NAMA KHOI MUNICIPALITY

WATER USE LICENSE APPLICATION
FRESH WATER REPORT
PROPOSED PIPELINE RECONSTRUCTION FOR THE WATER PROVISION OF

KOMAGGAS

A requirement in terms of Section 21 (c) and (i) of the
National Water Act (36 of 1998)
April 2020

EnviroAfrica
Environmental Management and Impact Assessment
Omgewingsbestuur en Impakbeoordeling

bvi 50 YEAR CELEBRATION EST 1967-2017
ENGINEERING • PROCUREMENT • MANAGEMENT

WATSAN Africa

Index

Abbreviations

Critical Biodiversity Area	CBA
Department of Environmental Affairs	DEA
Department of Environmental Affairs and Nature Conservation	DENC
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
Mean Annual Runoff	MAR
Present Ecological State	PES
Section of an Act	S
South Africa National Biodiversity Institute	SANBI
Water Use License Application	WULA

List of Figures

List of Tables

1 Introduction

The town of Komaggas in the far north west of the Northern Cape Province have since long suffered from a limited potable water supply because the insufficient pipeline from boreholes. These boreholes are located far afield and the diameter of the pipeline is too small, with the results that the pumps are working hard against the flow resistance of the pipe, with a trickle of water coming out on the other side at Komaggas. It has become necessary that the pipeline is replaced. The new pipe will have a much larger diameter.

The Nama Khoi Municipality has appointed the civil engineering consulting company BVi of Upington (Figure 1) to investigate the water provision situation at Komaggas, design a new pipeline and oversee the construction process. In terms of current environmental legislation, an EIA is required for the work. Apart from the EIA, a WULA is required as well. BVi has appointed Enviro Africa of Somerset West to carry out the EIA. Since the WULA is an integral part of the EIA, Enviro Africa, in turn, appointed Dr Dirk van Driel of WATSAN Africa to produce the required Fresh Water Report and to submit the WULA to the DWS.

The format and contents of the Fresh Water Report has been developed over a number of years and must contain adequate information for the relevant authorities, such as DWS and DENC and its agencies to derive at informed decisions. The Fresh Water Report is to contain a completed Risk Matrix.

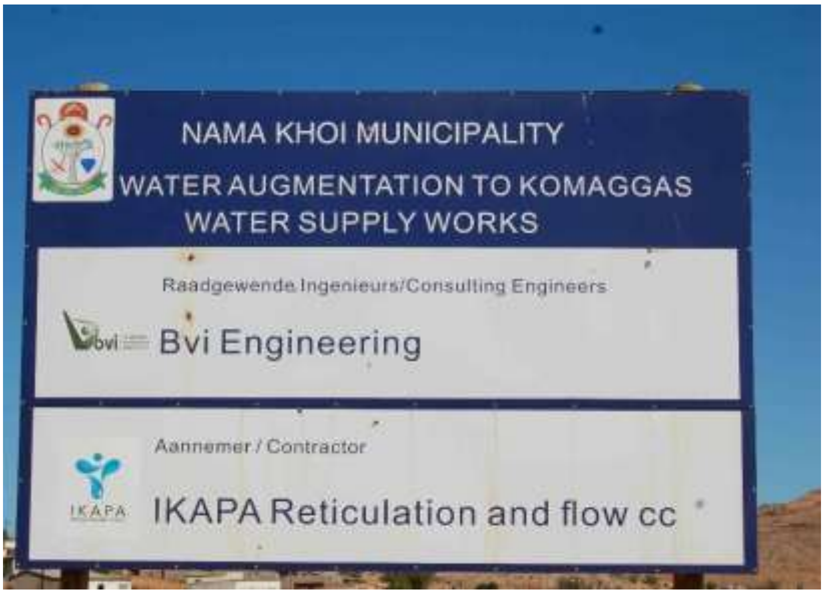

Figure 1 Komaggas Water Augmentation

The issues pertaining to this WULA are pressing, apart from the inadequate pipeline in need of replacement. The pressure on the water resource is high, with the available water already over-allocated. Over-abstraction and climate change have visibly impacted on the South African natural aquatic environment and this will predictably happen at Komaggas as well, should the current demand for water persist.

2 Legal Framework

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

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

The proposed upgrade of the pipeline would be across water courses. The flow may be impeded.

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

The proposed pipeline upgrade may 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 Rainfall

The rainfall varies from 150mm per year at Kamieskroon to only 92mm at Kleinzee, with Komaggas in between at 112mm. The rainfall is higher on the peaks and ridges of the Kamies Mountains and it becomes less at the lower altitudes towards the ocean. Rainfall is mainly in the winter as it is in these climates, which are classified as Mediterranean.

This is a low rainfall, with semi-desert to desert conditions. People are dependent on ground water, as surface water under these dry conditions is few and far between.

4 Quaternary Catchment

The Kommagas River is in the F30G quaternary catchment.

5 Conservation Status

Only part of the Buffels River is classified as a NFEPA on the SANBI BGIS webpage. The Komaggas River, the tributary of concern for this report, is not listed.

6 Vegetation Type

The vegetation in and around Komaggas is listed as Namakwaland Strandveld (Appendix), according to Mucina and Rutherford (2006). It is not listed as endangered in any way. Much of the vegetation is typically the seasonal annuals that emerge in abundance during the winter rains, as well as geophytes that emerge after the rain.

7 Buffels River Catchment

Figure 2 View from Spektakel Pass over floodplain and Spektakel Aquifer

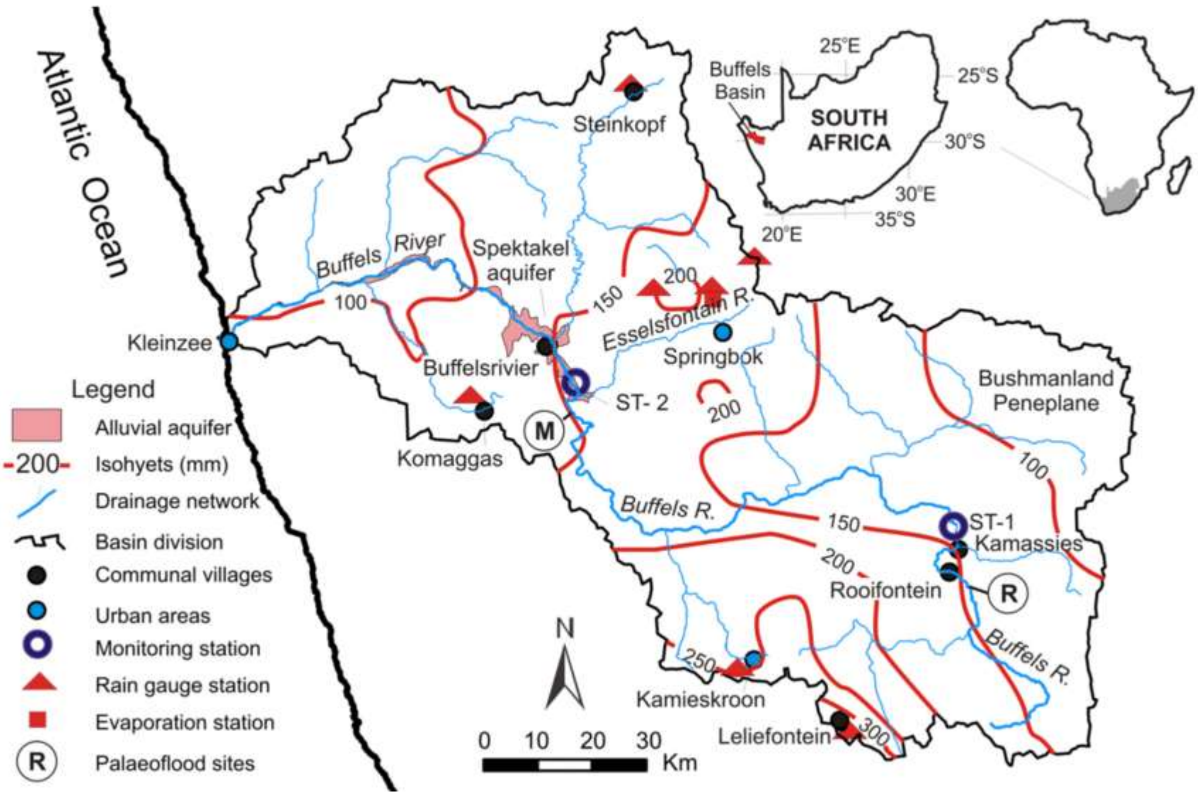

Figure 3 Buffels River Catchment (Benito *et al*, 2011)

The Buffels River and its catchment is located in the arid north west of South Africa along the Atlantic sea board (Figure 2 and 3). Benito *et al* (2011) provides much insight into the catchment's characteristics. The river is only approximately 175km long, following the curve of the river, from its beginning in the mountainous terrain of northern Namakwaland to its mostly closed mouth at the ocean.

The catchment area is 9460km^2 in size.

The Kamies Mountains south of Springbok has a peak of approximately 1700masl and another of 1500masl, with the higher ridges up to 1300masl. Komaggas is at 476masl.

The MAR is only 10.7million m^3, which is little considering the catchment area.

From what is reported in the literature, mostly based on anecdotal evidence, there is water in the river once in 3 to 5 years. It is hard to estimate the frequency of episodic floods. It seems that there has been one flood of note during the past 27 years.

Yet, the mobilisation and deposition of sediments are evident over the length of the river. The middle reaches downstream of the Spektakelberg are approximately 600m wide, with a braided riverbed and continuous sand banks.

The presence of shallow ground water in the Buffels River and its upper tributaries is indicated by a mature stand of mainly sweet thorn trees *Vachellia karoo*, opposed to the barren surrounding landscape. These trees derive their water supply from the underlying ground water.

The Spektakelberg aquifer (Figure 2) located under the river bed is an important feature of the catchment, as it renders ground water to the towns, villages and mines in the area. Closer to the ocean is the Kleinzee aquifer. These aquifers are perpetually replenished by the ground water that migrates along the river bed.

The water surface area estuary is only 1.3ha, which is very small and is not even recognised as a valid estuary by some authors (Fielding, 2016). It is mostly closed to the ocean and only opens up during very large flood events, which are infrequent. The sand berm that separates the estuary from the ocean is 100m wide and even wider and forms a part of the shoreline dune field.

8 The Project

Figure 4 Project (BVi)

8.1 Current Infrastructure

Figure 4 is not very clear, but if enlarged to 120% or more, it becomes clear.

The furthest point of the water provision scheme is in the floodplain of the Buffels River, where water is sourced from the ground water in the alluvium of the river with a series of boreholes. The water is pumped via a pipeline to a reservoir up the hill above the township of Buffelsrivier 7.6km downstream. From here it is pumped further upstream for another 3.8km to the Kwadas Pump Station, another 9.1km to the Voorberg Pumpstation and then another 12 km all the way to the township of Komaggas.

Between the Voorberg Pump Station and Komaggas two more boreholes have been drilled and these will be integrated into the system with pipelines in due course.

At Buffelsrivier, Kwadas, Voorberg and one further along the pipe to Komaggas are reservoirs, one at each of these points.

8.2 The Terrain

For the construction of a pipeline, the terrain is challenging, with sandy riverbeds, narrow gorges, steep mountain sides and rocky substrates. The pipeline follows roughly a semicircle, first to the north west along the Buffels River, then over the hills and mountain sides into the Komaggas River, a tributary of the Buffels River, in an easterly direction, then along the Kommaggas River to the south. The pipeline crosses the road and the Komaggas River several times.

8.3 Scope of Works

Mr Winston Cloete Pr. Eng. of BVi outlined the scope of works as follows:

Construction of 1.5 Ml Concrete Reservoir
Construction of a 78Kl Reservoir at Buffelsrivier township

Construction of water pipelines form new boreholes (± 2.0km in total). Underground uPVC pipeline or above ground steel pipeline

- New pipeline 1: Supply pipeline from Borehole KG19-DT5,3,2 – 230m
- New pipeline 2: Supply pipeline from Borehole KG19- DT1 – 525m
- New pipeline 3: Supply pipeline from Borehole KG19- DT4 – 1,520m

Construction of Electrical Supply lines to new boreholes

- Option 1: Section1 + Section2+ Section3+ Section4+ Section6 – 10.7km
- Option 2: Section1 + Section6+ Section5+ Section4+ Section3 – 10.7km

Upgrading of service roads to all boreholes

Equipment of new boreholes.

- KG19-DT1
- KG19-DT2
- KG19-DT3
- KG19-DT4
- KG19-DT5
- KG19-DT6

Refurbishment of existing boreholes

- KG 109
- KG 108
- KG 107
- KG 115
- KG 100
- KG 2
- KG 4
- KG 106
- KG 102
- KG 104

In yet another email message, the project was described as follows:

- Construction of 1.5 Ml Reservoir (near existing reservoir site in Komaggas)
- Refurbishment of existing water main from Buffelsrivier to Komaggas (brown, magenta, orange and blue lines) (Figure 4).
- Construction of new water pipelines between boreholes (green lines)
- Refurbishment of existing pump station

The WULA requires that each of these aspects are evaluated, specifically with regard to the impact or potential impact on the aquatic environment.

8.4 The new reservoir

Figure 5 Komaggas Reservoir

A new reservoir is to be constructed adjacent to the existing reservoir, up against the hill above the township of Komaggas.

The envisaged reservoir is not located near any natural drainage line and therefore, if constructed, not have any impact on the aquatic environment.

There is going to be a new small water storage facility of 78Kl at Buffelsrivier (Figure 25, p27). This is going to be high up the hill and won't have any impact at all on the aquatic environment.

8.5 Refurbishment of the Pipeline

8.5.1 First section next to Komaggas to 2.5 km

The first section of the pipeline that is to be evaluated stretches from Komaggas along the road that connects the town to the R355 trunk road. The R355 connects Springbok and Kleinzee. The Komaggas Road is a tarred road. It follows a drainage line in a valley that stretches from the south west to the north east diagonally across the map (Figure 6). For most of the way, the Komaggas road has the drainage line on the one side and the pipeline on the other. The road separates the pipeline from the drainage line.

The refurbishment entails that the existing above-ground pipeline will be replaced with a similar one with a bigger diameter.

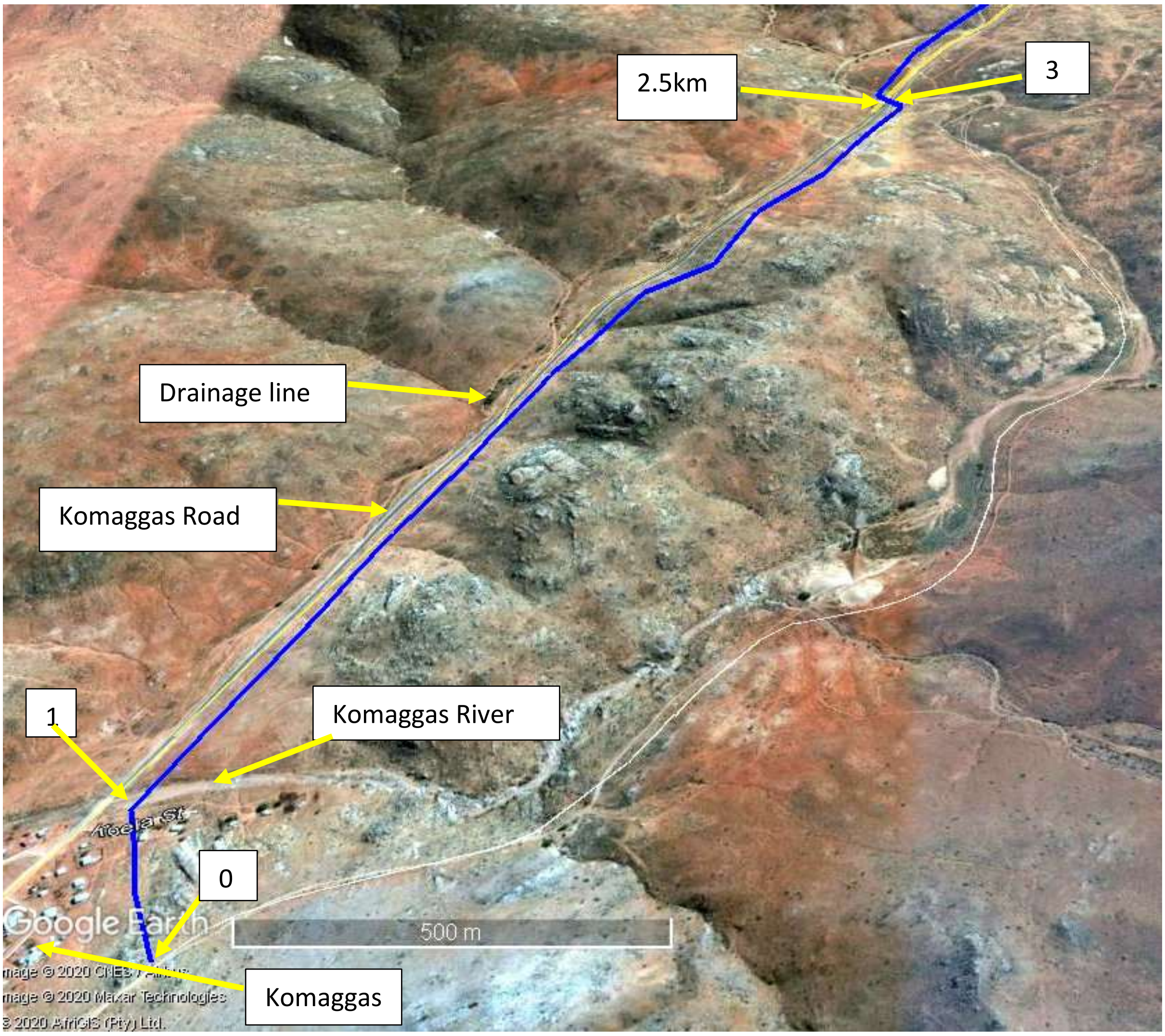

Figure 6 Section of pipeline at Komaggas

Figure 7 Pipeline crossing the Komaggas River

Where the pipeline enters Komaggas, it crosses the Komaggas River, a tributary of the Buffels River. Here the pipeline goes underground (Figure 7 and 8). The pipeline is simply dug in underneath the Komaggas River. Reportedly, it has been buried to a depth of 1.5m. Note that the Kommagas River flows to the south west and it joins the Buffels River much further downstream.

Figure 8 Pipeline crossing the Komaggas River (Continued)

8.5.2 Potential impact of the crossing on the aquatic environment

After more than 10 years of the operation of the pipeline, there is no visible impact on the river bed. There is no visible scar where the pipeline was originally covered. When the old pipeline is removed from the river bed and replaced with a new one, it stands to reason that there will be loose backfill material. It is expected that after levelling and landscaping the disturbed ground, the river bed will return to its current state, with very little evidence that a pipeline passes underneath.

Figure 7 shows that the pipeline has been dug in in the river bed rather than on the banks of the river. Likewise, it exits in the river bed. In the event of a 1:100 year-flood, the pipeline may be washed away.

8.5.3 Recommendations

It is therefore recommended that the pipeline is trenched through the entire river bed, from bank to bank, to make proper provision for large floods. It is obvious that the river and its episodic floods, scarce as they may be, poses a much larger threat to the pipeline than the pipeline poses to the natural aquatic environment.

Figure 9 Next 2.5 km of pipeline

For the next 2.5 km, out of town towards the north east (Figure 6 and 9), the pipeline is more than 100m away from the Komaggas River (Figure 10) or any other drainage line and its refurbishment would therefore not be considered for the WULA.

8.5.4 The 2.5km mark

The crossing at 2.5 km passes underneath the Komaggas Road through the culvert (Figure 10). Concrete anchors support the pipeline on the river bed (Figure 10). On one side of the culvert the pipeline is underground (Figure 1), to emerge above ground on the bank of the river (Figure 11).

8.5.5 Impacts at the 2.5km mark

The existing pipeline has little impact on the aquatic environment at 2.5km. When there is flowing water, it would pass under the pipeline and past the anchors, without significant changes to the flow. The underground pipeline would have no effect on the ecology of the river. The impact happened during the construction phase, of which there was no sign left during the site visit.

Figure 10 Crossing at 2.5km

Figure 11 Pipeline emerge from underground at 2.5km

On the other hand, a 1:100 year-flood would be likely to wash away the anchors and damage the pipeline.

8.5.6 Recommendation pertaining to the 2.5km mark

It is recommended that the upgraded pipeline is dug in underground at least for 1.5m deep all the way through the river bed and that the anchors are removed. This is with the exception of where it passes through the culvert, where the current situation is the practical solution.

8.6 From 2.5km mark to the Balancing Reservoir No. 3

The location of the reservoir (Figure 12) is indicated on Figure 4, p10.

Further upstream the pipeline crosses the Komaggas River yet another three times and a drainage line four times as well for a total of seven crossings (Figure 9, arrows), apart from the one at mark 2.5km.

To limit the volume this report, some principles are emphasised, rather than discussing each and every crossing.

Figure 12 Reservoir 3

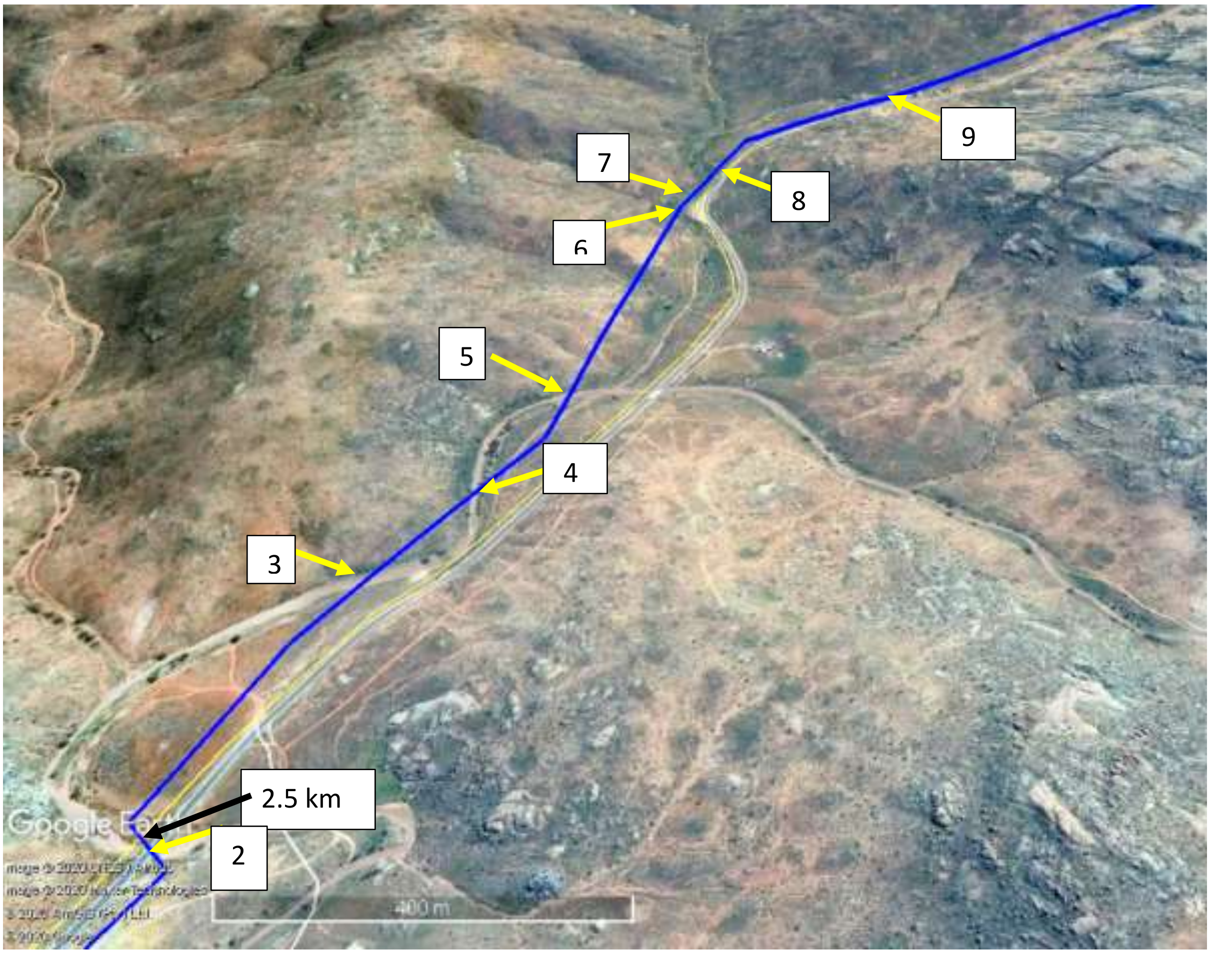

Figure 13 Pipeline 2.5 km out of Komaggas

Figure 14 Crossing between 2.5km and Reservoir 3

Figure 15 Crossing near Reservoir 3

One of the crossings over a drainage line is clearly not having any impact on the aquatic environment (Figure 14), but the pipeline and its anchors are bound to be washed away in the case of a large flood.

It is recommended that the refurbished pipeline be installed on higher pedestals and that these pedestals are constructed further away from the banks of the drainage line, as to avoid any impact.

In another instance, the pipeline crosses a wider river bed (Figure 15). Again, there is not any noticeable impact on the aquatic environment, the impact was during the construction phase and is no longer apparent, but the pipeline is prone to be damaged during heavy floods. The one anchor on the bank has already been washed away and is suspended mid-air. In these cases, it may not be feasible to build higher pedestals, but it could be preferable to dig the pipeline in underground at least 1.5m deep.

8.7 From Reservoir 3 to Reservoir 2

There are 11 crossings between Reservoir 3 and Reservoir 2. Reservoir 2 is at the Voorberg pump station. The pipeline here is aboveground as well, mounted on pedestals.

The points where the existing pipeline crosses the Komaggas River as well as other drainage lines, are indicated on Figure 16 and Figure 17.

A photographic record of some of these crossings is included (Figure18 and Figure 19).

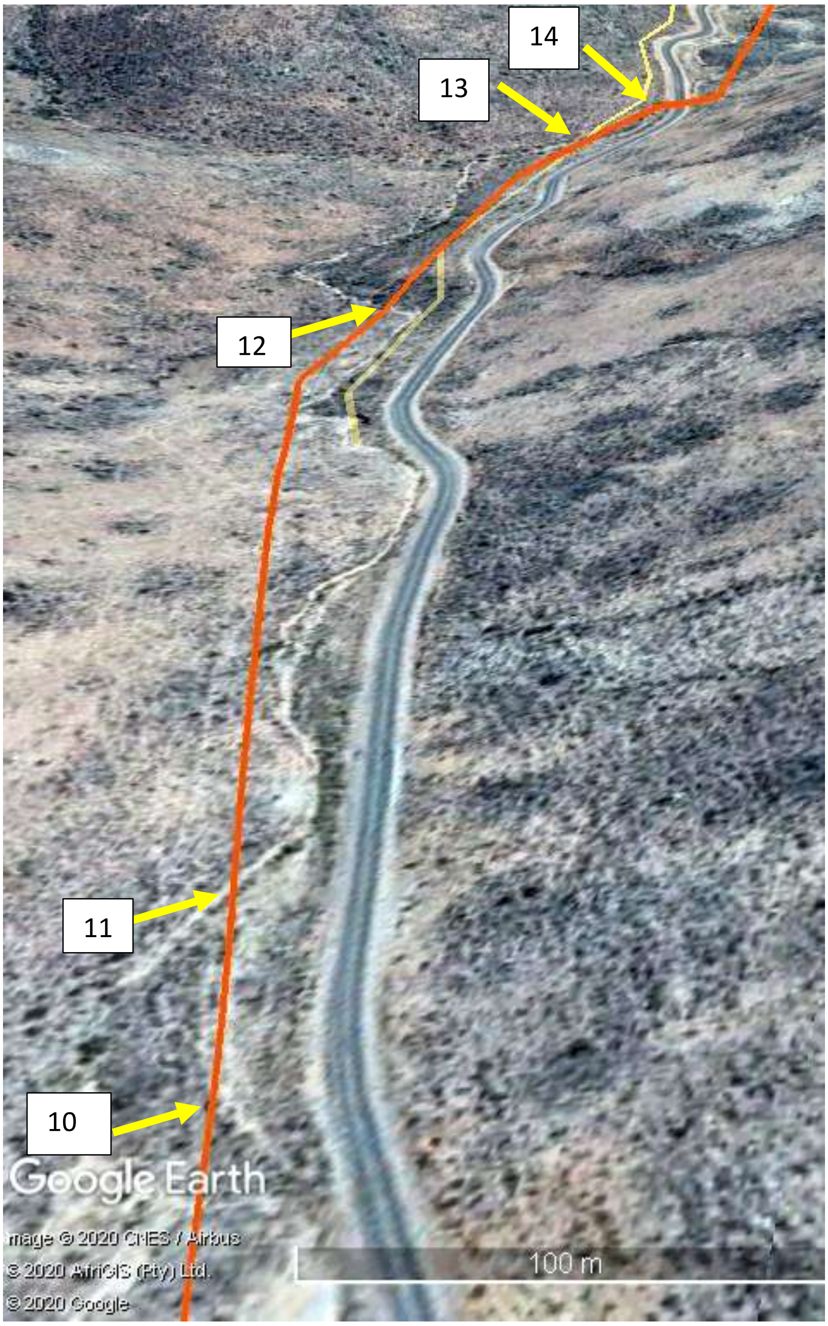

Figure 16 Crossings between Reservoir 3 and Reservoir 2

The issues are exactly the same as of the previous section of the pipeline. The impact on the aquatic environment is negligible. The pipeline is vulnerable to major floods. Vulnerability can be addressed by digging the pipe in underground through the river bed, where possible. The trench should be long enough to reach right through the river banks and up the inclines so that the pipe only emerges out of the ground out of reach of major floods. Where this is not possible, because the ground is too rocky, or where the drainage line's channel is narrow, pedestal anchors may be the better alternative. These should be high enough to let floods through underneath the pipeline and positioned high enough up on the banks out of reach of major floods.

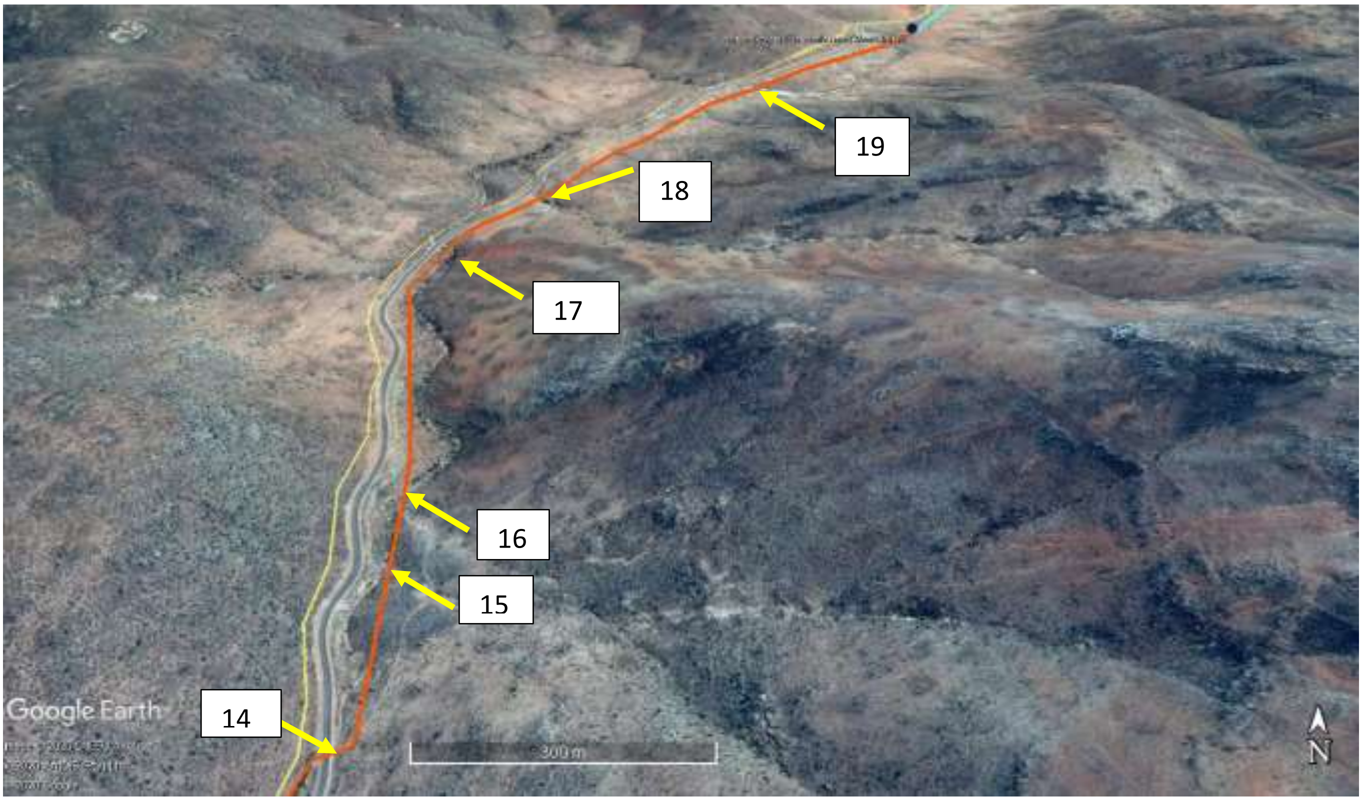

Figure 17 Crossings between Reservoir 3 and Reservoir 2 continued

Adjacent and to the north of Reservoir 2, there is a sub-catchment watershed boundary. To the south of that the flow is down the Komaggas River to the south west. To the north of that the flow is towards the north east down a short drainage line that finds its way to the Buffels River.

Figure 18 Photographic record of crossings between Reservoir 3 and 2

Figure 19 Photographic record of crossings between Reservoir 3 and 2

Figure 20 Reservoir 2

8.8 Section of pipeline between Reservoir 2 and Reservoir 1

The existing pipeline is underground. It is away from any rivers or drainage lines. It could not have had any impact on the aquatic environment during its construction phase. If ever it is dug up to be replaced by a larger pipeline, it would not have any impact on the aquatic environment either.

8.9 Section of pipeline between Reservoir 1 to the Buffelsrivier Reservoir

This section of pipeline is underground as well. It passes underneath a drainage line (Figure 21) that enters the Buffels River nearby. It runs underneath a short reach of the Buffels River broad and sandy bed. From there to the Buffelsrivier Reservoir (Figure 22) it does not have any effect on the aquatic environment.

The network is connected to boreholes further upstream in the Buffels River, right in the flood plain. This pipeline is underground as well. There is no visible impact. The impact was during the construction phase. If ever these pipelines are to be replaced with new ones, the only condition is that they should be buried deep enough so that a flood would not denude them. Apart from this, the backfilled and landscaped trenches would not have a significant impact and any scar would probably disappear after the first rainfall event or strong wind that moves sand over the river bed.

Figure 21 Drainage line at Buffelsrivier township

Figure 22 Buffersrivier Reservoir

8.10 Boreholes

Two new boreholes have been drilled near Reservoir 2 (Figure 23).

Figure 23 Boreholes near Reservoir 2

These boreholes are located more than 32m away from drainage lines, but closer than 100m.

These boreholes have already been drilled (Figure 24), but have not yet been fitted with head gear. The pipelines connecting these boreholes with the existing network has not yet been constructed. These pipes will be underground.

The borehole drilling has had no visible impact on the drainage lines nearby. It is not expected that the connecting pipelines will have any either, as they will be remote from drainage lines.

Figure 24 Boreholes BH BR18/2 and BH BR 18/3

Figure 25 Boreholes in the Buffels River

Figure 26 Operational boreholes in the Buffels River floodplain

As the rest of the potable water provision infrastructure, the existing boreholes probably had little impact on the Buffels River and its floodplain (Figure 25). The structures (Figure 26) are small if compared to the vastness of the floodplain. When in flood, the water would simply flow past the structures, without any further impact.

Likewise, the pipelines that connect the boreholes to the pipeline network downstream would only have had an impact during construction, of which nothing is visible at present.

Borehole 18/3 (Figure 25) must still be drilled. It is not expected that the drilling and the pipeline will have any significant impact.

There are a number of disused boreholes in the floodplain. Some have headgear in various stages of neglect. There is a possibility that some of these can be revived and newly fitted and equipped. Again, this will not have a significant impact on the aquatic environment and should be allowed to go ahead.

Likewise, there are a number of boreholes in the town of Komaggas. These are all away from any drainage line. The above-ground infrastructure as well as the pipelines underground are not liable to cause any impairment on any aquatic habitat.

9 Water Abstraction

The aquatic and riparian ecology should and must be taken into consideration in any Fresh Water Report. Hence the possible impact of ground water abstraction is discussed.

The vegetation in these arid parts is sparse, with a low diversity op plant species and a limited habitat variability. The Buffels River and most of its tributaries are overgrown with a mature stand of sweet thorn *Vachellia karoo*, together with some other scrub and low trees such as *Searsia* species. At the town of Buffels River, the river bed is up to 600m wide, with a well-developed stand of sweet thorn trees (Figure 27). This considerably adds to the habitat variability of the region. These tree lines stretch over the otherwise barren landscape and provide a linear connected habitat that would have been entirely absent if it was not for the shallow ground water in the unconfined aquifer in the alluvium. Likewise, these tree lines provide habitat and nourishment to a variety of fauna that would have been entirely absent, was it not for the gradual migration of shallow ground water along the river bed.

All over the arid and semi-arid landscape of the western half of South Africa, these tree lines are considered to have a special and high conservation value.

The tree lines are currently threatened, in an ever-increasing degree. Abstraction of ground water for human use and the resulting drop of the underground water table can deny these trees of their water supply. In some parts the drying out on drainage lines have already made a mark on the landscape. When travelling on the N7 trunk road through the Hardeveld past Garies, the stretches of dead tree lines are all too obvious.

It is often argued that the demise of tree lines is the result of climate change and not because of over-abstraction of groundwater. If this was valid, a more general dying off over a much wider part of the landscape could be expected, including the Buffels River. Perhaps it would never be known how much can be contributed to climate change and how much to over-abstraction.

Nevertheless, the SRK report (2019) about the groundwater situation and the boreholes in and around Buffelsrivier and Komaggas townships indicates that ground water abstraction over a long period of time has by far outstripped the replenishment of groundwater by rainfall. This has resulted in a drop of the water table.

Obviously, if abstraction it to continue at this rate and even increase as the demand grows, eventually the tree roots will no longer reach the ground water, with catastrophic outcomes to the ecology.

The SRK report indicates that water quality improves if it rains up the catchment, with a decrease in the salt concentration. This shows that the groundwater in the alluvium of the Buffels River is sensitive to rainfall. From this it can be deducted that rainfall and abstraction are intricately balanced and connected, with over-abstraction resulting into predictable and deleterious impacts on the ecology.

The SRK report does not make any mention of ecological impacts, as it is pertinently focussed on water for human use. It is perhaps time that hydrogeologists, together with botanists and ecologists, look into the value of the tree lines along alluviums and the possible effects of water abstraction. It is recommended that the DWS takes this into account when allocating more water to the townships and mines along the Buffels River alluvium. The available water is already over-allocated.

Figure 27 Buffels River tree line

10 Access Roads

Figure 28 Access Road

Figure 29 Access Road Continued

The access roads to the boreholes in the Buffels River floodplain vary from faint two-track paths to well-worn dirt roads (Figure 28 and 29). These roads are obviously not only used by water provision staff, but also by the local population, since the founding of Buffels River township and before. No new roads are planned to existing or new boreholes.

10.1 Possible Impacts

These roads have an impact because they create preferential flow paths, when the river has water during rainfall events. So far there are no signs of erosion, but then some of the existing channels in the braided river along the floodplain may have been scoured out because of previous roads.

At the moment the roads are not much of a concern, but should the population increase with more traffic on the dirt roads, discouragement and control may become necessary.

11 Electric Supply Lines

A 380V overhead electric supply line in the floodplain up to a point has been operational for a long time. It never had and still not has any mentionable impact. From this point the lines are underground.

The electric supply lines to the existing boreholes in the Buffels River floodplain have already been laid, underground. The trenches have been backfilled and landscaped and there is no trace of these currently.

New boreholes will be energised with photovoltaic cells. No new electric supply lines will be installed.

12 Retention Walls

The SRK mentions retention walls across the Buffels River to hold back flowing water to promote infiltration to the aquifer below. Two such earthen walls have been noticed during the site visit, but they did not seem to be functional, with the middle parts missing. This is not a novel idea and many drainage lines have been blocked in this way, mostly on farms.

It is doubtful if an earthen wall will withstand a 1:100 year-flood, but it would retain the small flows, as scarce and infrequent as floods may be.

The tree lines would benefit from these retention walls, if the gain in ground water is not depleted by increased abstraction. Construction would cause some local loss of vegetation, but this seems inconsequential if weighed against possible benefit. It should be officially allowed, should there ever be a request directed at the DWS.

13 Present Ecological State

Table 1 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

Table 2 Komaggas River Habitat Integrity

Instream	score	weight	Product	Maximum Score
Water Abstraction	20	14	280	350
Flow modification	24	12	288	325
Bed modification	23	13	299	325
Channel modification	23	13	299	325
Water quality	24	14	226	350
Inundation	24	10	240	250
Exotic macrophytes	24	9	216	225
Exotic fauna	15	8	120	200
Solid waste disposal	24	6	144	150
max score		100	2112	2500
% of total			84.4	
Class			**C**	
Riperian Zone				
Water abstraction	18	13	234	325
Inundation	23	11	253	275
Flow modification	21	12	252	300
Water quality	24	13	312	325
Indigenous vegetation removal	21	13	273	325
Exotic vegetation encroachment	24	12	288	300
Bank erosion	23	14	299	350
Channel modification	23	12	276	300
		100	2187	2500
% of total			87.4	
Class			**B**	

The Komaggas River and its tributaries are heavily grazed by mainly goats and some cattle. In the township of Komaggas, ‘n number of boreholes probably have an impact on the Komaggas River. For all of the other impacts listed in Table 2, not many marks can be deducted, as the aquatic environment and the riparian zone, mostly dry and arid as it mostly is. The river scores a B, with not much change from the natural condition. The riparian zone scores an A, with hardly any impact.

The construction of the new pipeline is not about to change any of this. During the construction phase, there will be a visible impact, but in the time following during the operational phase, the impact will probably not be noticeable any more.

Table 3 Buffels River Habitat Integrity

Instream	**score**	**weight**	**Product**	**Maximum Score**
Water Abstraction	15	14	210	350
Flow modification	22	12	226	325
Bed modification	20	13	260	325
Channel modification	20	13	260	325
Water quality	24	14	336	350
Inundation	22	10	220	250
Exotic macrophytes	24	9	216	225
Exotic fauna	12	8	96	200
Solid waste disposal	24	6	144	150
max score		100	1968	2500
% of total			78.7	
Class			**B**	
Riperian Zone				
Water abstraction	15	13	260	325
Inundation	22	11	264	275
Flow modification	22	12	288	300
Water quality	24	13	312	325
Indigenous vegetation removal	24	13	312	325
Exotic vegetation encroachment	24	12	288	300
Bank erosion	24	14	336	350
Channel modification	22	12	276	300
		100	2338	2500
% of total			93.4	
Class			**A**	

The Buffels River is impacted some more, if compared to the upper tributaries. In the Buffels River, more ground water abstraction must be accounted for, as well as a lot more grazing by farm animals. The roads and preferential flow paths should be taken into consideration. Hence the instream habitat at the Buffelsrivier township scores a C, which is consistent with the findings of Benito *at al* (2011) for the entire Buffels River catchment. The riparian zone scores a B, which is only slightly impacted. Again, the new pipeline will probably not change the classification.

14 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 4).

Table 4. Ecological Importance according to endangered organisms (Kleynhans,1999).

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

There is no permanent water in the Buffels River and its tributaries at the river reach in and around Buffelsrivier and Komaggas and hence no habitat for any fish. Therefore, the river cannot be regarded as important, according to this evaluation.

However, the river and its shallow groundwater provided tree-line habitat, which is important on a regional scale.

The pipeline does not affect in any way the river's importance.

15 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.”

If the Buffels 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 Buffels River’s ES is rated as “Moderate” at Buffelsrivier and Komaggas.

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

The Buffels River and its tributaries provides sustenance and moisture as long as the water table and its saturated zone above is high enough for the trees to reach. As soon as the water table drops beyond that point, the die-off would be sudden and catastrophic, as it was elsewhere in Namakwaland and in the Karoo.

If the water table ever was to rise again, it would take many years for the tree line to re-establish itself and grow back to maturity. From this perspective, the Buffels River can be viewed as sensitive.

A scientific prediction as to what level of abstraction would lead to this catastrophic result would be useful for the management of the water resource and the river’s ecology.

One of the mitigation measures could be to monitor the tree line along the Buffels River according to a premeditated scientific program and to adjust ground water abstraction if deleterious impacts become apparent.

16 Impact Assessment

Some of the decision-making authorities 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 5.

Table 5 Impact Assessment

Description of impact

Construction
Re-trench pipelines into sandy river beds
Trenching of electrical cables in river bed

Impact
Disturb river bed

Mitigation measures
Limit the footprint
Level and landscape after construction
Exit pipe from the river bed well out of riparian zone

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

Description of impact

Construction
Dismantle existing pipeline at drainage line crossings
Construct new pipeline at drainage line crossings

Impact
Disturbance of drainage lines at crossings

Mitigation measures
Limit foot print
Clean up after construction
If new pedestals are required, construct well out of riparian zone

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

Description of impact **Construction** Construction of new roads in Buffels River bed Ongoing use existing roads **Impact** Create preferential flow paths **Mitigation measures** Prevent construction of new road Limit use of roads								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Replaceability
Without mitigation								
Negative	Local	High	Long term	High	Definite	Certain	Irreversible	Irreplaceable
With mitigation measures								
Negative	Local	Medium	Long term	Medium	Definite	Sure	Irreversible	Irreplaceable

Description of impact **Construction** Reconstruct retaining walls in Buffels River bed **Impact** Disrupt flow Promote replenishment of ground water **Mitigation measures** Limit foot print Clean up after construction								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceable
Without mitigation								
Positive	Regional	High	Long term	High	Definite	Certain	Irreversible	Irreplaceable
With mitigation measures								
Positive	Regional	High	Long term	High	Definite	Sure	Irreversible	Irreplaceable

Description of impact **Construction** Ongoing abstraction of water from the alluvium **Impact** Destruction of tree line **Mitigation measures** Limit water abstraction to sustainable levels Disallow increase of abstraction Plan for alternative water resources Monitor tree line and adjust abstraction according to monitoring results								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative/ Direct	Regional	High	Long term	High	Definite	Certain	Irreversible	Irreplaceable
With mitigation measures								
Negative	Regional	Medium	Long term	Medium	Definite	Sure	Irreversible	Irreplaceable

The reconstruction of the retention walls in the Buffels River is controversial, as it will contribute towards the replenishment of the ground water and towards preserving the tree line, which is a positive impact. At the same time, it would disrupt the natural flow down the river, which could be viewed from a more purist point of view as negative. Moreover, if the wall is washed away by a serious flood, as is evident in this catchment, nothing can be done but counting the costs and to reconstruct the wall. For the sake of this evaluation the impact is regarded as positive.

The impacts of trenching in sandy river beds, as well as the reconstruction of the pipeline across drainage lines is slight and after some time not noticeable. From this perspective the development should be allowed to go ahead. Even the roads have a small impact that should not sway decision-makers towards disallowing the project.

The main concern is the ongoing over-abstraction of ground water in the alluvium of the river. In the long run this could be devastating to the riverine ecology.

17 Risk Matrix

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 6 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 6 (continued) represent the same activities as in Table 5.

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

Table 6 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Re-trench pipelines into sandy river beds Trenching of electrical cables in river bed	**Digging trenches in floodplain**	Disturb floodplain	26	Low
2	Dismantle existing pipeline at drainage line crossings Construct new pipeline at drainage line crossings	**Construction works in drainage lines**	Disturb drainage lines	24	Low
3	Construction of new roads in Buffels River bed Ongoing use existing roads	**Creating preferential flow paths**	Alter aquatic and riparian habitat	50	Low
4	Reconstruct retaining walls in Buffels River bed	**Obstructing flow**	Alter aquatic habitat	52	Low
5	Ongoing abstraction of water from the alluvium	**Drop water table**	Threat to tree line, eventual die-off.	60	Medium

Table 6 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	2	1	1	1	1.25	1	1	3.25
2	1	1	1	1	1	1	1	3
3	2	1	1	1	1.25	1	4	6.25
4	3	1	1	1	1.5	1	4	6.25
5	1	1	1	1	1	1	3	5

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significan-ce	Risk Rating
1	1	1	5	1	8	26	Low
2	1	1	5	1	8	24	Low
3	1	1	5	1	8	50	Low
4	1	1	5	1	8	52	Low
5	3	3	5	1	12	60	Medium

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 impacts are low, insignificant. The reconstruction of the pipeline is not a threat to the aquatic habitat and should be allowed to carry on as proposed, according to the Risk Matrix.

However, the ongoing of ground water abstraction above the rate of natural replenishment is probably not sustainable. It is unknown at what point the vegetation in the floodplain will suffer because of over-abstraction. At the moment there is no sign of an impact. This may change, suddenly, as it did elsewhere in the region.

It can be argued, with valid reasons, that the abstraction of ground water has little if anything to do with the actual construction of the pipeline. The brief of this WULA was to evaluate the reconstruction of the pipeline and that the availability of water was entirely another project within the ambit of regional and national authorities. It is for the DWS to decide how and from where the current shortfall on water demand is to be addressed. Abstraction and the availability of water is outside of the current brief. It does not have any bearing on the envisage reconstruction project.

On the other hand, the Fresh Water Report won't be complete if there is no mention of the discrepancy between the availability and demand as well as the predictable impacts on the aquatic habitat.

The Risk Matrix indicates that the construction of the pipeline should go ahead.

It indicates that the current demand for water and future growth in water demand at Komaggas and Buffelrivier is of much concern and that it calls for serious thought and consideration. The authorities, engineering fraternity and all active in the water field are, no doubt, all actively seeking long-term solutions.

18 Resource Economics

The goods and services delivered by the environment, in this case the Buffels River and the Komaggas River, 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 these rivers, the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 30 and 31) is an accepted manner to visually illustrate the resource economic footprint of the drainage lines, from the data in Table 7.

Table 7. Goods and Services

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

0	Low
5	High

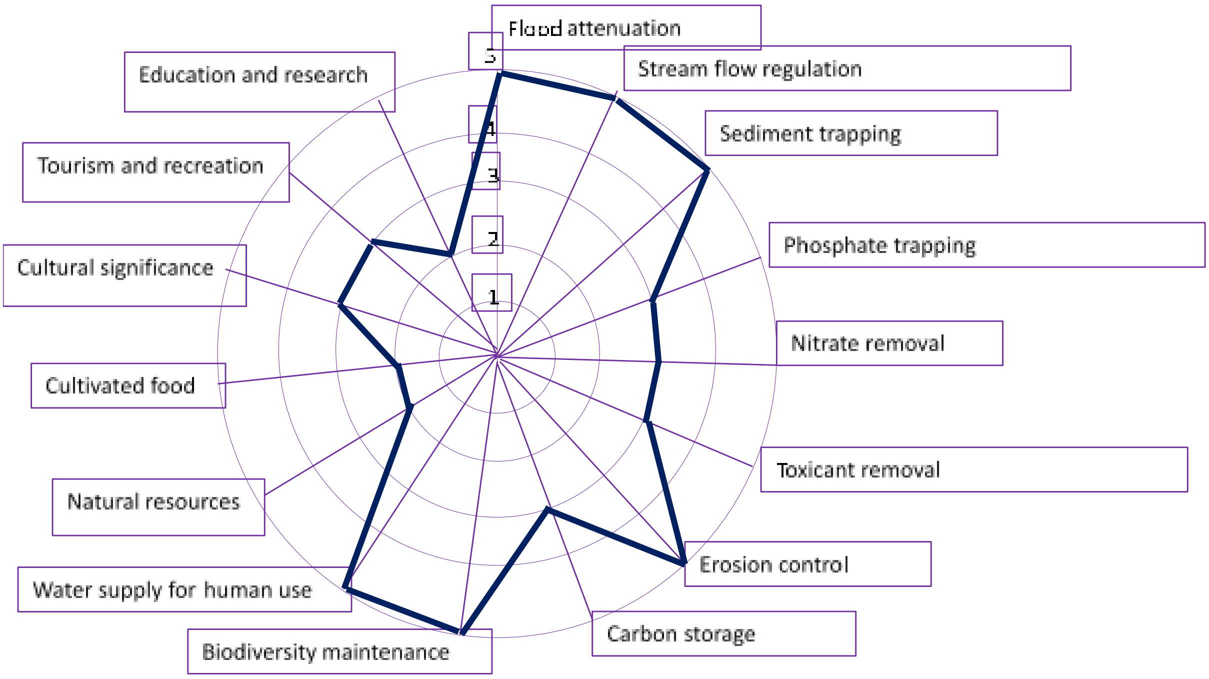

Figure 30 Resource Economics Footprint Buffels River at the Buffelsrivier township

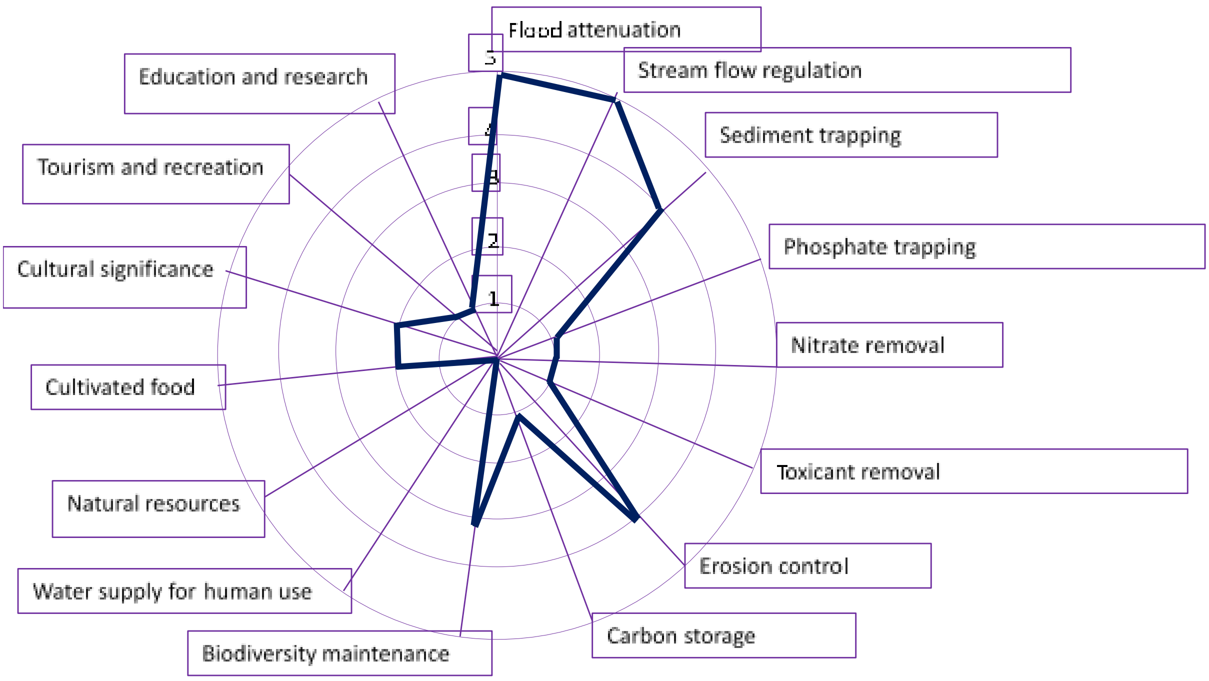

Figure 31 Resource Economics Footprint Komaggas River

The size of the star shape (Figure 18) is the one attribute that attracts the attention of decision-makers. A big star alerts them.

For a mostly dry river in an arid region, the star shape (spider diagram) for the Buffels River is rather large. It indicates the economic significance in term so for goods and services cannot be ignored.

The star shape for the Komaggas River is much smaller, simply because as a tributary, it is much smaller than the Buffels River.

The reconstruction of the pipeline is not about to change any of this.

Intrinsic to the methodology, the economic goods will increase for the Buffels River as water abstraction increases, while the threat to the natural environment increases as well.

18 Conclusions

Figure 32 has been adapted from one of the most recent DWS policy documents.

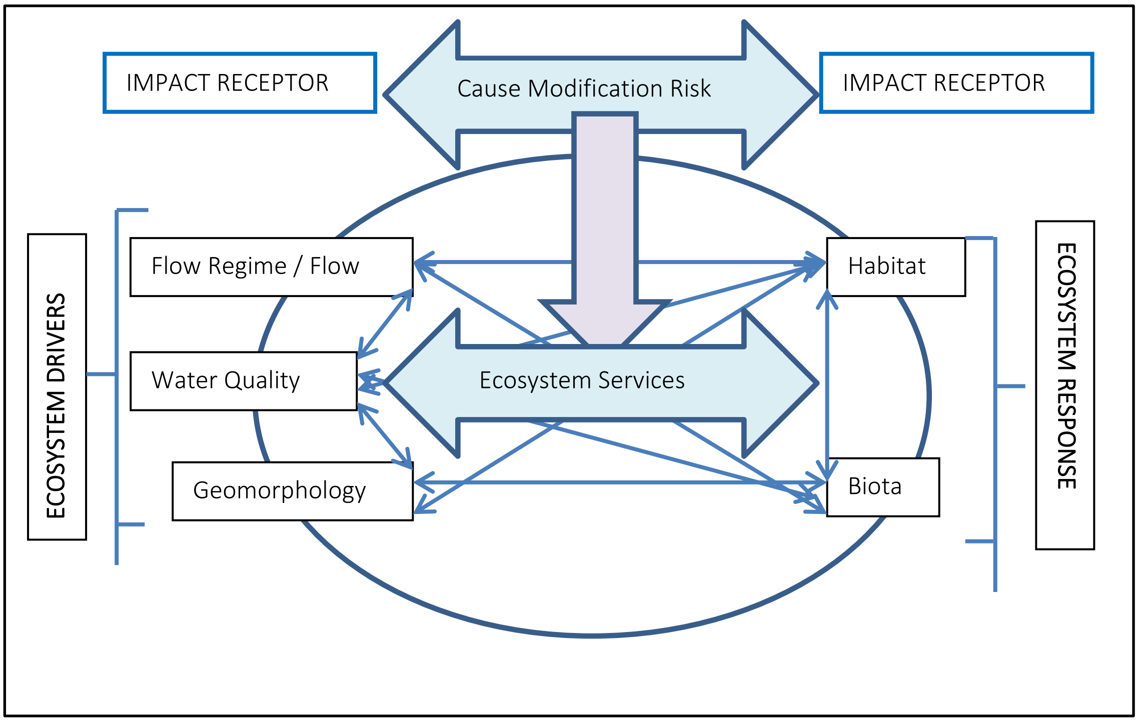

Figure 32 Minimum Requirements for a S21(c) and (i) Application.

An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on 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 32.

The most obvious driver is the perpetual migration of shallow unconfined ground water down the catchment. The next driver is the occasional and infrequent episodic floods. These floods scour out the river bed and assure the existence and integrity of the river morphology. As important are the long drought periods in this arid landscape without any surface water in the river. These circumstances perpetuate as the line of trees that spans across the landscape.

The main impact on the riverine ecology is the abstraction of ground water for human use. If current levels of over-abstraction persist and even increase, the tree line will predictably suffer and die back.

The reconstruction of the proposed pipeline will not add to any current impacts on the Buffels River, its tributaries and the aquatic environment. According to the Risk Matrix, it should be given the go-ahead.

The current over-abstraction of ground water was never a part of the Fresh Water Report, only the reconstruction of the pipeline. Nevertheless, the findings strongly suggest that water abstraction from the Buffels River alluvium should be curbed and that alternative water resources should be found, difficult and expensive as it may seem. This is the domain of the DWS and its provincial agencies and is not included in the brief of this Fresh Water Report.

20 References

Benito, G., B. A. Botero, V. R. Thorndycraft, M. Rico, Y. S´anchez-Moya, A. Sope˜na, M. J. Machado & O. Dahan. 2011. *Rainfall-runoff modelling and palaeoflood hydrology applied to reconstruct centennial scale records of flooding and aquifer recharge in ungauged ephemeral rivers.* Hydrol. Earth Syst. Sci., 15, 1185–1196.

Fielding, P. 2016. *Situation assessment report towards the development of an estuary management plan for the Buffels estuary*. Department of Environmental Affairs, Pretoria.

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

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

Visser, D. 2019. *Komaggas Water Borehole Investigations Hydrogeological Report.* SRK Consulting Engineers. Cape Town.

21 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: D van Driel

Name of the company: WATSAN Africa Date: 24 April 2020

22 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.
- Past Director: UNESCO West Coast Biosphere, South Africa
- Past Director (Deputy Chairperson): Grotto Bay Home Owner’s Association
- Past Member Dassen Island Protected Area Association (PAAC)

Membership of Professional Societies

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

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, Muggievlag Storm Water Canal, Vredenburg
- Fresh Water Report, Marksman’s Nest Rifle Range, Malmesbury
- Biodiversity Report, Muggievlak Storm Water Canal, Vredenburg
- Strategic Planning Sanitation Report, Afghanistan Government, New Delhi, India

23 Appendix

22.1 SKs 7 Namaqualand Strandveld

VT 31 Succulent Karoo (67%) (Acocks 1953). LR 57 Lowland Succulent Karoo (70%) (Low & Rebelo 1996).

Distribution Northern and Western Cape Provinces: Namaqualand Sandveld—from Gemboksvlei (at southern foothills of the Vyftienmyl se Berge in southern Richtersveld as far south as Donkins Bay (south of Doringbaai). Especially in the northern region (plains north and south of Buffels River) this unit penetrates deeply inland (40 km in places). Most of the area is situated deep inland (isolated from the coast by a belt of SKs 8 Namaqualand Coastal Duneveld) and approaching the coast only near the river mouths of the Buffels River, Swartlintjies River, Spoeg River, Bitter River and Groen River. South of Abraham Villiersbaai (south of Groen River mouth) Namaqualand Strandveld descends to the coast and continues as an unequally broad band as far south as Donkins Bay (north of Lamberts Bay). In the south it also reaches deeply inland along the Groen and Swartdoorn Rivers as well as along the lower stretches of the Olifants River. Altitude 20–380 m.

Vegetation & Landscape Features Flat to slightly undulating landscape of coastal peneplain. Vegetation is low species-rich shrubland dominated by a plethora of erect and creeping succulent shrubs (*Cephalophyllum, Didelta, Othonna, Ruschia, Tetragonia, Tripteris, Zygophyllum*) as well as nonsucculent shrubs (*Eriocephalus, Lebeckia, Pteronia, Salvia*). Annual mixed with perennial flora can present spectacular displays in wet years.

Geology & Soils Quaternary stabilised aeolian, deep, red or yellowish red, stable dunes and deep sand overlying marine sediments and granite gneisses. Sometimes weakly defined scattered heuweltjies are found further away from the sea. Unstable white sand dune plumes originate from the river mouths and extend north- and northeastwards up to 25 km inland. Dunes become slightly more stable north of Kleinzee. The area is a combination of Ah, Ae, Af, Ai and Ag land types.

Climate Arid, winter-rainfall area with MAP of 112 mm. Almost all the rainfall occurs from May to August and almost always no rainfall in December and February. Frost is a rare event. Lowest temperatures in winter are 8–10ºC and the highest temperatures in the summer just below 30ºC. See also climate diagram for SKs 7 Namaqualand Strandveld (Figure 5.39).

Important Taxa Succulent Shrubs: *Didelta carnosa* var. *carnosa* (d), *Euphorbia burmannii* (d), *Othonna cylindrica* (d), *Ruschia brevibracteata* (d), *Salsola nollothensis* (d), *Tetragonia fruticosa* (d), *T. spicata* (d), *Zygophyllum morgsana* (d), *Adromischus mammillaris*, *Aridaria noctiflora* subsp. *noctiflora*, *Euphorbia tuberculata* var. *macowani*, *Exomis microphylla* var. *axyrioides*, *Manochlamys albicans*, *Othonna sedifolia*, *Salsola namibica*, *Sarcocaulon flavescens*, *Senecio sarcoides*, *Stoeberia utilis*, *Tylecodon paniculatus*, *T. reticulatus*, *T. wallichii* subsp. *wallichii*. Tall Shrubs: *Nylandtia spinosa*, *Putterlickia pyracantha*. Low Shrubs: *Galenia fruticosa* (d), *Pteronia onobromoides* (d), *Tripteris oppositifolia* (d), *Zygophyllum spinosum* (d), *Asparagus capensis* var. *capensis*, *Berkheya fruticosa*, *Chrysocoma longifolia*, *Galenia secunda*, *Helichrysum cylindriflorum*, *H. hebelepis*, *Hermannia cuneifolia*, *H. multiflora*, *H. trifurca*, *Hirpicium alienatum*, *Justicia cuneata* subsp. *latifolia*, *Lebeckia halenbergensis*, *L. spinescens*, *Limeum africanum*, *Nenax arenicola*, *Pelargonium praemorsum*, *Pharnaceum aurantium*, *P. confertum*, *Pteronia divaricata*, *Salvia lanceolata*, *Tripteris sinuata*, *Wiborgia fusca* subsp. *fusca*. Semiparasitic Shrub: *Thesium spinosum*. Woody Climbers: *Asparagus fasciculatus*, *A. retrofractus*, *Microloma sagittatum*. Herbs: *Oncosiphon suffruticosum* (d), *Amellus microglossus*, *Arctotheca calendula*, *Gazania jurineifolia* subsp. *scabra*, *Heliophila coronopifolia*, *Hermannia althaeifolia*, *Leidesia procumbens*, *Nemesia ligulata*, *Osteospermum pinnatum*, *Rhynchopsidium pumilum*. Geophytic Herbs: *Bulbine frutescens*, *Oxalis annae*, *O. pes-caprae*, *O. purpurea*. Succulent Herbs: *Aloe arenicola*, *Conicosia pugioniformis* subsp. *pugioniformis*, *Psilocaulon dinteri*. Graminoids: *Ehrharta calycina* (d), *Schismus barbatus* (d), *Stipagrostis zeyheri* subsp. *macropus* (d), *Chaetobromus involucratus* subsp. *dregeanus*, *Cladoraphis cyperoides*, *Ehrharta barbinodis*, *E. delicatula*, *E. triandra*, *Pentaschistis airoides*, *Willdenowia incurvata*.

Biogeographically Important Taxa ([NQ]Namaqualand endemic, [N]Northern distribution limit) Succulent Shrubs: *Othonna arborescens*[N], *Vanzijlia annulata* [NQ]. Tall Shrubs: *Euclea racemosa*[N], *Rhus glauca*[N]. Low Shrubs: *Aspalathus spinescens* subsp. *lepida*[N], *Dischisma struthioloides* [NQ], *Lebeckia grandiflora*[N], *Leucoptera nodosa* [NQ], *Lobostemon pearsonii*[N], *Pelargonium crassipes* [NQ], *Pteronia fastigiata*[N], *Salvia africana-lutea*[N]. Semiparasitic Shrub: *Thesium elatius*[N]. Herbaceous Climber: *Indigofera procumbens*[N]. Herbs: *Zaluzianskya villosa*[N] (d), *Diascia nana*[N], *Indigastrum costatum* subsp. *macrum*[N], *Kedrostis psammophylla* [NQ], *Manulea altissima* subsp. *longifolia* [NQ], *Nemesia versicolor*[N], *Trichogyne lerouxiae* [NQ]. Geophytic Herbs: *Ferraria foliosa*[N] (shared with FS 1 Lambert's Bay Strandveld), *Gethyllis polyanthera*[N], *Holothrix grandiflora*[N], *Lachenalia bulbifera*[N], *Oxalis compressa*[N], *O. flava*[N], *O. pulchella* var. *glauca* [NQ]. Succulent Herb: *Othonna gymnodiscus*[N], *Tetragonia pillansii* [NQ]. Graminoids: *Ehrharta ramosa* subsp. *aphylla*[N], *E. villosa* var. *maxima*[N], *Thamnochortus lucens*[N].

Endemic Taxa Succulent Shrubs: *Lampranthus suavissimus*, *Tylecodon decipiens*, *T. fragilis*. Low Shrubs: *Afrolimon* sp. nov. (*Mucina 210103/1* STEU), *Gorteria* sp. nov. (*Le Roux, Karis & Mucina 050905/2* STEU), *Sutera multiramosa*. Geophytic Herbs: *Lachenalia valeriae, Romulea sinispinosensis*.

23.2 Methodology used in determining significance of impacts

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

Table 23.2.1 Nature and type of impact

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

Table 23.2.2 Criteria for the assessment of impacts

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

Table 23.2.3 Significance Rating

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

Table 23.2.4 Probability, confidence, reversibility and irreplaceability

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

23.3 Risk Matrix Methodology

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

Negative Rating

TABLE 1- SEVERITY

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

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

TABLE 2 – SPATIAL SCALE

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

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

TABLE 3 – DURATION

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

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

TABLE 4 – FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

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

TABLE 5 – FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the environment?

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

TABLE 6 – LEGAL ISSUES

How is the activity governed by legislation?

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

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

TABLE 8: RATING CLASSES

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

A low risk class must be obtained for all activities to be considered for a GA

TABLE 9: CALCULATIONS

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

23.4 Chainage of the pipeline from Komaggas to the furthest borehole

No.	Chainage Km	Coordinates	Elevation masl
0	0	29°47’34.43”S 17°29’38.86E	340
1	0.3	29°47’26.09”S 17°29’33.74E	297
2	2.5	29°46’36.18”S 17°30’84.43E	375
3	3.0	29°46’14.42”S 17°30’31.12E	384
4	3.2	29°46’08.96”S 17°30’28.60E	384
5	3.4	29°46’54.28”S 17°30’20.22E	392
6	3.9	29°46’39.51”S 17°30’23.85E	400
7	4.1	29°46’34.19”S 17°30’25.60E	403
8	4.4	29°46’27.29”S 17°30’31.50E	417
9	4.7	29°46’18.80”S 17°30’42.02E	443
10	7.6	29°46’14.19”S 17°30’21.42E	519
11	7.7	29°46’14.14”S 17°30’17.19E	513
12	8.2	29°43’56.73”S 17°30’12.19E	466
13	8.6	29°43’44.22”S 17°30’12.35E	446
14	8.7	29°43’40.11”S 17°30’13.28E	442
15	9.0	29°43’31.51”S 17°30’14.10E	429
16	9.2	29°43’29.99”S 17°30’15.38E	419
17	10.7	29°42’57.04”S 17°30’13.29E	379
18	11.1	29°42’38.55”S 17°30’30.78E	328
19	11.7	29°42’17.93”S 17°30’46.66E	262
20	32,5	29°45’15.25”S 17°38’15.10E	209

The locality numbers 1 to 20 are illustrated on Figures 6, 7, 13, 16, 17, 23 and 25.

23.5 Borehole Locations available on BVi maps

KG19-DT1	29°44’50.81”S 17°31’48.14”E
KG19-DT5	29°45’01.44”S 17°31’15.27”E
KG 2	29°47’56.50”S 17°38’35.08”E
KG 4	29°45’01.17”S 17°38’37.99”E
KG 100	29°47’27.97”S 17°29’57.73”E
KG 102	29°48’11.69”S 17°29’55.35”E
KG 104	29°48’27.79”S 17°29’23.69”E
KG 106	29°48’10.55”S 17°29’49.87”E
KG 107	29°47’17.49”S 17°30’06.07”E
KG 108	29°47’19.38”S 17°30’12.47”E
KG 109	29°46’56.00”S 17°30’24.64”E
KG 110	29°47’07.35”S 17°30’12.89”E
KG 115	29°47’35.40”S 17°30’44.35”E
KG 118	29°44’06.25”S 17°37’39.41”E
BR 18/1	29°44’06.28”S 17°37’41.17”E
BR 18/2	29°45’13.70”S 17°38’19.53”E
BR 18/3	29°45’31.44”S 17°38’31.77”E
BH 7-B	29°44’55.29”S 17°38’11.05”E

23.6 Buffels River Catchment Graphic Version