000 scale geological map (3318 Cape Town).



Map 4: Aquifer types of the Culcatta study area (1:500 000 scale DWS, 2000)



Map 5: Groundwater quality within the Culcatta study area (Electrical Conductivity in mS/m), (DWS, 2000).



Map 6: Groundwater vulnerability at the Culcatta site (DWS, 2005).