HARTENBOS
Garden Estate
Natuur-Landgoed

SERVICES REPORT

FOR

HARTENBOS GARDEN ESTATE RESIDENTIAL DEVELOPMENT ERF 3122 HARTENBOS

PROJECT No: 1704062

Compiled By:

LJR Civil Consultants cc
DESIGN & DRAUGHTING ENGINEERING CONSULTANTS
2000/007738/23

55 Louis Trichardt Street
Parktown Estate
Pretoria
0084
Tel: (012) 804 1514
E-mail: ljr@ljr.co.za

JUNE 2022

SERVICES REPORT

FOR

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ERF 3122 HARTENBOS

I N D E X

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FOR

HARTENBOS GARDEN ESTATE RESIDENTIAL DEVELOPMENT
ERF 3122 HARTENBOS

1. INTRODUCTION

1.1 GENERAL

LJR Civil Consultants CC has been appointed by the Hartenbos Hills Propco (Pty) Ltd, to compile a Services Report, for the proposed Hartenbos Garden Estate residential development.

Please note: This project will be done in phases.

1.2 LOCALITY

The site is situated in Hartenbos, Mosselbay, Western Cape, Erf 3122. Locality plan is on the layout plan, attached as Annexure A.

1.3 LAND OWNER

Hartenbos Garden estate

Postal address		:	252 Val de Vie Paarl 7646
Contact Person		:	Dr. Kotie Kruger
Contact number	Cell.	:	082 375 9679
	E-mail	:	ajkcons@gmail.com

1.4 CONSULTING ENGINEERS

LJR Civil Consultants CC

Company Registration No.		:	2000/007738/23
Physical address		:	55 Louis Trichardt Street Parktown Estate Pretoria 0084
Postal address		:	(Same as physical address)
Contact person		:	Louis Roets
Professional registration no.		:	9370055
Contact number -	Cell.	:	083 283 7540
	Tel.	:	(012) 804 1514
	E-mail	:	ljr@ljr.co.za

2. DESCRIPTION OF SITE

2.1 LAYOUT AND PROPOSED DEVELOPMENT PARAMETERS

A site layout plan from PJ le Roux Town and Regional Planner is attached in Annexure B that also indicates the proposed phasing of the project. The proposed development parameters are as follows:

Total site Area 60.519ha
The developable area will consist of:

Ptn Nos	No of Units	Extent (ha)	Zoning	Land Use
1-279	279	10,9151	Single Residential I	Dwelling House
280-282	3	0,8394	General Residential Zone III	Terrace Apartments (Flats)
283-290	8	12,0308	Open Space Zone II	Private Open Space with tearooms, telecom station
291	1	23,9230	Open Space Zone III	Nature conservation area with tearoom and utility
292	1	0,1884	Open Space Zone II	Sport facilities, clubhouse, restaurant, bar, office utility
293	1	0,3720	Open Space Zone II	Maintenance Shed/Store, utility
294	1	2,4333	General Residential Zone III	Village precinct, flats, clubhouse, frail care and recreation*
295	1	8,8884	Transport Zone III	Private Road
296	1	0,9286	Utility Zone	Municipal Reservoir
TOTAL	**296**	**60,5190ha**		

2.2 TOPOGRAPHY

The property is roughly between 102 and 135 metres above sea level. The slope of the site is mostly to the eastern side. The developed area has a moderate slope and the undeveloped area has a steep slope.

2.3 GEOTECHNICAL CONDITION

A detailed Geotechnical Investigation of the site was done in November 1984 by Schwartz Tromp and Associates. An extract from the report is attached in Annexure C, indicate a summary of engineering properties of on-site materials. (Table 7.2)

3. CIVIL SERVICES

3.1 DESIGN STANDARD

All Civil Services will be designed according to the design standards as per "Guidelines for human settlements planning and design "Red Book" and Mosselbaai Municipality requirements.

3.2 ACCESS

Access to the development will be via Kammiebos Lane with a 20m road reserve.

3.3 ROADS

3.3.1 Road Type

All internal roads to be permanently surfaced with asphalt or brick paving, with kerbing.

Minimum road width is 5.0m in 13m road reserve, 5.0m in 16m road reserve and 6.0m in 20m road reserve. Roads Layout Plan is attached in Annexure D.

Typical road cross section indicating the road positions on services is attached in Annexure E.

3.3.2 Traffic Impact Assessment

A traffic impact assessment for the development forms part of a separate report that was done by a traffic engineer specialist, Tech IQ Consulting engineers.

They concluded that the existing external road network can accommodate the projected 2026 traffic demand, provided that the following road improvements should be implemented:

i. A 60m exclusive left turn lane with 60m taper on the southern approach of Louis Fourie Road at the intersection of Louis Fourie Road and Boekenhout Avenue. This left turn lane serves both Erf 3122 and the adjacent Renosterbos development.

ii. Installation of traffic signals and the provision of an exclusive right turn lane on Waboom Street at the intersection of Waboom Street, Louis Fourie Road, the R328 to Oudtshoorn and the R102 to Groot Brak. This improvement was recommended by ITS in 2018 in the TIA for the Outeniquasbosch development.

The contribution of the applicant to the provision at an exclusive left turn lane on the southern approach of Louis Fourie Road at its intersection with Boekenhout Avenue should be addressed in the Engineering Service Agreement.

The Traffic Impact Assessment is attached in Annexure F.

3.4 STORMWATER

3.4.1 Design Methodology

Stormwater system will be designed according to design standard as per “Guidelines for human settlements planning and design “Red Book”, and proposals as per this

report. It is proposed that stormwater on the developable area will be handled as follows:

- Major storm 1 in 25 years to be handled by the road system, with a maximum flow depth of 150mm.
- All roads will be designed with a cross fall or camber of 3%.
- All pipe systems to be designed for the 1 in 5 year storm, minimum size 450 with kerb inlets.
- To ensure that the out flows of the increased post development does not put the downstream development at risk and that erosion does not take place, detention structures will be constructed at all outlets. Furthermore it is proposed to implement the SUDS (Sustainable Urban Drainage System).
  In short it means to get surface run-off as quickly as possible back into the natural ground by using of well vegetated buffer strips, unlined grass channels with rock/subsoil drains (retention channels), and energy dissipaters.
- Rain harvesting systems to be implemented.

Also taking into account the key stormwater management objectives from the Baseline Assessment of wetlands prepared by Freshwater Consulting for this project. Below a summary of their objectives;

Stormwater management objectives

1 **Minimise the Threat of Flooding –** by designing a system that mimics pre-development responses to storms, reduces the volume of runoff by promoting infiltration, reducing the peak flows and time-to-peak by detention and slow release of flood runoff.

2 **Protect receiving water bodies – this should be achieved by:**

a) Preventing the deterioration of water quality,

b) Maintaining the natural flow regime and seasonality of these systems, this means low flows too;

c) Preventing erosion or sedimentation of wetlands and streams, and

d) Preservation of Natural River channels, wetlands and vegetation.

3 **Promote Multifunctional use of stormwater Management systems –** to maximise the use of resource and thereby minimise costs and the pressure on land for public land use, conservation etc.

4 **Develop sustainable Environments** – through minimising the need for intensive maintenance intervention.

3.4.2 Stormwater Catchments

Attached in Annexure G is the Stormwater Management Plan, which indicates the catchment areas and water sheds.

The biggest portion of the development is on the western side of the development, with a water shed that runs on the western side. Therefore most of the catchments will drain east towards Road A. Road A between points A and B runs with the contours. To ensure that stormwater can drain towards the Kerb inlet, it is proposed to construct Road A in a saw tooth manner with high points indicated with dots on the plan and lower points at the kerb inlet. This defines the catchment areas as indicated on the stormwater management plan.

The 5 in 1 and 1 in 25 year pre- and post-development are indicated in the table below:

Catchment	Pre-development		Post-development	
	1 in 5 years (m^3 /s)	1 in 25 years (m^3 /s)	1 in 5 years (m^3 /s)	1 in 25 years (m^3 /s)
A	0.010	0.018	0.035	0.063
B	0.019	0.035	0.066	0.120
C	0.012	0.022	0.014	0.026
D	0.006	0.012	0.018	0.032
E	0.023	0.042	0.041	0.074
F	0.021	0.038	0.026	0.047
G	0.016	0.028	0.077	0.139
H	0.006	0.011	0.030	0.059
I	0.053	0.096	0.290	0.530
J	0.021	0.038	0.074	0.135
K1	0.020	0.037	0.085	0.155
K2	0.040	0.074	0.147	0.267
L1	0.009	0.016	0.034	0.062
L2	0.011	0.020	0.054	0.099
L3	0.002	0.004	0.007	0.012
M	0.026	0.048	0.082	0.150

N	0.040	0.072	0.132	0.241
O1	0.032	0.058	0.093	0.170
O2	0.005	0.010	0.037	0.067
P1	0.013	0.024	0.084	0.153
P2	0.023	0.043	0.065	0.118
P3	0.017	0.032	0.062	0.112
P4	0.009	0.016	0.024	0.044
P5	0.007	0.012	0.019	0.035
Q	0.012	0.022	0.022	0.040
R1	0.002	0.005	0.009	0.016
R2	0.012	0.023	0.051	0.093
S	0.014	0.025	0.060	0.110
T1	0.006	0.011	0.022	0.041
T2	0.011	0.020	0.040	0.073
V	0.009	0.016	0.033	0.059
X	0.006	0.011	0.022	0.039
Y	0.010	0.019	0.038	0.069

3.4.3 Rain harvesting

Rain harvesting can be achieved by installing rainwater tank at each house/building and rainwater collection tanks at some outlets. This water can then be used for irrigation of the green areas and/or to supplement the water for the sewer system, filling of swimming pool, etc.

Typical tank that is used at houses/building to collect rainwater is uPVC tanks (Jo-Jo tanks). Example of these tanks is attached in Annexure H. Different tanks are available on the market, above ground tanks are normally chosen to tie into the architects theme of the development. The tanks can be installed above ground or underground. The collected water can be utilized for irrigation or for supplementing the water for the sewer via a pump system.

The tank that will be installed at the outlets (wing walls) of the stormwater pipe system will be the typical horizontal and will be installed underground. It is proposed that a silt trap be installed before the inlet of the tank to minimize silt flow into the tank. This harvested water can be utilized for irrigation via a pipe and pump system.

3.4.4 Stormwater Erosion Control

Stormwater erosion is one of the most challenging factors of stormwater management as it happens quickly and destructively. With the slopes in the study area being fairly steep, surface runoff on bare soil could have negative impacts on the receiving environment due to transportation of silt to the storage (attenuation close) ponds. Should erosion occur, the eroded soil may need to be replaced to reinstate the integrity of the slopes and banks. In doing so, awareness will be necessary to prevent the use of unsuitable soil in replacing the eroded soil.

It is possible to make use of sand bags/straw bales to prevent erosion during the construction phase of the development, before stabilizing vegetation is established. Following the construction phase, it is recommended that rapidly growing grasses be planted on site as this will serve to stabilize disturbed soil as well as retard sheet flow.

3.4.5 Stormwater pollution control

Sewer reticulation within the development must be designed in such a way as to obviate blockages and possible overtopping of manholes. The blockage or leakage of any sewer may pose considerable pollution threats to both surface and groundwater resources.

3.4.6 Stormwater Management Recommendation

It is recommended that the stormwater system as indicated on the stormwater management plan be constructed. Detail design must be done to determine pipe size, kerb inlet lengths and detention structure sizes. It is recommended that detention structures are constructed with Gabions and with geo-fabric. That rainwater harvesting tanks at outlets, as shown on the plan, be installed and the rainwater harvested used for irrigation of green areas. Furthermore it is recommended to install flow retention channels at green area as indicated on the plan. Buildings to be fitted with rain harvesting tanks, where practical. A Stormwater Maintenance Plan must be implemented to ensure that the stormwater system function over long term.

3.5 WATER

3.5.1 Existing Bulk Water Supply

An existing reservoir (Hartenboskop – 3.5Ml) is situated on the north side of the site. A 200 dia. pipe runs from the reservoir to the existing township. The exact position of the 200 dia. pipe is not known and must be determined on site.

A bulk service report was compiled by GLS Consulting Engineers, see attached in Annexure I. The report indicates that Hartenboskop reservoir has sufficient capacity. For the development a booster pump station must be constructed that will supply the water reticulation of the proposed development.

Furthermore, an existing new 160 dia. 200 meter long pipe is to be installed at the Hartenbos pump station – this cost will be for the developers. A 200 dia. gravity line must be installed from the Hartenboskop reservoir within the road reserve of the new development for future developments. This cost will be played off against bulk contributions.

Comments on the township layout has indicated that allowance must be made for a future reservoir in the Utility stand. Discussions with Mr. E Louw of the Municipality has indicated that allowance for a future 1200kl must be made.

3.5.2 Expected Water Usage

5The total annual daily demand is calculated as follows:

• Residential erven (350-600m²): 117 erven x 0.7kl/day =		81.9kl/day
• Residential erven (≤ 350m²): 122 x 0.6kl/day =		73.2kl/day
• Residential erven (200m²): 40 x 0.6kl/day =		24kl/day
• Residential (Terrace apartments): 54 x 0.6kl/day =		32.4kl/day
• Residential (Village apartments): 144 x 0.6kl/day =		86.4kl/day
• Care centre (apartments/rooms 45m²): 20 x 0.5kl/day =		10.0kl/day
• Care centre (rooms 28m²): 34 x 0.5kl/day =		17kl/day
	Total	324.9kl/day
	=	3.76l/s

A 15 l/s for fire is applicable.

3.5.3 Proposed Water Reticulation

The internal water network will be designed as follows:

a. All pipes will be laid in the road reserve and all erven will be provided with a metered connection.
b. Minimum residual head to be 24m.
c. Minimum residual head under peak flow plus minimum hydrant flow (15l/s) to be 7m.

d. Hydrants to be spaced at 240m maximum.

3.5.4 Proposed Water Consumption Measures

a. Low volume shower heads to be installed.
b. Storage tanks to be provided at all buildings to collect rainwater that can be used for gardening.
c. Toilets to be equipped with a double flush system.

A proposed water layout plan is attached in Annexure J.

3.6 SEWER

3.6.1 Existing Bulk Sewer Connection

A GLS report attached in Annexure I, indicates that the existing bulk sewage system has sufficient capacity to accommodate the additional sewage from the proposed development.

3.6.2 Expected Sewage Outflow

• Residential erven (350-600m²): 117 erven x 0.6kl/day =		70.2kl/day
• Residential erven (≤ 350m²): 122 x 0.5kl/day =		61kl/day
• Residential erven (200m²): 40 x 0.5kl/day =		20kl/day
• Residential (Terrace apartments): 54 x 0.5kl/day =		27kl/day
• Residential (Village apartments): 144 x 0.5kl/day =		72kl/day
• Care centre (apartments/rooms 45m²): 20 x 0.4kl/day =		8kl/day
• Care centre (rooms 28m²): 34 x 0.4kl/day =		13.6kl/day
	Total	271.8kl/day
	=	3.14l/s

3.6.3 Proposed Sewer System

The internal sewer reticulation will consist of 160mm dia. uPVC class 400 gravity pipes with 110mm house connection. Due to the topography of the site some areas will drain to pump stations that will pump back to the gravity system that will drain to the existing system in Geelhoud Lane. All pump stations and rising mains will be designed according to the ‘Red Book”:

i) Rising Mains

Velocities:
The minimum velocity of flow in a rising main should be 0.7 m/s.
The maximum velocity of flow in a rising main should be 2.5 m/s.

Minimum Diameter:
The minimum diameter of a rising main should be 100mm, except where a macerator system is used, in which case the diameter can be reduced to 75mm.

Gradient:
Wherever practicable, rising mains should be graded so as to avoid use of air and scour valves.

Stilling Chambers:
Stilling chambers should be provided at the heads of all rising mains, and should be so designed that the liquid level always remains above the soffit level of the rising main where it enters the chamber. Stilling chambers should preferably be ventilated.

ii) Sumps for Pump Stations

Emergency Storage:
A minimum emergency storage capacity representing a capacity equivalent to four hours flow at the average flow rate should be provided, over and above the capacity available in the sump at normal top-water level (i.e. the level at which the duty pump cuts in). This provision applies only to pump stations serving not more than 250 dwelling units. All pump stations will serve less than 250 dwelling units.

Sizing:
In all pump stations, sumps should be sized and pump operating controls placed so as to restrict pump starts to a maximum of six per hour.

Flooding:
Care should be taken in the design of pump stations in order to avoid flooding of the dry well and/or electrical installations by Stormwater or infiltration.

Screens:
Adequate protection, where necessary, in the form of screens or metal baskets, should be provided at the inlets of the pump stations for the protection of the pumping equipment.

iii) Pumps

Standby:
All pump stations should be provided with at least one standby pump of a capacity at least equal to the capacity of the largest duty pump. The standby pump should come into operation automatically if a duty pump or its driving motor fails due to mechanical failure.
The development must have a mobile generator, able to power the biggest pump.

iv) Safety Precautions

Safety precautions in accordance with the relevant legislation should be incorporated into the design of all pump stations and, in particular:

- All sumps and dry wells should be adequately ventilated;

- Handrails should be provided to all landings and staircases and to the sides of open sumps and dry wells;
- Skid-proof surfaces should be provided to all floors and steps; and
- The layout of the pumps, pipework and equipment should allow easy access to individual items of equipment without obstruction by pipework.

A proposed Sewer Layout plan is attached in Annexure K.

4. WASTE DISPOSAL

Allowance was made for a central waste disposal area at the entrance gate, from where the municipality will collect the solid waste.

5. SERVITUDES

Most new and existing services will be located within the road reserves on public open spaces – where services crosses stands – servitudes must be registered. A 2m Servitude must be registered over the 200dia gravity water pipe line.

6. COST ESTIMATE AND BULK CONTRIBUTIONS

The table below indicates cost estimate including bulk contributions as calculated by Mosselbay DC Calculator – with tariffs 2020/2021 (excluding VAT).

Description of Service	Total Cost	
Internal services		
Construction cost internal services	R	60,951,592.75
Construction cost fire / construction road	R	4,544,362.06
Security fence	R	1,683,937.68
Stormwater rain harvesting tanks	R	459,998.00
Sub Total	R	67,639,890.49
Bulk/external upgrades		
Upgrade of Louis Fourie and Boekenhout intersection	R	478,400.00
Upgrade of Louis Fourie and Waboom intersection including traffic signals	R	1,289,500.00
Upgrade 200m 160dia supply pipeline at pump station	R	177,726.50
Install 200 dia water pipeline for future developments	R	3,049,786.74
Sub Total	R	4,995,413.24
Sub Total	R	72,635,303.73
P & G	R	9,079,412.97
Sub Total	R	81,714,716.70
Contingencies 5%	R	4,085,735.83
Total Estimate Construction cost	R	85,800,452.53
Bulk Contributions		
Water	R	6,351,744.00
Sewer	R	6,317,106.84
Roads	R	1,527,807.54
Storm water	R	201,627.27
Solid waste	R	1,356,574.50
Total Bulk Contributions	R	15,754,860.15
Less Bulk Upgrades		
Upgrade of Louis Fourie and Boekenhout intersection	R	478,400.00
Upgrade of Louis Fourie and Waboom intersection including traffic signals	R	1,289,500.00
Install 200 dia water pipeline for future developments	R	3,049,786.74
Sub Total	R	-4,817,686.74
Total Bulk Construction cost	R	10,937,173.41
TOTAL ESTIMATE PROJECT COST (VAT EXCLUDED)	R	96,737,625.94

Final contribution to be as per Service Agreement and final construction amounts.

7. CONCLUSION

It is therefore recommended that the proposed township be approved, as existing services are available and will have the capacity if upgrades are implemented as proposed in this report.

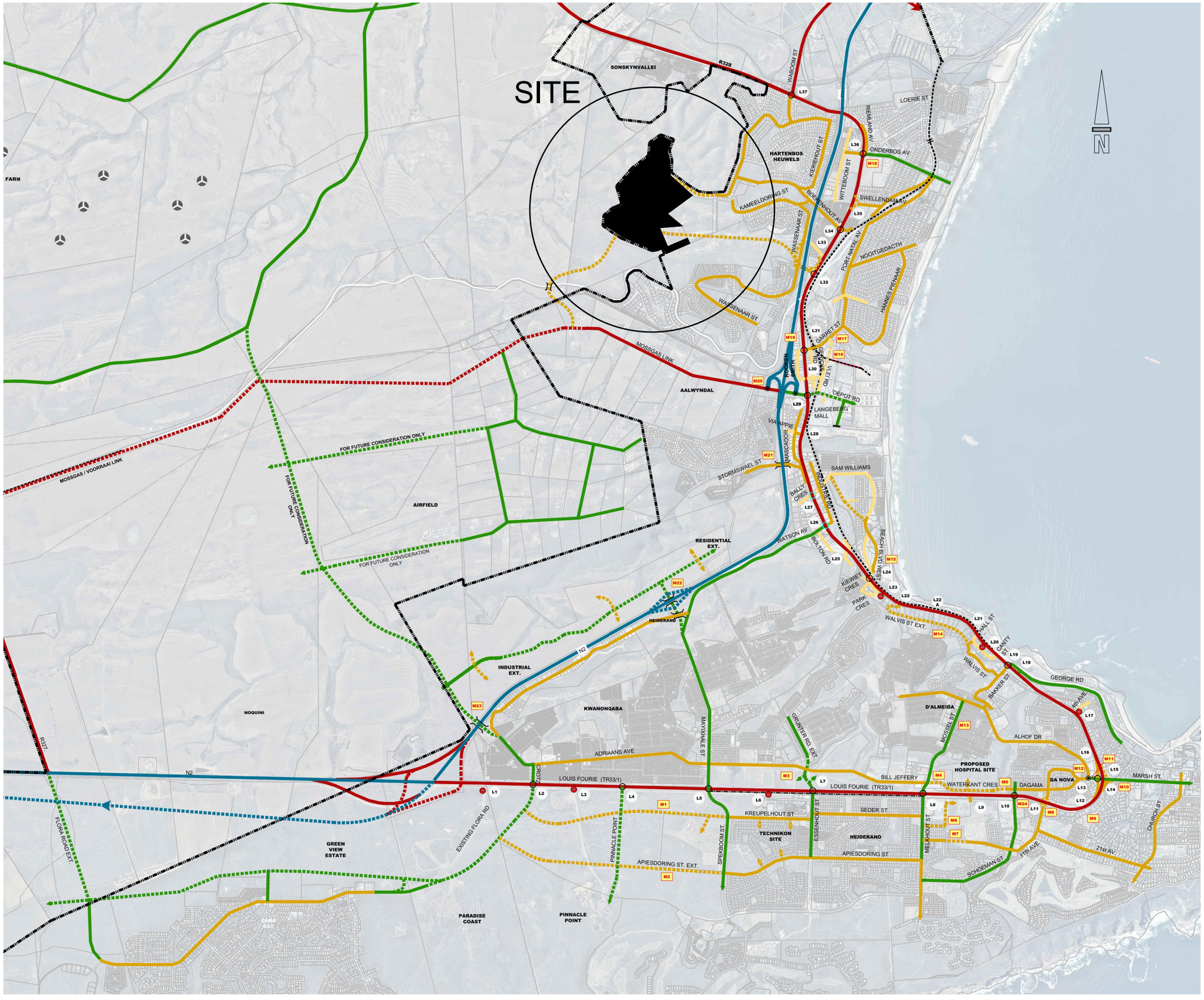
The design of the services for the Township will be done to standard as indicated in this report. The construction drawings for the project will be presented to the Council for approval, on completion of the designs. We trust therefore that you will give this Services Report your urgent and favourable attention.

For more information please contact Louis Roets at 083 283 7540.

J. L. Roets Pr. Tech (Eng)

ANNEXURE A

LOCALITY PLAN



REVISIONS			
NO.	DATE	INI.	DESCRIPTION
0	19/02/2018	LJR	FOR APPROVAL

LJR Civil Consultants cc
DESIGN & DRAUGHTING ENGINEERING CONSULTANTS
2000/007738/23

55 LOUIS TRICHARDT STREET
PARKTOWN ESTATE
PRETORIA
0084

CELL : 083 283 7540
TEL : 012 804 1514
E-mail : ljr@ljr.co.za

CLIENT

HARTENBOS Garden Estate Natuur-Landgoed

PROJECT

HARTENBOS GARDEN ESTATE

TITLE

LOCALITY PLAN

DESIGN	JL Roets Prof Reg No: 937005
DRAWN	LJR
DATE	FENRUARIE 2018
PROJECT NUMBER	1704062
COMPUTER NAME	Hart Localty Plan.dwg
SCALE	N.T.S
DRAWING NUMBER	1704062/L/001
REVISION	0

ANNEXURE B

SITE LAYOUT PLAN

Phasing	
Phase 1	
Phase 2	
Phase 3	
Phase 4	

Notes:

1. A servitude right of way and services to be registered over Erf 3122 in favour of Mossel Bay Municipality for services and to access the municipal infrastructure (reservoir) (to be surveyed)
2. All dimentions and areas are provisional and are subject to cadastral survey

* Convenient shop, beauty salon, laundary

Ptn Nos	No of Units	Extent (ha)	%	Zoning	Land Use	
1-40, 43-279 297-299	280	±10,9908	18,0	Single Residential I (SRI)	Dwelling house	
280-282	3	±0.8394	1,4	General Residential Zone III (RZIII)	Terrace Apartments (Flats)	
283-290	8	±12,0989	19,9	Open Space Zone II (OSZII)	Private Open Space with tearooms	
291	1	±23,9230	39,6	Open Space Zone III (OSZIII)	Nature conservation area	
292	1	±0,3686	0,6	Open Space Zone II (OSZII)	Sport Facilities, clubhouse, restaurant, bar, offices utility	
294	1	±2,4333	4,0	General Residential Zone III (RZIII)	Village precinct, flats, clubhouse, frailcare & recreation *	
295	1	±8,7082	14,4	Transport Zone III (TZIII)	Private Road	
296	1	±0,9286	1,5	Utility Zone (UZ)	Municipal Reservoir	
TOTAL	**296**	**60,5190ha**	**100**			

P-J Le Roux
STADS-EN STREEKBEPLANNER/
TOWN AND REGIONAL PLANNER
Hoofstraat 262 Main Road, Paarl
(t) 021-8722499 (f) 086 605 8431
(email) pj@pjleroux.co.za

Project:
Application for Rezoning & Subdivision: Erf 3122 Hartenbos

Description:
Subdivision Plan

HARTENBOS
Garden Estate
Natuur-Landgoed

Skaal	*NTS*	*Leer nr.*	*H 10-113*
Teken	*PJLR*	*Datum*	*NOVEMBER 2021*
Keur	*PJLR*	*Tekening nr.*	*H 10-113 SUB 1-REV 11*

ANNEXURE C

GEOTECHNICAL REPORT

REPORT ON

GEOTECHNICAL INVESTIGATION FOR

HARTENBOS EXTENSION 4 TOWNSHIP, CAPE PROVINCE

for

LIEBENBERG AND STANDER

REPORT NO. : 84/153/1

NOVEMBER 1984

SCHWARTZ TROMP and ASSOCIATES
Geotechnical Engineers

✉ 48662 Roosevelt Park 2129
☎ (011) 789-3742
Suite 2, Ferndale Mews South,
15 Dover Street, Ferndale
Randburg, 2194

JRCY/bjl

REPORT NO. : 84/153/1 NOVEMBER 1984

GEOTECHNICAL INVESTIGATION FOR HARTENBOS EXTENSION 4 TOWNSHIP, CAPE PROVINCE

1. INTRODUCTION AND TERMS OF REFERENCE

At the request of Mr G. Gerber of Liebenberg and Stander we have carried out a geotechnical investigation for the proposed development of the township of Hartenbos Extension 4. The objectives of this investigation may be summarised as follows :

i) To determine the nature, distribution and engineering properties of near-surface soils as they affect the construction of roads and services.

ii) To evaluate excavation procedures associated with installation of services and road cuttings.

iii) To comment on and give recommendations with regard to the stability of both natural and cut slopes.

iv) To evaluate both on-site and locally available materials for use as construction materials.

v) To give foundation recommendations for a proposed reservoir and to evaluate in general terms founding conditions for both school and residential structures.

The requirements for the investigation were discussed at a series of meetings and a site inspection attended by Mr G. Gerber of Liebenberg and Stander and our Mr K. Schwartz. In addition it was indicated to us that the civil works would be carried out in accordance with the SABS Standardised Specification for Civil Engineering Construction (SABS 1200) and that all recommendations should therefore take the requirements of the relevant SABS 1200 specifications into consideration.

At the request of Mr G. Gerber a preliminary report dealing with the various investigation objectives given in points i) to v) above was prepared immediately after the completion of the field investigation. This preliminary report was sent to Liebenberg and Stander on 19 November 1984.

2. INFORMATION SUPPLIED

The following information was supplied to us by Liebenberg and Stander in order to facilitate the investigation :

i) A site plan to the scale of 1:2000 showing the proposed township layout and contours.

ii) A site plan to the scale of 1:2500 showing proposed test pit positions and existing roads, tracks and services.

iii) A set of aerial photographs prepared by Photosurveys (Cape) (Pty) Ltd giving stereographic cover of the area of investigation

3. SITE LOCATION AND DESCRIPTION

The site for the proposed development is located in the municipality of Hartenbos, Cape. The area straddles the existing N2 National Road, with the major portion of the proposed township being located to the west of this road. The Hartenbos to Oudtshoorn road bounds the site to the north. The Phase 1 area of development lies adjacent to the N2 and forms about 60% of the total township area, while Phase 2 lies to the west of Phase 1.

Topographically the area is one of rugged relief. Deep gullies with steep side slopes disect a land surface which comprises hillcrests and associated relatively gently sloping side slopes. The proposed township layout is largely confined to the latter hillcrests and side slopes. The Phase 1 area lies at a lower elevation (15m - 100m AMSL) compared to the Phase 2 area which is located at an elevation of between 100m and 135m AMSL.

Existing developments in the area of investigation comprise a small coloured residential settlement and water reservoirs located in the Phase 1 area of the township and a number of houses to the east of the N2 Freeway. Existing cemetaries are located on Stands 2406 and 2165.

4. NATURE OF THE INVESTIGATION

The investigation was divided into a number of separate exercises and these are described in the following sections :

4.1 Airphoto Interpretation

Conventional airphoto interpretation techniques were used to examine and identify photo features and define mappable units both in terms of geology and landform.

4.2 Field Investigation

4.2.1 Walkover Survey

A walkover survey of the area was conducted in order to check significant physical features. At the same time natural and artificial exposures of the soil profile occurring in the area of interest were visually profiled by an engineering geologist. Copies of the recorded soil profiles (designated EP 1 to EP 8) are included in Appendix A. Profile locations are shown on drawing nos. 84/153/1 and 84/153/2 which cover the Phase 1 and Phase 2 areas of development respectively.

4.2.2 Test Pits

Sixty six test pits were excavated between 29 and 31 October 1984 using a Liebherr 922 tracked backhoe supplied by Transand (Pty) Ltd. Test pits were taken

either to refusal of the machine or to its depth limit and were then visually profiled by either a geotechnical engineer or an engineering geologist. During profiling, disturbed soil samples were taken from selected horizons for possible laboratory testing. Test pit positions (designated TP 1 to TP 66) are shown on drawing nos. 84/153/1 and 84/153/2. Copies of the recorded soil profiles are presented in Appendix A.

4.2.3 Local Quarries

Soil samples were taken for possible laboratory testing at two nearby quarries owned by Commerical Quarries (Pty) Ltd. Quarry 1 is located approximately 2 km from Hartenbos Extension 4 on the Oudtshoorn road while Quarry 2 lies 0,5 km to the south of the Phase 1 area of development.

4.3 Laboratory Testing

The following tests were carried out on selected soil samples recovered during the field stage of investigation :

i) Atterberg Limits and particle size distribution analyses to determine basic engineering properties and effect classification.

ii) Particle size distribution analyses on granular non-plastic materials to effect classification.

iii) Moisture/Density and California Bearing Ratio (CBR) tests to evaluate compaction characteristics and post-compaction strength.

Copies of the recorded test results are presented in Appendix B.

5. DISCUSSION ON TERRAIN CLASSIFICATION

The area of investigation has been mapped using the landscape approach in which terrain classes are recognised on their external features and interrelationships. The method adopted specifically is the land system/land facet classification which makes use of airphoto interpretation coupled with direct field checking. The basic unit of this classification is the "land facet", which is an area of ground with a simple surface form, a specific succession of soil profile horizons (each with reasonably uniform properties) and a characteristic groundwater regime. A recurrent pattern of genetically linked land facets is known as a "land system", which is generally dominated by one major geomorphic process.

In the present area of investigation two land facets within a single land system are considered to occur :

i) Hillcrests and related shallow side slopes (Land Facet 1).

ii) Steeper side slopes leading into drainage channels or gullies (Land Facet 2).

The occurrence and distribution of these land facets as interpreted from the remote (airphoto) and direct (test pits) methods of investigation outlined in Section 4. is shown on drawing nos. 84/153/1 and 84/153/2 (Site Plan and Soil Engineering Map).

In order to define the character of the land system and interrelation between its constituent land facets, a facet index has been prepared and is presented in Table 5.1. In general terms the major portion of the proposed township falls into Land Facet 1, with limited development planned in the steeper side slope areas of Land Facet 2, which generally occurs around the perimeter of both the Phase 1 and Phase 2 areas.

6. SITE GEOLOGY

6.1 General

Available geological maps show the area of investigation to be underlain by horizontally disposed sediments of the Cretaceous Period. These sediments comprise conglomerates interbedded with lenticular siltstones and sandstones. The area has a climatic N-value of 3,0 (Weinert, 1974) so that chemical decomposition of the rock can be expected to form the dominant mode of weathering. Transported soils of colluvial origin occur from surface masking the underlying residual soils and rocks. Site geology is illustrated on the Soil Engineering Map (see drawing nos. 84/153/1 and 84/153/2). In view of the nature of the investigation (in particular the spacing of test

TABLE 5.1

FACET INDEX FOR THE LAND SYSTEM - HARTENBOS EXT. 4

LAND FACET	FORM	SOILS AND ROCKS	ASSOCIATED HYDROLOGY	LAND COVER
1	Hillcrests and related shallow side slopes - slope : 0° - 11° width : 70m - 800m	Fine colluvium not exceeding 1,0m in thickness. Comprises gravelly silty sand overlying shattered clayey silts. These transported soils are underlain directly by residual siltstones, sandstones and conglomerates of the Cretaceous Period.	Above groundwater influence.	Short bush grass on crests and grass and bushes on side slopes.
2	Steeper side slopes leading into deep dissecting drainage channels (gullies) or coastal plain - slope : 10° - 60° width : 90m - 350m	Coarse colluvium in excess of 1,0m in thickness. Comprises silty sandy gravels generally, but in coastal plain little or no gravel. These transported soils are underlain by residual siltstones, sandstones and conglomerates of the Cretaceous Period.	Generally above groundwater influence except in gully floors where moderate depth to the water table is anticipated.	Short bush grass and scattered bushes. Generally less vegetation in gully floors.

pits) as well as the lenticular nature of the sediments, it should be borne in mind that the indicated lithological boundaries on the Soil Engineering Map must be considered to be approximate. Both the transported soils and residual soils and rocks are discussed in the following sections, while detailed descriptions of the various horizons may be found in the recorded soil profiles (see Appendix A).

6.2 Transported Soils

The fine colluvial soils of Land Facet 1 (hillcrest and shallow side slope) do not generally exceed a thickness of 1,0m. They comprise in essence a loose gravelly silty sand at surface and between 0,3m and 0,8m thick underlain by a stiff shattered clayey silt up to 0,5m in thickness. Occasionally the shattered colluvial horizon is absent.

The coarse colluvium of Land Facet 2 (steeper side slopes) exceeds 1,0m in thickness and in places is at least 3,0m thick. The colluvium here comprises a silty sandy gravel in general. However on the extreme eastern and northern sides of the Phase 1 area, there is a noticeable decrease in the proportion of gravel, although the deep colluvial profile is preserved.

6.3 Residual Soils and Rocks

The Cretaceous sediments comprising conglomerates interbedded with lenticular siltstones and sandstones have weathered to form layers of residual soils which are variable in thickness.

In comparison to the coarse grained conglomerates the relatively fine grained siltstones and sandstones have weathered appreciably to form residual siltstone and sandstone soils which occur to depths in excess of approximately 4,0m below surface in some areas. Relatively shallow weathering characterises the conglomerates, with thin residual soils overlying conglomerate bedrock.

In the Phase 1 area of the proposed township the residual siltstone horizons form a significant portion of the horizontally disposed succession (as do the residual sandstones to a lesser extent). In contrast, only limited residual siltstone and sandstone development was encountered in the Phase 2 area. These trends are illustrated in the Soil Engineering Map.

All the residual horizons are characterised by medium to widely spaced bedding (horizontal) with very limited development of jointing, so that the general impression is one of "relative intactness" in the residual materials.

6.4 Water Table

No water table or zones of significant seepage were encountered during the field investigation. It therefore appears that the local water table occurs at depth and below the influence of construction procedures associated with township development. However it can be expected that in natural drainage channels the water table will approach ground level, particularly during the wet season or periods of prolonged rainfall.

7. GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

Geotechnical considerations relevant to the development of Hartenbos Extension 4 township in terms of roads and services are discussed in this section of the report. Founding conditions and recommendations are dealt with in Section 8.

7.1 Excavation Procedures

General excavation procedures for roads and services based on material origin and the SABS 1200 excavation classification are presented in Table 7.1. In terms of the SABS 1200 Earthworks Specification and the in situ soil/rock consistencies as profiled, the following relationships are considered applicable:

i) "soft excavation" - very loose/very soft through to dense/stiff.

ii) "intermediate excavation " - very dense/very stiff through to very soft rock.

iii) "hard rock excavation" - soft rock or better.

In specific areas therefore the relevant test pit soil profiles may be used in conjunction with the above relationships and Table 7.1 to evaluate excavation procedures.

TABLE 7.1

EXCAVATION PROCEDURES BASED ON SABS 1200

MATERIAL ORIGIN	MATERIAL DESCRIPTION	SABS 1200 EXCAVATION CLASSIFICATION		
		SOFT EXCAVATION	INTERMEDIATE EXCAVATION	HARD ROCK EXCAVATION
Transported soil	Land Facet 1 fine colluvium	✓		
	Land Facet 2 coarse colluvium	✓		
Residual soil	Residual siltstone soils	✓	✓	
	Residual sandstone soils	✓	✓	
	Residual conglomerate soils	✓	✓	
Rock	Generally soft rock conglomerate or better (below backhoe refusal depth)			✓

7.2 Slope Stability

7.2.1 Natural Slopes

No evidence of instability in naturally-occurring slopes in the area has been observed, either from the aerial photographs or directly from the field investigation. In the areas where township development is proposed natural slope angles range from less than 5° in hillcrest areas through to 20° on the steeper side slopes leading into gullies. The residual soils and rocks are competent and of relatively high strength while the upper transported soils exhibit moderate strength.

It is our opinion that the natural slopes as they occur at present in the areas where development is proposed, are stable. However water has a significant effect on slope stability and care should be exercised in the planning and construction of the township to ensure that the free-draining nature of these slopes is maintained. Particular care should be exercised where structures are located in areas of relatively steep side slope to ensure that pore water pressure build-up in near-surface soils is kept to a minimum.

7.2.2 Cut Slopes

Slopes cut for roads and earthworks and up to 5,0m in depth should be excavated to a slope angle of 1(V) : 1,5(H). Long term erosion and ravelling can be expected to occur, particularly in the residual siltstone and sandstone horizons and loose unconsolidated colluvial deposits. In this regard the Soil Engineering Map may be used to identify potential problem areas. Suitable precautions that can be taken to maintain the long-term stability of cut slopes include vegetating (grassing) the slopes and stone pitching.

7.3 Materials Usage

Engineering properties of soils occurring on Hartenbos Extension 4 and obtainable from the local quarries are summarised in Tables 7.2 and 7.3 respectively. Potential uses of these materials in the development of the township are presented in Tables 7.4 and 7.5 together with costs in the case of quarry materials. Particular considerations regarding the various material types and their use as construction materials are discussed in the following sections. The distribution and extent of these materials is shown on the Soil Engineering Map (drawing nos. 84/153/1 and 84/153/2).

TABLE 7.2

SUMMARY OF ENGINEERING PROPERTIES OF ON-SITE MATERIALS

TEST PIT NUMBER	DEPTH (m)	MATERIAL ORIGIN	LL	PI	% PASSING 0,075mm SIEVE	GM	CBR AT % Mod. AASHTO			AASHTO CLASSIFICATION
							98%	95%	93%	
TP 24	0,2 - 0,6	Fine shattered colluvium (Facet 1)	47	25	55	0,84	5	5	3	A - 7 - 6
TP 41	0,4 - 0,8	Fine shattered colluvium (Facet 1)	74	37	50	1,11	2	2	2	A - 7 - 5
TP 45	0,4	Fine shattered colluvium (Facet 1)	68	36	44	1,42	-	-	-	A - 7 - 5
TP 59	0,0 - 1,9	Fine shattered colluvium (Facet 1)	24	12	50	0,71	31	23	18	A - 6
TP 31	0,4 - 1,4	Coarse colluvium (Facet 2)	17	8	55	0,54	54	40	34	A - 4
TP 32	0,0 - 1,5	Coarse colluvium (Facet 2)	-	S/P	5	2,58	148	77	50	A - 1 - a
TP 2	1,7	Residual siltstone	69	36	77	0,33	-	-	-	A - 7 - 5
TP 12	1,8	Residual siltstone	92	69	80	0,40	-	-	-	A - 7 - 6
TP 15	3,0	Residual siltstone	51	20	99	0,01	-	-	-	A - 7 - 5
TP 17	1,2 - 1,8	Residual siltstone	22	8	88	0,13	3	2	2	A - 4

TABLE 7.2 (CONTD)

TEST PIT NUMBER	DEPTH (m)	MATERIAL ORIGIN	LL	PI	% PASSING 0,075mm SIEVE	GM	CBR AT % Mod. AASHTO			AASHTO CLASSIFICATION
							98%	95%	93%	
TP 28	1,0 - 2,0	Residual siltstone	59	20	74	0,40	3	2	1	A - 7 - 5
TP 36	1,0 - 2,0	Residual siltstone	34	12	67	0,38	6	5	5	A - 6
TP 7	1,5	Residual sandstone	-	-	13	1,14	-	-	-	A - 2 - 4
TP 19	1,0 - 2,0	Residual conglomerate	19	9	9	2,51	-	-	-	A - 2 - 4
TP 33	1,2	Residual conglomerate	-	N/P	4	2,53	-	-	-	A - 1 - a
TP 39	0,5 - 1,5	Residual conglomerate	39	12	8	-	140	110	-	A - 2 - 6
TP 43	1,6	Residual conglomerate	22	7	10	2,30	-	-	-	A - 2 - 4
TP 57	0,6 - 1,2	Residual conglomerate	22	8	34	0,95	30	21	16	A - 2 - 4

TABLE 7.3

SUMMARY OF ENGINEERING PROPERTIES OF QUARRY MATERIALS

QUARRY	QUARRY'S MATERIAL DESIGNATION (SAMPEL NO.)	LL	PI	% PASSING 0,075mm SIEVE	GM	CBR AT % Mod. ASHTO COMPACTION			AASHO CLASSIFICATION
						98%	95%	93%	
2 (South of Hartenbos Ext 4	Subbase (SB 2)	26	13	17	2,08	43	22	14	A - 2 - 6
1 (North of Hartenbos Ext 4	Base course (BC 1)	15	3	8	2,48	169	147	132	A - 1 - a
	Subbase (SB 1)	15	3	8	2,44	51	26	11	A - 1 - a
	Crusher dust (CD 1)	-	-	9	2,11	-	-	-	A - 1 - a
	River gravel (RG 1)	-	-	6	2,28	-	-	-	A - 1 - a
	River sand (RS 1)	-	-	1	1,67	-	-	-	A - 1 - b
	Building sand (BS 1)	-	-	13	0,88	-	-	-	A - 2 - 4

TABLE 7.4

SUMMARY OF POTENTIAL USES OF ON-SITE MATERIAL

LAND FACET	MATERIAL TYPE	EXPECTED THICKNESS RANGE (m)	POTENTIAL USES					COMMENTS
			BASE	SUBBASE	SELECTED LAYERS	GENERAL FILL	SPOIL	
1	Fine colluvium. Gravelly silty sand.	0,2 - 1,0			✓	✓		Relatively thin and difficult to select.
1	Fine colluvium. Shattered clayey silt.	0,1 - 1,0					✓	Unsuitable for use.
2	Coarse colluvium. Silty sandy gravel.	1,0 - 3,0	✓	✓				Light crushing may be required to break up coarse fraction if used as base.
1 & 2	Residual siltstone.	0,5 - 4,0+					✓	Unsuitable for use.
1 & 2	Residual sandstone.	0,5 - 4,0+			✓	✓		Of limited extent and difficult to select.
1 & 2	Residual conglomerate.	1,0 - 3,0+	✓	✓				Light crushing may be required to break up coarse fraction.

TABLE 7.5

SUMMARY OF POTENTIAL USES OF QUARRY MATERIALS AND CURRENT COSTS

QUARRY NUMBER	QUARRY'S MATERIAL DESIGNATION	POTENTIAL USES						QUARRY PRICE Cu. METRE (R)
		BASE	SUBBASE	SELECTED LAYER	CONCRETE SAND	BUILDING SAND	PIPE BEDDING	
2 (South of Hartenbos Ext 4)	Subbase			✓				3,30
1 (North of Hartenbos Ext 4)	Base course	✓	✓					10,07
	Subbase			X				3,30
	Crusher dust				X			10,29
	River gravel	X	X					7,92
	River sand				✓	✓		9,13
	Building sand					X		6,63

KEY : ✓ Complies with SABS specification

X Does not comply with SABS specification but may be suitable if standards are revised

7.3.1 Colluvium

The upper gravelly colluvial soils of Land Facet 1 are considered suitable for use in road construction (see Table 7.4). This material could be stockpiled for future use, but may be difficult to select due to its relatively thin vertical extent.

The shattered clayey silts of Land Facet 1 which generally underlie the gravelly horizon are potentially expansive and considered to be unsuitable for use in road construction. However if mixed with the overlying gravelly colluvium, they will form a suitable general fill. More details are given in Section 7.3.6.

Transported colluvial gravels of Land Facet 2 exhibit low plasticity and good compaction characteristics although light crushing may be required to break up coarser gravel fractions.

7.3.2 Residual Siltstone Soils

The upper residual siltstone soils are potentially expansive and are considered to be unsuitable for use in road construction. Further details in this regard are discussed in Section 7.3.6. The quality of the residual siltstone soils could be improved with the addition of granular soils.

7.3.3 Residual Sandstone Soils

Residual sandstone soils are of limited extent (see Soil Engineering Map). However these soils are considered to form a suitable subgrade and may be used in selected layers and as a general fill.

7.3.4 Residual Conglomerate Soils

Good compaction qualities and good subgrade conditions characterise the residual conglomerate soils. As set out in Table 7.4 these materials are suitable for use as subbase and base possibly with some light crushing in the case of the latter.

7.3.5 Quarry Materials

Suitable construction materials are available from the No. 1 and No. 2 quarries of Commercial Quarries (Pty) Ltd (see Tables 7.3 and 7.5). Although these materials are being used locally and available information (Weinert, 1980) indicates that no potential problems are anticipated, it is recommended that further testing be carried out on any quarry materials that will be used in order to assess suitability, particularly as regards deleterious impurities and variability. No pipe bedding material falling within the SABS specification was located in the area. However in view of the nature of the development certain of the local quarry materials may prove suitable if less stringent criteria are adopted.

7.3.6 Problem Areas for Road Construction

The potentially expansive nature of the shattered fine colluvium (Land Facet 1) and residual siltstone soil, indicates that these materials form a poor subgrade. It is anticipated that the relatively thinly developed shattered fine colluvium can easily be removed to spoil (see Section 7.3.1). In areas of road construction where residual siltstone soils occur, it is recommended that these materials be undercut to a depth of 0,6m below finished road level with excavated material being removed to spoil. The relevant areas are delineated on the Soil Engineering Map and it is anticipated that they can be defined more accurately by inspection during construction.

The fine grained nature and low post-compaction strength of the residual siltstone soils indicate that care should be exercised (when undercutting) to create as little disturbance of these soils as possible before the placing of the selected layers.

8. EVALUATION OF GENERAL FOUNDING CONDITIONS AND RECOMMENDATIONS

8.1 Proposed Reservoir

It has been indicated to us by Mr G. Gerber that it is proposed to construct a reservoir at the topographical high point in the Phase 2 area of development (elevation $\pm$ 135m AMSL). With reference to the relevant test pit profiles (TP 38 and TP 39)

it is recommended that the proposed reservoir be founded at a depth of between 0,5m and 1,0m below natural ground level. Founding should take place on dense residual sandstone/conglomerate using a maximum allowable bearing pressure of 400 kN/m^2, in which case total settlements are not expected to exceed 10mm. Limited occurrence of residual siltstone soils occurs in the immediate vicinity of the site of the proposed reservoir, and from the available literature it appears that these soils although potentially expansive, have a low swelling pressure. Nevertheless water emanating from the reservoir should be carefully controlled to prevent ingress into the subsurface soils since thin interbedded siltstone lenses or bands can be expected to occur across the area.

8.2 Schools

Available information shows that a primary school is planned on Stand 1799 in the Phase 2 area of development. From the Soil Engineering Map it may be seen that the Land Facet 1/Land Facet 2 boundary passes through the site, so that it can be anticipated that both the nature of the colluvium and its thickness change across the area. To the west of the facet boundary shallow fine colluvium overlies residual conglomerate (or limited siltstone rock), while to the east of the facet boundary coarse colluvium (gravelly silty sand) exceeding 1,0m in thickness overlies residual conglomerates.

The fine colluvium is considered to be potentially moderately expansive while the coarse colluvium is highly compressible. The colluvium in general is therefore considered to be unsuitable for use as a founding horizon. Both the residual conglomerates and siltstone rock exhibit low compressibility and will in our opinion form suitable founding horizons.

It is therefore recommended that the proposed structures be founded at depths of between 0,5m and 1,2m on residual siltstones/conglomerates using a maximum allowable bearing pressure of 400 kN/m². In this event total settlements are not expected to exceed 10mm. Suitable compaction of the coarse colluvium should be carried out prior to casting the floor slabs. Cognisance should be taken of the potentially expansive fine colluvium when designing surface beds and in view of its relatively shallow vertical extent, consideration should be given to its removal and replacement with a suitably compacted inert granular fill (such as the coarse colluvium).

8.3 General Founding Conditions for Residential and Other Structures

The following general comments may be made with regard to the location of structures on the in situ soils and rocks underlying the Phase 1 and 2 areas of development :

i) Shattered potentially moderately expansive horizons occur within the fine colluvium of Land Facet 1 and must be taken into account in the design of structural foundations and surface beds.

ii) The coarse colluvium of Land Facet 2 is generally moderately to highly compressible and exceeds a thickness of 1,0m. These soils as they occur in situ are considered unsuitable for use as a founding horizon. However with special treatment such as compaction, founding could take place on these soils.

iii) Residual conglomerate and sandstone soils and rocks in both Land Facets 1 and 2 form competent founding horizons of moderate to low compressibility. These materials occur within 1,0m of ground surface in Land Facet 1 which covers the major portion of the proposed township.

iv) Potentially very highly expansive residual siltstone soils occur in the vicinity of the existing reservoirs and cemetary (Stand 2165) on the Phase 1 area of development (see Soil Engineering Map). The stratigraphically underlying residual siltstone horizon to the north (in the vicinity of TP 27 and TP 17) is considered to be potentially moderately expansive. Foundation design should take this into account when placing structures in areas where residual siltstone soils occur.

J.R.C. YATES
Schwartz Tromp and Associates

K. SCHWARTZ Pr. Eng.
Schwartz Tromp and Associates

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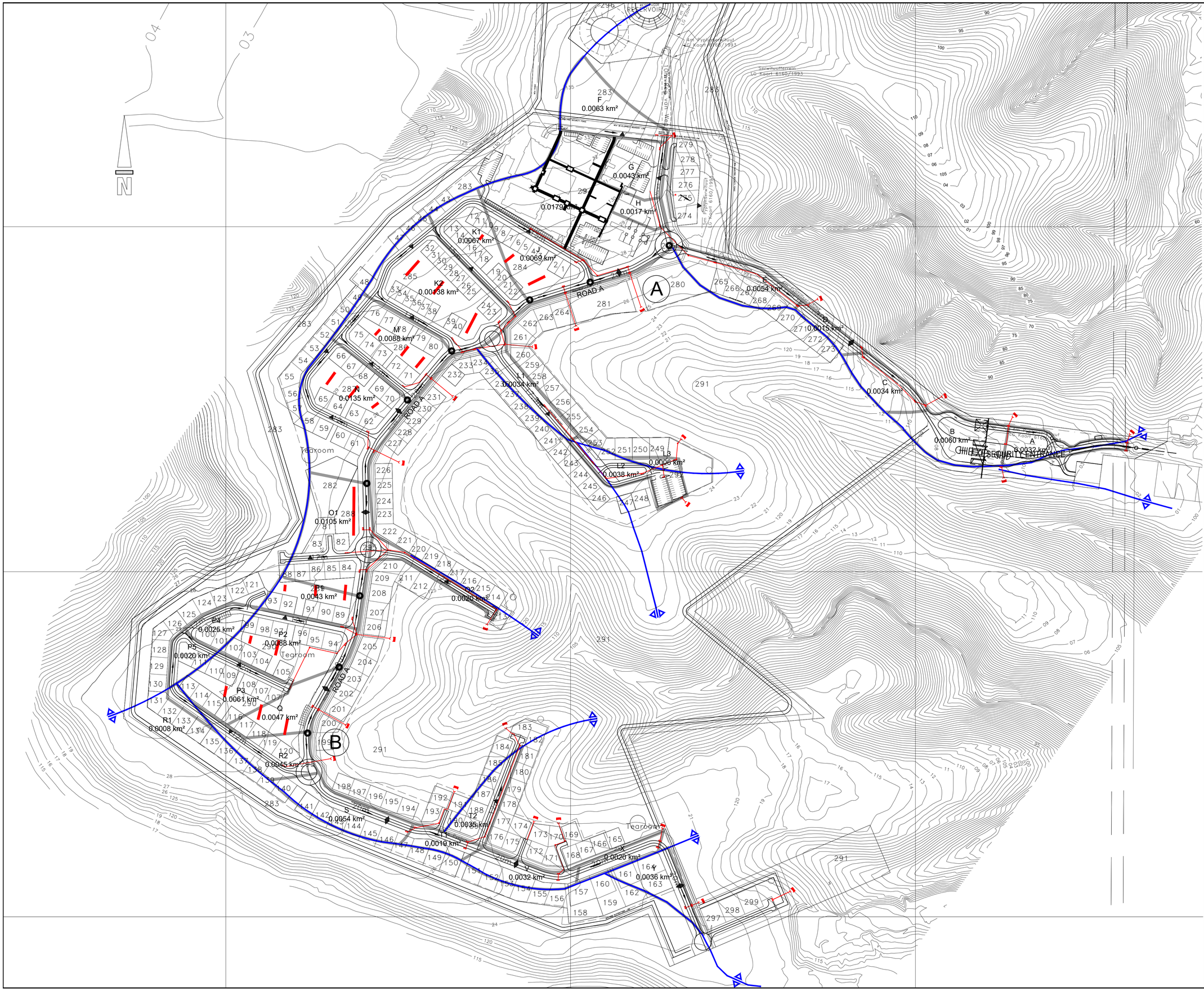
ANNEXURE G

STORMWATER MANAGEMENT PLAN



LEGEND

- STORMWATER PIPE
- KERB INLET
- STORMWATER OUTLET
- STORMWATER MANHOLE
- ENERGY DISSIPATION / DETENTION STRUCTURE
- HIGH POINTS ON ROAD
- ROAD CROSS FALL
- STORMWATER FLOW DIRECTION
- FLOW RETENTION CHANNELS (SWALE)
- RAINWATER STORAGE TANK
- WATER SHED
- STORMWATER CATCHMENT AREA

REVISIONS

NO.	DATE	INI.	DESCRIPTION
0	05/05/2021	LJR	ISSUE FOR APPROVAL

LJR Civil Consultants cc
DESIGN & DRAUGHTING ENGINEERING CONSULTANTS
2000/007738/23

55 LOUIS TRICHARDT STREET
PARKTOWN ESTATE
PRETORIA
0084

CELL : 083 283 7540
OFFICE: 063 566 6151
E-mail : ljr@ljr.co.za

CLIENT

HARTENBOS
Garden Estate
Natuur-Landgoed

PROJECT

HARTENBOS GARDEN ESTATE

TITLE

STORMWATER MANAGEMENT PLAN

DESIGN	JL Roets — Prof Reg No: 937005
DRAWN	LJR
DATE	MAY 2021
PROJECT NUMBER	1704062
COMPUTER NAME	Hart Roads & Stormwater.dwg
SCALE	1:2000
DRAWING NUMBER	1704062/100
REVISION	0

ANNEXURE H

RAIN HARVEST TANKS

Vertical Storage Tanks

Vertical storage tanks from JoJo Tanks are used for storing **water**, **fertilisers**, **chemicals** and **most other liquids**. These vertical storage tanks cater for your every water storage capacity need, from storing between 260 and 20 000 litres.

These UV-resistant and chemical-resistant polyethylene tanks are available in a **range of colours** to suit any domestic, commercial or industrial application.

These vertical storage tanks are ideal for storing water and chemical-based liquids as well as for rainwater harvestingto be used in limited water supply, water disruptions and in emergency applications.

JoJo Tanks is supplied through a wide distribution network across South Africa and Zimbabwe.

- Ideal for space-sensitive operations (see Slimline™)
- Storing 260 to 20 000 litres
- For storing water and chemicals
- UV and chemical resistance
- Communal drinking water solutions available
- Range of accessories and colours available

View our range of Vertical Storage Tanks

Slimline 1 000 Litre Vertical Storage Tank

Vertical Tanks

2 500 Litre MultiSlim Vertical Storage Tank

Slimline 750 Litre Storage Tank

Interested in becoming a JoJo Tanks specialist supplier? Find out how!

As **South Africa's leading water tanks supplier**, JoJo Tanks prides itself in the high quality and performance of our plastic storage tanks and products. We certify our installation teams to ensure an OEM-compliant tank fitment. And guarantee your products for 8 years!

To find out more about our installation services, click here.

Horizontal Storage Tanks

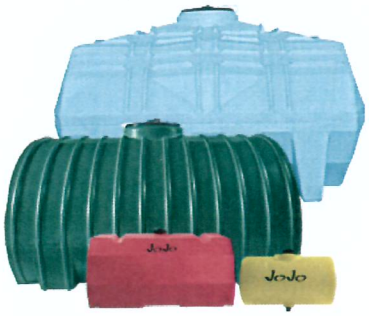
Horizontal tanks are ideal for storing water, liquid fertiliser, diesel and chemicals, with a **range of sizes available to suit your requirements.**

These **high-quality polyethylene tanks** are ideal for all liquid storage in agricultural, industrial, commercial and domestic applications.

These tanks can be fitted onto the back of an LDV or truck to provide a mobile water source to deliver water to remote areas or those experiencing water shortages.

JoJo Tanks are supplied through a wide distribution network across **South Africa and Zimbabwe.**

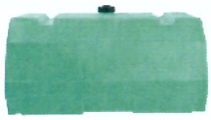
- Range of tank sizes: 240 – 5 500 lt
- Lengths from 1 080 – 1 495 mm
- Range of accessories and colours available



View our range of Horizontal Storage Tanks

240 Litre Storage Tank

500 Litre Storage Tank



600 Litre Storage Tank

750 Litre Storage Tank

900 Litre Storage Tank

ANNEXURE I

GLS REPORT PROPOSED

17 May 2021

LJR Civil Consultants cc
89 Rauch Avenue
Georgeville
Pretoria
0002

Attention: Mr Louis Roets

Dear Sir

PROPOSED DEVELOPMENT OF HARTENBOS GARDEN ESTATE ON ERF 3122 HARTENBOS HEUWELS: BULK WATER AND SEWER SERVICES

The request by Mr Louis Roets regarding comments on the existing water and sewer system and conceptual design of infrastructure required to accommodate the proposed development, refers.

This document should inter alia be read in conjunction with the following reports:

- *"Mossel Bay Municipality Water Master Plan"* dated April 2017.
- *"Mossel Bay Municipality Sewer Master Plan"* dated April 2017.

Please note that this report supersedes the previous report dated 06 March 2018 in this regard.

1. WATER DISTRIBUTION SYSTEM

1.1 *Existing water distribution system*

The proposed development is located at Hartenbos Heuwels to the west of Hartenbos near the Hartenboskop reservoir. The proposed development will be supplied from the existing 3500 kl Hartenboskop reservoir (TWL = 137 m). The Hartenboskop reservoir is supplied via an existing booster pumping station located at the lower 9140 kl Hartenbos reservoir (TWL = 80 m).

1.2 *Water demand*

The annual average daily water demand (AADD) for the proposed development as well as the existing stands (fully occupied) in the Hartenboskop reservoir zone was calculated as follows:

• Hartenboskop zone fully occupied	=	539	kL/d
• Proposed development	=	365	kL/d
Total	=	904	kL/d

A fire flow criteria of 15 L/s is applicable.

GLS Consulting (Pty) Ltd
T +27 21 880 0388 | F +27 21 8800 389
13 Elektron Street, Techno Park, Stellenbosch, 7600 | PO Box 814, Stellenbosch, 7599, South Africa
Reg no: **2007/003039/07** | *a member of the EOH Group of Companies*
www.eoh.co.za | www.gls.co.za

Directors: A Bohbot, JW King, Z Mayet, BF Loubser, JJ Streicher and LC Geustyn

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1.3 *Future water distribution system*

In the Water Master Plan it was proposed that the erven for this development be supplied from the Hartenboskop reservoir via a proposed booster pumping station (see Figure 1 attached).

1.4 *Proposed water supply*

Reservoirs

The annual average daily water demand (AADD) for the Hartenboskop reservoir zone was calculated taking into consideration the existing stands (fully occupied), the proposed development on ERF 3122 and including all the proposed future developments in the reservoir supply area as listed in the 2017 Master plan.

The total future water demand, supplied as proposed from the Hartenboskop reservoir, was calculated as follows:

• Future development Erf 3122	=	365	kL/d
• Hartenboskop zone fully occupied	=	539	kL/d
• Other developments and rezoning	=	900	kL/d
Total	=	1 804	kL/d

The total future water demand of 1 804 kL/d amounts to a required reservoir storage capacity of 3 608 kL to comply with the required 48 hours of AADD reservoir storage capacity. The existing 3 500 kL Hartenboskop reservoir will in future have a marginal deficit of 108 kL, which amounts to 47 hours of storage capacity.

The 3 500 kL capacity should be sufficient to accommodate the proposed development including other future developments as stipulated in the Master Plan (Developments P01, A05, U04 and R05 in Brandwacht), to comply with roughly 48 hours of AADD reservoir storage capacity.

Pumping stations

There is sufficient capacity at the existing Hartenbos Heuwels pumping station to meet the increased demand at the Hartenboskop reservoir, i.e. 50 L/s with two duty pumps and one standby. The duty point should however be verified.

Pipelines

A new parallel reinforcing 200 m x 160 mm Ø supply pipeline at the pumping station is proposed. It was proposed in the Master plan to implement a new 1620 m x 200 mm Ø gravity pipeline from the Hartenboskop reservoir, within the road reserve of the Erf 3122 development, to supply water to future development area (A5) and to rezone water supply to Seemeeu Park in future. The installation of this pipeline should be strongly considered and it should be noted that this pipeline should be separated from the booster pipe network of the proposed development.

2. SEWER SYSTEM

2.1 *Existing sewer system*

The existing sewage gravitates from Hartenbos Heuwels to the Cemetery pumping station. The Cemetery pumping station pumps the sewage directly to the existing Hartenbos WWTP.

2.2 *Sewage flow*

The AADD for the future development was calculated as 365 kL/d. The peak day dry weather sewer flow (PDDWF) was calculated as 313 kL/d. The instantaneous peak dry weather flow (IPDWF) was calculated as 7 L/s and the instantaneous peak wet weather flow (IPWWF) was calculated as 8 L/s.

2.3 *Proposed sewer system*

Pipelines and pumping stations

The existing Cemetery sewer pumping station and rising main have sufficient capacity to accommodate the additional sewage from the proposed development.

3. COSTS IMPLICATIONS

3.1 *Water*

The developer of the proposed development will be liable for the Bulk Service Levy (as calculated by the Mossel Bay Municipality) as a contribution towards water infrastructure.

3.2 *Sewerage*

The developer of the proposed development will be liable for the Bulk Service Levy (as calculated by the Mossel Bay Municipality) as a contribution towards sewer infrastructure.

3.3 *Total cost*

The cost of the internal booster pumping station, and the water and sewer reticulation systems (not estimated in this study) will be for the developer's own account. The cost of the required 200 m x 160 mm Ø pipeline will be for the developers own account. The cost of the 200 mm Ø gravity main indicated in the Master plan to supply other future areas should be recovered from the Mossel Bay Municipality, if implemented.

We trust you find the above of value.

Yours sincerely

GLS Consulting (Pty) Ltd
REG. NO.: 2007/003039/07

_____

Per: JJ STREICHER

cc. The Manager: Civil Engineering Services
Mossel Bay Municipality
Private Bag X29
MOSSEL BAY
6500

Attention: Mr Eric Louw

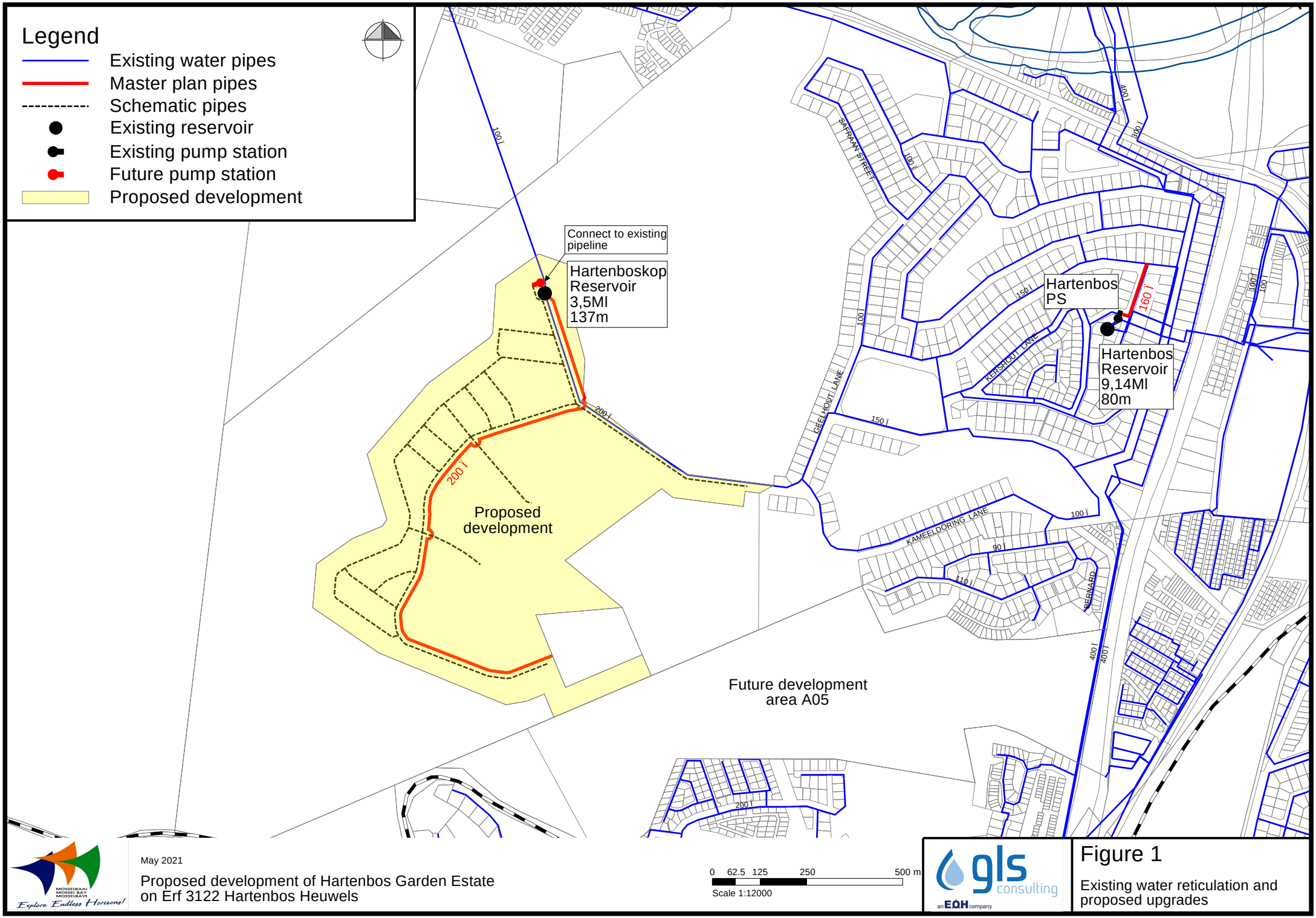
Legend
Existing water pipes
Master plan pipes
Schematic pipes
Existing reservoir
Existing pump station
Future pump station
Proposed development
Connect to existing pipeline
Hartenboskop Reservoir 3,5Ml 137m
Hartenbos PS
Hartenbos Reservoir 9,14Ml 80m
Proposed development
Future development area A05
SAFFRAAN STREET
GEELHOUT LANE
KERSHOUT LANE
KAMEELDORING LANE
BERNARD
100 ï
150 ï
160 ï
200 ï
400 ï
90 ï
110 ï
0 62.5 125 250 500 m
Scale 1:12000
May 2021
Proposed development of Hartenbos Garden Estate on Erf 3122 Hartenbos Heuwels
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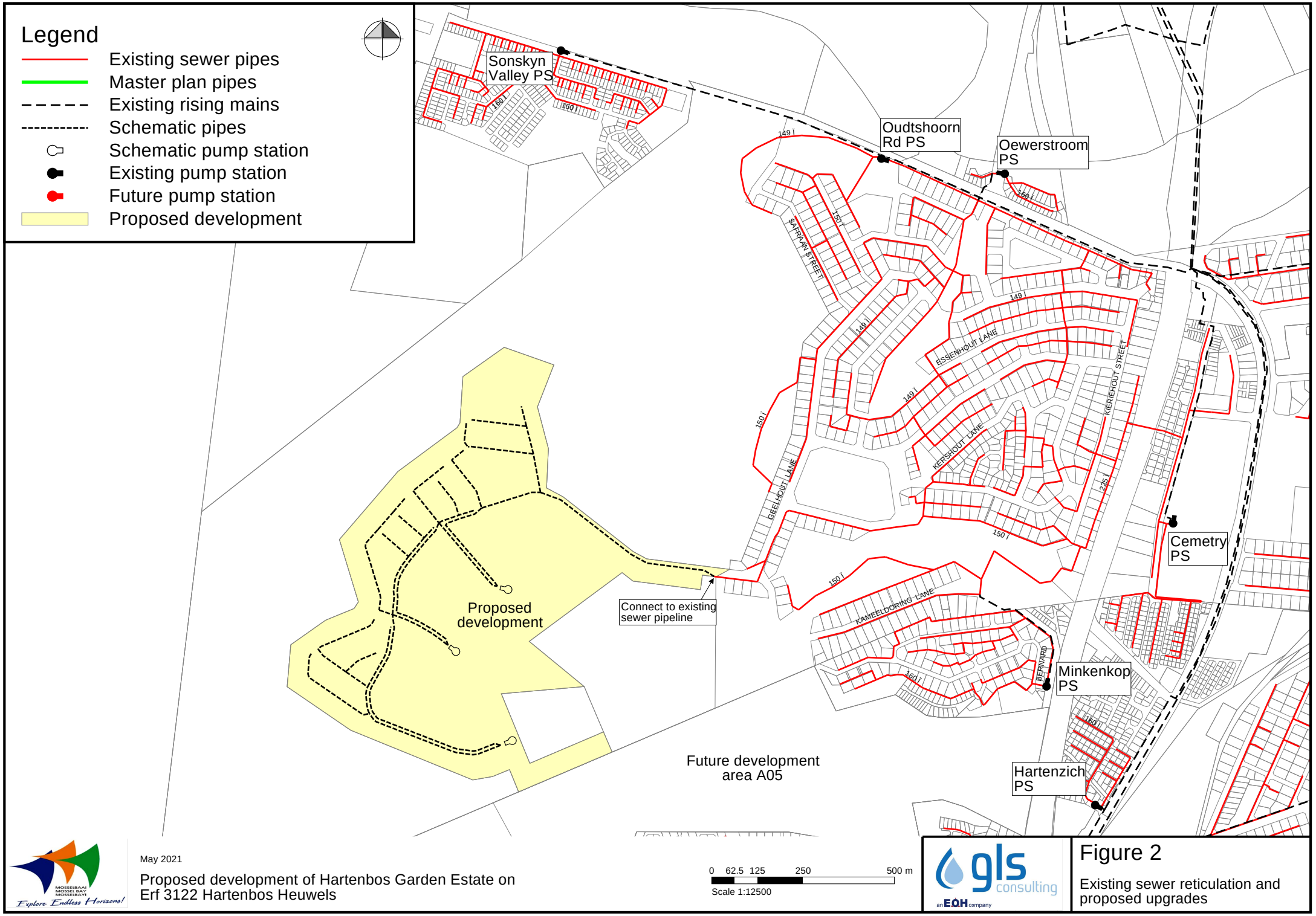
Figure 1
Existing water reticulation and proposed upgrades



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Proposed development of Hartenbos Garden Estate on Erf 3122 Hartenbos Heuwels

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Figure 2

Existing sewer reticulation and proposed upgrades

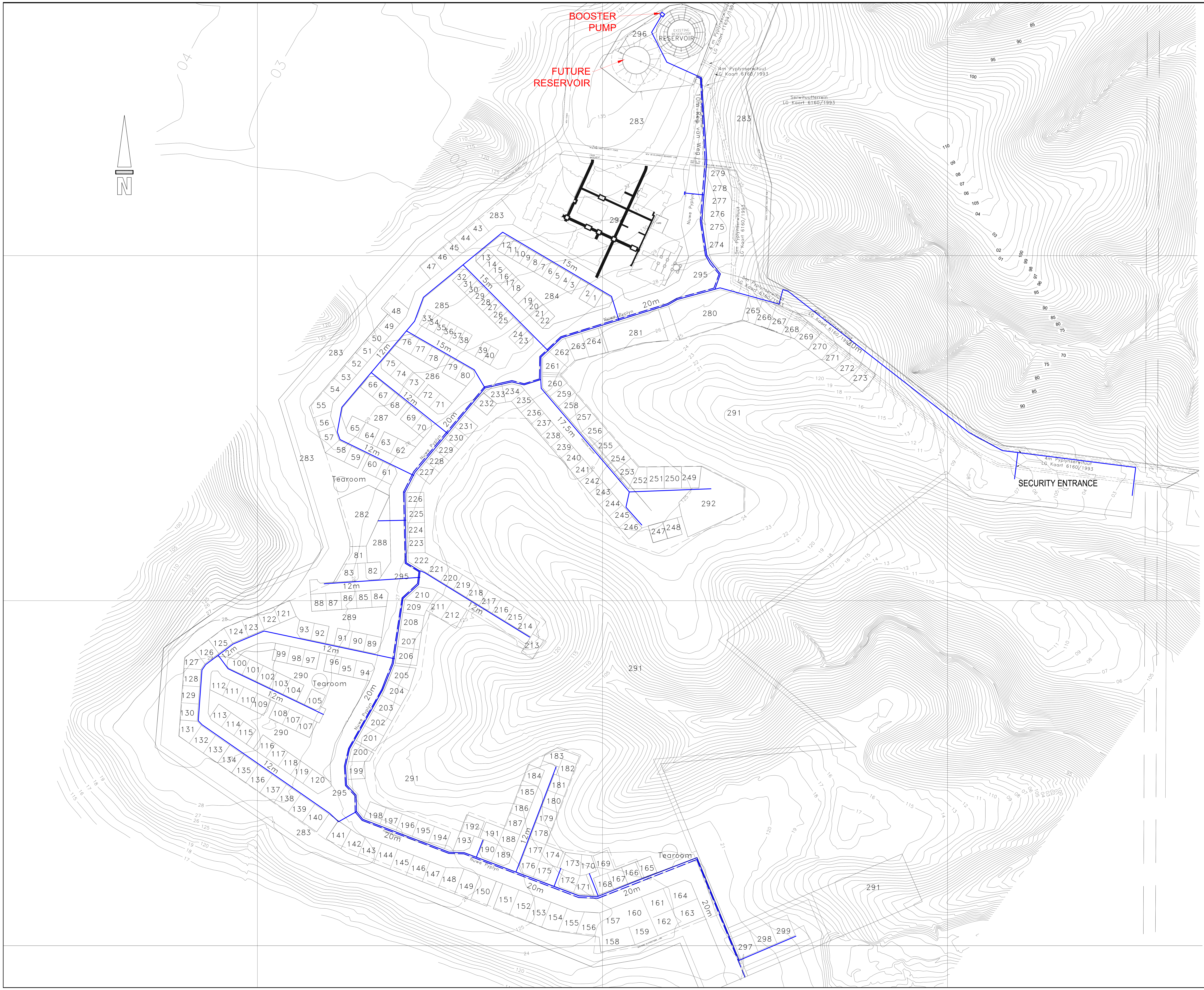
ANNEXURE J

WATER LAYOUT PLAN

LEGEND

WATER PIPE

200Ø PIPE FOR FUTURE DEVELOPMENT



REVISIONS

NO.	DATE	INI.	DESCRIPTION
0	05/05/2021	LJR	ISSUE FOR APPROVAL

CLIENT

HARTENBOS Garden Estate Natuur-Landgoed

PROJECT

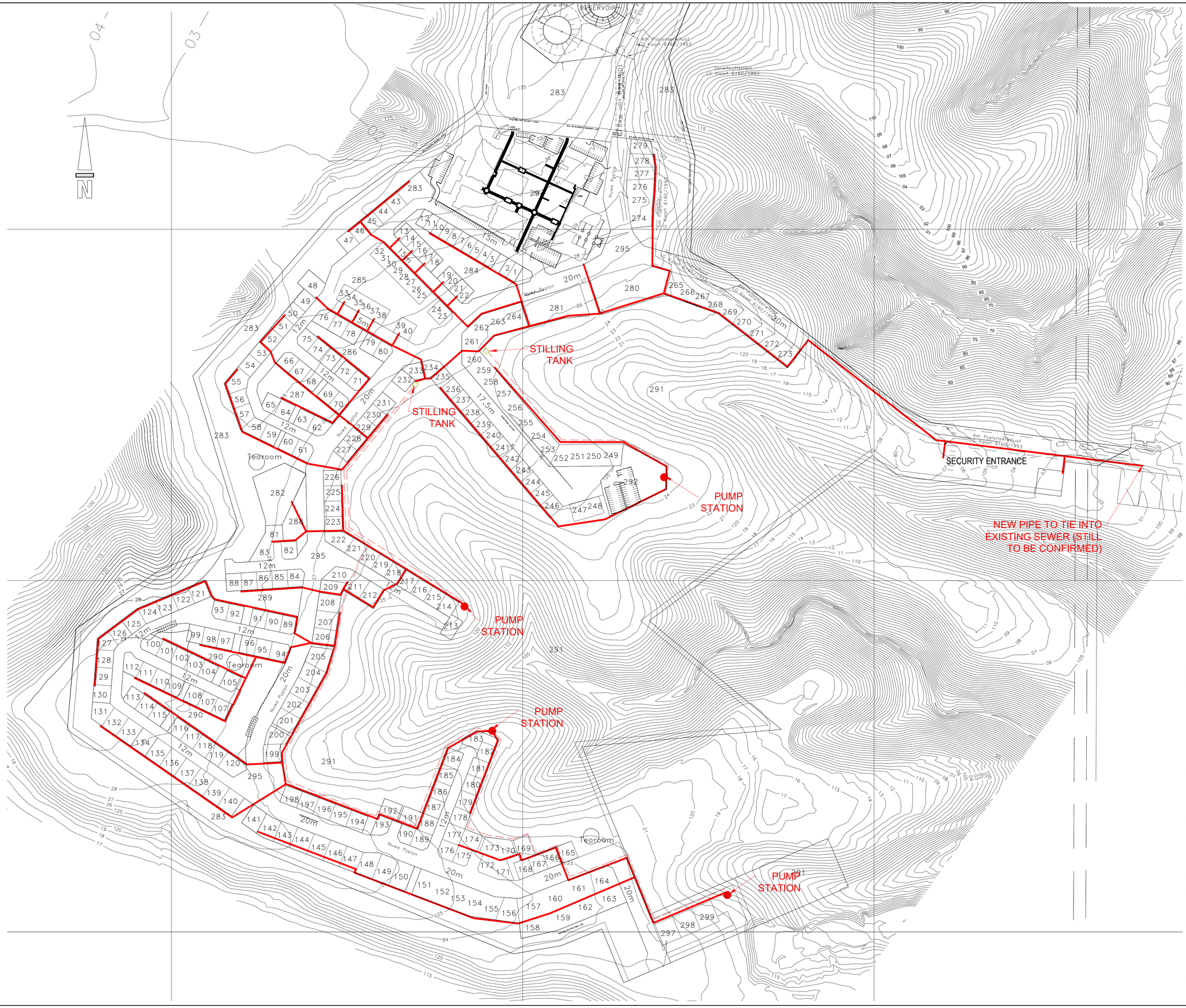
TITLE

WATER RETICULATION LAYOUT PLAN

DESIGN	JL Roets Prof Reg No: 937005
DRAWN	LJR
DATE	MAY 2021
PROJECT NUMBER	1704062
COMPUTER NAME	Hart Water.dwg
SCALE	1:2000
DRAWING NUMBER	1704062/400
REVISION	0

ANNEXURE K

SEWER LAYOUT PLAN



REVISIONS

NO.	DATE	INI.	DESCRIPTION
0	05/05/2021	LJR	ISSUE FOR APPROVAL

LJR Civil Consultants cc
DESIGN & DRAUGHTING ENGINEERING CONSULTANTS
2000/007738/23

55 LOUIS TRICHARDT STREET
PARKTOWN ESTATE
PRETORIA
0084

CELL : 083 283 7540
TEL : 012 804 1514
E-mail : ljr@ljr.co.za

CLIENT

HARTENBOS
Garden Estate
Natur-Landgoed

PROJECT

HARTENBOS GARDEN ESTATE

TITLE

SEWER NETWORK
LAYOUT PLAN

DESIGN	JL Roets — Prof Reg No: 937005
DRAWN	LJR
DATE	MAY 2021
PROJECT NUMBER	1704062
COMPUTER NAME	Hart Sewer.dwg
SCALE	1:2000
DRAWING NUMBER	1704062/300
REVISION	0