Department of Public Works

HYDROGEOLOGICAL EVALUATION FOR THE PROPOSED ADDITIONS AND ALTERATIONS TO THE SAPS TRAINING FACILITY AT VERDRAG, THABAZIMBI, LIMPOPO PROVINCE

HYDROGEOLOGICAL ASSESSMENT

February 2012

WSM LESHIKA CONSULTING (PTY) LTD

Department of Public Works

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WH11122 GW VERDRAG SAPS TRAINING FACILITY

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1. INTRODUCTION

This report gives the results of a Hydrogeological study conducted regarding the ground water resources and assesses the envisaged impact of the existing and proposed development on these resources and makes recommendations to mitigate these impacts.

The hydrogeological conditions pertaining to the area and potential impacts accessed are based on the field census conducted, existing borehole information and the experience of **WSM Leshika (Pty) Ltd** in the area.

2. TERMS OF REFERENCE

The proposal submitted by WSM Leshika (Pty) Ltd was approved by the Interdesign Landscape Architects whom instructed us to proceed with the investigation.

3. SCOPE OF WORK

WSM Leshika was tasked with providing:

- A list of existing available borehole information
- Evaluation of ground water resources and water quality
- Evaluation of the impact the existing and proposed development will have on the ground water resources
- Give recommendations to mitigate these impacts

4. SITE LOCALITY AND DESCRIPTION

4.1 Location

The site is situated approximately 35 kilometres directly east of Thabazimbi along the Thabazimbi Alma Road. The area consists of the farms Buffelskloof 452 KQ, Groenfontein 458 KQ and Buffelspoort 459KQ located in the Thabazimbi Municipal area, Limpopo Province, see figure 1. The land is owned by the Department of Public Works.

4.2 Climate

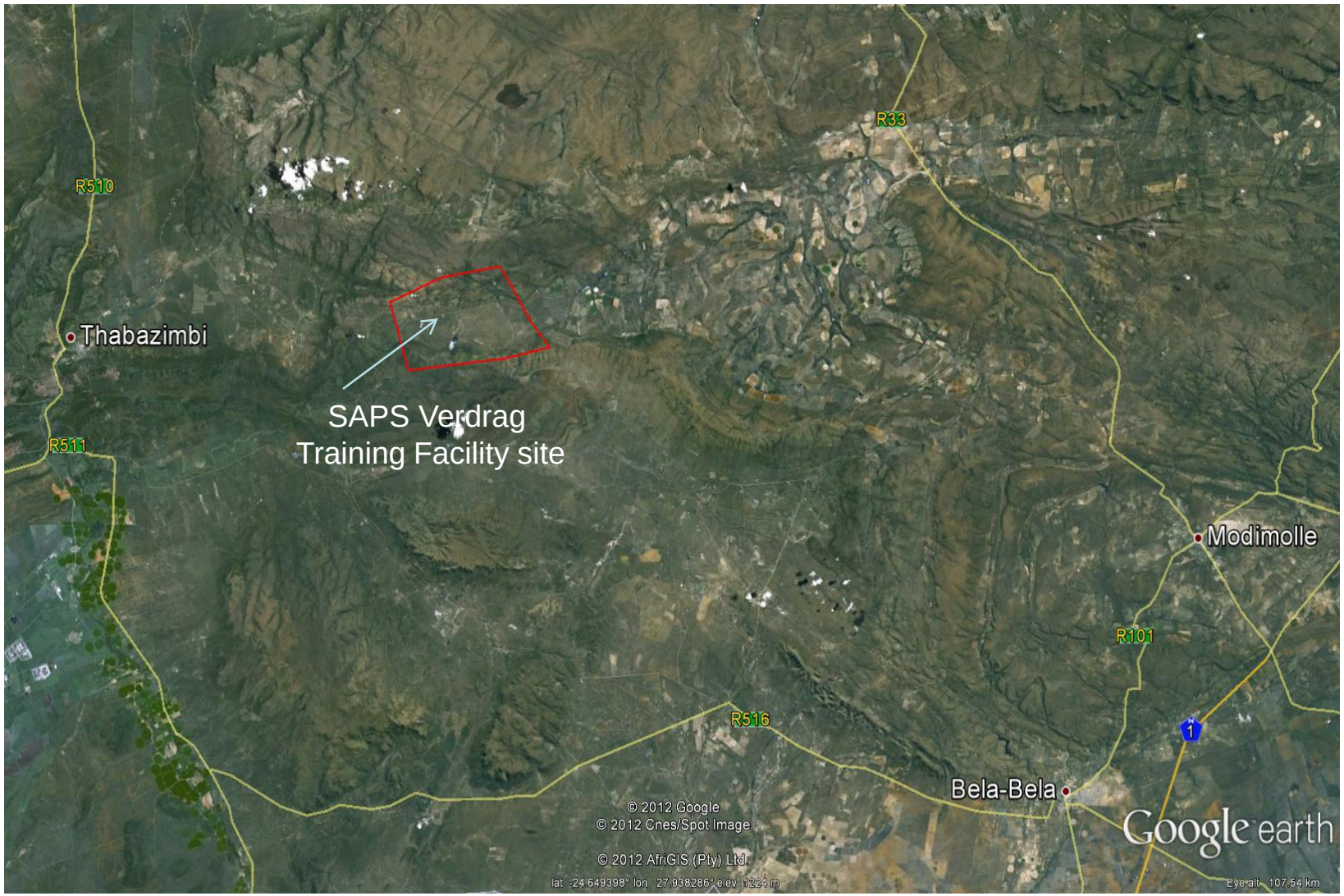
Climate is hot with day temperature ranging between $20^0 – 35^0$ in the summer months. Winters are mild to warm with day temperatures averaging around $5^0 – 25^0$. Mean annual precipitation (MAP) is 645 mm with 80% of rainfall occurring between November and March. Mean annual S-pan evaporation (MAE) is approximately 1 700 mm for the area.(WR 2005, DWA).

4.3 Physiography and drainage

The site is located mainly in the A 24 G quaternary catchment with a small portion in the upper A 24 H catchment and covers the middle upper reaches of tributaries of the Sand River, which eventually drains into the Crocodile River. The area can be described as hilly along the southern slopes of the Sandrivierberge in the north with a flattish central valley and a line of ridges forming the southern boundary. The relief varies between 1 800 metres above mean sea level (m.am.s.l.) along the Sandrivierberge in the north to about 1080 m.a.m.s.l. on the western boundary where a tributary of the Sand river exits the property.

4.4 Soils and vegetation

Cover consists of shallow, moderately sandy soils (with minor clays) that are only developed in the valley depressions. Rock sub-outcrop occurs along the slopes and on



WSM LESHIKA CONSULTING (PTY) LTD	Site locality map	Figure 1

the elevated plateaus. Ferricrete was observed at the eastern oxidation ponds (see photo below) overlying completely weathered sandstone.

Photo 1: Soil profile at eastern oxidation ponds

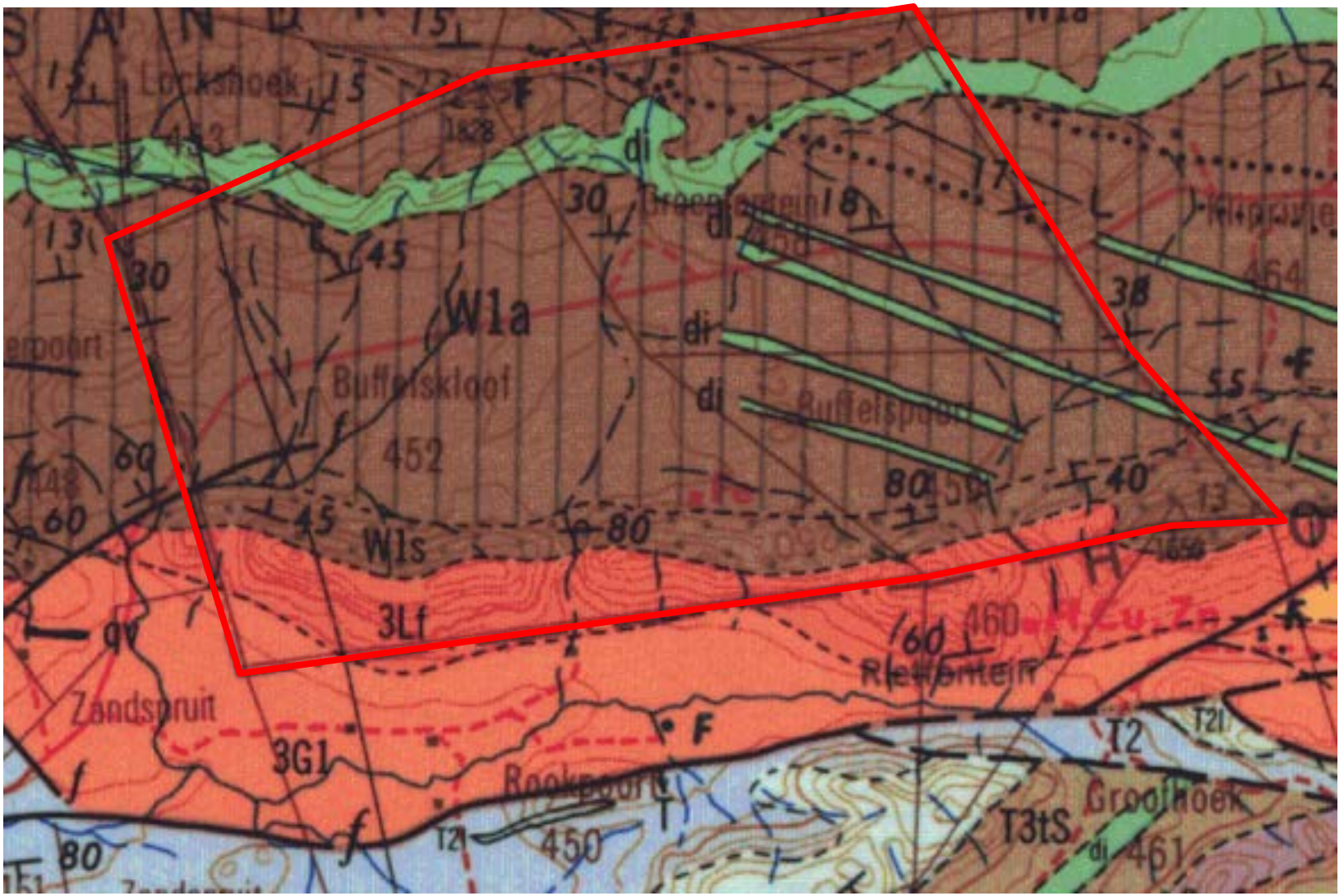
Vegetation consists of Sourish Mixed Bushveld

5. GEOLOGY

The 1: 250 000 geological map 2426 Thabazimbi indicates that the site is underlain mainly by rocks of the Alma formation (W1a) of the Nylstroom subgroup of the Waterberg Group. These rocks consist of siltstones, sandstones, conglomerates, feldspathic grouwak and arkose.

The ridges on the southern boundary consist of Felsite (3Lf) with granite (3G1) and dolomite (T2) occurring further south.

Numerous Diabase (di) sills and dykes have intruded into the Waterberg Group rocks See figure 2.



WSM LESHIKA CONSULTING (PTY) LTD	Geology Map	Figure 2

6. HYDROGEOLOGICAL EVALUATION

6.1 Existing borehole data

Six existing boreholes were said to exist on the site. Only 3 were found during the site visit (see table 1 below and figure 3).

Table 1: Borehole information

Borehole No	Latitude	Longitude	Depth (mbgl)	SWL(mbgl)	Estimated Yield (l/s)	Use
BH-1	24.551415°	27.744086°	?	?	1.5	Back up supply
BH-2	24.546361°	27.782830°	?	?	1	Domestic (Eco and Delta)
BH (W754)	24.569233°	27.745808°	?	?	1	Domestic and irrigation (existing Beta camp)
BH (W755)	24.551611°	27.746958°	?	?	?	?
BH (W703)	24.554302°	27.746212°	?	?	?	?
BH (W704	24.548820°	27.748266°	?	?	?	?
mbgl	metres below ground level					
	Not located during field census					

Yields have been estimated by considering the pump head gear and discharge pipe sizes. It is recommended that these boreholes be tested to determine their sustainable yields.

6.2 Aquifers

The main aquifers in the area are thought to be fractured and weathered aquifers in the in the Alma formation rocks and along the sill and dyke contact zones. The dykes often form groundwater barriers.

WSM LESHIKA CONSULTING (PTY) LTD

Borehole Locality Map

Figure 3

6.3 Aquifer storage

The aquifer storage is difficult to determine. As the predominant aquifer type is known to be a fractured and weathered aquifer, the storage is estimated from Vegters Maps to be very low or less than 0.001.

6.4 Groundwater levels and flow

Although no water levels could be measured water levels in the area are expected to be less than 15 metres below ground level. Groundwater flow is thought to follow a subdued form of the surface topography, i.e. flow in a southerly and westerly direction towards the Sand river.

6.5 Recharge and estimated sustainable abstraction potential

Recharge can be described as the replenishment from rainfall to the aquifers. Information from the Groundwater Resources Assessment Study (GRA II) gives average annual recharge as about 8mm with about 4mm contributing to the base flow in the rivers.

For the farm area of 7 600ha this amounts to an average available volume of:

- 76 000 000 000m^2 X 0.004m = 304 000 m^3/annum

Taking drought periods into account the sustainable volume of groundwater that can be abstracted is estimated to be 210 000 m^3/annum or 580 m^3/day.

The existing boreholes are estimated to yield a maximum of 3.5l/s thus for a pumping cycle of 24 hours they are able to abstract a maximum of about 300 m^3/day.

6.6 Water quality

The groundwater water quality is expected to be good (class 0-1) with slightly elevated iron content. No samples were available for analysis at the time of the site

visit as the borehole were not pumping. It is recommended that samples be taken to confirm the water quality and also to check if any contamination is present. It is recommended that samples be analised for macro elements, hydrocarbons and bacteria.

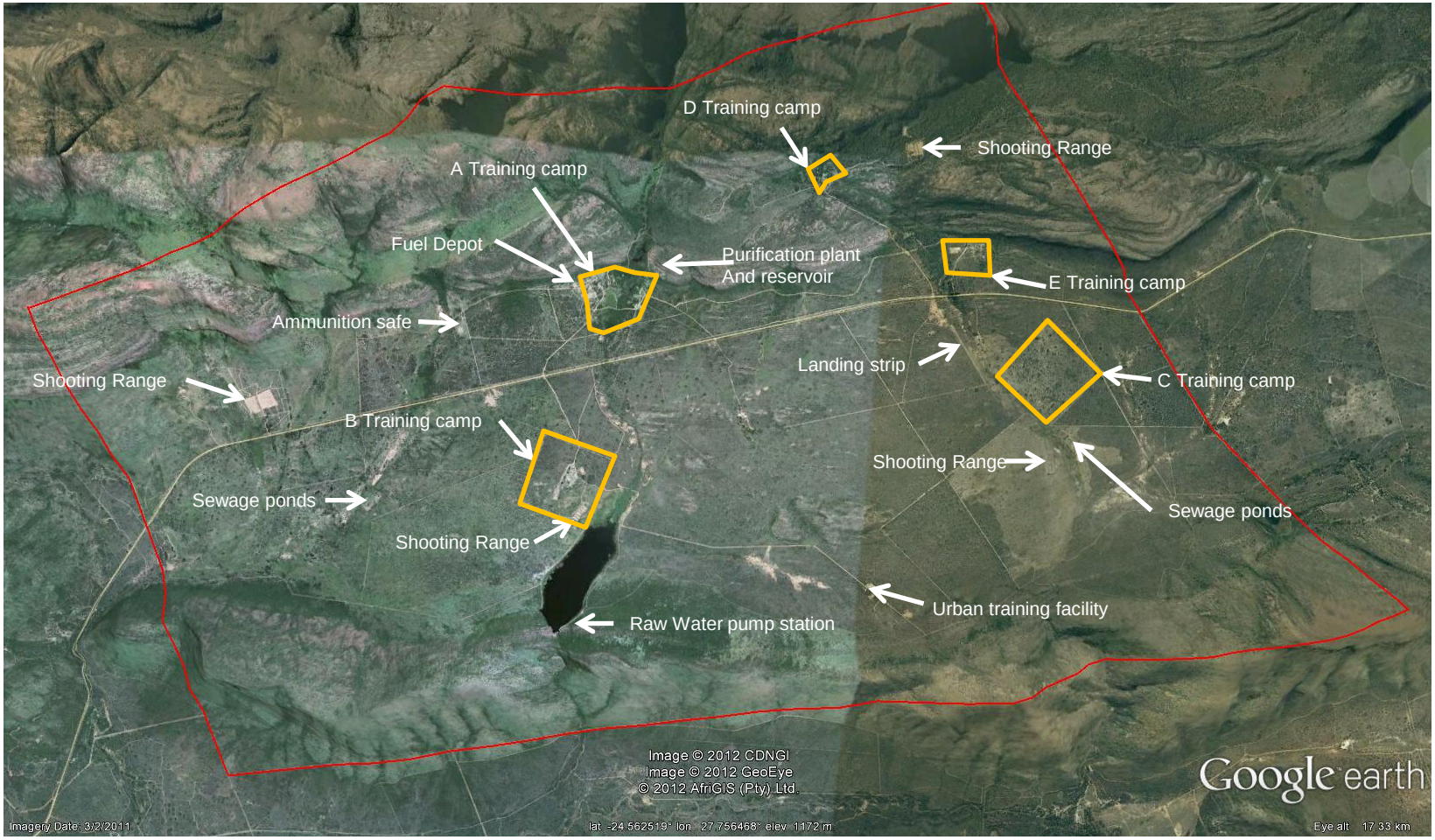
7. DESCRIPTION OF THE SAPS VERDRAG TRAINING FACILITY AND PROPOSED ADDITIONS AND ALTERATIONS

The existing training facility consists of the following:

- Training camps A, B, C, D and E
- Workshops at training camp A
- Shooting range
- Sewage ponds
- Ammunition safe
- Fuel Depot
- Water purification works and storage reservoir
- Raw water pipeline
- Clean water reticulation pipelines
- Sewage pipelines
- Electricity lines
- Landing strip

The following additions and alterations are proposed:

- a new A training camp be established
- B training camp be demolished and replaced
- D and E camps be upgraded
- a new residential area be established
- a new ammunition safe be built
- a new shooting range and admin block be built
- a new landing strip be built
- sewage system be upgraded
- water supply system be upgraded
- electricity be upgraded



WSM LESHIKA CONSULTING (PTY) LTD	Existing infrastucture Development	Figure 4

8. IMPACT ASSESSMENT ON THE GROUNDWATER RESOURCE AND PROPOSED MITIGATION MEASURES

The following activities could have an impact on the groundwater resource:

- Abstraction of groundwater
- Sewage system
- Fuel depot

and are discussed in more detail below.

8.1 Abstraction of groundwater

Only a portion of the facility is supplied with water from groundwater resources. With the envisaged additions and alterations the water supply system is envisaged to be solely from the Rookpoort dam. Groundwater will only be used as a backup source. Thus groundwater abstraction will have an insignificant impact on the groundwater resource

8.2 Sewage system

The existing sewage system discharges sewage into 2 different oxidation ponds which are poorly operated and maintained. Although the volumes appear to be small there is a small risk of contamination of the groundwater.

It is recommended that during the upgrading, the sewage system be replaced with properly designed treatment works. It would also be preferable if all the sewage can be treated in one plant.

The existing oxidation ponds will then need to be closed and rehabilitated.

8.3 Fuel Depot

Petroleum products spilled on surface will either run off into surface water drainage channels or enter the soil profile and percolate vertically down to the

groundwater level, which is thought to be at a relatively shallow depth. Thereafter the light non aqueous phase liquids (LNAPL's) such as petrol will be transported on the groundwater in a presumably southerly direction and the dense non aqueous phase liquids (DNAPL's) such as motor oil will move down until solid bedrock is encountered where it will move along the bedding planes and through fractures.

Due to the relatively pervious nature of the soils near surface, it may be assumed that the pollutants will travel through the upper soils and weathered bedrock at a relatively high rate down to the less weathered bedrock. As the boreholes in the area are thought to have moderate yields it is assumed that the bedrock is well fractured in places. These permeable fracture zones could provide preferential flow paths

It can therefore be assumed that the aquifer will be at a moderate to high risk to pollution from surface spills.

The following precautionary measures are therefore recommended:

- Sealing of the forecourt area and other areas where fuel products are handled to prevent infiltration of petroleum products into the soil underlying the site.
- Storm water draining from the surfaced areas should ideally be collected in a sealed sump to be treated or removed.
- Preventative measures should be installed to prevent the storm water or other liquids draining into the natural soil.
- The site will need some good planning to cope with surface runoff and runoff volumes must be calculated and proper separation facilities installed.
- The free product and polluted water must be removed from site by a licensed contractor.

Prevention of pollutants reaching the groundwater and soil will be a good practice and may include the following :

- Subsurface fuel tanks should be placed in concrete encasements with a sump system to prevent spilled fuel from entering the soil and weathered rock.
- Fuel lines and dispensers should be rendered leak-proof. This may include the boxing of these services.

9. MANAGEMENT AND MONITORING

As no long-term water levels and abstraction rates are available the above evaluation is based on the best knowledge and experience available. However it is strongly advised that a proper management and monitoring programme be implemented to ensure that the groundwater resources are protected. This should include:-

- measuring volumes of groundwater pumped
- measuring water levels at least quarterly
- take water samples from all production boreholes and analyse for microbiological and macro elements least twice annually
- also analyse for TPH/BTEXN at BH-1 to determine if the fuel depot has or is polluting the groundwater

10. CONCLUSIONS AND RECOMMENDATIONS

From the evaluation, the following conclusions are made:

- 3 Existing boreholes were found at the site;
- Groundwater occurs mainly in fractured and weathered clastic sediments;
- Water table is relatively shallow with a southerly and westerly flow direction towards the Sand River;
- Storage capacity is expected to be low <0.001;
- Average annual recharge is estimated to be 8mm of which 4mm contributes to the base flow of the rivers;

- Existing groundwater quality is expected to be good – Class 0-1;
- the aquifer is not at risk to over abstraction as the water supply is proposed to come from the Rookpoort Dam with groundwater as backup
- There is a small risk of pollution of the groundwater from the existing oxidation ponds and it is recommended that when the sewage system is refurbished consideration should be given to establishing a proper sewage treatment works
- The aquifer will be at a moderate to high risk to pollution from petroleum spills and thus the mitigation measures discussed in paragraph 8 will need to be implemented;

The following recommendations are also made:

- That the mitigation measures be implemented as described in paragraph 8;
- That a proper monitoring and management plan be implemented as described in section 9;

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