KAI !GARIB MUNICIPALITY

9 11th Avenue, Kakamas 8870

WATER USE LICENSE APPLICATION FOR THE PROPOSED URBAN DEVELOPMENT AT BLAAUWSKOP, NORTHERN CAPE

FRESH WATER REPORT

A REQUIREMENT IN TERMS OF SECTION 21 OF THE NATIONAL WATER ACT
MAY 2020

MACROPLAN

EnviroAfrica
Environmental Management and Impact Assessment
Omgewingsbestuur en Impakbeoordeling

watsan AFRICA

Index

Abbreviations

Northern Cape Department: Co-Operative Governance, Human Settlements and Traditional Affairs	COGHSTA
Critical Biodiversity Area	CBA
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Impact Assessment	EIA
Electronic Water Use License Application (on-line)	eWULAA
Government Notice	GN
Hectares	ha
Legal water use	LWU
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
Non-government organization	NGO
Present Ecological State	PES
South Africa National Biodiversity Institute	SANBI
Section of an Act of Parliament	S
Water Use License Application	WULA

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1 Introduction

The Barzani Group, on behalf of GOCHSTA, appointed Mr Len Fourie of Macroplan in Upington to produce the plans and lay-out of severlal townships along the Lower Orange River, from Groblershoop to Keimoes and surrounds. The Blaauwskop settlement on the southern bank of the Orange River to the east of Keimoes is one such development.

Macroplan appointed Enviro Africa of Somerset West for the required impact assessment in terms of NEMA, together with the public participation process (Figure 1).

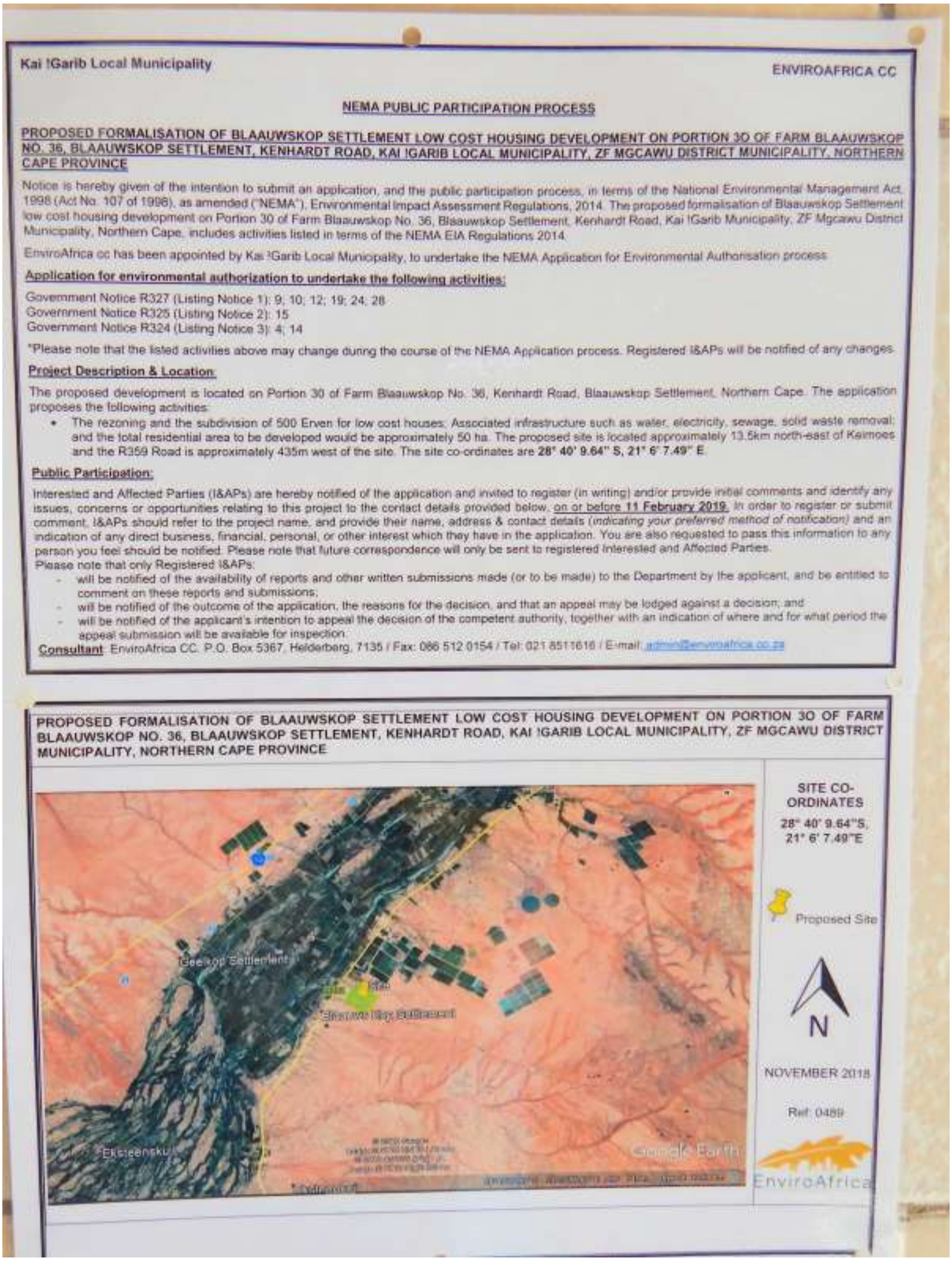
Likewise, Dr Dirk van Driel of WATSAN Africa of Cape Town was appointed to deal with the WULA in terms of the NWA for this envisaged urban development.

The required site visit was conducted on 8 February 2019.

These developments all span mostly dry drainage lines, which are nevertheless regarded as legitimate water resources, for which a WULA is mandatory. Moreover, these development can have an impact on the Orange River water quality. Some of them are adjacent to an irrigation canal, which poses challenges.

The Fresh Water Report must contain adequate information to allow for informed decision-making. The decision to approve the proposed urban development rests with DWS officials, in terms of S21 of the NWA. The Fresh Water Report must contain specified information according to a set profile, which has been developed over a number of years over many such reports and in accordance with GN509. A Risk Matrix is to be completed, as published on the DWA webpage.

In total nine of these reports will have to be produced. This is the last report in this series. For each of these reports, the issues are very much the same, with a similar terrain and social-economic circumstances. Consequently, the reports are the same, being mirror images of one another, but adapted to the specific localities and specific issues for each of the townships.



Kai !Garib Local Municipality

ENVIROAFRICA CC

NEMA PUBLIC PARTICIPATION PROCESS

PROPOSED FORMALISATION OF BLAAUWSKOP SETTLEMENT LOW COST HOUSING DEVELOPMENT ON PORTION 30 OF FARM BLAAUWSKOP NO. 36, BLAAUWSKOP SETTLEMENT, KENHARDT ROAD, KAI !GARIB LOCAL MUNICIPALITY, ZF MGCAWU DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

Notice is hereby given of the intention to submit an application, and the public participation process, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended ("NEMA"), Environmental Impact Assessment Regulations, 2014. The proposed formalisation of Blaauwskop Settlement low cost housing development on Portion 30 of Farm Blaauwskop No. 36, Blaauwskop Settlement, Kenhardt Road, Kai !Garib Municipality, ZF Mgcawu District Municipality, Northern Cape, includes activities listed in terms of the NEMA EIA Regulations 2014.

EnviroAfrica cc has been appointed by Kai !Garib Local Municipality, to undertake the NEMA Application for Environmental Authorisation process.

Application for environmental authorization to undertake the following activities:

Government Notice R327 (Listing Notice 1): 9; 10; 12; 19; 24; 28
Government Notice R325 (Listing Notice 2): 15
Government Notice R324 (Listing Notice 3): 4; 14

*Please note that the listed activities above may change during the course of the NEMA Application process. Registered I&APs will be notified of any changes.

Project Description & Location:

The proposed development is located on Portion 30 of Farm Blaauwskop No. 36, Kenhardt Road, Blaauwskop Settlement, Northern Cape. The application proposes the following activities:

- The rezoning and the subdivision of 500 Erven for low cost houses; Associated infrastructure such as water, electricity, sewage, solid waste removal; and the total residential area to be developed would be approximately 50 ha. The proposed site is located approximately 13.5km north-east of Keimoes and the R359 Road is approximately 435m west of the site. The site co-ordinates are **28° 40' 9.64" S, 21° 6' 7.49" E**.

Public Participation:

Interested and Affected Parties (I&APs) are hereby notified of the application and invited to register (in writing) and/or provide initial comments and identify any issues, concerns or opportunities relating to this project to the contact details provided below, on or before **11 February 2019**. In order to register or submit comment, I&APs should refer to the project name, and provide their name, address & contact details (*indicating your preferred method of notification*) and an indication of any direct business, financial, personal, or other interest which they have in the application. You are also requested to pass this information to any person you feel should be notified. Please note that future correspondence will only be sent to registered Interested and Affected Parties.

Please note that only Registered I&APs:

- will be notified of the availability of reports and other written submissions made (or to be made) to the Department by the applicant, and be entitled to comment on these reports and submissions;
- will be notified of the outcome of the application, the reasons for the decision, and that an appeal may be lodged against a decision; and
- will be notified of the applicant's intention to appeal the decision of the competent authority, together with an indication of where and for what period the appeal submission will be available for inspection.

Consultant: EnviroAfrica CC. P.O. Box 5367, Helderberg, 7135 / Fax: 086 512 0154 / Tel: 021 8511616 / E-mail: admin@enviroafrica.co.za

PROPOSED FORMALISATION OF BLAAUWSKOP SETTLEMENT LOW COST HOUSING DEVELOPMENT ON PORTION 30 OF FARM BLAAUWSKOP NO. 36, BLAAUWSKOP SETTLEMENT, KENHARDT ROAD, KAI !GARIB LOCAL MUNICIPALITY, ZF MGCAWU DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

Figure 1 Public participation

2 Legal Framework

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

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

The proposed development is spanning the banks of a drainage line. A drainage line would be altered, should the development go ahead.

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

Some part of the proposed development will alter the characteristics of the banks of a drainage line.

Government Notice 267 of 24 March 2017

Government Notice 1180 of 2002. *Risk Matrix.*

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

Government Notice 509 of 26 August 2016

An extensive set of regulations that apply to any development in a water course is listed in this government notice in terms of Section 24 of the NWA. No development take place within the 1:100 year-flood line without the consent of the DWS. If the 1:100-year flood line flood line is not known, no development may take place within a 100m from a water course without the consent of the DWS. The development is adjacent to drainage lines, which are defined as legitimate water resources.

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

The EIA Regulations of 2014 No.1 Activity 12 states that no development may take place within 32m of a water course without the consent of the Department of Environmental Affairs and its provincial representatives. A part of the development is adjacent to drainage lines. Consequently, this regulation is relevant to this application.

This Fresh Water Report is exclusively focussed in S21 (c) and (i) of the NWA

Appendix 6 of GN R926 of 7 April 2017

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

3 Climate Keimoes

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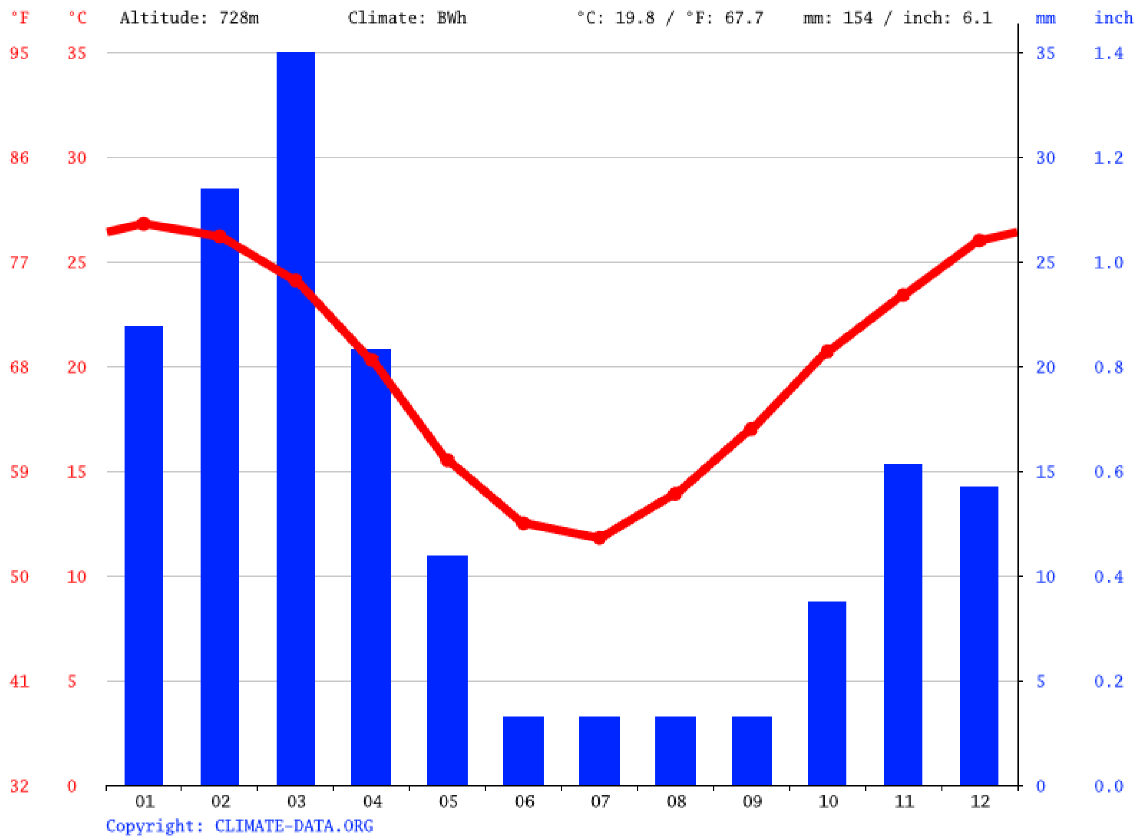


Figure 2 Climate Keimoes

Keimoes, the closest locality to Blaauwskop with on-line climate data, receives only 154mm of rain annually, which leaves the area semi-arid. The rainfall is entirely inadequate for growing crops. The large-scale agriculture in the district is for all its needs dependent on irrigation out of the Orange River. Most of the rain is during summer (Figure 2).

Rainfall often occurs in late afternoon sudden and violent electric thunder storms. Rainfall is highly variable, with occsional high rainfall events, perhaps once in a couple of years. Droughts are common, with dry periods lasting for years. The summers are hot and dry, with midday temperatures often more than 40° centicrade.

4 Location

Figure 3 Location

The location of the project is indicated in Figure 3. It is 30 km to the south west of Upington, as the crow flies, and 13 km east of Keimoes, on the south bank of the Orange River, in the Northern Cape.

5 Vegetation

The South African National Biodiversity Institute (SANBI) indicated the vegetation type on the property as Bushmanland Arid Grassland. The vegetation around the river is indicated as Lower Gariep Alluvial Vegetation. The Orange River is a National Freshwater Ecosystem Priority Area (NFEPA). The riparian area is indicated as Nama Karoo Bushmanland Flood Plain Wetland, despite that most of it today is manicured agriculture.

6 Quaternary Catchment

Blaauwskop is in the D73D quaternary catchment.

7 The Project

The plot of land is indicated in Figure 4 and its coordinates in Table 1.

The plot of land is bordering onto the irrigation canal (Figure 5). This is a prominent feature that will have an impact on the planning and the operation of the site. Houses have been built right to the edge of the canal. At the time of the site visit, children were playing in and around the canal (Figure 6), which is fast flowing, with very steep sides and is dangerous.

The plot is 100ha in size and 1500 erven with dwellings are envisaged, together with urban infrastructure. On the last count during the site visit, approximately 170 existing dwellings were recorded (Figure 7). The construction of new informal houses is ongoing.

Figure 4 Portion 36, Farm Blaauwskop

Table 1 Coordinates Portion 36 Farm Blaauwskop

Point	Coordinates
A	28°39’52.13S 21°06’04.24”E
B	28°40’10.69S 21°05’50.89”E
C	28°40’23.81S 21°06’12.90”E
D	28°40’05.51S 21°06’26.80”E

Figure 5 Irrigation canal

Figure 6 Children at irrigation canal

Figure 7 Dwellings

8 Drainage Lines

The landscape around much of the Lower Orange River as well as the Sak and Hartbees River is dominated by a dense succession of drainage lines. They spread along the river with many smaller tributaries to cover the entire area. The iron oxides in the sands renders a red hue that is visible from space on the Google Earth images. These reds are concentrated in the drainage lines, making them even more visible (Figure 8).

The drainage lines are mostly dry, with water only during rains and perhaps shortly thereafter. During the odd thunder storm, drainage lines can come down in flood. These floods maintain the drainage line's morphological integrity, as sediments are moved and these water ways are scoured out.

Because rainfall events are far apart, the drainage lines must have been form over millennia, even since geological times.

Around the Orange River and even the Sak and Hartbees River, large-scale agriculture has changed the drainage lines into drainage channels among the vineyards and orchards. The upper reaches away from the rivers are less impacted, even near-pristine, as intense agriculture is not possible, apart from those areas where water is piped over long distances from the Orange River.

Much of the discussion in this report is about these drainage lines.

9 Sub-Catchments

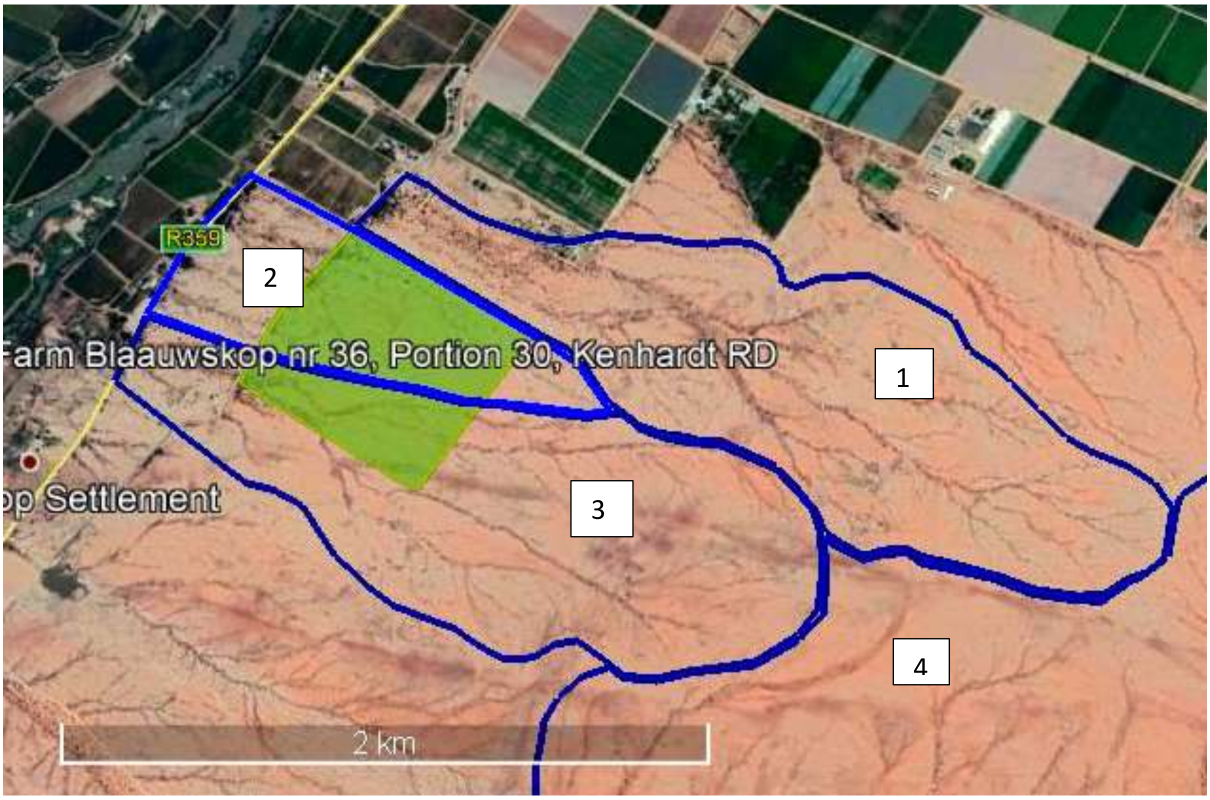


Figure 8 Catchment areas

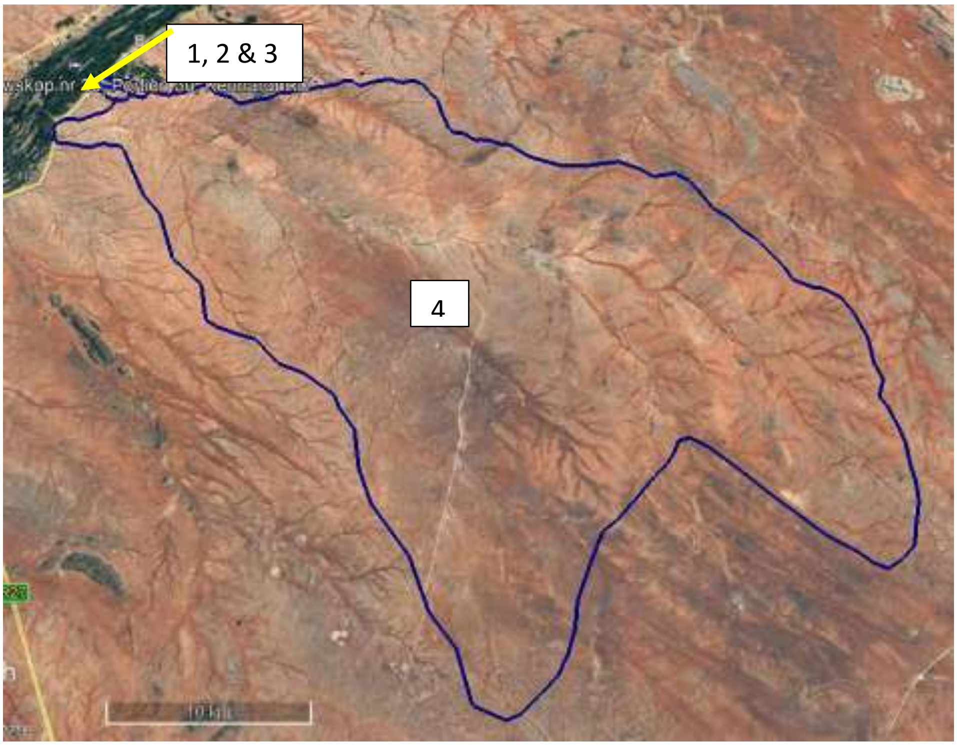


Figure 9 Larger sub-catchment

Table 2 Sub-catchments

No	Area Ha	Circumference km	Highest Point masl	Lowest Point masl	Distance km	Slope
1	156	6.6	818	776	2.9	1.45
2	145	5.7	776	769	1.6	0.43
3	62	3.8	809	770	2.45	0.02
4	89380	153	1021	758	55	>0.01

There are three very small sub-catchments span the block of land that has been earmarked for development (Figure 8, Table 2). These each have a small drainage line that end up against the vineyards.

The fourth sub-catchment is, at almost 90 000 hectares, by far the largest, but it does not span the development area and is adjacent to it, bordering onto it (Figure 9, Table 2).

The slope of sub-catchment 1 (Figure 8) is rather steep, with a drop of 1.45m over a distance of 100 horizontal metres. This slope, together with sandy soils, is normally enough reason to be careful of erosion during high rainfall events and calls for proper planning of a storm water system in this part of the development. In this case, this is a low rainfall area and the sub-catchments are very small, which negates the need for large storm water management infrastructure.

The slope of sub-catchment 2 is far less, with only 0.43m drop over 100m, with the slope in sub-catchment 3 being insignificant, with virtually level land with probably a very slow runoff rate.

The largest sub-catchment is entirely level (Table 1). The slope is the steepest at the high end of the sub-catchment and tapers off towards the middle and lower end. Like so many other similar sub-catchments in the region, sand is eroded from the higher parts and subsequently deposited lower down to create a wide flood plain that can readily be seen on Google Earth images (Figure 8). The tree lines on these wide flood plains are wider, probably because the ground water migrating down the drainage lines in the sands, albeit sparse, spread out over a wider area.

The larger sub-catchment connects to the Orange River downstream of Blaauwskop with a prominent canal through the vineyards (Figure 9).

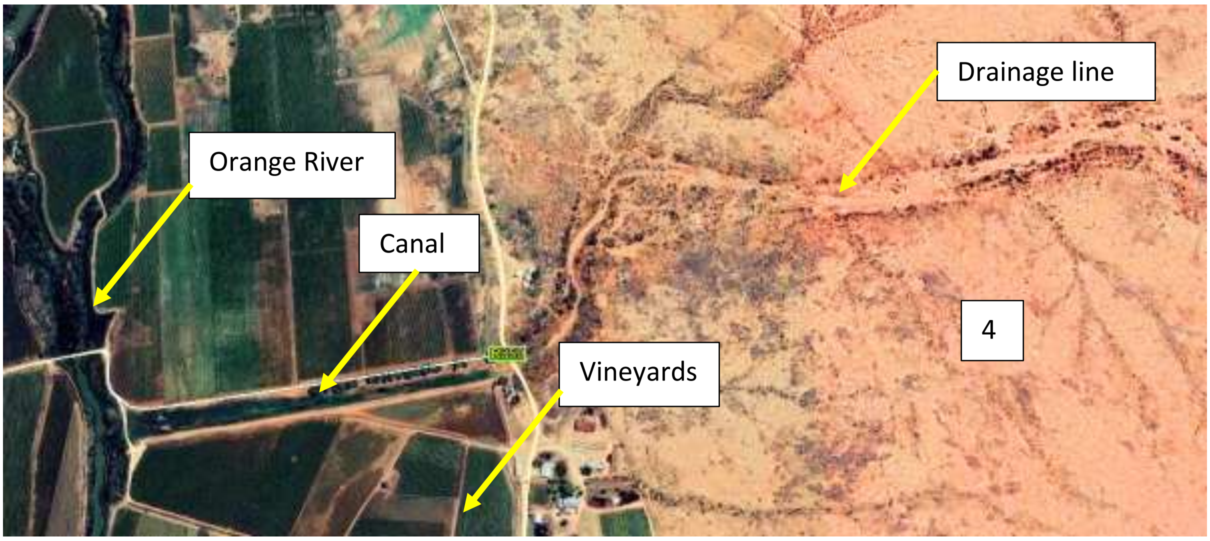


Figure 10 Larger drainage line canal

Figure 11 Drainage line in sub-catchment 1

10 Blaauwskop Drainage lines

The mostly dry drainage lines in sub-catchment 2 and 3 run right through the existing housing, with houses located on the banks, without any buffer zone (Figure 11).

The drainage lines were full of litter and household waste during the site visit.

The drainage lines pass over the irrigation canal. Concrete slabs have been constructed over the canal at each of the crossings, with concrete walls on either side of the crossing to keep storm water from entering the canal (Figure 12, 13 and 14).

Figure 12 Crossing No. 1

Figure 13 Crossing No.2

Figure 14 Crossing No. 3

It is expected that a number more of these crossings will have to be constructed, as the new development progresses, to keep runoff and litter out of the irrigation canal.

The drainage lines appear to be fairly natural on both sides of these crossings, with mostly swarthaak trees (*Senegalia mellifera*), as well as the invasive *Prosopis* trees being the riparian vegetation (Figure 15). The beds were mostly sandy, with little if any vegetation.

Figure 15 Drainage line vegetation

The drainage lines and surrounds were grazed by goats and other livestock.

11 Impacts on the Lower Orange River

The river is heavily utilized for agriculture, with the banks entirely modified into cultured vineyards. A multitude of large electric water pumps have been placed in the river for abstracting large volumes of water for irrigation. Abstraction significantly lowers the flow in the river.

Berms for the purpose of flood protection have been constructed on the banks of the river for most of its length. These berms have been constructed by the Department of Water Affairs and now have been a feature of the landscape for many decades. The berms keep flood water out of adjacent agricultural land and has denaturalised the riparian zone.

The single most impact on the Orange River are the two very large dams, The Gariep Dam and the Vanderkloof Dam. The river flow has been modified to a much more even regime, different from the varied flown with high peak flows and low drought flows.

The Lower Orange River is lined with a dense system of mostly dry drainage lines. These drainage lines only flow during and shortly after heavy rains. Their contribution to the flow of the Orange River is insignificant. Most of the flow comes from the Lesotho Highlands and some from the Vaal River. However, many of these drainage lines have been transformed into engineered agricultural return flow furrows that carries the excess of over irrigation back to the Orange River. Agricultural return flow adds much to the nutrient load of the Orange River because runoff contains fertilizer. Nitrogen is added in large quantities. Since phosphorus readily binds to the soil, not much phosphorus is added.

Return flow can contain a heavy silt load, thereby elevating turbidity in the river.

It is suspected that pesticides in agricultural return flow have a heavy impact on biomonitoring results, significantly reducing the SASS5 score.

The banks of the Orange River in the area is densely overgrown with Spaanse Riet (*Arundo donax*). This is classified as an aggressive and exotic invasive plant, which effectively prevents access to the river. The reeds result in a homogeneous aquatic habitat. This lack of variation supresses the SASS5 score, with only a limited number of aquatic macroinvertebrate species present in this habitat.

The impact of concern for this particular WULA is the return flow out of urban areas, of which Upington is the most significant, with its release of treated sewage effluent into the Orange River. In addition, a number of human settlements similar to Blaauwskop are being planned, where existing wastewater treatment works are inoperable and where these works are absent. This poses a threat to the water quality of the Orange River and of course a threat to the regional agricultural export industry. Hence it is necessary to monitor the Orange River, within the typical cost structure and timespan of a WULA. Biomonitoring seems to be the indicated option.

12 Biomonitoring the Lower Orange River

The biomonitoring was carried out according to the description of Dickens & Graham (2002).

Biomonitoring was carried out on the Lower Orange River during site visits for successive WULAs. So far 12 samples have been analyzed at 11 localities (Table 3). The site furthest east was at Hopetown and furthest west at Augrabies, with Upington in the middle. All of these are located upstream of the Augrabies Falls.

Another sample was analyzed at Styerkraal just east of the border post of Onseepkans downstream of the Augrabies Falls.

The river is mostly braided, with many smaller streams and with islands in the middle. The river sports many rapids and riffles, but also pool-like features where the river is broad and slower flowing.

The bottom is mainly muddy, with some large rocky outcrops in the middle of the river.

13 Lower Orange River Biomonitoring Results

The biomonitoring results have been captured in Table 1 and depicted in Figure 17.

The classes from A to F in Figure 18 has been assigned for mature rivers on flood plains such as the Lower Orange River.

Only 2 of the samples were classified a good and relatively unimpacted (Class A). Four were in Class B and C, which can be regarded as acceptable under the circumstances of an impacted river reach. These classes can possible be labelled as the ideal, a compromise between agriculture and aquatic ecological functioning.

Four samples were poor (Classes E and F), an undesirable state of affairs.

The one sample downstream of the Augrabies Falls was extremely poor.

Table 3 Biomonitoring in the Lower Orange River

Locality	Coordinates	Date	SASS 5	No Taxa	ASPT
Augrabies Lair trust	28°38’41.53S 20°26’08.49E	5/09/17	18	4	4.5
Augrabies Lair Trust	28°38’41.53S 20°26’08.49E	5/10/17	43	9	4.8
Groblershoop	28°52’31.80S 21°59’13.49E	14/8/18	41	7	5.9
Kakamas Triple D	28°45’08.37S 20°35’06.16E	15/8/18	50	9	5.6
Hopetown Sewer	29°36’05.07S 24°06’05.00E	7/10/18	29	7	4.1
Hopetown Sewer	29°36’08.06S 24°21’06.16E	7/10/18	29	8	3.6
Keimoes Housing	28°42’37.12S 20°55’07.81E	8/02/19	51	7	7.3
Upington Erf 323	28°27’11.91S 21°16’14.02E	12/2/19	56	9	6.2
Upington Affinity	28°27’11.91S 21°16’14.02E	20/5/19	54	9	6
Styerkraal	28°27’25.28S 21°15’01.87E	21/5/19	15	6	2.5
Grootdrink Bridge	28°17’15.30S 21°03’50.87E	17/5/20	34	7	5.3
Turksvy Dam	28°27’09.21S 21°17’20.72E	17/5/20	69	13	5.3

14 Biomonitoring sampling point

The sampling point should be chosen as close as possible and just downstream of a possible impact. In the case of Blaauwskop, this was not possible, because the Orange River was heavily overgrown with reeds, an impenetrable barrier (Figure 16). The closest point at the time was in Upington, Erf 323 as indicated in Table 1.

The river here was approximately 150m wide, pool-like with a slow current of some 0.1m^{-s} in the middle of the river but only 0.02m^{-s} next to the river bank at the sampling point. The *Phragmitis* reeds here were cleared to accommodate a floating jetty and a pump for the abstraction of water. At this point there was a sturdy concrete slipway for the launching of boats. There was a lot of froth and debris in the shallow water. The river was turbid at the time.

This site was right on the verge of the 4m high flood wall, of which there are many kilometres along both banks of the Lower Orange River. The bank was steep, with the submerged bank steep as well, with limited shallow water.

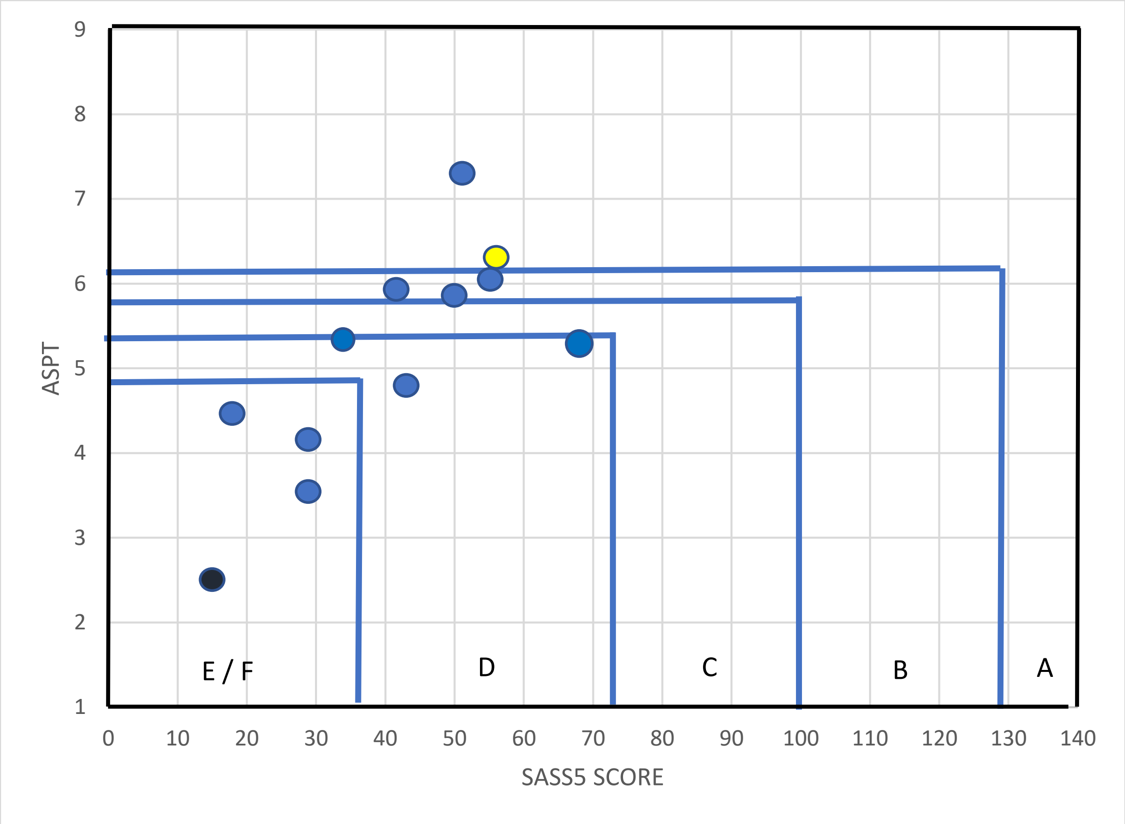
The available habitat was submerged vegetation, emerging vegetation muddy bottom and the jetty served as bedrock.

The biomonitoring results are given in the Appendix.

The results were surprisingly good (Figure 17), indicating a near-pristine, almost unimpacted state of the river. This is above the target (“C”, impacted, but with most ecological functioning intact).

The impacts from all of the new housing developments, including Blaauwskop, should be managed to such an extent that the Orange River does not drop below a C class.

Figure 16 Reeds



Integrity Class	Description
A	Pristine; not impacted
B	Very Good; slightly impacted
C	Good; measurably impacted with most ecological functioning intact
D	Fair; impacted with some loss of ecological functioning
E	Poor; loss of most ecological function
F	Very Poor; loss of all ecological function

Figure 17 Lower Orange River biomonitoring results

The yellow dot represents the sampling point in Upington. All the other dots represent previous sampling.

15 Present Ecological State (PES)

Table 4 Habitat Integrity according to Kleynhans, 1999

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

The PES and EIS are protocols that have been produced by Dr Neels Kleynhans (Table 4 to 7) in 1999 of the then DWAF to assess river reaches. The PES is one of the evaluations that is prescribed for S21 (c) and (i) WULA's. The scores given are solely that of the practitioner and are based on expert opinion.

Sub-catchments 1, 2 and 3 have been lumped because they were very similar. They all score a D, very much altered, with much of the ecological functioning lost.

Sub-catchment 4 has been evaluated separately because it is much bigger, not in the township, with a proportionate smaller lower reach that has been canalised. This sub-catchment is less impacts, in a better state and scores a C for both the instream and riparian habitat, with most of the ecological functioning still intact.

Table 5 Present Ecological State of the Drainage Line 1, 2 and 3

Instream	Score	Weight	Product	Maximum score
Water abstraction	24	14	336	350
Flow modification	13	13	169	325
Bed modification	14	13	182	325
Channel modification	15	13	195	325
Water quality	16	14	224	350
Inundation	14	10	140	250
Exotic macrophytes	20	9	180	225
Exotic fauna	12	8	96	200
Solid waste disposal	10	6	60	150
Total		100	1402	2500
% of total			56.1	
Class			D	

Riparian				
Water abstraction	24	13	312	325
Inundation	14	11	154	275
Flow modification	13	12	156	300
Water quality	16	13	208	325
Indigenous vegetation removal	14	13	182	325
Exotic vegetation encroachment	20	12	240	300
Bank erosion	20	14	280	350
Channel modification	15	12	180	300
Total			1142	2500
% of total			45.7	
Class			D	

Table 6 Present Ecological State of Drainage Line 4

Instream				
	Score	Weight	Product	Maximum score
Water abstraction	24	14	336	350
Flow modification	23	13	299	325
Bed modification	22	13	286	325
Channel modification	21	13	273	325
Water quality	20	14	280	350
Inundation	21	10	210	250
Exotic macrophytes	20	9	180	225
Exotic fauna	18	8	144	200
Solid waste disposal	20	6	120	150
Total		100	1958	2500
% of total			78.3	
Class			C	
Riparian				
Water abstraction	24	13	312	325
Inundation	21	11	143	275
Flow modification	23	12	144	300
Water quality	20	13	195	325
Indigenous vegetation removal	19	13	156	325
Exotic vegetation encroachment	20	12	252	300
Bank erosion	22	14	266	350
Channel modification	21	12	168	300
Total			1636	2500
% of total			65.4	
Class			C	

Much has been published on the ecological state of South African rivers and the Orange River is no exception. In fact, it seems somewhat arrogant to assess the Lower Orange River, even at the sampling point, with a team of one and with the financial backing of a single WULA. This is a large undertaking that is to be contemplated by a team of experts. Nevertheless, this is what the WULA requires.

The river at the Upington sampling point, as elsewhere, has been impacted by major dams, large-scale water abstractions, an influx of agricultural chemicals, encroachment of reeds and exotic macrophytes, translocated and exotic fish, levees, bridges and many other infarctions.

Table 7 Present Ecological State Orange River

Instream	Score	Weight	Product	Maximum score
Water abstraction	15	14	210	350
Flow modification	15	13	195	325
Bed modification	20	13	260	325
Channel modification	22	13	286	325
Water quality	15	14	210	350
Inundation	12	10	120	250
Exotic macrophytes	18	9	162	225
Exotic fauna	15	8	120	200
Solid waste disposal	20	6	120	150
Total		100	1593	2500
% of total			63.7	
Class			C	
Riparian				
Water abstraction	15	13	195	325
Inundation	14	11	154	275
Flow modification	15	12	180	300
Water quality	15	13	195	325
Indigenous vegetation removal	15	13	195	325
Exotic vegetation encroachment	15	12	180	300
Bank erosion	20	14	280	350
Channel modification	18	12	216	300
Total			1595	2500
% of total			63.8	
Class			C	

However, the river at Upington was less impacted than further downstream, as at Kakamas. The river at Upington was stronger flowing, with much more water. The condition of the river gradually deteriorates as water abstraction and return flows increases downstream.

Hence the river was scored a C (Table 4), which signifies that it has been impacted, but despite these impacts still exhibits appreciable ecological functioning. The riparian zone scores a C as well.

There is a good chance that other practitioners would score the river very much the same.

Importantly, the proposed development at Blaauwskop is not about to change the PES of the Orange River at Upington.

16 Ecological Importance

The Ecological Importance (EI) is based on the presence of especially fish species that are endangered on a local, regional or national level (Table 8).

There are no fish in the drainage line, as there is no permanent water. According to this assessment, which is prescribed for WULA's, the drainage line is not important.

No other endangered species, either plant or animal, were detected in or near the drainage line.

Table 8 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)

As has been stated before, the higher vegetation in and around the drainage lines are of particular importance in these arid regions and add significantly to biodiversity. These should be considered as ecologically important.

The Orange River is most important, according to this assessment.

According to Skelton (1993) 12 species of indigenous fish occur in the Lower Orange River. Since 2011 another one was added, as well as 3 exotic species. These are the following:

Barbus trimaculatus
B paludinosus
B. hospus
Labeobarbus kimberleyensis (Near threatened)
L aenus
Labeo umbratus
L capensis
Austroglanis sclateri (Widespread elsewhere)
Clarias gariepinus
Pseudocrenilabrus philander (Threatened locally but abundant elsewhere)
Pseudobarbus quathlabae
Mesobola brevianalis (critically endangered)

Exotic and translocated fish:

Cyprinus carpio
Tilapia sparrmanii
Oreochromus mossambicus

Those in blue are endangered to a varying extent. Those indicated in red are exotic or translocated fish.

The only one that causes real concern in the largemouth yellow-fish *Labeobarbus kimberleyensis*. It is endemic to the Orange River system and hence is threatened not only on a local scale, but on a national scale as well. This puts the Lower Orange in category 4. This renders the Orange River as important.

According to the owners of the Kalahari River and Safari Co. along the northern bank of the Orange River on the Riemvasmaak Road, mature blue kurper *Oreochromus mossambicus* are regularly captured in increasing numbers. It now takes at least 4 man-days to capture a single yellow fish.

Yellow fish are generally infected with cestode bladder worms, while darters (*Anhinga rufa*) that predate on these fish are heavily infected with tape worms. It seems as if the translocated Tilapia are not affected by these parasites.

According to Mr Chris van der Post, a renown angling guide and the owner of the Gkhui Gkhui River Lodge near Hopetown, there are still many smallmouth-yellow fish around, but largemouth yellow-fish are scarce.

17 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.

17.1 Ecological Sensitivity Drainage Lines

The question arises**,** according to the ES definition, if the drainage lines would recover to its original ecological state prior to any human impact. If the roads and vineyards, along with the rubble and trash be removed, would the drainage line recover? The answer is probably yes, even though the drainage lines would find new routes and even though it would take many decades, perhaps more than a century, in this semi-arid region where re-growth of vegetation can take a long time. However, this is not a realistic scenario. Development is here to stay, together with its impacts. From this point of view the drainage line can be considered as ecologically sensitive.

17.2 Ecological Sensitivity Orange River

The Lower Orange River has absorbed numerous and deep-cutting human impacts. Yet is still functions as an aquatic ecosystem. In the highly improbable event of ceased human impact, the river here would probably bounce back to its previous glory. In this respect the river cannot be categorised as sensitive. It is dreaded among conservation minded people that the Lower Orange River might have some more capacity to absorb further impact.

18 Possible Impacts

The impacts on sub-catchments 2 and 3 are going to be the greatest, as the township will be built right over these drainage lines.

Drainage lines of sub-catchments 1 and 4 are adjacent to the new development and would be spared of houses right on its banks.

The impacts include trampling and over-grazing of the sub-catchment, destruction of the drainage lines, littering and the danger of untreated sewage ending up in the drainage canal and the Orange River.

19 Mitigation Measures

A buffer zone of 20m should be allowed on either side of these drainage lines, a green zone through the envisaged township.

The township should be arranged in such a way that the drainage lines still connect to the stormwater infrastructure over the irrigation canal. Stormwater should not be allowed to enter the irrigation canal. Where necessary, additional infrastructure should be built over the irrigation canal.

Litter and household waste have been noted in the drainage lines of the existing township. This problem, if not properly managed, will escalate when the township expands. Litter and waste should not be allowed to enter the canal. It should not be allowed to wash down the drainage lines and into the Orange River. Infrastructure to catch the waste should be installed and these structures should be regularly cleaned.

Another 1500 households would put strain on the current sewage and wastewater handling system. It would be disastrous if sewage ends up in the Orange River. Proper planning and infrastructure are necessary.

The three smaller sub-catchments can probably not produce enough runoff, even during a large rainfall event, to pose a threat to the new development. The larger sub-catchment of almost 90 000 ha is large enough to produce a sudden and dangerous pulse of runoff during a high rainfall event, perhaps of 30 to 40mm in a day. Residents should be aware of the potential hazard.

The authorities will have to give the dangers of children in and around the irrigation canal some thought, because the danger of drownings increases as the township grows.

20 Impact Assessment

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology (Table 23.1, Appendix).

The main benefit of this exercise is that it allows for the evaluation of mitigation measures. Later follows the Risk Matrix. This is different from the Impact Assessment as it does not attempt to weigh the success of mitigation measures.

The assessment indicates that the impacts are acceptable, provided that the mitigation measures are adequate to contain these impacts (Table 6).

Table 9 Impact Assessment

Description of impact Construction phase. Destruction of drainage lines **Mitigation measures** Construction only during the dry season, limit the foot print, vegetate disturbed areas. Maintain buffer zone Keep building rubble and sediments out of drainage lines. Connect drainage lines to storm water infrastructure over irrigation canal								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Cumulative	Regional	Medium	Long term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Cumulative	Local	Low	Long term	Low	Unlikely	Sure	Reversible	Replaceable

Description of impact Operational phase. Litter and sewage into the drainage lines and Orange River **Mitigation measures** Assure a proper municipal litter and urban waste collection and removal system Install adequate wastewater treatment facility and infrastructure								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Cumulative	Regional	Medium	Long term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Cumulative	Local	Low	Long term	Low	Unlikely	Sure	Reversible	Replaceable

These mitigation measures can be effective, but only if municipal services are maintained.

21 Risk Matrix

The purpose of the Risk Matrix is to determine if a General Authorisation of a License is applicable.

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 10 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 10 (continued) represent the same activities as in Table 9, with sub-activities added.

The methodology is tabled in the Appendix.

Table 10 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Construction	Sediments / debris washing down the drainage lines	Silting up of drainage line	26	Low
2	Wastewater / sewage	Sewage ending up in the drainage line and the Orange River	Pollution of the river	54	Low
3	Urban solid waste	Waste ending up in the drainage line and in the river	Pollution of drainage line and Orange river	48	Low

Table 10 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1	1	1	2	1	1.25	1	1	3.25
2	1	2	1	2	1.5	1	2	4.5
3	1	1	1	1	1	1	2	4

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1	1	1	5	1	8	26	Low
2	3	3	5	1	12	54	Low
3	3	3	5	1	12	48	Low

Values have been given under the Assumption that mitigation measures will be in place.

The risk of material importance is the possibility of urban waste and untreated sewage down the drainage line and into the Orange River. The risk increases because of the cumulative risks posed by the various developments along the reach of the Orange River. It is supposed that if the contamination in the river rises and the farming community becomes aware of it, that there would be a strong reaction, leading to curbing or ending the problem. This assumption influenced the score for “duration”, as the problem was perceived not to continue.

In most cases loosened soil and silt that can be washed down the drainage lines during construction are considered to be a risk to the aquatic environment. In the event of the Blaauwskop development, the risk is so small that it is not worth considering in a Risk Matrix.

The Risk Matrix indicates that the risks to the aquatic environment are low. A General Authorisation should be in order for this application and a License is deemed not to be the indicated level of authorisation.

22 Resource Economics

Table 11. Goods and Services three smaller drainage lines

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

0	Low
5	High

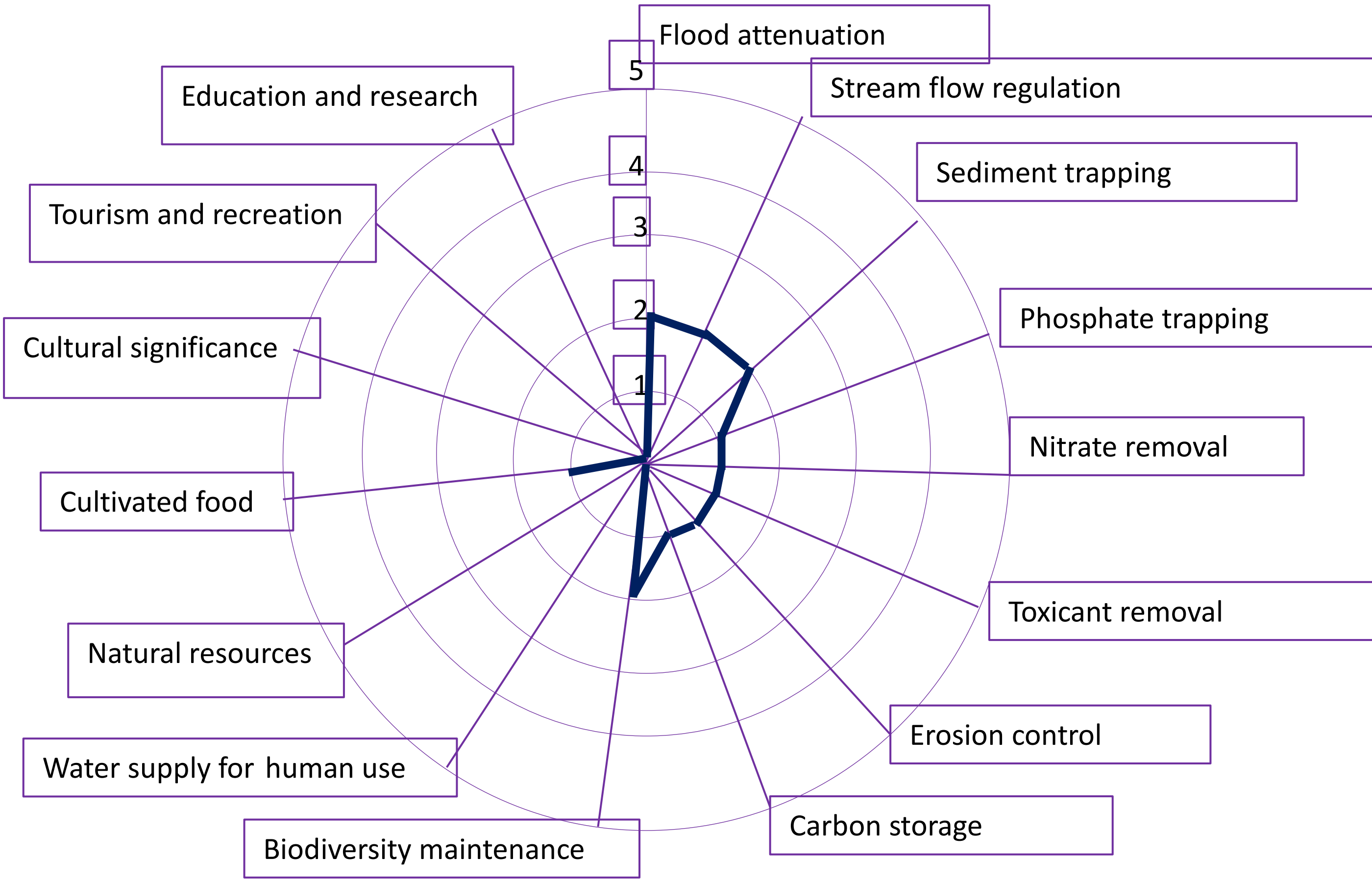


Figure 18 Resource Economic Footprints of the smaller drainage lines

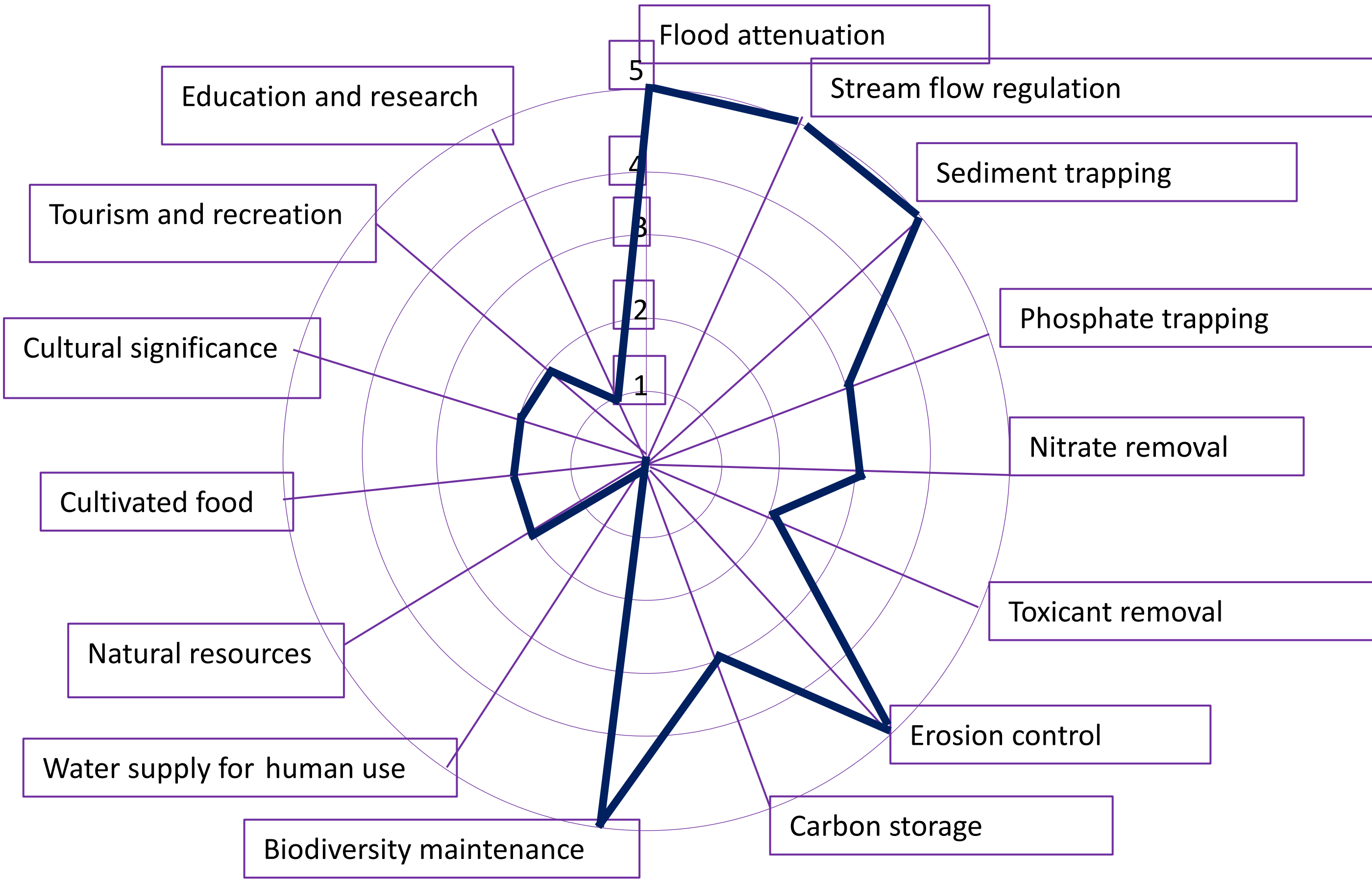


Figure 19 Resource Economic Footprints of the larger drainage lines

The goods and services delivered by the environment, in this case the drainage line at the new Blaauwskop housing development, is a Resource Economics concept as adapted by Kotze *et al* (2009). The methodology was designed for the assessments of wetlands, but in the case of the drainage line the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 18 and 19) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 8.

The size of the star shape attracts the attention of the decision-makers. This shape (spider diagram, Figure 18) of the lumped three smaller drainage lines is very small, indicating that the water course has a small economic foot print. If these drainage lines are lost because of development, it won't represent a mentionable loss in environmental goods and services.

However, the larger drainage line renders considerably more economic goods and services and has a significant conservation value, with a much larger star shape (Figure 1).

A large river such as the Orange River renders a full house of goods and services, with a score of 5 for all of them. The spider diagram becomes a perfect circle.

The development at Blaauwskop is not about to change any of this. However, cumulative impacts of many such developments along the Lower Orange River on water quality and long-term water provision for human use and irrigation is the first to come to mind when the considering the future.

23 Site Visits: General Observations

Pertaining to Fresh Water Reports in general, urban wastewater is of importance because untreated waste ends up in water ways, which rebels against the NWA and other contemporary South African environmental legislation. Photographic evidence is presented in several of the nine townships along the Lower Orange River that are now under consideration for expansion where anaerobic pond systems for the treatment of sewage lie idle and are not being utilized for the treatment of urban sewage. Instead raw sewage is dumped in drainage lines. Likewise, several sewage pump stations are dysfunctional, overflowing, with large quantities of raw sewage flowing down drainage lines.

Household solid waste is not collected and removed according to standard municipal operating procedures. Very large quantities of waste accumulate in the townships and the streets. Large quantities of waste end up in the drainage lines as well.

These two aspects are crucial to the WULA and environmental authorisation of any further urban development. If these malpractices are allowed to continue and if the normal municipal services continue to be absent, this untenable situation would become worse when these townships expand.

This is not only a tangible threat to human health and human well-being in the Northern Cape, but in many South African municipalities, as well as in cities elsewhere in the world where WATSAN Africa concluded contracts.

In a number of the townships, graveyards are illegally located right in drainage lines or within the 32m buffer zone from drainage lines.

From a Fresh Water Report perspective, a Licence or General authorisation should probably not be granted until the sewage and waste issues are satisfactory and sustainably resolved. But then this is entirely the prerogative of the DWS and its officials.

24 Conclusions

Figure 20 has been adapted from one of the most recent DWS policy documents.

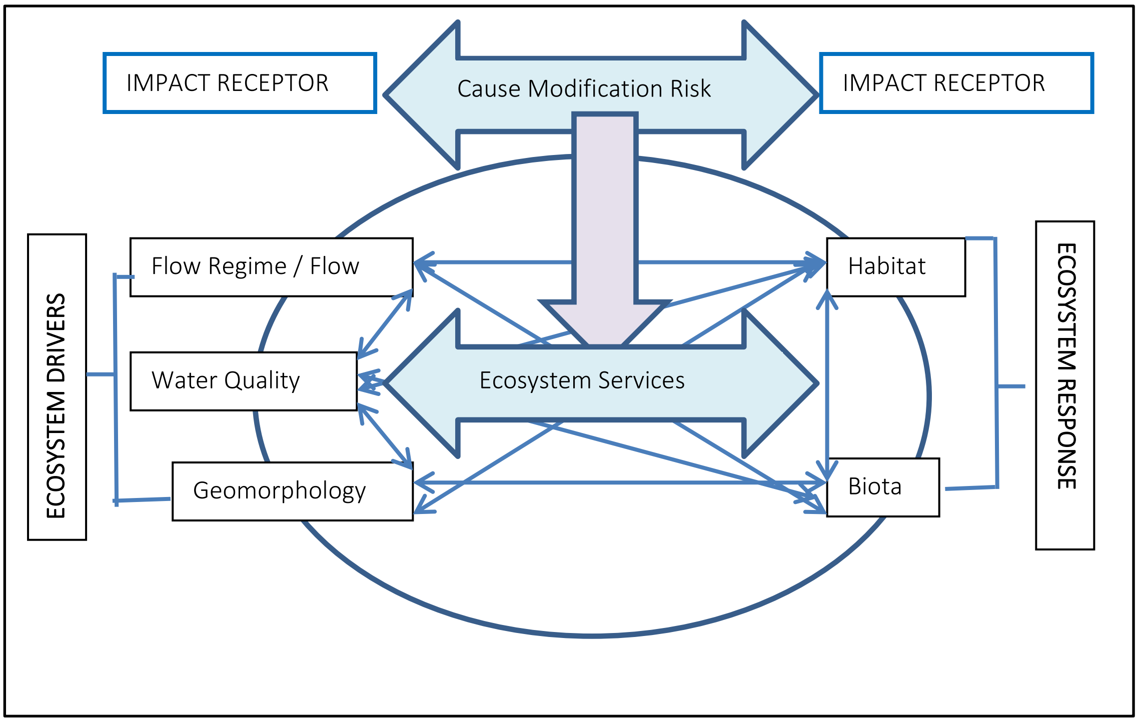


Figure 20 Minimum Requirements for a S21(c) and (i) Application

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 (Figure 20). The WULA and the EAI must provide mitigation measured for these impacts.

The driver of the drainage lines is the occasional flood that follows sudden and intense rainfall events. This is followed by prolonged droughts and intense summer heat that prevents the development of any viable aquatic habitat. This is apart from shallow ground water that explains the growth of a somewhat more prolific vegetation along the drainage lines.

The current sewage and solid waste situation are threats to the WULA. The authorities may insist that these issues be resolved before a General Authorization is approved.

Apart from this, the findings of this Fresh Water Report indicate that a general Authorization would be in order for the development of an urban housing scheme at Blaauwskop.

25 References

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Skelton, P. 1993. *Freshwater Fishes of Southern Africa*. Southern Book Publishers, Halfway House.

26 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 26 June 2020

27 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

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 Report, Sanitation, Afghanistan Government, New Delhi, India
- Fresh Water Report, Potable Water Pipeline, Komaggas
- Fresh Water Report, Wastewater Treatment Works, Kamieskroon
- Fresh Water Report, Turksvy Farm Dam, Upington
- Fresh Water Report Urban Development Erf 4440, Kuruman
- Fresh Water Report, Groblershoop Urban Development, IKheis Municipality
- Fresh Water Report, Boegoeberg Urban Development, IKheis Municipality
- Fresh Water Report, Opwag Urban Development, IKheis Municipality
- Fresh Water Report, Wegdraai Urban Development, IKheis Municipality
- Fresh Water Report, Topline Urban Development, IKheis Municipality
- Fresh Water Report, Grootdrink Urban Development, IKheis Municipality
- Fresh Water Report, Gariep Urban Development, IKheis Municipality
- Fresh Water Report, Bonathaba Farm Dam, Hermon
- Botanical Report, Sand Mine Greystone Trading, Vredendal
- Botanical Report, Namakwa Klei Stene, Klawer

28 Appendix

28.1 Biomonitoring results

SASS5 Score Sheet										
Date	12 Feb 19	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Erf 232	Porifera	5		**Hemiptera**			**Diptera**		
	Upington	Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5		Ceratopogonidae	5	
Coordinates	28°27' 11.91"	Huridinea	3		Hydrometridae	6		Chironomidae	2	
	21°16'14.02"	**Crustacea**			Naucoridae	7	7	Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	6.3	Potamonautidae	3		Notonectidae	3	3	Empididae	6	
Temperature °C	26,7	Atyidae	8	8	Pleidae	4	4	Ephydridae	3	
pH	8.5	Palaemonidae	10		Veliidae	5	5	Muscidae	1	
EC mS/m	25.8	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	
SASS5 Score	56	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	9	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	6,2	**Ephemeroptera**			Dipseudopsidae	10		Tipulidae	5	
		Baetidae 1 sp	4	4	Ecnomidae	8		**Gastropoda**		
Other Biota		Baetidae 2 sp	6		Hydropsychidae 1 sp	4		Ancylidae	6	
		Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	
	Cyprinus carpio	Caenidae	6		Hydropsychidae <2 sp	12		Hydrobiidae	3	
		Ephemeridae	15		Phylopotamidae	10		Lymnaeidae	3	
		Heptageniidae	13		Polycentropodidae	12		Physidae	3	
		Leptophlebiidae	9		Psychomyidae	8		Planorbidae	3	
		Oligoneuridae	15		**Cased Caddis**			Thiaridae	3	
Comments		Polymitarcyidae	10		Barbarochthonidae	13		Viviparidae	5	
		Prosopistomatida	15		Calamoceratidae	11		**Pelecipoda**		
		Teloganodidae	12	12	Glossostomatidae	11		Corbiculidae	5	
		Trichorythidae	9		Hydroptilidae	6		Sphariidae	3	
		Odonata			Hydrosalpingidae	15		Unionidae	6	
		Calopterygidae	10		Leptostomatidae	10	10			
		Clorocyphidae	10		Leptoceridae	6				
		Chorolestidae	8		Petrothrincidae	11				
		Coenagrionidae	4		Pisulidae	10				
		Lestidae	8		Sericostomatidae	13				
		Platycnemidae	10		**Coleoptera**					
		Protoneuridae	8		Dyticidae	5				
		Aesthnidae	8		Elmidae Dryopidae	8				
		Corduliidae	8		Gyrinidae	5				
		Gomphidae	6		Haliplidae	5				
		Libellulidae	4		Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5				
					Limnichidae	10				
					Psephenidae	10				
Score				24			32			0

28.2 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 26.2.1 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 28.2.2 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 28.2.3 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 28.2.4 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.

28.3 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	1
Fully covered by legislation (wetlands are legally governed)	5
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