MÔRESTER
Estate · Landgoed

Technical Report

Proposed

Toeka Dam and Harmony Dam

On the Farm Houdenbek 415, Koue Bokkeveld, Ceres District

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

May 2018

EnviroAfrica
Environmental Management and Impact Assessment
Omgewingsbestuur en Impakbeoordeling

WATSAN Africa

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1 Introduction

Morester Boerdery is a well-established farming operation on the Koue Bokkeveld to the west of the hamlet Dorp-op-die-Berg in the Ceres district of the Western Cape.

Harmony Trust together with Morester Boerdery (the BBBE partner) plan develop fruit trees and vegetable crops on existing agricultural land (a PALS BBBEE initiative) and require the proposed Toeka and Harmony dams for irrigation purposes.

Morester Boerdery appointed EnviroAfrica to conduct the required Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act (NEMA, 107 of 1998).

EnviroAfrica, in turn, appointed WATSAN Africa to handle the Water Use License Application (WULA) on behalf of Morester Boerdery with the Department of Water and Sanitation (DWS) in terms of the National Water Act (NWA, 36 of 1998).

Supporting documents are required for WULA's. The Technical Report (previously known as the Fresh Water Report) is one such supporting document. Many of the attributes and the aspects important for the WULA's of the two envisaged dams are similar and can be dealt with in a single technical report.

2 Feasibility

A Fresh Water Report focusses not only on the local impacts of a new farm dam, but on that of the river on which it is constructed. This is both on the upstream and downstream impacts. The impacts on the Houdenbek River and further downstream to the Doring River are important as well.

The Olifants-Doring River and it catchment has been the subject of several reports. It is a very large catchment and because of its size very much beyond the scope of the Fresh Water Report. Nevertheless, to render this report relevant and well-considered a couple of contentious issues must be mentioned

The combined storage capacity of farm dams in the upper Doring River catchment is probably more than the Mean Annual Runoff (MAR). This has dire consequences for river health, especially further down the river system, particularly the Doring River, as its hydroperiod is already impaired.

Yet another dam such as the envisaged Harmony and Toeka Dams would serve to worsen the situation.

However, the flow down these rivers is highly variable, with major floods that recur every 3 to 5 years. These floods are reportedly so large that it the farm dam's combined capacity makes no material difference of the flow down the Doring River during peak flow conditions.

It is from these large floods that the Harmony and Toeka Dams would be filled. Pumps will be placed in the Houdenbek River or in existing dams that are filled by the

Houdenbek River. These pumps would have to be large in order to fill the Harmony and Toeka Dams within the short period of the Houdenbek River's hydroperiod.

The River Health Programme Report (2006) recommended that new dams should not be added to the system. (Let it be quickly added that the Clanwilliam Dam is to be doubled in size).

During a meeting on 11 October 2017 in Ceres with Dr Bruce Paxton and his team of the Fresh Water Research Centre at the University of Cape Town expressed the view that it remains to be decided by the authorities if there is enough water available to fill the envisaged dams. The Ecological Reserve may already be compromised. Dr Paxton published on this topic (2016) and is a leading authority in this field.

This meeting was followed by one in Citrusdal on 26 October 2017 with Mr Rassie Nieuwoudt of the DWS. He was most positive about the BEE attributes of the project. He re-iterated that is was for a departmental team of decision-makers investigate the availability of water in the catchment.

CapeNature expressed its reservations about the proposed new dams in a letter dated 21 July 2017. The concern about the Toeka Dam was that it would further reduce the runoff in an already water stressed river system. The proposed Harmony Dam is in the proclaimed Koue Bokkeveld Mountain Catchment Protected Area. It construction would result in the loss of valuable habitat.

If water offtake during peak flows in the Houdenbek River would be allowed, it could well be that offtake during periods of base flow and low flow can be officially prohibited. This would limit the deleterious impact on the hydroperiod lower down the catchment. This prohibition would be very difficult to enforce.

Howard (2010) stated that *"diverting available water from the Houdenbecks River to off-channel storage is not really an option. A 0.25 m^3s^{-1} diversion will not deliver a firm yield above 0.5 million m^3 per annum and that a 0.5 m^3s^{-1} diversion to a 4.0 million m^3 off-channel dam results in a 30% failure yield of 1.88 million m^3 per annum".* The two dams that are now being planned have a combined capacity of 2.25 million m^3 and it seems as if the owners of the properties are willing to accept this rate of failure, as the relatively small size of the planned farming venture and the storage of water over 3 years allow for such a failure.

This report would be incomplete if these issues were not mentioned. However, the availability of water and the possible impacts further downstream will not be further discussed. It is for the DWS to decide if the project is to go ahead.

3 BEE

From the above it stands to reason that the envisaged dams project is up against a significant challenge. On the other hand, this is a most desirable project from an empowerment, development and economic point of view. Agriculture is the hub of the local economy. Most of the people here depends on agriculture for their livelihood. Like in so many parts of the country, joblessness and poverty is rife. Hence the BEE Harmony Trust project on the next-door farm Winkelhaak 224. There already are 40 hectares of vegetables on Winkelhaak of which many families of farm workers not only receive wages, but formally share in the profits as well, from which they receive an annual dividend.

The following is from the Morester webpage:

"Harmony Trust is a workers' trust, established by the permanent workers of the Harmony Group (Môrester Estate, Ceres and Middeltuin, Clanwilliam). The trust was founded in 2003 and has since functioned in partnership with Môrester Estate to expand their business interest. During 2006, 81 beneficiaries (with 96 dependants) each received a Land Redistribution Agricultural Development (LRAD) grant and invested it in the purchasing of the 64 ha farm Harmonie in the Koue Bokkeveld in the Ceres area. The Harmony Trust is the 100% owner of the land and has irrigation equipment, cattle and a cash investment with a total net asset value roughly estimated at R8,6 million".

For the sustainability of the venture it has become necessary to add permanent crops. Seventy hectares of fruit trees are planned, for which the water from the Harmony Dam is required.

Although the Harmony Dam would be constructed on the Farm Houdenbek, the water is destined for the Harmony Trust on Winkelhaak.

4 Legal Framework

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

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

The proposed construction of the weir and the diversion canals will have a permanent effect on the flow of the river.

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

The proposed weir will permanently change the characteristics of the river.

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. These will have a profound bearing on the construction of the proposed Toeka and Harmony Dams.

5 **Present Ecological State** (PES).

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

These aspects have been assessed for the Toeka and Harmony Dams and are reported upon in this report.

Table 1 Scores for ecological conditions and habitat descriptions (Louw & Kleynhans, 2007, from Ann. 2012)

Ecological Category	Ecological Condition % score	Description of the habitat
A A/B	92 - 100 87 - 92	Still in a reference condition
B B/C	82 - 87 77 - 82	Slightly modified from a reference condition. A small change in natural habitats and biota has taken place but the basic ecosystem function is essentially unchanged
C C/D	62 - 77 57 - 62	Moderately modified from the reference condition. Loss of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged
D D/E	42 - 57 37 - 42	Largely modified from the reference condition. A large loss natural habitat, biota and basic ecosystem function has occurred.
E E/F	22 - 37 17 - 22	Seriously modified from the reference condition. The loss of natural habitat, biota and basic ecosystem function is extensive.
F	0 - 17	Critically / Extremely modified from the reference condition. The system has been critically modified with an almost complete loss of natural habitat and biota. In the worst instances basic ecosystem functions have been destroyed and the changes are irreversible.

6 Ecological Importance

Table 2. Ecological Importance and Sensitivity Categories (EISC) according to endangered organisms (Kleynhans,1999).

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

This aspect has been assessed for the Toeka and Harmony Drainage Lines and reported upon later on in the report.

7 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.

These aspects will have been assessed and is reported upon later in the report.

8 Impact Assessment

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology (Table 4, p14).

The main benefit of this exercise is that it allows for the evaluation of mitigation measures.

The main impact under consideration is the movement of sediments and construction material during the construction phase.

The proposed construction of the Harmony and Toeka Dams has a limited number of steps. Likewise, the methodology has been simplified to suit the construction of the weir.

- Local means the localities the construction sites (Table 4, p14).
- Regional means downstream beyond the boundary of the site and down the drainage lines into the Houdenbek River and beyond.
- Short term means the time during the construction phase.
- Long term means the operational period of the weir and the long-term water abstraction.
- Probability is expressed with a 5-point scale: Improbable, Low, Medium, High, Probable.
- The Confidence Level can either be low, medium or high. The same applies to Intensity and Significance.
- Significance is the combined effects of Extent, Duration and Intensity

Again, this assessment was carried out for both dams and reported upon later on in this report.

9 Risk Matrix

The Risk Matrix must be completed according to the requirement of GN267 and GN 509. Risk matrices have been completed for the Toeka and the Harmony Dams and are given lower down in this report.

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. The tables here are replicas of the Excel spreadsheet that has been adapted to fit the format of this report.

The risk matrix is completed under the assumption that the mitigation measures are in place.

The scores that were given are solely that of the assessor, according to the guidelines on the DWS webpage.

10 Toeka

10.1 Toeka Catchment

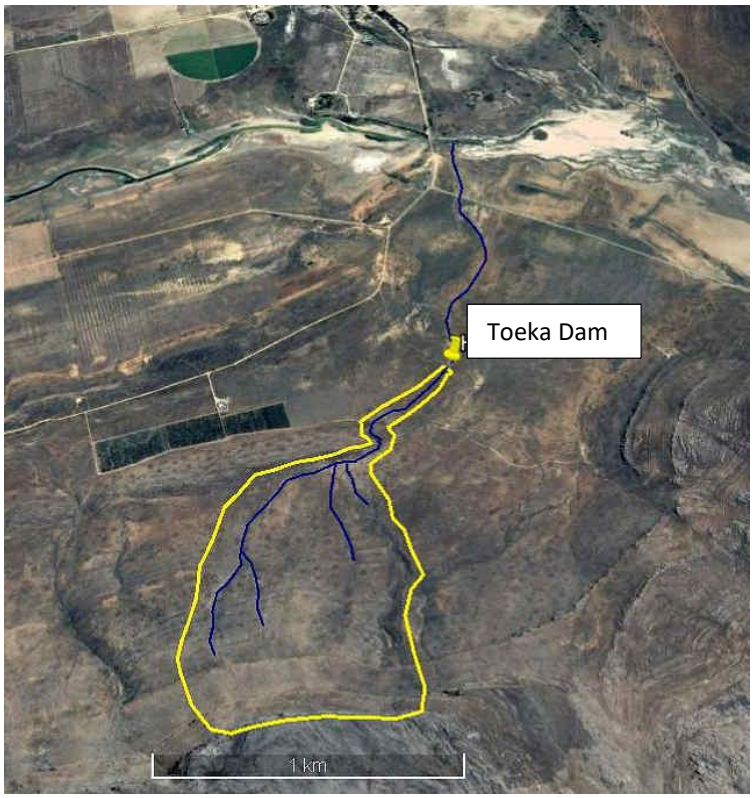

Figure 1 Toeka Catchment

The proposed Toeka Dam is to be constructed in a faint drainage line. This drainage line raises on a high mountain ridge and proceeds over relative level land over a distance of 2.1km to the Houdenbek River.

The ridge is approximately 1500m above sea level. The dam wall where it will cross the drainage line is at 952m above sea level. At this point the coordinates are as follows:

32°59’59.30” S
19°27’44.36” E

The catchment area of the drainage line is very small above the dam, only 2.2 square kilometres. The runoff is, as the crow flies, from the mountain ridge on the top of the catchment to the confluence with the Houdenbek River is only 3.25km. The circumference of the catchment is 5km.

There are numerous drainage lines from the mountain to the river, most of which are much bigger than the Toeka drainage line. When it rains in winter, when the rains are good, the entire area at the dam site floods and resembles a wetland rather than a stream. This is because of the contribution of the drainage lines combined, rather than that of a single drainage line. This doesn't happen every winter, as the rain fall is erratic and variable. The wetness only lasts when it rains and after a short few weeks the area is entirely dry again.

Most of the dam site is on ploughed-over land (Figure 2). During the site visit there were no signs of any wetland or riparian vegetation.

Figure 2 Toeka Dam Site. Foto Peet Botes.

10.2 Toeka Dam

The dam will have a capacity of 2 million $m^{3.}$ The length of the wall will be 636m and it will be 14m high. It will cover an area of 35 hectares.

10.3 Toeka Present Ecological State

Table 3 Toeka Flood Plain Habitat Integrity

Instream	score	weight	Product	Maximum Score	Remark
Water Abstraction	23	14	322	350	
Flow modification	23	13	299	325	
Bed modification	24	13	312	325	
Channel modification	24	13	312	325	
Water quality	23	14	322	350	
Inundation	23	10	230	250	
Exotic macrophytes	12	9	108	225	
Exotic fauna	2	8	16	200	
Solid waste disposal	24	6	144	150	
max score		100	2065	2500	
% of total			82.6		
Class			**B**		Slightly Modified
Riperian Zone					
Water abstraction	23	13	299	325	
Inundation	23	11	253	275	
Flow modification	22	12	264	300	
Water quality	24	13	312	325	
Indigenous vegetation removal	12	13	156	325	
Exotic vegetation encroachment	10	12	120	300	
Bank erosion	23	14	322	350	
Channel modification	22	12	264	300	
		100	1990	2500	
% of total			79.6		
Class			**C**		Moderately modified

The runoff from the high ground onto the flood plain and the drainage line is natural, apart from the farm dam towards the west that may have some influence. The entire area between the foot of the mountain and the Houdenbek River is temporary and partly submerged during infrequent periods of heavy winter rains. The existing farm dam may have some influence on inundation, hence some marks have been subtracted.

The faint drainage line is not markedly modified. According to the Google Earth image some of the area has been ploughed over, but during the site visit it was evident that some of the original vegetation has grown back. Cattle and other livestock accounts for the exotic fauna.

The drainage line has been slightly modified and the riparian zone has been moderately modified.

10.4 Toeka Ecological Importance

There is no permanent submerged aquatic habitat in the Toeka Catchment. Hence there are no fishes and the catchment cannot be considered as ecologically important. During the site visit no other endangered species of any description were encountered. The botanical report of Dr Dave McDonald was not available during the writing of this report and may prove otherwise.

10.5 Toeka Ecological Sensitivity

The main impact on the Houdenbek floodplain is grazing by farm animals. If grazing is terminated and the flood plain left to its own natural devises, it seems possible that it would return to its original status. Therefore, the flood plain and drainage line are not deemed as ecologically sensitive.

If the dam is removed, which is not likely to ever happen, it can be expected that the land would return to grazing pasture. From this perspective the area is not particularly ecologically sensitive.

10.6 Toeka Impact Assessment

Table 4 Harmony Mitigation of Impacts

Possible Impact		Extent	Duration	Intensity	Significance	Probability	Confidence
Clearing of the dam sites	Without mitigation	Regional	Long term	Medium	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Collecting construction material from dam sites	Without mitigation	Regional	Medium term	Medium	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Construction of the dams	Without mitigation	Regional	Short term	Medium	High	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Clearing of dam sites	Without mitigation	Regional	Long term	Medium	Medium	Probable	High
	With mitigation	Regional	Long term	Low	Low	Low	Medium
Stabilisation of the new dam walls	Without mitigation	Regional	Long term	Medium	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Operation of the dam	Without mitigation	Regional	Long term	Medium	Medium	Probable	Medium
	With mitigation	Regional	Long term	Low	Low	Probable	Medium

Mitigation Measures:

1. The clearing of the construction site involves the removal of the riparian vegetation and the loose rocks in the drainage lines to expose the bedrock. This can be done minimally, as little as possible, without excessive impact. There will be a permanent instream impact, but it can be limited to an area as small as possible.

2. Likewise, as little as possible building material can be stockpiled on the building sites, with no more than is immediately required. Care should be taken that sand and other debris do not get washed into the drainage lines along with storm water.

3. If the actual construction of the dam walls is carried out with due consideration for the riparian and instream environment, the impact can be limited to the building site and prevented from having an impact further down the drainage lines. The single most significant mitigation measure in this respect is the timing of the construction phase. It should be done during the dry season, February and March, when the flood plain and drainage lines are dry.

4. Access road should be limited to only one per construction site.

5. During the operational phase of the dam the 25% IFR should be implemented, as is suggested in the Toeka preliminary dam design (Sarel Bester Engineers, 2018).

As with many of these small and medium-sized dam wall, the downstream impacts can readily be mitigated.

The direct long-term impacts of the water storage and the consequent flow reduction down the drainage lines and eventually down the Houdenbek River have not been assessed. This will be considered along with the taking of water from the Houdenbek River.

The significance of the impact is rated as low. This supports the view that the flood plain is already impacted upon by agriculture and construction of the dam would not represent a significant loss of aquatic habitat.

10.7 Toeka Risk Matrix

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 4 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 7 (continued) represent the same activities as in Table 7.

The risk matrix is completed under the assumption that the mitigation measures are in place.

The construction of any dam across a water course can never be low. The initial impact of removing the topsoil comes out as moderate, but it is nevertheless a notable impact. The flowing collection of construction material from the floor of the proposed dams is less because most of the impact has already taken place by this stage of the project. The construction of the dam walls also leaves a notable impact, which comes out as only moderate.

The Risk Matrix indicates that a license is required. A General Authorisations is not appropriate for this WULA.

Table 5 Toeka Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1.1	Clearing of the dam sites	Removal of vegetation, loose rocks, soil	Destruction of riparian vegetation and aquatic habitat	80	Moderate
1.2			Downstream accumulation of sediments	32	Low
2	Collection of construction material from dam sites	Material in riparian and aquatic habitat	Disturbance of habitat	28	Low
3.1	Construction of dam walls	Placing of construction material	Instream habitat destruction	80	Moderate
3.2			Downstream dehydration of Harmony drainage line	138	Moderate
4	Clearing of dam site	Rehabilitation	More sand and material in aquatic habitat	40	Low
5	Stabilisation of new dam walls	Construction	Sand in downstream aquatic habitat	24	Low
6	Operation of dam	Implementation of 25% IFR	Desiccation of flood plain	71.5	Medium

Table 5 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1.1	1	1	5	5	3	3	4	10
1.2	1	1	1	1	1	2	1	4
2	2	1	2	1	1.5	1	1	3.5
3.1	2	1	5	5	4	1	5	10
3.2	5	1	5	3	3.5	3	5	11.5
4	1	1	1	1	1	3	1	5
5	1	1	1	1	1	1	1	3
6	3	1	1	1	1.5	2	2	5.5

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1.1	1	1	5	1	8	80	Moderate
1.2	1	1	5	1	8	32	Low
2	1	1	5	1	8	28	Low
3.1	1	1	5	1	8	80	Moderate
3.2	3	3	5	1	112	138	Moderate
4	1	1	5	1	8	40	Low
5	1	1	1	1	8	24	Low
6	1	5	5	2	13	71.5	Moderate

The Toeka risk rating comes out as “Moderate”, but since this the site is already impacted upon by agriculture, a “Low” rating is in order, as the impact does not signify a further degradation of available aquatic habitat.

11 Harmony

11.1 Harmony Catchment

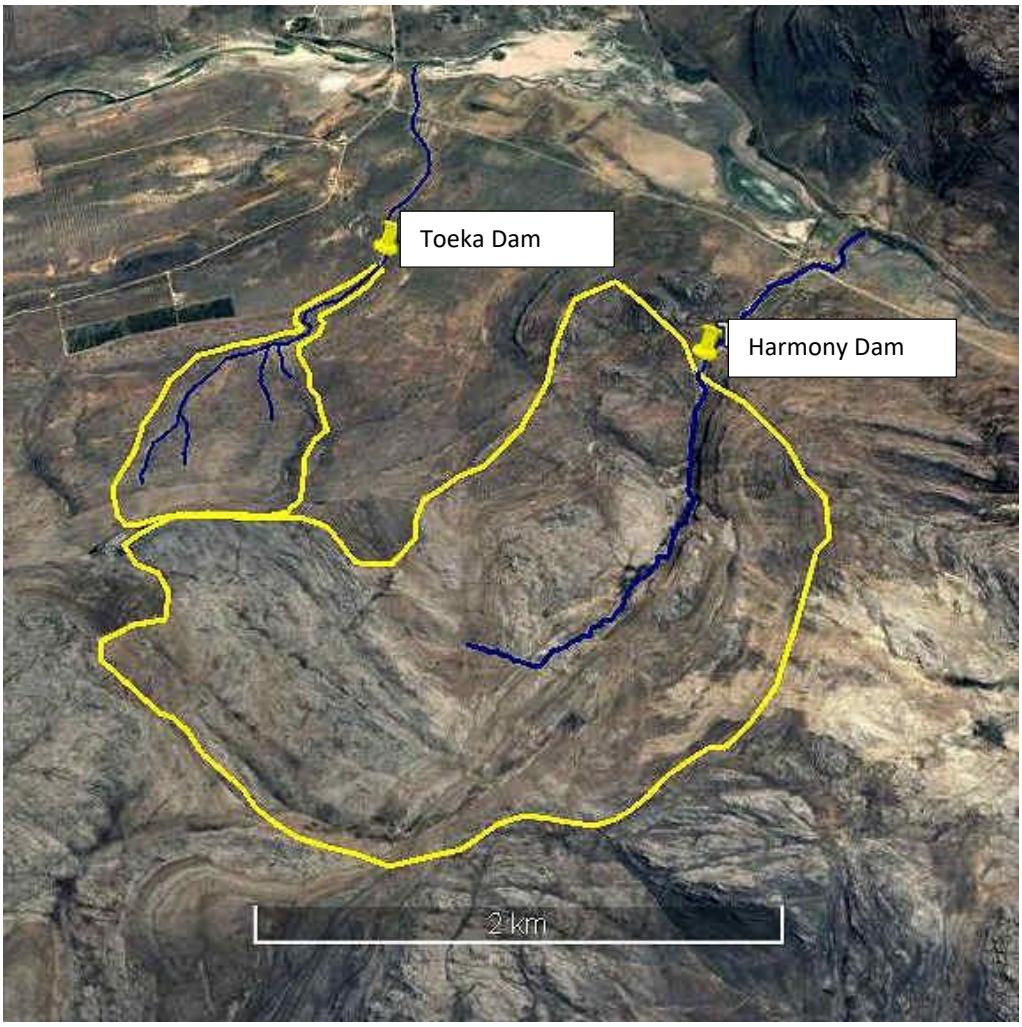

Figure 3 Harmony Dam Catchment

The proposed Harmony Dam is in yet another small drainage line just to the east of the envisaged Toeka Dam. This drainage line was dry during the site visit but was much better developed and visible than the one at Toeka.

The catchment area is bigger at 4.7km^2, with a circumference of approximately 10km. The catchment is approximately 2.8 km long from north to south and 2.8km as well wide from east to west.

The drainage line can be followed from the Houdenbek River up into the mountain for approximately 3.7km.

It shares a boundary with the Toeka Catchment. There seems to be another faint drainage line between the Harmony and Toeka Catchments, with a small catchment area of its own.

At the site of the proposed dam wall the drainage line is still natural, even near-pristine. The riparian zone is narrow and with steep sides and with a healthy stand of the restio *Elegia capensis* (Figure 4). This is a wetland indicator species and a sure sign of a mountain stream.

Figure 4

Elegia capensis

The drainage line downstream of the dam site is straightened, lined with high berms and deeply incised. From here the stream is highly impacted since farming started in the area many decades ago and has progressed since then to where the stream is today as a man-made trench (Figure 5).

The location of the new Harmony dam is marked by an earthen wall (Figure 6) which seems to have been constructed to divert a portion of the flow from the catchment away from the Harmony drainage line. This separate stream runs alongside the drainage line into the overflow channel from the Harmony Dam, from where it flows into the Houdenbek River. This configuration will be further described later in the report. The site of the envisaged Harmony Dam wall has already been significantly disturbed.

Figure 5

Harmony Drainage

Figure 6

Diversion Wall

The Harmony drainage line passes underneath a dirt road with a small culvert that is covered with a concrete slab (Figure 7), from where it flows into the Morester Dam.

The separate stream mentioned earlier crosses the road and flows into the dam's overflow below the spillway to bypass the dam.

Figure 7

Harmony drainage line culvert

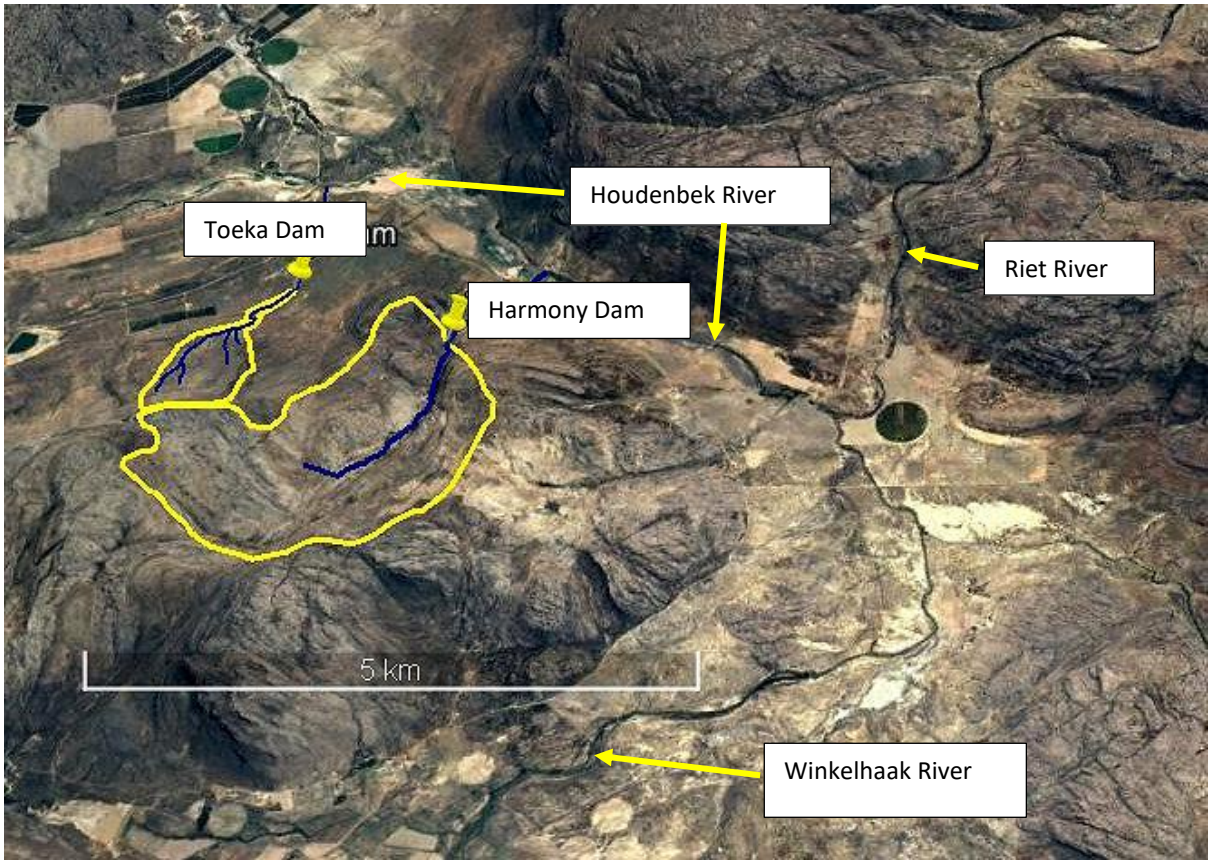

Figure 8 Larger Scale Map

On the larger scale map (Figure 8) is can be seen that the Harmony and Toeka Catchments flow into the Houdenbek River, which together with the Winkelhaak River in turn flows into the Riet River.

The Riet River flows into the Groot River not far away from its confluence with the Doring River. The Doring River is the main tributary of the Olifants River. The Olifants River is next to the Berg River the main river system on the Western Cape's Atlantic

sea board. More information is available in the National River Health Programme reports.

According to the Elsenburg delineation tool, the Harmony catchment yields 330 000m^3 on average per year.

11.2 Harmony Dam

The dam will have a capacity of 250 000m^3. The dam wall will have a length of 270m and the wall will be 13m high. It will cover a surface area of 5 hectares.

The coordinates of the dam wall are as follows:

32°59'54.72" S
19°27'42.70" E

It will be filled with runoff from its own catchment. In dry years, when the runoff is inadequate to fill the dam, it will have to be filled from the much larger Toeka Dam.

11.3 Harmony Instream Flow Requirement (IFR)

The IFR, or ecological release, from the Harmony dam is set at 25%, according to the Sarel Bester Engineers preliminary design report. This demands to 82 500m^3 per year.

11.4 Harmony Present Ecological State

Apart from the farm road that runs alongside the Harmony drainage line and the farm animals that forage on the land, there were no any other discernible impacts. Because of this road, the locality cannot be given full marks.

The sides of the drainage line are rather steep (figure 9), with very little room for a riparian zone. The sides are grown over with a dense stand of *Protea laurifolia* (Figure 10), but no riparian zone indicator vegetation. The instream habitat was marked by a good stand of *Elegia capensis*, but no other instream vegetation.

The drainage line and its riparian zone were both near-pristine at the time of the site visit.

Table 6 Harmony Dam Present Ecological State

Instream	score	weight	Product	Maximum Score	Remark
Water Abstraction	23	14	322	350	
Flow modification	23	13	299	325	
Bed modification	24	13	312	325	
Channel modification	24	13	312	325	
Water quality	23	14	322	350	
Inundation	23	10	230	250	
Exotic macrophytes	12	9	108	225	
Exotic fauna	2	8	16	200	
Solid waste disposal	24	6	144	150	
max score		100	2065	2500	
% of total			82.6		
Class			**A**		Near pristine
Riperian Zone					
Water abstraction	23	13	299	325	
Inundation	23	11	253	275	
Flow modification	22	12	264	300	
Water quality	24	13	312	325	
Indigenous vegetation removal	22	13	286	325	
Exotic vegetation encroachment	23	12	276	300	
Bank erosion	23	14	322	350	
Channel modification	22	12	264	300	
		100	2276	2500	
% of total			91.0		
Class			**A**		Near pristine

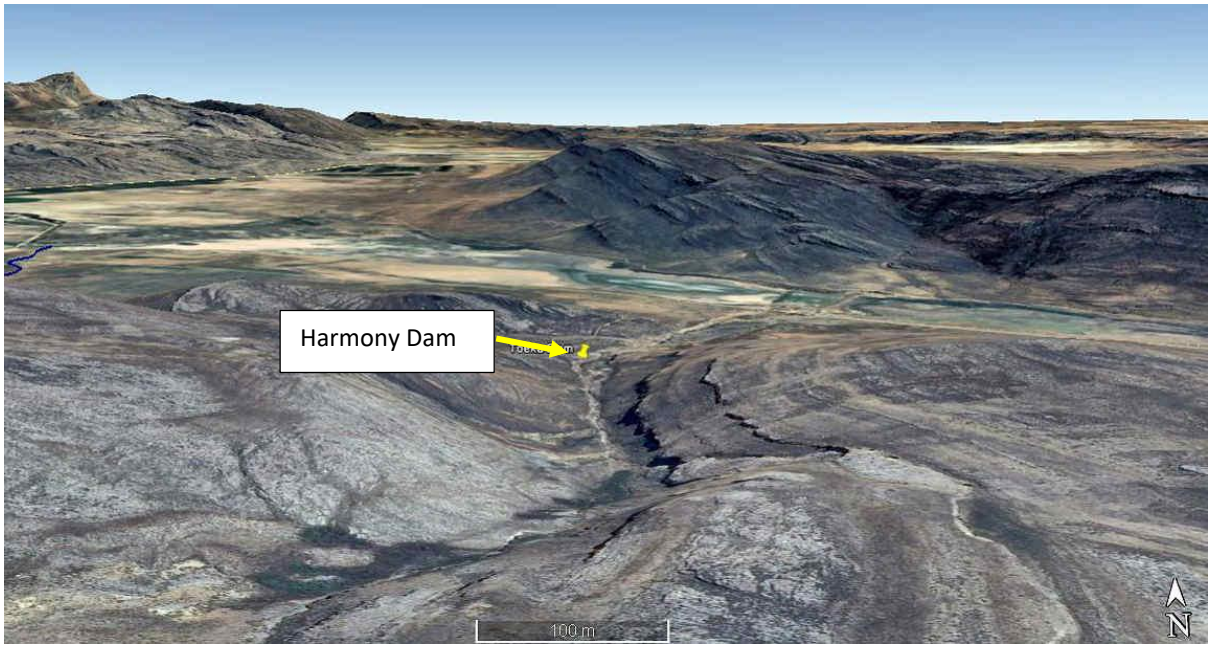

Figure 9 Harmony Dam Site Topography Google Earth Image.

11.5 Harmony Ecological Importance

Like the Toeka catchment, the Harmony catchment is not blessed with any permanent aquatic habitat and therefore no endangered fish species were present. Hence, the Harmony drainage line and the site of the proposed dan cannot be considered as ecologically important. No other endangered species of any description were encountered.

11.6 Harmony Ecological Sensitivity

The riparian zone is terrestrial. If flooded or disturbed by the construction of dam wall, it is doubtful if the original vegetation would ever grow back. This area can therefore be considered as most sensitive.

However, this evaluation is supposed to focus on the aquatic habitat. If the dam is to be removed, it can be expected that the drainage line would return to a condition that is closer to what it is today. The aquatic habitat therefore is not particularly ecologically sensitive.

The drainage line downstream of proposed dam site is most disturbed. It nevertheless had a good stand of mature *Elegia capensis.* This species resurrects itself, even in disturbed areas. Since this is the dominant plant, this indicates that the instream habitat would bounce back if the dam is removed and the habitat restored to its original status. It is unlikely that this would ever happen. Once built, would be a permanent landscape feature. However, if the IFR is set at 25% of the MAR, some die-off of the restios could be expected. It nevertheless shows that the instream habitat is less ecologically sensitive.

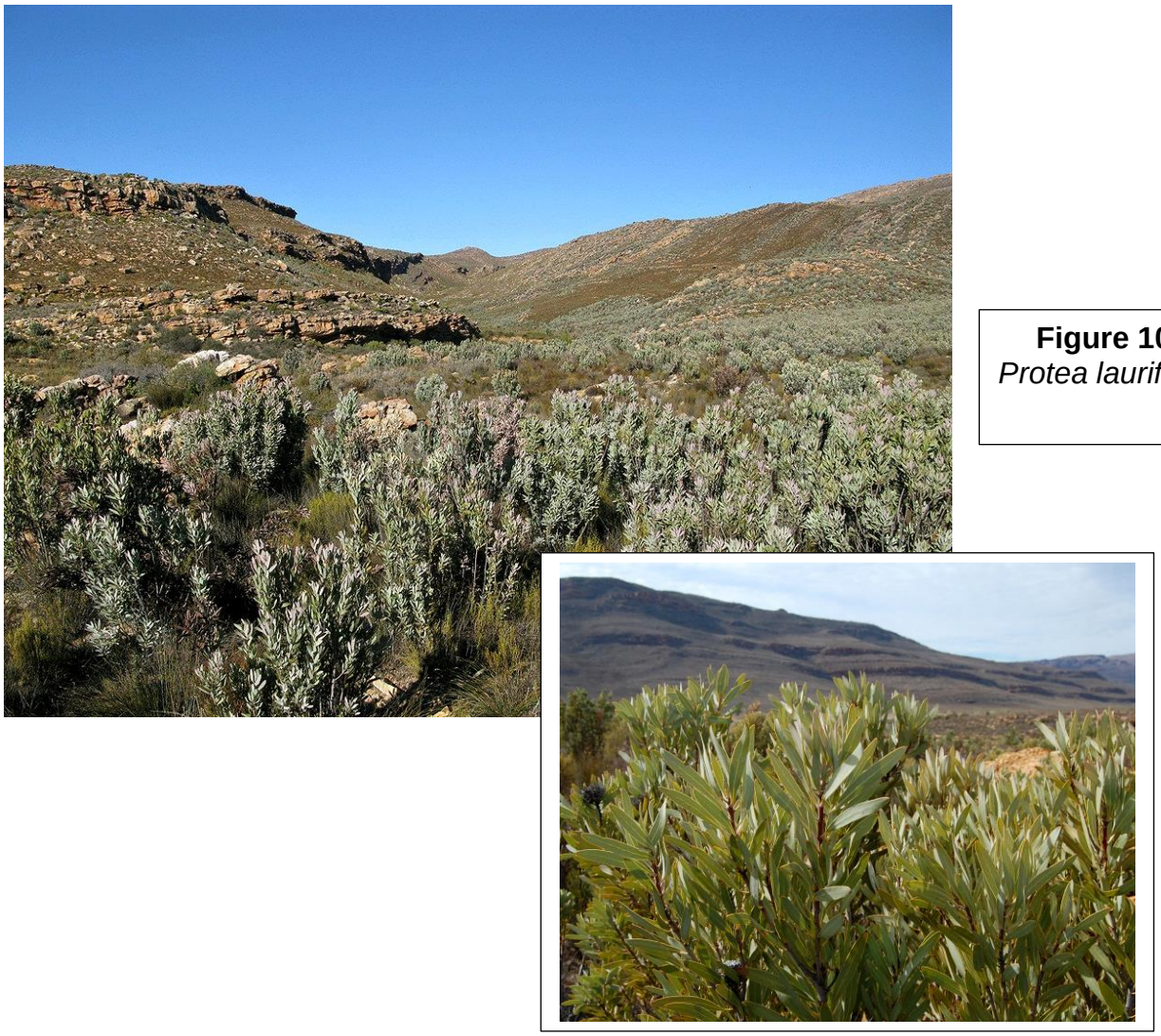

Figure 10
Protea laurifolia

11.7 Harmony Impact Assessment

Table 7 Harmony Mitigation of Impacts

Possible Impact		Extent	Duration	Intensity	Significance	Probability	Confidence
Clearing of the dam sites	Without mitigation	Regional	Long term	Medium	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Collecting construction material from dam sites	Without mitigation	Regional	Medium term	Medium	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Construction of the dams	Without mitigation	Regional	Short term	Medium	High	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Clearing of dam sites	Without mitigation	Regional	Long term	Medium	Medium	Probable	High
	With mitigation	Regional	Long term	Low	Low	Low	Medium
Stabilisation of the new dam walls	Without mitigation	Regional	Long term	Medium	Medium	Probable	High
	With mitigation	Local	Short term	Low	Low	Low	High
Operation of Harmony Dam	Without mitigation	Regional	Long term	High	High	Probable	Medium
	With mitigation	Regional	Long term	Medium	Medium	Probable	Medium

The impact assessment is the same as that of that of the Toeka Dam, with the addition of the 25% IFR. Without the IFR the impact on the downstream drainage line probably would have remained high and not be reduced to medium.

11.8 Harmony Risk Matrix

Table 8 Harmony Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1.1	Clearing of the dam sites	Removal of vegetation, loose rocks, soil	Destruction of riparian vegetation and aquatic habitat	80	Moderate
1.2			Downstream accumulation of sediments	32	Low
2	Collection of construction material from dam sites	Material in riparian and aquatic habitat	Disturbance of habitat	28	Low
3.1	Construction of dam walls	Placing of construction material	Instream habitat destruction	80	Moderate
3.2			Downstream dehydration of Harmony drainage line	138	Moderate
4	Clearing of dam site	Rehabilitation	More sand and material in aquatic habitat	40	Low
5	Stabilisation of new dam walls	Construction	Sand in downstream aquatic habitat	24	Low
6	Operation of Harmony Dam	Implementation of 25% IFR	Dehydration of downstream drainage line	111	Moderate

Table 8 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1.1	1	1	5	5	3	3	4	10
1.2	1	1	1	1	1	2	1	4
2	2	1	2	1	1.5	1	1	3.5
3.1	2	1	5	5	4	1	5	10
3.2	5	1	5	3	3.5	3	5	11.5
4	1	1	1	1	1	3	1	5
5	1	1	1	1	1	1	1	3
6	3	1	3	2	2.25	2	5	9.25

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1.1	1	1	5	1	8	80	Moderate
1.2	1	1	5	1	8	32	Low
2	1	1	5	1	8	28	Low
3.1	1	1	5	1	8	80	Moderate
3.2	3	3	5	1	112	138	Moderate
4	1	1	5	1	8	40	Low
5	1	1	1	1	8	24	Low
6	3	3	5	1	12	111	Moderate

Some of the parameters come out as “Moderate”, which indicate that a license should be issued, rather than a General Authorisation.

12 Houdenbek River

12.1 Houdenbek Catchment

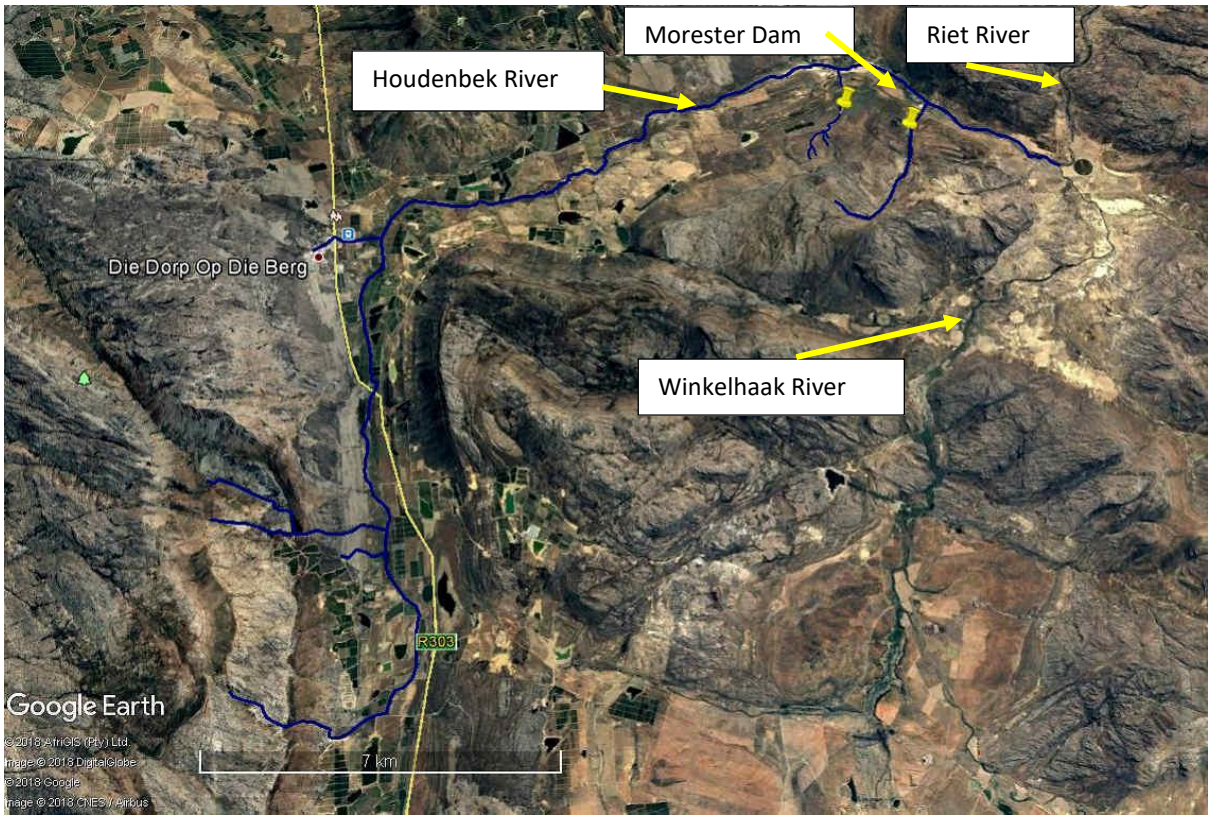

Figure 11 Houdenbek River

Most of the runoff originates from the high mountain ridges and peaks on the east of the catchment (Figure 11). Some peaks are over 1900m above sea level and many of the ridges above 1500m where the rainfall can be 1500mm per year and even more.

The river is approximately 37km long from its furthest mountain stream to its confluence with the Riet River.

The Houdenbek River is in the E21D quaternary catchment.

The catchment covers and area of 242.5 km^2, it receives a mean annual precipitation of (MAP) 627mm per year and the virgin mean annual runoff (MAR) amounts to 46 million m^3, according to the Elsenburg Farm Mapper.

The river valley is heavily developed into farm land, with numerous farm dams.

The Morester Farm is far down the river, close to the confluence. It is the last farm to receive water from the river. Apart from the small contributions of the Toeka and Harmony sub-catchments, it is dependent for its water on the Houdenbek River. The

farm dams higher up in the river are first in line to receive water before the Morester Farm gets it allocated share and before the Morester Dam alongside the river can be filled.

12.2 Harmony Trust Water Demand

The envisaged Toeka Dam cannot be filled from the runoff of its own catchment. The Toeka catchment can only produce 160 000m^3 on average per year. This is after the 25% IFR has been accounted for.

The water demand for the 75 hectares of fruit trees and vegetables on the Harmony Trust Winkelhaak property amounts to 712 500m^3 per year.

The shortfall of water on an annual basis will have to be sourced from the Houdenbek River, if the farming operation is to be successful.

The following quote is from the Sarel Bester Engineers preliminary design report:

According to Howard (2010) *"the available MAR of the Houdenbek River is approximately 24 million m^3 per annum after the irrigation demand as well as the requested reserve has been protected. Most of this water volume comes down during winter flooding periods or short bursts of rain. The new water use application is thus based upon the abstraction of water during these peak surplus periods.*

"However, the large storage volume is based upon the mentioned 30% statistical failure rate as well as the limiting factor of the pumping capacity. It is thus suggested that in general over a 2 to 3-year period a volume of about 2 million m^3 should be potted up to ensure availability of irrigation water over 2 to 4 year wet/dry cycles to meet the annual demand of 712 500m3 for the planned expansion of 75 hectares".

12.3 Site Selection

WULA's for the abstraction of water from mountain sub-catchments of large catchments such as the Olifants and the Breede during short bursts of peak flow is not unique to the Houdenbek situation. Similar WULA's occur in many instances in the Western Cape.

The question arises where the WULA on-site assessment should be done. This is a recurring question for other similar situations.

The impacts are not only directly downstream of these new abstractions but are felt further down the river system where the hydroperiod is shortened and the height of high flows are reduced. The cumulative effect of these abstractions is proven to be significant and to add more is not helping the situation.

However, the impact on the entire river system is the domain of qualified and experienced hydrologists. How much more abstraction can be allowed to approach or exceed the Ecological Reserve rests with the DWS. These are the larger issues that require teams of specialists working together in organised projects.

These issues are very much beyond the scope of a WULA and its budget.

For this reason, the assessment for the Huidenbek / Harmony Trust WULA will be focussed on solely the possible impact on the envisaged new abstraction in the Houdenbek River. A WULA is required for the 712 500 m^3 from the Houdenbek River and the Toeka and Harmony Catchments. The impact from this new water abstraction must be assessed on the Houdenbek River close to and downstream from the confluence of the Harmony drainage line with the Houdenbek River.

Figure 12 Houdenbek River sampling point

The Morester Dam (Figure 12) is an instream dam with the Houdenbek River still visible along its northern bank. The DWS named it the Houdenbek Onder Dam. It is divided into two sections, with the larger part of the dam on the western side. It has two spillways, the one directly on the southern end of the dam (Figure 13) wall and the smaller one on the northern end at right angles with the dam wall (Figure 14).

Figure 13

Southern Spillway

Figure 14

Northern Spillway

The southern spillway follows a wide upside-down question mark-shaped cannel into the Houdenbeks River (Figure 13). This actually is the lower part of the Harmony Bypass. The northern spillway releases its water into the Houdenbek River through a short channel. The sampling point was chosen just downstream of where the Harmony Bypass meets the Houdenbek River.

The Morester Dam is monitored with a depth gauge (Figure 15). The dam was empty and dry at the time of the site visit. The wall (Figure 16) is provided with a valve (Figure 17) that allows for instream flow requirements (IFR) releases.

Figure 15
Gauge

Figure 16
Morester Dam Wall

Figure 17
Valve

The site visit was conducted on 18 May 2018.

12.4 The Houdenbek Sampling Site

The River was dry, with no sign of any water. The vegetation was much drought stressed.

The channel was well demarcated, deeply incised and braided at the sampling point. The river bed wore the scars of the occasional floods that came down with ferocity.

A dense stand of the indigenous willow *Salix mucronata* occurred higher up the banks as shrubs and small trees.

Lower down clumps of tall slender sedge *Cyperus fastigiatus* were present. There were mostly dried out with only a couple showing any signs of life. Reportedly this sedge forms dense stands when the river has water.

There was a smaller sedge as well (Figure 17), of which the identification is left to the experts. The culms were sharply triangular. These were less drought stressed and better coping with the harsh conditions.

There were patches of *Phragmitis australis*, which were waiting for the rains to take over more territory.

Figure 17

Houdenbek River Channel

There were several pine trees near the dam wall and a patch of poplar trees further downstream. Cattle were grazing the area. Apart from these as well as upstream water abstraction there were no other human-induced impacts.

Figure 18

Sedge species

Table 9 Houdenbek Present Ecological State

Instream	score	weight	Product	Maximum Score	Remark
Water Abstraction	5	14	70	350	
Flow modification	5	13	65	325	
Bed modification	24	13	312	325	
Channel modification	24	13	312	325	
Water quality	23	14	322	350	
Inundation	10	10	100	250	
Exotic macrophytes	20	9	180	225	
Exotic fauna	20	8	160	200	
Solid waste disposal	24	6	144	150	
max score		100	1665	2500	
% of total			66.6		
Class			**C**		Moderately Modified
Riperian Zone					
Water abstraction	5	13	65	325	
Inundation	5	11	55	275	
Flow modification	5	12	60	300	
Water quality	24	13	312	325	
Indigenous vegetation removal	22	13	286	325	
Exotic vegetation encroachment	23	12	276	300	
Bank erosion	23	14	322	350	
Channel modification	22	12	264	300	
		100	1640	2500	
% of total			65.6		
Class			**C**		Moderately Modified

Both the instream habitat and the riparian zone has been moderately modified, not because of direct on-site human impact, but because of large-scale upstream water abstraction.

12.5 Ecological Importance

There were no fish species or any other endangered species of any description on or anywhere near the site. Apart from serving as a conduit between the upper catchment and the Doring River, the site cannot be described as ecologically important.

12.6 Ecological Sensitivity

It is surmised that the site will bounce back to its condition before the drought, if it is allowed its natural share of water. Hence it cannot be described as ecologically sensitive.

12.7 Impact Assessment

Table 10 Houdenbek Mitigation of Impacts

Possible Impact		Extent	Duration	Intensity	Significance	Probability	Confidence
Abstraction of water	Without mitigation	Regional	Long term	High	High	Probable	Medium
	With mitigation	Local	Long term	Low	Low	Low	Medium

Mitigation measures:

The impact assessment is carried out under the assumption that the 25% IFR is in place and implemented.

The main impact of the addition abstraction of water would not be on the Houdenbek sampling site downstream of the Harmony confluence, but rather downstream in the Riet River and eventually in the Doring River. The Doring River is already stressed because of water abstraction in the upper catchment. This manifests as a much shortened hydroperiod and the lowering of the water level. More water abstraction from the pumping of water out of the Houdenbek River, together with the loss of water because of the damming of the Toeka and Harmony Catchments, would add to the existing impacts.

It is surmised that the impact could be minimised if the additional water abstraction is affected only when the river is in flood and at its peak flow. The impact would be limited when abstraction is disallowed during base flow and drought flow. Shortening of the hydroperiod would be least noticeable, if at all, if water would be taken only during peak flow.

The measuring of water levels in the Morester Dam is internalised in the Morester management. Likewise, additional measuring of water levels in the Houdenbek River would be an extension of current practice. It is recommended that a measuring mechanism is set up in the Houdenbek River. Abstraction of water for storage in the Toeka and Harmony Dams should only take place when the water level in the Houdenbek River is higher than will be indicated by this envisaged measuring device. Once the level drops lower than the mark on this yard stick, abstraction should be stopped.

The mark on this gauge, whatever form it takes, should be determined by an experienced hydrologist.

Contemporary water level gauges are sophisticated electronic, remotely controlled and computerized devices with perpetual logging facilities that allows for state-of-the-art environmental management.

With such measures, combined with the existing high level of management at the Morester operation, the downstream environmental impact could be reduced from high to low, as is indicated in Table 10. It is assumed that this instrument would be professionally calibrated according to standard operating procedures. The generated data would be available to the authorities and to all who have a scientific interest in the ways and behaviour of rivers.

12.8 Risk Matrix

The Risk Matrix for both the sampling site downstream of the Harmony confluence and downstream in the Doring River come out as low. This seems controversial, because the impacts on the Doring River are known to be significant.

The apparent reasons for this outcome is the way in which the parameters are constructed. The water abstraction from the Houdenbek River will only take place during peak flows, which will be during floods with an average recurrence of once in 3 years. This results in a rating of only 1, which does not reflect the much higher significance of the envisaged abstraction.

In addition, the 2 million m^3 of addition water storage capacity on the Morester operation is small if compared to the total capacity in the upper catchment. The rating is for this addition abstraction and not for the combined abstraction in the entire catchment. The additional abstraction is not going to add a significant difference to the current situation. The risk matrix does not reflect the situation in the lower catchment because of combined current and new abstractions.

Nevertheless, the risk matrix indicates that a General Authorisation is in order. This differs from the risks in the Toeka and Harmony drainage lines, which are best described as moderate and for which a licence is indicated.

Table 11 Houdenbek Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1.1	Abstraction of water from the Houdenbek River	Implement the 25% IFR	Instream and riparian zone on the sampling site downstream of the Harmony Drainage Line	50	Low
1.2			Downstream impact on the hydroperiod and water level of Doring River Disturbance of habitat	52	Low

Table 11 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1.1	2	1	1	1	1.25	3	2	6.25
1.2	3	1	1	1	1.5	3	3	6.5

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1.1	1	1	5	1	8	50	Low
1.2	1	1	5	1	8	52	Low

13 Resource Economics

The goods and services delivered by the environment is a Resource Economics concept as adapted by Kotze *et al* (2009). The methodology was designed for the assessments of wetlands. The lower Toeka catchment indeed resembles wetland conditions. The Harmony and Houdenbek situations are riverine. Nevertheless, the economic goods and services of the three areas under consideration are the same. It would be difficult to separate them. Hence, the sampling point in the Houdenbek River was considered to be representative of the entire Houdenbek Farm.

The diagram (Figure 20) is an accepted manner to visually illustrate the resource economic footprint the river.

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	5
Biodiversity maintenance	5
Water supply for human use	5
Natural resources	2
Cultivated food	5
Cultural significance	3
Tourism and recreation	5
Education and research	5

0	Low
5	High

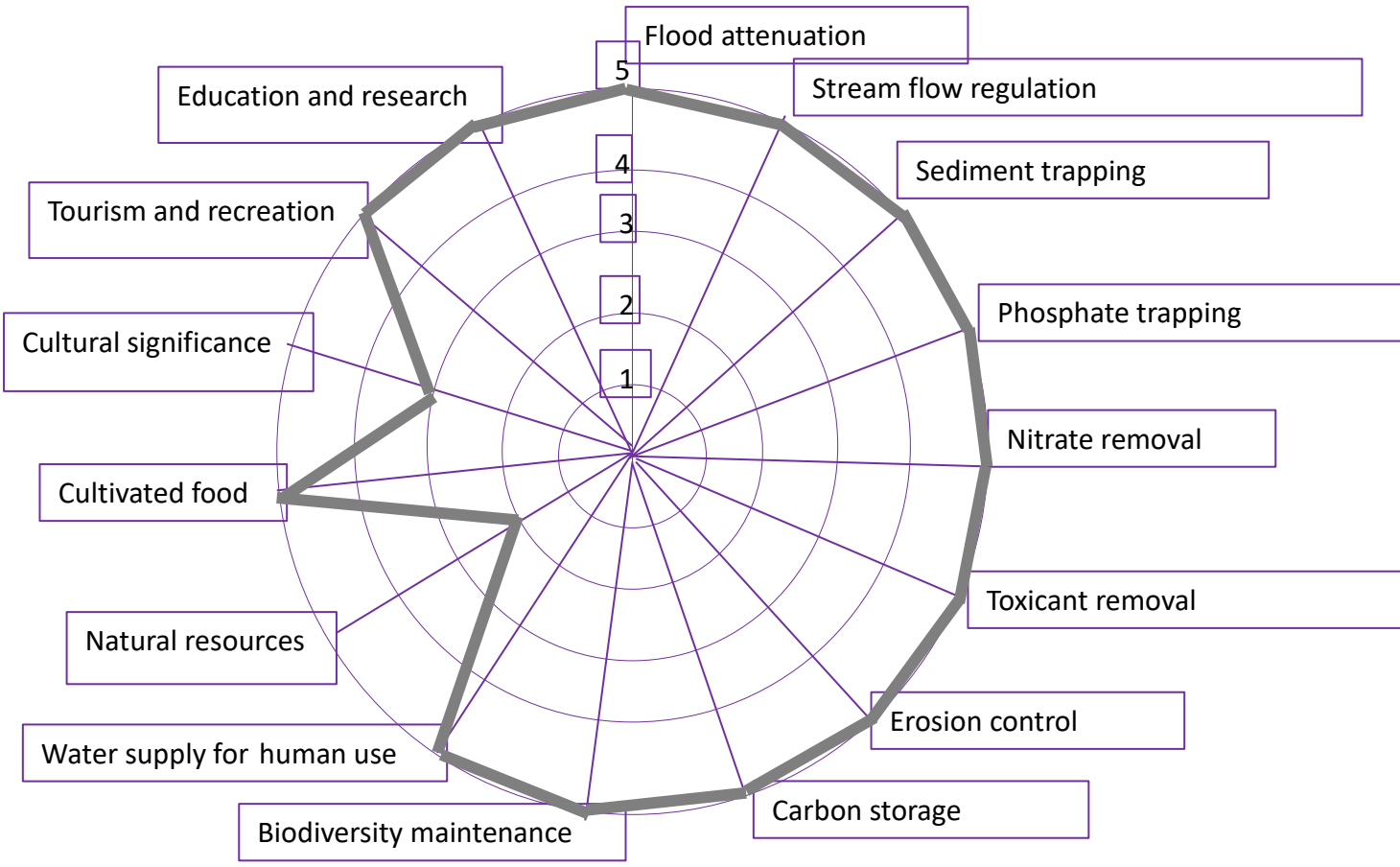

Figure 20. Resource Economics Footprint of the Houdenbek River

The star shape of Figure 20 is large and will probably catch the eyes of the decision-makers. The aspects under consideration were allocated full marks all around the star, except for two of the parameters. This illustrates that the Houdenbek Catchment at the Morester operation is important and that it demands due diligence from the decision-makers.

14 Conclusions

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

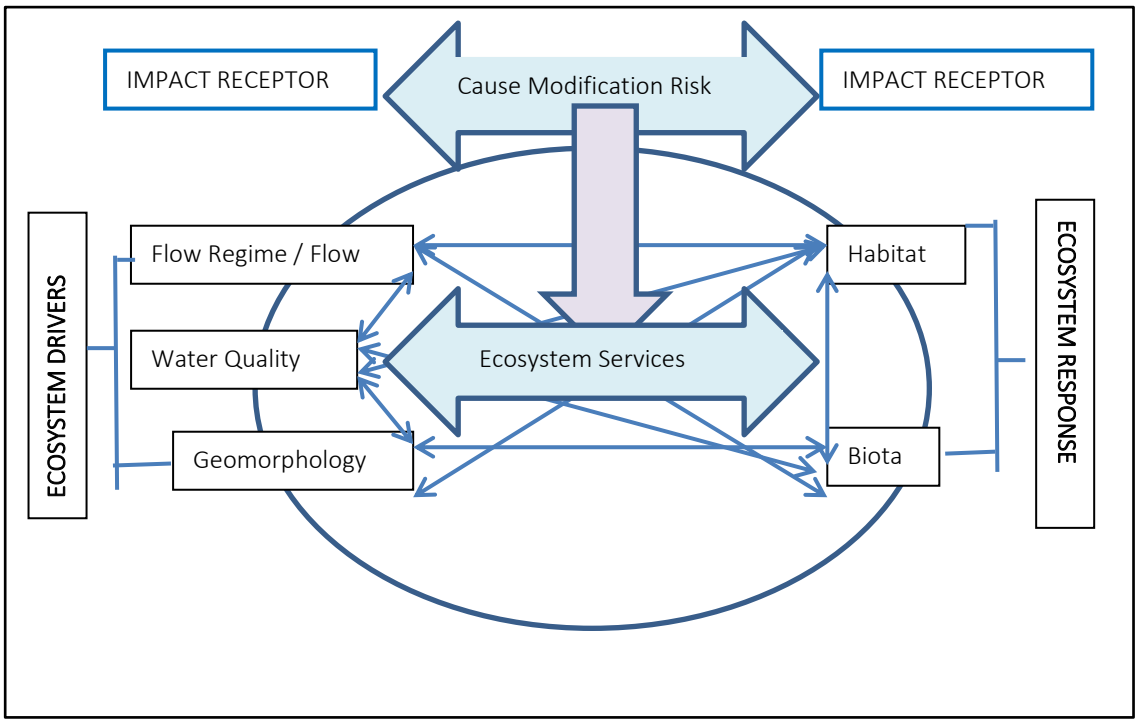

Figure 21 Minimum Requirements for a S21(c) and (i) Application

An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on all of the other drivers and responses. This, in turn, will predictably impact on the ecosystem services. 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 5.

The main driver of the Toeka and the Harmony drainage lines is the winter rain, especially the significant rainfall that occurs at a return rate of once in 3 years. This is opposed by the summer drought that erases any sign of surface water. The upper sub-catchments are not modified.

The situation with the Houdenbek River is similar. Rainfall heavy enough to result in peak flow occurs on average once in 3 years.

The destruction of aquatic habitat because of the construction of the envisaged dams is not deemed as significant. The impact receptor would be downstream in the Doring River, which is already water stressed.

The construction of instream dams warrants licence applications rather than General Authorisations, as indicated by the Risk Matrix. However, the aquatic habitat of the Toeka and Harmony drainage lines is not deemed ecologically important or sensitive, according to the definitions prescribed for this this report. More important is that the impact on the lower catchment such as the Doring River was controversially classified as “Low”. This is the result of the manner in which the risk matrix generates a classification, rather than a reflection of the extent of the impact. According to this outcome it is indicated that a General Authorisation would be in order for this application.

The impact on the Doring River can be significantly reduced if water abstraction is only allowed during peak flows.

The existing BEE irrigation venture that would be expanded and rendered profitable by the two dams and irrigation infrastructure is most desirable.

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16 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: May 2018

16 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 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

Recent Reports &
Water Use License Applications

- 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