PROPOSED FILLING STATION ALONG NORTHBOUND CARRIAGEWAY OF OLD VEREENIGING ROAD-R82 (K57) ON PTN.38/ OLIFANTSVLEI 327-IQ

MAY 2017

K&T PROJECT REFERENCE: 6882A1

REVISION 0

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This report has been prepared by Kantey & Templer (Pty) Ltd, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

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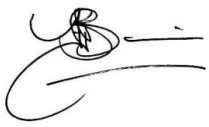
Signature:	

EXECUTIVE SUMMARY

INTRODUCTION

Kantey & Templer Consulting Engineers (K&T) has been appointed by Great Sites investments (Pty) Ltd to compile an Outline Services Scheme Report in support of the proposed rezoning and development of the remainder of portion 36 of the farm Olifantsvlei 327-IQ for the purpose of two filling stations, one on the northbound carriageway of the R82 and the other on the southbound. The following was found with regards to engineering services:

WATER

A new 110mmØ internal water main with a valve, water meter and two fire hydrants are proposed to service the site. This new water line will be feeding from the existing 150mmØ water line at the north western corner of the site where a water connection point is proposed.

No external water upgrades are required.

SEWER

An internal 160mmØ sewer pipe is proposed to service the site internally. This pipe will be located from a point near the toilets then past the convenience store to a low point at the south eastern corner of the site where the site sewer connection is proposed.
An external 200mmØ sewer pipe is required to service both the northbound and southbound filling stations. This sewer line will begin at the eastern corner of the northbound filling station and will be drilled underneath Vereeniging Road (R82) to a tie in point at the low point of the southbound filling station. The pipe will then run southwards along Wisane Road until the point where it ties into an existing 1370mmØ bulk sewer line approximately 1.5km south of the site.

We understand from Johannesburg Water officials that there is an opportunity to share the costs associated with the construction of the external sewer link with other potential developers in the area. The Johannesburg water officials indicated that they will not support an on-site package plant arrangement for this or any other development in the area.

SOLID WASTE REMOVAL

A dedicated refuse yard facility at a position internal to the site will be allocated. This facility must be constructed to comply with Pick-It-Up and JRA requirements.

STORMWATER

All stormwater runoff internal to the site will be managed and attenuated in accordance with JRA and COJ requirements. All stormwater runoff within the developed area of the site is to be managed through a series of kerb inlets, grid inlets and stormwater pipes which will ultimately discharge into an attenuation facility. All runoff will pass through an oil water separator ensuring that the natural water quality is not compromised.

A 600mmø culvert and headwall structure will be used to drain any stormwater draining from north of the site.

ROADS

It is proposed that an entrance and exit ramp be used be constructed for the northbound filling station in accordance with the Department of Public Transport and Works, BB2 Guidelines for Access to Filling Stations, November 2003 Manual.

COST ESTIMATE

The total cost to the developer toward the bulk contributions will be R 8 050 017.59

OUTLINE SCHEME REPORT FOR PROPOSED FILLING STATIONS ALONG THE NORTHBOUND CARRIAGWAY R82 ON PTN. 36/327-IQ

CONTENTS PAGE

ITEM **PAGE**

LIST OF APPENDICES:

A: DRAWINGS

6882A1 - OSR-01-A – Locality Plan
6882A1 - OSR-02-A – Proposed Site & Existing Services
6882A1 - OSR-03-A – Proposed Site and Services Layout
6882A1 - OSR-04-A – Proposed Roads Layout
6882A1 - OSR-05-A – Proposed & Existing Sewer Layout
6882A1 - OSR-06-A – Proposed Site SANBI Image
6882A1 - OSR-07-A – Proposed Site Catchment Area

Annexure B: Olifantsfontein Floodline Study

Annexure C: Wetland Assessment Olifantsvlei

1. INTRODUCTION

1.1 BACKGROUND

Kantey & Templer Consulting Engineers (K&T) have been appointed by Great Sites Investments (Pty) Ltd to compile an Outline Services Scheme Report in support of the proposed rezoning and development of the remainder of portion 36 of the farm Olifantsvlei 327-IQ.

The project involves two proposed filling stations along the Old Vereeniging Road (R82), located about 3.5km south of the interchange between M1 & N12 Southern Bypass. A third part of the site, situated east of Wisane Road, will be developed in the future.
The site locality is shown on drawing no. **6882A1-OSR-01-A: SITE LOCALITY** in Annexure A.

This report addresses the filling station situated on the **northbound carriageway** of the R82. The other filling station will be addressed in a separate Outline Services Scheme report, K&T project reference no. 6882A1.

1.2 SCOPE OF REPORT

The scope of this report is:

- Identify location of available existing services.
- Determine if existing services need to be extended.
- Determine connection points for site services.
- Specify design standards of proposed services
- Assess impact of the rezoned site on existing services and determine if upgrades are required
- If upgrades are required, determine size and extend of upgrades to existing services
- Cost estimate for internal and external services, bulk contributions

The engineering services addressed in this report are:

- Potable water and fire water supply
- Sewerage
- Solid waste removal
- Stormwater drainage
- Road infrastructure

1.3 PROJECT TEAM

Client:	Great Site Investments (Pty) Ltd, Farhat Shaik
Town planner:	Ikanyeli Development (Pty) Ltd, Samuel Makhunga
Architect:	Not appointed yet. No SDP available, provisional SDP has been drawn by K&T.
Civil engineer:	Kantey & Templer (Pty) Ltd
Transportation engineer:	Kantey & Templer (Pty) Ltd

2. SITE DESCRIPTION

2.1 TOPOGRAPHY & LOCATION

Location:	Along northbound carriageway of R82 provincial road. 3.4 km south of interchange between M1 & N12 Southern Bypass. Between intersection with Pierpont & Angela road / Access to Quarry	
Current Land Use Zoning:	Agricultural	
Existing structures:	No buildings or access road – concrete block paved stormwater channel along eastern boundary of the site	
Level & fall of terrain:	Altitude of approximately 1 644 m to 1678 m above mean sea level. Slope falling to the north-east-east. Approximate gradient of 42% to 13% towards the east. Low point at south east corner	
Vegetation:	Short grass at the eastern part, many scattered shrubs and small trees at the western part.	
Geology & soil:	Residual soils on rock, presence of rock outcrops. Underlain by andesite and conglomerate of the Ventersdorp Group & Transvaal Supergroup. Soil potentially collapsible, consolidation might occur. Geotechnical investigation will be required.	
Surrounding Land Use:	North	Ptn.153/327-IQ; smallholding with dwellings and sheds used for agricultural purposes.
	East	Roadreserve of R28 dual carriageway provincial road;
	South	Ptn.37/327-IQ; Vacant land.
	West	RE 323-IQ; Afrisam Eikenhof Quarry.

2.2 PROPOSED ZONING & LAND USE

Proposed Land Use Zoning:	Residential, (Low, medium and high density), Retail, Shops, Offices and business purposes, Drive thru, filling station, Financial institution, Motor agencies, Vehicle fitment centers, Transport facility, storage business, Place of public worship and warehousing
Height Zone:	3 Storey
Coverage:	60%.
Floor Area Ratio (FAR):	0.6 Permissible.
Density:	Floor area to be a minimum of 3000 m²
Servitudes:	SDP to be submitted
Parking:	6 bays per 100m² retail floor area, 4 bays per 100m² office floor area

3. WATER

3.1 EXISTING WATER INFRASTRUCTURE

According to the GIS data there is an existing 150mmØ JW water pipe running along the western boundary of the smallholding on Ptn.153/327-IQ and terminating at the north-western boundary of the site. This water pipe is fed by the Naturena reservoir, situated 1.0 km north-west of the site.
The pipe lengths up to the reservoir amounts to 2.19 km: 150mmØ pipe length 1.155 km, 600mmØ pipe length. 350m and a 750mmØ pipe length 685m.

3.1.1 DESCRIPTION

3.1.2 AVAILABLE PRESSURE

Required pressure by JW standards:

PRESSURE bar			
ABSOLUTE MINIMUM	**MINIMUM**	**MAXIMUM**	**PREFERRED FOR COMMERCIAL**
2.0	2.5	9.0	3.5

Assuming the line is fed by gravity, the available water pressure on site can be determined as follows:

RESERVOIR		BULK WATER PIPE				SITE		
NAME	**ELEVATION m**	**LENGHT TO RESERVOIR**	**Ø BULK WATER PIPE km**	**ESTIMATED LOSS bar/km**	**ESTIMATED LOSS bar**	**ELEVATION m**	**STATIC HEAD m**	**PRESSURE BAR**
NATURENA	1776.0	2.19	140	0.50	1.09	1652.00	124.00	**11.31**

The static pressure minus estimated losses of 0.5 bar/km at the site amounts to 11.3 bar, but this is has been reduced by existing PRV's along the water line as the maximum allowable pressure is 9 bar. It is recommended to do a static pressure and flow test at the connection point at the detail design stage.

3.2 WATER DEMAND

The water demand, excluding the fire flow, was determined to come from three sources:

1. Domestic consumption of filling station & convenience store
2. Irrigation of landscaped area between on and off ramps
3. Carwash

3.2.1 DOMESTIC

According to the JW standards, the domestic demand for garages is 0.4kl/100m^2 which corresponds to the demand for shops mentioned in the literature.
The peak factor was taken as 4, which is in accordance to the JW standards.

ZONING	UNIT DEMAND	FLOOR AREA m2	AADD kl/d	DOMESTIC FLOW l/s
GARAGE	0.4kl/100m^2	3000	12	**0.139**

3.2.2 **CARWASH**

The water demand for a carwash depends on which type of carwash is used and if there is any water recycling taking place. An estimate was derived from a document by the International Carwash Institute and was conservatively determined to be 40 gallons/car.
It was estimated that 50 cars will use the facility per day.

	WATER DEMAND per car				
DEVELOPMENT TYPE	gallons	litres	AMOUNT cars per day	ADD l/s/d	CARWASH FLOW l/s
CARWASH	40	151.4	50	7570	**0.088**

3.2.3 **IRRIGATION**

According to reports, the water usage for gardening amounts to 40% of the domestic consumption.

DOMESTIC FLOW l/s	PERCENTAGE FOR IRRIGATION	IRRIGATION FLOW l/s
0.139	40%	**0.056**

3.2.4 **DESIGN PEAKFLOW**

The peak factor was taken as 4.0, which is in accordance to the JW standards.

DOMESTIC FLOW l/s	CARWASH FLOW l/s	IRRIGATION FLOW l/s	TOTAL FLOW l/s	PEAK FACTOR	TOTAL PEAK FLOW l/s
0.139	0.088	**0.056**	**0.283**	**4**	**1.132**

The **design peak flow** amounts to 0.556 + 0.088 = **1.132 l/s.**

Determination of velocity in pipe at peak flow demand:

PIPE SIZE	OUTSIDE Ø mm	T WALL mm	INSIDE Ø mm	INSIDE AREA mm2	DESIGN PEAK FLOW l/s	V m/s
110Ø CLASS 16	110	6.7	96.6	7328.8	1.132	**0.154**

3.3 FIRE FLOW

The 2013 Johannesburg Water guidelines & standards for the design of water and sanitation services were used for the determination of the fire flow. SANS 10400 T standards are also applicable.

The fire department was contacted (081 507 7496) and it was confirmed that the above mentioned JW standards will be sufficient for filling stations.

The JW standard requirements are summarized as follows:

DEVELOPMENT TYPE	MINIMUM HYDRANT REQUIREMENT	DURATION OF FIRE	MAX. SPACING OF HYDRANTS
BUSINESS, COMMERCIAL & INDUSTRIAL	100l/s @ 1.5 bar working pressure	4h	180m

As mentioned in chapter 3.1, the static pressure minus estimated losses was determined to be 11.3 bar and the actual pressure at the site connection point has to be verified at the design stage.

Two fire hydrants will be provided as shown on dwg. No. **6882A1-OSR-03-A** Combined Services Layout. They will be approximately 60m spaced and they should cover the pumps and tanks within that range. Final position of the hydrants will be determined and approved by a specialist fire consultant who will be used to do the detail design of the fire system also.

3.4 PROPOSED SERVICES

3.4.1 MATERIALS

The following materials & standards are proposed:

PIPES	COUPLINGS	VALVES	HYDRANTS
110Ø HIGH IMPACT uPVC CLASS 16, SANS 966 PART1	SHOULDER ENDED 'VICTAULIC', SANS 966-2	JW TYPICAL DWG NO A3-3-12-1	JW TYPICAL DWG NO A3-6-12

Construction as per SANS1200 L.

3.4.2 CONNECTION POINT

The proposed connection point will be at the north-west corner of the site. A valve is proposed just after the connection point.

3.4.3 FLOW METER

The flow meter will be situated at the side of the exit ramp of the filling station.

The high flow rate will require a 110mmØ flow meter. However, as the domestic consumption is very low this could necessitate the installation of a compound meter with a 40mmØ or 50mmØ meter for domestic meterage, depending on the actual pressure. A final decision should be taken at detail design stage in liaison with the JW depot.

3.4.4 EXTERNAL SERVICES

No external services need to be constructed.

3.4.5 INTERNAL SERVICES

The 110mmØ waterpipe will enter the site at the north-west corner and run along the northern boundary and eastern boundary until the exit ramp where the flow meter is proposed.
The internal pipe will continue along the exit ramp until the parking area where a fire hydrant will be situated.
The pipe will continue and terminate at the toilets, which are likely to be situated at the back of the convenience store. A second fire hydrant will be situated at this point.
The layout is shown on drawing No. **6882A1-OSR-03-A**.

3.4.6 **SERVITUDES**

No servitudes are required for the water services.

3.4.7 **COST ESTIMATE**

Internal services:

ITEM	UNIT	QUAN	RATE	AMOUNT
110Ø uPVC CLASS 16 PIPE	m	236	R 350.00	R 82 600.00
VALVES	No.	1	R 12 000.00	R 12 000.00
85mm FIRE HYDRANT	No.	2	R 12 000.00	R 24 000.00
COMPOUND FLOW METER	No.	1	R 35 000.00	R 35 000.00
WATER CONNECTION	Sum	1	R 20 000.00	R 20 000.00
SUB TOTAL				R 173 600.00
P & G (15%)				R 26 040.00
TOTAL SUPPLY & CONSTR.				R 199 640.00

4. SEWER

4.1 EXISTING INFRASTRUCTURE

There is currently no existing infrastructure near the site. The developments around the site, such as the freeholdings and the conference centre are using sceptic tanks. As the area will see further development Johannesburg Water has indicated that a sewer pipe reticulation system is required and the use of septic tanks /package plants will not be supported.
The nearest sewer pipe downstream is a bulk 1350mmØ sewer pipe, situated 1.5 km downstream towards the south. This is a south east outfall sewer which drains in a westerly direction to the Boskoppies sewerage works.

4.2 DESIGN DISCHARGE

According to the JW standards the following parameters are applicable:

- Percentage due to extraneous inflow: 15%.
- Peak factor for commercial developments: 1.5.
- Sewer discharge (excluding peak factor) generally amounts to 80% in fully developed areas.

TOTAL WATER DEMAND l/s	PERCENTAGE FOR SEWER DISCHARGE	SEWER DISCHARGE l/s	PERCENTAGE EXTRANEOUS FLOW	SEWER DISCHARGE l/s	PEAK FACTOR	PEAK DISCHARGE
0.283	80%	0.226	15%	0.260	1.5	**0.390**

The peak sewer discharge **0.390 l/s.**

4.3 PROPOSED SERVICES

4.3.1 MATERIALS

The following materials & standards are proposed for the internal services:

PIPES	MANHOLES	MAX. MANHOLE SPACING m	MINUMUM FALL
160Ø uPVC CLASS 34 HD SANS 977	JW TYPICAL DWG NO A3-1-2	80.0	1:80 (1.25%)

The following materials & standards are proposed for the external services:

PIPES	PIPE UNDER ROAD	MANHOLES	MAX. MANHOLE SPACING m	MINUMUM FALL
160Ø uPVC CLASS 34 HD SANS 977		JW TYPICAL DWG NO A3-1-2	80.0	1:80 (1.25%)

4.3.2 CONNECTION POINT

The proposed connection point of the internal sewer with the proposed external sewer will be at the low point at the south-east corner of the site.

4.3.3 EXTERNAL SERVICES

A 200mmØ external sewer pipe is proposed running from the south-east corner of the western site crossing the R82.
The crossing under the R82 will be drilled using directional drilling technique. The pipe crossing the roadreserve of the R82 will connect with the tie-in point of the other proposed filling station situated along the southbound carriageway of the R82. From there the proposed 200mmØ sewer pipe will run southwards along Wisani road until it connects with an existing 1370mmØ south eastern outfall sewer.
The proposed 200mmØ sewer pipe will connect into the existing 1370mmØ pipe from the top by means of a saddle type connection.
The south eastern outfall sewer drains towards the Bushkoppies Sewerage works. Bothe the outfall sewer and the sewerage works have the capacity to support the proposed development.

4.3.4 INTERNAL SERVICES

Proposed is a 160mmØ sewer pipe running from the toilets at the back of the convenience store, past the building and pumps southwards and along the entrance ramp towards the low point of the site. The layout is shown on drawing **6882A1-OSR-05-A.**

4.3.5 COST ESTIMATE

Internal services:

ITEM	UNIT	QUAN	RATE	AMOUNT
160Ø uPVC CLASS 34 PIPE	m	78	650.00	R 50 700.00
MANHOLE	No.	1	10 000.00	R 10 000.00
NEW CONECTION	SUM.	1	50 000.00	R 50 000.00
SUB-TOTAL				R 110 700.00
P & G (15%)				R 16 605.00
TOTAL SUPPLY & CONSTR.				R 127 305.00

External services:

ITEM	UNIT	QUAN	RATE	AMOUNT
200Ø uPVC CLASS 34 PIPE	m	1708	750.00	R 1 281 000.00
MANHOLE	No.	31	10 000.00	R 310 000.00
NEW CONNECTION	No.	1	50 000.00	R 50 000.00
SUB-TOTAL				R 1 641 000.00
P & G (15)				R 246 150.00
TOTAL SUPPLY & CONSTR.				R 1 887 150.00

Johannesburg water indicated that there are other developers in the area who may be available to share this cost.

5. SOLID WASTE REMOVAL

There will be a dedicated refuse yard facility for the proposed development, located at a position internal to the site. The access to this facility will be as per Pick-It-Up requirements. The proposed site access will be designed and constructed to JRA standards and to Pick-It-Up requirements for refuse vehicle access. A minimum 4m wide lane will be provided at the main entrance for refuse vehicle to access the refuse yard. Details and positions of the refuse yards will be shown on the Architect's Site Development Plan (SDP) for approval.

6. STORMWATER

The site has an average slope of 42% to 11% in an easterly direction across the site. The site currently drains overland towards the northbound dual carriageway (Vereeniging Road-R82 (K57)) where the runoff is channelled along the road reserve in a southerly direction.

6.1 EXISTING INFRASTRUCTURE

The site does have existing functioning stormwater infrastructure which currently services the site and its surrounding catchment. This infrastructure consists of a 3.8m wide channel located outside the north-eastern corner of the site which drains into two 1.5mø stormwater pipes crossing under Vereeniging Road (R82) discharging into a southbound watercourse. There is also a 500mm wide side drain along the northbound Vereeniging (R82) terminating at the southern boundary of the site. **Drawing 6882A1-0SR-03-A: PROPOSED SERVICES LAYOUT (ANNEXURE A)** shows the location and layout of the existing and proposed stormwater infrastructure.

6.2 ATTENUATION

6.2.1 JRA REQUIREMENTS

The Johannesburg Roads Agency (JRA) requires on-site attenuation for developments larger than 8,000m² in area. Stormwater attenuation is not required for land given off for road reserve servitudes and undeveloped public and private open spaces.
Since the developable area of 18,645.6 m² for the proposed development is greater than the threshold, a stormwater attenuation facility will be required for this development.

For planning purposes, the JRA guidelines dictate that the attenuation volume should be approximately 350m³ per hectare.

Consequently, for this development the following applies:

SITE AREA	ATTENUATION RATE	VOLUME STORAGE REQUIRED
1.86451 ha	350 m³/ha	652.575 m³

6.2.2 COJ REQUIREMENTS

- The COJ's Catchments Management Policy requires the **integration** of environmental components with engineering components as part of **sustainable** catchment management.
- The document indicates that minor, major and **environmental systems** be interlinked to form an ecological system that prioritises **water quality management**.
- **Peak discharge, Discharge Volume, Runoff frequency** and water quality are to be considered during stormwater runoff management.
- The COJ requires that **water quality** preservation measures be implemented for surface runoff and attenuated stormwater.

6.3 FLOODLINES & WETLANDS

The proposed development is not affected by any flood lines due to runoff from the upper catchment area being diverted into an existing 3.8m wide channel. The contributing catchment area has an area of 408172.8168 m² (0.41 km²) which is less than 1km² meaning that a floodline report is not required as in accordance to Chapter 14, Part 3 of the National Water Act (Act 36 of 1998) . **Drawing 6882A1-0SR-07-A: PROPOSED SITE CATCHMENT AREA (ANNEXURE A)** shows the contributing catchment areas for both "site 1" and "site 2".

The site classifies as a Critical Bio Diversity Area (CBA) as in accordance with the South African National Biodiversity Institute (SANBI) map as can be seen in drawing **6882A1-0SR-06-A: PROPOSED SITE SANBI IMAGE (ANNEXURE A)**.

A Wetland Assessment of the site was conducted by The Biodiversity Company and it was found that the site does not form part of the **National Freshwater Ecosystem Priority Area** (NFEPA). The assessment did however confirm the presence of a channelled valley bottom wetland within 500m of the project area.

Attached as Annexures

I. Olifantsfontein Floodline Study
II. Wetland Assessment Olifantsvlei

6.4 PROPOSED SERVICES

6.4.1 MINOR SYSTEM

The minor system refers to the internal stormwater infrastructure on the site.

The following measures are proposed in terms of the design of the minor system:

- The run-off will be captured by **kerb inlets, grid inlets** and conveyed to an attenuation facility via an underground **stormwater pipe network**.
- The internal stormwater pipe network will be designed to **accommodate** the runoff generated by storm events with a **recurrence interval of up to 5 years**.
- An oil/water separator will be used to ensure that the natural water quality is not compromised.
- Two 600mmø culverts, 1m wide stormwater channel and headwall structure will be used to facilitate stormwater draining from the northern half of the site.

The layout of the proposed stormwater layout is shown on drawing **6882A1-OSR-03-A.**

6.4.2 **MAJOR SYSTEM**

The major system acts as a backup emergency system in case of major storm events with a recurrence interval of greater than 5 years. Its function is to protect the properties and infrastructure from damage and flooding during such events.

The following measures are proposed in terms of the design of the major system:

- All runoff generated by the proposed development during the major system will drain overland towards the attenuation facility. All parking areas and internal road network will be designed accordingly.
- The attenuation structure on site will be designed to withstand the major flows. Erosion protection at the discharge points will be provided for in the form of gabions and reno mattresses.
- The outlet structures of the attenuation facility will overflow at recurrence of intervals of 1:25y and higher. Emergency overflows will be provided.
- The attenuation facility will be significantly robust and large enough to accommodate the 1:50 recurrence storm but will not attenuate for storms of this magnitude.

6.4.3 **COST ESTIMATE**

Internal services:

ITEM	UNIT	QUAN	RATE	AMOUNT
450Ø HDPE PIPE	m	88	850.00	R 74 800.00
KERB INLET	No.	5	12 000.00	R 60 000.00
MAN-HOLE	No.	2	10 000.00	R 20 000.00
OIL/WATER SEPERATOR	No.	1	30 000.00	R 30 000.00
ATTENUATION POND	m³.	652.575	1 000.00	R 652 575.00
HEADWALL	No.	1	50 000.00	R 50 000.00
SUB -TOTAL				R 887 375.00
P & G (15%)				R 133 106.25
TOTAL SUPPLY & CONSTR.				R 1 020 481.25

External services:

ITEM	UNIT	QUAN	RATE	AMOUNT
600Ø CULVERT	m	14	12 000.00	R 168 000.00
HEADWALL	No.	2	50 000.00	R 100 000.00
1m WIDE CHANNEL	m	60	30 000.00	R 1 800 000.00
SUB -TOTAL				R 2 068 000.00
P & G (15%)				R 310 200.00
TOTAL SUPPLY & CONSTR.				R 2 378 200.00

7. ROADS

7.1 EXISTING INFRASTRUCTURE

The site is located approximately 500m upstream to the intersection of Pierpont Drive and Vereeniging Road-R82 (K57.01) and approximately 500m downstream to the Angela Road and Vereeniging Road-R82 (K57.01) intersection.
The land use surrounding the site is predominantly residential and agricultural land. The site is currently vacant and agricultural in nature and is accessible from the north bound direction of Vereeniging Road-R82 (K57.01).The surrounding road network is shown on the attached drawing: **6882A1-OSR01-A – LOCALITY PLAN (Annexure A).**

7.2 TRAFFIC IMPACT

The impact that the proposed filling station will have on the surrounding existing road network is addressed in the Traffic Impact Assessment that will be compiled and submitted to the JRA by Kantey and Templer consulting Engineers. In this report it is calculated that the southbound filling station will generate **774 trips** during the 24 hour period.

7.3 GEOMETRY

7.3.1 STANDARDS

All road infrastructure for the site will be configured in accordance with the Department of Public Transport and Works, BB2 Guidelines for Access to Filling Stations, November 2003 Manual.

7.3.2 DESCRIPTION

The Filling station will have its own access points off the existing Vereeniging Road-R82 (K57). These access points will include acceleration & de-acceleration lanes feeding in and out of exit and entrance ramps providing access to the site from existing Vereeniging road-R82 (K57) which is a Provincial Road under the Gautrans jurisdiction. It should be mentioned that a substantial amount of fill material will be required to construct the entrance and exit ramps.
The proposed new access is indicated in the accompanying drawing **6882A1-OSR-04-A**: Road Layout & Access.

7.3.3 COST ESTIMATE

External services:

ITEM	UNIT	QUAN	RATE	AMOUNT
NEW VEREENIGING ROAD ACCESS	m²	1401.3137	1500.00	R 2 101 970.55
SUB-TOTAL				R 2 101 970.55
P & G (15%)				R 315 295.58
TOTAL SUPPLY & CONSTR. (Excl VAT)				R 2 417 266.133

8. COST SUMMARY

8.1 CONSTRUCTION COSTS

The following items are excluded for these cost estimates: -

a) Professional Fees including survey, detailed design, project management, contract administration, legal etc (Allow 15%)
b) Demolishing and removing of buildings and structures.
c) External roadworks as per the TIA.
d) Minimal allowance has been made for rock.
e) Individual water meters and council deposits.
f) Cost of registration of servitudes.
g) Cost for Electrical and Telkom supply.
h) Any contingency items.
i) Prices exclude VAT and escalation.
j) Internal services for buildings.

Internal services:

ITEM	AMOUNT
WATER	R 199 640.00
SEWER	R 127 305.00
STORMWATER	R 1 020 481.25
TOTAL SUPPLY & CONSTR	R 1 347 426 .25

External services:

ITEM	AMOUNT
SEWER	R 1 887 150.00
ROADS	R 2 417 266.13
STORMWATER	R 2 378 200.00
TOTAL SUPPLY & CONSTR.	R 6 682 616.13

The cost associated with the construction of the external sewer will be shared between the two filling stations on the east and west of Vereening Road-R82 (K57). Reference to the southbound filling stations can be found on a similar Outline Scheme Report by Kantey & Templer with the project reference 6882A2.

8.2 BULK SERVICE CONTRIBUTIONS

These figures are based on the City of Johannesburg March 2016 formulae and exclude rebates for bulk contributions paid for existing rights and are calculated on the proposed rights of the filling station development. **(Note that no rebates for existing rights over and above the existing rights have been considered).**

These bulk contribution figures are revised from time to time with new contribution figures applicable wef 1 July 2015.

Note that the City of Johannesburg Technical Co-ordination Department will prepare the final calculations.

Potable Water (Excl. VAT)

Filling Station: 3000 m² @ 0.4kl/100m² = 12kl/day
Car Wash: 151.4 l/car @ 50 cars/day = 7.57kl/day
Irrigation: 40% of 12 kl/day = 4.8kl/day

Total = (12+7.57+4.8)kl/day @ R4,824.00/kl/day
24.37kl/day @ R4,824.00/kl/day = **R 117 560.88**

Sewage (Excl. VAT)

Filling Station: 80% of domestic ie (12+7.57+4.8) kl/day = 19.496kl/day
Extraneous Flow: 15% of 19.496 kl/day = 2.9244kl/day

Total = (19.496+2.9244) kl @ R8,584.00/kl/day = **R 192 456.71**

Roads and Stormwater (No VAT applicable) (Filling Station southbound only)

774 trips generated @ R10 000.00 per trip generated. = **R 7 740 000.00**

Total Bulk Contributions (Excl. VAT) = **R 8 050 017.59**

It is the intention of the developer to enter into negotiations with the JHB Roads Agency and Johannesburg Water to sign an Engineering Services Agreement (ESA) to facilitate the offset of bulk contributions against the cost of the required new roads & stormwater that have been identified. In terms of the ESA, the provision of various infrastructure items may be classified as external infrastructure in that they resolve and address existing capacity problems and may therefore be offset against the applicable bulk contributions.

9. RECOMMENDATIONS & CONCLUSION

9.1 RECOMMENDATIONS

9.1.1 WATER

A new 110mmØ internal water main with a valve, water meter and two fire hydrants are proposed to service the site. This new water line will be feeding from the existing 150 Ø water line at the north western corner of the site where a water connection point is proposed.

No external water upgrades are required.

9.1.2 SEWER

An internal 160Ø sewer pipe is proposed to service the site internally. This pipe will be located from a point near the toilets then past the convenience store to a low point at the south eastern corner of the site where the site sewer connection is proposed.
An external 200 Ø sewer pipe is required to service both the northbound and southbound filling stations. This sewer line will begin at the eastern corner of the northbound filling station and will be drilled underneath Vereeniging Road (R82) to a tie in point at the low point of the southbound filling station. The pipe will then run southwards along Wisane Road until tying into an existing 1370mmØ bulk sewer line (south eastern outfall sewer) approximately 1.5km south of the site. This outfall sewer drains to the west into the Boskoppies Sewerage works. Both the outfall sewer and the sewage works are confirmed to have sufficient capacity.

9.1.3 SOLID WASTE REMOVAL

A dedicated refuse yard facility at a position internal to the site will be allocated. This facility must be constructed to comply with Pick-It-Up and JRA requirements.

9.1.4 STORMWATER

All stormwater runoff internal to the site will be managed and attenuated in accordance with JRA and COJ requirements. All stormwater runoff within the developed area of the site is to be managed through a series of kerb inlets and stormwater pipes which will ultimately discharge into an attenuation facility. All runoff will pass through an oil water separator ensuring that the natural water quality is not compromised.

Two 600mmø culverts, 1m wide channel and headwall structure will be used to drain any stormwater draining from north of the site.

9.1.5 ROADS

It is proposed that a set de-acceleration and acceleration lanes with entrance and exit ramps be constructed for the northbound filling station in accordance with the Department of Public Transport and Works, BB2 Guidelines for Access to Filling Stations, November 2003 Manual.

9.1.6 COST ESTIMATE

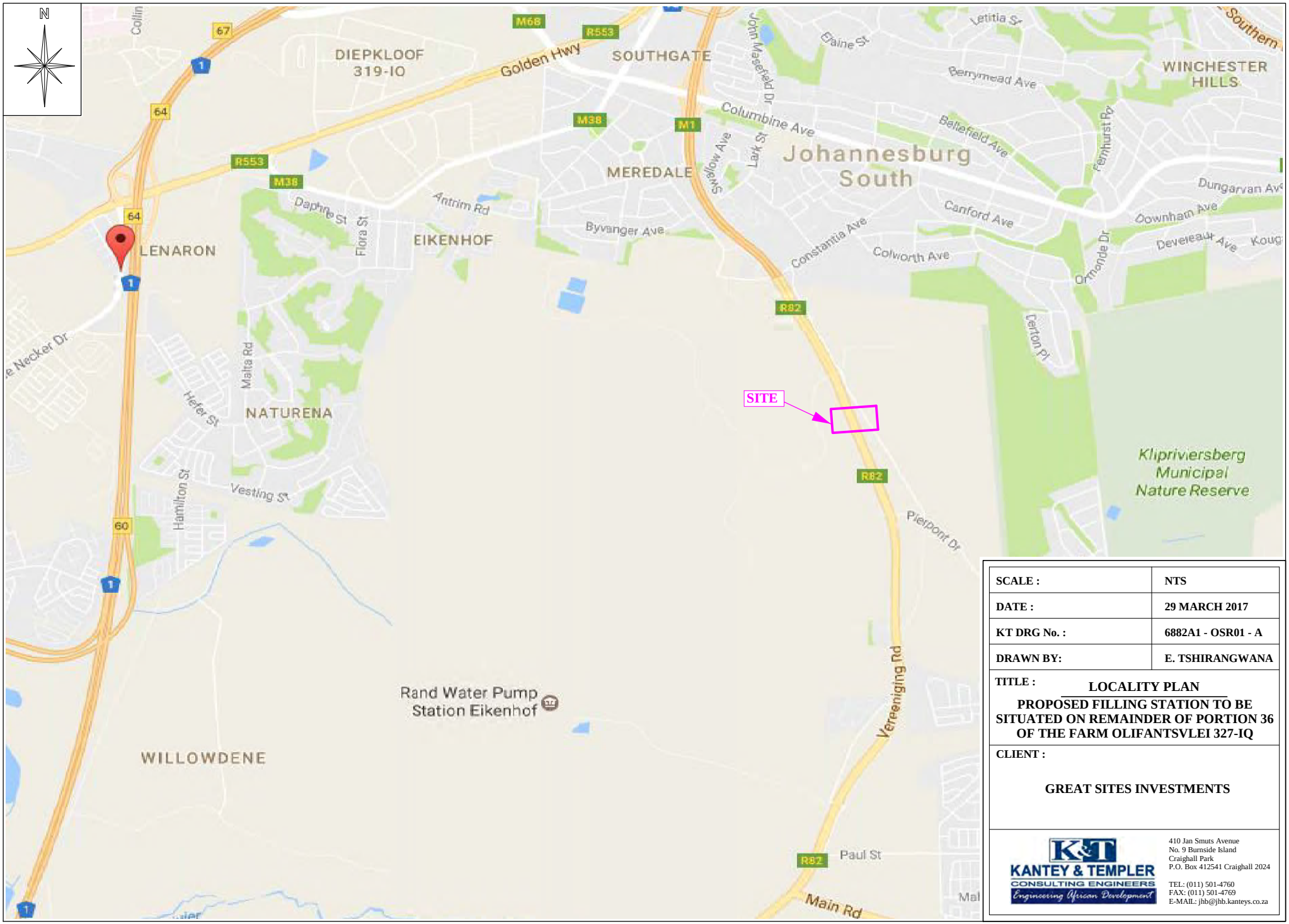
The construction costs for internal civil services (excluding professional fees) is R 1 347 426.25
The construction costs for external civil services (excluding professional fees) is R 6 682 616.13
The total cost to the developer toward the bulk contributions will be R 8 050 017.59

9.2 CONCLUSION

Provided the proposed infrastructure mentioned in this report is constructed, this development and rezoning should be supported by the local authority, as there is sufficient capacity in the existing and proposed municipal infrastructure.

APPENDIX A

DRAWINGS



SCALE :	**NTS**
DATE :	**29 MARCH 2017**
KT DRG No. :	**6882A1 - OSR01 - A**
DRAWN BY:	**E. TSHIRANGWANA**

TITLE : **LOCALITY PLAN**

PROPOSED FILLING STATION TO BE SITUATED ON REMAINDER OF PORTION 36 OF THE FARM OLIFANTSVLEI 327-IQ

CLIENT :

GREAT SITES INVESTMENTS

KANTEY & TEMPLER CONSULTING ENGINEERS
Engineering African Development

410 Jan Smuts Avenue
No. 9 Burnside Island
Craighall Park
P.O. Box 412541 Craighall 2024

TEL: (011) 501-4760
FAX: (011) 501-4769
E-MAIL: jhb@jhb.kanteys.co.za

N

PROPOSED SITE 1

PROPOSED SITE 2

PROPOSED SITE 3

RE/87/327-IQ

153/327-IQ

RE/36/327-IQ

RE/71/327-IQ

37/327-IQ

130/327-IQ

180/327-IQ

38/327-IQ

39/327-IQ

RE/5/327-IQ

RE/140/327-IQ

181/327-IQ

EAGLES NEST

RE/40/327-IQ

20

150

160 PVC

R.W.B. Servitude

AV

BLACK TOP

5,0 FROM EDGE OF

1,0 FROM EDGE OF BLACK TOP

1,0m from edge of the blacktop

2,6 from edge of rd

10,3 from edge of rd

Poles indicating valve's position

2,0

1370

C' MAIN OUTFALL SEWER 3,78m WIDE

LEGEND:

- EXISTING SEWERS
- EXISTING STORMWATER
- EXISTING WATER

SCALE :	**1:5300**
DATE :	**29 MARCH 2017**
KT DRG No. :	**6882A1 - OSR-02 - A**
DRAWN BY:	**E. TSHIRANGWANA**

PROPOSED SITE & EXISTING SERVICES

PROPOSED FILLING STATION TO BE SITUATED ON REMAINDER OF PORTION 36 OF THE FARM OLIFANTSVLEI 327-IQ

CLIENT :

GREAT SITES INVESTMENTS

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LEGEND:

- EXISTING WATER
- PROPOSED WATER
- PROPOSED STORMWATER

SCALE :	**1:1000**
DATE :	**11 APRIL 2017**
KT DRG No. :	**6882A1 - OSR-03 - A**
DRAWN BY:	**E. TSHIRANGWANA**

PROPOSED SERVICES LAYOUT

PROPOSED FILLING STATION TO BE SITUATED ON REMAINDER OF PORTION 36 OF THE FARM OLIFANTSVLEI 327-IQ

CLIENT :

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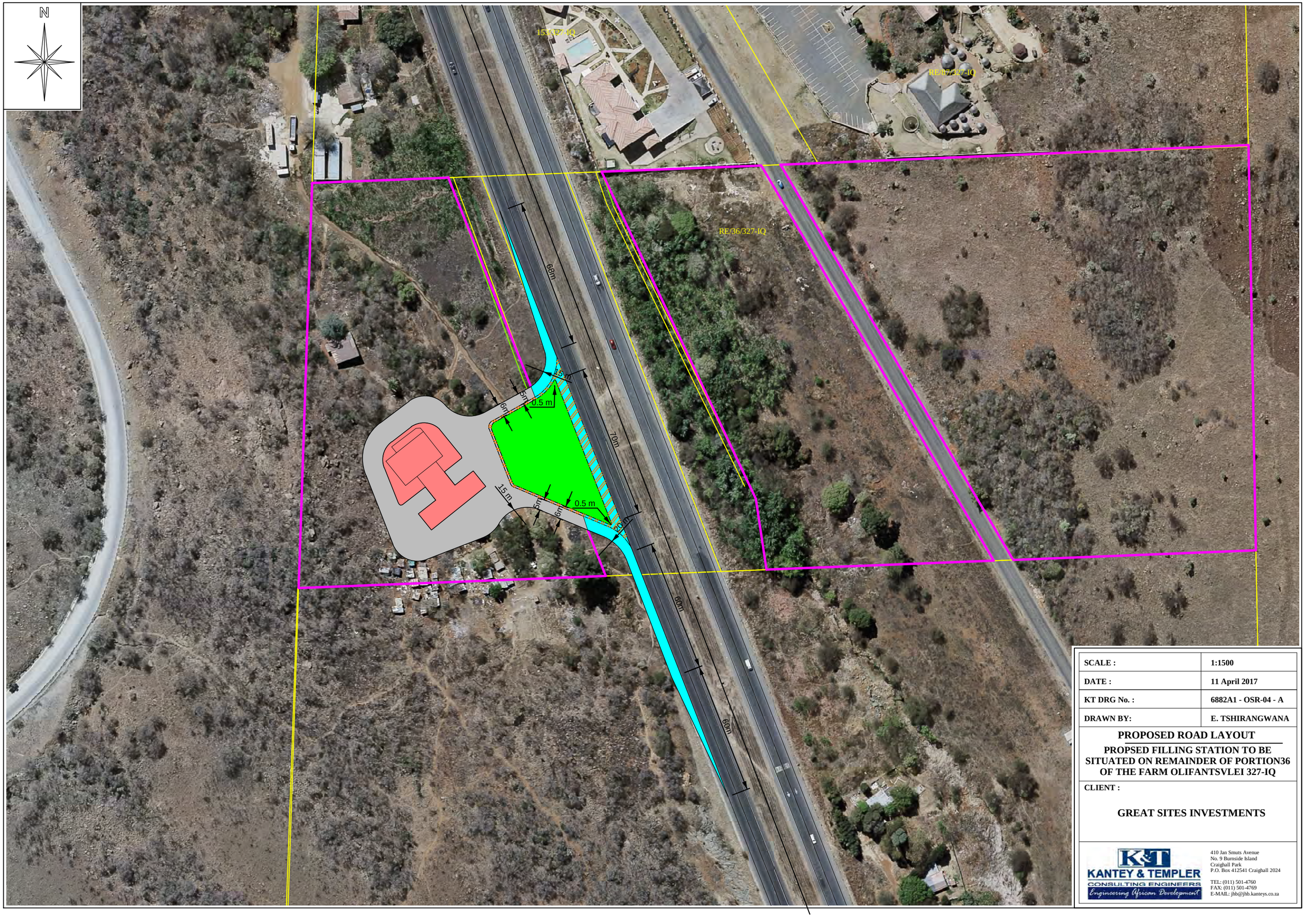

SCALE :	**1:1500**
DATE :	**11 April 2017**
KT DRG No. :	**6882A1 - OSR-04 - A**
DRAWN BY:	**E. TSHIRANGWANA**

PROPOSED ROAD LAYOUT

PROPSED FILLING STATION TO BE SITUATED ON REMAINDER OF PORTION36 OF THE FARM OLIFANTSVLEI 327-IQ

CLIENT :

GREAT SITES INVESTMENTS

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N

PROPOSED SITE 1

PROPOSED SITE 2

SITE 1 PROPOSED SEWER CONNECTION

SITE 2 PROPOSED SEWER CONNECTION

160mm SEWER

160mm SEWER

PROPOSED DIRECTIONAL DRILLING UNDER VEREENIGING ROAD (R82)

PROPOSED 200mm SEWER LINE

PROPOSED 200mm SEWER LINE

PROPOSED 200mm SEWER LINE

PROPOSED 200mm SEWER LINE

PIERPONT DRIVE

WISANE STREET

VEREENIGING ROAD (R82)

EAGLES NEST

PROPOSED SEWER CONNECTION INTO EXISTING

MAIN OUTFALL SEWER 3.78m WIDE

153/327-IQ

RE/37/327-IQ

RE/36/327-IQ

RE/71/327-IQ

137/327-IQ

37/327-IQ

139/327-IQ

188/327-IQ

38/327-IQ

39/327-IQ

RE/57/327-IQ

RE/140/327-IQ

181/327-IQ

RE/60/327-IQ

142/327-IQ

733

DRG. No.	DESCRIPTION

REFERENCE DRAWINGS

REV	DESCRIPTION	DR.	APP.	DATE
A	ISSUED FOR APPROVAL	A		26/04/17

	INITIALS	SIGN	DATE
DESIGNED	M.E.T		26/04/17
DRAWN	M.E.T		26/04/17
PROJECT ENG.	J.J		26/04/17
APPROVED	F.B.B		26/04/17

KANTEY & TEMPLER
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CLIENT
GREAT SITES INVESTMENTS

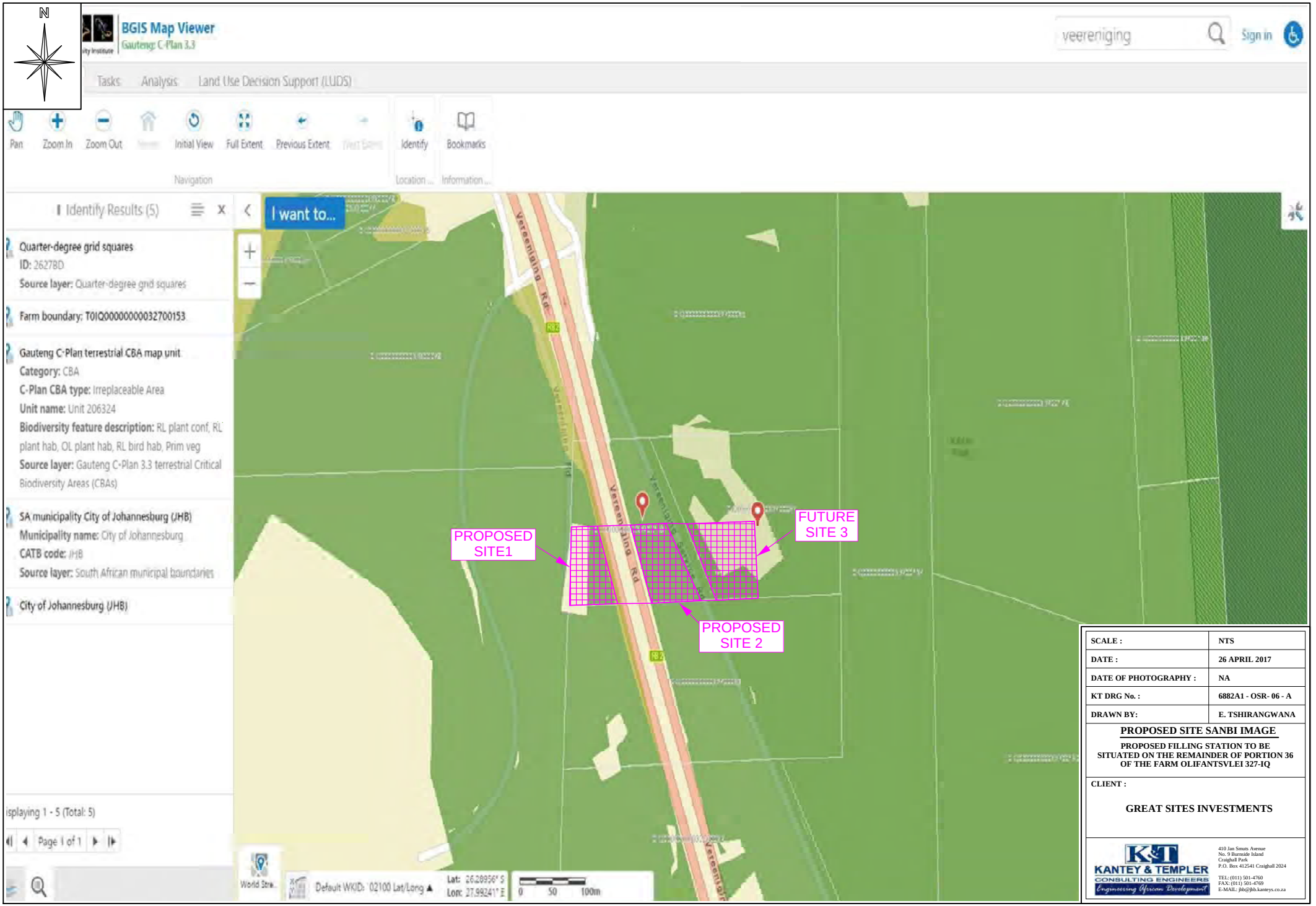
PROJECT
PROPOSED FILLING STATION TO BE SITUATED ON REMAINDER OF PORTION 36 OF THE FARM OLIFANTSVLEI 327-IQ

TITLE
PROPOSED & EXISTING SEWER LAYOUT

SCALE 1:3000

DRAWING No. 6882A1-OSR-05

REV A



SCALE :	NTS
DATE :	26 APRIL 2017
DATE OF PHOTOGRAPHY :	NA
KT DRG No. :	6882A1 - OSR- 06 - A
DRAWN BY:	E. TSHIRANGWANA

PROPOSED SITE SANBI IMAGE

PROPOSED FILLING STATION TO BE SITUATED ON THE REMAINDER OF PORTION 36 OF THE FARM OLIFANTSVLEI 327-IQ

CLIENT :

GREAT SITES INVESTMENTS

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N

AREA = 597613.0975 m2

AREA = 408172.8168 m2

SITE 1

SITE 2

DRG. No.	DESCRIPTION
	REFERENCE DRAWINGS

REV	DESCRIPTION	DR.	APP.	DATE
A	ISSUED FOR APPROVAL	ET		02/05/17

	INITIALS	SIGN	DATE
DESIGNED	ET		02/05/17
DRAWN	ET		02/05/17
PROJECT ENG.	JJ		02/05/17
APPROVED	FBB		02/05/17

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CONSULTING ENGINEERS
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CLIENT

GREAT SITES INVESTMENTS

PROJECT

PROPOSED FILLING STATION TO BE SITUATED ON REMAINDER OF PORTION 36 OF THE FARM OLIFANTSVLEI 327/IQ

TITLE

CATCHMENT AREA

SCALE 1:2000

DRAWING No. 6882A1-OSR-07 REV A

Annexure B

Olifantsfontein Floodline Study

Mei 2017

HYDROLOGICAL INVESTIGATION

OLIFANTSVLEI
1:100Y INDICATIVE FLOODLINES

W.M. SCHARF Pr.Eng
Engineering Consultant
For: Gestion Engineering
and Project Consultants (Pty) Ltd

Suite D3, 500 @ Nature Office Park
500 Botterklapper Street, Lynnwood
Tswhane, 0081
Tel: 012 942 9531
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TABLE OF CONTENTS

INDICATIVE FLOODLINE INVESTIGATION
OLIFANTSVLEI

1. INTRODUCTION

1.1. Terms of Reference

Gestion Engineering and Project Consultants was appointed for an indicative hydrological and floodline study. The study is required as part of the project report for the proposed fuel facility on a portion of Olifantsvlei, located on Wisane Street, approximately 750 m North-East from Afrisam Eikenhof Quarry, Gauteng. The purpose of the study is the estimation of the design flood run-off values for the catchment, and the investigation of the influence of the proposed improvements on the floodplain.

1.2. Study Area

The study area is located on the remainder of portion 36 of the farm Olifantsvlei no 327-IQ, approximately 750 m North-East of Afrisam Eikenhof Quarry, Gauteng, on Wisane Street. The referenced GPS location is:

26°17'28.54"S
27°59'39.63"E

An artificial watercourse traverse the site, mainly draining north to south, and originating in the catchment area to the north. The watercourse consists of constructed earth and concrete drains, and was probably constructed as part of the R 82 (Vereeniging Road) stormwater management. The catchment area eventually drains into the Kliprivier, South of the site and forms part of natural watercourses which eventually discharges into the Vaal River, which drains eastwards up to the Vaal Dam. The locality is shown on Figure 1 below.

Relevant maps:

- 1:50 000 topographic map (WGS2530DB)
  Chief Directorate National Geo-spatial Information of South Africa
- Google Earth satellite/aerial photograph
  © Google

.

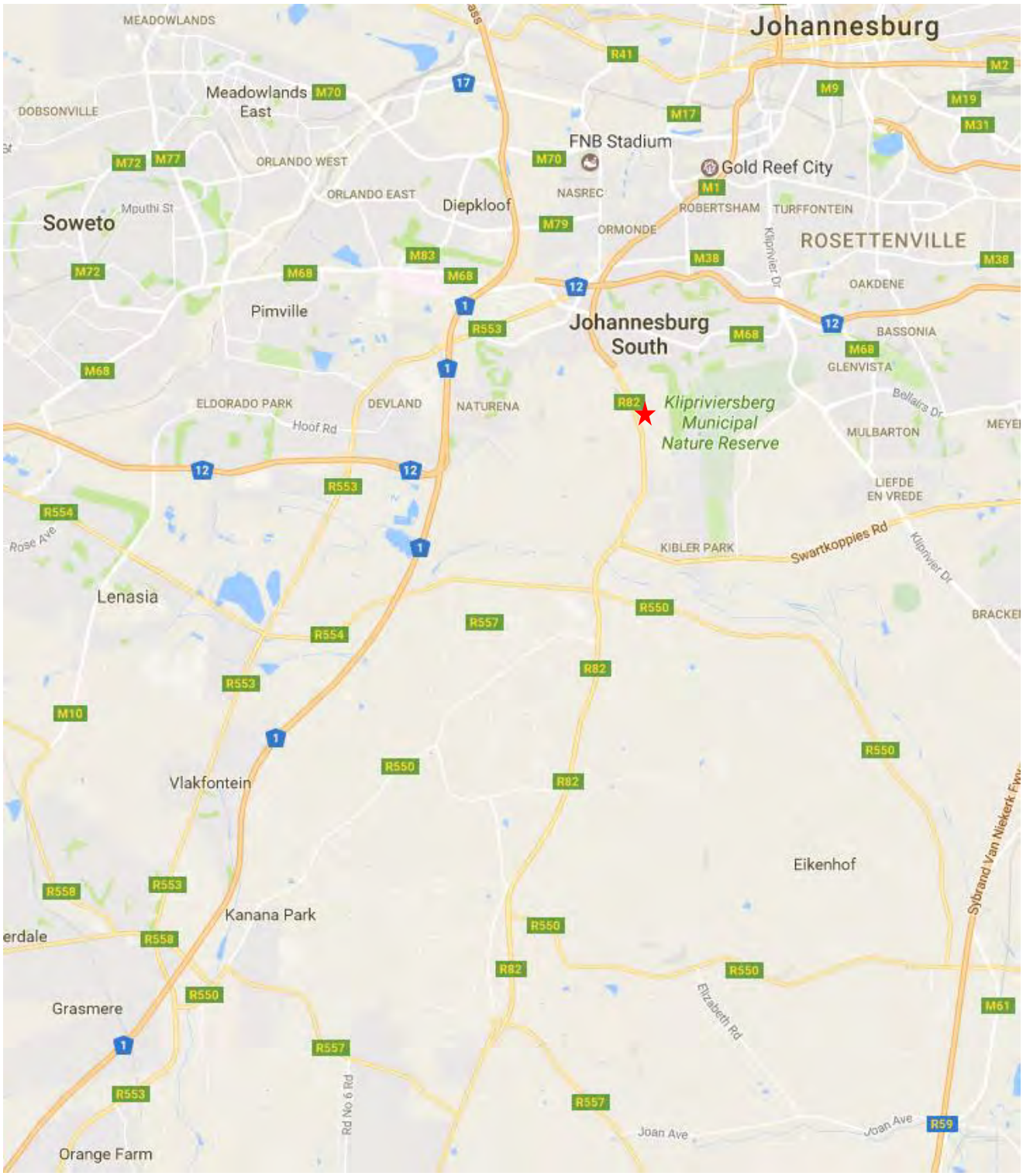

Figure 1: Locality

2. CATCHMENT INFORMATION

2.1. Catchment Area

The artificial watercourse flowing through the site is draining the catchment area from Kliprivierberg Nature Reserve, Johannesburg South, Kanana Park, Vlakfontein and Elandsfontein (H_{max} = 1799 m.a.m.s.l). The catchment area is relatively small, with no defined perennial watercourses this early in the catchment. The watercourse through the site is artificially created as part of the R82 construction stormwater management plan. The catchment area eventually drains into the Kliprivier, South of the site and forms part of natural watercourses which eventually discharges into the Vaal River, which drains eastwards up to the Vaal Dam. The outlet of the catchment for this specific site is at a height of 1653 m.a.m.s.l. Run-off from this catchment continues in a Southerly direction, through formal stormwater management systems and eventually discharges into the Kliprivier.

There is only one contributory area to this site. The Catchment is relatively small, relatively steep

Catchment delineation was based on a surface model grid extracted from Google Earth, and the available 1:50 000 topographical maps. A summary of the relevant catchment characteristics is given below in Table 1.

2.2. Topography

Table 1: Catchment characteristics

Characteristic	Catchment
Area, A (km^2)	0.52
Height at highest point (m)	1799
Height at catchment outlet (m)	1653
Height at 10% of watercourse length, $H_{10\%}$ (m)	1680
Height at 85% of watercourse length, $H_{85\%}$ (m)	1780
Maximum height difference, H_{max} (m)	146
Maximum watercourse length, L (km)	0.849
Average catchment slope, S_{avg} (m/m)	0.157
Distance between catchment outlet, and centroid of catchment, L_o (km)	0.360
Average time of concentration, T_c (hours)	0.500

3. RAINFALL INFORMATION

Historic rainfall data was sourced from the nearest South African weather station site (Johannesburg Botanical Gardens).

Rainfall data has also been gathered from the nearest five weather stations (in a total 86 kilometre radius) to compile statistical representative information (refer to table 2 below).

Table 2: Rainfall station details

Weather station name	Weather station number	Distance (km)	MAR (mm)
Vereeniging	0438784 3	35.55	559
JHB Botanical Gardens	0475879 0	14.45	543
JHB International	0476399 0	29.27	543
Springs	0476762A3	46.55	586
Grand Central	0513239 0	34.90	723
Potchefstroom	0437104A4	103.20	507

The mean annual rainfall is calculated as 704 mm/year.

4. DESIGN FLOOD DETERMINATION

4.1. Outline of strategy

A downstream control point was chosen at which point the design run-off is calculated. Control points are generally at confluence points, at the catchment outlet, and the middle of extensive river reaches, preferably at control flow points.

4.2. Peak flood estimation

The following deterministic methods for calculating the peak discharges were used to estimate a final expected discharge at each control point:

- Rational method;
- Alternative rational method;
- Empirical Method

5. INDICATIVE FLOODLINE DETERMINATION

5.1. Cross-sections

Based on the surface elevations obtained from Google Earth, an indicative surface model was constructed in a GIS environment (*ESRI ArcMap 10.1*), allowing the extracting of suitable cross-sectional information (using the *HEC-GeoRAS* extension for ArcMap). In the absence of specific detailed cross-sectional surveys, these extracted indicative cross-sections were used for the flood simulations.

The maximum spacing for cross sections was determined to be on average 30m.

Based on this, cross-sections were designed using this maximum indicated cross-section spacing, as well as the following factors:

- Change in average bed slope of the stream;
- Change in bank descriptions and general roughness values;
- Sudden change in plan geometry;
- Obstructions;

A total of 12 indicative cross-sections were extracted, and exported as part of the applicable HECRAS model.

5.2. Flow profile calculation

5.2.1 Method

A one dimensional steady flow (gradual-varied) analysis model was designed using HEC-RAS software. The software computation is based on the solution of the one-dimensional energy equation based on Manning's roughness values. In order to analyse a mixed flow regime for the different flow profiles, flow controls needs to be defined for each tributary, or flow reach. A flow control is a section of the flow channel where the relationship between flow rate (Q) and flow depth (y_n) is known. In the absence of control structures (such as culverts or weirs), a section with constant and known slope is selected, where the water surface is expected to be at a critical energy depth.

5.2.2 Flow depth calculation

The flow profile for the 1:50 year (50% recurrence) up to the 1:100 year (0,5% recurrence) was modelled, with the anticipated flow depths for each profile being known at each cross-section. With the final expected water level known for each cross section, the water levels are projected on the extracted surface model, resulting in an expected area of inundation. The outer extent of this inundation region forms the final floodline profile. Refer to **Annexure A** for final floodline layout.

It must be highlighted that the computed floodline layout is indicative only. The layout will approximate an actual designed layout, but in the absence of surface or control section surveys it remains a planning tool. It is however useful to investigate the hydrological functioning of the floodplain, and its sensitivity to change.

6. DISCUSSION AND CONCLUSION

The study area is located on the remainder of portion 36 of the farm Olifantsvlei no 327-IQ, approximately 750 m North-East of Afrisam Eikenhof Quarry, Gauteng, on Wisane Street

The watercourse consists of constructed earth and concrete drains, and was probably constructed as part of the R 82 (Vereeniging Road) stormwater management. The catchment area eventually drains into the Kliprivier, South of the site and forms part of natural watercourses which eventually discharges into the Vaal River, which drains eastwards up to the Vaal Dam.

A detailed hydrological catchment analysis was performed in order to calculate design run-off values to be used for floodline calculation. Various deterministic and empirical methods were used in the calculation, taking into account the various constraints of each method.

Since no specific geotechnical information is available, the SCS-SA method was omitted as part of this study. The empirical method utilising Q_T/Q_{RMF} ratios resulted in above-average flow values, and these results were subsequently also omitted from the final mean averages.

The flood analysis model was used to investigate the influence of the proposed weir structures on the floodplain, including the velocity distribution surrounding the proposed improvements.

The final results indicated a good correlation between the final design values and the resulting design flows can therefore be used with confidence.

The 1:100 year indicative floodline model indicated that the proposed improvements will not have an adverse or detrimental effect on the floodplain.

7. REFERENCES

1. Chadwick, A., Morfett, J., Hydraulics *in civil and environmental engineering 3rd Ed*., Spon Press, 2002.
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3. Lurie, J., South *African geology for mining, metallurgical, hydrological and civil engineering 9th Ed*., Lupon Publishing, 2004.
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5. Shaw, E.M., Hydrology in practice 3rd Ed., Chapman and Hall, 1994.
6. Smithers, J.C., Schulze, W.E., Design *rainfall and flood estimation in South Africa*, Water Research Commission Report No: K5/1060, University of Natal, 2002.
7. Smithers, J.C., Schulze, W.E., *The estimation of design rainfalls for South Africa using a regional scale invariant approach,* School of Bioresources Engineering and Environmental Hydrology, University of KwaZulu-Natal, 2004.
8. Smithers, J.C., Schulze, W.E., Long *duration design rainfall estimates for South Africa*, Water Research Commission Report No: 811/1/00, University of Natal, 2002.
9. Thompson, D.B., the *Rational Method*, Civil Engineering Department, Texas Tech University, 2006.

8. MAP AND SOFTWARE RESOURCES

1. 1:50 000 topographic map. WGS2530DB. *Chief Directorate National Geo-spatial Information of South Africa;*
2. Google Earth satellite/aerial photograph, © *Google,* http://www.google.com/
3. Planet GIS Professional 4.0, http://www.planetgis.co.za
4. Mpumalanga 5m contours, http://www.planetgis.co.za
5. Stormwater Management Model (SWMM) V5.0.022. *United States Environmental Protection Agency (EPA).* http://www.epa.gov/nrmrl/wswrd/wq/models/swmm/
6. Hydrologic Engineering Centers River Analysis System (HEC-RAS) V4.1.0. US Army Corps of Engineers. http://www.hec.usace.army.mil/software/hec-ras/

ANNEXURE A: Schematic catchment layout and contour map

SCALE 1 : 500 0 5 10 20 30 40 50 m

STORMWATER CATCHMENT LAYOUT
SCALE 1 : 500

LEGEND

1 : 50
1 : 100

Q 1 : 50 = 14m³/s
Q 1 : 100 = 18m³/s

NOTES / LEGEND

DO NOT SCALE DRAWING
IF IN DOUBT, REFER TO DRAWING OFFICE

CLIENT PLAN NUMBER

REFERENCE DRAWINGS

NUMBER	REVISION	DRAWING DESCRIPTION
187-001	A	FLOODLINES

APPROVED BY COUNCIL / CLIENT

CITY ENGINEER / CLIENT | REG. NO. | DATE

AMENDMENTS CODE

A-Y / : REPORT/DESIGN/TENDER
0-99 / : CONSTRUCTION
Z / : AS BUILT

/A : BY CLIENT
/B : BY ARCHITECT
/C : BY MECHANICAL / ELECTRICAL
/D : BY GESTION
/E : BY OTHER ( )

DATE	INITIAL	CODE	REVISION DESCRIPTION
2017/04/07	WJR	A	ISSUED FOR APPROVAL

GESTIÓN Engineering and Project Consultants
Gestión Engineering & Project Consultants Pty(Ltd)
Reg. No. 2012/058582/07
Suite 104,
Soetdoring Office Building
7 Protea Street,
Centurion,
Gauteng
South Africa
Tel: +27 72-117-0335
Fax: +27 86-536-5978
info@gestion.co.za
www.gestion.co.za

CLIENT

PROJECT

REMAINDER OF PORTION 36 OLIFANTSVLEI 327-IQ

DRAWING TITLE

FLOODLINES

APPROVED BY GESTION

ENGINEER/TECHNOLOGIST | REG. NO. | DATE

SCALE	AS SHOWN	DRAWN	WJR
DESIGNED	WJR	CHECKED	WMS

PLAN NUMBER	REVISION NO.	DATE SAVED
187-001	A	19/05/2017

A1

Annexure C

Wetland Assessment Olifantsvlei

Wetland Assessment for the proposed Olifantsvlei Service Station

Gauteng

May 2017

REFERENCE

Olifantsvlei

CLIENT

Prepared for:

Gestion Engineering and Project Consultants Pty(Ltd)

Tel: +27 12-942-9531

Fax: +27 86-536-5978

cvdw@gestion.co.za

www.gestion.co.za

Prepared by:

The Biodiversity Company

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Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany

Report Name	**Wetland Assessment for the proposed Olifantsvlei Service Station**	
Reference	**Olifantsvlei**	
Submitted to	**Gestion**	
Report writer	**Wayne Jackson**	
Report Reviewer	**Andrew Husted**	

www.thebiodiversitycompany.com

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EXECUTIVE SUMMARY

The Biodiversity Company was commissioned to conduct a wetland assessment as part of the Basic Assessment (BA) environmental authorisation process and Water Use Licence Application (WULA) for the proposed service station in Olifantsvlei, Gauteng. A single site visit was conducted in April 2017, this would constitute a wet season survey.

The aim of the study was to complete a wetland assessment for the project area, ensuring that all legislative and provincial requirements are achieved.

Deliverable	Yes / No	Comment
Wetlands within 500m of the project area	Yes	Channelled valley bottom
Presence of NFEPA wetlands	No	
Present Ecological State (PES) of the wetlands determined	Yes	HGM1 = D – Largely Modified
Eco-Services that were rated as moderately-high or very high.	Yes	• Flood attenuation.
EIS assessment with results of A or B.	No	Highest rating was a C for HGM 1

One (1) HGM unit was identified within the 500m project assessment boundary. The channelled valley bottom wetland drains from the north to the south on the eastern portion of the main road. There is a small wetland portion on the western side of the road which drains under the road to the main wetland. The area has been significantly altered by the main road and erosion is evident on the channel banks. The catchment is steep and any runoff generated will result in a sharp hydrograph. The dominant soils are shallow rocky soils on the slopes with Rensburg soils in the valley bottom.

The PES results for the channeled valley bottom wetland was determined to be largely modified. The channelled Valley Bottom (HGM 1) had an overall intermediate level of service, with flood attenuation being the only service rated as high.

HGM 1 showed a Moderate (C) level of importance for the Ecological Importance & Sensitivity as well as for the Hydrological Importance respectively. The Direct Human benefits were rated to be Low with a (D) rating.

A buffer zone of 15m during the construction and the operational phase is recommended for the wetland areas, this buffer is calculated assuming mitigation measures are applied.

The proposed service station and associated infrastructure (roads) do pose a risk on the identified wetland system, with the level of risk determined to vary from low to moderate, without mitigation. The highest risks identified for the construction phase, were those associated with the clearing of areas, the construction of infrastructure, and possible crossings and stabilisation of wetlands. These moderate risks can be reduced to low risks if the mitigation measures are implemented.

The operational phase shows moderate risk for all aspects however these are on the border of being low risks and with mitigation can be successfully reduced to low. These risks are mainly associated with increased flow volumes and peaks into the receiving environment as well as possible contamination of the system.

Table of Contents

Tables

Figures

I, Wayne Jackson declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Wayne Jackson

Wetland Ecologist

The Biodiversity Company

8 May 2017

1 INTRODUCTION

The Biodiversity Company was commissioned to conduct a wetland assessment as part of the Basic Assessment (BA) environmental authorisation process and Water Use Licence Application (WULA) for the proposed service station in Olifantsvlei, Gauteng. A single site visit was conducted in April 2017, this would constitute a wet season survey.

1.1 Objectives

The aim of the assessment is to provide information to guide the development of the proposed service station with respect to the current state of the wetland systems in the area of study. This was achieved through the following:

- The delineation and assessment of wetlands within 500m of the project area;
- A risk assessment for the proposed development; and
- The prescription of mitigation measures and recommendations for identified risks.

2 KEY LEGISLATIVE REQUIREMENTS

2.1 National Water Act (NWA, 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): "Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

Wetlands have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

2.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

3 PROJECT AREA

The project area is situated just south of Johannesburg (Figure 1) of the M1 highway.

Figure 1: Locality map showing the general setting in relation to the proposed project area

4 LIMITATIONS

The following aspects were considered as limitations for the water resource assessment;

- The GPS used for wetland delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.
- Wetland systems identified at desktop level within 500 m of the project area were considered for the identification and desktop delineation, with wetland areas within the project area being the focus for ground truthing.
- The information regarding the activities to be completed on the site, allowed us to do a general assessment on the impacts and the buffer requirement.
- The exact layout has not been given so we cannot asses whether the infrastructure will encroach on the wetland or not.

5 METHODOLOGY

5.1 Wetland Assessment

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and also then includes structural features at the lower levels of classification (Ollis, Snaddon, Job, & Mbona, 2013).

5.1.1 Wetland Classification System

A distinction is made between four Landscape Units for Inland Systems on the basis of the landscape setting in which a HGM is situated, which broadly considers (Ollis, Snaddon, Job, & Mbona, 2013):

- Slope;
- Valley floor;
- Plain; and
- Bench.

The HGM Units, which are defined primarily according to:

- Landform, which defines the shape and localised setting of a wetland;
- Hydrological characteristics, which describe the nature of water movement into, through and out of the wetland; and
- Hydrodynamics, which describe the direction and strength of flow through the wetland.

Seven primary HGM units are recognised for Inland Systems on the basis of hydrology and geomorphology (Ollis, Snaddon, Job, & Mbona, 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvium (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used in order to ensure consistency with the wetland classification terms in South Africa.

5.1.2 Desktop assessment

The following information sources were considered for the desktop assessment;

- Information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org);
- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel, et al., 2011);
- Contour data (5m).

5.1.3 Wetland Delineation

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 2. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

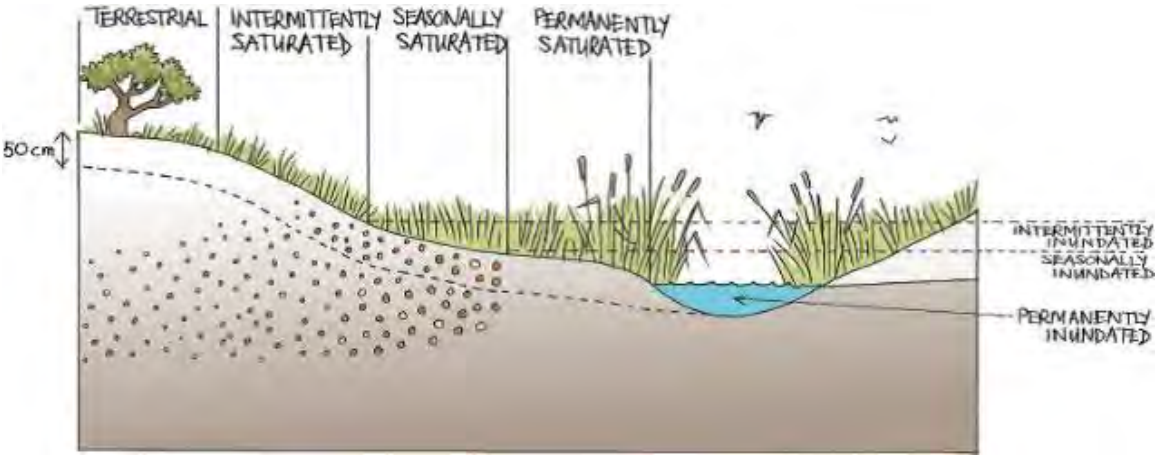

Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis, Snaddon, Job, & Mbona, 2013)

5.1.4 Present Ecological Status (PES)

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society (ecosystem services). Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing promote their conservation and wise management.

Level of Evaluation

WET-Health provides two levels of assessment:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where many wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Units of Assessment

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom and whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled).

Quantification of Present Ecological State (PES) of a Wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a PES score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores and Present State categories are provided in Table 1 and Table 2.

Table 1: The magnitude of impacts on wetland functionality (Macfarlane, et al., 2009)

Impact Category	Description	Score
None	No Discernible modification or the modification is such that it has no impacts on the wetland integrity	0 to 0.9
Small	Although identifiable, the impact of this modification on the wetland integrity is small.	1.0 to 1.9
Moderate	The impact of this modification on the wetland integrity is clearly identifiable, but limited.	2.0 to 3.9
Large	The modification has a clearly detrimental impact on the wetland integrity. Approximately 50% of wetland integrity has been lost.	4.0 to 5.9
Serious	The modification has a highly detrimental effect on the wetland integrity. More than 50% of the wetland integrity has been lost.	6.0 to 7.9
Critical	The modification is so great that the ecosystem process of the wetland integrity is almost totally destroyed, and 80% or more of the integrity has been lost.	8.0 to 10

Table 2: The PES categories (Macfarlane, et al., 2009)

Impact Category	Description	Impact Score Range	Present State Category
None	Unmodified, natural	0 to 0.9	A
Small	**Largely Natural** with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.0 to 1.9	B
Moderate	**Moderately Modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2.0 to 3.9	C
Large	**Largely Modified.** A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	D
Serious	**Seriously Modified.** The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6.0 to 7.9	E
Critical	**Critical Modification.** The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10	F

Overall Health of the Wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole is calculated. Since hydrology, geomorphology and vegetation are interlinked their scores are aggregated to obtain an overall PES health score using the following formula (Macfarlane, et al., 2009):

Health = ((Hydrology score) x3 + (Geomorphology score) x2 + (Vegetation score) x2)) ÷ 7

5.1.5 Wetland Ecosystem Services

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze, Marneweck, Batchelor, Lindley, & Collins, 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (

Table 3):

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate trapping
- Nitrate removal
- Toxicant removal
- Erosion control
- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

Table 3: Classes for determining the likely extent to which a benefit is being supplied (Kotze, Marneweck, Batchelor, Lindley, & Collins, 2009)

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

5.1.6 Ecological Importance and Sensitivity (EIS)

The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 4.

Table 4: Description of EIS categories

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

5.2 Risk assessment

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines. The matrix assesses impacts in terms of consequence and likelihood. Consequence is calculated based on the following formula:

Consequence = Severity + Spatial Scale + Duration

Whereas likelihood is calculated as:

Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection.

Significance is calculated as:

Significance \Risk= Consequence X Likelihood.

The significance of the impact is calculated according to Table 5.

Table 5: Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

5.3 Buffer Determination

A buffer zone is defined as “A strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another.” (Macfarlane, *et al.,* 2014).

Buffer zones protect water resources in a variety of ways, such as;

- Maintenance of basic aquatic and wetland processes;

- The reduction of impacts on water resources from activities and adjoining land uses;
- The provision of habitat for aquatic and semi-aquatic species;
- The provision of habitat for terrestrial species; and
- The provision of societal benefits.

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane, *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity.

6 RESULTS & DISCUSSIONS

6.1 Desktop Assessment

6.1.1 Geology & Soils

The geology of the area is mainly Ventersdorp lava, breccia and tuff.

According to the land type database (Land Type Survey Staff, 1972 - 2006) the development falls within the Ib43 land type. It is expected that, the dominant soils in the crest and midslope positions will be soils of the shallow Glenrosa and Mispah forms. The soils that dominated the footslopes and the valley bottoms are Rensburg and Bonheim soil forms.

6.1.2 Wetland NFEPAs

There were no wetland NFEPA's identified within the project area.

6.1.3 City of Johannesburg wetlands

A wetland audit was completed for the City of Johannesburg (2009) with the intention of locating wetland areas that may then be considered for spatial planning. The available dataset was considered in order to identify any possible wetland areas in close proximity to the project area. The dataset does indicate the presence of channelled valley bottom wetland within 500m of the project area (Figure 3).

Figure 3: The CoJ (2009) wetlands within project area

6.2 Wetland Assessment

The survey included assessing all the wetland indicators as well as assessing the Present Ecological Score (PES) or health of the wetland, the wetland's ability to provide goods and services (Eco-Services) and the Ecological Importance and Sensitivity (EIS) of the wetlands.

The wetland delineation and HGM units are shown in Figure 4. The wetland classification as per SANBI guidelines (Ollis, Snaddon, Job, & Mbona, 2013) in Table 6.

Figure 4: Project overall wetland delineation

One (1) HGM unit was identified within the 500m project assessment boundary, namely;

- Channelled Valley Bottom (HGM 1).

Table 6: Wetland classification as per SANBI guideline (Ollis, Snaddon, Job, & Mbona, 2013)

UNIT	LEVEL 1	LEVEL 2		LEVEL 3	LEVEL 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Highveld	Central Bushveld Group 1	Valley Floor	Channelled Valley Bottom	N/A	N/A

6.2.1 Channelled Valley Bottom (HGM 1)

The channelled valley bottom wetland drains from the north to the south on the eastern portion of the main road. There is a small wetland portion on the western side of the road which drains under the road to the main wetland. The area has been significantly altered by the main road and erosion is evident on the channel banks. The catchment is steep and any runoff generated will result in a sharp hydrograph. The dominant soils are shallow rocky soils on the slopes with Rensburg soils in the valley bottom.

Figure 5: The channelled valley bottom within the project area

6.3 Present Ecological State (PES)

The PES results are described in the sections below with the results presented in Table 7.

HYDROLOGY

The catchment area is very steep with shallow rocky outcrops. The area has been developed with large roads and the natural hydrology has been seriously altered (E) by the drainage lines that have been installed as well as all the impervious areas that are present.

GEOMORPHOLOGY

The geomorphology of the systems has been altered by the drainage channels that have been installed as well as the increased runoff from impervious areas. The main road has been developed on a possible wetland areas which has reduced the wetland size in the area.

VEGETATION

Alien vegetation has established across the wetland system with the existing infrastructure also altering the vegetation component.

Table 7: The PES results for the project area

Wetland	Area (ha)	Hydrology		Geomorphology		Vegetation	
		Rating	Score	Rating	Score	Rating	Score
HGM 1	0.64	E: Seriously Modified	6.0	D: Largely Modified	4.2	D: Largely Modified	4.8
Overall PES Score		5.2		Overall PES Class		D: Largely Modified	

6.4 Ecosystem Services Assessment

The Ecosystem services provided by the HGM unit present at the site were assessed and rated as per Table 8 using the WET-EcoServices method (Kotze, Marneweck, Batchelor, Lindley, & Collins, 2009). The summarised results for the HGM units are shown in Table 9. The HGM units were classified according to the HGM type in order to perform the WET-EcoServices assessment.

The Channelled Valley Bottom (HGM 1) had an overall intermediate level of service with the following showing Moderately High levels of services;

- Flood attenuation.

The remaining services for the HGM unit were scored as intermediate or lower.

Table 8: Eco-Services rating of likely extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low

1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

Table 9: The Eco-Services being provided by the wetlands

Wetland Unit					HGM 1
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		2.5
			Streamflow regulation		1.7
			Water Quality enhancement benefits	Sediment trapping	2.0
				Phosphate assimilation	1.5
				Nitrate assimilation	1.2
				Toxicant assimilation	1.8
				Erosion control	2.0
			Carbon storage		1.3
	Direct Benefits	Biodiversity maintenance			0.9
		Provisioning benefits	Provisioning of water for human use		0.6
			Provisioning of harvestable resources		0.0
			Provisioning of cultivated foods		0.0
		Cultural benefits	Cultural heritage		0.0
			Tourism and recreation		1.3
			Education and research		1.0
Overall					17.8
Average					1.2

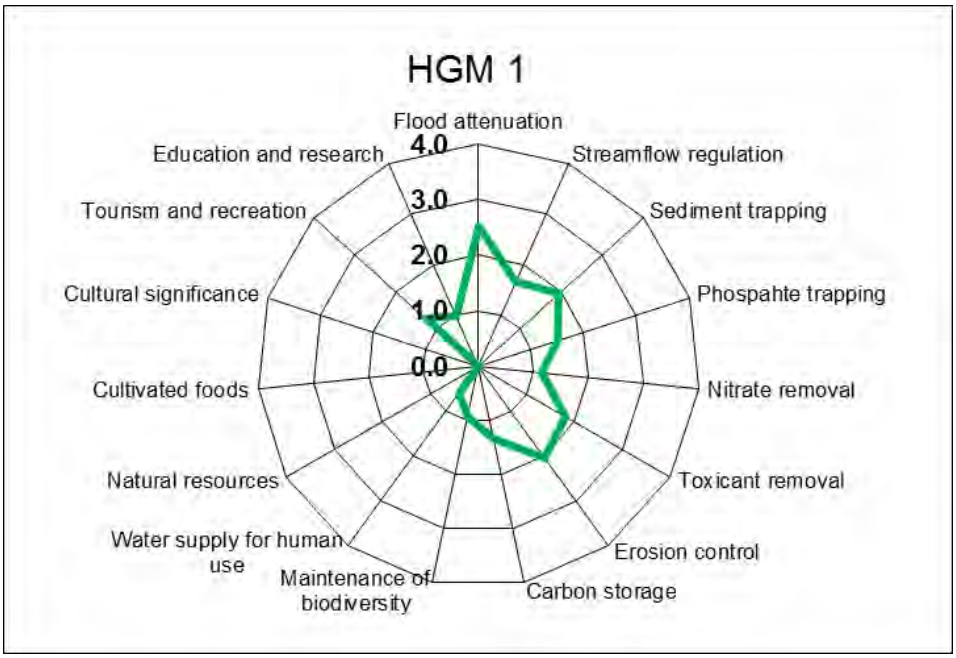

Figure 6: The spider diagram for Eco-Services rendered by the HGM unit

6.5 Ecological Importance & Sensitivity (EIS)

The EIS assessment was applied to the HGM units described in the previous section in order to assess the levels of sensitivity and ecological importance of the wetland. The results of the assessment are shown in Table 10.

HGM 1 showed a Moderate (C) level of importance for the Ecological Importance & Sensitivity as well as for the Hydrological Importance respectively. The Direct Human benefits were rated to be Low with a (D) rating.

Table 10: The EIS results for the project

WETLAND IMPORTANCE AND SENSITIVITY	
HGM 1	
	Importance
ECOLOGICAL IMPORTANCE & SENSITIVITY	**2.0**
HYDROLOGICAL/FUNCTIONAL IMPORTANCE	**1.8**
DIRECT HUMAN BENEFITS	**0.5**

6.6 Buffer Zones

The wetland buffer zone tool was used to calculate the appropriate buffer required for the proposed service station. The model shows that the largest risk (High) posed by the project during the construction phase is that of “increased sediment inputs and turbidity”.

During the operational phase a high risk was identified to the alteration of flow volumes, where moderate risks were posed by the possible inputs of nutrients, toxins and heavy metals, and also the input of pathogens.

These risks are based on what could threaten the wetland and what buffer would be required at a desktop level.

After conducting the field investigations buffer zones were suggested for the identified wetlands to address the vulnerability of the wetlands to impacts. A buffer zone of 15m during the construction and the operational phase is recommended for the wetland areas, as presented in Table 11, this buffer is calculated assuming mitigation measures are applied.

Table 11: The risk results from the wetland buffer model for the project

Threat Posed by the proposed land use / activity		Rating
Construction Phase	1. Alteration to flow volumes	VL
	2. Alteration of patterns of flows (increased flood peaks)	L
	3. Increase in sediment inputs & turbidity	H
	4. Increased nutrient inputs	VL
	5. Inputs of toxic organic contaminants	VL
	6. Inputs of toxic heavy metal contaminants	L
	7. Alteration of acidity (pH)	N/A
	8. Increased inputs of salts (salinization)	N/A
	9. Change (elevation) of water temperature	VL
	10. Pathogen inputs (i.e. disease-causing organisms)	VL
Operational Phase	1. Alteration to flow volumes	M
	2. Alteration of patterns of flows (increased flood peaks)	H
	3. Increase in sediment inputs & turbidity	L
	4. Increased nutrient inputs	M
	5. Inputs of toxic organic contaminants	M
	6. Inputs of toxic heavy metal contaminants	M
	7. Alteration of acidity (pH)	VL
	8. Increased inputs of salts (salinization)	VL
	9. Change (elevation) of water temperature	VL
	10. Pathogen inputs (i.e. disease-causing organisms)	M

Construction Phase	**15**
Operational Phase	**15**

7 RISK ASSESSMENT

The proposed project is for the development of a new service station facility. The risk assessment considered aspects that may impact directly, or indirectly as a result of the project, which is located on the periphery of wetland systems.

Findings from the DWS aspect and impact register / risk assessment are provided in Table 12, Table 13, and Table 14.

Table 12: Impacts assessed for the proposed project

Activity	Aspect	Impact
Construction and operation of a service station including additional infrastructure	Construction of new infrastructure	Impeding the flow of water Loss of aquatic habitat Siltation of watercourse. Erosion of watercourse. Sedimentation of the watercourse. Flow sediment equilibrium change Water quality impairment
	Clearing areas	
	Watercourse crossings	
	Road Construction & Maintenance	
	Stream Channel Stabilisation	
	Land Management	
	Site Drainage	
	Settling Ponds	
	Stormwater Management	
	Erosion and sedimentation control	
	Pollution Control	
	Installation of new tanks & oil traps	
	Operation of machinery & equipment	
	Temporary infrastructure	
	Staff ablutions	
	Operation of service station	

Table 13: DWS Risk Impact Matrix for the proposed project

Severity								
Aspect	**Flow Regime**	**Water Quality**	**Habitat**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**
Construction Phase								
Construction of new infrastructure	**3**	**3**	**3**	**3**	3	**2**	**4**	9
Clearing areas	4	4	3	3	3.5	2	3	8.5
Watercourse crossings	4	3	3	3	3.25	2	3	8.25
Road Construction & Maintenance	**3**	**3**	**3**	**3**	3	**2**	**3**	8
Stream Channel Stabilisation	3	2	2	2	2.25	1	3	6.25
Land Management	2	2	2	2	2	2	2	6
Site Drainage	3	3	3	2	2.75	1	3	6.75
Settling Ponds	3	4	3	2	3	1	3	7
Stormwater Management	3	3	3	2	2.75	2	3	7.75
Erosion and sedimentation control	2	3	3	3	2.75	2	2	6.75
Pollution Control	0	5	0	4	2.25	1	2	5.25
Installation of new tanks & oil traps	**3**	**3**	**3**	**3**	3	**2**	**4**	9
Operation of machinery & equipment	0	5	0	4	2.25	1	2	5.25
Temporary infrastructure	2	3	3	3	2.75	2	2	6.75
Staff ablutions	0	5	0	4	2.25	1	2	5.25
Operational Phase								
Drainage patterns change due to road extent and levels	2	1	2	1	1.5	3	4	8.5
Site Management	2	1	1	1	1.25	3	4	8.25
Storm water management	2	2	1	2	1.75	2	4	7.75
Traffic / vehicle activity	1	2	1	2	1.5	2	4	7.5
Operation of service station	3	2	2	2	2.25	2	4	8.25

Table 14: DWS Risk Impact Matrix for the proposed project continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Construction of new infrastructure	1	4	**1**	2	8	72	**Moderate***	**Low**
Clearing areas	1	4	1	2	8	68	**Moderate***	**Low**
Watercourse crossings	1	3	5	1	10	82.5	**Moderate***	**Low**
Road Construction & Maintenance	1	4	1	2	8	64	**Moderate***	**Low**
Stream Channel Stabilisation	1	2	5	2	10	62.5	**Moderate***	**Low**
Land Management	1	1	1	1	4	24	**Low**	**Low**
Site Drainage	1	3	1	2	7	47.25	**Low**	**Low**
Settling Ponds	1	2	1	2	6	42	**Low**	**Low**
Stormwater Management	1	2	1	2	6	46.5	**Low**	**Low**
Erosion and sedimentation control	1	2	1	2	6	40.5	**Low**	**Low**
Pollution Control	1	2	1	2	6	31.5	**Low**	**Low**
Installation of new tanks & oil traps	1	2	1	1	5	45	**Low**	**Low**
Operation of machinery & equipment	1	3	1	2	7	36.75	**Low**	**Low**
Temporary infrastructure	1	2	1	1	5	33.75	**Low**	**Low**
Staff ablutions	1	2	1	2	6	31.5	**Low**	**Low**
Operational Phase								
Drainage patterns change due to road extent and levels	3	2	1	1	7	59.5	**Moderate***	**Low**
Site management	3	1	1	1	6	49.5	**Moderate***	**Low**
Storm water management	3	1	1	1	6	46.5	**Moderate***	**Low**
Traffic / vehicle activity	4	2	1	1	8	60	**Moderate***	**Low**
Operation of service station	4	1	1	1	7	57.75	**Moderate***	**Low**

(*) denotes - In accordance with General Notice 509 “Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below.”

The proposed service station and associated infrastructure (roads) do pose a risk to the identified wetland system, with the level of risk determined to vary from low to moderate, without mitigation. The highest risks identified for the construction phase, were those associated with the clearing of areas, the construction of infrastructure, and possible crossings and stabilisation of wetlands. These moderate risks can be reduced to low risks if the mitigation measures are implemented.

The operational phase shows moderate risk for all aspects however these are on the border of being low risks and with mitigation can be successfully reduced to low. These risks are mainly associated with increased flow volumes and peaks into the receiving environment as well as possible contamination of the system.

7.1 Project mitigation measures

The following specific mitigation measures are provided:

- The new tanks should be double walled steel tanks which consist of a primary steel inner tank shell and a secondary containment steel outer shell which are separated by a continuous interstitial space between the two shells;
- All steel tanks and coatings must comply with the requirements of the South African National Standard (SANS 1535);
- The drainage lines feeding the wetlands are to be protected and no contaminants are allowed to enter these drains. These drainage lines must be vegetated to act as some form of constructed / biological system to reduce flow and polish water;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- A suitable storm water plan must be compiled for the property. This plan must attempt to displace and divert storm water from the Shell service station, and discharge the water into adjacent areas without eroding the receiving areas. It is preferable that run-off velocities be reduced and flows discharged into the local watercourses

7.2 General mitigation measures

The following general mitigation measures are provided:

- The construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access;
- Laydown yards, camps and storage areas must be beyond the water resources. Where possible, the construction of the road and crossings must take place from the existing dirt road and not from within the aquatic systems;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces;
- Temporary storm water channels and preferential flow paths should be filled with aggregate and/or logs (branches included) to dissipate and slow flows limiting erosion;
- Prevent uncontrolled access of vehicles through the river system that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;

- All chemicals and toxicants to be used for the road upgrade must be stored outside the channel system and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- All removed soil and material must not be stockpiled within the system. Stockpiling should take place outside of the watercourse. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Erosion and sedimentation into the channel must be minimised through the effective stabilisation (gabions and Reno mattresses) and the re-vegetation of any disturbed banks;
- Temporary and permanent erosion control methods may include silt fences, flotation silt curtains, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed embankments, erosion mats, and mulching;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- Large trees and other debris often collect upstream against the culverts, damming up the channel with risk of flooding and damaging the river crossing and its banks. This debris should be cleared routinely with appropriate disposal of the debris. Timber can be sold or donated to local communities;
- No dumping of construction material on-site may take place;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported;
- Due to the potential increase of pedestrians using the new road, it is suggested that waste bins are installed and maintained at the end of the new road to reduce solid waste disposal into the stream. Signage discouraging littering of the system can also be erected;
- Quarterly vegetation rehabilitation surveys need to be conducted of the vegetation within the project footprint for a period of at least a year after construction has been completed to assess vegetation regrowth and recovery; and
- An alien invasive plant management plan needs to be compiled and implemented post construction to control current invaded areas and prevent the growth of invasives on cleared areas.

8 CONCLUSIONS

One (1) HGM unit was identified within the 500m project assessment boundary. The channelled valley bottom wetland drains from the north to the south on the eastern portion of the main road. There is a small wetland portion on the western side of the road which drains under the road to the main wetland. The area has been significantly altered by the main road and erosion is evident on the channel banks. The catchment is steep and any runoff generated will result in a sharp hydrograph. The dominant soils are shallow rocky soils on the slopes with Rensburg soils in the valley bottom.

The PES results for the channeled valley bottom wetland was determined to be largely modified. The channelled Valley Bottom (HGM 1) had an overall intermediate level of service, with flood attenuation being the only service rated as high.

HGM 1 showed a Moderate (C) level of importance for the Ecological Importance & Sensitivity as well as for the Hydrological Importance respectively. The Direct Human benefits were rated to be Low with a (D) rating.

A buffer zone of 15m during the construction and the operational phase is recommended for the wetland areas, this buffer is calculated assuming mitigation measures are applied.

The proposed service station and associated infrastructure (roads) do pose a risk on the identified wetland system, with the level of risk determined to vary from low to moderate, without mitigation. The highest risks identified for the construction phase, were those associated with the clearing of areas, the construction of infrastructure, and possible crossings and stabilisation of wetlands. These moderate risks can be reduced to low risks if the mitigation measures are implemented.

The operational phase shows moderate risk for all aspects however these are on the border of being low risks and with mitigation can be successfully reduced to low. These risks are mainly associated with increased flow volumes and peaks into the receiving environment as well as possible contamination of the system.

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