5. BIOPHYSICAL DESCRIPTION OF THE SITE

5.1 Location of the site

The proposed filling station will be located on Portion 1 of Erf 10769, Middelburg X26, Middelburg. The site is located south of La Roca Boulevard (i.e. access road to the Middelburg Mall) and west of Samora Machel Street (R35). Figure 5.1 indicates the location of the site.

The co-ordinates for the centre of the site are:

Site	Latitude (S):			Longitude (E):		
Erf 10769	25°	48'	33.08"S	29 °	27'	39.38"E

The proposed access road from Samora Machel Street (R35) (hereafter referred to as the proposed access road) will extend across the Remainder of Portion 27 of Middelburg Town and Townlands 287 JS to the site.

The co-ordinates of the access road are:

Latitude (S):			Longitude (E):		
25°	48'	39.20"S	29°	27'	41.90"E
25°	48'	36.30"S	29°	27'	41.90"E
25°	48'	36.10"S	29°	27'	42.10"E
25°	48'	35.00"S	29°	27'	40.60"E
25°	48'	35.10"S	29°	27'	40.50"E

The Surveyor-General 21 digit site reference number for the proposed project is:

T	O	J	S	0	0	2	3	0	0	0	1	0	7	6	9	0	0	0	0	1
T	O	J	S	0	0	0	0	0	0	0	0	0	2	8	7	0	0	0	2	7

The said property falls under the jurisdiction of the Steve Tshwete Local Municipality (MP313) and the Nkangala District Municipality.

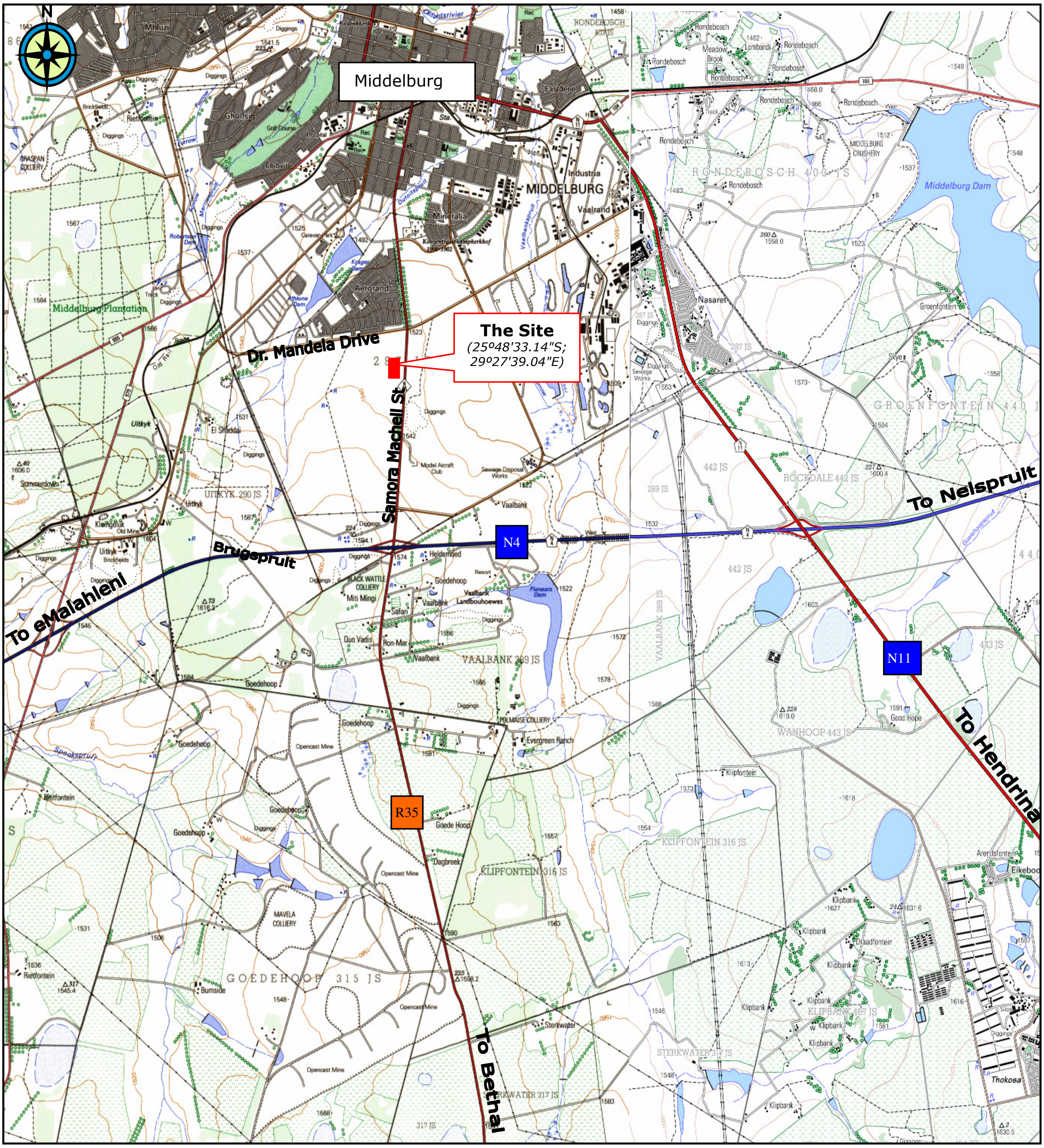


Figure 5.1: Location of site *(taken from 1: 50 000 2529 CD and DC-not to scale)*

5.2 Climate

5.2.1 Regional climate

The South African Weather Bureau has partitioned the country into 15 climatic regions. This division is based on:

- geographic considerations, more specifically the prominent mountain ranges (great escarpment) which constitute the main climatic divides, besides also other features such as rivers and political boundaries;
- the interior plateau - use has been made of the change from BW to BS and from BS to C climates according to the Köppen classification.

The site falls within Climatic Region H – The Highveld.

The climate is typical of the Highveld, with warm summers and cold winters with occasional severe frosts. Rainfall typically occurs as high-intensity short duration thunderstorms. The average frost period is 111 days per annum. The mean annual temperature is 22.5°C, with recorded extremes of -11°C and 34°C.

The site occurs in Mpumalanga and falls in the summer rainfall region, which is characterised by thunderstorm activity and relatively low average rainfall. The mean annual rainfall is 735mm compared to the mean annual potential evaporation of 1500mm. Pertinent climate data was obtained from the Middelburg (No.0515/826) and Belfast (No. 0517/0109) weather stations.

5.2.2 Mean monthly rainfall

The average number of days per month having rainfall depths in excess of 0.1mm, together with the average monthly depth of rainfall, are given in Table 5.1.

Table 5.1: Average monthly rainfall depths (mm) and days with rainfall of > 0.1mm.

Month	Average Depth	Average Days
January	132	13.8
February	103	11.2
March	88	9.5
April	42	6.5
May	19	2.9
June	7	1.5
July	9	1.7
August	8	0.9
September	22	3.7
October	63	8.3
November	124	13.0
December	118	13.1
Total	**735**	**86.1**

5.2.3 Mean annual rainfall

The maximum rainfall intensities recorded at the relevant weather stations are shown in Table 5.2.

Table 5.2: Maximum rainfall intensities.

24 Hour Rainfall Depths (mm)			
Maximum recorded	**1:50 Yr. Storm**	**1:100 Yr. Storm**	**1:200 Yr. Storm**
117	104	118	134

5.2.4 Mean annual evaporation

The mean monthly evaporation figures recorded at the relevant weather stations are given in Table 5.3. The data in the table was obtained using an 'A' Pan.

Table 5.3: Mean monthly evaporation figures

Month	Evaporation (mm)	Rainfall (mm)	Monthly deficit (mm)
January	160	132	28
February	140	103	37
March	110	88	22
April	110	42	68
May	85	19	66
June	70	7	63
July	75	9	66
August	110	8	102
September	140	22	118
October	160	63	97
November	160	124	36
December	180	118	62
Total Average	1500	735	765

5.2.5 Mean monthly maximum and minimum temperatures

The average and actual maximum and minimum temperatures between the weather stations are given in Table 5.4.

Table 5.4: Mean monthly maximum and minimum temperatures (ºC)

Month	Daily Maximum	Daily Minimum	Highest Temperature	Lowest Temperature
January	27.2	13.7	32.0	9.1
February	26.8	13.4	30.8	9.0
March	26.8	11.4	30.2	6.4
April	23.9	7.4	27.9	1.4
May	21.3	2.2	26.1	-2.9
June	18.5	-1.8	22.4	-6.0
July	18.4	-1.7	23.0	-5.8
August	21.4	0.8	26.0	-4.1
September	24.0	5.3	29.2	-1.3
October	26.0	10.1	31.2	4.4
November	26.2	11.8	31.8	5.9
December	27.1	13.2	31.2	7.8
Yearly Average	**23.9**	**7.2**	**28.4**	**2.0**

5.2.6 Prevailing wind direction

Wind pattern data obtained from the Middelburg weather station is presented in Table 5.5. In addition, the wind pattern data recorded at the Middelburg (Aerorand) air quality station is shown in the various windroses below (Figure 5.2).

Table 5.5: Mean monthly wind speed and direction

Month	N		NE		E		SE		S		SW		W		NW	
	N	v	n	v	N	v	N	v	N	v	n	v	n	V	n	v
January	161	3.0	287	3.2	44	3.1	92	3.3	122	3.6	96	3.3	109	3.7	48	4.5
February	142	2.9	295	3.2	44	3.1	74	3.4	112	3.4	101	2.9	141	3.9	60	4.2
March	152	2.8	304	3.3	36	3.1	54	3.1	100	3.4	104	2.9	139	3.4	63	3.5
April	170	2.7	211	3.3	47	3.2	95	3.4	149	3.6	146	2.8	87	3.4	39	3.0
May	172	2.6	166	2.9	59	3.4	89	3.7	162	3.9	167	2.9	67	3.0	51	3.3
June	146	2.5	149	3.0	54	3.6	117	3.0	157	3.8	166	2.7	86	3.2	43	3.2
July	162	2.5	184	2.9	51	3.9	99	3.9	142	3.6	143	2.8	79	3.4	53	4.2
August	174	5.4	180	3.4	40	3.5	86	4.1	141	4.1	182	3.0	83	3.2	40	4.4
September	197	3.2	223	3.8	27	3.5	70	3.9	131	4.3	171	3.3	84	4.0	41	3.9
October	190	3.4	243	3.7	33	3.6	71	3.6	142	4.0	160	3.8	83	4.3	42	3.6
November	174	3.2	225	3.6	28	3.1	68	3.1	185	3.8	154	3.5	92	4.1	40	3.9
December	180	3.1	254	3.4	34	3.0	69	3.3	154	3.5	135	3.3	95	4.0	40	4.0
Average	**188**	**2.0**	**227**	**3.3**	**41**	**3.3**	**82**	**3.8**	**141**	**3.8**	**146**	**3.1**	**95**	**3.7**	**47**	**3.8**

n = average direction frequency per 1000 readings *v = velocity (m/s)*

As can be seen from the windrose data for Middelburg, the dominant wind direction from January to August is generally in a south easterly direction. From October to December, the dominant winds blow generally in a north westerly direction.

5.2.7 The incidence of extreme weather conditions

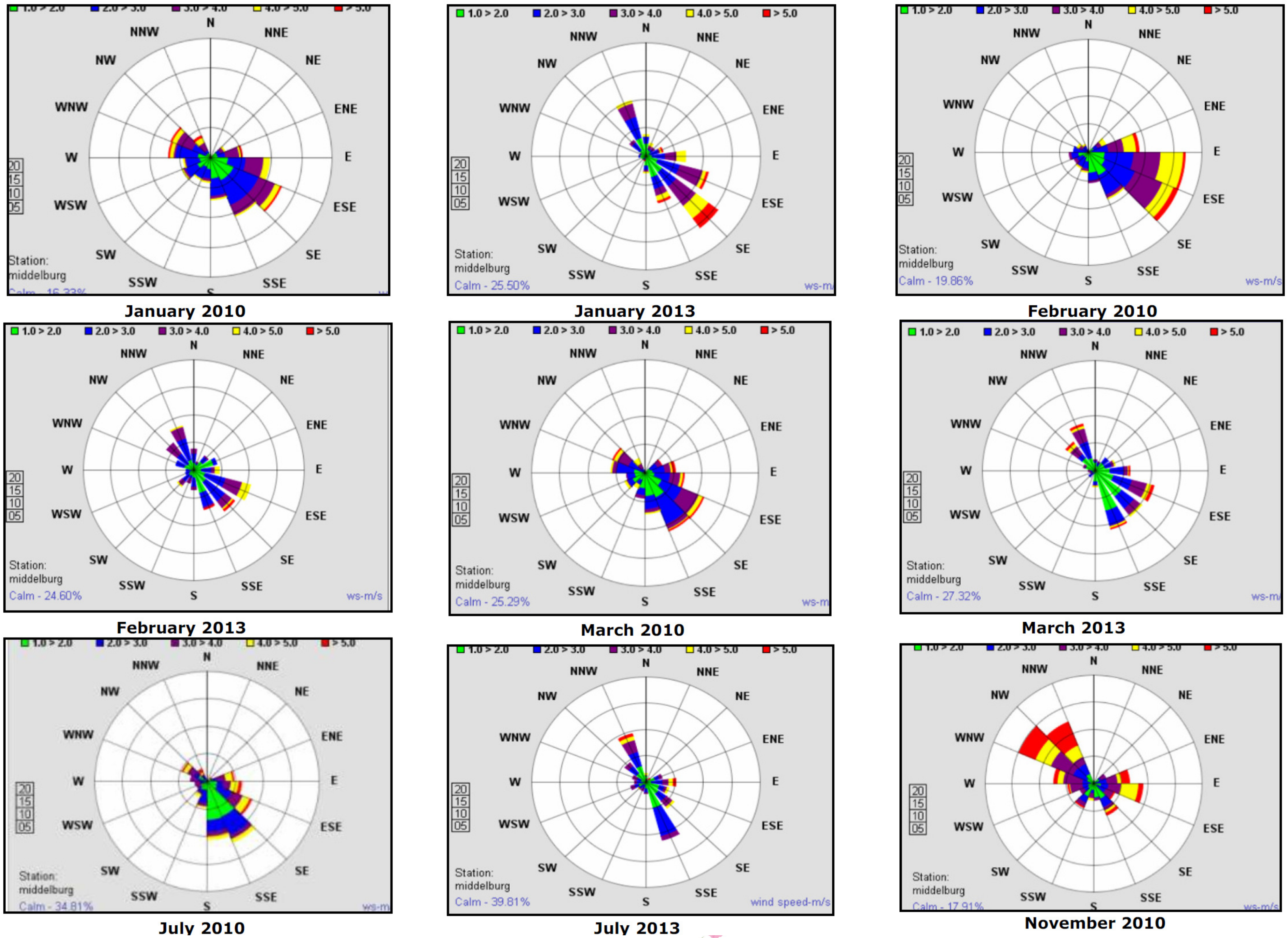
Being located on the Highveld, the area is prone to extreme weather on a regular basis. These weather conditions include droughts, floods and strong gusty winds prior to and during thunderstorms. Frost also occurs on an average of 120 to 150 days between April and September.

5.2.8 Climate change

According to the Mpumalanga Biodiversity Sector Plan Handbook (Lotter *et. al.*, 2014), there has already been notable shifts in climate in terms of increased average temperatures in Mpumalanga. Heat waves are becoming more frequent while cold days, nights and frost are becoming less frequent.

In addition, spring events such as flowering, bird migration and egg-laying are happening earlier in the year. Altitudinal range shifts for species such as the black mamba, red toad, black-bellied starling, yellow weaver, etc. have already been recorded.

Assuming moderate to high increases in greenhouse gas concentrations (e.g. carbon dioxide), regional modelling scenarios indicate that the north-eastern interior of South Africa will experience higher minimum, average and maximum temperatures over the next few decades (Lotter *et. al*., 2014). Higher temperatures will be accompanied by increased incidents of drought, rainfall increases along the escarpment and a shift in rainfall pattern.



AdiEnvironmental cc

Figure 5.2: Windroses - Middelburg

The Nkangala District Municipality drafted a Climate Change Mitigation and Response Strategy (CCMRS) in 2013. Table 5.6 provides a summary of the expected key potential climate changes for the district.

Table 5.6: Summary of key potential climatic changes for the Nkangala District Municipality (2036 - 2065 relative to 1961 - 2000) (taken from the CCMRS, 2013)

Variable	Projected change
Temperature	Average temperatures (minimum and maximum) are expected to increase by 1ºC to 3ºC.
Rainfall	Average rainfall is projected to decrease by 10 - 30%.
Extreme Events	Increases in the frequency and intensity of extreme events. This includes more severe storms and flooding, and more severe droughts. Temperature-related extremes such as increases in the number and intensity of very hot days (maximum temperatures > 35ºC) and extended very hot spells to increase.
Water resources	As temperatures and evaporation increase and rainfall decreases, already scarce water resources will become further depleted. Existing water quality problems will be exacerbated.

It is expected that the predicted climate change will mainly impact on the mining, energy, agriculture and tourism sectors (CCMRS, 2013).

5.3 Land use

5.3.1 Land ownership

Portion 1 of Erf 10769 JS (Middelburg X26), on which the filling station is proposed, is registered to the applicant, Pearl Star Investments 85 cc under Title Deed T10684/2014. A copy of the Deeds Office Property report is provided in Appendix 1.

The Remainder of Portion 27 of Middelburg Town and Townlands 287 JS, over which the proposed access road would extend, belongs to the Steve Tshwete Local Municipality.

5.3.2 Zoning of the site

Portion 1 of Erf 10769 is currently zoned "Business 2" in terms of the Steve Tshwete Town Planning Scheme (2004). The property will be rezoned to "Public Garage" for the purpose of the filling station.

The Remainder of Portion 27 of Middelburg Town and Townlands 287 JS is zoned "Agricultural" and will remain as such.

5.3.3 Size of the site

Property	Property Size	Development footprint
Portion 1 of Erf 10769, Middelburg X26 - filling station	5000 m^2	5000 m^2
Remainder of Portion 27 of Middelburg Town and Townlands 287 JS - proposed access road	4 132 ha	120m x 5m or 600 m^2

5.3.4 Servitudes

No servitudes are known to be registered against Portion 1 of Erf 10769.

According to Urban Dynamics (2006), the bulk water pipeline extending along Samora Machel Street (R35) and along the eastern boundary of the site is not associated with a formal servitude. However, provision was made for a 5 m reserve along the water pipeline which was zoned Public Open Space as part of Middelburg X26. This area belongs to the Steve Tshwete Local Municipality and is leased by G. Strydom.

5.3.5 Land use and existing infrastructure on site

Figure 5.3 provides an aerial view of the site indicating the existing land uses and infrastructure in the area.

The said site is currently vacant and no formal infrastructure is present. La Roca Boulevard extends along the northern boundary of the site and Samora Machel Street (R35) is located towards the east (Figure 5.3).

The majority of the site has been cleared of vegetation (Figure 5.3) and is used as an informal truck parking area (Photo 5.1). Trucks access the said site and adjacent vacant land from Samora Machel Street (R35) via an informal gravel road (Figure 5.3).

The eastern portion of the filling station site as well as the proposed access road footprint area comprise natural vegetation (Figure 5.3).

A storm water trench is present on the northern boundary of the site (Figure 5.3 and Photo 5.2). Building rubble was dumped adjacent to this trench in the form of a berm. The trench channels storm water from the adjacent Retail City across the site towards a culvert underneath La Roca Boulevard (Figure 5.3 and Photo 5.4). Another storm water trench drains water from the Public Open Space located on the eastern boundary of the site underneath La Roca Boulevard (Figure 5.3 and Photo 5.5).

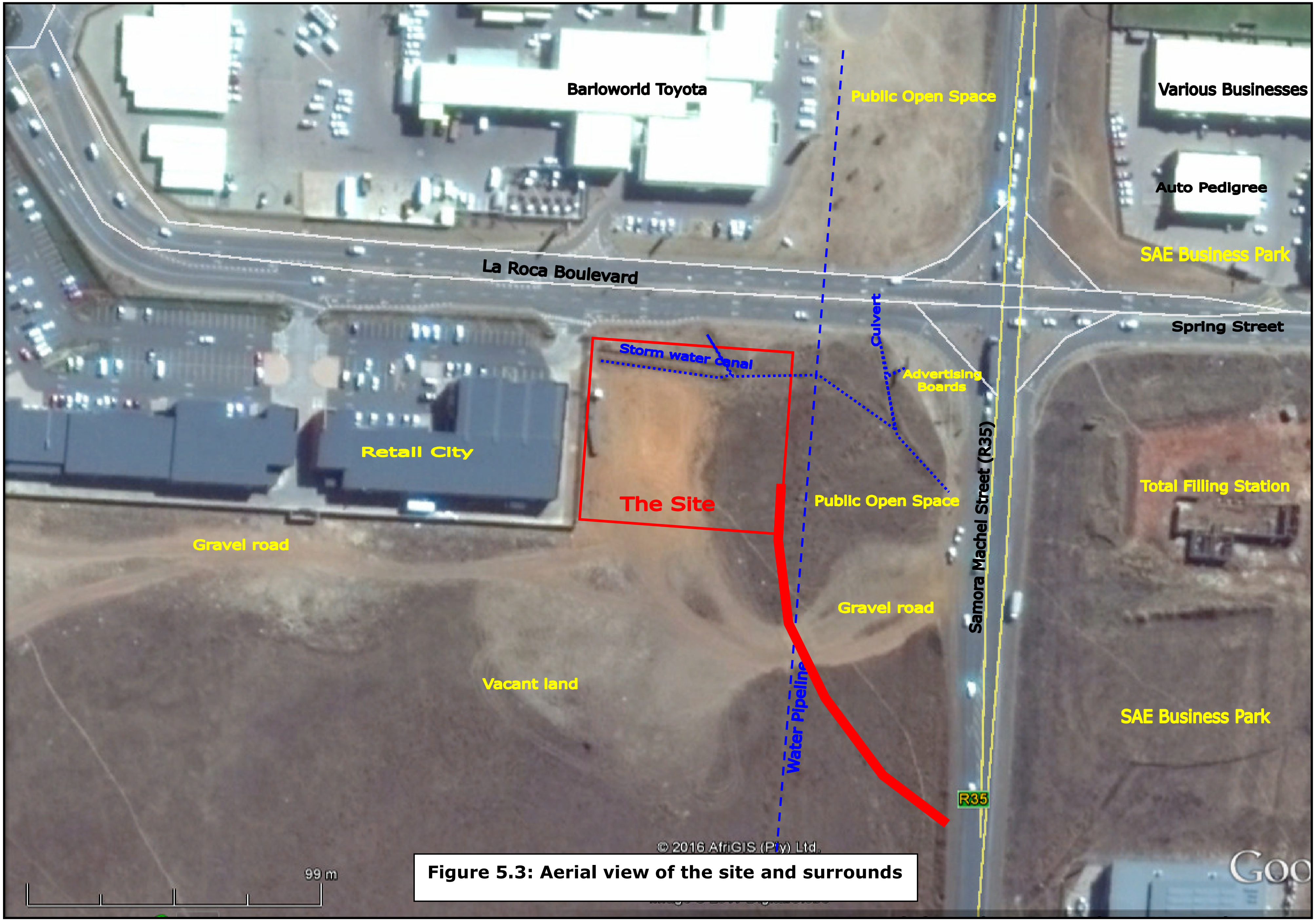


Figure 5.3: Aerial view of the site and surrounds

Photo 5.1: A view of the cleared area on site

Photo 5.2: A view of the storm water trench on the northern boundary of the site

Photo 5.3: A view of the bulk water pipeline on the eastern boundary of the site

Photo 5.4: A view of the trench located east of the site

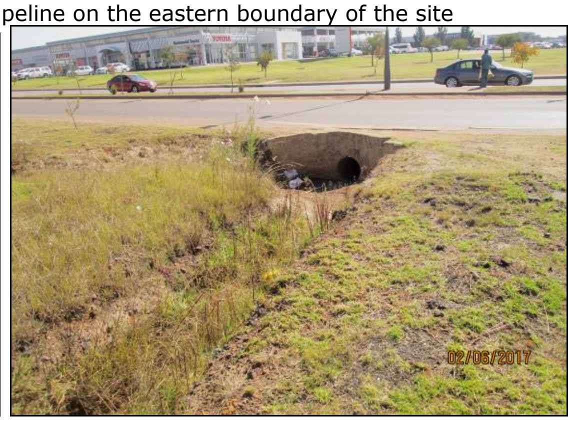


Photo 5.5: A view of the storm water culvert underneath La Roca Boulevard

5.3.6 Surrounding land uses

Figure 5.3 provides an indication of the surrounding land uses.

The Middelburg Mall (comprising various businesses) and Barloworld Toyota are located north of the site. Various businesses and a retail centre are also present north east and west of the site (Figure 5.3).

The vacant area directly east of the site and along the eastern and northern boundaries of the Middelburg Mall is set aside as Public Open Space. This area is leased by G. Strydom for parking and landscaping purposes (Figure 6.2).

A Total filling station was constructed east of the site on the corner of Spring and Samora Machel Streets (R35) (Figure 5.3) and recently opened for business (middle October 2017).

The Remainder of Portion 27 of the farm Middelburg Town and Townlands 287 JS, which is located south of the site, is currently vacant (Figure 5.3). This property belongs to the Steve Tshwete Local Municipality and plans are underway for the construction of a hospital (near the N4 national road) and/or a high density residential area.

An industrial area (SAE Business Park) is located east of Samora Machel Street (R35). This industrial/business park is still under development with many stands still vacant (Figure 5.3).

Other land uses in the area include service infrastructure (i.e. water, sewage, storm water, electricity, phone lines, roads) and advertising boards.

A Sasol gas pipeline is present approximately 600 m north of the site adjacent to Dr Mandela Drive.

5.4 Geology

A geotechnical study was undertaken for the original Middelburg Mall development (Middelburg X26) by P. Hansmeyer of Engeolab cc (hereafter referred to as Hansmeyer, 2004). The proposed filling station site (Erf 10769) was included in this geotechnical study.

According to Hansmeyer (2004) and the 1:250 000 Geological Series (2528 Pretoria map; Figure 5.4), the said site is underlain by purple-grey shale of the Loskop Formation (Vls). The Loskop shales are sequentially overlain by beige silt derived from in-situ decomposed shale and brown colluvial silty sand.

A massive diabase dyke (di) trends in an easterly-westerly direction just north of the said site. The contact zone between the diabase dyke and the Loskop Shale is located just north of the site underneath La Roca Boulevard as indicated in Figure 5.9b. The proposed filling station will not be located on this contact zone (Figure 5.9b).

The following do not occur on site:

- dolomite, sinkhole or doline areas;
- unstable geological features.

The said site has not been undermined.

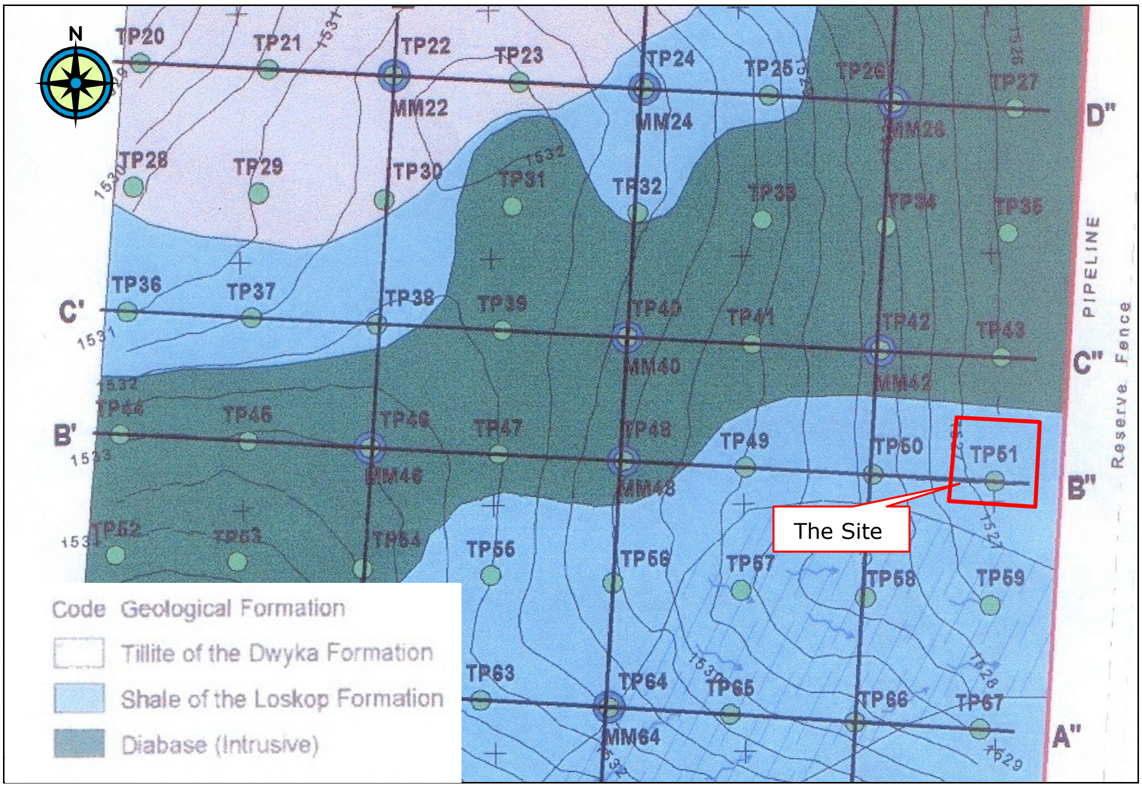


Figure 5.4: Geology of the site (taken from Hansmeyer, 2004)

5.5 Topography

The said site lies at approximately 1527 meters above mean sea level (mamsl). The site is fairly flat with a gentle slope (average gradient of 0.014) in a north westerly direction towards the corner of La Roca Boulevard and Samora Machel Street (R35).

According to the AGIS Comprehensive Atlas of the Department of Agriculture, Forestry and Fisheries, the terrain type is plains with open low hills or ridges as indicated in Figure 5.5.

The topography of the site has been impacted by the clearing of vegetation and the dumping of gravel/soil in the western and central portions of the site. In addition, the excavation of a storm water trench on the northern boundary and the dumping of building rubble to form a berm have impacted on the topography.

A bulk water pipeline is located on the eastern boundary of the site (Figure 5.3). The installation of the water pipeline has resulted in a slightly raised soil profile, which is likely to cause some ponding in the eastern portion of the site.

The topography of the immediate surrounding area has been impacted by development (e.g. Middelburg Mall, businesses, roads, etc.) as indicated in Section 5.3.6.

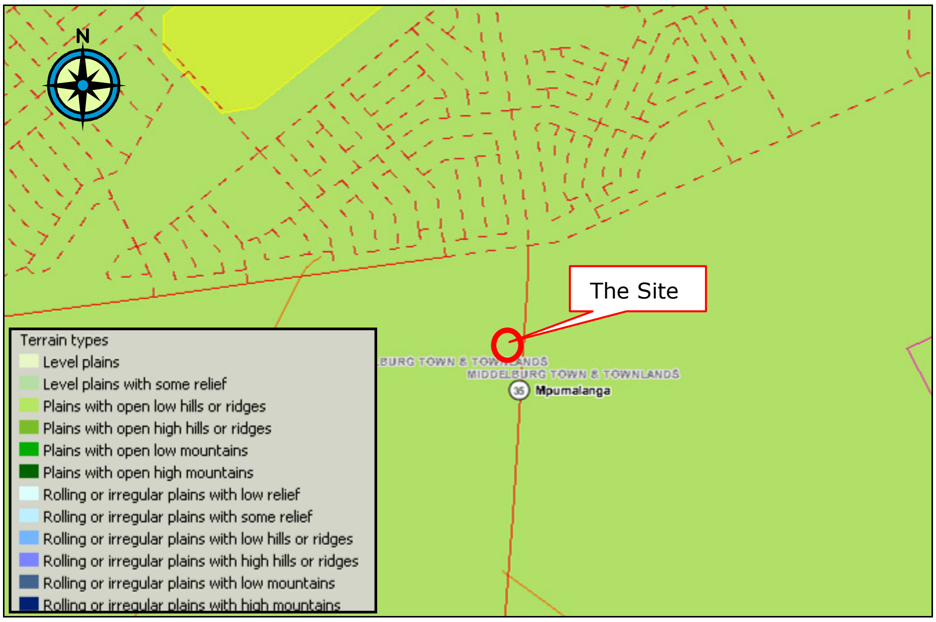


Figure 5.5: Terrain type of the proposed site (taken from Department of Agriculture, Forestry and Fisheries)

5.6 Soil

5.6.1 General

According to the AGIS Comprehensive Atlas of the Department of Agriculture, Forestry and Fisheries, the said site falls within the Ba land type (Figure 5.6). The Ba land types comprise of plinthic soils (with subsurface accumulation of iron and manganese oxides due to fluctuating water table) with low to intermediate base status. Red soils are not widespread. Upland duplex and black clay soils are rare. According to Rehab Green (2004), these soils have a Moderate to High agricultural potential.

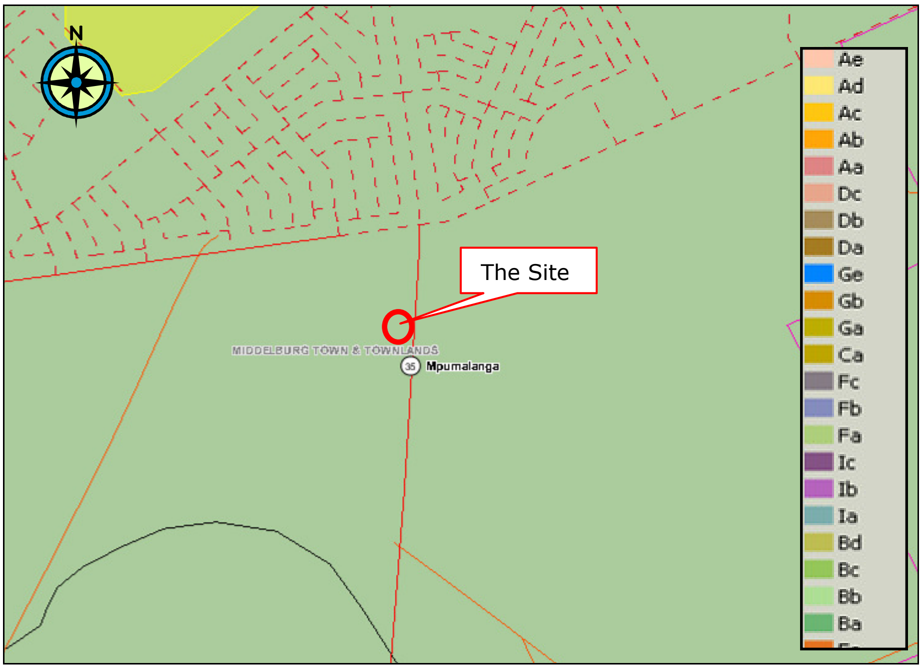


Figure 5.6: Land type of the proposed site (taken from Department of Agriculture, Forestry and Fisheries)

According to Venter (2017), wetland soils (possibly Longlands/Wasbank soil forms) are present in the eastern portion of the site (Figure 5.15). These wetland soils are brown to red-brown sand becoming grey between 15 and 30 cm depth. Red and orange mottling is present.

The soil outside the wetland area (Figure 5.15) was found to be brown sand that becomes lighter with depth. The sand layer is ±70 cm deep and no mottling was evident. A clay layer is present underneath the sand layer.

The clearing of vegetation over the majority of the site and utilization of the cleared area for truck parking have impacted on the soil of the said site. Gravel was also dumped on site to prevent wheel entrenchment, which further altered the topsoil layer. Subsequently, the soil in the western portion of the site (Figure 5.15) could not be sampled with the auger due to soil compaction (Venter, 2017).

Other impacts on the soil include the excavation of a storm water trench, installation of a water pipeline, dumping of building rubble, littering and the installation and subsequent removal of an advertising board.

The soil of the immediate surrounding area has also been impacted by development (e.g. Middelburg Mall, businesses, roads, etc.) as indicated in Section 5.3.6. Some erosion was noted at the storm water trenches and culvert located on the corner of La Roca Boulevard and Samora Machel Street (R35).

Photo 5.6: A view of the western portion of the site where the vegetation was cleared and gravel/soil was dumped

5.6.2 Agricultural potential/land capability

The site is currently vacant and has not been used for agricultural purposes for many years. The property is situated within the urban boundary of Steve Tshwete Local Municipality and forms part of the Middelburg X26.

In terms of land capability, the proposed site is indicated according to the Department of Agriculture, Fisheries and Forestry as moderate potential arable land (Figure 5.7). Looking at grazing, Figure 5.8 indicates that the area has a high grazing value of <4 ha required per animal unit. However, the site is no longer used for agricultural purposes.

Figure 5.7: Land capability of the proposed site (taken from Department of Agriculture, Forestry and Fisheries)

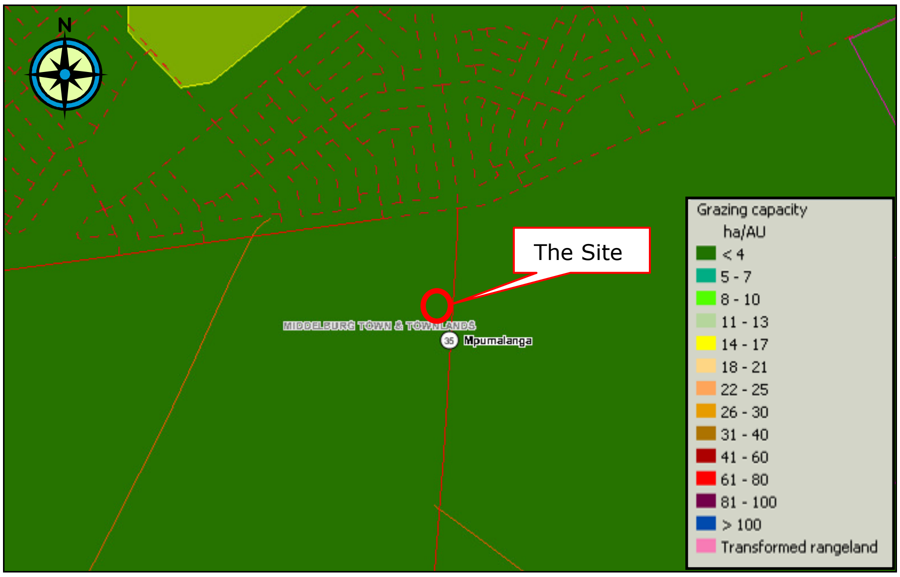


Figure 5.8: Grazing capacity of the proposed site (taken from Department of Agriculture, Forestry and Fisheries)

5.6.3 Geotechnical study

A geotechnical study was undertaken for the Middelburg Mall development (Middelburg X26) by P. Hansmeyer of Engeolab cc (hereafter referred to as Hansmeyer, 2004). The proposed filling station site (Erf 10769) was included in this geotechnical study.

One test pit (TP51) was excavated on site and another test pit (TP59) to the south of the site (Figures 5.9a and 5.9b).

As indicated in Figure 5.9b (TP51), the western and central portions of the site comprise collapsible soils, whilst medium to highly active clay is present on the entire site. The following shallow soil profile was recorded for the onsite test pit TP51 (Figure 5.9a):

- 0.00 to 0.30 cm: Slightly moist, light beige-brown, loose to medium dense, intact, medium grained silty SAND with roots; Colluvium.
- 0.30 t0 0.70cm: Moist, light khaki-beige, loose to medium dense, intact, medium grained silty SAND; Colluvium.
- 0.70 cm: Refusal on khaki-beige-grey, very stiff slickensided CLAY derived from in situ decomposed SHALE of the Loskop Formation.

Hansmeyer (2004) indicated that no seepage was recorded in test pit TP51. A copy of the test pit profile is provided in Appendix 4.

A deeper soil profile was recorded for test pit TP59 (Figure 5.9a):

- 0.00 to 0.20 cm: Slightly moist, light beige-brown, loose to medium dense, intact, medium grained silty SAND with roots; Colluvium.
- 0.20 to 1.20cm: Moist, light khaki-beige, loose to medium dense, intact, medium grained silty SAND; Colluvium.
- 1.20 to 1.30 cm: Moist, khaki-beige mottled grey, partially cemented, coarse ferruginised sandy concretions in a matrix as above; Pedogenic layer.
- 1.30 cm: Refusal on well cemented pedocrete as above.

Hansmeyer (2004) indicated that no seepage was recorded in test pit TP59. A copy of the test pit profile is provided in Appendix 4.

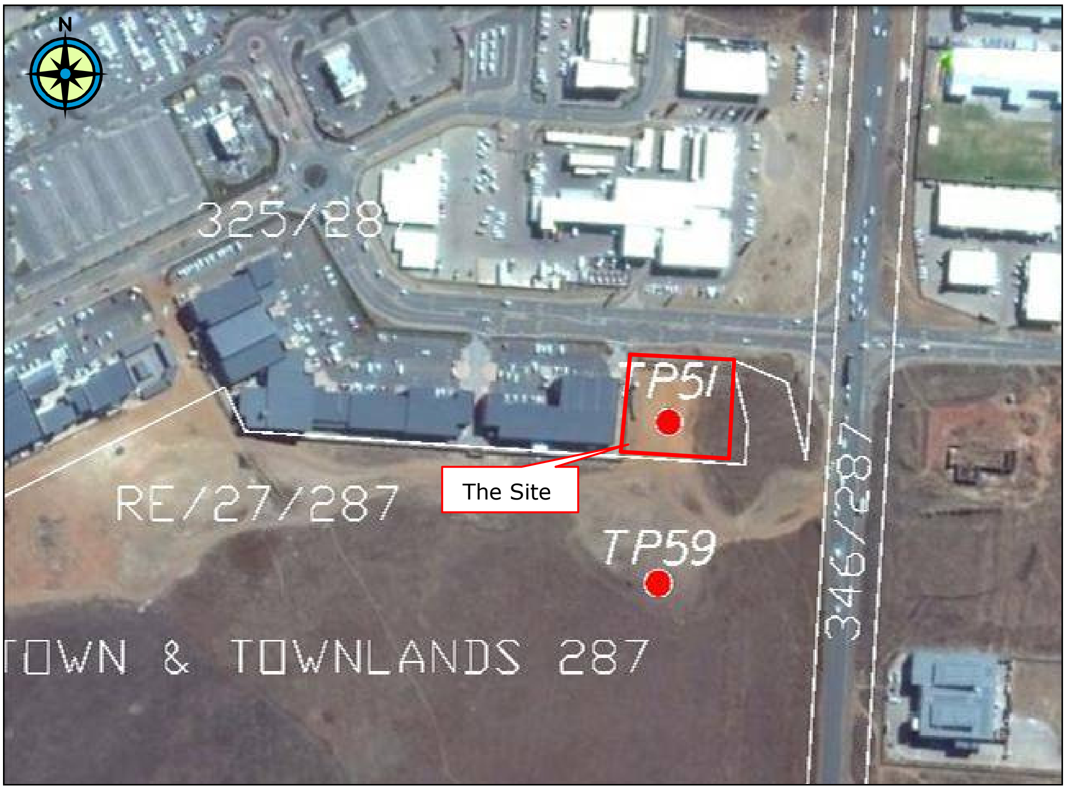


Figure 5.9a: Location of test pits in relation to the site

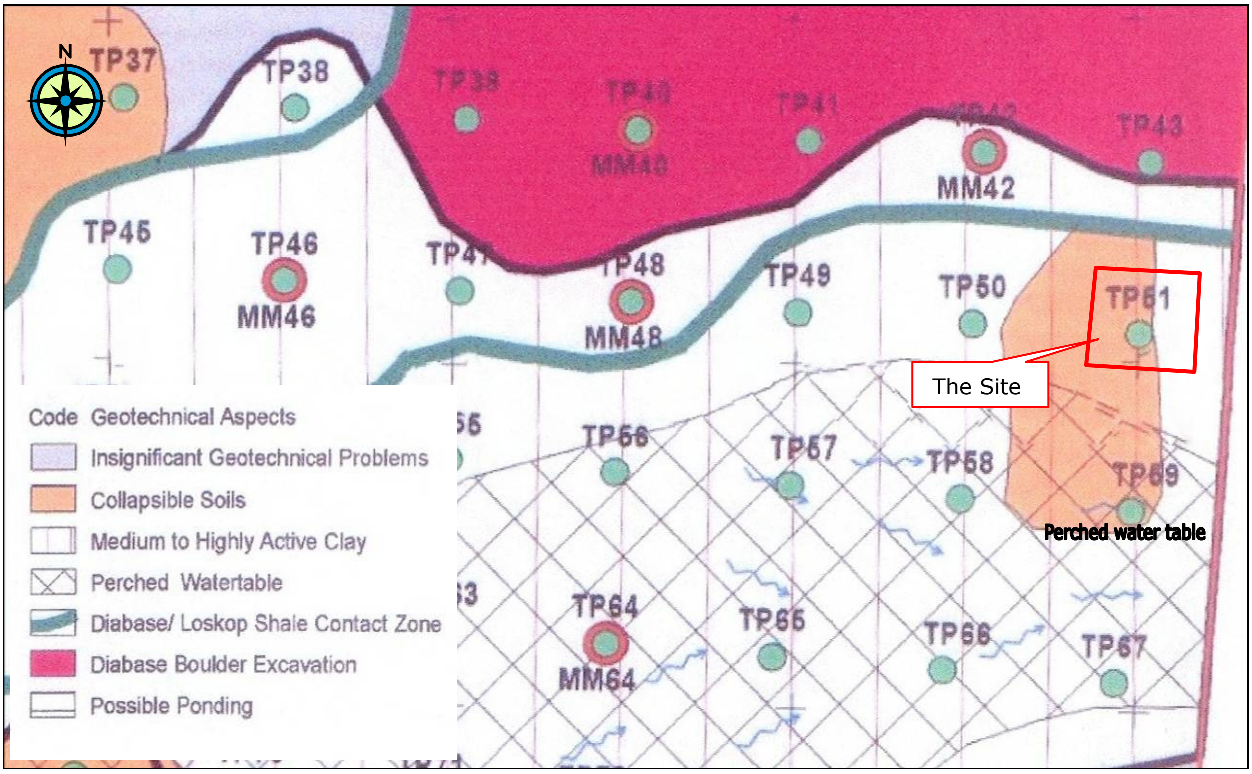


Figure 5.9b: Geotechnical zones (taken from Hansmeyer, 2004)

<u>Collapsible Soils (Figure 5.9b):</u>
The western and central portions of the site are overlain by brown silty colluvial sands (> 1m thick) with a loose to medium dense consistency (Hansmeyer, 2004). According to Hansmeyer (2004), this horizon is also typically moderate compressible (Mv = 1,04E-04 m^2 /KN) recording slightly to highly collapsible materials (CP = 3,85% - 10,1%) and an average collapse potential of 8,4%.

Bearing capacity values indicate an allowable bearing capacity of ±100 KPa with 15 mm of consolidation settlement. The collapse settlement is expected to be slightly higher than normal settlement at 20mm.

According to Hansmeyer (2004), the following construction methods would apply:

- deep strip foundations or;
- compaction of in-situ soils below individual footings and floors.
- piles, or mini-piles.

<u>Medium to Highly Active Clay (Figure 5.9b):</u>
The entire site is underlain by medium to highly active clays (up to 2m thick and more) derived from in-situ decomposed diabase and Loskop shale (Hansmeyer, 2004).

According to Hansmeyer (2004), construction techniques would require any of the following:

- removal of the active clay layer and construction of a soil raft.
- piled foundations or;
- a cut to fill operation.

Perched water table (Figure 5.9b):
Hansmeyer (2004) did not indicate the presence of a perched water table for the proposed filling station site (TP51, Figure 5.9).

However, Venter (2017) indicated the presence of a seep wetland on site (Figure 5.15). It should be noted that geotechnical test pits are excavated up to a depth of 2.5m, whereas only 50 cm of soil is investigated by the wetland specialist for hydromorphic characteristics. Additional indicators apart from soil (such as vegetation and topography) are also used to identify wetlands.

A perched water table is present south of the site at test pit TP59 (Figure 5.9b). According to Hansmeyer (2004), this area is characterised by a well-developed pedocrete and very moist to wet soils, especially during high rainfall periods. This area is also at a slightly lower elevation than the rest of the site and surface water tends to drain towards this feature.

Venter (2017) did not identify a wetland within this area (Figure 5.15) due to the absence of wetland features (e.g. no signs of prolonged wetness were observed in the vegetation or the top 50cm of the soil profile). Some mottling was observed in the deeper profile, starting from 60 or 70cm depth. It is also possible that the water table may be higher for very short periods, but not for long enough at a depth of less than 50cm to affect the vegetation and soil profile. The geotechnical report (Hansmeyer, 2004) is therefore accurate in indicating a perched water table, but not at a depth that will indicate wetland conditions to the south of the site.

According to Venter (2017), the area indicated as having a perched water table very broadly corresponds to the seep wetland identified south and south west of the site (Figure 5.15). The perched water table and wetland area however, do not correspond exactly.

The proposed access road would extend across the area where the perched water table was identified (Figure 5.9b). According to Hansmeyer (2004), subsurface drains are recommended to accommodate a possible rebound in the perched water table below.

5.7 Natural vegetation

5.7.1 Regional vegetation and conservation status

According to 'The vegetation of South Africa, Lesotho and Swaziland', the study area falls within the Mesic Highveld Grassland Bioregion, specifically the Rand Highveld Grassland (veld type Gm11; Figure 5.10) (Mucina & Rutherford, 2006). The vegetation type was previously referred to by Low and Rebelo (1998) as Moist Sandy Highveld Grassland (38) and Rocky Highveld Grassland (34) and by Acocks (1953) as Bankenveld (61).

This grassland is found at an altitude of 1 300 metres above mean sea level (mamsl) to 1 635 mamsl in areas between rocky ridges from Pretoria to eMalahleni (Witbank). It also extends onto ridges in the Stoffberg and Roossenekal regions as well as west of Krugersdorp.

This vegetation type is species-rich and comprises wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. The most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus*. A high diversity of herbs, many of which belong to the *Asteraceae* family, is also a typical feature. Rocky hills and ridges carry sparse woodlands with *Protea caffra* subsp. *caffra, Acacia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Rhus* is most prominent.

Almost half of the Rand Highveld Grassland has already been transformed by cultivation, urbanisation, plantations and dams. This vegetation type has been afforded the status of **Endangered** with a conservation target of 24%. Only approximately 1% of this vegetation type is currently conserved.

The National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists this vegetation type as **Vulnerable**.

Vulnerable (VU) ecosystems - being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems.

The stated purpose of listing 'threatened ecosystems' is primarily to reduce the rate of ecosystem degradation and species extinction.

The study area is not situated within any of the South African centres of endemism recognised by Van Wyk and Smith (2001).

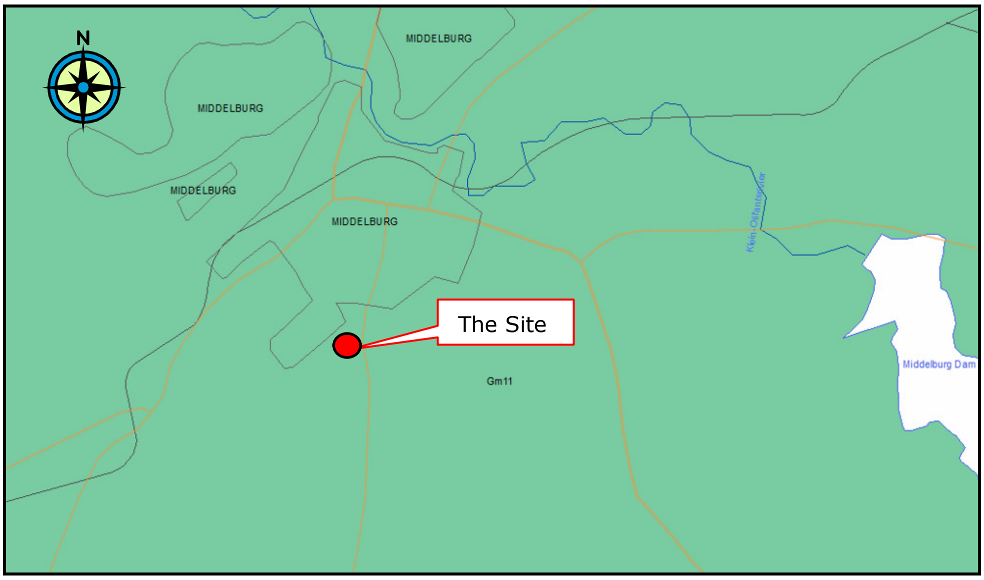


Figure 5.10: Vegetation type (taken from Mucina and Rutherford, 2006)

The said site is indicated as **'No Natural Habitat Remaining'** (Figure 5.11) in terms of the terrestrial biodiversity assessment of the Mpumalanga Biodiversity Conservation Plan (2006).

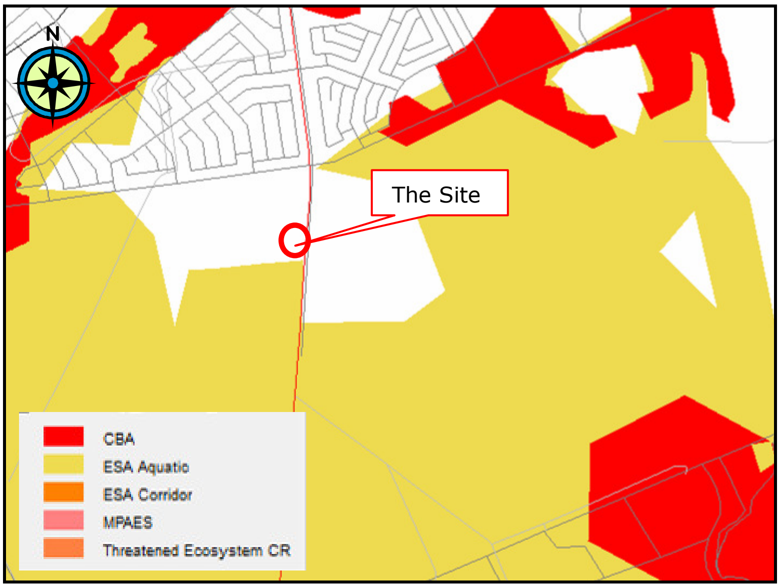


Figure 5.11: Terrestrial biodiversity assessment - Mpumalanga Biodiversity Conservation Plan, 2006

Since the proposed site does not fall within a Critical Biodiversity Area (CBA) as identified in the Mpumalanga Conservation Plan (2006), no Listed activities in terms of Listing Notice 3 (GN R324) of the Environmental Impact Assessment Regulation (2014, as amended) are applicable.

Over the last few years (2007 – 2013), the Mpumalanga Tourism and Parks Agency reviewed and updated the Mpumalanga Biodiversity Conservation Plan (2006) in order to align the spatial data with the bioregional plan requirements of the South African National Biodiversity Institute (SANBI) and surrounding provinces.

The Mpumalanga Biodiversity Sector Plan (MBSP, 2013) is a biodiversity planning tool that provides the most recent spatial biodiversity information to inform land-use and development planning (Lotter *et al*., 2014). The main mapping categories used in the MBSP (in descending order of importance in terms of meeting conservation targets), are:

- Protected Areas;
- Critical Biodiversity Areas (Irreplaceable and Optimal);
- Ecological Support Areas;
- Other Natural Areas;
- Modified (Heavily Modified and Moderately Modified-old lands).

According to the Mpumalanga Biodiversity Sector Plan (MBSP, 2013), the site and surrounding area are classified as **Ecological Support Area (ESA): Protected Area Buffer and Critical Biodiversity Area (CBA): Optimal** (Figure 5.12).

The said site was classified as 'ESA: Protected Area Buffer' since it is located within the buffer zone of the Kruger Dam Private Nature Reserve. This reserve is 453.656 ha in extent and comprises a number of properties, including residential suburbs (Figure 5.12). As can be seen from Figure 5.12, this 'nature reserve' is not managed as such and has not been protected for many years. No information regarding the de-proclamation of the nature reserve could be found.

The reasons for indicating the site as a CBA: Optimal is also unknown, since the site and surrounding area have been heavily modified by the development of Middelburg Mall and the SAE Business Park (Figure 5.12). Natural grassland and wetlands are however, present south of the site which would justify the CBA allocation in these areas.

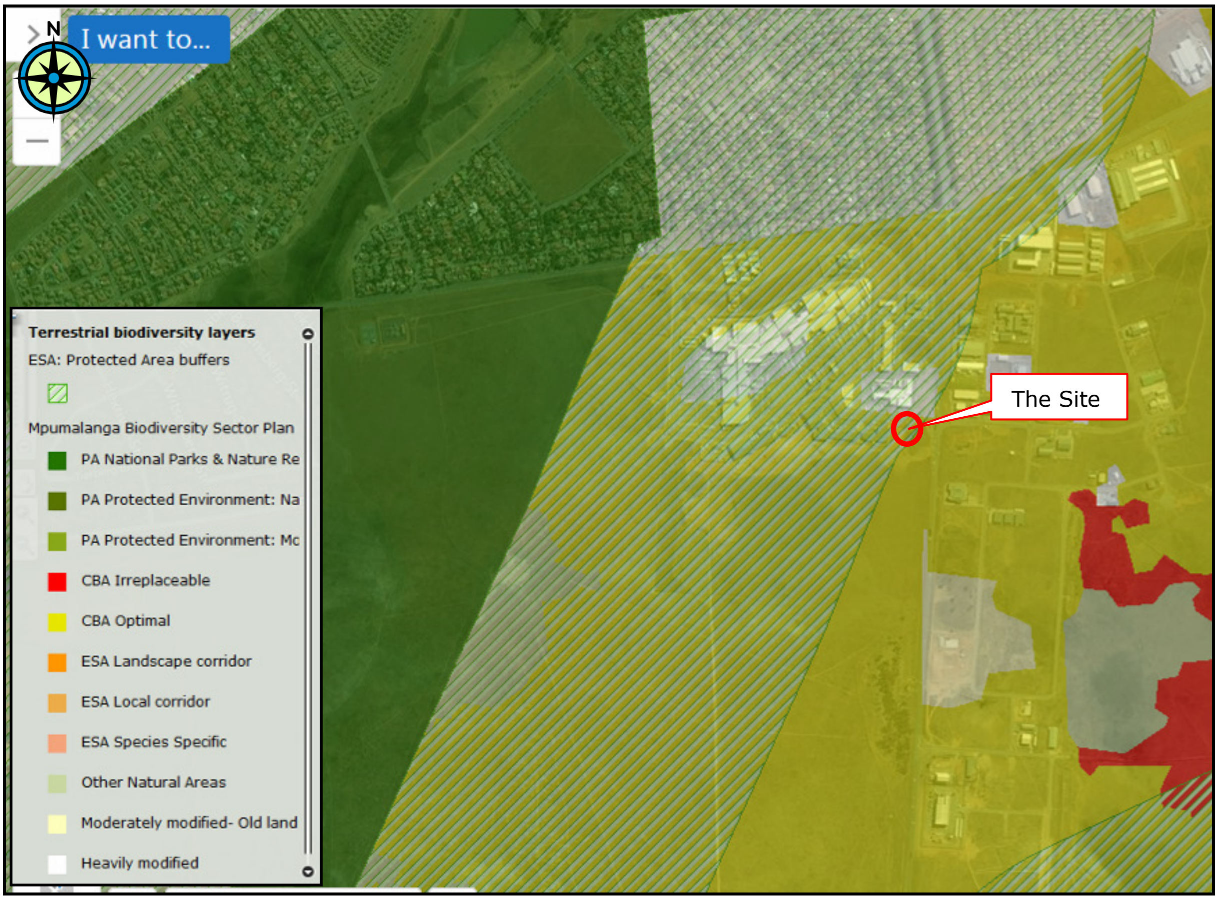


Figure 5.12: Terrestrial biodiversity assessment - Mpumalanga Biodiversity Sector Plan, 2013

5.7.2 Vegetation found on site and surrounds

A vegetation and wetland specialist study was conducted for the site by I. Venter of Kyllinga Consulting (hereafter referred to as Venter, 2017). A copy of the report is provided in Appendix 5. This report should be consulted with regards to methodology used.

Venter (2017) investigated the vegetation of the proposed filling station site (referred to as The Site in the various figures). In addition, the vegetation of the Public Open Space between the said site and Samora Machel Street (R35) as well as a portion of the vacant land south of the site were also investigated (referred to as Investigated Site in the various figures).

Venter (2017) identified the following vegetation units as indicated in Figure 5.13:

Vegetation Unit	The Site (ha)	Investigated Site (ha)	Conservation Status
Cleared area	0.0809	0.297	Very Low
Grassland	0.0	0.1874	Moderate

Vegetation Unit	The Site (ha)	Investigated Site (ha)	Conservation Status
Wetland	0.196	0.5558	Moderate
Cleared wetland	0.2272	0.3502	Low
TOTAL:	**0.5041**	**1.3904**	

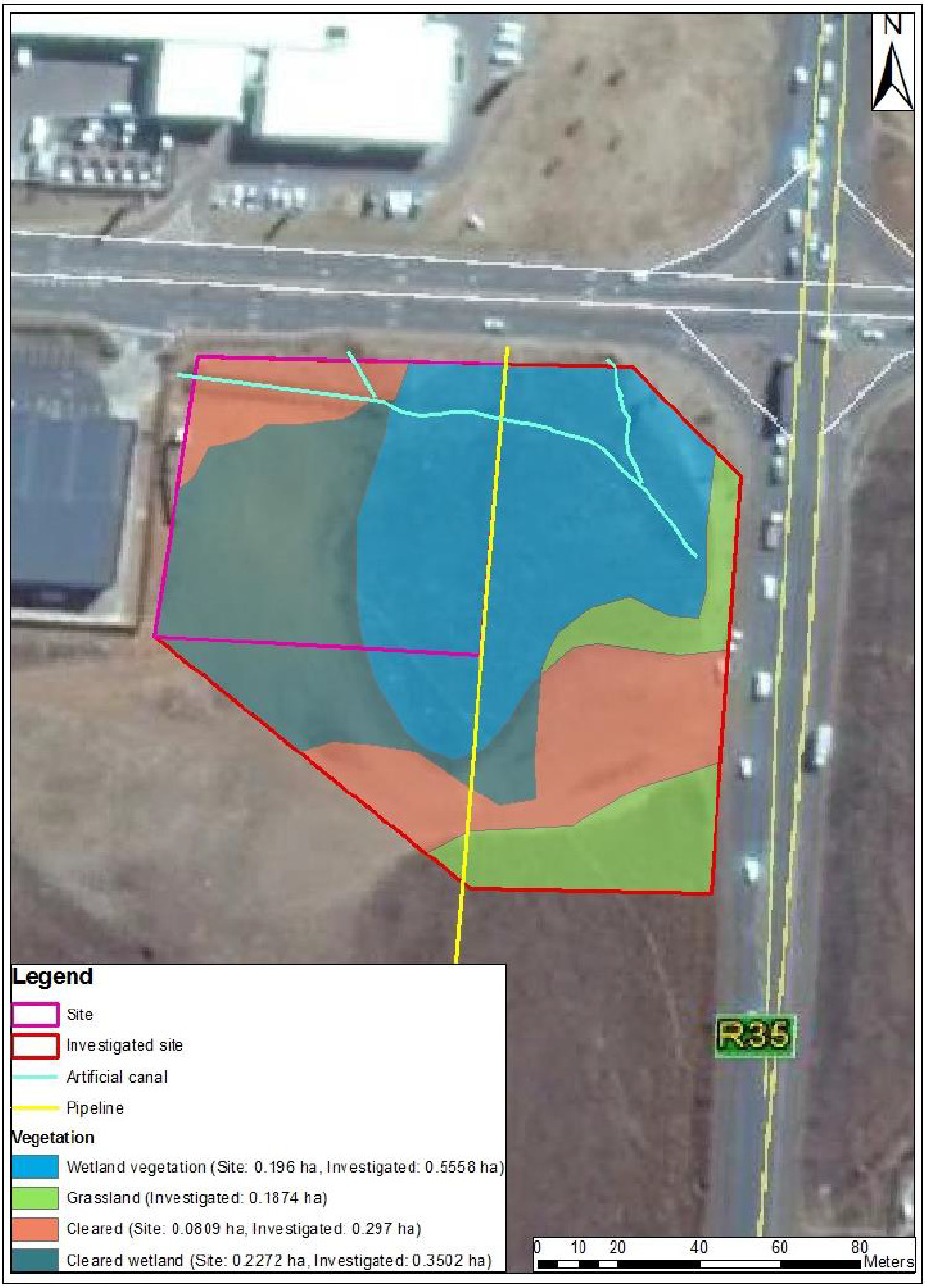


Figure 5.13: Vegetation units identified on site (taken from Venter, 2017)

Cleared area (Figure 5.13)
The western and central portions of the site as well as a portion of the vacant property south of the site are being used by heavy vehicles as an informal parking area (Photo 5.7). The vegetation was thus removed and a gravel layer dumped on site to prevent wheel entrenchment. Only a few pioneer species (mostly alien species) are present within the cleared area. Venter (2017) recorded a total of 17 species in the cleared area e.g. *Acanthospermum australe, Datura stramonium, Hypochaeris radicata, Malvastrum coromandellanum, Schkuhria pinnata* and *Solanum sisymbrifolium*. A full list of species noted is provided in Addendum E of Appendix 5.

Photo 5.7: A view of the cleared western and central portions of the site.

Due to the high level of disturbance, this area is considered to be of Very Low conservation importance from a vegetation point of view.

Grassland (Figure 5.13)
No grassland vegetation is present on the proposed filling station site. However, the proposed access road will extend across disturbed grassland vegetation south of the site as indicated in Figure 5.13 and Photo 5.8.

According to Venter (2017), the grassland closely resembles the Rand Highveld Grassland with a fair representation of grass and forb species. A few alien species are also present due to disturbances such as adjacent development, the dumping of rubble, littering, etc.

Photo 5.8: A view of the grassland vegetation located south and east of the filling station site

A total of 32 plant species (of which the majority were forbs) were recorded by Venter (2017) within the grassland vegetation unit. Some of the species observed include *Anthericum fasciculatum, Brachiaria deflexa, Cyanotis speciosa, Elephantorrhiza elephantina, Eragrostis superba* and *Jamesbrittenia aurantiaca*. A full list of recorded species are provided in Addendum E of Appendix 5.

Venter (2017) indicated that the grassland vegetation unit is of Moderate conservation importance due to the disturbances to the north, east and west of the site. The sensitivity of the grassland unit on the vacant land south of the site should however, be considered of high conservation importance.

Wetland (Figure 5.13)
As indicated in Figure 5.13, the eastern portion of the site and a large section of the Public Open Space between the site and Samora Machel Street (R35) comprises wetland vegetation. According to Venter (2017), the cleared area on site possibly also comprised wetland vegetation before it was cleared (Figure 5.13).

The wetland vegetation comprises of a combination of facultative and obligate sedge and grass species, with a few forb species present. The following are some of the species observed on site: *Fimbristylus complanata, Eragrostis gummiflua, Haplocarpa scaposa, Cynodon dactylon, Setaria sphacelata, Ranunculus multifidus* and *Berkheya radula*.

Due to the disturbances on site (e.g. excavation of storm water trenches, installation of water pipeline, etc.; Photo 5.9) and surrounding development, several weedy and alien species were also noted in this unit. The wetland area on the corner of La Roca Boulevard and Samora Machel Street (R35) is invaded by Kikuyu Grass as evident in Photo 5.10. Other species indicating disturbance include *Cyperus esculentus, Conyza bonariense* and *Verbena bonariense.* A full list of recorded species is provided in Addendum E of Appendix 5.

Photo 5.9: A view of the wetland vegetation in the north eastern portion of the site. Note the disturbance as a result of excavation.

Even though the wetland vegetation is not particularly rare or unique, it is still of conservation importance.

The orchid (*Orthochilus welwitschii*) was noted in the wetland south of the site (outside of the site boundaries but within a 500 m radius). The wetland south of the site is therefore considered to be of Moderate to High conservation importance.

Photo 5.10: Wetland vegetation invaded by Kikuyu Grass

5.7.3 Plant Species of Conservation Concern

The term 'Species of Conservation Concern' refers to the IUCN threatened and Near Threatened categories as well as the South African Red List categories (i.e. Critically Rare, Rare and Declining).

According to Venter (2017), no Plant Species of Conservation Concern were observed on site. It is extremely unlikely that any species of conservation importance will occur on the site, since the site and surrounding area are very disturbed and therefore unlikely to support vulnerable/threatened plant populations.

The orchid (*Orthochilus welwitschii* - previously *Eulophia welwitchii*) was however, noted in the wetland south of the site (outside of the site boundaries but within a 500 m radius)

5.7.4 Protected plant species

In addition to the IUCN categories, the following legislation affords protected status to selected indigenous plant species:

- National Forests Act (Act 84 of 1998),
- NEMA Biodiversity Act (Act 10 of 2004, as amended in 2007), and
- Mpumalanga Nature Conservation Act (No.10 of 1998).

National Forests Act (Act 84 of 1998)

The National Forests Act lists 47 tree species that may not be removed or damaged without a license from the National Department of Agriculture.

None of the 47 tree species listed in Schedule A of this Act occurs within the study area or its immediate surroundings.

NEMA Biodiversity Act (Act 10 of 2004, as amended in 2007)

The intention of the Biodiversity Act is to protect plant species (e.g. cycads, yellow arum lily, protea, etc.) that are directly threatened in terms of their utilisation. The destruction, collection or trading of any species listed in this Act requires a permit.

As indicated in Section 5.7.3, no habitat for plant species of conservation is present on site.

Mpumalanga Nature Conservation Act (No. 10 of 1998)

A number of plant species are protected in the Mpumalanga Province under the Mpumalanga Nature Conservation Act, whether they are considered to be threatened or not. This includes, but is not limited to, the following common names: ferns, flame lilies, christmas bells, pineapple flowers, clivia, nerine, crinum, ground lily, fire lily, irises, all orchids. A permit has to be obtained prior to their removal.

No protected plant species or trees were noted on site.

The orchid (*Orthochilus welwitschii* - previously *Eulophia welwitchii*) was however, noted in the wetland south of the site (outside of the site boundaries but within a 500 m radius). All orchid species are protected under the Mpumalanga Nature Conservation Act (No. 10 of 1998).

5.7.5 Invader or exotic species

Declared Weeds and Invaders are subject to the Conservation of Agricultural Resources Act (Act 43 of 1983) as amended in 2001. In terms of this Act, landowners are legally responsible for the control of alien plant species on their properties.

In addition, a number of plant species are listed as alien invasive species in terms of the Alien Invasive Species (AIS) Regulations, as defined in the National Environmental Management Biodiversity Act (Act no. 10 of 2014). The AIS regulations place each declared alien invasive plant species into one of four categories and stipulates measures for the eradication of plants in each of the four categories.

- *Category 1a: Invasive species which must be combated and eradicated. Any form of trade or planting is strictly prohibited.*
- *Category 1b: Invasive species which must be controlled and wherever possible, removed and destroyed. Any form of trade or planting is strictly prohibited.*
- *Category 2: Invasive species, or species deemed to be potentially invasive, in that a permit is required to carry out a restricted activity. Category 2 species include commercially important species such as pine, wattle and gum trees. Plants in riparian areas are Category 1b.*
- *Category 3: Invasive species, which may remain in prescribed areas or provinces. Further planting, propagation or trade, is however prohibited. Plants in riparian areas are Category 1b.*

Invasive plant species were noted on site by Venter (2017) in the areas associated with vegetation clearance and disturbances such as trench excavations, dumping of rubble, etc. The invasive plant species recorded on site are indicated in Table 5.7.

Table 5.7: Invasive plant species recorded on site (taken from Venter, 2017)

Species	Category	Growth form	Wetland	Cleared area
Datura stramonium	1b	Shrub		X
Pennisetum clandestinum	1b if not present in the wetland prior to October 2014	Grass	X	X
Solanum sisymbrifolium	1b	Shrub		X
Verbena bonariense	1b	Forb	X	X

5.8 Animal life

5.8.1 Regional conservation status

According to the Mpumalanga Biodiversity Sector Plan (MBSP, 2013), the site and surrounding area are classified as **Ecological Support Area (ESA): Protected Area Buffer and Critical Biodiversity Area (CBA): Optimal** (Figure 5.12).

The said site was classified as 'ESA: Protected Area Buffer' since it is located within the buffer zone of the Kruger Dam Private Nature Reserve. This reserve is 453.656 ha in extent and comprises a number of properties, including residential suburbs (Figure 5.12). As can be seen from Figure 5.12, this 'nature reserve' is not managed as such and has not been protected for many years. No information regarding the de-proclamation of the nature reserve could be found.

The reasons for indicating the site as a CBA: Optimal is also unknown, since the site and surrounding area have been heavily modified by the development of Middelburg Mall and the SAE Business Park (Figure 5.12). Natural grassland and wetlands are however, present south of the site which would justify the CBA allocation in these areas.

The entire site and surrounding area are classified as **Other Natural Areas** in terms of the Freshwater Biodiversity Assessment (Figure 5.14).

Other Natural Areas (ONAs) are defined as:

Natural areas that are potentially available to changes in land-use, subject to environmental authorisation processes. Although they are not identified to support freshwater CBAs or ESAs, they still provide important ecosystem services. Freshwater ONAs are particularly important in buffers around rivers and wetlands to reduce siltation and improve water quality. Old lands were included under Freshwater ONAs because of their functional importance in supporting and maintaining freshwater CBAs.

It should be noted that the MBSP freshwater assessment includes information obtained from the National Freshwater Ecosystem Priority Areas (NFEPA) and threatened freshwater ecosystems databases (National Biodiversity Assessment 2011).

Figure 5.14: Freshwater biodiversity assessment - Mpumalanga Biodiversity Sector Plan, 2013

No Critical Biodiversity Areas (CBA's) for aquatic species, Ecological Support Areas (ESA's) for fish, wetlands or wetland clusters are present on or near the site (Figure 5.14).

5.8.2 Animal life found on site and surrounds

No animal species were noted on site during the site visits. It is highly unlikely that animal species would permanently inhabit the site due to all the activities taking place in the area (e.g. business, residential, traffic, etc.). In addition, the majority of the vegetation on site was removed, in effect destroying the habitat on site.

Smaller species such as rodents, insects, reptiles, amphibians, etc. could utilize the remaining wetland vegetation on site (Figure 5.13) and the grassland vegetation within the adjacent Public Open Space Area (Figure 5.13). It is expected that many animal species (including birds) will be present on the vacant property located south of the site, especially in the wetland area.

5.8.3 Species of conservation concern

No species of conservation concern (e.g. Giant Bullfrog, Hedgehog, Serval, etc.) were noted on site during the site visits. It is unlikely that species of conservation concern will be present due to the disturbed nature of the vegetation and the human activities taking place on site and in the surrounding area.

5.9 Surface water

5.9.1 Catchment

The proposed site is located within the Upper Olifants Water Management Area (WMA) and more specifically the B12D quaternary catchment.

5.9.2 Floodline

No rivers or streams are present on site or near the site. The closest river/streams are DuToitspruit (±1.8 km northwest of site) and the Vaalbankspruit (±2.7 km northeast of site) (Figure 5.1).

The site will therefore not be affected by the 1:50 or 1:100 year floodlines.

5.9.3 Surface water runoff

The site is fairly flat with a gentle slope in a north easterly direction towards the R35 provincial road and the Vaalbankspruit (located ±2.7 km northeast of site; Figure 5.1). Developments are present between the said site and the Vaalbankspruit (Figure 5.3).

Rain and storm water drain as sheet wash across the property into a culvert underneath La Roca Boulevard (Figure 5.3). A storm water trench is present on the northern boundary of the site (Figure 5.3 and Photo 5.2). The trench channels storm water from the adjacent Retail City across the site towards the said culvert. Another storm water trench drains water from the Public Open Space located on the eastern boundary of the site towards the culvert (Figure 5.3 and Photo 5.5).

5.9.4 Wetlands identified on site and within a 500 m radius of the site

5.9.4.1 Introduction

The Mpumalanga Biodiversity Sector Plan (MBSP, 2013) does not indicate any important wetlands or wetland clusters on or near the site (Figure 5.14).

A vegetation and wetland specialist study was conducted for the site by I. Venter of Kyllinga Consulting (hereafter referred to as Venter, 2017). In addition, a wetland verification and situational assessment was done by N. Sharratt of Aqua Assess Consulting Services (hereafter referred to as Sharrat, 2017). A copy of both reports is provided in Appendix 5.

Venter (2017) investigated the proposed filling station site (referred to as The Site in the various figures) as well as the Public Open Space (between the said site and Samora Machel Street (R35)) and a portion of the vacant land south of the site (referred to as Investigated Site in the various figures).

5.9.4.2 Wetland units identified

Venter (2017) identified the following wetland units as indicated in Figure 5.15:

Wetland Unit	The Site (0.5ha)	Investigated Site (1.3902 ha)
Cleared seep wetland	✓	✓
Seep wetland	✓	✓
Seep seasonal/permanent zone	✓	X

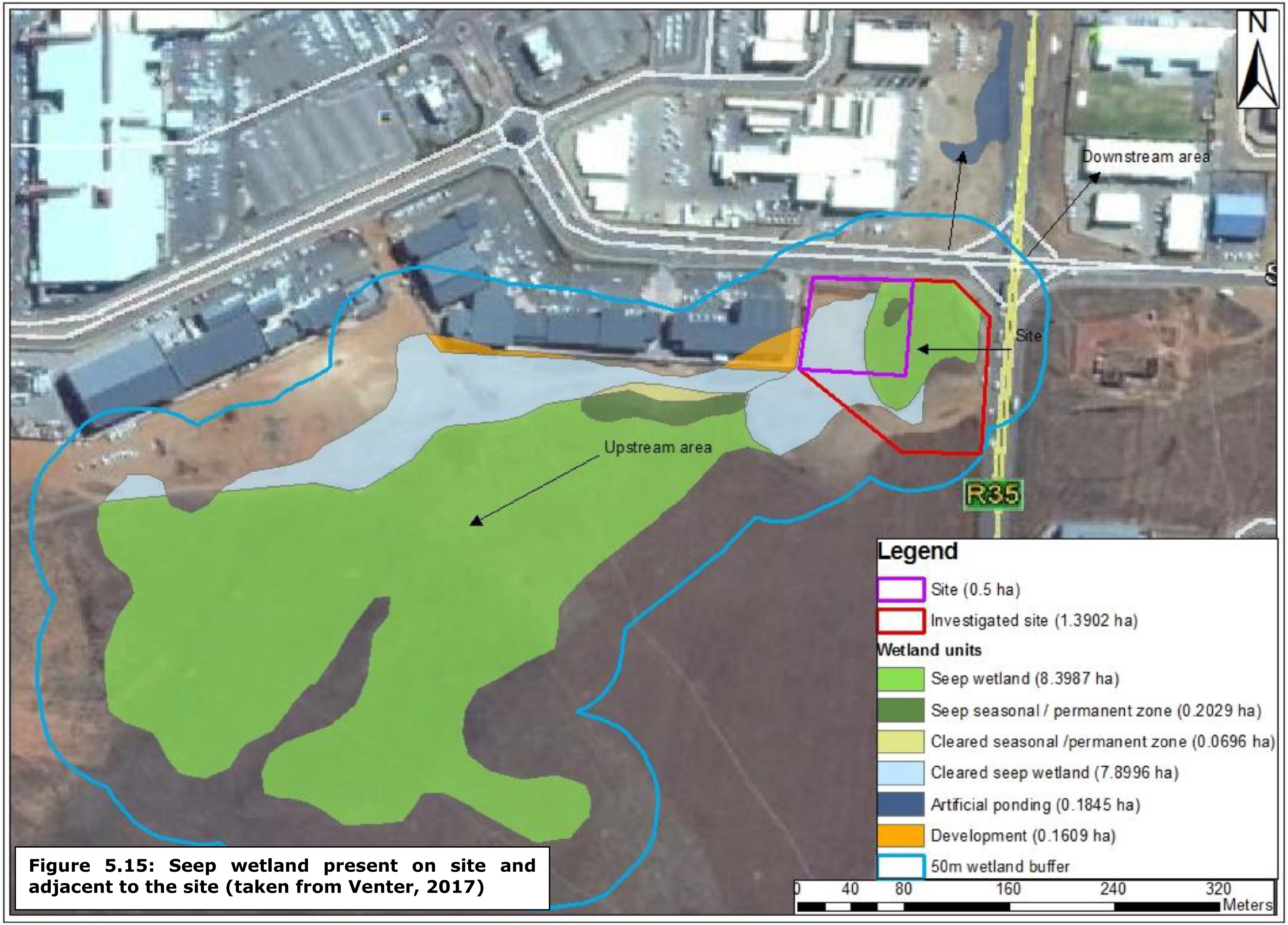


Figure 5.15: Seep wetland present on site and adjacent to the site (taken from Venter, 2017)

Venter (2017) indicated that a seep wetland is present on site and crossing the site diagonally as indicated in Figure 5.15. According to Venter (2017), the wetland may have extended north east of the intersection in the past. However, the area has been developed and no signs of a wetland are present (Figure 5.15).

The seep wetland on site originates on the adjacent vacant property south and south west of the site as indicated in Figure 5.15.

Some of the vegetation within this seep wetland was cleared for truck parking or roads, but the majority of the wetland is intact (Figure 5.15). The seep wetland in the eastern portion of the site (0.196 ha) has also been impacted, but is still intact (Figure 5.15 and Photo 5.11).

Photo 5.11: A view of the remaining seep wetland vegetation in the eastern portion of the site (taken from Venter, 2017).

As indicated in Section 5.7, the western and central portions of the site were cleared of vegetation (Cleared seep wetland; 0.2272 ha in extent; Figure 5.15) in order to allow heavy vehicles to use this area for parking. Soil/gravel was imported and spread on site to prevent wheel entrenchment. Venter (2017) could not sample the soil in the western portion of the site due to the imported gravel/soil and compaction of the soil layer by trucks.

Photo 5.12: A view of the cleared portion of the seep wetland on site (taken from Venter, 2017).

Impacts on the wetland located between the site and Samora Machel Street (R35) (0.5558 ha; Figure 5.15) include the installation and removal of a sign-board, excavation of storm water trenches, the dumping of building rubble and littering.

Topography

The site slopes down towards the north-east, with the seep located in the lower-lying area. Venter (2017) indicated that seeps are not necessarily located in depressions or valley-bottoms.

Vegetation

The wetland vegetation on site is largely disturbed, with portions of the wetland vegetation removed (Figure 5.15). Venter (2017) indicated that the vegetation could not be used in terms of the delineation of the wetland within the cleared area.

The onsite wetland vegetation comprises of a combination of facultative and obligate sedge and grass species, with a few forb species present. The following are some of the species observed on site: *Fimbristylus complanata, Eragrostis gummiflua, Haplocarpa scaposa, Cynodon dactylon, Setaria sphacelata, Ranunculus multifidus* and *Berkheya radula*. A few species indicating disturbance are also present, including *Pennisetum clandestinum, Conyza bonariense* and *Verbena bonariense.* The vegetation is therefore a good indication of the wetland boundaries.

Soil

The soil on site was investigated for hydromorphic features. Since gravel and soil were dumped in a portion of the cleared area, the soil auger could not be used in this portion (sample point 18), which limited the soil sampling. Soil samples could however be taken around the section with gravel.

The wetland soils comprise a brown to red-brown sand that become grey between 15 and 30 cm depth. Red and orange mottling is present. A clay layer is located underneath the sand layer and it is expected that phreatic water is present on top of the clay layer (Venter, 2017). Although unclear, the soil in the wetland unit appears to be of the Longlands or Wasbank soil forms, which are soil forms associated with temporary to seasonal wetness (Venter, 2017).

The soil outside the wetland unit (Figure 5.15) is a brown sand that becomes lighter with depth. The sand layer is approximately 70cm deep and does not have any mottling. No signs of hydromorphic features were observed. The sand layer is located on top of a clay layer and it is expected that phreatic water is present on top of the clay layer. Further details regarding soils on site are provided in Addendum F of Appendix 5.

Impacts identified

Upstream impacts: The upstream (southern) portion of the site (Figure 5.15) is still intact, with very few disturbances present. Some site clearing took place very close to the southern portion of the wetland, to the west, but does not encroach into the wetland (Venter, 2017).

From historical aerial photographs it is evident that the adjacent Retail City is located within the 50 m wetland buffer zone. According to Venter (2017), approximately 0.16ha of the wetland has been developed (Figure 5.15).

Photo 5.13: A view of the seep wetland located south and south west of the site (looking in a westerly direction towards Retail City).

The soil disturbances to the south of Retail City encroach into the wetland (Figure 5.15) and soil has been pushed into the permanent wetness zone of the wetland unit. A large section of the wetland was cleared where trucks park. Gravel was imported into this portion to prevent wheel entrenchment, which further altered the top layer of the soil (Venter, 2017).

On-site impacts: The intersection is located on the downstream portion of the wetland and stormwater canals are present adjacent to the roads, with a stormwater culvert passing under the road. The adjacent Retail City encroaches into the buffer of the wetland unit and a small corner of the wetland (Figure 5.15).

A soil stormwater canal extends from the adjacent Retail City to the culvert passing under the road and is currently eroding. Some sedimentation is also taking place in the lower portion of the canal. No formal stormwater system is currently present on site.

Although stormwater enters the wetland unit adjacent to the road, the stormwater is unlikely to contribute significantly to the wetness of the wetland on site (Venter, 2017).

A stormwater canal is located on the downstream portion of the site, adjacent to the road reserve and the water passes through the culvert unobstructed. The contribution to wetness is therefore limited to the canal area and is of a short-term nature (Venter, 2017).

A sign-board was present between the site and Samora Machel Street (R35) but has been removed. Some soil disturbances are therefore present in the grassland and wetland unit adjacent to the site.

In addition, a previously constructed water pipeline passes in a north-south direction on the eastern border of the site. The pipeline was constructed in 1983. The pipeline has resulted in a slightly raised soil profile over the pipe, which is likely to cause some ponding on the eastern portion of the property. This is not expected to have a significant impact on the hydrology of the property, although it causes some short-term ponding. The short-term ponding may result in a change in the soil profile. It is possible that signs of wetness, such as mottling in the soil profile, may develop in this time. Whether the wetness increased as a result of the pipeline or not, the system is still considered to be of high conservation importance and any development will require a water use license (Venter, 2017).

Downstream impacts: The downstream portion of the wetland is largely impacted (Figure 5.15), especially on site. It is expected that the wetland extended to the north-east of the intersection of the R35 and Spring Street. The section to the north-east of the intersection is however already developed and no signs of the wetland are present (Figure 5.15).

A small wet patch (artificial ponding area; Figure 5.15) is present to the north of the site, in front of the Barloworld Toyota garage. This is as a result of stormwater outflow from the developments. The water passes from the ponding area through a culvert under the R35 to the east.

Historical aerial photographs
Due to the disturbances on site older aerial photographs of the site were investigated.

The Google Earth aerial photographs from 2014 are very clear and therefore the previous extent of the wetland area clearly visible (Venter, 2017).

In addition, an aerial photograph from approximately 1974 was also obtained for the site. This aerial photograph is however not of very good quality and is unclear. A seep wetland is however visible on site. From this aerial photograph the wetland area appears to be wider than in the 2014 Google Earth image. However, since the image is unclear, it cannot be used for the delineation of the wetland area. The aerial photograph does however indicate that a seep was present on site in the past.

Sharratt (2017) agreed that based on historical imagery, as well as soil and vegetation wetness signatures on site, there is a wetland present on site. This wetland can be classified as a hillslope seepage wetland (Brinson, 1993; Marneweck and Batchelor, 2002) which probably had a seasonal to temporary hydrological regime under natural conditions.

However, this wetland has been severely disturbed and has become highly modified as a result of the following activities:

- The construction of a shopping centre and roads adjacent to the site, resulting in stormwater runoff into the wetland.
- The clearing of vegetation, placement of gravel and soil compaction to create a parking area which extends through most of the site.
- A pipeline constructed through the wetland, which converted subsurface flows to surface flows along a preferential flow path.
- Tracks and trenches extending through the wetland which also create surface flows along preferential flow paths.
- Dumping of gravel and topsoil thereby causing disturbance of soils within the wetland area.
- Stormwater runoff from the adjacent hardened surfaces (shopping area and tar roads) has *increased* water supply to the wetland, resulting in the increased extent of the wetland and longer periods of wetness.

Sharratt (2017) indicated that the wetlands identified on site therefore need to be discussed within the context of these disturbances.

Under natural (unimpacted) conditions, water inputs would have been mainly by subsurface flows (within the soil profile) from upslope areas (to the southwest of the site). It is likely that this historical wetland extended through the site. However, after the construction of the shopping centre and clearing of vegetation for road construction as well as the creation of pathways/trenches through the seepage area, the manner in which water flowed through the landscape changed substantially. Much of the subsurface seepage was converted to surface flows along preferential flow paths and ponding of water occurred within trenches, along pipelines and within disturbed areas. As such, the extent of the wetland was altered to reflect the presence of water and obligate wetland plant species were able to colonise areas of ponding or along preferential flow paths. In addition, the surrounding hardened surfaces (tar roads and shopping centre), resulted in greater volumes of stormwater reaching the wetland, resulting in an increase in the extent of the wetland area. Therefore, the hydrology and associated vegetation, as well as soils, have all been largely modified relative to the original state and extent of the seepage wetland.

5.9.4.3 Present Ecological State (PES)

Venter (2017) calculated the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) for the entire wetland unit and not only for the portion of the wetland located on site (Figure 5.15).

Although it is expected that the wetland extended to the north-east of the site (i.e. across the intersection), the possible historical extent of the wetland in that area could not be determined. The PES was therefore determined for the portion of the unit located upstream of Spring Street (Figure 5.15).

Venter (2017) indicated the overall PES of the wetland as PES Class B (i.e. Largely Natural). However, the expected PES of the wetland is closer to PES Class C or D (Moderately to Largely Modified) if the downslope impact is considered (Venter, 2017).

The most significant impacts are to the vegetation and hydrology of the wetland unit, resulting in a vegetation and hydrological PES of Class C (i.e. Moderately Modified). The geomorphological PES is Class A (i.e. Natural). This will however change should the impacts from the intersection and downstream areas be considered.

Sharratt (2017) indicated that the hydrology and associated vegetation, as well as soils, have all been largely modified relative to the original state and extent of the seepage wetland. The prevalence of alien vegetation on site has further decreased the ecological integrity of wetland habitats. The PES should therefore be indicated as Class D.

The portion of the wetland upstream of the site (Figure 5.15), which is the majority of the wetland unit, is still in a very good condition and appears to be natural (Venter, 2017). As indicated, the disturbances are confined to the downstream portion of the wetland and is therefore present on site and in close proximity to the site.

5.9.4.4 Ecological Importance and Sensitivity (EIS)

Venter (2017) also calculated the Ecological Importance & Sensitivity (EIS) for the entire wetland unit and not only the portion on site as indicated in Table 5.8a.

Table 5.8a: Summary table of the EIS and functional importance of the wetland unit (taken from Venter, 2017)

Ecological and Functional Importance	Importance	Class	Confidence
Ecological Importance & Sensitivity	1.8	Moderate	3.7
Hydro-functional Importance	1.1	Low to Moderate	3.0
Direct Human Benefits	0.5	Low	4.0

The EIS for the entire wetland unit is Moderate (Table 5.8a) indicating that the wetland is of local to regional importance. According to Venter (2017), the system is located in a Vulnerable vegetation type and is still in a largely natural condition with temporary to permanent wetness zones. The seep is of limited hydro-functional importance (Low to Moderate; Table 5.8a) and no signs of human benefits (Low; Table 5.8a) were observed.

Sharratt (2017) indicated that the Cleared Wetland area was identified only on historical imagery and not on soil or vegetation characteristics (the soil was considered too hard for augering). As such, this cleared area, which may have had wetland features in the past, should, strictly speaking, be referred to as "historical wetland" as the current presence of hydromorphic features and the presence of subsurface water (within 50cm of the surface) could not be determined at the time of the survey. In view of this, Sharratt (2017) recommended that this cleared area therefore be excluded from the PES and EIS assessment as there were no wetland habitats present to assess (i.e. compacted earth and gravel only) and wetland functionality was limited (subsurface flows have largely been converted to surface flows due to the construction of the adjacent shopping centre which extends into the "historical wetland", and soil compaction for road construction).

5.9.4.5 Sensitivity and conservation importance

Venter (2017) combined vegetation and wetland components to obtain the overall sensitivity and conservation importance of the site as indicated in Table 5.8b. Figure 5.16 presents the overall sensitivity of the site.

Table 5.8b: Summary of sensitivity and conservation importance (taken from Venter, 2017)

Unit	Vegetation sensitivity	Wetland sensitivity	Overall sensitivity	Conservation importance	Size on site (ha)	Size on investigated site (ha)
Seep Wetland	Moderate	High	High	High	0.196	0.5558
Cleared wetland	Low	Moderate	Moderate	High	0.2272	0.3502
Grassland	Moderate	Low	Moderate	Moderate		0.187
Cleared grassland	Low	Low	Low	Low	0.0809	0.297

As indicated in Table 5.8b, the Seep Wetland has an overall sensitivity of High (Table 5.8b; Figure 5.16) and a conservation importance rating of High (Table 5.8b; Figure 5.17).

The Cleared Wetland Area has an overall sensitivity of Moderate (Table 5.8b; Figure 5.16) and a conservation importance of High (Table 5.8b; Figure 5.17).

Since all wetlands (whether disturbed or not) are of High conservation importance, the majority of the site is of High conservation importance (Figure 5.17), even when highly disturbed, especially if rehabilitation of the area is possible.

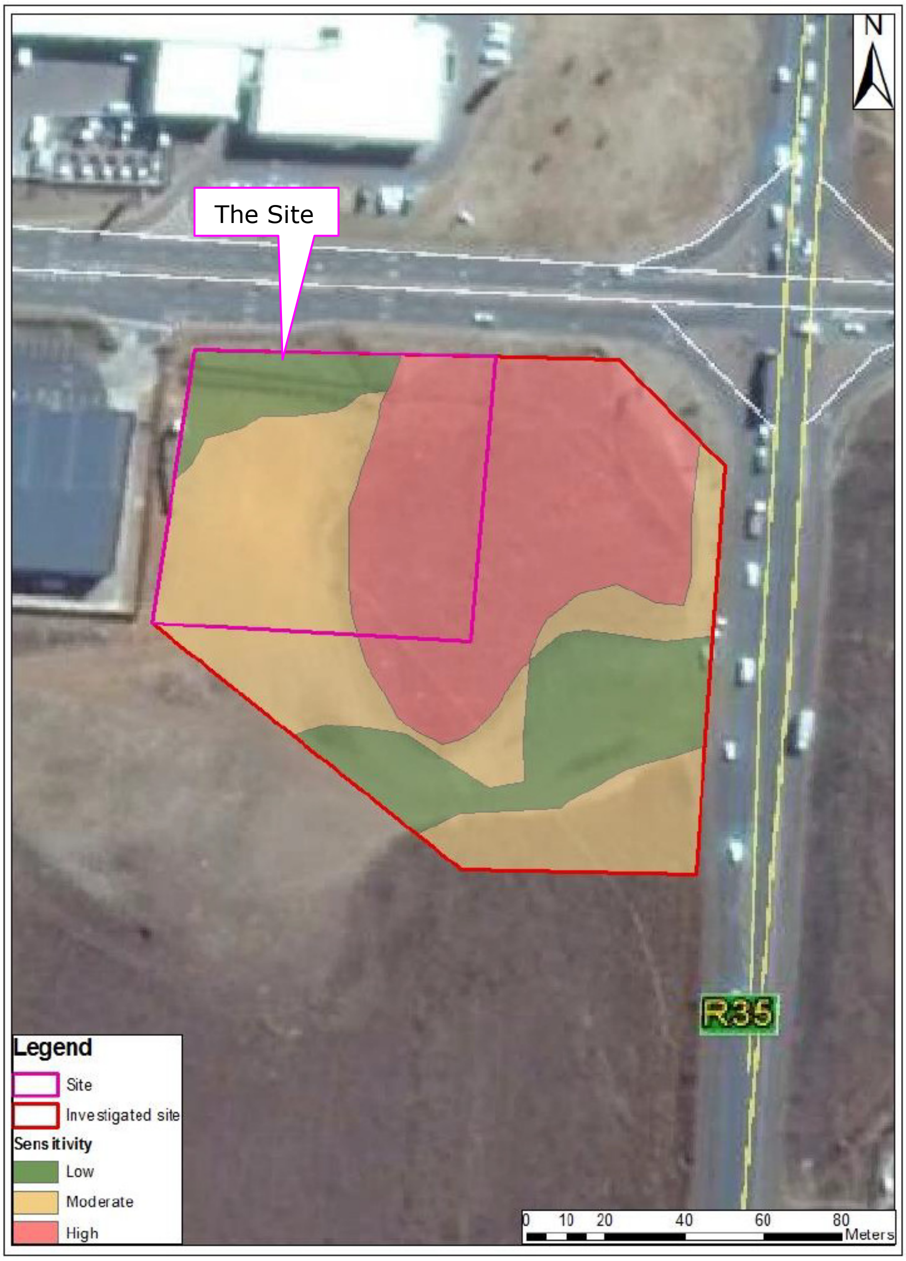


Figure 5.16: Sensitivity of the site (taken from Venter, 2017)

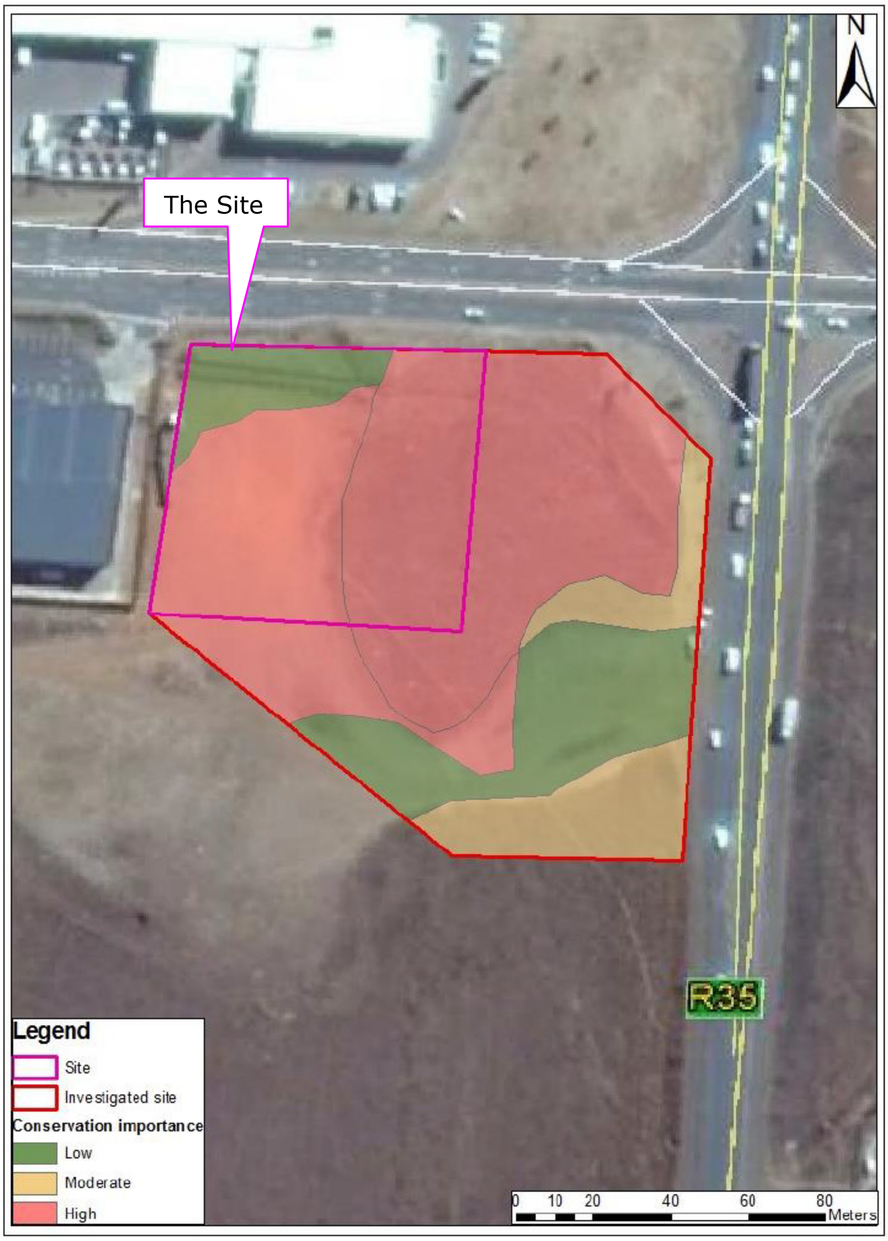


Figure 5.17: Conservation importance of the site (taken from Venter, 2017)

5.10 Groundwater

A geohydrological investigation was conducted for the proposed filling station site by J. van der Walt of Geo-Pollution Technologies (hereafter referred to as Van der Walt, 2017). A copy of the geohydrological study is provided in Appendix 6. This report should be consulted with regards to methodology used.

The objective of the study was to determine the following:

- Presence of groundwater users in the vicinity of the site;
- Depth to the water table;
- Approximate direction of groundwater flow;
- Current quality of the groundwater in the area.

The investigation comprised of a site survey, hydrocensus, pump testing/aquifer testing, the measurement of the groundwater level at existing boreholes and the collection and analysis of groundwater samples.

5.10.1 Hydrogeological setting

According to the 1: 500 000 Hydrogeological Map (2526), the site geology hosts an intergranular and fractured aquifer system with median borehole yields ranging between 0.1 - 0.5 l/s. Aquifers in the area are classified as minor with a moderate vulnerability.

According to van der Walt (2017), the highest potential for groundwater occurrence is expected to be found along contact zones between the sedimentary shale and intrusive diabase.

As indicated in Section 5.4, a massive diabase dyke (di) trends in an easterly-westerly direction just north of said site. The contact zone between the diabase dyke and the Loskop Shale is located just north of the site underneath La Roca Boulevard as indicated in Figure 5.9b. The proposed filling station will not be located on this contact zone (Figure 5.9b).

5.10.2 Perched water table

As indicated in Section 5.6.3, Hansmeyer (2004) did not indicate the presence of a perched water table for the proposed filling station site (TP51, Figure 5.9).

However, Venter (2017) indicated the presence of a seep wetland on site (Figure 5.15). It should be noted that geotechnical test pits are excavated up to a depth of 2.5m, whereas only 50 cm of soil is investigated by the wetland specialist for hydromorphic characteristics. Additional indicators apart from soil (such as vegetation and topography) are also used to identify wetlands.

A perched water table is present south of the site at test pit TP59 (Figure 5.9b). According to Hansmeyer (2004), this area is characterised by a well-developed pedocrete and very moist to wet soils, especially during high rainfall periods. This area is also at a slightly lower elevation than the rest of the site and surface water tends to drain towards this feature.

Venter (2017) did not identify a wetland within this area (Figure 5.15) due to the absence of wetland features (e.g. no signs of prolonged wetness were observed in the vegetation or the top 50cm of the soil profile). Some mottling was observed in the deeper profile, starting from 60 or 70cm depth. It is also possible that the water table may be higher for very short periods, but not for long enough at a depth of less than 50cm to affect the vegetation and soil profile. The geotechnical report (Hansmeyer, 2004) is therefore accurate in indicating a perched water table, but not at a depth that will indicate wetland conditions to the south of the site.

According to Venter (2017), the area indicated as having a perched water table very broadly corresponds to the seep wetland identified south and south west of the site (Figure 5.15). The perched water table and wetland area however, do not correspond exactly.

The proposed access road would extend across the area where the perched water table was identified (Figure 5.9b). According to Hansmeyer (2004), subsurface drains are recommended to accommodate a possible rebound in the perched water table below.

5.10.3 Hydrocensus

A hydrocensus was conducted on site and in the surrounding area to identify groundwater users and to collect groundwater related data. Van der Walt (2017) identified five (5) boreholes within a 500 m radius of the site. Four (4) of the boreholes are used for water supply. The borehole positions are indicated in Figure 5.18 and the hydrocensus information is provided in Table 5.9.

Table 5.9: Summarized hydrocensus information (taken from Van der Walt, 2017)

ID	Owner	Distance and direction from site centre	SWL (mbgl)	Use
BH1	Retail City	207 m west	4.85	Consumption; Domestic
BH2	Alzu Voere	370 m west	5.51	Consumption; Domestic
BH3	J Vorster	410 m north	NM	Consumption; Domestic
BH4	J Vorster	330 m north	4.82	Newly drilled
BH5	Geoline Logging Services	390 m south east	7.7	Test borehole

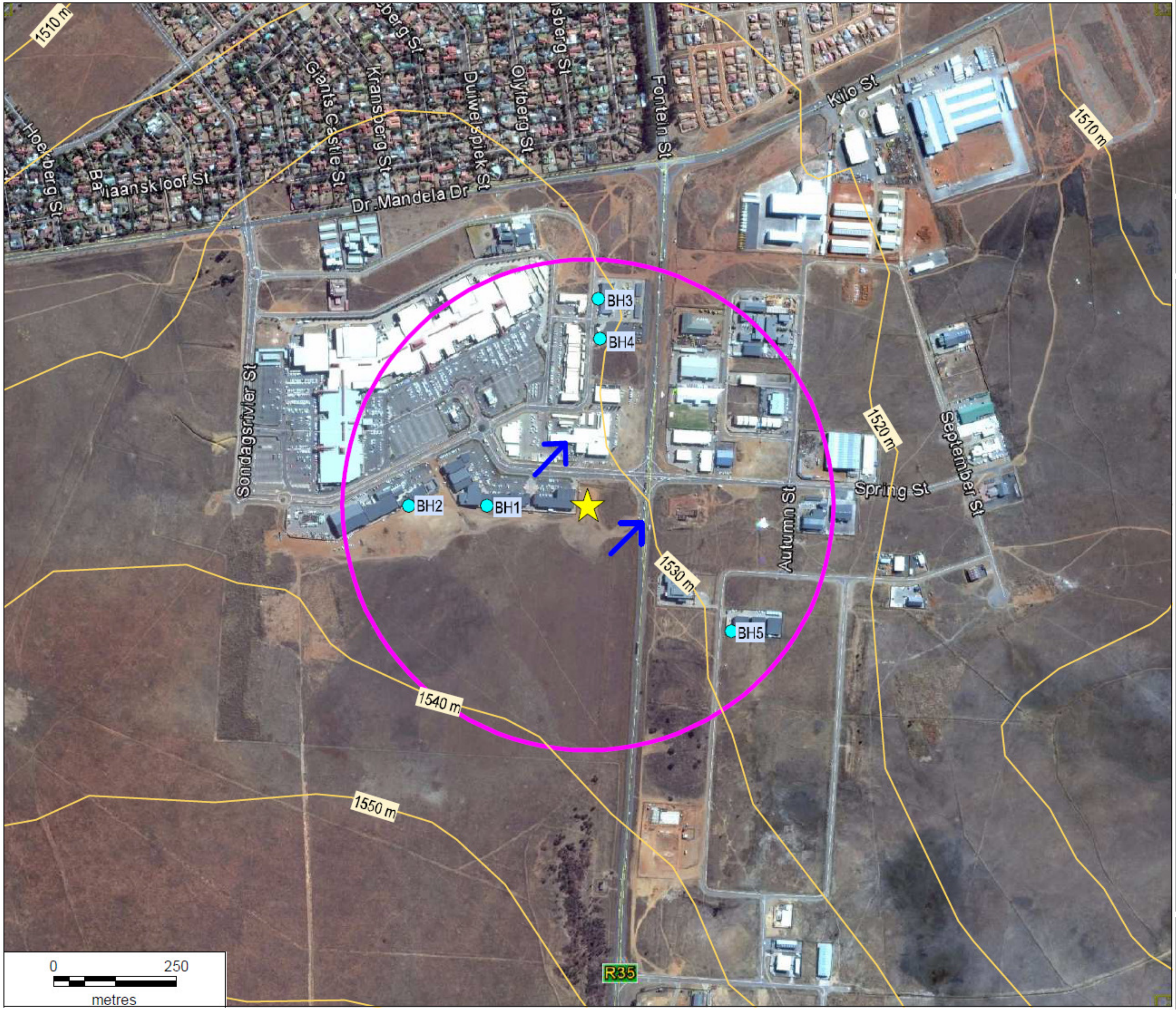
Legend: NM = not measured.

5.10.4 Groundwater flow and levels

The groundwater flow direction is inferred to simulate surface drainage patterns which are in a north easterly direction towards the Vaalbankspruit situated at the bottom of an adjacent valley (approximately 2.7km northeast of the site; van der Walt, 2017).

Van der Walt (2017) indicated that flow across the site is mostly unobstructed. Short term ponding is not expected to have a significant impact on the site hydrology.

The hydrocensus established that the groundwater levels in the area are relatively shallow and vary between 4.82 to 7.70 mbgl (Table 5.9). This means that there will be a small buffer zone between the water table and shallow (<4 mbgl) product infrastructure (underground fuel tanks and pipelines).



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Garsfontein East, 0060
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MIDDELBURG FILLING STATION
LOCALITY MAP
(February 2017)

LEGEND

- Site Location
- Relief Lines (10m Intervals)
- Calculated Groundwater Flow Direction
- Water supply borehole
- 500m Buffer Radius

Figure 5.18: Boreholes identified as part of hydrocensus (taken from Van der Walt, 2017)

NORTH

Gauss-Kruger (Transverse Mercator)
WGS84, Lo 29

5.10.5 Groundwater quality

Van der Walt (2017) collected a groundwater sample from each of the 5 boreholes (BH1 to BH5; Table 5.9; Figure 5.18) in order to screen for volatile petroleum hydrocarbons and to test the water quality in terms of inorganic elements. The water quality information is presented in Tables 5.10 and 5.11.

Table 5.10: Results of the petroleum hydrocarbon analyses (taken from Van der Walt, 2017)

Well	ALMIDBH1	ALMIDBH2	ALMIDBH3	ALMIDBH4	ALMIDBH5
Sample depth (mbgl)	4.85	5.51	NM/CNM	4.82	7.70
Benzene	BDL	BDL	BDL	BDL	BDL
Toluene	BDL	BDL	BDL	BDL	BDL
Ethylbenzene	BDL	BDL	BDL	BDL	BDL
Xylenes	BDL	BDL	BDL	BDL	BDL
MTBE	BDL	BDL	BDL	BDL	BDL
TAME	BDL	BDL	BDL	BDL	BDL
Naphthalene	BDL	BDL	BDL	BDL	BDL
1,2,4 Trimethyl benzene	BDL	BDL	BDL	BDL	BDL
1,3,5 Trimethyl benzene	BDL	BDL	BDL	BDL	BDL
Acenapthene	BDL	BDL	BDL	BDL	BDL
Acenaphthylene	BDL	BDL	BDL	BDL	BDL
Fluorene	BDL	BDL	BDL	BDL	BDL
Phenanthrene	BDL	BDL	BDL	BDL	BDL
Anthracene	BDL	BDL	BDL	BDL	BDL
Fluoranthene	BDL	BDL	BDL	BDL	BDL
Pyrene	BDL	BDL	BDL	BDL	BDL
TPH C10-C12	BDL	BDL	BDL	BDL	BDL
TPH C12-C16	BDL	BDL	BDL	BDL	BDL
TPH C16-C20	BDL	BDL	BDL	BDL	BDL
Total VPHs Identified	BDL	BDL	BDL	BDL	BDL
Estimated VPHs Unidentified	BDL	BDL	BDL	BDL	BDL

All results are in mg/l
BDL: Below Detection Limit
NA: Not Analysed

As indicated in Table 5.10, no petroleum hydrocarbons were detected in any of the water samples. The boreholes situated within 500 m of the site are therefore not contaminated by petroleum hydrocarbon compounds.

Table 5.11: Results of the drinking water quality analyses (taken from Van der Walt, 2017)

Paramter		Unit	SANS 241: 2015 Recommended Limits	Risk	Results				
					BH1	BH2	BH3	BH4	BH5
Physical & Aesthetic determinands									
Electrical conductivity at 25^{0}C	EC	mS/m	≤ 170	Aesthetic	16.9	18.7	21	16.1	5.07
Total Dissolved Solids	TDS	mg/liter	≤ 1200	Aesthetic	119	131	147	112	35.5
pH at 25^{0}C		pH units	≥ 5 to ≤9.7	Aesthetic	7.55	7.32	7.16	7.31	6.34
Chemical Determinands - Macro determinands									
Nitrate as N	NO_3	mg/liter	≤ 11	Acute Health	1.27	1.29	1.46	1.22	1.3
Sulphate	SO_4	mg/liter	Acute Health ≤500; Aesthetic ≤250	Acute Health/Aesthetic	11.4	11.1	14.2	7.77	10.1
Fluoride	F	µg/liter	≤1500	Chronic Health	0.215	0.048	0.142	0.092	0.088
Ammonia as N	NH_3	mg/liter	≤ 1.5	Aesthetic					
Chloride	Cl	mg/liter	≤ 300	Aesthetic	1.22	1.26	3.98	2.25	0.694
Sodium	Na	mg/liter	≤ 200	Aesthetic	22.5	17.6	18.3	17.1	8.92
Concentration deemed to present an unacceptable health risk for lifetime consumption.									

As indicated in Table 5.11, none of the water quality constituents' concentrations exceed the SANS standard limits. According to Van der Walt (2017), the groundwater is of exceptional quality.

5.11 Air quality

The proposed filling station is located in the Steve Tshwete Municipal area hot spot, which extends across the Steve Tshwete Local Municipality from its border with eMalahleni to Arnot in the east. This is an area where measured or modelled concentrations exceed, or are predicted to exceed, ambient air quality standards as identified in the Air Quality Management Plan for the Highveld Priority Area (HPA; Republic of South Africa, 2011). This Priority Area was declared in terms of Section 18(1) of the National Environmental Management: Air Quality Act 2004 (Act 39 of 2004) due to poor air quality and associated health risks.

Exceedances do not occur throughout the hotspot, but in three nodes. In the Middelburg node the modelled and monitored PM_{10} concentrations, as well as modelled SO_2 concentrations, exceed the ambient standard.

The air quality of the site is predominately governed by various industrial and mining activities in and around Middelburg.

Activities in the surrounding area that could potentially impact on the air quality of the site include the following:

- Emissions from the Middelburg industrial area (2.8 km east of the site);
- Dust from mining activities in the area (2.6 km south and 3.4 km west of the site);
- Dust from heavy vehicles driving and parking on site;
- Dust and vehicle emission from construction activities at the new SAE Business Park;
- Emissions from vehicles utilizing the surrounding road network;
- Smoke emitted from veld fires.

5.12 Noise

The following existing activities could impact upon the ambient noise level of the site:

- Traffic (especially trucks) travelling on the tar roads in the area (especially Samora Machel Street (R35));
- Business and industrial activities taking place in the area;
- Construction activities at the new SAE Business Park;
- Blasting as a result of mining activities in the surrounding area (2.6 km south and 3.4 km west of the site).

The major contributing factor to the ambient noise level of the site would however, be as a result of traffic.

5.13 Sites of archaeological and cultural interest

5.13.1 Cultural Heritage sensitivity

As previously indicated in Section 5.3.5, the said site has been heavily impacted upon through the clearing of vegetation, dumping of soil and surrounding development.

According to the National Heritage Resources Act (Act 25 of 1999) (hereafter referred to as the Act) a Heritage Impact Assessment must be done under the following circumstances:

a. The construction of a linear development (road, wall, power line canal etc.) exceeding 300m in length.
b. The construction of a bridge or similar structure exceeding 50m in length.
c. Any development or other activity that will change the character of a site and exceeds 5 000m^2 or involve three or more existing erven or subdivisions thereof.
d. Re-zoning of a site exceeding 10 000 m^2.
e. Any other category provided for in the regulations of SAHRA or a provincial heritage authority.

As per the above, a Heritage Impact Assessment was not required for the proposed filling station or the proposed access road due to the following:

a. The proposed access road will only be 120 m (and not 300m) in length.
b. No bridges or similar structure will be constructed.
c. The development will not exceed 5 000m^2 or involve three or more existing erven or subdivisions thereof.
d. The site is only 5 000m^2 (and not 10 000 m^2).

The Act also states that no structures or graves older than 60 years may be impacted. No structures, buildings, graves, etc. are present on site.

The South African Heritage Resources Agency (SAHRA) was consulted and subsequently waived the requirement for a Heritage Impact Assessment due to the disturbed nature of the said site (letter dated: 26 June 2017; Appendix 10). According to SAHRA, the heavy foot and vehicle traffic on site would have destroyed all surface heritage resources.

5.13.2 Palaeontological sensitivity

According to the Act, no person may impact on any palaeontological site or meteorite without a permit from SAHRA.

SAHRA requested (letter dated: 26 June 2017; Appendix 10) that a desktop Palaeontological Desktop Study be commissioned since the site is located in a moderately sensitive area for fossiliferous rock strata (Figure 5.19).

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required

Figure 5.19: Requirement for palaeontological study (taken from SAHRA, 2014)

In view of the above-mentioned, Dr. H. Fourie, an accredited palaeontologist, was appointed to assist with the required study. Dr. Fourie (2017) however, indicated that an exemption application could be submitted to SAHRA. A copy of the letter requesting exemption is provided in Appendix 13.

Dr. Fourie (2017) indicated the following in the exemption application (Appendix 13):

This letter serves as a Letter of Exemption. The development will be located on a Formation with a Low Palaeontological sensitivity, therefore there is a low possibility that significant fossils will be present in the bedrock of these geological units. The formation is surrounded by the Dwyka Group of Moderate Sensitivity and the Selons River Formation with a Low Sensitivity, therefore a Desktop Study or Field Study is not necessary (Groenewald and Groenewald, 2014).

The development will be situated on the Loskop Formation consisting of shale, sandstone, conglomerate, and volcanic rocks. It is Vaalian in age (2100 - 2200 Ma) and situated above the Rooiberg Group of the Transvaal Supergroup and underlies the Waterberg Group. This formation reaches its maximum thickness of about 1000 m in the area north of Middelburg. It stands as a formation on its own (Kent 1980).

The Loskop purple-grey shales are sequentially overlain by beige silt derived from in-situ decomposed shale and brown colluvial silty sand. Dolomite, sinkholes or doline areas, watercourses and alluvium do not occur on site.

5.14 Sensitive landscapes

As indicated in Table 5.8b, the Seep Wetland has an overall sensitivity of High (Table 5.8b; Figure 5.16) and a conservation importance rating of High (Table 5.8b; Figure 5.17).

The Cleared Wetland Area has an overall sensitivity of Moderate (Table 5.8b; Figure 5.16) and a conservation importance of High (Table 5.8b; Figure 5.17).

Venter (2017) indicated that all wetland units are considered to be of high conservation importance, even when highly disturbed, especially if rehabilitation of the area is possible.

5.15 Visual aspects

Due to the flat topography and developed nature of the area, the site is highly visible from all the surrounding properties and roads making it ideal for a filling station.

The site is visible from La Roca Boulevard, Samora Machel Street (R35), the adjacent Retail City, the adjacent vacant land, Barloworld Toyota, SAE Business Park and its various businesses (Figure 5.4).

5.16 Traffic

A traffic impact assessment was conducted by B. Roberts of Moyeni Professional Engineering (hereafter referred to as Roberts, 2017) with regards to the proposed filling station. A copy of the said report is provided in Appendix 12 and should be consulted with regards to the methodology used.

5.16.1 Existing road network

Figure 5.3 provides an aerial view of the said site and surrounding road network. Access to the proposed filling station site will be provided from La Roca Boulevard (i.e. access road to Middelburg Mall) and Samora Machel Street (R35).

The main access road to the Middelburg Mall (La Roca Boulevard; Figure 5.3) is located on the northern boundary of the site. La Roca Boulevard is a Class 4a, local distributor road as indicated in Table 5.12. Sidewalks/walkways (for pedestrians) are found adjacent to La Roca Boulevard.

Access to the proposed filling station site will be provided from La Roca Boulevard (Figure 4.2). La Roca Boulevard is separated by a median but a partial access was recently constructed for the retail shops adjacent to the filling station site. This will also provide access to the proposed filling station.

Samora Machel Street (R35) is located approximately 130m to the east of the site (Figure 5.3). The R35 provincial road is a regional road (Class 2 - primary distributor; Table 5.12) that connects with the N4 national road (Class 1; Table 5.12) approximately 2.6km south of the site. The R35 extends from the centre of Middelburg, past the proposed site to Bethal. It should be noted that no paved sidewalks exist along the R35 as pedestrian walkways are not permitted along Class 2 routes for safety reasons. A pedestrian crossing is provided at the signalised R35/Samora Machel intersection.

Dr Mandela Drive (Class 3 - district distributor; Table 5.12) is located approximately 600m north of the site on the northern boundary of the Middelburg Mall. This road extends in an east-westerly direction and provides a link between the R555 provincial road and the N11 national road.

Table 5.12 provides a summary of the road network classification in the vicinity of the proposed filling station site.

Table 5.12: Road network classification (taken from Roberts, 2017)

Road / Street	Class	Carriageway	Road reserve width (m)	Number of lanes	Characteristic
N4 freeway	1	Dual	80	6	Sanral
R35	2	Single	60	2	Sanral
Spring Street / La Roca Blvd	4a	Single	35	2	Municipal
Mandela Dr	3	Single	30	2	Municipal

According to Roberts (2017), the road network in this local area is a mature one. The proposed filling station site is not affected by future roads as new roads (as per the Spatial Development Framework) will only be constructed as development takes place.

5.16.2 Existing traffic volumes

Roberts (2017) indicated that classified manual traffic counts were conducted by Trafsol on 18 October 2017. The said traffic counts are provided in Annexure A of Appendix 12.

Table 5.13 provides a summary of the link traffic flows along Samora Machel Street (R35) and La Roca Boulevard.

Table 5.13: Link Traffic Flows (taken from Roberts, 2017)

Road	Flow (vph)	AM peak hour	PM peak hour	Capacity (vph) / Number of lanes required/existing
R35 (Samora Machel Street)	Northbound	583	888	1900/1/1
	Southbound	963	752	1900/1/1
La Roca Boulevard	Eastbound	304	543	3900/1/2
	Westbound	308	679	3900/1/2

In the worst case, 963 vehicles per hour (Table 5.13) travel along Samora Machel Street (R35). According to Roberts (2017), this road operates satisfactory at 51% of its link capacity. Similarly, La Roca Boulevard with a maximum flow of 17% of its link capacity operates satisfactory (Roberts, 2017).

Roberts (2017) indicated that a traffic growth rate of 4% per annum (pa) was adopted in this growing corridor (Annexure C of Appendix 12). According to

Roberts (2017), the growth factor is 1,276 for the 5 years between 2017 and 2022.

Table 5.14 provides an indication of the modal split in terms of type of vehicles utilizing the various roads.

Table 5.14: Modal Split (taken from Roberts, 2017)

Mode	All surveyed hours and all streets/roads	
	Vehicles	Percentage
Cars	33 983	91.4
Mini-bus taxi	986	2.7
Buses	23	0.1
Trucks	2 164	5.8
All vehicles	**37 156**	**100**

From Table 5.14, it is evident that the majority of traffic comprises cars (91.4%), followed by trucks (5.8%) and taxi's (2.7%).

Table 5.15 provides an indication of the total passing traffic during the AM and PM peak hours.

Table 5.15: Total passing traffic (AM/PM peak hour) (taken from Roberts, 2017)

Peak hour	In / Out
From the south	583 / 888
From the east	308 / 679
From the west	304 / 543
13 hour counts	**16 647**
From the south	7 251
From the east less common trips	5620 - 1815 = 3 805
From the west	5591
24 hour counts (Add 20%)	**19 976**
From the south (left and through)	8 701
From the east less common trips	4 566
From the west	6 709

According to Table 5.16, the dominant distribution route (51%) in terms of traffic is Samora Machel Street/R35.

Table 5.16: Trip distribution (taken from Roberts, 2017)

Direction of Origin	Percentage (%) (AM/PM periods)	Route followed
From the south	51	R35
From the east	20	La Roca Boulevard
From the west	29	La Roca Boulevard
Total	**100**	

Roberts (2017) utilized the total passing traffic volumes (Table 5.15) and the estimated trip draw off rate (as a percentage; Table 5.17) to calculate the estimated number of trip draw off vehicles per 24 hours (Tables 5.18) in terms of visiting the proposed filling station.

Table 5.17: Trip draw off rate and Trip draw off vehicles per 24 hours (taken from Roberts, 2017)

Peak hours	In (%)	Out (%)	IN	OUT
From the south	4	4	348	354
From the east	2	2	91	91
From the west	3	3	201	201
Total			**640**	**646**

As per Table 5.17, the expected trip draw off in terms of the proposed filling station is 640 vehicles per day (intercepted per day).

5.16.3 Capacity analyses

Roberts (2017) calculated the existing and future traffic flows for the adjacent intersection (R35) for the AM and PM peak hours using the AutoJ software system. The detailed capacity analyses are provided in Annexure C of Appendix 12.

5.16.3.1 Samora Machel Street (R35) and La Roca Boulevard/Spring Street intersection

Based on the capacity analyses, Roberts (2017) indicated the following:

- The western and to some extent the eastern approaches are tending towards capacity in 2017.
- In future years, additional right turning lanes on the east-west approaches are expected to be required to meet the growing background traffic.

5.16.3.2 La Roca Boulevard and the proposed access intersection

Based on the capacity analyses, Roberts (2017) indicated the following:

- This access is currently restricted in that it operates as a left-in left-out, with a right-turn lane from the west. There is no right-out lane as it is restricted by the median in the centre of La Roca Boulevard.
- Traffic leaving the Retail shopping centre, west of the site, needs to travel some 230m to the Middelburg Mall, make a U-turn and travel back to the R35. This movement is wasted travel and undesirable although safe.
- Adding the proposed filling station to the equation further complicates the geometric layout.

- The capacity analysis showed that the delay on the north-south approaches is in the order of 5 seconds.

- Adding the filling station traffic, the worst case is the right-out delay being 11 seconds for a stop control situation.
- Changing the intersection to a roundabout (Figure 5.20) reduces this delay to 5 seconds. The thorough traffic expected delay alters from 5 to 6 seconds which is satisfactory.
- All approaches are expected to operate at satisfactory levels of service.

- In testing various alternatives, the roundabout layout (Figure 5.20) is desirable and preferable for the following reasons:
  - All turning movements can be safety accommodated.
  - Combining the Retail shopping centre and the proposed filling station access on the south side of La Roca Boulevard means all side road traffic is channelled in an orderly and safe manner before the roundabout.
  - Travel speeds are lowered improving safety.

Roberts (2017) indicated the following:
- The 2017 and 2019 traffic situations are NOT expected to be problematic.
- No road upgrading, except for the proposed roundabout access (Figure 5.20), is required for the with-site scenario.
- As is the case on the east side, the roundabout access proposal is expected to operate satisfactorily.

5.16.4 Access from Samora Machel Street (R35)

5.16.4.1 Left-in-only access road (Figure 4.2)
Kotze (2017) proposed that a left-in-only access road (Figure 4.2) from Samora Machel Street (R35) be constructed to the proposed filling station in order to intercept northbound traffic from the provincial road.

The left-in-only access road from Samora Machel Street (R35) was approved 'in principle' by SANRAL (letter dated: 21 October 2016; Appendix 10) subject to detailed design being submitted before construction.

5.16.4.2 Left-in left-out only access road
Roberts (2017) reviewed the site accesses to the proposed filling station as recommended by Kotze (2017) i.e. a left-in-only from Samora Machel (R35).

The left-in-only access from Samora Machel Street (R35) does not allow vehicles direct access to Samora Machel Street (R35). Customers leaving the site would only be able to exit via La Roca Boulevard. According to Roberts (2017), a left-in arrangement will again highlight the wasted additional 460m needed to return in the opposite direction towards the R35/Samora Machel Street (see Section 5.16.3.2).

Roberts (2017) thus proposed a left-in left-out access from Samora Machel Street (R35) (Figure 5.20). A barrier median on Samora Machel Street (R35) will however, be required to prevent right-in and right-out unsafe movements (Roberts, 2017).

5.16.5 Conclusion

The following conclusions were made by Roberts (2017) in terms of the traffic impact assessment:

- The local intersection associated with the proposed R35 filling station development is expected to operate at satisfactory levels of services and in a safe manner up to 2019 (see Annexure C of Appendix 12).
- No road upgrading is required by the developer except for a proposed roundabout in La Roca Boulevard (Figure 5.20).
- There are no road network concerns as this development's access can accommodate the short and long- term road layouts.
- The following road upgrades (Figure 5.20) are proposed in terms of access to the site:
  - A left-in left-out access from Samora Machel Street (R35) with associated barrier;
  - A new roundabout in La Roca Boulevard.
- Regarding pedestrians:
  - Pedestrian walkways: No paved sidewalks exist on the R35 as pedestrian walkways are not permitted along Class 2 Routes for safety reasons;
  - Pedestrian crossings: Exists at the Samora Machel/R35 intersection.
- Public transport: Since this is a filling station application, public transport is minimal and can be accommodated on site.

Roberts (2017) made the following recommendations:

- That the R35 Middelburg proposed filling station development and its associated land uses be approved from a Traffic and Transportation point of view with no road upgrades, no non-motorised transport and no public transport facilities being required.
- The site's two access points be approved in principle (as per Figures B and B1-1 of Appendix 12) for implementation.
- Permission from the Municipality must be obtained with regards to the left-in left-out access road from the R35 that extends across the Remainder of Portion 27 of Middelburg Town and Townlands 287 JS. (It should be noted that the proposed alignment of the R35 access does not affect the leased site).

Figure 5.20: Proposed access from Samora Machel Street (R35) and La Roca Boulevard (taken from Roberts, 2017)

5.17 Sense of place

The proposed filling station will be located on Portion 1 of Erf 10769, Middelburg X26. The said site is zoned for business purposes (Business 2) and forms part of the approved Middelburg X26.

According to Urban Dynamics (2017), the site is also located in a secondary node area (i.e. the Middelburg Mall node; Figure 5.21) as identified in the Steve Tshwete Spatial Development Framework (SDF, 2015). The primary purpose of a secondary node is to "play a support function to the CBD and to enhance access to convenience goods and services to all communities in town" (SDF, 2015).

There are only two other filling stations located within a 3 km radius of the site, namely the Midwater Centre Engen and the new Total filling station opposite the site (recently opened i.e. operational middle October 2017). According to Urban Dynamics (2017), the lack of competitor sites within the 3km radius clearly indicates that there is a need for an additional filling station in the area.

The high visibility of the site from Samora Machel Street (R35) and the Middelburg Mall access road (La Roca Boulevard) lends itself perfectly in terms of visibility for a filling station.

Traffic volumes in the area are expected to increase, since the SAE Business Park located east of the site is still expanding and future residential and commercial developments are proposed on the vacant land south and west of the site (Area 9-Aerorand South; Figure 5.21). The Steve Tshwete Local Municipality proposes to establish approximately 3650 erven in this area for middle and high income housing. A row of erven adjacent to Samora Machel Street (R35) will be earmarked for business uses (Figure 5.21).

A new hospital is currently being constructed to the south of the area.

In addition to the above-mentioned, the proposed filling station will be convenient (in terms of refuelling and purchasing items such as bread and milk) for employees working long hours at the Middelburg Mall. The development will also be convenient for visitors from surrounding towns to the Middelburg Mall as they would no longer have to travel past the Middelburg Mall into town to refuel.

Additional job opportunities would be provided, which could aid in the economic stability of a few families (Urban Dynamics, 2017).

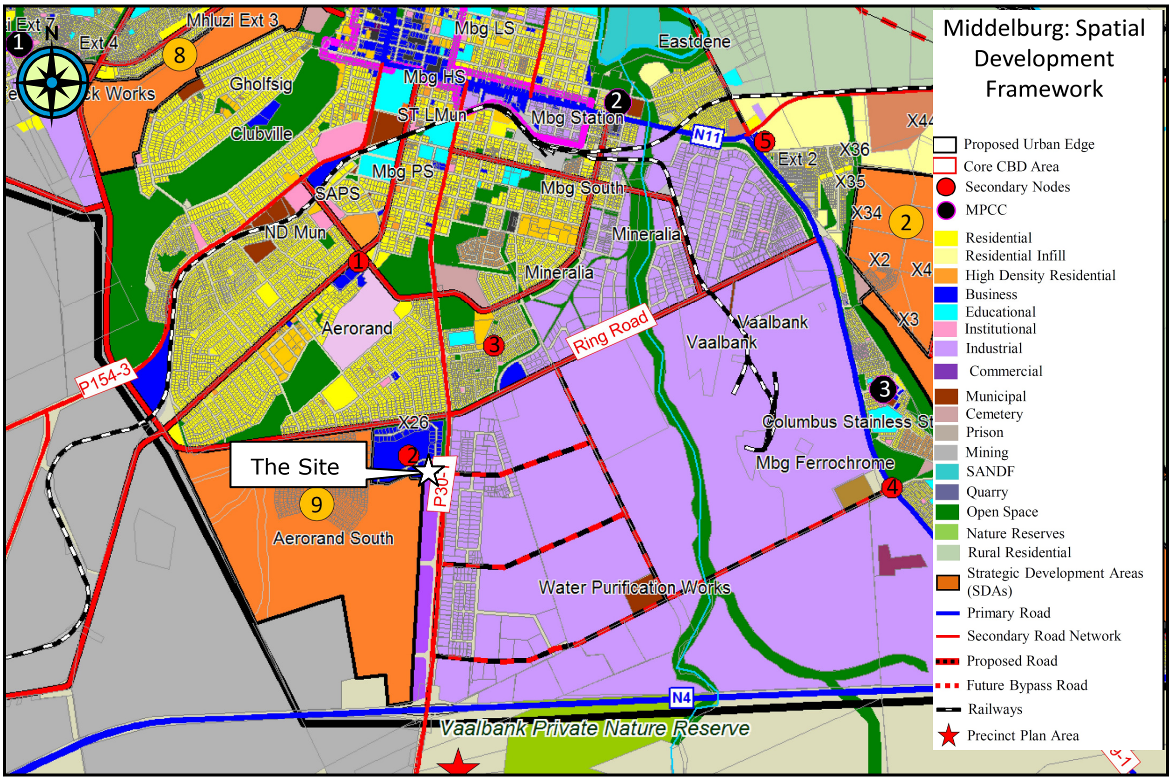

Figure 5.21: Steve Tshwete Spatial Development Framework (2015)