TURN180 ENVIRONMENTAL CONSULTANTS

STORMWATER MANAGEMENT PLAN

THE PROPOSED ESTABLISHMENT OF A FILLING STATION AND AN AGRICULTURAL RELATED SALES AND STORAGE AREA ON THE REMAINING EXTENT OF THE FARM OUTSPAN 1960, BLOEMFONTEIN, FREE STATE

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Site Information:

Farm / Erf Name	: Outspan
Farm Number	: 1960
Farm Portion	: RE
21 Digit Surveyors Code	: F00300000000196000000
District	: Bloemfontein
Metro Municipality	: Mangaung Metropolitan Municipality
Site coordinates (Centre of site)	: 29° 4'16.49"Sand 26° 8'34.75"E

DECLARATION OF INDEPENDENCE

Turn 180 Environmental Consultants is an independent company and has no financial, personal or other interest in the proposed project, apart from remuneration for work performed in the delivery of services relating to environmental management. There are no circumstances that compromise the objectivity of the study.

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1 INTRODUCTION AND BACKGROUND

The purpose of the Storm Water Management Plan **("SWMP")** is to accompany and inform the Basic Assessment Report (**"BAR"**) and Environmental Management Programme report (**"EMPr"**) as a supporting information document for the application to establish a filling station and an agricultural related sales and storage area. This report contains measures to manage storm water to reduce the risk of water contamination of the study area as well as the surrounding environment.

The proposed development is situated on the Remaining Extent of the Farm Outspan 1960, Bloemfontein, Free State **("study area")**. The study area has an approximate extent of 15.31 ha and is currently vacant. The footprint of the development will be approximately 8.87 ha in extent.

1.1 Scope of Work

The purpose is to develop a SWMP for the proposed filling station and agricultural related sales and storage area in support of the Basic Assessment process undertaken in terms of the 2014 EIA Regulations as amended in 2017 under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (**"NEMA"**). The main objectives of the SWMP are to ensure:

- Protection of life and property from flood hazards,
- Prevention of erosion,
- Protection of water resources from pollution,
- Ensure continuous operation through different hydrological cycles,
- Maintaining downstream water quality and quantity requirements,
- Protection of the natural environment with the emphasis on the watercourses and their ecosystems.

1.2 Methodology

- Desktop assessment of all available hydrological and rainfall data, topographic information, contours, and aerial photographs.
- Incorporation of the relevant Best Practices.
- Analysis of the EMPr and BAR.

1.3 Principles considered during the development of the SWMP

- Prevent the contamination of clean runoff.
- Contaminated water must be contained and prevented from reaching the surrounding environment.
- The SWMP must be sustainable for the life cycle of the operation and relevant for all different hydrological cycles.
- The statutory requirements of the various regulatory authorities and stakeholders must be considered and incorporated.

2 OVERVIEW OF THE HYDROLOGICAL CYCLE AND PROCESSES THAT AFFECT THE GENERATION AND MANAGEMENT OF STORM WATER

2.1 Background

The study area is located within the quaternary catchment C52H (refer to figure 1 below) which forms part of the Upper Orange Water Management Area **("WMA")** in the Free State. The study area borders the R64 road and is situated within the Spitskop Small Holdings area on the outskirts of Bloemfontein. The surrounding area consists predominately of agricultural activities and numerous businesses. There are no watercourses or wetlands present on the study area. However, there is a poorly defined channel present on site which may be construed as a drainage line, but which is most likely an artificial modification (Van Rensburg, 2019). The nearest waterbody to the site, which may possibly be a wetland, is situated approximately 340 m to the southeast of the site, on the other side of the R64 road on another property.

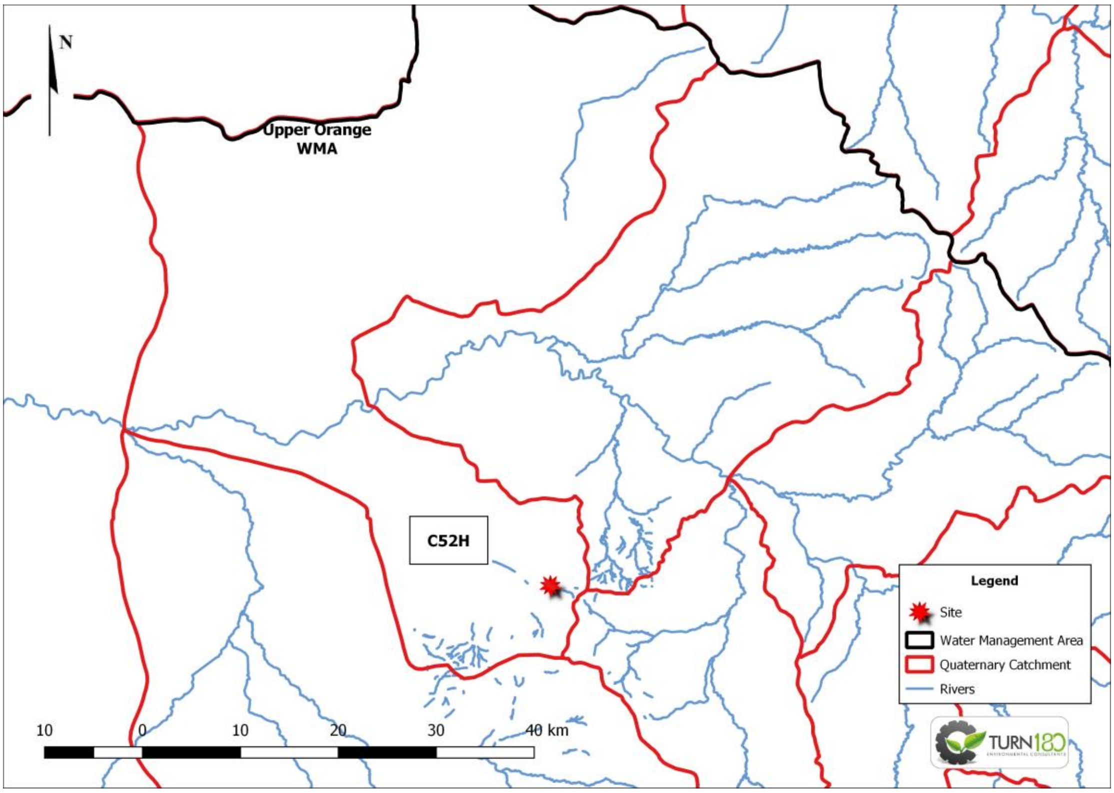

Figure 1: Map indicating the WMA and Quaternary Catchment in which the study area falls.

2.2 Precipitation, Evaporation and Temperature

The site is in Rainfall Zone C5D, with an average Mean Annual Precipitation **("MAP")** of approximately 500 - 600 mm per annum (refer to figure 2) which occurs from late spring through summer. The study area falls within Evaporation Zone 19C and the Mean Annual Evaporation **("MAE")** is between 1700 -1800 mm/annum (refer to figure 3) (Water Research Council, 2005). The Mean Daily Maximum temperature during summer is about 31°C and 17°C during winter respectively (refer to figure 4) (Meteoblue, 2019).

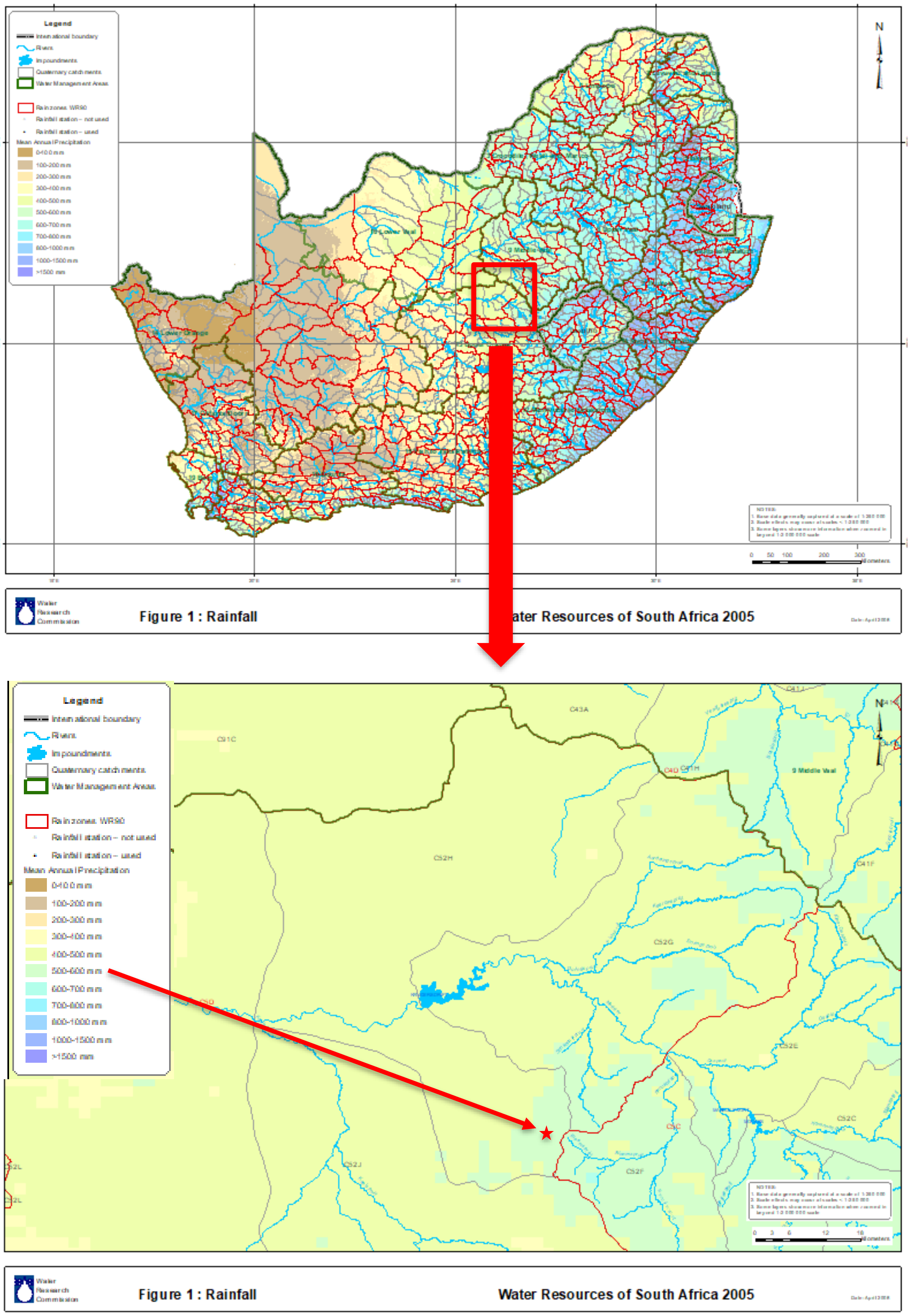

Figure 2: Map indicating the MAP of the study area.

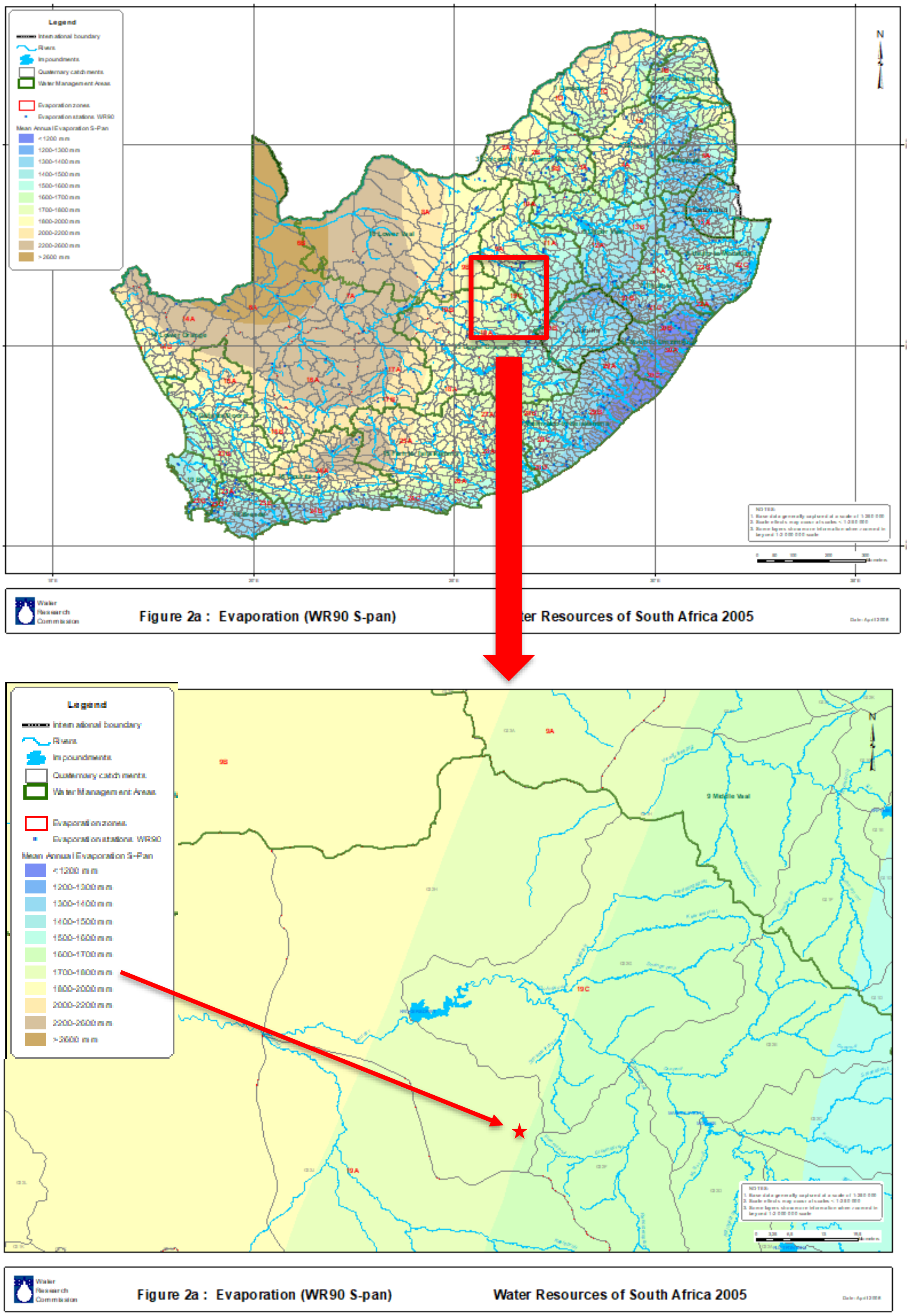

Figure 3: Map indicating the MAE of the study area.

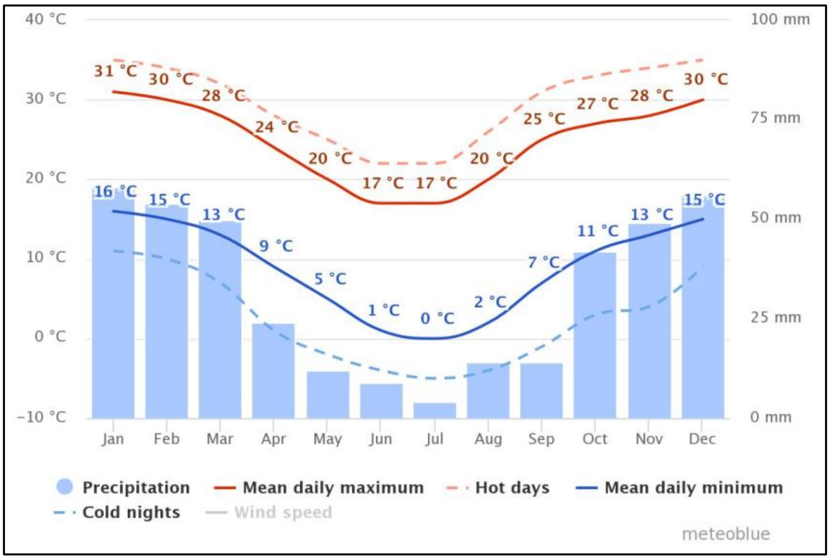

Figure 4: Figure indicating the Maximum and Minimum Daily Temperatures for the study area.

Due to the medium MAP and the medium MAE the average storm water runoff volumes are thus rated as being of relatively low amount. The runoff for the study area and the surrounding environment is between 5-10 mm/annum (refer to figure 5) (Water Resource Council, 2005). The amount of runoff from an area is however dependent on the infrastructure and activities as paved surfaces will prevent infiltration of water which will lead to more runoff from the site. As the development includes a filling station which will store hazardous substances, it is necessary that storm water management measures be implemented in order to prevent contamination of water resources.

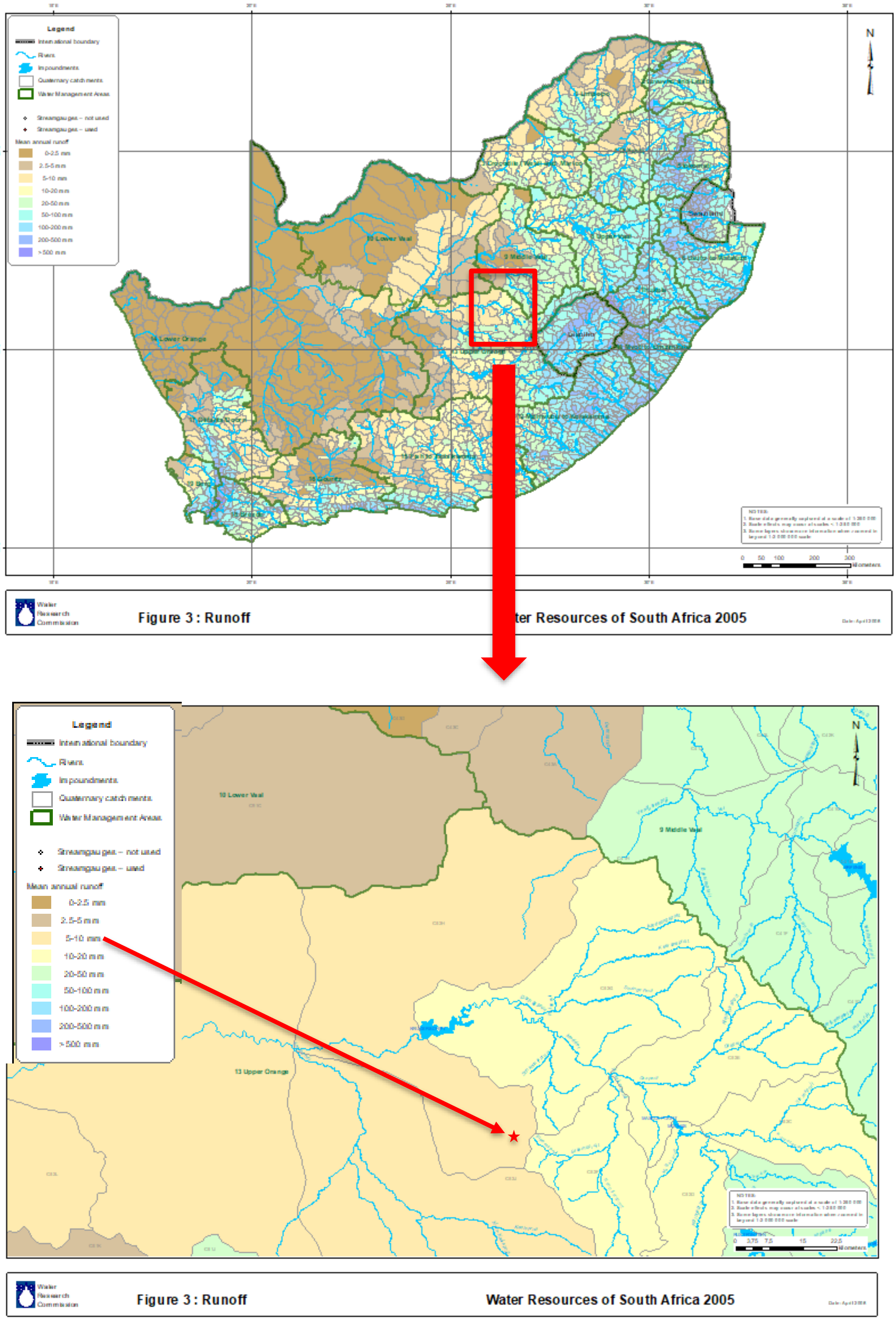

Figure 5: Map indicating the Mean Annual Runoff for the study area.

2.3 Infiltration

Under normal conditions, or when land is undisturbed, the rate of infiltration is on average 80%. The type of development or land modification has an impact on the rate of infiltration and therefore the amount of storm water generated.

The study area is currently vacant of any development and still contains natural vegetation. However, after the development is complete, the site will contain numerous buildings and the area will be paved, which will aid runoff. The lack of vegetation leads to an increased overland flow during rainfall events, which in turn hinders infiltration. Therefore, runoff will increase from what is indicated above after the development is complete.

2.4 Topography

Runoff is generated whenever the rain reaches the ground faster than it can infiltrate and the energy of the runoff water is a direct function of its potential to cause erosion.

The study area is relatively flat. However, storm water drains in a north, north western direction at an average slope of 1.3% (Cilliers, 2019). Due to runoff being an inevitable factor during any rainfall event and that the site will consist mainly of paved areas and buildings after the development is complete, runoff will occur at this site and flow to the lowest nearby location outside the study area, which is the Abrahamskraal road to the north west of the study area. The storm water will then follow this road until it reached the Modder River approximately 27km away (Cilliers, 2019).

The surface water flow patterns are a function of the local topography and indicated in Figure 6 below.

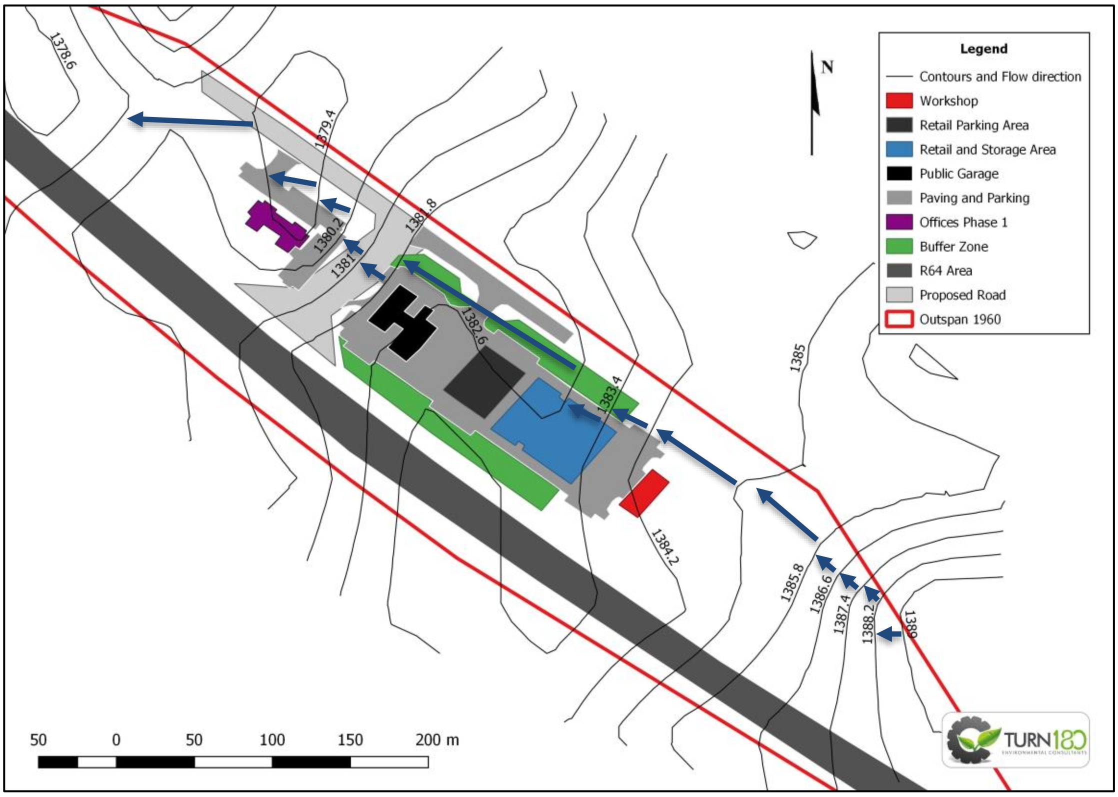

Figure 6: Storm water flow patterns of the study area.

2.5 Recharge

Recharge is the vertical movement of surface water through the unsaturated zone to reach the groundwater horizon. The rate of recharge for this area is estimated to be between 15 – 20 mm/annum.

However, due to the nature of the development (clearance of vegetation) and the geography of the area, which consist of a top layer of 30m of red sand (Van Wyk, 2019) (Refer to the Geohydrological Report), recharge may take place at an accelerated rate. Therefore, there is an increased risk for contamination of the aquifer.

2.6 Groundwater flow

The aquifer of exploitable water is deep-seated and expected to be between 90 – 110 meters below ground level ("**mbgl**"). The study area's aquifer is classified as being a minor aquifer and are estimated to yield around 3 000 L/s (Van Wyk, 2019).

The combination of the deep ground water table, geology and relatively low relief (approximately 1 380m above sea level) make the area not conducive for the formation of any fountains or the recharge of surface water features from groundwater.

3 IMPACT ASSESSMENT

3.1. Assessment methodology

The environmental significance assessment methodology is based on the following determination:

Environmental Significance = Overall Consequence x Overall Likelihood.

3.1.1.Determination of Consequence

Consequence analysis is a mixture of quantitative and qualitative information and the outcome can be positive or negative. Several factors can be used to determine consequence. For the purpose of determining the environmental significance in terms of consequence, the following factors were chosen: Severity/Intensity, Duration and Extent/Spatial Scale. Each factor is assigned a rating of 1 to 5, as described in the tables below.

Determination of Severity

Severity relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects impact on the biophysical and socio-economic environment (Table 1).

Table 1: Rating of severity

Type of criteria	Rating				
	1	2	3	4	5
Quantitative	0-20%	21-40%	41-60%	61-80%	81-100%
Qualitative	Insignificant / Non-harmful	Small / Potentially harmful	Significant / Harmful	Great / Very harmful	Disastrous Extremely harmful
Social/ Community response	Acceptable / I&AP satisfied	Slightly tolerable / Possible objections	Intolerable / Sporadic complaints	Unacceptable / Widespread complaints	Totally unacceptable / Possible legal action
Irreversibility	Very low cost to mitigate/ High potential to	Low cost to mitigate	Substantial cost to mitigate / Potential to mitigate impacts /	High cost to mitigate	Prohibitive cost to mitigate / Little or no mechanism

Type of criteria	Rating				
	1	2	3	4	5
	mitigate impacts to level of insignificance / Easily reversible		Potential to reverse impact		to mitigate impact Irreversible
Biophysical (Air quality, water quantity and quality, waste production, fauna and flora)	Insignificant change / deterioration or disturbance	Moderate change / deterioration or disturbance	Significant change / deterioration or disturbance	Very significant change / deterioration or disturbance	Disastrous change / deterioration or disturbance

Determination of Duration

Duration refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place (Table 2).

Table 2: Rating of Duration

Rating	Description
1: Low	1 Month
2: Low-Moderate	1 – 3 Months
3: Moderate	More than 3 Months
4: Moderate-High	5 – 10 Years
5: High	More than 10 Years

Determination of Extent/Spatial Scale

Extent refers to the spatial influence of an impact, be it contained to the immediate surroundings (site), extending to the surrounding area, regional (will have an impact on the region), national (will have an impact on a national scale) or international (impact across international borders) (Table 3).

Table 3: Rating of Extent / Spatial Scale

Rating	Description
1: Low	Immediate, fully contained area (site)
2: Low-Moderate	Surrounding Area
3: Moderate	Regional
4: Moderate-High	National
5: High	International

Determination of Overall Consequence

Overall consequence is determined by adding the factors determined above and summarised below, and then dividing the sum by 3 (Table 4).

Table 4: Example of calculating Overall Consequence

Consequence	Rating
Severity	Example 4
Duration	Example 2
Extent	Example 4
SUBTOTAL	Example 10
TOTAL CONSEQUENCE:(Subtotal divided by 3)	Example 3.3

3.1.2.Determination of Likelihood

The determination of likelihood is a combination of Frequency and Probability. Each factor is assigned a rating of 1 to 5, as described and in Tables 5 and 6.

Determination of Frequency

Frequency refers to how often the specific activity, related to the event, aspect or impact, is undertaken (Table 5).

Table 5: Rating of frequency

Rating	Description
1: Low	Once a year / once during construction
2: Low-Moderate	Once / more in 6 Months
3: Moderate	Once / more a Month
4: Moderate-High	Once / more a Week
5: High	Daily

Determination of Probability

Probability refers to how often the activity/event or aspect has an impact on the environment (Table 6).

Table 6: Rating of probability

Rating	Description
1: Low	Almost never / almost impossible
2: Low-Moderate	Very seldom / highly unlikely
3: Moderate	Infrequent / unlikely / seldom
4: Moderate-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

Overall Likelihood

Overall likelihood is calculated by adding the factors determined above and summarised below, and then dividing the sum by 2 (Table 7).

Table 7: Example of calculating the overall likelihood

Likelihood	Rating
Frequency	Example 4
Probability	Example 2
SUBTOTAL	Example 6
TOTAL LIKELIHOOD (Subtotal divided by 2)	Example 3

3.1.3. Determination of Overall Environmental Significance

The multiplication of overall consequence with overall likelihood will provide the environmental significance, which is a number that will then fall into a range of LOW, LOW-MODERATE, MODERATE, MODERATE-HIGH or HIGH, as shown in the table below (Table 8).

Table 8: Determination of overall environmental significance

Significance or Risk	Low	Low-Moderate	Moderate	Moderate-High	High
Overall Consequence X Overall Likelihood	1 - 4.9	5 - 9.9	10 - 14.9	15 – 19.9	20 - 25

Qualitative description or magnitude of Environmental Significance

This description is qualitative and is an indication of the nature or magnitude of the Environmental Significance. It also guides the prioritisations and decision-making process associated with this event, aspect or impact (Table 9).

Table 9: Description of the environmental significance and the related action required.

Significance	**Low**	**Low-Moderate**	**Moderate**	**Moderate-High**	**High**
Impact Magnitude	Impact is of very low order and therefore likely to have very little real effect. Acceptable.	Impact is of low order and therefore likely to have little real effect. Acceptable.	Impact is real, and potentially substantial in relation to other impacts. Can pose a risk to the company	Impact is real and substantial in relation to other impacts. Pose a risk to the company. Unacceptable	Impact is of the highest order possible. Unacceptable. Fatal flaw.
Action Required	Maintain current management measures. Where possible improve.	Maintain current management measures. Implement monitoring and evaluate to determine potential increase in risk. Where possible improve	Implement monitoring. Investigate mitigation measures and improve management measures to reduce risk, where possible.	Improve management measures to reduce risk.	Implement significant mitigation measures or implement alternatives.

Surface Water

The following impacts may occur on the surface water as a result of the construction and operational phases of the activity:

- Contamination of nearby surface water resources through spillage of petrochemical substances.

1. Contamination of nearby surface water resources through spillage of petrochemical substances.								
	Outspan 1960 (Preferred Location Alternative)							
Potential Impact Description:	According to the Ecological Assessment (Van Rensburg, 2019) a longitudinal, poorly defined channel is present on site, but this is most likely an artificial modification due to road construction of storm water ditches. Even though there are no surface water features on site or within 100 m of the site, there are some other surface water resources in the vicinity which can be contaminated through dirty runoff from site during rainfall events (petrochemical spills). These resources include a waterbody, which could possibly be a pond or wetland, approximately 340 m southeast of the proposed site.							
Duration of Impact:	During construction and operational phases							
	Construction phase							
	Severity	**Duration**	**Extent**	**Consequence**	**Probability**	**Frequency**	**Likelihood**	**Significance**
Without Mitigation	2	3	2	2.33	2	4	3	6.99

With Mitigation	1	1	1	1	1	4	2.5	2.5
Mitigation Measures	• Construction vehicles and machinery should be serviced regularly to prevent any leaks. • Drip trays should be placed underneath immobile vehicles and machinery. • Any spills of hazardous substances should be cleaned immediately by removing the contaminated soil and disposing of it as hazardous waste. • Appropriate storm water measures such as channels and/or culverts should be constructed around the construction site to prevent clean storm water from entering the site during rainfall events and dirty storm water from leaving the site.							
	Operational Phase							
	Severity	**Duration**	**Extent**	**Consequence**	**Probability**	**Frequency**	**Likelihood**	**Significance**
Without Mitigation	2	3	2	2.33	3	5	4	9.32
With Mitigation	1	1	1	1	2	5	3.5	3.5
Mitigation Measures	• Potentially hazardous substances relating to the filling station will be stored inside a bunded area with an impermeable surface which has the capacity to store more than 110% of the volume of the substance. • Any spills of hazardous substances should be cleaned immediately by removing the contaminated soil and disposing of it as hazardous waste.							

	• The storm water measures that were implemented during the construction phase should be maintained around the operational area to prevent clean storm water from entering the site during rainfall events and dirty storm water from leaving the site. • Dirty storm water may not leave the operational area and enter natural drainage lines. This water must first go through oil separators before leaving the site.
Can the impact be reversed	Yes, the impact can be reversed by implementing the correct clean-up procedures.
Will the impact cause irreplaceable loss to resource	No.
Cumulative Impacts	There may be cumulative impacts due to the surrounding areas also being developed and potentially causing contamination of the surrounding water resources. However, this is expected to be low, as the identified waterbody is situated in a vacant field close to a homestead. The waterbody is not surrounded by much development.

Summary of impacts				
	Construction		Operational	
Potential Impacts	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
1. Contamination of nearby surface water resources through spillage of petrochemical substances	6.99	2.5	9.32	3.5
Grand Average Total:	6.99 (Low-Moderate)	2.5 (Low)	9.32 (Low-Moderate)	3.5 (Low)
The overall environmental significance indicates that the impact on Surface Water will be LOW during the construction phase and the operational phase with the correct mitigation.				

Groundwater

The following impacts may occur on the groundwater as a result of the construction and operational phases of the activity:

- Contamination as a result of spillages of hazardous substances.
- The development may induce surface runoff and therefore reduce infiltration. Lower infiltration will lead to lower groundwater recharge.

1. Contamination as a result of spillages of hazardous substances.								
	Outspan 1960 (Preferred Location Alternative)							
Potential Impact Description:	Hazardous substances from construction vehicles and machinery can seep into the groundwater and cause contamination during the construction phase. During operation, diesel and petrol will be stored in underground tanks which may leak and contaminate the groundwater resource.							
Duration of Impact:	During construction and operational phases							
	Construction phase							
	Severity	**Duration**	**Extent**	**Consequence**	**Probability**	**Frequency**	**Likelihood**	**Significance**
Without Mitigation	3	3	2	2.66	3	4	3.5	9.31
With Mitigation	2	2	1	1.66	2	4	3	4.98
Mitigation Measures	• Construction vehicles and machinery should be serviced regularly to prevent any leaks. • Drip trays should be placed underneath immobile vehicles and machinery. • Any spills of hazardous substances should be cleaned immediately by removing the contaminated soil and disposing of it as hazardous waste.							

	• Quarterly water sample analysis must be conducted on the monitoring borehole in order to test for groundwater contamination.

	Operational Phase							
	Severity	**Duration**	**Extent**	**Consequence**	**Probability**	**Frequency**	**Likelihood**	**Significance**
Without Mitigation	4	4	2	3.33	3	5	4	13.32
With Mitigation	3	3	1	2.33	2	5	3.5	8.155
Mitigation Measures	• Potentially hazardous substances relating to the filling station will be stored inside a bunded area with an impermeable surface which has the capacity to store more than 110% of the volume of the substance. • Underground storage tanks should be inspected regularly for leaks and if any are detected they should be fixed immediately. • Any spills of hazardous substances should be cleaned immediately by removing the contaminated soil and disposing of it as hazardous waste.							

Can the impact be reversed	Yes, the impact can be reversed by limiting the number of spillages and immediate clean-up of any hazardous substances. Any contamination to the aquifer itself as a result of hazardous substances infiltrating into the water can be remedied by natural attenuation if the aquifer isn't contaminated any further.
Will the impact cause irreplaceable loss to resource	No.
Cumulative Impacts	There may be a cumulative impact in conjunction with the surrounding land uses which can also contribute to contamination of the groundwater.

2. Induced surface runoff causing lower infiltration to the aquifer as a result of the development	
	Outspan 1960 (Preferred Location Alternative)
Potential Impact Description:	Clearance of vegetation and levelling of the site during construction may lead to water from rainfall events obtaining high flow velocities as there are no natural obstacles (vegetation) slowing down the flow of water. These high flow velocities won't allow water to seep into the ground and recharge the aquifer. During the operational phase the same will happen due to the site being paved.

Duration of Impact:	During construction and operational phases							
	Construction phase							
	Severity	**Duration**	**Extent**	**Consequence**	**Probability**	**Frequency**	**Likelihood**	**Significance**
Without Mitigation	2	2	2	2	3	4	3.5	7
With Mitigation	1	1	1	1	2	4	3	3
Mitigation Measures	• Clearance of vegetation for this development is unavoidable and permanent. Therefore, the footprint of the site should be kept as small as practicable possible in order to limit the impact.							
	Operational Phase							
	Severity	**Duration**	**Extent**	**Consequence**	**Probability**	**Frequency**	**Likelihood**	**Significance**
Without Mitigation	2	2	2	2	3	5	4	8

With Mitigation	1	1	1	1	2	5	3.5	3.5
Mitigation Measures	• Clearance of vegetation for this development is unavoidable and permanent. Therefore, the footprint of the site should be kept as small as practicable possible in order to limit the impact.							
Can the impact be reversed	Yes, through proper storm water management water can be diverted to surrounding areas that are not paved.							
Will the impact cause irreplaceable loss to resource	No							
Cumulative Impacts	None. Although the majority of the surrounding area is also developed, most of the area is not completely paved and still contains natural groundcover.							

Summary of impacts				
	Construction		Operational	
Potential Impacts	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
1. Contamination as a result of spillages of hazardous substances.	9.31	4.98	13.32	8.155
2. Induced surface runoff causing lower infiltration to the aquifer as a result of the development	7	3	8	3.5
Grand Average Total:	8.155 (Low – Moderate)	3.99 (Low)	10.66 (Moderate)	5.8275 (Low – Moderate)
The overall environmental significance indicates that the impact on Groundwater will be LOW during the construction phase and LOW – MODERATE during the operational phase with the correct mitigation				

4 STORM WATER MANAGEMENT PLAN

4.1 Surface Water / Storm Water Runoff

When a site like this is developed it is required that berms and/or trenches be built around the site to allow clean storm water to be diverted around the site into the natural drainage lines and to prohibit dirty storm water from the site from entering natural drainage lines.

It is recommended that a trench be constructed around the site, especially at the north eastern and eastern boundaries, in order to divert clean storm water from rainfall events around the site into natural drainage lines. Refer to figure 7 below. The operational area is considered to be a "dirty" area and clean storm water is not allowed to run over this area and become contaminated. The recommended trench will divert the clean storm water, which flows in a north westerly direction, around the site and into the natural drainage line/path that runs along the Abrahamskraal road towards the Modder River. A culvert would also need to be built underneath the new planned access road that connects with the R64 road, in order to allow for the flow of storm water.

It is not expected that large volumes of hazardous substances will be stored on site during construction. Small containers containing hazardous substances can be placed within drip trays. The fuel tanks will be placed underground, and the area will be roofed. It is recommended that the area where the filling of vehicles occurs be slightly elevated to prevent storm water from the surrounding area from flowing over the filling area where spills may occur. The storage tanks will also be located underground, underneath a roofed area. Water from the gutters of the roof should be diverted away from the filling station.

Construction vehicles may not be serviced or washed on site. These vehicles should also be maintained in order to prevent leaks and all immobile vehicles should have drip trays placed underneath them.

During the operational phase, repairs of tractors and other vehicles will take place at the workshop area. No storm water is allowed to run over this area, as it is a "dirty" area. Any wash water originating from the workshop should go through an oil separator before it is allowed to drain into storm water channels.

All potentially hazardous substances associated with the activity should be stored under a roof where water cannot enter. These substances refer to pesticides and fertilizer. No soluble materials which may cause pollution to watercourses may be stored in a manner where it is not protected from rain and storm water.

4.2 Groundwater

Due to the nature of the operation (filling station) it is recommended that a borehole be drilled downstream from the site where the filling station will be located, to monitor water quality and to determine whether the operation is contributing to groundwater contamination. Hazardous substances should be stored in bunded areas, with a controlled outlet and impermeable surface, that can contain 110% of the volume of the substance in order to prevent contamination of groundwater. It is also recommended that any spills be cleaned up immediately as any rainfall can infiltrate to the aquifer, contaminating it from the surface.

A groundwater monitoring programme should be implemented to monitor the quality of water upstream and downstream of the filling station to determine if any pollution occurs as a result of the underground storage of fuel at the filling station.

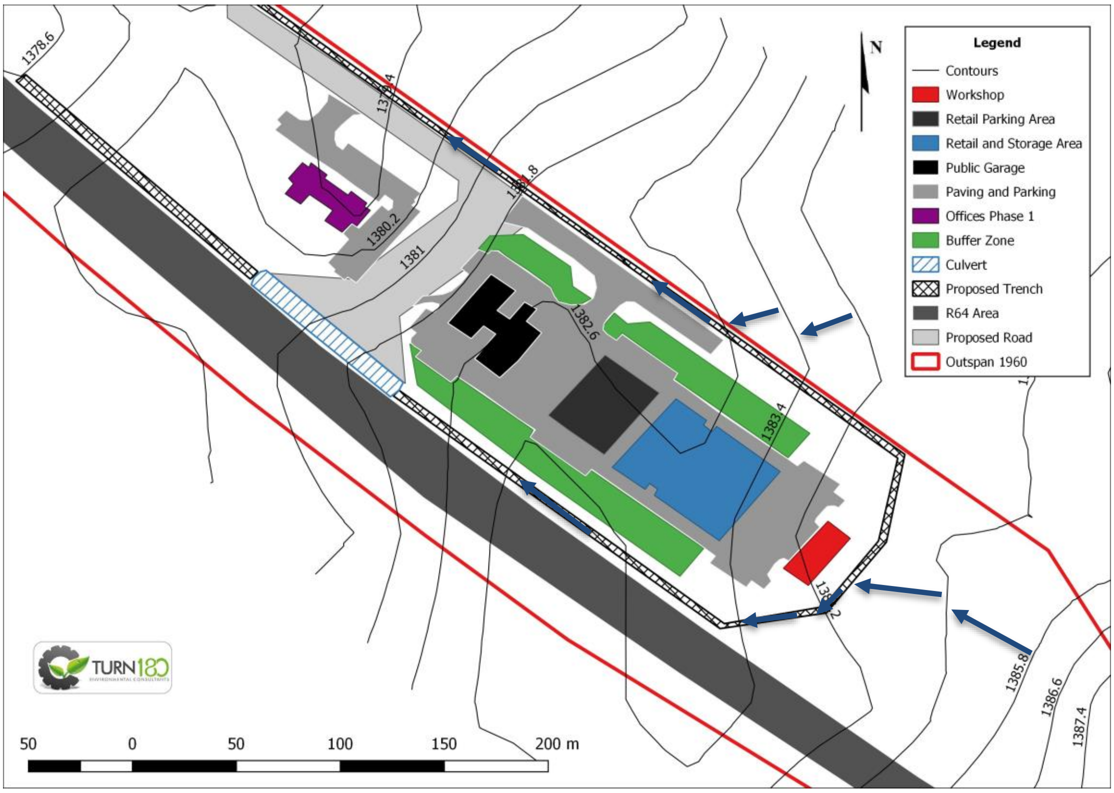

Figure 7: Map indicating the recommended storm water management measures that should be implemented on site.

5 CONCLUSION

The study area is located in an area with a medium MAP and MAE and therefore the amount of storm water that will be generated is relatively low. However, due to the nature of the operation (filling station that stores hazardous substances) storm water measures in the form of a trench around the site is recommended. This is recommended in order to divert clean storm water around the site into the natural drainage lines that drain toward the Abrahamskraal road and the Modder River. It is also advised that any wash water originating from the workshop during the operational phase must first go through an oil separator before draining into the storm water channels. It is also recommended that a monitoring borehole be drilled downstream from the site where the garage will be located in order to monitor possible contamination of groundwater.

If the above-mentioned measures are implemented, the impact relating to storm water should be low to moderate.