HOTAZEL SOLAR FACILITY 2 (PTY) LTD

PRELIMINARY WATER CONSUMPTION STUDY FOR HOTAZEL 2

Prepared for:

Cape Environmental Assessment Practitioners (Pty) Ltd

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ACCRONYMS AND ABBREVIATIONS

AC	Alternating Current
DC	Direct Current
kV	Kilovolt
MW	Megawatt
MWp	Megawatt Peak
PV	Photovoltaic(s)
SEF	Solar Energy Facility
SWSA	Strategic Water Source Areas
UN	United Nations
Wp	Watt Peak
WUL	Water Use License

1. PURPOSE AND SCOPE

South Africa is a relatively dry country, with an annual rainfall of about half of the global average. In many parts of the country, particularly in the Northern Cape, water often has to be supplied from a distant source. In addition to this, climate change together with population growth is increasing the pressure on South Africa's limited water resources.

In recent years, new policy and regulatory instruments have been introduced that aim to promote sustainable energy and expand electricity generation capacity. The Integrated Resource Plan (IRP 2019) sets the direction for the energy sector, with a shift away from coal, increased adoption of renewables and gas, and an end to the expansion of nuclear power. The IRP calls for some 6 000MW of new solar PV capacity and 14 400MW of new wind power capacity to be commissioned by 2030.

As the renewable energy sector is set to expand over the next 10 years, it is important to understand the water footprint of renewable energy production. Therefore, this report provides preliminary estimations of the water requirements for the proposed Hotazel Solar Facility 2 (Hotazel 2) in the Northern Cape Province, South Africa.

2. LOCATION

Hotazel 2 is proposed on the Remaining Extent (Portion 0) of the Farm York A 279, situated in the District of Hotazel in the Northern Cape Province (Figure 1). The property is 636.79 ha and is located approximately 3.5 km south-east of the town of Hotazel. The proposed development site is situated approximately 3 km south-east of the Eskom Hotazel Substation. Access to the site can be gained via the R31 that connects the town of Hotazel to Kuruman.

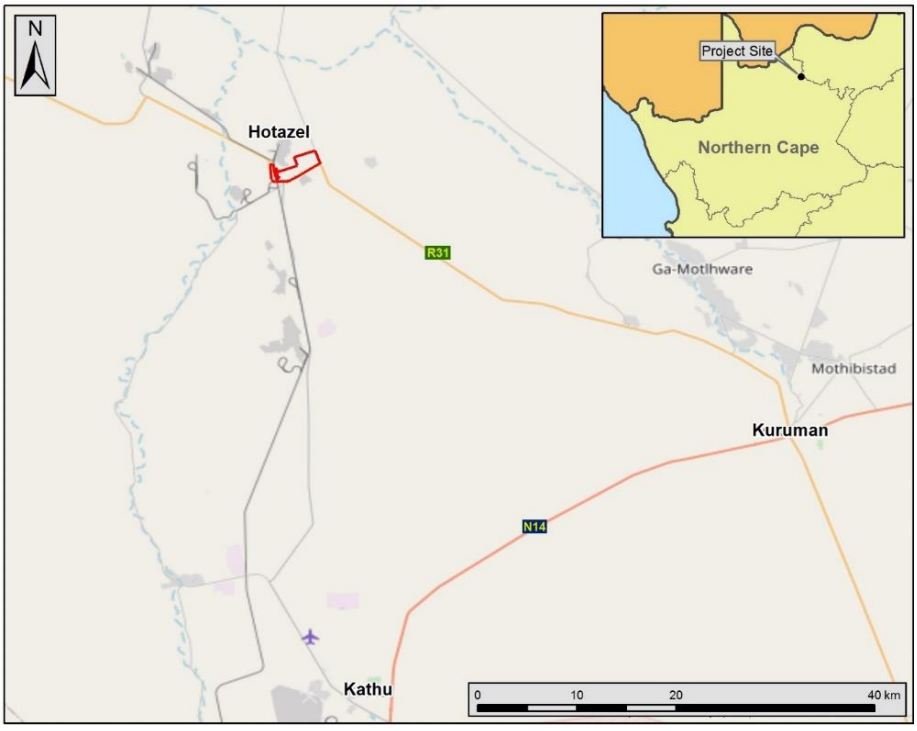

Figure 1: Locality of the Property.

3. BASIC DESCRIPTION OF FACILITIES

Hotazel 2 is to consist of solar photovoltaic (PV) technology with fixed, single or double axis tracking mounting structures, with a net generation (contracted) capacity of 100 MW_{AC} (MegaWatts), as well as associated infrastructure, which will include:

- On-site substation / collector switching station;
- Auxiliary buildings (gate-house and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc.);
- Inverter-stations, transformers and internal electrical reticulation (underground cabling);
- Access and internal road network;
- Laydown area;
- A 132kV overhead powerline to connect the on-site substation / collector switching station to the national grid via the Eskom Hotazel substation;
- Rainwater tanks; and
- Perimeter fencing and security infrastructure.

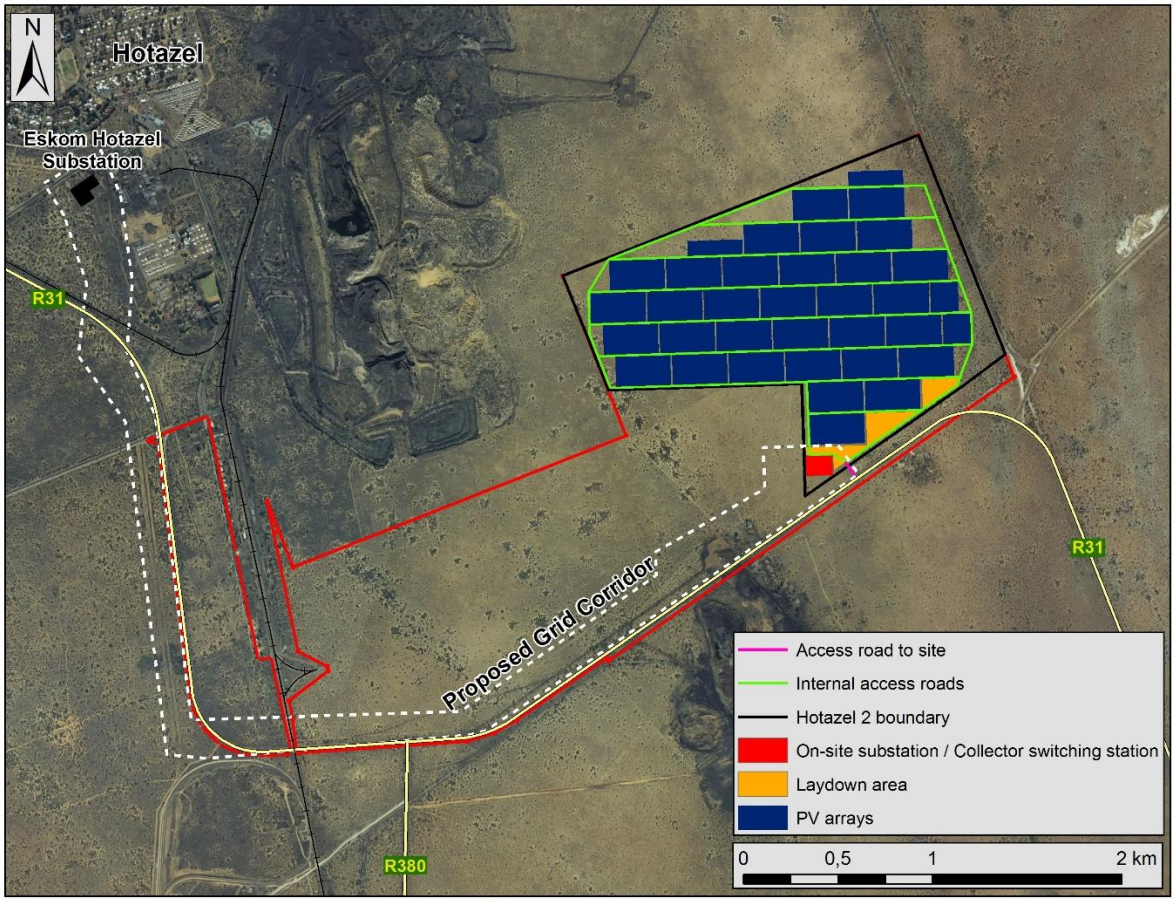

Figure 2: Proposed Hotazel 2 Layout

4. WATER NEEDS AND CONSUMPTION

4.1 INTRODUCTION

Water will be required during both the construction and operational phases of the project. The construction phase is expected to last about 18 months, where after the facility will operate for 20 years.

During both phases of the project, water will be required for sanitation (i.e. drinking, cooking and cleaning). In addition to this, during the construction phase, water will be needed for construction processes and, during the operation phase, water will be needed for plant maintenance (module cleaning and road maintenance & irrigation).

4.2 CONSTRUCTION PHASE

4.2.1 Sanitation Water Requirements

It is estimated that there will be a maximum of approximately 400 workers on site at the peak of the construction period. The average number of construction workers on site per day is estimated to be a maximum of approximately 200. The United Nations (UN) suggests that a person needs in the region of 20 - 50 litres of water a day to ensure their basic needs for drinking, cooking and cleaning (UN-Water, n.d.). The calculations in Table 1 assume 50 litres/worker/day with the assumption that portable chemical toilets will be used at the construction site.

Table 1: Construction Phase – Sanitation Water Requirements.

Consumption (Litres/worker/day)	**Construction Duration**	**Workers on site**	**Total Consumption** (Litres)	**Total Consumption** (m^3)
50	540 days	200	5 400 000	**5 400**

4.2.2 Construction Process Water Requirements

Water consumption during the construction process is associated primarily with the compaction of roads to meet minimum quality requirements. The requirement is estimated to be 50 litres/m^3. A further 3 000 m^3 quantity has been allowed for other general uses such as concrete curing, road maintenance, dust suppression etc.

Table 2: Construction Phase – Process Water Requirements.

Construction Process	**Consumption** (Litres/m^3)	**Construction Quantities**	**Total Consumption** (Litres)	**Total Consumption** (m^3)
Compaction of roads	50 Litres/m^3	72 000 m^3 of granular material	3 600 000	**3 600**
Others	-	-	-	**3 000**
TOTAL				**6 600**

Note: Non-potable and recycled water may be used for the above construction processes.

4.3 OPERATIONAL PHASE

4.3.1 Sanitation Water Requirements

Employment numbers at a solar energy facility depends largely on the extent to which operational processes are automated. For the purpose of these calculations, it is assumed that Hotazel 2 will employ a maximum of 60 workers at any given point in time during the 20-year operational lifespan of the Plant. The United Nations (UN) suggests that a person needs in the region of 20 - 50 Litres of water a day to ensure their basic needs for drinking, cooking and cleaning (UN-Water, n.d.). Assuming 50 Litres/worker/day, the total annual consumption calculated for the operational phase of the facility 1 095m^3.

Table 3: Operational Phase – Sanitation Water Requirements.

Consumption (Litres/worker/day)	**Number of days**	**Number of Employees**	**Annual Consumption** (Litres)	**Annual Consumption** (m^3)
50	365	60	1 095 000	**1 095**

4.3.2 Plant Maintenance Water Requirements

Module cleaning

For this purpose it is assumed that the solar PV modules will be cleaned twice per annum. A plant with a net generating capacity of 100 MW corresponds to a total peak installed capacity of between 115 MWp and 125 MWp, depending on the permitted inverter ratio. Assuming a module size of 400 Wp, the facility will see a maximum of 312 500 units installed. The estimated water consumption is calculated in the following table.

Table 4: Operational Phase – Plant Maintenance Water Requirements.

Quantity (modules)	**Area** (m^2 per module)	**Water Consumption** (Litres/m^2)	**Consumption per Clean** (Litres)	**Cleans/year**	**Total Consumption** (m^3)
312 500	2.01	3	1 884 375	2	**3 769**

Road maintenance

It is assumed that 200 m^3 per annum will be required for road maintenance and irrigation purposes.

4.4 WATER STORAGE REQUIREMENTS

It is assumed that potable water will be stored in small water tanks on site. A typical example would be a standard 5000 Litre JoJo water tank measuring 1.82m in diameter and 2.1m in height.

Grey water and sewerage will be discharged to an approved watertight septic tank system, for collection by authorized agents.

4.5 SUMMARY OF WATER CONSUMPTION

The total water consumption estimated for the construction phase is 12 000m^3, for the total 18-month construction period.

The total water consumption estimated for the operational phase is 5 064m^3 per annum, for the 20-year operational lifespan of the facility.

5 GROUNDWATER AND RAINWATER

5.1 INTRODUCTION

In order to reduce the demand placed on the municipality, the project will look to use both rainwater and groundwater during the construction and operational phases.

5.2 GROUNDWATER

The proposed Hotazel 2 facility will be located near Hotazel in the Northern Cape Province. According to Figure 3 below, the area may have a groundwater occurrence of between 0.1 and 2 litres per second.

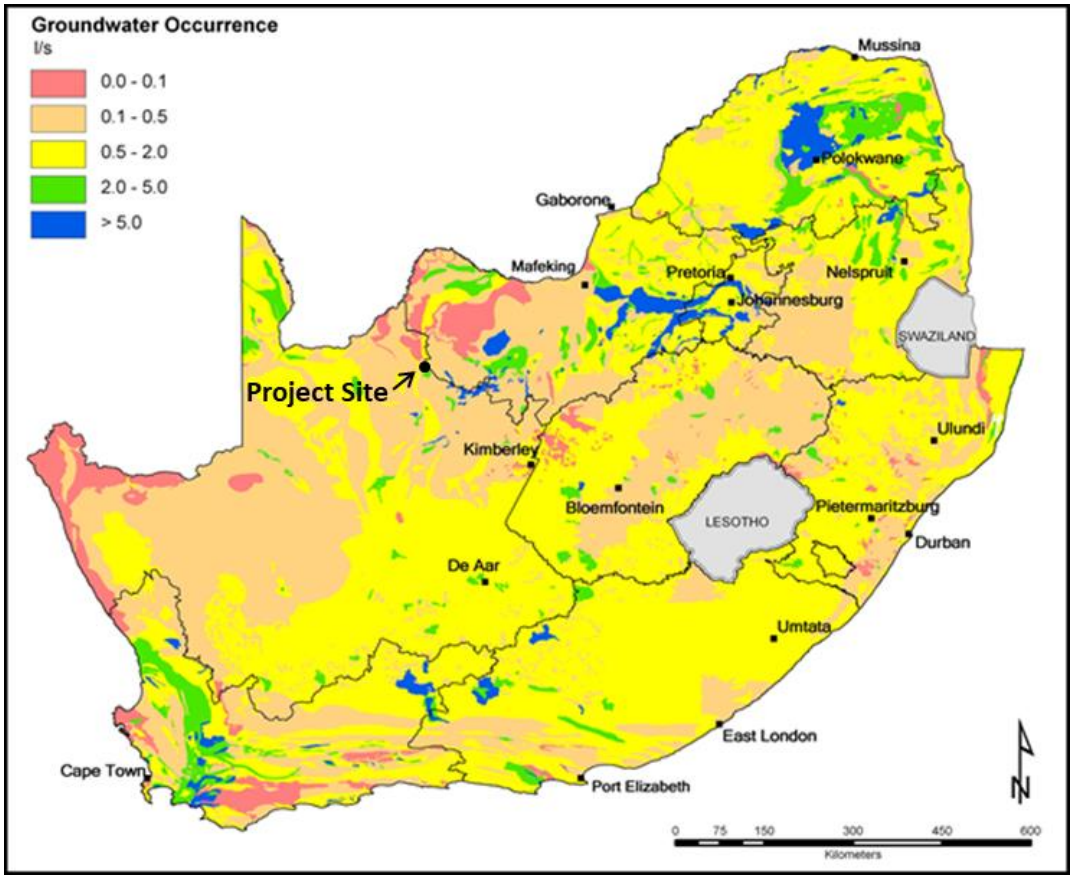

Figure 3: Groundwater occurrence in South Africa (Department of Water Affairs)

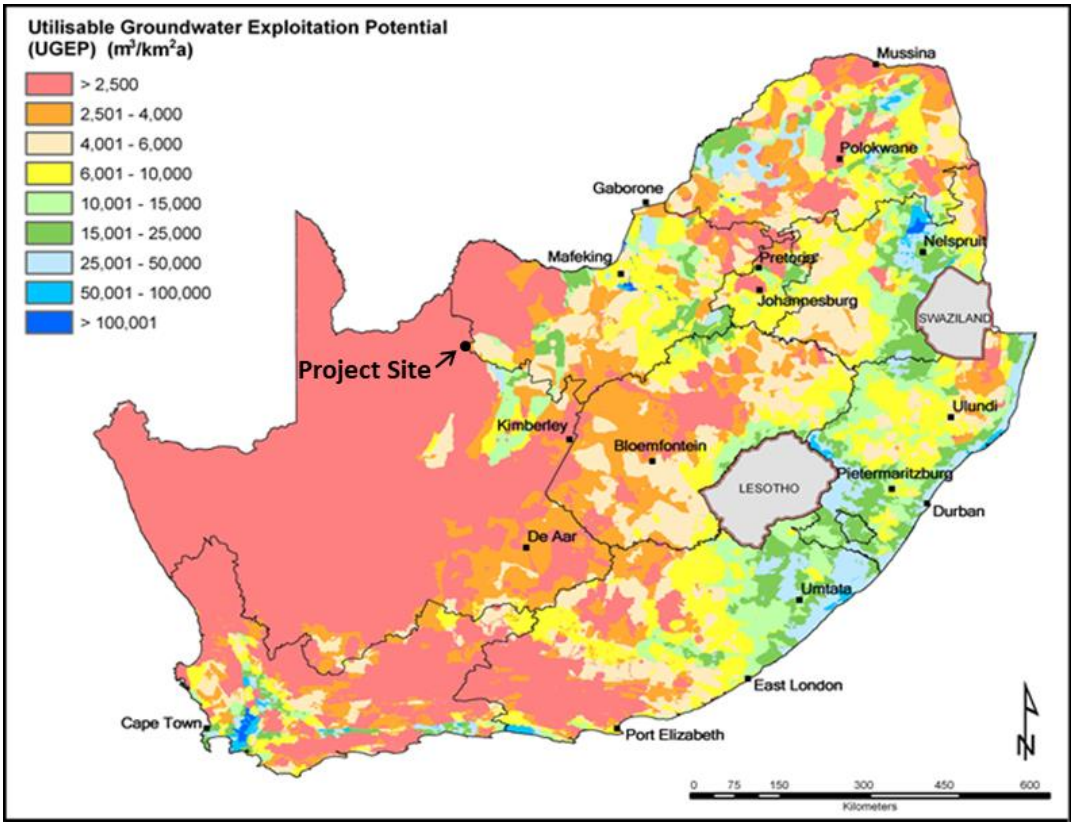

Figure 4: Utilisable groundwater exploitation potential, South Africa (Department of Water Affairs)

Figure 4 above indicates that the utilisable groundwater exploitation potential in the area is rather low. The Developer will solicit the services of a consultant to undertake an assessment of groundwater resources that will include hydrocensus and yield test studies. Should borehole extraction prove to be a feasible water supply option for the proposed Hotazel Solar facility, then the formal processes will commence for registration of the necessary Water Use License (WUL) applications and the municipality will be notified accordingly.

5.3 RAINWATER

Figure 5 below depicts the average rainfall for the area over a 12-month period. This information was gathered from the weather station at Winton, situated approximately 46km from the proposed site. The average rainfall for Hotazel over a 12-month period is calculated to be approximately 343 mm. Figure 6 below depicts a mean annual runoff map of South Africa (Biodiversity GIS, 2007) in which it is shown that Hotazel may experience runoff of anywhere between 0 – 60 mm per annum.

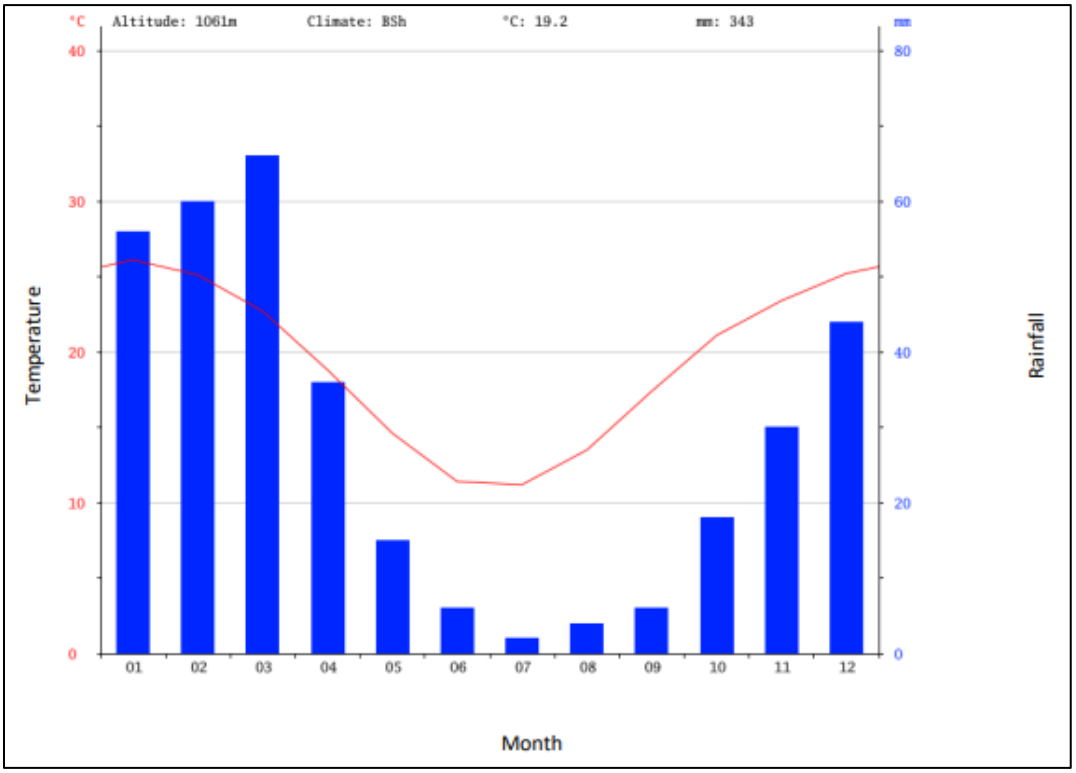

Figure 5: Average temperature and rainfall

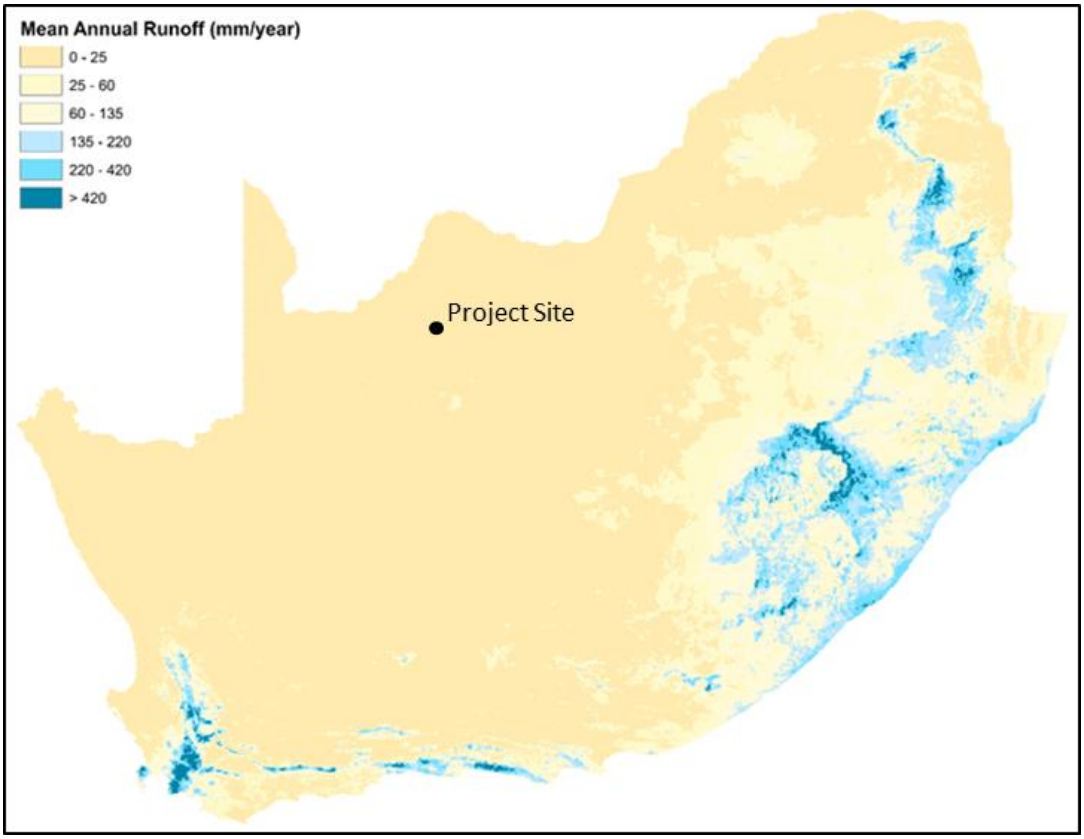

Figure 6: Mean Annual Runoff for South Africa (Biodiversity GIS, 2007)

5.4 FLOW ESTIMATE

As a minimum it is intended to catch and store rainfall that falls on the roof of the facility buildings. These calculations are indicative, and are based on the monthly average rainfall of 28.58 mm.

The Rational Method is used to calculate the rain flow: **Q = C x I x A**

Where:	**Q**	is	**Flowrate**
	C	is	the **Coefficient of Runoff**
	I	is	the **Intensity of the storm**, and
	A	is	the **Catchment Area**

For the roof, the coefficient of runoff, **C**, is equal to **1**.

The intensity of the storm, **I**, is equal to **0.0397 mm/hr**.

The dimension of the roof is:

- b = 30 m; 2a = 10 m; d = 0.6 m, with a total area of 300 m^2.

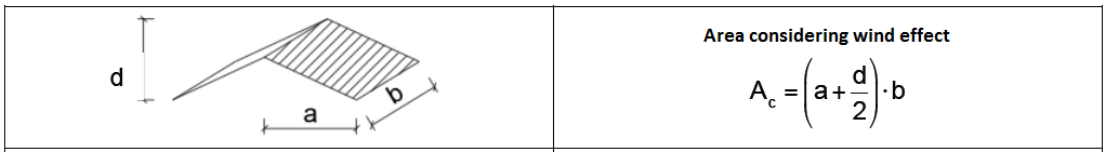

Figure 7: Wind effect formula

Taking the wind effect into consideration (see Figure 7), the rainfall catchment area, **A**, of the roof is reduced to **159 m^2**.

The total flowrate, **Q**, is equal to **0.006 m^3/hr**.

Therefore, for an average of 365 days it would be possible to accumulate 55.3 m^3 of rainfall, which meets only 5% of the annual sanitation water needs during operation of the solar energy facility, indicating that potable water will need to be trucked in to the facility.

6 LIST OF REFERENCES

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