FRESHWATER ASSESSMENT FOR THE PROPOSED PHOTOVOLTAIC (SOLAR) ENERGY FACILITIES ON DU PLESSIS DAM FARM NEAR DE AAR, NORTHERN CAPE

May 2013

Prepared for:

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Executive Summary

Mulilo proposes to construct three PV facilities, each with a generation capacity of 75MW AC on Du Plessis Dam Farm (Remainder of farm 179), near De Aar. A previous EIA was undertaken at the same location and information is available and environmental sensitive areas were taken into consideration in the preliminary designs. It is therefore proposed to further develop a site which is already well studied, found suitable for the proposed development, is located close to existing and proposed Eskom infrastructure, and where no fatal flaws have been identified.

The freshwater features on the farm Du Plessis Dam consist of ephemeral tributaries of the Brak River. These tributaries are considered to be in a largely natural ecological state, with a low ecological importance and sensitivity. The expected impacts of the proposed activities are likely to be as follows:

- *Solar energy facility (brown polygons):* The preferred proposed layout will result in some modification of a few minor freshwater features/drainage lines on the site.
- *Overhead transmission lines/corridors (white polygons with yellow lines):* The preferred transmission lines/corridors will cross two minor freshwater features/drainage lines.
- *Substations (black rectangles).* The Central substation as well as PV1 and possibly PV2 substations are located within the wide depressions that are indicated as freshwater features/drainage lines. These areas tend to be much wetter than the surrounding areas and it is advised that the substations be located at least 30m outside of these wide drainage areas.
- *Access routes (red lines) and water pipeline (blue line):* The proposed access route and water pipeline will cross the two drainage channels crossed by the transmission lines.
- *Layout camp:* The proposed laydown camp is located outside of any identified freshwater features therefore the potential impact on freshwater features is very low for this component.

While the likely significance of the proposed preferred and alternative layouts are similar (moderate significance), the preferred layout (Alternative 1) is seen as the better option in terms of its potential impact on the freshwater features. In particular, by relocating the proposed substations mentioned above to outside of the demarcated drainage line, the potential impact of the proposed layout for the preferred alternative, would be significantly reduced.

Should the following recommended mitigation measures be implemented, the significance of the impact is expected very low:

- A buffer of 30m should be maintained adjacent to the identified streams for the proposed PV footprint area as well as the substations.
- Construction activities for the proposed infrastructure that will need to take place within the river channels and riparian zone (i.e. linear development components – roads, transmission lines and water pipeline) should transect the streams at right angles and be limited as far as possible to ensure minimum disturbance of this area. Disturbed areas within the riparian zones and stream

beds should be rehabilitated as soon as possible after construction has been completed and revegetated with suitable indigenous vegetation. Where possible previously disturbed areas such as existing roads or transmission line routes should be utilised. Disturbed areas should be visually monitored every 3 months and kept free of invasive alien plant growth.

- Construction should preferably take place during the low flow months (May to October) to minimize the risk of erosion and contaminated runoff from construction sites into adjacent freshwater features.
- All rubble, sand and waste material resulting from the construction activities should be removed from any stream and drainage channels to ensure that flow in these channels are not impeded.
- Invasive alien plants should be removed from the disturbed areas within the drainage channels.
- Contaminated runoff from the construction sites should be prevented from entering the streams.
- All materials on the construction sites should be properly stored and contained.
- Disposal of waste from the sites should also be properly managed.
- Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from the river systems/freshwater features and regularly serviced.
- The laydown area(s) should be cleaned and rehabilitated after construction is complete according to the approved rehabilitation plan.
- There should be an approved storm water management plan in place for the operation phase of the project. Storm water runoff from the constructed areas should also be visually monitored after large rainfall events to ensure that eroded areas do not develop, particularly within the drainage channels.
- A decommission plan should be drawn up and approved for the site that addresses the removal of the PV facilities and infrastructure post operation phase. The decommission plan should address aspects such as monitoring and management of invasive alien plants and erosion of the site after the activities on the site are complete.

A water use authorization application may need to be submitted to the Department of Water Affairs Northern Cape Regional Office for approval of the water use aspects of the proposed activities, in particular a water use authorisation will be required for any development activities relating to the stream crossings.

TABLE OF CONTENTS

1. BACKGROUND

Mulilo Renewable Energy (Pty) Ltd (Mulilo) proposes to construct three separate solar energy facilities, on Du Plessis Dam Farm (Remainder of Farm 179), near De Aar in the Northern Cape. Each of the three proposed facilities would have a maximum generation capacity of 75MW Alternating Current (AC) through photovoltaic (PV) technology.

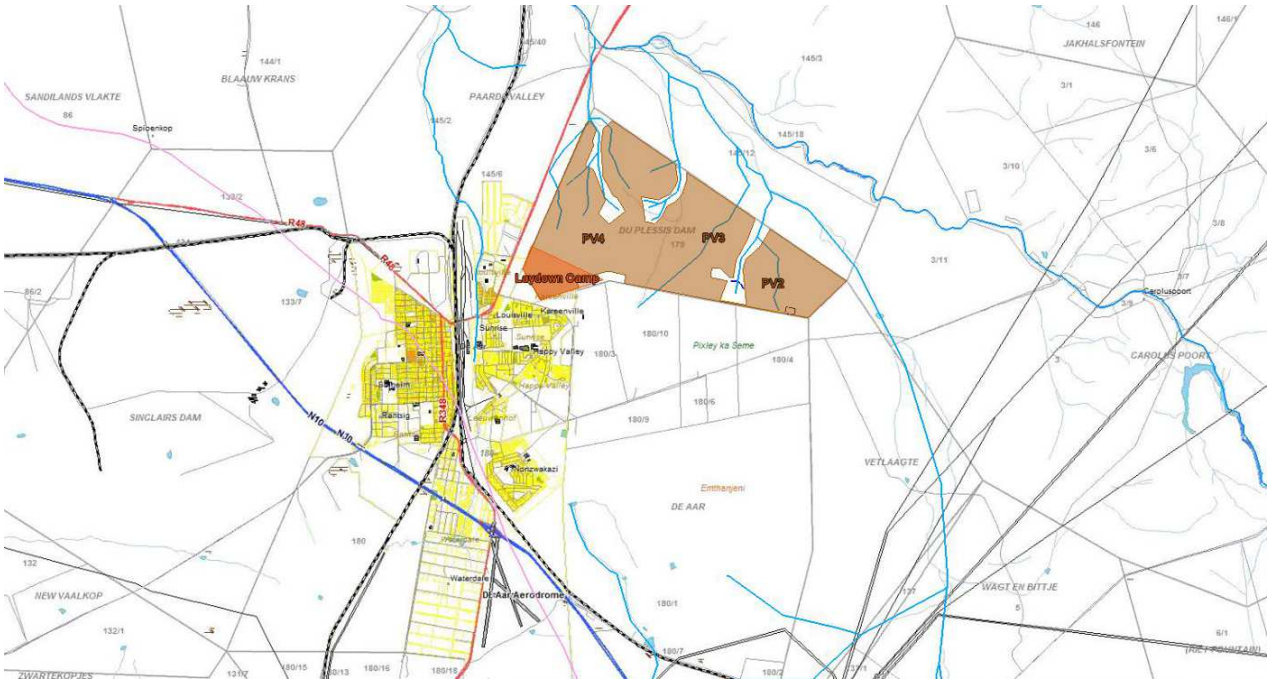


Figure 1. Locality map of the proposed photovoltaic energy facilities

The nature of the activity includes:

- Technology: A photovoltaic component comprising of numerous arrays of PV panels to generate up to 75MW per facility, through the photovoltaic effect.
- Transmission lines (132kV) and substations.
- Boundary fencing: Each 75MW facility will be fenced for health, safety and security reasons.
- Roads: one access road and internal access roads for servicing and maintenance.
- Water supply infrastructure.
- Storm water infrastructure: Including drainage channels, berms, detention areas and kinetic energy dissipaters.
- Buildings: Buildings would likely include onsite substations, a connection building, control building, guard cabin, an electrical substation and solar resource measuring substation.

2. TERMS OF REFERENCE

The proposed Terms of Reference for the aquatic specialist studies are as follows:

- Summary of available information pertaining to surface water (streams, dams and wetlands) in close vicinity to the sites;
- Undertake water quality and biotic assessments sampling for stream, wetland and dam condition assessments;
- Describe and determine importance, functionality and trophic state of the water resources;
- Assess the potential impact of the change in site hydrology (quantity) and water chemistry (quality) on any streams, dams and wetlands during the construction and operational phases;
- Assessment of cumulative impacts;
- Evaluate (a) magnitude, frequency of occurrence, duration and probability of impacts, (b) the local, regional, and national significance of predicted impacts, (c) the level of confidence in findings relating to potential impacts, (d) the degree to which the impact can be reversed, and (e) cumulative impacts that may occur as a result of the activities;
- Recommend mitigation measures aimed at minimising the potential negative impacts and enhancing potential positive impacts while retaining reasonable operational efficiencies;
- List additional or required permitting and/or licensing requirements; and
- Take cognisance of the Wetland Delineation Guideline Document of the Department of Water, and if applicable the DEA&DP draft guideline: "Guideline for involving biodiversity specialists in EIA processes.

3. APPROACH TO THE STUDY AND STUDY LIMITATIONS AND ASSUMPTIONS

Input into this report was informed by a combination of desktop assessments of existing freshwater ecosystem information for the study area and catchment, as well as by a more detailed assessment of the freshwater features at the various proposed sites. Aquatic Ecosystem Health assessments were carried out to provide information on the ecological condition and ecological importance and sensitivity of the river and wetland systems to be impacted. The assessments were carried out using the Department of Water Affairs developed methodologies.

The site was visited in January 2012 (Belcher, 2012) during the first EIA process and again in May 2013 for this assessment. During the May 2013 field visit, the characterisation, mapping and integrity assessments of the freshwater features were undertaken. This information/data was used to inform the potential impact of the proposed activities as well as the recommended mitigation measures.

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. Analysis of the freshwater ecosystems was undertaken according to nationally developed

methodologies and was undertaken at a rapid level which was considered a suitable level of evaluation for this freshwater impact assessment.

4. USE OF THIS REPORT

This report reflects the professional judgment of its author. The full and unedited content of this should be presented to the client. Any summary of these findings should only be produced in consultation with the author.

5. OVERVIEW OF THE PROPOSAL

5.1. Overview of the Study Area

The study area is situated in the Northern Cape Province, within the boundaries of the Emthanjeni Local Municipality as well as the greater Pixley ka Seme District Municipality near De Aar. The broader landscape consists of predominantly flat lowlands along with few flat-topped hills.

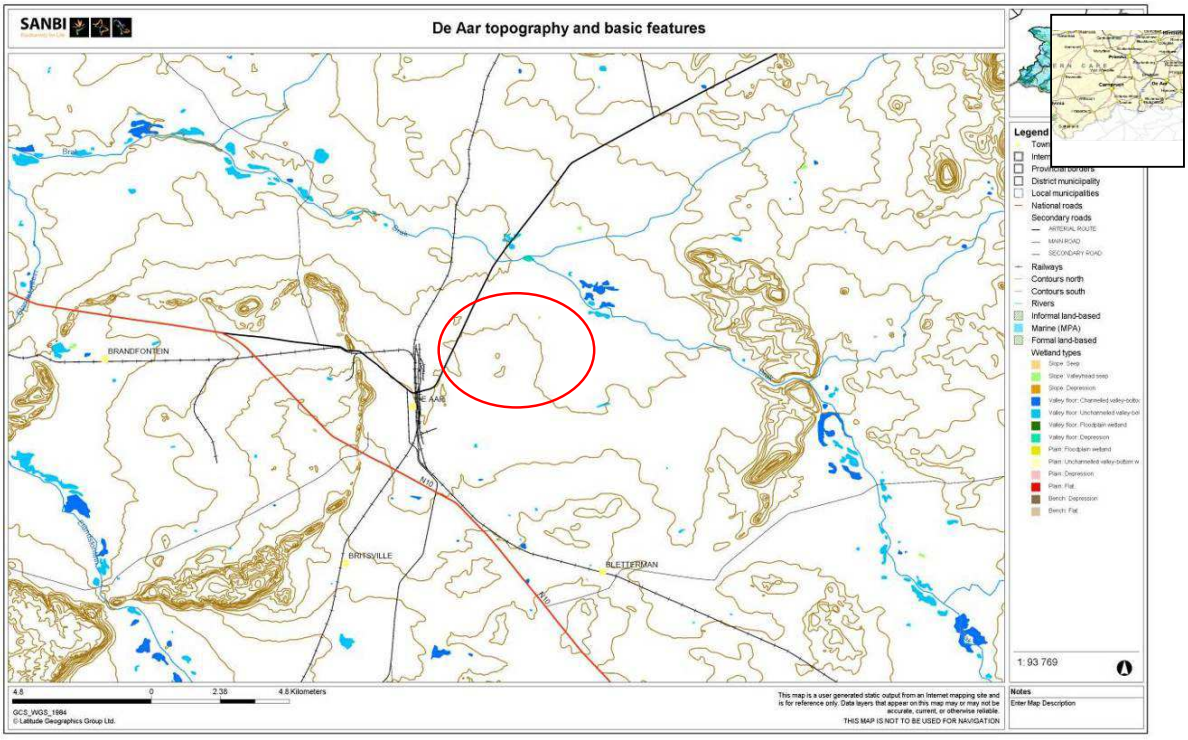


Figure 2. Locality map for the study area

The main water feature in the area is the Brak River, a tributary within the Orange River System. Most of the land surrounding De Aar is undeveloped and only utilised for grazing of sheep, cattle, goats, ostriches or game such as springbok.

5.2. Activity Description and Alternatives

Mulilo proposes to construct three PV facilities, each with a generation capacity of 75MW AC on Du Plessis Dam farm (Remainder of farm 179), near De Aar (see Figure 14). The total extent of the three proposed facilities would be approximately 755ha as set out in Figure 3.

A previous EIA was undertaken at the same location (Aurecon, 2013) and information is available and environmental sensitive areas were taken into consideration in the preliminary designs. It is therefore proposed to further develop a site which is already well studied, found suitable for the proposed development, is located close to existing and proposed Eskom infrastructure, and where no fatal flaws have been identified.

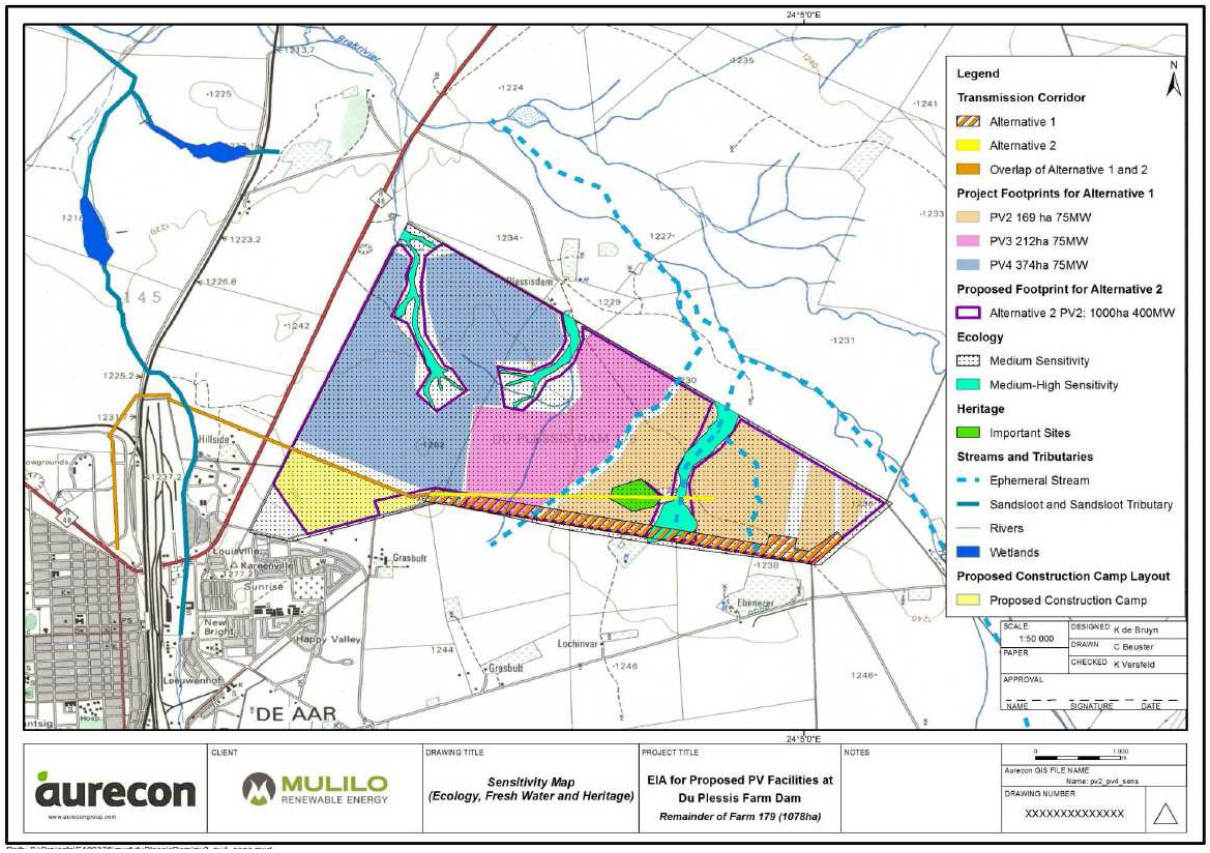


Figure 3. Diagram of the proposed localities of the Photovoltaic power generation facilities

Each of the proposed PV facilities would consist of the following:

- **Solar energy facility:** A photovoltaic component comprising of numerous arrays of PV panels and associated support infrastructure to generate up to 75MW per facility, through the photovoltaic effect.
- **Transmission lines:** 132kV overhead transmission lines to connect each facility to the central onsite substation or an existing Eskom substation.
- **Facility substations:** An onsite 132kV, 3 bay central substation.

- **Boundary fence:** Each 75MW facility will be fenced for health, safety and security reasons.

It is proposed that the following infrastructure be shared between the three facilities to lessen the impact on the surrounding environment:

- **Central substation:** One central 132kV substation and connection to Eskom grid. This central substation will connect the PV facilities with Eskom's De Aar substation via either an existing overhead 132kV Eskom line or the previously authorised 132kV overhead transmission line directly to De Aar substation.
- **Roads:** Access road and internal access roads for servicing and maintenance of the site.
- **Water supply infrastructure**: It is proposed that potable water will be obtained from the Emthanjeni Municipality. Water will be transferred to the site via the municipal pipeline from the nearest municipal supply point and will be contained onsite in a jo-jo tank. However, the Municipality would need to confirm availability of capacity to do so.
- **Storm water infrastructure**: Including drainage channels, berms, detention areas and kinetic energy dissipaters.
- **Buildings**: Buildings would likely include onsite substations, a connection building, control building, guard cabin, an electrical substation and solar resource measuring substation.

Proposed Alternatives

Two scale and magnitude alternatives are being considered, however the approved capacity limit (MW) of the facilities will determine the layout of the facilities.

Layout Alternative 1

This alternative consists of the three proposed 75MW PV facilities and associated infrastructure as indicated in Figure 3 (referred to as PV2, PV3 and PV4). These layouts take cognisance of the 75MW Department of Energy cap and the environmentally sensitive areas as identified by Aurecon (2012).

Layout Alternative 2

This alternative consists of one 400MW PV facility. The layout for this alternative was developed by extending and combining the proposed 75MW facilities. This alternative is thus not limited to the DOE's 75MW cap per project. By increasing the capacity it has the benefit of utilising industries at scale thereby reducing associated development and construction costs which reduces lending rates and essentially lower the tariff of electricity sold. As indicated in Figure 3 the layout of extended PV1 more or less overlaps with the Alternative 1 layouts.

5.3. Legal Requirements

The following Acts, regulations and ordinances are applicable to the development:

The National Environmental Management Act (Act No. 107 of 1998) (NEMA)

Chapter Seven of the NEMA states that:

"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment".

The Act also clearly states that the landowner, or the person using or controlling the land, is responsible for taking measures to control and rectify any degradation. These may include measures to:

"(a) investigate, assess and evaluate the impact on the environment;

(b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment:

(c) cease, modify or control any act, activity or process causing the pollution or degradation:

(d) contain or prevent the movement of pollutants or degradation: or

(e) eliminate any source of pollution or degradation: or

(f) remedy the effects of the pollution or degradation."

- NEMA Basic Assessment Regulations, GN R543 of 2010

Activities listed in terms of Chapter 5 of NEMA in Government Notice No. R. 544, 5 and 6 trigger a mandatory Basic Assessment, or even a full scoping EIA process, prior to development.

The National Environmental Management Second Amendment Act (Act No.8 of 2004) provided for formal procedures for offenders in terms of Section 24G to apply for rectification of the unlawful commencement of listed activities.

National Water Act, 1998 (Act No. 36 of 1998)

The purpose of the National Water Act (Act 36 of 1998) (NWA) is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the NWA as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorisation

and register as users. The NWA also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

- Regulations Requiring that a Water User be Registered, GN R.1352 (1999)

Regulations requiring the registration of water users were promulgated by the Minister of the Department of Water Affairs (DWA) in terms of provision made in section 26(1)(c), read together with section 69 of the NWA. Section 26(1)(c) of the NWA allows for registration of all water uses including existing lawful water use in terms of section 34(2). Section 29(1)(b)(vi) also states that in the case of a general authorisation, the responsible authority may attach a condition requiring the registration of such water use. The Regulations (Art. 3) oblige any water user as defined under section 21 of the Act to register such use with the responsible authority and effectively to apply for a Registration Certificate as contemplated under Art.7(1) of the Regulations.

- General Authorisation in terms of s. 39 of the National Water Act, GN R 1199 of 2009

Government Notice R1199 was issued as a revision of the General Authorisations (No. 1191 of 1999) for Section 21 (c) and (i) water uses as defined under the NWA (Act 36 of 1998). The revision was published and came into effect on 2009/12/18. According to the preamble to Part 6 of the National Water Act, "*This Part establishes a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing general authorisations in the Gazette...*"

"The use of water under a general authorisation does not require a licence until the general authorisation is revoked, in which case licensing will be necessary…"

The authorisation of water use activities for Sections 21 (a) - abstraction, 21 (c) - change to the bed, banks and characteristics of a water course and 21 (i)- impeding and diverting the flow, will need to be applied for at the Northern Cape Regional Office of the Department of Water Affairs. As such, the regional office will need to be notified of the proposed activities and will need to give comments as to whether the activities require a licence process or not in a-non binding letter.

6. AQUATIC SYSTEMS IN THE STUDY AREA

6.1. Description of the Study Area

a. Physical Characteristics

The proposed project is located just northeast of the town of De Aar, in the Northern Cape Province. De Aar was established in 1903 and derives its name refers from the water-bearing arteries that occur underground. The surrounding area is characterised by wide open plains and low hills, with sparse settlements and predominately wide open spaces.

Figure 4. A view of the De Aar area

b. Climate

De Aar normally receives on average about 196mm of rain per year, mostly during autumn. The lowest rainfall (1mm) usually occurs in August and the highest (45mm) in March (Figure 5). The average midday temperatures for De Aar range from 16°C in June to 30.3°C in January. The region is the coldest during July when the mercury drops to 0.3°C on average during the night.

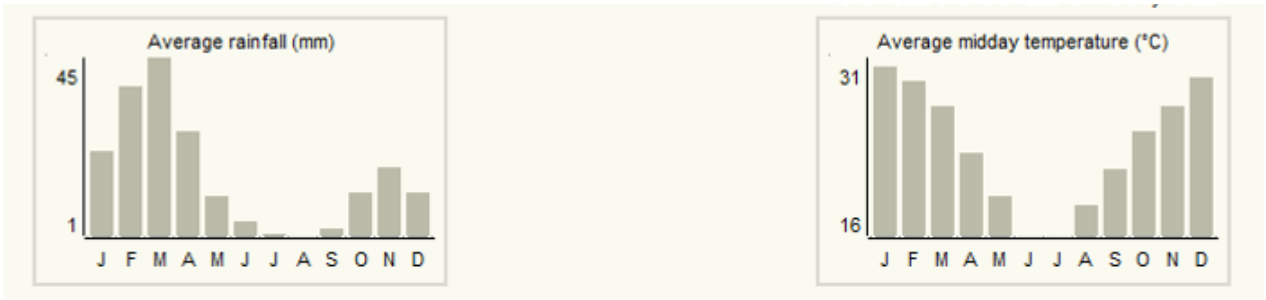


Figure 5. Average monthly rainfall for the area (SA Explorer, 2008)

c. Geology and Soil

The geology of the study area can be described as being underlain by flat-lying sedimentary rocks of the Karoo Supergroup, which have been intruded by innumerable sills and dykes of dolerite.

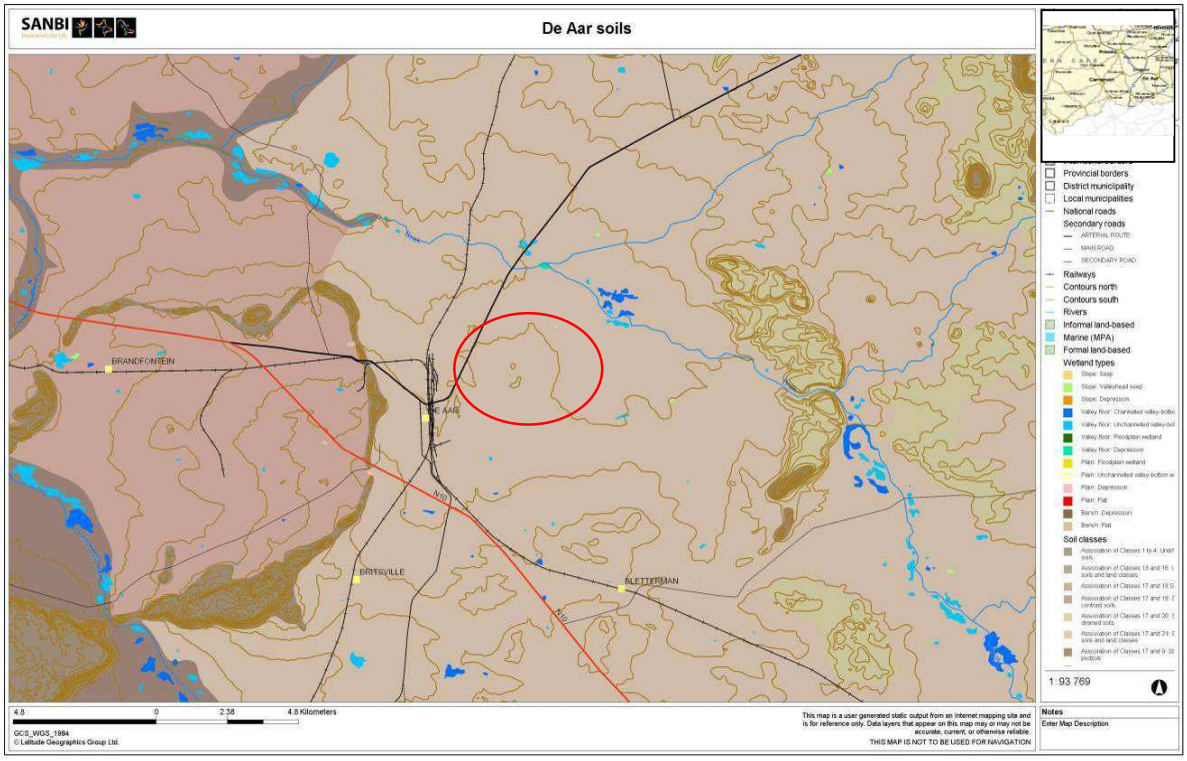


Figure 6. Soil map for the area (Biodiversity GIS, 2009)

The overlying soils are variable from shallow to deep, red-yellow apedal, freely draining soils to very shallow Glenrosa and Mispah forms (Figure 6). The soils in the study site are primarily red soils of a restricted soil depth, excessive drainage, high erodibility and low fertility. Calcrete soils are also prevalent as a result of the climatic conditions and underlying parent material.

d. Flora

The study area lies near the eastern edge of the Nama Karoo biome, and is mapped according to the national vegetation types (2006) as being of the vegetation type Northern Upper Karoo (Figure 7) which is considered to be least threatened. The vegetation cover is generally dominated by sparse dwarf karroid scrub and tufted grass with bare patches of sand in between. Portions of the area are in a disturbed condition, most likely as a result of livestock grazing.

Along the Brak River the common reed *Phragmites australis* dominates the instream habitat, while there is very little discernible riparian vegetation. The ephemeral streams have no visible aquatic vegetation.

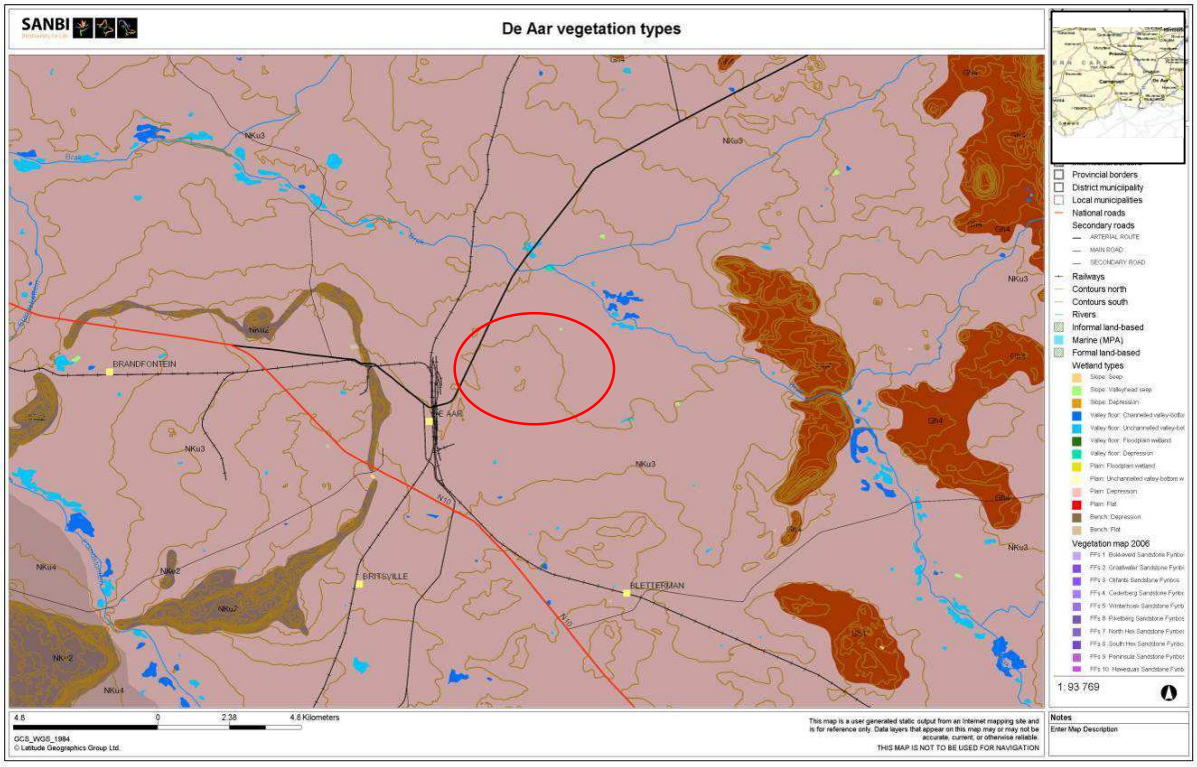


Figure 7. Vegetation map for the area (SANBI Biodiversity GIS)

e. Aquatic features and fauna

The main aquatic feature within the study area is the Brak River (Figure 8), a seasonal tributary within the Orange River System. The river flows to the north of the study area with a number of its tributaries crossing the site as they flow in a northerly direction. Most of the small tributaries within the study area are ephemeral and are discernible only as slightly shallow depressions with no clear associated vegetation and slightly clayey soils (Figure 9). A small, shallow dam has been constructed within one of these drainage channels.

Figure 8. The Brak River to the north of the study area

Figure 9. An ephemeral tributary of the Brak River at Du Plessis Dam

These freshwater features are discussed in more detail in the following section.

f. Land use

Much of the study area is largely undeveloped, with a homestead and the veld being used for grazing of sheep, cattle and game such as springbok. The closest urban area is De Aar, with the township of Nonzwakazi located to the southwest of the farm. Smaller towns of Britstown, Philipstown, Hanover and Richmond occur within a 65km radius of De Aar.

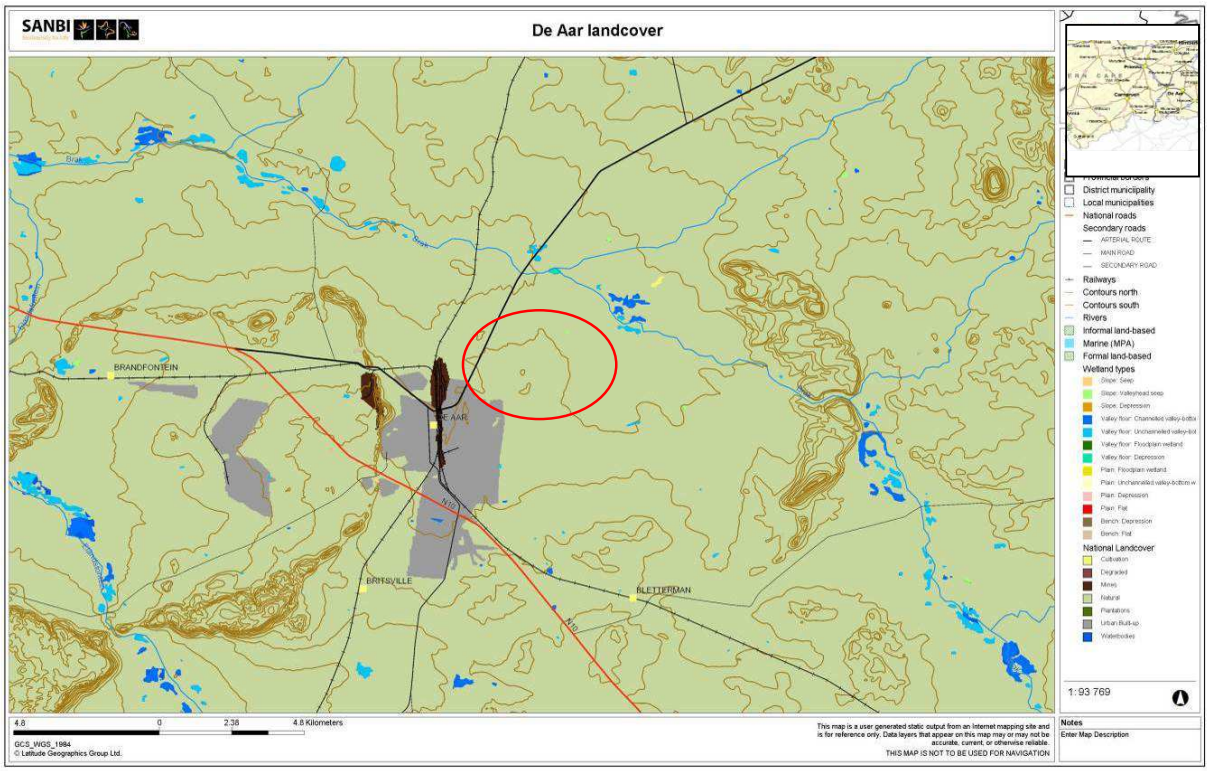


Figure 10. Land cover map for the area (SANBI Biodiversity GIS, 2011)

g. Freshwater Biodiversity and Conservation

In the study area, the Brak River has been identified as having conservation importance. Figure 11 is the Freshwater Ecosystem Protected Areas (FEPA) map for the area. FEPAs are strategic spatial priorities for conserving freshwater ecosystems and associated biodiversity. FEPAs were determined through a process of systematic biodiversity planning and were identified using a range of criteria for serving ecosystems and associated biodiversity of rivers, wetlands and estuaries.

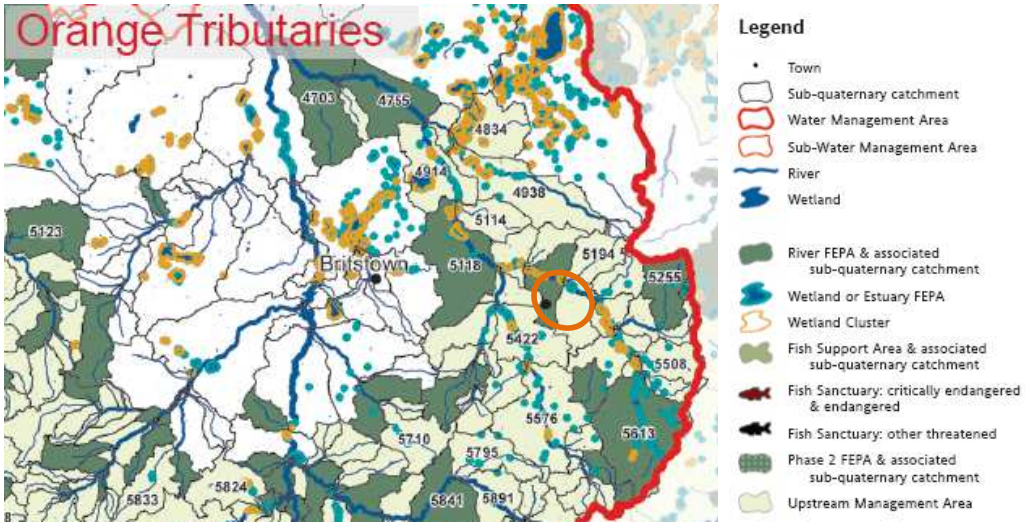


Figure 11. Freshwater Ecosystem Priority Areas for the study area (orange oval)

6.2. Freshwater Assessment of the Study Area

The Index for Habitat Integrity (IHI) and a Site Characterisation were used to provide information on the ecological condition of the Brak River tributaries within the study area.

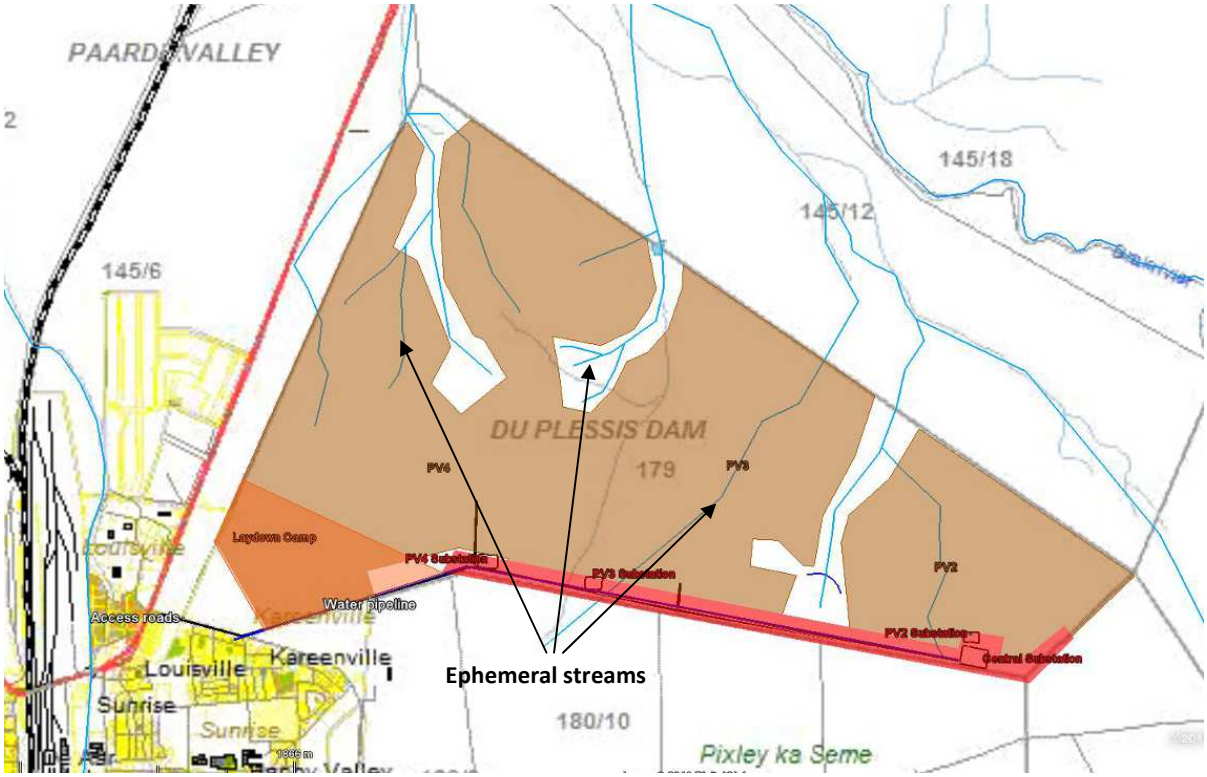


Figure 12. Water features in the study area

River classification

In order to assess the condition and ecological importance and sensitivity of the rivers in the study area, it is necessary to understand how the rivers might have appeared under unimpacted conditions. This is achieved through classifying rivers according to their ecological characteristics, in order that it can be compared to ecologically similar rivers.

River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. Any comparative assessment of river condition should only be done between rivers that share similar physical and biological characteristics under natural conditions. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river types. The primary classification of rivers is a division into Ecoregions. Rivers within an ecoregion are further divided into sub-regions.

Ecoregions are groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification presented in Department of Water Affairs and Forestry in 1999, which divides the country's rivers into ecoregions, was used. The river assessed lies within the Nama Karoo Ecoregion, with the characteristics as described in Table 1.

Sub-regions (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota. Table 2 provides the geomorphological features of the streams assessed.

Table 1. Characteristics of the Nama Karoo Ecoregion (Dominant Types In Bold)

Main Attributes	Description
Terrain Morphology: Broad division	Plains; Low Relief; Plains Moderate Relief; Lowlands; **Hills and Mountains; Moderate and High Relief**; Open Hills, Lowlands; Mountains; Moderate to High Relief; Closed Hills; Mountains; Moderate and High Relief
Vegetation types	Eastern Mixed Nama Karoo; Upper Nama Karoo; **Bushmanland Nama Karoo**; Orange River Nama Karoo
Altitude (m a.m.s.l)	300-1700
MAP (mm)	0 to 500
Rainfall seasonality	Late to very late summer to Winter
Mean annual temp. (°C)	12 to 20
Median annual simulated runoff (mm) for quaternary catchment	<5 to 60

River/Site Characterisation

The Brak River drains shrubland vegetation in an area with a very low rainfall. As a result, the water within the river system is saline and turbid and seasonally flowing. At the time of the field visits in January 2012 and May 2013, the river consisted of isolated pools and was not suited to an assessment of water quality or aquatic biota present. From the Site Characterisation assessments, the geomorphological and physical characteristics of the Brak River tributaries can be classified as shown in Table 2.

Table 2. Geomorphological and Physical features of the Brak River tributaries

River	Ephemeral tributaries of the Brak River
Geomorphological Zone	Foothill rivers in the Upper Karoo Geomorphic Province
Lateral mobility	Unconfined
Channel form	Complex
Channel pattern	Multiple thread: low sinuosity
Channel type	Silt/clayey with pebbles
Channel modification	Moderate modification (trampling and grazing within river channel, instream impoundments)
Hydrological type	ephemeral
Ecoregion	Nama Karoo

DWA catchment	D62D
Vegetation type	Northern Upper Karoo shrubland
Rainfall region	Autumn

c. Index of Habitat Integrity

The evaluation of Index of Habitat Integrity (IHI) provides a measure of the degree to which a river has been modified from its natural state. This assessment was undertaken for the Brak River tributaries (Table 3). The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale with 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact).

The IHI assessment is based on an evaluation of the impacts of two components of the rivers, the riparian zone and the instream habitat. Assessments are made separately for both components, but data for the riparian zone are interpreted primarily in terms of the potential impact on the instream component.

The estimated impact of each criterion is calculated as follows:

Rating for the criterion/maximum value (25) x weight (percent)

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components respectively. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category (Table 3).

Table 3: Habitat Integrity categories (From DWAF, 1999)

Category	Description	Score (% of Total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In worst instances, basic ecosystem functions have been destroyed and changes are irreversible.	0

The ephemeral streams at Du Plessis Dam (Figure 12 and 14) are largely natural with the modification of the habitat occurring as a result of the surrounding farming activities (livestock grazing). The results from the habitat integrity assessment are shown in Table 4.

Table 4. Index of Habitat Integrity Assessment results and criteria assessed of ephemeral tributaries

Instream Criteria	Weight	Score	Riparian Zone Criteria	Weight	Score
Water abstraction	14	3	Water abstraction	13	3
Flow modification	13	4	Inundations	11	3
Bed modification	13	6	Flow modification	12	4
Channel modification	13	4	Water quality	13	3
Water quality	14	3	Indigenous vegetation removal	13	5
Inundation	10	3	Exotic vegetation encroachment	12	2
Exotic macrophytes	9	0	Bank erosion	14	5
Exotic fauna	8	0	Channel modification	12	4
Solid waste disposal	6	1			
Category		B	Category		B

Figure 13. The ephemeral stream at Du Plessis Dam

d. Ecological Importance and Sensitivity (EIS)

EIS (Table 4) considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table 5). The median of the resultant score is calculated to derive the EIS category (Table 6).

Table 4. Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 5. Definition of the four-point scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

Scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table 6. Results of the EIS assessment for the Brak River tributaries

Biotic Determinants	Ephemeral tributaries
Rare and endangered biota	0
Unique biota	0
Intolerant biota	0
Species/taxon richness	1
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	1
Refuge value of habitat type	0
Sensitivity of habitat to flow changes	1
Sensitivity of flow related water quality changes	1
Migration route/corridor for instream and riparian biota	1
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas,	0

PNEs	
RATINGS	0.5
EIS CATEGORY	Low

The rivers are all considered to be of a low Ecological Importance and Sensitivity.

7. ASSESSMENT OF IMPACTS

7.1. Description and assessment of Impacts of proposed activities

This section provides an assessment of the overall potential impacts to freshwater ecosystems that are likely to be associated with the proposed activities. The impact assessment and recommended mitigation measures are grouped according to the various proposed activities, that is, the proposed solar energy facilities; the overhead transmission lines, the access routes and the supporting infrastructure. More detailed impacts for specific aspects of the project for each activity and its alternatives are dealt with in more detail in the next section.

Impact of proposed Solar Energy Facilities:

Construction Phase

Nature of Impact: Due to the intensive nature of the construction activities for the solar energy facilities, they could be expected to have a moderate impact on any freshwater features within the proposed development area. For the preferred development layout (Alternative 1), the PV sites have been selected are outside of any of the identified freshwater features identified in the previous freshwater assessment for the area. With some additional changes to the layout plan, there is likely to be a limited impact on the ecological condition of these features as a result of a change of land cover of the surrounding landscape. The proposed alternative (Alternative 2) is likely to have a more significant impact as freshwater features are included within the proposed PV sites (see following section for more detail).

Clearing of the land of its covering vegetation could result in eroded areas which could extend into the freshwater features near the proposed construction areas. The disturbance of the site compaction of the soils will also impact on the surface and subsurface water flow on the site. In addition, the disturbance of habitat during and after the construction activities provides an opportunity for invasive alien plants to proliferate into the disturbed areas. Impairment of the surface water quality and an increase in turbidity could potentially occur, namely sedimentation during the construction phase, if activities are to take place during the wet season.

Significance of impacts without mitigation: A localized shorter term impact (up to four years) of moderate to high intensity (depending on the distance between the construction activities and the freshwater features) that is expected to have a moderate to low overall significance in terms of its impact on the identified aquatic ecosystems in the area (this is dependent on the selection of the preferred verses the alternative layout plan is mentioned above and provided in more detail in the following section).

Proposed mitigation: Construction activities should as far as possible be limited to the delineated site for the proposed development and the identified access routes. A buffer of 30m should be maintained adjacent to the identified freshwater features. This would require that the proposed location for the Central substation as well as PV2 Substation would need to be moved outside of the delineated drainage channel and recommended buffer area (Figure 12).

It is important that any of the cleared areas that are not hardened surfaces are rehabilitated after construction is completed by revegetating the areas disturbed by the construction activities with suitable indigenous plants. Invasive alien plants that currently exist within the immediate area of the construction activities should also be removed and the sites monitored and managed for invasive alien regrowth during the operational phase.

Run-off over the exposed areas should be mitigated to reduce the rate and volume of run-off and prevent erosion occurring on the site and within the freshwater features and drainage lines. Contaminated runoff from the construction site(s) should be prevented from entering the rivers. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from the river system and regularly serviced. These measures should be addressed, implemented and monitored in terms of the Environmental Management Programme for the construction phase.

Significance of impacts after mitigation: A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be low.

Operation Phase

Nature of Impact: During the operation phase regular access will be required to the site for maintenance and cleaning of solar panels.

Significance of impacts without mitigation: A localized longer term impact (more than 15 years) impact of low intensity (depending on the distance between the PV facilities and the freshwater features) that is expected to have a low to negligible overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Operational activities should as far as possible be limited to the delineated site for the proposed development and the identified access routes. Invasive alien plant growth should be monitored on an on-going basis to ensure that these disturbed areas do not become infested with invasive alien plants.

Storm water run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any storm water leaving the PV facilities site.

Significance of impacts after mitigation: A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be low.

Impact of the Overhead Transmission lines:

Construction and Operation Phase

Nature of Impact: An impact of very limited significance is expected on the drainage characteristics of minor tributaries of the Brak River during and after the construction phase. This is due to the fact that the overhead transmission lines in general follow routes where overhead transmission lines are already in existence.

Significance of impacts without mitigation: A localized shorter term impact of moderate to low intensity that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Where transmission lines need to be constructed over/through the drainage channel, disturbance of the channel should be limited and any structures placed at least 30m outside of the identified freshwater features. All crossings over drainage channels or stream beds after the construction phase should be rehabilitated such that the flow within the drainage channel is not impeded.

Significance of impacts after mitigation: A localized, short-term impact will still occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

Impact of the Access Routes:

Construction and Operation Phase

Nature of Impact: An impact of limited significance is expected at the access route river crossings of ephemeral streams during and after the construction phase.

Significance of impacts without mitigation: A localized shorter term impact of moderate to low intensity that is expected to have a low to very low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation: Access routes should preferably be located along existing farm/Eskom roads wherever possible. Where access routes need to be constructed through ephemeral streams, disturbance of the channel should be limited. All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. Any disturbed areas should be rehabilitated and monitored to ensure that these areas do not become subject to erosion or invasive alien plant growth. Where roads are located along steep gradients, erosion control measures should be put in place to reduce the potential for erosion to take place.

Significance of impacts after mitigation: A localized, short-term impact will occur during the construction phase; however, the overall significance of the impact on the aquatic ecosystems is expected to be a very low impact.

Cumulative impact of the overall project activities on freshwater ecosystems:

Should all the proposed renewable energy projects in and around De Aar be approved, there is likely for some impact of a low significance on the aquatic features to occur. This is due to the fact that there will be an increased hardening of surfaces, change of land cover and an increase in the activities taking place within the Brak River catchment which can be expected to alter the flow, water quality and habitat of the streams within the river system. In general of the activities relating to the renewable energy projects are outside of the identified freshwater features and provided the construction and operation activities of the various projects remain contained within the allocated areas and any disturbed areas within the freshwater features rehabilitated, as is usually stipulated through the environmental authorisation process, the overall impact should be limited and of a low significance.

7.2. Summary of assessment of potential impacts of the proposed activities:

Construction Phase:

Potential impact on freshwater features	Proposed PV Facilities and substations
Nature of impact:	Limited disturbance of freshwater related habitats at the construction sites and some loss of drainage channel habitat
Extent and duration of impact:	Localised short term impacts
Intensity of Impact	Moderate to high
Probability of occurrence:	Probable as a result of construction activities in close proximity to stream beds / drainage channels
Degree to which impact can be reversed:	Medium to high
Irreplaceability of resources:	Medium to low
Impact prior to mitigation:	Low
Significance of impact pre-mitigation	Low
Degree of mitigation possible:	Very low
Proposed mitigation:	• A buffer of 30m should be maintained adjacent to the identified streams for the proposed PV footprint area as well as the substations. • The proposed location for the Central substation as well as PV2 Substation should be moved outside of the delineated drainage channel and its 30m buffer. • There should be minimal use of machinery within the drainage channels and disturbance within this area should be kept to a minimum. • Disturbed areas within the riparian zones and stream beds should be rehabilitated as soon as possible after construction has been completed and revegetated with suitable indigenous vegetation. Rehabilitation works should be undertaken according to an approved rehabilitation plan. • Invasive alien plant growth within the disturbed areas should be visually monitored every 3 months and any regrowth of invasive alien plants removed.

	• Run-off over the exposed areas should be mitigated according to an approved storm water management plan to reduce the rate and volume of run-off and prevent erosion occurring on the site and within the freshwater features and drainage lines.
Impact post mitigation:	Very Low
Significance after mitigation	Very Low

Potential impact on freshwater features	Proposed transmission lines, access roads and water pipeline
Nature of impact:	Disturbance of habitat and possibly impedance/diversion of flow at river crossings
Extent and duration of impact:	Localised short term impacts
Intensity of Impact	Low
Probability of occurrence:	Probable depending on the extent of construction activities within stream bed
Degree to which impact can be reversed:	High
Irreplaceability of resources:	Medium to Low
Impact prior to mitigation:	Low
Significance of impact pre-mitigation	Very low
Degree of mitigation possible:	Very low
Proposed mitigation:	• Construction activities for the proposed infrastructure that will need to take place within the river channels and riparian zone (i.e. linear development components – roads, transmission lines and water pipeline) should transect the streams at right angles and be limited as far as possible to ensure minimum disturbance of this area. • Minimise duration and extent of construction activities in the river – construction should also preferably take place in the low flow season. • Clearing of debris, sediment and hard rubble associated with the construction activities should be undertaken post construction to ensure that flow within the drainage channels are not impeded or diverted. • Rehabilitate disturbed stream bed and banks and revegetate with suitable indigenous vegetation according to the approved rehabilitation plan. • All crossings over drainage channels or stream beds should be such that the flow within the drainage channel is not impeded. • Any disturbed areas should be rehabilitated and visually monitored every 3 months to ensure that these areas do not become subject to erosion or invasive alien plant growth.
Impact post mitigation:	Very Low to negligible impact
Significance after mitigation	Very Low/Insignificant

Potential impact on freshwater features	Proposed Laydown Areas

Nature of impact:	Disturbance of habitat and possibly impedance/diversion of flow at river crossings
Extent and duration of impact:	Localised short term impacts
Intensity of Impact	Moderate to Low
Probability of occurrence:	Probable
Degree to which impact can be reversed:	High
Irreplaceability of resources:	Medium to Low
Impact prior to mitigation:	Low
Significance of impact pre-mitigation	Low
Degree of mitigation possible:	Very low
Proposed mitigation:	• Contaminated runoff from the construction site(s) should be prevented from entering the rivers. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from the river systems/freshwater features and regularly serviced. These measures should be addressed, implemented and visually monitored every week in terms of the EMP for the construction phase. • The laydown area should be cleaned and rehabilitated after construction is complete according to the approved rehabilitation plan.
Impact post mitigation:	Very Low
Significance after mitigation	Very Low to insignificant

Operation Phase:

Potential impact on freshwater features	Maintenance of PV facilities and associated infrastructure
Nature of impact:	Limited ***disturbance of freshwater related habitats*** at the stream crossings for transmission lines and access roads as well as along the length of the site adjacent to any streams
Extent and duration of impact:	Localised longer term impacts
Intensity of Impact	Low
Probability of occurrence:	Probable as a result of construction activities within stream beds and riparian zones
Degree to which impact can be reversed:	Medium to high
Irreplaceability of resources:	Medium to Low
Impact prior to mitigation:	Very low due to the existing disturbances within these streams
Significance of impact pre-mitigation	Very low
Degree of mitigation possible:	Very low
Proposed mitigation:	• Disturbed areas should be visually monitored every 3 months and kept free of invasive alien plant growth. • There should be an approved storm water management plan in

	place for the operation phase of the project. • Storm water runoff from the constructed areas should also be visually monitored after large rainfall events to ensure that eroded areas do not develop, particularly within the drainage channels.
Impact post mitigation:	Very Low
Significance after mitigation	Very Low to insignificant

Decommission Phase:

Potential impact on freshwater features	Existence of PV facilities and associated infrastructure post operation phase
Nature of impact:	Longer term ***loss of freshwater related habitats*** for streams within PV sites as a result on unmitigated erosion and invasive alien vegetation growth once the operation phase for the project has ceased.
Extent and duration of impact:	Localised long term impacts
Intensity of Impact	Low
Probability of occurrence:	Probable as a result of past activities in stream beds and riparian zones
Degree to which impact can be reversed:	Medium to high
Irreplaceability of resources:	Medium to Low
Impact prior to mitigation:	Very low due to the existing disturbances within these streams
Significance of impact pre-mitigation	Very low
Degree of mitigation possible:	Very low
Proposed mitigation:	• A decommission plan should be drawn up and approved for the site that addresses the removal of the PV facilities and infrastructure post operation phase. The decommission plan should address aspects such as monitoring and management of invasive alien plants and erosion of the site after the activities on the site are complete.
Impact post mitigation:	Very Low
Significance after mitigation	Very Low to insignificant

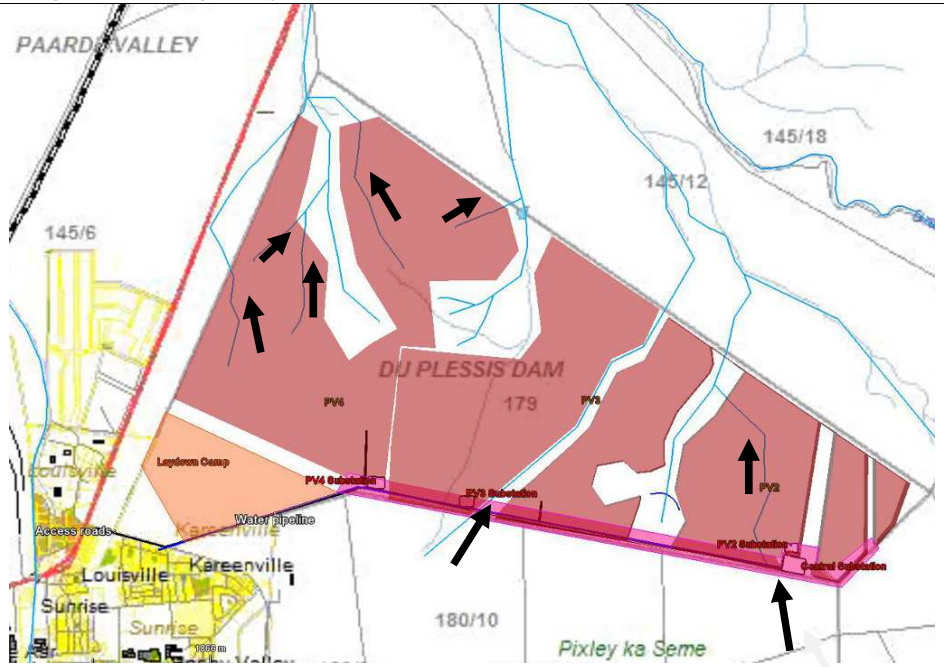
Cumulative Impacts:

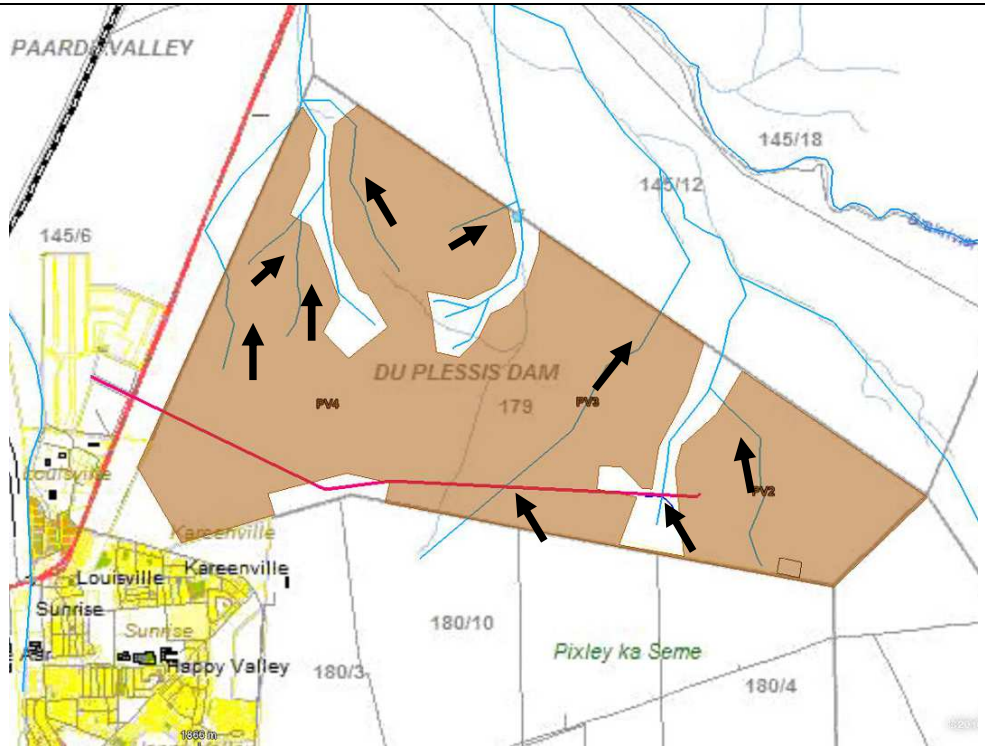
Key impacts	Extent	Magnitude	Duration	SIGNIFICANCE (Without Mitigation)	Probability	Confidence	Reversibility
Impact to surface water ecosystem No mitigation	Regional	Medium/Low	Longer term	Low	Probable	Medium	Reversible
Impact to surface water ecosystem with mitigation	Regional	Low	Longer term	Very Low	Improbable	Medium	Reversible

7.3. Assessment of Proposed Activities and Alternatives at Sites

The proposed activities and alternatives for Du Plessis Dam Farm are discussed in the following table:

Table 7. Assessment of Proposed Activities at Site: Preferred and Alternative Layout Plans (white arrows indicate potential impact areas on freshwater features)

Site	Google Earth image/map	Comment
Du Plessis Dam Farm (Preferred site – Alternative 1)		*Solar energy facility (brown polygons):* The preferred proposed layout will result in some modification of a few minor freshwater features/drainage lines on the site. *Overhead transmission lines/corridors (white polygons with yellow lines):* The proposed transmission lines/corridors for Alternative 1 will cross two minor freshwater features/drainage lines. *Substations (black rectangles).* The Central substation as well as PV1 and possibly PV2 substations are located within the wide depressions that are indicated as freshwater features/drainage lines. These areas tend to be much wetter than the surrounding areas and it is advised that the substations be located at least 30m outside of these wide drainage areas. *Access routes (red lines) and water pipeline (blue line):* The proposed access route and water pipeline for Alternative 1 will cross the two drainage channels crossed by the transmission lines. *Layout camp:* The proposed laydown camp for Alternative 1 is located outside of any identified freshwater features. *Summary of Impacts to freshwater features:* A few of the identified freshwater features/drainage lines on the site will be modified within the footprint of the proposed PV sites as well as two of the substations for Alternative 1. The proposed location for the Central substation as well as PV2 Substation would need to be moved outside of the delineated drainage channel and 30m buffer zone. The transmission line, access road and water pipeline will also need to cross freshwater features/drainage lines but can be easily mitigated. ***The likely significance of the proposed Alternative 1 layout is moderate.***

Du Plessis Dam Farm (Alternative site 2)		*Solar energy facility (brown polygons):* The proposed layout for Alternative 2 will result in some modification of a few minor freshwater features/drainage lines on the site. Slightly more than the preferred site. *Overhead transmission lines/corridors (white polygons with yellow lines):* The proposed transmission lines/corridors for Alternative 2 will cross two minor freshwater features/drainage lines. This has a similar impact as the preferred alternative (Alternative 1). *Substations (black rectangles).* Should the Central substation as well as PV1 and possibly PV2 substations be located along the proposed transmission line for Alternative 2 and outside of the wide drainage areas, the impact is likely to be lower than the preferred option in Alternative 1 for this component. *Access routes (red lines) and water pipeline (blue line):* The proposed access route and water pipeline are likely to be the same as for the preferred alternative (Alternative 1) and will cross the two drainage channels. *Summary of Impacts to freshwater features:* A few of the identified freshwater features/drainage lines on the site will be modified within the footprint of the proposed PV sites as well as two of the substations. The transmission line, access road and water pipeline will also need to cross freshwater features/drainage lines. ***While the likely significance of the proposed Alternative 2 layout is moderate and similar to that for the preferred layout, the preferred layout (Alternative 1) is seen as the better option in terms of its potential impact on the freshwater features.***

8. CONCLUSIONS AND RECOMMENDATIONS

The Brak River tributaries within the study area are considered to be in a largely natural ecological state, with a low ecological importance and sensitivity. The expected impacts of the proposed activities are likely to be as follows:

- *Solar energy facility (brown polygons):* The preferred proposed layout will result in some modification of a few minor freshwater features/drainage lines on the site.
- *Overhead transmission lines/corridors (white polygons with yellow lines):* The preferred transmission lines/corridors will cross two minor freshwater features/drainage lines.
- *Substations (black rectangles).* The Central substation as well as PV1 and possibly PV2 substations are located within the wide depressions that are indicated as freshwater features/drainage lines. These areas tend to be much wetter than the surrounding areas and it is advised that the substations be located at least 30m outside of these wide drainage areas.
- *Access routes (red lines) and water pipeline (blue line):* The proposed access route and water pipeline will cross the two drainage channels crossed by the transmission lines.
- *Layout camp:* The proposed laydown camp is located outside of any identified freshwater features therefore the potential impact on freshwater features is very low for this component.

While the likely significance of the proposed preferred and alternative layouts are similar (moderate significance), the preferred layout (Alternative 1) is seen as the better option in terms of its potential impact on the freshwater features. In particular, by relocating the proposed substations mentioned above to outside of the demarcated drainage line, the potential impact of the proposed layout for the preferred alternative, would be significantly reduced.

Should the following recommended mitigation measures be implemented, the significance of the impact is expected very low:

- A buffer of 30m should be maintained adjacent to the identified streams for the proposed PV footprint area as well as the substations. This would require that the proposed location for the Central substation as well as PV2 Substation would need to be moved outside of the delineated drainage channel and buffer area.
- Construction activities for the proposed infrastructure that will need to take place within the river channels and riparian zone (i.e. linear development components – roads, transmission lines and water pipeline) should transect the streams at right angles and be limited as far as possible to ensure minimum disturbance of this area. Disturbed areas within the riparian zones and stream beds should be rehabilitated as soon as possible after construction has been completed and revegetated with suitable indigenous vegetation. Where possible previously disturbed areas such as existing roads or transmission line routes should be utilised. Disturbed areas should be visually monitored every 3 months and kept free of invasive alien plant growth.

- Construction should preferably take place during the low flow period to minimize the risk of erosion and contaminated runoff from construction sites into adjacent freshwater features.
- All rubble, sand and waste material resulting from the construction activities should be removed from any stream and drainage channels to ensure that flow in these channels are not impeded.
- Invasive alien plants should be removed from the disturbed areas within the drainage channels.
- Contaminated runoff from the construction sites should be prevented from entering the streams.
- All materials on the construction sites should be properly stored and contained.
- Disposal of waste from the sites should also be properly managed.
- Construction workers should be given ablution facilities at the construction sites that are located at least 100m away from the river systems/freshwater features and regularly serviced.
- The laydown area(s) should be cleaned and rehabilitated after construction is complete according to the approved rehabilitation plan.
- There should be an approved storm water management plan in place for the operation phase of the project. Storm water runoff from the constructed areas should also be visually monitored after large rainfall events to ensure that eroded areas do not develop, particularly within the drainage channels.
- A decommission plan should be drawn up and approved for the site that addresses the removal of the PV facilities and infrastructure post operation phase. The decommission plan should address aspects such as monitoring and management of invasive alien plants and erosion of the site after the activities on the site are complete.

A water use authorization application may need to be submitted to the Department of Water Affairs Northern Cape Regional Office for approval of the water use aspects of the proposed activities, in particular a water use authorisation will be required for any development activities relating to the stream crossings.

9. REFERENCES

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