GEOTECHNICAL ASSESSMENT STUDY AT GOEDEHOOP (SOVENTIX) SOLAR SITE, DISTRICT HANOVER/DE AAR FOR AN ENVIRONMENTAL IMPACT ASSESSMENT PHASE 3 FOOTPRINT

(INCLUDING MINOR ADDITIONS TO PHASES 1&2 FOOTPRINTS & OVERHEAD POWERLINE ROUTE)

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Project number: **COUNCIL FOR GEOSCIENCE CO2017-5806 (Phase 80)**
Date: **2022.05.11**

Council for Geoscience

1. SCOPE OF WORK

The scope of work is to conduct a study covering the geotechnical aspects of the Phase 3 footprint area for construction of a 300 MW photovoltaic solar farm in order to:

- Identify and map the different soil and rock formations
- Determine the topographical and drainage variation
- Identify possible sources of both road construction materials and concrete aggregate
- Assess the perceived impacts foundation conditions may have on the construction and operation phases of the proposed development and recommend mitigation measures (the original Phase 1 and 2 footprint areas were similarly investigated in 2016/2017 and 2021).

The present study is conducted by way of a desktop investigation exercise supported by a brief ground truthing site visit and is meant to apart from assessing the Phase 3 study area (terrain), also augment and extend the findings of the Phase 1 & 2 study areas as follows:

- Add a small (53 Ha terrain – green coloured polygon in Figure 1) section to the west of the Phase 2 footprint
- Add a small (0,99 Ha terrain) portion ("Staging" Area – orange coloured polygon in Figure 1) along the access route between the N10 tarred road and the Phase 1 area. This includes investigating an alternative access route between the staging area and the De Bad farm house east of the staging area.
- Add the (8,1 km long route) terrain of the planned overhead power line which will connect the substations of Phases 1, 2 and 3.

The Phase 3 area and three additional small terrains listed here above as a group are referred to as "the site" in this report.

2. LOCATION

(see Figure 1)

The site is situated 26 kilometres northwest of Hanover in the Northern Cape and to the northeast of the N10 tarred road between the towns of Hanover and De Aar Northern Cape Province. (The railway line connecting Noupoort and De Aar passes southwest of the Phase 3 terrain). In plan view the Phase 3 terrain consists of southwestern (Alternative 1) and northeastern (Alternative 2) sections with a central exclusion zone (the low-lying drainage channel orientated roughly southeast-northwest). The additions to Phases 1 and 2 elements are located in close proximity to the Phase 3 terrain as indicated in Figure 1.

3. METHODOLOGY ADOPTED IN PREPARING THE REPORT

A desk study was undertaken during which the geology and topography of the site were reviewed from presently available maps, satellite imagery and reports. These were utilized to plan localities to be visited during the site visit. The site visit was undertaken during late April 2022 (wet season). During this visit a total of thirty eight soil profile and rock mass descriptions were undertaken at localities distributed throughout the site (refer to Appendix I) in order to asses geological and geotechnical conditions and

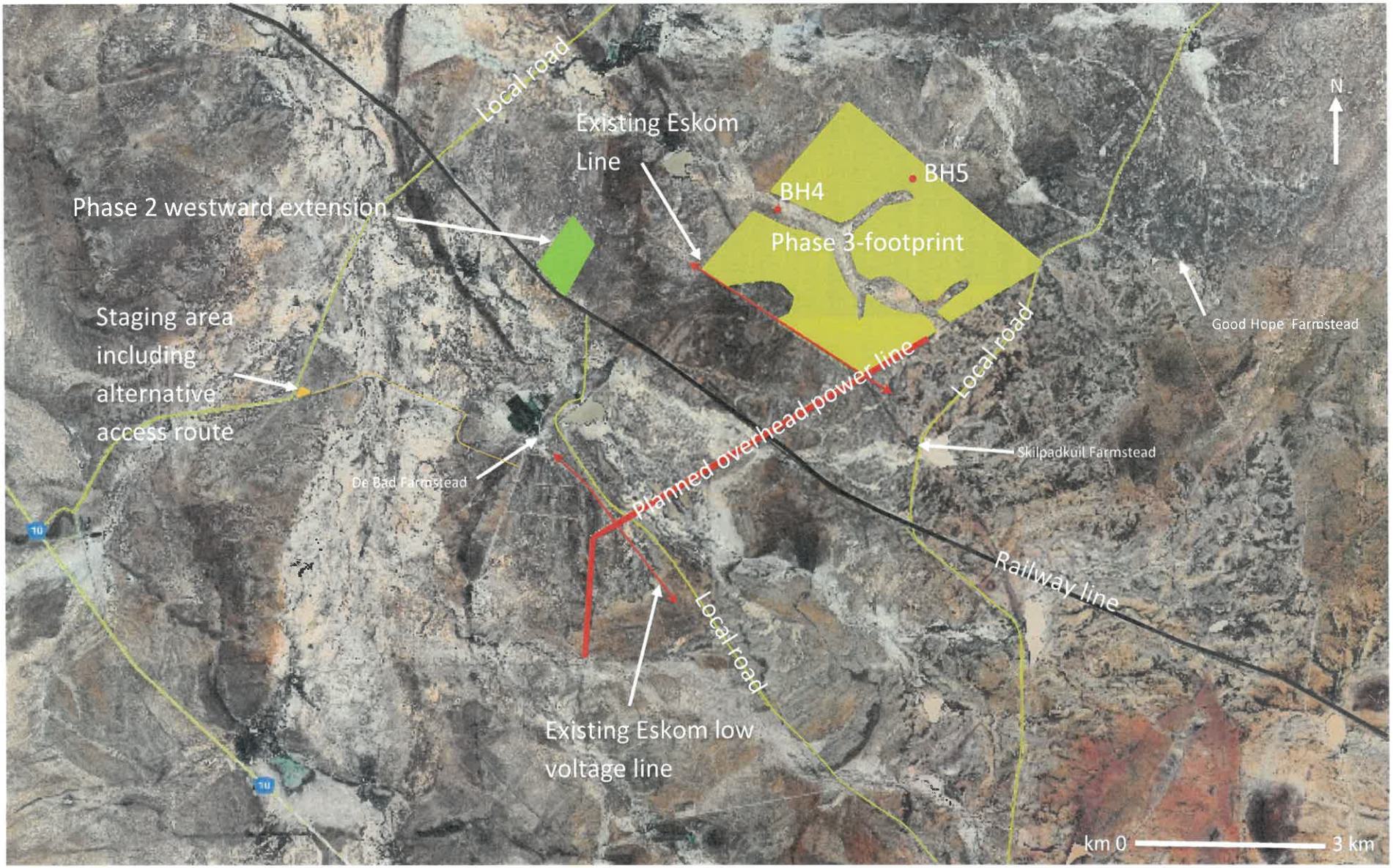

Figure 1: Location of the site consisting of: Phase 3 terrain (yellow polygons), Phase 2 westward extension terrain (green polygon), staging area terrain (orange polygon including alternative access route to Phase 1 terrain) and planned overhead power line route (thick red line). Additional elements indicated are: Roads (national & local - yellow), railway line (black), existing Eskom lines (red, arrowed), borehole locations on Phase 3 terrain (red dots).

confirm desk study results.

4. SITE SPECIFICS

4.1. EXISTING INFRASTRUCTURE

Apart from the tarred road (N10) and the railway line from Noupoort to De Aar (with its adjacent gravel service road) which both pass southwest of the Phase 3 terrain, additionally, three secondary gravel roads, (indicated as "local roads" in Figure 1) service the site. A number of farm tracks allow limited access to the site [whilst full access to the site area is either on foot or by driving through the natural (shrub land) bush]. Additionally, an existing Eskom line runs along the south-western Phase 3 terrain boundary and barbed wire farm fences divide the Phase 3 terrain into a number of separate farm camps.
The Phase 2 extension terrain adjoins the railway line and its gravel service road to the north thereof.
The Staging Area terrain adjoins the local gravel road connecting the N10 to the site and lies directly to the east on the gravel road.
The planned overhead power line terrain connecting the Phase 1, 2 and 3 substations will cross over an existing low voltage Eskom power line, a local gravel road, the railway line (and its adjacent gravel service road), and the existing Eskom line located along the southwestern boundary of the Phase 3 terrain.

4.2 TOPOGRAPHY, DRAINAGE AND ON-SITE SURFACE WATER

The Phase 3 terrain occurs in an area of denuded topography with slight surface slope mainly towards the west and the centrally located drainage channel (which is orientated northwestwards). The elevation varies from 1 393 masl (northeastern corner) to 1 333 masl (where the drainage channel exits the terrain along the northwestern border). Drainage occurs largely as sheet flow, whilst the centrally located drainage channel (an upper tributary of the Brak River) which is excluded from the footprint, cuts through the terrain in a northwestern direction. The drainage channel bisects the terrain in two halves of roughly equal size) and links up with the non-perennial Brak River several kilometres northwest of the terrain. A number of small (earthen-walled) reservoirs as well as one borehole (BH4) occurs within the centrally located drainage channel, whilst another borehole (BH5) occurs inside the northeastern terrain boundary.

The westward extension to the Phase 2 footprint (a terrain of 53 Ha) occurs in an area of denuded topography with slight surface slope towards the southwest. Drainage occurs as sheet flow, and no dams or boreholes occur on the terrain itself (a borehole occurs directly west of the terrain though). The terrain lies 600 metres northeast of one of the upper tributaries (a flat, open valley) of the Brak River.

The (0,99 Ha) Staging Area terrain west of the Phase 1 terrain occurs in an area of denuded topography with slight surface slope towards the east, drainage occurs as sheet flow, and no dams or boreholes occur on the terrain itself. The terrain lies 900 metres west of the main upper tributary (a flat, open valley) of the Brak River. A shallow drainage channel occurring outside the northeastern terrain boundary drains the immediate area towards the southeast. A dormant road quarry occurs 90 metres northwest of the terrain (the quarry contained no water during the site visit).

The alternative access route from the staging area to the Phase I terrain (see orange line east of locality P2 in Figure 2) passes eastward along a farm track. The first 900 metres of this route occurs along the same plain the staging area is located on. Thereafter (eastwards) the route crosses the main drainage channel of the Brak River over a distance of 300 metres. The river is dammed up directly up slope of the crossing - by a 2 metres high weir constructed of sandstone/siltstone slabs and mortar. Periodic flooding and erosion of the track surface is evident along this section. Continuing eastwards after the crossing the track traverses the low lying eastern bank of the river over a distance of 1,5 kilometres. Along this section submerged and semi-submerged surface soil conditions had evidently lead to passing vehicles getting stuck in several spots some time prior to the field visit. The last 1,2 kilometres of the route up to the Phase 1 access route near De Bad farmstead has a slight westwards inclination and is well drained towards the west.

The (8,1 km long) route of the planned overhead power line connecting the Phase 1 substation to the Phase 2 and Phase 3 substations (see purple line in Figure 2) starts off at the Phase 1 substation with a 1,9 kilometres long section in a northern direction, after which it turns northeastwards (and stretching over an additional 6,2 kilometres distance before reaching the Phase 3 substation). The topography and surface drainage for the first section and up to roughly 700 metres northeast of the above mentioned turning point is as described in the corresponding chapter 4.2 of the 2021 report (Stapelberg, 2021). To recoup and add, the Phase 1 substation is located in a low-lying area on the northern bank of a westward draining upper tributary (a flat, open valley) of the Brak River. Periodic inundation may thus occur in the immediate vicinity of the substation. More towards the north the route is situated down slope of the western foot of a north-south orientated (dolerite) ridge (with westward directed sheet flow drainage). Further towards the north (towards the route turning point mentioned above), the route moves up the steepish slope of the ridge and eventually runs along the ridge crest – here surface drainage occurs as unconcentrated sheet flow down both the western and eastern ridge slopes. From the turning point to roughly 700 metres northeast thereof (where the route crosses the local gravel road) surface flow is eastwards to north eastwards and occurs as unconcentrated sheet flow down the steep eastern hill slope of the ridge and its adjoining (horizontally inclined) pediplain. Northeast of the local road crossing and for a distance of 2,5 kilometres beyond that (up to the railway crossing), the route traverses a low-lying valley area which includes two flat, open drainage channels and the adjoining wetlands belonging to an upper tributary of the Brak River. Drainage along this valley section is towards the northwest. (Access to this 2,5 kilometre stretch (east of locality P9) proved difficult during the site visit due to standing water and ditches along the drainage channel, whilst from the eastern end the railway track restricts access west of P32). Northeast of the railway crossing the route elevation gradually rises over a three kilometres distance (from 1 335 masl to 1 360 masl - which is the level of the Phase 3 substation area). Along this three kilometres distance drainage is in the form of unconcentrated sheet flow in the direction of the (very gently sloped) undulated topography of the land (towards the west over the first 1,8 kilometres and towards the northwest over the last 1,2 kilometres (northwestwards from where the route enters the Phase 3 terrain and passes the planned construction camp laydown area and up to the substation locality).

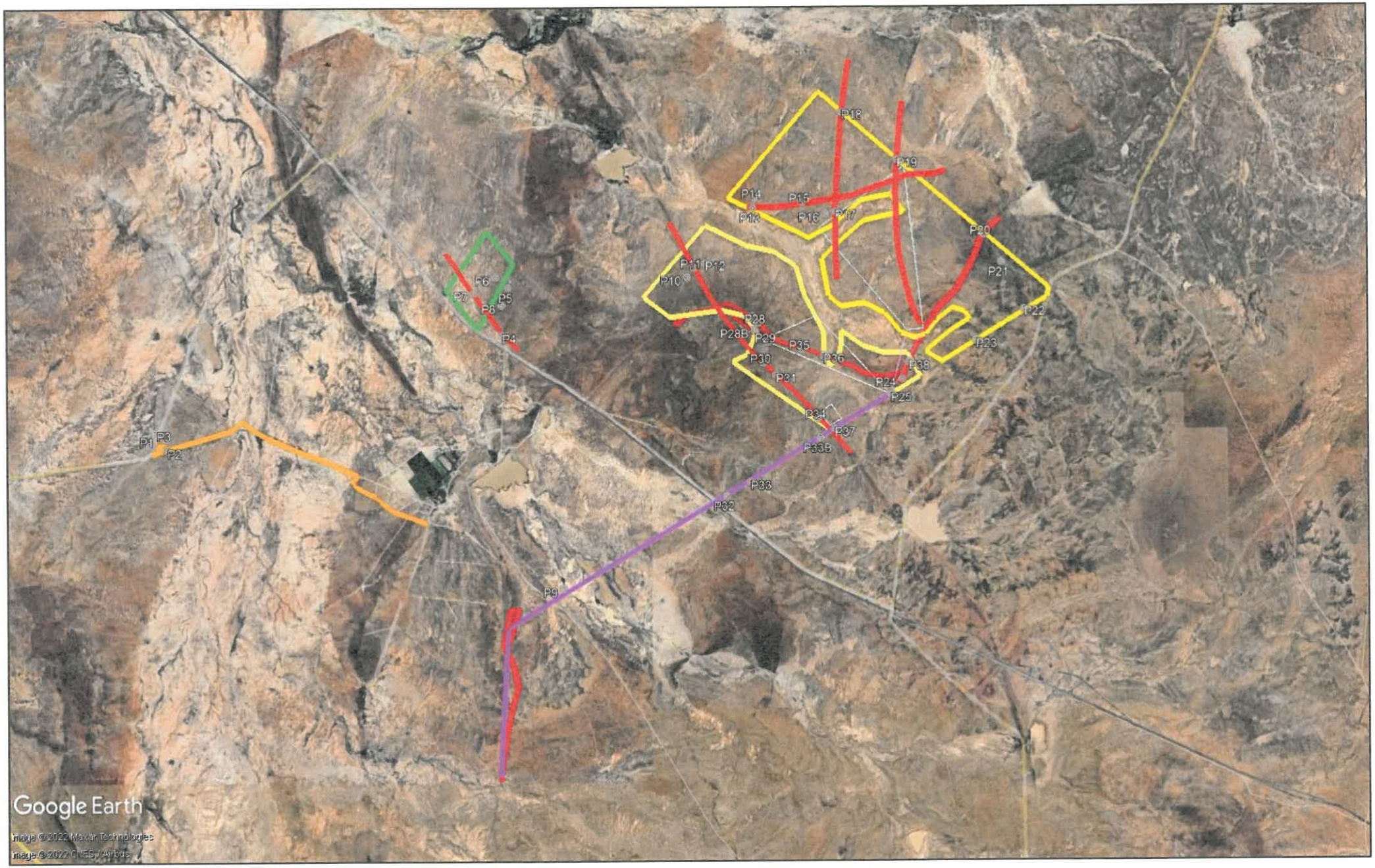

Figure 2: Position of particular observation localities (numbered white dots – refer to Appendix I). Additional polygons are as follows: Yellow = Phase 3 terrain, green = Phase 2 extension area terrain, orange = Staging Area terrain and possible alternative access rote, purple line = Eskom line route between substations of three phases, red = dolerite dykes and sill, white square = construction laydown area, light blue/pink/white triangles = subsurface cabling routes.

4.3 VEGETATION COVER

The project area occurs in the Nama Karoo Biome and more specifically within the Eastern Mixed Nama Karoo Vegetation Type (Hoffman, 1996). This Vegetation Type is dominated by a mix of grass and shrub vegetation types, which are subject to dynamic changes in species composition depending on seasonal rainfall events. Dominant shrubs are the Bitterkaroo, Kapokbush and Thornkapok. Sweet thorn trees are common only along stream channels. Furthermore sweet thorn trees and shrubs are known to prefer soil derived from dolerite rock and small (shrub like) trees can indeed be observed for many parts of the area underlain by the dolerite rock sill, dykes and hillwash soil derived from dolerite. Due to the very narrow surface expression of the majority of dykes, this correlation is less distinct for them than for the dolerite sill.

4.4 GENERAL GEOLOGY AND SOILS

4.4.1 Bedrock

4.4.1.1 Sediments

The bedrock of the region consists of sediments (mostly fine to medium-grained sandstone, but also siltstone and mudstone in parts) of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup.

4.4.1.2 Dolerite

Dolerite dykes and sills both are sheet-like rock bodies intruded into the sedimentary rock. They are distinguished by their orientation relative to the sedimentary bedding [sills are orientated parallel or sub-parallel to the sedimentary bedding (thus roughly horizontal in this area), while dykes cut across the sedimentary bedding planes (and are thus roughly orientated vertical or near-vertical in this area)]. A number of dolerite sheets of Karoo age have been intruded into the sediments on the site. Due to the fact that the dykes are often very narrow (metre scale), they often do not have such a pronounced effect on topography as that of the wider dykes or the sills. (Dolerite in general has a slow weathering rate compared to that of sediments and often forms local topographical high points). Dolerite dykes and sills are indicated in Figure 2 across the different terrains as follows:

Phase 3 terrain: Several dykes and one sill occur on the terrain. The dyke running sub-parallel to the south-western boundary is the most prominent, has a width of up to 50 metres in parts (refer to locality P34) and has a visible influence on the terrain topography – forming a linear ridge.
A dolerite sill underlies part of the terrain, the width of the sill however varies substantially (from roughly 50 to 100 metres in parts (refer to localities P24 and P28) to less than 10 metres (refer to localities P35 and P36). Furthermore, in parts the sill appears to have been virtually weathered away, with only baked sediments remaining (refer localities P24 and P29) or split into dolerite outcrop or cobbles separated by sandstone outcrop (refer to locality P20 and P29).

Phase 2 westward extension terrain: One dyke occurs on the terrain – orientated north westwards and cutting through the entire terrain but apparently pinching out in parts (refer to localities P4 and P7).

Staging area terrain: No dolerite occurs on terrain – this is also true for the alternative access route east of the terrain.

Planned overhead power line route: One dolerite dyke is intermittently located along parts of the north-south orientated limb of the route. The dyke (referred to as a sill in some previous reports by Stapelberg) has a pronounced effect on topography (causing a ridge which increases in height from 0 metres (south) to 20 metrres (north – at route turning point).

4.4.2 Soils

Observations during the ground truthing exercise indicate that the entire site has very thin soils and either bedrock sub-outcrop at less than 0,5 metres depth below ground surface or bedrock outcrop/dispersed outcrop (refer to observation descriptions at particular location points in Appendix I). The thickest soils (1,0 to 1,2 metres thickness over minor parts) occur in areas of either gully wash material, alluvial deposits or pediplain positions (at low landscape localities). These soils are generally of a silty sand to clayey sand nature.

These observations generally correlate with earlier studies [Stapelberg (2017; 2021); Van den Berg and De Wet (2017)] of soils in the site area.

4.4.3 Usage of rock for construction materials

Brink (1983) cautions against the use of mudstone from the Karoo Supergroup for use as construction materials – particularly for use as concrete aggregate and to a limited extent for road layer materials. Characteristics which have in the past been found to be of particular concern are:

- An excessive propensity to shrinkage of concretes made from sandstone aggregates
- Low moduli of elasticity of both sandstones and mudrock
- Deterioration of sandstone in the road layers after construction
- Breakdown and slaking of mudrock upon exposure (i.e. also in road layers)
- Swelling characteristics of mudrock
- Poor strength of mudrock

Preference should be given to the use of dolerite rock as construction material, however, sedimentary rock may be used with caution for the lower road layers – especially the sandstones and also mudstone/shale which have been baked by dolerite intrusions (i.e. in close proximity to dolerite rock).

4.4.4 Dormant quarries

No dormant quarries exist on any of the terrains (including the line route) making up this site. However, a number of small dormant quarries exist in close proximity to the site as follows:

- A number of road quarries along the local road passing east of the Phase 3 terrain:
  - 2,2 kilometres northeast of the easternmost terrain corner (at coordinates 30,821773° S; 24,403240° E

  - 2,6 kilometres in a straight line south of the terrain (at coordinates 30,87138° S; 24,36794° E and 30,87254° S; 24,36635° E) – where the local road intersects the railway line
- Two quarries along the railway line and located near the westwards extension terrain to the Phase 2 area (these quarries are also cited by Stapelberg (2017) – and were then referred to as positions A1 and A17:
  - 320 metres east of the southernmost terrain corner (at coordinates 30,84143° S; 24,31322° E) – refer to locality P4 in Appendix I of the present report.
  - 330 metres west of the westernmost terrain corner (at coordinates 30,8333° S; 24,30296° E)
- A road quarry across (west of) the local road passing west of the Staging Area terrain:
  - 90 metres west of the terrain (at coordinates 30,85369° S; 24,26418° E) – refer to locality P1 in Appendix I of the present report.
- A road quarry where the planned Eskom Line Route crosses the local road near the western border of the Phase 1 footprint area:
  - 150 metres southeast of the local road and line route crossing (at coordinates 30,87197° S; 24,32169° E). This locality has been cited before by Stapelberg (2021) – and was then referred to as position B41.

None of the above-mentioned quarries utilizes good quality sandstone or dolerite rock and can be recommended as construction material source. Better quality material (sandstone) which appears to be intermittently used in road layers occurs at a large dormant quarry near the N10 national road (at coordinates 30,87990° S; 24,23715° E). This quarry, which is located 16 kilometres by road from the Phase 3 terrain, has been cited before by Stapelberg (2017) – and was then referred to as position C1.

4.4.5 Proposed quarry sites on Phase 3 terrain

4.4.5.1 The dolerite dyke running sub-parallel to the southwestern terrain boundary (see localities P11, P30, P31 and P34) has a width of between 20 and 50 metres and a quarry for utilization of dolerite from this dyke can be located anywhere along the strike of the dyke. The argument that rock cairns (occurring at locality P31) may render that area historically sensitive status, thus possibly preventing development in that vicinity, may perhaps be flawed. Similar rock cairns occur on the dolerite ridge at locality P34, hence, it could be argued that the cairns were originally built to mark spots where drilling for groundwater was planned. However, when dolerite dykes were also discovered in the northern parts of the terrain, the plan to undertake drilling at P30/P34 was then probably abandoned due to the more favourable landscape position for reservoir building in the vicinity where boreholes BH4 and BH5 are located today.

4.4.5.2 Rock from the irregularly shaped dolerite sill traversing the Phase 3 terrain (see localities P20, P24, P26, P27, P28, P29, P35, P36, P38) as well as the adjacent baked sediments may be utilized as construction materials. This possible source occur in close proximity (200 m away from at P24) to the locality of the Phase 3 substation. The main drawback of this source in comparison to that mentioned in chapter 4.4.5.1 is that the dyke appears to be thin or even weathered away in parts (see P24 and P29) leaving lesser quality baked sediments as construction material source.

5. PERCEIVED IMPACTS OF FOUNDATION CONDITIONS ON THE PROPOSED DEVELOPMENT AND POSSIBLE MITIGATION MEASURES

The site is largely underlain by soft to medium hard rock sandstone/siltstone or dolerite at depths of less than 0,5 metres (mostly less than 0,3 metres) below ground level.

5.1 For solar panels overturning moment will be the main load on the solar panel structure support columns and excavation to 1,0 metres below natural ground level will probably be required to ensure overturning stability. Considering the time-consuming nature of pad footing construction (breaking out and removal of rock and casting of reinforced concrete), and furthermore the difficulty which rock mass at depths shallower than 1,0 m will cause to placement of screwed piles, rammed piles is considered the most effective support option for solar panels. However, since driving to at least 1 metre depth may prove difficult over the major part of the site (where depth to bedrock are < 0,5 metres), as an alternative, ground beam concrete footings (which make use of concrete strip footings at very shallow depth below ground level to act as support and counterweight for solar panels) may possibly have to be utilized. This founding option is expected to be considerably more costly than using of piles.

5.2 For founding of the containerized battery storage units and gas turbines as well as the gas storage vessel either ground beams or a concrete surface bed on compacted gravel footing option can be considered. Determination of soil profile variations over the footprint areas are needed to ensure even footing settlement and prevention of structural distress.

5.3 The drainage channel of an episodic river and very low surface slopes as well as a number of (earthen wall) reservoirs occur along the environmentally sensitive zone (excluded from development) between the northeastern and southwestern parts of the Phase 3 terrain. Consequently, access roads crossing this zone as well as underground cabling routes 1, 2 and 3 (which all cross this zone in parts) will be subject to submerged conditions from time to time. The access roads will thus require laying of a compacted gravel layer to lift their elevation and increase traction.

- For large parts of the service road along the planned Eskom line connecting the Phase 1 and 2 substations, laying of a compacted gravel road layer will also be required to lift the road elevation and increase surface traction. [The gravel layers need to be placed in the low laying area between the district gravel road (P9) up to the railway line crossing (P32) over a 2,5 kilometres distance].
- If the alternative access road from the "staging area" to the Phase 1 area is to be used, laying of a compacted gravel road layer will be required over a 1,8 kilometres distance to lift the road elevation and increase surface traction.

5.4 If commercially available sources of concrete aggregate prove to be too distant and expensive for utilization on site, dolerite rock or baked sediments from the Phase 3 terrain can be considered for this purpose (see chapter 4.4.5). The materials need to be tested for quality purposes (hardness, strength, durability and mineral composition, degree of weathering and durability as well as grading, Atterberg limits and compaction-moisture density values). A rock breaking plant may have to be established on site.

5.5 The planned Eskom substation will be located along a high lying part of the southeastern Phase 3 terrain border with good quality sedimentary rock mass foundation at shallow depth (less than 0,5 metres) below ground level.

5.6 Digging of trenches for laying of the underground cabling will be complicated by the frequent occurrence of rock outcrop or sub-outcrop at less than 0,5 metres depth on the Phase 3 terrain. Excavation will be particularly difficult where the routes cross dolerite dykes or the sill.

5.7 On the Phase 2 extension area terrain clayey sand cover of 0,3 to 0,5 metres thickness occur above the sedimentary rock mass, whilst dolerite rock outcrop occurs in parts along the locality of the dyke (as indicated in Figure 2). Overflow from the borehole occurring west of the terrain may from time to time cause submerged conditions in the southwestern terrain corner area.

5.8 Stable subsoil conditions occur on the Staging Area terrain.

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APPENDIX I

Location	Coordinates (decimal degrees)		Description	Photographed
	Latitude (S)	Longitude (E)		
P1	30,85359°	24,26419°	Dormant quarry of roughly 2 metres depth. Dark olive, highly weathered (slaked), very fine grained, soft rock mudstone containing minor lenses of dusky red, moderately to highly weathered, fine grained sandstone of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. The sandstone weathers to rounded cobbles The quarry occurs 100 metres west of the proposed staging area and directly west of the local gravel road connecting the N10 tar road to Burgerville. The quarry is roughly 80 metres in diameter and contains no water. Soil cover above the rock mass (sub-outcrop) is of roughly 0,3 metres thickness.	x4
P2	30,854105°	24,26664°	Soil (loose silty sand) thickness on top of weathered bedrock mass less than 0,16 m - refer to DCP determinations.	x2
P3	30,85294°	24,26660°	Coarse dark olive siltstone gravel (clast size 2-8 cm) occurs in distributed outcrop and sub-outcrop. (Loose silty sand to 0,1 metres depth - see DCP determination).	
P4	30,84108°	24,31330°	Dormant quarry directly east of the Phase 2 extension area (has also been described in the 2017 investigation and then called locality A1). Quarry depth 1-2 m. Dark olive to dusky green siltstone but stained white by calcrete coating in some joints. In parts dusky red weathering, slightly harder, fine grained sandstone is embedded in the siltstone. A dark green (weathering dark red), medium to coarse grained, medium hard to hard rock dolerite dyke of 2 to 8 metres thickness cuts trough the north eastern corner of the quarry. It occurs to 250 to 300 metres southeast of the quarry and also northwestwards of the quarry, cuts through the Phase 2 extension area, and lines up with the borehole occurring west of the site. The dolerite outcrop disappears in parts - which suggests that the dyke may perhaps pinch out in those parts. Upwards tilted (20-40^{O}) sediments north of the dyke to the west of the quarry indicate intrusion forces created by the dyke.	x10
P5	30,83357°	24,31418°	Loose silty sand soil to a depth of 0,36 metres, and very dense soil to 0,48 metres depth. Weathered gravel beyond that depth. Hard rock at 0,5 m - refer to DCP determinations.	
P6	30,83452°	24,31240°	Loose silty sand soil to a depth of 0,17 metres, dense soil to 0,4 metres depth and very dense soil to 0,45 metres depth. Weathered gravel/bedrock beyond that depth - refer to DCP determinations.	
P7	30,83626°	24,30939°	Distributed dolerite outcrop and sub-outcrop indicates a dolerite dyke width of 1-2 metres in this vicinity.	
P8	30,83769°	24,31325°	Loose silty sand soil to a depth of 0,16 metres, dense soil to 0,3 metres depth, very dense soil to 0,34 metres depth and weathered gravel/hard rock beyond that depth - refer to DCP determinations.	
P9	30,87014°	24,32163°	The observation point occurs on the south western bank of a water filled drainage ditch along the planned Eskom line connecting the Phase 2 and 3 substations. Eastwards progression along the line route by vehicle is presently impossible, the ditch is roughly 0,5 metres deep. Loose silty sand soil to a depth of 0,19 metres, medium dense soil to 0,36 metres depth, dense soil to 0,5 metres depth and very dense soil to 0,56 metres depth. Weathered gravel/hard rock beyond that depth - refer to DCP determinations.	
P10	30,83460°	24,33906°	Light grey to light greenish grey, slightly weathered, medium grained, medium hard rock sandstone. The outcrop and distributed outcrop occurs over a width of 5 metres and length of 50 metres and strikes in a roughly 100-110^{O} direction.	
P11	30,83353°	24,33998°	Dark green (pink weathering), slightly weathered, medium grained, hard rock dolerite. Dolerite presents with typical onion peel (rounded) weathering pattern. The dyke is 20 to 25 metres wide and gives a positive landform shape (it leads to a convex ridge standing proud of adjoining topography by between 1 and 2 metres). Surface slope dips eastwards from the dyke. (A photograph taken here shows both a dolerite cobble and baked siltstone surrounding the dolerite dyke).	x1
P12	30,83303°	24,34151°	Poorly defined, light green, slightly weathered, fine grained, very closely bedded (horizontally), medium hard rock sandstone outcrop of 10 m diameter.	x2
P13	30,82670°	24,34822°	Light green, slightly weathered, fine grained, very closely bedded (horizontally), medium hard rock sandstone distributed outcrop and sub-outcrop at 0,3 metres depth in shallow dug out area between an old (rock wall) sheep pen and shallow reservoir. The sandstone forms plate-like bedrock sheets and can be observed over a distance in excess of 50 metres towards the west. The sheep pen walls are of stacked sandstone slabs. Dolerite cobbles suggest possible dolerite rock to the north of the shallow excavation.	x2
P14	30,82552°	24,34846°	Light green, slightly weathered, fine grained, very closely bedded (horizontally), medium hard rock sandstone outcrop of 5 m diameter. A similar outcrop of 10 to 15 metres diameter occurs 30 metres towards the north. (The north striking "dolerite dyke" observed on the satellite imagery for this position is in fact a camp fence).	
P15	30,82608°	24,35506°	Light green to light olive, slightly weathered, fine grained, closely bedded, medium hard rock sandstone outcrop and distributed outcrop occurs over a diameter of 150 to 200 metres. Deep vehicle tracks in this vicinity indicate localities where surface soils are water logged and where previous investigators got stuck. No dolerite dyke could be confirmed for this position (no dolerite rock observed).	
P16	30,82742°	24,35827°	Light green to light olive, slightly weathered, fine grained, closely bedded, medium hard rock sandstone outcrop and distributed outcrop occurs over a distance of 80 metres in the field track. Surface soils are water logged in parts in this vicinity.	
P17	30,82713°	24,35962°	Dolerite dyke crossing field track. The outcrop consists of distributed dark green to black rounded cobbles over a 1 to 2 metres width. Tilted sandstone bedding adjacent to the dyke indicates intrusion pressures. Dyke followed out to the north over a distance of at least 100 metres.	
P18	30,81585°	24,36055°	Satellite imagery suggests a N-S orientated dolerite dyke at this locality. However, only minor rounded dolerite gravel particles occur here - the dyke cannot be confirmed (no clear outcrop).	
P19	30,82124°	24,36815°	Locality of a roughly 1 m wide (at surface) dolerite dyke locally striking in direction 23^{O} (east of north) - but eventually linking up with the borehole referred to as BH5 -which occurs directly south of this locality (and 400 metres distant).	x3 of siltstone and dolerite cobbles

P20	30,82987°	24,38004°	The dolerite sill (dyke?) here occurs as two split-up members. The one near the foot of the low hill is 5 metres wide and the one near the hill top 10 metres wide. Roughly 25 metres southeast of the last dolerite outcrop (on the hill top) the sandstone appears baked by the intrusion.	x1
P21	30,83304°	24,38252°	Locality of a mesa which forms the westward extension of higher lying hilly terrain occurring to the east thereof. This hill is 8 to 10 metres high and has side slopes of 30-40^{O}. The sandstone consists of light olive to dark yellow, slightly weathered, medium grained, closely to very closely bedded, medium hard rock. Roughly 3 metres below the hill top occurs a 0,3 metres thick horizontal bed of dark olive stained black, fine grained, soft rock mudstone.	x1
P22	30,83834°	24,38561°	Locality of an aardvark burrow of roughly 1,2 metres depth indicating silty sand with traces of (shale) gravel. Relatively elevated vegetation growth probably indicates deep soil and high soil moisture in this general area.	
P23	30,84185°	24,37896°	Locality of a low (2-4 metres high) sandstone ridge forming the westward extension of higher lying terrain occurring east of the site border (off site). The ridge extends towards the west-northwest over a distance of 70 to 100 m. Elevation height drops to lower levels southwest of the ridge.	
P24	30,84622°	24,36879°	Dolerite sill and baked siltstone outcropping 200 m northeast of the substation locality (probable locality for construction material quarry?). Outcrop on slightly elevated topography (2-3 metres) in the vicinity of a lone shrub (in this grassland area) of roughly 1,5 metres height and 2 metres width. The dolerite is blueish grey and weathers reddish and is stained black in parts. The baked siltstone is slightly weathered, closely jointed (10-20 mm diameter cubical blocks), hard rock forming a plate-like upper surface sheet. 100 metres west of this locality the dolerite outcrop is still at least 50 metres in width - but 150 metres west of the locality only distributed dolerite outcrop is visible.	x3 of baked siltstone outcrop and minor dolerite cobbles
P25	30,84797°	24,36717°	Locality of convergence of two planned underground cabling routes as well as the substation for phase 3. Moist, dark reddish orange, loose, clayey sand occurs to 0,32 m depth, dense clayey sand to 0,37 m depth and bedrock (DCP refusal) at 0,37 m depth. Rock shards at surface level in this vicinity suggest bedrock to be dark olive siltstone.	
P26	30,83909°	24,34802°	Locality of a 5 to 10 m wide dolerite dyke which outcrops sub-parallel to the field track and can be followed out at least 300 metres northwest of this locality (local strike direction 300^{O} - i.e. 60^{O} west of north).	
P27	30,83938°	24,34836°	Locality where the dolerite dyke (of locally 2 to 3 m width) intersects the field track. The dyke is displaced in parts (and dolerite boulders in parts occur 10 to 15 metres south of where expected if the dyke were continuous). This probably indicates remnants of a sill rather than a dyke.	
P27B	30,83936°	24,34815°	An aardvark burrow here indicates topsoil thickness of at least 1 metre.	
P28	30,83984°	24,34881°	Distributed outcrop and boulders of pink weathering, moderately weathered, hard rock dolerite. Outcrop is covered by sandy topsoil from 20 metres north of the field track. Dolerite also outcrops in a 3 to 4 metre high ridge roughly 100 metres to the south of this position (marked P28B on the map - the ridge strikes towards the southeast over a distance of at least 100 m). Sparsely distributed dolerite boulders in the area between P28 and P28B suggest that this area may be underlain by dolerite (i.e. occurring in sub-outcrop). Sandstone outcrops south of (and up slope of) P28B .	x4 of dolerite ridge boulders
P29	30,84200°	24,35024°	Locality of baked siltstone outcrop over a 5 to 10 metres Φ area with sandstone outcropping towards the north (down slope).	x2 of baked siltstone
P30	30,84435°	24,34957°	Locality where the track crosses a dolerite dyke. The dyke is 35 metres wide at this locality and strikes in direction 135^{O} (east of south). The dyke forms positive topography with the surface northwest thereof at 1-2 metres lower elevation (but with a gradual slope change). The dolerite rock weathers pinkish and to rounded cobbles and gravel.	x1 of dolerite dyke
P31	30,84572°	24,35125°	Locality of three rock cairns occurring on ridge formed by dolerite dyke. The locality of cairns together with those in the vicinity of P34 create the impression that the cairns have possibly been packed with the idea of clearly marking the locality of the dolerite dyke (possibly indicating positions for borehole drilling?) - and that drilling was later abandoned here taking in mind the better landscape position at the BH4 and BH5 positions. The cairns are thus probably not of much historical significance.	
P32	30,85956°	24,34441°	From where the proposed Eskom connection line crosses the local gravel road (servicing the railway track) to 50 metres northeast thereof the landscape position is low lying and the grass cover tall - indicating relatively thick soil (0,5-1,0 m?) and high soil moisture. Sandstone outcrop occurs further towards the northeast and up to position P32.	
P33	30,85796°	24,34768°	In between positions P32 and P33 elevation (height) gain is gradual and sandstone outcrop occurs at 3 or 4 localities. Surface drainage is towards the southwest and no zones of poor drainage were observed.	
P33B	30,85299°	24,35740°	From P33 to the southernmost corner of the phase 3 terrain the elevation gain is very slight and this part can be considered a plain (with drainage towards the northwest though). Soil cover thickness appears to be thin (less than 0,5 metres) but only 2 small sandstone outcrops occur over a 1,1 kilometre distance between and P33 and P33B. No dolerite could be confirmed (observed) at locality P33B.	
P34	30,85072°	24,35716°	Locality of two rock cairns spaced 15 metres apart and roughly 5 metres northeast of the field track. The cairns occur along the crest of the low hill forming the dolerite ridge. The dolerite dyke is here 50 metres wide and weathers slower than the adjacent sediments - creating positive topography with the ridge standing proud of the ground surface to the northeast and southwest thereof - ridge side slopes are very gradual though.	x2 of rock cairns on dolerite dyke
P35	30,84284°	24,35494°	The dolerite sill here crosses a field track and is only 7 to 8 metres wide at this locality. A baked sandstone surface occurs upslope (south) of the sill. Downslope (northwards) the sill is covered by surficial sand. The outcrop here strikes in direction 125^{O} (southeast).	
P36	30,84360°	24,35787°	The dolerite sill here is 7 metres wide (and occurs up slope of a shallow ground fill reservoir containing very little water at present).	
P37	30,85129°	24,35938°	Very thin (125 mm - refer to DCP determination) soil cover and frequent sandstone gravel and cobbles at surface level in construction laydown area planned for phase 3 terrain.	
P38	30,84433°	24,36970°	The dolerite sill here is 15 to 17 metres wide and baked (dark brown/black) siltstone occurs east thereof.	

DCP/Hand auger observations

			Number of shots	0	5	10	15	20	25	30	35	40	45	
P2	30,85410°	24,26664°	Penetration/shot	32	5	1	3	3	1	0	Refusal depth.			Hand auger: Dry, dark reddish orange, silty clayey SAND. Hillwash. To 120 mm depth and refusal at that depth on dark olive siltstone gravel.
			Depth	0	160	185	190	205	220	225				
P3	30,85294°	24,26660°	Penetration/shot	22	4	0					Refusal depth.			Hand auger: Dry, light reddish orange, silty clayey SAND. Hillwash. To 100 mm depth and refusal at that depth on dark olive coarse siltstone gravel.
			Depth	0	110	130								
P5	30,83357°	24,31418°	Penetration/shot	73	14	6	3	2	2	1				Stopped (poor penetration)
			Depth	0	365	435	465	480	490	500				
P6	30,83452°	24,31240°	Penetration/shot	34	16	10	7	7	6	8	3	2	1	Near refusal - stopped
			Depth	0	170	250	300	335	370	400	440	455	465	
P8	30,83769°	24,31325°	Penetration/shot	32	11	7	6	6	5	4	1			Near refusal - stopped
			Depth	0	160	215	250	280	310	335	355			
P9	30,87014°	24,32163°	Penetration/shot	38	23	11	17	6	6	5	5	4	1	Near refusal - stopped
			Depth	0	190	305	360	445	475	505	530	555	575	
P25	30,84797°	24,36717°	Penetration/shot	63	8	2	0							Refusal - bounces back (on rock)
			Depth	0	315	355	365							
P37	30,85129°	24,35938°	Penetration/shot	25	0									Refusal - bounces back (on rock after four shots)
			Depth	0	125									