Parsons & Associates
specialist groundwater consultants cc
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Report

381/GBR-F1

Specialist Groundwater Study

Assessment of Potential Impacts from Proposed Filling Station on Portion 4 of Farm 135 Klipfontein (Erf 135) Great Brak River

report prepared for

Bruyncon Consulting and Construction (Pty) Ltd

Ref: 381/GBR ***January 2018***

tel (028) 273-8676 ***PO Box 151 Pringle Bay 7196*** ***fax (086) 604-8082***

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LIST OF DEFINITIONS

Aquifer: a geological unit that contains sufficient saturated permeable material to store and transmit water; and to yield economical quantities of water to boreholes or springs.

Borehole: includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer.

Electrical conductivity: is a measure of how well a material accommodates the transport of electric charge. The more salts dissolved in the water, the higher the EC value. It is used to estimate the amount of total dissolved salts, or the total amount of dissolved ions in the water.

Geohydrology: used interchangeably with hydrogeology.

Groundwater: water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.

Hydraulic conductivity: measure of the ease with which water will pass through the earth's material and defined as the rate of flow through a cross-section of one square metre under a unit hydraulic gradient at right angles to the direction of flow.

Hydraulic gradient: the slope of the water table or piezometric surface; is a ratio of the change of hydraulic head divided by the distances between the two points of measurement.

Hydrogeology: study of the properties, circulation and distribution of groundwater.

Minor aquifer system: These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying base flow for rivers.

Monitoring: comprises the collection, analysis and storage of data on a regular basis to provide information for effective groundwater management.

Porosity: ratio of the volume of void space to the total volume of the rock or earth material.

Primary aquifer: an aquifer in which water moves through the original interstices of the geological formation

Transmissivity: the rate at which a volume of water is transmitted through a unit width of aquifer under a unit hydraulic head (m2/d); product of the thickness and average hydraulic conductivity of an aquifer.

Unconfined aquifer: an aquifer with no confining layer between the water table and the ground surface where the water table is free to fluctuate.

DECLARATION OF INDEPENDENCE, QUALIFICATION AND EXPERIENCE

Project:	Great Brak River filling station
Applicant:	Micaren Exel Petroleum Wholesales (Pty) Ltd.
Client:	Bruyncon Consulting and Construction (Pty) Ltd
Environmental Consultant:	Cape EAPrac

DECLARATION OF INDEPENDENCE

I hereby declare that I have no financial or other interest in the undertaking of the proposed activity other than the imbursement of consultants fees.

QUALIFICATIONS AND EXPERIENCE

I have a Ph.D degree in Hydrogeology from the Institute for Groundwater Studies, University of the Free State and have practised as a Hydrogeologist since 1984. Prior to establishing Parsons & Associates Specialist Groundwater Consultants[cc] in 1996, I worked for the Department of Water Affairs: Directorate of Geohydrology (1984 – 1990) and the CSIR: Groundwater Programme (1990 – 1996). I am a registered Professional Natural Scientist (Reg. No. 400163/88), and regularly attend conferences, lectures and training courses to remain abreast of developments in my field.

Dr Roger Parsons
Ph.D. (U.F.S.) Pr.Sci.Nat.

1 INTRODUCTION

1.1 Problem Statement

It has been proposed that a filling station be established on Portion 4 of Farm 135 Klipfontein (Erf 135) Great Brak River (Figure 1). The property is owned by the Mossel Bay Municipality, but the proponent has secured a long-term lease from them with an option of buying the site in the future. Two positions for the facility are being considered – Alternative 1 and Alternative 2 (Figure 2) – but these are materially the same from a hydrogeological impact assessment perspective. The development will include a forecourt area, a convenience store and underground tanks capable of storing 184 KL of fuel.

The property is located in Long Street directly adjacent to the N2 national road (Figure 1). In addition to other potential impacts, filling stations have the potential to impact underlying groundwater systems. This generally occurs as a result of surface spills and / or leakage from underground storage tanks. Consequently, both the Department of Water and Sanitation (DWS) and Department of Environmental Affairs and Development Planning (DEADP) require potential impacts to aquifers to be assessed. Under the National Environmental Management Act (Act 107 of 1998) and the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended), development of filling stations is a listed activity and is subject to environmental authorisation. A basic assessment needs to be undertaken to inform the decision-making process.

To this end, Parsons & Associates Specialist Groundwater Consultants[cc] was appointed to undertake a hydrogeological assessment of the site and assess the potential impact to the groundwater regime. The hydrogeological study forms part of the Basic Assessment being undertaken by Cape Environmental Assessment Practitioners (Cape EAPrac) on behalf of Micaren Exel Petroleum Wholesales (Pty) Ltd.

1.2 Terms of Reference

In terms of the proposal of 12 January 2017 submitted to Cape EAPrac, Parsons & Associates was required to undertake the following activities as part of the groundwater investigation of Erf 135:

- Review hydrogeological conditions prevailing on site;
- Attend the digging of trail pits on site to review in situ material and collect groundwater samples;
- Submit the groundwater samples to a reputable laboratory for analysis;
- Assess the contamination status of the site and potential impact of establishing a filling station on the hydrogeological regime and the adjacent Brak River;
- Document the results of the groundwater investigation in a short report, including recommendations for further groundwater investigation of contamination – if required.

It was specifically noted no drilling would be undertaken during the assessment and that Parsons & Associates would not be required to attend any project or public meetings. The proposal was accepted on 23 March 2017 by Bruyncon Consulting and Construction (Pty) Ltd.

1.3 Methodology

It was not possible to attend the digging of the trial pits dug by Paton (2017). However, the information from the trial pitting was forward to us by Outeniqua Geotechnical Services. During the digging of the trial pits, Outeniqua Geotechnical Services specifically looked for signs of hydrocarbon contamination and collected water samples which they dispatched to our offices by courier.

This assessment was based on available hydrogeological information and an appreciation of the site. Available information included that of:

- Parsons and Veldtman (2006), who described and assessed the groundwater resources of the Outeniqua coastal area based on data stored in the National Groundwater Data Base (NGDB) and information presented in various geohydrological reports assessed by them.
- Published geological maps and geohydrological maps (Meyer, 1999) of the George area.
- Experienced gained while implementing an Emergency Borehole Project during 2009 and 2010 to supplement existing water supplies to Mossel Bay and George.
- The geotechnical investigation of the site by Paton (2017).

As Parsons & Veldtman (2006) indicated there were no geohydrological data stored in the NGDB for the area in the vicinity of the proposed filling station, a project-specific search of the NGDB was not undertaken. Further, no boreholes were identified in the vicinity of the proposed filling station.

2 DESCRIPTION OF AFFECTED ENVIRONMENT

2.1 Site Description

2.1.1 Physiography and Climate

The location of the proposed filling station is indicated in Figure 1. It is located some 40 m south-west of the bank of the Great Brak River in a broad flat floodplain. The site is at an elevation of only 8 mamsl.

The climate along the coast is temperate; with moderately hot summers and mild to chilly winters. Rain falls throughout the year, with slightly higher rainfall being recorded during spring and late summer. Precipitation is mostly generated from cold fronts approaching from the southwest and is orographically influenced. Average annual rainfall is in the order of 720 mm/a while mean annual potential evaporation amounts to 1 400 mm/a.

2.1.2 Drainage

The site is located in quaternary catchment K20A and falls within the Gouritz Water Management Area. The area around the site drains into the Great Brak River which flows into the Great Brak Estuary.

2.1.3 Vegetation

The study area falls within the Fynbos Biome, but most of the site has been transformed and bears little resemblance of the natural vegetation.

2.1.4 Geology

The site is underlain by alluvial sediments thought to be several meters thick. No rock was encountered in the trial pits dug to a depth of about 3 m by Paton (2017). The sediments are dominated to a depth of about 2.5 m by a light brown medium grained sand containing shells in places. In turn, these overlie dark grey medium grained sands which also contain shells in places. These unconsolidated sediments overlie the Uitenhage Group which is found to north and west of the site. Granite rocks of the Maalgaten Suite occur to the north and east. No significant geological structures are indicated on the geological map prepared by Coetzee (1979).

2.1.5 Aquifer Characteristics

Aquifers associated with alluvial deposits are intergranular in character, and owe their water-bearing abilities to the primary hydraulic properties of the unconsolidated sediments. The hydrogeological potential of the aquifer is driven by these properties and the thickness of the aquifer. While the alluvial deposits may have moderate to high groundwater hydraulic conductivities and storativities, the limited extent and thickness of the aquifer indicate it to be of limited importance, but it could be used at a local scale for garden irrigation. The use of the aquifer is further restricted by its proximity to the saline Great Brak River.

Paton (2017) measured depth to groundwater across the site to range between 2.2 m and 2.8 m below ground level, with the slight variation being a function of topographical changes. The hydraulic gradient of the aquifer is expected to be very flat (< 0.001) owing to the prevailing topography and proximity to the river. At a local scale groundwater is expected to flow towards the river i.e. in a north easterly direction.

The quality of the groundwater in the area is expected to be good to moderate. However the electrical conductivity (EC) of 170 mS/m measured in the groundwater samples from the trial pits probably reflects the tidal interaction between the surface and groundwater.

Based on the above, the local primary aquifer in the vicinity of the proposed site can be considered no more than a minor aquifer system of limited local importance. However, the aquifer system may have moderate to high vulnerability to anthropogenic impacts owing to the shallow depth to groundwater and the transmissive nature of the aquifer.

2.2 Potential Sources of Contamination

The site is located in a semi-rural area. Bitumen was previously stored on the site, but this posed little risk of contaminating the underlying aquifer. No visual or olfactory signs of contamination were observed during the digging of the trial pits (Paton, *per.comm.*, 2017). Besides potential contamination by leaking sewer pipes and the impact of garden irrigation and fertilization, no other obvious sources of contamination are apparent. The aquifer is expected to be in near-pristine condition.

2.3 Groundwater Use

No groundwater abstraction is expected within 500 m of the proposed sites. Great Brak River is supplied by a municipal water supply by the Mossel Bay Municipality. The Great Brak River police station is located directly west of the proposed site and marks the start of the Great Brak River residential erven. The river is located to the north and the N2 national road is located east and south of the site.

3 IMPACT DESCRIPTION AND ASSESSMENT

3.1 Sources of Risk

Two main sources of potential contamination occur at filling stations:

- Spillage of fuel at surface; and
- Leakage from underground storage tanks and pipes.

These sources of contamination are only relevant during the operational phase of the project, and are not applicable during construction. Occurrence of spillages can be controlled by careful operation and appropriate management of run-off from the platform. However, leakage from tanks and pipes below surface is not readily detected. Based on work by Barber et al. (1990), as many as 20% of subsurface storage systems in Perth, Australia had failed and resulted in groundwater contamination. Strict adherence to design, construction and operation specifications, however, can significantly reduce the risk of leakage and contamination. Monitoring groundwater quality downstream of underground storage tanks can also be used to identify leaks and facilitate timeous intervention.

Petroleum hydrocarbon compounds are the contaminants of concern. In addition to being light non-aquous phase liquids (LNAPL's) which float on the surface of water, these contaminants are readily mobile in the subsurface. Remediation and clean-up of significant leaks is both technically difficult and expensive.

3.2 Alternatives

Three alternatives are considered in this groundwater assessment, namely:

- No-go alternative i.e. the site is not developed as a filling station and its status remains unchanged;
- Alternative 1 – where the development is as described in Section 1.1 and the filling station is located is as presented in Figure 2; and
- Alternative 2 – the same as for Alternative 1 but in the position shown in Figure 2.

3.3 Impact Assessment

No impacts to the underlying aquifer system are expected during the construction of the proposed filling station (Table 1). Consequently, no mitigation actions are required. While not part of our brief, it is noted the impact of sediment-laden run-off from the construction site into the Great Brak River requires consideration.

Establishing a filling station at the proposed site could impact the underlying aquifer system if the underground storage tanks leak or if pipes and joins were to leak (Table 2). Leakage from underground storage tanks can go undetected for long periods of time, sometimes resulting in significant groundwater contamination in the near vicinity of the site. However, the absence of groundwater users in the vicinity of the filling station (and particularly downgradient of the site) and the likelihood of the resource never being develop for more than garden irrigation suggests groundwater users are not at risk if the proposed filling station were to be established. The minor classification of the aquifer supports this. Consequently the significance of any impact would be low, but with remediation the impact would be insignificant to groundwater users.

However, it is possible that undetected contamination from leaking underground storage tanks could impact the Great Brak River via contaminated groundwater discharging into the river – particularly during low tides (Table 3). Alternative 1 is located 130 m from the bank of the river and Alternative 2 is 165 m distant. This difference is not considered material as it would only result in a time delay in the impact reaching the river. The implication of impacting the Great Brak River is at least of medium significance, given the importance of the estuary and the pressure that it faces (Anchor Environmental Consultants, 2012). Appropriate design and construction will reduce the risk of this happening while groundwater monitoring will allow for timeous intervention (corrective action, remediation). With remediation the significance of contamination occurring would be reduced to low / insignificant.

Periodic spills of small quantities of fuel at surface also do not pose a significant risk to the underlying groundwater system or the river (Table 4 and 5). By capturing spilt fuel before it infiltrates into the subsurface and preventing it entering the stormwater systems removes the risk of contamination of both surface and groundwater systems. This would reduce the significance of the impact from low to insignificant.

3.3 Mitigation

Industry norms relating to the design, construction and maintenance of filling stations in general and underground storage tanks in particular should be adhered to. These are set out in the South African Bureau of Standards code SABS 089, SABS 1535 and SABS 1830. Of particular relevance is the recommendation regarding the regular testing of the underground tanks.

Further, regular groundwater monitoring by a qualified and competent practitioner should also be implemented. It is recommended at least one monitoring boreholes be established between the underground storage tanks and the Great Brak River, the exact position of which should be confirmed once the design of the filling station has been completed. The boreholes should be drilled to a depth of about 10 m and should be sampled every six months. The sampled groundwater should be analysed for total petroleum hydrocarbons (TPH), the BTEX compounds, polycyclic aromatic hydrocarbons (PAH), phenol and lead.

Table 1: Assessment of the impact of contaminating the underlying groundwater system during the construction phase.

Alternative	Nature of impact	Extent of impact	Duration of impact	Intensity	Probability of occurrence	Status of the impact	Degree of confidence	Level of significance	Significance after mitigation
No-Go (status quo)	Contamination of underlying aquifer during construction phase	na	na	na	na	na	Very high	None	na
Alternative 1		na	na	na	na	na	Very high	Low	Insignificant
Alternative 2		na	na	na	na	na	Very high	Low	Insignificant

Table 2: Assessment of the impact of contaminating the underlying groundwater system during the operational phase on groundwater users.

Alternative	Nature of impact	Extent of impact	Duration of impact	Intensity	Probability of occurrence	Status of the impact	Degree of confidence	Level of significance	Significance after mitigation
No-Go (status quo)	Contamination of underlying aquifer impacting groundwater users	na	na	na	na	na	Very high	None	na
Alternative 1		Site	Long term	High	Probable	Negative	Very high	Low	Insignificant
Alternative 2		Site	Long term	High	Probable	Negative	Very high	Low	Insignificant

Table 3: Assessment of the impact of contaminating the underlying groundwater system during the operational phase on the Great Brak River.

Alternative	**Nature of impact**	**Extent of impact**	**Duration of impact**	**Intensity**	**Probability of occurrence**	**Status of the impact**	**Degree of confidence**	**Level of significance**	**Significance after mitigation**
No-Go (status quo)	Contamination of underlying aquifer impacting the Great Brak River	na	na	na	na	na	Very high	None	na
Alternative 1		Site	Long term	High	Probable	Negative	Very high	Medium	Low / insignificant
Alternative 2		Site	Long term	High	Probable	Negative	Very high	Medium	Low / insignificant

Table 4: Assessment of the impact of spills contaminating the underlying groundwater system during the operational phase.

Alternative	**Nature of impact**	**Extent of impact**	**Duration of impact**	**Intensity**	**Probability of occurrence**	**Status of the impact**	**Degree of confidence**	**Level of significance**	**Significance after mitigation**
No-Go (status quo)	Impact of spills impacting groundwater	na	na	na	na	na	Very high	None	na
Alternative 1		Site	Long term	Medium	Probable	Negative	Very high	Low	Insignificant
Alternative 2		Site	Long term	Medium	Probable	Negative	Very high	Low	Insignificant

Table 5: Assessment of the impact of contaminating the underlying groundwater system during the operational phase on groundwater users.

Alternative	**Nature of impact**	**Extent of impact**	**Duration of impact**	**Intensity**	**Probability of occurrence**	**Status of the impact**	**Degree of confidence**	**Level of significance**	**Significance after mitigation**
No-Go (status quo)	Impact of spills impacting surface water	na	na	na	na	na	Very high	None	na
Alternative 1		Site	Long term	Medium	Probable	Negative	Very high	Low	Insignificant
Alternative 2		Site	Long term	Medium	Probable	Negative	Very high	Low	Insignificant

4 CONCLUSIONS AND RECOMMENDATIONS

Based on a study of available information and an appreciation of the site, the primary aquifer in the vicinity of the proposed filling station is no more than minor aquifer system of limited local importance. However the aquifer has a moderate to high vulnerability to anthropogenic impacts.

The site is considered suitable for development as filling station. Though the establishment of any filling station poses a risk, it is improbable that the proposed filling station poses a significant risk to the aquifer or any groundwater users. The aquifer has little potential to be developed and it is unlikely that there is any groundwater use within 500 m of the proposed filling station. There are no groundwater users downgradient of the site.

The greatest risk is posed to the Great Brak River located about 130 m north of the position of Alternative 1. The risk needs to be managed by appropriate design, construction and management of the facility and monitoring of groundwater to detect any migration of contamination from the site to the river, if it were to occur.

Based on the above, it is motivated that permission for the proposed development should be granted subject to the implementation of:

- Environmentally acceptable industry design, construction and operation norms for filling stations; and
- Implementation of regular pressure testing and six monthly monitoring of groundwater.

Should any sign of groundwater contamination be detected, the relevant authorities are to be notified and appropriate remedial action implemented.

Dr Roger Parsons
Ph.D. (U.F.S.) Pr.Sci.Nat.

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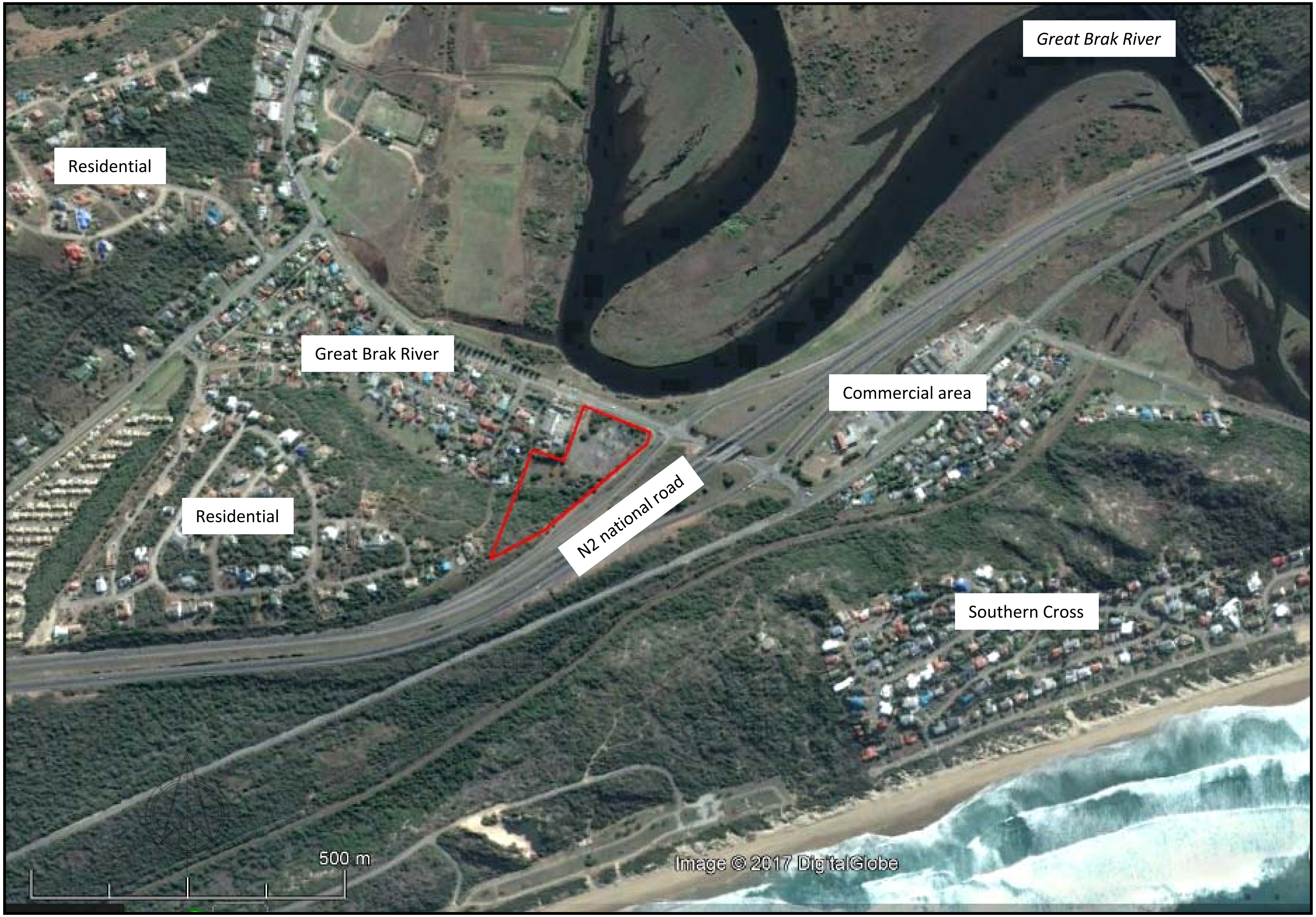

Figure 1: Position of Portion 4 of Farm 135 Klipfontein (Erf 135) Great Brak River in relation to the village of Great Brak River and the N2 national road.

Figure 2: Position of the two alternative locations of the proposed filling station on Portion 4 of Farm 135 Klipfontein (Erf 135) Great Brak River

4. THE SPECIALIST

Note: *Duplicate this section where there is more than one specialist.*

I ..DR ROGER PARSONS......, *as the appointed Specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I :*

- *in terms of the general requirement to be independent:*
  - *other than fair remuneration for work performed in terms of this application, have no business, financial, personal or other interest in the development proposal or application and that there are no circumstances that may compromise my objectivity; or*
  - *am not independent, but another specialist (the "Review Specialist") that meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);*
- *in terms of the remainder of the general requirements for a specialist, have throughout this EIA process met all of the requirements;*
- *have disclosed to the applicant, the EAP, the Review EAP (if applicable), the Department and I&APs all material information that has or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application; and*
- *am aware that a false declaration is an offence in terms of Regulation 48 of the EIA Regulations, 2014 (as amended).*

Signature of the Specialist:	[signature]
Name of Company:	PARSONS & ASSOCIATES SPECIALIST GROUNDWATER CONSULTANTS CC
Date: 6 / 3 / 2019	