Doornkraal Agri

Think different. Think Perfection.

PO Box 484
Ceres

Fresh Water Report

For the licensing of a proposed new bridge, new road sections and replanting of orchards on

Farm Visgat 207, Ceres RD

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

November 2021

EnviroAfrica

Environmental Management and Impact Assessment

Omgewingsbestuur en Impakbeoordeling

watsan AFRICA

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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

Visgat Farm is one of the production units of Doornkraal Agri. Visgat Farm is in the Witzenberg Valley to the north of Ceres in the Western Cape. It produces fruit, in particular pears, for the export market.

The gravel access road to the farm must be upgraded to accommodate the trucks that transport produce out of the valley. The bends in the roads are too tight for these trucks and the culverts over the streams are not designed to carry the weight. A new bridge over the Olifants River must be constructed as well.

In addition, three blocks of fruit trees must be re-planted. The old, unproductive trees have already been removed and the land is now awaiting to be replanted.

An EIA is required for these planned developments. The directors of the Doornkraal Agri enterprise appointed Enviro Africa of Somerset West to carry out the legally required EIA.

Likewise, Dr Dirk van Driel of WATSAN Africa of Cape Town was appointed to conduct the WULA. The planned developments are on the banks or in the beds of streams and rivers of the property, for which official approval is required, hence the WULA.

The WULA requires a Freshwater Report. The report must be compiled according to a set format and contents, with prescribed methodologies.

The Freshwater Report must be submitted along with a Risk Matrix.

After the completion of the Freshwater Report, the project must be registered on the online eWULAAS facility. This facility dictates the procedures and the steps that must be followed leading to the licensing of the project and its components.

This report must include aspects that are required for the EIA process and its scoping report, as well as for the EMPr.

The report includes a component to assess the ecological importance of the reach of the upper Olifants River that passes through Visgat Farm. The ecological importance, according to various indicators, is high. This will pose challenges to the design engineers as well as the contractors, who must employ the utmost caution to preserve the aquatic and terrestrial environment of this most ecologically sensitive region.

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 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.

Appendix 6 of GN R926 of 7 April 2017

This Government Notice outlines the minimum requirements of the contents of specialist reports for EIA's.

3 Locality

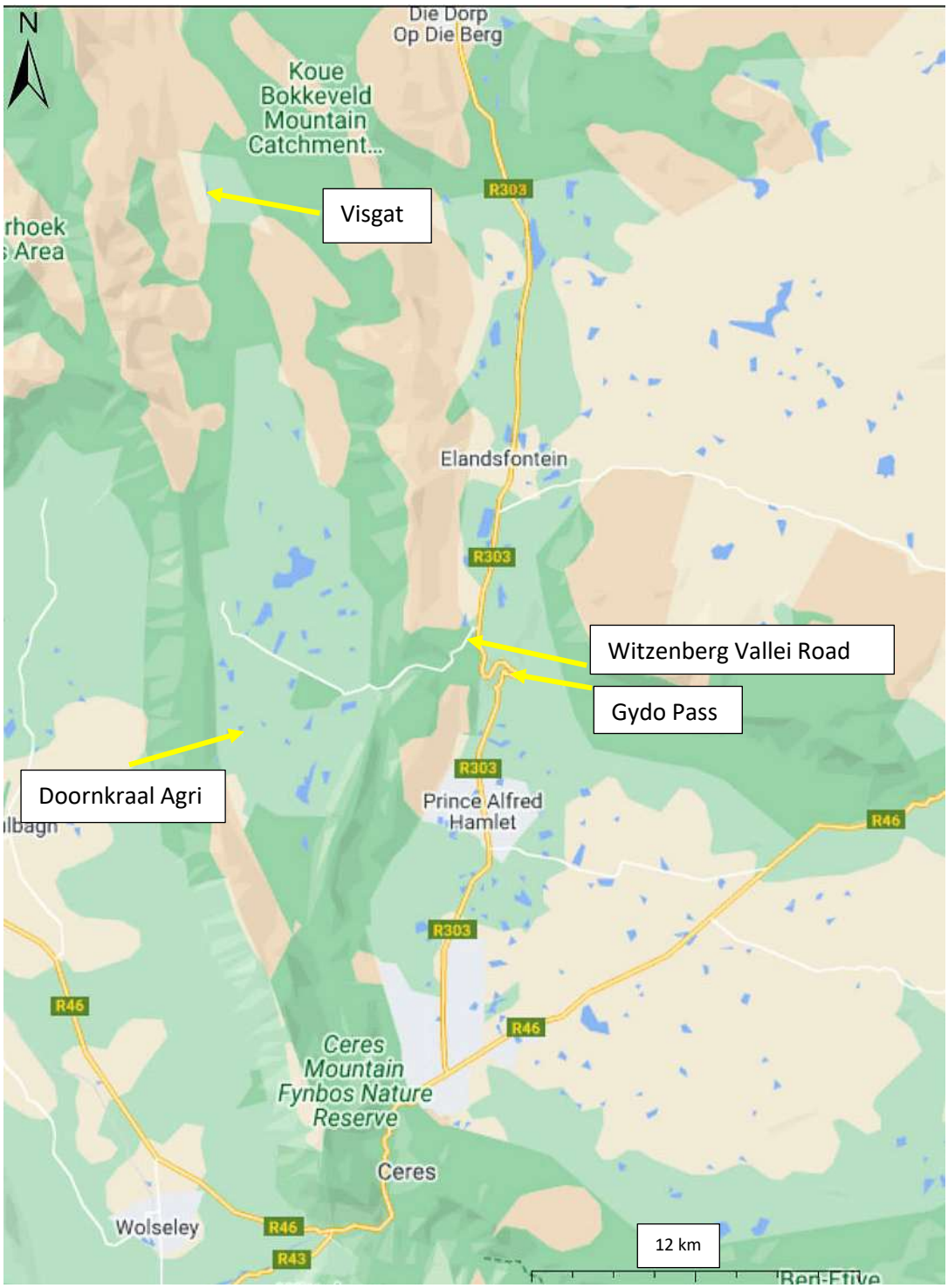


Figure 1 Locality

The locality of Visgat Farm is indicated in Figure 1.

The farm is 30km in a straight line, as the crow flies, to the north of Ceres. Take the R303 out of Ceres, pass through Prince Alfed Hamlet and up the Gydo Pass to the Witzenberg Vallei turnoff. At the very end of the Witzenberg Vallei Road is Doornkraal Agri, the proprietors of Visgat Farm. However, Visgat Farm is in the far north corner of the valley. There is a junction just over the Witzenberg Mountain. Take the road to the north. This road turns in a gravel road and ends at Visgat.

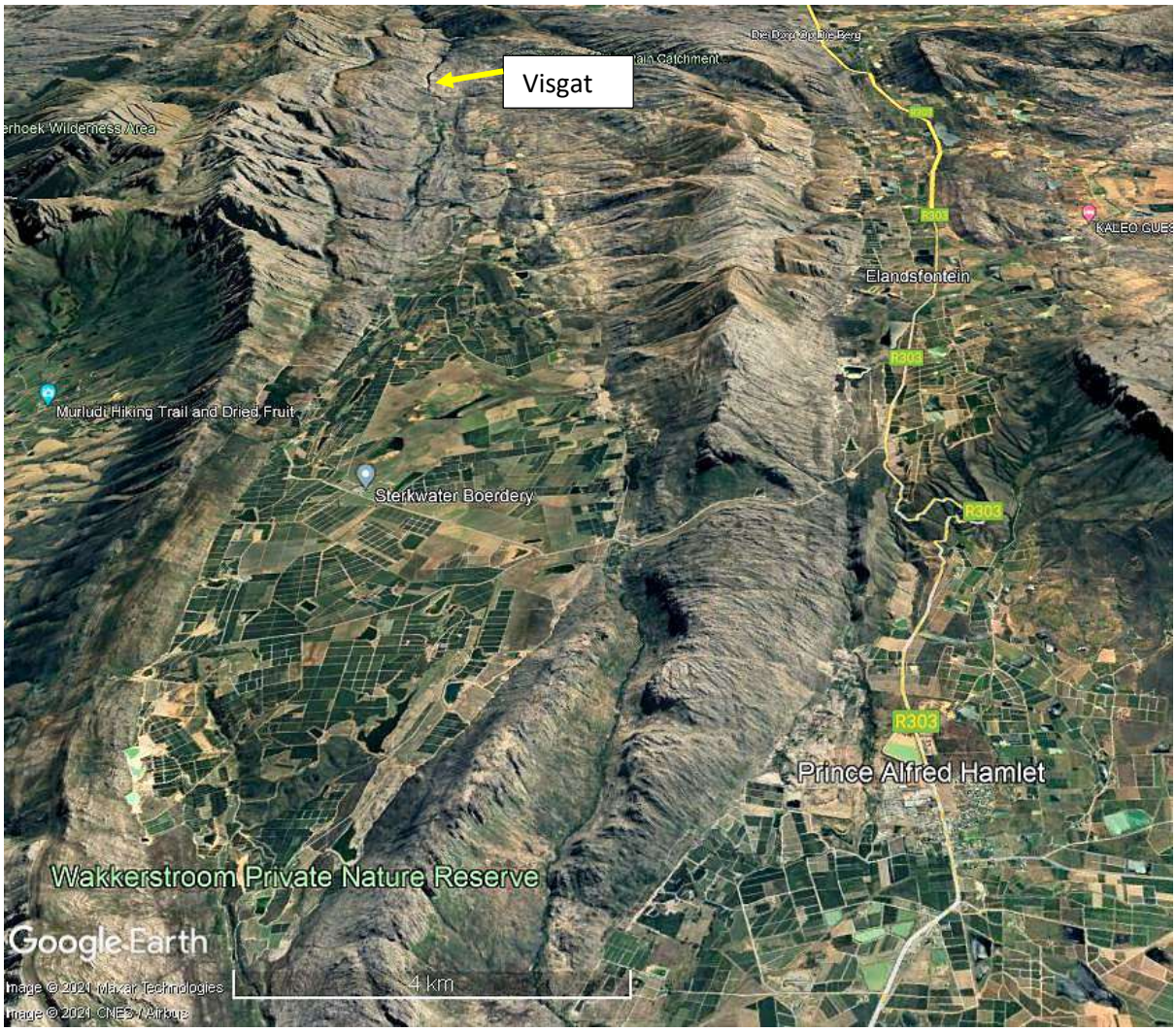


Figure 2 Witzenberg Vallei

Visgat Farm is located in the very northern end of a broad valley between two mountain ranges (Figure 2). Most of the valey has been transformed into intensive fruit farming enterprizes. The Upper Olifants River flows from south to north through the length of the valley.

4 Quaternary Catchment

The affected part of Visgat Farm is in the E10A quaternary catchment.

The northern part of the farm is in the E10B quaternary catchment. This is not the part in which the proposed project is located.

5 Conservation Status

5.1 Vegetation

The vegetation on Visgat Farm is listed as Winterhoek Sandstone Fynbos. It is listed as “Least Threatened”. The vegetation is poorly known because of the inaccessibility of the mountainous terrain. The riverine and riparian zone is not listed as a separate vegetation type.

5.2 SANBI Webpage

The Olifants River is listed as a NFEPA.

5.3 Western Cape Biodiversity Spatial Plan

Parts of Visgat Farm and its surounds is listed as a Terrestrial CBA (Figure 3). The Olifants River is listed as a River CBA.

Most of the velley here is mountain catchment area, with little if any development. Visgat Farm is adjacent to the Groot Winterhoek Wilderness Area.

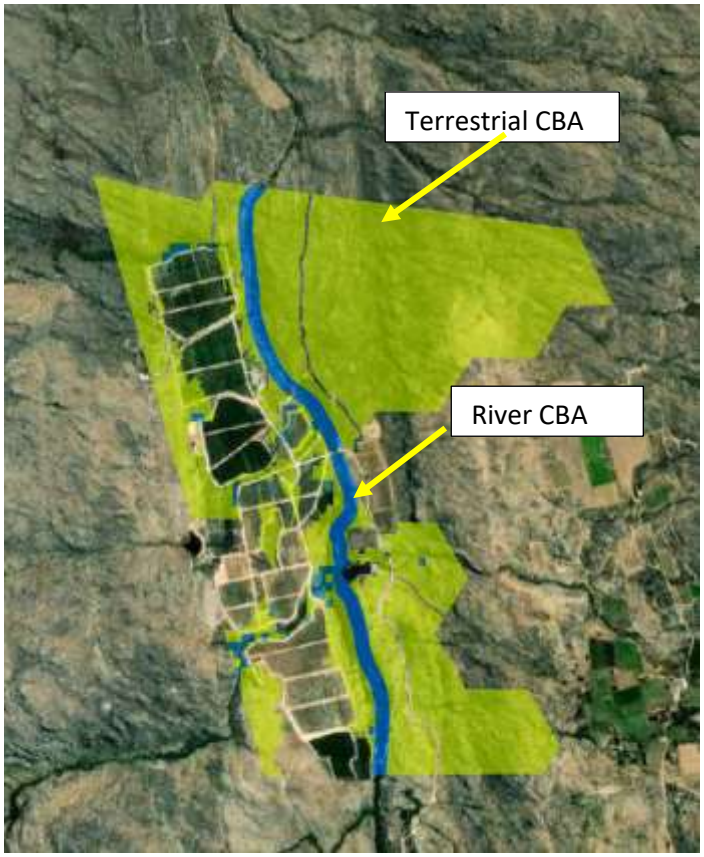


Figure 3 Western Cape Biodiversity Spatial Plan

5.4 DEA Screening Tool

The screening tool yielded the following results:

Table 1 Screning Tool

Theme	Sensitivity
Animal species Aquatic biodiversity Plant species Terrestrial biodiversity	High Very high High Very high

For this freshwater report, only the themes pertaining to biodiversity have been listed.

6 Climate

On-line climatic data for Visgat Farm and surrounds is not available. Ceres is the closest town for which data is available (Figure 4).

https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/ceres_republic-of-south-africa_3369129

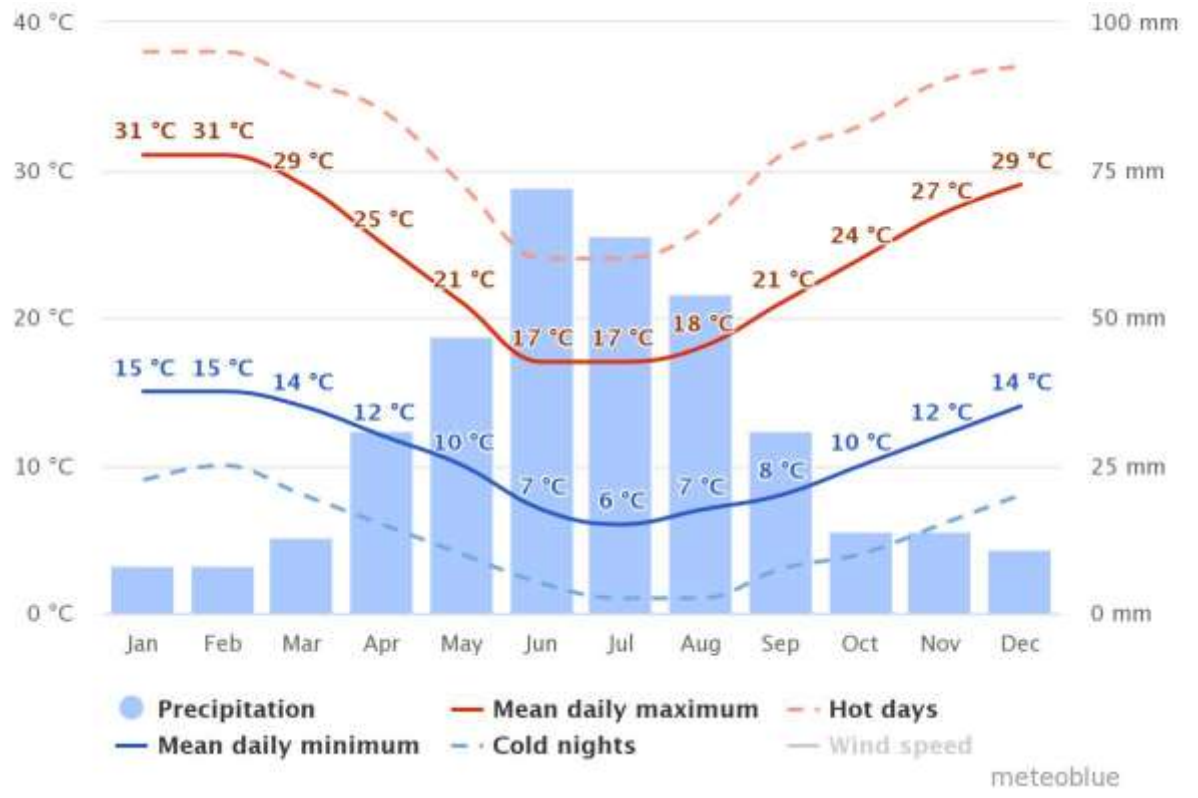


Figure 4 Climate Ceres

Rainfall is dependent on elevation, with the highest rainfall on the mountain peaks and the ridges. Peaks of more than 1700masl flanks Visgat Farm, with mountain ridges of 1500masl. The rainfall here is high, 2000mm per year and more. It is much lower down in the valleys. At 460masl, the annual rainfall for Ceres is 1088mm. Visgat Farm is at 680masl. It is not surprizing that the farm manager puts the annual rainfall at 1500mm.

Most of the rain falls during winter, with the summers dry and hot, with desiccating winds. Fruit growing and the export industry is entirely dependant for its irrigation needs during summer on water out of the Olifants River. Water is pumped out of the

Figure 5 Weir (Doornkraal Agri webpage)

Figure 6 Irrigation dam

river at a weir near the southern farm boundary (Figure 5) into a holding dam up the slope, from where the entire farm is irrigated (Figure 6).

The upgrade of the gravel access road, the new bridge and the establishment of the orchards should be completed during the dry summer months during low flow conditions.

7 Project

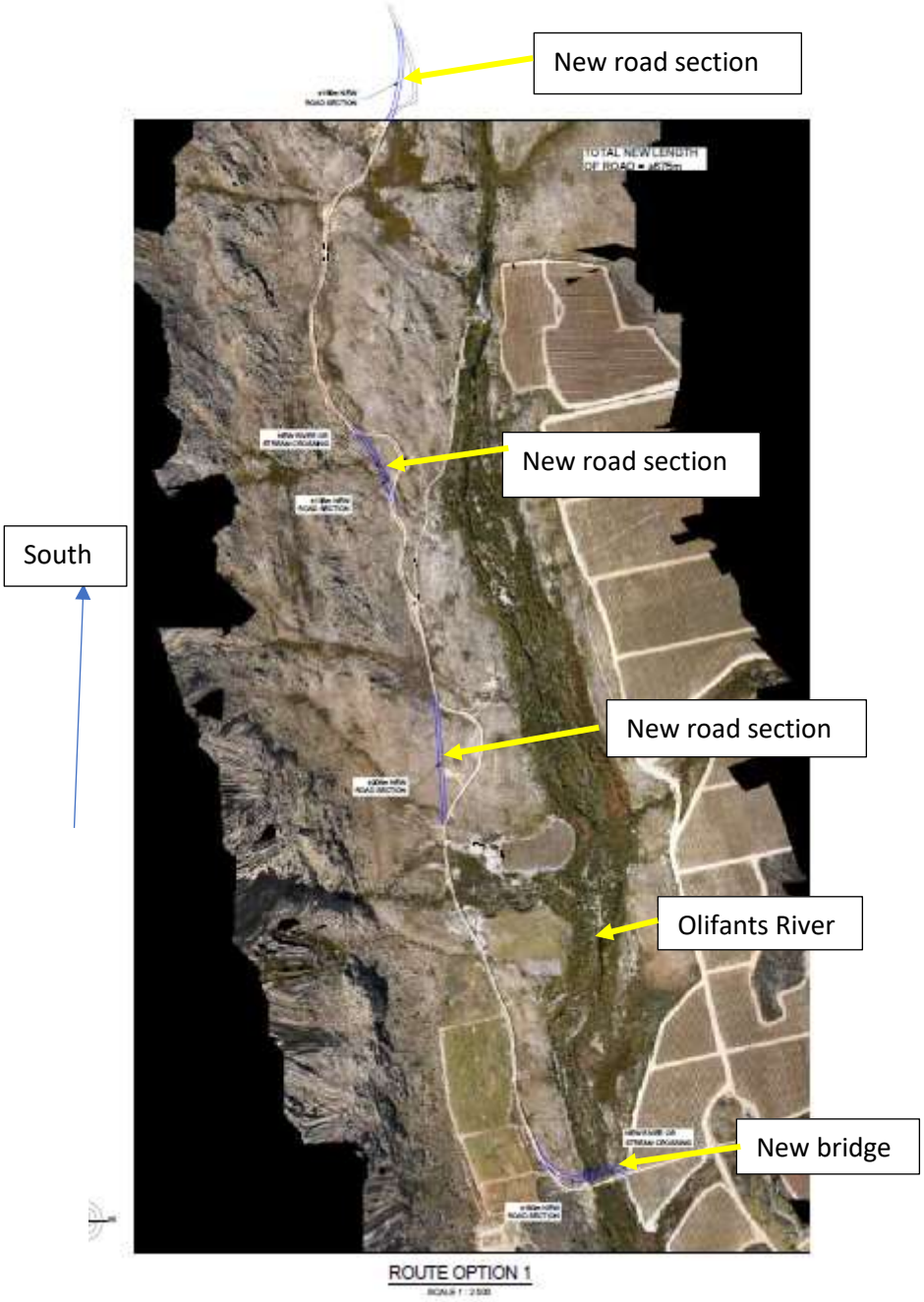


Figure 7 Project (EnginX Consulting)

The project includes a new bridge over the upper Olifants River at Visgat Farm. The existing bridge is unsafe for the trucks that transport the produce from the farm. It is regularly under water during the rainy season. The new bridge will consist of a number of prefabricated concrete culverts that wiil be placed on a foundation on the bedrock alongside the existing bridge. The new bridge will be 7.5m wide and will be 750mm higher than the existing bridge.

To prevent any more enviromental damage as a result of the existing bridge, it is recommended that this bridge be left as it is and not broken down. Removal of the bridge will probably do more damage than preserving it.

Three sections of road must be constructed (Figure 7) to straighten the road for large trucks. The current bends in the road make it impossible for the larger vehicles to pass. The total length of the new sections together demands to 675m. These new sections pass a number of smaller streams, for which culverts must be placed. These streams were flowing strongly during the site visit.

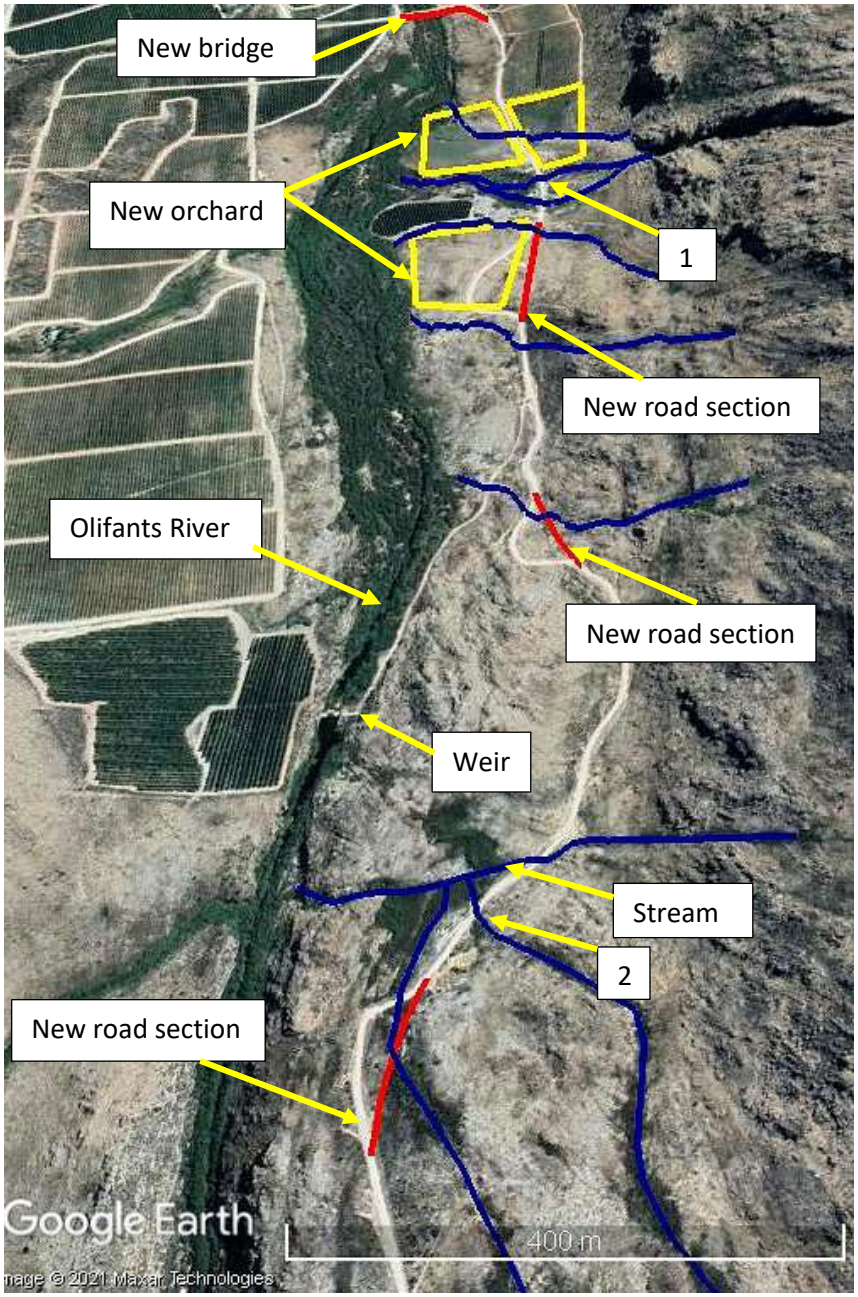


Figure 8 Project

The map was redrawn to indicate the new blocks of of pear orchards (Figure 8). Actually, none of these blocks are new, as they have been planted before. The remnants of the uprooted orchards remain on the grounds (Figure 11). According to plan, these blocks will be replanted. These 3 blocks together amount to 5 hectares.

Several streams cross the road as well as the new orchards. The planned developments therefore "trigger" S21 (c) and S21 (i) of the NWA. These streams are indicated in blue on Figure 8.

Figure 9 Remnants

Figure 10 Pipe culvert

Figure 11 Tracks

Figure 12 Erosion

The streams underneath the road through pipe culverts (Figure 10).

One such culvert is on Point No. 1 on Figure 8. The stream separates the two areas where the new orchards are planned. There was running water on both sides of the

culvert at the time of the site visit. The water was running at a flow rate, very roughly estimated, of one liter per second. A set of tracks passed through the stream on the side of the road. This was for heavy machinery that could not pass over the culvert.

The farm road along this stream, leading to the southerly new block of orchard, was heavily eroded (Figure 12).

Figure 13 Run

Further up the road to the south, at the southmost new road section, the stream was much stronger (Point No.2 on Figure 1), over small waterfalls (Figure 13) at a flow rate of approximately 5 liters per second.

8 Biomonitoring

8.1 Methodology

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.

8.2 Sampling Point

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. The planned developments are all adjacent and upstream of the bridge over the Olifants River on Visgat Farm.

Figure 14 Bridge

The sample was taken on both sides of the bridge (Figure 14), upstream and downstream on 11 November 2021. The coordinates of the sampling point were as follows:

33°04’35.84”S and 19°13’00.69”E

Measurements were taken with a calibrated YSI handheld field instrument. These were as follows (Table 2):

Table1 Water Quality

Parameter	Measurement
Temperature °C pH Electrical conductivity mSm^{-1} Dissolved Oxygen mgl^{-1}	14.5 6.6 3.4 8.0

The water had a brownish colour like tea, as is usual for natural water in upper Fynbos Mountain catchments. The water was slightly acidic as well, which is considered as normal for this aquatic habitat. The water was extremely fresh, with very little dissolved salts, as indicated by the electrical conductivity.

The river was, at the time of the site visit, flowing very fast at a rate of a roughly estimated $3m^3 s^{-1}$. The velocity of the stream in the middle was approximately $1ms^{-1}$ and slower nearer to the banks. According to the farm manager, this is the usual low flow of the river during the dry summer season and it very seldom gets any lower. It takes only 20mm of rain for the river to overtop the bridge.

The aquatic habitat consisted of sandstone bedrock, stones-and-cobbles-in-current and coarse sand in the current. There was no habitat out of the current.

Mush of the stream was lined with a healthy stand of palmiet *Prionium serrata* (Figure 15). This formed most of the emerging vegetation habitat, along with a variety of riparian shrub. Submerged vegetation was present in the form of drowned grasses and sedges.

Figure 15 Palmiet

The river downstream of the bridge is channelled into a narrow gorge (Figure 16). The river here was a white-water rapid at the time of the site visit.

Figure 16 Stream downstream of the bridge

Figure 17 Riparian zone

A drone image (Figure 17) shows a wide and well-developed riparian zone. The river at the sampling point upstream of the bridge is lined with a bank of barren sandstone towards the east. The opposite bank has a much wider riparian zone.

The riparian zone on the east is marked with large-scale pear orchards (Figure 18).

Figure 18 East bank across the bridge

Note that the area adjacent and upstream of the bridge was denuded of vegetation when heavy earth-moving machinery passed through the river, as the bridge would not carry the weight. This is the area where the new bridge will be located.

8.3 Biomonitoring Results

Table 3 Biomonitoring results

Parameter	Score
SASS5 Score	83
Number of Taxa	15
ASPT	5.5

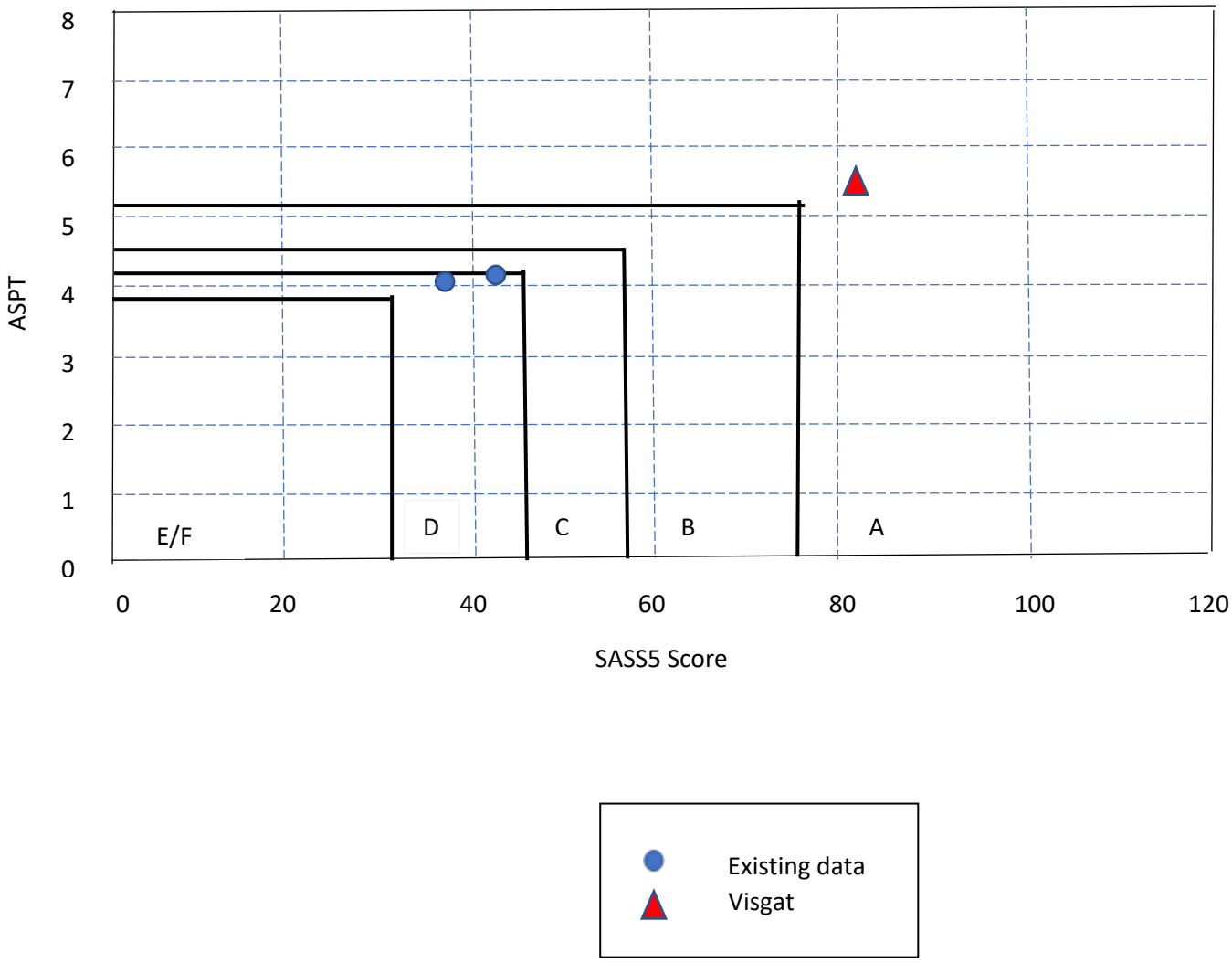
The biomonitoring results are given in the SASS5 Score Sheet in the Appendix and in Table 3.

The data in Table 3 indicates that the Upper Olifants River at Visgat is unimpacted, pristine. However, a still higher score can be expected of over a 100, with an ASPT of more than 6, with more of the high-scoring organisms. In this sample, really, there were only 2, Leptophlebiidae and Glossostomatidae. This indicates that indeed there is some impact from agriculture, but the impact is too small to lower the integrity class one notch down (Figure 19).

The pristine status is like that of the Ratel River, a tributary of the Olifants River in the upper catchment (DWAF, 2006). This was the only sampling point in the entire Olifants Doring River Catchment that was classified as an “A”, pristine, prior to the current sampling point at Visgat.

The score was much higher than that of samples taken at previous occasions for similar projects lower down the Olifants River close to the town of Klawer and close to the confluence of the Doring and the Olifants River. These samples indicated a “D” classification, with a marked impact from agriculture (Figure 19).

The DWS is currently running regular biomonitoring sampling runs in various rivers across the country, including the Olifants Doring River. These results are yet not publicly available for purposes of comparison.



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 19 Visgat Biomonitoring Results

9 Impacts and Mitigating Measures

Adequate provision must be made for the protection of the aquatic environment in the EMPr.

The project should be completed during the dry summer months and during low flow conditions.

9.1 Riparian zones

Biomonitoring indicated that the water quality, because of the farming activities, have been impacted, but only slightly, not enough to lower the score into a lower class. All the streams entering the Upper Olifants River pass through cultivated areas, subject to agricultural return flow. During the time of the site visit, the flow in these streams was evidently large enough to dilute and offset the impact of agrichemicals. It is hoped that this amicable situation may remain, for which the riparian zones of rivers and stream must remain intact. It is planned that some of the new orchards on Visgat Farm (Figure 1) will intrude into the riparian zone of the Olifants River. It is recommended that the orchards should be expand elsewhere, if possible, rather to sacrifice any of the riparian zone, to maintain the 5 hectares of ne orchard as planned.

In terms of the NEMA and its regulations, a buffer zone of 32m wide between any development and the edge of the riparian zone must be maintained. In terms of the NWA, a buffer zone of 100m must be maintained. Five hectares of orchard is little and to make provision for buffer zones would render the replanting of the orchard too small to be viable. For the orchards to go ahead, the buffer zones must be officially waived.

However, the riparian zone of the Olifants River must remain untouched. It is wide enough to buffer the impact of agriculture on the river if it remains.

The area at Point 1 of Figure 1, where the stream passes through the blocks of the planned new orchards, was never planted. It is possible and practical to maintain a buffer zone of 32m on both banks of the stream.

Earth-moving and agricultural machinery must be kept out of the riparian zone during the construction phase and thereafter.

9.2 Agricultural return flow

Agricultural return flow must be prevented. Over-irrigation must be prevented.

State-of-the art and contemporary instrumentation should be installed in the orchards to measure the moisture content in the soil, according to which irrigation schedules can be planned and adapted. These systems are telemetrically connected to a control centre from where the irrigation system is attuned to the irrigation needs in the orchards.

In not already installed, such a system should be installed in the existing orchards.

9.3 Construction of culverts

The pipe culverts along the access road must be upgraded to handle heavy earth moving and farming machinery, even in places where the road is not about to be upgraded. This must eliminate the need for machinery to bypass the culverts and take to the stream beds for a passage to Visgat Farm. From a conservation point of view, as well as from preserving the water quality in the river, double road passes through in the river must be avoided.

The construction process usually entails the opening and levelling of a part of a stream with earth moving machinery, upon which a concrete slab is cast into the stream bed to act as a foundation for the culverts. The stream is temporarily diverted away from this part until the concrete has set. The other half of the stream bed is subsequently levelled and provided with a concrete slab, while the stream flow is diverted over the half that has already been covered with a concrete slab foundation. The river or stream is the most is the most vulnerable during this stage of the construction, with the most potential impact. The construction footprint must be kept to a minimum. Special care must be taken in the ecologically sensitive aquatic environments. This phase will have to be carefully plant and swiftly executed to prevent gross loss of sediments down the river.

Where new culverts are to be constructed and pipe culverts are to be replaced, the main impact is probably the washing down of large quantities of mud and silt down the river. This must be limited to a minimum, in order not to unduly and not to deleteriously impact on the aquatic environment and not to render the water less fit for use for downstream water users.

Once the culverts have been placed on the stream beds, the on ramps on both sides must be placed, compacted, landscaped and planted with stabilising vegetation as quickly as possible to prevent the erosion of these ramps and more washing down of mud down the streams and the river.

9.4 Construction of the Road Sections

The middle new section and the southernmost one will be in mountainous terrain and probably will have to be blasted to move many tons of rock. The material out of these cuttings must be taken off site where it can be levelled and landscaped to fit in with the surroundings. This preferably must be done on already disturbed land. No new or pristine land must be used for this purpose. Where this material is stored prior to removal, the storage area must be kept as small as possible.

Moreover, these cuttings will be close to and over small mountain streams, which requires special care to prevent mud and silt washing down the streams and ending up in the river.

During construction, only one access road to the construction site must be allowed. New access roads will serve a preferential flow paths for runoff and would add to the erosion potential.

The newly built road shoulders must be landscaped and planted immediately following construction to prevent erosion.

Pooling on the road during rainfall must be prevented.

During the operational phase of these gravel roads, prone to erosion exacerbated by heavy rainfall, running water must be deviated from the roads with appropriate storm water management infrastructure. Next to the road shoulders, paved swales will probably be necessary to prevent running storm water to erode deep trenches.

9.5 Alien and invader organisms

Official programs such as Working for Water has, according to the Visgat farm manager, removed much of the black wattle, pine and blue gum tree infestation. Reinfestation is evident along the river. The ongoing control of invasive vegetation should not be left to the government and its departments, but the farming community should join in to bring their part.

The farm manager is much aware of invasive fish in the river such as trout and largemouth black bass. Fishing for these fish species is permitted and promoted and captured fish is not returned to the river.

9.6 ECO

A qualified and independent ECO must be appointed to oversee the construction of the road and the culverts, as well as the establishment of the new orchards.

10 Present Ecological State

Table 4 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 4 and 5) 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.

Both the riparian zone and the instream habitat were classified as "B", with only a small measure of impacts and with the ecological functioning intact.

It is not foreseen that the envisaged alterations to the access road, the new bridge and the replanting of the orchards will lower the classification, provided that the mitigation measures are adhered to.

Table 5 Present Ecological State of the Olifants River at Visgat Farm

Instream	Score	Weight	Product	Maximum score
Water abstraction	20	14	280	350
Flow modification	21	13	273	325
Bed modification	21	13	234	325
Channel modification	21	13	273	325
Water quality	23	14	322	350
Inundation	24	10	240	250
Exotic macrophytes	24	9	216	225
Exotic fauna	17	8	136	200
Solid waste disposal	24	6	144	150
Total		100	2118	2500
% of total			84.7	
Class			B	
Riparian				
Water abstraction	20	13	260	325
Inundation	24	11	264	275
Flow modification	21	12	252	300
Water quality	23	13	299	325
Indigenous vegetation removal	22	13	286	325
Exotic vegetation encroachment	22	12	264	300
Bank erosion	24	14	288	350
Channel modification	23	12	276	300
Total			2189	2500
% of total			87.6	
Class			B	

Likewise, the two small mountain streams that will be affected by the new road sections can also be classified as “B” for both instream and riparian habitat.

11 Ecological Importance

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

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)

Table 7 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 7). Most of these fish species are encountered in the upper tributaries.

The planned developments on Visgat Farm are not about to any way further compromise the status of any of these fish, provided that the mitigation measures are

adhered to. The presence or absence of these fish cannot serve to discourage the envisaged developments

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

12 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.

Large parts of the upper Olifants River catchment have been transformed. The impact is evident from the biomonitoring results. The question irises if aquatic biota would recover if agriculture would cease its impact. This is a most unlikely scenario. The impact will remain and recovery unlikely. From this angle, the upper Olifants River catchment and its aquatic habitat is ecologically sensitive.

13 EISC

The DWS demand that the river be placed in a category according to the EISC methodology (Table 8). The EISC is one of the essential items that is required for the Risk Matrix.

The EISC for the Olifants River at Visgat Farm was set as “High”.

Table 8 EISC for the Olifants River at Visgat Farm

Determinant	Score	Confidence
Rare and endangered species	4	4
Populations of unique species	3	4
Species / Taxon richness	3	4
Diversity of habitat	2	4
Migration Route/ Breeding and feeding site for wetland species	4	4
Sensitivity to water quality changes	4	4
Flood storage, energy dissipation, particulate / element removal	4	4
Protection status	3	4
Ecological integrity	3	4
Average	3.3	

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.

14 Impact Assessment

Some of the authorities, such as DEADP and CapeNature, 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 indicates that the mitigating measures can be successfully implemented. It will, however, take a major effort from the engineering consultant, the contractor and the ECO, along with interest and focus from the company directors.

The impact of the orchards stretches beyond the construction phase. The operational phase is regarded as permanent, with impacts stretching far beyond that of the

Table 9 Impact Assessment

Description of impact **Construction of new bridge** Diverting the flow Preparing the riverbed Placement of the concrete foundation Placement of the culverts Construction of ramps Washing down of mud, sediments and debris down the river Impact on water quality Impact on aquatic habitat Mitigation measures Work must be done during the dry season, low flow conditions Downstream placement of sediment containing measures Due diligence to limit sediments washing down the river Vegetation of ramps and shoulders								
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	Site specific	Low	Short term	Low	Definite	Sure	Reversible	Replaceable

construction phase. Visgat is a state-of-the-art farming operation and current environmental monitoring indicates that the impact is limited. There is no reason to believe that this effort will be upheld and even improved upon.

Description of impact

Construction of 3 new road sections

Blasting and excavation
Removal of blasted material
Transport of gravel
Preparing gravel road surface
Construction of stormwater management infrastructure

Washing down of mud, sediments and debris down the river
Impact on water quality
Impact on aquatic habitat

Mitigation measures

Work must be done during the dry season, low flow conditions
Downstream placement of sediment containing measures
Due diligence to limit sediments washing down the river
Limit footprint

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	Site specific	Low	Short term	Low	Definite	Sure	Reversible	Replaceable

Description of impact

Operation of 3 new road sections

Wear and tear on gravel roads

Washing down of mud, sediments and debris down the river
Impact on water quality
Impact on aquatic habitat

Mitigation measures

Maintain the road surface
Maintain storm water management infrastructure
Due diligence to limit sediments washing down the river

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

Description of impact

Establishment and replanting of 3 orchards

Tilling / ripping the land
Preparing the land
Construction of trellis
Planting trees
Operation of the orchards

Washing down of mud, sediments and debris down the river
Impact on water quality
Impact on aquatic habitat

Mitigation measures

Work must be done during the dry season, low flow conditions
Stay out of the riparian zone
Limit the footprint to the demarcated agricultural land

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

Description of impact **Operation of the 3 orchards** Agricultural return flow Agrichemicals in river Impact on water quality Impact on aquatic habitat Mitigation measures Install state-of-the-art soil moisture measurement equipment Prevent agricultural return flow Prevent over-irrigation								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Local	Medium	Long term	Medium	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Site specific	Low	Long term	Low	Definite	Sure	Reversible	Replaceable

15 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 22.5, p59, 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 p60 to derive at a value for Significance. The value for Significance can subsequently be evaluated according to Table 22.5.2.

Table 22.5.2 provides a yardstick for decision-making to allow or disallow a development with its concomitant impact on the environment.

The scores for the Olifants River at Visgat Farm 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.

Table 10 Significance Score

Parameter	Score
Conservation value	4
Likelihood	3
Duration	5
Extent	1
Severity	1
Significance	40

This is a combined score. All parts of the project are considered, the new bridge, road sections and the orchards. The impact will be greatest when during the construction phase, with the most change that mud and silt will wash down the river. These impacts will not be permanent. Once construction ceased, during the operational phase, it is expected that the impact will stabilize to where it was much prior to construction. The numerical significance score is given for the operational phase.

The score indicates that the significance is Medium/Low, with a temporary impact at the construction site. It is expected that the significance during construction will be higher, in the order of Medium/High, but will move to acceptable levels as construction activities are wound down.

16 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 11 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report.

The flow diversion for the construction of the new bridge will be temporary, only during the initial construction phase. A pulse of mud and sand flowing down the strongly flowing river can be expected during this phase. This can be mitigated with sandbags, straw bales and barriers aimed at containing the impact, as is best engineering practice. This impact will be measurable at the construction site and directly downstream but will dissipate immediately after ceasing construction. It is the long-term impact that is of more concern, with the possibility of a perpetual release of mud and sand into the river. In the interest of conciseness, a weighted average is given, with the emphasis on the long-term impact. It makes sense because the construction

Table 11 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Construction of the new bridge Operation of the bridge	Clearing of the riverbed Diverting the flow Placement of the foundation Placement of the culverts Construction of the ramps Vegetate the ramps	Washing down of sediments and debris down the river Destruction of aquatic habitat	51	Low
2	Construction of 3 road sections Operation of road sections	Blasting and earth-moving Transport of blasted material Preparation of the road surface Construction of stormwater infrastructure	Washing down of sediments and debris down the river Destruction of aquatic habitat	54	Low
3	Operation of the 3 new road sections	Runoff from road into streams and river	Destruction of aquatic habitat	54	Low
4	Establishment of 3 replanted orchards	Ripping of the land Preparing the orchards Construction of trellis and irrigation Planting of trees Operation of the orchards	Washing down of sediments and debris down the river Agrichemicals in the river Destruction of aquatic habitat	54	Low
5	Operation of 3 replanted orchards	Runoff from orchards into river	Pollution Agrichemicals	54	Low

Table 11 Continued Risk Matrix

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	2	1	1	1	1.25	1	2	4.25
2	2	1	2	1	1.5	1	2	4.5
3	2	2	1	1	1.5	1	2	4.5
4	1	2	1	2	1.5	1	2	4.5
5	1	2	1	2	1.5	1	2	4.5

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1	5	1	5	1	12	51	Low
2	5	1	5	1	12	54	Low
3	5	1	5	1	12	54	Low
4	5	1	5	1	12	54	Low
5	5	1	5	1	12	54	Low

and long-term impact is the same, the washing down of sand and sediments down the river.

The Risk Matrix indicates that a General Authorization is the correct level of authorization.

17 Resource Economics

The goods and services delivered by the environment, in this case the Olifants River at the Visgat Farm, 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 20) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 12.

Table 12. 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	2
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 most services rendered to maximum capacity.

The proposed developments on Visgat Farm are not about to take away or reduce any of the rendered ecological services.

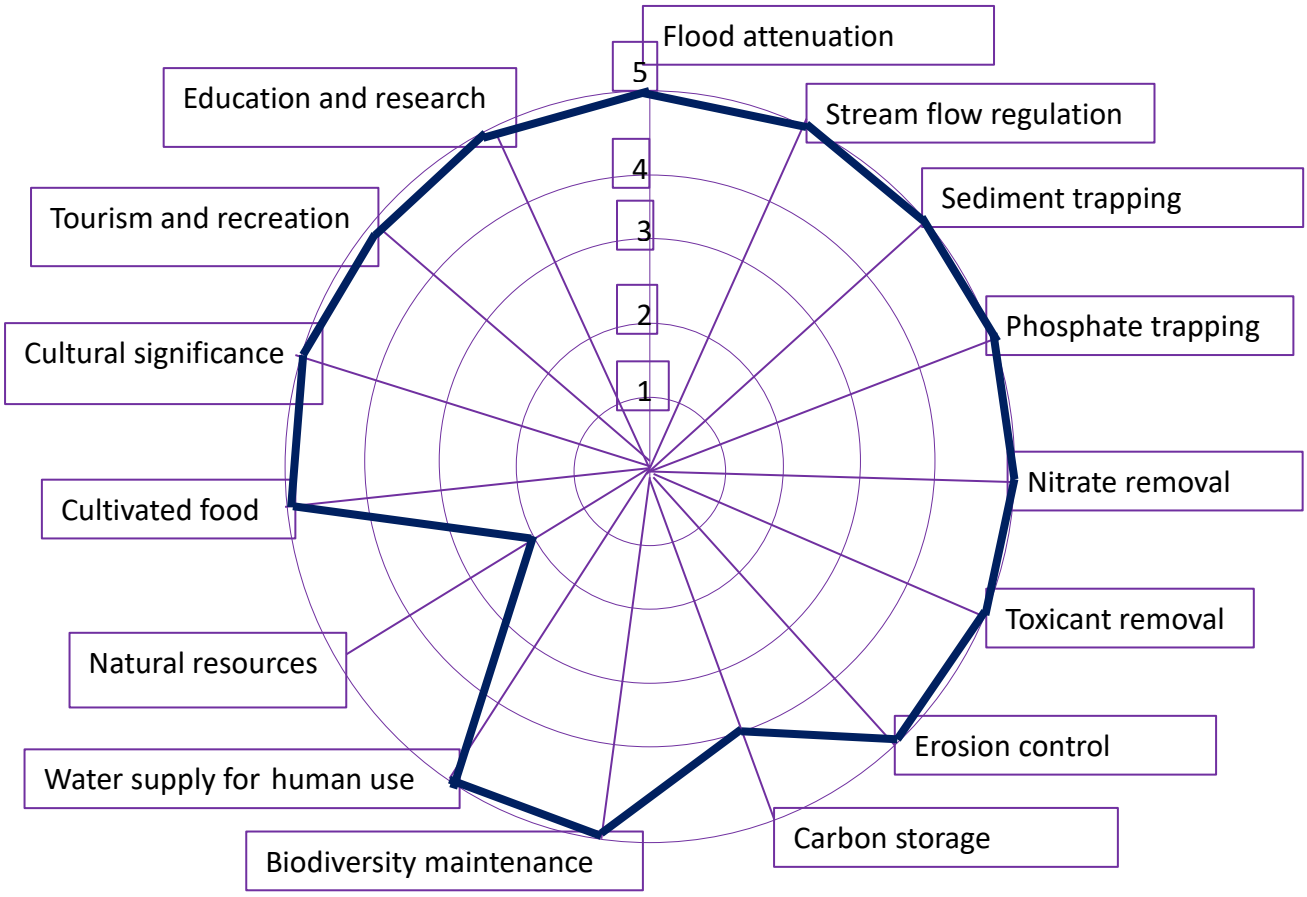


Figure 20. Resource Economics Footprint of the Olifants River at the Visgat Farm site

18 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 21). The WULA and the EAI must provide mitigation measured for these impacts.

Figure 21 has been adapted from one of the most recent DWS policy documents.

The driver of the river is the massive rainfall on the high peaks and ridges of the mountains on both sides of the valley. This rainfall assures a flow throughout the year, with a high peak flow during the rainy winter months. A relatively small downpour is required for the river to overtop the existing bridge.

The top half of the upper Olifants River catchment is highly developed, with a large-scale fruit farming industry and with a significant water need for the irrigation of crops. This is in the high sponge area of the catchment, just below the source of the Olifants River. The mountain sides and the lower part of the Witzenberg Valley are still pristine

and near pristine which allows for a significant un-impacted runoff that ameliorates the agricultural impact. This is evident from the biomonitoring results at Visgat Farm. This will remain the situation as long as conservation authorities curb the establishment of more fruit farms in the pristine areas.

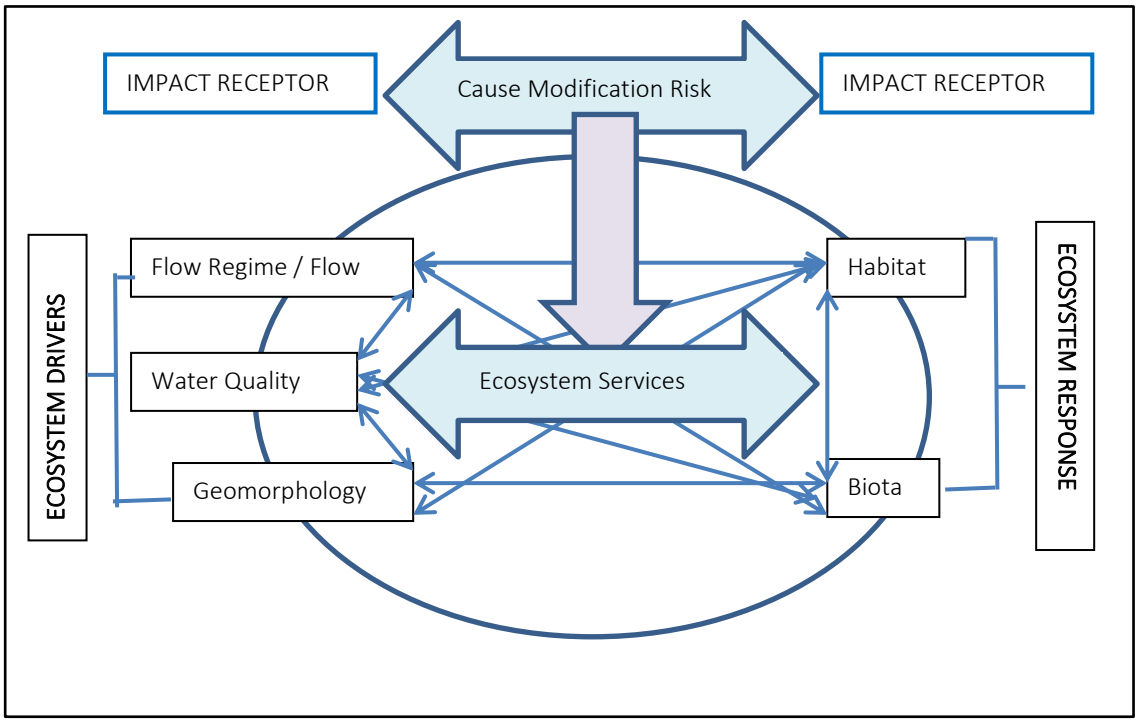


Figure 21 Minimum Requirements for a S21(c) and (i) Application

The impact of the proposed new bridge, the new road sections and the replanted orchards during construction will be short-lived, with mud and sand washing down the river. This can be contained to some extent. Given the strong flow in the river, the mud will be washed away, with no lasting impact. The long-tem impact is of more concern, with the possibility of a perpetual release of mud, sand and agrichemicals into the river. This can be prevented with proper mitigating measures, due diligence and state-of-the-art technology. Visgat Farm is such an establishment, with high level of management and a proven track record.

It is expected that the proposed developments on Visgat Farm will not alter or lower the ecological service rendered by the uppper Olifants River. On the long-term, the services will very much stay the same.

The Olifants River at Visgat is rated as ecologically sensitive. It is ecologically important because of the fish community. The DEA screening tool indicated a high and very high sensitivity. The conservation value is high, but because of the low impact of the envisaged developments at Visgat, the numerical significance was Medium / Low. Despite of the ecological sensitivity, the development can go ahead, according

to these findings, provided that the level of management remain high and provided that mitigating measurers are strictly applied.

The Risk Matrix indicates that the ecological risks to the aquatic environment are at the high end of the “Low” category. The risks are acceptable.

It is therefore recommended that the proposed developments are authorized. A General Authorization is the correct level of authorization. A License is not called for.

19 References

Department of Water Affairs and Forestry. 2006. *State of the River Report. Olifants Doring.* DWAF, Pretoria.

Dickens, CWS & PM Graham. 2002. *The South African Scoring System (SASS) Version 5 Rapid Bioassessment Method for Rivers*. African Journal of Aquatic Science

Kleynhans, C.J. 1999. *Assessment of Ecological Importance and Sensitivity*. Department of Water Affairs and Forestry. Pretoria.

Kotze, G., G. Marneweck, A. Batchelor, D. Lindley & Nacelle Collins. 2009. *A technique for rapidly assessing ecosystem services supplied by wetlands.* Water Research Commission, Pretoria.

Mucina, L. & M.C Rutherford. 2006. The vegetation of South Africa, Lesotho and Swaziland. SANBI, Pretoria.

20 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:  23 November 2021

21 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
- Freshwater Report New Wave Dam, Klawer

22 Appendix

22.1 Engineering Report

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Reference: 2133WC-Route Options
Date: 4 October 2021

Alphabec

Att: To Whom it may concern

gerbrandt@alphabec.co.za

DOORNKRAAL VISGAT FARM GRAVEL ROAD UPGRADE: SUMMARY OF CONCEPT OPTIONS

This letter is to provide an overview and summary of the three options tabled for the Doornkraal Visgat farm gravel road upgrade.

1. Introduction

Doornkraal Visgat farm is an apple farm situated to the North of Prins-Alfred Hamlet, Western Cape, next to the Olifantsriver.

The gravel access road presents challenges to get the produce from the farm with interlink trucks due to the size of the road and mainly numerous sharp corners. This has a major effect on the productivity and profitability of the farm.

To address this, the owner of the farm proposes to upgrade the road to better suite the transportation of the harvest and increase the productivity of the farm.

The Olifantsriver is to the West of the existing road with some smaller streams to the East mouthing in the Olifantsriver. The road thus crosses a few streams.

The undisturbed vegetation surrounding the road is mostly Fynbos. The soil classification involves a lot of hard rock and boulders.



2. New Route Proposed Options

Three proposed routes are proposed and summarized below. Also refer to drawings 2133WC-C-100 to 102.

The existing road will remain and used as alternative route when maintenance must be done, this will include the existing water crossings.

Replacement of the existing bridge

For all three options the major water crossing (bridge) over the Olifantsriver to the North of the existing road will be replaced. The existing bridge is in a poor condition and poses a major functional and safety risk. During the winter months when rain and/or snow fall have occurred the bridge floods rendering it inaccessible. This is seen as a major safety risk whilst continuous damage to the bridge will inevitably result in the bridge failing.

The replacement of the bridge will be done using pre-cast concrete culverts placed upstream of the existing one, founded on the river rock near or at the surface. The width of the new bridge will be in the range of 7.5m. To prevent the new bridge from flooding and allow access all year round the top of the bridge level will be raised by 500 to 750mm compared to the existing.

Using pre-cast elements to construct the bridge is considered the most environmentally friendly and economical solution. Minimal mixing and/or casting of concrete will be done during construction eliminating the possible impact on the surrounding undisturbed environment.

During construction careful attention will be given to prevent the river overflowing or damaging the undisturbed embankments.

General repairs to the existing road

Further to the rerouting of the existing road, maintenance and making good of the existing is also planned. This will involve repairing of existing water crossings, constructing more drainage systems diverting water away from the road surface (i.e. mitre drains) and adjusting some of the existing levels to minimize steep hills minimizing rutting.

Option 1

- Quantity of diversions – 4.
- Quantity of new water crossings – 2.
- Estimated total length of upgrade – 675m.

This option is considered as the least intrusive of the environment with only small sections rerouted, mainly where there are sharp corners restricted the movement of the transport vehicles.

The total length of new road sections required is the shortest of the three options resulting in the most economical option.

This option is based on the idea that most of the existing road will remain in use with minimal rerouting.

Option 2

- Quantity of diversions – 3.
- Quantity of new water crossings – 3.
- Estimated total length of upgrade – 1 325m.

This option is considered as the most intrusive of the environment with most of the existing road abandoned to create the most direct route to the farm.

The total length of new road sections required is the longest of the three options resulting in the least economical option. This involve significant earthwork to be done and importation of fill material to construct the road.

This option is based on the idea to create the most direct route greatly benefitting the transportation of goods.

Option 3

- Quantity of diversions – 2.
- Quantity of new water crossings – 4.
- Estimated total length of upgrade – 1 180m.

This option considered the benefits of both Options 1 and 2 – shortest route to for the transportation of goods, economical factor, and impact on the environment.

The total length of new road sections required is almost double that of Option 1, yet some 145m (11%) shorter than Option 2. The economical factor for this option is expected to be like that of Option 2.

This option will also involve significant earthwork to be done and importation of fill material to construct the road.

3. CONCLUSION

Option 1 will have the least amount of impact on the environment and is the shortest route and is the most economical solution of the three.

Options 2 and 3 will involve significant earthworks and importation of fill material with the greatest impact on the environment. These options are expected to have a similar economical impact and be significantly greater than Option 1.

Our recommendation is to proceed to detail design and construction of Option 1.

We trust this information will meet your requirements, but do not hesitate to contact us if any additional information is required.

Yours Sincerely,

Josia Frick [PrEng. 202001398]
Technical Director
EnginX Consulting (Pty) Ltd

22.2 Winterhoek Sandstone Fynbos

VT 69 Macchia (100%) (Acocks 1953). Mesic Mountain Fynbos (89%) (Moll & Bossi 1983). LR 64 Mountain Fynbos (90%) (Low & Rebelo 1996). BHU 51 Groot Winterhoek Mountain Fynbos Complex (59%) (Cowling et al. 1999b, Cowling & Heijnis 2001).

Distribution Western Cape Province: Groot Winterhoek Mountains from Dasklip Pass in the north to Saronsberg and Nuwekloof Pass, including the Witsenberg and Skurweberge (west of Gydo Pass) (which encircle a large patch of FFh 1 Kouebokkeveld Shale Fynbos in the Agter-Witsenberg) to the vicinity of Ceres and including the Gydo, Waboom, Vaalkloof and Houdenbek Mountains in the east. Altitude 350–1 800 m. (The highest peaks of the Groot Winterhoek Mountains bear vegetation of FFs 30 Western Altimontane Sandstone Fynbos.)

Vegetation & Landscape Features Moderately undulating high plain in the west, with rugged high peaks in the south and southeast, and two linear parallel north-south high mountains in the east, dissected by the Olifants River Valley. The eastern blocks are relatively flat, south- and north-sloping, dissected tablelands. Vegetation is mainly closed restioland in deeper moister sands, with low, sparse shrubs that become denser and restios less dominant in the drier habitats. Proteoid and ericaceous fynbos are found on higher slopes while asteraceous fynbos is more common on lower slopes. Cape thicket is prominent on the lowest slopes.

Geology & Soils Acidic lithosol soils derived from Ordovician sandstones of the Table Mountain Group (Cape Supergroup). Land types mainly Ic, Fa and Ib.

Climate MAP 370–1 350 mm (mean: 790 mm), peaking markedly May to August. Southeasterly cloud occasionally brings heavy mist precipitation at higher altitudes in summer. This is the wettest of the northern Sandstone Fynbos types. Mean daily maximum and minimum temperatures 26.7°C and 3.1°C for February and July, respectively. Frost incidence 10–30 days per year. See also climate diagram for FFs 5 Winterhoek Sandstone Fynbos (Figure 4.21).

Important Taxa ([W]Wetlands) Small Tree: *Protea nitida* (d). Tall Shrubs: *Protea repens* (d), *Aspalathus aemula*, *A. linearis*, *Euryops abrotanifolius*, *E. serra*, *E. speciosissimus*, *E. tenuissimus* subsp. *trifurcatus*, *Leucadendron rubrum*, *Metalasia muraltiifolia*, *Protea laurifolia*. Low Shrubs: *Ursinia pinnata* (d), *Aspalathus argyrella*, *A. commutata*, *A. filicaulis*, *A. perfoliata* subsp. *perfoliata*, *A. perforata*, *A. pinea* subsp. *pinea*, *A. retroflexa* subsp. *angustipetala*, *A. rugosa*, *A. rupestris*, *A. ulicina* subsp. *ulicina*, *A. villosa*, *Erica parilis*, *E. rigidula*, *E. tenuis*, *E. totta*, *Euryops rupestris* var. *dasycarpus*, *Leucadendron arcuatum*, *L. glaberrimum* subsp. *erubescens*, *L. salignum*, *Metalasia rogersii*, *Paranomus lagopus*, *Passerina nivicola*, *Phylica chionocephala*, *P. obtusifolia*, *Protea acaulos*, *P. effusa*, *P. nana*, *P. pendula*, *P. piscina*, *P. pityphylla*, *P. recondita*, *P. witzenbergiana*, *Serruria cygnea*, *S. effusa*, *Sorocephalus lanatus*, *Spatalla caudata*[W], *Ursinia coronopifolia*, *U. punctata*. Pseudocarnivorous Shrub: *Roridula dentata*. Herb: *Ursinia sericea*. Geophytic Herbs: *Geissorhiza bolusii*[W], *G. intermedia*, *G. ovalifolia*, *G. ovata*, *G. parva*, *G. ramosa*, *G. scillaris*, *Romulea saxatilis*. Graminoids: *Cyathocoma ecklonii*[W], *Elegia macrocarpa*.

Endemic Taxa ([W]Wetlands) Low Shrubs: *Agathosma alligans*, *A. cordifolia*, *Aspalathus corniculata*, *A. empetrifolia*, *A. fasciculata*, *A. juniperina* subsp. *gracilifolia*, *A. suaveolens*, *A. sulphurea, Capelio tomentosa*, *Disparago gongylodes*, *Erica amalophylla*, *E. greyi*, *E. irrorata*, *E. leucosiphon*, *Euchaetis ericoides*, *E. esterhuyseniae*, *Euryops longipes* var. *lasiocarpus*, *Lachnaea villosa*, *Leucadendron diemontianum*, *L. gydoense*, *Macrostylis barbigera*, *M. ramulosa*, *Metalasia juniperoides*, *M. serrulata, Pelargonium capillare*, *Phylica alticola*, *P. bolusii*, *P. nervosa*, *P. salteri*, *P. trachyphylla*, *Prismatocarpus implicatus*, *Selago valliscitri*, *Serruria reflexa*, *Sheilanthera pubens*, *Sorocephalus scabridus*, *Spatalla tulbaghensis*, *Stoebe montana*, *Thamnea hirtella*, *Thesmophora scopulosa*, *Wahlenbergia brachyphylla*. Succulent Shrubs: *Lampranthus antonii*, *L. microsepalus*, *Oscularia guthriae*, *Ruschia intermedia*. Herbs: *Centella umbellata*, *Globulariopsis obtusiloba*, *Lotononis laticeps*, *Pseudoselago quadrangularis*, *Steirodiscus gamolepis*, *Trieenea frigida*, *Vellereophyton felinum*, *V. lasianthum*, *Zaluzianskya isanthera*. Geophytic Herbs: *Disa introrsa*, *Geissorhiza esterhuyseniae*, *Romulea albomarginata*, *Tritoniopsis lesliei*[W]. Succulent Herb: *Crassula alcicornis*. Graminoids: *Carpha schlechteri*, *Isolepis minuta*.

Conservation Least threatened. Target 29%. Statutorily conserved (24%) in the Grootwinterhoek Wilderness Area, with an additional 59% protected in private reserves such as Koue Bokkeveld and Winterhoek. Only 5% transformed (cultivation: protea nurseries and fruit orchards). Aliens *Pinus radiata*, *P. pinaster* and *Hakea sericea* are scattered. Erosion very low.

Remarks Groot Winterhoek is a poorly studied region, mainly due to difficulty of access. The fynbos on quartzite of Gydoberg, Waboomsberg and Houdenbeksberg have been included in this type based on the distribution of proteas—these are wetter than normal quartzite and their floras appear to be more similar to Winterhoek Sandstone Fynbos than to FFq 2 Swartruggens Quartzite Fynbos.

References Boucher (1987, 1990, 1996a, 1997c, 2000), Rourke (1993).

22.3 Biomonitoring score sheet

SASS5 Score Sheet										
Date	09 Oct 21	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Olifants River	Porifera	5		**Hemiptera**			**Diptera**		
	Visgat	Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3	3	Corixidae	3		Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5	5	Ceratopogonidae	5	
Coordinates	33°04' 35.84S"	Huridinea	3		Hydrometridae	6		Chironomidae	2	2
	19°13'00.69"	**Crustacea**			Naucoridae	7	7	Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	8.0	Potamonautidae	3		Notonectidae	3		Empididae	6	
Temperature °C	14.5	Atyidae	8		Pleidae	4		Ephydridae	3	
pH	6.6	Palaemonidae	10		Veliidae	5	5	Muscidae	1	
EC mS/m	3.4	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	5
SASS5 Score	83	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	15	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	4	Ancylidae	6	
	Tadpoles	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	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	11	Corbiculidae	5	
		Trichorythidae	9		Hydroptilidae	6		Sphariidae	3	
		Odonata			Hydrosalpingidae	15		Unionidae	6	
		Calopterygidae	10		Leptostomatidae	10				
		Clorocyphidae	10		Leptoceridae	6	6			
		Chorolestidae	8		Petrothrincidae	11				
		Coenagrionidae	4	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	6	Haliplidae	5				
		Libellulidae	4		Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5	5			
					Limnichidae	10				
					Psephenidae	10				
Score				28			48			7

22.4 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 22.4.1 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 22.4.2 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 22.4.3 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 22.4.4 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.

Table 22.5 Numerical Significance

Table 22.5.1 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 22.5.2 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 22.5.3 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)

22.6 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