DECLARATION OF INDEPENDENCE

DPR Ecologists and Environmental Services is an independent company and has no financial, personal or other interest in the proposed project, apart from fair remuneration for work performed in the delivery of ecological services. There are no circumstances that compromise the objectivity of the study.

Report Version	**Final 1.0**		
Title	**Freshwater Ecological Assessment for a proposed solar development (extent of 134 hectares) for the Wonderpan solar facility located near Prieska, Northern Cape Province.**		
Author	**DP van Rensburg (Pr.Sci.Nat)**		**May'22**

Executive Summary

The proposed solar development is situated on the Farm Karabee 50, Portion 4 while a powerline will also connect to a northern solar facility and will cross over Portion 2 and 8 of the same farm (Appendix A: Map 1). This area is situated approximately 15 km to the south of the town of Prieska. The development will consist of a PV solar development with extent of 134 hectares with grid connection powerline with length of approximately 10 km. The area contains a multitude of watercourses ranging from small indistinct drainage lines to larger seasonal streams. The site itself contains no watercourses but will border along the north west on a small stream system (Appendix A: Map 2). The powerline will also cross over several watercourses of which the Karabeeloop forms a large stream system with prominent wetland areas (Appendix A: Map 1).

The surface water features in this area is dominated by the Karabeeloop which is a large stream system but will only be affected by the proposed grid connection powerline where this line will be constructed in the watercourse (Appendix A: Map 1). A smaller but still fairly significant tributary of the Karabeeloop occurs adjacent to the PV solar footprint and will most likely be affected by it (Appendix A: Map 2). A few smaller drainage lines will also be crossed by the powerline and will also be assessed in overview. The Karabeeloop will most likely contain some surface water during the rainy season while the smaller tributary adjacent to the PV solar site and those being crossed by the powerline are all ephemeral, i.e. they will only flow during times of high rainfall. Flood debris within these watercourses does however indicate that flash floods do occur from time to time. All of these watercourses contain prominent riparian vegetation while wetland areas are uncommon but still present in some areas. The Karabeeloop does however contain quite extensive wetland areas.

The watercourses in the study area do contain prominent riparian conditions while wetland conditions are absent from the small drainage lines, only present in patches within the larger tributary adjacent to the site, while the Karabeeloop contain prominent wetland conditions within its main channel. This was also confirmed by using obligate riparian vegetation which are confined to watercourses in this arid region and obligate wetland species which are confined to wetlands and cannot occur in conditions outside of these systems. As a result, where they occur, wetland conditions can be considered to occur.

Where the tributary watercourse adjacent to the site contains some wetland conditions as well as the main channel of the Karabeeloop which contains quite prominent wetland conditions these systems can be classified into a specific wetland type. The tributary adjacent to the site as well as the Karabeeloop in the study area can mostly be characterised as channel systems (SANBI 2009). This accurately described those areas containing wetland conditions where these saturated conditions occur only within patches or within the main channel of these system and are clearly absent from the banks, floodplain and riparian zone.

The stream system adjacent to the solar footprint may not the largest watercourse in the area, though it will be the main watercourses being affected by the PV solar development (Appendix A: Map 2). The stream system is situated along the western border of the solar footprint and a 2 km section of the stream will likely be affected by the development. The stream is a tributary of the Karabeeloop and flows into it approximately 4 km to the east of the solar footprint. It is notable that over its entire course it is affected by almost no impacts apart from a few small road crossings and farming activities associated with domestic livestock. It is therefore almost completely natural and unmodified. The stream forms the low point in the landscape and forms a shallow valley. It contains a substantial floodplain and the entire valley bottom consists of alluvial sand deposits.

A defined channel is generally poorly defined and represented by shallow channels in the valley bottom. It discharges by flash floods which contains substantial volumes but which are fast flowing, draining away within a short period.

The affected stream, associated Karabeeloop and the smaller drainage lines are only affected by a few impacts and which are generally not large impacts. An Index of Habitat Integrity (IHI) was conducted for these watercourses within the study area (Appendix D). The results of the IHI indicated that the stream system has an Instream IHI of category B: Largely Natural and Riparian IHI of Category B: Largely Natural. This is considered accurate since the stream is located entirety in a natural area with few impacts. The EI&S of the floodplains associated with the ephemeral stream and associated tributaries has been rated as being Moderate.

A Risk Assessment for the proposed solar facility as well as the grid connection powerline which will affect the adjacent stream system, Karabeeloop and associated drainage lines have been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E).

The stream system situated adjacent to the solar development is still a largely natural system and therefore regarded to have a high conservation value (Appendix A: Map 2). The stream system should therefore be completely excluded from the development and should not encroach into the riparian zone of the stream as delineated. The stream and associated riparian zone should also be regarded as no-go areas and no construction or operational activities including stockpiling, clearing, laydown areas, vehicle movement or any other associated activities should occur in or near this stream system. As long as this is implemented successfully, the anticipated risk on the stream should remain low. Furthermore, although it should not be directly affected, it may however still be indirectly affected by the development, most probably as a result of increased runoff from the panels and an increased sediment load. Erosion is therefore also probable. The development will therefore have to design and implement a comprehensive storm water management system in order to manage runoff and prevent erosion which will affect the stream system.

The proposed gird connection powerline will also cross over several small drainage lines and construction is likely to have some impact on these systems (Appendix A: Map 1). The powerline will cross these watercourses perpendicularly which will minimise the disturbance footprint. The powerline alignment should also endeavour to place pylons on either side of the drainage lines and not within the channel as this will increase erosion. Given the small size of these drainage lines and the low anticipated impact of the powerline, the risk is anticipated to remain low.

According to the current powerline alignment a large portion of it (Approximately 3 km section) will be situated within the main channel of the Karabeeloop and as can be expected this will result in significant disturbance of the stream (Appendix A: Map 1). Construction and pylons in the main channel is also likely to cause significant scouring and erosion of the stream. As a result, this will be regarded as a moderate risk and will consequently require significant mitigation. Re-alignment of the powerline should also be considered which should aim to perpendicularly cross the Karabeeloop only once and should not be located parallel within the main channel (Appendix A: Map 1). This will minimise the anticipated impacts of the powerline and should such an alignment be taken the risk is anticipated to be considerably lower. This is also subject to the powerline avoiding the placement of pylons directly within the main channel of this watercourse.

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Wetland Assessment

1. Introduction

1.1 Background

Natural vegetation is an important component of ecosystems. Some of the vegetation units in a region can be more sensitive than others, usually as a result of a variety of environmental factors and species composition. These units are often associated with water bodies, water transferring bodies or moisture sinks. These systems are always connected to each other through a complex pattern. Degradation of a link in this larger system, e.g. tributary, pan, wetland, usually leads to the degradation of the larger system. Therefore, degradation of such a water related system should be prevented.

Though vegetation may seem to be uniform and low in diversity it may still contain species that are rare and endangered. The occurrence of such a species may render the development unviable. Should such a species be encountered the development should be moved to another location or cease altogether.

South Africa has a large amount of endemic species and in terms of biological diversity ranks as one the ten highest in the world. This has the result that many of the species are rare, highly localised and consequently endangered. It is our duty to protect our diverse natural resources.

South Africa's water resources have become a major concern in recent times. As a water scarce country we need to manage our water resources sustainably in order to maintain a viable resource for the community as well as to preserve the biodiversity of the system. Thus, it should be clear that we need to protect our water resources so that we may be able to utilise this renewable resource sustainably. Areas that are regarded as crucial to maintain healthy water resources include wetlands, streams as well as the overall catchment of a river system.

The impacts of solar farms on the environment is not yet fully understood, although most impacts have now been identified and the manner in which these impacts affect the environment is becoming evident. This is also true for the impact that these facilities have on the surface water systems and runoff from the panels. Impacts include the rain shadow caused by the panels and the coupled runoff and infiltration patterns, erosion caused by these runoff patterns and disruption of surface watercourses.

As a result of the above it is necessary to determine the presence of water sources and any associated wetland conditions in the study area and the likelihood that the development may impact on them.

The proposed solar development is situated on the Farm Karabee 50, Portion 4 while a powerline will also connect to a northern solar facility and will cross over Portion 2 and 8 of the same farm (Appendix A: Map 1). This area is situated approximately 15 km to the south of the town of Prieska. The development will consist of a PV solar development with extent of 134 hectares with grid connection powerline with length of approximately 10 km. This will require the clearance of a large extent of vegetation and the surface disturbance of a large area. The anticipated impacts would therefore be high, especially where watercourses and wetlands occur, and the development will have to take this into consideration. The study area still consists exclusively of natural and unmodified vegetation and it therefore remains likely that elements of conservation importance will occur in the area. Consequently, all the watercourses and wetlands in the area are also still fairly natural with low levels of disturbance. The area is dominated by flat plains but with many low ridges and hills also being present. The area contains a multitude of watercourses ranging from small indistinct drainage lines to larger seasonal streams. The site itself contains no watercourses but will border along the north west on a small stream system (Appendix A: Map 2). The powerline will also cross over several watercourses of which the Karabeeloop forms a large stream system with prominent wetland areas (Appendix A: Map 1).

A site visit was conducted on 12 April 2022. The study area includes the entire PV solar footprint of 134 hectares as well as the 10km grid connection powerline. The stream system adjacent to the solar footprint was surveyed as well as the majority of watercourses being crossed by the powerline. The survey was undertaken during late autumn and after ample rainfall had occurred. This enabled accurate delineation of watercourses, wetland areas and riparian zones. The majority of watercourses in the area are ephemeral (will only flow every other year) while the Karabeeloop is considered partially seasonal.

The report together with its recommendations and mitigation measures should be used to minimise the impact of the proposed development.

1.2 The value of biodiversity

The diversity of life forms and their interaction with each other and the environment has made Earth a uniquely habitable place for humans. Biodiversity sustains human livelihoods and life itself. Although our dependence on biodiversity has become less tangible and apparent, it remains critically important.

The balancing of atmospheric gases through photosynthesis and carbon sequestration is reliant on biodiversity, while an estimated 40% of the global economy is based on biological products and processes (Johnson 2005).

Biodiversity is the basis of innumerable environmental services that keep us and the natural environment alive. These services range from the provision of clean water and watershed services to the recycling of nutrients and pollution. These ecosystem services include:

- Soil formation and maintenance of soil fertility.
- Primary production through photosynthesis as the supportive foundation for all life.
- Provision of food, fuel and fibre.
- Provision of shelter and building materials.
- Regulation of water flows and the maintenance of water quality.
- Regulation and purification of atmospheric gases.
- Moderation of climate and weather.
- Detoxification and decomposition of wastes.
- Pollination of plants, including many crops.
- Control of pests and diseases.
- Maintenance of genetic resources.

1.3 Value of wetlands and watercourses

Freshwater ecosystems provide valuable natural resources, which contributes toward economic, aesthetic, spiritual, cultural and many recreational values. Yet the integrity of freshwater ecosystems in South Africa is rapidly declining in recent times. This crisis is largely a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (the need to utilise these recourses between different stakeholders, i.e. individuals, communities, corporate and industrial) and institutional (Implementing appropriate governance and management). Water affects every activity and aspiration of human society and sustains all ecosystems.

Freshwater ecosystems provide many of our fundamental needs, enable important regulating ecosystem services, supports functional faunal and floral communities:

- Water for drinking and irrigation
- Food such as fish and water plants.
- Building material such as clay and reeds.
- Preventing floods and easing the impacts of droughts.
- Remove excess nutrients and toxic substances from water
- Rivers, wetlands and groundwater systems maintain water supplies and buffer the effects of storms, reducing the loss of life and property to floods.
- Riverbanks help to trap sediments, stabilise
- river banks and break down pollutants draining from the surrounding land.

1.4 Details and expertise of specialist

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Professional registration:
South African Council for Natural Scientific Professions No. (400284/13) (Ecological Science).

Membership with relevant societies and associations:

- South African Society of Aquatic Scientists (SASAQS0091)
- South African Association of Botanists
- South African Wetlands Society (3SLY4IG4)

Expertise:

- Qualifications: B.Sc. (Hons) Botany (2008), M.Sc. in Vegetation Ecology (2012) with focus on ephemeral watercourses.
- Vegetation ecologist with over 10 years experience of conducting ecological assessments.
- Founded DPR Ecologists & Environmental Services (Pty) Ltd in 2016.
- Has conducted over 200 ecological and wetland assessments for various developments.
- Regularly attend conferences and courses in order to stay up to date with current methods and trends:

2017: Kimberley Biodiversity Symposium.
2018: South African Association of Botanists annual conference.
2018: National Wetland Indaba Conference.
2019: SASS5 Aquatic Biomonitoring Training.
2019: Society for Ecological Restoration World Congress 2019.
2019: Wetland rehabilitation: SER 2019 training course.
2020: Tools For Wetlands (TFW) training course.

2. Scope and limitations

- To provide a description of watercourses, wetlands and riparian vegetation included within the study area and immediately adjacent areas.
- Identify watercourses including rivers, streams, pans and wetlands and determine the presence of wetland conditions within these systems.
- Where wetland conditions have been identified the classification of the wetland system will be given.
- To identify possible negative impacts that could be caused by the development.
- To evaluate the present state of the wetlands and riparian vegetation in close proximity to the development. The importance of the ecological function and condition will also be assessed.
- Determine the Present Ecological State (PES) and Ecological Importance & Sensitivity (EIS) for the watercourses in close proximity to the development.
- Conduct a risk assessment and determine the likelihood that watercourses and wetlands will be adversely affected by the development.

2.1 Riparian Vegetation

Aspects of the riparian vegetation that will be assessed include:

- The vegetation types of the region with their relevance to the study area.
- The overall status of the riparian vegetation along the wetlands and watercourses in the study area.
- Species composition with the emphasis on dominant-, rare- and endangered species.
- Presence of wetland conditions and riparian vegetation using obligate wetland and riparian species.

The amount of disturbance present on the study area assessed according to:

- The amount of grazing impacts.
- Disturbance caused by human impacts.
- Other disturbances.

2.2 Wetlands and watercourses

2.2 Wetlands and watercourses

Aspects of the wetlands and watercourses that will be assessed include:

- Identification of watercourses including rivers, streams, pans and wetlands.
- Determine the presence of wetland conditions and riparian vegetation using obligate wetland and riparian species.
- Describe watercourses and wetlands and importance relative to the larger system.
- Conduct Index of Habitat Integrity (IHI) assessment of watercourses to inform the condition and status of these systems.

2.4 Limitations

- Some geophytic or succulent species may have been overlooked due to a specific flowering time or cryptic nature.

- Although a comprehensive survey of the site was done it is still likely that several species were overlooked.
- Due to time constraints only limited soil sampling could be done.
- The wetlands and watercourses in the study area are ephemeral and seasonal in nature and do not contain an aquatic component (including invertebrates and fish species).
- Smaller drainage lines may have been overlooked where a distinct channel or riparian vegetation is absent.
- Due to the large extent of the study area only spot surveys of wetlands were undertaken.

3. Methodology

3.1 Several literature works were used for additional information.

General ecology:

- Red Data List (Raymondo *et al.* 2009).
- Vegetation types (Mucina & Rutherford 2006).
- NBA 2018: South African Inventory of Inland Aquatic Ecosystems (SAIIAE).
- NBA 2018 Technical Report: Inland Aquatic (Freshwater) Realm.
- National Freshwater Ecosystem Priority Areas 2011 (NFEPA).
- Strategic Water Source Areas 2018 (SWSA).
- SANBI (2011): List of threatened ecosystems.
- NEM:BA: List of threatened ecosystems and Threatened Or Protected Species (TOPS).

Vegetation:

- Red Data List (Raymondo *et al.* 2009).
- Vegetation types (Mucina & Rutherford 2006).
- Field guides used for vegetation and riparian species identification (Bromilow 1995, 2010, Coates-Palgrave 2002, Court 2010, Fish *et al* 2015, Gerber *et al* 2004, Gibbs Russel *et al* 1990, Grifiths & Picker 2015, Manning 2009, Roberts & Fourie 1975, Shearing & Van Heerden 2008, Smith *et al* 1998, Smith & Crouch 2009, Van Ginkel *et al* 2011, Van Ginkel & Cilliers 2020, Van Oudtshoorn 2004).

Wetland methodology, delineation and identification:

- Department of Water Affairs and Forestry 2004, 2005, 2008, Collins 2006, Duthie 1999, Kleynhans *et al* 2008, Marnewecke & Kotze 1999, Nel *et al* 2011, SANBI 2009.

3.2 Survey

The site was assessed by means of transects and sample plots.

- Noted species include rare and dominant species.
- The broad vegetation types present at the site were determined.
- The state of the environment was assessed in terms of condition, grazing impacts, disturbance by humans, erosion and presence of invader and exotic species.
- The state of the habitat was also assessed.

All rivers, streams, pans and wetlands were identified and surveyed where they occurred in the study area. These systems were determined by use of topography (land form and drainage pattern) and riparian vegetation with limited soil sampling (Appendix B & C). The following outlines the process applied during the on-site survey in order to obtain all required data:

- Perform desktop overview of the study area utilising available resources (Section 3.1). From the desktop overview identify the different landscape forms, possible wetland areas, watercourses and their relative flow patterns. Using this information, identify transects and sample plots for possible on-site survey. This should be both representative of the wetland or watercourse as a whole but should also include any prominent or significantly unique features.

- Possible sites identified during the desktop overview should be surveyed on-site. Where access is not possible or where desktop features are considered poor representatives of the wetland or watercourse the survey site or transect should be moved to another location, without compromising a comprehensive overview of the system.
- Where a lateral transect is taken of a watercourse this is done from the water's edge, across the marginal, lower and upper zones and extended across the floodplain until the edge of the riparian zone is reached.
- Where a transect is taken of a wetland system, this should preferably be taken across the entire wetland at its widest part or where it is most relevant to the proposed development, from the terrestrial surroundings, across the temporary, seasonal and perennial zones across the wetland.
- Soil samples are taken at 10 meter intervals along the survey transect, or where a distinct transition into a different zone is observed.
- A survey of the plant species within each distinct riparian or wetland zone is undertaken and includes the identification of obligate wetland species, riparian species, terrestrial species, exotic species and the general species composition and vegetation structure which allows for an accurate description of the watercourse or wetland.
- Visual survey of the general topography which substantiates the presence of riparian zones and wetland forms.
- Other general observations include any impacts observed, the overall ecosystem function, presence of fauna, surrounding land uses and the overall condition of the watercourse or wetland.
- Data is recorded by means of photographs with GPS coordinates taken at all relevant soil sampling sites and borders of riparian and wetland zones.

Data obtained during the on-site survey is utilised to provide the following information on the system:

- Desktop overview and assimilation of information on the likely impacts and functioning of the wetland system.
    - Review all available spatial data and resources in order to provide an estimate of the likely impacts and condition of the wetland or watercourse system.
- Confirm the presence of the wetland or watercourse system and provide an estimate of its borders.
    - The border of wetland conditions or the edge of the riparian zone will be confirmed by using soil sampling, obligate wetland vegetation and topography. This will also include the delineation of any temporary, seasonal or perennial zones of wetness along wetlands and the marginal, lower, upper and riparian zones along watercourses.
- Provide a description of the wetland or watercourse.
    - Provide the hydrogeomorphic setting of the wetland, a longitudinal profile which will aid in determining the erodibility of the wetland and provide an overall description of the wetland and impacts affecting it.
    - Provide a general description of the lateral zonation of the watercourse banks including the marginal, lower, upper and riparian zones and a description of the riparian vegetation along the banks of the watercourse. This will also include the description of any impacts or modification of the watercourse.
- Assess the current condition of the wetland or watercourse.

- Utilising information obtained from the assessments listed above, determine the condition of this portion of the wetland by applying the WET-Health 2 tool.
    - Utilising information obtained from the assessments listed above, determine the condition of the relevant section of the watercourse by applying the Index of Habitat Integrity (IHI) tool.
- Utilising all of the information obtained from the assessment, provide recommendations to mitigate anticipated impacts that the development will have.

These systems were determined by use of topography (land form and drainage pattern) and riparian vegetation with limited soil sampling (Appendix B & C).

The following guidelines and frameworks were used to determine the presence of the rivers, streams, pans and wetlands in the study area:

- Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Edition 1. Department of Water Affairs and Forestry, Pretoria.
- Marnewecke & Kotze 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

The following guidelines and frameworks were used to determine the sensitivity or importance of these identified watercourses in the study area:

- Nel *et al.* (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

- Government of South Africa. 2008. National Protected Area Expansion Strategy for South Africa 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa, Pretoria.

- Duthie, A. 1999. Appendix W5: IER (floodplain and wetlands) determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

These guidelines provide the characteristics which can be utilised to determine if a wetland or watercourse is present and also aids in determining the boundary of these systems.

The following were utilised to inform the condition and status of watercourses:

- Kleynhans, C.J., Louw, M.D. & Graham, M. 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity. Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 377-08.

The following were utilised to inform the condition and status of wetlands:

- Macfarlane, D.M., Ollis, D.J. & Kotze, D.C. 2020. WET-Health (Version 2.0): a refined suite of tools for assessing the present ecological state of wetland ecosystems. WRC Report No. TT 820/20.

A Risk Assessment will be conducted for the proposed development in or near watercourses and wetlands in accordance with the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use.

3.3 Criteria used to assess sites

Several criteria were used to assess the study area and determine the overall status of the environment.

3.3.1 Vegetation characteristics

Characteristics of the vegetation in its current state. The diversity of species, sensitivity of habitats and importance of the ecology as a whole.

Habitat diversity and species richness: normally a function of locality, habitat diversity and climatic conditions.
Scoring: Wide variety of species occupying a variety of niches – 1, Variety of species occupying a single nich – 2, Single species dominance over a large area containing a low diversity of species – 3.

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species.
Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely – 3.

Ecological function: All plant communities play a role in the ecosystem. The ecological importance of all areas though, can vary significantly e.g. wetlands, drainage lines, ecotones, etc.
Scoring: Ecological function critical for greater system – 1, Ecological function of medium importance – 2, No special ecological function (system will not fail if absent) – 3.

Degree of rarity/conservation value:
Scoring: Very rare and/or in pristine condition – 1, Fair to good condition and/or relatively rare – 2, Not rare, degraded and/or poorly conserved – 3.

3.3.2 Vegetation condition

The sites are compared to a benchmark site in a good to excellent condition. Vegetation management practises (e.g. grazing regime, fire, management, etc.) can have a marked impact on the condition of the vegetation.

Percentage ground cover: Ground cover is under normal and natural conditions a function of climate and biophysical characteristics. Under poor grazing management, ground cover is one of the first signs of vegetation degradation.

Scoring: Good to excellent – 1, Fair – 2, Poor – 3.

Vegetation structure: This is the ratio between tree, shrub, sub-shrubs and grass layers. The ratio could be affected by grazing and browsing by animals.
Scoring: All layers still intact and showing specimens of all age classes – 1, Sub-shrubs and/or grass layers highly grazed while tree layer still fairly intact (bush partly opened up) – 2, Mono-layered structure often dominated by a few unpalatable species (presence of barren patches notable) – 3.

Infestation with exotic weeds and invader plants or encroachers:
Scoring: No or very slight infestation levels by weeds and invaders – 1, Medium infestation by one or more species – 2, Several weed and invader species present and high occurrence of one or more species – 3.

Degree of grazing/browsing impact:
Scoring: No or very slight notable signs of browsing and/or grazing – 1, Some browse lines evident, shrubs shows signs of browsing, grass layer grazed though still intact – 2, Clear browse line on trees, shrubs heavily pruned and grass layer almost absent – 3.

Signs of erosion: The formation of erosion scars can often give an indication of the severity and/or duration of vegetation degradation.
Scoring: No or very little signs of soil erosion – 1, Small erosion gullies present and/or evidence of slight sheet erosion – 2, Gully erosion well developed (medium to large dongas) and/or sheet erosion removed the topsoil over large areas – 3.

3.3.3 Faunal characteristics

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species or very unique and sensitive habitats can potentially be a fatal flaw.
Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely.

3.4 Biodiversity sensitivity rating (BSR)

The total scores for the criteria discussed in section 3.3 were used to determine the biodiversity sensitivity ranking for the sites. On a scale of 0 – 30, five different classes are described to assess the biodiversity of the study area. The different classes are described in the Table 1:

Table 1: Biodiversity sensitivity ranking

BSR	BSR general floral description	Floral score equating to BSR class
Totally transformed (5)	Vegetation is totally transformed or in a highly degraded state, generally has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area has lost its inherent ecological function. The area has no conservation value and potential for successful rehabilitation is very low.	29 – 30
Advanced Degraded (4)	Vegetation is in an advanced state of degradation, has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area's ecological function is seriously hampered, has a very low conservation value and the potential for successful rehabilitation is low.	26 – 28
Degraded (3)	Vegetation is notably degraded, has a medium level of species diversity although no species of concern are present. Invasive plants are present but are still controllable. The area's ecological function is still intact but may be hampered by the current levels of degradation. Successful rehabilitation of the area is possible. The conservation value is regarded as low.	21 – 25
Good Condition (2)	The area is in a good condition although signs of disturbance are present. Species diversity is high and species of concern may be present. The ecological function is intact and very little rehabilitation is needed. The area is of medium conservation importance.	11 – 20
Sensitive/Pristine (1)	The vegetation is in a pristine or near pristine condition. Very little signs of disturbance other than those needed for successful management are present. The species diversity is very high with several species of concern known to be present. Ecological functioning is intact and the conservation importance is high.	0 - 10

4. Wetland Assessment

For the purpose of this report the general ecology of the study area will first be discussed followed by a discussion of the watercourses and wetland systems.

4.1 Ecology and description of the study area

Refer to the list of species encountered on the site in Appendix B.

The proposed solar development is situated on the Farm Karabee 50, Portion 4 while a powerline will also connect to a northern solar facility and will cross over Portion 2 and 8 of the same farm (Appendix A: Map 1). This area is situated approximately 15 km to the south of the town of Prieska. The development will consist of a PV solar development with extent of 134 hectares with grid connection powerline with length of approximately 10 km. This will require the clearance of a large extent of vegetation and the surface disturbance of a large area. The anticipated impacts would therefore be high, especially where watercourses and wetlands occur, and the development will have to take this into consideration. The study area still consists exclusively of natural and unmodified vegetation and it therefore remains likely that elements of conservation importance will occur in the areas. Consequently, all the watercourses and wetlands in the area are also still fairly natural with low levels of disturbance. The area is dominated by flat plains but with many low ridges and hills also being present. The area contains a multitude of watercourses ranging from small indistinct drainage lines to larger seasonal streams. The site itself contains no watercourses but will border along the north west on a small stream system (Appendix A: Map 2). The powerline will also cross over several watercourses of which the Karabeeloop forms a large stream system with prominent wetland area (Appendix A: Map 1).

According to Mucina & Rutherford (2006) the area consists of Northern Upper Karoo (NKu 3) and Bushmanland Arid Grassland (Aza 4). These vegetation types are currently listed as being of Least Concern (LC) within the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004). They are not currently subjected to any pronounced development pressures.

Northern Upper Karoo (NKu 3) dominates along the powerline route. It contains a varied topography with undulating plains, ridges, hills and uneven rocky terrain, incised by a high amount of small watercourses. The vegetation is dominated by a shrubland with the shrub/small tree, *Senegalia mellifera* subsp. *detinens* (Black Thorn) being dominant with a dwarf karroid shrub and grass component also being prominent. Given the varied topography the vegetation contains a significant species diversity with several species of conservation importance.

Bushmanland Arid Grassland (NKb 3) dominates the PV solar footprint. It has a more uniform topography being fairly flat while sloping toward the surrounding watercourses. The vegetation is also dominated by a shrubland with the shrub/small tree, *Senegalia mellifera* subsp. *detinens* (Black Thorn) being dominant with a dwarf karroid shrub and grass component also being prominent. The vegetation seems to be somewhat more uniform with a lower species diversity though species of conservation concern are still present.

The site is situated within the Upper Karoo Region and under natural condition would be dominated by low shrub, dwarf karroid shrubs and sparse grasses. This is still the case for the entire area with roads, railways and farmsteads being the only areas of significant disturbance. The terrestrial vegetation is dominated by a dense shrub layer, dominated by *Senegalia melifera* subsp. *detinens,* while the grass layer is fairly well developed with a prominent dwarf shrub component. Several protected species were noted and Red Listed species such as *Hoodia officinalis* was also noted in the surrounding areas. Areas of natural vegetation is therefore highly likely to contain elements of conservation importance.

The Northern Cape Critical Biodiversity Areas Plan (2016) has recently been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e., Critical Biodiversity Areas. The solar footprint and majority of the powerline route is listed as an Ecological Support Area (ESA) as it supports the functioning of the surrounding watercourses and wetlands.

The topography is dominated by fairly flat plains but with interspersed low hills and ridges. These hills and ridges are also associated with the watercourses in the area and it is evident that uneven terrain and hills and ridges increase along the Karabeeloop watercourses which is a fairly large system (Appendix A: Map 1). The surrounding plain areas also promotes incision of the landscape by numerous ephemeral streams and drainage lines. The Karabeeloop is also coupled with steeper slopes and calcrete dominated landscapes which also represent natural erosional features. Altitude at the solar footprint is fairly uniform and varies from 999m to 1004m while the altitude along the powerline decreases steadily from the site (999 m) toward the connection point (964 m) as the powerline follows the course of the Karabeeloop.

The study area still consists almost exclusively of natural vegetation without any significant transformation (Appendix A: Map 1). It is currently utilised for grazing by domestic livestock and consequently the only impacts are associated with this and include dirt tracks, tarred road, railway line, fencelines, a homestead and associated disturbances and stock watering points with local disturbance. This should clearly indicate that the area is largely natural with few impacts. Domestic livestock farming over a long period can however cause degradation of the vegetation composition and may in some instances lead to a decrease in diversity and modification of the vegetation structure. In this instance, the vegetation is dominated by the shrub/small tree, *Senegalia melifera* subsp. *detinens* (Black Thorn). This species is well-known to proliferate in overgrazed areas and can become problematic. In the study area it is considered a natural and characteristic element of the vegetation type.

The study area is located on the north-western margin of the Karoo Basin, which is filled with carboniferous glacial deposits of the Dwyka Formation. The Dwyka Formation represents the bedrock in the area and consists of tillite and diamictite. The Dwyka Formation is overlain by Quaternary deposits consisting of sand, gravel, calcrete and silcrete. The general geology of the study area is dominated by calcrete terraces (plateau landscape), with Dwyka tillites of the Karoo Supergroup forming the steep slopes and ridges along the larger incised watercourses.

The region has an approximate mean annual rainfall of 260mm per annum which occurs largely as thunderstorms between October and April with a mean annual evaporation of 200–300 mm/annum This is considered a relatively low rainfall and causes the area to form part of the more arid parts of South Africa. The occurrence of wetlands are therefore not common, however, due to the proximity to the Orange River located approximately 5 km to the north, watercourses are abundant and the larger systems such as the Karabeeloop do contain prominent wetland conditions. The surface water runoff in the area is restricted to very high rainfall events that results in an estimated mean annual runoff (MAR) for the area between 0-2.5 mm. The mean maximum and minimum temperatures of the region are 39˚C and -2.3˚C.

Mostly as a result of the natural and unmodified nature of the area it was notable that very few exotic weeds or invaders were present (Appendix B).

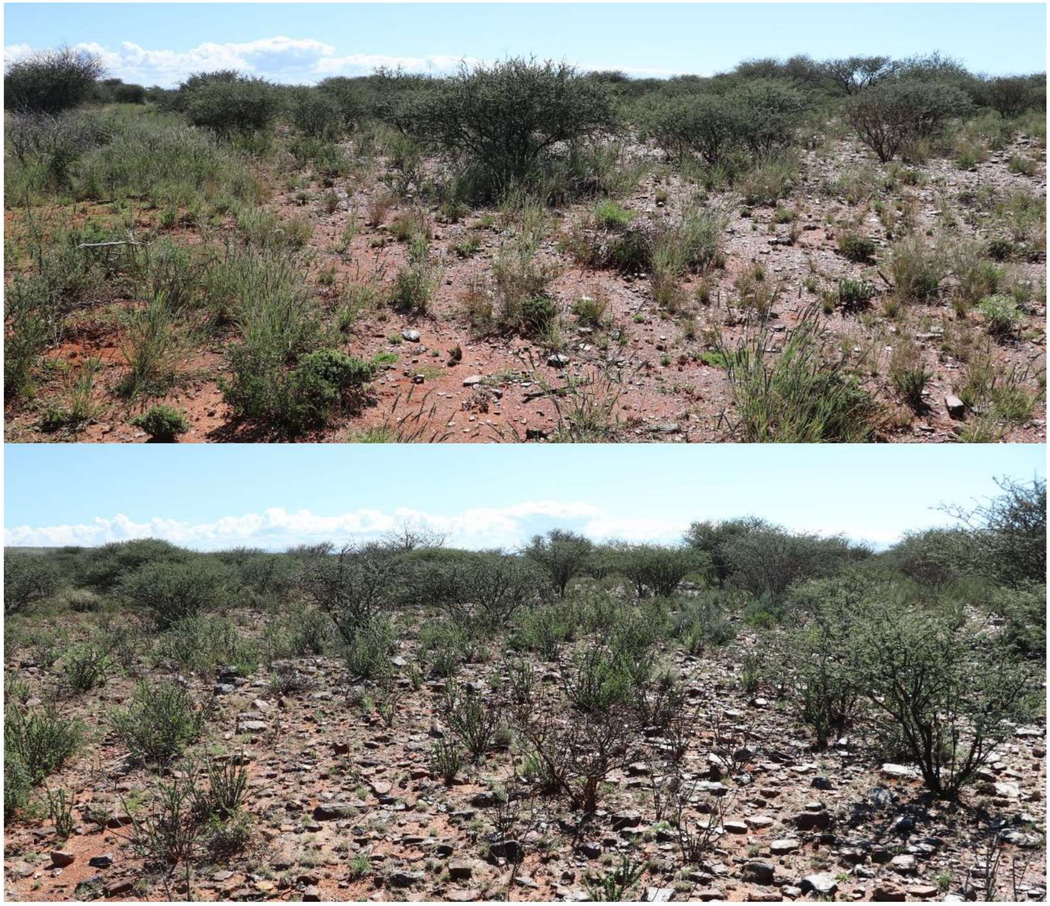


Figure 1: The terrestrial portions of the site is dominated by a low shrub layer with a fairly well developed grass layer and dwarf karroid shrubs. Note also a relatively flat topography here.

Figure 2: Larger watercourses in the area support a dense riparian vegetation community clearly different from the surrounding terrestrial areas.


Figure 3: The Karabeeloop is a large watercourse with extensive wetland conditions. This stream system will be affected by the grid connection powerline.

4.2 Wetland and Watercourses Assessment

4.2.1 Introduction

The surface water features in this area is dominated by the Karabeeloop which is a large stream system but will only be affected by the proposed grid connection powerline where this line will be constructed in the watercourse (Appendix A: Map 1). A smaller but still fairly significant tributary of the Karabeeloop occurs adjacent to the PV solar footprint and will most likely be affected by it (Appendix A: Map 2). A few smaller drainage lines will also be crossed by the powerline and will also be assessed in overview. The Karabeeloop will most likely contain some surface water during the rainy season while the smaller tributary adjacent to the PV solar site and those being crossed by the powerline are all ephemeral, i.e. they will only flow during times of high rainfall. Flood debris within these watercourses does however indicate that flash floods do occur from time to time. All of these watercourses contain prominent riparian vegetation while wetland areas are uncommon but still present in some areas. The Karabeeloop does however contain quite extensive wetland areas.

The assessment of the watercourses and wetlands which will be affected by the development will consist of the following:

- The watercourse situated adjacent to the PV footprint will be the main system affected by the development and will therefore be the focus of the study (Appendix A: Map 2).
- The grid connection powerline will cross over the Karabeeloop as well as a few smaller watercourses and drainage lines and these will therefore be assessed only in overview (Appendix A: Map 1).
- A historical borrow pit occurs along the northern border of the site which accumulates surface runoff and forms artificial wetland conditions. It is however completely artificial and do not contribute significantly toward the surface water of the site and is consequently of negligible conservation value. It will be noted in the report but will not form part of the discussions.

The term watercourse refers to a river, stream, wetland or pan. The National Water Act (NWA, 1998) includes rivers, streams, pans and wetlands in the definition of the term watercourse. This definition follows:

Watercourse means:

- A river or spring.
- A natural channel in which water flows regularly or intermittently.
- A wetland, lake or dam into which water flows.
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Riparian habitat is an accepted indicator of watercourses used to delineate the extent of wetlands, rivers, streams and pans (Department of Water Affairs and Forestry 2005).

The classification of stream orders from 1 to 3 can be illustrated by means of the Strahler 1952 classification. The watercourse adjacent to the site and smaller drainage lines which will be affected by the powerline are all first order stream systems while the Karabeeloop is a second order system. This also indicates that all of the watercourses which will be affected by the solar development and powerline form part of the same system and can therefore also be assessed as a whole.

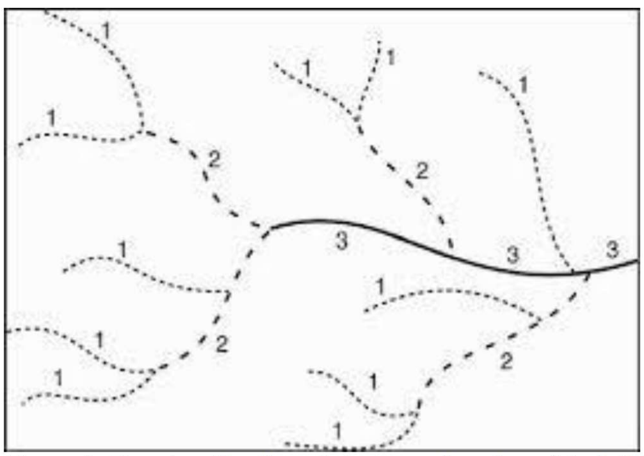


Figure 4: The classification of stream orders from 1 to 3 (Strahler 1952)

4.2.2 Wetland indicators

Obligate wetland vegetation was utilised to determine the presence and border of wetland conditions (Appendix B). Due to time constraints and the extent of the study area soil samples were only taken within sample points within the watercourses and wetlands to confirm the presence of wetland conditions. Soil samples were investigated for the presence of anaerobic evidence which characterises wetland soils (Appendix C).

The vegetation survey indicated that the watercourse situated adjacent to the site contains prominent and quite dense riparian vegetation, while some portion also contain indistinct wetland conditions. The smaller drainage lines affected by the powerline also all contain at least some riparian species. The Karabeeloop which will be affected by the powerline contain extensive riparian areas while the main channel also contains prominent wetland conditions. The watercourses in this region function much differently than those in the higher rainfall regions of South Africa. What would in these high rainfall areas be regarded as a strictly terrestrial species is in this arid region confined to watercourses and wetlands and should therefore be regarded as an obligate riparian species. This will be discussed further in the following sections. Riparian conditions are therefore present along all of the affected watercourses in the area while sparse wetland conditions may be present along the watercourse affected by the solar footprint and the Karabeeloop contains quite extensive wetland conditions along its main channel. This was also confirmed by soil sampling within these watercourses which was dominated by sandy soils with only feint mottling where wetland conditions were identified. This also indicated that where wetland conditions were present it mostly consisted of temporary wetland conditions. The exception being the main channel of the Karabeeloop which contains at least seasonal wetland conditions. This all indicates that saturated soil conditions occur only for short periods after heavy rainfall when patches within these watercourses become inundated and soils saturated. These watercourses clearly also all function as flash flood systems whereby main channel flow only occurs after heavy rainfall events and flushes through the system in a relatively short period while temporary pools may form in the larger watercourses.

In conclusion, watercourses in the study area do contain prominent riparian conditions while wetland conditions are absent from the small drainage lines, only present in patches within the larger tributary adjacent to the site, while the Karabeeloop contain prominent wetland conditions within its main channel. This was also confirmed by using obligate riparian vegetation which are confined to watercourses in this arid region and obligate wetland species which are confined to wetlands and cannot occur in conditions outside of these systems. As a result, where they occur, wetland conditions can be considered to occur.

4.2.3 Classification of wetland systems

Where the tributary watercourse adjacent to the site contains some wetland conditions as well as the main channel of the Karabeeloop which contains quite prominent wetland conditions these systems can be classified into a specific wetland type.

The tributary adjacent to the site as well as the Karabeeloop in the study area can mostly be characterised as channel systems (SANBI 2009):

"An open conduit with clearly defined margins that (i) continuously or periodically contains flowing water, or (ii) forms a connecting link between two water bodies. Dominant water sources include concentrated surface flow from upstream channels and tributaries, diffuse surface flow or interflow, and/or groundwater flow. Water moves through the system as concentrated flow and usually exits as such but can exit as diffuse surface flow because of a sudden change in gradient. Unidirectional channel-contained horizontal flow characterises the hydrodynamic nature of these units. Note that, for purposes of the classification system, channels generally refer to rivers or streams (including those that have been canalised) that are subject to concentrated flow on a continuous basis or periodically during flooding, as opposed to being characterised by diffuse flow (see unchannelled valley-bottom wetland). As a result of the erosive forces associated with concentrated flow, channels characteristically have relatively obvious active channel banks. An active channel is a channel that is inundated at sufficiently regular intervals to maintain channel form and keep the channel free of established terrestrial vegetation. These channels are typically filled to capacity during bankfull discharge (i.e. during the annual flood, except for intermittent rivers that do not flood annually)."

This accurately described those areas containing wetland conditions where these saturated conditions occur only within patches or within the main channel of these system and are clearly absent from the banks, floodplain and riparian zone.

4.2.4. Overview of seasonal and ephemeral watercourses

As indicated the watercourses within the study area are all ephemeral in nature (Appendix A: Map 1 & 2). These range from the large Karabeeloop which clearly contain wetland areas, the larger tributary adjacent to the site to the small drainage lines being affected by the powerline. As ephemeral systems they all function in a unique manner different from normal watercourses. Seasonal, and especially ephemeral, systems are still poorly understood and their functioning is markedly different from perennial systems. This section will give an overview of the functioning of these systems.

Non-perennial rivers are systems in which surface flow stops and may disappear for some period of most years (Uys & Keeffe 1997). They can further be divided into seasonal and ephemeral systems where seasonal systems have a continuous channel flow during the rainy season and ephemeral systems have a highly variable frequency of connected channel flow, a high degree of natural disturbance and a lack of baseflow (Hughes 2008). Seasonal systems can be regarded as flowing between 20 % and 80 % of the year and ephemeral systems less than 20 % of the year (Kleynhans & Louw 1999). From this description it is clear that all the affected watercourses in the study area are ephemeral systems.

Precipitation in the catchments of seasonal and ephemeral rivers are generally highly sporadic, localised and of short duration as is the case in this arid area. This can be more pronounced during periods of drought as was recently experienced. Consequently, runoff is highly variable and peak discharges may be reached within minutes. As a result of the variable climatic conditions runoff may be generated over small areas so that tributary and even mainchannel flow occurs whilst large portions of the channel system remains dry. The downstream reduction in flow after flooding events is caused by the infiltration into channel and floodplain sediments as well as evaporative losses. This accurately describes the functioning and flow of the watercourses in the area.

Floods are essential to the existence, productivity and interactions of many biotic elements in seasonal and ephemeral ecosystems. The longitudinal transfer must play a vital role where any deliverance of moisture may serve to supplement available resources. Floods transfer materials laterally and longitudinally, but more importantly, water triggers ecosystem processes. Floods activate a diverse range of terrestrial decomposer communities which otherwise are inactive during dry stages. An ephemeral system functions as a floodplain without a river where the highly variable hydrologic regime supports a terrestrial biota, dependent upon flooding (Jacobsen 1997).

Small flow events play an important role in connecting isolated pools and thus exchange of genetic material. Small flow events also recharge pools. Larger flow events influence the channel geomorphology with regard to channel size and shape and sediment dynamics (Hughes 2008). During large flood events flow occurs laterally into the floodplain and reside there, the duration of this event depends on the rainfall, but typically lasts about 4-5 days (Rassam *et al.* 2006). These floods play a critical role in regulating organic matter transport and deposition and secondary production (Kleynhans & Louw 1999).

Floods have also been shown to play an important role in structuring riparian communities. Different plant species differ in their ability to withstand or regenerate after major floods. As floods alter the species composition of a community, invariably the ecosystem functions are also altered, especially where shifts occur in plant functional types (Stromberg, Lite & Dixon 2010).

From the above it should be clear that flooding is essential to the continued and natural functioning of the watercourses in the study area. It is also a real occurrence during the annual cycle of these watercourses and will occur annually in the seasonal systems but infrequently and perhaps only during years of high rainfall in the ephemeral systems such as occurs on the site.

The distribution of riparian communities in semi-arid rivers has been shown to be correlated to variation in topography. Flooding frequency and duration as well as water availability due to this variation in topography has often been cited as the reason for these distribution patterns. The catchment geology together with the hydrogeomorphic processes of a river causes a heterogeneous landscape with different morphologic units that also changes through space and time. This heterogeneous landscape is an important factor in vegetation development and gives rise to distribution of different vegetation types (Van Coller, Rogers & Heritage 1997).

Soil salinity is a factor that significantly affects the distribution, morphology and productivity of many riparian species. Soil enrichment by soluble salts occurs where flood waters contain a significant salt load. Soils that become enriched generally occur in the lower reaches of the river where water flow is slowed and together with infiltration and evaporation, salts are deposited (Jacobson 1997). This is evident within the alluvial floodplain of the tributary adjacent to the site as well as along the Karabeeloop. These also represent the lower reaches of these watercourses while those smaller drainage lines occurring along the powerline route are fast draining without any significant floodplain and here any significant salt accumulation is absent.

The above description should give a quite good description of the unique functioning that these watercourses have. It should also serve to indicate that although they may seem small and flow only occur sporadically they still have a complex functioning which provides several unique ecosystem services. They should consequently still be considered as sensitive systems.

4.2.5 Description of watercourses and wetlands

The study area contains the tributary stream adjacent to the PV solar footprint and the Karabeeloop and smaller drainage lines being crossed by the grid connection powerline (Appendix A: Map 1 & 2). A short description of each of these will be provided below. Note that the small drainage lines will be combined as a whole to serve as representative of the system.

Obligate wetland vegetation was also used to determine the presence of wetland conditions. Obligate wetland species are confined to wetlands and are only able to occur in wetlands. They are therefore reliable indicators of wetland conditions. Field observations over time as well as the following sources were used to determine FW and OW species:

- Marnewecke, G. & Kotze, D. 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

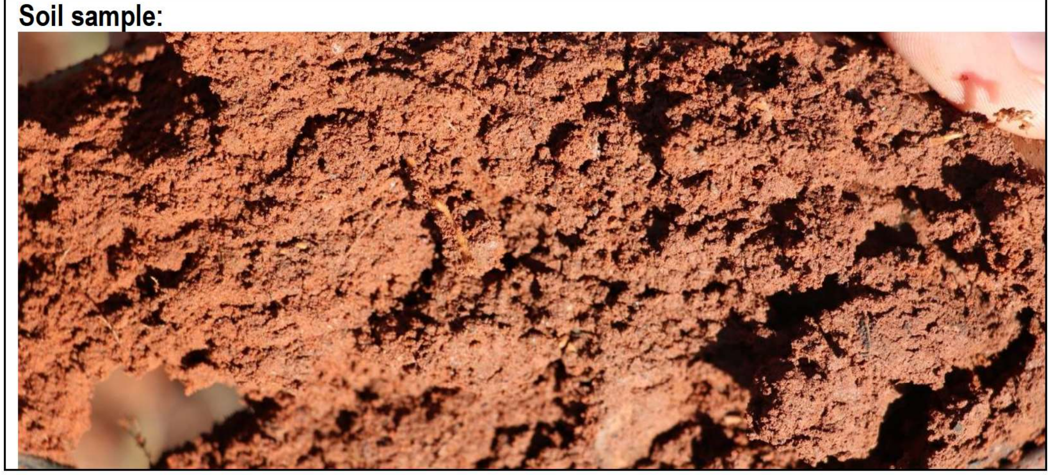
- DWAF. 2008. Updated manual for the identification and delineation of wetlands and riparian areas, prepared by M.Rountree, A.L. Batchelor, J. MacKenzie and D. Hoare.

Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

- Van Ginkel, C.E. & Cilliers, C.J. 2020. Aquatic and wetland plants of Southern Africa. Briza Publications, Pretoria.

Table 2: Description of the individual watercourses and wetlands which forms part of the study area (Appendix A: Map 1 & 2) (FW – Facultative wetland species, OW – Obligate wetland species, * - Exotic species).

Watercourse name:	**Coordinates of sampling**:	**Flow regime**:
#1 Ephemeral Stream – Adjacent to the PV Solar footprint and forms tributary of the Karabeeloop	S 29.806837°, E 22.850461° S 29.798267°, E 22.852635° S 29.794004°, E 22.854021°	Ephemeral
Description of watercourse: Though not the largest watercourse in the area, it will be the main watercourses being affected by the PV solar development. The stream system is situated along the western border of the solar footprint and a 2 km section of the stream will likely be affected by the development. The stream is a tributary of the Karabeeloop and flows into it approximately 4 km to the east of the solar footprint. Any impacts on the stream will therefore also likely affect the Karabeeloop which contributes towards its importance. The stream flows from south west to north east along the western border of the solar footprint. It originates a short distance to the west of the site along the slopes of the Asbestos Mountains. It is notable that over its entire course it is affected by almost no impacts apart from a few small road crossings and farming activities associated with domestic livestock. It is therefore almost completely natural and unmodified. The stream forms the low point in the landscape and forms a shallow valley. It contains a substantial floodplain and the entire valley bottom consists of alluvial sand deposits. A defined channel is generally poorly defined and represented by shallow channels in the valley bottom. This is mostly a result of the stream being situated within the lower lying plains where water flow slows down, sands and sediments are being deposited and because water flow is so slow, any channel becomes filled in and obscured. The area has received ample rains recently and yet the stream contained no surface water at the time of the survey. This also confirms the ephemeral nature of the stream. It discharges by flash floods which contains substantial volumes but which are fast flowing draining away within a short period. Where fences occur in the stream, flood debris also confirms this. The stream borders the solar development and would therefore not be directly affected by it as long as the border of the construction footprint does not encroach into the riparian zone as delineated. The stream may however still be indirectly affected by the development, most probably as a result of increased runoff from the panels and an increased sediment load. Erosion is therefore also probable. The development will therefore have to design and implement a comprehensive storm water management system in order to manage runoff and prevent erosion which will affect the stream system. Soils within the stream are dominated by reddish, sandy soils which are devoid of wetland conditions. However, a few patches occur where the soils contain feint mottling and can be regarded as a temporary wetland zone. Here the vegetation had also confirmed this. Overall, the vegetation within this stream is clearly different from the surrounding terrestrial areas and dominated by riparian vegetation. The streambed and floodplain is dominated by fairly dense		

grass layer which is dominated by many riparian grasses. These grasses are diagnostic of watercourses in this region and are not able to occur in the surrounding terrestrial areas. A short tree/shrub layer is also present and this consists of a mixture of terrestrial trees and shrubs. Exotic weeds are present, but rare and do not indicate any significant disturbance in the stream. Several indigenous pioneer herbs are also abundant but is an indication of the flood disturbance regime associated with all watercourses and are part of the natural species assemblage. The majority of plants occurring along the stream are considered to be strictly riparian in this region with only a few terrestrial species occurring.
Dominant plant species: Shrub/tree layer: *Lycium cinerium, Lycium bosciifolium, Pentzia globosa, Salsola aphylla, Lycium pumilum, Ziziphus mucronata, Phaeoptilum spinosum, Ehretia rigida*. Riparian grasses: *Setaria verticillata, Eragrostis rotifer, Digitaria eriantha, Eragrostis biflora, Panicum coloratum* (FW). Wetland species: *Ophioglossum sp., Cyperus betschuanus* (OW). Herbaceous species: *Geigeria filifolia, Trianthema triquetra, Galenia crystallina, Garuleum schinzii* subsp. *schinzii, Boerhavia cordobensis, Puppalia lappachea, Pavonia burchellii, Chenopodium carrinatum, *Datura ferox, Tetragonia arbuscula, Radyera urens, Mesembryanthemum sp.* Terrestrial species: *Sengalia melifera* subp. *detinens, Cenchrus ciliaris, Aristida congesta, Enneapogon cenchroides, Melinis repens.*
Protected plant species: *Ammocharis coranica, Boscia albitrunca, Nerine laticoma.*
Soil sample: 

A defined main channel is not clearly present in the stream although riparian vegetation can become very dense in many areas.

The stream system is clearly deifferntiated from the surrounding terrestrial areas.

A poorly defined channel may be present in some areas (blue). Note dense riparian grass cover.

Although surface water is absent, flood debris in the stream indicate that water flow must have reach at least a depth of 30 cm after recent rainfall.

Watercourse name:	**Coordinates of sampling:**	**Flow regime:**
#2 Karabeeloop – Large stream system which will be affected by the grid connection powerline	S 29.766969°, E 22.880342° S 29.751511°, E 22.874572° S 29.723147°, E 22.855339°	Ephemeral

Description of watercourse:

The largest and main watercourse in this area, all other affected watercourses also drain into this system. The stream system will be affected by a long section of powerline (approximately 3 km) which according to the current alignment, will be placed within the main channel of the stream. The Karabeeloop also flows into the Orange River approximately 5 km downstream of the site. Any impacts on the stream will therefore also likely affect the Orange River which contributes towards its importance. The stream flows from south east to north west and has its origin approximately 15 km to the south east of the site. From aerial imagery, this stream also does not seem to be affected by any impacts apart from a few small road crossings and farming activities associated with domestic livestock. It is therefore almost completely natural and unmodified.

The Karabeeloop is a quite large stream system and forms a low point in the landscape within a very broad but shallow valley. It contains an extensive floodplain and the entire valley bottom consists of alluvial sand deposits. The stream is quite large and contains a prominent channel which can be quite broad and deep in some areas. The stream also conveys large volumes of water and this was also apparent during the survey where many pools, saturated areas and wetland areas were observed in the main channel of the stream. Connected flow was however absent and it is clear that this is also an ephemeral system discharging by means of flash floods.

As indicated, a large section of the grid connection powerline will be situated within the main channel and this will result in significant disturbance of the stream. Construction and pylons in the main channel is also likely to cause significant scouring and erosion of the stream. The alignment of the powerline should aim to perpendicularly cross the Karabeeloop only once and should not be located parallel within the main channel. This will minimise the anticipate impacts of the powerline.

Soils within the Karabeeloop range from reddish soils where wetland conditions are obscure, to greyish soils with clear mottling, where wetland conditions are most prominent. Likewise, the vegetation along the stream also varies from a section dominated by riparian grasses, to sections dominated by aquatic herbs and wetland sedges. Exotic weeds are generally absent

although some areas do contain dense stand of *Atriplex nummularia,* a naturalised shrub which is now common along most Karoo rivers.
Dominant plant species: Shrub/tree layer: **Atriplex nummularia, Suaeda fruticosa, Suaeda sp.* Riparian grasses: *Eragrostis echinochloidea, Eragrostis rotifer, Panicum coloratum* (FW), *Sporobolus ioclados, Eragrostis bicolor*. Wetland species: *Cyperus difformis* (OW), *Alternanthera sessilis* (OW), *Marsilea sp., Isolepis sp.* (OW), *Schoenoplectus corymbosus* (OW) Herbaceous species: *Malephora crocea, Mesembryanthemum sp.*
Protected plant species: *Malephora crocea, Mesembryanthemum sp., Hoodia officinalis, Piaranthus conrutus* subsp. *cornutus, Titanopsis calcarea.*
Soil sample: 
 The Karabeeloop contains a clearly defined channel (blue) and wetland conditions are clearly prominent.