www.zerocarboncharge.co.za

Freshwater Report

for the proposed

ZCC Akkerboom electric automobile charging station.

T-N014-07

A requirement of the National Environmental Management Act (107 of 1998) and Section 21(c) and section 21(i) of the National Water Act (36 of 1998)

July 2023

EnviroAfrica

WATSAN Africa

Index

Abbreviations

Critical Biodiversity Area	CBA
Department of Fisheries, Forestry and the Environment	DFFE
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Importance and Sensitivity Class	EISC
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Impact Assessment	EIA
Electronic Water Use License Application (on-line)	eWULAAS
Government Notice	GN
Metres Above Sea Level	masl
National Environmental Management Act (107 of 1998)	NEMA
National Freshwater Environment Priority Area	NFEPA
National Water Act (36 of 1998)	NWA
Northern Cape Department of Environment & Nature Conservation	DENC
Present Ecological State	PES
Section of an Act of Parliament	S
South Africa National Biodiversity Institute	SANBI
Water Use License Application	WULA

List of Figures

List of Tables

1 Introduction

1.1 The Company, its Vision and its Mission

The following can be found on the CHARGE webpage:

"Internal combustion engine (ICE) vehicles produce 29% of the carbon emissions on earth. It is simply not sustainable for the future of our planet to keep producing them. Electric vehicles offer a solution in this regard, provided that they are not reliant on the burning of fossil fuels. Zero Carbon Charge powers our electric chargers with energy from the wind and the sun, which means there is virtually no impact on the planet.

"It is completely implausible to suggest that electric cars will not come to SA in significant numbers, or that we are going to have to wait for government to lead the way. It is far more plausible, actually irrefutable, that as conventional cars are phased out by the global manufacturers on the time scales set out above, the electric cars are produced by the international global automotive ecosystem, will find their way here.

"Zero Carbon Charge will commence with the construction of its first charging station in 2023. South Africans will have a cheaper and more sustainable alternative to fossil fuel when travelling on roads across the country."

Hence CHARGE has embarked on the construction and operation of a network of charging stations spread out all over South Africa.

1.2 The Assignment

Mr Joubert Roux of CHARGE appointed Mr Bernard de Witt of Enviro Africa in Somerset West to conduct the required environmental impact assessments (EIA's) for the sites. The legally imperative public participation is underway, with posters up on the site (Figure 1).

The ZCC site is located on mostly dry drainage lines, which are according to legislation, viewed as legitimate water resources, for which a WULA is required.

Subsequently, Dr Dirk van Driel of WATSAN Africa in Knysna was appointed to:

- Conduct the prescribed site visit. The site visit was conducted on 15 February 2023.
- Draft the Freshwater Report.
- Lodge the WULA on the online eWULAAS, the official application mechanism.

The Freshwater Report must contain adequate information to allow for informed decision-making. These decision-makers essentially are the DWS officials. The Freshwater report has developed in a set format and must contain specific information.

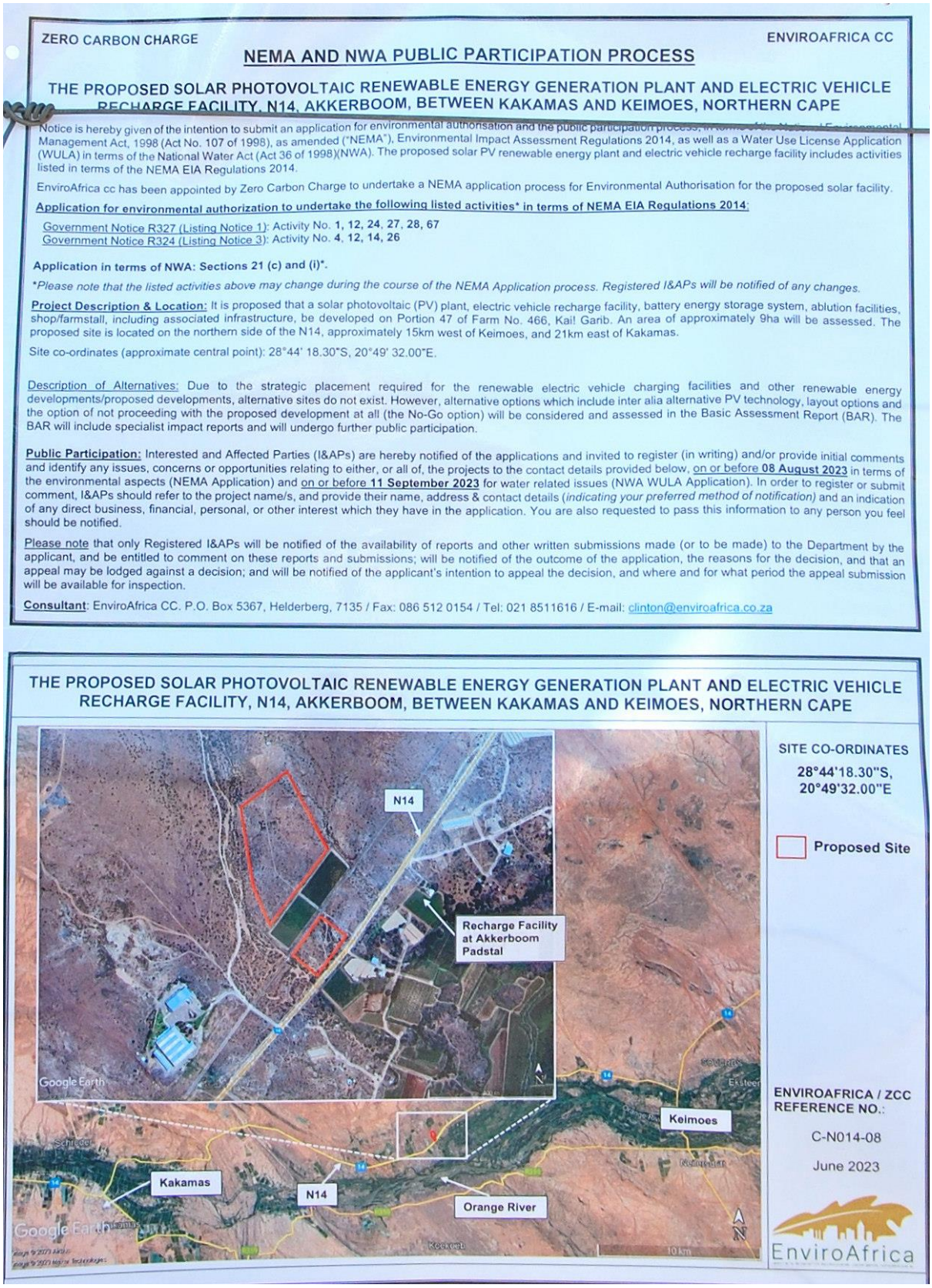


Figure 1 Public participation

Moreover, it must contain a Risk Matrix as published on the DWS webpage and as specified in gazetted government notices. This Risk Matrix is the official mechanism that aids the decision if a letter of consent, a General Authorization or a License is required. The Risk Matrix must be compiled and signed by a registered specialist scientist.

The Freshwater Report must contain adequate information for the EIA as well. Hence, several specified evaluations have been included.

2 Legal Framework

The proposed development "triggers" sections of the National Water Act. These are the following:

S21 (c) *Impeding or diverting the flow of a water course.*

The proposed ZCC site is adjacent to natural drainage lines that are identified in the NWA and its regulations as legitimate water resources. The drainage lines could possibly be altered, should the development go ahead.

S21 (i) *Altering the bed, bank, course of characteristics of a water course.*

The proposed ZCC site may alter the characteristics of the drainage lines.

Government Notice 267 of 24 March 2017

Government Notice 1180 of 2002. *Risk Matrix.*

The Risk Matrix as published on the DWS official webpage must be completed and submitted along with the Water Use Licence Application (WULA). The outcome of this risk assessment determines if a letter of consent, a General Authorization or a License is required.

Government Notice 509 of 26 August 2016

An extensive set of regulations that apply to any development in a water course is listed in this government notice in terms of Section 24 of the NWA. No development take place within the 1:100 year-flood line without the consent of the DWS. If the 1:100-year flood line flood line is not known, no development may take place within a 100m

from a water course without the consent of the DWS. Likewise, no development may take place within 500m of a wetland without the consent of the DWS.

National Environmental Management Act (107of 1998)

NEMA and regulations promulgated in terms of NEMA determines that no development without the consent and permission of the DFFE and its regional agencies may take place within 32m of a water course. The mostly dry drainage lines are perceived to be legitimate water courses.

3 Climate Keimoes

https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/keimoes_south-africa_991491

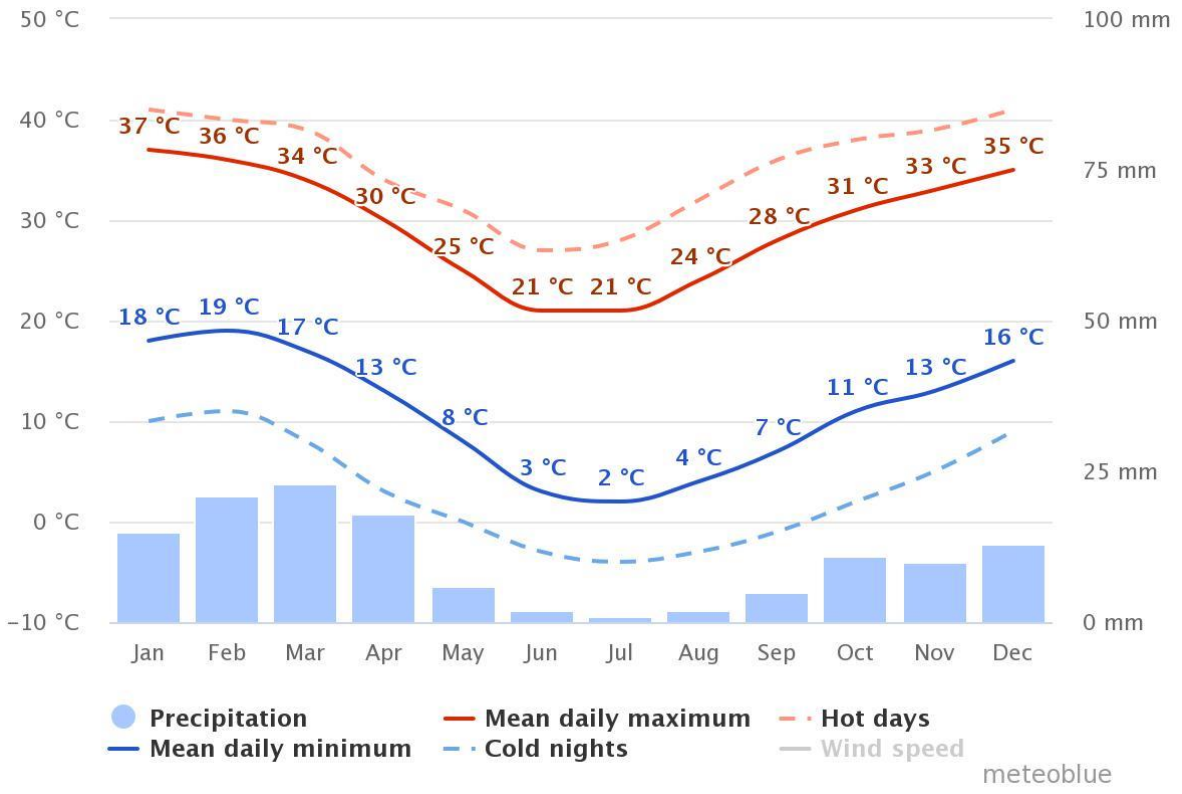


Figure 2 Climate Keimoes

The closest locality for which rainfall data is available online is Keimoes some 15 km away from Akkerboom. The average annual rainfall here is 191mm. This is an arid region with desert conditions.

Rainfall is erratic, with sudden summer thunderstorms and with fierce runoff. Droughts are common and may last several years.

The drainage lines exist because of sudden and intense downpours that occur only once in several years. These must have been formed over millennia since historical times. The contribution to the flow in the Orange River is negligible.

4 Locality

Figure 3 Locality

The Akkerboom vehicle recharge station will be on both sides of the N14 trunk road just over 15km to the west of Keimoes. It is close to the northern banks of the Orange River. The coordinates are as follows:

28°44'24.92"S and 20°49"36.78"E

5 Quaternary Catchment

The Akkerboom ZCC site is in the D73F quaternary catchment.

6 Conservation Status

6.1 DFFE Screening Tool

Table 1 Screening Tool Results

Theme	Rating
Animal species Aquatic biodiversity Avian Plant species Terrestrial biodiversity	Medium Low Low Low Very High

The Animal Species theme was rated as medium because of the possible presence of Ludwig's bustard *Neotis ludwigii*. It may still occur on the property. It may still utilize the property right next to the proposed solar panels. Therefore, this theme can be motivated as rating Low.

Despite the Aquatic Biodiversity being rated as Low, a Freshwater Report and a WULA will still be required, because of the requirements of the NWA.

The Terrestrial biodiversity was rated as very high because of the area is branded as a CBA. Because of the low impact nature of the proposed development as well as the wide expanse of the sort of habitat that is available in the district and in the area, this theme can also be motivated as of a Low rating.

There are protected plant species in the district. These do indeed occur on the site. The development does not appear to be a threat to any of these, as none of them will have to be removed or recued.

The proposed development is not about to change any of the DFFE screening tool ratings. The screening tool does not provide adequate impetus to disallow the proposed development.

6.2 Vegetation

Most of the site is in the Bushmanland Arid Grassland that is not endangered in any way and is of Least Concern. The lower portion of the proposed development is Lower Griep Alluvial Vegetation. This of Least Concern as well.

The proposed development would have no effect on this classification.

CBA's

"Critical Biodiversity Areas (CBA) are terrestrial (land) and aquatic (water) areas which must be safeguarded in their natural or near-natural state because they are critical for conserving biodiversity and maintaining ecosystem functioning." SANParks

https://www.google.com/search?q=critical+biodiversity+areas+south+africa&rlz=1C1GCEA_enZA1031ZA1031&oq=critical+biodiversity+areas+south+africa&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIKCAEQABiGAxiKBTIKCAIQABiGAxiKBdIBCTExNjEyajBqN6gCALACAA&sourceid=chrome&ie=UTF-8

It is hard to see how a small patch of Bushmanland Arid Grassveld and an part of the Orange River Catchment that does not contribute to the flow in the river can be regarded as a CBA. Therefore, the site should be reclassified as of a Low sensitivity.

7 Drainage Lines

The landscape around much of the Lower Orange River and the Sak River is dominated by a dense succession of drainage lines. They spread along the river with many smaller tributaries to cover the entire area. The iron oxides in the sands renders a red hue that is visible from space on the Google Earth images. These reds are concentrated in the drainage lines, making them even more visible (Figure 4).

The drainage lines are mostly dry, with water only during rains and perhaps shortly thereafter. During the odd thunderstorm, drainage lines can come down in flood. These floods maintain the drainage line's morphological integrity, as sediments are moved and these water ways are scoured out.

Because rainfall events are far apart, the drainage lines must have been form over millennia, even since geological times.

These drainage lines are driven by the very scant rainfall events, sudden and sometimes severe thunderstorms, spread out over millennia. Rainfall is interspersed by prolonged droughts. This gives rise to a sparse and drought resistant vegetation. The shallow ground water that migrates along these drainage lines provides just enough moist for higher vegetation to take root and to hold on under these very harsh climatic conditions. Drainage lines are ecologically important, as it provides denser and higher vegetation in an otherwise barren landscape, contributing to habitat variation, biodiversity and migration routes.

The upper sub-catchments of these drainage lines are mostly near-pristine, with only grazing. The lower parts are heavily impacted by agriculture and sand winning. This stark contrast is evident all over the region.

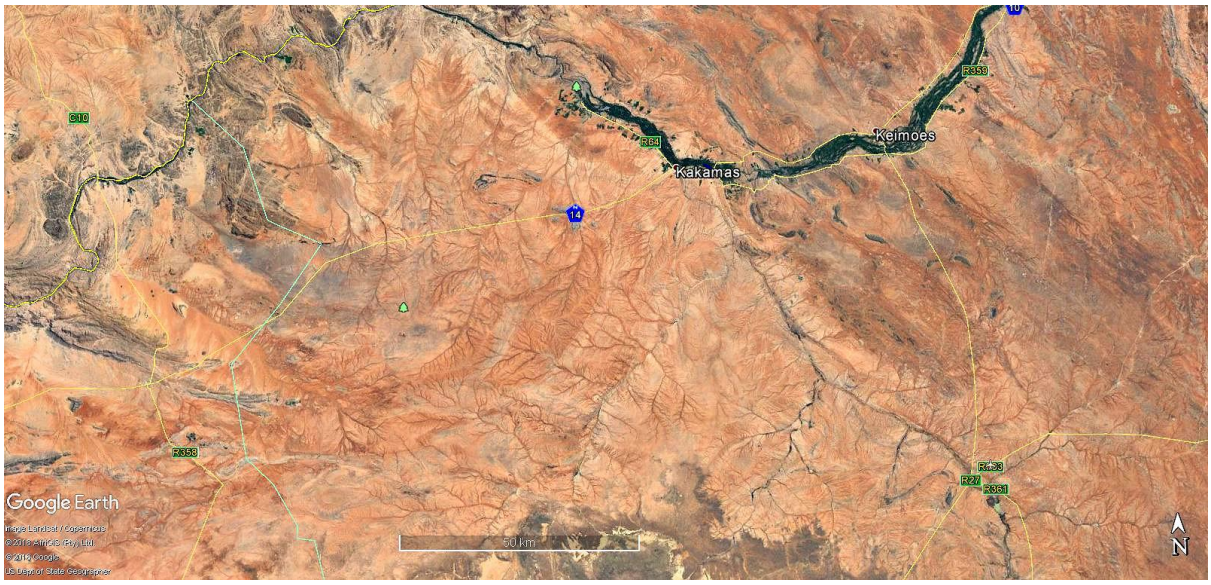


Figure 4 Drainage Lines

Around the Orange River, the Hartbees River and even the Sak River, large-scale agriculture has changed the drainage lines into drainage channels among the vineyards and orchards. The upper reaches away from the rivers are less impacted, even near-pristine, as intense agriculture is not possible, apart from those areas where water is piped over long distances from the Orange River.

Much of the discussion in this report is about these drainage lines.

8 Sheet Wash Plains

Drainage lines fan out to connect to one another in a broad and continuous fan, interconnected, with no visual demarcation between drainage lines. This is visible on Google Earth Images, as well as on the ground. During rainfall events, storm water spreads out all over, in a braided fashion, and the flow of water migrates sideways, left and right, to create this continuous fan of braided drainage lines known as sheet wash plains.

9 Sub-Catchment

The sub-catchment (Figure 5 & 6) in which the proposed solar energy plant is located is 905ha in size. The drainage line is from the top of the sub-catchment to the N14 trunk road is 8.2km long, following the curve of the drainage line.

The highest point in the sub-catchment is 785masl and lowest at the N14 is 692masl. The distance between these two points in a straight line is 6km. This translates into a mean slope of 1.5 vertical meters in every 100 horizontal meters. This is a gentle slope that does not provide for fast runoff velocities and a high erosion potential.

Nevertheless, there is a well-developed drainage line with a sandy bottom (Figure7). The lower reach is extensively braided.

The drainage line passes underneath two railway line bridges (Figure 8). These bridges were obviously constructed to make provision for adequate volume in the case of the large flood.

Close to the railway line, perhaps 60m downstream, the drainage line passes underneath the N14 trunk road. There are two box culvert bridges and a pair of 600 mm pipes (Figure 9).

Stil further downstream, adjacent and south of the N14, the drainage line is braided and diffuse, only to be collected in the drainage channels around the vineyards. The drainage line ends up in the northern-most channel of the braided Orange River. This channel is heavily overgrown with Spanish reed (*Arundo donax*) (Figure 10).

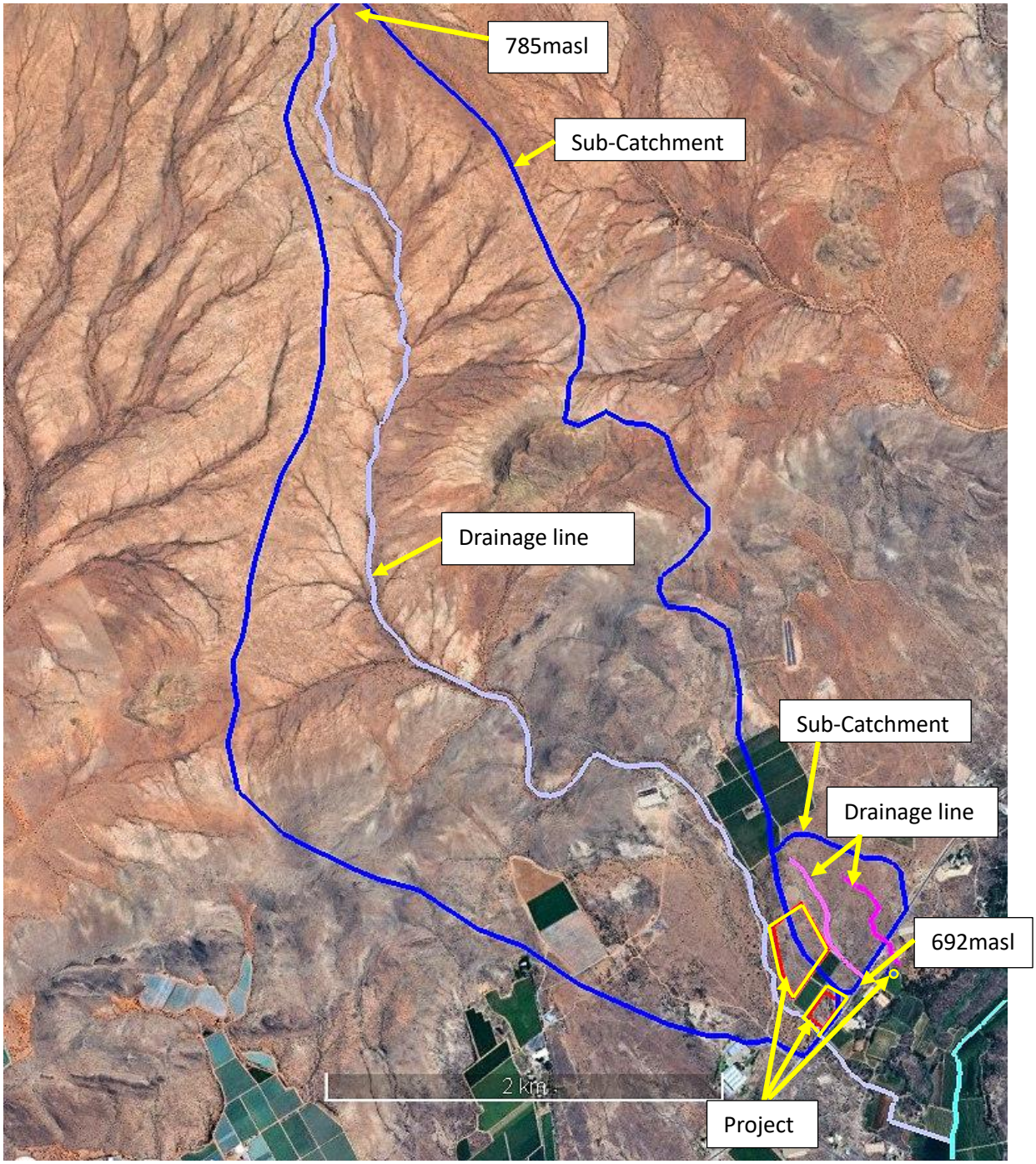


Figure 5 Sub-Catchment

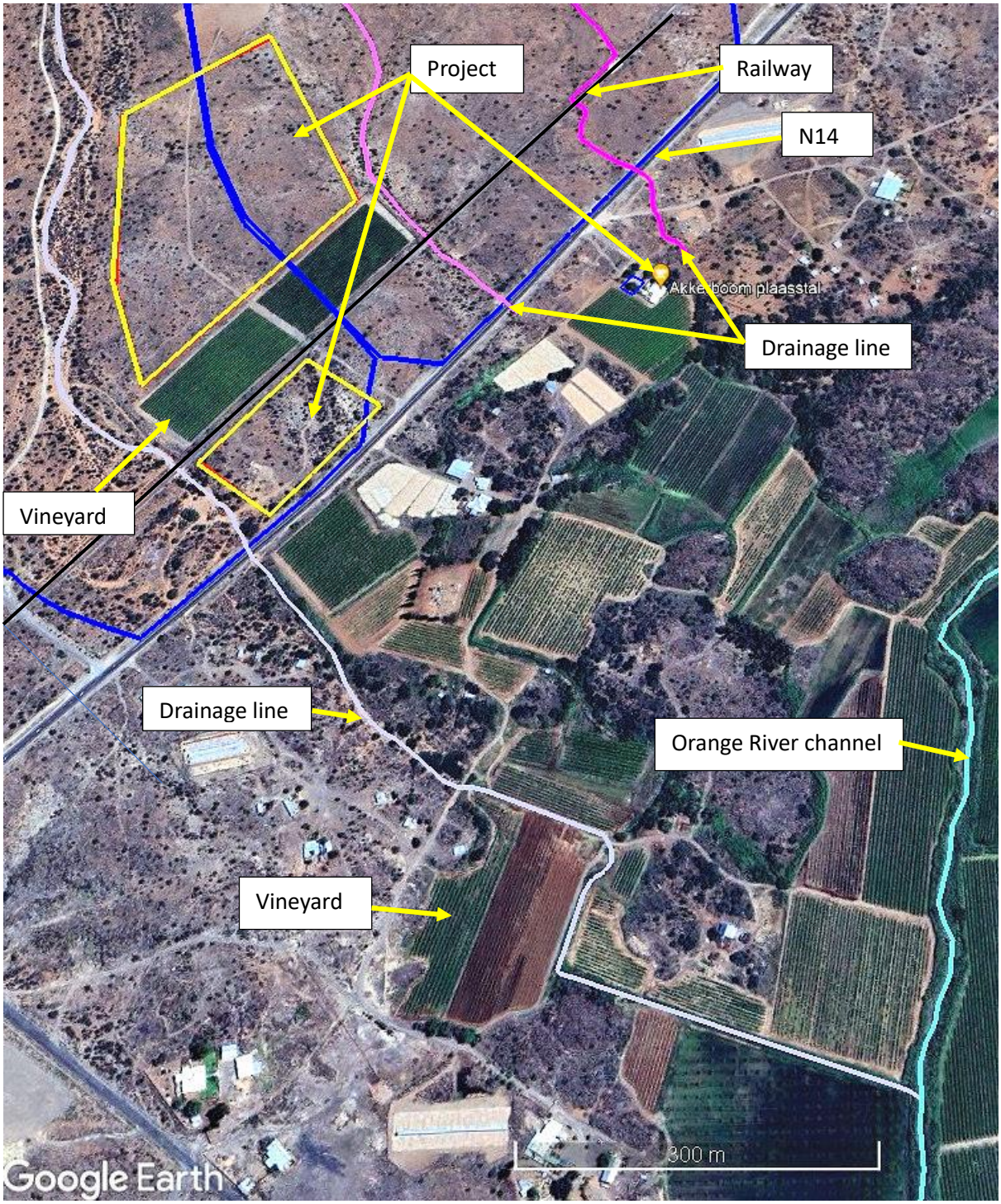


Figure 6 Enlarged

Figure 7 Sandy bottom

Figure 8 Railway bridges

Figure 9 N14 road bridges

Figure 10 Spanish reed

Figure 11 Riparian vegetation

The banks of the drainage line are overgrown with mainly swarthaak trees (*Senegalia melifera*) (Figure 11), with here and there a mature camelthorn tree (*Vachelia erioloba*).

The land surrounding the drainage line is level, with grasses and a scattering of trees (Figure 11).

Apart from a few tufts of prickly rush *Juncus punctorius* (Figure 12) downstream of one of the railroad bridges, no other wetland indicator plants were observed.

Figure 12 Surrounding land

Figure 13 Rush

There is yet another small sub-catchment on the southeastern corner of the much larger one (Figure 5). The drainage line has two tributaries that both passes underneath the N14, then become obscure across the N14 and in the vineyards to

eventually end up in the Orange River channel. The tributaries probably and originally connected in the past prior to human impact, but that confluence is no longer apparent.

Figure 14 Rocks

Figure 15 Railway culvert.

Where the western tributary touched upon the N14, it was stabilised with a pile of rocks (Figure 14). The drainage line here passes underneath the railway line trough a robust constructed culvert (Figure 15) and underneath the road through a low concrete structure (Figure 16).

Figure 16 Constructed box culverts.

10 The Project

Ultimately there will be 7 blocks of solar panels (Figure 17). Blocks will be constructed in phases, one at a time, as demand escalates. The solar panels will be elevated above ground level on stilts. This means that runoff won't be affected. The site's hydrology won't change. The ground remains permeable.

Nearby, across the N14 trunk road, next to the existing Akkerboom Farmstall, charging bays will be constructed, also in phases, each with its parking area. Electric vehicles will pull into a parking space to plug into the electricity supply for its battery to be charged.

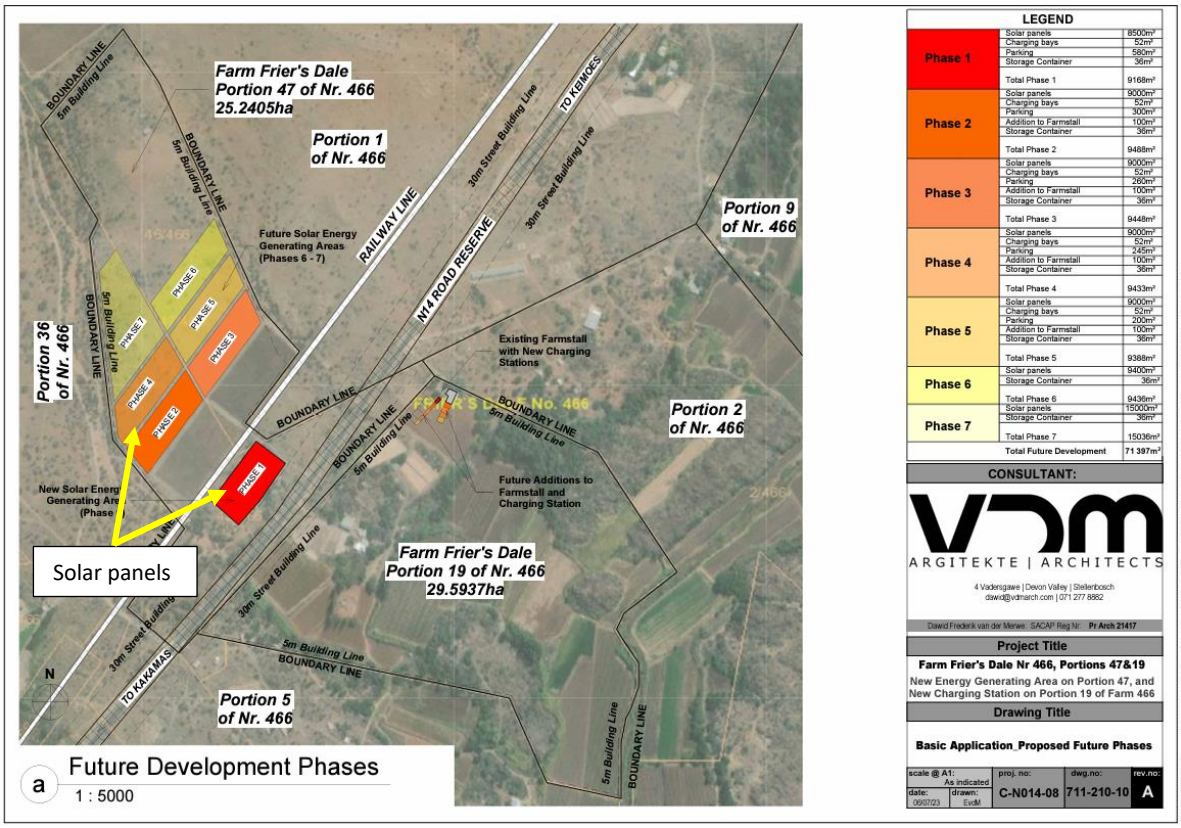


Figure 17 Screenshot Lay out solar panels.

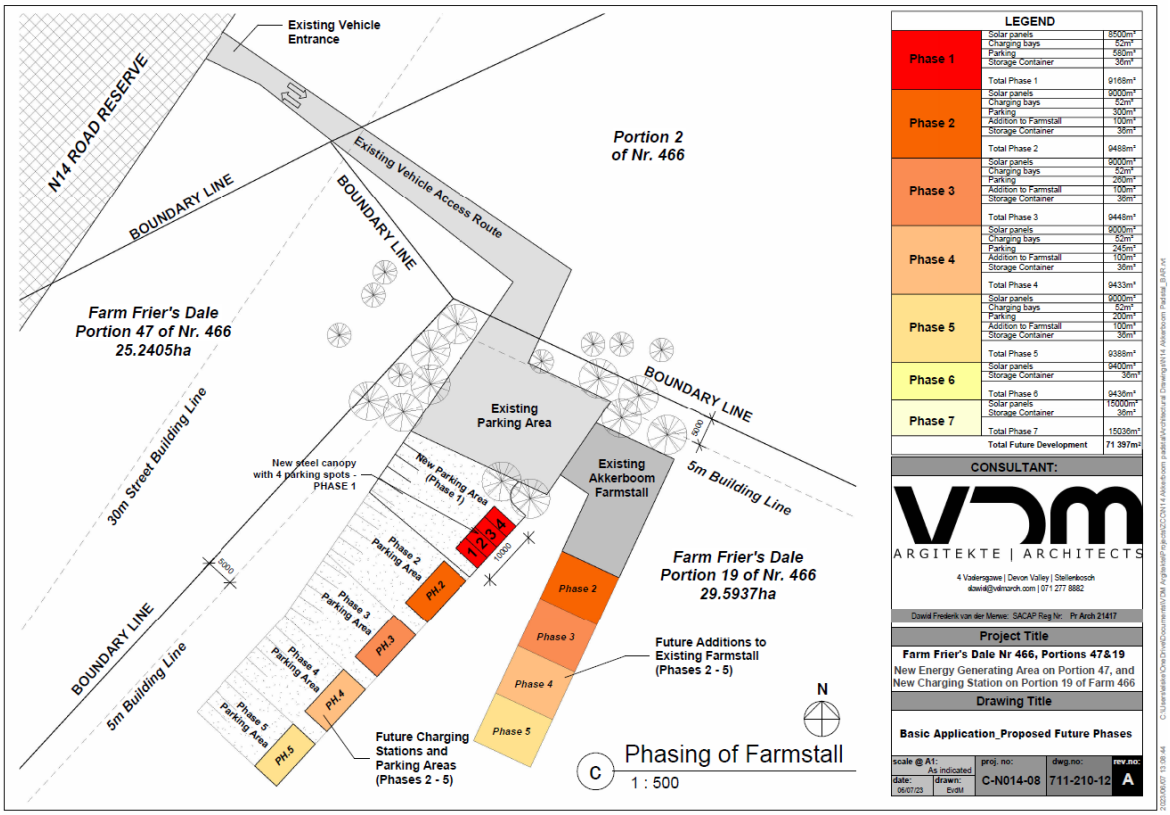


Figure 18 Screenshot Lay out charging station

11 Biomonitoring the Lower Orange River

11.1 Methodology

The biomonitoring was carried out according to the description of Dickens & Graham (2002).

Biomonitoring was carried out on the Lower Orange River during site visits for successive WULAs. So far 14 samples have been analyzed at 13 localities (Table 1). The site furthest east was at Hopetown and furthest west at Augrabies, with Upington in the middle. Thirteen of these localities are located upstream of the Augrabies Falls. One sample was analyzed at Styerkraal just east of the border post of Onseepkans downstream of the Augrabies Falls.

The river is mostly braided, with many smaller streams and with islands in the middle. The river sports many rapids and riffles, but also pool-like features where the river is broad and slower flowing.

The bottom is mainly muddy, with some large rocky outcrops in the middle of the river.

11.2 Impacts on the Lower Orange River

The river is heavily utilized for agriculture, with the banks entirely modified into cultured vineyards. A multitude of large electric water pumps have been placed in the river for abstracting large volumes of water for irrigation. Abstraction significantly lowers the flow in the river.

Berms for the purpose of flood protection have been constructed on the banks of the river for most of its length. These berms have been constructed by the Department of Water Affairs and now have been a feature of the landscape for many decades. The berms keep flood water out of adjacent agricultural land and has denaturalised the riparian zone.

The single most impact on the Orange River are the two very large dams, The Gariep Dam and the Vanderkloof Dam. The river flow has been modified to a much even regime, different from the varied flown with high peak flows and low drought flows.

The Lower Orange River is lined with a dense system of mostly dry drainage lines. These drainage lines only flow during and shortly after heavy rains. Their contribution to the flow of the Orange River is insignificant. Most of the flow comes from the Lesotho Highlands and some from the Vaal River. However, many of these drainage lines have been transformed into engineered agricultural return flow furrows that carries the excess of over irrigation back to the Orange River. Agricultural return flow adds much to the nutrient load of the Orange River because runoff contains fertilizer. Nitrogen is added in large quantities. Since phosphorus readily binds to the soil, not much phosphorus is added.

Return flow can contain a heavy silt load, thereby elevating turbidity in the river.

It is suspected that pesticides in agricultural return flow have a heavy impact on biomonitoring results, significantly reducing the SASS5 score.

The banks of the Orange River in the area is densely overgrown with Spaanse Riet (*Arundo donax*). This is classified as an aggressive and exotic invasive plant, which effectively prevents access to the river. The reeds result in a homogeneous aquatic habitat. This lack of variation supresses the SASS5 score, with only a limited number of aquatic macroinvertebrate species present in this habitat.

11.3 Lower Orange River Biomonitoring Results

The biomonitoring results have been captured in Table 1 and depicted in Figure 20.

The classes from A to F in Figure 1 has been assigned for mature rivers on flood plains such as the Lower Orange River.

Only 2 of the samples were classified a good and relatively unimpacted (Class A). Five were in Class B and C, which can be regarded as acceptable under the circumstances of an impacted river reach. These classes can possible be labelled as the ideal, a compromise between agriculture and aquatic ecological functioning.

Four samples were poor (Classes E and F), an undesirable situation.

The one sample downstream of the Augrabies Falls was extremely poor.

11.4 Limitations

The DWS maintains a formal and scheduled biomonitoring program throughout the country, including the Lower Orange River. This gives, no doubt, a much better indication of the state of the river than self-collected data. Because this data is not available to the consulting fraternity, self-collected data such as that of Figure 1 must suffice.

11.5 Bakenrant Sampling

Bakenrant was the closest locality to Akkerboom where biomonitoring was done (Figure 19).

The riverbanks are generally steep and overgrown with a dense stand of reeds, which deny access to the river for sampling. Sampling is allowed where the riverbanks are kept clear at water abstraction points, where pipes and pumps are located on the river.

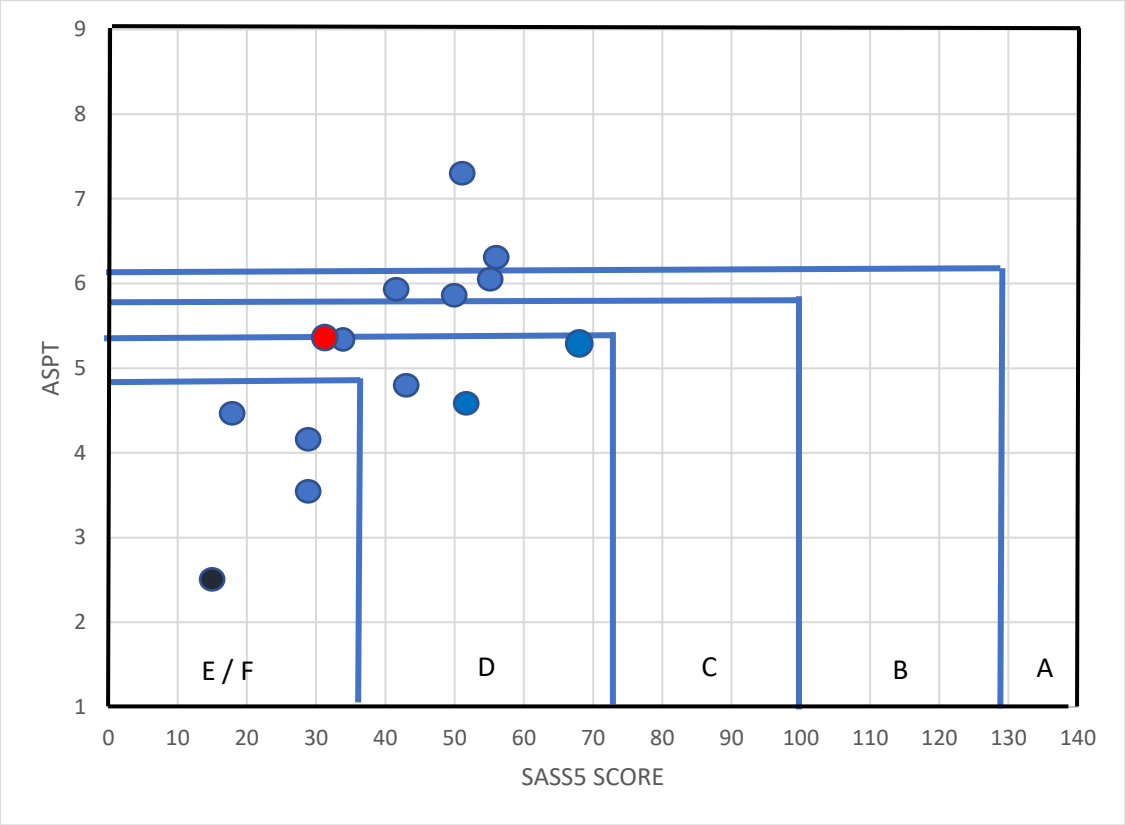
The Orange River at Bakenrant is perhaps 100m wide (Figure 19), flowing at a velocity of approximately $1ms^{-1}$ in the middle and with almost stagnant water against the riverbank. The water was turbid at the time of the site visit on 30 September 2022.

The habitat available to aquatic benthic organisms was limited, with only muddy and sandy bottom and some *Phragmitis* reeds as emerging vegetation. Hard substrate was provided by the pipes and rafts in the water. On the opposite banks were some more reeds and there were rocky outcrops in the middle of the river upstream, but these could not be reached because a boat was not available for sampling.

There was a significant volume of return flow out of the pumps. Reedbeds have developed between the blocks of vineyards and the river. These reeds established themselves in the many paths of agricultural return flow. The otherwise arid semi-desert has been transformed into large patches of reeds. There reeds help to reduce the return flow nutrient load, but all the flows together obviously have a significant impact on the water quality of the Orange River. Numerous water quality reports are available, among other the ones published by the Gariep Watch since 2017.

The SASS5 score was 33, with only 6 taxa that resulted in an ASPT of 5.5, which is surprisingly high, given apparent impacts. Biomonitoring results indicate a Class C-river (Figure 14), with measurable impacts but with significant ecological functioning.

Figure 19 Sampling Point at Bakenrant



Integrity Class	Description
A	Pristine; not impacted
B	Very Good; slightly impacted
C	Good; measurably impacted with most ecological functioning intact
D	Fair; impacted with some loss of ecological functioning
E	Poor; loss of most ecological function
F	Very Poor; loss of all ecological function

Figure 20 Lower Orange River Biomonitoring results

12 Present Ecological State

The PES and EIS are protocols that have been produced by Dr Neels Kleynhans (Table 2 and 3) in 1999 of the then DWAF to assess river reaches. The scores given are solely that of the practitioner and are based on expert opinion.

Table 2 Habitat Integrity according to Kleynhans, 1999

Category	Description	% of maximum score
A	Unmodified, natural	90 – 100
B	Largely natural with few modifications. A small change in natural habitats and biota, but the ecosystem function is unchanged	80 – 89
C	Moderately modified. A loss and change of the natural habitat and biota, but the ecosystem function is predominantly unchanged	60 – 79
D	Largely modified. A significant loss of natural habitat, biota and ecosystem function.	40 – 59
E	Extensive modified with loss of habitat, biota and ecosystem function	20 – 39
F	Critically modified with almost complete loss of habitat, biota and ecosystem function. In worse cases ecosystem function has been destroyed and changes are irreversible	0 - 19

12.1 Present Ecological State of the larger drainage line

The upper catchment of the larger drainage line is near-pristine, with grazing by goats (Figure 21) and springbuck the only observed impact. Downstream near the bridges some small-scale sand winning was observed. Downstream from the N14, the impacts are gross, with the stream channelled through the vineyards, entirely unnatural. It is always difficult to produce a realistic PES score for a water course with such vast contrast.

Table 3 Present Ecological State of the larger drainage line

Instream	Score	Weight	Product	Maximum score
Water abstraction	23	14	322	350
Flow modification	15	13	195	325
Bed modification	11	13	143	325
Channel modification	13	13	169	325
Water quality	18	14	252	350
Inundation	15	10	150	250
Exotic macrophytes	16	9	144	225
Exotic fauna	16	8	128	200
Solid waste disposal	12	6	72	150
Total		100	1602	2500
% of total			64.1	
Class			C	
Riparian				
Water abstraction	23	13	299	325
Inundation	14	11	154	275
Flow modification	14	12	168	300
Water quality	18	13	234	325
Indigenous vegetation removal	14	13	182	325
Exotic vegetation encroachment	16	12	192	300
Bank erosion	21	14	294	350
Channel modification	14	12	168	300
Total			1709	2500
% of total			68.4	
Class			C	

The vines were regarded as exotic macrophytes for this PES evaluation.

The score translates into a Class C for both instream and riparian. This does not tell the entire picture, as the upper catchment is probably a Class B and the lower part a Class E.

Figure 21 Livestock

12.2 Present Ecological State of the smaller drainage line

This drainage line is much shorter, with a much smaller catchment area. The impacts are relatively much bigger if compared to the larger drainage line. Therefore, the PES score is lower.

Instream and riparian both come out as Class D, with the ecological functioning much impaired.

Table 4 Present Ecological State of the smaller drainage line

Instream	Score	Weight	Product	Maximum score
Water abstraction	23	14	322	350
Flow modification	8	13	104	325
Bed modification	7	13	91	325
Channel modification	7	13	91	325
Water quality	16	14	224	350
Inundation	9	10	90	250
Exotic macrophytes	11	9	99	225
Exotic fauna	16	8	128	200
Solid waste disposal	12	6	72	150
Total		100	1221	2500
% of total			48.8	
Class			D	
Riparian				
Water abstraction	23	13	299	325
Inundation	8	11	88	275
Flow modification	8	12	96	300
Water quality	16	13	208	325
Indigenous vegetation removal	11	13	143	325
Exotic vegetation encroachment	14	12	168	300
Bank erosion	19	14	266	350
Channel modification	7	12	84	300
Total			1362	2500
% of total			54.1	
Class			D	

12.3 Present Ecological State of the Lower Orange River

Table 5 Present Ecological State Orange River downstream of Akkerboom

Instream	Score	Weight	Product	Maximum score
Water abstraction	15	14	210	350
Flow modification	15	13	195	325
Bed modification	20	13	260	325
Channel modification	22	13	286	325
Water quality	15	14	210	350
Inundation	12	10	120	250
Exotic macrophytes	18	9	162	225
Exotic fauna	15	8	120	200
Solid waste disposal	20	6	120	150
Total		100	1593	2500
% of total			63.7	
Class			C	
Riparian				
Water abstraction	15	13	195	325
Inundation	14	11	154	275
Flow modification	15	12	180	300
Water quality	15	13	195	325
Indigenous vegetation removal	15	13	195	325
Exotic vegetation encroachment	15	12	180	300
Bank erosion	20	14	280	350
Channel modification	18	12	216	300
Total			1595	2500
% of total			63.8	
Class			C	

Much has been published on the ecological state of South African rivers and the Orange River is no exception. In fact, it seems somewhat arrogant to assess the Lower Orange River, even at the sampling point, with a team of one and with the financial backing of a single WULA. This is a large undertaking that is to be contemplated by a team of experts. Nevertheless, this is what the WULA requires.

The Orange River at Akkerboom was assessed as a Class C for both instream and riparian, with most of the ecological functioning still intact.

The Orange River channel where the drainage lines connect to the river was not separately assessed, as it was entirely overgrown with reeds, ecologically much impaired and not a reflexion of the mainstream of the river.

The proposed development at Akkerboom, the solar panels and the charging station, are not about to change any of the classifications. This impact is insignificant if compared to the cumulative impacts of the massive agricultural and urban developments on the banks of the Lower Orange River.

Solar panels on stilts let through any flow of storm water and therefore do not impact on the flow regime of the drainage lines.

13 Ecological Importance

The Ecological Importance (EI) is based on the presence of especially fish species that are endangered on a local, regional or national level (Table 5).

There are no fish in the drainage line, as there is no permanent water. According to this assessment, which is prescribed for WULA's, the drainage line is not important.

No other endangered species, either plant or animal, were detected in or near the drainage line.

Table 6 Ecological Importance according to endangered organisms (Kleynhans,1999).

Category	Description
1	One species or taxon are endangered on a local scale
2	More than one species or taxon are rare or endangered on a local scale
3	More than one species or taxon are rare or endangered on a provincial or regional scale
4	One or more species or taxa are rare or endangered on a national scale (Red Data)

The drainage lines are dry most of the time, with no permanent water and therefore with no fish species. According to this assessment, the drainage lines are not ecological important.

This, however, is not entirely true, as drainage lines with its higher vegetation that that of the surrounding land, provide a significant habitat to a variety of species that would have been scarce or absent if it were not for the drainage lines, such as some reptiles and birds. The line of vegetation provides an ecological corridor for the migration and movement of organisms.

More camelthorn trees grow in the drainage lines than elsewhere. This is a protected species.

From this angle, the drainage lines at Akkerboom and elsewhere in the Kalahari are most important.

The Orange River is most important, according to this assessment.

According to Skelton (1993) 12 species of indigenous fish occur in the Lower Orange River. Since 2011 another one was added, as well as 3 exotic species. These are the following:

Barbus trimaculatus
B paludinosus
B. hospus
Labeobarbus kimberleyensis (Near threatened)
L aenus
Labeo umbratus
L capensis
Austroglanis sclateri (Widespread elsewhere)
Clarias gariepinus
Pseudocrenilabrus philander (Threatened locally but abundant elsewhere)
Pseudobarbus quathlabae
Mesobola brevianalis (critically endangered)

Exotic and translocated fish:

Cyprinus carpio
Tilapia sparrmanii
Oreochromus mossambicus

Those in blue are endangered to a varying extent. Those indicated in red are exotic or translocated fish.

The only one that causes real concern in the largemouth yellow-fish *Labeobarbus kimberleyensis*. It is endemic to the Orange River system and hence is threatened not only on a local scale, but on a national scale as well. This puts the Lower Orange in category 4. This renders the Orange River as important.

According to the owners of the Kalahari River and Safari Co. along the northern bank of the Orange River on the Riemvasmaak Road, mature blue kurper *Oreochromus mossambicus* are regularly captured in increasing numbers. It now takes at least 4 man-days to capture a single yellow fish.

Yellow fish are generally infected with cestode bladder worms, while darters (*Anhinga rufa*) that predate on these fish are heavily infected with tape worms. It seems as if the translocated Tilapia are not affected by these parasites.

According to Mr Chris van der Post, a renown angling guide and the owner of the Gkhui Gkhui River Lodge near Hopetown, there are still many smallmouth-yellow fish around, but largemouth yellow-fish are scarce.

14 Ecological Sensitivity

Ecological Sensitivity (ES) is often described as the ability of aquatic habitat to assimilate impacts. It is not sensitive if it remains the same despite of the onslaught of impacts. Put differently, sensitive habitat changes substantially, even under the pressure of slight impacts.

The Ecological Sensitivity also refers to the potential of aquatic habitat to bounce back to an ecological condition closer to the situation prior to human impact. If it recovers, it is not regarded as sensitive.

14.1 Ecological Sensitivity Drainage Lines

The question arises**,** according to the ES definition, if the drainage lines would recover to its original ecological state prior to any human impact. If the roads and vineyards, along with the rubble and trash be removed, would the drainage line recover? The answer is probably yes, even though the drainage lines would find new routes and even though it would take many decades, perhaps more than a century, in this semi-arid region where re-growth of vegetation can take a long time. However, this is not a realistic scenario. Development is here to stay, together with its impacts. From this point of view the drainage lines can be considered as ecologically sensitive.

14.2 Ecological Sensitivity Orange River

The Lower Orange River has absorbed numerous and deep-cutting human impacts. Yet is still functions as an aquatic ecosystem. In the highly improbable event of ceased human impact, the river here would probably bounce back to its previous glory. In this respect the river cannot be categorised as sensitive. It is dreaded among conservation minded people that the Lower Orange River might have some more capacity to absorb further impact.

15 EISC

The DWS demand that the river be placed in a category according to the EISC methodology (Table 7). The EISC is one of the essential items that is required for the Risk Matrix.

Table 7 EISC

Determinant	Drainage lines	Orange River
Rare and endangered species	1	4
Populations of unique species	1	4
Species / Taxon richness	2	4
Diversity of habitat	2	4
Migration Route/ Breeding and feeding site for wetland species	3	4
Sensitivity to water quality changes	1	3
Flood storage, energy dissipation, particulate / element removal	3	4
Protection status	0	4
Ecological integrity	2	3
Average	1.7	3.8
Score	Moderate	Very High

Score guideline:

Very High 4, High 3, Moderate 2, Low 1, None 0

Confidence Rating

Very High 4, High 3, Moderate 2, Low 1

The good state of the upper reach of the bigger drainage line is still in a reasonable ecological shape and this pushed the EISC up to “Moderate”.

The Orange River is of great significance, as all large rivers in the country are and the EISC cannot be anything but “Very high”.

16 Probable Impacts and Mitigating Measures

Impact assessment must be conducted according to the successive stages of a project. These are planning, construction, operation and closure.

During the plannning phase possible environmental impacts must be considered and included in the planning. For the Freshwater Report, aquatic environmental impacts are considered.

A ZCC charging station typically consists of an array of solar panels, batteries for the storage of electricity in an appropriate housing, housing for switchgear and associated electronics, a parking lot for electric vehicles and access roads to and from the facility.

Dickens *et al* (2003) lists several possible impacts on wetlands. This can be adjusted to suit the impacts on the drainage lines. The possible listed impacts of proposed installation on the site are discussed as follows:

Flow modification

The panels act like hard surfaces. The ground between the panels remains unpaved. Apart from the concrete anchors of the panel's upright supports, the runoff and the penetration of rainwater will not be affected. It is therefore not expected that the runoff will be modified.

The access roads will create preferential flow paths. This should be prevented by proper drainage infrastructure around the roads.

The parking area for the electric cars and possibly trucks represent a large, hardened surface that would result in runoff with erosion potential during a large rainfall event. This would have to be ameliorated with stormwater management infrastructure, such as landscaped swales and possibly retaining ponds.

Permanent inundation

The PV panels and other infrastructure will not dam the flow of storm water. No pooling or damming will occur on the entire PV installation. The inundation regime will not be affected.

Runoff from the parking area might. It is rather small, but it would nevertheless be preferable to install stormwater management infrastructure such as swales and retention ponds to prevent a pulse of stormwater racing down the drainage line.

Water quality modification

The PV panels are to be regularly cleaned from time to time. The panels are washed with water according to a schedule and standard operating procedures. It is not foreseen that the washing of the PV panels will result in any runoff. For this the volume of wash water is too little and the evaporation rate too high. No detergents of chemicals will be released, not on the short or longer term.

Moreover, new technology with non-stick and dirt-repellent surfaces allows for the cleaning of the panels with compressed air and not water.

Runoff from the parking lot laced with fuel and oil is unlikely, as electric vehicles are not driven by diesel and petrol.

Sediment load modification

Soil will be disturbed during the construction phase and it is possible that storm water can wash sand and mud into the small wetlands downstream of the site. Construction of access roads can contribute to the mobilisation of sediments. It is therefore necessary that measures are taken to prevent the washing away of sediments, such as immediate stabilisation and rehabilitation of disturbed areas.

Canalization

The lower reaches of the drainage lines have been heavily engineered into drainage trenches around the vineyards. There are already established vineyard in among the proposed solar panels as well.

The solar panels, its runoff and drainage will not require any more trenches. This is a low-rainfall area with little runoff. Even the occasional thunder storm will not effect the current runoff regime and the need for extra trenches, as solar panels are on stilts with a free and unrestricted flow underneath, not any different from the current circumstances.

Topographic alteration

The installation is not about to alter the topography of the landscape in any way.

Terrestrial Encroachment

The current savannah-like landscape with mainly grasses and a sparce stand of mainly swarthaak trees will have to make way for an array of solar panels, but other than this, the landscape will remain the same.

Invasive vegetation encroachment

Indigenous swarthaak trees show a tendency of invasion when the land is over-grazed. The solar panels will not have any effect on this invasive tendency.

Alien fauna

The site may be used for farm animals. There are springbuck and goats on the property. Grazing may continue, as long as over-grazing and trampling is controlled.

Over-utilization

Grazing may continue, but over-grazing and trampling must be controlled.

Isolation / Migration

The drainage line connects the upper catchment to the Orange River, despite the blockage of the vineyards and canals on lining the riverbanks. The solar panels are not about to change any of this and the ecological connectivity will remain.

Ground water table

Water for the construction and operation of the envisaged plant will be sourced from the Akkerboom operation. The proposed plant will not lower the water table or further dehydrate the ground in any way, as the soil underneath will remain pervious. The water table would benefit if the runoff from the parking area is allowed to penetrate the soil from retention ponds.

Waste

During the construction phase, portable toilets will be serviced by a reputable company and wastewater will be discharged in the municipal wastewater treatment works. During the operational phase, with only a limited number of workers, a septic tank and a soak-away system is indicated, as it is much to far away from the closest municipal sewerage system.

Litter will be collected in household wheelie bins and it will be disposed of on the municipal waste disposal site. These housekeeping issues will not be allowed to have any impact on the natural environment. It is accepted that waste management practices on the site will see to it that the current littering will come to an end.

The ZCC Akkerboom site would be in the public eye, with high-end electric vehicles visiting. Therefore, a tight shop would have to be run, to keep up with public demand,

with no litter and rubbish about. The site would have to be kept neat and tidy, as planned.

17 Impact Assessment

Some of the authorities, such as the DFFE and its provincial offices prescribe an impact assessment according to a premeditated methodology.

The main benefit of this exercise is that it allows for the evaluation of mitigation measures. Later follows a Risk Assessment. This is different from the Impact Assessment as it does not attempt to weigh the success of mitigation measures.

The methodology is set out in the Appendix.

The impact assessment follows the stages in the life cycle of a project. These stages include planning, construction, operation, decommissioning and rehabilitation.

The impact assessment follows the stages in the life cycle of a project. These stages include planning, construction, operation, decommissioning and rehabilitation.

The planning phase does not have any impact for which a Risk Matrix can be completed, as during this phase nothing is actually happening on the ground. It is nevertheless worth mentioning, with regard to the aquatic environment, that plans must be drafted to:

- Keep debris and sediment out of the drainage line during construction.
- Keep litter and rubbish out of the drainage line during operation.
- To perpetually control excessive growth of vegetation in the drainage line.
- To maintain stormwater management infrastructure.

These aspects must be kept onto the budget for as long as the charging station is in existence.

No provision is made for the closure and rehabilitation of the site because it is expected that electric vehicles will be a prominent feature of the foreseeable future and beyond.

The mitigating measures can easily and readily be implemented and the chances of successful implementation are excellent. The impacts assessment does not indicate any prohibition. The project should go ahead.

Table 8 Impact Assessment

Description of impact: Construction Phase

Levelling the ground
Construction of infrastructure such PV panels, parking area, farmstall
Construction of access road
Installation of water provision and sewerage
Installation of stormwater management infrastructure

Mitigation measures

Prevent loose soil and sediments from moving down the drainage line along with stormwater.

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	Medium	Short term	Medium	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Short term	Low	Definite	Sure	Reversible	Replaceable

Description of impact: Operational Phase

Runoff from the parking area
Litter and rubbish in the drainage lines

Mitigation measures

Prevent litter and rubbish entering the drainage lines

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Direct	Regional	Medium	Permanent	Medium	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Permanent	Low	Definite	Sure	Reversible	Replaceable

18 Risk Matrix

The purpose of the Risk Matrix is to determine if a General Authorisation of a License is applicable.

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 9 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 9 (continued) represent the same activities as in the Impact Assessment, with sub-activities added.

The methodology is tabled in the Appendix.

The environmental risks are small, even negligible, because the area that is to be developed is small.

The Risk Matrix indicates that a General Authorization is the indicated level of authorization. A License is not asked for.

Table 9 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Levelling the ground Construction of infrastructure such PV panels, parking area, farmstall Construction of access road Installation of water provision and sewerage Installation of stormwater management infrastructure	Mobilisation of soil	Soil washing down the drainage line. Destruction of drainage lines	28	Low
2	Runoff from the parking area Litter and rubbish in the drainage line	Litter and rubbish in the drainage line	Pollution of drainage line	36	Low

Table 9 Continued Risk Matrix

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1 2	1 1	2 1	2 1	1 1	1.5 1	1 1	1 1	3.5 3

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1 2	1 3	1 3	5 5	1 1	8 12	28 36	Low Low

19 Numerical Significance

Decision-makers often press on a numerical score for Significance**.** The score takes into consideration both the environmental value of the site and the degree of impact.

Table 26.4, p61, Appendix provides a system for allocation values for each of the parameters Conservation Value, Extent, Duration, Severity and Likelihood with regard to possible impacts These values are then entered into the equation on p62 to derive at a value for Significance. The value for Significance can subsequently be evaluated according to Table 26.4.2.

Table 26.4.2 provides a yardstick for decision-making to allow or disallow a development with its concomitant impact on the environment.

The scores that were given are entirely those of the specialist (Table 10), based on his or her knowledge and experience. These scores form a bases for debate and consensus, should contemporaries and decision-makers wish to add to the process.

The scores apply under the assumption that mitigation measures will be in place.

Table 10 Significance Score

Parameter	Drainage lines	Orange River
Conservation value	1	5
Likelihood	5	1
Duration	5	5
Extent	1	1
Severity	2	1
Significance	13	40
	Insignificant	Low

The significance rating for the drainage lines came out as “Insignificant”, mainly because the conservation value is not regarded as high. The rating was insignificant despite of some the impacts being of a permanent nature.

The significance rating for the Orange River is Low, even though the river has a high conservation value.

The solar panels and charging station, the low impact nature of the project, together with the low conservation value of either the drainage lines or the river, resulted in a significance value that is not raising any concern. Fron this perspective, the project should go ahead.

20 Resource Economics

The goods and services delivered by the environment is a Resource Economics concept as adapted by Kotze *et al* (2009). The methodology was designed for the assessments of wetlands, but in the case of the river, the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 22) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 9.

Table 11. Goods and Services

Goods & Services	Drainage Lines	Orange River
Flood attenuation	4	5
Stream flow regulation	4	5
Sediment trapping	3	5
Phosphate trapping	4	5
Nitrate removal	3	5
Toxicant removal	3	5
Erosion control	4	5
Carbon storage	4	5
Biodiversity maintenance	4	5
Water supply for human use	1	5
Natural resources	1	5
Cultivated food	2	5
Cultural significance	0	5
Tourism and recreation	0	5
Education and research	1	5

0	Low
5	High

A large star shape for the drainage lines combined would attract decision-maker's attention.

The right side is significant, but the left side of the spider diagram is depressed, indicating the goods and services rendered to ecological causes are high, but directly to humans low.

The proposed ZCC development is not going to alter the status in any sense. It would not change the shape or dimensions of the spider diagram. If anything. it would shed light on the effect of solar panels on the flow regime of an adjacent drainage line, but it is expected that there would be none.

The project should go ahead.

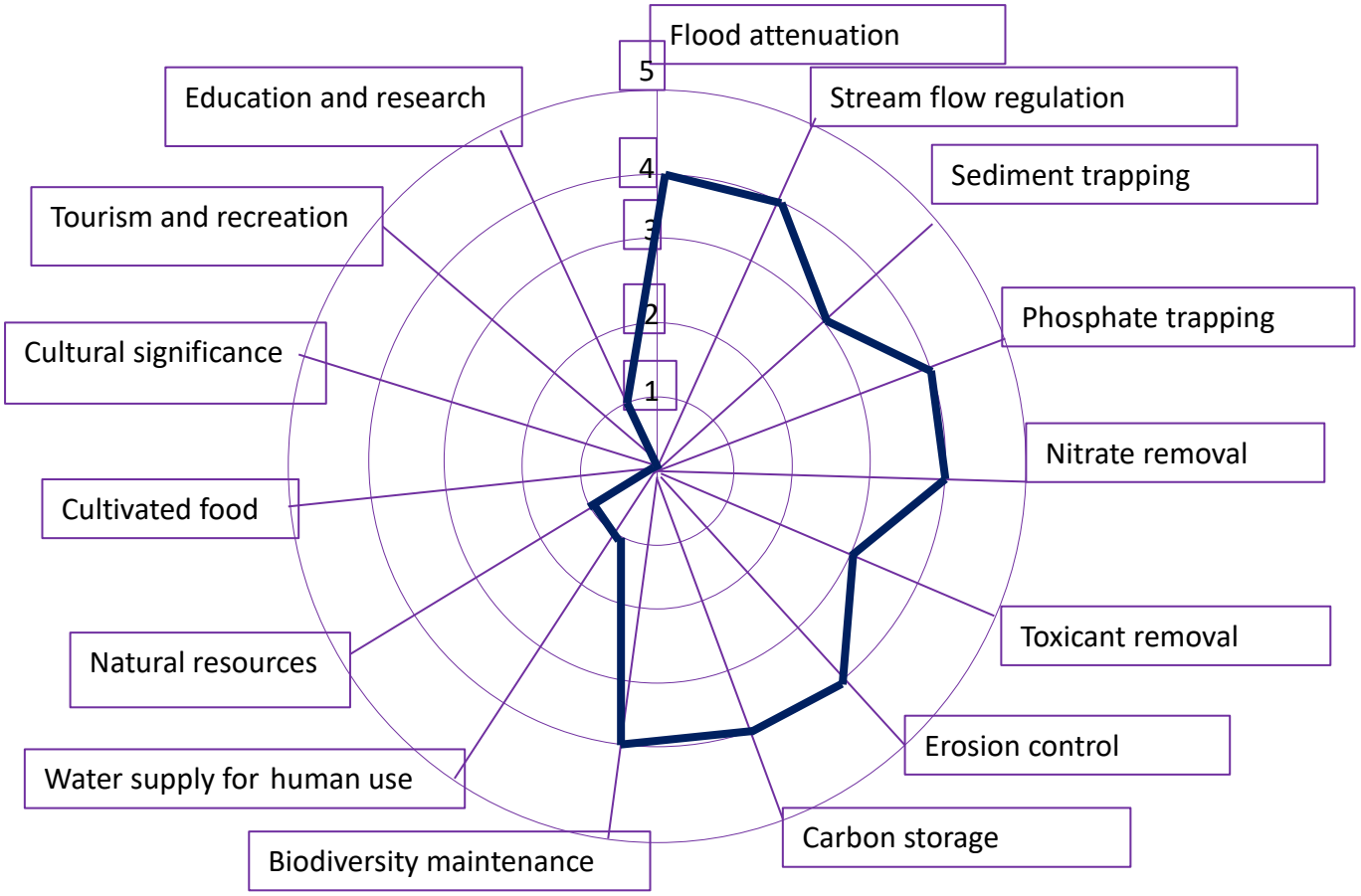


Figure 22. Resource Economics Footprint of the Drainage Line

21 Summary

Table 12 Summary of evaluations

Aspect	Status
DFFE Screening Tool	Sensitivity Low, Medium and Very High
Property	CBA
Drainage lines aquatic habitat	Not NFEPA
Vegetation	Least concern
PES of the drainage lines	Instream C and D, Riparian C and D
PES of the Orange River	Instream C, Riparian C
Ecological Importance drainage lines	Important
Ecological Importance of the Orange River	Important
Ecological Sensitivity drainage lines	Sensitive
Ecological Sensitivity of the Orange River	Arguably not sensitive
EISC drainage lines	Low
EISC Orange River	Very High
Impact assessment	Mitigation readily implementable
Risk Matrix	General Authorization
Resource Economics drainage lines	Medium footprint
Resource Economics Orange River	Very large footprint

Table 12 gives an overall and much condensed view of the evaluations and methodologies that have been applied to the drainage line and the Orange River.

It shows a mixed bag of outcomes, from ecologically sensitive to ecologically robust with resistance to human impact.

The proposed development is small, measured against other impacts and against the enormity of the receiving environment, nothing in the above table is about to change, should the development go ahead.

23 Discussion and Conclusions

'An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on all the other drivers and responses. This, in turn, will predictably impact on the ecosystem services (Figure 23). The WULA and the EAI must provide mitigation measured for these impacts.'

Figure 23 has been adapted from one of the most recent DWS policy documents.

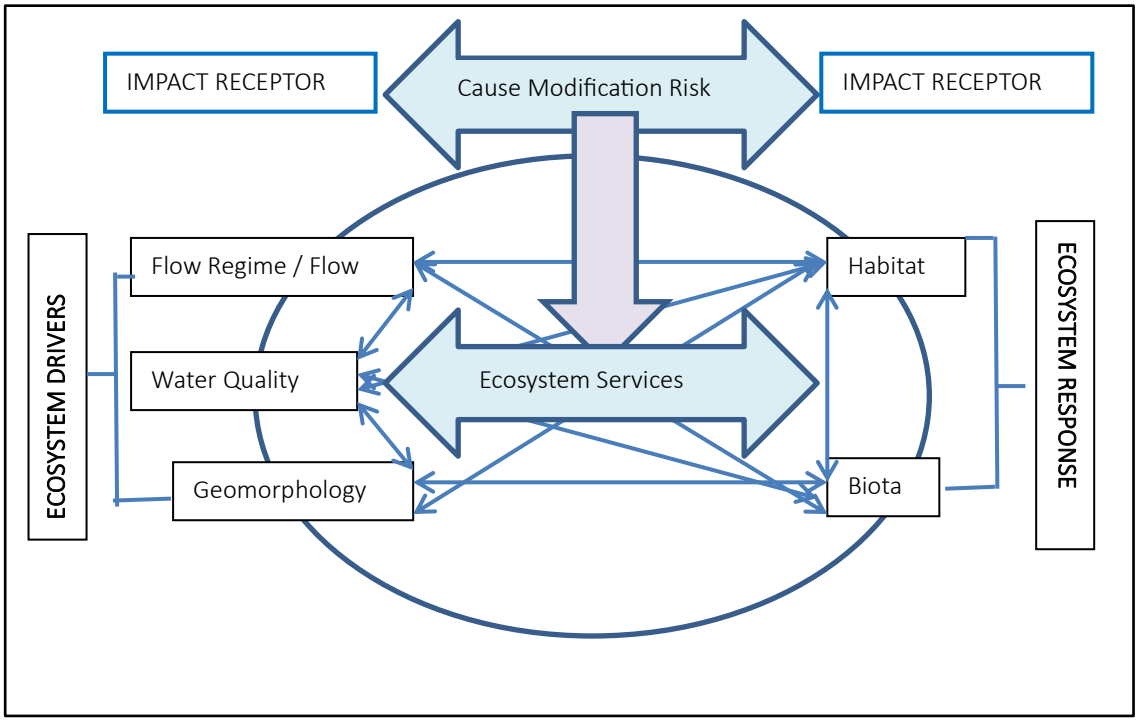


Figure 22 Minimum Requirements for a S21(c) and (i) Application

The driver for the drainage lines is the occasional summer thunderstorm that unleashes its fury on the sandy substrate to scour out once more the drainage line and deposit sediments elsewhere to broaden the sheet wash plains on the level landscape.

Along with the rain, the groundwater is as important. There may not be any water visible on the surface, but below may be a constant flow, however small, of shallow groundwater that trickles down the riverbed to keep the riparian vegetation and the ecological corridor alive.

The next driver is the drought. These droughts can be prolonged, even several years. Droughts determine the characteristics of the area as well as that of the water courses.

The main driver of the Orange River is far away on the Lesotho highlands, where most of its flow comes from. The vast and arid plains of the Lower Orange River area do not contribute measurably to the flow of the river.

Human impact has become a significant driver as development of the water resource progressed. The two large dams in the river have altered the flow, as well as the significant volume of water that is abstracted for large-scale agriculture.

Measures against this, the proposed solar energy plant along with the charging station have negligible impacts.

It is strongly recommended that the Akkerboom solar energy plant and associated charging station be approved in terms of a General Authorisation.

23 References

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24 Declaration of Independence

I, Dirk van Driel, as the appointed independent specialist hereby declare that I:

- Act/ed as the independent specialist in this application
- Regard the information contained in this report as it relates to my specialist input/study to be true and correct and;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management act;
- Have and will not have vested interest in the proposed activity;
- Have disclosed to the applicant, EAP and competent authority any material information have or may have to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the environmental Impact Assessment Regulations, 2010 and any specific environmental management act.
- Am fully aware and meet the responsibilities in terms of the NEMA, the Environmental Impacts Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R543) and any specific environmental management act and that failure to comply with these requirements may constitute and result in disqualification;
- Have ensured that information containing all relevant facts on respect of the specialist input / study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties facilitated in such a manner that all interested and affected parties were provided with reasonable opportunity to participate and to provide comments on the specialist input / study;
- Have ensured that all the comments of all the interested and affected parties on the specialist input were considered, recorded and submitted to the competent authority in respect of the application;
- Have ensured that the names of all the interested and affected parties that participated in terms of the specialist input / study were recorded in the register of interested and affected parties who participated in the public participation process;
- Have provided the competent authority with access to all information at my disposal regarding the application, weather such information is favourable or not and;
- Am aware that a false declaration is an offence in terms of regulation 71 of GN No. R543.

Signature of the specialist:  17 July 2023

25 Résumé

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Water Scientist

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Experience

USAID/RTI, ICMA & Chemonics. Iraq & Afghanistan **2007 -2011**
Program manager.

City of Cape Town **1999-2007**
Acting Head: Scientific Services, Manager: Hydrobiology.

Department of Water & Sanitation, South Africa **1989 – 1999**
Senior Scientist

Tshwane University of Technology, Pretoria **1979 – 1998**
Head of Department

University of Western Cape and Stellenbosch University 1994 - 1998 part-time

- Lectured post-graduate courses in Water Management and Environmental Management to under-graduate civil engineering students
- Served as external dissertation and thesis examiner

Service Positions

- Project Leader, initiator, member and participator: Water Research Commission (WRC), Pretoria.
- Director: UNESCO West Coast Biosphere, South Africa
- Director (Past Deputy Chairperson): Grotto Bay Homeowner's Association
- Past Member Dassen Island Protected Area Association (PAAC)

Membership of Professional Societies

- South African Council for Scientific Professions. Registered Scientist No. 400041/96
- Water Institute of South Africa. Member

Reports

- Process Review Kathu Wastewater Treatment Works
- Effluent Irrigation Report Tydstroom Abattoir Durbanville
- River Rehabilitation Report Slangkop Farm, Yzerfontein
- Fresh Water and Estuary Report Erf 77 Elands Bay
- Ground Water Revision, Moorreesburg Cemetery
- Fresh Water Report Delaire Graff Estate, Stellenbosch
- Fresh Water Report Quantum Foods (Pty) Ltd. Moredou Poultry Farm, Tulbagh
- Fresh Water Report Revision, De Hoop Development, Malmesbury
- Fresh Water Report, Idas Valley Development Erf 10866, Stellenbosch
- Wetland Delineation Idas Valley Development Erf 10866, Stellenbosch
- Fresh Water Report, Idas Valley Development Erf 11330, Stellenbosch
- Fresh Water Report, La Motte Development, Franschhoek
- Ground Water Peer Review, Elandsfontein Exploration & Mining
- Fresh Water Report Woodlands Sand Mine Malmesbury
- Fresh Water Report Brakke Kuyl Sand Mine, Cape Town
- Wetland Delineation, Ingwe Housing Development, Somerset West
- Fresh Water Report, Suurbraak Wastewater Treatment Works, Swellendam
- Wetland Delineation, Zandbergfontein Sand Mine, Robertson
- Storm Water Management Plan, Smalblaar Quarry, Rawsonville
- Storm Water Management Plan, Riverside Quarry
- Water Quality Irrigation Dams Report, Langebaan Country Estate
- Wetland Delineation Farm Eenzaamheid, Langebaan
- Wetland Delineation Erf 599, Betty's Bay
- Technical Report Bloodhound Land Speed Record, Hakskeenpan
- Technical Report Harkerville Sand Mine, Plettenberg Bay
- Technical Report Doring Rivier Sand Mine, Vanrhynsdorp
- Rehabilitation Plan Roodefontein Dam, Plettenberg Bay
- Technical Report Groenvlei Crusher, Worcester
- Technical Report Wiedouw Sand Mine, Vanrhynsdorp
- Technical Report Lair Trust Farm, Augrabies
- Technical Report Schouwtoneel Sand Mine, Vredenburg
- Technical Report Waboomsrivier Weir Wolseley
- Technical Report Doornkraal Sand Mine Malmesbury
- Technical Report Berg-en-Dal Sand Mine Malmesbury
- Wetland Demarcation, Osdrif Farm, Worcester
- Technical Report Driefontein Dam, Farm Agterfontein, Ceres
- Technical Report Oewerzicht Farm Dam, Greyton
- Technical Report Glen Lossie Sand Mine, Malmesbury
- Preliminary Report Stellenbosch Cemeteries
- Technical Report Toeka & Harmony Dams, Houdenbek Farm, Koue Bokkeveld
- Technical Report Kluitjieskraal Sand & Gravel Mine, Swellendam
- Fresh Water Report Urban Development Witteklip Vredenburg
- Fresh Water Report Groblershoop Resort, Northern Cape
- Fresh Water Report CA Bruwer Quarry Kakamas, Northern Cape
- Fresh Water Report, CA Bruwer Sand Mine, Kakamas, Northern Cape
- Fresh Water Report, Triple D Farms, Agri Development, Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Hopetown
- Fresh Water Report Hopetown Sewer
- Fresh Water Report Hoogland Farm Agricultural Development, Touws River
- Fresh Water Report Klaarstroom Wastewater Treatment Works
- Fresh Water Report Calvinia Sports Grounds Irrigation

- Fresh Water Report CA Bruwer Agricultural Development Kakamas
- Fresh Water Report Zwartfontein Farm Dam, Hermon
- Statement Delsma Farm Wetland, Hermon
- Fresh Water Report Lemoenshoek Farms Pipelines Bonnyvale
- Fresh Water Report Water Provision Pipeline Brandvlei
- Fresh Water Report Erf 19992 Upington
- Botanical Report Zwartejongensfontein Sand Mine, Stilbaai
- Fresh Water Report CA Bruwer Feldspath Mine, Kakamas
- Sediment Yield Calculation, Kenhardt Sand Mine
- Wetland Demarcation, Grabouw Traffic Center
- Fresh Water Report, Osdrift Sand Mine, Worcester
- Fresh Water Report, Muggievlak Storm Water Canal, Vredenburg
- Fresh Water Report, Marksman's Nest Rifle Range, Malmesbury
- Biodiversity Report, Muggievlak Storm Water Canal, Vredenburg
- Strategic Planning Report, Sanitation, Afghanistan Government, New Delhi, India
- Fresh Water Report, Potable Water Pipeline, Komaggas
- Fresh Water Report, Wastewater Treatment Works, Kamieskroon
- Fresh Water Report, Turksvy Farm Dam, Upington
- Fresh Water Report, Groblershoop Urban Development, IKheis Municipality
- Fresh Water Report, Boegoeberg Urban Development, IKheis Municipality
- Fresh Water Report, Opwag Urban Development, IKheis Municipality
- Fresh Water Report, Wegdraai Urban Development, IKheis Municipality
- Fresh Water Report, Topline Urban Development, IKheis Municipality
- Fresh Water Report, Grootdrink Urban Development, IKheis Municipality
- Fresh Water Report, Gariep Urban Development, IKheis Municipality
- Fresh Water Report, Bonathaba Farm Dam, Hermon
- Botanical Report, Sand Mine Greystone Trading, Vredendal
- Botanical Report Namakwa Klei Stene, Klawer
- Fresh Water Report Buffelsdrift Quarry, George
- Fresh Water Report Styerkraal Agricultural Development, Onseepkans.
- Technical Report Arabella Country Estate Wastewater Treatment Works, Kleinmond
- Fresh Water Report Calvinia Bulk Water Supply
- Fresh Water Report Swartdam Farm Dams, Riebeeck Kasteel
- Fresh Water Report Erf 46959, Gordon's Bay
- Fresh Water Report Melkboom Farm Dam, Trawal
- Stormwater Management Plan, Bot River Bricks
- Freshwater Report, Bot River Bricks
- Freshwater Report Sanddrif Farm, Joubertina
- Freshwater Report Zouterivier Cell phone tower, Atlantis
- Biodiversity Report Birdfield Sandmine, Klawer
- Freshwater Report New Wave Dam, Klawer
- Freshwater Report Harvard Solar Energy Plant, Bloemfontein
- Freshwater Report Doorn River Solar Energy Plant, Virginia
- Freshwater Report Kleingeluk Farm, De Rust
- Freshwater Report, Solar Energy Plant, Klein Brak River
- Site Verification Report Laaiplek Desalination Plant
- Freshwater Report, CA Bruwer Quarry, Kakamas
- Freshwater Report, Orren Managanese Mine, Swellendam
- Wetland Delineation, Klipheuvel ZCC Solar Energy
- Freshwater Report Delville Park, George
- Freshwater Report Wolseley bulk water pipeline
- Freshwater Report Urban Settlement No.1 Pababello Upington
- Freshwater Report Urban Settlement No.2 Pababello Upington
- Freshwater Report Pringle Rock Distillery, Rooiels
- Freshwater Report De Kuilen Resort, Kamiesberg

26 Appendix

26.1 Biomonitoring Results

SASS5 Score Sheet										
Date	30 Sep 22	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Orange River	Porifera	5		**Hemiptera**			**Diptera**		
		Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5		Ceratopogonidae	5	5
Coordinates	28°38' 35.84"S	Huridinea	3		Hydrometridae	6		Chironomidae	2	
	20°26'07.96"E	**Crustacea**			Naucoridae	7		Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	8.2	Potamonautidae	3		Notonectidae	3		Empididae	6	
Temperature °C	16.5	Atyidae	8	8	Pleidae	4		Ephydridae	3	
pH	7.7	Palaemonidae	10		Veliidae	5		Muscidae	1	
EC mS/m	42.8	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	
SASS5 Score	33	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	6	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	5,5	**Ephemeroptera**			Dipseudopsidae	10		Tipulidae	5	
		Baetidae 1 sp	4		Ecnomidae	8		**Gastropoda**		
Other Biota		Baetidae 2 sp	6	6	Hydropsychidae 1 sp	4		Ancylidae	6	
		Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	
		Caenidae	6		Hydropsychidae <2 sp	12		Hydrobiidae	3	
		Ephemeridae	15		Phylopotamidae	10		Lymnaeidae	3	
		Heptageniidae	13		Polycentropodidae	12		Physidae	3	
		Leptophlebiidae	9		Psychomyidae	8		Planorbidae	3	
		Oligoneuridae	15		**Cased Caddis**			Thiaridae	3	
Comments		Polymitarcyidae	10		Barbarochthonidae	13		Viviparidae	5	
		Prosopistomatida	15		Calamoceratidae	11		**Pelecipoda**		
		Teloganodidae	12		Glossostomatidae	11		Corbiculidae	5	
		Trichorythidae	9		Hydroptilidae	6		Sphariidae	3	
		Odonata			Hydrosalpingidae	15		Unionidae	6	6
		Calopterygidae	10		Leptostomatidae	10				
		Clorocyphidae	10		Leptoceridae	6				
		Chorolestidae	8		Petrothrincidae	11				
		Coenagrionidae	4		Pisulidae	10				
		Lestidae	8		Sericostomatidae	13				
		Platycnemidae	10		**Coleoptera**					
		Protoneuridae	8		Dyticidae	5				
		Aesthnidae	8		Elmidae Dryopidae	8				
		Corduliidae	8		Gyrinidae	5	5			
		Gomphidae	6		Haliplidae	5				
		Libellulidae	4		Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5				
					Limnichidae	10				
					Psephenidae	10				
Score				14			8			11

26.2 Methodology used in determining significance of impacts.

The methodology to be used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives is provided in the following tables:

Table 26.2.1 Nature and type of impact

Nature and type of impact	Description
Positive	An impact that is considered to represent an improvement to the baseline conditions or represents a positive change
Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new negative factor
Direct	Impacts that result from the direct interaction between a planned project activity and the receiving environment / receptors
Indirect	Impacts that result from other activities that could take place as a consequence of the project (e.g. an influx of work seekers)
Cumulative	Impacts that act together with other impacts (including those from concurrent or planned future activities) to affect the same resources and / or receptors as the project

Table 26.2.2 Criteria for the assessment of impacts

Criteria	Rating	Description
Spatial extent of impact	National	Impacts that affect nationally important environmental resources or affect an area that is nationally important or have macro-economic consequences
	Regional	Impacts that affect regionally important environmental resources or are experienced on a regional scale as determined by administrative boundaries or habitat type / ecosystems
	Local	Within 2 km of the site
	Site specific	On site or within 100m of the site boundary
Consequence of impact/ Magnitude/ Severity	High	Natural and / or social functions and / or processes are severely altered
	Medium	Natural and / or social functions and / or processes are notably altered
	Low	Natural and / or social functions and / or processes are slightly altered
	Very Low	Natural and / or social functions and / or processes are negligibly altered
	Zero	Natural and / or social functions and / or processes remain unaltered
Duration of impact	Temporary	Impacts of short duration and /or occasional
	Short term	During the construction period
	Medium term	During part or all of the operational phase
	Long term	Beyond the operational phase, but not permanently
	Permanent	Mitigation will not occur in such a way or in such a time span that the impact can be considered transient (irreversible)

Table 26.2.3 Significance Rating

Significance Rating	Description
High	High consequence with a regional extent and long-term duration High consequence with either a regional extent and medium-term duration or a local extent and long-term duration Medium consequence with a regional extent and a long-term duration
Medium	High with a local extent and medium-term duration High consequence with a regional extent and short-term duration or a site-specific extent and long-term duration High consequence with either local extent and short-term duration or a site-specific extent with a medium-term duration Medium consequence with any combination of extent and duration except site-specific and short-term or regional and long term Low consequence with a regional extent and long-term duration
Low	High consequence with a site-specific extent and short-term duration Medium consequence with a site-specific extent and short-term duration Low consequence with any combination of extent and duration except site-specific and short-term Very low consequence with a regional extent and long-term duration
Very low	Low consequence with a site-specific extent and short-term duration Very low consequence with any combination of extent and duration except regional and long term
Neutral	Zero consequence with any combination of extent and duration

Table 26.2.4 Probability, confidence, reversibility and irreplaceability

Criteria	Rating	Description
Probability	Definite	>90% likelihood of the impact occurring
	Probable	70 – 90% likelihood of the impact occurring
	Possible	40 – 70% likelihood of the impact occurring
	Unlikely	<40% likelihood of the impact occurring
Confidence	Certain	Wealth of information on and sound understanding of the environmental factors potentially affecting the impact
	Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact
	Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact
Reversibility	Reversible	The impact is reversible within 2 years after the cause or stress is removed
	Irreversible	The activity will lead to an impact that is in all practical terms permanent
Irreplaceability	Replaceable	The resources lost can be replaced to a certain degree
	Irreplaceable	The activity will lead to a permanent loss of resources.

26.3 Risk Matrix Methodology

RISK ASSESSMENT KEY (Referenced from DWA RISK-BASED WATER USE AUTHORISATION APPROACH AND DELEGATION GUIDELINES)

Negative Rating

TABLE 1- SEVERITY

How severe does the aspects impact on the environment and resource quality characterisitics (flow regime, water quality, geomorfology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5

Where "or wetland(s) are involved" it means

TABLE 2 – SPATIAL SCALE

How big is the area that the aspect is impacting on?

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catch	3
National (impacting beyond seconday catchment or provinces)	4
Global (impacting beyond SA boundary)	5

TABLE 3 – DURATION

How long does the aspect impact on the environment and resource quality?

One day to one month, PES, EIS and/or REC not impacted
One month to one year, PES, EIS and/or REC impacted but no change in status
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation
Life of the activity, PES, EIS and/or REC permanently lowered
More than life of the organisation/facility, PES and EIS scores, a E or F

TABLE 4 – FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

TABLE 5 – FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the environment?

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

TABLE 6 – LEGAL ISSUES

How is the activity governed by legislation?

No legislation
Fully covered by legislation (wetlands are legally governed)
Located within the regulated areas

TABLE 7 – DETECTION	
How quickly can the impacts/risks of the activity be observed on the environment (water resourc	
Immediately	
Without much effort	
Need some effort	
Remote and difficult to observe	
Covered	

TABLE 8: RATING CLASSES		
RATING	**CLASS**	**MANAGEMENT DESCRIPTION**
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale
A low risk class must be obtained for all activities to be considered for a GA		

TABLE 9: CALCULATIONS

Consequence = Severity + Spatial Scale + Duration
Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection
Significance \Risk= Consequence X Likelihood

Table 26.3 Numerical Significance

Table 26.3.1 Conservation Value

Conservation Value		
Refers to the intrinsic value of the area or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species	Low 1	The area is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
	Medium / Low 2	The area is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
	Medium 3	The area is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.
	Medium / High 4	The area is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.
	High 5	The area is considered critically endangered or is part of a proclaimed provincial or national protected area.

Table 26.3.2 Significance

Significance	Score	Description
Insignificant	4 - 22	There is no impact or the impact is insignificant in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site.
Low	23 - 36	An impact barely noticeable in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium / Low	37 - 45	Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved. Impacts may have medium to short term effects on the natural environment within site boundaries.
Medium	46 - 55	Impact is real, but not substantial. Mitigation is both feasible and fairly easily possible, but may require modification of the project design or layout. These impacts will usually result in medium to long term effect on the natural environment, within site boundary.
Medium High	56 - 63	Impact is real, substantial and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. These impacts will usually result in medium to long-term effect on the natural environment, beyond site boundary within local area.
High	64 - 79	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. These impacts will usually result in long-term change to the natural environment, beyond site boundaries, regional or widespread.
Unacceptable	80 - 100	An impact of the highest order possible. There is no possible mitigation that could offset the impact. The impact will result in permanent change. Very often these impacts cannot be mitigated and usually result in very severe effects, beyond site boundaries, national or international.

Table 26.3.3 Scoring system

Parameter	1	2	3	4	5
Conservation value Likelihood Duration Extent Severity	Low Unlikely Temporary Site specific Zero	Medium /Low Possible Short term Local Very low	Medium More possible Medium term Regional Low	Medium / High Probable Long term National Medium	High Definite Permanent International High

Significance = Conservation value (Likelihood + Duration + Extent + Severity)