Preliminary Water Consumption Study

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MOGARA SOLAR

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TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

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

1. PURPOSE AND SCOPE

This document defines the scope of the study for the definition of water needs and consumption during the **Construction Phase** and in the **Operation Phase** for Mogara Solar in the Northern Cape Province, South Africa.

2. LOCATION

Mogara Solar is proposed on the farms Portion 1 and Portion 2 of Legoko No 460, located in the District of Kuruman Rd, Northern Cape Province, within the jurisdiction area of the Gamagara Local Municipality. The properties total just under 2000 ha in extent and are located approximately 6 km South East of Kathu. The proposed development site in situated 5 km south east of the ESKOM Ferrum Substation located on the Farm Sekgame No. 461. Access to the site is provided via the N14 National Road that runs along the western boundary of the site.

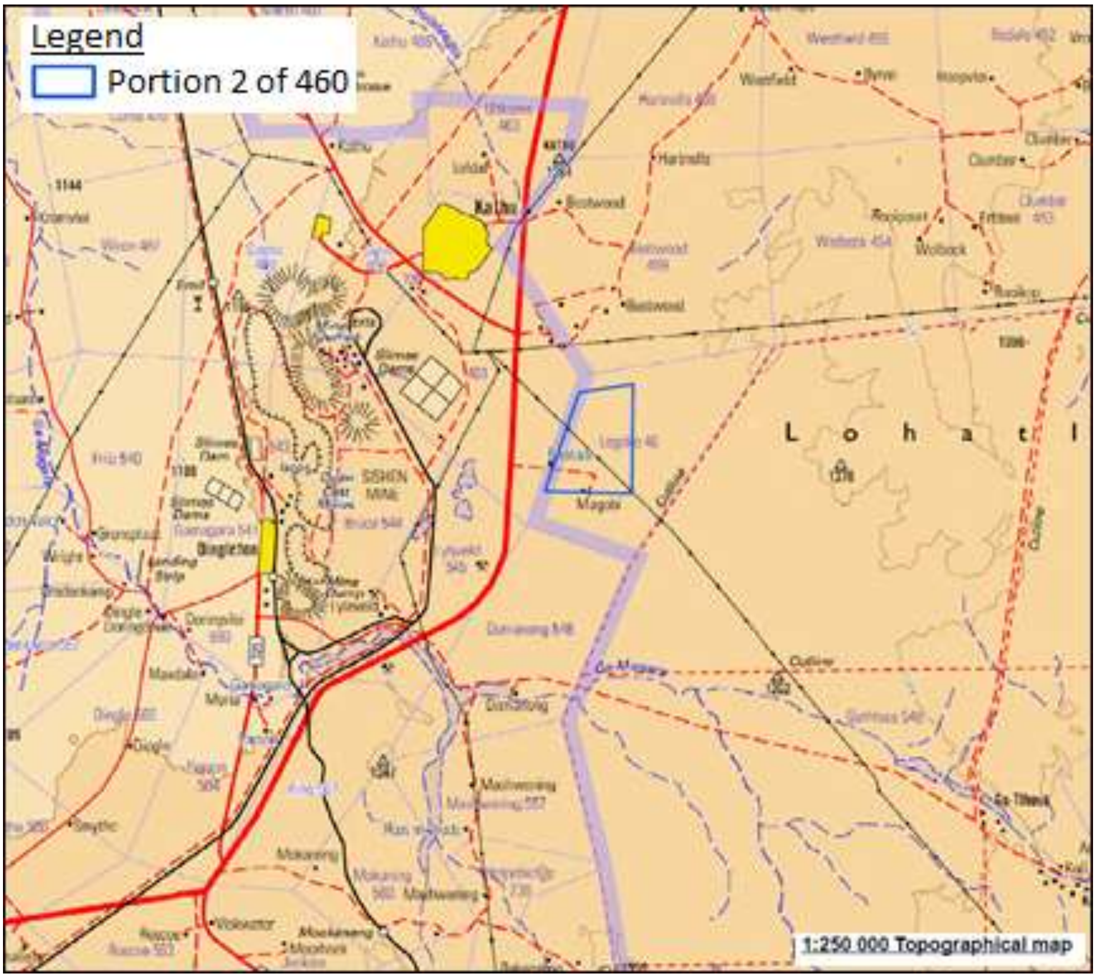


FIGURE 1: MOGARA SOLAR

3. BASIC DESCRIPTION OF THE FACILITIES

The solar photovoltaic (PV) plant will have a maximum installed capacity of 86.25 Megawatt (MW), with a net AC electrical generating capacity of 75 MW.

The main elements of Mogara Solar will be as follows:

- Modules (solar panels),
- Inverters,
- Transformers,
- Medium-voltage grid,
- Transformer Substation, and
- Internal and external roadways.

4. WATER NEEDS AND CONSUMPTIONS

4.1. INTRODUCTION

The estimates are based on two distinct phases, the first one being for the **construction** of the solar energy facility, and the second phase corresponding to the **operation and maintenance** of the installed energy-generating infrastructure.

4.2. CONSTRUCTION PHASE

The **Construction Phase** of Mogara Solar is broken down into two categories of requirements, **Sanitation** (drinking, cooking and cleaning) and **Construction Processes**. The construction duration of the SEF is estimated to be 18 months.

4.2.1. SANITATION WATER REQUIREMENTS

It is estimated that there will be approximately 500 workers on site at the peak of the construction period. The average number of construction workers on site per day is estimated to be approximately 250. 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 following calculations assume 50 litres/worker/day with the assumption that **portable chemical toilets** will be used at the construction site.

TABLE 1: CONSTRUCTION SANITATION WATER REQUIREMENTS

Consumption (Litres/worker/day)	**Construction Duration**	**Workers on site**	**Total Consumption** (Litres)	**Total Consumption** (m^3)
50	540 days	250	6,750,000	**6,750**

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 250 m^3 quantity has been allowed for other general uses such as concrete curing, road maintenance, terrain irrigation etc.

TABLE 2: CONSTRUCTION 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	35,000 m^3 of granular material	1,750,000	**1,750**
Others	-	-	-	**250**
TOTAL				**2,000**

Note: Recycled water as opposed to potable water may be used for the above construction processes.

4.3. OPERATIONAL PHASE

The **Operational Phase** of Mogara Solar is broken down into two categories of requirements, **Sanitation** (drinking, cooking and cleaning) and **Plant Maintenance** (module cleaning and road maintenance & irrigation). The construction duration of the SEF is estimated to be 18 months.

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 Mogara Solar 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 during the operational phase of the facility is calculated to be **1,095 m^3**.

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. The maximum allowable DC/AC ratio is 1.15. Therefore a plant with a net generating capacity of 75 MW corresponds to a total peak installed capacity of 86.25 MWp. Assuming a module size of 330 Wp, the facility will see 261,364 units installed. The estimated water consumption is calculated in the following table.

TABLE 3: 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)
261,364	1.95	3	1,528,979	2	**3,058**

Road maintenance

It is assumed that 200 m^3/year 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 of such would be a standard JoJo 5,000 Litre water tank measuring 1,820 mm in diameter and 2,100 mm 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 CONSUMPTIONS

The total water consumption estimated for the **Construction Phase** is **8,750 m^3**, for the total **18-month construction period**.

The total water consumption estimated for the **Operational Phase** is **4,353 m^3 per annum**, for the **20-year operational lifespan** of the SEF.

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 Mogara Solar facility will be located near Kathu in the Northern Cape Province. According to Figure 2 below, the area may have a groundwater occurrence of between 0.1 and 2 litres/second.

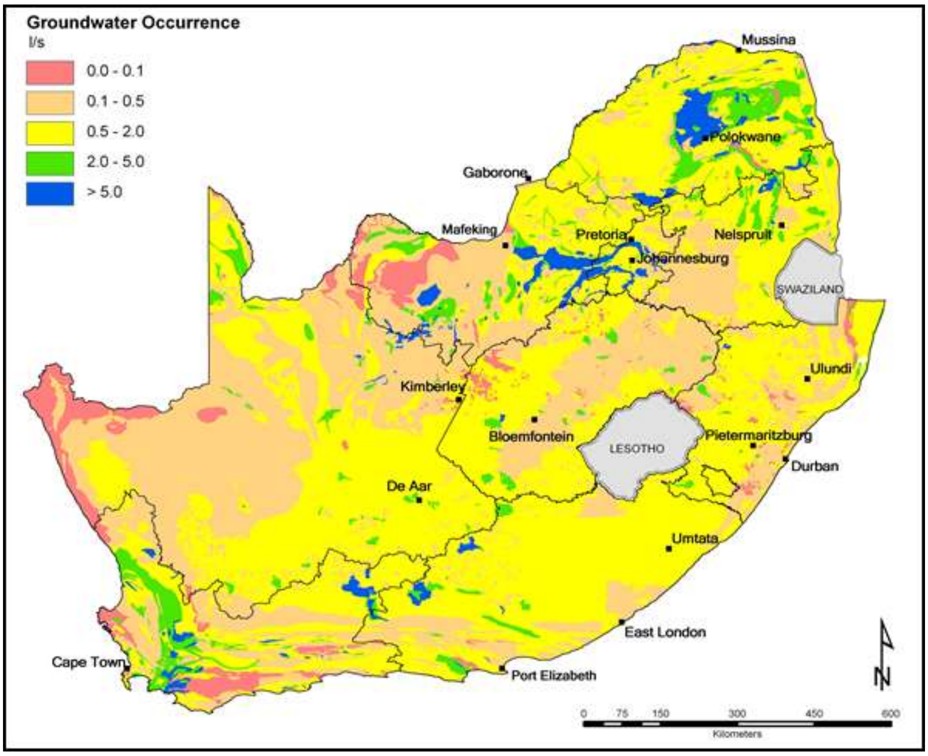


FIGURE 2: GROUNDWATER OCCURENCE IN SOUTH AFRICA (DEPARTMENT OF WATER AFFAIRS)

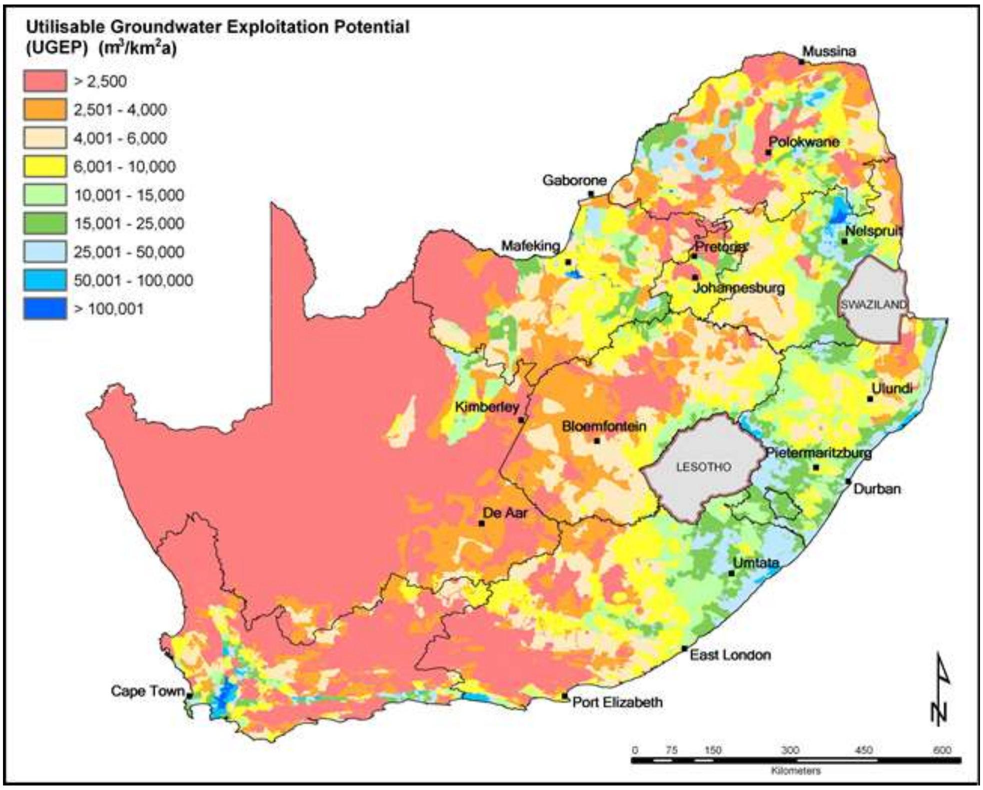


FIGURE 3: UTILISABLE GROUNDWATER EXPLOITATION POTENTIAL, SOUTH AFRICA (DEPARTMENT OF WATER AFFAIRS)

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 Mogara Solar facility, then the formal processes will commence for registration of the necessary water use license (WUL) applications and the municipality notified accordingly.

5.3. RAINWATER

Figure 3 below (World Weather Online, 2018) depicts the average rainfall amount and rainy days in Kathu over the past 12 months. The average rainfall for Kathu over a 12 month period is calculated to be 32.8 mm. Figure 4 below depicts a mean annual runoff map of South Africa (Biodiversity GIS, 2007) in which it is shown that Kathu may experience anywhere between 0 – 60 mm/year runoff.

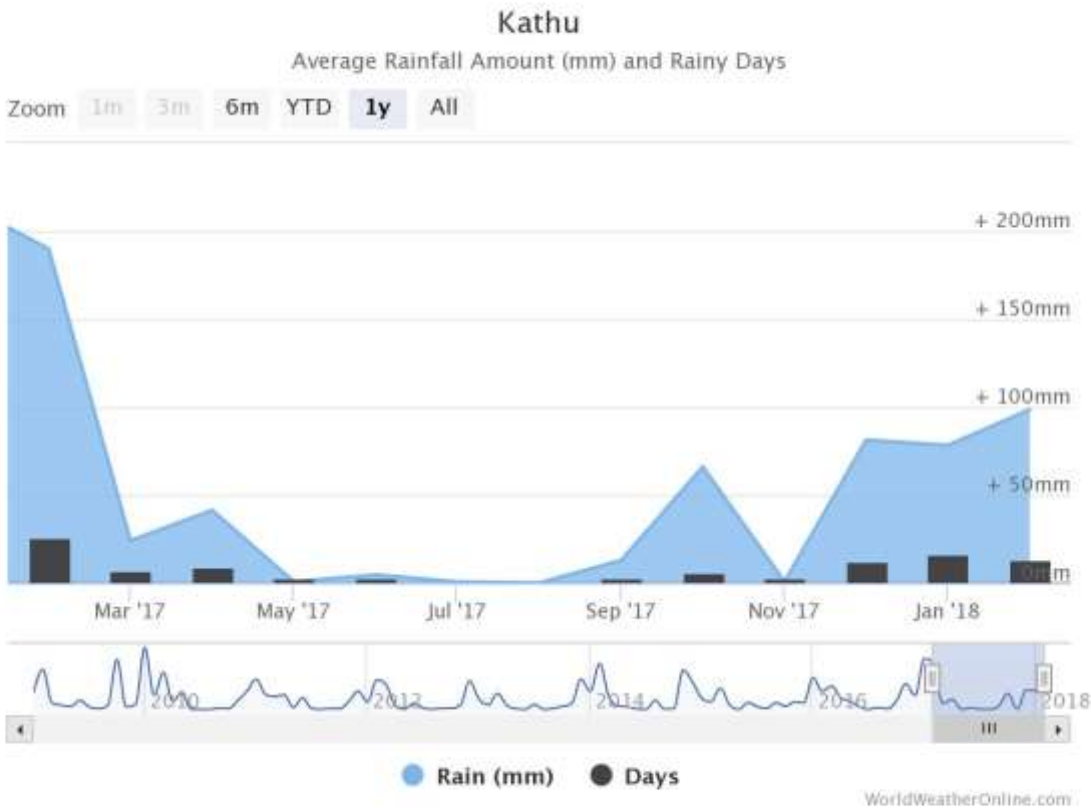


FIGURE 4: AVERAGE RAINFALL AMOUNT (MM) AND RAINY DAYS (WORLD WEATHER ONLINE, 2018)

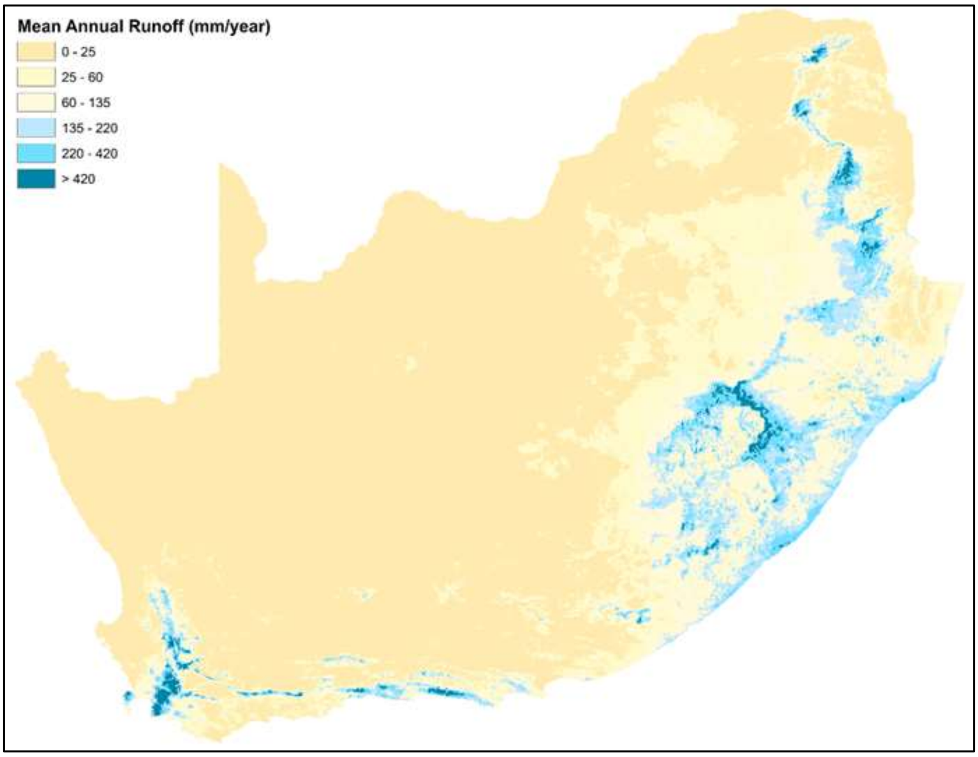


FIGURE 5: MEAN ANNUAL RUNOFF FOR SOUTH AFRICA (BIODIVERSITY GIS, 2007)

5.4. FLOW ESTIMATE

As a minimum it is intended to catch and store rainfall that falls on the roof of the substation building. These calculations are indicative, and are based on the monthly average rainfall of 32.8 mm.
The Rational Method is used to calculate the rain flow: **Q = C x I x A**

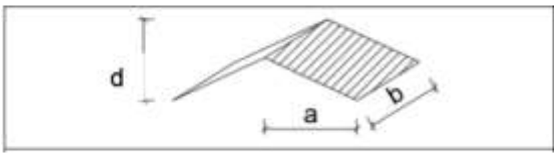
Where:	**Q**	is	**Flowrate**
	C	is	the **Coefficient of Runoff**
	I	is	the **Intensity of the storm**, and
	A	is	the **Catchment Area**

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

The Intensity of the storm, **I**, is equal to **0.046 mm/hr**.

The dimension of the roof is:

- b = 33 m; 2a = 8.55 m; d = 0.6 m, with a total area of 282,15 m^2.



$$A_c = \left(a + \frac{d}{2}\right) \cdot b$$

FIGURE 6: WIND EFFECT FORMULA

Taking wind effect into consideration (see Figure 5), the rainfall catchment area, **A**, of the roof is reduced to **151 m^2**.

The total flowrate, **Q**, is equal to **0,007 m^3/hr**.

Therefore, for an average of 365 days it would be possible to accumulate 60.8 m^3 of rainfall, which meets only 5.6% 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

Biodiversity GIS. (2007). *Strategic Water Source Areas (SWSA)*. Retrieved January 20, 2014, from Biodiversity GIS: http://bgis.sanbi.org/NFEPA/SWSAmap.asp

Department of Water Affairs. (n.d.). *Groundwater Occurence.* Eastern Cape Office.

UN-Water. (n.d.). *Statistics: Graphs and Maps*. Retrieved January 17, 2014, from UN-Water: http://www.unwater.org/statistics_san.html

WORLD WEATHER ONLINE. (n.d.). *Average Rainfall Amount (mm) and Rainy Days.* Retrieved 12 April 2018, from WORLD WEATHER ONLINE: http://www.worldweatheronline.com/Kathu-weather-averages/Northern-Cape/ZA.aspx