FINAL BASIC ASSESSMENT REPORT
APPENDICES: VOLUME NR. 2

DEVELOP AN AGRICULTURAL ESTATE ON REMAINDER PORTIONS 8, 13 AND 14 OF MALELANE ESTATE 140 JU: MALELANE, MPUMALANGA
PROJECT REFERENCE: 1/3/1/16/1E-346

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FOR SUBMISSION TO:

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SEPTEMBER 2021

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ABBREVIATIONS

ASAP	As Soon As Possible
Asl	Above sea level
CBAs	Critical Biodiversity Areas
cm	centimetre
DAFF	Department of Agriculture, Forestry and Fisheries
DARDLA	Department of Agriculture: Resource Management: Provincial
DARDLEA	Department of Agriculture, Rural Development, Land and Environmental Affairs
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Programme
ESAs	Ecological Support Areas
ESKOM	Electricity Supply Commission
GPS	Geographical Positioning System
HIA	Heritage Impact Assessment
HIV	Human Immunodeficiency Virus
I&AP's	Interested and Affected Parties
IEM	Integrated Environmental Management
KMAE	Kruger Malelane Agri Estate
LFIS	Low Flow Irrigation System
m	metre
mm	millimetre
m/s	metre per second
NA	Not Applicable
NDA	National Department of Agriculture
NEMA	National Environmental Management Act

MTPA	Mpumalanga Tourism and Parks Agency
PDI	Previously Disadvantaged Individual
RES	Rhengu Environmental Services
SABS	South African Bureau of Standards
SAHRA	South African Heritage Resources Agency
sqm	square metre

APPENDIX 6: TECHNICAL REPORTS AND STUDIES
APPENDIX 6.1: SERVICES REPORT

NOVEMBER 2020

ENGINEERING SERVICE REPORT FOR PROPOSED SUBDIVISIONS ON PORTIONS 8, 14 AND 14 OF THE FARM MALELANE ESTATE 140-JU

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SECTION A: INTRODUCTION

A-1 TERMS OF REFERENCE

This report has been compiled to give an overview of initial proposals for the provision of civil and electrical engineering services for proposed subdivisions on portions 8, 13 & 14 of the Farm Malelane Estate 140-JU. The development will consist of 25 subdivisions which will each have a demarcated area along the Crocodile River front or the stream to the east for the purpose of building a residence and the remainders of the properties will be used for farming.

A-2 OBJECTIVES

The objectives of the investigation are the following:

- to investigate the required bulk and connector services, as well as to propose appropriate levels of service for internal civil services;
- to evaluate all aspects pertaining to the internal and bulk engineering services to the subdivisions, in order to enable all role players to make decisions on the provision of services to the development.

A-3 SCOPE OF INVESTIGATION

The scope of the report includes:

- Study area and demarcation;
- Information and design criteria;
- Existing and anticipated development;
- Applicable Legislation;
- Water Supply:
  - Water Treatment
  - Bulk Water Supply
  - Storage facilities
  - Distribution
  - Proposed new infrastructure
- Sanitation:
  - Sewage Treatment
  - Sewerage flows and loading;
  - Outfall sewers;
  - Connector sewers ;

- Roads:
  - Existing roads network;
  - Future roads;
  - Proposed new roads;
- Storm Water Drainage:
  - Drainage areas;
  - Storm Water flows;
  - Proposed infrastructure;
- Disposal of Solid Waste;
- Environmental Issues;
- Financial Implications;
- Summary and Recommendations.

A-4 BACKGROUND

The subdivisions are intended to create 25 new residential development opportunities without losing the agricultural potential of the development area.

SECTION B: SUMMARY AND RECOMMENDATI4ONS

B-1 SUMMARY

B.1.1 The development is located south and adjacent to the 1:100 floodline of the Crocodile River, west of Malelane, opposite the National Kruger Park.

B.1.2 Access to the development will be from existing road D1239 which is an extension of Opdraend Street in Malelane.

B.1.3 The development will consist of 25 subdivisions of which each will have a demarcated area along the Crocodile River front or stream to the east for the purpose of building a residence and the remainders of the properties will be used for farming.

B.1.4 Bulk services are not available in the area, and all required infrastructure will have to be provided.

B.1.5 Raw water will be sourced from existing boreholes.

B.1.6 A sewage treatment plant will be constructed at a suitable position within the development area and all the sewage from the reticulated sites within the development will be treated at this treatment plant. Treated outflow will either be used for irrigation purposes or released in to a natural watercourse within the development. .

B.1.7 Eskom is the supply authority for electricity in the area. The electrical services report is attached under Annexure B.

B.1.8 The level of services to be provided for the remainder of the development is as follows:

- Water supply – connection per building for in-house supply;
- Sanitation – full waterborne sewerage system with a connection for each chalet and all other facilities on site.
- Roads – designed light structure, unsurfaced;
- Stormwater drainage – surface drainage channels;
- Electrical Supply – Bulk supply from Eskom and an underground reticulation system.
- Refuse removal – daily door-door by Resort Management, owner supplies storage. Waste will be collected weekly by the Nkomazi Municipality.

B-2 RECOMMENDATIONS

B.1.9 It is recommended that:

This report be considered by all role players.

SECTION C: PLANNING

PART I - GENERAL

C-1.1 STUDY AREA

The study area comprises a portion of Portions 8, 13 & 14 of the Farm Malelane Estate 140- JU, which is located west of the Crocodile River, just outside the 1:100 flood line, opposite the KNP and is ± 28.4 ha in size.

The area is located between contours 290m and 311m above mean sea level and the average annual rainfall is 460mm. The terrain is undulating with relative flat gradients with a natural waterway along the eastern boundary.

C-1.2 INFORMATION

Information has been obtained from the following sources:

- Van Staden Land Surveyors	:	Topographical and cadastral information
- Derick Peacock & Associates	:	Conceptual Layout Plan
- CSIR Building and Construction Technology	:	Human Settlement Planning and Design
- Sembcorp	:	Guideline for the planning, design and construction of water and sanitation services.

C-1.3 TOWN PLANNING ASPECTS

A layout plan for the development was compiled by Derick Peacock & Associates. This layout plan is used for the investigation into the provision of engineering services to the area. The conceptual layout has been included as Annexure A, and includes the basic civil infrastructure layout, position of raw water extraction, position of water and sewer treatment plants etc.

The development will consist of 25 subdivisions with each having a demarcated area along the Crocodile River front or stream to the east for the purpose of building a residence and the remainder of the properties will be used for farming.

C-1.4 ENVIRONMENTOL MANAGEMENT PROGRAMME

An Environmental Management Programme has been compiled by Rhengu Environmental Services.

C-1.5 EXISTING INFRASTRUCTURE

The only existing infrastructure is an agricultural irrigation system with water sourced from the Crocodile River.

C-1.6 GOVERNING LEGISLATION

The development of any area and the provision of services are inter alia governed by the following legislation:

- Constitution;
- National Environmental Management Act (Act 107 of 1996);
- Environmental Protection Act (Act 73 of 1989);
- Water Services Act (Act 108 of 1997);
- National Water Bill (Act 36 of 1998);
- Local Government Transitional Act: Second Amendment Act (Act 97 of 1996).

The main aspects with regard to legislation to be taken into account are the following:

- The right to a healthy environment and the protection of the environment are included in Chapter 2 of the Constitution as a basic human right. This means that any person can approach a court for relieve should he or she be of the opinion that his or her human rights are threatened. This places restrictions on the development of areas and the provision of infrastructure.

- The **Environmental Protection Act (Act 73 of 1989)** gives the Minister the power to require full Environmental Impact Assessments (EIA) on certain projects. In September 1997 the Minister identified various activities that require full EIA's, which activities include the following:

  - Rezoning of any area for development Waste water treatment facilities;
  - Bulk water supply facilities for potable water;
  - Roads, air fields, railways, etc;
  - Canals and channels including diversion of normal river flows;
  - Disposal of water.

- The **Water Services Act** requires that a water services development plan be compiled for all areas supplied with potable water by the supply authority concerned. One of the main objectives of the Act is to monitor and control the use of water and to limit losses. This requires the provision of metering facilities together with network requirements to facilitate zone metering, etc if practical.

PART 2: SERVICES DEMANDS

C-2.1 GENERAL

The level of civil services to be provided in terms of water and sewer will be in terms of current design standards to comply with current legislation and on the availability of funds as well as practical considerations.

C-2.2 DESIGN CRITERIA

The design criteria as recommended in the "Guidelines for Human Settlement Planning and Design", issued by the CSIR - Building and Construction Technology are applied, except where indicated otherwise.

C-2.3 PROPOSED LEVELS OF SERVICE

The levels of service adopted for the development are the following:

Water Supply	Potable water and connections for in-house supply and smart meters for management.
Sanitation	Full waterborne sanitation to sewer system and treatment works.
Roads (Class 5)	Designed light structure unsurfaced.
Storm water drainage	Surface storm water drainage incorporating grassed channels if required. .
Refuse removal	Weekly collection door-to-door, Resort Management supplies storage.

C-2.4 SERVICE DEMANDS

C.2.4.1 Water Supply for Household Use

The Unit Annual Average Daily Demand (AADD) for large residential stands are given as 1.3-2.0 kl/day/stand. Assuming 15% loss of water in the supply system, the Total Average Annual Daily Demand (TAADD) is therefore 57.5 kl/day.

C.2.4.2 Water Supply for Fire Fighting

The water supply system should cater the low fire-risk category. The following criteria must be met:

- Total Fire Flow - 15 l/s
- Minimum flow at any hydrant - 15 l/s
- Minimum pressure at fire node – 10m
- Minimum pressure at the rest of the system – 5m
- Duration of fire flow – 1hour

The storage demand for firefighting is therefore 54 kl.

Each trunk mains within the development must be designed for a design flow equivalent to the sum of the design fire flow plus the design instantaneous peak domestic demand for the area served by it.

Water Storage

A minimum storage of 36 hours of TAADD is recommended. The total storage capacity required equates to 140.25 kl (86.25 kl for 36 hours domestic and commercial demand and 54 kl for firefighting purposes).

C.2.4.3 Sewerage

The Unit Peak Daily Dry Weather Flow is calculated as follows:

Input data:

- Number of low density residential stands = 25
- Unit Peak Daily Dry Weather Flow 0.8 kl/unit/day (Unit Hydrograph Type 1)
- Person per unit = 5
- Peak Factor = 2.5

Calculation:

- Number of persons = 125
- Instantaneous Dry Weather Flow (IPDWF) (excluding infiltration) = 25 x 0.8 x2.5 ÷ (24h x 60min x 60s) = 0.579 l/s
- Peak Daily Dry Weather Flow (PDDWF) = 50 kl/day
- Average Daily Dry Weather Flow (ADDWF) = 19.2 ÷ 1.1 = 18.2 kl/day

Groundwater infiltration:

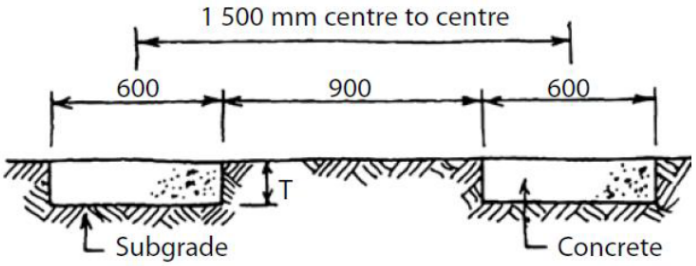
- Estimated pipe reticulation length = 25 x 25m = 625m
- Assume pipe diameter will be 100mm
- Infiltration flow = 0.04l/min/m/m x 625m x0.1mmØ ÷ 60sec = 0.042 l/s
  = 0.04 x (24h x 60 min x 60 sec) ÷ 1000
  = 3.6 kl/day

The AADWF plus infiltration = 18.2 + 3.46 = 21.66 kl/day

It is recommended that some spare capacity in the sewage treatment plant be provided to cater for storm water ingress.

C.2.4.4 Roads

Access to the development will be from road D1239 which is an extension of Opdraend Street in Malelane. The residential portions of the properties will be provided access from a road which will be constructed along the southern and western boundaries of the residential portions as indicated on the development plan. Consideration is being given to constructing concrete strip roads (see figure below), Otherwise the roads may be constructed as unsurfaced roads.



C.2.4.5 Storm Water Management

Proper storm water management is essential to ensure protection of life and property from flood hazards and that the natural environment is protected. The objectives of storm water management can be summarized as follows:

- to provide a storm water drainage system for the protection of property from damage by runoff from frequent storms;
- to prevent loss of life and reduce damage of property from severe storms;
- to prevent land and watercourse erosion;
- to protect water resources from pollution;
- to preserve natural watercourses and their eco-systems;
- to achieve the foregoing objectives at optimal total cost.

The area generally drains to the Crocodile River to the north which flows from west to east. The 1:100 year floodline have been calculated and are indicated on the drawings. No new development will be allowed within the 1:100 year floodplain.

C.2.4.6 Electricity Supply

The development will have a bulk supply from ESKOM with an underground reticulation system will be installed and will remain the property of the developer. The developer/resort management will be responsible for the maintenance and management of the system.

See Annexure B for the electrical services report.

C-2.5 DESIGN PARAMETERS

C2.5.1 Water Supply

Item	Sub-Item	Criteria
Velocity	Maximum	1,2 m/s
	Preferred	0,6 m/s
Pressures	Minimum peak flow	12 m
	Maximum	90 m
Minimum storage capacity		48 h of ADWD
Fire Flow		Low Risk – Group 2

C2.5.2 Sewage Disposal (Waterborne Sewerage)

Item	Sub-Item	Criteria
Minimum pipe Ø		100 mm
Minimum manhole spacing		80 m
Minimum flow velocity		0,7 m/s (full flow)
Peak design flow		Full bore capacity of pipe
Allowance for extraneous flows		15 %
COD loading		600 g/stand/day
Nitrogen loading		60g stand/day

C2.5.3 Streets

Item	Sub-Item	Criteria
New roadways	Road Category	Class 5c
	Traffic Class	ER (<0,05 x 10^6 E80's)
	Unsurfaced (Possibly two concrete strips)	5.0 m min

C2.5.4 Storm Water Drainage

Storm water drainage systems will be designed to accommodate a 1:2 year flood frequency.

C-2.6 CONSTRUCTION REQUIREMENTS

2.6.1 General

The proposed construction and material requirements are indicated below and will be incorporated in the detail design.

C2.6.2 Water Reticulation

ITEM	CRITERIA
Location	Where practical.
Pipe material	uPVC Class 12 for distribution
	HDPe Class 10 Type 4 for house connections
Valves	Resilient seal valve anti-clockwise closing to SABS 664, socketed for uPVC or flanged to Table D
Valve chambers	600mm x 600mm brick with cast iron cover
Air valves	Single orifice plastic
Water meters	Kent meters, complete with chamber

C2.6.3 Sewerage Reticulation

ITEM	CRITERIA	
Location	Where practical	
Pipe material	Heavy duty PVC pipes	
Manholes	1 000mm diameter precast concrete	
Rodding eyes	ABC cast iron with cast iron cover and frame box	
Manhole covers	Cast iron Type 2A in roadways	
	Cast iron type 4 VP for midblock sewers	
Stand connections	110 mm diameter with end cap , location 1m x 1m on low point of stand	
Minimum pipe diameter	100 mm	
Minimum gradients	Diameter	Minimum gradient
	100	1:120
	150	1:200
	200	1:300
	300	1:400

C2.6.4 Streets

ITEM	CRITERIA
Location	As per layout
Side walks	N/A
Kerbs	N/A
Edge restraints	N/A
Wearing course	Gravel
Structural design	N/A
Road markings	N/A

C2.6.5 Storm Water Drainage

ITEM	CRITERIA
Location	In road reserve directly adjacent to kerbs
Minimum diameter	N/A
Junction boxes	N/A
Stormwater channels	V-shaped, grassed
Kerb inlet	N/A

PART 3 – BULK SERVICES

C-3.1 GENERAL

The Nkomazi Local Municipality has no bulk services available in the vicinity of the development area and all bulk services will have to be provided by the developers.

C-3.2 WATER SUPPLY

C.3.2.1 Source

A groundwater resource evaluation study was done by In-Situ Consulting cc and three boreholes were tested and deemed suitable as a source of water for the residential development. The boreholes with recommended daily abstraction volumes are given in the table below:

Borehole Number	Coordinates	Borehole Depth (m)	Pump inlet depth (m)	Daily Abstraction Volume (m^3/day)
NK-02765	S25.501780° E31.476610°	45.38	30	107.57
NK-02766	S25.501840° E31.476140°	34.95	30	115.20
NK-02767	S25.502180° E31.474380°	44.00	40	57.60

Borehole NK-02767 Is located within the railway reserve and a servitude will have to be registered for the borehole before it may be considered a source of supply for the development.

The combined yield form the other two boreholes NK-02765 and NK-02766 is 222.77 m^3/day which is substantially more than the Total Average Annual Daily Demand (TAADD) which is 57.5 kl/day.

It is recommended that the abstraction schedule of the boreholes be less than 8 hours/day boreholes and that alternating pump schedules be implemented for boreholes NK-02765 and NK-02766 as they influence each other.

C.3.2.2 Water Treatment

The water quality tests done on water sourced from the boreholes indicate that the water is not safe for human consummation due to elevated turbidity values and high total Coliforms counts.

The water is also moderately to very hard which means that it contains high volumes of calcium and magnesium salts. This will cause damage to water heating appliances and will also cause scaling in water pipes.

The water will therefore have to be treated before it can be used for household use.

A Water Treatment Plant will be provided at the water storage facility and the detail of the proposed plant to be constructed is included under Annexure C.

The raw water from the boreholes will be pumped into a raw water holding tank (2500 liter is proposed), and then fed through the treatment plant with a small duty/standby pump installation to the clean water storage tank.

C.3.2.3 Storage and Supply

The storage requirements are 86.25 kl for domestic consumption (36 hours of TAADD) plus 54kl for firefighting which equates to 140.25 kl. A new reservoir of ± 150kl will be installed at the position as shown on the layout drawing. The elevation of the reservoir area is not sufficient to provide sufficient pressure, and a booster pump system with standby electricity will have to be provided.

Two outlets will be provided from the storage tank at different heights to ensure that water for firefighting purposes are always available in storage.

C-3.3 SEWAGE DISPOSAL

C.3.3.1 Bulk Drainage

The area drains towards the east, and lowest point is next to the Crocodile River. It is proposed that the sewer lines be laced just outside the riparian buffer. No reticulation lines will be constructed within the 1:100 year flood line and one sewer pump station will be required to pump sewer to the proposed sewer treatment plant.

The total Annual Average Dry Weather Sewage Flow is estimated at 21.66 kl/day.

C.3.3.2 Treatment

A Waste Water Treatment Plant will be constructed next to the water treatment plant and the treated water will be used for irrigation. The treated effluent will comply with the general standards required by the department of Water Affairs and Forestry and will be of such quality that the treated water can be used for irrigation purposes.

Detail of the treatment plant can be seen under Annexure D.

C-3.4 ACCESS

Access to the development will be from road D1239 located along the southern boundary of the development area. The road is an extension of Opdraend Road in Malelane.

C-3.5 DISPOSAL OF SOLID WASTE

It is proposed that solid waste be taken daily in municipal refuse bags to a holding facility at the entrance gate to the development. The holding facility must be properly walled in with a concrete floor, water supply for washing of the area as well as a drain. The Nkomazi Municipality collects the waste on a weekly bases.

C-3.6 ELECTRICITY SUPPLY

The supply authority in the area is ESKOM. A report has been compiled on the provision of electricity to the development by P&L Consulting Electrical Engineers. The report is herewith included as Annexure B.

PART 4 – INTERNAL SERVICES

C-4.1 GENERAL

The development will be provided with high order internal services which will consist of a metered water connection for each building, a waterborne sewerage connection for each building and access to a road network.

C-4.2 WATER RETICULATION

The proposed water reticulation network will consist mainly of uPVC Class 16 piping of varying diameters. The network will be designed to ensure a minimum peak flow pressure of 24m to each stand, with a maximum static pressure of 90 m. Provision will be made for fire flow and fire hydrants and fire hose reels will be provided.

Isolating valves will be provided so that a maximum of four valves must be closed to isolate a section of the network for maintenance. Scouring will be allowed at low points with the provision of fire hydrants. Air valves will be provided where required.

Smart water meters will be installed as well as bulk meters to enable the developer to manage the water consumption, have minimal water losses and to identity leaks.

C-4.3 SEWER RETICULATION

The sewer reticulation network will be installed with a minimum pipe size of 100mm (internal diameter) and a maximum manhole spacing of 80m. A house connection to each stand will be provided. Manholes will be located for convenient access.

The pipes will be placed where practical and will gravitate to low points form where the sewer will be pumped to the treatment plant.

C-4.4 STREETS

A road network will be provided to distribute traffic between activities within the development area.

From the Geotechnical Investigation conducted by Johan van der Merwe (Pty) Ltd it is evident that the soils present within the development area are unsuitable for to be used for the construction of roads and material for layer works will have to be imported.

C-4.5 STORM WATER MANAGEMENT AND EROSION CONTROL

The storm water channels and structures will be designed for a 1:2 year storm recurrence, except at the piped crossings where a 1:5 year storm recurrence is catered for. Run-offs from 1:20 year storms will also be evaluated to prevent or limit possible damage. The infrastructure will be located within the road servitudes.

Modern stormwater management practices is aimed at consider stormwater as part of the urban water cycle, a strategy which is increasingly being known as Water Sensitive Urban Design (WSUD) with the stormwater management component being known as Sustainable Drainage Systems (SuDS).

A number SuDS options are available which are grouped in three categories namely:

- Source Controls are used to manage stormwater runoff as close to its source as possible — generally within the boundaries of the property.
- Local Controls are used to manage stormwater runoff as a second 'line of defense' typically in public areas such as roadway reserves and parks.
- Regional Controls are used to manage stormwater runoff as a last 'line of defense'. They are generally large-scale interventions which are constructed on municipal land.

For this development it is expected that only Source and Local controls will be implemented.

Source Controls include the following and are normally specified by the estate architect as part of the Architectural Guidelines for the development:

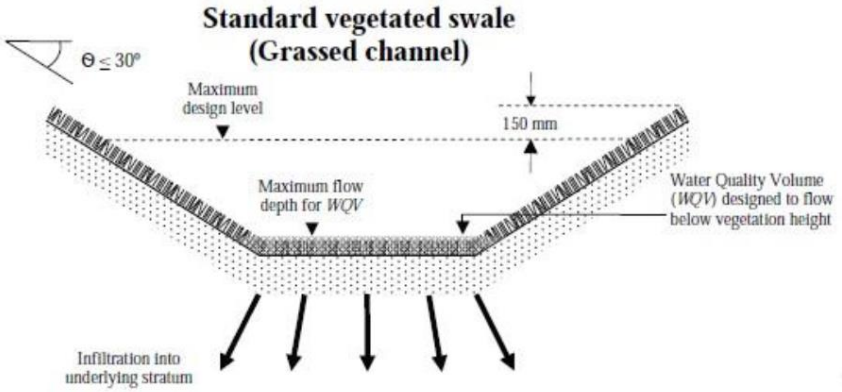
- Green roofs are vegetated roofs;
- Rainwater Harvesting refers to the temporary storage and reuse of rooftop and/or surface runoff.
- Soakaways are usually excavated pits that are packed with course aggregate and other porous media and are used to detain and infiltrate stormwater runoff from a single source.
- Permeable pavements comprise load-bearing, durable and pervious surfaces such as concrete block pavers (CBPs) laid on top of granular or stone base that can temporarily store stormwater runoff.

Local Controls include the following and

- Filter strips are vegetated areas of land that are used to manage shallow overland stormwater runoff through filtration;
- Swales are shallow grass-lined channels with flat and sloped sides that are used to convey stormwater from one place to another. They typically remain dry between rainfall events;
- Infiltration trenches are excavated trenches which are lined with a geotextile and backfilled with rock or other relatively large granular material. They are typically designed to receive stormwater runoff from adjoining residential properties;
- Rio-retention areas are landscaped depressions used to manage stormwater runoff through several natural processes such as filtration, adsorption, biological uptake and sedimentation;
- Sand filters usually comprise of an underground sedimentation chamber connected to a filtration chamber in which stormwater runoff is temporarily stored before being filtered through a sand filter.

This development can be considered as a very low density development which directly implies that runoff won't be significantly increasing impermeable areas.

It is proposed that soakaways be used within the residential sites to lessen the impact of runoff from the roofs combined with permeable paving, both source control measures. Another source control which could be considered is rainwater harvesting It is further proposed that swales by constructed adjacent to all the access roads as the primary local control. See the detail of a standard vegetates swale in the figure below:



Other measures will be in investigated during detail deign.

C-4.6 ELECTRICAL RETICULATION

An underground reticulation system will be installed within the road reserves and will remain the property of the developer. The developer/HOA will be responsible for the maintenance and management of the system. Each site will be supplied with a 60A single phase connection.

REFERENCES

References used in the compilation of this report are the following:

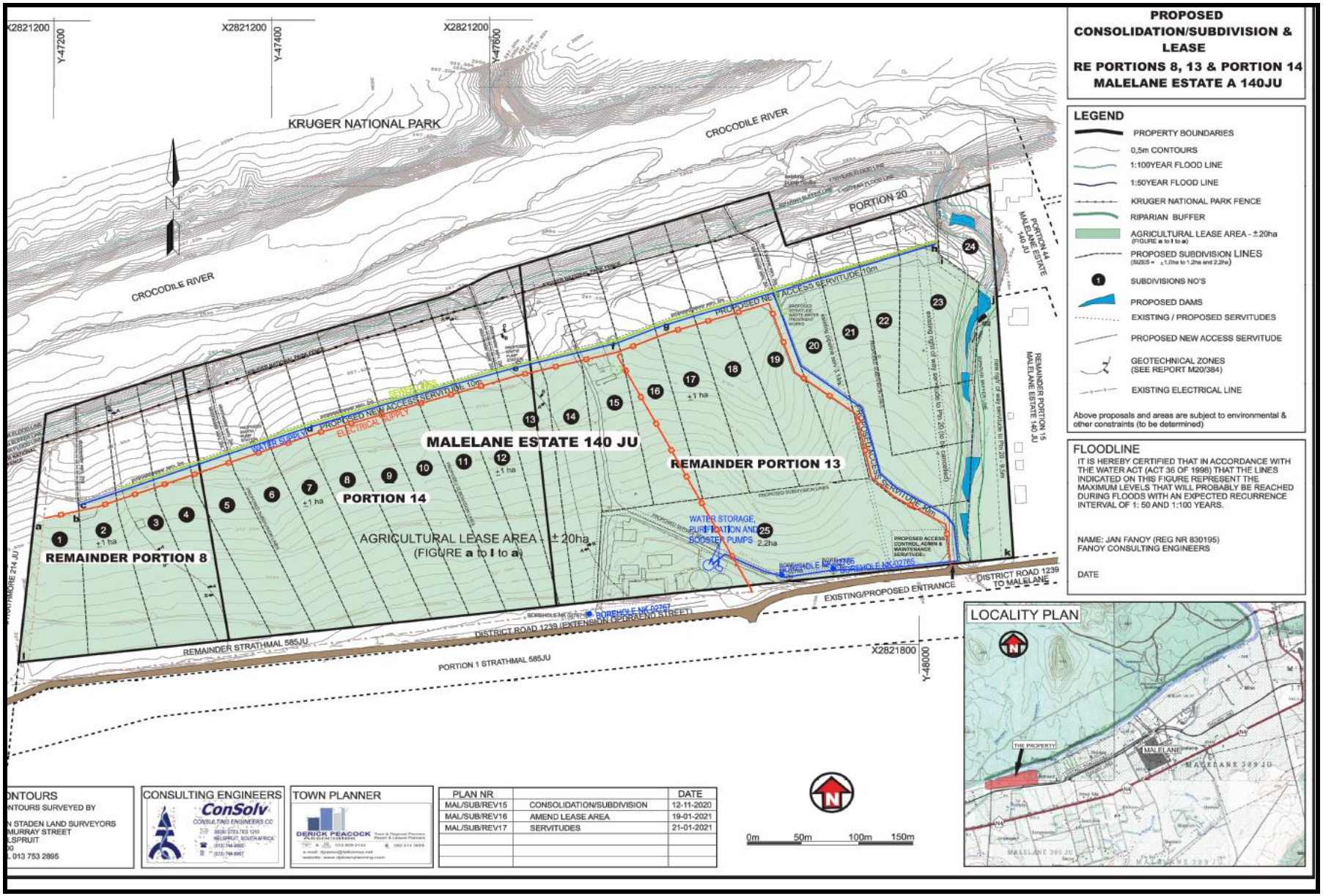
1. DEPARTMENT OF HUMAN SETTLEMENTS. *Neighborhood Planning and Design Guide, 2019.*
2. P&L CONSULTING ENGINEERS: Electrical Services Report for the Proposed Development on Portions 8, 13 & 14;
3. JOHAN VAN DER MERWE (PTY) LTD. Report an a Geotechnical Investigation carried out for the Proposed Residential Development on Portion 8, 13 & 14 of the Farm Malelane Estate 140-JU.
4. IN-SITU CONSULTING. Groundwater Source Evaluation on Portions 8, 13 & 14 of the Farm Malelane Estate 140-JU
5. HAMATINO CONSULTING ENGINEERS. Traffic Impact Statement for a Proposed Residential Development on Portions 8, 13 & 14 of the Farm Malelane Estate 140-JU.
6. WATER RESEARCH COMMISION. The South Africa Guidelines for Sustainable Drainage Susytems.

Yours sincerely

CONSOLV CONSULTING ENGINEERS

S.J.Triegaardt Pr.Eng

ANNEXURE A: CONCEPTUAL DEVELOPMENT LAYOUT


PROPOSED
CONSOLIDATION/SUBDIVISION & LEASE
RE PORTIONS 8, 13 & PORTION 14
MALELANE ESTATE A 140JU
LEGEND
PROPERTY BOUNDARIES
0,5m CONTOURS
1:100YEAR FLOOD LINE
1:50YEAR FLOOD LINE
KRUGER NATIONAL PARK FENCE
RIPARIAN BUFFER
AGRICULTURAL LEASE AREA - ±20ha
PROPOSED SUBDIVISION LINES
SUBDIVISIONS NO'S
PROPOSED DAMS
EXISTING / PROPOSED SERVITUDES
PROPOSED NEW ACCESS SERVITUDE
GEOTECHNICAL ZONES (SEE REPORT M20/384)
EXISTING ELECTRICAL LINE
Above proposals and areas are subject to environmental & other constraints (to be determined)
FLOODLINE
IT IS HEREBY CERTIFIED THAT IN ACCORDANCE WITH THE WATER ACT (ACT 36 OF 1998) THAT THE LINES INDICATED ON THIS FIGURE REPRESENT THE MAXIMUM LEVELS THAT WILL PROBABLY BE REACHED DURING FLOODS WITH AN EXPECTED RECURRENCE INTERVAL OF 1: 50 AND 1:100 YEARS.
NAME: JAN FANOY (REG NR 830195)
FANOY CONSULTING ENGINEERS
DATE
KRUGER NATIONAL PARK
CROCODILE RIVER
PORTION 20
MALELANE ESTATE 140 JU
REMAINDER PORTION 13
PORTION 14
REMAINDER PORTION 8
AGRICULTURAL LEASE AREA ± 20ha
(FIGURE a to l to a)
PROPOSED NEW ACCESS SERVITUDE 10m
PROPOSED ACCESS SERVITUDE 20m
WATER STORAGE, PURIFICATION AND BOOSTER PUMPS 2,2ha
EXISTING/PROPOSED ENTRANCE
DISTRICT ROAD 1239 TO MALELANE
DISTRICT ROAD 1239 (EXTENSION GEORGE STREET)
REMAINDER STRATHMAL 585JU
PORTION 1 STRATHMAL 585JU
REMAINDER PORTION 15 MALELANE ESTATE 140 JU
PORTION 44 MALELANE ESTATE 140 JU
X2821200
Y-47200
Y-47400
Y-47600
X2821800
Y-48000
LOCALITY PLAN
THE PROPERTY
MALELANE
CONTOURS
CONSULTING ENGINEERS
ConSolv
TOWN PLANNER
DERICK PEACOCK ASSOCIATES
PLAN NR
DATE
MAL/SUB/REV15 CONSOLIDATION/SUBDIVISION 12-11-2020
MAL/SUB/REV16 AMEND LEASE AREA 19-01-2021
MAL/SUB/REV17 SERVITUDES 21-01-2021
0m 50m 100m 150m

PARTNERSHIP • VENNOOTSKAP
P&L
CONSULTING ENGINEERS
RAADGEWENDE INGENIEURS

MALELANE ESTATE, MALELANE

PORTION 8, 13 and 14 OF 140 JU

SERVICES REPORT: ELECTRICAL

NOVEMBER 2020

Prepared By:
CJM Pienaar BScIng Hons Elek PrIng

TABLE OF CONTENTS

1. INTRODUCTION

This report has been compiled to give an overview of initial proposals for the provision of electrical and Telkom services for the proposed Malelane Estate on Portions 8,13 and14, 140 JU in the Malelane district. The development will consist of 25 units and water purification plant.

This report is based on the requirements from Eskom, Telkom and SANS for developments like this.
It is recommended that solar water heaters are used for this development.

2. PROJECT DESCRIPTION

The proposed development will consist of:

- 25 units
- Water purification plant

3. ELECTRICAL INFRASTRUCTURE

The supply authority will be Eskom. (There is an existing Eskom supply on site).
Please note that Eskom has an11m servitude on both sides of an overhead line.

The supply authority in this area is ESKOM. The design will be done to comply with the ESKOM standards. As soon as the development goes ahead, measurements will be taken of the existing Eskom capacity. Once the developer has decided whether solar or electrical water heaters will be used, we will apply for the balance of electrical capacity. I spoke to ESKOM and they have some capacity on their system. This capacity will be given on a first apply first served basis.
My recommendation is that before any work starts; a formal application must be made at Eskom. Eskom will then give a cost that must be paid before they will make a formal offer.

4. DESIGN PARAMETERS

We propose that this development comply with SANS 10400-XA.
This SANS regulation gives the standards for energy usage in buildings.
The climate zone for this area is 3 (Hot interior).
We did not design the electrical installation in the units
Please note the following requirements for electrical installations in this area (energy):

- The maximum energy demand under these conditions is 95W / m^2.
- The maximum annual electrical consumption under these conditions is 585kWh / m^2.

5. INTERNAL RETICULATION

As this camp is close to the Kruger National Park, I would propose an underground reticulation system. The development will get a supply point from ESKOM. The underground reticulation system will be the property of the developer.
The maintenance, meter reading and billing for electricity consumption will be handled by the developer. Each unit shall be supplied with a 60A single phase supply.

6. METERING

There will be a bulk meter at the Eskom point and no sub-metering.

7. STREET LIGHTING

I accept that no street lights will be required as this is a development close to the Kruger National Park.

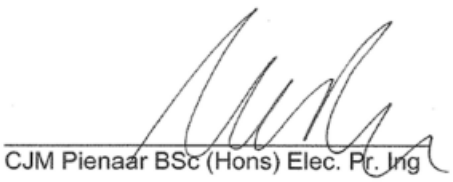
8. COMMUNICATION SYSTEM

We recommend a wireless LTE system as Telkom is phasing out copper systems.

9. EXISTING ELECTRICAL SERVICE

There are existing Eskom lines.
To move these lines, a process must be followed with Eskom.
This process takes approximately 6-9 months.
The design must be done and then it must be presented at their TEF meeting in Witbank.

Regards,



CJM Pienaar BSc (Hons) Elec. Pr. Ing

ANNEXURE C: WATER TREATMENT PLANT

WATER SOFTENER

Manufactured by Aquamat
WATER SOLUTIONS SINCE 1968

AQUAMAT WATER SOFTENERS

The smart, simple and cost-effective solution to all your hard water problems!

MADE IN SA

PROVEN INTERNATIONAL PERFORMANCE CREDENTIALS

AQUAMAT WATER SOFTENERS
DOMESTIC • INDUSTRIAL

THE PROBLEM:

WHAT IS HARD WATER?

Hard water is caused by the presence of too much calcium and magnesium. These minerals dissolve into the water and negatively affects its properties.

WHY IS IT A PROBLEM?

Whether you're running a household or an industrial business, water is the one element you simply can't do without. However if the water is hard, it can become more of a hindrance than a help. Instead of washing away impurities, hard water can actually have the opposite effect.

- **Washing and laundry**

  Instead of dissolving completely, soap combines with minerals in the water to form a sticky sludge. This soap curd sticks to skin and hair, as well as laundry fibres, making it very counter-productive to the cleaning process. The insoluble soap deposits also leave spots on dishes, tiles, floors and vehicles after rinsing.

- **Limescale**

  Household appliances such as kettles, dishwashers and water heaters can also suffer from limescale, which significantly reduces their efficiency and lifespan.

- **Plumbing problems**

  Perhaps the most troublesome concern is the effect hard water has on plumbing systems. Mineral deposits can clog up pipes and taps, reducing water flow and causing damage to the entire system.

TYPICAL APPLICATIONS

Residential

- Laundry and kitchen appliances
- Bathrooms, showers and toilets
- Personal hygiene

Industrial

- Boilers, heat exchangers, compressors
- Storage tanks and piping equipment
- Large laundry and restaurant facilities
- Wastewater reuse

LASTS UP TO 15 YEARS

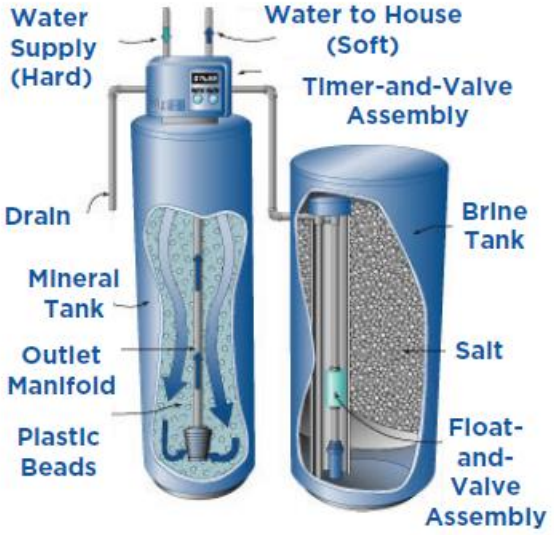
MORE COST EFFECTIVE

REMOVES ALL LIME HARDNESS

THE SOLUTION:

Aquamat Water Softener is the No. 1 hard water solution in Africa!

Aquamat Water Softeners use only the best quality high-capacity softener resins and control valves imported from the USA to effectively transform hard water into soft water. This innovative system eliminates the damaging effects of limescale and soap build up on your home and industrial machinery. The efficiently designed water softening
system is built to last up to 15 years, depending on the quality of water.



WHAT THE PRODUCT DOES:

How Aquamat Water Softeners work

Our Water Softener uses a highly effective and economical process known as ion exchange that removes calcium and magnesium from hard water in exchange for harmless sodium.

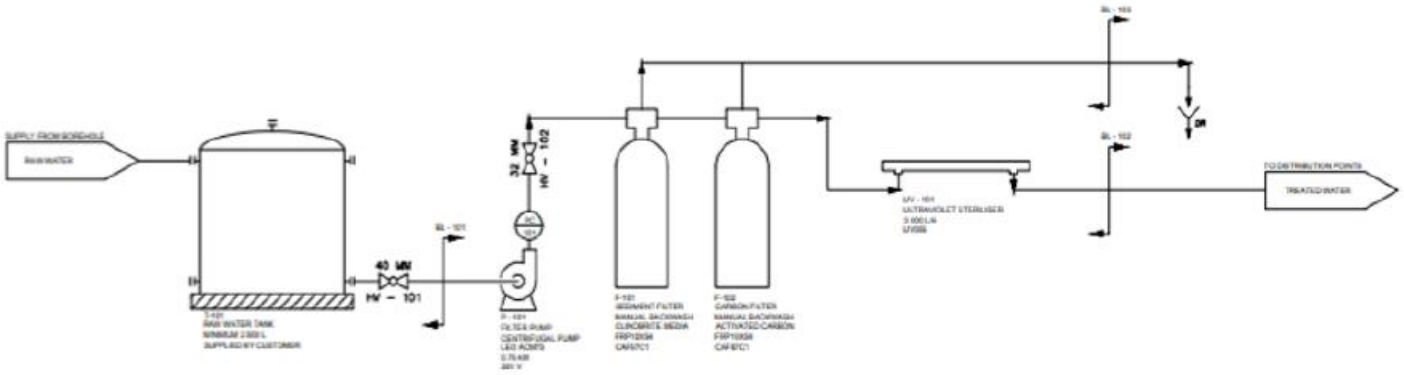
Hard water enters a mineral tank filled with resin beads covered in sodium ions. As the hard water flows past the resin beads, the sodium ions dissolve into the water and are replaced by the calcium and magnesium ions. Once the beads are saturated with calcium and magnesium ions, they need to be regenerated. A concentrated brine solution is flushed through the tank, washing the calcium and magnesium from the resin beads and replacing them with sodium. The mineral tank is then flushed of excess brine and the water is ready for use.

THE BENEFITS:

WHY THE AQUAMAT WATER SOFTENER SYSTEM IS BETTER THAN THE REST!

- Easy to install, use and maintain
- More cost-effective than distillation or reverse osmosis
- Uses high-quality imported resin beads and control valves
- Robust design lasts up to 15 years
- Removes limescale and soap deposits to protect appliances and plumbing
- Softens water to improve cleaning action and rinsing efficacy
- Suitable for domestic and industrial use

Water System Basic Layout



Water Softener or
Water Filter system
with UV Sterilisation

Drinking Water Softener system

Frame mounted
System

UV Sterilising UV

Booster pump on
Pressure switch

ANNEXURE D: MASKAM FUSION SEWAGE TREATMENT PLANT

Applications:

- Households and grouped housing
- Schools
- Hotels
- Office blocks
- Lodges & guest houses
- Farms
- Factories
- Informal settlements
- Commercial wastewater secondary treatment
  Waste strength reduction:
  <75 mg/l COD
  <25 mg/l TSS
- Commercial wastewater pre-treatment before discharging to municipal sewer network (COD reduction)

Material:

- All materials are noncorrosive in the septic environment.

Easy to install or retrofit:

Save water - Treat your waste water on-site and re-use for:

- Toilet flushing
- Irrigation
- Cleaning of hard landscaping
- Water features
- Other non-potable uses (potable use is possible through further treatment)

Maintenance:

- System will be provided with maintenance contract.
- Maintenance provider is dependent upon geographical location.
- 6 Monthly service required.
- No check-ups needed between service intervals.

Disinfection:

- Chlorine / UV / Ozone

Electrical Panel

- Monitors the system 24/7
- Warning light and siren will notify user if a problem occurs
- IP65 enclosure
- Power supply to Blower and UV (disinfection)
- Indicator lights on front of panel for each alarm condition
- Optional: GSM module

Air Pump

- Feeds oxygen to aeration chamber and powers recirculation/sludge return

Available models

Clarus Model	Daily Treatment Capacity * (litres per day)	Length (mm)	Width (mm)	Height (mm)	Power consumption (Watts) Excluding disinfection
ZF 450	1500	2160	1120	1580	58
ZF 800	3000	2500	1450	1880	58
ZF 1120	4000	3020	1750	2000	95
ZF 1440	5000	3380	1840	12150	115
ZF 2000	7500	3960	1990	2270	125
ZF 2400	9000	4670	1990	2270	210
ZF 3200	12000	4560	2260	2420	340
ZF 4000	15000	4860	2440	2540	340

* Daily treatment capacity is based on influent values equal to or less than domestic sewage (grey and black water combined). The influent values below is the maximum organic loading for the above treatment capacities. For influent with heavier loadings, please contact our office or your nearest Maskam Water Dealer to assist with sizing the correct plant for your application.

COD	400	BOD	250	Ammonia	20

CLARUS ENVIRONMENTAL
Zoeller Family of Water Solutions

Financing available

The saving in your water bill can cover the instalment

www.maskamwater.com

CLARUS ENVIRONMENTAL
Zoeller Family of Water Solutions™

3649 Cane Run Road • Louisville, KY 40211-1961, USA
1-800-928-7867 • 1-502-778-2731 • Fax: 1-502-774-3624
www.clarusenvironmental.com

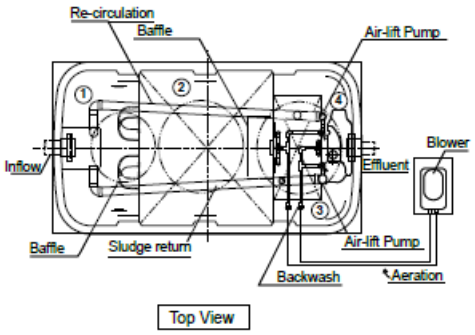
SECTION: C3.10.150
CL0053
1215
Supersedes
0214

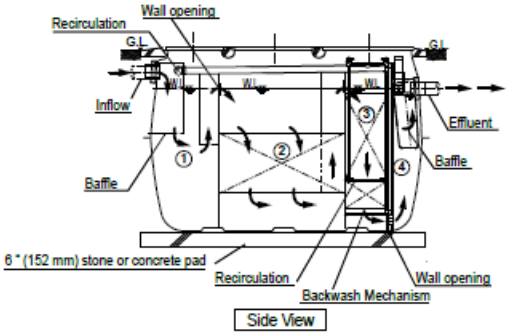
Fusion® Series Treatment Systems

PROCESS DESCRIPTION

NSF Certified to NSF/ANSI Standard 40 Class 1 Performance Designation

How the **Fusion®** system works





Numbers correspond to the explanations below.

1. **Sedimentation Chamber**
   This chamber is designed to physically separate solids (sludge) and fat/grease (scum) from the incoming water.

2. **Anaerobic Chamber**
   This chamber contains a spherical-skeleton type of filter media (4.3 inch diameter). Through fixed film processes on the surface of the filter media, biological anaerobic treatment thrives while suspended solids are captured. Furthermore, the microorganisms in this chamber convert nitrates in the recirculated water returning from the aerobic chamber to gaseous nitrogen. The nitrogen then escapes to the atmosphere.

3. **Aerobic Filter Media Chamber**
   The aerobic floating and circulating filter media chamber consists of an aeration upper section and a filter media lower section. The chamber is filled with hollow, cylindrical filter media (0.6 inch diameter and 0.55 inches long). Biological treatment takes place with the help of the fixed film growth on the filter media surface. Aeration is continuous. Residual suspended solids are captured by the filter media circulating in this section.

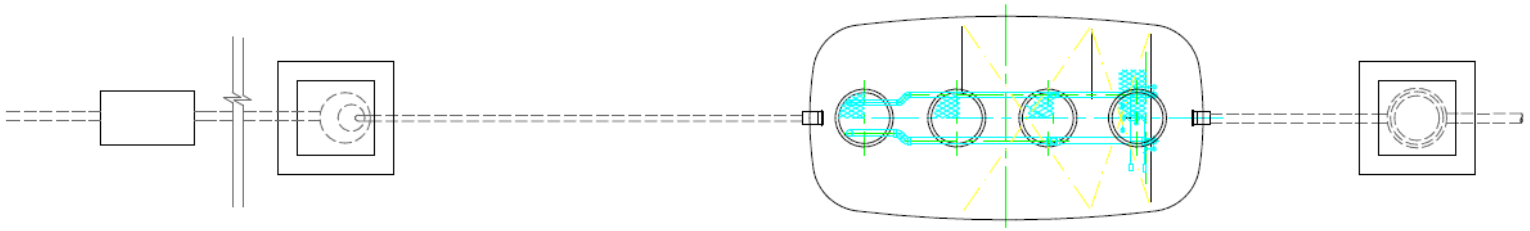
   The filter media in the Aeration chamber are backwashed regularly (5 or 10 minute cycle, twice a day) by the backwash system located at the bottom of the chamber. The backwashed water is transferred by an air lift pump back into the sedimentation chamber for further digestion.

4. **Treated Water Storage Chamber**
   During normal operation, a recirculation line transfers a portion of the treated water back into the sedimentation chamber by way of an air lift pump. This chamber is designed to temporarily store treated water coming out of the aerobic filter media chamber. The treated water in the storage chamber is ready for discharge.

All Clarus Environmental products must be installed and maintained in accordance with all applicable codes.
Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

Clarus Fusion ZF4000
Site Installation

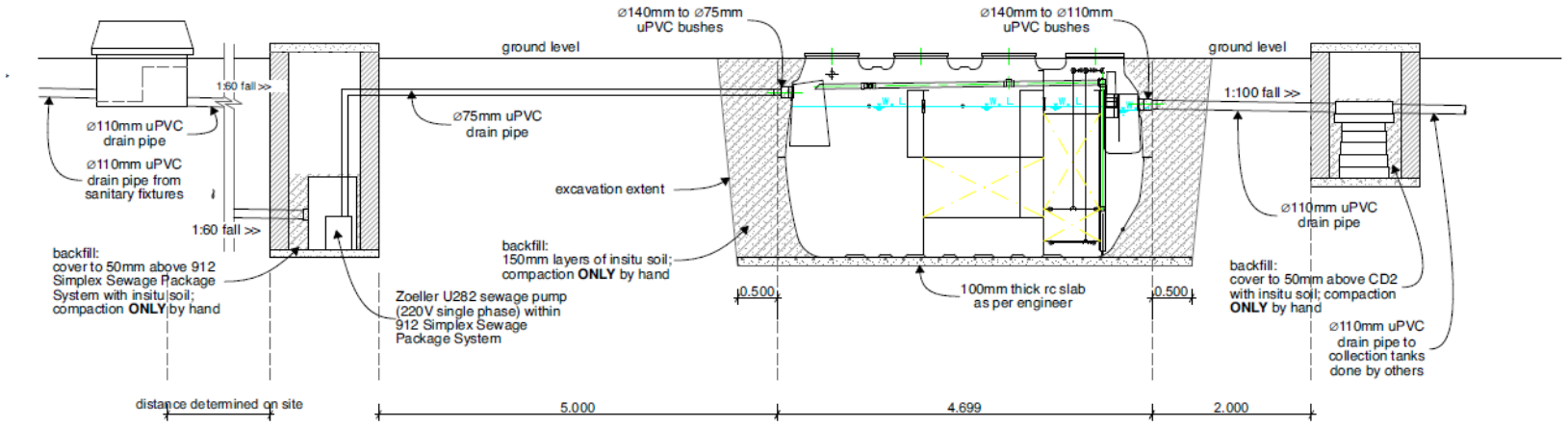
Electrical supply of 220/1 to the Fusion panel.
Zoeller pump and UVs from UV Chamber
connect into the panel, using 2,5mm wiring.



PLAN VIEW

S2 Hand Rake Screen	manhole built on-site by others Lifting Station	Clarus Fusion, ZF4000	manhole built on-site by others UV Chamber	done by others Collection Tanks

SECTION VIEW



APPENDIX 6.2:
GEOTECHNICAL REPORT
NOTE: The Soil Profile and Laboratory Results (27 pages) are not included. Interested and Affected Parties may request copies of the profiles/results from the EAP.

JOHANN van der MERWE (Pty) Ltd
CONSULTING APPLIED EARTH AND ENVIRONMENTAL SCIENTISTS

289 Polaris Avenue
Waterkloof Ridge 0181
Pretoria GAUTENG
SOUTH AFRICA

MOBILE : 082 570 2222
FAX: 0866 858 369
Email: jovdm@iafrica.com

P.O. Box 95562
WATERKLOOF 0145
Pretoria, GAUTENG
SOUTH AFRICA

PROJECT No: M20/3841 **6th July 2020**

DERICK PEACOCK ASSOCIATES
Resort and Leisure Planners
P.O. Box 39910
MORELETAPARK 0044

Attention: Mr. Derick Peacock

Dear Sir,

REPORT ON A GEOTECHNICAL INVESTIGATION CARRIED OUT FOR THE PROPOSED RESIDENTIAL DEVELOPMENT ON: *PORTIONS 8, 13 & 14 OF MALELANE ESTATE 140-JU,* NKOMAZI LOCAL MUNICIPALITY, MPUMALANGA PROVINCE

1. INTRODUCTION

This report presents results and observations on a foundation investigation carried out during June 2020 for a proposed residential development that is to be situated on Portions 8, 13 and 14 of the farm Malelane Estate 14-0JU. The investigation was carried out at the request of Mr. Derick Peacock who is acting on behalf of his client, Bluegrass Trading 1028, the registered owner of the property who proposes to establish a residential development on the property. The development will comprise of 20 waterfront stands overlooking the Crodocdile River to the north. The investigation consisted of a detailed geotechnical investigation during which time a number of test pits were excavated across the site, combined with soil sampling and testing.

2. TERMS OF REFERENCE

The objectives of the desk study were to: -

- Determine the engineering properties of the site soils and bedrock including potentially expansive material, low bearing capacity soils and areas difficult to excavate.

- Present appropriate recommendations for residential township design and precautionary measures in accordance with the requirements of the National Home Builders Registration Council's guidelines.

The investigation was carried out in terms of written instructions received from Mr. Derick Peacock during April 2016.

3. INFORMATION CONSULTED

The following information was available and was consulted: -

- Reference was made to the 1: 50 000 Topographical Map 2531AD Gutshwa.

- The 1: 250 000 scale Geological Series Map Sheet Number 2530 Barberton.

- A site contour plan and flood line determination prepared to a scale of 1: 2 000 by Van Staden Land Surveyors showing existing roads and structures, the boundaries of the proposed development and surface contours at 0,5m intervals.

- A colour aerial photograph of the property was obtained from Google Earth via the Internet.

- "Veld Types of South Africa" by J.P.H. Acocks. Third Edition 1988. Memoirs of the Botanical Survey of South Africa, No. 57.

- The publication "National Home Builders Registration Council's Home Building Manual, Part 1 & 2, February 1999.

4. SITE DESCRIPTION

The site for the proposed residential development is located due north-west of Malelane, the property is roughly trapezoidal in shape and covers a surface area of some 20 hectares. The study area is a fully operating agricultural venture presently used for the production of perennial summer and winter crops, a number of residential and farm structures are located in the northern central portion of the site. The study area is located on the southern limb of a broad valley that is flanked by the Crocodile River to the north. The study area is bordered by a non-perennial drainage feature to the east, by a railway line to the south, by a wholesale nursery to the west and by the Crocodile River to the north. The ground surface drains via sheetwash and the aforementioned drainage feature towards the north in the direction of the Crocodile River at an average gradient ranging of some 5%.

5. SITE INVESTIGATION

Twenty test pits were excavated across the site for the new development using a Case 695SR backactor supplied by the client. The test pits were entered and inspected by the undersigned, a registered professional engineering geologist, who described the soil and bedrock formations in terms of the methods advocated by Jennings *et al* (1973) namely, moisture condition, colour, soil consistency, soil structure, soil type and origin (MCCSSO).

During the test pit profiling, disturbed an undisturbed representative soil and a water sample were recovered from the test pits and submitted to SNALAB's commercial soils laboratory in Pretoria for testing and identification. Detailed descriptions of the test pit profiles are provided on the Soil Profile Sheets in Appendix 1 of the report whilst the laboratory test results appear in Appendix 2. The location of the test pits is shown on the "Geotechnical Map", Drawing Number M20/3841 at the back of the report.

6. OBSERVATIONS

The study area is underlain by transported sandy and gravelly soils overlying mafic and ultramafic schist bedrock belonging to the Tjakastad Formation, Onverwacht Group, Barberton Supergroup. No rock outcrops were observed during the investigation and the study area has been apportioned into three prominent geotechnical soil zones, Soil Zones "A" to "C" as shown on the "Geotechnical Map", Drawing Number M20/3841 in the pocket at the back of the report.

Soil Zone "A" materials cover the *western central portion* of the site and a generalized and simplified description of the typical soil profile that may be encountered here is as follows: -

0,0 – 0,7: Moist, reddish dark brown, stiff, shattered, sandy SILT containing abundant rounded GRAVELS and PEBBLES; colluvium. The horizon has been disturbed by agricultural activities.
0,7 – 1,2: Abundant coarse, flaky SCHIST FRAGMENTS and QUARTZ GRAVELS, clast supported in a matrix of dry, olive green, sandy SILT; residual schist. Overall consistency is loose.
1,2+: Greenish grey stained orange on joints, moderately weathered, very closely foliated, soft rock becoming medium hard rock SCHIST. Bedrock becomes hard rock from below 0,9m in some places.

Soil Zone "B" materials occupy the *eastern portion* of the site and a generalized and simplified description of the typical soil profile that may be encountered here is as follows: -

0,0 – 0,3: Dry, reddish brown, loose, clayey SAND; colluvium. The horizon has been disturbed by agricultural activities.
0,3 – 1,0: Moist, reddish brown, stiff becoming very stiff, sandy SILT containing abundant GRAVELS; colluvium/alluvium. Horizon not consistent.
1,0 – 2,2: Moist, dark brown and olive brown, loose, voided, clayey SAND alternating with purplish red blotched bluish black, very stiff, shattered, sandy SILT; alluvium.

Soil Zone "C" occupies a small area in the central northern portion of the site where a backfilled rubbish pit and disturbed ground conditions are present.

Slow excavation to abrupt refusal of the backactor was experienced from below 0,7m to 1,4m below surface in hard rock schist, elsewhere, no refusal was experienced down to at least 2,2m below surface. The water table, whether perched or permanent, was not encountered in any pit during the investigation which was carried out during the middle of the dry season.

7. GEOTECHNICAL CONSIDERATIONS

7.1 Compressible and Collapsible Soils

A number of undisturbed soil samples, representative of the colluvial soils that blanket Soil Zone "B", were tested to determine the collapse potential of the material according to the method advocated by Jennings (1974). A summary of the results of the laboratory tests appears below in Table 7.1.

TABLE 7.1: COLLAPSE POTENTIAL TEST RESULTS

HOLE NUMBER	DEPTH (m)	DRY DENSITY (kg/m³)	COLLAPSE POTENTIAL (%)	COMPRESSI-BILITY (%)	TROUBLE RATING
ME/14	0,6	1 654	10,20	1,89	Trouble
ME/17	0,7	1 587	1,40	1,64	Moderate Trouble

An analysis of the above results indicate that the colluvial soils which blanket the site are potentially moderately to highly collapsible and compressible with a collapse rating of "moderate trouble" to "trouble" in terms of collapse settlement, according to Jennings. The upper sandy and gravelly horizons that extend down to some 0,3m to 1,2m below surface across Soil Zone "A" are considered to be potentially compressible, based on a visual appraisal of the soil structure i.e. a loose consistency and a voided texture. These soils were unfortunately too friable to take undisturbed soil samples.

7.2 Expansive Soils

The site soils blanketing portions of Soil Zone "B" are generally silty and are potentially "low to borderline medium" in the degree of expansiveness, based on the results of the laboratory tests and according to the Van der Merwe (1964) method. A total surface heave value of possibly up to 15mm is predicted here, should the moisture condition of the soils change from a desiccated to saturated condition. Soil Zone "A" is occupied by soils that are potentially "low" in the degree of expansiveness and where total surface heave values of less than 7,5mm is predicted.

7.3 Excavation Characteristics

Very hard machine excavation and the use of jackhammers will be required to remove the schist bedrock at depths ranging from 0,7m to 1,4m below surface across Soil Zone "A". No problems should be experienced in excavating the site soils down to a depth of at least 2,2m below surface using conventional earth-moving machines across Soil Zone "B". The sidewalls of deep excavations should remain stable during construction in the dry season, unstable sidewall conditions may occur during construction in the wet season.

7.4 Foundations

Soil Zone "A"

The major portion of the proposed development classifies as a NHBRC Site Class "C/S1/H" according to the guidelines of the NHBRC Standards and Guidelines of 1999 and in view of the moderate horizon of potentially compressible soils which blanket this soil zone, one of the following foundation systems may be considered for rigid, residential masonry structures: -

Deep Strip Foundations

- Normal construction with drainage precautions and with mesh reinforced floor slabs.
- Founding on the dense residual schist of onto the soft rock to hard rock schist bedrock at depths ranging from 0,3m to 1,2m below surface and adopting a safe allowable bearing pressure ranging from 300 kPa to 1MPa, depending on the quality of the material exposed in the foundation trench.

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 footings.
- Light reinforcement in masonry.
- Site drainage and plumbing/service precautions to be taken.

Soil Raft

- Remove in situ material to 1m 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.
- Light reinforcement in masonry.
- Site drainage and plumbing/service precautions to be taken.

Modified Normal Construction

- Reinforced strip footings
- Articulation joints at some internal and all external doors
- Light reinforcement in masonry
- Site drainage and plumbing precautions to be taken
- Foundation pressure not to exceed 50 kPa.

Soil Zone "B"

The central portion of the proposed development classifies as a NHBRC Site Class "C1-C2/S1/H1" according to the guidelines of the NHBRC Standards and Guidelines of 1999 and in view of the moderate horizon of potentially collapsible, compressible and moderately expansive soils which blanket this soil zone, one of the following foundation systems may be considered for rigid, residential masonry structures: -

Soil Raft

- Remove in situ material to 1m 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.
- Light reinforcement in masonry.
- Site drainage and plumbing/service precautions to be taken.

Stiffened or Cellular Raft

- Stiffened or cellular raft with articulation joints or solid lightly reinforced masonry
- Site drainage and plumbing/service precautions to be taken.
- Foundation Pressure not to exceed 50 kPa.

Piled or Pier Foundation

- Reinforced concrete ground beams or solid slabs on piled or pier foundations.
- Ground slabs with fabric reinforcement
- Site drainage and plumbing/service precautions to be taken.

Soil Zone "C"

This soil zone tentatively classifies as a Site Class S2/P(fill) according to the National Home Builders Registration Council's (NHBRC) Standards and Guidelines of 1999 and in view of the fact that this zone is affected by disturbed ground conditions, it is recommended that stands that may be influenced by this soil zone, be reinstated prior to construction or be excluded from the development.

The design and construction of raft foundations (whether soil or concrete) should be carried out in accordance with and under supervision of a civil or structural engineer and the NHBRC a competent person should verify classification given here. The design of multi-storey structures should take cognizance of the potentially problematic conditions that prevail across the site. Areas of disturbed ground conditions (areas of fill, test pits, open furrows, agricultural activities etc.) may be encountered during construction and where present, these should be carefully reinstated.

7.5 Earthworks

The upper site soils were tested to determine their compaction characteristics. A summary of the test results appears below in Table 7.2: -

TABLE 7.2: SUMMARY OF COMPACTION TESTS

HOLE NO	DEPTH (m)	SOIL TYPE	PI	GM	CBR	TRH 14	SWELL (%)
ME/14	0,1 – 0,8	Gravelly sandy SILT	18	1,32	3	G10	2,36

Note : PI = Plasticity Index
GM = Grading Modulus
CBR = California Bearing Ration at 95% Mod AASHTO compaction

Based on the results of the compaction tests, it is evident that the upper blanketing silty soils occurring on site are unsuitable for use as fill underneath surface beds or for use in the construction of roads and paved area (G10 Quality). Material for construction purposes will therefore have to be imported to the site.

7.6 Ground Water and Soil Chemistry

No water seepages were encountered in the test pits during the investigation, however, the necessary damp-proofing precautions should therefore be taken underneath structures. The site soils are expected to be potentially chemically aggressive with regards to underground ferrous metal pipes (pH values ranging from 6,45 to 7,90 and electrical conductivity values ranging from 0,31 to 0,113 S/m) and the use of non-ferrous metal pipes or plastic pipes are recommended for wet services.

8. GENERAL

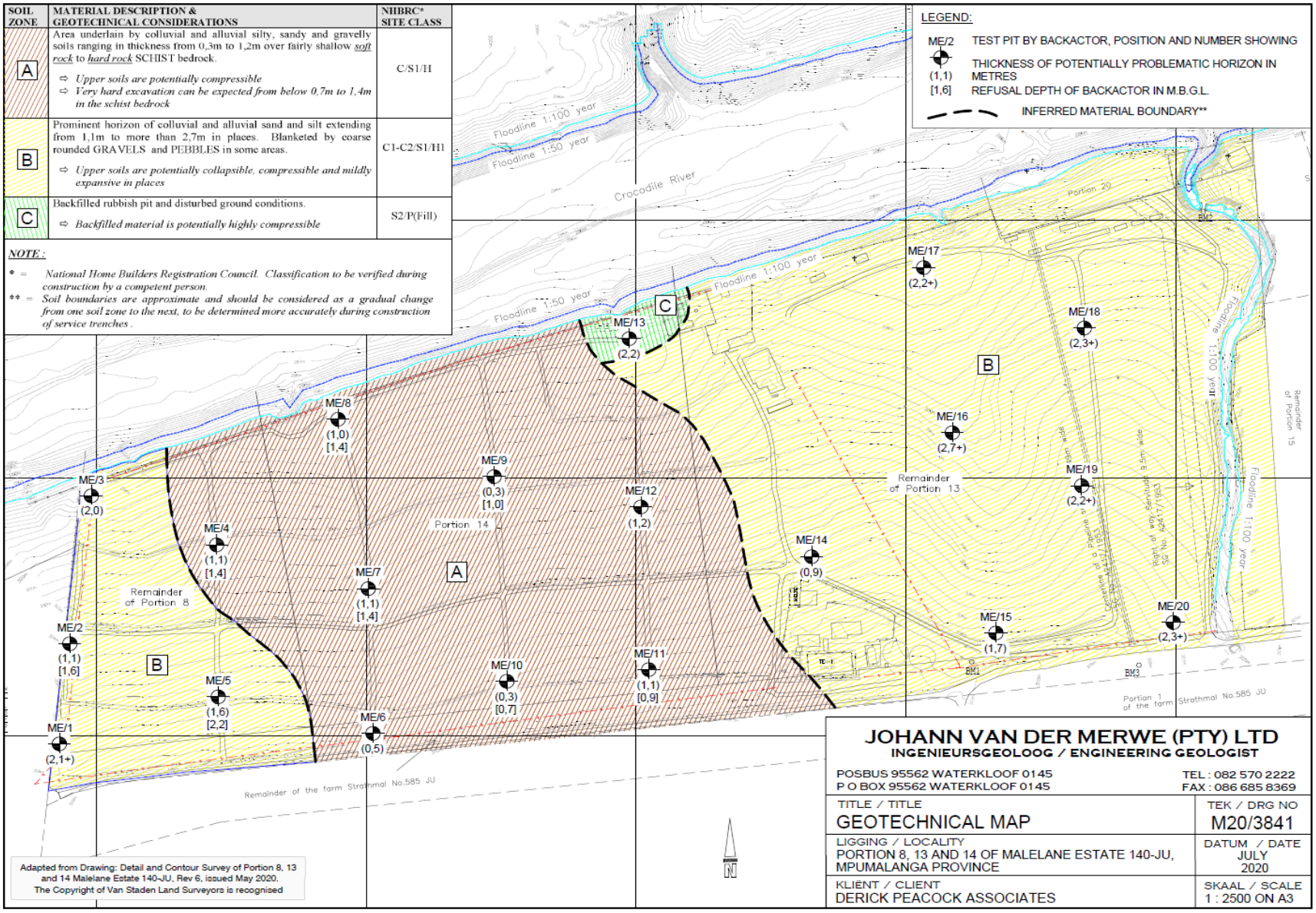
While every effort has been made to ensure that representative test pitting and sampling has been undertaken to probe the soils on-site, guaranteeing that isolated zones of either poor foundation material or hard rock excavation have not been identified, is impossible under the constraints of an investigation of this nature. The investigation has sought to highlight general areas of potential foundation and excavation problems, and to provide early warning to the design engineers and town planners. In view of the variability inherent in soils, a competent person must inspect all foundation excavations.

The placement of the engineered fills must be controlled with suitable field tests to ensure that the required densities are achieved during compaction, and that the quality of fill material is within specification.

We trust that the above information will meet with your immediate requirements, please do not hesitate to call for any further information.

Yours faithfully,

JOHANN VAN DER MERWE (Pr. Sci. Nat.)
Engineering Geologist
C:\WINDOWS\Desktop\data\reports\EPSPLANPEACK\MALELANE.doc


SOIL ZONE
MATERIAL DESCRIPTION & GEOTECHNICAL CONSIDERATIONS
NHBRC* SITE CLASS
A
Area underlain by colluvial and alluvial silty, sandy and gravelly soils ranging in thickness from 0,3m to 1,2m over fairly shallow soft rock to hard rock SCHIST bedrock.
⇨ Upper soils are potentially compressible
⇨ Very hard excavation can be expected from below 0,7m to 1,4m in the schist bedrock
C/S1/H
B
Prominent horizon of colluvial and alluvial sand and silt extending from 1,1m to more than 2,7m in places. Blanketed by coarse rounded GRAVELS and PEBBLES in some areas.
⇨ Upper soils are potentially collapsible, compressible and mildly expansive in places
C1-C2/S1/H1
C
Backfilled rubbish pit and disturbed ground conditions.
⇨ Backfilled material is potentially highly compressible
S2/P(Fill)
NOTE :
* = National Home Builders Registration Council. Classification to be verified during construction by a competent person.
** = Soil boundaries are approximate and should be considered as a gradual change from one soil zone to the next, to be determined more accurately during construction of service trenches .
LEGEND:
ME/2 TEST PIT BY BACKACTOR, POSITION AND NUMBER SHOWING
(1,1) THICKNESS OF POTENTIALLY PROBLEMATIC HORIZON IN METRES
[1,6] REFUSAL DEPTH OF BACKACTOR IN M.B.G.L.
INFERRED MATERIAL BOUNDARY**
Floodline 1:100 year
Floodline 1:50 year
Crocodile River
Portion 20
Remainder of Portion 15
Remainder of Portion 13
Portion 14
Remainder of Portion 8
Remainder of the farm Strathmal No.585 JU
Portion 1 of the farm Strathmal No.585 JU
ME/1 (2,1+)
ME/2 (1,1) [1,6]
ME/3 (2,0)
ME/4 (1,1) [1,4]
ME/5 (1,6) [2,2]
ME/6 (0,5)
ME/7 (1,1) [1,4]
ME/8 (1,0) [1,4]
ME/9 (0,3) [1,0]
ME/10 (0,3) [0,7]
ME/11 (1,1) [0,9]
ME/12 (1,2)
ME/13 (2,2)
ME/14 (0,9)
ME/15 (1,7)
ME/16 (2,7+)
ME/17 (2,2+)
ME/18 (2,3+)
ME/19 (2,2+)
ME/20 (2,3+)
BM1
BM2
BM3
A
B
C
N
Adapted from Drawing: Detail and Contour Survey of Portion 8, 13 and 14 Malelane Estate 140-JU, Rev 6, issued May 2020.
The Copyright of Van Staden Land Surveyors is recognised
JOHANN VAN DER MERWE (PTY) LTD
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FAX : 086 685 8369
TITLE / TITLE
GEOTECHNICAL MAP
TEK / DRG NO
M20/3841
LIGGING / LOCALITY
PORTION 8, 13 AND 14 OF MALELANE ESTATE 140-JU, MPUMALANGA PROVINCE
DATUM / DATE
JULY 2020
KLIËNT / CLIENT
DERICK PEACOCK ASSOCIATES
SKAAL / SCALE
1 : 2500 ON A3

APPENDIX 6.3:
HYDROLOGICAL ASSESSMENT AND FLOODLINE REPORT

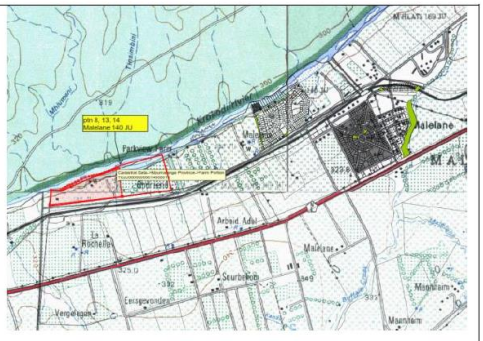
MALELANE ESTATE

HYDROLOGICAL ASSESSMENT

Proposed Residential Township: Portions 8, 13 and 14 Malelane 140 JU

SUMMARY REPORT (Rev 0)

8 June 2020



PREPARED FOR: **Bluegrass Trading 1028** PO Box 12074 SELCOURT 1567 VAT # 4230247084	**PREPARED BY: Rian Coetzee** **Specialist Hydrologist.** **REVIEWED BY: J Fanoy Pr. Eng.**
	Enquiries: J Fanoy Pr. Eng.

FLOOD RISK ASSESSMENT FOR MALELANE ESTATE PROPOSED DEVELOPMENT ON Portions 8, 13 and 14 Malelane Estate 140 JU MPUMALANGA PROVINCE

Document Approval and Quality Control

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Data analysis	R Coetzee	Engineering Technician – NDip Civil PM Dip
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Reviewed by	R Coetzee, J Fanoy	Eng. Tech – Hydrologist, Pr. Eng
Approved by	J Fanoy	Professional Engineer - Pr. Eng

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LIST OF ABBREVIATIONS

A	Area
AGIS	Agricultural Geo-Referenced System
CD:NGI	Chief Directorate : National Geospatial Information
CSIR	Council for Scientific and Industrial Research
cumec	cubic meters per second
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry (pre 2009)
DWS	Department of Water and Sanitation (since 2014)
E	East
EC	Ecological Classification
ECSA	Engineering Council of South Africa
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EL	Elevation
EMP	Environmental Management Plan
GN / GN704	Government Notice 704 of June 1999
HecRas	Hydraulic Engineering Centre's River Analysis System
km	Kilometres
Lat	Latitude
Lon	Longitude
m	Meters
M2	1:2-year 24 hour rainfall event
MAE	Mean Annual Evaporation
mamsl	metres above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff

N	North
NEMA	National Environmental Management Act (Act 107 of 1998)
NASA	The National Aeronautics and Space Administration
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act (Act 36 of 1998)
PES	Present Ecological State
PEMC	Present Ecological Management Class
Pr Eng	Professional Engineer
Q	peak discharge
RMF	Regional Maximum Flood
RHP	River Health Program
S	South
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency
SANS	South African National Standards
SAWS	South African Weather Services
SDF	Standard Design Flood
SWMP	Stormwater Management Plan
SRTM	The Shuttle Radar Topography Mission
W	West
WMA	Water Management Area (defined by DWA)
WR90	Surface Water Resources 1990 study
WR2005	Water Resources 2005 study
WR2012	Water Resources 2012 study
WSML	WSM Leshika Consulting (Pty) Ltd.
W.S.	Water Surface

1 INTRODUCTION

Rian Coetzee was appointed by **Bluegrass Trading 1028** to determine the floodlines in accordance with the Water Act (Act 36, 1998) with a recurrence period of 1:100 years for the Crocodile River, just north, adjacent to the farm Malelane 140 JU in the Mpumalanga Province and a local streams passing the site on the eastern boundary.

2 OBJECTIVES OF STUDY

This flood risk assessment has the following objectives:

- Give the reader a general overview of the receiving catchments.
- Enlist the hydrological characteristics for the receiving catchments.
- Hydraulically assess the significant streams or river reaches for the receiving catchments.
- Delineate the 1:100 year floodline for the significant streams or rivers based on localised topographical surveys.
- Delineate the riparian zones of the significant streams or rivers where no localised topographical surveys are available.

3 INFORMATION USED DURING THE STUDY

The following sources were used to obtain hydrological information relative to the study area:

- Chief Directorate : National Geospatial Information (CD:NGI)
- 1:50 000 Topographical Maps of South Africa (CD:NGI)
- 1:10 000 Orthographic Photo Imagery (CD:NGI)
- 20m Contour Interval Vector Data (CD:NGI)
- Water Resources of South Africa : 2012 Study (WR2012)
- South African Weather Services (SAWS)
- Agricultural Geo-Referenced System (AGIS)
- Shuttle Radar Topography Mission (SRTM) data

Other sources that was used in the study:

- 0.5m Interval Contours (Van Staden Surveyors, 4 June 2020)
- Digital Orthophoto (Van Staden Surveyors, 4 June 2020)

4 PROJECT LOCALITY

Figure 4.1 below shows the locality of the proposed development alongside the winding Crocodile River which form the southern boundary of the Kruger National Park and joins the Komati River at Komatipoort.

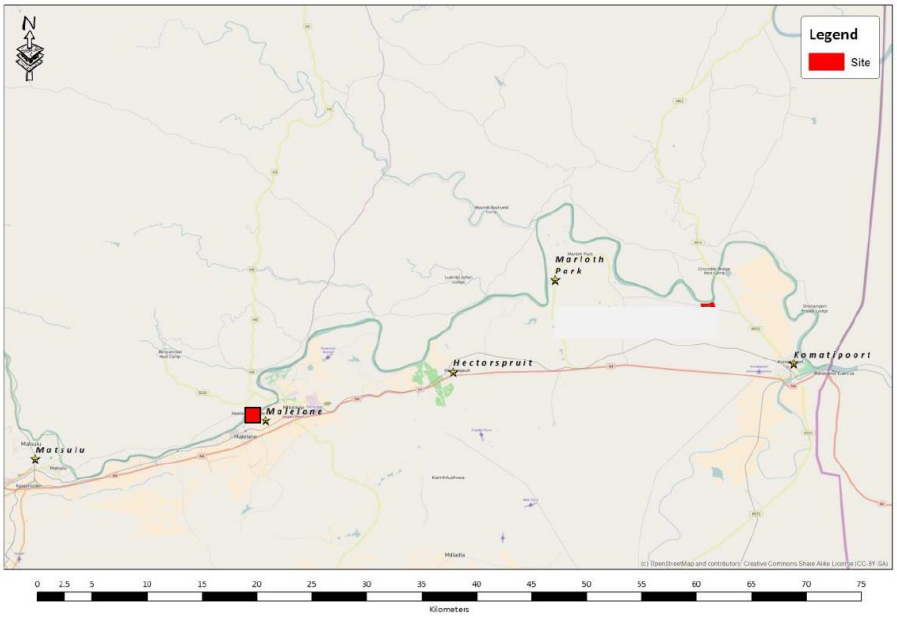

FIGURE 4.1: PROJECT LOCALITY

5 PROBABLE MAJOR RISKS INVOLVED

5.1 FLOODING

Floods generally develop over a period of days. When the accumulated run-off can no longer be conveyed in the beds and banks of the rivers and water spreads over the land next to it (the 'floodplain'), flooding occurs. However, this can happen in a short period of time when high rainfall events occur in the catchment area. These 'flash floods' occur with little or no warning and cause the biggest loss of human life than any other type of flooding.

5.2 EROSION

Soil can also be eroded by high volumes flowing at greater velocities, ruining crops, destroying agricultural land / buildings and drowning farm animals. Running water works as a sculptor to transform the earth's surface.

The intensity of water erosion naturally depends on the erodibility of surface deposits and the energy of water flows over the receiving surface.

6 HYDROLOGICAL SYSTEM

6.1 METHODOLOGY

This surface water assessment first discuss the regional hydrological characteristics that will set the baseline characteristics, and then the local hydrological characteristics of the study area.

6.2 REGIONAL HYDROLOGY

6.2.1 CROCODILE RIVER CATCHMENT AREA

The catchment area of the Crocodile River contributing to the flow down to the proposed development covers an area in the order of 10 095 km² and is shown in **Figure 6.1** below.

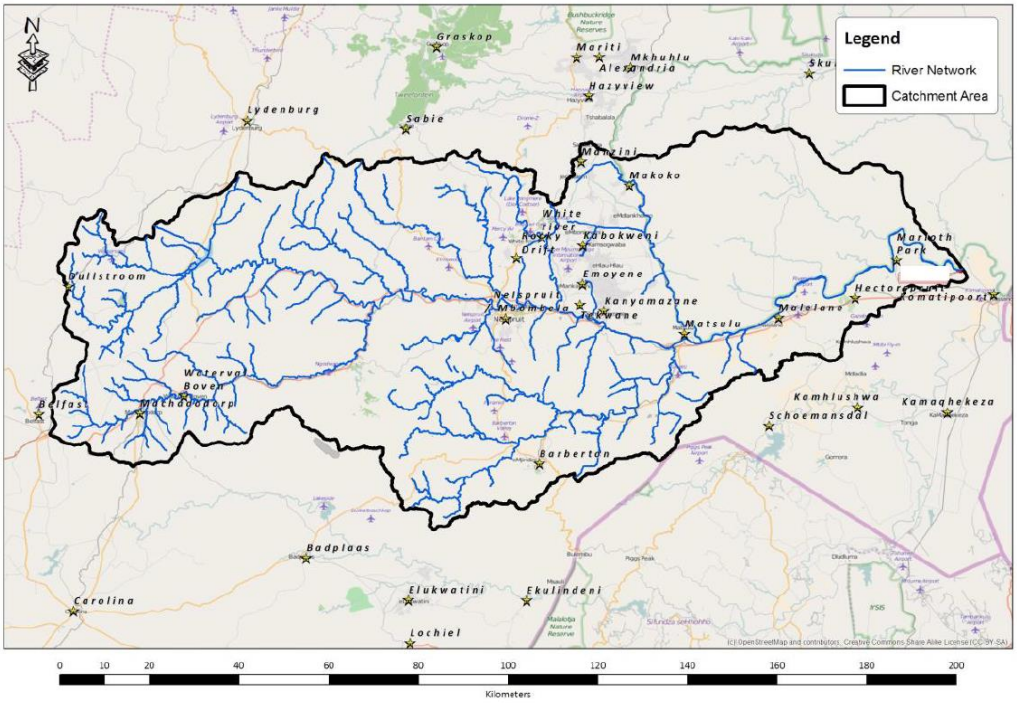

FIGURE 6.1: SITE CATCHMENT AREA

6.2.2 TERTIARY CATCHMENT AREAS

The effected Crocodile River's catchment area falls within the Inkomati Water Management Area, under tertiary catchments X21, X22, X23 and X24 as shown in **Figure 6.2** below. These tertiary catchments covers an area in the order of 10 440 km².

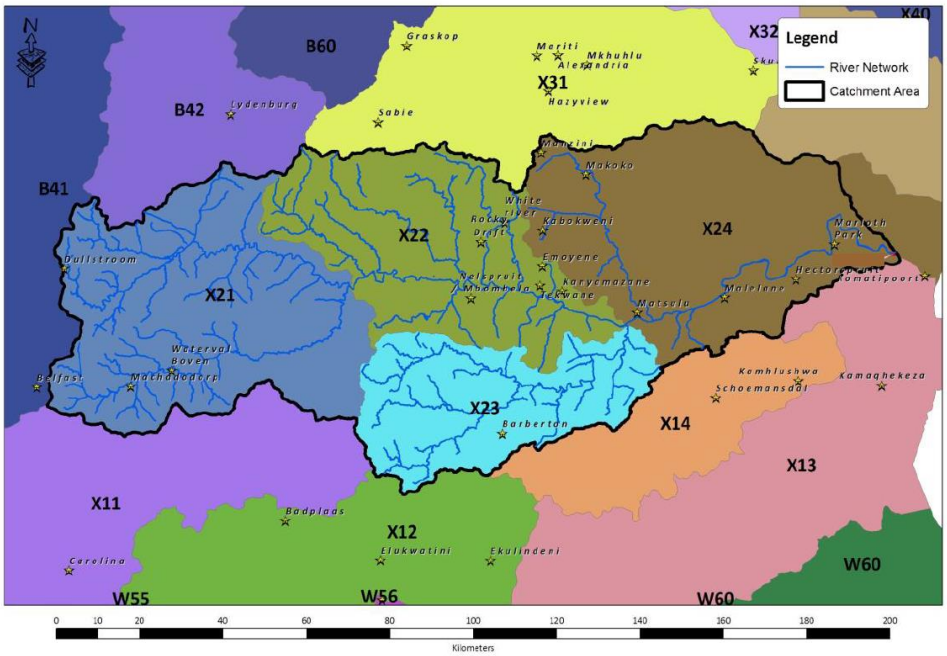

FIGURE 6.2: TERTIARY CATCHMENT AREA

6.2.3 REGIONAL TOPOGRAPHY

The topography of the study area was obtained from The National Aeronautics and Space Administration (NASA) and The Shuttle Radar Topography Mission (SRTM) GIS raster data set.

The topographical high of the region is found at the Steenkampsberg Mountains near Dullstroom to the west which has an elevation of approximately 2267 metres above mean sea level (m.a.m.s.l.). The upper catchment area of the Crocodile River consists of steep sided valleys with sharply defined cliff slopes on the eastern edge of the escarpment. From the escarpment the river levels out westwards and winds along the Schoemanskloof down to the town of Nelspruit, which then becomes incised with broad, flat bottomed valleys to an elevation of approximately 157 m.a.m.s.l. near the proposed site.

The region's topography is shown in **Figure 6.3** below.

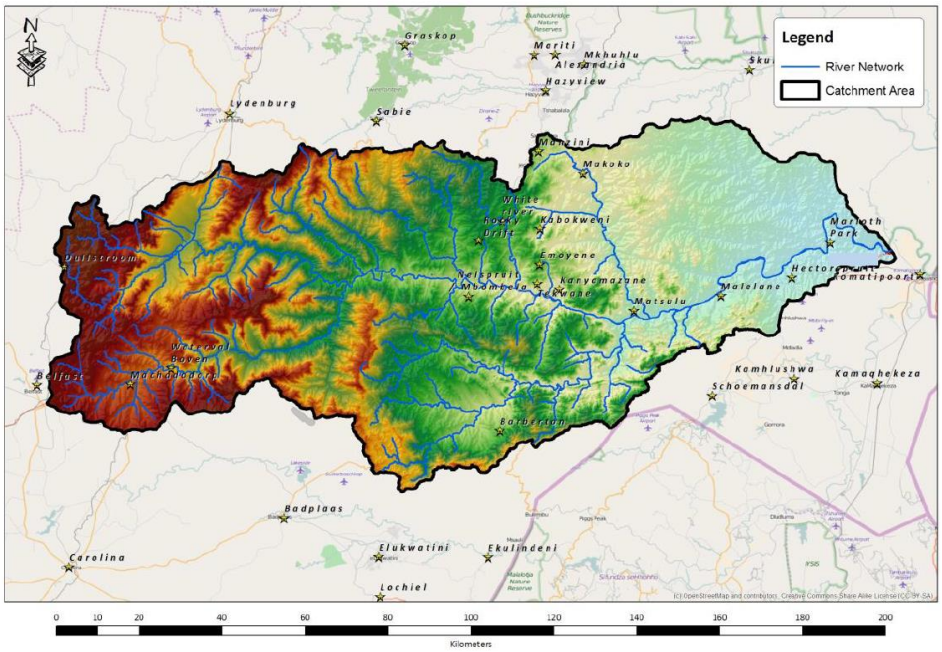

FIGURE 6.3: REGIONAL TOPOGRAPHY

6.2.4 REGIONAL CLIMATE

Based on the CSIR Köppen-Geiger classification for South Africa (Conradie and Kumirai 2012), the region is characterised by classifications of *(Cwa)* and *(Cwb)* to the middle and west of the catchment, which are zones of subtropical climate, characterised by hot, usually humid summers and mild to cool winters and a classification of *(Bsh)* to the east, which is a zone characterised by dry and arid climates and the most obvious climatic feature of this climate is that potential evaporation and transpiration exceed precipitation.

During the warm summer months of December, January, February and occasionally in March the average daily temperature may be less than 24°C in the western parts of the catchment and more than 31°C in the eastern parts, while the average daily temperature in winter may be less than 18°C in the west and more than 24°C in the east during the months of June, July and August (Agricultural Geo-Referenced Information System, AGIS). The regional climate for the area is shown in **Figure 6.4** below and the average maximum temperatures in the summer and winter months are shown in **Figure 6.5** and **Figure 6.6** respectively.

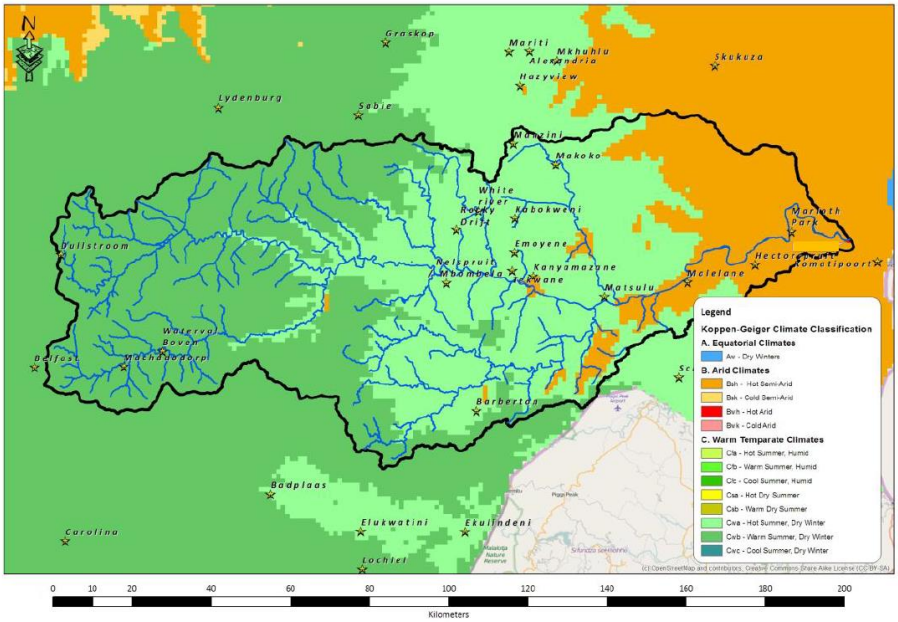

FIGURE 6.4: REGIONAL CLIMATE

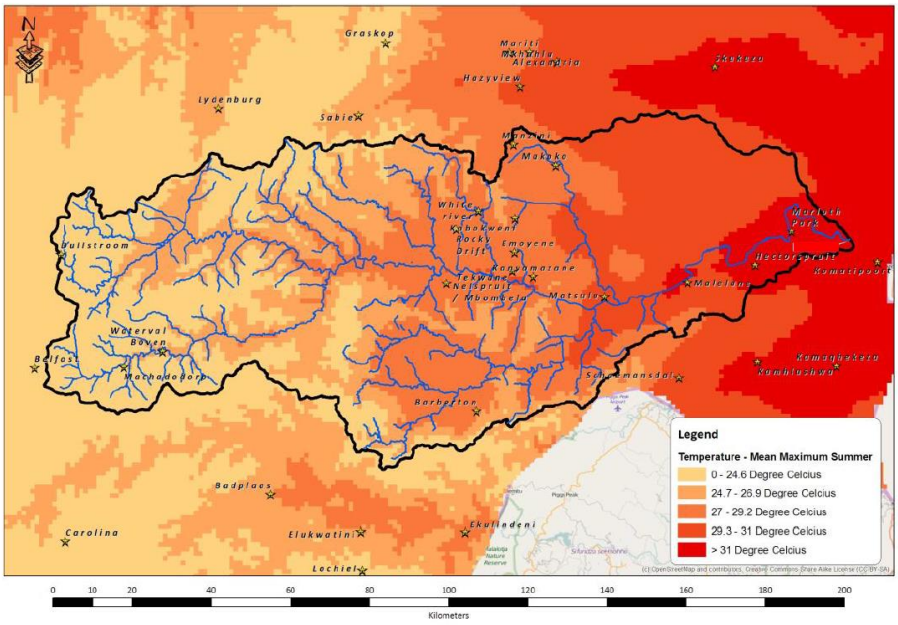

FIGURE 6.5: AVERAGE MAXIMUM SUMMER TEMPERATURE

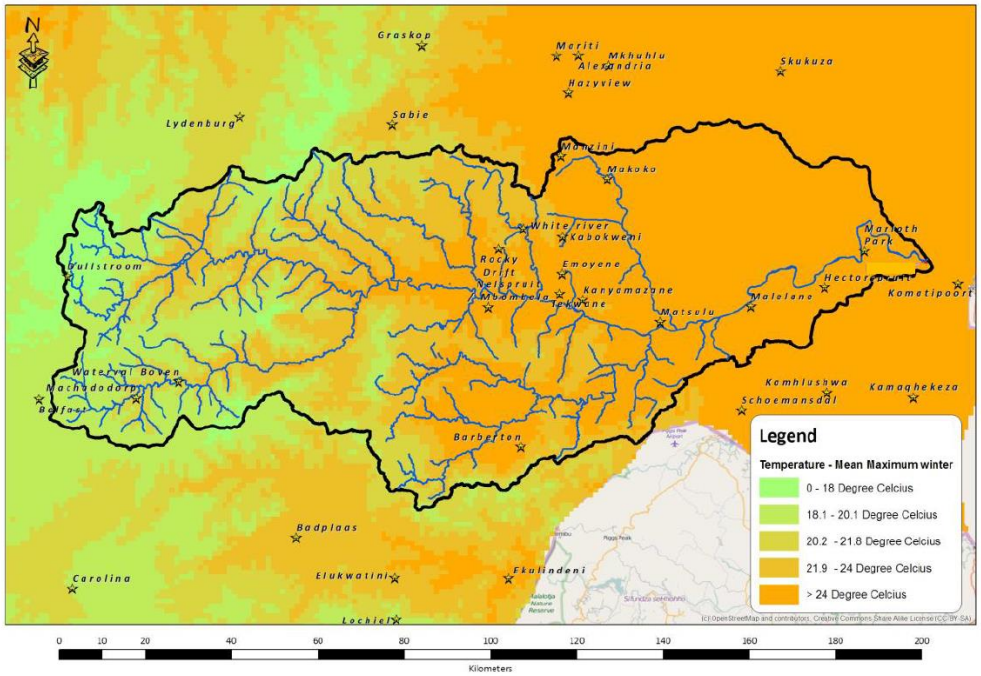

FIGURE 6.6: AVERAGE MAXIMUM WINTER TEMPERATURE

6.2.5 REGIONAL RAINFALL

The region is located within a summer rainfall zone (September to March) that has a mean annual precipitation (MAP) in excess of 1000mm centrical to the total catchment area, while the majority of the catchment area has a MAP ranging between 800-1000mm. The eastern parts may experience a lower MAP ranging between 600-800mm. The regional rainfall for the area is shown in **Figure 6.7** below.

The catchment area contains 37 rainfall gauging stations, which was analysed and shown in **Figure 6.8** and **Table 1** below. The mean rainfall intensity records of these stations was adopted in the calculations of the flood peaks.

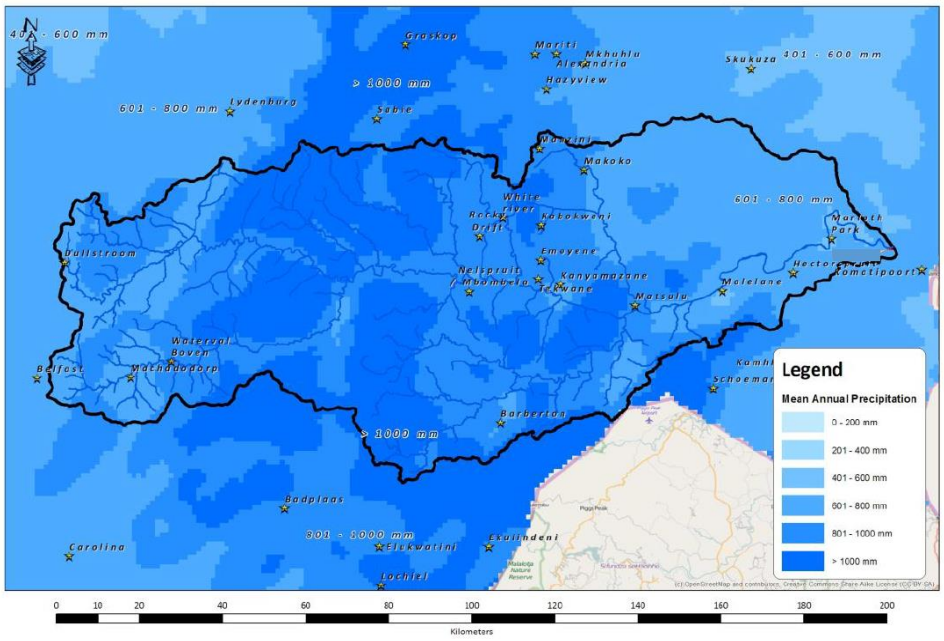

FIGURE 6.7: REGIONAL RAINFALL

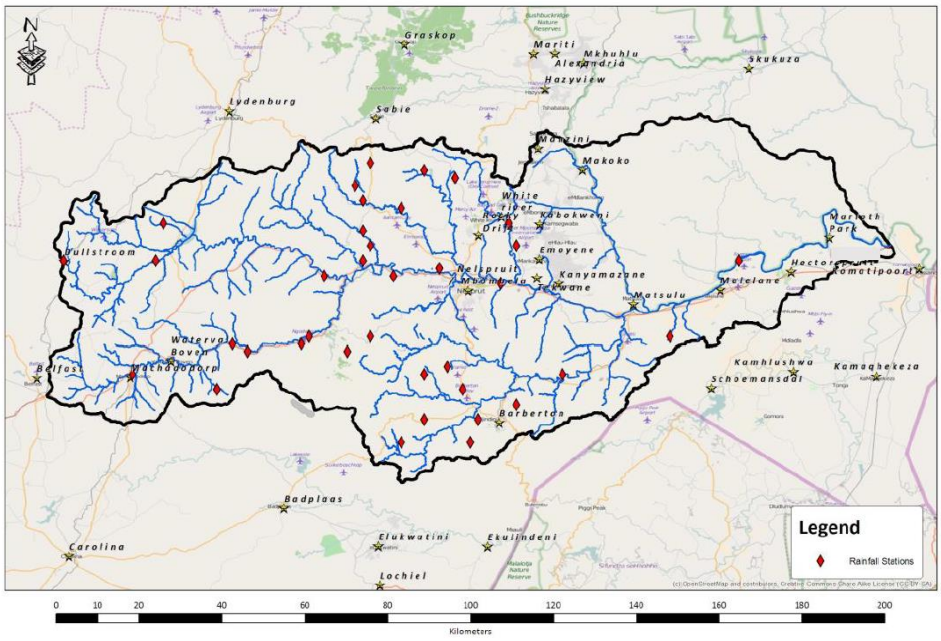

FIGURE 6.8: REGIONAL CATCHMENT RAINFALL STATIONS

TABLE 1: REGIONAL RAINFALL STATIONS

Nr	Station Nr	Station Name	MAP (mm)	M2 (mm)
1	517430	MACHADODORP	731	55
2	517762	WELTEVREDEN	906	60
3	517816	ELANDSHOEK	761	55
4	517877	AIRLIE (SAR)	695	58
5	518186	VLAKPLAATS	823	62
6	518215	GODWAN RIVER ESTATES	817	63
7	518367	COETZEESTROOM (FORESTRY)	923	64
8	518455	KAAPSEHOOP (SAP)	1433	92
9	518589	NELSHOOGTE (FORESTRY)	1093	76
10	518670	RETREAT	718	60
11	518676	FRANTZINASRUST	1106	82
12	518759	MACSVALE	785	69
13	518822	BORNMANSDRIFT	694	64
14	518859	OORSCHOT	778	64
15	518886	CARMICHAEL	649	59
16	519134	LOWLANDS	664	57
17	519310	RIVERBANK	611	61
18	520125	LETUBI	897	93
19	554175	DULLSTROOM (SAR)	761	55
20	554535	GOEDEHOOP (SCHOOL)	505	49
21	554560	RUSTENBERG	717	61
22	555297	ELANDSHOEK	847	66
23	555405	BROOKLANDS (FORESTRY)	1137	79
24	555437	TWEEFONTEIN	834	74
25	555441	RIETVALLEI	950	76
26	555445	BARCLAYVALE	833	70
27	555462	WATERVAL	1007	75
28	555473	KILLARNEY	866	68
29	555567	ALKMAAR	814	68
30	555588	ROSEHAUGH (FORESTRY)	1016	79
31	555673	WITKLIP (FORESTRY)	1166	84
32	555746	CAIRN (SAR)	730	68
33	555794	BULTFONTEIN (FORESTRY)	1001	77
34	556088	MAYFERN	737	66
35	556110	JATINGA	857	76
36	556143	THE KNOLL	791	73
37	557115	RIVERSIDE	546	66
		AVERAGE	**843**	**68**

6.2.6 FLOOD PEAK METHODOLOGY

Flood peaks can be estimated by using empirical, statistical and deterministic methods. In this study the statistical and deterministic methods were used and one method classified as an empirical method was used to evaluate the results obtained.

For the deterministic methods the flood hydrograph (the effect) is derived from precipitation and catchment characteristics (the cause).

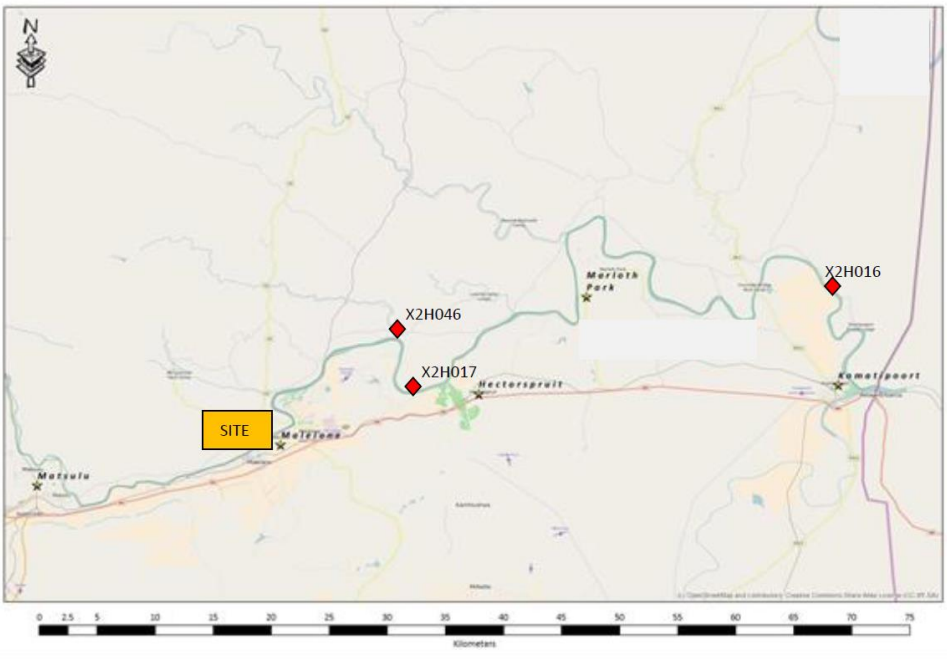

FIGURE 6.9: DWS RIVER GAUGE

The following methods, as described in the SANRAL Drainage Manual (2013), were used to determine the flood peaks. The software 'Utility Programs for Drainage' which has been developed by Sinotech, using the methods in the Manual, was also used in this study.

Statistical Methods.

The statistical methods are based on analyses of gauged river flow data. Annual flood peaks as measured at nearby flow gauging stations are fitted to a probability distribution function and thus the flow peaks associated with a probability of occurrence can be determined. The flow peaks are adjusted pro rata to the size of the site catchment are to obtain the flow peak applicable to the site.

Special distribution functions have been developed in the field of flood peak analysis and these include the Log Pearson Type 3 (commonly applied in the USA) and General Extreme Value (LEV1/MM) suite of functions (which include the 'Gumbel' function) that is described in the UK Flood Study Report.

The gauging weirs data were obtained from the Department of Water and Sanitation. However, the data sets are incomplete since large flood events (e.g. Demoina and the 2000 floods) exceeded the capacity of the measuring weirs. Relatively low flood values were therefore obtained. Fortunately, a report by Van Bladeren and Van der Spuy produced after the February 2000 floods included a thorough analysis of the floods for the Crocodile River.

Three gauging stations were evaluated downstream of the site in this study e.g. Riverside (X2H046), Thankerton (X2H017) and Tenbosch (X2H016), shown in **Figure 6.9**. Results obtained from the Tenbosch gauge was further analysed.

The Tenbosch gauge, included historical floods as far back as 1892/93. Van Bladeren and Van der Spuy's analysis for the 2000 flood at this gauge was estimated as **6 500 m^3/s**, having a recurrence interval in **excess of 200 years.**

The results from the Tenbosch gauging station were adopted for the hydrological calculations, since it was the only station reliable enough to measure the extreme flood of 2000. The catchment area at Tenbosch gauging station is ±10 365km^2, 22.37% more than the catchment area of 8470 km^2at the site. The flood peak for the flood peak at the site were therefore adjusted pro-rata to the site.

Standard Design Flood method (SDF)

The SDF method is an empirical regionally calibrated version of the Rational Method. The only information required for its application is the area of the catchment, the length and the slope of the main stream, and the drainage basin in which it is located.

This method was developed to provide a simple and robust method to flood calculations. The method is based on calibrated discharge parameters that are based on historical data that

sufficiently define the flood frequency relationships for 29 homogeneous basins in South Africa.

It is believed that unlike the Rational Method, Alexander (2002) states that the SDF Method is valid for catchments ranging from 10 to 40 000 km^2.

Van Bladeren (2005) identified that the SDF method over-estimated design floods in 11 of the basins, under-estimated the results in 5 basins and only had reasonable results in 8 of the basins. Gericke (2010), on the other hand concentrated on a smaller region, the DWA C5 region, where he identified that the SDF over-estimated results by up to 230%.

Hence, the SDF method should be seen as a conservative approach, similar to that of the RMF method, and the use of the SDF may result in significant over-design of some hydraulic structures which may make them to be uneconomical (e.g. dam spillways).

Regional Maximum Flood method (RMF)

Kovács (1988) developed the widely accepted Regional Maximum Flood (RMF) concept based on the work by Francou and Rodier. He also derived ratios of flood peaks for smaller events (i.e. 50, 100 and 200 year events) to the RMF. For this region where K=5.2, the ratios lead to estimates of 1:100-year flood peaks that are generally a factor 2.2 to 1.8 higher than those derived by Van Bladeren and Van der Spuy.

6.2.7 CATCHMENT CHARACTERISTICS AT TENBOSCH GAUGING STATION

The relevant catchment characteristics in aid of calculating the peak flows are shown in **Table 2** below.

TABLE 2: CATCHMENT CHARACTERISTICS AT TENBOSCH

Description	Crocodile River
Catchment area (km^2)	10 095
Length of watercourse to boundary (km)	298.54
Average stream slope (m/km)	0.00454
Height difference along 10-85 slope (m)	1015
SDF Basin Number	29
Veld Type	8
Kovács Region	K5.2

6.2.8 FLOOD PEAK ESTIMATES AT TENBOSCH GAUGING STATION

Applying the catchment data given in **Table 2** above, the flood peak estimates were obtained and are shown in **Table 3** below.

TABLE 3: FLOOD PEAK ESTIMATES

Flood Peak Method	Flood Peaks (m^3/s)	
	Recurrence Interval	
	50 Year	100 Year
Statistical Analysis of DWAF Data Using UPFLOOD (LEV1/MM)	2 334	4 251
Van Bladeren & Van Der Spuy Study 2	2 740	4 011
SDF	5 147	6475
RMF Method (Kovacs)	6 376	7 584

The selected flood peaks for the 1:50 and 1:100 year recurrence period are shown in **Table 4** below.

TABLE 4: FLOOD PEAKS

Catchment	Flood Peaks (m^3/s)	
	50 Year	100 Year
Statistical Analysis of DWAF Data Using UPFLOOD (LEV1/MM)	2334	4251
Pro-Rata at the Site adopted	**1910**	**3474**

Hydraulic results are discussed under Section 7.

6.3 LOCAL HYDROLOGY FOR SMALL STREAM

6.3.1 LOCAL CATCHMENTS

The stream on the eastern side of the property impede on the proposed site and by law required to be investigated. The catchment boundaries of the stream is shown in **Figure 6.10** below.

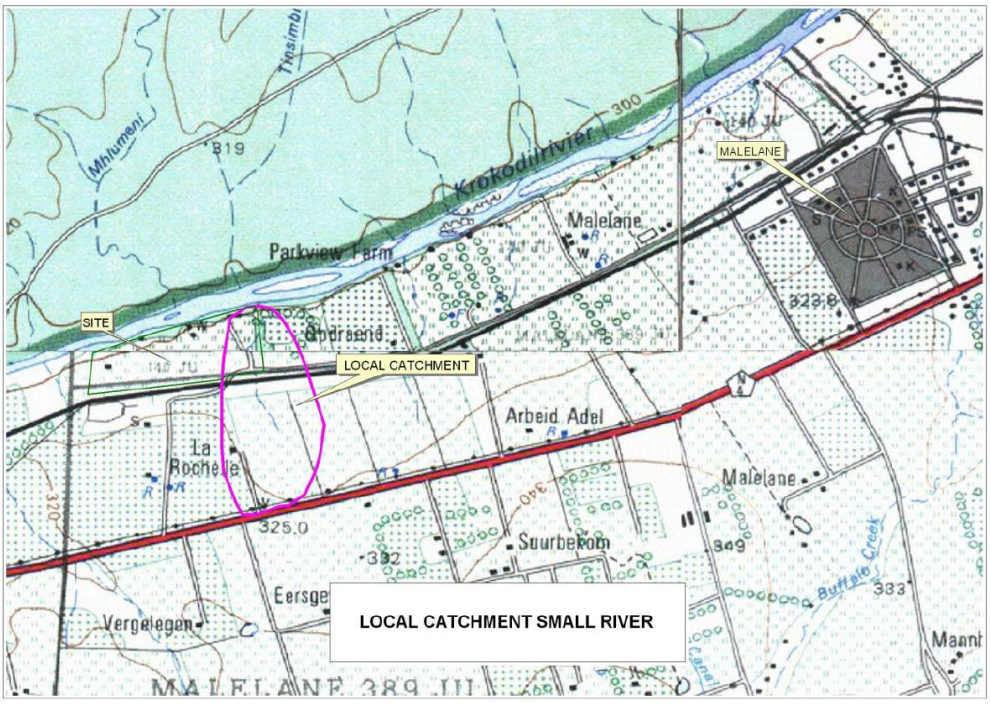

FIGURE 6.10: LOCAL CATCHMENTS

6.3.2 LOCAL RAINFALL

The nearest rainfall gauging station with the longest record of 67 years, Riverside Station No 557115. The rainfall intensity records of this station was adopted in the calculations and is also shown in **Table 5** below.

TABLE 5: LOCAL RAINFALL INTENSITY DATA

Station Number	Description	MAP (mm)	24-Hour Rainfall (mm)					
			1:2	1:5	1:10	1:20	1:50	1:100
557115	Riverside	546	66	97	122	150	193	230

6.3.3 FLOOD PEAK METHODOLOGY

The following methods, as described in the SANRAL Drainage Manual (2013), were used to determine the flood peaks. The software 'Utility Programs for Drainage' which has been developed by Sinotech, using the methods in the Manual, was also used in this study.

Rational Method with alternative (Alexander) method of calculating rainfall intensity.

The Rational Method is based on a simplified representation of the law of conservation of mass and the hypothesis that the flow rate is directly proportional to the size of the contributing area and the rainfall intensity.

Rainfall intensity is an important input in the calculations, therefore representative rainfall data as published in Department of Water Affairs' technical report TR102 and the modified Hershfield equation was used in determining the localised rainfall intensity.

The parameters for the calculations are as follows:

- the rainfall intensity is derived from the modified Hershfield equation for low time of concentrations and from interpolated values up to the 24-hour rainfall event
- the time of concentration is calculated for stream and overland flow as applicable
- the runoff factor is calculated for each area respectively as it may differ, for instance in the slope, vegetation cover and land use
- the percentage reduction factor for estimating the average precipitation over the catchments is applied

The Rational Method provides realistic results if it is used circumspectly, and it generally provide good results in studies when compared with other methods. The application of the Rational Method is generally recommended for catchments smaller than 15 km^2.

6.3.4 LOCAL CATCHMENT CHARACTERISTICS

The relevant catchment characteristics in aid of calculating the peak flows are shown in **Table 6** below.

TABLE 6: LOCAL CATCHMENT CHARACTERISTICS

Description	Small Stream
Catchment Area	50 ha
Time of concentration	14.5 min
Average slope	0.02 m/m
Combined run-off factor (C)	0.285
Length of longest watercourse	1000 m
Height difference (10-85)	20 m
Mean Annual Rainfall (MAP)	546
M2	66

6.3.5 FLOOD PEAK ESTIMATES

Applying the catchment data given in **Table 6** above, the flood peak estimates were obtained and are shown in **Table 7** and **Table 8** below.

TABLE 7: FLOOD PEAK ESTIMATES FOR THE SMALL STREAM

METHOD	Flood peaks per recurrence period (m^3/s)					
	2	**5**	**10**	**20**	**50**	**100**
RATIONAL	2	3	4.2	5.8	9.3	14
ALTERNATIVE RATIONAL	1.6	3	4	5.7	**8.8**	**12.3**

The Rational Method (also with alternative method for calculating rainfall intensity) is commonly accepted as a very reliable method on smaller catchments less than $15km^2$. Therefore it was concluded that the flood peak results for the Alternative Rational Method be adopted for the flood peak calculation and hydraulic modelling of the small stream.

7 HYDRAULIC ASSESSMENT

Hydraulic modelling of the Crocodile River and local stream was performed by means of the HEC-RAS program, associated with the RiverCAD software. A Manning roughness coefficient of 0.045 was used for the main river channel. The associated flood levels for the various cross-sections that were used to define the site stream are shown on drawings attached to this report and should be read in conjunction with **Tables 8 (small stream) and 11** (Crocodile River) below: Please note the "W.S Elev" column are applicable for the floodlevels expected for 1:100 year recurrent periods.

TABLE 8: CROSS-SECTIONAL RESULTS FOR THE SMALL STREAM

River Sta	Year	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Vel Chnl (m/s)	Top Width (m)
100	50	8.8	285.5	286.48	2.81	6.79
100	100	12.3	285.5	286.61	2.91	9.37
101	50	8.8	290	290.47	4.57	5.64
101	100	12.3	290	290.56	5.01	5.96
102	50	8.8	293.5	294.26	2.41	6.85
102	100	12.3	293.5	294.41	2.61	7.69
103	50	8.8	295	295.87	2.63	6.91
103	100	12.3	295	295.99	2.88	7.83
104	50	8.8	297	297.59	2.15	8.82
104	100	12.3	297	297.71	2.35	9.4
105	50	8.8	297.5	298.21	3.95	5.15
105	100	12.3	297.5	298.33	4.35	5.46
106	50	8.8	300.5	301.12	2.17	8.58
106	100	12.3	300.5	301.25	2.37	9.26
107	50	8.8	302	302.53	3.38	6.04
107	100	12.3	302	302.64	3.67	6.88
108	50	8.8	304.5	305.1	2.03	10.45
108	100	12.3	304.5	305.21	2.24	11

TABLE 9: CROSS-SECTIONAL RESULTS FOR CROCODILE RIVER

River Sta	Year	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Vel Chnl (m/s)	Top Width (m)
100	50	1910	284	287.73	5.41	119.41
100	100	3474	284	289.2	6.53	123.93
101	50	1910	283.5	289.3	2.91	149.68
101	100	3474	283.5	291.22	3.64	160.22
102	50	1910	284	289.54	2.9	150.18
102	100	3474	284	291.51	3.56	178.77
103	50	1910	283.5	289.7	3.23	124.04
103	100	3474	283.5	291.6	4.12	142.93
104	50	1910	283.5	290.01	3	129.19
104	100	3474	283.5	292.01	3.83	142.26
105	50	1910	283.5	290.3	2.69	138.05
105	100	3474	283.5	292.38	3.44	150.15
106	50	1910	283.5	290.42	2.91	131.91
106	100	3474	283.5	292.51	3.67	146.65
107	50	1910	283.5	290.66	2.77	134.03
107	100	3474	283.5	292.78	3.53	145.12
108	50	1910	284	290.83	2.8	133.83
108	100	3474	284	292.98	3.53	148.47
109	50	1910	284	291.03	2.76	137.78
109	100	3474	284	293.22	3.45	153.1
110	50	1910	284	291.23	2.67	142.33
110	100	3474	284	293.45	3.32	155.79
111	50	1910	283.5	291.44	2.44	145.39
111	100	3474	283.5	293.69	3.08	160.59
112	50	1910	284	291.59	2.31	156.82
112	100	3474	284	293.89	2.89	172.95
113	50	1910	284	291.69	2.38	162.7
113	100	3474	284	294.01	2.89	186.18

8 REGULATIONS

8.1 100 YEAR FLOODLINE

The **DWA Guidelines for Developments within a Floodline, March 2007**, regulates that no development within the 100 year floodline should be allowed unless proper mitigation measures are put in place. The relevant mitigation infrastructure should be designed by the relevant professional engineers.

8.2 WETLANDS

Please note that the purpose of this report is not to delineate wetland boundaries but to indicate the floodlines.

9 CONCLUSION

The maximum discharges associated with the various return periods were calculated by means of the most appropriate methods as described in SANRAL's Drainage Manual and the most appropriate values were selected.

We hereby certify that in accordance with the Water Act (Act 36 of 1998), the peak discharges at the site and shown in **Table 3 and Table 7** have been properly determined for the 1:100 year flood events.

The 1:50 year is not indicated for the small river, hence the insignificant difference in water level that could be seen as on line on the drawing.

Please note that the purpose of this report is to indicate the various floodlines in relation to the site, and thus excludes wetland delineation.

Jan Fanoy Pr Eng (830195)

Rian Coetzee

APPENDIX 6.4:
HYDROGEOLOGICAL REPORT

NOTE: The Bore Hole Profiles and Chemical Analysis Results (27 pages) are not included. Interested and Affected Parties may request copies of the profiles/results from the EAP.

GROUNDWATER SOURCE EVALUATION ON PORTIONS 8, 13 AND 14 OF MALELANE ESTATE 140JU - MPUMALANGA

HYDROGEOLOGICAL REPORT

VERSION 1

CLIENT: BLUEGRASS TRADING 1028

DATE: 5 October 2020

PROJECT NUMBER: 20-AM-954

PROVINCE: Mpumalanga

LOCAL MUNICIPALITY: Ehlanzeni

DISTRICT COUNCIL: Nkomazi

REPORT NUMBER: 20954eV1

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GROUNDWATER SOURCE EVALUATION ON PORTIONS 8, 13 AND 14 OF MALELANE ESTATE 140JU - MPUMALANGA

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Reviewer	Aubrey Meyer Senior Geohydrologist (Pr.Sci.Nat.)	
Managing Director		

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1. INTRODUCTION

In-Situ Consulting cc. was appointed by Mr. Derick Peacock on behalf of Bluegrass Trading 1028, on the 11th of September 2020, to assist with the groundwater sources evaluation project on portions 8, 13 and 14 of the farm Malelane Estate 140JU. The aim of the following report is to confirm the availability, sustainability and suitability of three (3) existing boreholes NK-02765, NK-02766 and NK-02767 as water supply sources for domestic purposes.

The investigation area is located approximately 3.5km due west of Malelane in the Nkomazi Local Municipality, Ehlanzeni District Municipality of the Mpumalanga Province.

2. AQUIFER SUSTAINABLILITY TESTING

The correct operation and utilisation of boreholes result from the assessment of the productive capacity (yield potential) of the hole as well as the productivity of the aquifer supporting the borehole. Subjecting boreholes and consequently aquifers to different pumping tests provides such knowledge. The borehole-testing program consists of a step drawdown test and constant discharge test. In short, aquifer testing entails the following:

2.1 Step Tests

The borehole is pumped at varying abstraction rates for periods of 60 minutes each and water levels are measured in the borehole at pre-determined intervals. The test effectively stresses the hole and gives an indication of its capable yield. The abstraction rate for the longer duration aquifer sustainability test is determined from the step test and its resultant data.

2.2 Constant Discharge Test

The constant discharge test is usually carried out for a period of approximately 24-hours and involves measuring the water levels in the borehole while pumping the water out and thus creating "drawdown" within the borehole. Drawdown is the difference between the measured water level at any time during the test and the position at which the water level would have been (static water level) if abstraction had not taken place. The main aim of the test is to lower the water level in the borehole to approximately 65% of the available drawdown and maintain the water level at this depth. The constant discharge test is performed to assess the productivity of the aquifer according to its response to the abstraction of water. The response is analysed and provide information in regard to the hydraulic properties of the groundwater system and arrive at an optimum yield for the medium to long-term utilisation of the borehole.

2.3 Recovery Readings

The rate at which the borehole recovers (water level rises) is also measured and recorded once the pump is switched off. This data is useful in determine the storage available to the borehole and the position of the main water strike(s).

Three boreholes were aquifer tested by In-Situ Groundwater Services under the supervision of In-Situ Consulting.

2.4 Aquifer Testing Results

2.4.1 Borehole NK-02765

Details of the aquifer tests set-up is shown in the tables below and further details are attached in Appendix B.

Table 1: Pumping Details – NK-02765

Coordinates	Borehole Depth (m)	Date Testing Commenced	Static Water Level (mbc)	Test Pump Depth (mbc)	Available Drawdown (m)
S25.501780° E31.476610°	45.38	10/09/2020	12.30	38.46	26.16

(mbc – meters below casing)

Analysis of the step-drawdown data indicated that a constant discharge test could be performed at a rate of 29 232L/hr (8.12 L/s). The Constant Discharge Test was carried out for a period of 48-hours and achieved a maximum drawdown of 16.78 meters or 64% of the available drawdown. The water level in the borehole recovered to only 92% of the initial static water level 48-hours after pumping stopped. Based on the aquifer test data, assessing of the pumping curves, location of the borehole relative to other boreholes and the recovery data, the following abstraction recommendation was made:

Table 2: Recommended Abstraction Rates – NK-02765

Pump Inlet Depth (m)	Abstraction Rate (L/s)	Abstraction Rate (L/hr)	Abstraction Schedule(hrs/day)	Daily Abstraction Volume (m^3/day)
30.00	3.74	13 464	8	107.57
	2.49	8 856	12	
	1.25	4 500	24	

2.4.2 Borehole NK-02766

Details of the aquifer tests set-up is shown in the tables below and further details are attached in Appendix B.

Table 3: Pumping Details – NK-02766

Coordinates	Borehole Depth (m)	Date Testing Commenced	Static Water Level (mbc)	Test Pump Depth (mbc)	Available Drawdown (m)
S25.501840° E31.476140°	34.95	15/09/2020	12.95	32.46	19.51

(mbc – meters below casing)

Analysis of the step-drawdown data indicated that a constant discharge test could be performed at a rate of 22 752L/hr (6.32 L/s). The Constant Discharge Test was carried out for a period of 24-hours and achieved a maximum drawdown of 15.75 meters or 81% of the available drawdown. The water level in the borehole recovered to 100% of the initial static water level within 10-hours after pumping stopped.

Based on the aquifer test data, assessing of the pumping curves, location of the borehole relative to other boreholes and the recovery data, the following abstraction recommendation was made:

Table 4: Recommended Abstraction Rates – NK-02766

Pump Inlet Depth (m)	Abstraction Rate (L/s)	Abstraction Rate (L/hr)	Abstraction Schedule(hrs/day)	Daily Abstraction Volume (m^3/day)
30.00	4.00	14 400	8	115.20
	2.67	9 612	12	
	1.33	4 788	24	

Boreholes NK-02765 and NK-02766 abstract water from the same aquifer. If both boreholes are to be utilised it is strongly recommended to pump them at alternating schedules, allowing 12 and/or 16 hours recovery between pumping cycles. Best practise is to pump one of the boreholes per day (24hr cycle), allowing recovery time and pump the second borehole on the subsequent day, followed by recovery cycle.

2.4.3 Borehole NK-02767

Details of the aquifer tests set-up is shown in the tables below and further details are attached in Appendix B.

Table 5: Pumping Details – NK-02767

Coordinates	Borehole Depth (m)	Date Testing Commenced	Static Water Level (mbc)	Test Pump Depth (mbc)	Available Drawdown (m)
S25.502180° E31.474380°	44.00	17/09/2020	11.51	41.46	29.95

(mbc – meters below casing)

Analysis of the step-drawdown data indicated that a constant discharge test could be performed at a rate of 7 416L/hr (2.06 L/s). The Constant Discharge Test was carried out for a period of 24-hours and achieved a maximum drawdown of 12.39 meters or 41% of the available drawdown. The water level in the borehole recovered to 100% of the initial static water level 10-hours after pumping stopped. Based on the aquifer test data, assessing of the pumping curves, location of the borehole relative to other boreholes and the recovery data, the following abstraction recommendation was made:

Table 6: Recommended Abstraction Rates – NK-02767

Pump Inlet Depth (m)	Abstraction Rate (L/s)	Abstraction Rate (L/hr)	Abstraction Schedule(hrs/day)	Daily Abstraction Volume (m^3/day)
40.00	2.00	7 200	8	57.60
	1.34	4 824	12	
	0.67	2 412	24	

3. GROUNDWATER CHEMISTRY

3.1 Sampling Procedure

Groundwater samples were collected from the tested boreholes and sent to Labserve Laboratory in Nelspruit for potability analysis. The laboratory analyses expressed in mg/L are presented in the Management Recommendation Report (Appendix B).

3.2 Water Quality Analysis

Water quality is analised according to the SANS 241-1:2015 potability standards. Water quality of domestic water, utilised for human consumption and food preparation, must be safe to use if the consumers' health is to be protected. For this reason, the *"Quality of Domestic Water Supplies"* (Second edition, 1998) was set forward by the Department of Water Affairs and Forestry, Department of Health and the Water Research Commission in 1998.

3.3 Water Quality Results

Parameters that may pose health or aesthetic affect are listing below, including treatment option if deemed necessary by SANS241-1:2015 and DWF's 1998 standards. See Appendix C for the full Water Analysis Report.

Table 7: Chemistry Results – NK-02765

Parameter	Results	Health / Aesthetic / Other Effects	Water Treatment		
			Home	Conventional	Advanced
MICROBIAL PROPERTIES					
Total Coliforms Count	76 cfu/100ml	Clinical infections may occur in sensitive groups with continuous exposure.	Boil water, add household bleach, expose to sunlight or use sand filtration.	Hypochlorite solution or other chlorine compounds. Ultra violet radiation. Fast sand filtration.	Disinfection by various combinations of halogens, other oxidants, irradiation, ultrafiltration, ozone, chlorine dioxide, chlorine gas.
PHYSICAL PROPERTIES					
Mercury (Hg)	0.0010 mg/l	No adverse health effects expected	Suitable for human consumption.		
Selenium (Se)	0.025 mg/l	No adverse health effects with short to medium-term use. Lifelong use may have potential danger of selenium accumulation in individuals with selenium-rich diets (diet very rich in sea food)	Suitable for human consumption.		
Electrical Conductivity (EC)	87 mS/m	No health effects, noticeable salty taste.	Suitable for human consumption.		
Total Dissolved Solids (TDS)	629 mg/l				
Total Hardness (TH)	501 mg/l	Very hard water.	No treatment available.	Lime treatment.	Ion exchange. Precipitation with sodium carbonate, settlement and filtration.

Water from borehole **NK-02765** is not in compliance with the SANS 241-1:2015 drinking water standards due to an elevated total Coliforms count; chlorination or an alternative disinfectant treatment is recommended. This is very hard water.

Table 8: Chemistry Results – NK-02766

Parameter	Results	Health / Aesthetic / Other Effects	Water Treatment		
			Home	Conventional	Advanced
MICROBIAL PROPERTIES					
Total Coliforms Count	161 cfu/100ml	Clinical infections common, even with once-off consumption.	Boil water, add household bleach, expose to sunlight or use sand filtration.	Hypochlorite solution or other chlorine compounds. Ultra violet radiation. Fast sand filtration.	Disinfection by various combinations of halogens, other oxidants, irradiation, ultrafiltration, ozone, chlorine dioxide, chlorine gas.
PHYSICAL PROPERTIES					
Selenium (Se)	0.022 mg/l	No adverse health effects with short to medium-term use. Lifelong use may have potential danger of selenium accumulation in individuals with selenium-rich diets (diet very rich in sea food)	Suitable for human consumption.		
Electrical Conductivity (EC)	89 mS/m	No health effects, noticeable salty taste.	Suitable for human consumption.		
Total Dissolved Solids (TDS)	643 mg/l				
Total Hardness (TH)	167 mg/l	Moderately hard water.	Suitable for human consumption.		
Turbidity (NTU)	1 NTU	No health or aesthetic effects expected. If the water has a murky appearance the following treatments can be implemented:	Flocculation, sedimentation and filtration. Slow sand filter. Disposable filtration kits	Slow sand filtration or flocculation, settlement and filtration.	Same as conventional.

Water from borehole **NK-02766** is not in compliance with the SANS 241-1:2015 drinking water standards due to an elevated turbidity value and high total Coliforms count. Clinical infections will be common, even with once-off consumption; chlorination or an alternative disinfectant treatment is recommended. This is very hard water that may have a murky appearance.

Table 9: Chemistry Results – NK-02767

Parameter	Results	Health / Aesthetic / Other Effects	Water Treatment		
			Home	Conventional	Advanced
MICROBIAL PROPERTIES					
Total Coliforms Count	70 cfu/100ml	Clinical infections may occur in sensitive groups with continuous exposure.	Boil water, add household bleach, expose to sunlight or use sand filtration.	Hypochlorite solution or other chlorine compounds. Ultra violet radiation. Fast sand filtration.	Disinfection by various combinations of halogens, other oxidants, irradiation, ultrafiltration, ozone, chlorine dioxide, chlorine gas.

Parameter	Results	Health / Aesthetic / Other Effects	Water Treatment		
			Home	Conventional	Advanced
PHYSICAL PROPERTIES					
Selenium (Se)	0.022 mg/l	No adverse health effects with short to medium-term use. Lifelong use may have potential danger of selenium accumulation in individuals with selenium-rich diets (diet very rich in sea food)	Suitable for human consumption.		
Electrical Conductivity (EC)	78 mS/m	No health effects, noticeable salty taste.	Suitable for human consumption.		
Total Dissolved Solids (TDS)	564 mg/l				
Total Hardness (TH)	400 mg/l	Very hard water.	Suitable for human consumption.		
Turbidity (NTU)	2 NTU	No health or aesthetic effects expected. Slight chance of adverse aesthetic effects and infectious disease transmission.	Flocculation, sedimentation and filtration. Slow sand filter. Disposable filtration kits	Slow sand filtration or flocculation, settlement and filtration.	Same as conventional.

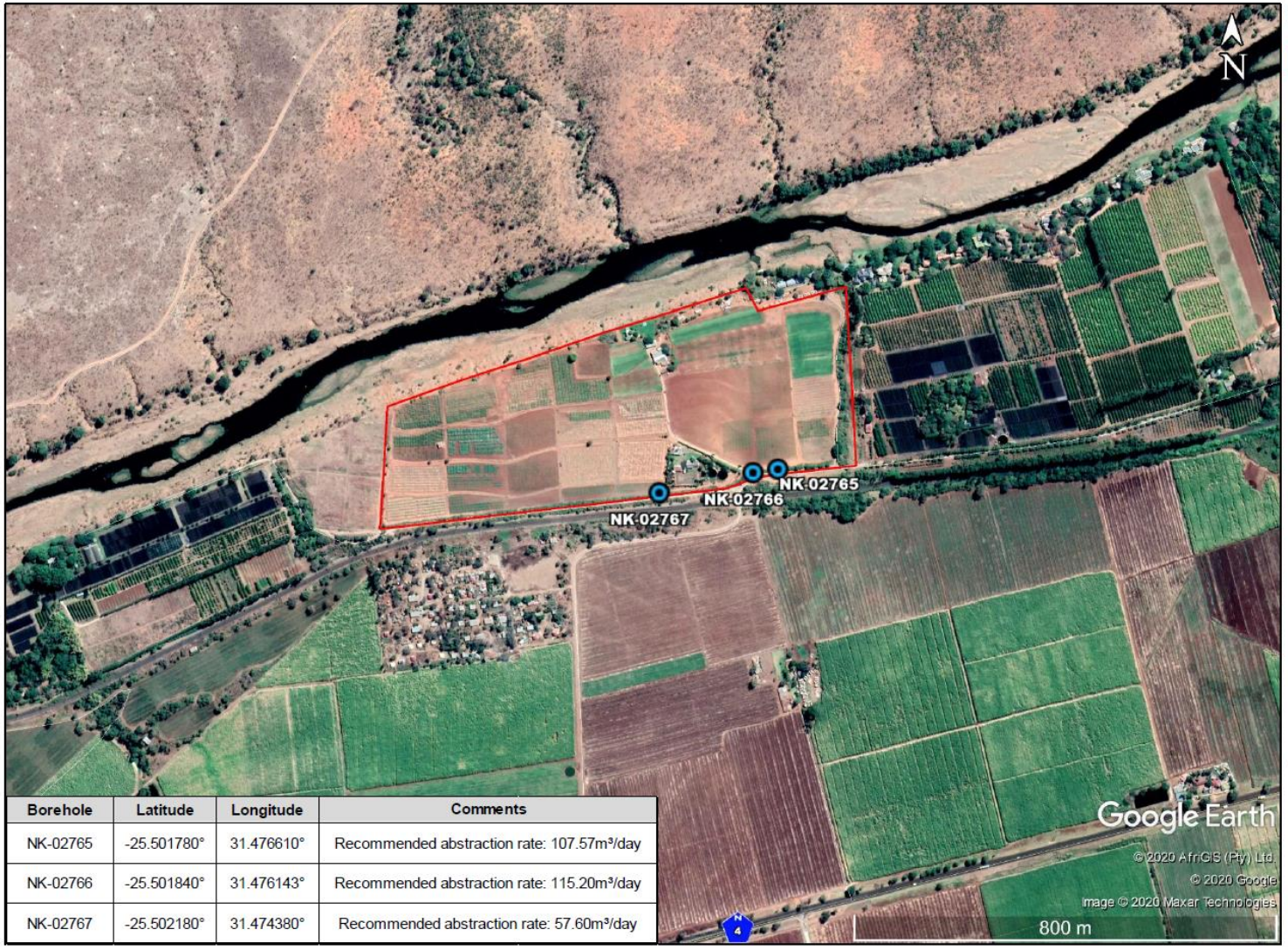
Water from borehole **NK-02767** is not in compliance with the SANS 241-1:2015 drinking water standards due to an elevated total Coliforms count; chlorination or an alternative disinfectant treatment is recommended. This is very hard water may have a murky appearance.

4. CONCLUSIONS AND RECOMMENDATIONS

- The data analysis and recommendations are extrapolated over a 2-year period with a safety factor of 50%. The production borehole should be subjected to a full aquifer testing program every 4 to 5 years to ensure continued sustainability.
- It is recommended that the production borehole be equipped with a protection circuit and timer to ensure that the abstraction schedules can be set and monitored. The critical water level must not be exceeded at any stage and water level monitoring is also recommended.
- Boreholes NK-02765 and NK-2766 influenced each other during the constant tests, indicating that they abstract water from the same aquifer, it is therefore recommended that alternating pumping schedules be implemented.
- Borehole **NK-02765** will be able to deliver a sustainable yield of 107 568L/day (107.57m³/day) at the recommended pumping rate; refer to table 2.
- Borehole **NK-02766** is able to deliver a sustainable yield of 115 200L/day (115.20m³/day) at the recommended pumping rate; refer to table 4.

- Borehole **NK-02767** is able to deliver a sustainable yield of 57 600L/day (57.60m³/day) at the recommended pumping rate; refer to table 6.
- It is recommended that an 8- and/or 12-hours/day duty cycle be implemented, and the boreholes be allowed to recover for the remainder of the day (12- and/or 16-hours).
- Do not over pump initially or at any stage as this could damage the borehole and influence the borehole's yield!
- Water from borehole **NK-02765** is not in compliances with the SANS241-1:2015 potability standards due to an elevated total Coliforms count and therefore not safe for human consumption without treatment. Refer to table 7 for treatment options.
- Water from borehole **NK-02766** is not in compliances with the SANS241-1:2015 potability standards, due to an elevated turbidity value and high total Coliforms Count, and therefore not safe for human consumption. Refer to table 8 for treatment options.
- Water from borehole **NK-02767** is not in compliances with the SANS241-1:2015 potability standards due to an elevated turbidity value and total Coliforms count and therefore not safe for human consumption without treatment. Refer to table 9 for treatment options.

SITE MAP. Malelane Estate 389JU:



Borehole	Latitude	Longitude	Comments
NK-02765	-25.501780°	31.476610°	Recommended abstraction rate: 107.57m³/day
NK-02766	-25.501840°	31.476143°	Recommended abstraction rate: 115.20m³/day
NK-02767	-25.502180°	31.474380°	Recommended abstraction rate: 57.60m³/day

LEGEND:

- Investigation Area
- Tested Borehole

MAP REFERENCE:
Colour satellite images, provided by Google Earth, 2020 AfriGis (PTY) Ltd. Image @ 2020 Maxar Technologies

IN-SITU CONSULTING

APPENDIX 6.5:
TRAFFIC IMPACT ASSESSMENT REPORT

DERICK PEACOCK TOWN & REGIONAL PLANNERS

TRAFFIC IMPACT STATEMENT

(JULY 2020)

TOWNSHIP ESTABLISHMENT:

MALELANE ESTATE A

PREPARED BY:
HAMATINO CONSULTING ENGINEERS
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WHITE RIVER
1240
Cell 083 2766805
Email: hws@hswart.co.za

NKOMAZI LOCAL MUNICIPALITY
P.O BOX 101
MALELANE
1320

Nkomazi Municipality

Hamatino Consulting Engineers	**TITLE OF REPORT:** **TRAFFIC IMPACT STATEMENT: CONSOLIDATION / SUBDIVISION: REMAINDER PORTION 8; REMAINDER PORTION 13; PORTION 14 MALELANE ESTATE A 140-JU**
Report File Name:	P29_20/TIA/Malelane Estate
Client:	Derick Peacock Associates Town & Regional Planners
Hamatino Consulting Engineers 13 Hooggelegen Street White River 1240 Prepared by: H.W. Swart Hendrikus Wouterus Swart ID: 7110185095080 PR : 200270005	
Prepared by:	H.W. Swart

DESCRIPTION OF REVISIONS	REVISION	DATE

EXECUTIVE SUMMARY

ABSTRACT

Client is desirous to consolidate / subdivide Portions 8, 13 and 14 of Malelane Estate A No 140 JU. The applicant is currently in process to obtain the necessary statutory approvals required for the commencement of the above-mentioned development.

The development will comprise the provision of a maximum of 25 residential units on the above-mentioned property.
Access to the property will be provided from provincial road D 1239 which abuts the development along the southern boundary.

The compilation of a full-scale traffic impact study is not requirement in accordance with TMH 16 (South African Traffic Impact and Site Traffic Assessment Manual), hence this statement report.

RECOMMENDATIONS

Based on the conclusions that have been derived from this study (refer section 10), the following are recommended:

- That the development be supported from a traffic engineering point of view;
- That access to the development be provided in accordance with figure 2, section 8;
- That the proposed access locality to the development be supported;
- It is advised that home owners make arrangements to either fetch workers at the bus terminal or arrange for transportation between the bus terminal and the development access by means of mini bus taxi.

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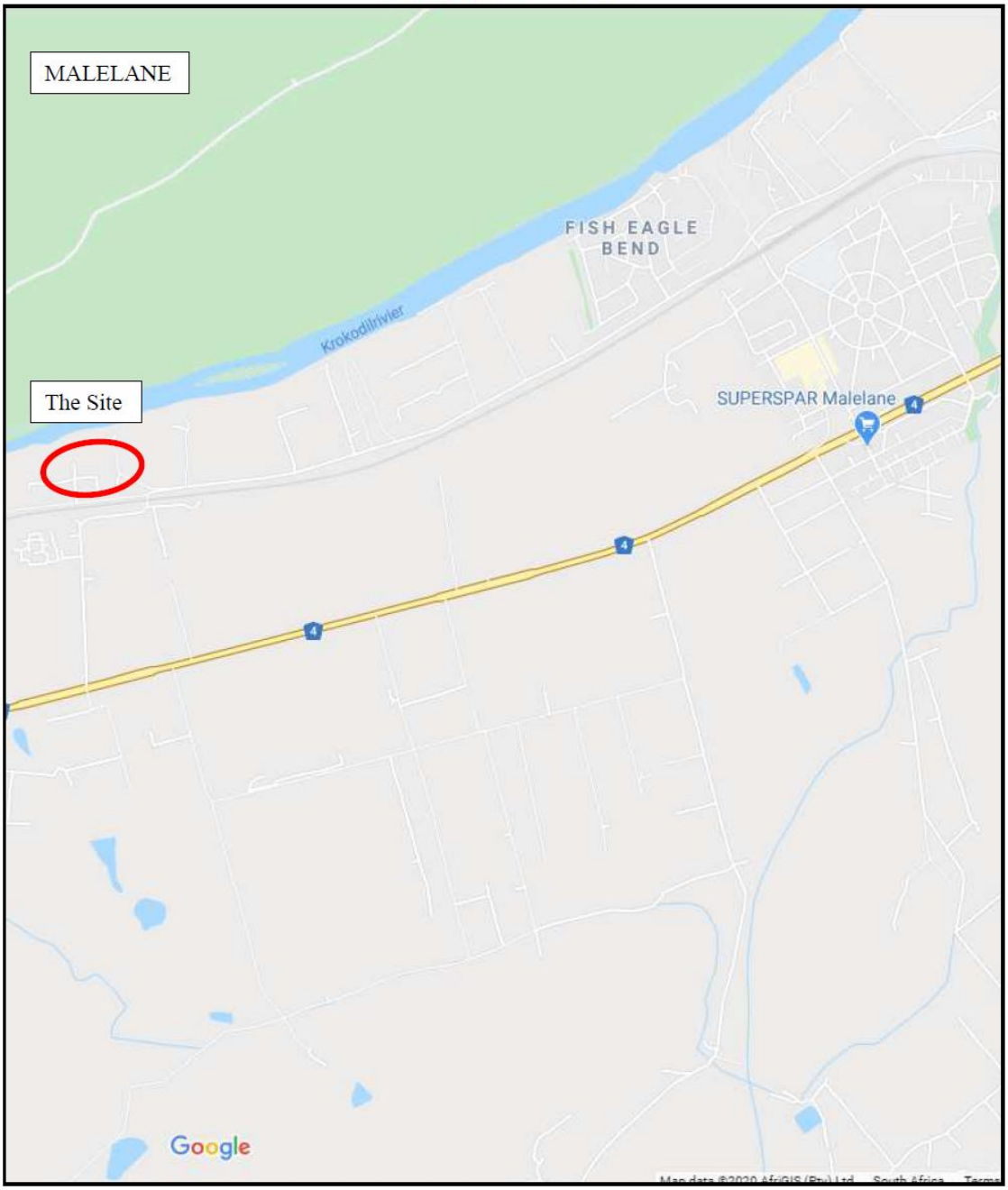


1. INTRODUCTION

1.1 BACKGROUND

Client is desirous to consolidate / subdivide Portions 8, 13 and 14 of Malelane Estate A No 140 JU. The applicant is currently in process to obtain the necessary statutory approvals required for the commencement of the above-mentioned development.

The development will comprise the provision of a maximum of 25 residential units on the above-mentioned property.
Access to the property will be provided from provincial road D 1239 which abuts the development along the southern boundary.

The compilation of a full-scale traffic impact study is not requirement in accordance with TMH 16 (South African Traffic Impact and Site Traffic Assessment Manual), hence this statement report.

1.2 PURPOSE OF THIS STUDY

The primarily purpose of this study is to ensure that the access and external road infrastructure to the development is appropriate, safe and will be able to accommodate the anticipated traffic demand in a safe and efficient manner.

1.3 STUDY AREA

The study area is limited to an analysis of the following intersections:

- Development Access Intersection;
- D1239 / Dwergarend Street;

1.4 TRAFFIC NOMENCLATURE

Traffic nomenclature used in this report includes the following:

Vph	:	Vehicles per hour
Pcu	:	Passenger car unit
Kph	:	Kilometres per hour
V/C	:	Volume to capacity ratio
LOS	:	Level of service

According to the Highway Capacity Manual, the LOS is defined according to the following table:

TABLE 1: LEVEL OF SERVICE

LEVEL-OF-SERVICE CRITERIA FOR PRIORITY INTERSECTIONS & ROUNDABOUTS

Level of Service	Average Control Delay (S/veh)
A	0-10
B	>10-15
C	>15-25
D	>25-35
E	>35-50
F	>50

LOS CRITERIA FOR SIGNALIZED INTERSECTIONS

LOS	Control Delay per Vehicle (s/veh)
A	0-10
B	>10-20
C	>20-35
D	>35-55
E	>55-80
F	>80

Table 1 indicates the levels of services as A to F, of which A is the best and F is the worst level of service.

An explanation of the respective levels of services is as follows:
Level of Service A: Free flowing traffic with a volume to capacity ratio between 0 to 0.1

Level of Service B: Low stable flow with a volume to capacity ratio between 0.1 to 0.3

Level of Service C: High stable flow with a volume to capacity ratio between 0.3 to 0.7

Level of Service D: Approaching unstable flow with a volume to capacity ratio between 0.7 to 1.0

Level of Service E: Unstable flow with a volume to capacity ratio of 1.0

Level of Service F: Forced flow

Intersections or lanes with a Level of Service E or F should be upgraded as soon as possible.

2. METHODOLOGY

The methodology undertaken in conducting this study was as follow:

- Discussion of the project with the Client;
- Conduct weekday morning (06h00 to 09h00am) and afternoon (15h00 to 18h00) peak hour traffic counts in order to determine the existing background traffic volumes;
- Analyse the existing intersection levels of service;
- Determine the number of trips that will be generated by the development. Trip generation was calculated by using trip generation rates for typical land uses, with specific reference to the South African Trip Data Manual (TMH 17);
- Determine the trip distribution, using the existing trip distribution pattern of the area;
- Determine the impact of the proposed development on the adjacent road network during peak traffic hour periods for both the 2020 as well as future year 2025 development scenarios;
- Propose mitigation measures if applicable;
- Analyse existing intersection safety and sight distances;
- Determine Access Intersection locality and layout in accordance with the roads master plan of this area;
- All of the above to be included in a single volume report, for approval by the local authority & Roads Authority.

3. TRAFFIC STATUS QUO

3.1 EXISTING PEAK HOUR TRAFFIC VOLUMES

Traffic surveys were conducted on Wednesday 29 and Thursday 30 July 2020 during the following times:

- Morning: 06h00 to 09h00 am (Thursday 30 July 2020);
- Afternoon: 15:00 – 18:00 pm (Wednesday 29 July 2020);

The weather was sunny and cool with no rain. Traffic flow was therefore not affected by any extreme weather conditions. However, the country was still under level 3 lockdown conditions at the time of the traffic count due to the Covid-19 pandemic. The counted traffic volumes were therefore escalated by the engineer in order to align with expected traffic volumes for analysis purposes. It is advised accordingly that a re-count be performed once the country is not subject to lock-down conditions any more in order to ascertain that the assumptions made for this study were reasonable.

The following information was deduced from the traffic counts:

TABLE 2: PEAK HOUR TRAFFIC COUNTS

Intersection	2020 Count (Escalated)	Peak hour	Peak hour Factor
AM TRAFFIC			
D1239 / Dwergarend St	255	06:45 – 07:45	0.87
PM TRAFFIC			
D1239 / Dwergarend St	302	16:15 – 17:15	0.94

The observed traffic volumes are shown in Appendix A to this report.

4. ANALYSIS: EXISTING SCENARIO 2020

4.1 AM AND PM: PEAK ANALYSIS

The Traffix for Windows as well as Sidra Intersection 5.0 software package was used to determine the existing levels of service, V/C ratios and the total delay experienced at the analysed intersections. Analysis performed is based on the method dictated in the Highway Capacity Manual.

It is evident from table 3 below that the analysed intersections are currently (2020) prior to development operating at an acceptable level of service.
No intersection upgrading is applicable in order to be able to accommodate the existing 2020 background traffic demand

TABLE 3: PEAK HOUR EXISTING LEVELS OF SERVICE (2020)

INTER-SECTION	LEVELS OF SERVICE AND DELAY (s)												
	Northbound			Southbound			Eastbound			Westbound			Int
	L	S	R	L	S	R	L	S	R	L	S	R	LOS
WEEKDAY AM													
D1239 / Dwergarend	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	9.3	0	0	n/a	n/a	0	7.3	9.3
WEEKDAY PM													
D1239 / Dwergarend	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	8.8	0	0	n/a	n/a	0	7.6	8.8

5. TRIP GENERATION & TRIP DISTRIBUTION

The Developer is currently in process to obtain the necessary statutory approvals in order to develop residential units consisting of the following:

- A maximum of 25 residential stands with a residential 1 zoning;

5.1 DEVELOPMENT TRIP GENERATION, DISTRIBUTION AND ASSIGNMENT TO THE ROAD NETWORK

5.1.1 TRIP GENERATION – MALELANE ESTATE

The typical trip generation for the applicable land uses were taken from the South African Trip Data Manual Version 1.0 (TMH 17) and adjusted in accordance with table 3.2 of the TMH 17 where applicable. The anticipated trip generation of the proposed development is depicted in table 4 below.

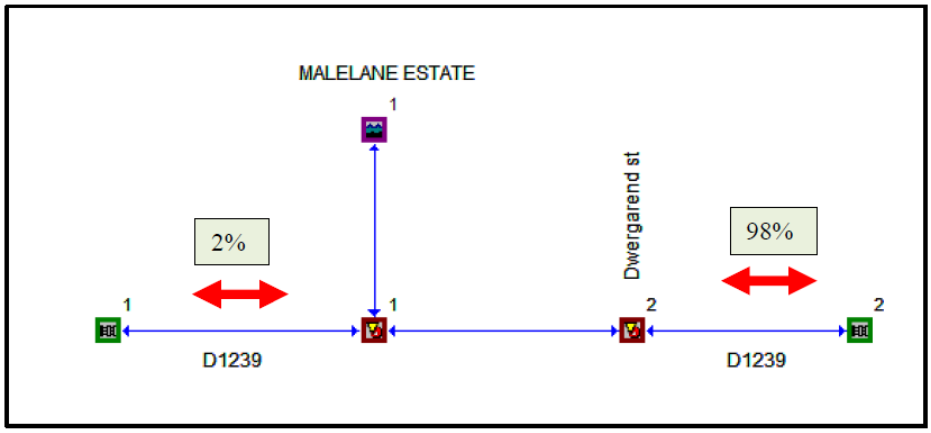
TABLE 4: DEVELOPMENT TRIP GENERATION

Land Use	Unit	Quant	Rate /100m²	Trips	Multiuse Reduct	Reduced Trips	DIRECTIONAL SPLIT	
							IN	OUT
WEEKDAY AM TRIP GENERATION								
Res 1	no	25	1.00	25	0%	25	6	19
TOTAL				**25**		**25**	**6**	**19**
WEEKDAY PM TRIP GENERATION								
Res 1	no	25	1.00	25	0%	25	18	8
TOTAL				**25**		**25**	**18**	**8**

5.1.2 TRIP DISTRIBUTION

The trip distribution was deduced from the existing traffic counts. The development trips are expected to distribute in accordance with figure 1 below.

FIGURE 1: TRAFFIX ROAD NETWORK & TRIP DISTRIBUTION



The anticipated trip generation and distribution as per this section was added to the existing background traffic (as per section 3) and analysed as such. The aforesaid analysis is included in sections 6 & 7 of this report.

6. BASE YEAR ANALYSIS WITH DEVELOPMENT (2020)

The trips that are expected to be generated by this mixed use development (refer paragraph 5.1.1) was assigned to the existing background traffic and distributed in accordance with paragraph 5.1.2 and analysed as such. A peak hour factor of 0.85 has been used in the analysis.

It is evident from table 5 below that the all the analysed intersections will be able to accommodate the expected development traffic demand.

No intersection upgrading is therefore required in order to accommodate the development traffic demand.

TABLE 5: PEAK HOUR LEVELS OF SERVICE WITH DEVELOPMENT (2020)

INTER-SECTION	LEVELS OF SERVICE AND DELAY (s)												
	Northbound			Southbound			Eastbound			Westbound			Int
	L	S	R	L	S	R	L	S	R	L	S	R	LOS
WEEKDAY AM													
D1239 / Dwergarend	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	9.4	0	0	n/a	n/a	0	7.4	9.4
D1239 / Access	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	8.5	0	0	n/a	n/a	0	7.3	8.5
WEEKDAY PM													
D1239 / Dwergarend	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	8.8	0	0	n/a	n/a	0	7.6	8.8
D1239 / Access	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	8.4	0	0	n/a	n/a	0	7.3	8.4

7. HORIZON YEAR ANALYSIS (2025)

A five-year horizon analysis has been conducted in order to determine the longer-term sustainability of the road's infrastructure.

A 5% traffic background growth has been assumed for analysis purposes

It is evident from table 6 below that all of the analysed intersections are expected to be operating at an acceptable level of service by the horizon year 2025.

TABLE 6: HORIZON YEAR LEVELS OF SERVICE (2025)

INTER-SECTION	LEVELS OF SERVICE AND DELAY (s)												
	Northbound			Southbound			Eastbound			Westbound			Int
	L	S	R	L	S	R	L	S	R	L	S	R	LOS
WEEKDAY AM													
D1239 / Dwergarend	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	9.8	0	0	n/a	n/a	0	7.4	9.8
D1239 / Access	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	8.5	0	0	n/a	n/a	0	7.3	8.5
WEEKDAY PM													
D1239 / Dwergarend	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	9.0	0	0	n/a	n/a	0	7.8	9.0
D1239 / Access	n/a	n/a	n/a	A	n/a	A	A	A	n/a	n/a	A	A	A
	n/a	n/a	n/a	0	n/a	8.5	0	0	n/a	n/a	0	7.3	8.5

8. ACCESS INTERSECTIONS

8.1 ACCESS TO DEVELOPMENT – REFER ANNEXURE C

The access to the development needs to align with the approved Nkomazi Roads Master Plan of this area.

According to the above-mentioned roads master plan, the existing road D1239 does from part of the said roads master plan and access from this road shall be in order.
Further to the above, the development is being bordered by the Crocodile River and Kruger National Park along the northern boundary. No further possible developments to the north which may have to gain access through this land portion is therefore applicable.

The proposed town access is depicted further below in figure 2 and also attached to the report as annexure C.

FIGURE 2 : DEVELOPMENT ACCESS LOCALITY

8.2 SIGHT DISTANCE

The proposed access intersection on Road D1239 will be priority controlled with priority of movement provided along Road D1239 and stop condition on access road.

8.2.1 STOPPING SIGHT DISTANCE (50 km/h)

Sight distance in both direction (east and west) is in excess of 220m.

The following elements have an influence on the sight distance calculation and consequently need to be considered prior to the sight distance calculation:

- Vehicular speeds along Road D1239;
- Grade of Access;
- Road D1239 cross section (width and number of lanes).

The above elements are discussed below as bulleted above.

8.2.1: VEHICULAR SPEED ALONG D1239

Road D1239 is a gravel road at the locality of the proposed access intersection. The average vehicle speed at the locality of the access intersection is probably below 50 km/h along this portion of the D1239. A speed of 50 km/h has been nevertheless been adopted for the sight distance calculations.

8.2.2: GRADIENT OF ACCECSS ROAD

The access gradient is less than 4 % and will therefore have no influence on the sight distance calculation.

8.2.3: ROAD CROSS SECTIONS AT THE ACCESS INTERSECTIONS

The D1239 is a gravel road single carriageway, with a width of approximately 6.0m wide.
The development access from the D1239 is a full access with standard gap size requirements.

8.2.4: GAP ACCEPTANCE SIGHT DISTANCE (SHOULDER SIGHT DISTANCE)

Having taking cognisance of the discussion above, the relevant shoulder and stopping sight distances are discussed in the remainder if this section.

The shoulder sight distance (as described by the Committee of State Road Authorities) or the Gap acceptance sight distance is the sight distance required by drivers entering an intersection

to enable them to establish that it is safe to do so and then carry out the manoeuvres necessary either to join or to cross the opposing traffic stream.

Sight distance values are based on the ability of the driver of a vehicle to see an approaching vehicle along the main road. Shoulder sight distances are measured from an eye height of 1.05m to an object height of 1.3m (passenger car). The eye height from trucks is 1.8m

Since the volume of heavy vehicles that will make use of this entrance is unsubstantial, the sight distance requirements of a light vehicle will be applicable to this sight distance calculation.

Sight distance calculations are based on speeds as discussed in section 8.2.1 above.

8.2.5: REQUIRED GAP ACCEPTANCE SIGHT DISTANCE CALCULATION

The TMH 16 Vol. 2 (South African Traffic Impact and Site Impact Assessment Standards & Requirements Manual) prescribes a sight distance that will be equal to a gap size of 7.5s (for passenger cars) for right turn and 6.5s for left turn.

The sight distance calculation is therefore as follow:

The following attributes are applicable to the D1239:

- Gradient : less than 4%;
- Gap size adjustment due to gradient is applicable (reduce);
- Speed : 50 km/h

Required sight towards the west (left turn): (50km/h / 3.6) x (6.5) = 90.27m

Sight towards the east (right turn): (50 km/h / 3.6 x (7.5) = 104.17m

The above sight distance calculations are compared with prescribed norms and are tabled in table 7 below for ease of reference.

TABLE 7: SUMMARY OF SIGHT DISTANCE CALCULATIONS (50 km/h)

INTERSECTION	REFERENCE	SIGHT DISTANCE TOWARDS	REQUIRED (m)	AVAILABLE	RESULT
D1239	TMH 16	Towards west (left turn)	91	+220	OK
		Towards east (right turn)	105	+220	OK

Following all of the above, it is proposed that the proposed access locality to the development be supported.

8.3 STOPPING SIGHT DISTANCE

8.3.1: STOPPING SIGHT DISTANCE

The stopping sight distance is defined as the required distance along the main road to bring a vehicle safely to a standstill if required. Stopping sight distance is measured from an eye height of 1.05m to an object height of 0.15m (eye height of 1.8m for trucks). Stopping sight distance is expresses as:

$$S = 0.694v + v^2/254f+-G$$

The required stopping sight distance is calculated to be 62.23m. The required stopping sight distance is available on site at the access intersections locality.

8.4 ACCESS INTERSECTION CAPACITY ANALYSIS & INTERSECTION LAYOUT

The access intersection has been analysed in previous sections, tables 5 and for the horizon year 2025 scenario in section 7 of this report, table 6.

The proposed access intersection layout will be a conventional priority-controlled intersection with priority of movement along Road D1239 and a stop condition on the access road approach to the intersection.
Note that road D1239 is currently a gravel road and subject to low traffic volumes of less than 500 v/day. It is the intention of the developer to maintain the status quo in this regard.

No paint markings at the intersection will therefore be possible and shall clear road signs therefore be provided.

9. PUBLIC TRANSPORTATION

Public transport is this area is mainly provided by means of bus and mini-bus taxis.
Buscor who operates from a main bus depo located in Nelspruit, has a satellite depo in Malelane.

A large bus depo and taxi rank facility is located in Malelane and approximately 3.5km from the development.

The above distance exceeds the normal allowable walking distance.

The size of the development is however of such a small scale that the provision of additional public transportation is not proposed. It is advised that home owners make arrangements to either fetch workers at the bus terminal or arrange for transportation between the bus terminal and the development access by means of mini bus taxi.

10. CONCLUSIONS & RECOMMENDATIONS

10.1 CONCLUSIONS

It has been found that:

- All of the analysed intersections are **currently (2020)** prior to development operating at an acceptable level of service. No intersection upgrading is therefore applicable in order to accommodate the existing 2020 background traffic demand.

- The trip generation of the development is expected to be as follow:
  - 25 AM trips (6 in; 19 out);
  - 25 PM trips (18 in; 8 out);

- All the analysed intersections will be able to accommodate the expected development traffic demand;

- All of the analysed intersections are expected to be operating at an acceptable level of service by the horizon year 2025;

- The development access intersection (three leg priority-controlled intersection) is expected to be operating at an acceptable level of service by the horizon year 2025;

- The proposed access intersection layout will be a conventional priority-controlled intersection with priority of movement along Road D1239 and a stop condition on the access road approach to the intersection;

- Note that road D1239 is currently a gravel road and subject to low traffic volumes of less than 500 v/day. It is the intention of the developer to maintain the status quo in this regard.

- The access to the development does align with the approved Nkomazi Roads Master Plan of this area;

- The required stopping sight distance is calculated to be 62.23m. The required stopping sight distance is available on site at the access intersections locality;

- The size of the development is of such a small scale that the provision of additional public transportation is not proposed. It is advised that home owners make arrangements to either

fetch workers at the bus terminal or arrange for transportation between the bus terminal and the development access by means of mini bus taxi.

10.2 RECOMMENDATIONS

Based on the conclusions that have been derived from this study, the following are recommended:

- That the development be supported from a traffic engineering point of view;
- That access to the development be provided in accordance with figure 2, section 8;
- That the proposed access locality to the development be supported;
- It is advised that home owners make arrangements to either fetch workers at the bus terminal or arrange for transportation between the bus terminal and the development access by means of mini bus taxi.

REFERENCES

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2. Committee of State Road Authorities, 1988, **TRH 17 Geometric design of Rural Roads,** National Department of Transport, Pretoria.

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5. National Department of Transport, 1995, **Manual for Traffic Impact Studies,** Research Report PR 93/635, BKS (Pty) Ltd, Pretoria.

6. South African National Roads Agency Limited, 2002, **Geometric Design Guidelines,** Version 1.0, CSIR, Pretoria.

7. Transportation Research Board, **Highway Capacity Manual,** Washington D.C.

APPENDIX 6.6:
WASTE COLLECTION AFFIRMATION

Nkomazi Local Municipality

9 Park Street - Malalane
Private Bag X101
Malalane,
1320
Tel: (013) 790 0245
Fax: (013) 790 0886
Customer Care No. (013) 790 0990

www.nkomazi.gov.za

Enq: Nokuphila Mkhatshwa - 0828833748

TO : **CONSOLV CONSULTING ENGINEER CC**
MR STEFAN

FROM : **DIRECTOR COMMUNITY SERVICES**
MS T.A KASEKE

DATE : **28 JANUARY 2021**

RE : **AUTHORIZATION TO DISPOSE AT STEENBOK DISPOSAL SITE**

This letter serves to confirm that ***Consolv Consultation Engineer cc*** is currently busy with development at Portions 8,13 & 14 of the farm Malelane Estate 140-JU Nkomazi area has authorization from Waste Management section to dispose their general waste at Nkomazi Local Municipality Steenbok disposal site.

Hope you will find the above in order

Regards

28/01/2021

Director: Community Services
Ms. T.A Kaseke

Date