GCS-RP/34/2021: GEOHYDROLOGICAL STUDY REPORT FOR THE PIENAARSRIVIER FILLING STATION, PIENAARSRIVIER, LIMPOPO PROVINCE.

Report Prepared for ACCURATE TRADING 47 (PTY) LTD

GCS

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Carel de Beer

Executive Summary

ACCURATE TRADING 47 (PTY) LTD, contracted Geotechnical Consult Services (GCS) to conduct a geohydrological investigation for a new filling station on ERF 425 (6 895m²) and ERF 426 (7 972m²) Pienaarsrivier, with a combined total coverage of 1.4 hectares, Limpopo Province.

This investigation form part of the Environmental Impact Assessment (EIA) Process (Basic Assessment) for the proposed BP filling station and shopping complex planned on the site.

The area is underlain by a dolerite sill. Locally the site is underlain by reworked residual dolerite grading into weathered and fresh dolerite at depth. The total thickness of the dolerite sill in the area can be up to 120m.

The water sample were analysed based on the SANS 241 constituents for future correlation the hydrocarbon content were also analysed based on accepted test protocols. The background concentration of gasoline range aromatics (C6 to C10) is less than 10 µg/L. The total petroleum hydrocarbons (C10-C28) concentration in the water sample is 382 µg/L as is the concentration of the petroleum hydrocarbons (C28-C40) concentration.

Potable water is supplied by the municipality an no groundwater from the borehole on site will be used. The facility will also be linked to the municipal sewerage system. No groundwater will be abstracted from the property and the borehole on site is equipped as a monitoring borehole only.

The groundwater management plan, consisting of stormwater management and an oil trap will collect the runoff from the forecourt areas.

No significant impacts on groundwater resources and water users are expected if the underground fuel storage tank installations are constructed to specification.

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LIST OF ABBREVIATIONS/ACRONYMS

Abbreviations/ Acronyms	Descriptions
%	Percent
ºC	Degrees Celsius (Assumed dry bulb unless indicated otherwise)
FOS	Factor of Safety
earth quake	Seismic event induced by tectonism
km	kilometre
kPa	kilopascals
ℓ	Litres
ℓ/m^3	Litres per cubic metre
ℓ/s	Litres per second
m	metres
mamsl	metres above mean sea level
m/s	metres per second (velocity)
m^2	Square metres
m^3	Cubic metres
m^3/s	Cubic metres per second
MCE	Maximum Credible Earthquake
SPT	Standard Penetration Test
tremor	Mining induced seismicity
UCS	Uniaxial Compressive Strength

1. INTRODUCTION

1.1. TERMS OF REFERENCE

ACCURATE TRADING 47 (PTY) LTD, contracted Geotechnical Consult Services (GCS) to conduct a geohydrological investigation for a new filling station on ERF 425 (6 895m²) and ERF 426 (7 972m²) Pienaarsrivier, with a combined total coverage of 1.4 hectares, Limpopo Province.

This investigation form part of the Environmental Impact Assessment (EIA) Process (Basic Assessment) for the proposed BP filling station and shopping complex planned on the site.

1.2. SCOPE OF WORK

The scope of work for this project as per Proposal no: GCS/PR/034/2021 for a basic assessment:

- Desktop assessment of local and regional geohydrology
- Determine the local groundwater level
- Collect a groundwater sample
- Install a monitoring borehole on site
- Define the background groundwater quality
- Propose a groundwater management plan

1.3. LIMITATIONS

The information provided in this specialist report is based on information provided by the client and or the client's representatives, published scientific literature, maps, and information published in the public domain and that collected by Geotechnical Consult Services during the site visits between July and October 2021

1.4. AUTHOR'S CREDENTIALS AND &DECLARATION OF INDEPENDENCE

The Author of this report Carel J de Beer is a professional engineering geologist, registered with the South African Council of Natural and Scientific Professions (Pri. Sci. Nat # 400211/05). Carel has 20 years' experience in the mining and civil industries and is a member if the South African institute of Rock Engineers.

The compilation of the report, and any other work done by Geotechnical Consult Services (GCS) for the Client Company, is strictly in return for professional fees. Payment for the work is not in any way dependent neither on the outcome of the work, nor on the success or otherwise of the Company's own business dealings. As such there is no conflict of interest in GCS undertaking the study as contained in this document.

Figure 1: Locality Map – Pienaarsrivier Filling Station

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2. SITE INFORMATION

2.1. LOCATION AND LAND USE

The site is located to the west of the N1and east of the R101, on the southern side of the D626 road opposite the Pienaarsrivier Primary School at the town of Pienaarsrivier in the Limpopo Province at the approximate co-ordinates; 25°12'21.28"S 28°18'0.23"E. Refer to Figure 1

Current there are no infrastructure or buildings on the site. The new infrastructure will consist of truck stop area, filling station and forecourt, a convenience store as well as a small shopping complex. Underground and above ground fuel storage will be installed on site.

2.2. CLIMATE

The prevailing climate in Bela-Bela is known as a local steppe climate. The average annual temperature is 19.6 °C. With an average of 23.5 °C, February is the warmest month. July is the coldest month, with temperatures averaging 13.0 °C.

The average annual rainfall is 636 mm. The driest month is July with 3 mm of precipitation. The heaviest rainfall is in December, averaging 127 mm, with 15.3 rainy days during the month.

The month with the highest relative humidity is January (61.30 %). The month with the lowest relative humidity is September (33.37 %).

2.3. TOPOGRAPHY AND DRAINAGE

The site is located on a valley floor land facet with slight slope to the southeast. The average elevation is 1049mams.

The site is located at the southwestern extent of the Springbok Flats. The Springbok Flats is an extensive plain situated in Limpopo, South Africa. The southern boundary is the Pienaars River which intersects the N1 main road between Pretoria and Polokwane. To the west it includes the towns of Bela-Bela, Modimolle, Mookgophong and Mokopane. Towards the east it includes the towns Roedtan, Crecy, Marolong, Nutfield, Tuinplaas and Settlers. The 80 km wide and 130 km long swath of land is orientated in a northeasterly direction and is centered on Roedtan.

The site is located within the A23C Quaternary catchment drained by the Pienaars Revier and is part of the Crocodile River catchment. The site is located on the western slope of a local perennial drainage. Refer to Figure 2 for the location of the site relative to the drainage network.

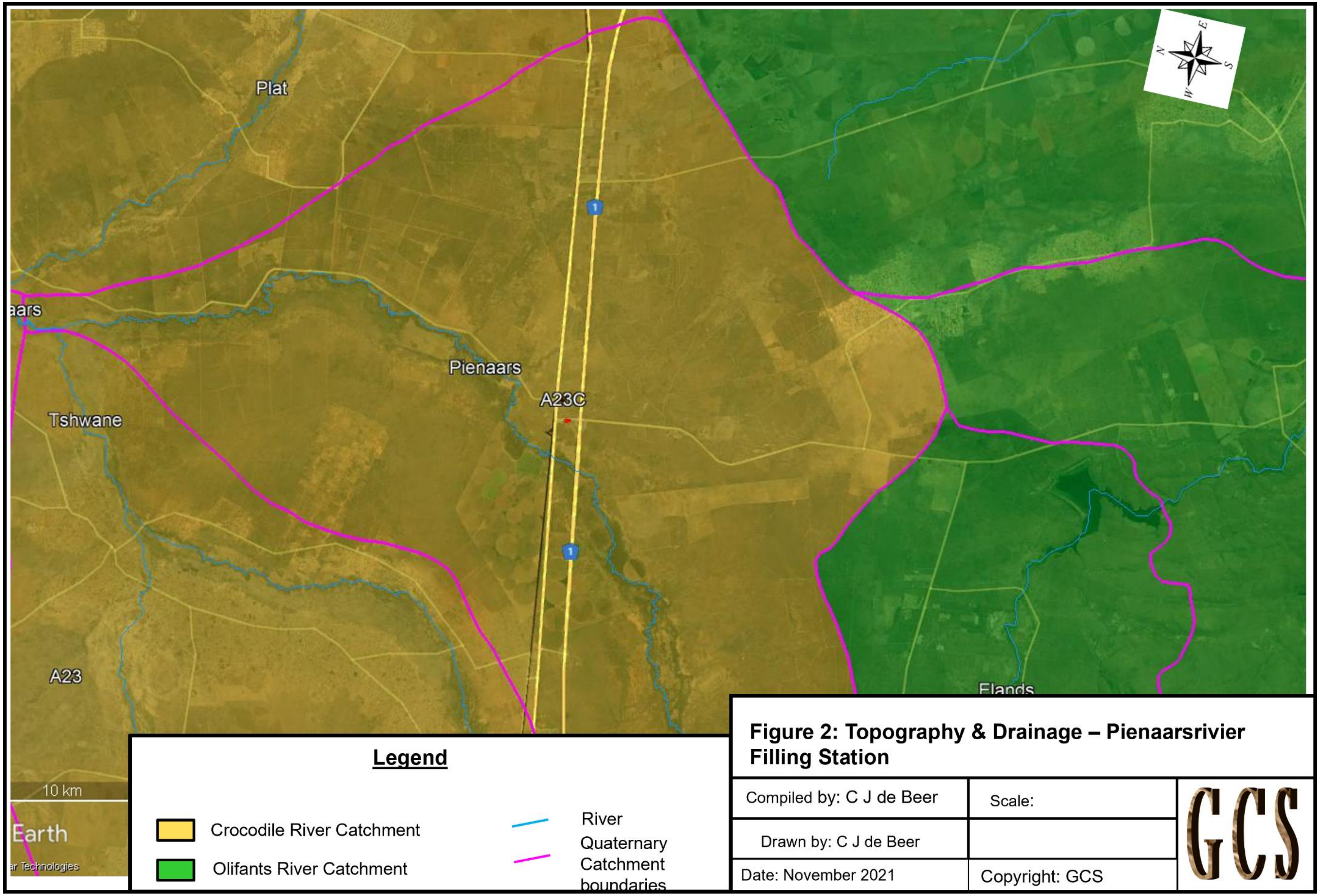

Figure 2: Topography & Drainage – Pienaarsrivier Filling Station

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2.4. REGIONAL GEOLOGY

A comprehensive exploration program commenced in 1976to define the geology of the Springbok Flats and was completed in 1982. During the exploration program 3 000 boreholes were drilled. These borehole data was re-interpreted in conjunction with downhole geophysical surveys in order to create a sedimentological database suitable for the reconstruction of palaeo-environments of the Karoo-aged strata in the Springbok Flats Karoo Basin (SFKB). Structurally the SFKB comprises two elongated basins i.e. Roedtan Basin (north) and Settlers-Tuinplaats Basin (south). These two basins are bordered by pre-Karoo aged tectonic features i.e. Thabazimbi-Murchison lineament (northern boundary of the Roedtan Basin) and the Droogekloof Fault Zone (northern boundary of the Settlers-Tuinplaats Basin). These tectonic features were continuously active after the deposition of the Karoo strata in the SFKB resulting that the existing SFKB is considered to be a preserved Karoo-aged basin. Stratigraphically the SFKB was subdivided into 7 distinctive lithostratigraphic units. Lithostratigraphic Unit 1 comprises glacier derived sediments and is correlated with the Dwyka Group of the Main Karoo Basin. Lithostratigraphic Unit 2 is a mega upward coarsening cycle resembling a deltaic deposit. This deltaic deposit is overlain by a cyclothem consisting of Lithostratigraphic Units 3 and 4 respectively. Lithostratigraphic Unit 3 is a composite coal zone. Based on selected seam horizons a coal zone resource of 3492 mt was demarcated. In areas adjacent to palaeotopographical highs uranium is associated with the coal zone and a resource of 363.0 mt with an average grade of 0.40 kg/t U_3O_8 was calculated. A prominent regionally developed disconformity marks the commencement of Lithostratigraphic Unit 5. A continuum of fluvial environments including alluvial fans, braided rivers, meandering river systems and anastomosed river systems was postulated as depositional environments for Lithostratigraphic Unit 5. A lithostratigraphic unit, comprising basal calcrete conglomerates followed by intensely bioturbated siltstone and a lesser bioturbated sandstone respectively, constitutes Lithostratigraphic Unit 6. The texture and sedimentary structures of Lithostratigraphic Unit 7 which overlies Lithostratigraphic Unit 6 is compatible with a typical aeolian deposit. The termination of the Karoo-aged strata in the SFKB is marked by the presence of amygdaloidal basaltic lavas. Dolerite dyke and sill intrusions occur in the area. The Pienaarsrivier dolerite sill is in the order of 150m thick.

2.5. GEOHYDROLOGY

The site is located within the A26C Quaternary (Figure 2), and 1425m northwest of the Pienaars River and falls within the Crocodile West and Marico Water Management Area.

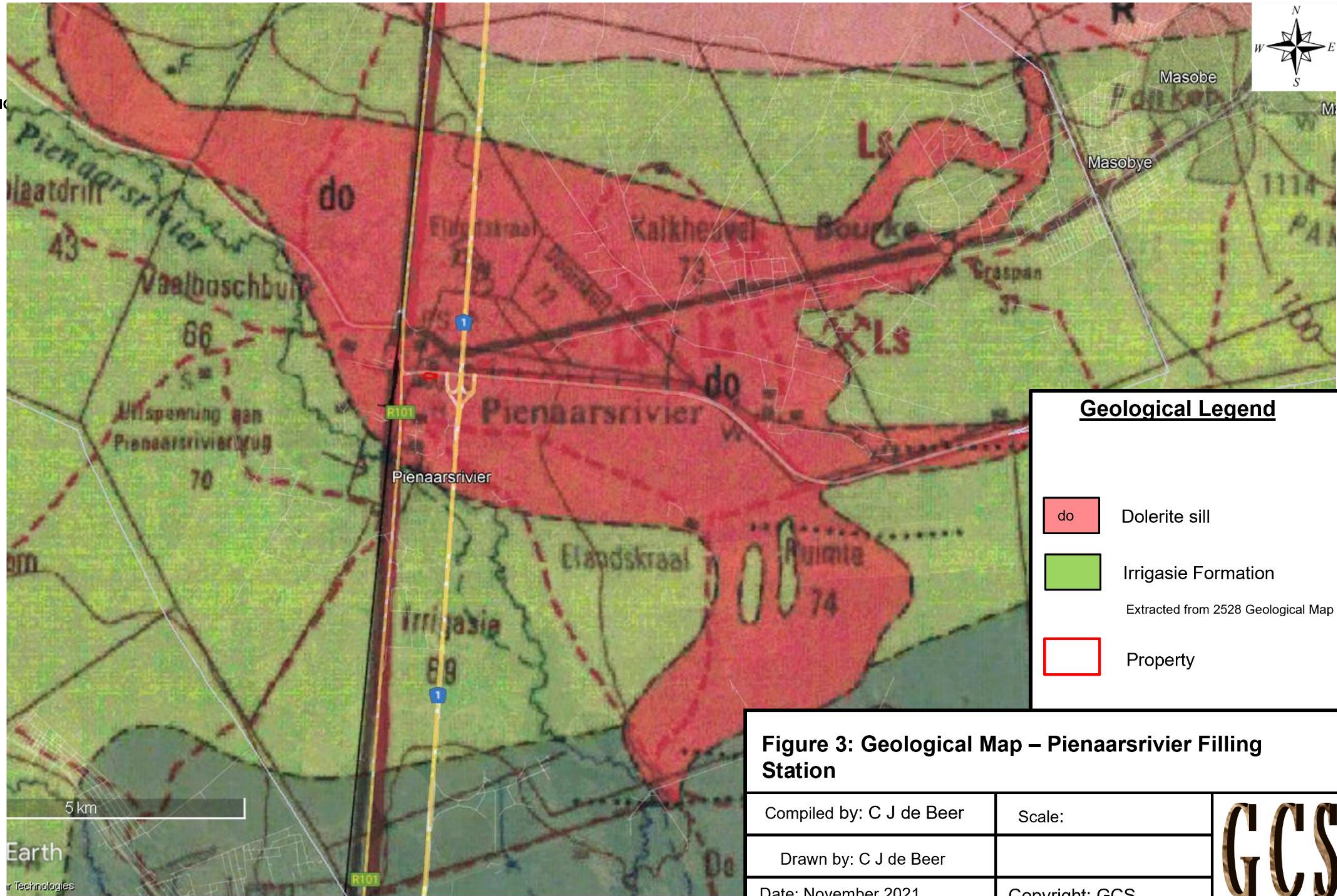

Figure 3: Geological Map – Pienaarsrivier Filling Station

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3. DATA COLLECTION

3.1. DESKTOP STUDY

During the desktop study all the available information was collected and used to compile field maps and design the field investigation. A field map was compiled for the fieldwork stage from Google Earth images, site plans, and the 1:250 000 (2528 Warmbad) Geological Map.

Groundwater and quaternary information were collected from the national groundwater database and the Chart program of the Department of Water affairs.

3.2. FIELDWORK

After a preliminary site visit in July a borehole position was determined based on the proposed layout and the expected groundwater flow in the area. It was decided to position the borehole between the forecourt area and the Pienaar's River.

PHOTO 1: DRILLING OF MONITORING BOREHOLE

Torque Africa Drilling was contracted to drill a water monitoring borehole at the selected position and to equip it as a long-term monitoring borehole. The drilling was conducted on 17 September 2021. The borehole was drilled 132mm and a casing installed to 24m after an initial water strike at 17mthe upper 16m of the casing were solid and the bottom two 4m lengths were perforated. Attempting to continue drilling the borehole deeper to the planned depth of 30m, no sample return was achieved due to the difference between the diameter of the percussion hammer and the inside diameter of the casing was less than 10mm. this resulted in the drill chips wedging the hammer. Due to the risk of losing the drilling equipment in the hole. It was decided to terminate the hole at 24m below surface. A gravel pack was also installed around the casing and a concrete plinth was installed, see photo 2.

PHOTO 2: CONCRET PLINTH AND LOCKABLE CAP INSTALLED ON BOREHOLE

The driller flushed the borehole for 1 hour and then it was left to settle for seven days before the water sample was collected using a bailer on 25 September 2021 (Photo 3)

The water sample was delivered to Set point Analytical laboratories for analysis.

PHOTO 3: WATER SAMPLE COLLECTED

Before the water sample were collected the static water level in the borehole were measured at 4.57m below the collar

3.3. LABORATORY TESTING

The water sample was tested at Set Point Laboratories, in Isando, a SANSAS registered laboratory, according to SANS 241 specification.

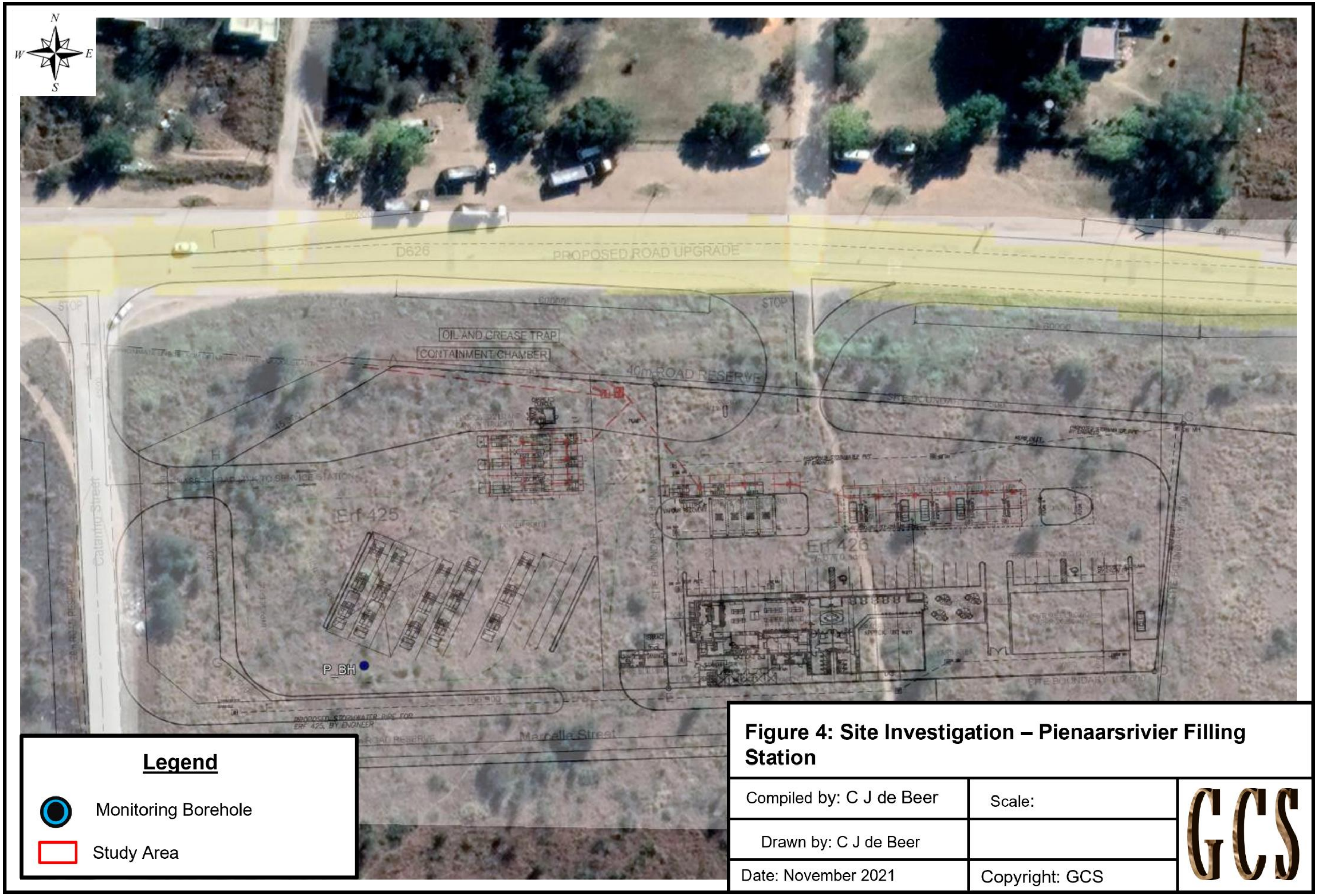

Figure 4: Site Investigation – Pienaarsrivier Filling Station

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3.4. AVAILABLE WATER ON SITE

Potable water is supplied by the municipality. No abstraction is planned from the borehole.

Toilets and wastewater systems of the proposed project will be linked to the municipal wastewater treatment system.

A water trap and run-off collector will be installed where all the runoff from the forecourt and the truck stop will be collected and treated.

4. SITE INVESTIGATION RESULTS

4.1. PERCUSSION DRILLING RESULTS

The soil profile encountered in the monitoring borehole correlated well with the soil profiles and drilling done during the geotechnical investigation:

The profile consists of up to 2m thick reworked residual dolerite, overlying a 8m thick zone with highly weathered weak rock dolerite. From 10m the staining on fractures in the dolerite indicated that the weathering grade increased to moderately weathered strong rock. A weak groundwater intersection was encountered at 17m on the contact with competent bedrock no other water strikes were encountered to 24m where the borehole was terminated.

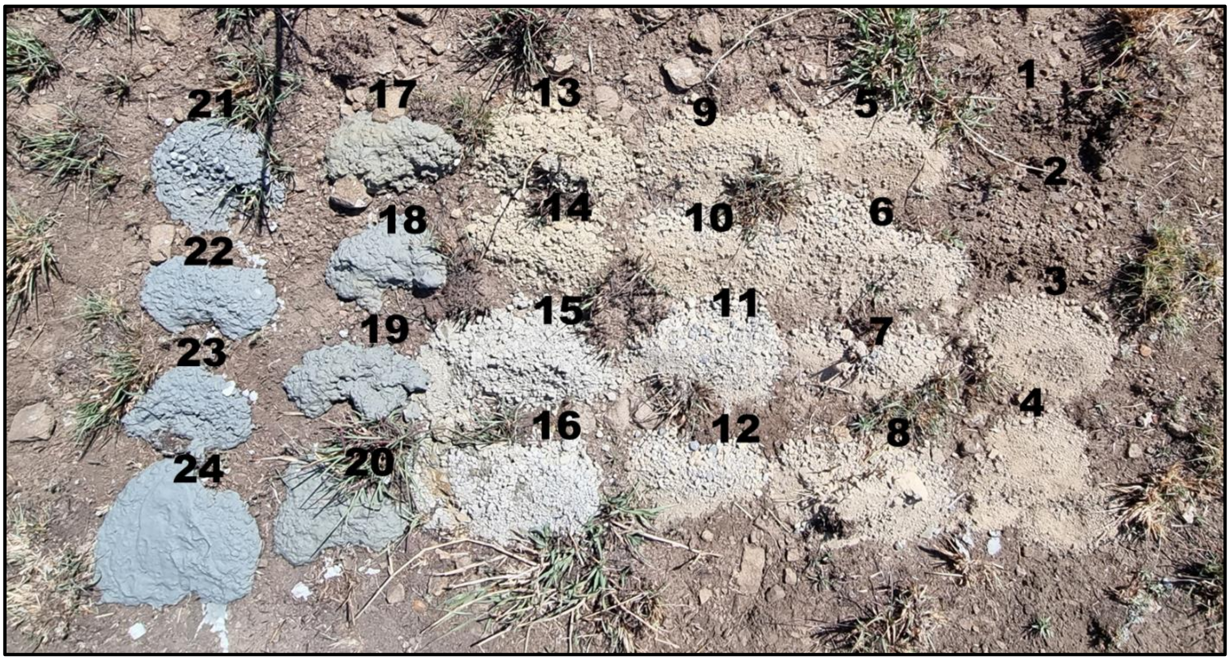


PHOTO 4: MONITORING BOREHOLE PROFILE.

Refer to Appendix A for the percussion borehole log.

4.2. RESULTS OF THE LABORATORY TESTING

The laboratory analysis of the water sample collected from the monitoring borehole is presented in the section below.

4.3. Ground Water Quality

The laboratory test results are presented in Appendix B and are summarized below in Table 1.

The SANS 241-2015 standard was used to assess the water quality as this standard suite of tests covers all the major constituents. Because the proposed land use will be a filling station the hydrocarbon analysis was included as well.

Thed baseline water quality analysis is presented in table 1 below.

TABLE 1: SUMMARY OF GROUNDWATER CHEMISTRY TEST RESULTS

Determinant	Method no	Unit of measurement	SANS 241:2015 Standard – Operational limit	Pienaar's River monitoring Borehole sample – background water quality
Microbiological Parameters				
E.Coli	#	MPN/100mL	0	0
Total Coliforms	#	MPN/100mL	≤10	>200
Chemical properties and parameters				
pH	M460	value @ 25^{0}C	5.0-9.7	7.71
Conductivity	M461	mS/m @ 25^{0}C	<170	133
Total Dissolved Solids	#	mg/L	<1000	833
Turbidity	#	NTU	<1	222
Colour		Hazen Units	<20	1
Ammonia Nitrogen	M464	mg/L N	≤1.5	1.22
Nitrate & Nitrate Nitrogen	M467	mg/L N	≤11	<0.10
Chloride	M469	mg/L Cl^{-}	≤300	43.5
Fluoride	M475	mg/L F^{-}	≤1.5	1.52
Sulphate	M476	mg/L $SO4^{=}$	≤500	76.9
Calcium	M474	µg /L Ca	<150	51.8
Magnesium		mg/L Mg	<70	66.9
Potassium		mg/L K	<50	10.8
Sodium		mg/L Na	<200	74.4
Zinc		mg/L Zn	<5.0	<0.06
Aluminium	M474	mg/L Al	<300	<0.15
Antimony		mg/L Sb	<10	<0.73
Arsenic		mg/L As	<10	<0.53
Cadmium		mg/L Cd	<5	<0.10
Total Chromium		mg/L Cr	<100	14.5
Cobalt		µg /L Co	<500	0.70
Copper		µg /L Cu	<1000	<1.00
Iron		mg/L Fe	<200	<0.99
Lead		µg /L Pb	<20	<1.00
Manganese		mg/L Mn	<400	345
Mercury		mg/L Hg	<1	<0.50
Nickel		mg/L Ni	<20	7.69
Selenium		mg/L Se	<20	<2.00
Vanadium		µg /L V	<200	3.79
Uranium		µg/L U	<200	3.79
Gasoline range organics (C6-C10		µg/L		<10

Determinant	Method no	Unit of measurement	SANS 241:2015 Standard – Operational limit	Pienaar's River monitoring Borehole sample – background water quality
Total petroleum hydrocarbons (C10-C28)		µg/L		<382
Total petroleum hydrocarbons (C28-C40)		µg/L		<382

Hydrocarbons

Spills and leaks of petroleum products are relatively common. This is not surprising in view of their extensive and widespread storage, transportation and use. Exposure to the constituents of petroleum products through drinking-water can be of short- or long-term duration. However, exposure is frequently the result of an accidental spill or short-term incident, in which the main issue for drinking-water is short-term exposure. Such incidents may lead to high concentrations of total petroleum hydrocarbons (TPH), in which case the probability of unacceptable taste and odour being detected by consumers will be significantly increased.

Low concentration spills and leakages from example underground storage facilities is more difficult to detect by odour and chemical analysis is therefore required.

It is not practical to analyse for all possible petroleum hydrocarbons in water, since it would be prohibitively costly to quantify each individual compound using current analytical technology. Because specific data are unavailable for many of the individual components of petroleum hydrocarbons, fractions were characterized from the available data in the literature by the Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG, 1998a). This Working Group based its fractions on physicochemical properties and also on data from partitioning models. It was important that when delineating the fractions, the fractions were consistent with available analytical techniques. Hydrocarbon mixtures separate and partition based on these properties. There will be differences in both mobility and the level of adsorption, resulting in separation of the mixture. However, it was considered reasonable to assume that chemicals of a similar nature (e.g., aliphatic or aromatic) and boiling point would behave similarly. The TPHCWG specified the delineation of the different fractions on the basis on an order-of-magnitude differentiation in these simple partitioning properties. In general terms, alkanes have relatively low acute toxicity, but alkanes having carbon numbers in the range of EC5–EC12 have narcotic properties, particularly following inhalation exposure to high concentrations. Repeated exposure to high concentrations of n-hexane may lead to irreversible effects on the nervous system. Alkenes exhibit little toxicity other than weak anaesthetic properties. Most of the smaller aromatic compounds are of relatively low toxicity except for benzene, which is a known human carcinogen.

The fact that petroleum products are complex mixtures of hundreds of individual hydrocarbons is a complicating factor in determining their toxicity in the event of contamination of water. This means that the traditional approach of evaluating individual components is largely inappropriate. In order to overcome this difficulty, it is more practical to consider a series of hydrocarbon fractions and to determine appropriate tolerable concentrations for those fractions. Of the 250 individual compounds identified in petroleum by the TPHCWG, toxicity data were available only for 95. Of these 95, the TPHCWG concluded that there were sufficient data to develop toxicity criteria for only 25.

The approach used by the TPHCWG to make the problem more manageable was to divide TPH into a series of fractions based on the number of carbon atoms in conjunction with general structure. The toxicity data available on fraction-specific mixtures cover the aromatic fractions (>EC6–EC8, as described above) and the aliphatic fractions of TPH. Data on mixtures containing the higher-molecular-weight substances, >EC8–EC16 and >EC16–EC35 aromatic fractions, refer only to the EC8– EC11 range. There are no toxicity data on the highest-molecular-weight compounds, >EC35. However, compounds above EC20 are neither volatile nor soluble in water. In addition, compounds >EC35 are not likely to be absorbed by the oral or dermal routes of exposure >EC5–EC6 and >EC6–EC8 aromatic fraction These two fractions consist of one compound each, which are benzene and toluene, respectively. Benzene is a known human carcinogen following occupational exposure, although toluene is of lower toxicity. Drinking-water guidelines have been established for both substances and toluene has a very low reported odour threshold in water.

>EC8–EC10, >EC10–EC12 and >EC12–EC16 aromatic fraction

Within this carbon range, a number of individual compounds have been identified, but oral RfDs or drinking-water guidelines have been developed for only a limited number. These are ethylbenzene (EC8.5), xylenes (EC8.6–8.81), naphthalene (EC11.69), isopropylbenzene (EC9.13), acenaphthene (EC15.5) and biphenyl (EC14.26). The TPHCWG concluded that there were no additional studies on individual compounds that could be used to develop additional RfDs. However, oral data are available on a mixture within this EC number range consisting of naphthalene/methylnaphthalenes (EC11.69–13.87).

An RfD of 0.03 mg/kg of body weight per day was determined from the oral toxicity study on the naphthalene/methylnaphthalenes mixture, and this is broadly similar to, or lower than, RfDs and guidelines for other substances in this group. The only exception is 2-methylnaphthalene, which is found at concentrations of up to 1.5% by weight in some jet fuel and diesel. An RfD of 0.005 mg/kg of body weight (rounded value) was determined in 2003

(US EPA, 2005). This was based on a benchmark dose calculated from pulmonary proteinosis observed in mice given 2-methylnaphthalene in the diet for 81 weeks, with an uncertainty factor of 1000 applied to the benchmark dose of 4.7 mg/kg of body weight per day. Deriving a group RfD using this value would be excessively conservative. However, methylnaphthalenes would not be the major contributor to this group of compounds in the case of a spill reaching water, and they also appear to have very low taste and odour thresholds in water.

>EC16–EC21 and >EC21–EC35 aromatic fraction

There are a small number of RfDs for chemicals in this EC range. These include fluorene (EC16.55), anthracene (EC19.43), fluoranthene (EC21.85) and pyrene (EC20.8). The RfD for pyrene was considered by the Working Group as a suitable conservative surrogate. The RfD of 0.03 mg/kg of body weight per day for pyrene (US EPA, 2005) is similar to the RfDs for fluorene, anthracene and fluoranthene and is, therefore, suitable to represent the fraction-specific RfD for the EC17+ carbon range. This is certainly conservative, since the higher-molecular-weight compounds are normally considered to be less toxic and more poorly absorbed. A number of these compounds are also considered to be PAHs, which are also considered as a separate group below.

Considering the explanation above, it is very difficult to define a threshold toxicity for the different groups based purely on the concentrations found in water. The concentrations of the C6-C10, C10 to C28 and the C28 to C40 concentrations measured and defined in table 1 should be regarded as the baseline concentrations for hydrocarbon pollution for the site.

The concentration of gasoline range aromatics (C6 to C10) is less than 10 μg/L. Total petroleum hydrocarbons (C10-C28) concentration in the water sample is 382 μg/L as is the concentration of the petroleum hydrocarbons (C28-C40) concentration.

5. GROUNDWATER EVALUATION

5.1. GROUNDWATER LEVEL

The local perched water table associated with the bedrock contact occur ed at 17m. the phreatic surface that develop in the borehole indicated a static water level of 4.57m below the collar of the monitoring borehole.

5.2. FLOODING RISK

The site is well outside the 1:100 year flood limit of the Pienaarsrivier.

5.3. PERMEABILITY AND POLLUTION TRANSPORT

From the geotechnical investigation and site visit, the overburden is approximately 2 m thick. The permeability of the vadoze zone is low as calculated using Hazen's formula (between 4.5 $x10^{-5}$ and $1.06x10^{-3}$ cm/s). The dolerite bedrock is generally massive with and jointing and discontinuities tend to be discontinuous.

All possible care has to be taken to contain all spillages and the prescribed geosynthetic liners have to be installed below the underground tanks to prevent pollution of the soil and ultimately the groundwater.

Regular monitoring of the water quality in the inspection well should be conducted.

5.4. GEOHYDROLOGICAL RISKS

All due actions have been taken in the design and construction of the filling station. There is storm water control and run off collection facilities installed for the current facilities. The proposed underground storage tank will be within the same footprint. Therefore, the likelihood for contamination of the groundwater will be low. The impact will also be low because there are no other primary groundwater users down-gradient of the proposed filling station.

No significant impacts on groundwater resources and water users are expected if the underground fuel storage tank installations are constructed to specification.

5.5. GROUNDWATER MANAGEMENT PLAN

All the water collected from the forecourt areas will be collected in a stormwater drainage network and collected in an oil trap where the sludge and contaminated water can be collected and disposed of off-site and the clean water be discharged (after testing) to the municipal drainage network or recirculated for use on site. The stormwater runoff system and oil trap will be designed by the appointed engineer. The sludge and contaminated water will be collected and transported by an accredited waste removal contractor and disposed of through a waste disposal facility that is registered to handle hydrocarbon waste.

All relevant requirements to prevent, monitor and correct fuel spillage as set out in SANS 10089-3 should be adhered to as a minimum requirement.

It is recommended that the water quality of in the monitoring borehole be monitored on a yearly basis for hydrocarbon pollution. The water in the inspection well should also be monitored visually on a monthly basis and a sample collected and tested if pollution is suspected. Water samples must be collected every six months from the inspection pit and annually from the monitoring borehole and sent for hydrocarbon analysis.

The geotechnical and geohydrological conditions on site is suitable for the planned construction of the proposed filling station as well as the l underground and above ground fuel storage facilities. All requirements regarding the installation of the underground fuel storage facilities, should however, be adhered to.

6. RECOMMENDATIONS

To follow on this assessment, it is recommended that the following be adopted:

- The groundwater management plan, consisting of cut off drains to divert clean water around the site, and a system of drains that collect the runoff from the forecourt and the truck stop area, be designed and constructed to allow the run-off water to be collected. This water should be tested and treated (if required) to the required applicable standard for stormwater discharge before it is discharged into the drainage system.
- Contaminated water and solid waste should be removed from site by an accredited waste management contractor and disposed of at a waste storage facility registered to handle hydrocarbon waste.

7. CONCLUSIONS

- The area is underlain by a dolerite sill.
- Locally the site is underlain by reworked residual dolerite grading into weathered and fresh dolerite at depth. The total thickness of the dolerite sill in the area can be up to 120m.
- The concentration of gasoline range aromatics (C6 to C10) is less than 10 µg/L. The total petroleum hydrocarbons (C10-C28) concentration in the water sample is 382 µg/L as is the concentration of the petroleum hydrocarbons (C28-C40) concentration.
- Potable water is supplied by the municipality an no groundwater from the borehole on site will be used.
- The facility will also be linked to the municipal sewerage system
- No groundwater will be abstracted from the property.
- The borehole on site is equipped as a monitoring borehole only.
- The groundwater management plan, consisting of cut off drains to divert clean water around the site and a system of drains that collect the runoff from the forecourt and the car wash area is in place.
- **No significant impacts on groundwater resources and water users are expected if the underground fuel storage tank installations are constructed to specification.**

8. REFERENCES AND BIBLIOGRAPHY

9.1. BRINK, A.B.A.,1983. “Engineering Geology of Southern Africa Volume 1”, Building Publications, Pretoria.

9.2. BRINK, A.B.A., PARTRIDGE, T.C., WILLIAMS, A.A.B., 1982. “Soil Survey for Engineering”, Oxford University Press, New York.

9.3. JENNINGS, J.E., BRINK, A.B.A., WILLIAMS, A.A.B., 1973. “Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa”, The Civil Engineer in South Africa, January 1973.

9.4. NATIONAL HOME BUILDERS REGISTRATION COUNCIL (NHBRC) (1995) “Standards and Guidelines” First Issue 1995.

9.5. VAN DER MERWE, D.H., 1964. “The Prediction of Heave from the Plasticity Index and Percentage Clay Fractions of Soils”, The Civil Engineer in South Africa, June 1964.

9.6. WEINERT, H.H., 1980. “The Natural Road Construction Materials of Southern Africa”, Academica, Cape Town.

9.7. WILLIAMS, A.A.B., PIDGEON, J.T. and DAY, P.W., 1985. “Problem Soils in South Africa – State of the Art: Expansive Soils”, The Civil Engineer in South Africa, July 1985

9. APPENDIX A – PERCUSSION LOG

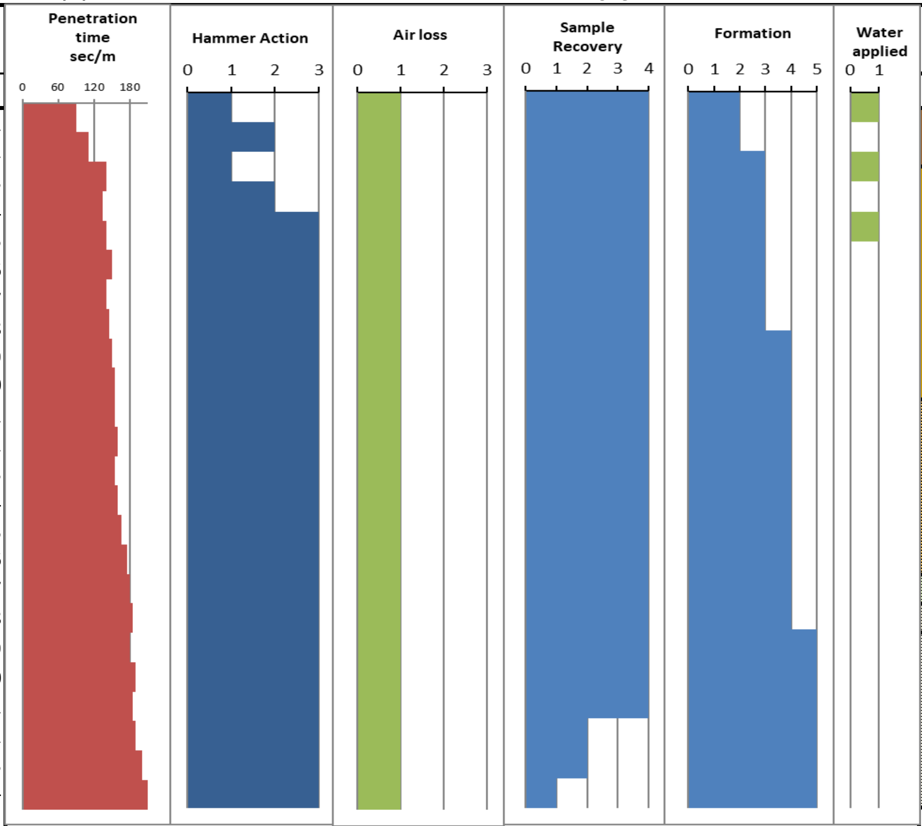
PERCUSSION BOREHOLE LOG

BOREHOLE : P_BH

Client	**Tekplan**	Total Depth	**34**	Diameter	165mm
Location	**Clayville Filling Station**	Air Pressure	**18 bar**		
Date	**5/5/2021**	Water Strike	**None**		

Lat: -25.205689°
Long: 28.28919°
ELEVATION: 1049m

Depth (m) From	TO
0	1
1	2
2	3
3	4
4	5
5	6
6	7
7	8
8	9
9	10
10	11
11	12
12	13
13	14
14	15
15	16
16	17
17	18
18	19
19	20
20	21
21	22
22	23
23	24



Geological Discription

Profile	From	To	
	0	2	Dry, medium brown, gravelly silty clay, REWORKED RESIDUAL DOLERITE
	2	10	Dry, yellow brown, very weak to weak rock, fractured, COMPLETELY TO HIGHLY WEATHERED DOLERITE
	10	16	Dry, pale yellow brown, weak rock, fractured, HIGHLY to MODERATELY WEATHERED DOLERITE
	16	17	Wet, pale grey-green, medium strong rock, fractured, MODERATELY WEATHERED DOLERITE
	17	18	Wet, pale grey, medium strong rock, fractured, MODERATELY WEATHERED DOLERITE
	18	24	Wet, pale grey, strong rock, fractured, MODERATE to SLIGHTLY WEATHERED DOLERITE

Hammer Action	Air loss	Sample Recovery	Water applied	
1=Very irregular 2=Irregular 3=regular	1=None 2=Slight 3=Medium 4=total	4=Good 3=Medium 2=Poor 1=None	0=No 1=Yes	Comment: 1 minor break at 17m <0.1l/s

10. APPENDIX B –LABORATORY TEST RESULT

SETPOINT LABORATORIES

For Attention:	Carel de Beer	**Report number:**	WAT/22/0420
Customer:	Geotechnical Consult Services	**Report issue date:**	2021/10/15
Postal address:	11 Jakkals Rd, Van Riebeeck Park	**Date completed:**	2021/10/15
Tel number:	0828716675	**Order No:**	Paid
Fax Number:			

Water Analysis Report

Sample name			**South African National Drinking Water Standard (SANS 241:2015) Recommended operational limit**	**PIENAARSREVIER FILLING STATION**			
Sample date and time				2021/10/04			
Sample container description				Plastic Container			
Submission date				2021/10/08			
Sample type				Water			
Set Point ID				WAT/22/0420-0001			
Visual Inspection				N/A			
Method no	**Determinand**	**Unit**					
Microbiological Parameters							
#	E.Coli	MPN/100mL	0	0			
#	Total Coliforms	MPN/100mL	≤ 10	> 200.5			
Chemical Properties and Parameters							
M464	Ammonia Nitrogen	mg/L N	≤ 1.5	1.22			
M469	Chloride	mg/L	≤ 300	43.5			
#	Colour	Hazen Units	≤ 15	1.00			
M461	Conductivity	mS/m @ 25°C	≤ 170	133			
M475	Fluoride	mg/L	≤ 1.5	1.52			
M467	Nitrate & Nitrite Nitrogen	mg/L N	≤ 11	<0.10			
M460	pH	-	≥5.0 to ≤9.7	7.71			
M476	Sulphate	mg/L	≤ 500	67.9			
M473	Total Dissolved Solids	mg/L @ 180°C	≤ 1200	833			
#	Turbidity	NTU	≤ 1.0	222			
M474	Aluminium (Al)	mg/L	≤ 0.3	<0.15			
M474	Antimony (Sb)	µg/L	≤20	0.73			
M474	Arsenic (As)	µg/L	≤10	0.53			
M474	Barium (Ba)	µg/L	≤700	57.5			
M474	Boron (B)	mg/L	≤2.4	<0.35			
M474	Cadmium (Cd)	µg/L	≤3	<0.10			
M474	Calcium (Ca)	mg/L	<150	51.8			
M474	Chromium (Cr)	µg/L	≤50	14.5			
M474	Cobalt (Co)	µg/L	-	0.70			
M474	Copper (Cu)	µg/L	≤2000	<1.00			
M474	Iron (Fe)	mg/L	≤2	0.99			
M474	Lead (Pb)	µg/L	≤10	<1.00			
M474	Magnesium (Mg)	mg/L	≤ 70	66.9			
M474	Manganese (Mn)	µg/L	≤400	345			
M474	Mercury (Hg)	µg/L	≤6	<0.50			

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Directors: T Matheolane, T.M.E Pitsi, N.N. Robinson
Company Secretary: Y.M. Dembskey

M474	Nickel (Ni)	µg/L	≤70	7.69			
M474	Potassium (K)	mg/L	≤ 50	10.8			
M474	Selenium (Se)	µg/L	≤40	<2.00			
M474	Sodium (Na)	mg/L	≤200	74.7			
M474	Uranium (U)	µg/L	≤30	0.24			
M474	Vanadium (V)	µg/L	-	3.79			
M474	Zinc (Zn)	mg/L	≤ 5	<0.06			
#	Gasoline Range Organics C6-C10	µg/L	-	<10.0			
#	Total Petroleum Hydrocarbons C10-C28	µg/L	-	<382			
#	Total Petroleum Hydrocarbons C28-C40	µg/L	-	<382			

Please Note: **N/A: Not applicable** **RTF : Result to follow**

 # Non SANAS accredited methods.

Results only relate to the samples tested and are reported on an "as received" basis, unless otherwise specified.

This report may not be reproduced, except in full, without the written approval of Set Point Laboratories;

Results are subject to uncertainty of measurement, which are indicated on the enclosed information sheet.

While every effort is made to provide analysis of the highest accuracy, the liability of Set Point Laboratories is restricted to the cost of the analysis.

 # Comment:

Please refer to the recommended limits of the South African National Drinking Water Standard (SANS 241:2015) in the green column.

Nthudzeni Mabidi
(Report Compiler)

Moses Lelaka
Technical Signatory

 # Tests marked "Non SANAS Accredited methods", as well as any comments, opinions or interpretations expressed in this report are not included in the SANAS Schedule of Accreditation for this laboratory.

SETPOINT LABORATORIES

INFORMATION SHEET TO ANALYSIS REPORT

Methods used, tests subcontracted and accredited ranges:

DETERMINAND	Method code	Accredited	Ave. Uncertainty	Technique	Limit of Detection	Analytical range
pH	M460 / M860	Yes	1.3%	Electro-metric	0.3	4-10
Conductivity	M461 / M861	Yes	6.2%	Electro-metric	1 mS/m	1-1000 mS/m
Alkalinity	M463 / M863	Yes	4.2%	Titration	10mg/L CaCO3	10 - 1000 mg/L CaCO3
Ammonia Nitrogen	M464	Yes	13.1% < 2.6 mg/L >2.4%	Automated Photometric	0.1 mg/L NH3-N	0.1 - 77.6 mg/L NH3-N
Ammonia Nitrogen	M864	Yes	1.8%	Automated Photometric	0.1 mg/L NH3-N	0.1 - 2.0 mg/L NH3-N
Nitrate Nitrogen	M465 / M865	Yes	Calculated from M467 and M466 or M867and M866	Automated Photometric	0.1mg/L NO3-	Calculated from M467 and M466 / M867and M866
Nitrite Nitrogen	M466 / M866	Yes	11.8%	Automated Photometric	0.1 mg/L NO2-N	0 - 2 mg/L NO2-N
Nitrate and Nitrite Nitrogen	M467 / M867	Yes	12.5%	Automated Photometric	0.1 mg/L NO3+NO2-N	0.1 - 10 mg/L NO3+NO2-N
Ortho Phosphate	M468 / M868	Yes	7.2%	Automated Photometric	0.1 mg/L o-PO4-P	0.1 - 5 mg/L o-PO4-P
Chloride	M469 / M869	Yes	4.9%	Automated Photometric	3 mg/L Cl	3 - 50 mg/LCl
Fluoride	M475 / M875	Yes	6.4%	Automated Photometric	0.1 mg/L F	0.1 - 2 mg/L F
Sulphate	M476 / M876	Yes	6.6%	Automated Photometric	3 mg/L SO4	3 - 100 mg/L SO4
Hexavalent Chromium	M471 / M871	Yes	3.0%	Automated Photometric	0.005 mg/L Cr6+	0.005 - 0.2 mg/LCr6+
COD	M462 / M862	Yes	1.3%	Closed reflux/colourmetric	10mg/L O2	10-1500mg/L O2
Total Suspended Solids	M472 / M872	Yes	6.4%	Gravimetric	10mg/L TSS	10-1500mg/L TSS
Total Dissolved Solids	M473 / M873	Yes	1.5%	Gravimetric	10mg/L TDS	10-1500mg/L TDS
Al	M474 / M874	Yes	3.30%	ICP-OES	0.15 mg/L	0.15 - 15 mg/L
Ag	M474	Yes	0.32 ug/L	ICP-MS	0.50 ug/L	0.50 - 50 ug/L
As	M474 / M874	Yes	3.70%	ICP-OES	0.10 mg/L	0.10 - 15 mg/L
As	M474	Yes	0.33 ug/L	ICP-MS	0.50 ug/L	0.50 - 50 ug/L
B	M474 / M874	Yes	4.40%	ICP-OES	0.35 mg/L	0.35 - 15 mg/L

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Directors: T Matheolane, T.M.E Pitsi.

Ba	M474 / M874	Yes	3.50%	ICP-OES	0.01 mg/L	0.01 - 15 mg/L
Ba	M474	Yes	0.30 ug/L	ICP-MS	0.30 ug/L	0.30 - 100 ug/L
Be	M474 / M874	Yes	4.90%	ICP-OES	0.02 mg/L	0.02 - 15 mg/L
Be	M474	Yes	0.37 ug/L	ICP-MS	0.10 ug/L	0.10 - 50 ug/L
Ca	M474 / M874	Yes	2.70%	ICP-OES	0.50 mg/L	0.50 - 15 mg/L
Cd	M474 / M874	Yes	4.50%	ICP-OES	0.02 mg/L	0.02 - 15 mg/L
Cd	M474	Yes	0.36 ug/L	ICP-MS	0.10 ug/L	0.10 - 50 ug/L
Co	M474 / M874	Yes	3.00%	ICP-OES	0.02 mg/L	0.02 - 15 mg/L
Co	M474	Yes	0.36 ug/L	ICP-MS	0.20 ug/L	0.20 - 50 ug/L
Cr	M474 / M874	Yes	3.00%	ICP-OES	0.05 mg/L	0.05 - 15 mg/L
Cr	M474	Yes	0.36 ug/L	ICP-MS	3.0 ug/L	3 - 100 ug/L
Cu	M474 / M874	Yes	3.10%	ICP-OES	0.10 mg/L	0.10 - 15 mg/L
Cu	M474	Yes	0.36 ug/L	ICP-MS	1.0 ug/L	1 - 100 ug/L
Fe	M474 / M874	Yes	3.20%	ICP-OES	0.10 mg/L	0.10 - 15 mg/L
Hg	M474	Yes	0.04 ug/L	ICP-MS	0.50 ug/L	0.50 - 5 ug/L
K	M474 / M874	Yes	4.20%	ICP-OES	0.04 mg/L	0.04 - 15 mg/L
Mg	M474 / M874	Yes	2.90%	ICP-OES	0.05 mg/L	0.05 - 15 mg/L
Mn	M474 / M874	Yes	3.80%	ICP-OES	0.02 mg/L	0.02 - 15 mg/L
Mn	M474	Yes	0.40 ug/L	ICP-MS	0.25 ug/L	0.25 - 50 ug/L
Mo	M474 / M874	Yes	3.20%	ICP-OES	0.02 mg/L	0.02 - 15 mg/L
Mo	M474	Yes	0.36 ug/L	ICP-MS	1.0 ug/L	1.0 - 50 ug/L
Na	M474 / M874	Yes	7.70%	ICP-OES	0.20 mg/L	0.20 - 15 mg/L
Ni	M474 / M874	Yes	3.00%	ICP-OES	0.02 mg/L	0.02 - 15 mg/L
Ni	M474	Yes	0.33 ug/L	ICP-MS	1.0 ug/L	1.0 - 100 ug/L
Pb	M474 / M874	Yes	3.00%	ICP-OES	0.05 mg/L	0.05 - 15 mg/L
Pb	M474	Yes	0.37 ug/L	ICP-MS	1.0 ug/L	1.0 - 100 ug/L
Si	M474 / M874	Yes	6.80%	ICP-OES	0.25 mg/L	0.25 - 15 mg/L
Sb	M474	Yes	0.35 ug/L	ICP-MS	0.50 ug/L	0.50 - 50 ug/L
Se	M474	Yes	0.35 ug/L	ICP-MS	2.0 ug/L	2.0 - 50 ug/L
Sn	M474	Yes	0.41 ug/L	ICP-MS	0.20 ug/L	0.20 - 50 ug/L
Sr	M474 / M874	Yes	5.60%	ICP-OES	0.01 mg/L	0.01 - 15 mg/L
Sr	M474	Yes	0.32 ug/L	ICP-MS	0.50 ug/L	0.50 - 50 ug/L
Th	M474	Yes	0.35 ug/L	ICP-MS	0.20 ug/L	0.20 - 50 ug/L
Tl	M474	Yes	0.29 ug/L	ICP-MS	0.10 ug/L	0.10 - 50 ug/L
U	M474	Yes	0.30 ug/L	ICP-MS	0.20 ug/L	0.20 - 50 ug/L
V	M474 / M874	Yes	2.90%	ICP-OES	0.10 mg/L	0.10 -15 mg/L
V	M474	Yes	0.36 ug/L	ICP-MS	0.20 ug/L	0.20 - 50 ug/L
Zn	M474 / M874	Yes	4.90%	ICP-OES	0.06 mg/L	0.06 - 15 mg/L

Note: All other tests or elements reported are not accredited unless specified otherwise.

Record: Analysis report information sheet, revision status: 2020-02-28

Compiled and approved by: T Horsfield