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

FRESH WATER REPORT
and Stormwater Management Plan

A REQUIREMENT IN TERMS OF SECTION 21 OF THE NATIONAL WATER ACT
MAY 2023

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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
Spatial Planning and Land Use Management Act 16 of 2013	SPLUMA
Water Use License Application	WULA

1 Introduction

The Dawid Kruiper Municipality advertised for tenders pertaining to new urban developments in Upington. One such proposed township is in Paballelo on the verge of the city to the north along the R360 trunk road. Several consultants and specialists must be appointed to take the municipality through the legal and environmental processes, in particular the SPLUMA legislation (Act 16 of 2013). Other relevant legislation is the NEMA and the NWA. This process was started to make provision for the much-needed residential erven in the sub-economic market.

Enviro Africa of Somerset West was subsequently appointed to carry out the EIA, in terms of NEMA, together with the public participation process (Figure 1). This process started in March 2023.

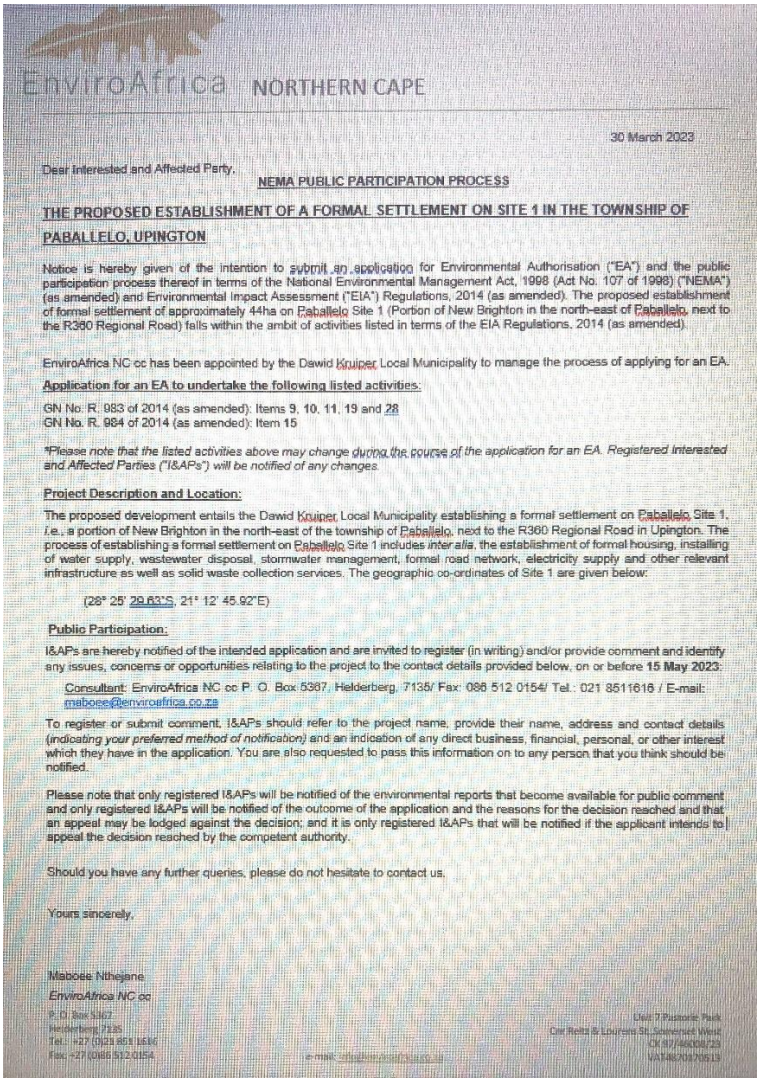
Likewise, WATSAN Africa was appointed to produce the Fresh Water Report and carry out the WULA in terms of the NWA. The required site visits were conducted on 20 and 21 May 2020.

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 must be completed, as published on the DWA webpage.

Several of similar reports have already been produced for townships along the Lower Orange River. This report was produced with the same contents and lay-out, following a set template, but adapted for this specific locality.

A Freshwater Report and a WULA is required because there are two very faint drainage lines on the land. These are mostly dry, but nevertheless are regarded as legitimate water resources in terms of the NWA.



EnviroAfrica NORTHERN CAPE

30 March 2023

Dear Interested and Affected Party,

NEMA PUBLIC PARTICIPATION PROCESS

THE PROPOSED ESTABLISHMENT OF A FORMAL SETTLEMENT ON SITE 1 IN THE TOWNSHIP OF PABALLELO, UPINGTON

Notice is hereby given of the intention to submit an application for Environmental Authorisation ("EA") and the public participation process thereof in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA") (as amended) and Environmental Impact Assessment ("EIA") Regulations, 2014 (as amended). The proposed establishment of formal settlement of approximately 44ha on Paballelo Site 1 (Portion of New Brighton in the north-east of Paballelo, next to the R360 Regional Road) falls within the ambit of activities listed in terms of the EIA Regulations, 2014 (as amended).

EnviroAfrica NC cc has been appointed by the Dawid Kruiper Local Municipality to manage the process of applying for an EA.

Application for an EA to undertake the following listed activities:

GN No. R. 983 of 2014 (as amended): Items 9, 10, 11, 19 and 28
GN No. R. 984 of 2014 (as amended): Item 15

**Please note that the listed activities above may change during the course of the application for an EA. Registered Interested and Affected Parties ("I&APs") will be notified of any changes.*

Project Description and Location:

The proposed development entails the Dawid Kruiper Local Municipality establishing a formal settlement on Paballelo Site 1, i.e., a portion of New Brighton in the north-east of the township of Paballelo, next to the R360 Regional Road in Upington. The process of establishing a formal settlement on Paballelo Site 1 includes *inter alia*, the establishment of formal housing, installing of water supply, wastewater disposal, stormwater management, formal road network, electricity supply and other relevant infrastructure as well as solid waste collection services. The geographic co-ordinates of Site 1 are given below:

(28° 25' 29.63"S, 21° 12' 45.92"E)

Public Participation:

I&APs are hereby notified of the intended application and are invited to register (in writing) and/or provide comment and identify any issues, concerns or opportunities relating to the project to the contact details provided below, on or before **15 May 2023**.

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

To register or submit comment, I&APs should refer to the project name, provide their name, address and 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 on to any person that you think should be notified.

Please note that only registered I&APs will be notified of the environmental reports that become available for public comment and only registered I&APs will be notified of the outcome of the application and the reasons for the decision reached and that an appeal may be lodged against the decision; and it is only registered I&APs that will be notified if the applicant intends to appeal the decision reached by the competent authority.

Should you have any further queries, please do not hesitate to contact us.

Yours sincerely,

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EnviroAfrica NC cc

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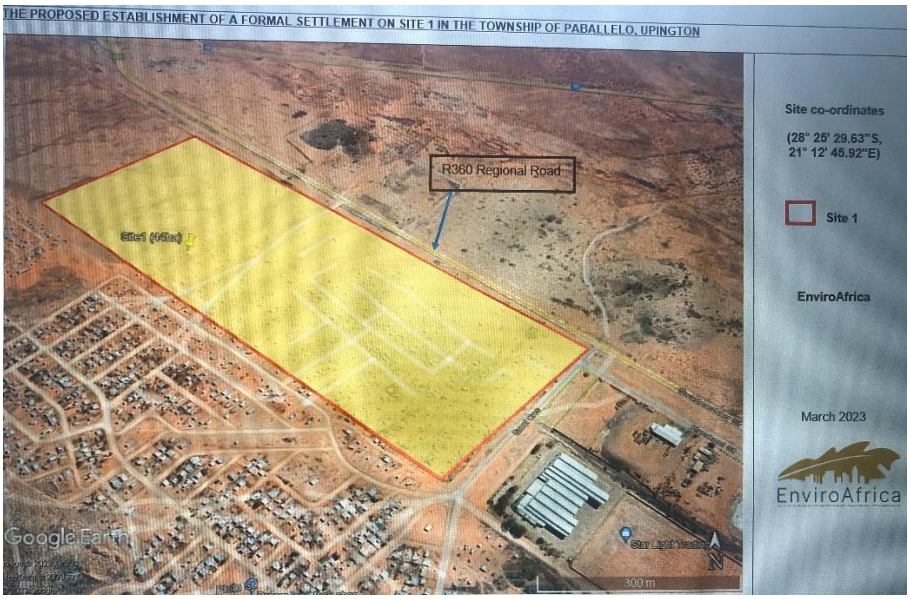


Figure 1 Public Participation

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 Forestry, Fisheries and the Environment 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 mainly focussed in S21 (c) and (i) of the NWA.

3 Overview Dawid Kruiper Local Municipality

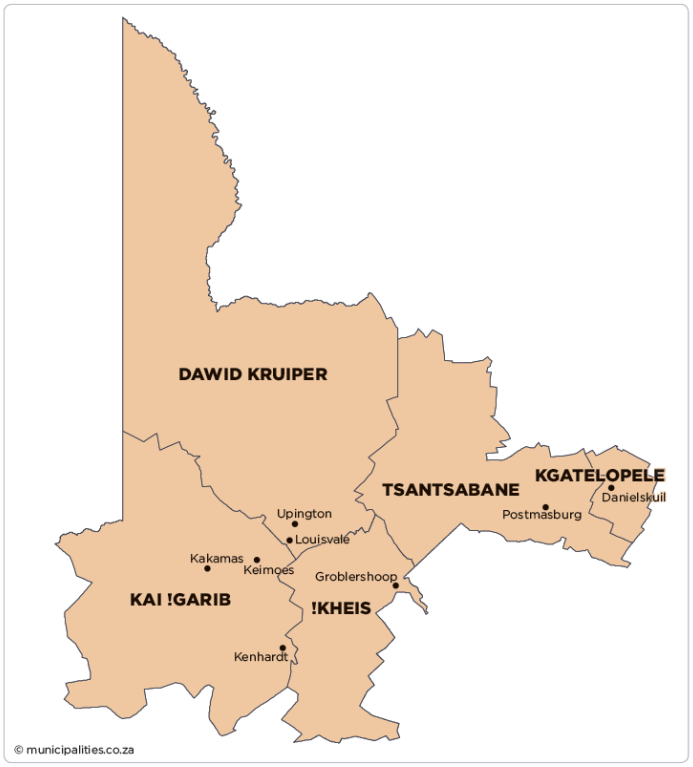


Figure 2 Map Dawid Kruiper Municipality

The Dawid Kruiper Municipality covers a surface area of 44 399km^2. The population in 2017 was 144 000. It is demarcated in the south by the Orange River and to the north stretches the wide expanses of the Kalahari Desert. It is flanked by Namibia in the west and by Botswana in the east. Most of the economic activity is concentrated in the city of Upington.

Large-scale farming with grapes, mainly raisins, wine and export fruit is the mainstay of the local economy. Farming activities are labour intensive and provide literally thousands of employment opportunities. These people require housing and many of them are concentrated in small settlements along the Lower Orange River. WATSAN Africa has been active in the official authorisation process of new settlements in the area, in and around the Dawid Kruiper Municipality, as indicated in Figure 3.

The Paballelo development will cover a surface area of 51 hectares and will make provision of 800 erven.

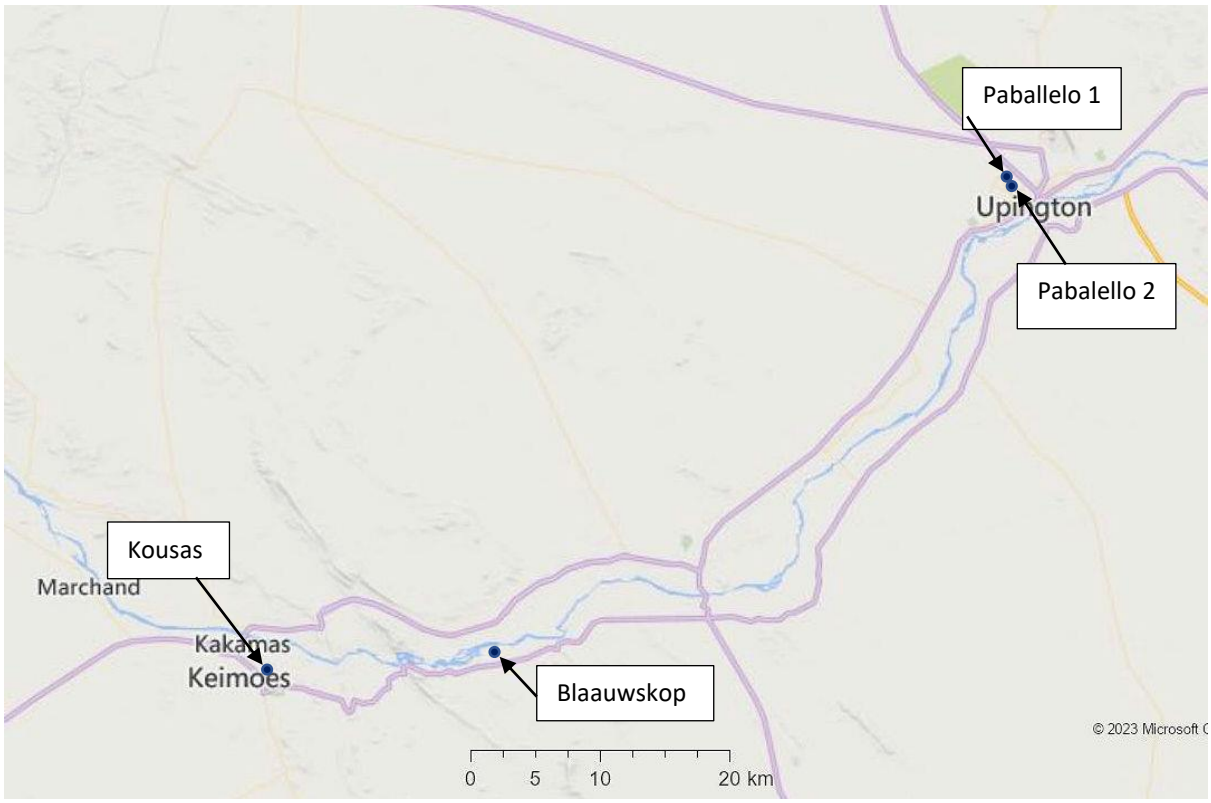


Figure 3 New settlements in and around the Dawid Kruiper Municipality.

4 Locality

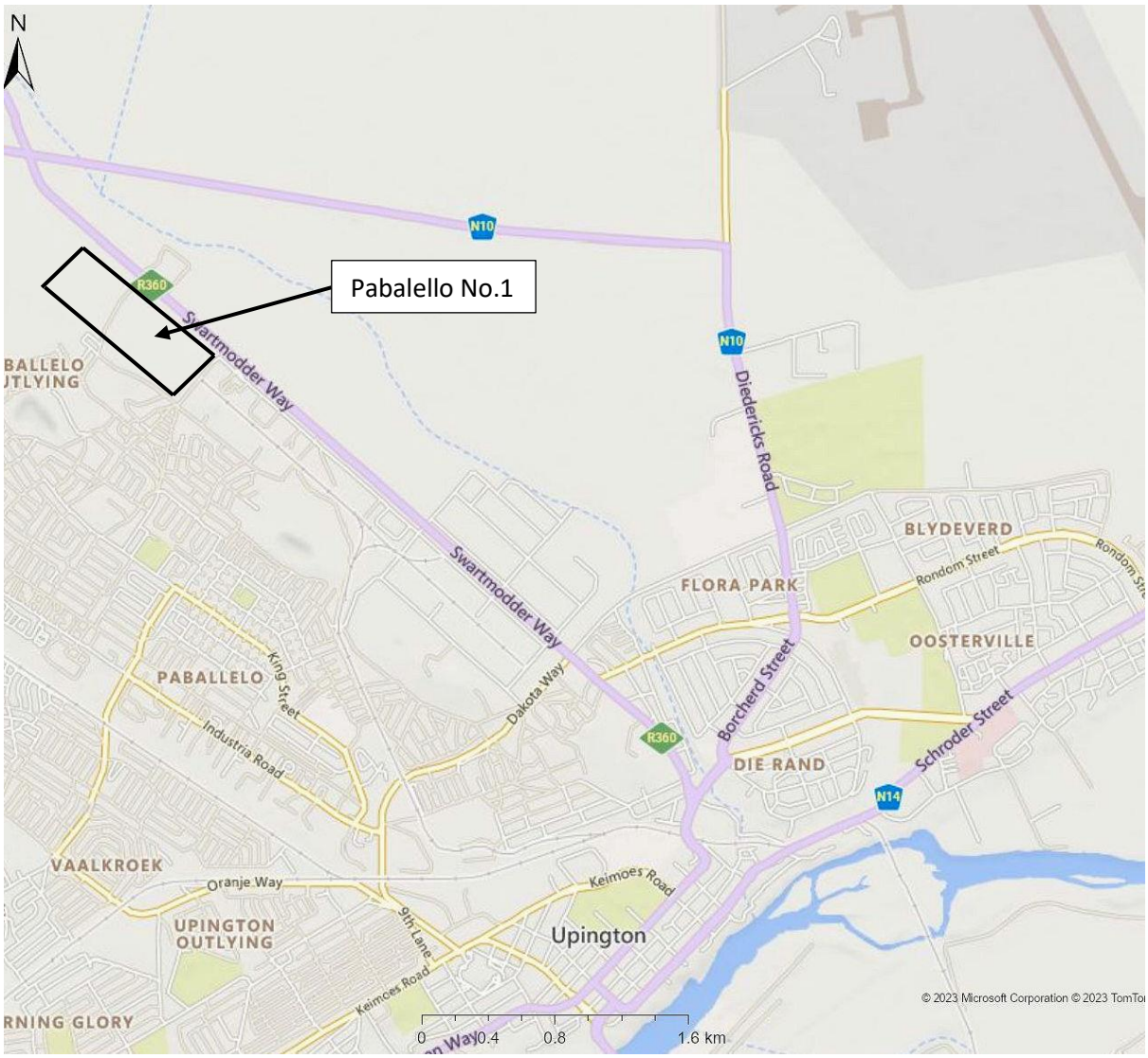


Figure 4 Locality

The locality of the proposed urban development is indicated in Figure 4. It is on the outskirts of Upington in the Northern Cape along Swartmodder Way (R366).

The coordinates in the middle of the proposed township are as follows:

28°25’30.36”S and
21°12’45.19:E

5 Climate Upington

https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/upington_south-africa_945945

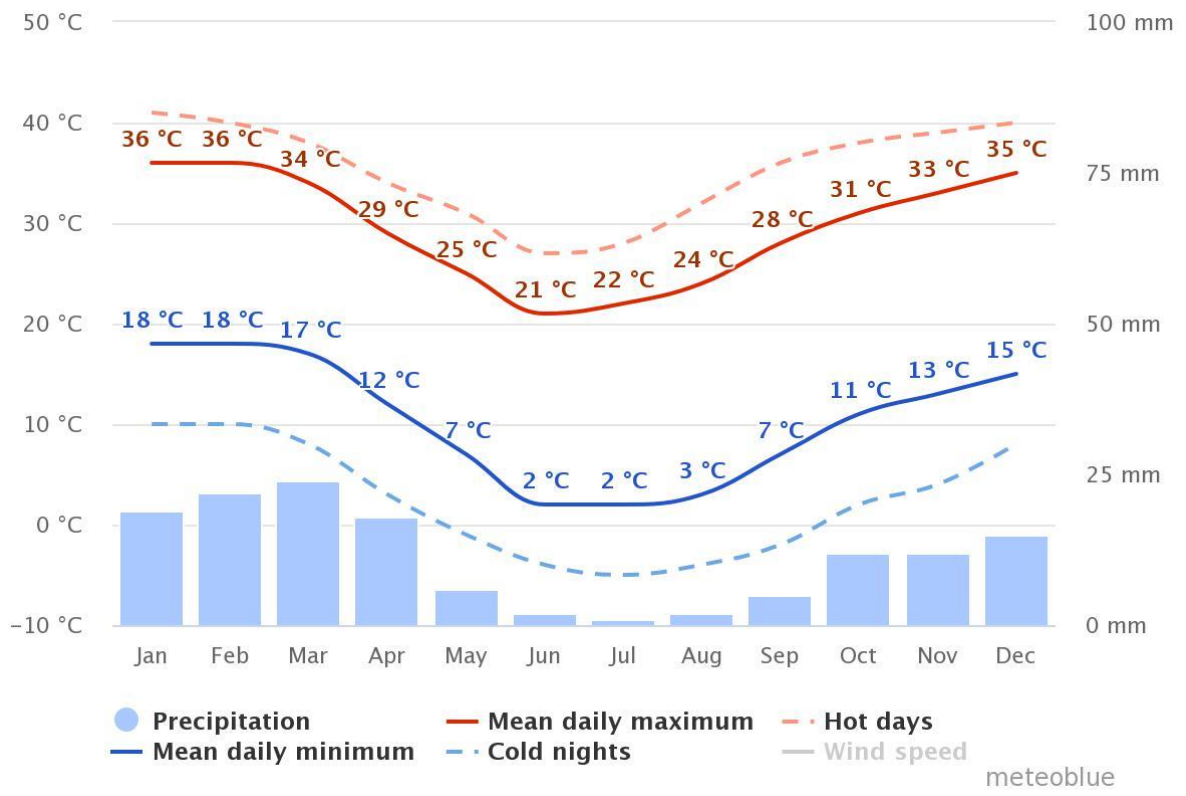


Figure 5 Climate Upington

Summers in Upington are extremely hot, with tempreatures often higher than 40°C. The winters are moderate.

The avarage annual rainfall only demands to 164mm, with rainfall during summer and little or no rain during winter. The dry season with no rain can last for 7 months or longer.

(http://www.upington.climatemps.com › precipitation).

Sudden electric thunderstorms happen, with fierce downpours, sometimes with hail. Rainfall is erratic, with very long periods of drought that can last for years.

The Orange River came down in flood twice over these last two years. The bulk of this water was from the upper catchment and despite of the rain in Upington, the lower catchment does not contribute much to the flow.

Upington and surrounds are entirely dependent on the Orange River for its water needs and is not reliant on rainfall.

6 Quaternary Catchment

Upington is in the D73F quaternary catchment.

7 Conservation Status

7.1 DFFE Screening Tool

Table 1 DFFE Screening Tool Results

Theme	Sensitivity Rating
Animal Species Plant Species Terrestrial Biodiversity	High Low Very High

The Animal Species Theme was rated as High because of the possible presence of the lanner falcon *Falco biarmicus*. This is a cosmopolitan species. The development at Paballelo is not going to make any difference to its conservation status. Likewise, Ludwig's bustard *Neotis ludwigii* is listed as Endangered in South Africa because of its propensity to collide with power lines, which can be fatal. No such power lines will be constructed at the envisaged Parabello township.

The Terrestrial Biodiversity is listed as Very high because it is indicated as an ESA. The Screening Tool does not indicate why it is listed as such, but it is unlikely that the proposed township will have any material impact on the conservation status of this ESA.

Mr Peet Botes Pr.Sci.Nat, environmental consultant, has produced an elaborate report to address these screening tool concerns. According to this report, there are no valid reasons to back up any concern.

7.2 Spatial Biodiversity Plans

The Orange River is listed as a NFEPA, as are all large rivers and major tributaries in South Africa. The drainage lines in and around Paballelo are not listed.

7.3 Vegetation

According to Mucina and Rutherford (2006) the vegetation type is Kalahari Karoid Shrubland, which is listed as Least Concern. Apart from a sparce scattering of original plants, there is nothing left of this vegetation on the proposed site.

8 Municipal Services

The lay-out of the township, streets, erven, open spaces, etcetera, has not yet been done. A professional town and regional planner must still do this work.

Residents have outside toilets (Figure 8). Some of them have self-made pit latrines, other a bucket system that is being emptied by the municipality into tanker trucks and then removed to the municipal wastewater treatment works.

Potable water is provided from 5000 litres JoJo tanks in the township that are filled from municipal tanker trucks. Residents fill their household containers from these tanks.

Eventually, each erf will be provided with a proper unit that consists of a outside toilet connected to the central waterborne sewerage as well as a tap connected to the formal municipal potable water provisioning system. This planning is still in the early stages, according to Mr Thys Neels from the municipality, and it will take time and funding to finalise. Meanwhile, the official authorisation processes must proceed, such as the EIA and the WULA.

Household solid waste is currently removed according to a fixed schedule by the municipality utilising the so-called black bag system. The township is remarkably clean, according to observations.

Swales have been constructed in green zones among some of the houses. A swale is a shallow depression, perhaps half a metre deep and 2 metres wide, with gentle sloping sides, smoothed over and landscaped. Swales are part of the urban stormwater management system.

9 Northern Cape Drainage Lines

The landscape around much of the Lower Orange River and the Hartbees River is dominated by a dense succession of drainage lines, each with their own sub-catchment. The drainage lines 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 6).

The drainage lines are mostly dry, with water only during rains and perhaps shortly thereafter. During the odd thunderstorm, 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 formed over millennia, even since geological times.

The vegetation in these arid parts is sparse, with a low diversity op plant species and a limited habitat variability. Drainage lines are often overgrown with a mature stand of sweet thorn *Vachellia karoo*, together with some other scrub and low trees such as *Searsia* species. In other parts the dominant tree is swarthaak *Senegalia mellifera.* The protected camelthorn tree *Vachellia erioloba* marks these drainage lines.

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 drainage line's 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 drainage lines.

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.

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.

The conservation of drainage lines along the Lower Orange River deserves and demands attention by decision-making authorities, environmental practitioners, the conservation and farming community alike. As more of these drainage lines are impacted upon, and because impacts are radical by nature, because sections of drainage lines are replaced by vineyards or other forms of agriculture, or transformed into return flow infrastructure, the necessity for a widely accepted conservation policy becomes urgent as development escalates.

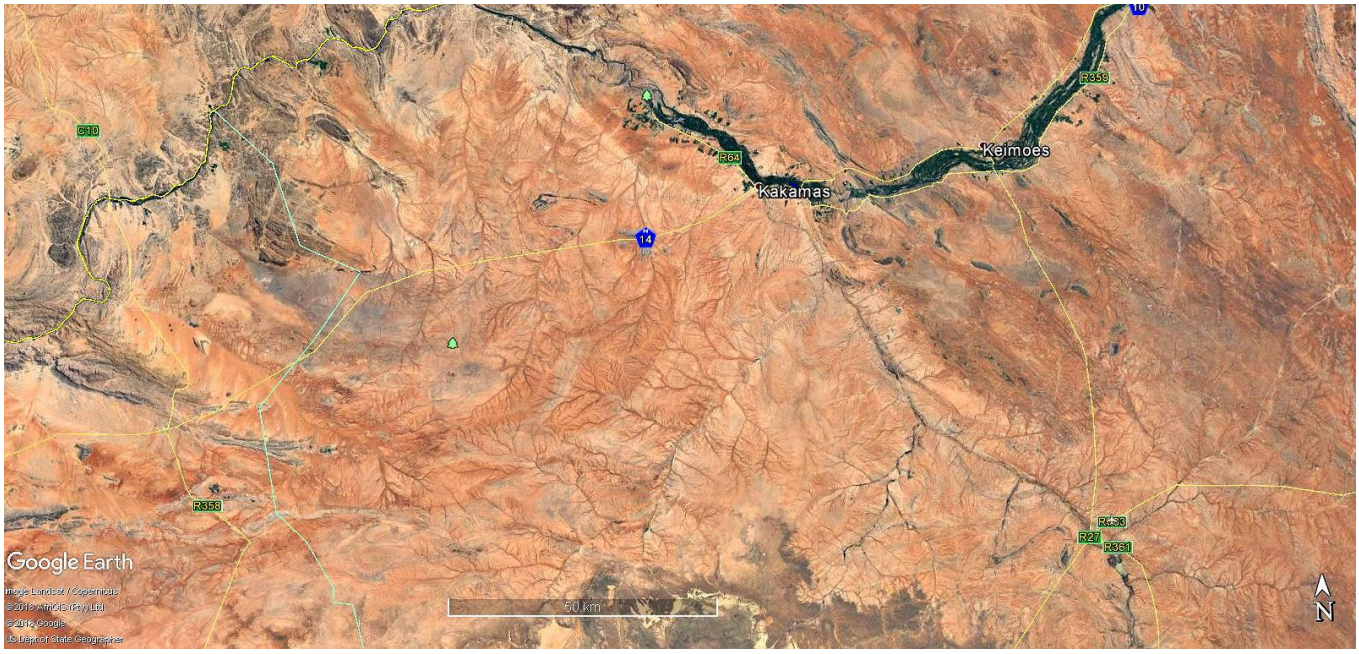


Figure 6 Northern Cape Drainage Lines

10 Paballelo Drainage Lines

The drainage lines on the Paballelo site are very faint and almost unrecognisable, because of human impacts such as informal urban development (Figure 7 & 8), grazing of livestock, trampling and littering (Figure 9). All that is left is a shallow depression with sparse higher vegetation than that of the surrounds.

There are still some remnants of drainage lines on the site (Figure 10 &11). The larger one in the middle goes right through the site and into a larger drainage line that stretches into a southeast direction around the built-up area and the stops against Dakota Street in town, from where it carries on as part of the city's stormwater drainage system in a straight line to the N10, from where it is no longer to follow it to where it ends up in the Orange River though stormwater infrastructure.

These drainage lines have been obliterated to such an extent that the need for a Freshwater Report and a WULA was questioned at the beginning of the project. It was nevertheless decided to carry on with the procedure, rather to have the project halted in an advanced stage of the approval process because of the authorities objecting to legal procedures not being followed.

Figure 7 Informal housing.

Figure 8 Streets

Figure 9 State of the vegetation

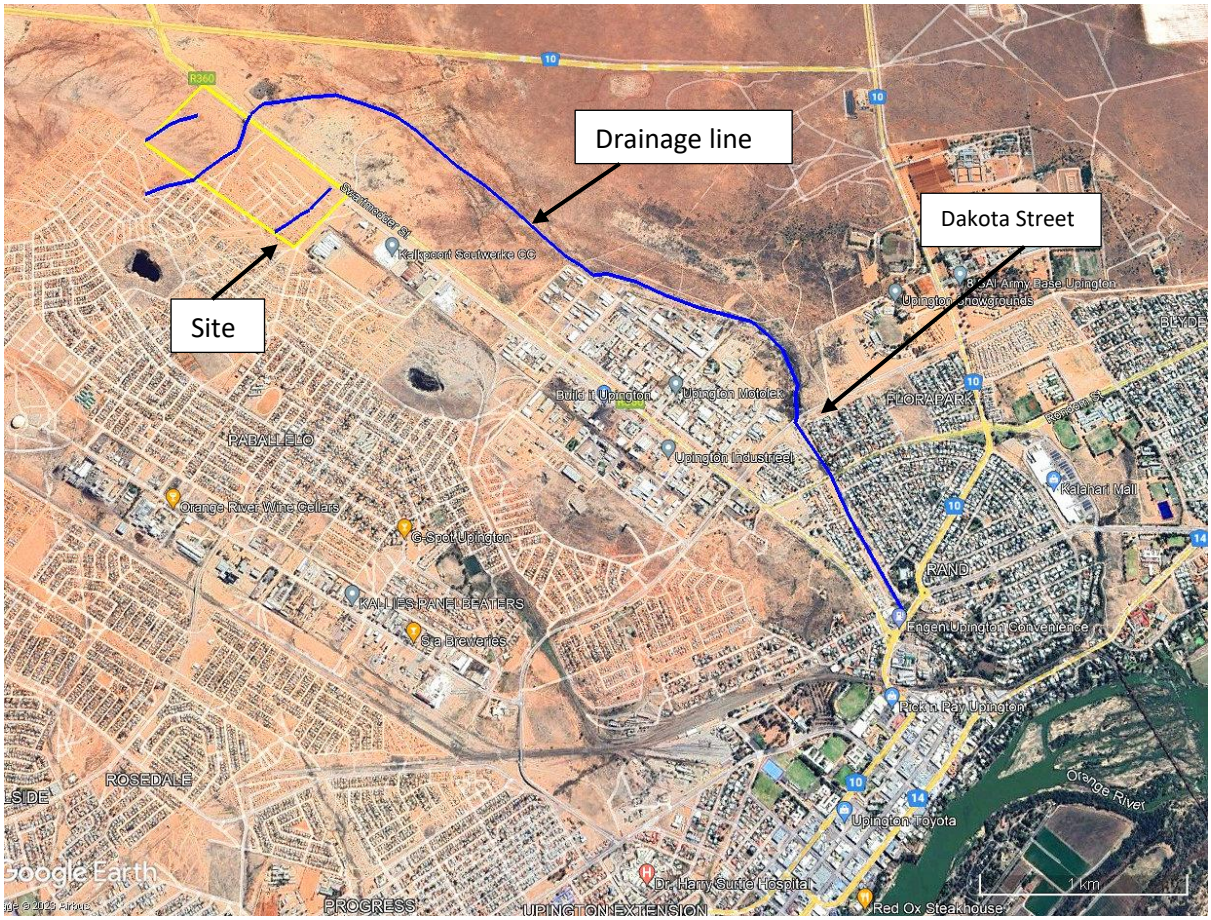


Figure 10 Site Drainage Lines

Occupation of the site (Figure 7 & 8) has been ongoing now for several years, as the planted trees in some of the fenced-in yards have grown into large trees, with some gardens well established. There are a number of spaza shops. The dirt streets are well used. The main streets have been formalised, graded and with road signs (Figure 8).

There is still some natural vegetation left in the green parts among the houses, but in the undeveloped parts to the north, the land is mostly barren or with the natural shrub replaced with mainly grasses (Figure 9). Seemingly, depicted on Figure 7, is a shallow swale that serves as a stormwater conduit.

Figure 11 Site

11 Sub-Catchment

The surface area of a sub-catchment is of importance, as it is one of the determinants for the runoff and the risk for flooding.

The sub-catchment of drainage lines can be determined by connecting the highest points around a drainage lines, using the Google Earth's polygon function. The red hue in drainage lines, especially in the very upper sub-catchments, help to demarcate sub-catchment areas. The sub-catchment in which Pabalello is located poses challenges, as much of the telling signs are obliterated by urban development and grazing. The sub-catchment is flanked by dunes and dune fields, which demarcates the sub-catchment.

The surface area of the entire sub-catchment from Dakota Street is approximately 45 000 hectares (Figure 1), which is large enough to generate flooding. However, the average rainfall is very low with little risk of flooding, with a probable recurrence frequency of once in more than 100 years.

Likewise, it is difficult if not impossible with the means available and with the signs left on the ground to determine the surface area of the drainage lines traversing the new housing project in Paballelo. It is probably no more than 40 hectares, with that of the smaller ones probably no more than 20 hectares. The risk of flooding is negligible.

The average slope on the proposed development is 1.4 vertical metres in every 100 horizontal meters from east to west, which is a gentle slope.

Nevertheless, it is recommended that houses are constructed out of the way and not in the drainage line crossing the site. The 100m controlled zone in terms of GN509 would render the development unviable. The 32m controlled zone in terms of the NEMA is, for flooding reasons, unnecessary either, if only space is left for any runoff during very large downpours. A constructed swale would do. For this, the permission of the DWS is required.

12 Biomonitoring the Lower Orange River

12.1 Methodology

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 13 samples have been analyzed at 12 localities (Table 1). The site furthest east was at Hopetown and furthest west at Augrabies, with Upington in the middle. Twelve of these localities are located upstream of the Augrabies Falls. One 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.

12.2 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 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 are 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.

12.3 Lower Orange River Biomonitoring Results

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

The classes from A to F in Figure 1 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 situation.

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

12.4 Limitations

The DWS maintains a formal and scheduled biomonitoring program throughout the country, including the Lower Orange River. This gives, no doubt, a much better indication of the state of the river than self-collected data. Because this data is not available to the consulting fraternity, self-collected data such as that of Figure 1 must suffice.

To keep up with what is currently happening in the river, a new round of sampling is urgently required.

12.5 Biomonitoring at Belurana

The Belurana sampling site was the most representative of the Orange River just downstream of Upington. It is located against the steep incline of the flood control wall along the northern bank of the river (Figure 8), next to the N10 road bridge and the pipeline bridge on the Orange River (Figure 9).

The riverbank is mostly inaccessible because of the impenetrable reeds, but at the sampling site, the reeds are controlled and the riverbank is kept open. The bottom was muddy and the water turbid. The current was strong in the middle of the river at a velocity of approximately $1ms^{-1}$, but much slower along the banks. There were no rocks or bedrock. The reeds provided emerging and submerged vegetation. Knotweed *Persicaria lapathipholia* and a *Cyperis* sedge provided more aquatic habitat.

The macroinvertebrates recorded at Belurana are listed in the SASS5 score sheet in the Appendix.

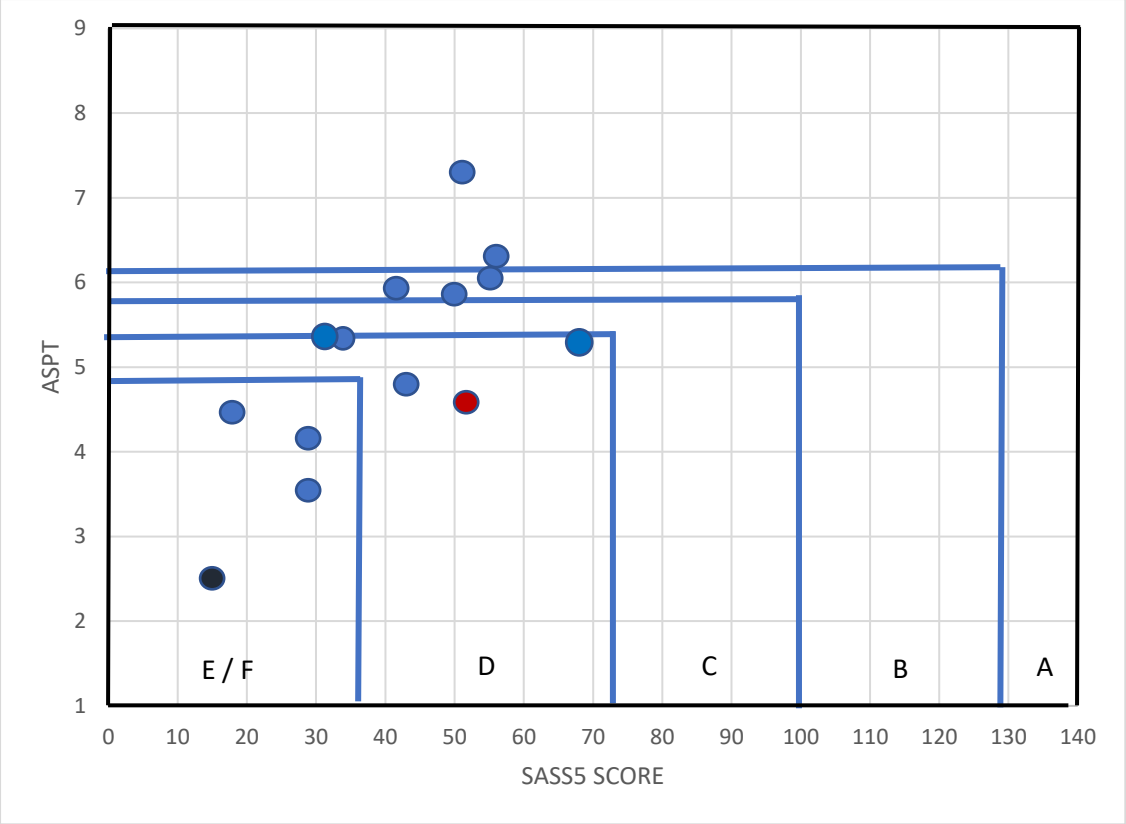
The SASS5 score was 51, with an ASPT of 4.6, which indicated that the river at Belurana was measurably impacted, with some loss of ecosystem function (Figure 12).

However, this impact is probably less than that from the large-scale agriculture in the region as well as that from Upington's streets.

Biomonitoring results indicate a Class C- river (Figure 14), with measurable impacts but with significant ecological functioning.

Table 2 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	17/5/21	69	13	5.3
Belurana Upington	28°27'49.79S 21°14'32.67E	15/12/21	51	11	4.6
Bakenrant	28°38'35.84S 20°26'07.96E	15/12/21	33	6	5.5



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 12 Lower Orange River Biomonitoring results

13 Present Ecological State

The PES and EIS are protocols that have been produced by Dr Neels Kleynhans (Table 3,4 and 5) in 1999 of the then DWAF to assess river reaches. The PES is one of the evaluations that is prescribed for S21 (c) and (i) WULA's. The scores given are solely that of the practitioner and are based on expert opinion.

Table 3 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

Table 4 Present Ecological State of the drainage line crossing the proposed Paballelo development

Instream	Score	Weight	Product	Maximum score
Water abstraction	25	14	350	350
Flow modification	20	13	260	325
Bed modification	9	13	117	325
Channel modification	8	13	104	325
Water quality	15	14	210	350
Inundation	9	10	90	250
Exotic macrophytes	18	9	162	225
Exotic fauna	11	8	88	200
Solid waste disposal	15	6	90	150
Total		100	1471	2500
% of total			58.8	
Class			D	
Riparian				
Water abstraction	25	13	325	325
Inundation	8	11	88	275
Flow modification	19	12	228	300
Water quality	15	13	195	325
Indigenous vegetation removal	5	13	65	325
Exotic vegetation encroachment	18	12	216	300
Bank erosion	20	14	280	350
Channel modification	9	12	108	300
Total			1505	2500
% of total			60.2	
Class			C	

The scores of D for instream and C for riparian ware better than expected, but will drop with one or two classes when the drainage line is altered into a shallow swale to accommodate storm water. The decision-making authority will have to decide if this is acceptable, but according to WATSAN Africa, given the state of the environment in this part of the city and the state of the drainage line all the way to the Orange River, the aquatic environment that would be altered is negligible.

Table 5 Present Ecological State Orange River at the N10 road bridge

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	10	11	110	275
Flow modification	11	12	132	300
Water quality	15	13	195	325
Indigenous vegetation removal	5	13	65	325
Exotic vegetation encroachment	4	12	48	300
Bank erosion	20	14	280	350
Channel modification	10	12	120	300
Total			950	2500
% of total			38.0	
Class			E	

It is unthinkable that a small development such as Paballelo would have any effect on the status of the river at Belurana next to the road bridge, not incrementally or otherwise, given the many other impacts on the Orange River.

14 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 6).

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

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

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. The vegetation in the Paballelo drainage lines is insignificant and does not contribute to biodiversity.

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.

15 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.

The drainage lines in and around the Paballelo development can be considered as ecologically sensitive. This is an arid region, where the regrowth of vegetation may take decades, once removed or disturbed. The drainage lines will predicably be altered into stormwater swales and will never be returned to an original, unimpacted state. From this angle, the drainage lines are most sensitive. If these drainage lines do not rebound, it would be of little ecological significance.

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. The river will never rebound as long as human impact persists, with its intrinsic capacity permanently impaired. From this angle then, the river can be viewed as ecologically sensitive.

16 EISC

The DWS demand that the river be placed in a category according to the EISC methodology (Table 5). The EISC is one of the essential items that is required for the Risk Matrix.

Table 7 EISC for the Paballelo Drainage Lines

Determinant	Score	Confidence
Rare and endangered species	1	4
Populations of unique species	1	4
Species / Taxon richness	1	4
Diversity of habitat	1	4
Migration Route/ Breeding and feeding site for wetland species	2	4
Sensitivity to water quality changes	2	4
Flood storage, energy dissipation, particulate / element removal	1	4
Protection status	1	4
Ecological integrity	1	4
Average	1.2	

Score guideline:

Very High 4, High 3, Moderate 2, Low 1, None 0

Confidence Rating

Very High 4, High 3, Moderate 2, Low 1

The EISC for the Drainage Lines was set at 1.2, which is “Low”.

Table 8 EISC for the Orange River

Determinant	Score	Confidence
Rare and endangered species	4	4
Populations of unique species	3	4
Species / Taxon richness	3	4
Diversity of habitat	2	4
Migration Route/ Breeding and feeding site for wetland species	4	4
Sensitivity to water quality changes	3	4
Flood storage, energy dissipation, particulate / element removal	4	4
Protection status	3	4
Ecological integrity	3	4
Average	3.2	

The EISC for the Orange River was set at 3.2, which is “High”.

17 Probable Impacts and Mitigating Measures

It is unthinkable that the proposed development at Paballelo would have material incremental impacts on the Orange River.

The drainage lines would most likely be substantially altered into swales for stormwater management.

Given the arid climate, the very small sub-catchment area and the already degraded state of the environment, the proposed housing development can hardly do any more environmental damage that must be mitigated. Therefore, houses must not be built in the drainage line, a flow path must be kept open, the swales must be properly landscaped. Litter must regularly be collected in the green zones where the swales are and removed to the municipal landfill site.

It would be preferrable to limit pedestrian traffic and farm animals in the green zones where the swales are, but this is hard to control. It can only be hoped that some vegetation will grow back, as is evident in the already existing storm water swales.

It is not necessary to maintain the 32m legally required controlled zone on both banks of the drainage lines that probably and eventually will become stormwater swales. It can be less. For this, official authorization is required.

18 Impact Assessment

Some of the authorities, such as the DFFE and its provincial offices 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.

This assessment focusses specifically on the aquatic environment.

Table 9 Impact Assessment

Description of activities

Construction of roads
Construction of more dwellings
Construction of water provision and sanitation infrastructure
Construction of electricity provision infrastructure

Description of impacts

Washing of sediments, sand and mud own the drainage lines and into the urban stormwater system.
Degrading of aquatic habitat

Mitigation measures

Keep construction activities out if the drainage lines.
Limit the footprint of construction activities.

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Local	High	Short term	Medium	Probable	Certain	Irreversible	Irreplaceable
With mitigation measures								
Negative	Local	Low	Short term	Low	Unlikely	Sure	Irreversible	Irreplaceable

Table 9 Impact Assessment

Description of activities

Alteration of drainage lines into stormwater swales
Rehabilitation and landscaping of swales

Description of impacts

Washing of sediments, sand and mud own the drainage lines and into the urban stormwater system.
Degrading of aquatic habitat

Mitigation measures

Construct during the dry period.
Keep construction period as short as possible, start and finish before next rainy season.

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Negative	Local	High	Short term	Medium	Probable	Certain	Irreversible	Irreplaceable
With mitigation measures								
Negative	Local	Low	Short term	Low	Unlikely	Sure	Irreversible	Irreplaceable

The impact assessment shows that mitigating measures can prevent excessive environmental damage to the drainage lines downstream of the planned development, but it cannot save the drainage liness on-site, as the drainage line will probably have to altered into stormwater swales. As there currently is practically no viable aquatic habitat in these drainage lines, it does not represent any material environmental loss.

The swales would represent a new, urban aquatic environment, which could be viable, if there was more water. It is doubtful if the swales would ever reach that status, given the arid conditions.

Description of activities

Operational period. Habitation of new dwellings

Description of impacts

Littering and trampling of stormwater swales.

Mitigation measures

Remove litter according to schedule.
Limit traffic in swales.
Limit livestock number is swales, if possible at all.

Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Indirect	Local	High	Short term	Medium	Probable	Certain	Irreversible	Irreplaceable
With mitigation measures								
Indirect	Local	Low	Short term	Low	Unlikely	Sure	Irreversible	Irreplaceable

19 Numerical Significance

Decision-makers often press on a numerical score for Significance**.** The score takes into consideration both the environmental value of the site and the degree of impact.

Table 27., p52, Appendix provides a system for allocation values for each of the parameters Conservation Value, Extent, Duration, Severity and Likelihood with regard to possible impacts These values are then entered into the equation on p52 to derive at a value for Significance. The value for Significance can subsequently be evaluated according to Table 27.3.2.

Table 27.3.2 provides a yardstick for decision-making to allow or disallow a development with its concomitant impact on the environment.

The scores that were given are entirely those of the specialist (Table 10), based on his or her knowledge and experience. These scores form a bases for debate and consensus, should contemporaries and decision-makers wish to add to the process.

The scores apply under the assumption that mitigation measures will be in place.

Table 10 Significance Score

Parameter	Drainage lines	Orange River
Conservation value	1	4
Likelihood	5	1
Duration	5	5
Extent	1	1
Severity	2	1
Significance	13	32

The drainage lines are going to be impacted and these impacts would be permanent, but because the drainage lines do not have much if any conservation value, the numerical significance is rated as Low.

The numerical significance of the Orange River is rated as Low as well, despite of its high conservation value. The likelihood of any impact is insignificant.

20 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 11 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 11 (continued) represent the same activities as in Table 11, with sub-activities added.

The methodology is tabled in the Appendix.

The Risk Matrix indicates that a General Authorisation is the indicated level of approval. A License is not called for.

Table 11 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Construction of roads Construction of more dwellings Construction of water provision and sanitation infrastructure Construction of electricity provision infrastructure	Washing of sediments, sand and mud own the drainage lines and into the urban stormwater system.	Degrading of aquatic habitat	26	Low
2	Alteration of drainage lines into stormwater swales Rehabilitation and landscaping of swales	Washing of sediments, sand and mud own the drainage lines and into the urban stormwater system.	Degrading of aquatic habitat	28	Low
3	Operational period. Habitation of new dwellings	Littering and trampling of stormwater swales.	Degrading of aquatic habitat	52.5	Low

Table 8 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1 2 3	1 2 1	2 1 1	1 2 2	1 1 1	1.25 1.5 1.25	1 1 1	1 1 3	3.25 3.5 5.25

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1 2 3	1 1 4	1 1 4	5 5 1	1 1 1	8 8 10	26 28 52.5	Low Low Low

21 Resource Economics

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

The diagram (Figure 13 & 14) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 9.

Table 12. Goods and Services

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

A large star shape for the drainage lines would attract decision-maker's attention. This shape of the spider diagram is very small. The drainage lines do not have a significant resource economic footprint. From this perspective, not much would be lost if the drainage lines are impacted.

Never in the history of WATSAN Africa has a drainage line scored so low as the ones in Paballelo. It has almost no economic resources significance (Figure 13).

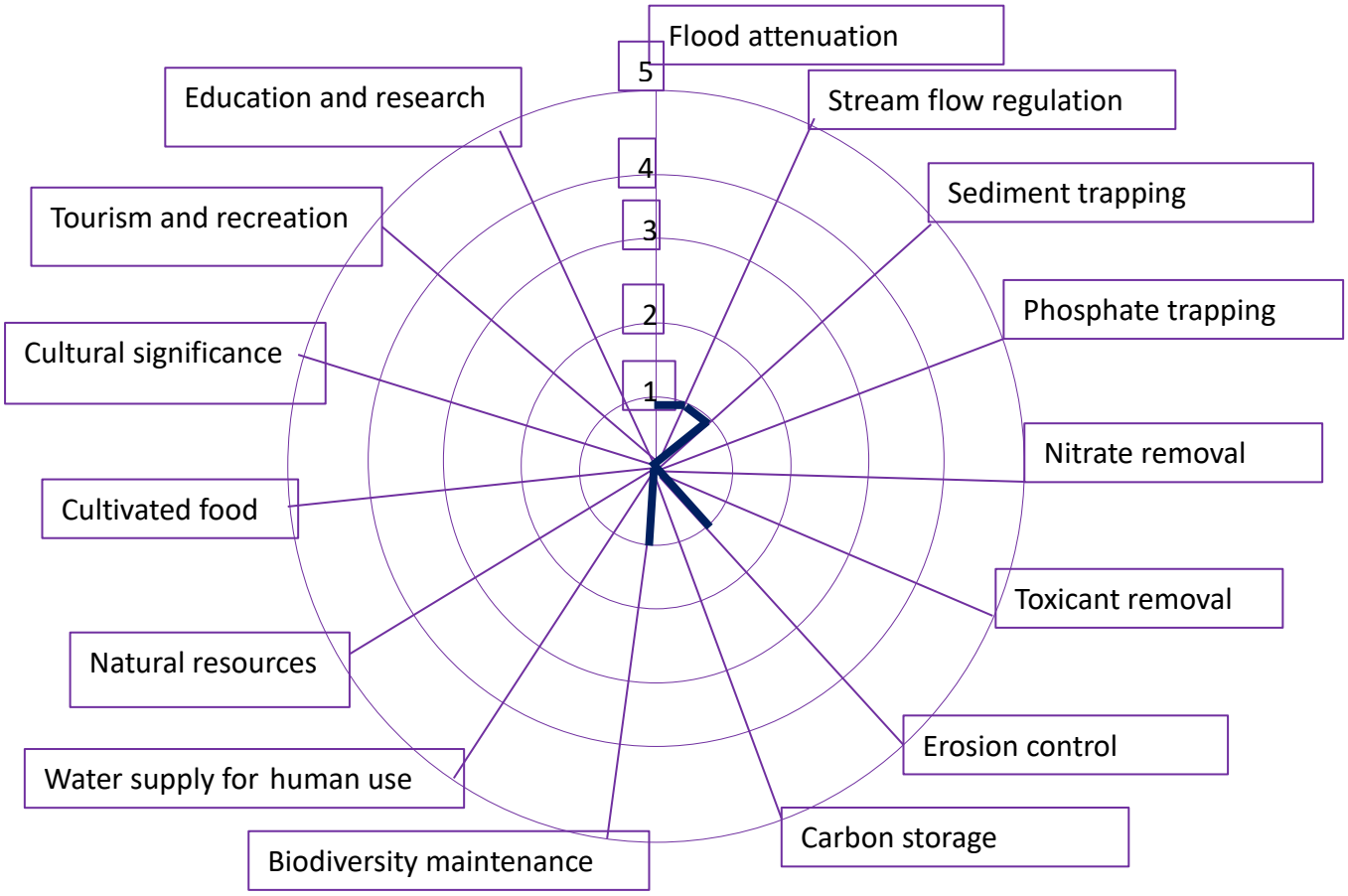


Figure 13. Resource Economics Footprint of the Drainage Lines

For the Orange River, like most large rivers, this is a futile exercise, as large rivers score a perfect circle. It has been included for the sake of completeness.

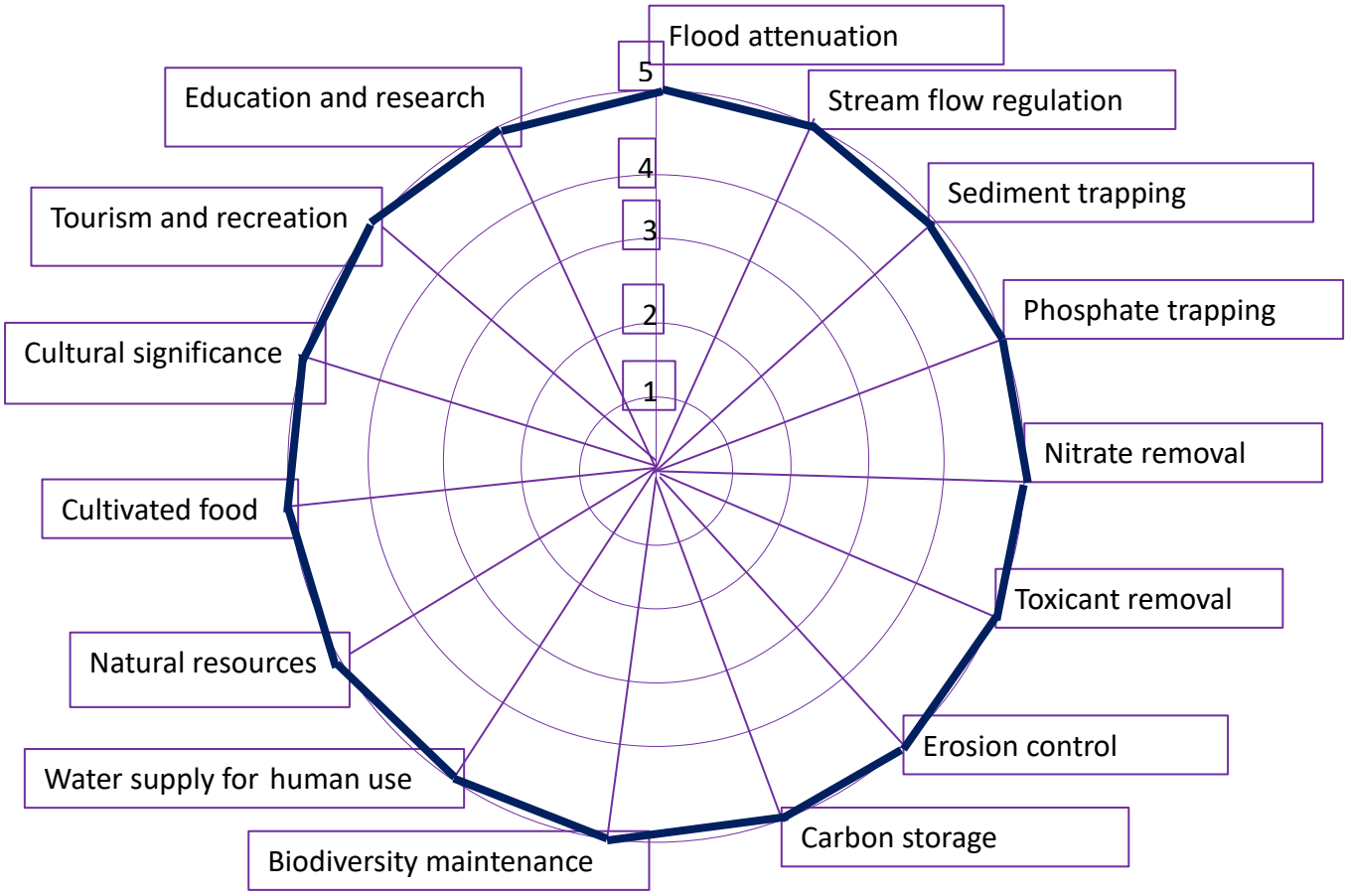


Figure 14. Resource Economics Footprint of the Orange River

The proposed development at Paballelo is not about to detract from or add to the ecological goods and services of the drainage lines or the Orange River.

22 Summary

Table 13 Summary of evaluations

Aspect	Status
DFFE Screening Tool	Sensitivity Low, High and Very High
Paballelo new site	Not listed as ESA of CBA
Drainage lines aquatic habitat	Not NFEPA
Oranje River	NFEPA
Vegetation	Least concern
PES of the drainage lines	Largely modified
PES of the Orange River	Moderately impacted
Ecological Importance Drainage lines	Not important
Ecological importance Orange River	Most important
Ecological Sensitivity Drainage lines	Sensitive
Ecological Sensitivity Orange River	Sensitive
EISC drainage lines	Low
EISC Orange River	High
Impact assessment	Mitigation cannot save drainage lines from impact.
Risk Matrix	General Authorization
Resource Economics drainage lines	Negligible footprint
Resource Economics Orange River	Very large footprint

Table 13 gives an overall and much condensed view of the evaluations and methodologies that have been applied to the drainage lines at Baballelo and to the Orange River. In short, it explains that the river is much more important than the drainage lines and that Pabalello is unlikely to have a measurable impact on the river.

Table 13 explains that the drainage lines are entirely unimportant from either a conservation or resource economics point of view, as determined by the prescribed evaluations.

23 Discussion and Conclusions

An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on all the other drivers and responses. This, in turn, will predictably impact on the ecosystem services (Figure 15). The WULA and the EAI must provide mitigation measured for these impacts.

Figure 15 has been adapted from a relevant DWS policy document.

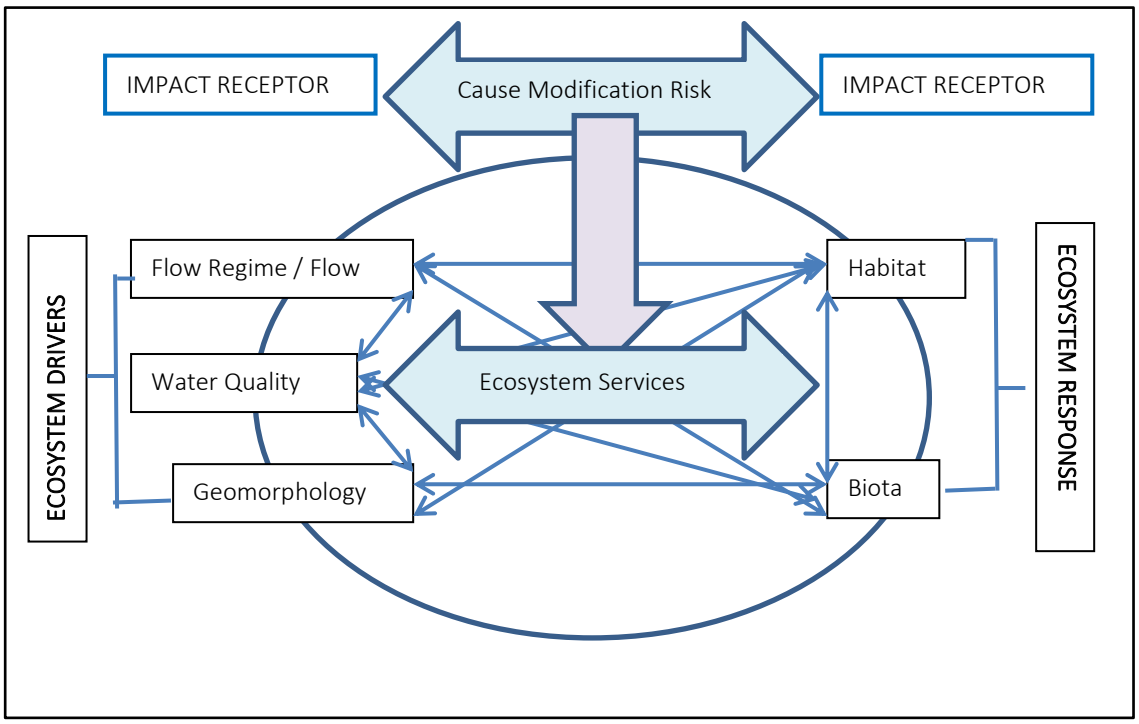


Figure 15 Minimum Requirements for a S21(c) and (i) Application

The driving force behind the Orange River is the runoff from the Lesotho highlands far away in the upper catchment. Thunderstorms in summer and snow melts during winter. This is where the massive runoff volumes originate that maintain the Orange River system. The low ground of the Lower Orange River does not contribute to the flow in the Orange River. The flow is seasonal, with peak flows and periodic flooding following high summer rainfall events and low flow in winter, when precipitation on the high ground is less. Low flow periods can be extended due to long periods of drought.

The riverine habitat and aquatic organisms are adapted to perennial circumstances, with an adequate flow down the river all year round, even during drought conditions.

Human impact has become a driving force, with large dams and abstraction of water for irrigation. The river's water is used far and wide, piped long distances awa for human use in many towns and villages.

Agricultural return flow, with its load of agrichemicals and silt is a significant impact. So is treated sewage effluent from cities and towns, including that of Upington.

Despite of this, the river maintained most of its ecological integrity and ecological functioning.

The new development at Paballelo is a mere speck in the grand scheme of the Orange River. It is not about to add or detract any of the ecosystem services. Its impact is insignificant, with no measurable effect on the river's ecological functioning.

The Risk Matrix indicates that a General Authorization is in order.

24 References

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25 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:  15 January 2022

26 Résumé

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Experience

WATSAN Africa, Cape Town. Scientist **2011 - present**

USAID/RTI, ICMA & Chemonics. Iraq & Afghanistan **2007 -2011**
Program manager.

City of Cape Town **1999-2007**
Acting Head: Scientific Services, Manager: Hydrobiology.

Department of Water & Sanitation, South Africa **1989 – 1999**
Senior Scientist

Tshwane University of Technology, Pretoria **1979 – 1998**
Head of Department

University of Western Cape and Stellenbosch University 1994 - 1998 part-time

- Lectured post-graduate courses in Water Management and Environmental Management to under-graduate civil engineering students
- Served as external dissertation and thesis examiner

Service Positions

- Project Leader, initiator, member and participator: Water Research Commission (WRC), Pretoria.
- Director: UNESCO West Coast Biosphere, South Africa
- Director (Deputy Chairperson): Grotto Bay Homeowner's Association
- Member Dassen Island Protected Area Association (PAAC)

Membership of Professional Societies

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

Reports

- Process Review Kathu Wastewater Treatment Works
- Effluent Irrigation Report Tydstroom Abattoir Durbanville
- River Rehabilitation Report Slangkop Farm, Yzerfontein
- Fresh Water and Estuary Report Erf 77 Elands Bay
- Ground Water Revision, Moorreesburg Cemetery
- Fresh Water Report Delaire Graff Estate, Stellenbosch
- Fresh Water Report Quantum Foods (Pty) Ltd. Moredou Poultry Farm, Tulbagh
- Fresh Water Report Revision, De Hoop Development, Malmesbury
- Fresh Water Report, Idas Valley Development Erf 10866, Stellenbosch
- Wetland Delineation Idas Valley Development Erf 10866, Stellenbosch
- Fresh Water Report, Idas Valley Development Erf 11330, Stellenbosch
- Fresh Water Report, La Motte Development, Franschhoek
- Ground Water Peer Review, Elandsfontein Exploration & Mining
- Fresh Water Report Woodlands Sand Mine Malmesbury
- Fresh Water Report Brakke Kuyl Sand Mine, Cape Town
- Wetland Delineation, Ingwe Housing Development, Somerset West
- Fresh Water Report, Suurbraak Wastewater Treatment Works, Swellendam
- Wetland Delineation, Zandbergfontein Sand Mine, Robertson
- Storm Water Management Plan, Smalblaar Quarry, Rawsonville
- Storm Water Management Plan, Riverside Quarry
- Water Quality Irrigation Dams Report, Langebaan Country Estate
- Wetland Delineation Farm Eenzaamheid, Langebaan
- Wetland Delineation Erf 599, Betty's Bay
- Technical Report Bloodhound Land Speed Record, Hakskeenpan
- Technical Report Harkerville Sand Mine, Plettenberg Bay
- Technical Report Doring Rivier Sand Mine, Vanrhynsdorp
- Rehabilitation Plan Roodefontein Dam, Plettenberg Bay
- Technical Report Groenvlei Crusher, Worcester
- Technical Report Wiedouw Sand Mine, Vanrhynsdorp
- Technical Report Lair Trust Farm, Augrabies
- Technical Report Schouwtoneel Sand Mine, Vredenburg
- Technical Report Waboomsrivier Weir Wolseley
- Technical Report Doornkraal Sand Mine Malmesbury
- Technical Report Berg-en-Dal Sand Mine Malmesbury
- Wetland Demarcation, Osdrif Farm, Worcester
- Technical Report Driefontein Dam, Farm Agterfontein, Ceres
- Technical Report Oewerzicht Farm Dam, Greyton
- Technical Report Glen Lossie Sand Mine, Malmesbury
- Preliminary Report Stellenbosch Cemeteries
- Technical Report Toeka & Harmony Dams, Houdenbek Farm, Koue Bokkeveld
- Technical Report Kluitjieskraal Sand & Gravel Mine, Swellendam
- Fresh Water Report Urban Development Witteklip Vredenburg
- Fresh Water Report Groblershoop Resort, Northern Cape
- Fresh Water Report CA Bruwer Quarry Kakamas, Northern Cape
- Fresh Water Report, CA Bruwer Sand Mine, Kakamas, Northern Cape
- Fresh Water Report, Triple D Farms, Agri Development, Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Hopetown
- Fresh Water Report Hopetown Sewer
- Fresh Water Report Hoogland Farm Agricultural Development, Touws River
- Fresh Water Report Klaarstroom Wastewater Treatment Works

- Fresh Water Report Calvinia Sports Grounds Irrigation
- Fresh Water Report CA Bruwer Agricultural Development Kakamas
- Fresh Water Report Zwartfontein Farm Dam, Hermon
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- Fresh Water Report, Marksman's Nest Rifle Range, Malmesbury
- Biodiversity Report, Muggievlak Storm Water Canal, Vredenburg
- Strategic Planning Report, Sanitation, Afghanistan Government, New Delhi, India
- Fresh Water Report, Potable Water Pipeline, Komaggas
- Fresh Water Report, Wastewater Treatment Works, Kamieskroon
- Fresh Water Report, Turksvy Farm Dam, Upington
- Fresh Water Report, Groblershoop Urban Development, IKheis Municipality
- Fresh Water Report, Boegoeberg Urban Development, IKheis Municipality
- Fresh Water Report, Opwag Urban Development, IKheis Municipality
- Fresh Water Report, Wegdraai Urban Development, IKheis Municipality
- Fresh Water Report, Topline Urban Development, IKheis Municipality
- Fresh Water Report, Grootdrink Urban Development, IKheis Municipality
- Fresh Water Report, Gariep Urban Development, IKheis Municipality
- Fresh Water Report, Bonathaba Farm Dam, Hermon
- Botanical Report, Sand Mine Greystone Trading, Vredendal
- Botanical Report Namakwa Klei Stene, Klawer
- Fresh Water Report Buffelsdrift Quarry, George
- Fresh Water Report Styerkraal Agricultural Development, Onseepkans.
- Technical Report Arabella Country Estate Wastewater Treatment Works, Kleinmond
- Fresh Water Report Calvinia Bulk Water Supply
- Fresh Water Report Swartdam Farm Dams, Riebeeck Kasteel
- Fresh Water Report Erf 46959, Gordon's Bay
- Fresh Water Report Melkboom Farm Dam, Trawal
- Stormwater Management Plan, Bot River Bricks
- Freshwater Report, Bot River Bricks
- Freshwater Report Sanddrif Farm, Joubertina
- Freshwater Report Zouterivier Cell phone tower, Atlantis
- Biodiversity Report Birdfield Sandmine, Klawer
- Freshwater Report New Wave Dam, Klawer
- Freshwater Report Harvard Solar Energy Plant, Bloemfontein
- Freshwater Report Doorn River Solar Energy Plant, Virginia
- Freshwater Report Kleingeluk Farm, De Rust
- Freshwater Report, Solar Energy Plant, Klein Brak River
- Site Verification Report Laaiplek Desalination Plant
- Freshwater Report, CA Bruwer Quarry, Kakamas
- Freshwater Report, Orren Managanese Mine, Swellendam
- Freshwater Report Bakenrant Boerdery, Kakamas
- Freshwater Report C & A van Niekerk Boerdery, Marchant
- Freshwater Report KTE Pipeline, Kenhardt
- Freshwater Report Delville Park, George
- Site Verification Report, Delville Park, George

27 Appendix

27.1 Biomonitoring Results

SASS5 Score Sheet										
Date	15 Dec 21	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Lower Orange River	Porifera	5		**Hemiptera**			**Diptera**		
		Coelenterata	1		Belostomatidae	3	3	Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5	5	Ceratopogonidae	5	
Coordinates	28°27' 49.79"	Huridinea	3		Hydrometridae	6		Chironomidae	2	
	21°14'32.67"	**Crustacea**			Naucoridae	7	7	Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	6.0	Potamonautidae	3		Notonectidae	3	3	Empididae	6	
Temperature °C	25.2	Atyidae	8	8	Pleidae	4	4	Ephydridae	3	
pH	8.2	Palaemonidae	10		Veliidae	5	5	Muscidae	1	
EC mS/m	27.2	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	
SASS5 Score	51	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	11	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	4,6	**Ephemeroptera**			Dipseudopsidae	10		Tipulidae	5	
		Baetidae 1 sp	4	4	Ecnomidae	8		**Gastropoda**		
Other Biota	Clarias gariepinus	Baetidae 2 sp	6		Hydropsychidae 1 sp	4		Ancylidae	6	
	Oreochromus mossaml	Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	
		Caenidae	6		Hydropsychidae <2 sp	12		Hydrobiidae	3	
		Ephemeridae	15		Phylopotamidae	10		Lymnaeidae	3	
		Heptageniidae	13		Polycentropodidae	12		Physidae	3	
		Leptophlebiidae	9		Psychomyidae	8		Planorbidae	3	
		Oligoneuridae	15		**Cased Caddis**			Thiaridae	3	
Comments		Polymitarcyidae	10		Barbarochthonidae	13		Viviparidae	5	
		Prosopistomatida	15		Calamoceratidae	11		**Pelecipoda**		
		Teloganodidae	12		Glossostomatidae	11		Corbiculidae	5	
		Trichorythidae	9		Hydroptilidae	6		Sphariidae	3	
		Odonata			Hydrosalpingidae	15		Unionidae	6	
		Calopterygidae	10		Leptostomatidae	10				
		Clorocyphidae	10		Leptoceridae	6				
		Chorolestidae	8		Petrothrincidae	11				
		Coenagrionidae	4	4	Pisulidae	10				
		Lestidae	8		Sericostomatidae	13				
		Platycnemidae	10		**Coleoptera**					
		Protoneuridae	8		Dyticidae	5				
		Aesthnidae	8		Elmidae Dryopidae	8				
		Corduliidae	8		Gyrinidae	5	5			
		Gomphidae	6		Haliplidae	5				
		Libellulidae	4		Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5				
					Limnichidae	10				
					Psephenidae	10				
Score				16			35			0

27.2 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 27.2.1 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 27.2.2 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 27.2.3 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 29.7.4 Probability, confidence, reversibility and irreplaceability

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

Table 27.3 Numerical Significance

Table 27.3.1 Conservation Value

Conservation Value		
Refers to the intrinsic value of the area or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species	Low 1	The area is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
	Medium / Low 2	The area is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
	Medium 3	The area is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.
	Medium / High 4	The area is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.
	High 5	The area is considered critically endangered or is part of a proclaimed provincial or national protected area.

Table 27.3.2 Significance

Significance	Score	Description
Insignificant	4 - 22	There is no impact or the impact is insignificant in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site.
Low	23 - 36	An impact barely noticeable in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium / Low	37 - 45	Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved. Impacts may have medium to short term effects on the natural environment within site boundaries.
Medium	46 - 55	Impact is real, but not substantial. Mitigation is both feasible and fairly easily possible, but may require modification of the project design or layout. These impacts will usually result in medium to long term effect on the natural environment, within site boundary.
Medium High	56 - 63	Impact is real, substantial and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. These impacts will usually result in medium to long-term effect on the natural environment, beyond site boundary within local area.
High	64 - 79	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. These impacts will usually result in long-term change to the natural environment, beyond site boundaries, regional or widespread.
Unacceptable	80 - 100	An impact of the highest order possible. There is no possible mitigation that could offset the impact. The impact will result in permanent change. Very often these impacts cannot be mitigated and usually result in very severe effects, beyond site boundaries, national or international.

Table 27.3.3 Scoring system

Parameter	1	2	3	4	5
Conservation value Likelihood Duration Extent Severity	Low Unlikely Temporary Site specific Zero	Medium /Low Possible Short term Local Very low	Medium More possible Medium term Regional Low	Medium / High Probable Long term National Medium	High Definite Permanent International High

Significance = Conservation value (Likelihood + Duration + Extent + Severity)

27.4 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