Fresh Water Report

For the licensing of a proposed irrigation dam on

Portion 101 and 168 of Farm Melkboom 384, Vanrhynsdorp RD

A requirement in terms of the National Water Act (36 of 1998).

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Index

List of Figures

List of Tables

Abbreviations

Critical Biodiversity Area	CBA
Department of Environmental Affairs	DEA
Department of Environmental Affairs and Development Planning	DEA&DP
Department of Water Affairs and Forestry	DWAF
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Environmental Impact Assessment	EIA
Ecological Support Area	ESA
International Union for the Conservation of Nature	IUCN
Government Notice	GN
Metres Above Sea Level	masl
National Environmental Management Act (107 of 1998)	NEMA
National Water Act (36 of 1998)	NWA
National Freshwater Environmental Priority Area	NFEPA
Present Ecological State	PES
Section of an Act	S
South Africa National Biodiversity Institute	SANBI
Water Use License Application	WULA

1 Introduction

Cederberg Farming (Pty) Ltd are the owners of Portions 101 and 168 of Farm Melkboom 384, Vanrhynsdorp RD. The company was started in 2015 and owns some 20 portions of various farms in the adjoining area. The focus is on quality agricultural products, in particular table grapes but also vegetables, for a most discerning export market. Farming methods and technology are on a very high international standard, with an acute focus on quality products that would exceed consumer expectations all over Europe and anywhere in the world. These high intentions are clearly visible when the impressive facilities and best practices already on the ground are observed.

Likewise, the worker's accommodations have been upgraded, 9 dwellings in total, to meet modern standards.

A large pack store has been constructed to meet the demands of contemporary international logistics.

The company appointed Bester Consulting Engineers of Ceres to conduct a feasibility study for an irrigation dam on the properties.

This is an off-channel dam. It is to be constructed outside of a water course.

The proposed dam was named the "New Wave Dam".

The maximum storage capacity of the larger of the options that is being investigated will be 180 000m^3, with a dam wall that would not exceed 12m in height.

Bester Consulting appointed Enviro Africa of Somerset West to conduct the legally required EIA for the proposed dam. This is a requirement of the NEMA.

Subsequently, WATSAN Africa of Cape Town was appointed to produce the Freshwater Report. Bester Consulting needs this report for the WULA which they will deal with themselves in terms of the NWA.

The Freshwater report addresses aspects of S21 (c) and S21 (i) of the NWA. These aspects include impeding the flow in rivers and impacting on the banks and riparian zones of river and streams. It must be stressed that this report does not deal with S21(b) of the NWA, which is for the storage of water. Bester Consulting deals with this aspect of the legislation.

Likewise, S21(a) focusses on the abstraction of water from water resources such as the Olifants River. It must be immediately stressed that water for farming on the said portions of Melkboom Farm an Existing Legal Use (ELU) in terms of the NWA. This is not a new application for additional water for irrigation. The WULA is only for the storage of water.

A completed Risk Matrix must be submitted along with the Freshwater Report.

A Freshwater Report essentially focusses on the WULA. The contents and the format of the report has been established over a multitude of WULA's all over the country. It

has become necessary to introduce a substantial volume that focusses on the requirements of the EAI and the NEMA as well. The methodologies have been standardised, as has been promulgated in Government Notices.

2 Legal Framework

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

S21 (b) *Storing of water*

The New Wave Dam will be used for the storage of water for the farming operation. For this consent is requires in terms of S21(b).

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

The proposed development is spanning the banks of a drainage line. The drainage line has been altered.

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

Some part of the proposed development altered the characteristics of the banks of the drainage line.

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, the development triggers a part of the National Environmental Management Act, NEMA, 107 of 1998).

The EIA Regulations of 2014 No.1 Activity 12 states that no development may take place within 32 m of a water course without the consent of the Department of Environmental Affairs and its provincial representatives

Government Notice No 42561 of 5July 2019

A requirement to submit a report on ecological sensitivity as generated by the on-line DEA Screening Tool is compulsory for EIA's in South Africa.

3 Locality

Figure 1 Locality

4 Climate Vanrhynsdorp

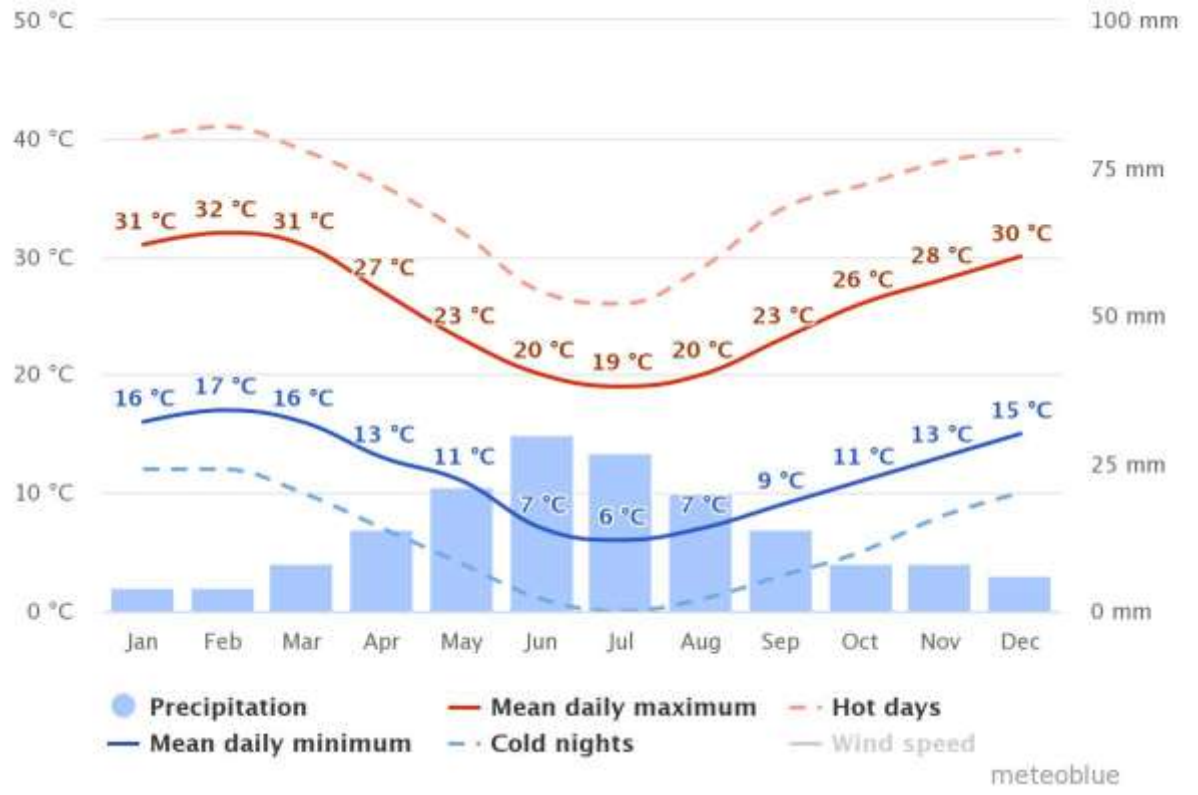


Figure 2 Vanrhynsdorp Climate

Vanrhynsdorp is the closest locality of which climatological data is available on-line (Figure 2). This is an arid area, with hot and dry summers and with mild winters with a little rain. The annual rainfall amounts to only 224mm. This is a harsh part of the world, with local names for districts such as the Knersvlakte and the Hardeveld, all part of the arid Namakwaland.

Rainfall is dependent of elevation, but even here is little consolation, as the Gifberg that rises above the coastal flats in on average 550 masl, which is too low for increasing the rainfall, for which a 1500 masl and more is required.

The rainfall is far too little to sustain horticulture. The vineyards are very much dependent on irrigation out or the Olifants River and out of the irrigation canals. Water must be abstracted during the high flow winter months and stored for irrigation during the dry summer months when water is needed most. For this very reason, the proposed New Wave Dam is required. Without this dam, water security for the farming operation would be wholly lacking. The irrigation canals have weatheerd of age, may leak and even break down. The proposed irrigation dam will do much to store water for use during those times that the irrigation canals are not operational.

5 Quaternary Catchment

The New Wave Dam is in the E33G quaternary catchment.

6 Vegetation

According to the SANBI BGIS website, the vegetation in and around the river has been named Namakwaland Riviere. It is of Least Concern and is not endangered in any way, despite the large-scale development in the river valley.

The proposed New Wave Dam is in Vanrhynsdorp Gannabosveld which is Vulnerable. However, the land here has been ploughed over and worked for many generations and nothing is left of the original vegetation. The proposed dam is not about to further degenerate this veldt type.

7 Conservation Status

The river is listed as a NFEPA on the SANBI Website.

In terms of the Western Cape Biodiversity Spatial Plan, the Olifants River has been listed as a CBA.

8 DEA Screening Tool

The Screening Tool rendered the following results (Table 1):

Table 1 Screening Tool results

Theme	Concern	Common name	Screening tool	IUCN
Animal species	*Aquilla verreauxii*	Verreaux's (black) eagle	High	Least Concern
	Circus maurus	Black harrier	High	Endangered
	Neotis ludwigii	Ludwig's bustard	High	Endangered
	Sagittarius serpentarius	Secretary bird	Medium	Endangered
	Bullacris obliqua	Bladder grasshopper	Medium	Vulnerable
	Brinckiella aptera	Mute winter kytadid	Medium	Vulnerable
	Brinckiella mauerbergerorum	Mauerberger's winter kytadid	Medium	Vulnerable
	Pachysoma glentoni	Dung beetle	Medium	Vulnerable
Aquatic biodiversity	NFEPA		Very high	
	CBA		Very high	
Plant species	List of plant species		Low	
			Medium	
Terrestrial biodiversity	CBA's		Low	
	ESA's			

These results are essentially the same as that for another dam previously investigated and that has been proposed in proximity of the New Wave Dam.

Animal species theme

There is a high likelihood to see Verreaux's eagles soaring overhead at the New Wave Dam and surrounds, where it is searching for prey such as rock hyrax (dassies) and scrub hare. The cumulative impact of the large-scale farming along the Olifants River reduced the habitat for prey animals. There is still enough habitat left against the slopes and near-vertical rocky inclines of the vast mountain ranges in the region, so much so that the New Wave Dam and the farming industry does not present a material threat to prey items and the eagles that feed on them. The belief that eagles are responsible for stock losses has largely been replaced by a contemporary duty of care for eagles among the farming community.

Black harriers are relatively scarce, iconic, not seen every day even in its distribution area and certainly a prize tick on any bird watcher's life list. These raptors are highly nomadic and very mobile. They can be seen typically gliding low over shrubland, hunting.

It can be debated if these bird's dire conservation status is the result of them being naturally scarce or because of the cumulative impact of large-scale farming. Probably because of both.

It is unlikely that these birds will be regularly recorded over New Wave Dam, as elsewhere in its distribution area. It seems unfair to jeopardize this WULA because of the very slight possibility of spotting a black harrier over New Wave or in the district.

Ludwig's bustard is the one bird that is of particular concern, as it is more prone than any other bird to collide with power lines (Shaw *et al*, 2018). The New Wave Dam project does not include high overhead power lines in which birds can possibly collide.

The secretary bird has seen a decline across its distribution area in Africa south of the Sahara. There is always a possibility to spot these birds strutting over the un-developed parts around the farming area. Because of the vast distribution area, New Wave Dam is not about to make any difference to their conservation status.

Bladder grasshoppers (*Bullacris* species) are evasive and hard to spot, but their electric and eerie calls at night in the coastal regions of the Western Cape where they are endemic, is a familiar sound in late winter and early summer. The males have inflated bodies, rotund, barrel shaped, that serves as a sound box to amplify their calls. The New Wave Dam is located well inland, away from these insect's preferential habitat. The dam does not pose any threat to these insects' continued existence.

The bush crickets (*Brinckiella* species) are well-known as they are often attracted to light at night, sitting on walls with their green laterally flattened bodies and very long antennae. They have a wide distribution all over the succulent Karoo and Fynbos of the Cape province. The New Wave Dam on the brink of Namaqualand is probably at the very boundary of their distribution area. As such, the Ndew Wave Dam development does not pose any material threat to their existence.

The scarab beetle *Pachysoma glentoni* is a highly unusual, specialised insect of the arid regions of the South-Western Cape (Holter *et al*, 2006). It collects and buries desert detritus, which is then digested by fungi. This digested product serves as nutrients for the beetle and its offspring. The beetle solely occurs in sand dunes and there are no such dunes on the New Wave property and especially not where the dam and the vineyards are today.

Aquatic biodiversity theme

NFEPA's and CBA's are always listed as of "Very High" sensitivity. The Olifants River is such a NFEPA. It is highly impacted because of agricultural development. The water that is going to be stored in the new dam does not represent any new abstraction and there will be no further streamflow reduction impacts.

Much can be done to limit further impacts on the riparian zone. These are discussed in various paragraphs that are to follow.

Plant species theme

This aspect will be discussed in the Botanical Report, for which a registered specialist scientist has been appointed.

Terrestrial biodiversity theme

The map shows that the specific locality of the New Wave Dam is listed as of Low sensitivity. It therefore does not require any more motivation for this application.

Statement

In conclusion, the Screening Tool does not indicate that the New Wave Dam project should not be submitted for approval.

First and foremost, there is no terrestrial habitat left that could serve to protect insect species such as bladder grasshoppers and bush crickets. This habitat has been lost since the onset of agriculture in the area millennia ago. Likewise, there is no habitat left for birds such as bustards and birds of prey. Moreover, there is adequate habitat left in the surrounds that is still intact, large stretches of land, where viable populations of these endangered and vulnerable organisms survive. The construction and operation of a dam for the irrigation of vineyards would not restrict these organisms any further.

However, the aquatic habitat along with the riparian zone stands is sharp contrast, as it still is viable and important habitat, with its linear connectivity still intact. It is critically important that what is left of the original habitat is protected. Further degradation can be prevented by proper mitigation. These measures are discussed in the text to follow. A section is dedicated to mitigating measures. These are reiterated in the impact assessment.

9 The Project

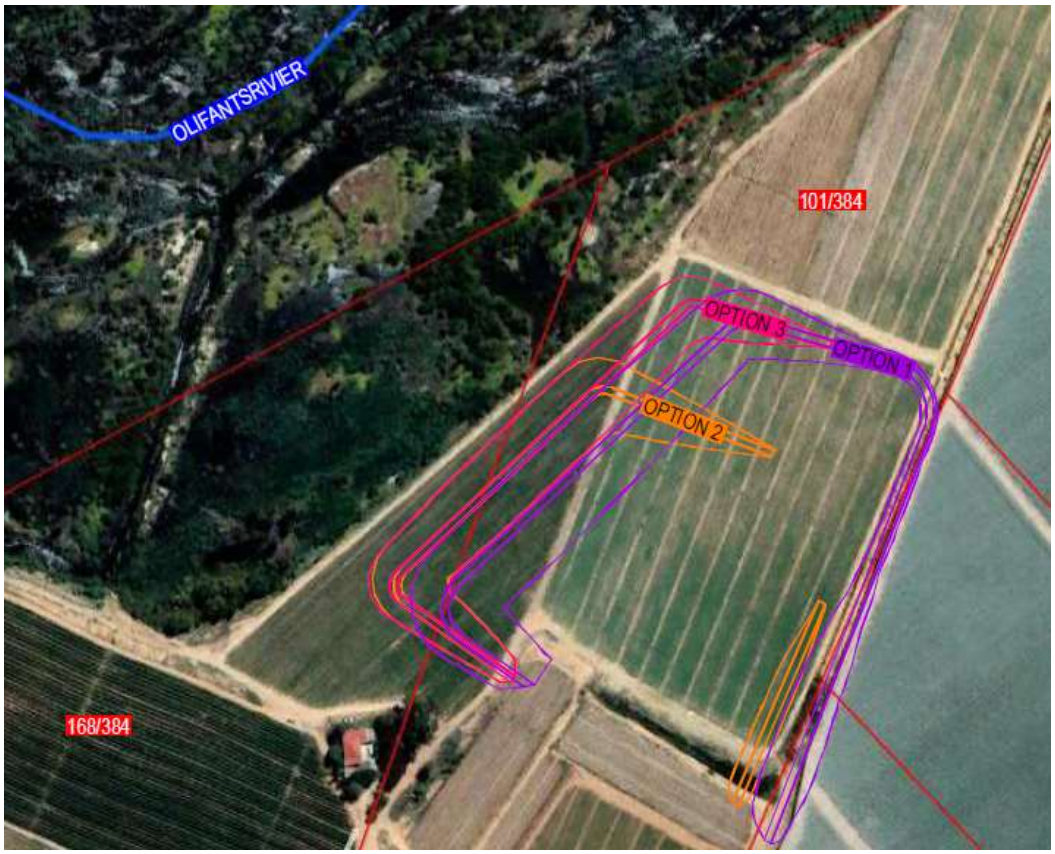


Figure 3 Project (Bester Engineering)

Figure 4 Ploughed over land

The dam wall will be placed right on the riverbank.

There are 3 options (Figure 3), but it is expected that Option No. 3 will be the preferred option. It is the largest of the proposed options.

The dams will be located on already ploughed of land that has been utilised for agriculture for many decades (Figure 4). The surrounding land is being prepared for vineyards, complete with high-tech trellis, irrigation infrastructure and shade net cover.

10 Biomonitoring

10.1 Olifants River

Figure 5 Olifants River Catchment (Google Maps)

The Olifants River is a river in the north-western area of the Western Cape Province of South Africa (Figure 5). The upper and main catchment area of the Olifants river is around Ceres and the Cederberg mountains. It is 265km long, with a basin area of 46 220km^2. It flows out into the Atlantic Ocean near Lutzville. Its main tributary is the Doring River.

The river rises on the high mountain ridges and the peaks of the Cedar Mountains. The rainfall here is much higher than in the valley, up to 1500 mm per year and even higher.

The Clanwilliam Dam is the largest dam, with the smaller Bulshoek Dam further downstream. There are a multitude of farm dams in the catchment area. There is a well-established system of irrigation canals on both sides of the river, supplying water to hundreds of farms in the river valley and even further up the slopes.

The Olifants River is providing water for the irrigation of a large and established farming industry, with products such as citrus and grapes and wine for the high-end export market. Irrigation return flow is the biggest impact.

The river flows strongly during the winter rains, but flow stops during most dry and hot summers, with many stagnant pools.

10.2 Sampling Point

The biomonitoring procedure was carried out according to the description of Dickens & Graham, 2002. This is a procedure that has been developed over a long period of time for South African rivers and is widely used by the DWS and in general water resource management.

The biomonitoring point on the river is ideally chosen as close as possible to a locality downstream of the impact, as to limit the effect of other impacts and to single out the impact that is to be evaluated. This is not always possible but nevertheless is given the best attempt. The sampling point is located just downstream of where the new dam wall is planned (Figure 6).

The river here is some 10m wide and densely overgrown with *Phragmitis* reeds. Access to the river is allowed by a patch that has been cleared for the pump where water is abstracted for the farming operation (Figure 7).

The banks of the river were steep, 10m high and higher in places, engineered, for the purpose of farming and vineyards (Figure 8), with more high terraces up the slope. The embankments showed signs of erosion, with loose sediments washing down the slope during rainfall events. The river here closely follows the southern bank, with more streams in the wide braided riverbed.

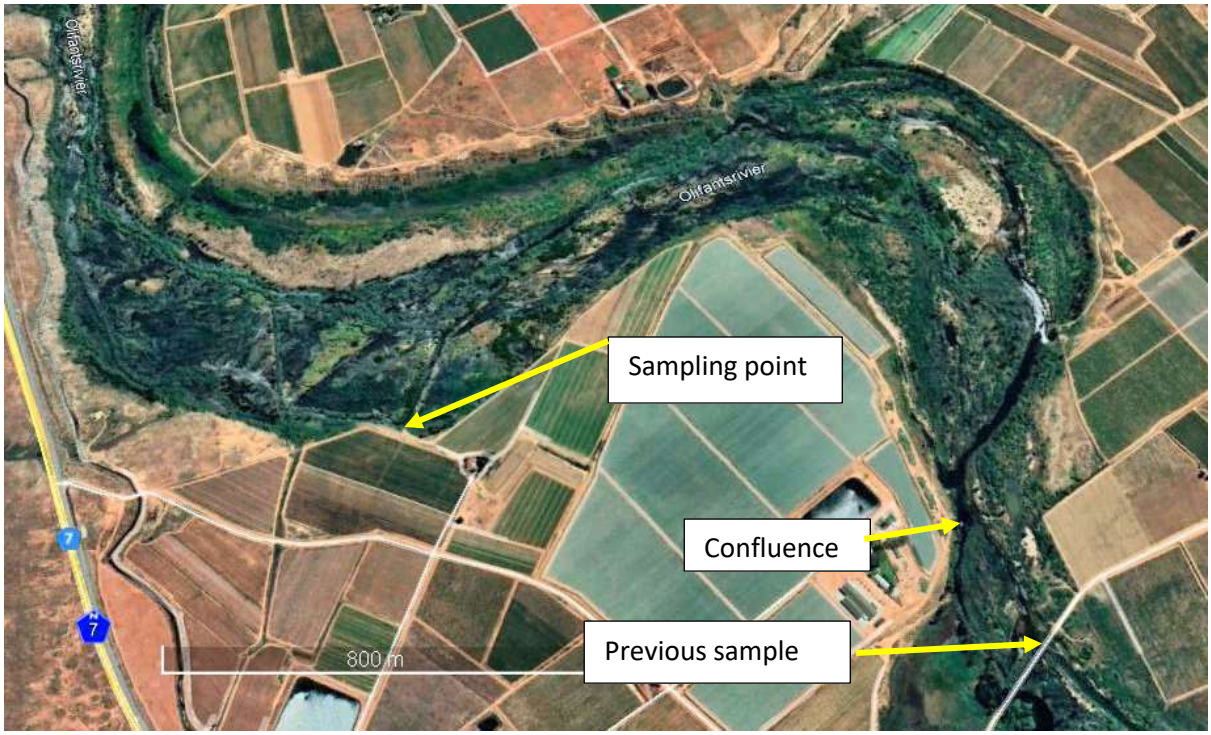


Figure 6 Sampling Point map

Figure 7 Sampling point

Figure 8 Riverbank

Higher up the riverbanks, Port Jackson willow *Acacia saligna* form dense stand in places. At the time of the site visit, the trees were flowering, profusely. There were some eucalyptus trees as well, some were dead, probably because of droughts during previous seasons.

This season, during the site visit, was particularly wet, with a higher rainfall than the average. The current in the middle of the river was at least $1ms^{-1}$. Along the banks, the current was slow in places, with no current at all in places. The water was clear, with good visibility.

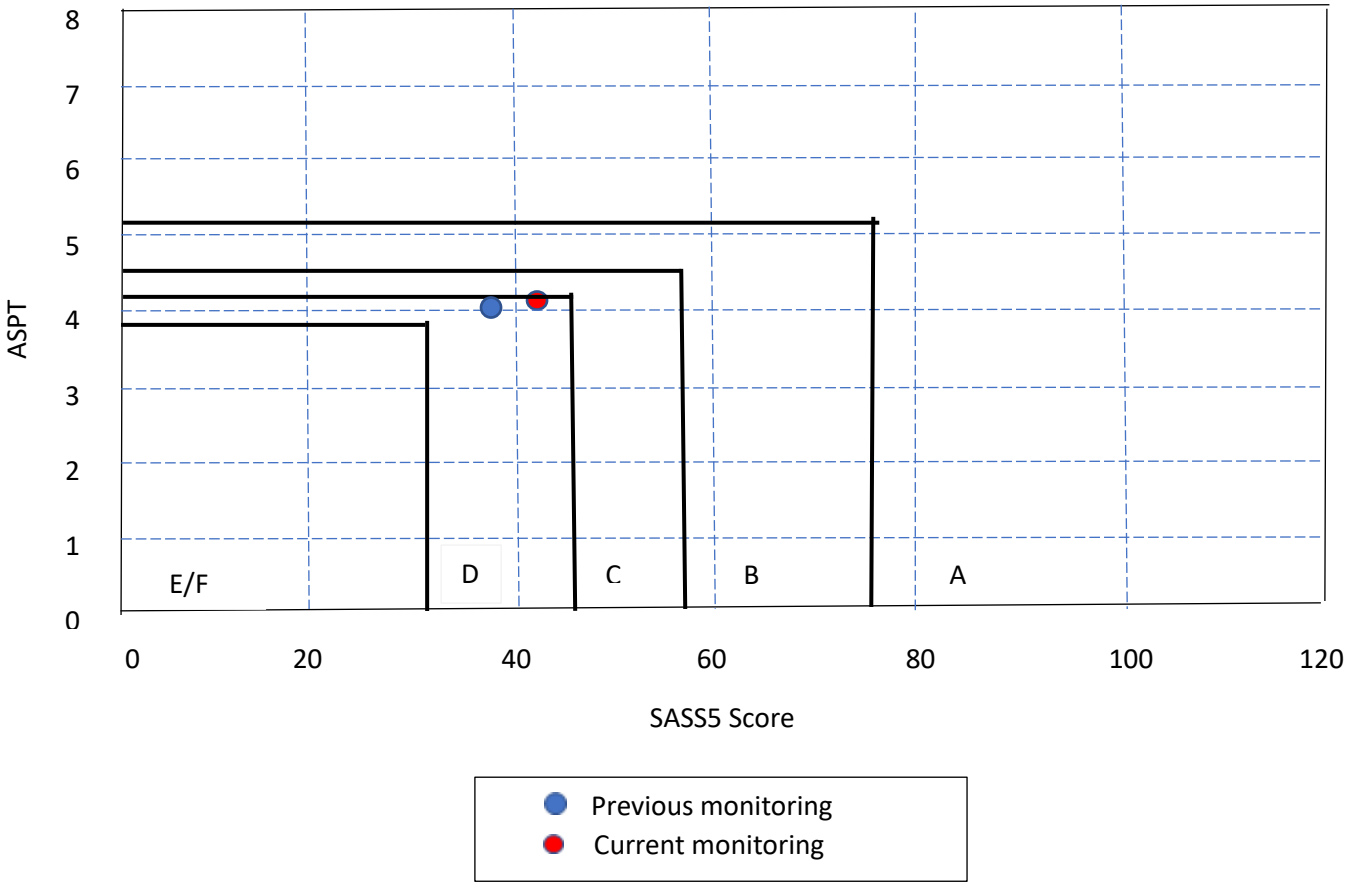
The banks were wet, with signs of higher flow shortly before. The shallows were overgrown with patches of *Cladophora* algae, with thick deposits on the banks.

The aquatic habitat was monotonous, with a sandy and muddy riverbed, with no bedrock and no stones in and out of current. There was no submerged vegetation, only emerging vegetation.

10.3 Monitoring Results

The results are given in the SASS5 score sheet in the Appendix.

The score came to 42, with 10 taxa and an ASPT of 4.2. It is plotted in Figure 1. This represents a Class D-river, impacted with loss of ecological functioning which can be expected in a river in a highly developed agricultural region.



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 9 Biomonitoring Results

The score is almost the same as was recorded during a previous round of biomonitoring for a similar project (Van Driel 2021, Figure 9). The previous sample was taken at the low water bridge just upstream of the Doring River confluence.

The result corresponds to that of the State-of-the-River Report (DWAF, 2006). It seems as if the river maintains its equilibrium with the impacts and does not show signs of further deterioration at this stage.

The state of the river is the result of intensive horticulture of a millennium and more. Although the proposed New Wave Dam would be adding to the cumulative impact of a multitude of dams, it is not expected to further lower the biomonitoring score.

11 Present Ecological State

Table 2 Habitat Integrity according to Kleynhans, 1999

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

The PES is a protocol that has been produced by Dr Neels Kleynhans (Table 2 and 3) in 1999 of the then DWAF to assess river reaches. The PES is one of the evaluations that is prescribed for S21 (c) and (i) WULA's. The scores given are solely that of the practitioner and are based on expert opinion.

Since the proposed New Wave Dam is located on the banks of the Olifants River, it is necessary to classify the river according to the prescribed methodology. This is

somewhat arrogant, as the classification of a major river is the premise of an entire team of specialists over a longer period. It is beyond the run-of-the-mill WULA, both in terms of budget and available time. Nevertheless, this is what the WULA requires and this is the best attempt. This evaluation focusses on the reach of the river at the site of the proposed dam.

Table 3 Present Ecological State of the Olifants River at the site of the proposed New Wave Dam

Instream				
	Score	Weight	Product	Maximum score
Water abstraction	12	14	168	350
Flow modification	12	13	156	325
Bed modification	18	13	234	325
Channel modification	11	13	143	325
Water quality	15	14	210	350
Inundation	12	10	120	250
Exotic macrophytes	9	9	81	225
Exotic fauna	20	8	160	200
Solid waste disposal	23	6	138	150
Total		100	1410	2500
% of total			56.4	
Class			D	
Riparian				
Water abstraction	12	13	156	325
Inundation	12	11	132	275
Flow modification	12	12	144	300
Water quality	15	13	195	325
Indigenous vegetation removal	9	13	117	325
Exotic vegetation encroachment	9	12	108	300
Bank erosion	22	14	308	350
Channel modification	9	12	84	300
Total			1244	2500
% of total			49.8	
Class			D	

The classification came out as a “D” for both the instream and the riparian zone, which is modified with a loss of ecological functioning. This score is perhaps lower than for the entire Olifants River, as there are reaches which are not as highly impacted as the highly developed reach around the New Wave Dam.

The construction and the operation of the New Wave Dam, even though it adds to the accumulative impact of many such dams, is not about to lower the score any further, not if the appropriate mitigating measures are put in place.

12 Ecological Importance

Table 4. 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)

This assessment is based on the presence of absence of endangered fish species.

Table 5 Fish species of the Olifants / Doring River System

Species	Common name	Habitat	IUCN status
Pseudobarbus serra	Sawfin	Upper Olifants	Endangered
P. calidus	Clanwilliam redfin	Upper tributaries	Near threatened
P. erubescens	Twee Riviere redfin	Upper tributaries	Endangered
P. phlegethon	Fiery redfin	Upper tributaries	Endangered
Labeobarbus seeberi	Clanwilliam yellowfish	Upper Olifants	Endangered
Galaxias zebratus	Cape galaxias	Olifants / Doring	Near threatened
Austroglanis barnardi	Clanwilliam rock catfish	Upper tributaries	Endangered
Enteromius anoplus	Chubbyhead barb	Widespread	Least concern
Labeo seeberi	Clanwilliam sandfish	Doring River	Endangered

The Olifants / Doring River system is most important, as it is home to fish species on the IUCN RED List of endangered species (Table 5). Most of these fish species are encountered in the upper tributaries. The Clanwilliam yellowfish do not occur in the Olifants River in the vicinity of the New Wave Dam anymore. Likewise, the Clanwilliam sandfish is unlikely to occur in this river reach. Much scientific research is needed to illustrate the conservation value of the Lower Olifants River.

It is therefore doubtful if the construction and the operation of the proposed New Wave Dam would in any way further compromise the status of any of these fish. The presence or absence of these fish cannot serve to discourage the construction of the proposed dam.

Endemic fish species have been decimated by exotic small mouth bass, an introduced and aggressive invader. This has probably done more damage than all of the other impacts combined, including agriculture.

13 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.

The species of fish that occur in the Olifants River system are dependent on the habitat with its set of biotic and abiotic circumstances. Rivers are resilient and if left to recover, the habitat could possibly support the fish species that it once had, distributed over its entire length. The river at the proposed dam has been impacted to such an extent that it would be unthinkable that the original fish community would ever return. Likewise, it seems unthinkable that the river would bounce back if large-scale agriculture were removed from the catchment. This is not about to ever happen as long as human habitation exists. From this perspective, the Olifants River can be viewed as ecologically sensitive.

14 EISC

The DWS demand that wetland be placed in a category according to the EISC methodology (Table 6). The EISC is one of the essential items that is required for the Risk Matrix.

Table 6 EISC for the Olifants River at the site of the proposed New Wave Dam

Determinant	Score	Confidence
Rare and endangered species	3	4
Populations of unique species	3	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	2	4
Flood storage, energy dissipation, particulate / element removal	4	4
Protection status	3	4
Ecological integrity	1	4
Average	2.6	

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 EISC can then be determined in Table 6, according to the score of Table 5.

The classification for the Olifants River at the site was set as “Moderate”.

15 Possible impacts and mitigation

Construction of dams can result in much loose sediments that can wash into the river during the rainy season. It is therefore advisable to limit the construction phase during the dry season. The new dam wall should be stabilised and vegetated prior to the next rainy season.

Irrigation dams are very aggressive aquatic habitats because of the fluctuating water levels. It would be ecologically advantageous to leave a small volume of water, say 0.3 to 0.4m deep after the irrigation season. This would render the proposed dam with at least some aquatic habitat, albeit for waterfowl and a very limited range of other aquatic organisms.

The banks of the river have been engineered to steep embankments. This keeps the river out of the surrounding vineyards during floods, but construction devastated the riparian habitat and its vegetation. There are still elements of the riparian zone left and this must be protected and conserved. This should not be left to government alone, but the farming community should stand in as well.

Alien vegetation such as Port Jackson and blue gum trees should be removed. This is a long-term process that should be sustained. Saplings should be removed on a scheduled basis.

There are still some indigenous trees left, such as sweet thorn *Vachellia karoo*, which should be encouraged to proliferate to take up the space of removed exotics, along with other indigenous vegetation.

The embankments along the river and further up the slope, of which there are many, should be stabilised. Erosion should be prevented. Loose sediments along with storm water should not be allowed to enter the river. Likewise, runoff from farm roads along the vineyards should be provided with stormwater management infrastructure. Stormwater management plants can be concise, with simple techniques and can be readily implemented.

Agricultural return flow because of over-irrigation must be prevented. Highly sophisticated electronically controlled systems are designed to measure the moisture content of soils to adjust and regulate the volume of water that is to be irrigated. Just the right volume of water is irrigated on those parts that require to be watered. All of this is controlled from an application on a cell phone. It is fully expected that Cederberg Farming is very much on top of this technology.

Abstraction from the river and mitigating its impacts is not being considered in this report as the DWS has no doubt already discounted this ELU against the Ecological Reserve.

16 Impact Assessment

Some of the authorities, such as DEADP and CapeNature, prescribe an impact assessment according to a premeditated methodology.

Table 7 Impact Assessment

Description of impact Construction of the dam Washing of loose sediments into the river Mitigation measures Stabilise newly constructed dam walls Prevent the transport of sediments into the river.								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Local	Medium	Medium term	Medium	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Short term	Low	Definite	Sure	Reversible	Replaceable

Description of impact Operation of the dam Mitigation measures Leave some water in the dam at the end of the irrigation season								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Local	Low	Long term	Low	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Positive	Local	Low	Long term	Low	Definite	Sure	Reversible	Replaceable

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 two tabled impacts and their mitigation measures are the only ones that pertains to the actual construction and the operation of the dam. The other measures that have been mentioned pertain to the operation of the farming operation and are not tabled in the impact assessment.

The impact assessment is simple, with only two steps. It shows that the impacts can easily be ameliorated.

17 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 24.3, p41, 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 p42 to derive at a value for Significance. The value for Significance can subsequently be evaluated according to Table 23.3.2.

Table 8 provides a yardstick for decision-making with regard to allow or disallow a development with its concomitant impact on the botanical environment.

The scores for the Olifants River at the site of the proposed New Wave Dam that were given are entirely those of the specialist, 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.

The scores given were as follows:

Table 8 Significance Score

Parameter	Score
Conservation value	4
Likelihood	1
Duration	5
Extent	1
Severity	1
Significance	32

The score indicates that the impacts is Medium / Low. It is more likely to be low, because the proposed dam is an off-channel dam, out of the riparian zone. Even though it is right on the bank of the river, the impact is rated as Low.

The score for Duration is high because of the ongoing operation of the dam. This is not about to have any impact on the river, apart from the ELU, which falls outside the scope of this report.

18 Risk Matrix

This assessment has been designed to assist in the decision if a General Authorisation or a License is required, should the development be allowed.

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.

Table 9 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Construction of the new dam	Washing down of sediments into the river	Destruction of aquatic habitat	24	Low
2	Operation of the dam	Drying out of the dam	Unavailability of artificial aquatic habitat	32	Low

Table 9 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1 2	1 1	1 1	1 5	1 1	1 4	1 1	1 4	3 9

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1 2	1 1	1 1	5 1	1 1	8 4	24 32	Low Low

The listed activities are the same as that of the impact assessment, with sub-activities added.

As has been stated, the two listed activities pertain to the construction and operation of the proposed dam. Other mitigation measures mentioned pertain to the ongoing farming operation and not to the construction of the new dam. Hence, these have not been included in the risk matrix.

The risk matrix indicated that the risks to the aquatic environment are extremely low and even negligible. Therefore, a General Authorisation is in order and a Licence is not called for.

19 Resource Economics

The goods and services delivered by the environment, in this case the Olifants River at the New Wave Dam site, 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 drainage line the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 10) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 10.

Table 10. Goods and Services

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

A large river in an active agricultural area can be expected to render all off the listed services. The visual representation yields an almost complete circle, with all services rendered to maximum capacity.

This does not mean that no nutrients and sediments are transported out to the sea. The surplus is so large, partly because of human impact, that the river's capacity is outstripped, resulting in a net loss.

The proposed New Wave Dam adds to the production of cultivated food, even minutely so if compared to that of the region, while it does not measurably detract from the ecological services such as nutrient removal and sediment trapping.

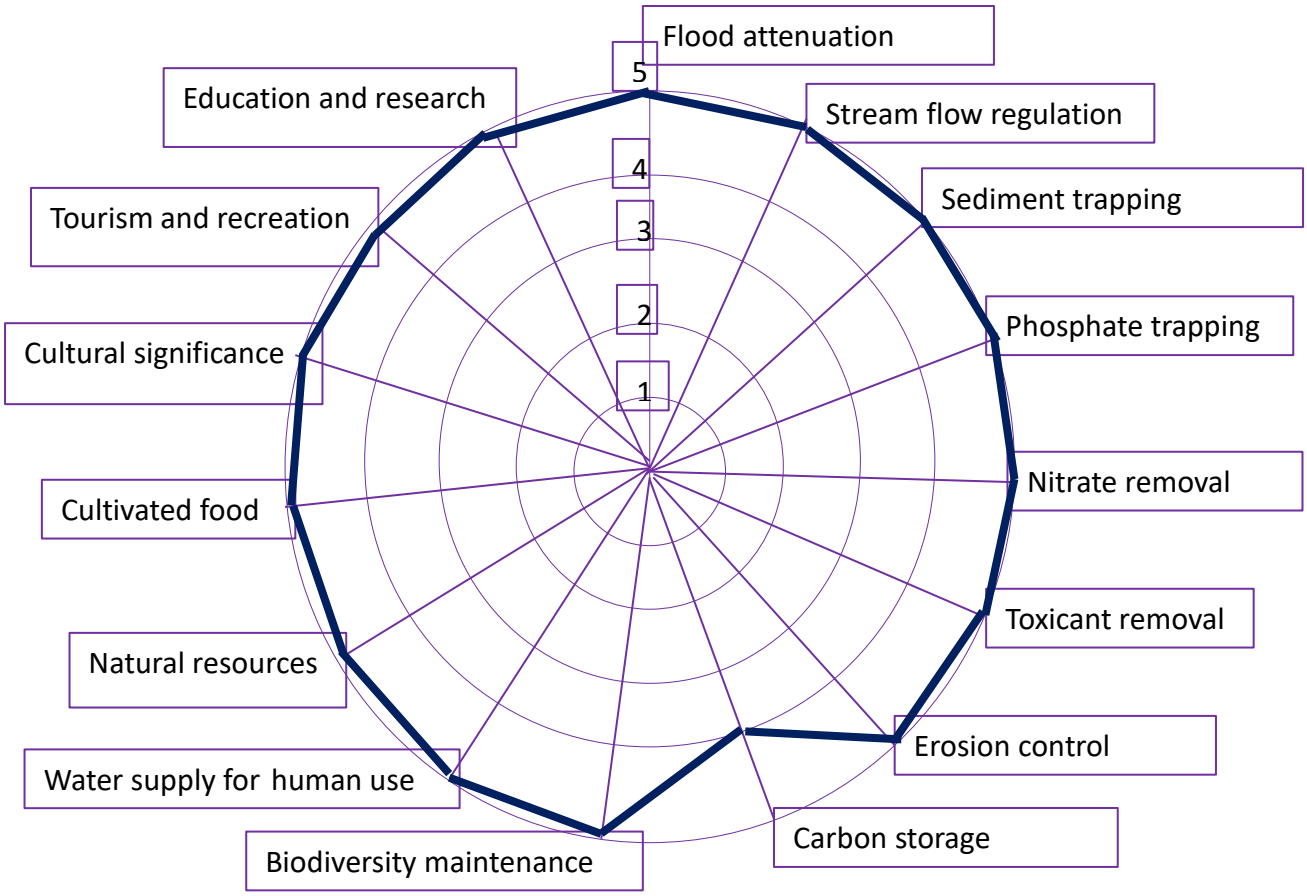


Figure 10. Resource Economics Footprint of the Olifants River at the New Wave Dam site

20 Conclusions

An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on all of the other drivers and responses. This, in turn, will predictably impact on the ecosystem services (Figure 11). The WULA and the EAI must provide mitigation measured for these impacts.

Figure11 has been adapted from one of the most recent DWS policy documents.

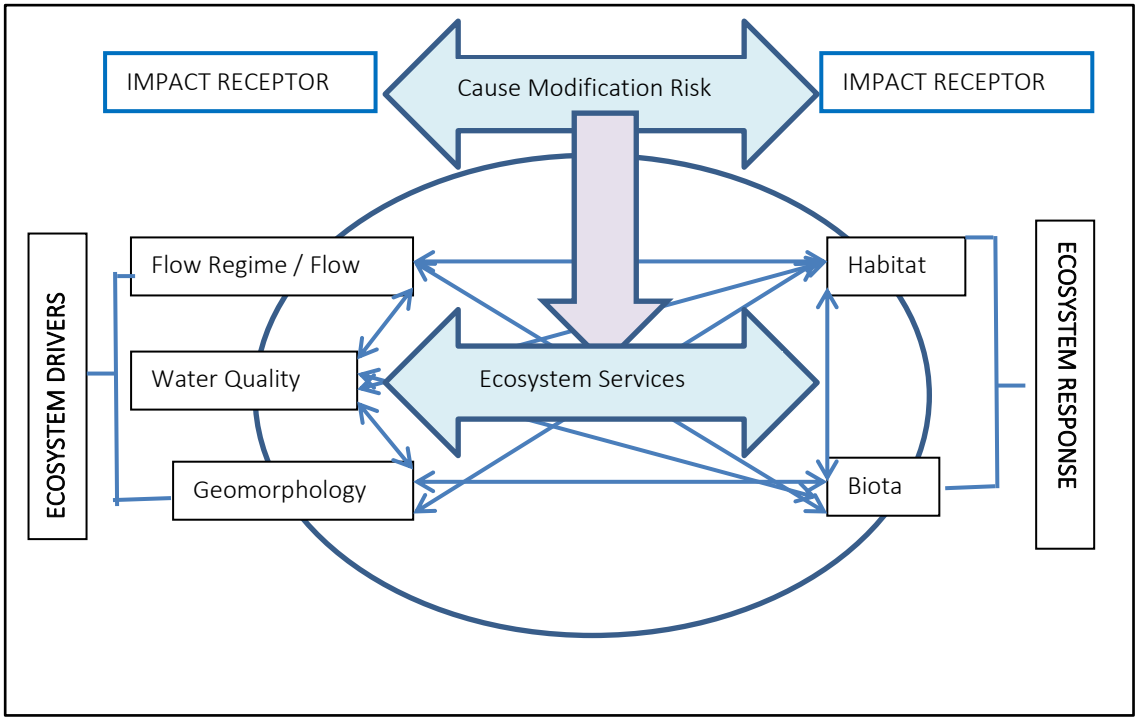


Figure 11 Minimum Requirements for a S21(c) and (i) Application

The main drivers of the Olifants River are the winter rains, followed by the long and dry summer. This results in the typical extremes of high flow alternated by low flow and even drought flow. This pattern is hugely modified by human interference. High flows are reduced by large dams as well as a multitude of farm dams. Low flows are evened out with releases from the Clanwilliam Dam. This pattern will be even more modified if the Clanwilliam Dam wall is raised, according to plan.

In the overall scheme, the proposed New Wave Dam's addition to the cumulative impact on the flow modification is negligible. This particularly true because no new abstraction is called for. The purpose of the dam is for the storage of water that already has been allocated and is defined as an ELU.

The only real impact is the possible transport of sediments into the river during the construction process. To ameliorate sediment transport, mitigation measures will have to be implemented.

The proposed dam is an off-channel dam. It is to be built outside of the riparian zone on land that has been farmed since the onset of agriculture in the valley. It is within the 100m buffer zone, for which approval is requested.

This reach of the Olifants River has been highly impacted by agriculture, with the banks formed into terraces for vineyards.

There is no reason why a S21 (c) and S21 (i) General Authorisation for the construction and the operation of the proposed New Wave Dam should not be issued. A Licence is not called for.

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22 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:  22 September 2021

23 Résumé

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Experience

WATSAN Africa, Cape Town. Scientist **2011 - present**

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 (Deputy Chairperson): Grotto Bay Homeowner's Association
- 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

24 Appendix

24.1 Veldt Types

24.1.1 Namaqualand Riviere

Distribution Northern and Western Cape Provinces: Along dry riverbeds throughout Namaqualand, but especially the Buffels, Bitter, Spoeg, Groen, Sout, Doring Rivers and lower reaches of the Olifants River. Within this unit we also classify alluvia of intermittent rivers of the Hantam region. Altitude ranging from 0–800 m.

Vegetation & Landscape Features Complex of alluvial shrubland (*Suaeda fruticosa*, *Zygophyllum morgsana*, *Ballota africana* and *Didelta spinosa*) and patches of tussock graminoids occupying riverbeds and banks of intermittent rivers. In places low thickets of *Acacia karroo* and *Tamarix usneoides* can be encountered.

Geology, Soil & Hydrology Alluvial sandy soils on Quaternary fluviatile sediments that overlie Namibian-age sediments and Mokolian gneisses. Seasonally wet (late winter). The riverbed sometimes carries torrential flood waters. In summer, patches of crystallised salt film may cover the soil surface in slight, clayey depressions.

Climate Arid, seasonal climate with MAP around 150 mm (with 100 mm on the coast and 250 mm on the Hantam Plateau). Most of the erratic rainfall occurs between June and August. Hot summers (marked by extremely high evapotranspiration) and cool winters, with fairly frequent frost. MAT 18.1°C (range 15.7°C for Hantam Plateau and 18.5°C for Knersvlakte). See also climate diagram for AZi 1 Namaqualand Riviere (Figure 13.2).

Important Taxa **Riparian thickets** Small Tree: *Acacia karroo* (d). Tall Shrubs: *Melianthus pectinatus*, *Rhus burchellii*, *Tamarix usneoides*. Low Shrub: *Ballota africana* (d). Semiparasitic Epiphytic Shrub: *Viscum capense*. **Dry river bottoms** Tall Shrub: *Lebeckia sericea*. Low Shrubs: *Galenia africana* (d), *Gomphocarpus fruticosus* (d), *Hermannia disermifolia*, *Jamesbrittenia fruticosa*, *Salvia dentata*. Succulent Shrubs: *Suaeda fruticosa* (d), *Zygophyllum morgsana* (d), *Atriplex cinerea* subsp. *bolusii*, *Didelta carnosa* var. *carnosa*, *Lycium horridum*, *Salsola tuberculata*, *Tetragonia fruticosa*, *T. pillansii*, *Zygophyllum retrofractum*. Herbaceous Climber: *Didymodoxa capensis*. Graminoids: *Cynodon dactylon* (d), *Odyssea paucinervis* (d), *Cyperus marginatus*, *Diplachne fusca*, *Ehrharta longiflora*, *Isolepis antarctica*, *Scirpus nodosus*. Herbs: *Limonium dregeanum* (d), *Arctotheca calendula*, *Cotula coronopifolia*, *Galium tomentosum*. Geophytic Herb: *Crinum variabile*. Succulent Herbs: *Conicosia elongata*, *Mesembryanthemum guerichianum*.

Endemic Taxon **Dry river bottoms** Succulent Shrub: *Sarcocornia terminalis* (d).

Conservation Least threatened. Target 24%. Only very small portion statutorily protected in nature reserves (Lutzville). Almost 20% transformed for cultivation (vineyards along the entire lower reaches of the Olifants River) or by building of dams (Driekoppies Dam). Exotic shrubs *Nicotiana glauca* and *Prosopis* species are often found in riverbeds. The latter is probably the most important woody invader species found in Namaqualand. In some years invasive indigenous *Gomphocarpus fruticosus* may appear in abundance in the alluvia, while in other years it would disappear completely. Another invasive indigenous species is *Galenia africana* which can be dominant along some of the water courses, especially in the south.

Reference Boucher (2003).

24.1.2 Vanrhynsdorp Gannabosveld

VT 31 Succulent Karoo (92%) (Acocks 1953). LR 57 Lowland Succulent Karoo (95%) (Low & Rebelo 1996). BHU 77 Knersvlakte Vygieveld (79%) (Cowling & Heijnis 2001).

Distribution Western Cape Province: Namaqualand, southern Knersvlakte between Vredendal and Vanrhynsdorp at the foot of the Matsikamma and Gifberg Mountains as well as northeast of Vanrhynsdorp. About half of the area lies at 100–200 m and most of the rest at 200–300 m.

Vegetation & Landscape Features Mainly flat or only slightly undulating landscape supporting succulent shrubland dominated by *Salsola* (over large stretches), *Drosanthemum, Ruschia* and some disturbance indicators such as (mainly) short-lived Aizoaceae, including representatives of the genera *Galenia, Psilocaulon, Caulipsolon* and *Mesembryanthemum*. In the south, the shale plains can acquire a grassland appearance through seasonal dominance of *Bromus pectinatus* and *Stipa capensis*. Spectacular annual and geophyte flora can appear in spring after good winter rains.

Geology & Soils The greater part of this area is underlain by schists, phyllite and sandstones of the Gariep Supergroup, which outcrop when they are not covered by recent superficial deposits of alluvium and duripan crusts (calcrete). Soils are sandy-loamy, moderately deep, slightly acid to alkaline, with high skeletal content. More than half of the area is classified as Ag land type, followed by Fc land type, with Db and Ae land types only of minor importance.

Climate Winter-rainfall climate with dry, hot summers and mild, rainy winters. MAP of 163 mm is considerably higher than in the other parts of the Knersvlakte due to the orographic effects of the neighbouring Matsikamma and Gifberg Mountains and the Escarpment. Almost all the rainfall occurs between April and August. The lowest temperatures in winter 5–10°C; the highest temperatures in summer 30–35°C. Winters are mild, with rare occurrence of frost (on average 3 days per year). See also climate diagram for SKk 5 Vanrhynsdorp Gannabosveld (Figure 5.53).

Important Taxa Succulent Shrubs: *Caulipsolon rapaceum* (d), *Drosanthemum deciduum* (d), *D. hispidum* (d), *Euphorbia mauritanica* (d), *Salsola namibica* (d), *S. zeyheri* (d), *Adromischus sphenophyllus*, *Antimima dasyphylla*, *Aridaria brevicarpa*, *A. noctiflora* subsp. *noctiflora*, *Delosperma crassum*, *Drosanthemum latipetalum*, *Euphorbia aspericaulis*, *Lampranthus uniflorus*, *Manochlamys albicans*, *Ruschia fugitans*, *Tetragonia hirsuta*, *T. sarcophylla*, *Tylecodon reticulatus*, *T. ventricosus*, *Zygophyllum cordifolium*. Low Shrubs: *Galenia fruticosa* (d), *Asparagus capensis* var. *capensis*, *A. suaveolens*, *Chrysocoma longifolia*, *Eriocephalus microphyllus* var. *pubescens*, *Galenia africana*, *Hermannia cuneifolia*, *Pteronia paniculata*, *Selago albida*, *Tripteris sinuata*. Herbs: *Gazania lichtensteinii* (d), *Foveolina dichotoma* (d), *Oncosiphon suffruticosum* (d), *Tribulus terrestris* (d), *Adenogramma glomerata*, *Amellus microglossus*, *Arctotis hirsuta*, *Cotula microglossa*, *Cromidon corrigioloides*, *Dimorphotheca sinuata*, *Felicia namaquana*, *F. tenella*, *Gazania krebsiana* subsp. *arctotoides*, *Gorteria diffusa* subsp. *diffusa*, *Grielum humifusum*, *Heliophila pendula*, *Nestlera biennis*, *Osteospermum pinnatum*, *Plantago cafra*, *Rhynchopsidium pumilum*, *Tripteris microcarpa*. Geophytic Herbs: *Babiana minuta*, *B. sambucina* var. *longibracteata*, *Cyanella orchidiformis*, *Dipcadi crispum*, *Lapeirousia exilis*, *Massonia echinata*, *Moraea galaxia*, *M. miniata*, *Oxalis annae*, *O. compressa*, *O. pes-caprae*, *O. purpurea*, *Sparaxis galeata*, *Strumaria unguiculata*, *Trachyandra falcata*, *T. jacquiniana*, *T. scabra*. Succulent Herbs: *Psilocaulon junceum* (d), *Apatesia helianthoides*, *A. sabulosa*, *Phyllobolus nitidus*, *Psilocaulon leptarthron*. Graminoids: *Stipa capensis* (d), *Bromus pectinatus, Ehrharta ramosa* subsp. *aphylla*, *Enneapogon desvauxii*, *Ficinia argyropa*, *Karroochloa tenella*, *Pentaschistis patula*, *Stipagrostis ciliata*, *S. zeyheri* subsp. *macropus*, *Tribolium pusillum*.

Biogeographically Important Taxa ([NQ]Namaqualand endemic, [K]Knersvlakte endemic) Succulent Shrubs: *Drosanthemum schoenlandianum*[K], *Malephora purpureo-crocea*[NQ]. Herbs: *Manulea altissima* subsp. *longifolia*[NQ], *Ursinia pygmaea*[K]. Geophytic Herbs: *Babiana salteri*[K], *Lapeirousia simulans*[K], *Oxalis copiosa*[NQ].

Endemic Taxa Succulent Shrub: *Euphorbia fasciculata*. Geophytic Herbs: *Eriospermum eriophorum*, *Ornithogalum diluculum*. Succulent Herb: *Brownanthus glareicola*. Herb: *Cotula pedunculata*.

Conservation Vulnerable region due to transformation pressure. None of the unit is conserved in statutory conservation areas. Target 28%. So far 20% transformed into cultivated land and open-cast gypsum mining. Rehabilitation after open-cast mining remains minimal due to lack of little viable topsoil to cover the rehabilitated fields. Aliens (*Atriplex, Bromus*) have invaded large patches of vegetation. Increased cover of *Stipa capensis* (despite the name still unclear whether of indigenous or alien origin) diminishes grazing potential for sheep (due to damage to wool by caryopses). Erosion is moderate (71%) to high (18%).

References Greeff (1987), Steinschen et al. (1996), Schmiedel (2002a, b), Boucher (2003).

24.2 Biomonitoring Results

SASS5 Score Sheet										
Date	20 Sep 21	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Olifants River	Porifera	5		**Hemiptera**			**Diptera**		
	Klawer	Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5	5	Ceratopogonidae	5	
Coordinates	31°52' 05.08"	Huridinea	3		Hydrometridae	6		Chironomidae	2	2
	18°37'37.33"	**Crustacea**			Naucoridae	7		Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	7.0	Potamonautidae	3		Notonectidae	3	3	Empididae	6	
Temperature °C	17.3	Atyidae	8		Pleidae	4		Ephydridae	3	
pH	7.4	Palaemonidae	10		Veliidae	5	5	Muscidae	1	
EC mS/m	77	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	
SASS5 Score	42	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	10	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	4,2	**Ephemeroptera**			Dipseudopsidae	10		Tipulidae	5	
		Baetidae 1 sp	4	4	Ecnomidae	8		**Gastropoda**		
Other Biota		Baetidae 2 sp	6		Hydropsychidae 1 sp	4		Ancylidae	6	
		Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	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	
		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	5			
		Aesthnidae	8	8	Elmidae Dryopidae	8				
		Corduliidae	8		Gyrinidae	5				
		Gomphidae	6		Haliplidae	5				
		Libellulidae	4	4	Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5				
					Limnichidae	10				
					Psephenidae	10				
Score				16			21			5

Table 24.3 Numerical Significance

Table 24.3.1 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 24.3.2 Scoring system

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.

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)

24.4 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 24.4.1 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 24.4.2 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 24.4.3 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 24.4.4 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.

24.5 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