Bass Diii Berries (Pty) Ltd

Private Bag X3036
Western Cape
Paarl
7620

PROPOSED NEW FARM DAM
on
PORTION 12 OF THE FARM SCHERPEN HEUVEL 481, WORCESTER

FRESH WATER REPORT

WATER USE LICENSE APPLICATION

A requirement of Section 21 of the National Water Act (36 of 1998)

November 2020

EnviroAfrica
Environmental Management and Impact Assessment
Omgewingsbestuur en Impakbeoordeling

WATSAN Africa

Index

List of Figures

List of Tables

Abbreviations

Average Score per Taxon	ASPT
Critical Biodiversity Area	CBA
Department of Environment, Fisheries and Forestry	DEFF
Department of Environmental Affairs and Development Planning	DEA&DP
Department of Mineral Resources	DMR
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Management Plan	EMP
Environmental Impact Assessment	EIA
Electronic Water Use License Application (on-line)	eWULAA
Government Notice	GN
Metres Above Sea Level	masl
National Environmental Management Act (107 of 1998)	NEMA
National Freshwater Environment Priority Area	NFEPA
National Water Act (36 of 1998)	NWA
Present Ecological State	PES
Section of an Act	S
South Africa National Biodiversity Institute	SANBI
South African Scoring System version 5	SASS5
Water Use License Application	WULA

1 Introduction

Bass Diii (Pty) Ltd, the owner of the Farm Scherpen Heuvel 481 possesses an existing legal water use of 1 125 076m^3 for the irrigation of 130 hectares, endorsed by the Central Breede River Water Users Association. As all along the length of the Breede River, farming operations require water for irrigation during the dry summer months, when agricultural products grow and ripen for harvesting. This is a time when the flow in the Breede River is low, with periods of no flow, standing water. Recent droughts emphasised the sequence of events, a dilemma which would probably deepen as a result of climate change. During the rainy winter season, when high rainfall events occur, peak flows down the river are massive. For the sustainability and growth for the regional agricultural industry is has become necessary to construct dams to store a part of this high flow for use later in the season.

Bass Diii is not any different. Hence the owners decided to construct a new dam on the property.

A dam of this proportion requires an EIA, in terms of the NEMA. Enviro Africa of Somerset West has been appointed to conduct the EIA. The concomitant public participation has already been initiated (Figure 1). The on-site posters have been put up.

Likewise, the dam requires a S21 (c) and (i) WULA in terms of the NWA. Subsequently Enviro Africa appointed Dr Dirk van Driel of WATSAN Africa in Cape Town to produce the Fresh Water Report that is required for the WULA.

The contents and format of the Fresh Water Report has been developed over a number of years and over many WULA's, according to the minimum requirements of the DWS. It has to contain a Risk Matrix, as specified by GN267 of 2017.

The Fresh Water Report contains an Impact Assessment as well, to answer to the requirements of the EIA, according to a premeditated methodology.

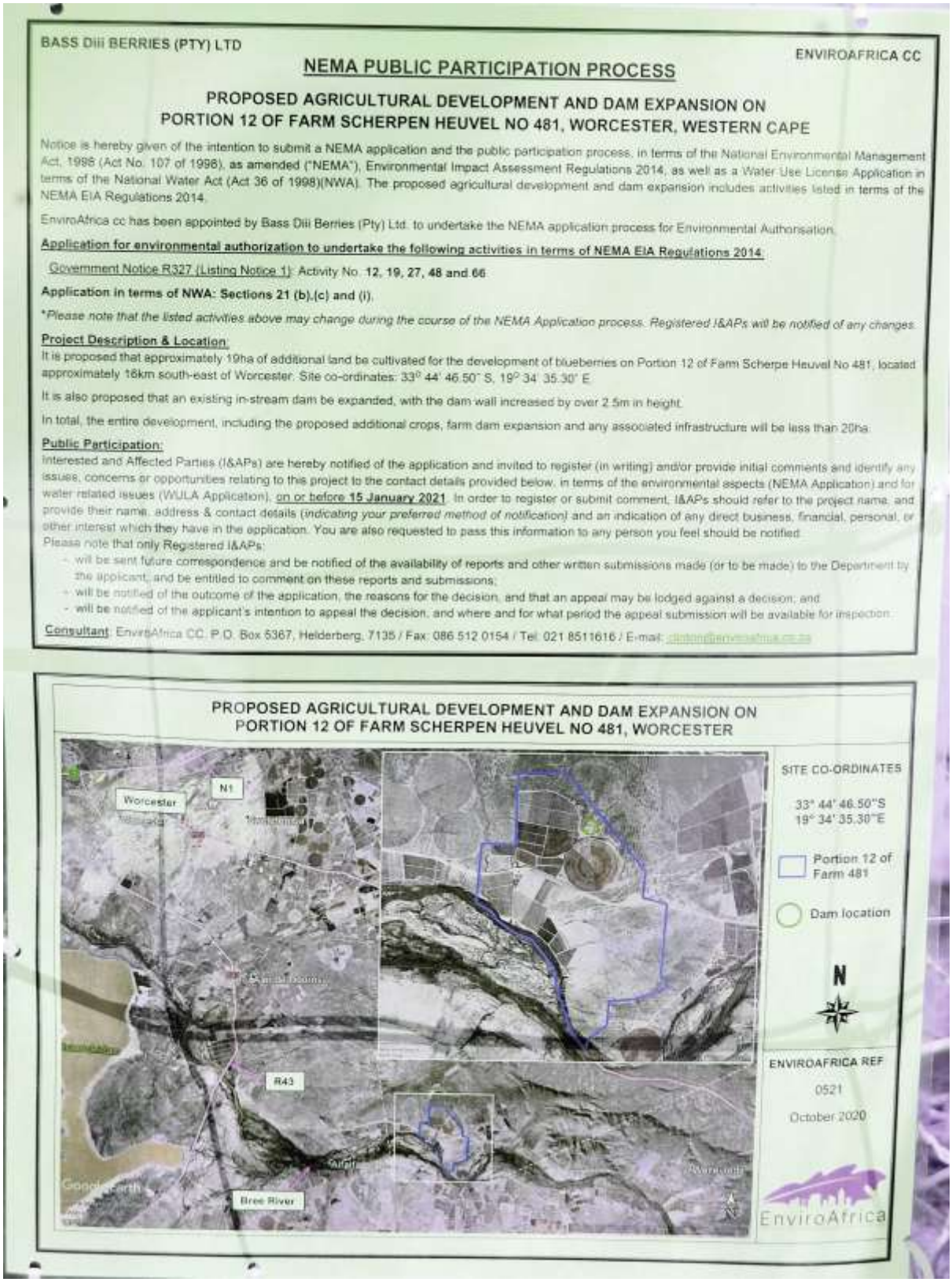


Figure 1 Public participation

2 Legal Framework

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

S21 I *Impeding or diverting the flow of a water course*

The proposed farm dam would be constructed across a water course. The flow will be impeded.

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

The proposed farm dam would alter the characteristics of the water course.

Government Notice 267 of 24 March 2017

Government Notice 1180 of 2002. *Risk Matrix.*

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

Government Notice 509 of 26 August 2016

An extensive set of regulations that apply to any development in a water course is listed in this government notice in terms of Section 24 of the NWA. No development take place within the 1:100 year-flood line without the consent of the DWS. If the 1:100-year flood line flood line is not known, no development may take place within a 100m from a water course without the consent of the DWS. Likewise, no development may take place within 500m of a wetland without the consent of the DWS.

This report deals with S21 (c) and (i) of the NWA.

National Environmental Management Act (107of 1998)

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

3 Climate Worcester

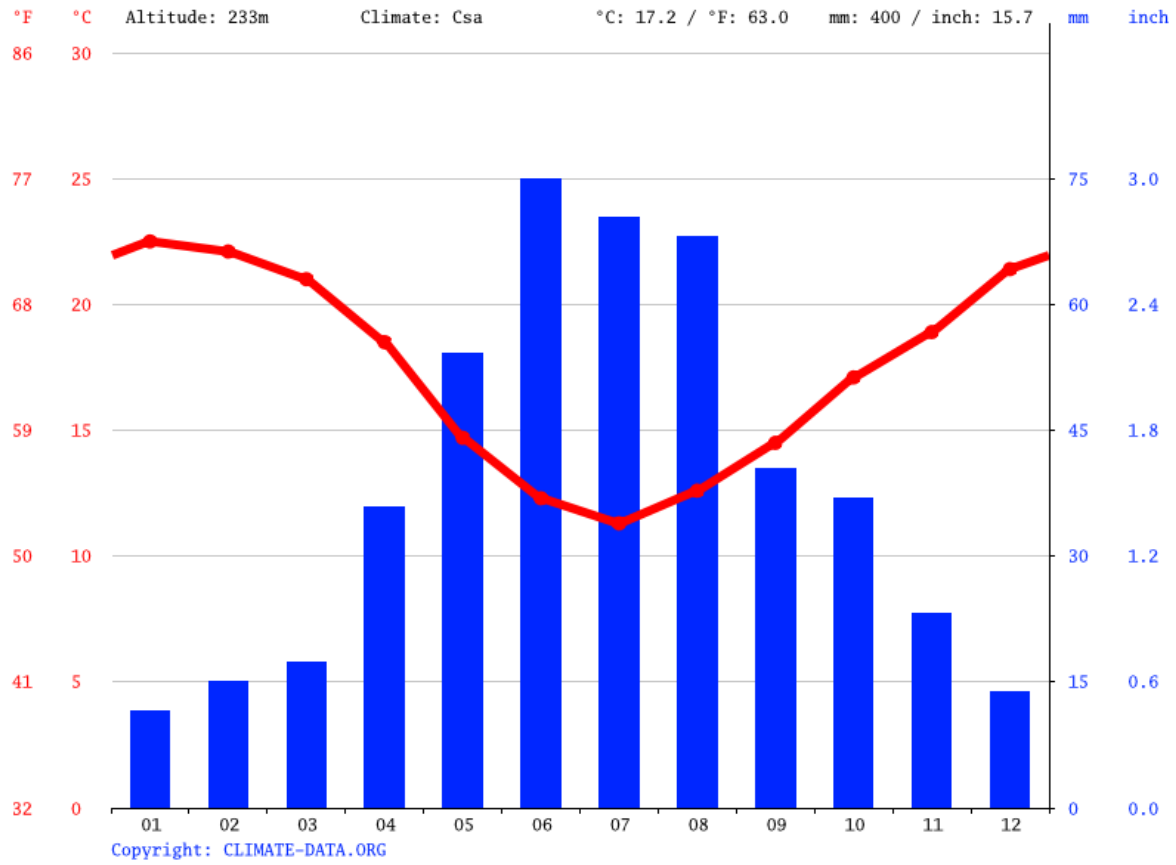


Figure 2 Worcester Climate

Worcester is the closest locality to Farm Scherpen Heuvel for which climate on-line data is available (Figure 2).

Precipitation is the lowest in January, with an average of 10 mm. Most of the precipitation here falls in June, averaging 65 mm. With long, dry summers and most rain in winter, the climate can be defined as Mediterranean. Summer is marked by midday temperatures of over 40°C, with hot, desiccating winds. Summer rainfall is too low to support permanent crops such as fruit, berries and grapes and is entirely dependent on irrigation out of the Breede River.

Worcester and surrounds are marked by ranges of the Cape Folded Mountains. On the high ground, ridges and peaks of over 2000masl, rainfall is significantly higher than on the low land of the Breede River valley at some 200masl. The rainfall on the mountains can top 1500mm per year and is responsible for the winter peak flow down the river. It is this part of the flow that can still be stored and utilized for irrigation during the dry season.

During summer the river shrinks to a “saline trickle”, sometimes without flow at all, with water not fit for agriculture.

4 Quaternary Catchment

Scherpen Heuvel Farm is in the H40F quaternary catchment.

5 Locality

Figure 3 Locality

Scherpen Heuvel Farm is located on the northern bank of the Breede River, 16km to the south east of Worcester and 30km to the north west of Roberson, as the crow flies (Figure 3).

The new dam wall centre is at the coordinates:

33°45’01.04”S
19°34’51.04”E

6 The New Dam

Figure 4 New Dam

The dam (Figure 4) was designed by DJ Hagen & Associates, following the careful evaluation of alternative dam sites. The new dam will have a holding capacity of 300 000m^3 and will cover a surface area of 4 hectares. The dam wall will be 530m long and 18.4m high. It will be 3.3m deep on average. Much of the material for the construction of the dam wall will be sourced from the basin.

The area that is to be irrigated out of the new dam is depicted in figure 5. Blue berries will be planted on a total of 51 hectares of existing farm land. Only 6.6 virgin land will have to be cleared for new blue berry plantings.

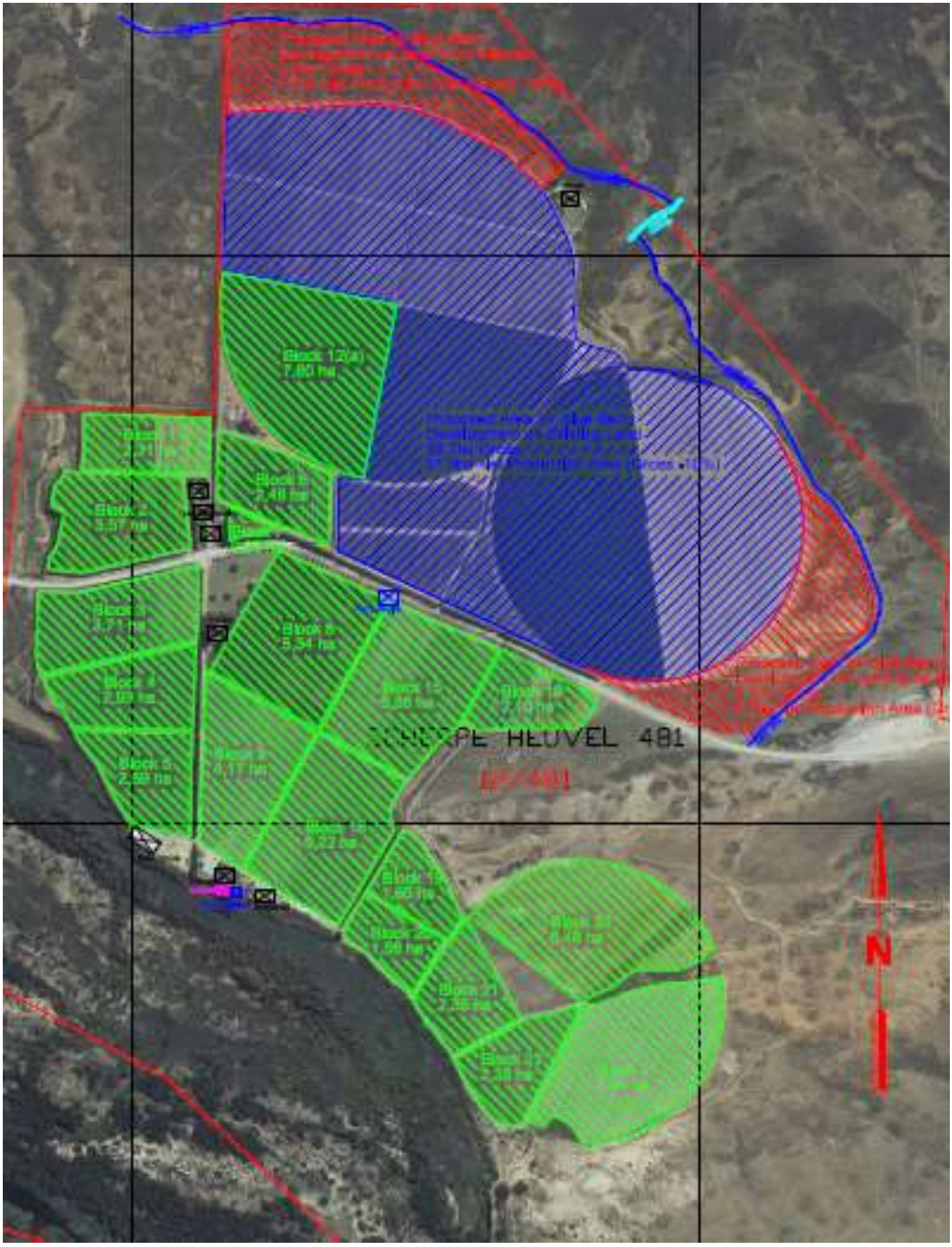


Figure 5 New blue berry hectares

7 Vegetation

Mucina & Rutherford (2006) classifies the vegetation type of the new dam's catchment area as Robertson Karoo, which is indicated as "Least Concern", even though only 16% is officially conserved and even though there is a high level of plant endemism. A species list is provided in the Appendix.

8 Conservation Status

The location where the existing dam is located is indicated as a wetland NFEPA.

9 Sub-Catchments

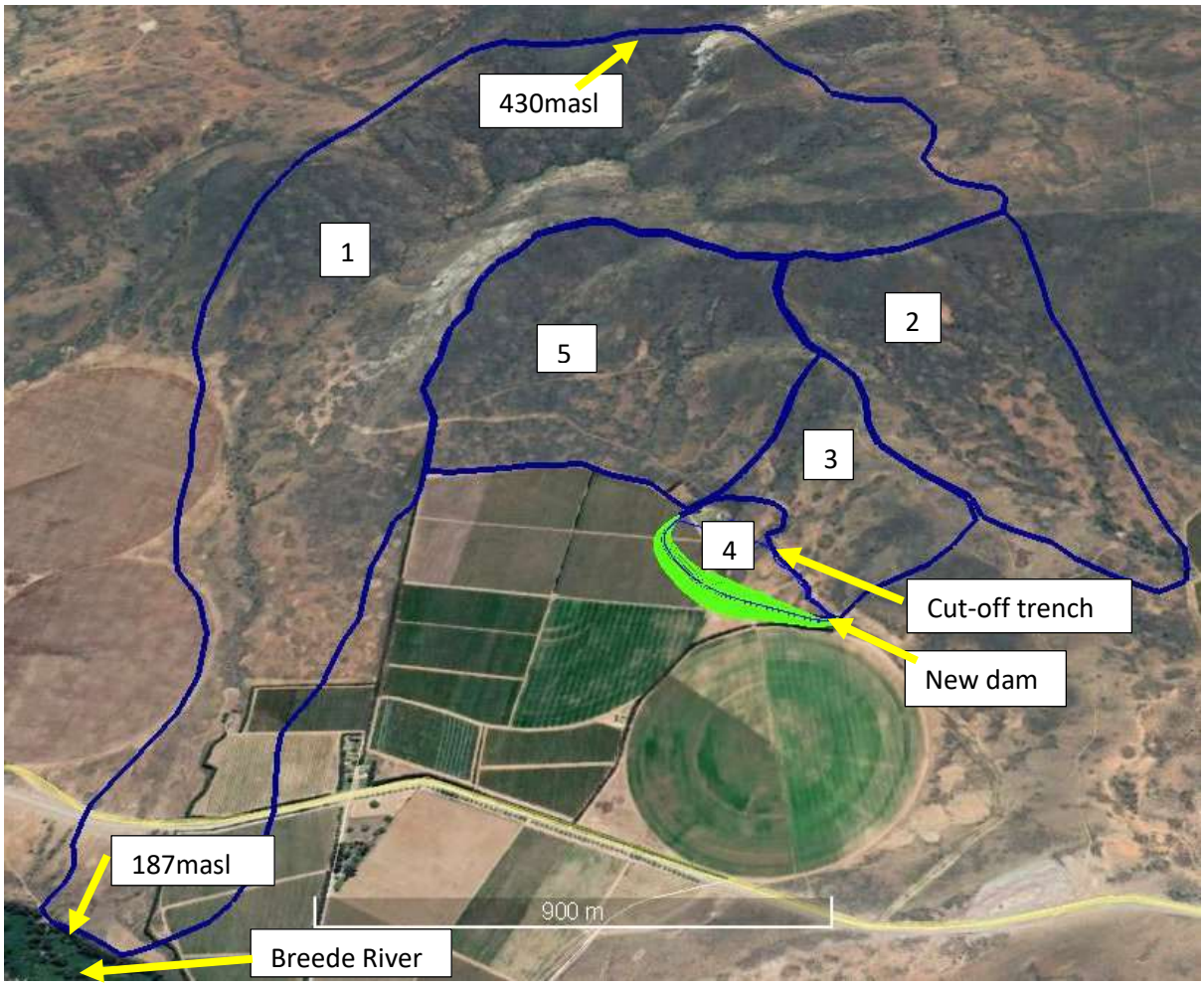


Figure 6 Sub-Catchment Area

Table 1 Sub-Catchment area

No.	Surface Area (ha)	Top elevation (masl)	Bottom elevation (masl)	Length (m)	Slope
1	187	430	186	2639	0.09
2	46	402	251	2021	0.07
3	22	335	252	695	0.12
4	5.6	266	237	245	0.12
5	51	383	244	1842	0.08

There are 5 small sub-catchments of interest in the area of the new dam on Scherpen Heuvel Farm (Figure 6). The surface area of each, as well as the highest elevation, lowest elevation, the distance from the highest to the lowest elevation as the crow flies and the slope of each catchment is given in Table 1.

Sub-catchment area No. 1 is by far the largest of the five, with a strongly defined drainage line. This drainage line was dry at the time of the site visit. Reportedly it only flows during high rainfall events and shortly thereafter.

The drainage line of Sub-Catchment 1 (Figure 7) passes underneath the dirt road to the west of Sherpen Heuvel Farm in a pipe-culvert (Figure 8). Here the drainage line had a broad bed overgrown with grasses at the time of the site visit (Figure 7). Down stream of the culvert, the drainage line is deeply incised, with barren vertical banks as a result of erosion (Figure 9). This bears testimony of a strong flow during high rainfall events.

None of the runoff from Sub-Catchment No.1 will flow into the proposed new dam.

To the north of this sub-catchment is a ridge that marks the watershed. From here storm water flows in a number of drainage lines to the north and into the Nuy River, which connects to the Breede River approximately 15km upstream of Scherpen Heuvel Farm, following the bend of the river.

None of the runoff of Sub-Catchment No.2 will end up in the proposed new dam either. The natural flow through a very faint drainage line is directed towards the south east. This drainage line ends abruptly against a large orchard of fruit trees. To the south east of this orchard is a farm dam with an overflow to a well-marked stream to the Breede River. This probably was the natural flow of this drainage line, but it seems as it had been overtaken with irrigation return-flow from the orchards.

Sub-catchment No.3 is the natural catchment area of the proposed new dam, with two faint drainage lines out of the hills to the north of the dam site (Figure 10). Together with the surface area of the proposed new dam, it covers a surface area of 22 ha.

Figure 7 Sub-catchment No.1 drainage line upstream of culvert

Figure 8 Sub-catchment 1 drainage line pipe culvert

Figure 9 Sub-catchment No. 1 drainage line downstream of culvert

Figure 10 Sub-Catchment No.3 Hills

Sub-Catchment No. 3 is cut into two parts by a trench and a berm (Figure 11) that was constructed to divert storm water out of the upper sub-catchments away from the agricultural areas. His seems like standard practice in the district, where many kilometres of these cut-off berms have been constructed. This effectively diverts any runoff away from the proposed new dam as well. The berm stretches all the way to the west to connect to Sub-Catchment No.1 and to divert any runoff into its drainage line. Likewise, to the east the cut-off trench stretches all the way to Sub-Catchment No. 2 to release any runoff into that drainage line.

Downhill from the cut-off berm, only 5.6 ha of the 22 hectares remain. This remaining area, together with the new dam's surface area, was named Sub-Catchment No. 4. This is the only portion of the sub-catchment that will carry runoff into the proposed new dam. It stands to reason that the runoff from Sub-Catchment No.4 is too little to make any measurable contribution to the filling of the new dam. The dam will be filled, according the plan, entirely from water pumped out of the Breede River.

This corresponds to the findings of Hagen (2020) in his technical report pertaining to the design of the proposed new dam.

Figure 11 Berm and cut-off trench

The average slopes down the drainage lines are steep (Table 1), between 7 and 12 vertical metres in every 100 horizontal metres, which promotes a fast runoff and a high erosion potential. The cut-off trench has been placed in such away at an elevation between 250 and 260masl over its entire length so that the slope is even and that erosion of the trench is limited.

Figure 12 Arable land with centre pivot.

Figure 13 Vineyards

Downhill from Sub-Catchment No. 3 / 4, there is arable land with a centre pivot irrigation system. This farmed land has entirely replaced any signs of drainage lines or aquatic habitat (Figure 12).

There is still patch of land between Sub-Catchment No. 1 and 3 of some 51 ha without any discernible drainage lines. This was termed Sub-Catchment No.5 (Figure 6).

Downhill it ends against the farm road and large vineyards (Figure 13). Since no drainage lines were detected during the site visit on this part of the land, it is omitted from any further discussion.

10 NFEPA

Figure 14 NFEPA

A small wetland NFEPA is listed on the SANBI BGIS webpage. It was indeed found on the exact construction site of the proposed new dam. Runoff from the sub-catchment collects behind a berm (Figure 14) next to the farm road. At the time of the site visit, there was no water and the area was overgrown with reeds.

This wetland was created by the berm and is entirely artificial. This begs the question if this indeed is a valid and ground-truthed wetland. It will be replaced, according to plan, with the new dam.

If one elects not to think along ecologically purist lines, the artificial expansion of this wetland may well be viewed as positive. Farm dams are for the most aggressive aquatic environments as it is often pumped dry at the end of the dry season, with no water left for ecological functioning. If at least some water is left in the new dam and that not all of the water is used for irrigation, it may benefit a permanent aquatic environment.

The Breede River is indicated as a NFEPA as well, as all major South African rivers are.

11 Biomonitoring

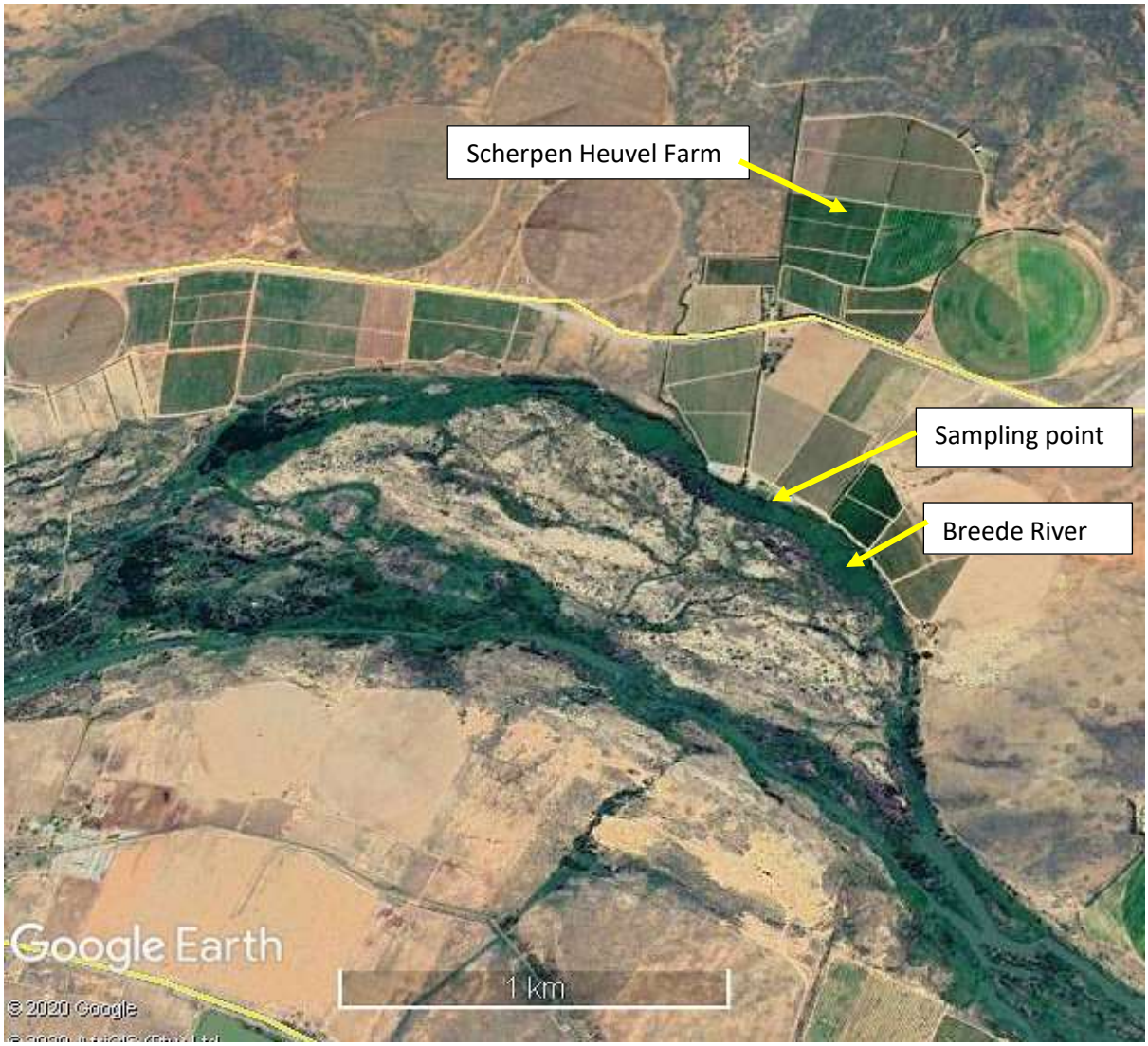


Figure 15 Sampling point

The proposed dam is close to the Breede River, only 1.1km away. Moreover, Scherpen Heuvel Farm is located right on the bank of the Breede River. Hence it is appropriate to look into the status of the Breede River.

Access to the river was limited because of the dense growth of blue gum trees and reeds. The only locality that was available is at the pump installation, where an area is kept open and free form reeds to enable the abstraction of water for the farming operation.

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

Table 2 Water Quality

Parameter	Value
Temperature °C	19.6
pH	7.3
Electrical conductivity mSm^{-1}	33.8
Dissolved Oxygen mgl^{-1}	4.2

Table 3 Biomonitoring Score

Parameter	Score
SASS5	30
Number of Taxa	8
ASPT	3.8

time for South African rivers and is widely used by the DWS and in general water resource management.

The biomonitoring was done of 19 October 2020.

The river at the sampling point (Figure 15) was braided, with an island in the middle. The sampling point was essentially a pool that was created among the dense stand of reeds. This pool was maintained and the reeds kept back to ensure a proper water feed into the pumps (Figure 16). The pool here was about 20m wide and 20 long, with no flow. The habitat consisted of emerging vegetation (reeds), submerged vegetation

(reed roots), floating vegetation (water cress), bed rock (concrete structure for the pumps) and muddy bottom. At the sampling point right at the pumps, the river was more than a metre deep, with the bank straight down, vertical. The habitat was rather limited, the available sampling site small.

Next to the sampling site very large blue gum trees were growing, with smaller trees scattered around the sampling site and all over the river.

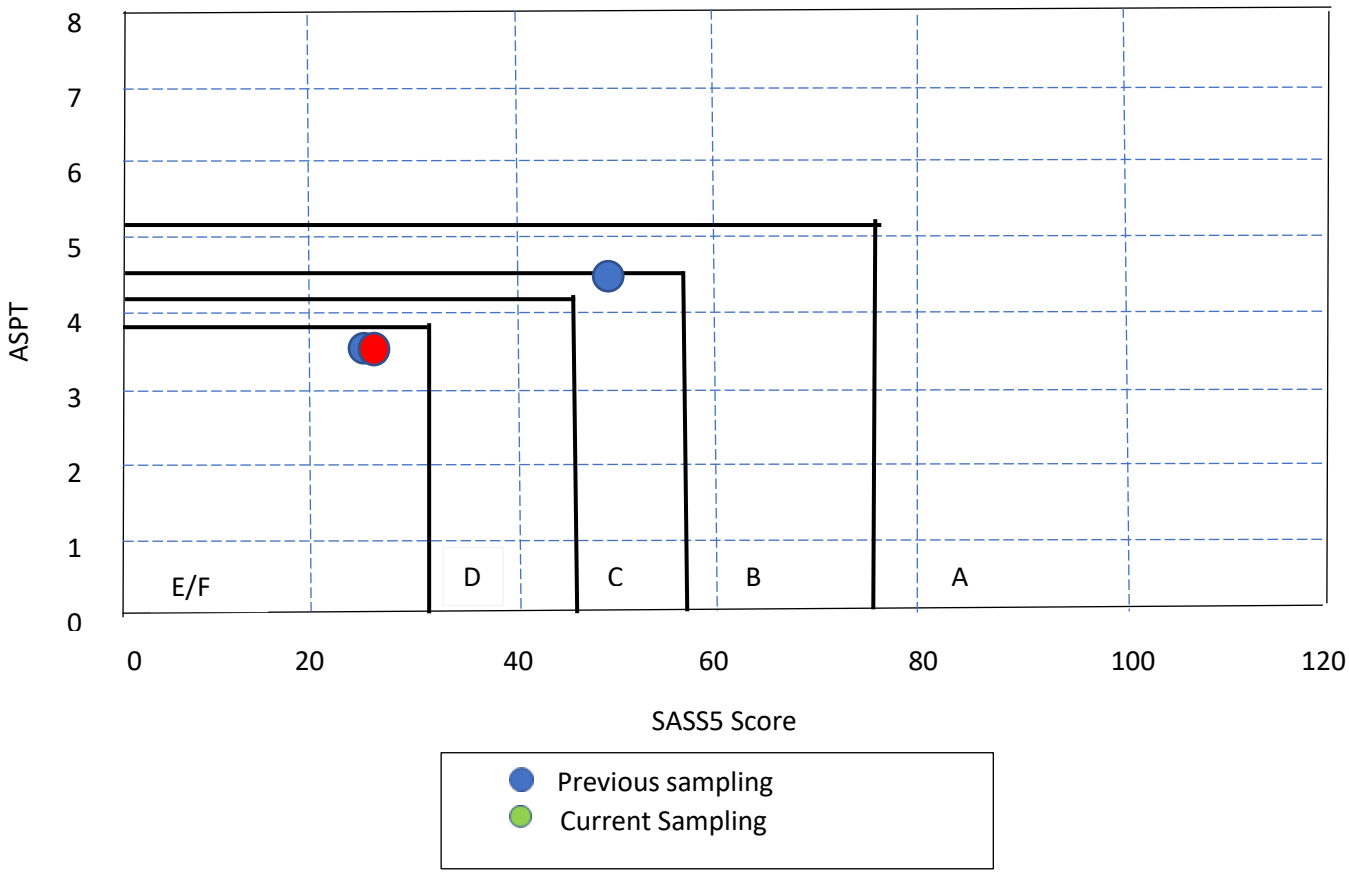
The river here is not always as placid as during sampling. During the rainy winter season, the pumps were pulled out of the river, as the water level rose substantially, with a very strong current. Two seasons ago, during the drought, the river was dry. Flow is highly variable.

The dissolved oxygen concentration (Table 2) was rather low, going down to 3.9mgl^{-1} further down and to almost zero at the bottom.

Given these aquatic habitat restraints, there were many organisms, high numbers, but all were of the low-scoring type that is often present in slow-flowing, mature rivers.

The SASS5 score (Table 3) indicates that the river at the time of sampling was in a poor state, highly impacted, class E, with much of the ecological functioning lost. This corresponds to that of another sampling point that WATSAN visited for a previous project (Figure 17) upstream from Swellendam. The score was much lower than at Bruintiesrivier, a sampling point some 70 km downstream from Scherpen Heuvel Farm (Figure 17).

Figure 16 Sampling point



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 17 Biomonitoring Results

According to the State of the River Report of the National River Health Programme in 2011 the sampling point much further downstream in the Breede River was indicated as “Fair”. The state of the river at Scherpen Heuvel is worse than what is generally observed in the Breede River.

12 Present Ecological State

The PES is a protocol that was designed by Dr Neels Kleynhans in 1999 of the then DWAF to assess river reaches (Table 4 and 5). The scores given are solely that of the practitioner and are based on expert opinion.

Table 4 Habitat Integrity according to Kleynhans, 1999

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

The upper part of the drainage line of Sub-Catchment No.1 is near-pristine, with the occasional farm animal in the hills. It is impacted by the large centre pivot irrigated farmed land in its middle reaches, as well as by the farm land on the eastern bank. The drainage line meanders and is largely left intact. The bed and the flow are interrupted by the dirt road and pipe culvert. Downstream of the culvert, the drainage line is deeply incised and eroded, but still ecologically functional to its confluence with the Breede River. The flow is augmented with storm water out of the cut-off trench. There may be some agricultural return flow that impacts on the water quality.

The drainage line for both instream and riparian habitat score a “B” (Table 5), which signifies a relatively unimpacted state.

The new proposed dam will not change the PES status.

Table 5 Sub-Catchment No.1 drainage line Habitat Integrity

Instream	**score**	**weight**	**Product**	**Maximum Score**
Water Abstraction	24	14	336	350
Flow modification	20	13	260	325
Bed modification	21	13	273	325
Channel modification	21	13	273	325
Water quality	19	14	266	350
Inundation	20	10	200	250
Exotic macrophytes	17	9	153	225
Exotic fauna	21	8	168	200
Solid waste disposal	24	6	144	150
max score		100	2073	2500
% of total			82.9	
Class			**B**	
Riperian Zone				
Water abstraction	24	13	312	325
Inundation	20	11	220	275
Flow modification	20	12	240	300
Water quality	19	13	247	325
Indigenous vegetation removal	22	13	286	325
Exotic vegetation encroachment	19	12	228	300
Bank erosion	19	14	266	350
Channel modification	23	12	276	300
		100	2075	2500
% of total			83.0	
Class			**B**	

The two faint drainage lines out of the hills into Sub-Catchment No.3 (including that of Sub-Catchment No.4) are near-pristine in the upper catchment, with perhaps the occasional farm animal the only impact, apart from the two-track farm roads. The drainage lines are interrupted by the cut-off trench. Further down the sub-catchment, the drainage lines are non-existent and have been entirely replaced by cultivated farm land. The stark difference between the upper sub-catchment and the highly impacted lower part complicated the PES evaluation, for which an estimated mean must be arrived at.

For this evaluation, farm crops are viewed as exotic vegetation.

The score came out as a “D”, which signifies a highly impacted status. The new proposed dam will hardly lower the PES rating, since it already is highly impacted with little room for deterioration, but with a possibility that it might move to an “F”.

Table 6 Sub-Catchment No.3 drainage line Habitat Integrity

Instream	**score**	**weight**	**Product**	**Maximum Score**
Water Abstraction	24	14	336	350
Flow modification	4	13	52	325
Bed modification	3	13	39	325
Channel modification	4	13	52	325
Water quality	15	14	210	350
Inundation	4	10	40	250
Exotic macrophytes	12	9	108	225
Exotic fauna	21	8	168	200
Solid waste disposal	24	6	144	150
max score		100	1149	2500
% of total			46.0	
Class			**D**	
Riperian Zone				
Water abstraction	24	13	312	325
Inundation	4	11	44	275
Flow modification	4	12	48	300
Water quality	15	13	195	325
Indigenous vegetation removal	12	13	156	325
Exotic vegetation encroachment	11	12	132	300
Bank erosion	19	14	266	350
Channel modification	4	12	48	300
		100	1201	2500
% of total			48.0	
Class			**D**	

The situation with the drainage line of Sub-Catchment No.2 is similar to that of Sub-Catchment No.3, with the upper parts near-pristine and with an abrupt interruption where it meets the orchards. It differs because the drainage line is visible downstream of the orchards, flows into a small farm dam, from where it carries on further to its confluence with the Breede River (Figure 18). The lower reach is engineered and straightened and impacted by the surrounding orchards. This difference calls for a separate PES evaluation for this sub-catchment..

The drainage line scores an “E” for instream and a “D” for riparian habitat. The drainage line is worse off than that of Sub-Catchment No.3 because of the possible water abstraction out of the farm dam and the impact of the orchards in the lower reach.

It is not expected that the proposed new dam would change any of this. If it does, it does not really be of significance, because the score is so low and because the drainage line, apart from its upper reach, can hardly deteriorate any further.

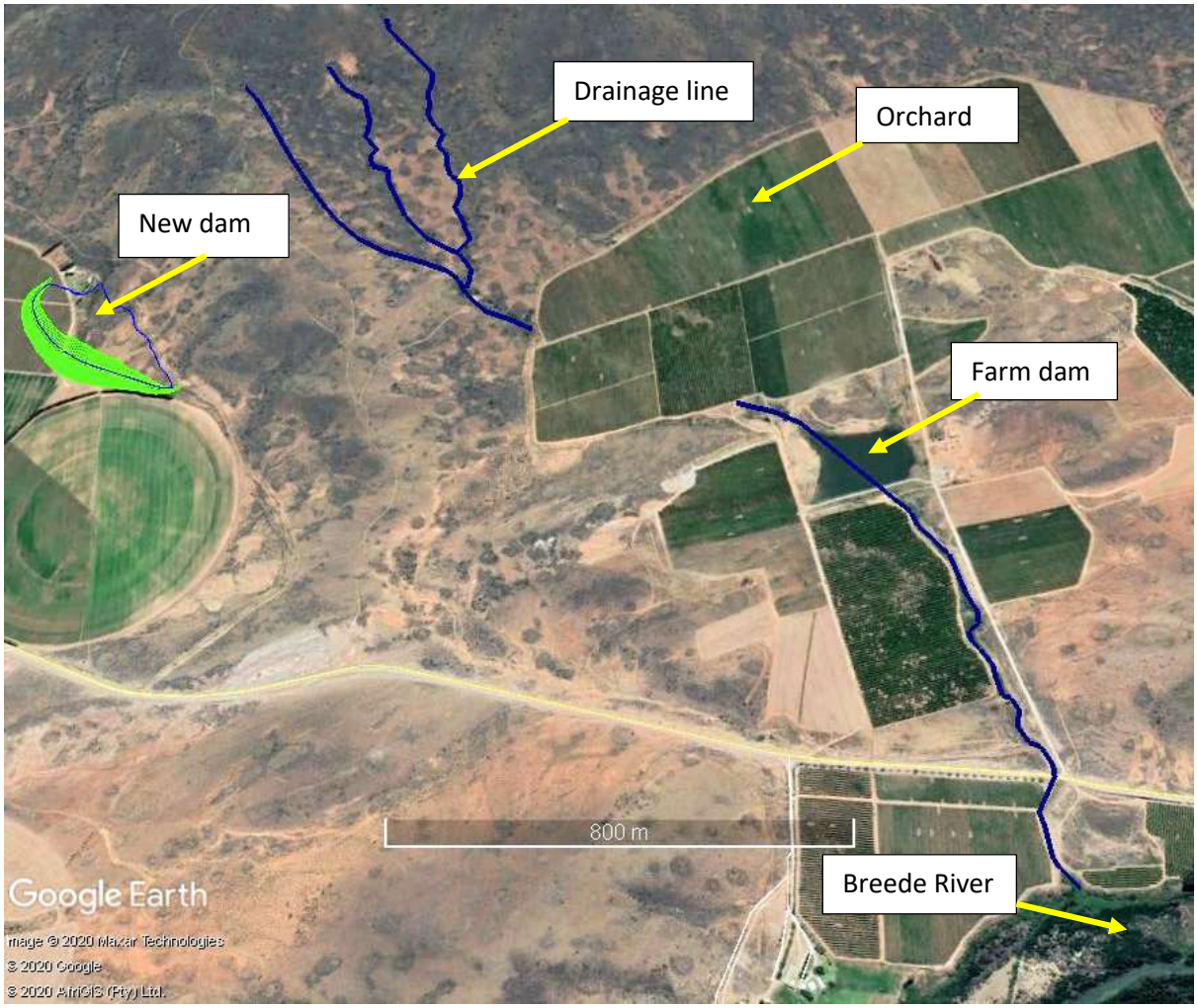


Figure 18 Sub-Catchment No.2 drainage line

Table 7 Sub-Catchment No.2 drainage line Habitat Integrity

Instream	**score**	**weight**	**Product**	**Maximum Score**
Water Abstraction	15	14	112	350
Flow modification	6	13	78	325
Bed modification	7	13	91	325
Channel modification	7	13	91	325
Water quality	11	14	14	350
Inundation	5	10	50	250
Exotic macrophytes	12	9	108	225
Exotic fauna	21	8	168	200
Solid waste disposal	24	6	144	150
max score		100	856	2500
% of total			34.2	
Class			**E**	
Riperian Zone				
Water abstraction	15	13	195	325
Inundation	5	11	55	275
Flow modification	6	12	72	300
Water quality	11	13	143	325
Indigenous vegetation removal	10	13	130	325
Exotic vegetation encroachment	10	12	120	300
Bank erosion	19	14	266	350
Channel modification	3	12	36	300
		100	1017	2500
% of total			40.7	
Class			**D**	

The main impact on the Breede River (Table 5) is the large-scale water abstraction that is taking place all along its entire length. This reduced water levels and resulted in the river to stop flowing during the dryer parts of the year. Some years the dry weather flow has been described as a “saline trickle”. Hence the river at the sampling point has been classified as C, or “Moderately Modified” (Table 5).

The riparian zone suffers from all these impacts, on top of which the massive invasion of exotic trees must be added. Hence a classification of D, or “Largely Modified” was derived at for the river’s riparian zone at the sampling site.

The proposed dam is not going to change this classification, since the impact would be insignificant, compared to the large-scale existing impacts along the river. It is going to be another relatively small element in the cumulative impact that has already officially been discounted against the Ecological Reserve.

Table 8 Breede River Sampling Point Habitat Integrity

Instream	**score**	**weight**	**Product**	**Maximum Score**
Water Abstraction	8	14	112	350
Flow modification	9	13	117	325
Bed modification	24	13	312	325
Channel modification	24	13	312	325
Water quality	15	14	210	350
Inundation	20	10	200	250
Exotic macrophytes	5	9	45	225
Exotic fauna	13	8	104	200
Solid waste disposal	20	6	120	150
max score		100	1532	2500
% of total			61.3	
Class			**C**	
Riperian Zone				
Water abstraction	8	13	104	325
Inundation	17	11	187	275
Flow modification	9	12	108	300
Water quality	15	13	195	325
Indigenous vegetation removal	2	13	26	325
Exotic vegetation encroachment	1	12	12	300
Bank erosion	22	14	308	350
Channel modification	23	12	276	300
		100	1216	2500
% of total			48.6	
Class			**D**	

13 Ecological Importance

The EI was developed by Dr Neels Kleynhans of the DWS.

“Ecological Importance (EI) refers to the diversity, rarity, uniqueness of habitats and biota and it reflects the importance of protecting these ecological attributes from a local, regional and international perspective.”

The Ecological Importance (EI) is based on the presence of especially fish species that are endangered on a local, regional or national level (Table 9).

Table 9. 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)

In the near-pristine tributaries of the Breede River, up against the slopes of the high mountain catchments, indigenous fish such as *Sandelia capensis, Galaxias zebratus* and the endangered Red Data *Pseudobarbus burchelli* are still present, but in the lower reaches these have been replaced by exotic species such as carp *Cyprinus carpio* and barbel *Clarias gariepinus.* Hence the Breede River specifically at the sampling point cannot be considered to be ecologically important, according to this particular assessment. This is despite the general knowledge among aquatic scientists that the Breede River indeed is an important ecological feature on the Southern Cape landscape.

The drainage lines have no permanent water and hence no fish and therefore cannot be regarded as aquatic ecologically important.

14 Ecological Sensitivity

"Ecological Sensitivity (ES) refers to the ability of an ecosystem to tolerate disturbances and to recover from impacts. The more sensitive a system is, the lower the tolerance will be to various forms of alterations and disturbances. This serves as a valuable indicator of the degree to which a water resource can be utilised without putting its ecological sustainability at risk and the level of protection the system requires."

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.

If the Breede River is left to its own devises, with current impacts removed, it would probably bounce back to a condition closer to the original. However, this would never happen. The river can get much worse if more impacts are added.

The Breede River's ES is rated as "Moderate" at the sampling point.

If ever agriculture in the Breede River valley is to cease, for some unthinkable reason, it is unlikely that the Scherpen Heuvel Farm drainage lines would bounce back to its original ecological state because of the low rainfall. Vegetation re-growth is slow. The reaches that have been grossly altered will take decades if not a century or more to regenerate riparian vegetation. From this perspective the drainage line can be perceived as ecologically sensitive.

15 Mitigation Measures

The proposed new dam is to be constructed, for the most part, in an already heavily disturbed site, on a site on which agricultural activities have been taken place for many years. On the site and downstream of the site, there are no drainage lines any longer that can possibly be impacted and for which mitigation measures should be compiled. It seems inapplicable to induce mitigation measures for such an already denaturalised aquatic habitat.

The drainage lines upstream of the dam are already impacted by the cut-off trench. Here, as well, no impact is foreseen, as long as construction activities are limited to the construction site and the footprint is limited.

The drainage lines up the hill above Scherpen Heuvel Farm are still in a near-pristine condition and should be conserved. The proposed new dam is unlikely to have any impact on this part of the sub-catchment and no mitigation measures are necessary

During the operational phase of the proposed new dam, the following is applicable:

- No more water should be abstracted from the Breede River as is specified in the License issued in terms of S21 (a) of the NWA.
- Exotic trees such as invasive Port Jackson should not be allowed to take over disturbed areas or for that matter, anywhere on the property. A coordinated control program may be required.
- The situation around the blue gum trees in the Breede River is dire and not nearly enough is being done by both the relevant government agencies and land owners. Every opportunity should be taken to escalate existing as well as new control programs.
- The new dam would result in more irrigation and the probability of more return flow. Over-irrigation and return flow should be prevented by the implementation of contemporary irrigation technology.
- Some water should be left in the dam and not all should be used for irrigation to maintain aquatic ecological functioning throughout the year.

16 Impact Assessment

Table 10 Impact Assessment

Description of impact **Construction** Construction vehicles and activities in upper sub-catchment Destruction of drainage lines in the upper sub-catchment **Mitigation measures** Keep vehicles and activities out the upper sub-catchment Limit the construction footprint								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceable
Without mitigation								
Negative	Local	High	Long term	High	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Very Low	Long term	Zero	Definite	Sure	Reversible	Replaceable

Description of impact

Operation

Abstraction of water out of the Breede River.
Over-abstraction impinges on Ecological Reserve

Mitigation measures

Strictly stay within the License allocation

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceable
Without mitigation								
Negative	Local	High	Long term	High	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Very Low	Long term	Zero	Definite	Sure	Reversible	Replaceable

Description of impact

Operation

Re-growth of invasive trees
Continued growth of blue gum trees in the Breede River

Mitigation measures

Control invasive trees
Embark on a program to remove blue gum trees from Breede River banks

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceable
Without mitigation								
Negative	Regional	High	Long term	High	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Local	Low	Long term	Low	Definite	Sure	Reversible	Replaceable

Description of impact **Operation** Irrigation out of new dam Over-irrigation result in agricultural return flow Return flow into the Breede River **Mitigation measures** Prevent over-irrigation Prevent agricultural return flow Keep return flow out of Breede River								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceable
Without mitigation								
Cumulative	Regional	High	Long term	High	Definite	Certain	Reversible	Replaceable
With mitigation measures								
Negative	Regional	Low	Long term	Low	Definite	Sure	Reversible	Replaceable

Some of the decision-making 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 assessment is given in Table 10.

The Impact Assessment indicates that some impacts, such as the destruction of the upper catchment, can be entirely prevented. It shows that impacts such as pollution of the Breede River because of agricultural return flow, can be minimised and even prevented. The proliferation of invasive vegetation can be addressed, if only eradication efforts are supported.

The proposed dam should be allowed. The impact assessment has not shown up any fatal flaws.

17 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 24.6, p55, 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 p55 to derive at a value for Significance. The value for Significance can subsequently be evaluated according to Table 24.5.

Table 11 provides a yardstick for decision-making with regard to allow or disallow a development with its concomitant impact on the botanical environment.

The scores 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 11 Significance Score

Parameter	Score
Conservation value	2
Likelihood	5
Duration	5
Extent	1
Severity	1
Significance	24

The significance came out as low. Small, faint mostly dry drainage lines in the upper parts of a verry small catchment cannot be significantly, from an aquatic ecological point of view.

18 Risk Matrix

Table 12 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Construction of the dam	Destruction of the upper part of the drainage lines and its catchment	Loss of aquatic habitat	24	Low
2.1	Operation of the dam	Over-abstraction out of the Breede River	Impingement on the Ecological Reserve	55	Low
2.2		Over-Irrigation	Agricultural return flow in Breede River	55	Low
2.3		Proliferation of invader trees	Destruction of riparian zone	42	Low

Table 8 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	1	1	1	1	1	1	1	3
2.1	1	1	2	2	1.5	2	2	5.5
2.2	1	2	1	2	1.5	2	2	5.5
2.3	2	1	1	1	1.25	2	2	5.25

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1	1	1	5	1	8	24	Low
2.1	2	2	5	1	10	55	Low
2.2	2	2	5	1	10	55	Low
2.3	1	1	5	1	8	42	Low

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 12 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 8 (continued) represent the same activities as in Table 12.

The Risk Matrix is a requirement of Government Notice 1180 of 2002 in terms of the National Water Act (36 of 1998).

The purpose of the Risk Matrix is to provide information with regard to the decision if a General authorization or a License is the appropriate level of authorization.

Values have been assigned assuming that the mitigation measures are in place.

The Risk Matrix has been compiled under the assumption that no more water will be abstracted from the Breede River than is currently the case, once the dam has been completed, as the volume of water has already been allocated and is fixed under license. Likewise, the flow in the drainage lines has already been impacted by the cut-off trench and the proposed new dam would make no difference in the flow down the catchment. However, availability of water right through the year would probably increase the likelihood of over-irrigation and agricultural return flow, but that can be prevented with the implementation of contemporary technology, such as the measurement of soil moisture and the programming of irrigation according to measured values. For the further proliferation of invader species of trees, the score was given against the background that there is already a heavy infestation and that the proposed new dam would not add to the problem. A control program as one of the license conditions would alleviate the problem, especially if more land-owners join the program.

The Risk Matrix indicates that a General Authorization would be in order and that a License is not called for.

19 Resource Economics

The goods and services delivered by the environment, in this case the Scherpen Heuvel drainage lines, 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 Scherpen Heuvel drainage lines the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 19) is an accepted manner to visually illustrate the resource economic footprint of the drainage lines, from the data in Table 13.

Table 13. Goods and Services of the Scherpen Heuvel drainage lines

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

0 Low
5 High

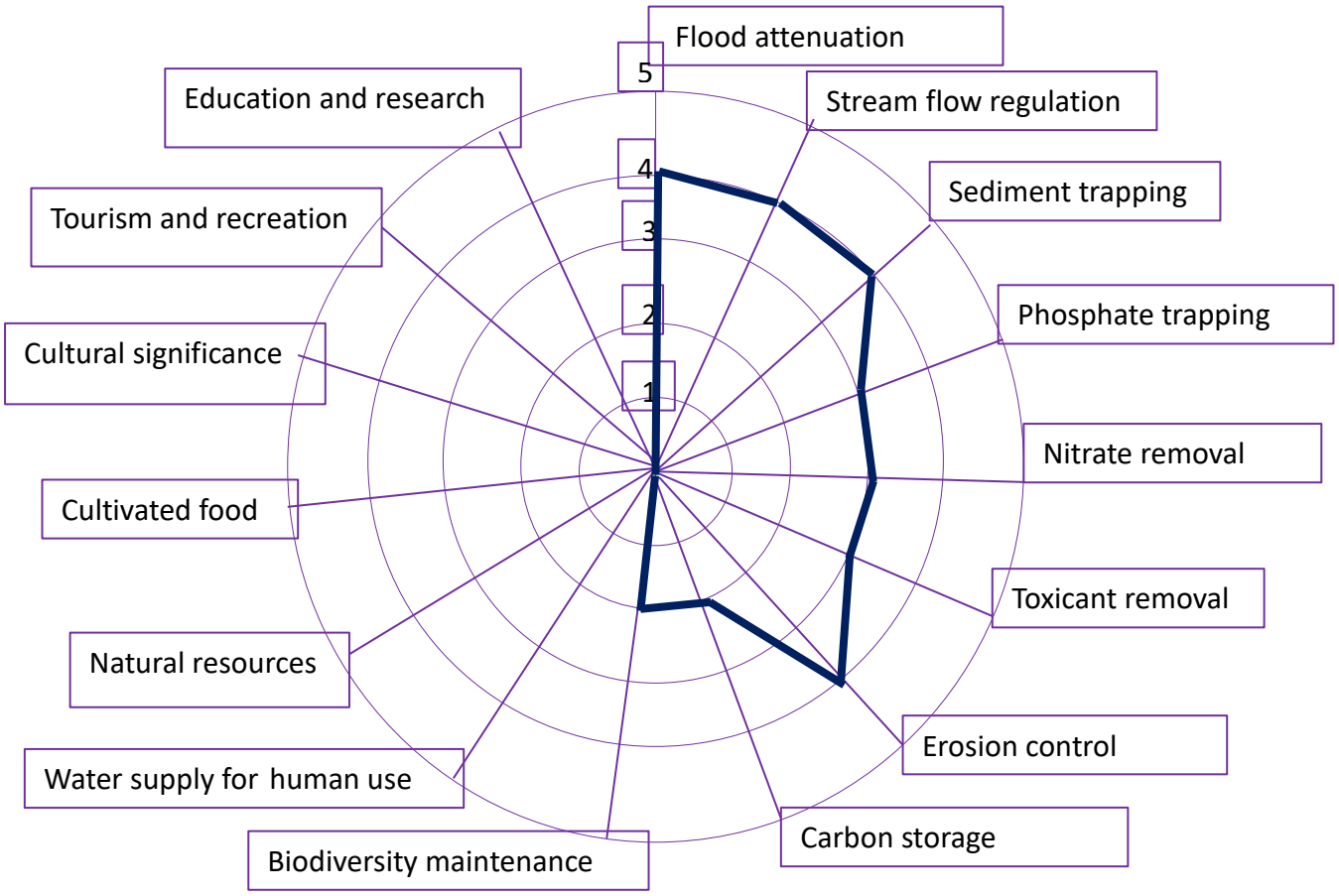


Figure 19. Resource Economics Footprint Sub-Catchment No.1 drainage line

The size of the star shape (Figure 19) is the one attribute that attracts the attention of decision-makers. A big star alerts them. This star is small, indicating that the ecological goods and services of the Sub-Catchment No.1 drainage line are limited, with some contribution towards flood control and nutrient trapping.

Its resource economics footprint of Sub-Catchment No.2 drainage line is even smaller.

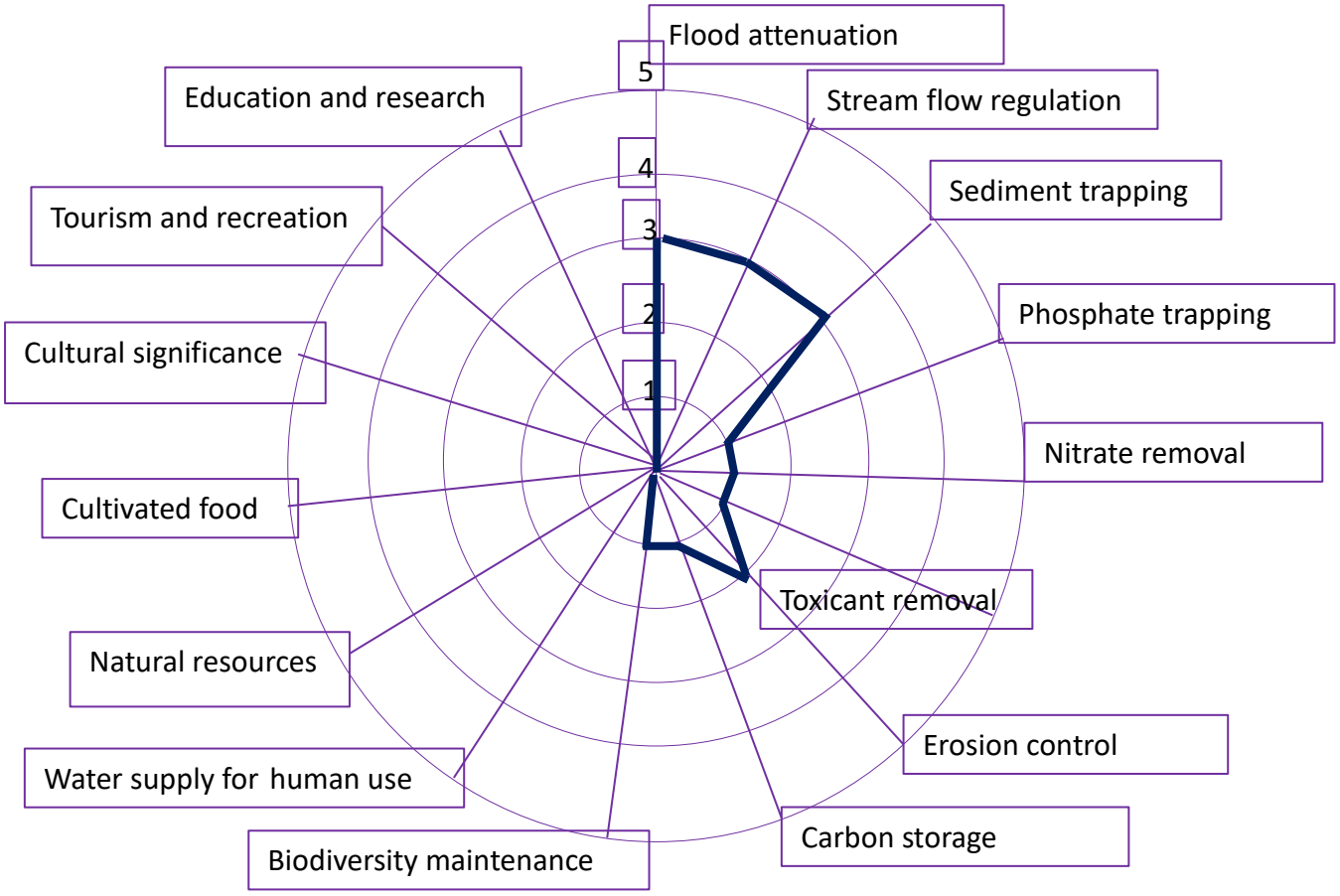


Figure 20. Resource Economics Footprint Sub-Catchment No.2 drainage line

The star shape for the Sub-Catchment 3/4 drainage lines is very small (Figure 21) and the resource economics footprint is entirely insignificant, taking into consideration the only part that is left is the upper catchment with very faint drainage lines.

It stands to reason that not much would be lost in terms of resource economics if the proposed new dam was to impact on these drainage lines. Even so, the dam is downstream of the upper sub-catchment and won't detract from the little goods and services that are left.

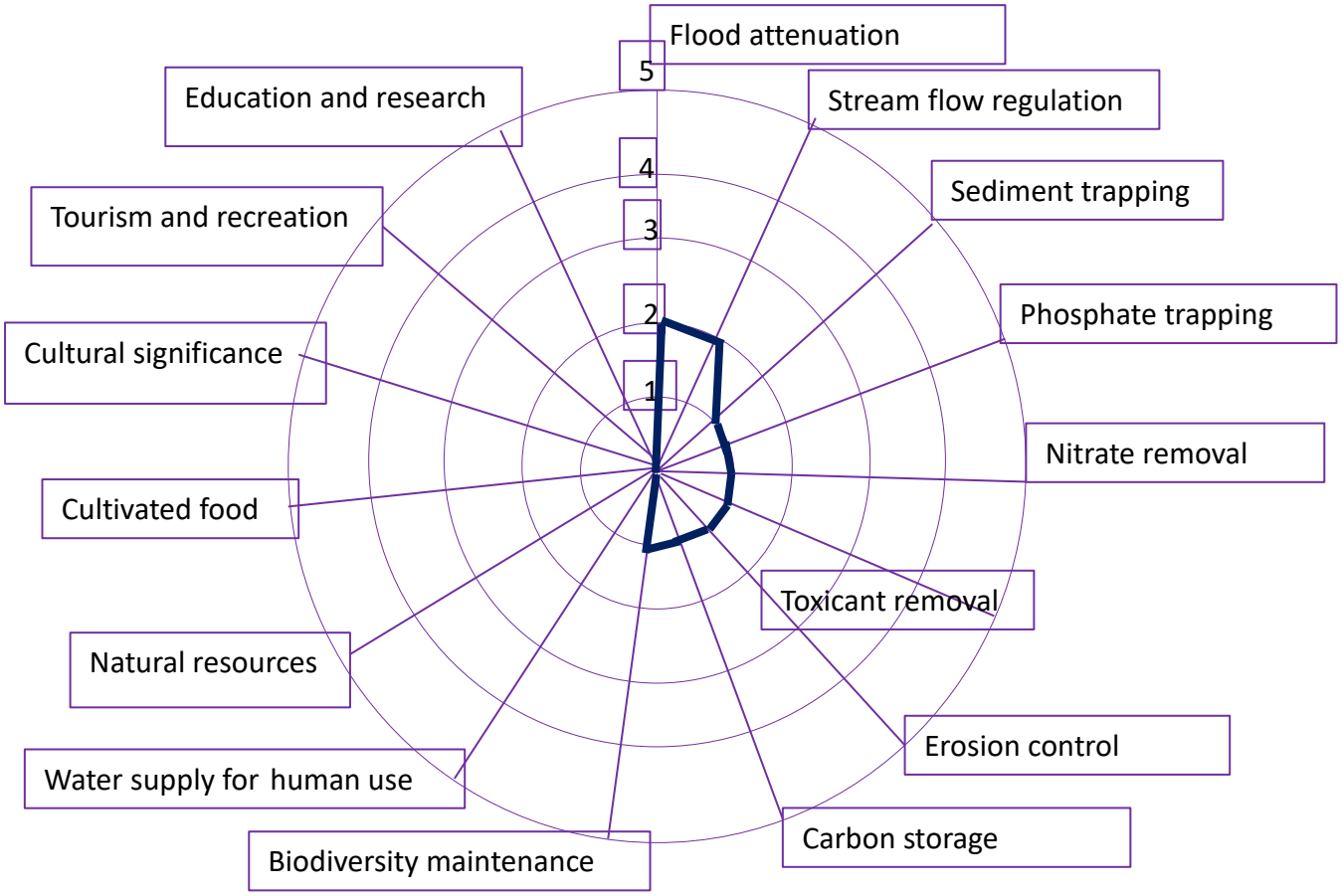


Figure 21. Resource Economics Footprint Sub-Catchment No.3/4 drainage lines

It would be a futile exercise to draft a spider diagram for the Breede River, as it would be a complete circle, providing all possible ecological goods and services that can be expected from a large river.

20 Conclusions

Figure 22 has been adapted from one of the most recent DWS policy documents

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

The conclusions can be structured along the outline that is provided by Figure 22.

The main driver of the Scherpen Heuvel drainage lines is the winter rain that results in brief flow of water. The long, hot and dry summers account for the lack of water in the drainage lines for most of the year. Agriculture has modified these drainage lines. Sub-Catchment No.1 still retains most of its natural properties, but No.2, 3 and 4 have been entirely modified. The proposed new dam, even though it would be a prominent feature on the local landscape, is not about to change the ecological functioning or take anything away from the rendered goods and services. These goods and services are miniscule, as it is, with not much to lose anyway. The lower reach of the drainage lines, where the new dam is to be constructed, has been entirely modified, with no aquatic ecological functioning left.

Moreover, the Risk Matrix indicated, given the very small size of the affected drainage lines, that a General Authorization would be in order and that a License is not called for.

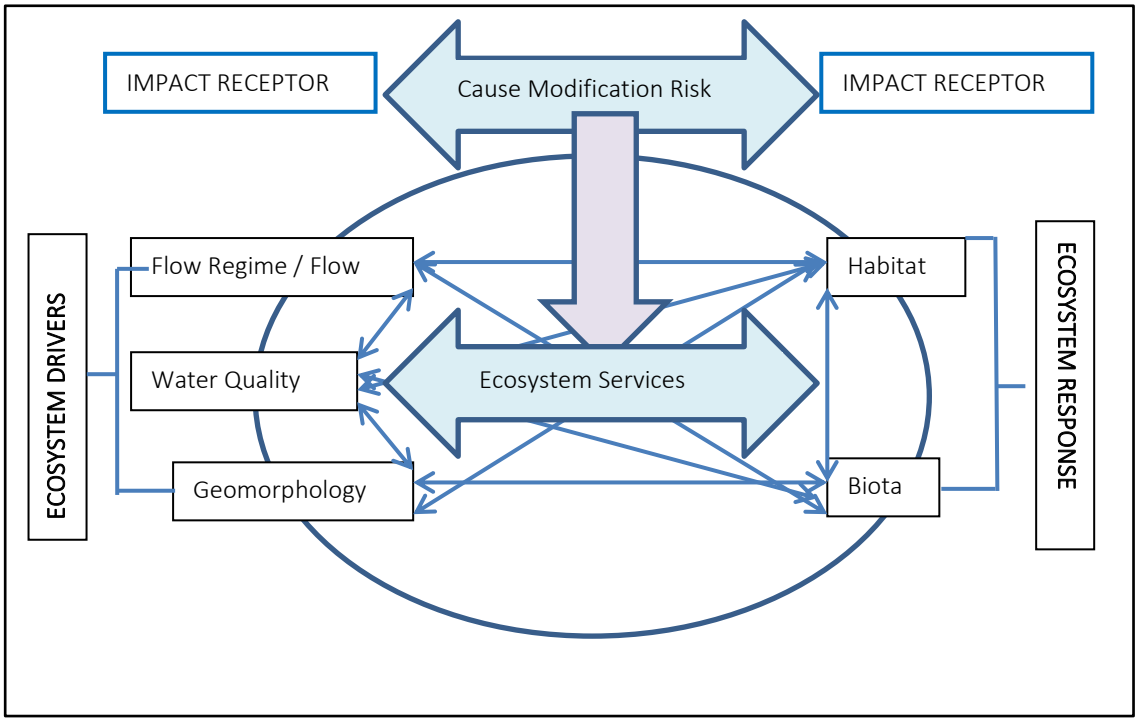


Figure 22 Minimum Requirements for a S21(c) and (i) Application.

21 References

Anonymous. 2011. *State of the River Report. Breede River*. Department of Water Affairs and Forestry, Pretoria.

Dickens, CWS & PM Graham. 2002. *The South African Scoring System (SASS) Version 5 Rapid Bioassessment.* African Journal of Aquatic Science 2002, 27: 1–10**.**

Haagen, DJ. 2020. Enlarged Bass Diii Dam. DJ Haagen & Associates, Cape Town.

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. Rutherford. 2006. *The Vegetation of South Africa, Lesotho and Swaziland.* Strelitzia 19: 1 – 2019. SANBI, Pretoria

For the identification of aquatic plants:

Annelise Gerber, Carina J. Cilliers, Carin van Ginkel & Rene Glen. 2004. *Easy Identification of Aquatic Plants.* Department of Water Affairs. Pretoria

Griffiths, C., Jenny Day, M. Picker. 2015. *Freshwater Life*. Struik. Cape Town.

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: 

Name of the company: WATSAN Africa Date: 12 November 2020

23 Résumé

Dr Dirk van Driel
PhD, MBA, PrSciNat, MWISA
Water Scientist

PO Box 681
Melkbosstrand 7437
saligna2030@gmail.com
079 333 5800 / 022 492 2102

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 Home Owner'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 Waste Water 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

24 Appendix

24.1 Robertson Karoo

VT 26 Karroid Broken Veld (77%) (Acocks 1953). Worcester-Robertson Karoo (Acocks 1979). LR 58 Little Succulent Karoo (83%) (Low & Rebelo 1996). BHU 87 Robertson Broken Veld (81%) (Cowling & Heijnis 2001). Bosjiesveld (local name).

Distribution Western Cape Province: Broad valley of the middle reaches of the Breede River around Worcester, Robertson and Ashton. Altitude 160–960 m.

Vegetation & Landscape Features Undulating flats and adjacent hills (sometimes with very steep flanks) supporting dwarf succulent shrubland to succulent thicket of medium height dominated by succulent species of *Euphorbia, Crassula* (and related genera) and vygies (*Drosanthemum* and *Ruschia* the major structural players). *Euphorbia mauritanica* (var. *corallo-thamnus*) is usually dominant on heuweltjies, which are an important element of the landscape and vegetation of the Robertson Karoo (Midgley & Musil 1990, Van Wyk & Smith 2001).

Geology & Soils Shale of the Devonian Ceres and Bidouw Subgroups (Bokkeveld Group, Cape Supergroup) as well as diamictite and shale of the Carboniferous Dwyka and Ecca Groups (Karoo Sequence). Jurassic Enon conglomerates occur as well. The soils are deep, red, apedal and loamy to loamy-sandy with a high clay and sodium content. Fc land type is representative of half of the region, while Fb and Ic are of lesser importance.

Climate Robertson Karoo is a semi-arid region with a mainly winter-rainfall regime and with maximum precipitation occurring in August (61 mm for Worcester, Smitheman & Perry 1990). Another slight precipitation peak is in June. MAP 125–350 mm; most of the region receiving about 300 mm. The low precipitation of this region surrounded from all sides by various Fynbos Biome vegetation units is ascribed to the rainshadow effect due to the high surrounding mountain ranges. MAT is above 16°C. Summer temperatures are high and in January vary from 30–40°C (an average of 34.5°C in February was recorded for Worcester). Occasional northwestern berg winds may intensify the heat. Winter nights might experience light frost—7 days a year on average. See also climate diagram for SKv 7 Robertson Karoo (Figure 5.65).

Important Taxa Succulent Shrubs: *Aloe microstigma* (d), *Cotyledon orbiculata* var. *orbiculata* (d), *Crassula rupestris* subsp. *commutata* (d), *Euphorbia burmannii* (d), *E. mauritanica* (d), *Lycium oxycarpum* (d), *Ruschia caroli* (d), *R. cymosa* (d), *Senecio junceus* (d), *Tylecodon paniculatus* (d), *Adromischus filicaulis* subsp. *marlothii*, *A. maculatus*, *A. mammillaris*, *Antimima fergusoniae*, *A. peersii*, *Cephalophyllum curtophyllum*, *C. purpureo-album*, *Crassula atropurpurea* var. *anomala*, *C. cultrata*, *C. nudicaulis*, *C. subaphylla*, *C. tetragona* subsp. *tetragona*, *Drosanthemum micans*, *D. striatum*, *Hereroa tenuifolia*, *Lampranthus dependens*, *L. haworthii*, *Leipoldtia schultzei*, *Pelargonium alternans*, *Phyllobolus grossus*, *P. nitidus*, *P. splendens*, *Ruschia multiflora*, *Tetragonia fruticosa*. Tall Shrubs: *Euclea undulata* (d), *Lebeckia cytisoides*. Low Shrubs: *Pentzia incana* (d), *Pteronia incana* (d), *Amphithalea spinosa*, *Anginon difforme*, *Asparagus burchellii*, *Ballota africana*, *Carissa haematocarpa*, *Chrysocoma ciliata*, *Elytropappus rhinocerotis*, *Eriocephalus africanus*, *E. ericoides*, *Felicia filifolia*, *Galenia africana*, *G. fruticosa*, *Helichrysum hamulosum*, *Hirpicium integrifolium*, *Microdon polygaloides*, *Oedera genistifolia*, *Pelargonium ramosissimum*, *Prenia englishiae*, *Pteronia fasciculata*, *P. paniculata*, *Selago ramosissima*, *Wahlenbergia thunbergiana*. Semiparasitic Shrub: *Thesium patulum*. Woody Succulent Climber: *Sarcostemma viminale*. Geophytic Herbs: *Albuca maxima* (d), *Drimia altissima* (d), *D. capensis* (d), *Kniphofia sarmentosa*, *Moraea viscaria*, *Oxalis pes-caprae*. Succulent Herbs: *Psilocaulon junceum* (d), *Crassula capitella* subsp. *thyrsiflora*, *C. cotyledonis*, *C. muscosa*, *Duvalia elegans*, *Gasteria disticha*, *Haworthia arachnoidea*, *Mesembryanthemum longistylum*, *Psilocaulon bicorne*, *Senecio radicans, Stapeliopsis breviloba*. Graminoids: *Ehrharta calycina*, *E. delicatula*, *E. longiflora*, *E. ramosa* subsp. *aphylla*.

Biogeographically Important Taxa ([S]Southern distribution limit, [W]Western distribution limit) Low Shrub: *Pteronia flexicaulis*[W]. Herbaceous Climber: *Cyphia angustifolia*[S]. Herb: *Arctotis cuprea*[S].

Endemic Taxa Succulent Shrubs: *Drosanthemum speciosum* (d), *Antimima biformis*, *A. hamatilis*, *A. leipoldtii*, *Brianhuntleya intrusa*, *Delosperma macrostigma*, *Drosanthemum anomalum*, *D. laxum*, *D. leptum*, *D. papillatum*, *D. pickhardii*, *D. pulchrum*, *D. thudichumii*, *D. tuberculiferum*, *D. worcesterense*, *Euphorbia nesemannii*, *Phyllobolus caudatus*, *Ruschia subteres*, *Sceletium varians*, *Stayneria neilii*. Low Shrubs: *Aizoon karooicum*, *Aspalathus ferox, Polhillia obsoleta*. Herbaceous Succulent Climbers: *Ceropegia fimbriata* subsp. *connivens*, *C. occulta*. Herb: *Pelargonium oxaloides*. Geophytic Herbs: *Eriospermum bowieanum*, *Pelargonium violiflorum*. Succulent Herbs: *Astroloba rubriflora*, *Conophytum ficiforme*, *Crassula simulans*, *Haworthia herbacea* var. *herbacea*, *H. maculata*, *H. maraisii*, *H. pubescens*, *H. reticulata*, *Stapelia paniculata* subsp. *scitula*.

Conservation Least threatened. Target 16%. Small area statutorily conserved in the Vrolijkheid Nature Reserve as well as on the premises of the Karoo Desert National Botanical Garden in Worcester (Oliver 2000) and in the Department of Agriculture Field Reserve (Olivier 1979). Marginal patches of the Robertson Karoo are under protection of private reserves such as Matroosberg, Drooge Riviers Berg, Langeberg-wes, Riviersonderend and Doornkloof. About 16% has been transformed by

urban development as well as by cultivation: vineyards and orchards. Alien plant invasions can be a problem in places. The pressure of natural erosion processes is moderate (45%) to both high (24%) and low (22%).

Remark The region is the heart of the Worcester-Robertson Karoo Centre of Endemism (Van Wyk & Smith 2001). Two genera are endemic to this unit—*Stayneria* and *Brianhuntleya* (Van Wyk & Smith 2001, Chesselet et al. 2003). *Drosanthemum* and *Haworthia* show a high concentration of local endemics.

References Olivier (1966, 1979), Joubert (1968), Acocks (1979, 1988), Boshoff (1989), Midgley & Musil (1990), Smitheman & Perry (1990), Oliver (2000), Cowling & Heijnis (2001), Van Wyk & Smith (2001), Chesselet et al. (2003).

24.2 Biomonitoring Results

SASS5 Score Sheet										
Date	19 Oct 20	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Breede River	Porifera	5		**Hemiptera**			**Diptera**		
	Bass Berries	Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5		Ceratopogonidae	5	
Coordinates	33°45' 34.43"	Huridinea	3		Hydrometridae	6		Chironomidae	2	2
	19°24'26.81"	**Crustacea**			Naucoridae	7		Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	4.15	Potamonautidae	3		Notonectidae	3	3	Empididae	6	
Temperature °C	19.6	Atyidae	8		Pleidae	4	4	Ephydridae	3	
pH	7.35	Palaemonidae	10		Veliidae	5		Muscidae	1	
EC mS/m	33.8	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	
SASS5 Score	30	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	8	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	3,8	**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	
		Caenidae	6	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	4	Pisulidae	10				
		Lestidae	8		Sericostomatidae	13				
		Platycnemidae	10		**Coleoptera**					
		Protoneuridae	8		Dyticidae	5				
		Aesthnidae	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				18			10			2

24.3 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 23.3.1 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 24.3.2 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 24.3.3 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 24.3.4 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 24.4 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 24.5 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 24.6 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)

24.7 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