APPENDIX K

Surface Water Assessment

REPORT

April 2016

ACWA POWER AFRICA HOLDINGS (PTY) LTD

Surface Water Baseline and Impact Assessment Report for the Proposed 75 MW PV 1 Solar Facility (Proposed Bokpoort II Solar Development) near Groblershoop, Northern Cape

Submitted to:
ACWA Power Africa Holdings (Pty) Ltd

Report Number: 1400951-300592-9

Distribution:

1 Copy - ACWA Power Africa Holdings (Pty) Ltd
1 Electronic copy - ProjectReports@golder.co.za

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

ACWA Power Africa Holdings (Pty) Ltd (hereafter referred to as ACWA Power) is proposing to establish a solar facility (proposed Bokpoort II Solar Development) on the north-eastern portion of the Remaining Extent (RE) of the Farm Bokpoort 390 near Groblershoop in the Northern Cape.

The proposed Bokpoort II Solar Development consists of three separate applications for environmental authorisation. ACWA Power is proposing to construct two (2) 75 Mega Watt (MW) photovoltaic (PV) facilities and one (1) 150 MW Concentrated Solar Power (CSP) Tower facility. The combined power generation capacity of the entire Bokpoort II solar development will be 300 MW. Each of the solar technologies will have separate associated infrastructure that will not overlap in footprint.

Golder Associates was tasked to assess the following surface water aspect associated with the proposed Bokpoort II Solar development:

- Whether the water demand requirements were able to integrate into the current and future status of the Orange Water Management Area;
- Potential sources of surface water pollution associated with the proposed development; and
- Storm water management requirements associated with the proposed development.

This report addresses the surface water baseline and impact assessment for the proposed 75 MW photovoltaic facility (PV1).

2.0 SCOPE OF WORK

- Surface Water Baseline Assessment:
  - Compiling a map showing the catchment areas, site infrastructure and the major surface water drainage lines;
  - The available daily rainfall data will be collected and checked for integrity. The rainfall data will be patched to produce a daily rainfall record for use in surface water modelling;
  - Rainfall statistics such as monthly averages, number of rain days per month, distribution of annual totals and the 2, 5, 10, 20, 50, 100 and 200 year recurrence interval 24 hour storm depths will be determined;
  - The available climate data will be collected and reviewed to produce monthly potential evaporation and temperature statistics based on regional and local climatic data;
  - The surface water resources in the study area will be mapped and described;
- Current and Future Water Requirements
- Identify current and future water demands; Assessment of potential sources of surface water pollution; and
- Assess storm water management requirements.

3.0 REGIONAL DESCRIPTION

The Bokpoort II Solar Development project is situated in the Lower Orange Main Stem Catchment (116539) and is governed by the Orange Water Management Area (WMA). The Bokpoort II Solar Development project is approximately 80km south east of Upington and approximately 10km north east of the Orange River in the iKheis Local Municipality in the ZF Mgcawu District municipality. The catchment is still largely undeveloped with limited water resources and water uses. The project site is situated in the D73D quaternary catchment.

Figure 1 illustrates the Orange WMA, Figure 2 denotes the catchment area affecting the project site and Figure 3 represents the locality map of the project site and indicates where local weather stations reside.

Figure 1: Orange Water Management Area

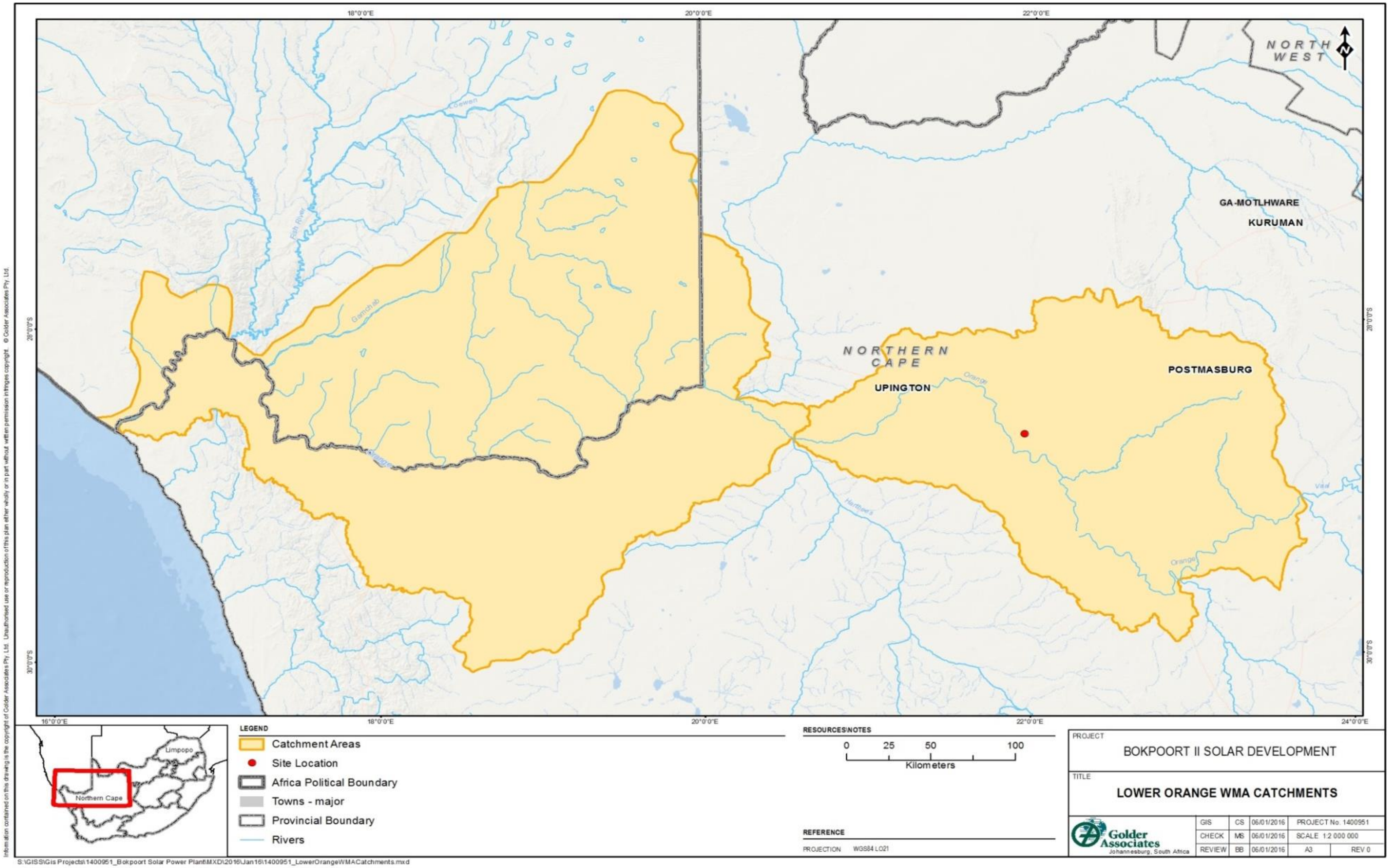


Figure 2: Lower Orange Main Stem catchment area

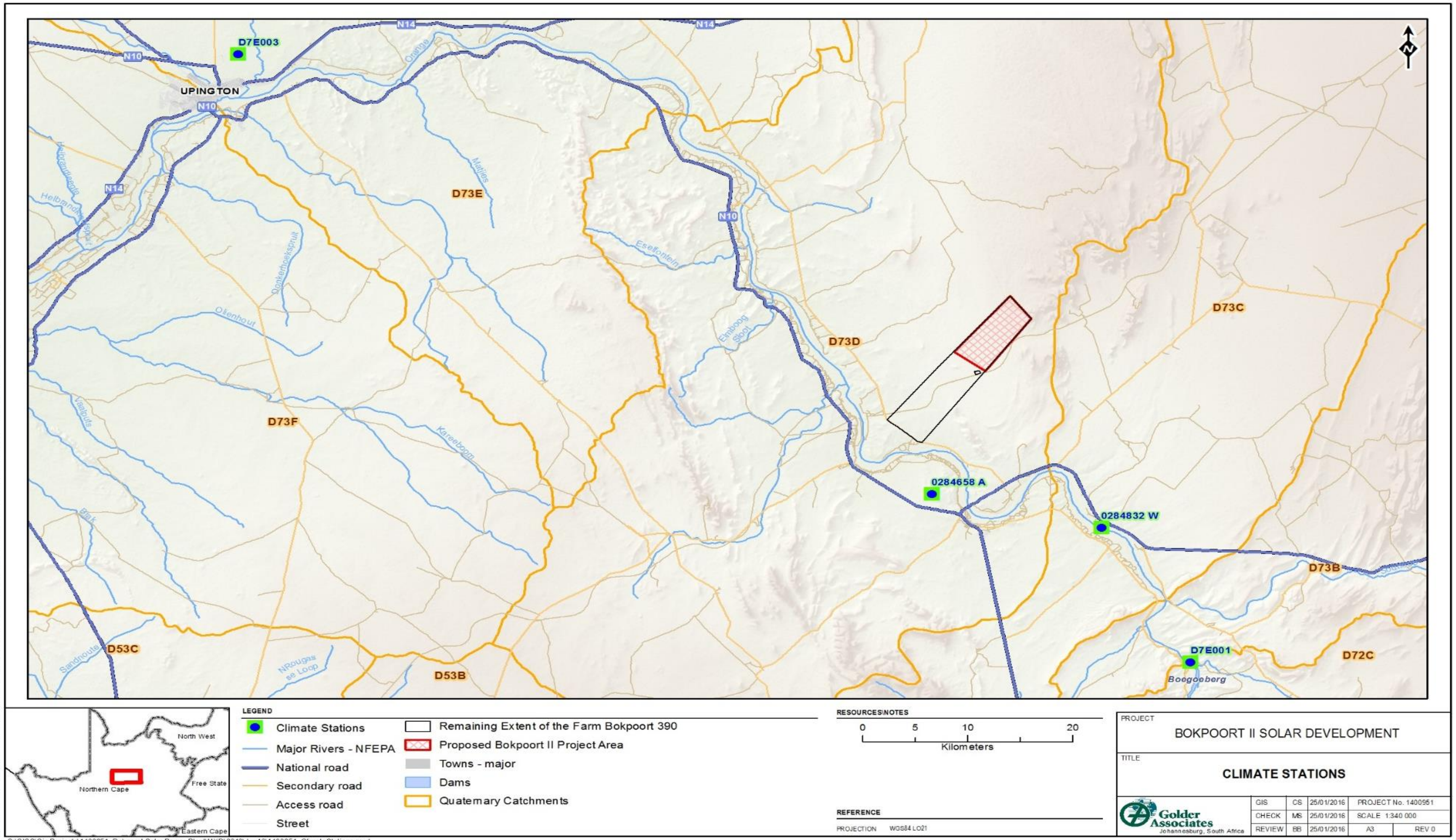


Figure 3: Locality map of the Bokpoort II Solar Development Project

4.0 WATER RESOURCE CLASSIFICATION

Classification of water resources aims to ensure that a balance is reached between the need to protect and sustain water resources on the one hand and the need to develop and use it on the other. The Water Resource Classification System (Department of Water Affairs and Forestry, 2007) places the following principles at the forefront of implementation:

- Maximising economic returns from the use of water resources;
- Allocating and benefits of utilising the water resources fairly; and
- Promoting the sustainable use of water resources to meet social and economic goals without detrimentally impacting on the ecological integrity of the water resource.

The Resource Classification System is used to classify each quaternary catchment in South Africa in either a Class I, II or III, defined as:

- Class I - Minimally used: Water resource is one which is minimally used and the overall condition of that water resource is minimally altered from its pre-development condition;
- Class II - Moderately used: Water resource is one which is moderately used and the overall condition of that water resource is moderately altered from its pre-development condition; and
- Class III - Heavily used: Water resource is one which is heavily used and the overall condition of that water resource is significantly altered from its pre-development condition.

Water Resource Classification has not yet been undertaken in the Orange River. In this respect the Resource Water Quality Objectives (RWQO) that were developed as part of the Water Resources Planning project for the Upper and Lower Orange River in 2009 (DWAF, 2009) have been used against which to compare the water quality of the river.

5.0 WATER QUALITY

There are two Department of Water and Sanitation monitoring points in the Orange River: D7H8, upstream of the site and D7H5, downstream of the site at Upington. The water quality at both points is good when compared against the interim RWQO developed as part of the Water Resources Planning project for the Upper and Lower Orange River in 2009 (DWAF, 2009). The water is however slightly alkaline and nitrate and orthophosphate exceed the limits set which would lead to eutrophication in the river.

The water quality requirement for the proposed project may however be stricter than that abstracted so that some kind of treatment may still be needed.

Table 1: Water quality in the Orange River at DWS monitoring points compared against the interim RWQOs

Parameter	Units	Interim RWQO*	Upstream (D7H8)			Downstream (D7H5)		
			5	50	95	5	50	95
pH		7.1-8.4	7.26	8.13	8.55	7.19	8.14	8.45
Electrical Conductivity	mS/m	70	18.47	26.40	47.64	21.10	32.30	55.83
Total Dissolved Solids	mg/L	400	145.00	197.22	317.46	151.95	228.00	374.19
Calcium	mg/L	80	18.50	23.70	33.75	19.24	25.71	35.69
Chloride	mg/L	100	5.00	13.49	40.93	7.68	17.85	48.09
Fluoride	mg/L	0.7	0.12	0.20	0.34	0.16	0.23	0.41
Potassium	mg/L	15	1.26	1.92	4.26	1.40	2.24	4.29
Magnesium	mg/L	30	6.87	9.70	16.89	7.26	11.40	20.67

Parameter	Units	Interim RWQO*	Upstream (D7H8)			Downstream (D7H5)		
			5	50	95	5	50	95
Sodium	mg/L	70	7.20	13.50	33.44	9.44	18.10	44.14
Ammonia	mg/L	0.015	0.02	0.04	0.12	0.02	0.03	0.11
Nitrate	mg/L	0.2	0.02	0.24	0.67	0.02	0.18	0.81
Orthophosphate	mg/L	0.02	0.01	0.02	0.06	0.01	0.02	0.08
Silica	mg/L	20	3.22	6.80	8.55	2.60	6.71	8.63
Sulphate	mg/L	80	7.21	20.10	59.61	8.60	23.90	64.65
Total Alkalinity	mg/L	300	73.70	92.20	113.76	70.47	104.70	139.27

*the stricter of the RWQOs set at the two points has been chosen

6.0 ASSESSMENT OF CLIMATE DATA

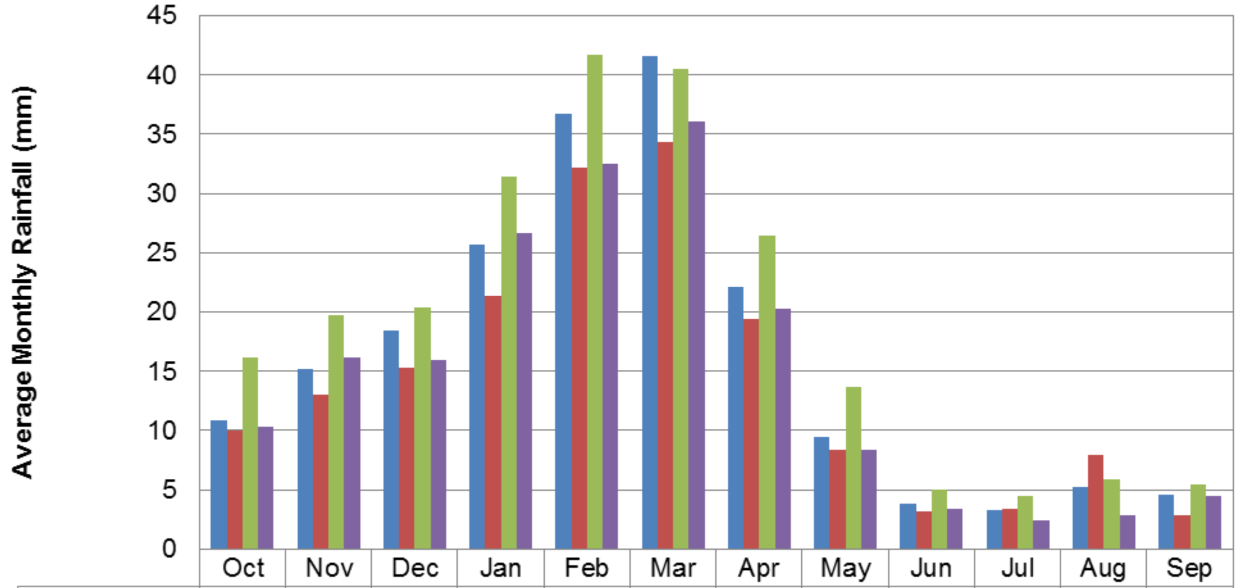
Climate data in the area around the project site was sourced from the Daily Rainfall extraction utility (Kunz, 2004) and the Department of Water and Sanitation's website (Department of Water Affairs, 2008) . The rainfall stations are presented in Table 2.

Table 2: Rainfall Stations

Station	Name	Altitude (masl)	From	To	No of Years	MAP(mm)
0284658 A	Opwag	939	1972	1999	29 (0% patched)	197
0284832 A	Grobelershop (pol)	880	1900	1999	99 (49.5% patched)	171
D7E001	Boegoeberg Res @ Boegoeberg Dam	980	1930	2014	84	231
D7E003	P V Ryneveld Airport @ Upington	830	1902	2004	102	179

Figure 4 shows the monthly rainfall distribution for the five rainfall stations in the region and Figure 5 illustrates the cumulative plots for the four rainfall stations in the region. The monthly rainfall is seen to be fairly uniform with low peaks. The D7E001 station (Boegoeberg Res @ Boegoeberg Dam) was chosen as the station used in the study for the following reasons:

- D7E001's rainfall record is of a long duration;
- The station D7E001 is seen to be still active such that recent rainfall data is available;
- The patched data applied to the D7E001 records is minimal, thus providing a reliable set of data; and
- The D7E001 station's MAP falls within a suitable range of nearby stations.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Opwag	10.82	15.14	18.44	25.68	36.69	41.57	22.14	9.43	3.78	3.24	5.18	4.59
Groblershop	10.01	13.04	15.26	21.38	32.21	34.34	19.45	8.36	3.14	3.37	7.98	2.88
D7E001	16.16	19.69	20.39	31.47	41.73	40.52	26.44	13.62	5.00	4.45	5.90	5.44
D7E003	10.35	16.21	15.91	26.69	32.48	36.07	20.25	8.34	3.37	2.45	2.84	4.47

Figure 4: Monthly rainfall distribution for rainfall stations in the surrounding area

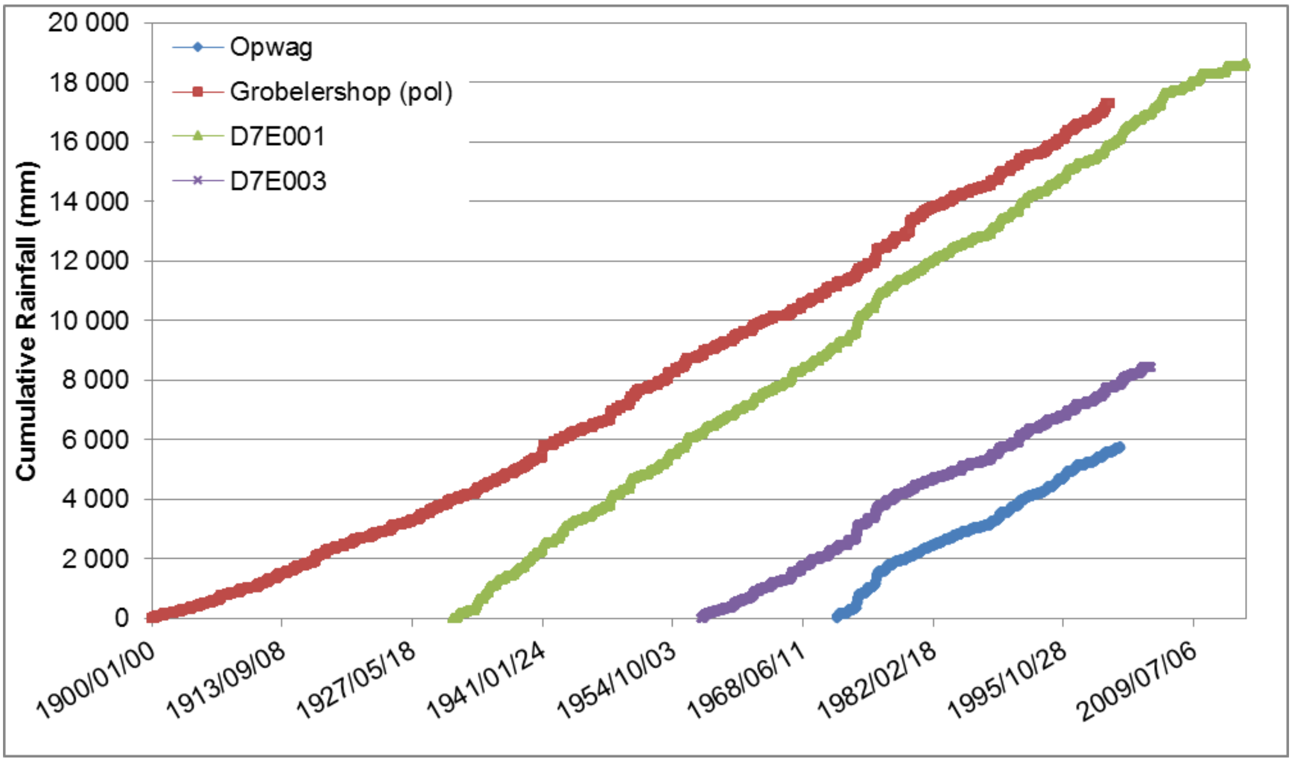


Figure 5: Cumulative rainfall for the rainfall stations in the Bokpoort area

Figure 6, Figure 7 and Figure 8 indicate the daily rainfall, monthly boxplot, and annual rainfall for the D7E001 rainfall station respectively.

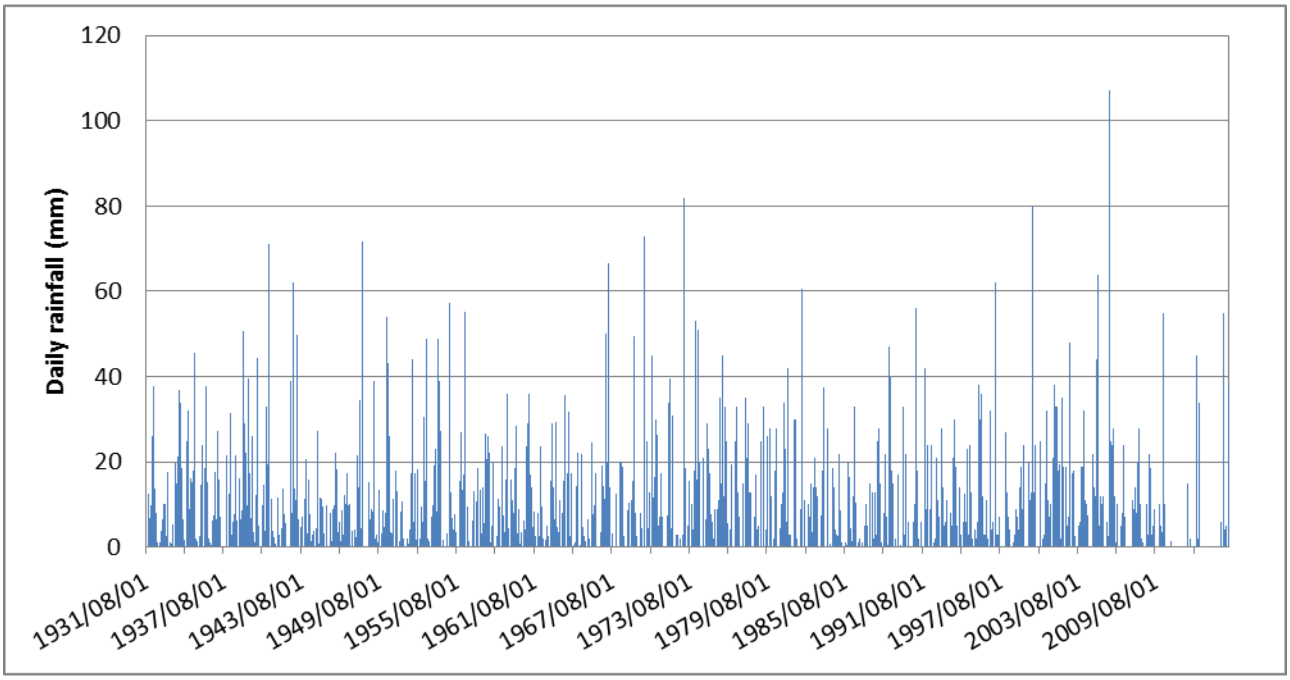


Figure 6: Daily rainfall for the D7E001 station

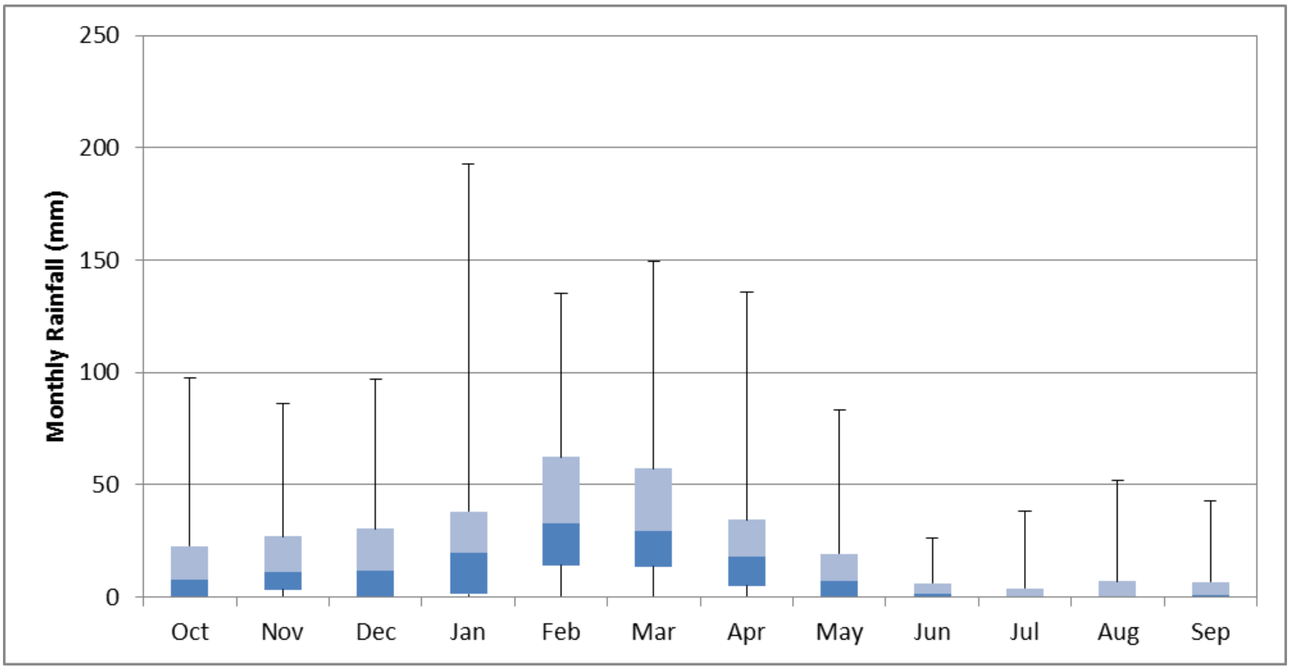


Figure 7: Monthly box plot averages for the D7E001 station

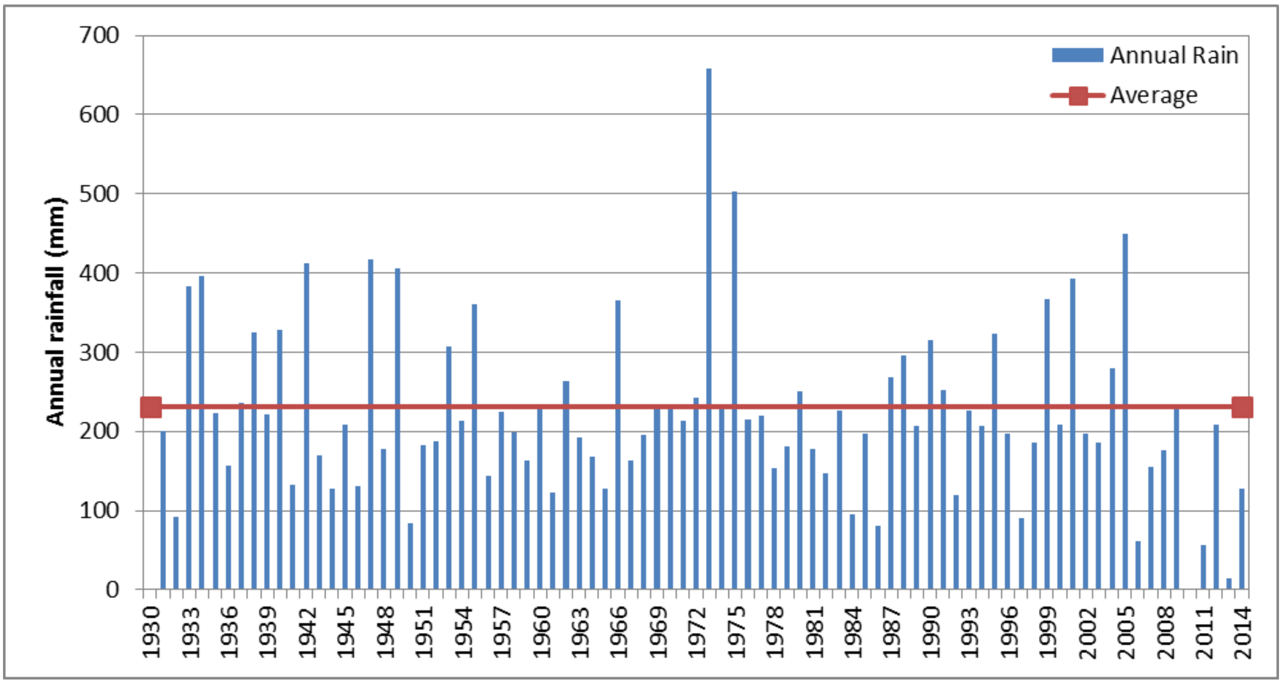


Figure 8: Annual rainfall for the D7E001 station

The highest rainfall year was in 1973 with 658 mm of rain in that year. The average Mean Annual Precipitation (MAP) for the D7E001 weather station indicates a low 190 mm.

The 5, 50 and 95 percentiles of the annual rainfall totals for the rainfall station are presented in Table 3. Figure 9 shows the cumulative distribution function of the annual rainfall totals measured at the D7E001 station.

Table 3: 5, 50, and 95 percentile of the annual rainfall totals

Station Number	Station name	5th percentile	50th percentile	95th percentile
D7E001	Boegoeberg Res.	81	208	412

Table 3 indicates the following occurrences at D7E001, based on the data collected at the station:

- There is a 95% chance that the station will experience an annual rainfall of 81 mm or more;
- There is a 50% chance that the station will experience an annual rainfall of 208 mm or more; and
- There is a 5% chance that the station will experience an annual rainfall of 412 mm or more.

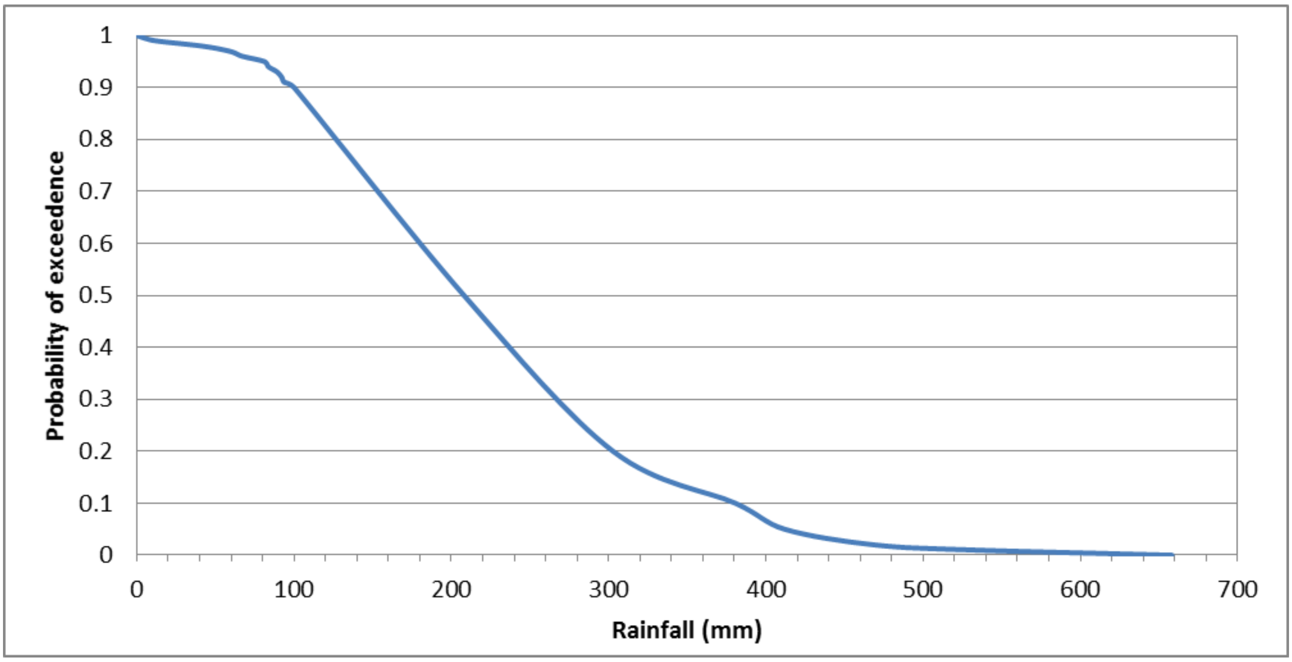


Figure 9: Probability of exceedance for the D7E001 station

At the D7E001 station, 23 events measured more than 50 mm/day and of the 23 events, 1 event measured over 100 mm/day. The following Table 4 shows the highest 5 recorded rainfall events at the D7E001 station.

Table 4: High Rainfall Events

Maximum Recorded Daily Rainfall (mm)	Date of Maximum Rainfall
107	2006/01/05
82	1973/02/15
80	2000/02/16
71.6	1948/04/16
71.1	1941/01/31

In order to determine the likely magnitude of storm events, a statistical approach, using the Reg Flood program (Alexander, van Aswegen, & Hansford, 2003) was applied to the available recorded daily rainfall depths. The maximum 24 hour rainfall depth for each year was analysed. The 24-Hour rainfall depths for the 1 in 2, 1 in 5, 1 in 10, 1 in 50, 1 in 100 and 1 in 200 recurrence intervals at the D7E001 station and is provided in Table 5.

Table 5: 24 Hour Rainfall Depths for Different Recurrence Intervals (mm/day)

Recurrence Interval (years)	1 in 2	1 in 5	1 in 10	1 in 20	1 in 50	1 in 100	1 in 200
24 Hour Rainfall Depth (mm)	35	41.5	62	73	85	97	107

7.0 TEMPERATURE

Temperature data was sourced for the Groblershoop area to represent the site area (World Weather Online, 2016) Temperature data is seen graphically in Figure 10. High average summer temperatures in the months of September to March range between 29^0 C and 37^0 C with winter temperatures in the months April to August ranging between 23^0 C and 30^0 C. Low average temperatures range between 14^0 C and 20^0 C with winter temperatures ranging between 4^0 C and 9^0 C.

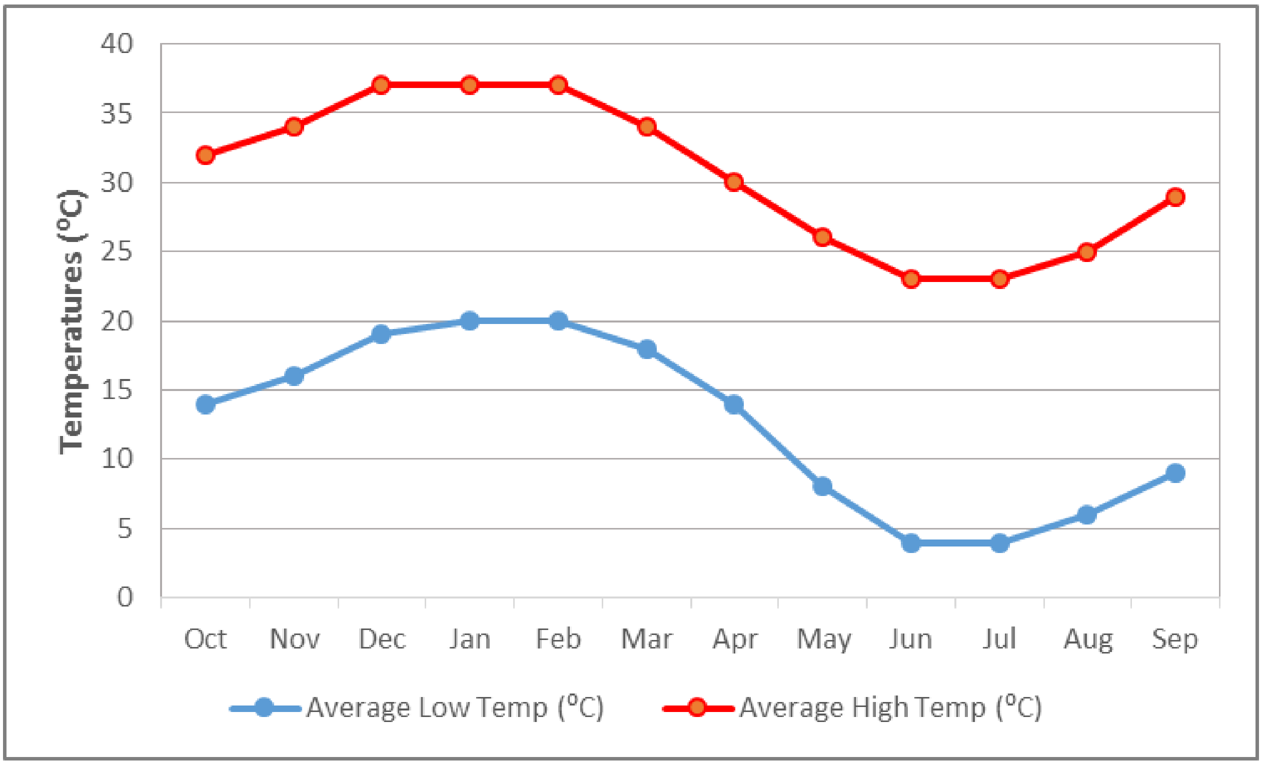


Figure 10: Average Temperature (ºC) Graph for Groblershoop.

8.0 POTENTIAL EVAPORATION

Monthly evaporation data were available from the DWS station D7E001, located approximately 40km south east of the project site. This station has an approximate Mean Annual Evaporation (MAE) of 2166.3 mm over a period of 1931-2008. Monthly mean, minimum and maximum evaporation depths are shown in Figure 11.

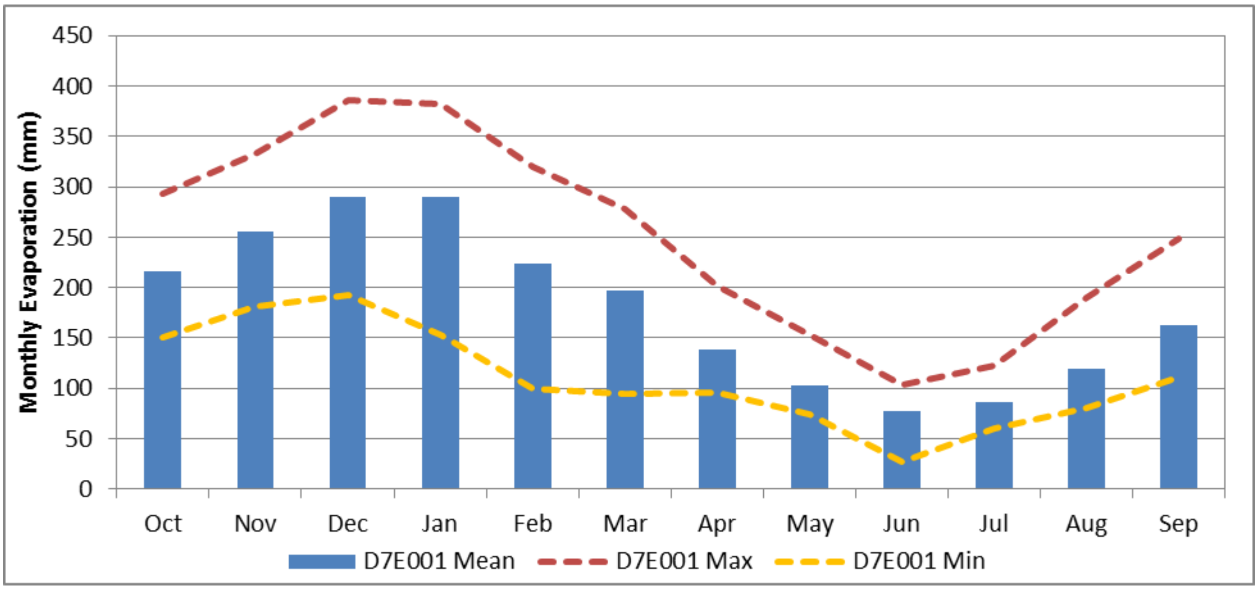


Figure 11: Monthly mean, minimum and maximum evaporation for station D7E001

Figure 11 shows that the highest evaporation occurs in the summer months of September to March. The average monthly evaporation values are shown in Table 6.

Table 6: Average month evaporation values for station D7E001

Month	Monthly Evaporation (mm)
Oct	216
Nov	255
Dec	290
Jan	290
Feb	223
Mar	197
Jun	139
Jul	103
Aug	77
Sep	87

9.0 SITE DESCRIPTION

The Orange River located west and southwest of the project area is the predominant perennial surface water feature in the vicinity of the proposed development. This section of the river falls in the Lower Orange Water Management Area (LOWMA). The Orange River is the main source of water for the ZF Mgcawu (previously referred to as the Siyanda) District and iKheis Local Municipality. The ZF Mgcawu District Environmental Management Framework cited that the evaporation rate in the LOWMA is estimated at 3000 mm which is much higher than the Mean Annual Rainfall. The banks of the Orange River are heavily used for irrigated agriculture.

The hydrological assessment conducted for the Bokpoort I EIA and satellite imagery review indicate that there are no areas of permanent surface water present on the site. Satellite imagery indicates some ephemeral drainage lines in the southern part of the proposed site, but these areas are only expected to contain flowing water during periods of exceptionally high rainfall. There are no significant wetlands, estuaries, Ramsar Sites or major dams present within the immediate vicinity of the study site. One seasonal pan occurs approximately 3km north of the Garona Substation and the Bokpoort I EIA indicates a 200m 'no development area' buffer demarcated around the pan. The smaller riparian systems in the region are impacted by livestock where natural habitats are grazed intensively.

The Orange River's water quality is categorised as Moderately Transformed (Class C) due to existing agricultural activities along the river banks. The Orange River's major inflow of water is from the Vaal River which has high nutrient levels which sometimes result in algal blooms. Slow water flow rates also cause siltation and turbidity of the water which leads to water quality degradation within the river.

A water pump will be installed in the Orange River to extract water for the proposed Bokpoort II development.

The area of quaternary D73D is 4291 km^2 (gross area). The area of the development is 24 km^2, 0.56% of the catchment. This indicates that area of development is small when compared to the quaternary catchment or to the water management area.

9.1 Potential Surface Water Impacts

The potential surface water impacts from the project, both direct and indirect, are summarised in Table 7. In summary these potential impacts contribute to overall surface water impacts and include:

- Change in surface water catchment areas;
- Changes in surface water quality;
- Change in surface water runoff; and

- Erosion.

The surface water quality impacts will ultimately impact on the Orange River and thus the downstream water users. The detailed impact assessment is outlined in Section 9.1.2.

Table 7: Summary of potential surface water impacts with respect to the Bokpoort Solar Development

Major aspect	Key Environmental Issues / Potential Impacts
Changes in surface water catchment areas	▪ Disruption and reduction in land due to construction of solar and associated infrastructure, and roads.
Changes in surface water quality	▪ Poor quality runoff from solar facility activities leaving residues on site such as lubricants used on cleaning panels left on site during storms; and ▪ Possible fuel and lubricants spillage from equipment and other chemical spills.
Change in surface water runoff	▪ Increased runoff due to vegetation and veld removal therefore decreasing infiltration into soil which may impact on downstream communities; ▪ Increased runoff due to large concrete terraces and roads; and ▪ Runoff impacts due to solar facility activities during operation and closure.
Erosion	▪ Erosion on site and surrounding areas may be increased due to site clearance of vegetation and veld.

9.1.1 Impact Assessment Methodology

The significance rating process for impacts follows the established impact/risk assessment formula described in Figure 12.

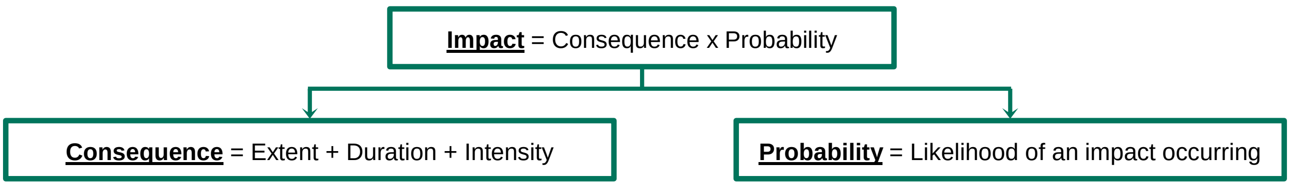


Figure 12: Impact / risk assessment formula

The significance of the impacts during the impact assessment phase was determined using the approach described in Table 8 and provides the method for defining intensity, geographic extent and duration.

Table 8: Impact assessment criteria

CRITERIA	DESCRIPTION			
EXTENT	**National (4)** The whole of South Africa	**Regional (3)** Provincial and parts of neighbouring provinces	**Local (2)** Within a radius of 2 km of the construction site	**Site (1)** Within the construction site
DURATION	**Permanent (4)** Mitigation either by man or natural process will not occur in such a way or in such a time span that the	**Long-term (3)** The impact will continue or last for the entire operational life of the development, but will be mitigated	**Medium-term (2)** The impact will last for the period of the construction phase, where after it will be entirely negated	**Short-term (1)** The impact will either disappear with mitigation or will be mitigated through natural process in a span

CRITERIA	DESCRIPTION			
	impact can be considered transient	by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory		shorter than the construction phase
INTENSITY	**Very High (4)** Natural, cultural and social functions and processes are altered to extent that they permanently cease	**High (3)** Natural, cultural and social functions and processes are altered to extent that they temporarily cease	**Moderate (2)** Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way	**Low (1)** Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected
PROBABILITY OF OCCURRENCE	**Definite (4)** Impact will certainly occur	**Highly Probable (3)** Most likely that the impact will occur	**Possible (2)** The impact may occur	**Improbable (1)** Likelihood of the impact materialising is very low

Low impact (3 - 6 points)	A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction or operating procedure.
Medium impact (7 - 9 points)	Mitigation is possible with additional design and construction inputs.
High impact (10 - 12 points)	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.
Very high impact (13 - 16 points)	Permanent and important impacts. The design of the site may be affected. Intensive remediation is needed during construction and/or operational phases. Any activity which results in a “very high impact” is likely to be a fatal flaw.

9.1.2 Surface Water Impacts

Table 9 sets out the detailed potential surface water impacts during construction, operation and at closure.

Table 9: Impact assessment during construction, operation and at closure

Aspect	Potential Impact	Extent	Duration	Intensity	Probability	Impact	Notes
CONSTRUCTION PHASE							
Water quality impacts due to runoff	■ Spillage of fuels, lubricants and other chemicals; and ■ Construction equipment, vehicles and temporary workshop areas will be a likely source of pollution as a non-point source. ■ Increased runoff due to vegetation and veld removal therefore decreasing infiltration into soil which may impact on downstream communities.	2	1	1	2	**8 - medium**	It is expected that without mitigation a **medium** negative impact can be expected. Mitigation will include: ■ Bunded areas to store chemicals and/or fuel; ■ Clean-up of spills as soon as they occur; and ■ Implementation of a Storm Water Management Plan (SWMP) as construction occurs. The significance of the impact after mitigation is likely to decrease to a **low** negative impact.
Decreased catchment area	Disruption and reduction in land due to construction of solar and associated infrastructure and roads.	2	2	1	1	**5 – low**	It is expected that without mitigation the impact is likely to be **low, as the percentage of the project area to the catchment is 0.56%**. Implementation of a well-designed SWMP will keep the clean water away from the project area to allow the maximum water to enter the environment, so that mitigation will reduce the impact to negligible.
Water quality impacts due to construction activities	Potential pollution transport via runoff of rainfall from disturbed areas during construction.	1	2	1	2	**8 - medium**	It is expected that without mitigation a **medium** negative impact can be expected. Mitigation will include: ■ Chemicals contained in bunded areas; ■ Spills cleaned up immediately; ■ A storm water management system that will route the clean storm water around the site Mitigation would reduce the impact to **low.**
Erosion of the watercourse	Erosion on site and surrounding areas may be increased due to site clearance of vegetation and veld.	1	1	1	1	**3 – low**	The low flow dynamics at the site will unlikely cause any surface water erosion and thus a **low** impact rating can be expected.
OPERATIONAL PHASE							
Changes in surface water quality	Potential poor quality runoff from solar panel site.	1	1	1	1	**3 – low**	Runoff from the site is expected to maintain a fair quality provided the site itself is kept in good condition.
Water quality impacts due to chemical spills/ equipment use	Spillage of fuels, lubricants and other chemicals.	2	1	1	2	**8 - medium**	It is expected that without mitigation a **medium** negative impact can be expected. Mitigation will include: ■ Clean-up of spills as soon as they occur; and ■ Maintenance of the abstraction pumps to prevent spills. The significance of the impact after mitigation is likely to decrease to a **low** negative impact.

Aspect	Potential Impact	Extent	Duration	Intensity	Probability	Impact	Notes
CLOSURE PHASE							
Demolition activities	Decommissioning may leave large barren areas that may increase erosion, which might increase the amount of suspended solids in downstream surface water.	1	1	1	1	**3 – low**	The total disturbed area is relatively small and it is likely that the impact will be minimal upon closure. However, the topography of the area should be, where possible, returned to pre-construction state. .

10.0 CURRENT AND FUTURE WATER REQUIREMENTS

This section summarises the current urban, industrial, agricultural and mining demands of the Lower Orange area as well as the projected future demands as determined by the Department of Water and Sanitation. During the assessment of available data, it was noted that the reports published by the Department of Water and Sanitation are dated 2014. However, the data set used for the report is based on 2013 data and is taken as the most current data available. The requirements of the Bokpoort II Solar Development project will also be described in this section.

The purpose of this section is to indicate whether there will be sufficient water supply for the proposed project.

10.1 Major Water Demands

Table 10 indicates the major water demands in the Lower Orange main stem (DWAF, 2013).

Table 10: Estimated Water Requirements of current users in the Lower Orange Main Stem (million m^3/a) (Department of Water Affairs, 2013)

Description	Area	2012	2015	2020	2025	2030	2035	2050
RSA Mining	Black Mountain Mine	1.916	13.916	13.916	13.916	13.916	13.916	13.916
RSA Mining	Alexander Bay Transhex Small Mines	5.047	5.214	2.869	3.026	3.184	3.342	3.500
RSA Urban	Prieshka Urban Demand	1.657	1.753	1.875	2.002	2.131	2.260	2.389
RSA Urban	Boegoeberg Small users	0.600	0.600	0.600	0.600	0.600	0.600	0.600
RSA Urban	Karos Geelkoppan	0.040	0.040	0.040	0.040	0.040	0.040	0.040
RSA Urban	Upington and Others	15.966	17.517	18.687	19.890	21.217	22.363	23.600
RSA Urban	Kakamas Urban Demand	2.327	2.536	2.758	2.974	3.199	3.424	3.649
RSA Urban	Pelladrift Water Board	2.035	2.078	2.118	2.163	2.209	2.255	2.302
RSA Urban	Namakwa Water Board	10.294	10.294	10.294	10.294	10.294	10.294	10.294
Namibia Mining	Haib Mine	0.000	3.000	3.000	3.000	3.000	3.000	3.000
Namibia Mining	Mines Rosh Pinah, Auchas, Skorpion	7.642	7.745	7.973	8.224	8.474	8.725	8.975
Namibia Urban	Aussenkehr Noordoewer	0.286	0.359	0.577	0.645	0.713	0.781	0.849
Namibia Urban	Urban Rosh Pinah, Skorpion, Oranjemund	8.482	8.581	8.802	8.829	8.857	8.884	8.911

10.2 New Water Users

DWS has recognised the potential for other projects in the area and have listed new projects and approved water use licenses. Table 11 represents the water requirements of new users and licenses which may impact the total water requirements in the Lower Orange Main Stem (DWAF, 2013).

Table 11: New water user requirements (million m^3/a) (Department of Water Affairs, 2013)

Project	2012	2015	2020	2025	2030
Olyvenhoutsdrift Solar park	0.01	0.249	0.488	1.716	2.907

Project	2012	2015	2020	2025	2030
(Assumed dry cooling)					
Konkoonsies Solar (License)	0.013	0.013	0.013	0.013	0.013
Aries Solar (License)	0.013	0.013	0.013	0.013	0.013
Solafrica (License)	0.875	0.875	0.875	0.875	0.875
Eskom Distribution division (License)	1.430	1.430	1.430	1.430	1.430
KaXu CSP (License)	0.011	0.011	0.011	0.011	0.011
Khi CSP (License)	0.022	0.022	0.022	0.022	0.022
Solar Capital (License)	0.028	0.028	0.028	0.028	0.028

10.3 Irrigation Water Demands

Irrigation in the Northern Cape, South Africa is considered a large consumer of the local water resources (Department of Water Affairs, 2013). Table 12 shows the total irrigation water volume estimates for the Lower Orange Catchment Management Areas. There is a base assumption that water demand for irrigation farming will not increase per annum.

Table 12: Total Irrigation Water Volume estimates (Department of Water Affairs, 2013)

Catchment	Field Requirement (million m^3/a)	Irrigated Area (ha)
Lower Orange Tributaries	19.8	1 32

10.4 Project Specific Water Demand

Once constructed, the Bokpoort II Solar Development will have specific water demands for cleaning of the proposed 75 MW PV1 solar facility. The water requirements for the PV1facility are shown in Table 13.

Table 13: 75 MW PVI Facility (Bokpoort II Solar Development) Requirement

Description	Water Demand (million m^3/a)
PV1	0.025

The proposed 75 MW PV1 facility is part of a larger proposed development project. Table 14 indicates the cumulative requirements of the entire Bokpoort II Solar Development

Table 14: Bokpoort II Solar Development Requirements

Description	Water Demand (million m^3/a)
Bokpoort II Solar Development Requirement	0.300

10.5 Urban Return Flows

Table 15 represents the return flow for 2012. Based on the percentage return flow (DWAF, 2013) a projection was created for return flow from Upington. These estimated values are represented in Table 16

Table 15: Main Urban Return Flows (Department of Water Affairs, 2013)

Sub System	Description	2012 Gross Demand (million m^3/a)	2012 Return Flows (million m^3/a)	Percentage Return Flow (%)
Lower Orange Main Stem	Upington	14.64	5.22	35.7

Table 16: Projected Urban return flows (million m^3/a) (Department of Water Affairs, 2013)

Description	2015	2020	2025	2030	2035	2050
Upington	5.74	6.12	6.51	6.95	7.32	7.73

10.6 Environmental Flow Requirements

Environmental flow in a river is the flow required to maintain the ecosystem in a negotiated ecological condition. Environmental requirements are dependent on the natural flow generated in the upstream catchments and therefore differ from month to month and for each year. Various parties including, but not limited to, The Lesotho Highlands Development Authority (LHDA), the governments of Lesotho, South Africa, Namibia, the World Bank have agreed that environmental flows should reside between 19% and 40% of the mean annual runoff. Table 17 indicates the average natural runoff into the area and the environmental flow requirements.

Table 17: Environmental Requirements (Department of Water Affairs, 2013)

Description	Natural Runoff from Catchment Area (million m^3/a)	Estimated Required Environmental Flow (million m^3/a)
Lower Orange Main stem	135	25.650 – 54.000

10.7 Total Predicted Water Demand, Inflow and Water Balance

Table 18, Table 19 and Table 20 indicates the estimated total demands, estimated inflow of water into the Lower Orange WMA, and the final water balance of the known flows in the area.

Table 18: Total Predicted Water Demands on the Lower Orange WMA (Department of Water Affairs, 2013)

Description	2020 (million m^3/a)	2025 (million m^3/a)	2030 (million m^3/a)
RSA Urban industrial demands	36.4	37.9	39.6
Namibia Urban Industrial Demands	9.38	9.47	9.57
RSA Mining	16.8	16.9	17.1
Namibia Mining	10.9	11.2	11.5
Irrigation Farming	19.8	19.8	19.8
New developments	2.88	4.11	5.3
PV1	0.025	0.025	0.025
Environmental demand (Average)	39.8	39.8	39.8

Table 19: Total Return Flow to the Lower Orange WMA (Department of Water Affairs, 2013)

Description	2020 (million m^3/a)	2025 (million m^3/a)	2030 (million m^3/a)
Natural Runoff	135	135	135
Upington Return Flow	6.5	6.9	7.3

Table 20: Water Balance for the Lower Orange WMA (Department of Water Affairs, 2013)

Description	2020 (million m^3/a)	2025 (million m^3/a)	2030 (million m^3/a)
Total Inflows	141.5	141.95	142.32
Total User Demands	136.04	139.37	142.70
Net Balance	5.47	2.58	-0.38
Net Balance with PV2 and CSP implementation	5.19	2.31	-0.65

11.0 STORM WATER MANAGEMENT

The PV1 facility requires a storm water management plan (SWMP) to mitigate flows to key infrastructure and to prevent clean storm water interacting with potentially polluted runoff water. There are no regulations specifically for solar power facilities giving guidance on the design criteria for sizing stormwater management infrastructure. In the absence of a specific guidelines, the mining Regulation 704 which is used in the power sector was used. Regulation 704 states that: "*every person in control of an activity must design, construct, maintain and operate any dirty water system at the activity so that it is not likely to spill into any clean water system more than once in 50 years*".

11.1 Proposed stormwater channel diversions

The proposed channel diversions are described below. The proposed region for the PV1 facility was discretised into sub-catchments based on the topography of the region. The sub-divided catchments are shown in Figure 13.

Stormwater is only diverted if required such that natural flow is not impeded unnecessarily. Key infrastructure that could generate polluted runoff was identified as the, local infrastructure and the onsite Eskom run substation. The stormwater runoff being generated from the surrounding catchments will be collected, contained and diverted around the, local infrastructure and substation. The locations of the channels are shown in Figure 13. The diverted water will then be discharged back into the environment which will flow naturally back to the Orange River.

- The stormwater runoff from sub-catchment S2 will be diverted away in a south westerly direction from the local infrastructure by means of the channel C1;
- The stormwater runoff from sub-catchment S1 will be diverted away in a southern direction from the local infrastructure by means of the channel C2;
- The stormwater runoff from sub-catchment S3 will be diverted away in a south westerly direction from the substation and local infrastructure by means of the channel C3;
- The stormwater runoff from sub-catchment S4 will be diverted away in a south westerly direction from the substation and local infrastructure by means of the channel C4.

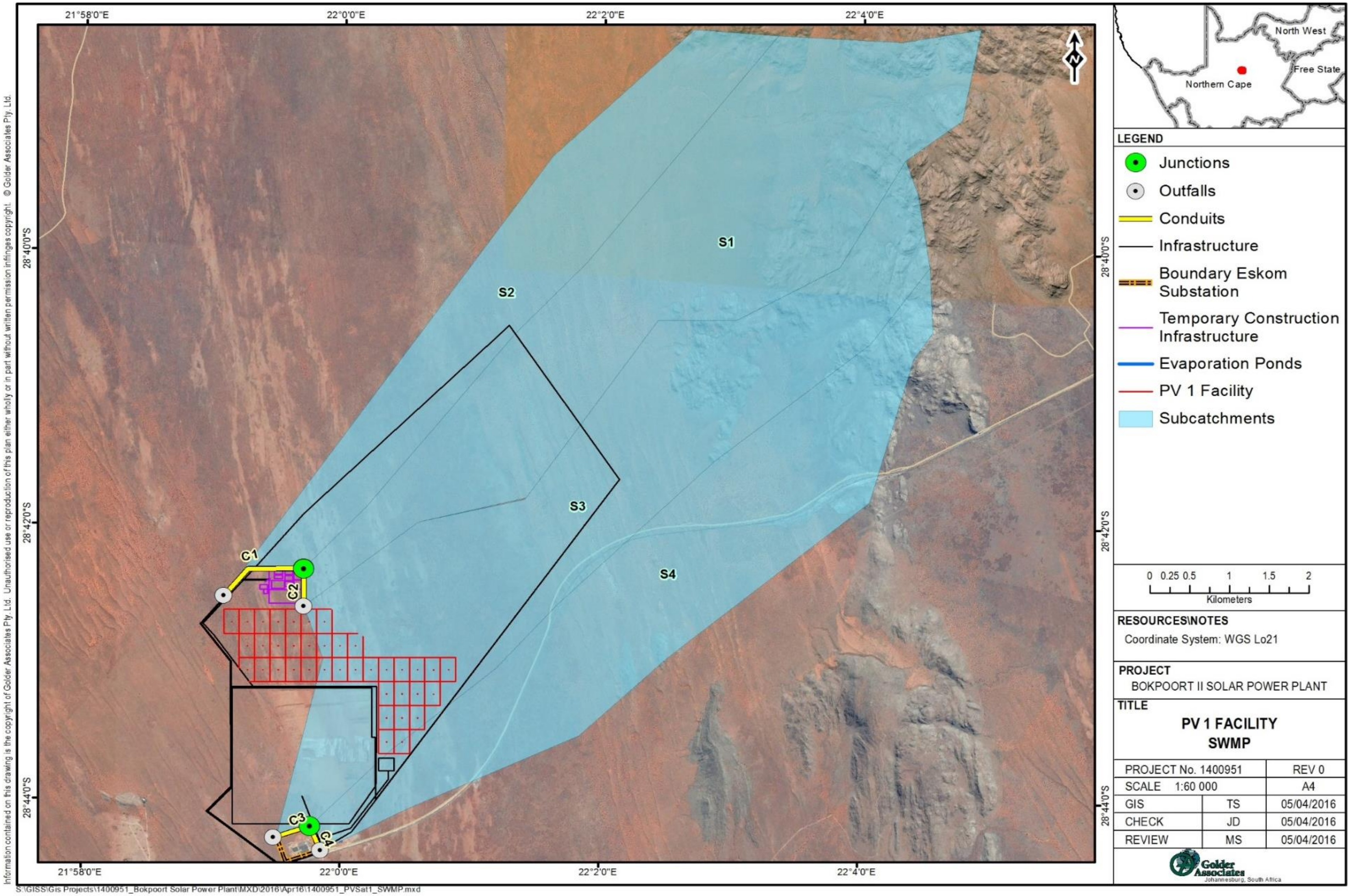


Figure 13: Proposed storm water management plan for the PV1 Facility

11.2 Modelling the stormwater diversion system

The PCSWMM model was used as the flood analysis model. PCSWMM is a dynamic rainfall-runoff simulation model used for single event or long-term simulation of runoff quantity (James, Rossman, & James, 2010). A model was set up for the site and the scenario described in 11.1 was generated.

11.2.1 Sub-catchment characteristics

The parameters used to model the overland and channel flow are given in Table 21. The Manning's 'n' coefficient used in the model for the impervious areas was taken as 0.016 and the coefficient for the pervious areas was taken as 0.15. The sub-catchments soil texture were classified as sandy loam, which indicates a capillary suction of 110.1 mm and a hydraulic conductivity of 21.8 mm/h. The catchment areas and slopes together with the total runoff volume and the flood peaks for the 1:50 year 24 hour storm event are presented in Table 21.

Table 21: Catchment areas, slopes and computed runoff volumes and flood peaks for the 50 year 24 hour storm

Catchment name	Area (ha)	Slope (%)	Percentage of impervious area (%)	Total runoff volume per 24 hours (ML)	Peak Runoff (m^3/s)
S1	1671	1.63	0	22.97	5.61
S2	885	1.40	0	13.72	3.37
S3	1645	1.58	0	20.07	4.88
S4	1270	1.68	0	17.5	4.28

11.2.2 Channel characteristics

All diversion channels have been sized to convey the 50 year return period flood peak. The South African SCS 24-hour Type 3 rain gauge was associated with the rainfall on the sub-catchments (Schmidt & Schulze, 1987). The dimensions of the channels, the channel slope and the maximum velocity are listed in Table 22. Allowable freeboard standards used for channel design were: for flow less than 10 m^3/s a 0.3 m freeboard was added to the flow depth while for flows above 10 m^3/s a freeboard of 0.6 m was added. The channels were modelled to be earth lined channels with a Manning's 'n" coefficient of 0.03.

Table 22: Dimensions of the diversion channels required to convey the 50 year return flood peak

Channel Name	Length (m)	Cross-Section	Height (m)	Bottom width (m)	Side slopes	Channel slope (m/m)	Maximum velocity (m/s)
C1	1174	Trapezoidal	1.3	1.3	1:1.5	0.005	1.72
C2	503	Trapezoidal	1.3	1.3	1:1.5	0.008	2.16
C3	484	Trapezoidal	1.3	1.3	1:1.5	0.006	1.94
C4	354	Trapezoidal	1.3	1.3	1:1.5	0.008	2.05

11.2.3 Erosion Control

Water Affairs stipulates that necessary works must be constructed to regulate the velocities of stormwater discharge. The outlets of stormwater channels are points of erosion potential. To prevent scour at stormwater outlets, protect the out structure and minimize the potential for downstream erosion, a flow transition structure is needed to absorb the initial impact of flow and reduce the speed of flow to a non-erosive velocity.

The flow velocities associated with the 50-year storm are considered to be at the upper end of acceptability for channels C2 and C4 but no excessive erosion is foreseen. Channels should be kept free of woody vegetation and should be inspected for erosion damage periodically such that corrective measures can be taken, should high erosion damage occur.

If high erosion damage is identified, the following outlet protection devices and energy dissipaters should provide sufficient protection and should be investigated which is most appropriate:

- Rip rap outlet Basins
- Stone pitching
- Gabions

11.3 Stormwater management plan for the CSP and PV2 facility implementation

The CSP and PV2 facility will require a stormwater management plan (SWMP) should the entire Bokpoort II development be implemented. To mitigate flooding of key infrastructure and to prevent clean storm water interacting with potentially polluted runoff, diversion channels should be designed to divert the runoff back to the environment. As for PV1, Regulation 704 has been used as a guide for sizing the channels.

No additional key infrastructure is present due to implementation of the CSP and PV2. The stormwater management plan will not to differ to the SWMP plan found in section 11.2. Figure 14 illustrates the SWMP for CSP, PV1, and PV2.

12.0 CONCLUSION

The proposed 75 MW PV1 facility’s water requirements will have a minimal impact on the total water user demands in the Lower Orange Main stem in the short to medium term (until 2025). Should the remainder of the Bokpoort II Solar Development be implemented (proposed CSP and PV2), the total impact on water demand will remain similar.

Table 20 indicates that the projected increase in water user demands could result in the unavailability of water in the medium to long term (2030 onwards) based on gathered information from DWS (Department of Water Affairs, 2013).

A stormwater management plan was developed for the PV1 facility to divert the 1 in 50 year storm event away from the proposed infrastructure. An overall stormwater management plan was developed for the entire Bokpoort II Solar Development implementation. Should the CSP facility be implemented it is recommended the evaporation pond is cleaned before the rainy season such that any potential overflow from the evaporation pond will reduce contaminates to the environment.

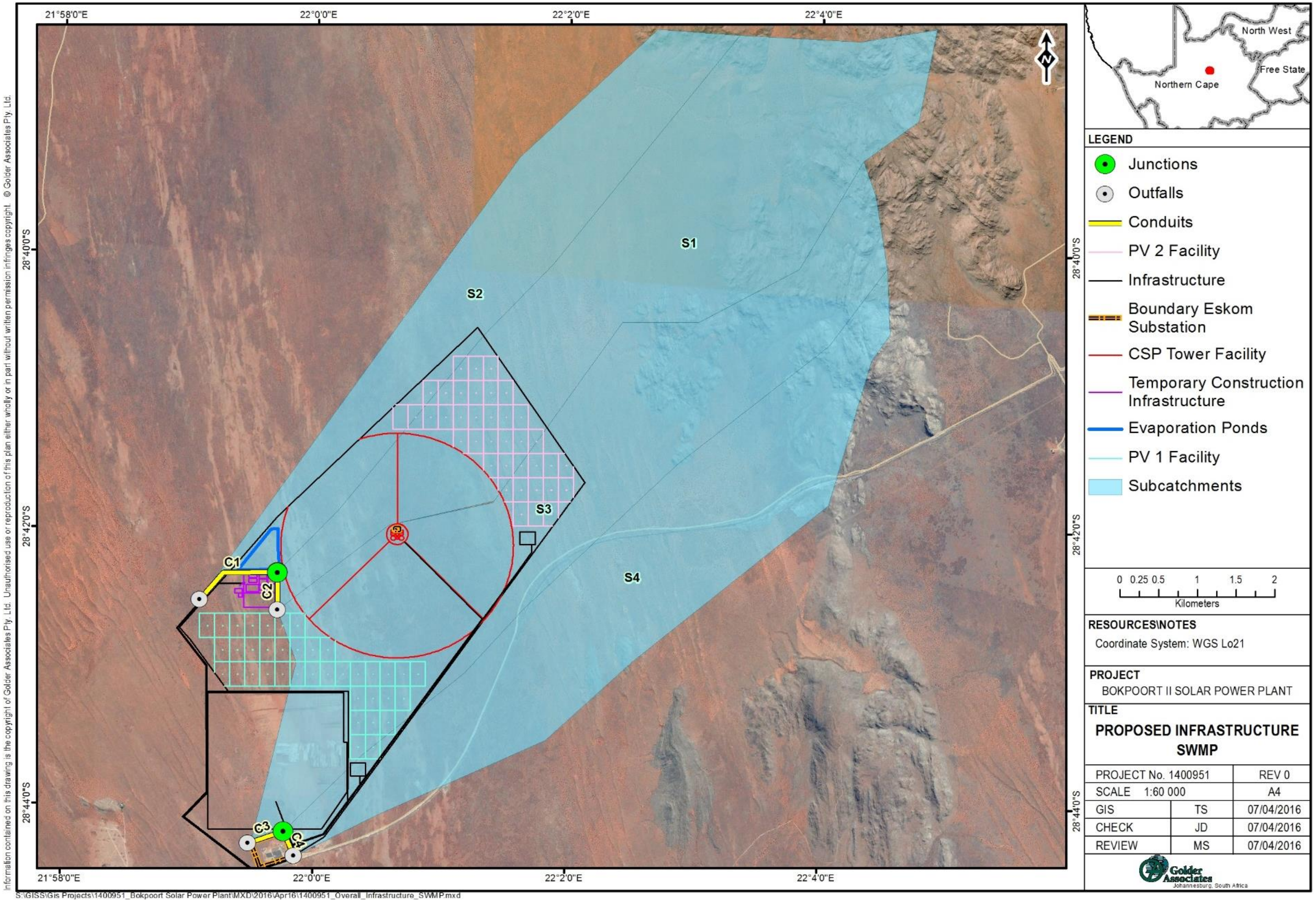


Figure 14: Stormwater management plan for CSP, PV1 and PV2

13.0 REFERENCES

Alexander, W. R., van Aswegen, F., & Hansford, J. R. (2003). UPFlood - Flood Analysis Programs. Version 4.0.0. Pretoria: University of Pretoria.

Department of Water Affairs. (2008). *Hydrological Services - Surface Water (Data, Dams, Floods and Flows)*. Retrieved April 01, 2013, from http://www.dwaf.gov.za/hydrology/

Department of Water Affairs. (2013). *Classification of significant water resources in the Crocodile (West), Marico, Mokolo and Matlabas Catchment: Management Classes Report.* South Africa: Department of Water Affairs. Directorate Water Resource Classification. Report No: RDM/WMA1,3/00/CON/CLA/0612.

Department of Water Affairs. (2013). *Development of Reconciliation Strategies for Large Bulk Water Supply Systems Orange River: Current and Future Urban Industrial Water Requirements.* South Africa.

Department of Water Affairs. (2013). *Development of Reconcilliation Strategies for Large Bulk Water Supply Systems: Irrigation Demands and Water Conservation/Water Demand Management.* South Africa.

Department of Water Affairs and Forestry. (2007). *The Developement of Water Resource Classification System (WRCS).* South Africa.

James, W., Rossman, L., & James, W. (2010). *User's guide to SWMM5* (13th ed.). Ontario: CHI.

Kunz, R. P. (2004). Daily Rainfall Data Extraction Utility. Version 1.4. Pietermaritzburg: Institute for Commercial Forestry Research.

Schmidt, E., & Schulze, R. (1987). *User manual for SCS-based design runoff estimation in Southern Africa.* Pretoria: WRC Report TT 31/87, Water Research Commission.

Smithers, J. C., & Schulze, R. E. (2002). Design Rainfall Estimation in South Africa Program. (Rainfall Statistics for Design Flood Estimation in South Africa. WRC Project K5/1060). Pretoria: WRC: Water Research Commission.

World Weather Online. (2016, May 10). Retrieved from World Weather Online: http://www.worldweatheronline.com/groblershoop-weather-averages/northern-cape/za.aspx

GOLDER ASSOCIATES AFRICA (PTY) LTD.

Jeffrey Dateling
Junior Water Resource Engineer

Lee Boyd
Water Resource Scientist

JD/LB/ck

\\joh1-s-fs1\gaadata\projects\1400951 - acwaeia-bokpoortncape\5.1 working docs\stormwater impact assessment\may 2016\1400951-300592-9\1400951300592-9_bokpoort_sw_pv1_final_130416.docx

APPENDIX A

24 HOUR STORM RAINFALL DEPTHS STATISTICAL ANALYSIS

Table A1 shows the data used in the Reg Flood program (Alexander, et al., 2003) to produce the 24 hour rainfall depths for the 1 in 2, 1 in 10, 1 in 20, 1 in 50, 1 in 100 and 1 in 200 recurrence intervals at the D7E001 station.

Table A1: Daily recorded maximum's for every year for D7E001

Year	Daily Maximum (mm)
1930	0.3
1931	37.9
1932	17.8
1933	36.8
1934	45.5
1935	37.8
1936	27.2
1937	31.5
1938	50.8
1939	44.5
1940	71.1
1941	13.7
1942	62.2
1943	20.6
1944	27.4
1945	22.1
1946	17.3
1947	71.6
1948	39.1
1949	54.1
1950	18
1951	44.2
1952	49
1953	49
1954	57.4
1955	55.1
1956	18.5
1957	26.7
1958	36.1
1959	28.5
1960	36.1
1961	23.6
1962	29.5
1963	35.6
1964	22.1

Year	Daily Maximum (mm)
1965	24.6
1966	66.6
1967	20.1
1968	49.5
1969	73
1970	30
1971	39.5
1972	82
1973	53
1974	29
1975	45
1976	33
1977	35
1978	33
1979	28
1980	42
1981	60.5
1982	21
1983	37.5
1984	22
1985	33
1986	15
1987	28
1988	47
1989	33
1990	56
1991	42
1992	28
1993	30
1994	24
1995	38
1996	62
1997	27
1998	24
1999	80
2000	32
2001	38
2002	48

Year	Daily Maximum (mm)
2003	32
2004	64
2005	107
2006	24
2007	28
2008	22
2009	55
2010	1.5
2011	15
2012	45
2013	6
2014	55

In order to determine the likely magnitude of storm events, a statistical approach, using the Reg Flood program (Alexander, van Aswegen, & Hansford, 2003), was applied to the available recorded daily rainfall depths. The maximum 24 hour rainfall depth for each year was analysed. This method statistically analyses the maximum daily rainfall depths for each year to determine the different recurrence interval daily rainfall depths. The best fit is the Extreme Value Type 1 distribution for D7E001. Figure A1 shows Extreme Value Type 1 graph for the D7E001.

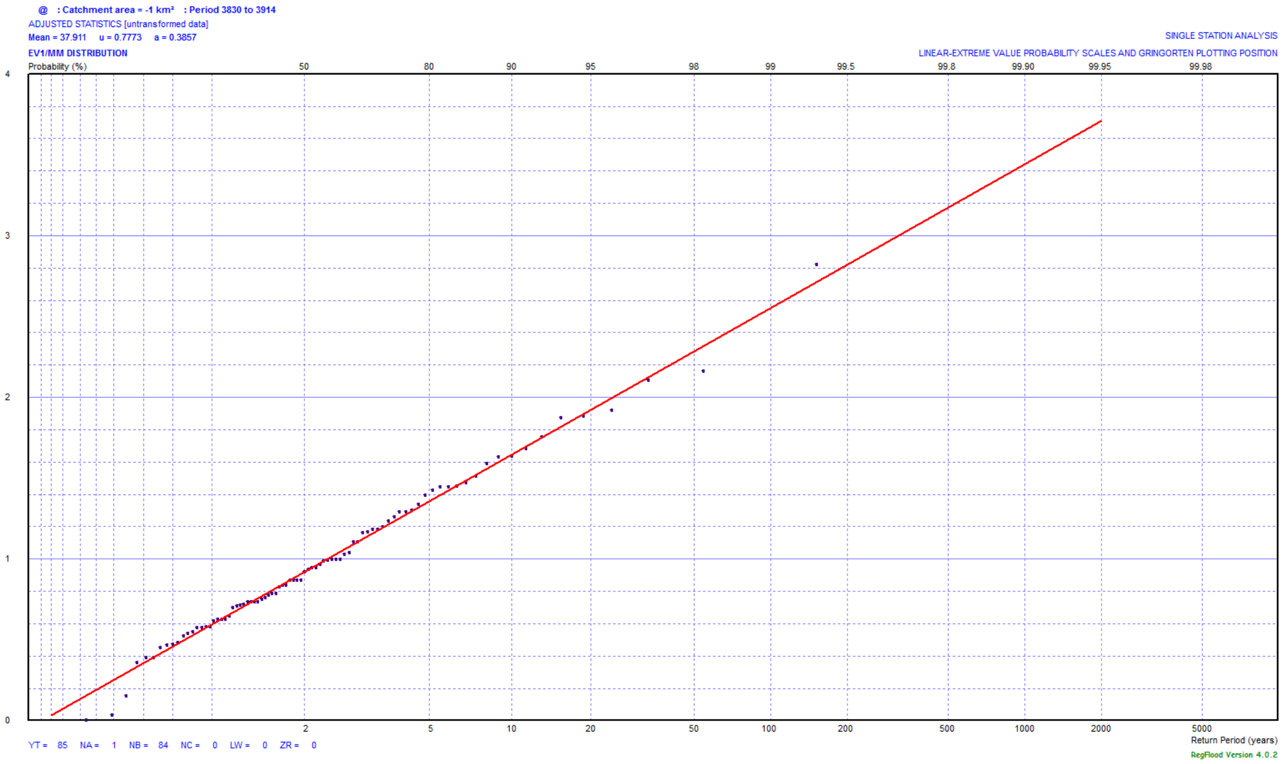


Figure A1: Extreme Value Type 1 curve for D7E001

APPENDIX B

DOCUMENT LIMITATIONS

DOCUMENT LIMITATIONS

This Document has been provided by Golder Associates Africa Pty Ltd ("Golder") subject to the following limitations:

i) This Document has been prepared for the particular purpose outlined in Golder's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

ii) The scope and the period of Golder's Services are as described in Golder's proposal, and are subject to restrictions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Golder in regards to it.

iii) Conditions may exist which were undetectable given the limited nature of the enquiry Golder was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

iv) In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

vii) The Client acknowledges that Golder may have retained sub-consultants affiliated with Golder to provide Services for the benefit of Golder. Golder will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from Golder and not Golder's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against Golder's affiliated companies, and their employees, officers and directors.

viii) This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

GOLDER ASSOCIATES AFRICA (PTY) LTD

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Africa (Pty) Ltd.
P.O. Box 6001
Halfway House, 1685
Building 1, Maxwell Office Park
Magwa Crescent West
Waterfall City
Midrand, 1685
South Africa
T: [+27] (11) 254 4800

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	14/12/16/3/3/2/881
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Proposed 75 MW Photovoltaic Development (PV1) on the Remaining Extent of the Farm Bokpoort 390 near Groblershoop in the !Kheis Local Municipalitly, Northern Cape.

Specialist:	**Junior Water Resource Engineer**		
Contact person:	**Jeffrey Dateling**		
Postal address:	P.O. Box 6001, Halfway House		
Postal code:	**1685**	Cell:	**072 672 0577**
Telephone:	**011 313 1080**	Fax:	**086 582 1561**
E-mail:	**jdateling@golder.co.za**		
Professional affiliation(s) (if any)			

Project Consultant:	Golder Associated Africa (Pty) Ltd		
Contact person:	Marié Schlechter		
Postal address:	P.O. Box 6001, Halfway House		
Postal code:	1685	Cell:	082 320 8150
Telephone:	011 254 4800	Fax:	086 582 1561
E-mail:	mschlechter@golder.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Jeffrey Dateling , declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Golder Associates

Name of company (if applicable):

2016/05/06

Date:

iLanda Water Services CC
Reg. No.: CK2011/077571/23

PO Box 44961
Linden
2104
Johannesburg, South Africa

Tel +27 (0)83 408 3241
Fax +27 (0)86 552 0407
bruce@ilandawater.co.za
http://www.ilandawater.co.za

WATER SERVICES

MEMO ON: PV 1 SURFACE WATER STUDY TECHNICAL REVIEW 0186

Memo No: 0186-Mem-002 Rev 0

Submitted to: Marié Schlechter
Golder Associates Africa (Pty) Ltd

PO Box 6001
Halfway House
1685

Distribution: Marié Schlechter
Golder Associates Africa (Pty) Ltd
iLanda Water Services CC – Library

Date: May 2016

1 INTRODUCTION

Golder Associates Africa (Pty) Ltd has commissioned iLanda Water Services CC to technically review the surface water baseline and impact assessment report for the proposed 75 MW PV 1 solar facility (proposed Bokpoort II solar development) near Groblershoop, Northern Cape. This memo documents the results of the review conducted.

2 QUALIFICATIONS OF THE REVIEWER

Dr Bruce Randell is a registered professional Civil Engineer with over 15 years' experience in Hydrology, Water Resources Engineering and Tailings Engineering. Dr Randell completed his BSc Civil Engineering and PhD (Water Resources Engineering) at the University of the Witwatersrand, Johannesburg, South Africa.

Dr Randell has extensive experience in conducting surface water specialist studies for mining and industrial projects in South Africa, as well other countries on the African continent. Dr Randell has significant experience in the Northern Cape where water resources work has been conducted for various mines. Dr Randell has frequently conducted site visits of these mines and has first-hand experience of the climate, hydrology, and topography of the Lower Orange River region.

3 REVIEWED DOCUMENT SCOPE OF WORK

The document that was reviewed was titled: Surface Water Baseline and Impact Assessment Report for the Proposed 75 MW PV 1 Solar Facility (Proposed Bokpoort II Solar

Development) near Groblershoop, Northern Cape, report number 1400951-300592-9, dated April 2016. The authors were Jeffrey Dateling and Lee Boyd.

The scope of work defined in the document is (SIC):

- Surface Water Baseline Assessment
  - Compiling a map showing the catchment area, site infrastructure and the major surface water drainage lines;
  - The available data will be collected and checked for integrity. The rainfall data will be patched to produce a daily record for use in surface water modelling;
  - Rainfall statistics such as monthly averages, number of rain days per month, distribution of annual totals and the 2, 5, 10, 20, 50, 100 and 200 year recurrence interval 24 hour storm depths will be determined;
  - The available climate data will be collected and reviewed to produce monthly potential evaporation and temperature statistics based on regional and local climatic data;
  - The surface water resources in the study area will be mapped and described;
- Current and Future Water Requirements
- Identify current and future water demands; Assessment of potential surface water pollution; and
- Assess storm water management requirements.

4 REVIEW COMMENTS

The document achieves the scope of work shown above.

The mapping is clear and shows the project location as well as applicable water management areas, quaternary catchments and nearby rivers.

The water quality data assessment is adequate and appropriate for this type of study.

The rainfall data selection is thorough and appropriate. The rainfall gauge used is reflective of the rainfall in the area. No temperature data is shown in the document, as mentioned in the scope of work. However, this is a minor limitation and does not detract from the document findings.

Figure numbers are incorrectly referenced in the text.

It is unclear how the peak rainfall data was obtained. The body of the document suggests that they were extracted from Design Rainfall Estimation Program and Appendix A suggest that a statistical method (Reg Flood program) was used. The statistical method is the preferred method. A Log Pearson Type III or Log normal distribution should be considered to see if the maximum rainfall depth of 107 mm can be better accommodated. Table 5 is incorrectly referenced.

The site description shows that the area of development is small when compared to either the quaternary catchment or to the water management area.

The document lacks a project description that can inform the reader of what activities will be undertaken on the project site, and therefore what impacts can be expected. It is assumed that this document will be read in conjunction with other sections of the EIA which will probably have a detailed project description. However, if this document is read in isolation, the reader will not know what potential polluting activities will occur on site.

Table 7 in the document partially addresses the above concern but it is not clear what would cause “Poor quality runoff from solar facility activities” or “Potential poor quality runoff from solar panel site”. This limitation is viewed as minor because the document recommends that dirty water is catered for in accordance with government Notice 704 of the National Water Act. However, it would provide clearer picture of potential polluting activities on site.

The impact assessment methodology is sound and in accordance with industry best practice. The application of the assessment methodology is appropriate, and mitigations measures are clear.

The current and future water requirements are a very detailed account of the water resources and demands on these water resources. The sections clearly shows the project’s water requirements and how these water requirements will impact on the water resources of the lower Orange River.

The storm water management recommendations appear simple, practical, and easy to implement. The appropriate legislation has been used. The flood peak calculations are realistic and not overly conservative. It is unclear on whether the storm water diversion trenches are lined or not. Back calculations suggest that unlined channels have been used.

If this is the case:

- the flow velocities associated with the 50-year storm flows are considered to be at the upper end of acceptability for channels C2 and C4, but no excessive erosion is foreseen.
- it is suggested that a paragraph be inserted on the maintenance of the channels – channels should be kept free of woody vegetation and should be inspected for erosion damage periodically.

Memo No: 0186-Mem-002 Rev 0

No indication of how localised erosion will be prevented at the storm water channel diversion outlets. This is a requirement by the DWS when issuing water use licences and should be included in this document at least in concept form or as a principle.

ILANDA WATER SERVICES CC

BN Randell, *BSc Eng (Civil), PhD, PrEng*
C:\ILANDA\PROJECTS\0186 BOKPOORT REVIEW\DOCUMENTS\0186-MEM-002 REV 0 BOKPOORT SURFACE WATER PV1 REVIEW.DOCX

Golder Associates

TECHNICAL MEMORANDUM

DATE May 2016 **PROJECT No.** 1400951

TO Marie Schlechter

FROM Jeffrey Dateling **EMAIL** jdateling@golder.co.za

RESPONSE TO MEMO: PV1 SURFACE WATER STUDY TECHNICAL REVIEW

1.0 INTRODUCTION

Golder Associates Africa (Pty) Ltd (Golder) commissioned iLanda Water Services CC to technically review the surface water baseline and impact assessment report for the proposed 75 MW PV1 solar facility (proposed Bokpoort II solar development) near Grobleershoop Northern cape. A document entitled "Bokpoort surface water CSP review" was submitted to Golder for the review. This memo serves as a reference to address all comments made in the review.

2.0 REVIEW COMMENTS

Comments were received regarding the report for the proposed 75 MW PV1 solar facility surface water report. Table 1 indicates how review comments that required report changes were addressed and what corrective actions were taken.

Table 1: Peer Review Comments and Action Taken

Review Comment	Action Taken
No temperature data is shown in the document, as mentioned in the scope of work.	The report now includes a section 7.0 to incorporate temperature data.
Figure numbers are missing and incorrectly referenced in the text.	Figure numbers are now present and correctly referenced.
It is unclear how the peak rainfall data was obtained.	Section 6.0 has been reworked to provide additional resolution on how the peak rainfall data was obtain. The best fit graph was changed to the Extreme Value Type 1 distribution. This does not impact the storm water management plan design.
The text at the bottom of page 10 has the incorrect font and refers to the incorrect table.	Text throughout the document is now consistent. Incorrect table references have been rectified.
The document lacks a project description that can inform the reader of what activities will be undertaken on the project site. It is assumed that this document will be read in conjunction with other sections of the EIA which will probably have a detailed project description.	It is recommended that this document be read in conjunction with other sections of the EIA to ensure a better understanding.
Table 7 in the document partially addresses the above concern but it is not clear what would cause "Poor quality runoff from solar facility activities"	Additional resolution has been inserted to create better clarity in Table 7.

Review Comment	Action Taken
It is unclear on whether the storm water diversion trenches are lined or not, If trenches are unlined: The flow velocities associated with the 50-year storm flows are considered to be at the upper end of acceptability for channels C2 and C4, but no excessive erosion is foreseen.	A description has been included to describe the type of channel used during modelling under section 11.2.2 Channel characteristics.
It is suggested that a paragraph be inserted on the maintenance of the channels – channels should be kept free of woody vegetation and should be inspected for erosion damage periodically.	This suggestion has been incorporated into a new section entitled: 11.2.3. Erosion control.
No indication of how localised erosion will be prevented at the storm water channel diversion outlets. This is a requirement by the DWS when issuing water use licences and should be included in this document at least in concept form or as a principle.	Localised erosion has now been accounted for in concept form and can be found in section 11.2.3.

Jeffrey Dateling
Junior Water Resource Engineer

Lee Boyd
Water Resource Scientist

JD/LB/ck

\\joh1-s-fs1\gaadata\projects\1400951 - acwaeia-bokpoortncape\5.1 working docs\stormwater impact assessment\may 2016\memo review\1400951_pv1_addressing_peer_review_160516.docx