Helderwyk

PARTRIDGE, MAUD AND ASSOCIATES

Bob de Reuck

CONSULTANTS IN THE EARTH SCIENCES

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10th March, 2009

Keyland Development (Pty.) Ltd.
P.O. Box 652725
BENMORE
2010

Attention: Mr. E. Nafte

Dear Sirs,

Geotechnical map of the Townships of Helderwyk
Extensions 1-4, situated on part of the Farm Witpoortjie 117-IR

As instructed by Mr. Nafte in an e-mail dated 24th February 2009 we submit herewith a revised geotechnical map of the above township. This map was prepared in accordance with our e-mail to you of 24th February 2009.

The revision was based on the information contained in reports entitled "Report on an engineering geological investigation for planning purposes of the proposed Townships of Helderwyk and Helderwyk Extensions 2, 3 and 4, Remainder of Portion 62 of the Farm Witpoortjie No. 117-IR, Brakpan Municipal Area" (Report No. 1-3/75 of June 1975) and "Report on an engineering geological investigation for the proposed Township of Helderwyk Extension 1" (Report No. 5-8/74 of November 1974). These reports were prepared on the instruction of the Schachat Management Company (Pty.) Limited of Johannesburg. As these reports are not available electronically and no new field or laboratory data were acquired in the course of this revision (which involved re-classification of the soil units in terms of the site classes given in the SAICE/IStructE Code of Practice: Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction), the original reports remain the only source of primary data accompanying the revised geotechnical map. Profiles from the large diameter trial holes augered beneath the site and the results of the laboratory analyses on soil samples recovered from these trial holes were re-evaluated in terms of today's requirement that soil units be classified according to the 1995 Code referenced above, i.e. in terms of their potential to generate differential movements beneath houses as a result

of the presence of potentially heaving, collapsing or compressible materials within the soil profile.

The categories of differential movement associated with the various materials types listed in the legend to the revised map differ somewhat from those used in the 1974/5 maps and reports. This is largely the result of the adoption of a more conservative approach in our re-evaluation of the criteria for identifying potentially heaving soils (the heave potential of structured and highly or very highly active horizons was re-assessed using the method proposed by Van der Merwe and Savage, as detailed on pp. 113-118 of Soil Survey for Engineering by A.B.A.. Brink, T.C. Partridge and A.A.B. Williams, Oxford University Press, 1982). It should be noted, also, that, because most of the soils identified as possessing a collapsible fabric are fine grained, with significant silt and clay contents, settlements occasioned by their inundation under the foundations of houses may not everywhere occur rapidly, but may take the form of the slower settlements typical of highly compressible soils; the magnitude of the final movements is, however, likely to be of a similar order in either case.

In interpreting the new geotechnical map reference should be made to Tables 4.1 and 4.2 of the 1995 Code, which are attached to this letter. In these the range of estimated soil movements, the construction type, the foundation design and building procedures associated with each site class are tabulated. In planning any development in this area the accompanying text, notably Sections 4, 5 and 6 of the Code, should be consulted in detail before deciding on the solutions most appropriate in each of the mapping units (site classes). We also draw attention to the fact that the original investigation was based on a grid of trial holes at fairly wide spacing. Site class boundaries have been interpolated between these data points and may, therefore, vary in detail from those presented on the geotechnical map. Actual conditions pertaining beneath each house should always be confirmed during site preparation works, and the design and construction procedures to be followed confirmed or adapted in terms of this local information. This will require the services of a suitably qualified and experienced Professional Engineer.

We trust that this information will assist in your plans for the development of the area.

Yours faithfully,

T.C. PARTRIDGE, Pr.Sci.Nat., Ph.D., F.S.A.I.E.G.

TABLE 4.1: FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY RESIDENTIAL BUILDINGS FOUNDED ON EXPANSIVE SOIL HORIZONS

SITE CLASS	ESTIMATED TOTAL HEAVE (mm)	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES (Expected damage limited to Category 1)
H	< 7,5	Normal	• Normal construction (strip footing or slab-on-the ground foundations) • Site drainage and service/plumbing precautions recommended
H1	7,5 - 15	Modified normal	• Lightly reinforced strip footings • Articulation joints at all internal/external doors and openings • Light reinforcement in masonry • Site drainage and plumbing/service precautions
		Soil raft	• Remove all or part of expansive horizon to 1,0 m beyond the perimeter of the structure and replace with inert backfill compacted to 93 % MOD AASHTO density at -1 % to +2 % of optimum moisture content • Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are <7,5 mm, or construction type appropriate to residual movements • Site drainage and plumbing/service precautions
H2	15 – 30	Stiffened or cellular raft	• Stiffened or cellular raft with articulation joints or solid lightly reinforced masonry • Site drainage and plumbing/service precautions
		Piled construction	• Piled foundations with suspended floor slabs with or without ground beams • Site drainage and plumbing/service precautions
		Split construction	• Combination of reinforced brickwork/blockwork and full movement joints • Suspended floors or fabric reinforced ground slabs acting independently from the structure • Site drainage and plumbing/service precautions
		Soil raft	• As for H1
H3	> 30	Stiffened or cellular raft	• As for H2
		Piled Construction	• As for H2
		Soil raft	• As for H1

NOTE:

1) Differential heave assumed to equal 50 % of total heave.

2) The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.

TABLE 4.2: FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES FOR SINGLE-STOREY RESIDENTIAL BUILDINGS FOUNDED ON HORIZONS SUBJECT TO BOTH CONSOLIDATION AND COLLAPSE SETTLEMENT

SITE CLASS	ESTIMATED TOTAL SETTLEMENT (mm)	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES (Expected damage limited to Category 1)
C	< 5	Normal	• Normal construction (strip footing or slab-on-the ground foundations) • Good site drainage
C1	5 - 10	Modified normal	• Reinforced strip footings • Articulation joints at some internal and all external doors • Light reinforcement in masonry • Site drainage and service/plumbing precautions • Foundation pressure not to exceed 50 kPa
		Compaction of in situ soils below individual footings	• Remove in situ material below foundations to a depth and width of 1,5 times the foundation width or to a competent horizon and replace with material compacted to 93 % MOD AASHTO density at -1 % to +2 % of optimum moisture content • Normal construction with lightly reinforced strip foundation and light reinforcement in masonry
		Deep strip foundations	• Normal construction with drainage requirements • Founding on a competent horizon below the problem horizon
		Soil raft	• Remove in situ material to 1,0 m beyond perimeter of building to a depth of 1,5 times the widest foundation or to a competent horizon and replace with material compacted to 93 % MOD AASHTO density at -1 % to +2 % of optimum moisture content • Normal construction with lightly reinforced strip footings and light reinforcement in masonry
C2	> 10	Stiffened strip footings, stiffened or cellular raft	• Stiffened strip footings or stiffened or cellular raft with articulation joints or solid lightly reinforced masonry • Bearing pressure not to exceed 50 kPa • Fabric reinforcement in floor slabs • Site drainage and service/plumbing precautions
		Deep strip foundations	• As for C1 but with fabric reinforcement in floor slabs
		Compaction of in situ soils below individual footings	• As for C1
		Piled or pier foundations	• Reinforced concrete ground beams or solid slabs on piled or pier foundations • Ground slabs with fabric reinforcement • Good site drainage
		Soil raft	• As for C1

NOTE:

1) Differential settlement assumed to equal 75 % of total settlement.
2) The relaxation of some of these requirements, e.g. the reduction or omission of steel or articulation joints, may result in a Category 2 level of expected damage.

Wetland Consulting Services (Pty.) Ltd.

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14 October 2010

Reference : WCS 530a/2009

HELDERWYK SHORT SOILS REPORT

1. Background

Wetland Consulting Services (Pty) Ltd was appointed to assess the levels of possible contamination derived from runoff from a nearby tailings dam in a temporary wetland area on a site known as Helderwyk .

Soils samples were collected from the surface 2-300mm from six localities within the study area, Figure 1. A number of samples were collected at each locality which were subsequently combined to provide a single sample for each locality.

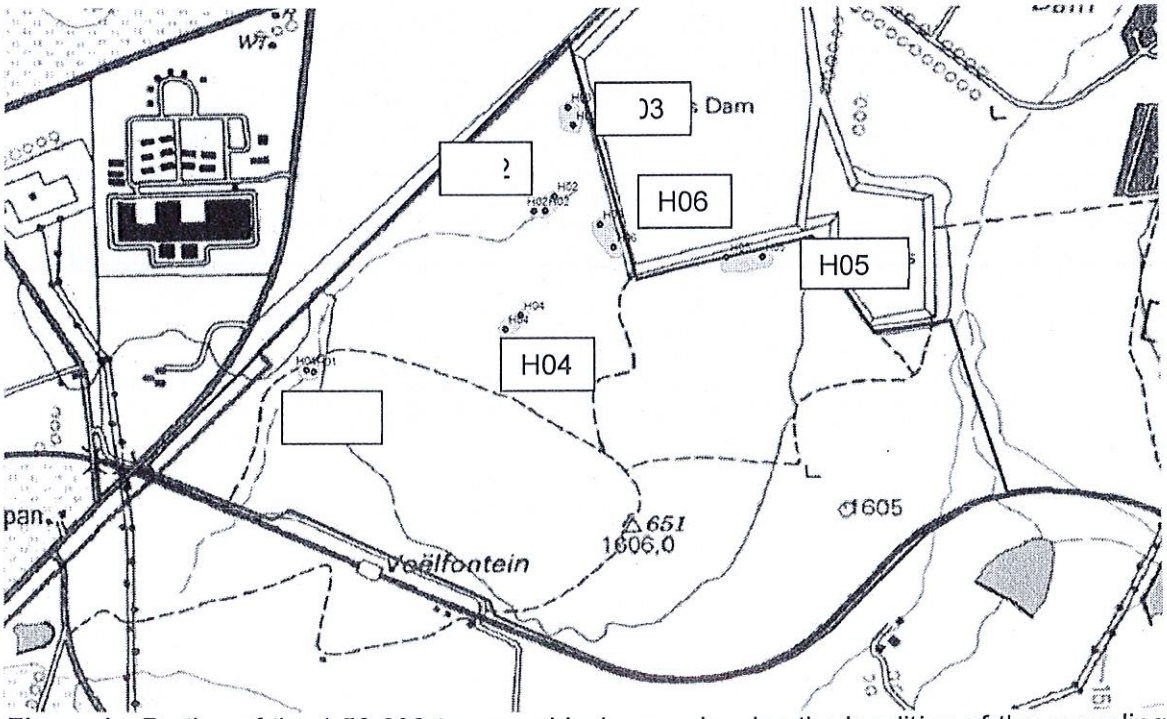

Figure 1. Portion of the 1:50 000 topographical map, showing the localities of the sampling sites

The samples were submitted to ARC for extraction and analysis. The samples were extracted with Ammonium Acetate/EDTA and the metals were determined using semi quantitative MS-ICP scan.

2. Results

The results of the analyses are presented below.

Element	Helderwyk Site						Reference Sites				
	H01	H02	H03	H04	H05	H06	Ref 1	Ref 2	Ref 3	Ref 4	Ref 5
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Mn	27.7	0.7	18.2	29	14	31	0.491	4.664	0.824	2.349	0.934
As	0.009	0.028	0.003	0.006	0.004	0.003	0.001	0.005	0.007	0.004	0.002
Co	1.000	0.060	0.300	0.700	0.200	0.800	0.012	0.039	0.010	0.019	0.014
Cr	0.007	0.007	0.002	0.004	0.005	0.002	0.000	0.002	0.004	0.002	0.001
Cu	5.800	0.500	0.300	0.600	0.300	0.500	0.003	0.002	0.004	0.004	0.003
Mo	0.003	0.001	0.004	0.003	0.003	0.004	0.009	0.100	0.020	0.160	0.020
Ni	1.440	0.120	0.100	0.700	0.160	0.120	0.019	0.061	0.019	0.070	0.021
Pb	1.300	0.010	0.500	0.500	0.400	0.400	0.008	0.001	0.000	0.000	0.000
U	0.005	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Zn	1.500	0.100	0.800	0.400	0.700	0.500	1.999	1.088	0.311	0.081	0.854

Based on the analyses presented above it would seem that the concentrations determined using this method, representing the potentially biologically available concentrations are, with the possible exception of manganese are low. The presence of high concentrations of manganese compared with the sites used as reference possibly reflect naturally high background levels associated with the local geological formations. Uranium was detected in two of the sample sites, HO1 and HO2, but at low concentrations, with one of the sites namely HO1 also supporting higher than average concentrations of cobalt, nickel, copper and lead. This site is located furthest from the tailings dam, the suspected source of some of the contaminants, possibly reflecting transfer and subsequent deposition along the drainage line.

3. Conclusion.

The results indicate that there are low levels of heavy metal contamination within the drainage line. As a consequence of these findings activities within the drainage line should be limited so as to avoid possible mobilization of these contaminants.

Geo Buro

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2013-11-01

The Director
Council for Geoscience
Private Bag X112
Pretoria
0001

Attention: Mrs Tharina Oosthuizen

HELDERWYK TOWNSHIPS – ROD FOR EIA PURPOSES

1. A geotechnical investigation has been done for the site by Patridge, Maud and Associates in 1974 and a revised report and zonation plan was compiled by Prof Tim Patridge in a letter dated 10 March 2009. The site is located in an area where Karoo sediments often overlie dolomitic materials at depth. It is also close to the contact between the Black Reef Formation and Malmani dolomite. Six percussion boreholes were drilled by this firm which generally showed good conditions, but the presence of dolomite was verified. The zonation map by Partridge and a Google Earth image with the borehole positions and borehole profiles are attached.

2. The developers do know that a dolomite stability investigation must be done for parts of the site. The CGS recommended the drilling of six percussion boreholes to try and establish which areas are dolomite and which is non-dolomitic. These holes were drilled under the supervision of GeoBuro. From the limited drilling information it is very difficult to establish the contact between dolomitic and non-dolomitic areas.

3. A ROD for EIA purposes is required. We herewith propose that a positive ROD be issued with provision that the entire site be regarded as a dolomitic terrain until proven otherwise. Areas that are

considered dolomitic must be subjected to a dolomite stability investigation as required by SANS 1936 (2012).

4. Please contact me if you require any additional information.

Yours faithfully

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Engineering geologist

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PERCUSSION BOREHOLE LOG

Version 2009.1

Geo Buro
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X= 0.000000 Y= 0.000000 Z= 0.00 masl

Project no:	7985-12	Client	**Bob de Reuck**
Project name:	Helderwyk	Drill contractor:	Hennie Erwee
Date drilled:	2013-01-29	Driller:	Jack
Date profiled:	2013-02-04	**BH NO:**	**HW1**

Penetr rate min:s/m	Penetration rate seconds/m (60 120 180 240 300)	Formation: CAV	V SFT	SFT	FAIR H	SOLID	Notes Symbol	Air loss	DEPTH m	Elevation mas	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
0 : 10			1.0						1.0	-1.0		<2		Dark red brown clayey silt; Colluvium. 100% clayey silt.
0 : 13			1.0						2.0	-2.0			2.0	
0 : 24			1.0						3.0	-3.0		<15		Light brown to pinkish brown sandy clay with yellow white and brown with grey, medium weathered, sub-angular chert; Chert gravel. 70% sandy clay, 30% chert.
0 : 34			1.0						4.0	-4.0			4.0	
0 : 38			1.0						5.0	-5.0				
0 : 29			1.0						6.0	-6.0		<5		Pinkish brown silt with yellow white and grey, slightly to medium weathered, angular chert; Residual shale with some chert. 80% silt, 20% chert.
0 : 10			0.2	0.8					7.0	-7.0				
0 : 8			1.0						8.0	-8.0			8.0	
0 : 37			1.0						9.0	-9.0				
0 : 12			1.0						10.0	-10.0				
0 : 9			1.0				▼		11.0	-11.0				
0 : 11			1.0						12.0	-12.0				
0 : 14			1.0						13.0	-13.0		<2		Dark brown to black clay; Dolomite residuum. 100%clay.
0 : 18			1.0						14.0	-14.0				
0 : 29			1.0						15.0	-15.0				
0 : 31			1.0						16.0	-16.0				
0 : 36			1.0						17.0	-17.0				
0 : 44			0.1	0.9					18.0	-18.0			18.0	
0 : 40			1.0						19.0	-19.0				
0 : 50			1.0						20.0	-20.0				
0 : 39			1.0						21.0	-21.0				
0 : 47			1.0						22.0	-22.0		<5		Light grey and grey white, medium weathered, angular syenite and light brown clayey sand; Residual syenite. 60% syenite, 40% clayey sand.
0 : 39			1.0						23.0	-23.0				
0 : 21			1.0						24.0	-24.0				
0 : 18			1.0						25.0	-25.0			25.0	
3 : 46			0.1			0.9			26.0	-26.0				
3 : 29						1.0			27.0	-27.0				
3 : 17						1.0			28.0	-28.0		<8		Blue grey and dark grey, unweathered, angular dolomite; Dolomite rock.I 100% dolomite.
3 : 24						1.0			29.0	-29.0				
3 : 19						1.0			30.0	-30.0				

Notes:

1. water encountered at 11m. Water level measured at 11,1m on 2013-01-30
2. No sample and no air loss.
3. Water used during drilling between 9-17m.
4. Hammer rate generally regular, except between 0-2m, 6-7m, 9-10m, 11-13m, 17-18m and 23-26m where it was irregular and between 7-8m and 10-11m where it was very irregular.

Notes (continue):

Logged by SPK

PERCUSSION BOREHOLE LOG

Version 2009.1

Geo Buro
Geotechnical Surveys

X= 0.000000 Y= 0.000000 Z= 0.00 masl

Project no:	7985-12	Client	**Bob de Reuck**
Project name:	Helderwyk	Drill contractor:	Hennie Erwee
Date drilled:	2013-01-29	Driller:	Jack
Date profiled:	2013-02-04	**BH NO:**	**HW1 (cont)**

Penetr rate min:s/m	Penetration rate seconds/m (0 60 120 180 240 300)	Formation: CAV	V SFT	SFT	FAIR H	SOLID	Notes Symbol	Air loss	DEPTH m	Elevation mas	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
3 : 14						1.0			31.0	-31.0		<8	31.0	Blue grey and dark grey, unweathered, angular dolomite; Dolomite rock. 100% dolomite.
0 : 0									32.0	-32.0				
0 : 0									33.0	-33.0				
0 : 0									34.0	-34.0				
0 : 0									35.0	-35.0				
0 : 0									36.0	-36.0				
0 : 0									37.0	-37.0				
0 : 0									38.0	-38.0				
0 : 0									39.0	-39.0				
0 : 0									40.0	-40.0				
0 : 0									41.0	-41.0				
0 : 0									42.0	-42.0				
0 : 0									43.0	-43.0				
0 : 0									44.0	-44.0				
0 : 0									45.0	-45.0				
0 : 0									46.0	-46.0				
0 : 0									47.0	-47.0				
0 : 0									48.0	-48.0				
0 : 0									49.0	-49.0				
0 : 0									50.0	-50.0				
0 : 0									51.0	-51.0				
0 : 0									52.0	-52.0				
0 : 0									53.0	-53.0				
0 : 0									54.0	-54.0				
0 : 0									55.0	-55.0				
0 : 0									56.0	-56.0				
0 : 0									57.0	-57.0				
0 : 0									58.0	-58.0				
0 : 0									59.0	-59.0				
0 : 0									60.0	-60.0				

Notes:

1. No water encountered.
2. No sample and no air loss.
3. No water used during drilling.
4. Hammer rate generally regular.

Notes (continue):

Logged by APM

PERCUSSION BOREHOLE LOG

Version 2009.1

Geo Buro
Geotechnical Surveys

X= 0.000000 Y= 0.000000 Z= 0.00 masl

Project no:	7985-12	Client	**Bob de Reuck**
Project name:	Helderwyk	Drill contractor:	Hennie Erwee
Date drilled:	2013-01-29	Driller:	Jack
Date profiled:	2013-02-04	**BH NO:**	**HW6**

Penetr rate min:s/m	Penetration rate seconds/m	Formation CAV	Formation V SFT	Formation SFT	Formation FAIR H	Formation SOLID	Notes Symbol	Air loss	DEPTH m	Elevation mas	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
0 : 10			1.0						1.0	-1.0		<2	1.0	Yellow brown clay; Colluvium/Residual shale. 100% clay.
0 : 34			1.0						2.0	-2.0				
0 : 44			1.0						3.0	-3.0		<5		Dark brown gravelly silt; Residual shale/slightly ferruginesed. 100% gravelly silt.
0 : 40			1.0						4.0	-4.0			4.0	
0 : 31			1.0						5.0	-5.0				
0 : 33			1.0						6.0	-6.0				Grey white silt and light grey to grey white, medium weathered, angular quartzite; Weathered quartzite. 50% silt, 50% quartzite.
0 : 34			1.0						7.0	-7.0		<5		
0 : 25			1.0						8.0	-8.0				
0 : 30			1.0						9.0	-9.0			9.0	
0 : 42			1.0						10.0	-10.0				
0 : 31			1.0						11.0	-11.0		<2		Light yellow brown silty clay; Residual syenite/shale? 100% silty clay.
0 : 28			1.0						12.0	-12.0				
0 : 24			1.0						13.0	-13.0			13.0	
0 : 34			0.9	0.1					14.0	-14.0				Light grey to light brown, medium weathered, angular quartzite and yellow brown to light brown sandy silt; Weathered quartzite. 60% quartzite, 40% sandy silt.
0 : 45			1.0						15.0	-15.0		<8		
0 : 40			1.0						16.0	-16.0			16.0	
1 : 16			0.5		0.5				17.0	-17.0				
1 : 22					1.0				18.0	-18.0				
1 : 5					1.0				19.0	-19.0				
1 : 0					1.0				20.0	-20.0		<10		Grey to blue grey, medium weathered, angular quartzite; Weathered quartzite. 100% quartzite.
1 : 3					1.0				21.0	-21.0				
1 : 1					1.0				22.0	-22.0				
1 : 38					1.0				23.0	-23.0			23.3	
3 : 25					0.3	0.7			24.0	-24.0				
3 : 19						1.0			25.0	-25.0				
3 : 39						1.0			26.0	-26.0				Light grey and dark grey with white speckles, unweathered, angular quartzite; Quartzite rock. 100% quartzite.
3 : 41						1.0			27.0	-27.0		<8		
3 : 21						1.0			28.0	-28.0				
3 : 28						1.0			29.0	-29.0			29.0	
0 : 0									30.0	-30.0				

Notes:

1. No water encountered. Water level measured at 6,6m on 2013-01-30
2. No sample and no air loss.
3. No water used during drilling.
4. Hammer rate generally regular, except between 0-1m, 13-14m, 16-17m and 23-24m where it was irregular.

Notes (continue):

Logged by SPK

PERCUSSION BOREHOLE LOG

Version 2009.1

Geo Buro
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X= 0.000000 Y= 0.000000 Z= 0.00 masl

Project no:	7985-12	Client	**Bob de Reuck**
Project name:	Helderwyk	Drill contractor:	Hennie Erwee
Date drilled:	2013-01-29	Driller:	Jack
Date profiled:	2013-02-04	**BH NO:**	**HW2**

Penetr rate min:s/m	Penetration rate seconds/m (60 120 180 240 300)	Formation CAV	V SFT	SFT	FAIR H	SOLID	Notes Symbol	Air loss	DEPTH m	Elevation mas	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
0 : 12			1.0						1.0	-1.0		<2		Dark brown to red brown silty clay; Collovium. 100% silty clay.
0 : 24			1.0						2.0	-2.0			2.0	
0 : 36			1.0						3.0	-3.0		<5		Light brown clayey sand and yellow white and brown, medium weathered, sub-angular quartz and shale; Transported. 60% clayey sand, 40% quartzite and shale.
0 : 41			1.0						4.0	-4.0			4.0	
0 : 38			1.0						5.0	-5.0				
0 : 47			1.0						6.0	-6.0				
0 : 45			1.0						7.0	-7.0				
0 : 39			1.0						8.0	-8.0		<2		Light yellow brown clayey silt; Residual syenite. 100% clayey silt.
0 : 42			1.0						9.0	-9.0				
0 : 36			0.1	0.9					10.0	-10.0				
0 : 41			1.0						11.0	-11.0				
0 : 38			1.0						12.0	-12.0			12.0	
0 : 33			1.0						13.0	-13.0		<5		Yellow brown to khaki green clay with light grey, brown and white, slightly to medium weathered, angular chert and shale; Residual syenite- slightly contaminated. 70% clay, 30% chert and shale.
0 : 46			0.1	0.9					14.0	-14.0			14.0	
0 : 27			1.0						15.0	-15.0				
0 : 49			0.4	0.6					16.0	-16.0				Dark brown clay; Residual syenite (with wad?). 100% clay.
0 : 40			1.0						17.0	-17.0		<2	17.0	
0 : 50			0.1	0.9					18.0	-18.0				
0 : 41			1.0						19.0	-19.0				
0 : 36			1.0						20.0	-20.0				
0 : 30			1.0						21.0	-21.0				
0 : 40			1.0						22.0	-22.0				
0 : 46			1.0						23.0	-23.0				
0 : 48			1.0						24.0	-24.0		<3		Yellow brown gravelly silt; Residual syenite. 100% gravelly silt.
0 : 51			1.0						25.0	-25.0				
0 : 55			1.0						26.0	-26.0				
0 : 58			1.0						27.0	-27.0				
1 : 1			0.4	0.6					28.0	-28.0				
0 : 49			1.0						29.0	-29.0				
0 : 52			1.0						30.0	-30.0			30.0	

Notes:

1. No water encountered. Water level measured at 7,1m on 2013-01-30
2. No sample and no air loss.
3. Water used during drilling between 15-17m.
4. Hammer rate generally regular, except between 0-1m, 9-10m, 13-14m, 15-16m and 17-18m where it was irregular.

Notes (continue):

Logged by SPK

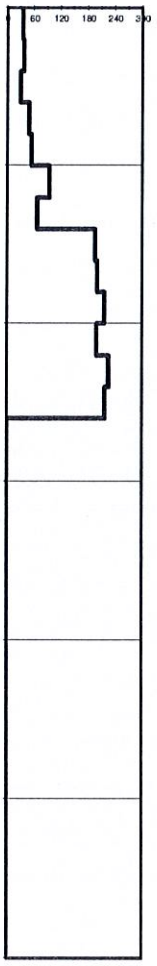
PERCUSSION BOREHOLE LOG

Version 2009.1

Geo Buro
Geotechnical Surveys

X= 0.000000 Y= 0.000000 Z= 0.00 masl

Project no:	7985-12	Client	**Bob de Reuck**
Project name:	Helderwyk	Drill contractor:	Hennie Erwee
Date drilled:	2013-01-29	Driller:	Jack
Date profiled:	2013-02-04	**BH NO:**	**HW2 (cont)**



Penetr rate min:s/m	Penetration rate seconds/m	Formation CAV	Formation V SFT	Formation SFT	Formation FAIR H	Formation SOLID	Notes Symbol	Air loss	DEPTH m	Elevation mas	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
0 : 35			1.0						31.0	-31.0				
0 : 37			1.0						32.0	-32.0				
0 : 30			1.0						33.0	-33.0				
0 : 49			1.0						34.0	-34.0		<5		Khaki green silt and light grey and khaki green, medium weathered, angular syenite; Syenite/Dolomite). 60% silt, 40% syenite.
0 : 54			1.0						35.0	-35.0				
1 : 34			0.4		0.6				36.0	-36.0				
1 : 8					1.0				37.0	-37.0			37.0	
3 : 16					0.1	0.9			38.0	-38.0				
3 : 21						1.0			39.0	-39.0				
3 : 36						1.0			40.0	-40.0				Dark grey with fine speckles, unweathered, angular syenite; Syenite/dolomite rock. 100% syenite.
3 : 19						1.0			41.0	-41.0				
3 : 46						1.0			42.0	-42.0				
3 : 38						1.0			43.0	-43.0		<8	43.0	
0 : 0									44.0	-44.0				
0 : 0									45.0	-45.0				
0 : 0									46.0	-46.0				
0 : 0									47.0	-47.0				
0 : 0									48.0	-48.0				
0 : 0									49.0	-49.0				
0 : 0									50.0	-50.0				
0 : 0									51.0	-51.0				
0 : 0									52.0	-52.0				
0 : 0									53.0	-53.0				
0 : 0									54.0	-54.0				
0 : 0									55.0	-55.0				
0 : 0									56.0	-56.0				
0 : 0									57.0	-57.0				
0 : 0									58.0	-58.0				
0 : 0									59.0	-59.0				
0 : 0									60.0	-60.0				

Notes:

1. No water encountered.
2. No sample and no air loss.
3. No water used during drilling.
4. Hammer rate generally regular except between 34-35m and 37-38m where it was irregular .

Notes (continue):

Logged by APM

PERCUSSION BOREHOLE LOG

Version 2009.1

Geo Buro
Geotechnical Surveys

X= 0.000000 Y= 0.000000 Z= 0.00 masl

Project no:	7985-12	Client	**Bob de Reuck**
Project name:	Helderwyk	Drill contractor:	Hennie Erwee
Date drilled:	2013-01-29	Driller:	Jack
Date profiled:	2013-02-04	**BH NO:**	**HW3**

Penetr rate min:s/m	Penetration rate seconds/m (60 120 180 240 300)	Formation: CAV	V SFT	SFT	FAIR H	SOLID	Notes Symbol	Air loss	DEPTH m	Elevation mas	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
0 : 21			1.0						1.0	-1.0		<10		Dark brown clay and yellow white, grey white and brown, medium weathered, angular quartzite;
0 : 29			1.0						2.0	-2.0			2.0	Colluvium. 60% clay, 40% quartzite.
0 : 18			1.0						3.0	-3.0				
0 : 16			1.0						4.0	-4.0				
0 : 20			1.0						5.0	-5.0				
0 : 34			1.0						6.0	-6.0				
0 : 29			1.0						7.0	-7.0				
0 : 31			1.0						8.0	-8.0				
0 : 28			1.0						9.0	-9.0		<2		Light yellow brown clayey silt; Residual shale. 100% clayey silt.
0 : 41			1.0						10.0	-10.0				
0 : 37			1.0						11.0	-11.0				
0 : 26			1.0						12.0	-12.0				
0 : 30			1.0						13.0	-13.0				
0 : 32			1.0						14.0	-14.0				
0 : 29			1.0						15.0	-15.0			15.0	
0 : 36			1.0						16.0	-16.0				
0 : 34			1.0						17.0	-17.0				
0 : 37			1.0						18.0	-18.0		<2		Pinkish brown silty clay; Residual shale. 100% silty clay.
0 : 41			1.0						19.0	-19.0				
0 : 30			1.0						20.0	-20.0				
0 : 28			1.0						21.0	-21.0			21.0	
0 : 40			1.0						22.0	-22.0				
0 : 32			1.0						23.0	-23.0				
0 : 29			1.0						24.0	-24.0				
0 : 44			1.0						25.0	-25.0		<5		Yellow brown silty clay with light grey, medium weathered, angular shale; Residual shale. 80% silty clay, 20% shale.
1 : 18			0.1	0.9					26.0	-26.0				
1 : 4				1.0			▼		27.0	-27.0				
1 : 9				1.0					28.0	-28.0				
1 : 19				1.0					29.0	-29.0			29.0	
3 : 16				0.1		0.9			30.0	-30.0		<8		

Notes:

1. Water encountered at 27,4m. Water level measured at 6,1m on 2013-01-30
2. No sample and no air loss.
3. No water used during drilling.
4. Hammer rate generally regular, except between 25-26m and 29-30m where it was irregular.

Notes (continue):

Logged by SPK

PERCUSSION BOREHOLE LOG

Version 2009.1

Geo Buro
Geotechnical Surveys

X= 0.000000 Y= 0.000000 Z= 0.00 masl

Project no:	7985-12	Client	**Bob de Reuck**
Project name:	Helderwyk	Drill contractor:	Hennie Erwee
Date drilled:	2013-01-29	Driller:	Jack
Date profiled:	2013-02-04	**BH NO:**	**HW3 (cont)**

Penetr rate min:s/m	Penetration rate seconds/m (60 120 180 240 300)	Formation: CAV	V SFT	SFT	FAIR H	SOLID	Notes Symbol	Air loss	DEPTH m	Elevation mas	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
3 : 29						1.0			31.0	-31.0	v vv vv vv			
3 : 14						1.0			32.0	-32.0	v vv vv vv			
3 : 20						1.0			33.0	-33.0	v vv vv vv	<8		Light grey with fine white speckles, unweathered, angular dolerite; Dolerite rock. 100% dolerite.
3 : 18						1.0			34.0	-34.0	v vv vv vv			
3 : 24						1.0			35.0	-35.0	v vv vv vv		35.0	
0 : 0									36.0	-36.0				
0 : 0									37.0	-37.0				
0 : 0									38.0	-38.0				
0 : 0									39.0	-39.0				
0 : 0									40.0	-40.0				
0 : 0									41.0	-41.0				
0 : 0									42.0	-42.0				
0 : 0									43.0	-43.0				
0 : 0									44.0	-44.0				
0 : 0									45.0	-45.0				
0 : 0									46.0	-46.0				
0 : 0									47.0	-47.0				
0 : 0									48.0	-48.0				
0 : 0									49.0	-49.0				
0 : 0									50.0	-50.0				
0 : 0									51.0	-51.0				
0 : 0									52.0	-52.0				
0 : 0									53.0	-53.0				
0 : 0									54.0	-54.0				
0 : 0									55.0	-55.0				
0 : 0									56.0	-56.0				
0 : 0									57.0	-57.0				
0 : 0									58.0	-58.0				
0 : 0									59.0	-59.0				
0 : 0									60.0	-60.0				

Notes:

1. No water encountered.
2. No sample and no air loss.
3. No water used during drilling.
4. Hammer rate generally regular.

Notes (continue):

Logged by APM

PERCUSSION BOREHOLE LOG

Version 2009.1

Geo Buro
Geotechnical Surveys

X= 0.000000 Y= 0.000000 Z= 0.00 masl

Project no:	7985-12	Client	**Bob de Reuck**
Project name:	Helderwyk	Drill contractor:	Hennie Erwee
Date drilled:	2013-02-06	Driller:	Jack
Date profiled:	2013-02-11	**BH NO:**	**HW4**

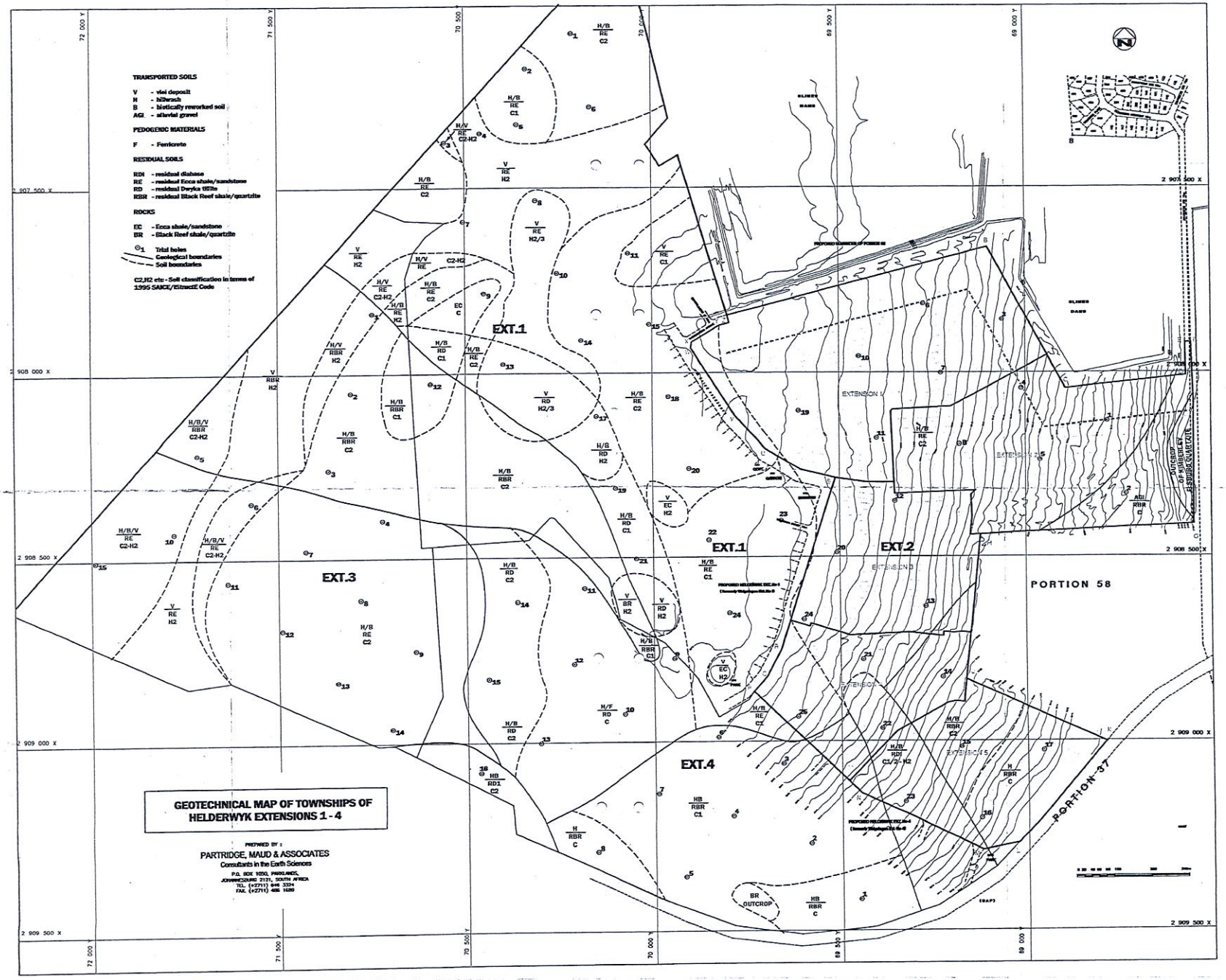
Penetr rate min:s/m	Penetration rate seconds/m (60 120 180 240 300)	Formation: CAV	V SFT	SFT	FAIR H	SOLID	Notes Symbol	Air loss	DEPTH m	Elevation mas	Symbol	Chip size mm	Drill depth (m)	DESCRIPTION
0 : 40			1.0						1.0	-1.0		<2	1.0	Light brown sandy clay; Colluvium. 100% sandy clay.
0 : 54			1.0						2.0	-2.0				
0 : 57			1.0						3.0	-3.0				
0 : 59			1.0						4.0	-4.0				
0 : 52			1.0						5.0	-5.0		<2		Yellow brown becoming light yellow brown silty clay; Residual shale. 100% silty clay.
0 : 54			1.0						6.0	-6.0				
0 : 30			0.2	0.8					7.0	-7.0				
0 : 24			1.0						8.0	-8.0				
0 : 21			1.0						9.0	-9.0			9.0	
0 : 32			1.0						10.0	-10.0				
0 : 23			1.0						11.0	-11.0				Yellow brown silt and yellow white, dark brown and black, medium to highly weathered, angular chert; Rerruginised chert and shale. 50% silt, 50% chert.
0 : 25			1.0						12.0	-12.0		<5		
0 : 30			1.0						13.0	-13.0				
0 : 35			1.0						14.0	-14.0			14.0	
0 : 31			1.0						15.0	-15.0				
0 : 33			0.4	0.6					16.0	-16.0				Yellow brown clayey silt; Residual syenite/dolerite. 100% clayey silt.
0 : 28			1.0						17.0	-17.0		<2		
0 : 37			1.0				▼		18.0	-18.0				
0 : 46			1.0						19.0	-19.0			19.0	
0 : 55			1.0						20.0	-20.0				
0 : 40			1.0						21.0	-21.0				
0 : 58			1.0						22.0	-22.0				Light grey, medium weathered, angular dolerite with light brown silt; Weathered syenite/dolerite. 70% dolerite, 30% silt.
1 : 6			0.2		0.8				23.0	-23.0		<8		
1 : 42					1.0				24.0	-24.0				
1 : 36					1.0				25.0	-25.0			25.0	
4 : 18					0.1	0.9			26.0	-26.0				
4 : 34						1.0			27.0	-27.0				Light green grey, unweathered, angular dolorite; Dolerite rock. 100% dolorite.
4 : 49						1.0			28.0	-28.0		<8		
4 : 34						1.0			29.0	-29.0				
4 : 28						1.0			30.0	-30.0				

Notes:

1. Water encountered at 18,9m. Water level measured at 14,2m on 2013-02-06
2. No sample and no air loss.
3. No water used during drilling.
4. Hammer rate generally regular, except between 6-7m, 15-16m and 25-26m where it was irregular.

Notes (continue):

Logged by SPK


TRANSPORTED SOILS
V - vlei deposit
H - hillwash
B - biotically reworked soil
AG - alluvial gravel
PEDOGENIC MATERIALS
F - Ferricrete
RESIDUAL SOILS
RDI - residual diabase
RE - residual Ecca shale/sandstone
RD - residual Dwyka tillite
RBR - residual Black Reef shale/quartzite
ROCKS
EC - Ecca shale/sandstone
BR - Black Reef shale/quartzite
Trial holes
Geological boundaries
Soil boundaries
C2,H2 etc - Soil classification in terms of 1995 SAICE/ISTRUCTE Code
EXT.1
EXT.2
EXT.3
EXT.4
EXTENSION 1
EXTENSION 2
EXTENSION 3
EXTENSION 4
EXTENSION 5
PORTION 58
PORTION 37
OUTCROP OF BLACK REEF QUARTZITE
BR OUTCROP
GEOTECHNICAL MAP OF TOWNSHIPS OF HELDERWYK EXTENSIONS 1 - 4
PREPARED BY :
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Council for Geoscience

Our Reference: F4314.1
Helderwyk Townships
Your Reference: 7985-CGS1
Enquiries: T Oosthuizen
Tel: 012 841 1160
Fax: 086 615 6682
No. of Pages: 3

5 November 2013

GDARD
P O Box 8769
Johannesburg
2000

Attention: **Tendani Rambuda**
(Reference:002/08 – 09/N0911)

By fax: *011 337 2292*

Dear Sir

HELDERWYK TOWNSHIPS

The firm, Geo Buro Geotechnical Surveys (GB) submitted a letter report: "Helderwyk Townships – ROD for EIA Purposes", dated 1 November 2013 to this office for comment. This office acts as an agent to state authorities in reviewing dolomite stability investigations on their behalf.

The following is indicated in the letter report by GB:

1) A geotechnical investigation has been conducted on the site in 1974 by Partridge, Maud and Associates. Based on the results of this investigation, it is evident that the site is located in an area where Karoo sediments often overlie dolomitic materials at depth. It is also close to the contact between the Black Reef Formation and the Malmani Sub-group dolomite.

2) 6 percussion boreholes were drilled across the site by GB. All the boreholes showed generally good conditions but the presence of dolomite was verified. GB indicates that from the limited number of boreholes on the site it is difficult to distinguish between dolomitic and non-dolomitic portions of the site.

3) GB requested that this office (CGS) support a positive ROD for EIA purposes, provided that the entire site is regarded as dolomitic until proven otherwise. The entire dolomitic portion will then be subjected to a dolomite stability investigation as required by SANS 1936 (2012).

The Council for Geoscience would like to indicate the following:

4) Six boreholes were drilled across this 311 hectare site which is earmarked for residential, commercial and other uses (schools etc.).

5) From the preliminary investigation it seems as if the eastern portion of the site is underlain by dolomite at a depth of less than 30 m. No dolomite was encountered in the western portion of the site, and quartzite was encountered at depth, which indicates that this portion of the site might be considered as non-dolomitic.

   The non-dolomitic portion of the site will however still need to be proven and the boundary between the dolomitic and non-dolomitic portion will have to be defined by means of additional drilling.

6) The six boreholes drilled across the site all represented suitable conditions from an ingress scenario for the proposed land uses. Borehole HW1 might represent a high risk (IHC 6) from a dewatering perspective, since dolomite residuum with rapid penetration rates were encountered below the groundwater level. This borehole might not be suitable for residential type developments, but commercial development types might be considered in this area.

7) In our opinion, this site would be considered suitable for the proposed land uses, and this office would provide in principle support for the ROD for EIA purposes for the development of this site. The following should be noted:
   * Some areas might be identified where poor conditions are present, and these should be excluded from the proposed development, if not in line with the prescriptions in SANS 1936-1:2012.
   * The boundary line between the non-dolomitic portion and dolomitic portion will have to be defined and this will need to be co-signed by the CGS.
   * The minimum required borehole densities, as stipulated in the SANS 1936-2:2012 will have to be met on the dolomitic portion of the site.
   * The proposed development types need to be in accordance with the requirements in the SANS 1936-1:2012, i.e. footprint drilling, density of development.

8) The proposal by GB that the entire site be considered as dolomitic until proven otherwise is therefore supported.

In principle this office confirms support of the proposed development of the Helderwyk townships, provided that the conditions as listed above are adhered to. All additional geotechnical information i.e. dolomite stability investigations, should be submitted to this office for our comment. The