July 2020

MDARDLEA Ref: 1/3/1/16/1 E - 238

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Bruintjieslaagte Dam – Devil's Creek – Schoemanskloof

Public review

ENPACT ENVIRONMENTAL CONSULTANTS CC
REG. 2004/051532/23

I. PROJECT INFORMATION

PROJECT DETAILS	
TITLE	Bruintjieslaagte Dam – Devil's Creek – Schoemanskloof
REPORT STATUS:	Environmental Impact Assessment Report (public review)
LOCATION:	Bruintjieslaagte 465 JT Schoemanskloof, City of Mbombela, Mpumalanga. The site is located south west of the N4 Schoemanskloof road on the Devil's Creek which is a tributary to the Crocodile River.
SG 21 DIGIT CODE:	T O J T 0 0 0 0 0 0 0 0 0 4 6 5 0 0 0 0 0
EAP:	Enpact Environmental Consultants CC PO Box 12027, Nelspruit, 1200 Tel: 013 752 6766 Fax: 088 013 7526766 E-mail: info@enpact.co.za
REPORT COMPILED BY:	Heinrich Kammeyer Enpact Environmental Consultants CC E-mail: heinrich@enpact.co.za
APPLICANT:	Joubert Family Trust Contact: Mr Lionel Eva PO Box 29, Schagen, 1207 Tel: 083 227 2415
REPORT PREPARED FOR SUBMISSION TO:	**Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs: DARDLEA** Ehlanzeni District Offices The Directorate: Environmental Impact Management 18 Jones Street Nelspruit, 1200
DATE OF COMPILATION:	**July 2020**
ACTIVITIES APPLIED FOR:	Notice no. R 983, 2014: Activity 12, 19, 27. Notice no. R 984, 2014: Activity 16. Notice no. R 985, 2014: Activity 12, 14.
MDARDLEA REFERENCE NUMBER:	1/3/1/16/1E-238

EAP Declaration

I hereby affirm/confirm:

- The correctness of the information provided in the report;
- I will ensure compliance with the EIA Regulations 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
- I will take into account, to the extent possible, the matters listed in regulation 18 of the regulations when preparing the application and any report, plan or document relating to the application;
- I will disclose to the proponent or applicant, registered interested and affected parties and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the environmental assessment practitioner

14 July 2020
Date

EXECUTIVE SUMMARY

Submitted to the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA) in terms of the requirements of Government Notices no. R982, R983, R984 and R985 for the Scoping and Environmental Impact Assessment (EIA) process in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

Application Summary

Project: Bruintjieslaagte Dam – Devil's Creek – Schoemanskloof.

Location: The dam site will be located on a Portion of the farm Bruintjieslaagte 465 JT, Devil's Creek, Schoemanskloof, City of Mbombela Local Municipality, Mpumalanga. The site is located south west of the N4 Schoemanskloof road in the Devil's Creek that is a tributary to the Crocodile River.

Activities:
EIA Regulations, 2014 published in the Government Notice No. R982, R983, R984 and R985, as amended under Section 24(5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998):

Listed activity:	**Project description:**
Description of the relevant Basic Assessment Activities as per Listing Notice 1 (GN No. R983)	
R.983, 2014: Activity 12 - The development of - i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs — (a) within a watercourse; excluding — (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.	The construction of a dam with a capacity of approximately 842 000m^3 and surface area of approximately 12.7 hectares at S25˚26' 15.30" E30˚35' 03.75".
R.983, 2014: Activity 19 - The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from (i) a watercourse.	The construction of a dam which will require the excavation, removal or moving of soil, sand or rock or/and the infilling or depositing of any material of more than 10 cubic meters.
R.983, 2014: Activity 27 - The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation.	The establishment of the Bruintjieslaagte dam will require the removal of approximately 12.7 hectares of indigenous vegetation.
Description of the relevant Scoping and EIA Activities as per Listing Notice 2 (GN No. R984)	
R.984, 2014: Activity 16 - The development of a dam where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high water mark of the dam covers an area of 10 hectares or more.	The construction of a dam with a wall height of approximately 24m and the high water mark of the dam will cover an area of approximately 12.7 hectares at S25˚26' 15.30" E30˚35' 03.75".

Description of the relevant Basic Assessment Activities as per Listing Notice 3 (GN No. R985)	
The clearance of an area of 300 square metres or more of indigenous vegetation in Mpumalanga (ii) Within critical biodiversity areas identified in bioregional plans;	The establishment of the Bruintjieslaagte dam will require the removal of more than 300 square metres and approximately 12.7 hectares of indigenous vegetation.
R.985, 2014: Activity 14 – The development of – (iv) dam or weirs where the dam or weir, including infrastructure and water surface area exceeds 10 square metres in size In Mpumalanga - Outside urban areas, in: (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans	The construction of a dam with a capacity of approximately 842 000 m^3 and the water surface area of the dam will cover an area of approximately 12.7 hectares.

Environmental Impact Assessment Application Process

Enpact Environmental Consultants CC was appointed by Joubert Familie Trust to do the environmental impact assessment process in order for the applicant to apply for environmental authorisation to construct an irrigation storage dam of a capacity and area size that meets the thresholds as listed in the EIA Regulations, 2014 as amended.

A new application for the Bruintjieslaagte dam was submitted to the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA) on 21 November 2019.

A dam for irrigation purposes will be constructed on the Devil's Creek, a tributary of the Crocodile River located in Schoemanskloof. The dam will be located on the Bruintjieslaagte 465 JT farm. There is an existing irrigation storage dam, Koedoeshoek dam, downstream from the proposed dam also in the Devil's Creek.

The dam wall length will be approximately 340 m and dam wall height 23.6 m. The dam storage capacity will be approximately 842 308 m^3 and the surface area at full supply level (FSL) approximately 12.7 hectare. The overflow will be 60m wide and the freeboard level is 4m.

The initial environmental application was submitted to MDARDLEA on 16 February 2017. The Scoping Report and Environmental Impact Assessment Report respectively were submitted to Interested and Affected Parties and the Regulating Authorities for comments during 2017. During 2018 and 2019 updated Environmental Impact Assessment Reports were submitted for information and comment.

During the specialist investigations and the initial Environmental Impact Assessment two very important environmental aspects were identified which required further specialist studies and assessment.

Firstly Blue Swallows (*Hirundo atrocaerulea*), listed as critically endangered within the borders of South Africa, were spotted flying over the project area by Anthony Emery of Emross Consulting and Dr L Taylor , the terrestrial/wetland specialist consultants in November 2016. Subsequently Blue Swallows were observed flying over the site by EAP and other bird specialist on another 3 separate field visits between December 2016 and March 2017. Further assessment and monitoring of the Blue Swallows were subsequently done over another three breeding seasons. It was determined with a high level of confidence that there are no nesting sites at or near the dam site and that the Blue Swallows are only

very infrequent visitors to the proposed dam area. The detail of the Blue Swallow surveys over 4-seasons is reported and assessed in this Environmental Impact Assessment Report.

Secondly Dr Rob Palmer of Nepid Consulting, the aquatic specialist sampled a small barb species (Genus: *Enteromius*) in the reach between a waterfall and existing dam (downstream of proposed dam site) in the Devils Creek during the initial EIA aquatic specialist study that he referred to tentatively as *Enteromius cf. motebensis*. Dr Pieter Kotze of Clean Stream Biological Services was requested to further assess of fish in the Devils Creek River. Dr Kotze reported that the fish sampled in this reach of the Devils Creek during August 2017 had various morphological attributes that coincides with the more common and widespread *Enteromius anoplus.* The Mpumalanga Tourism and Parks Agency then requested that fish from the Devils Creek population must be included in the MTPA's DNA assessment where fish from the "Chubbyhead group of barbs" from ten different localities were included in the MTPA study. As a precautionary and mitigation measure MTPA (Dr. F Roux and aquatic team) translocated 207 individuals of *Enteromius Devils Creek*(EDEV) from reach B (below waterfall) to reach A (above the waterfall) in March 2019. During May 2020 Dr Kotze confirmed that the translocation was successful and that 47 EDEV individuals were sampled upstream of the proposed dam wall. The detail of the various assessments from 2017 to 2020 of the *Enteromius Devils Creek* (EDEV) is reported and assessed in this Environmental Impact Assessment Report.

A new and third application which *includes* a Scoping Report with public participation (site notice and newspaper notice) was submitted. The Scoping Report and Plan of Study were accepted by the MDARDLEA on 11 February 2020.

This provided the applicant team with 106 days in which to conclude the Environmental Impact Assessment Report (EIR). The timeline was however impacted by the regulations around the Covid-19 pandemic. Directions Regarding Measures to Address, Prevent and Combat the Spread of COVID-19 Relating to National Environmental Management Permits and Licences were issued under the Disaster Management Act (Act 57 of 2002). There was a period between 27 March 2020 and 5 June 2020 where the application process could not proceed. With the lifting of the restrictions the application process recommenced after 5 June 2020 and it should be finalised before end of August 2020.

The EIR is made available for comment for a 30-day period. Comments received will be incorporated into the final report before submission to the MDARDLEA.

Following is a summary, conclusions and recommendations on the main issues/aspects that are addressed in the EIR:

Conclusion and recommendation

The "critical biodiversity" in terms of the Mpumalanga Biodiversity Plan was taken into account and several specialist assessments were done to assess the application site. The footprint area of the dam is small relative to similar habitat in the Devil's Creek catchment as well as adjacent farms.

The Blue Swallows were assessed over 4 breeding seasons. The Blue Swallows are infrequent visitors to the lower Devil's Creek valley and game camp plateau north of the proposed dam site. The proposed dam site is not a preferred foraging area for the Blue Swallows. There are no nesting sites in or near the dam basin area. Nesting sites are likely at a higher altitude in the upper reaches of the valley. As a precautionary measure the construction of the dam will be done outside the breeding period of the Blue Swallows during the period April to end-October.

Dr Rob Palmer of Nepid Consulting first sampled a small barb species (Genus: *Enteromius*) in the reach between a waterfall and existing dam (downstream of proposed dam site) in the Devils Creek. There was uncertainty as to the correct species description of the fish even after a further assessment was done by Dr Kotze. Based on all the information available at present, which included a DNA analysis, it is therefore not yet possible to confirm the exact taxonomic barb species (*Enteromius*) that occurs within the Devils Creek, Mpumalanga. It has however become increasingly clear that this species should be afforded high conservation status and all actions must be taken to preserve this population.

Morphologically this species exhibits characteristics of *Enteromius anoplus* (Chubbyhead barb) and *Enteromius motebensis* (Marico Barb), and hence previously referred to as *Enteromius cf anoplus/motebensis*. For the purposes of the current study and this report this species will be referred to as ***Enteromius "devils creek"*** (abbreviated: EDEV).

As a precautionary and mitigation measure MTPA (Dr. F Roux and aquatic team) translocated 207 individuals of *Enteromius Devils Creek*(EDEV) from reach B (below waterfall) to reach A (above the waterfall) in March 2019. During the May 2020 follow-up survey, Dr Kotze confirmed that the translocation was successful and that 47 EDEV individuals were sampled upstream of the proposed dam wall.

There is concern that construction activities may eradicate these individuals. It is therefore essential that a healthy population of the EDEV must be established upstream of any potential impacts (especially construction activities) in the conservation zone. Specific mitigation and management measures were proposed and is supported by the EAP and applicant for the reasons provided in the report.

Conservation important plant species that may occur on site are listed in the Emross Consulting and Taylor Environmental Report. Of all these plant species only *Eucomis autumnalis* (Common Pineapple Lily) was identified on the site. An ECO (ecologist) will survey the site and identify, rescue and relocate conservation important plant species prior to start of construction.

The hydrology study confirmed that sufficient water is available in the Devil's Creek for the proposed Bruintjieslaagte dam as well as the existing Koedoeshoek dam and that after allowance for the Ecological Water Requirement (EWR) there will be no impact on the aquatic ecology or downstream Crocodile River water users.

There are sufficient irrigation water use rights available and there will not be any new abstraction water use rights required for the Bruintjieslaagte dam. The dam is primary a provision for water security during drought periods. If water is required during drought periods water will be released from the Bruintjieslaagte dam into the Koedoeshoek dam from where it will be abstracted and linked to the irrigation system.

A Water use licence for the dam has been issued by the Department of Water and Sanitation.

The dam will only impact on some of the stonewall sites found on the Bruintjieslaagte farm in terms of archaeology. A permit was applied for from SAHRA and the affected sites were surveyed, excavated and documented.

The overall impact of the proposed dam can be mitigated to an acceptable level.

Based on the findings of all the specialist studies, the environmental impact assessment and proposed mitigation measures the EAP supports the Authorisation of the Bruintjieslaagte dam for an indefinite period. Construction should start within a period of five (5) years.

Blue Swallows

Blue Swallows (*Hirundo atrocaerulea*), listed as critically endangered within the borders of South Africa, were spotted flying over the project area by Anthony Emery of Emross Consulting and Dr L. Taylor of Taylor Environmental, the terrestrial/wetland specialist consultants during the first site visit in November 2016.

The discovery of Blue Swallows at Bruintjieslaagte was very exciting considering the species conservation status in South Africa. The site differs in many respects to what one would normally associate as Blue Swallow habitat and is atypical in many respects. The vegetation type is a savannah rather than grassland vegetation type with the area falling within the Legogote Sour Bushveld.

Although on the surface the site does not look suitable for Blue Swallow they do occur and have bred successfully. This seems to be as a consequence of certain environmental and anthropogenic factors that combined have fortuitously created suitable habitat for a species that is considered to be a mistbelt grassland specialist. It could be that the Devil's Creek valley has created a micro climate that traps mist thus providing suitable moisture while certain current and historical management practises have led to the availability of open habitat in what is mostly open woodlands and grassland.

To confirm that the sightings made by Anthony Emery was in fact that of Blue Swallows, Dr Ian White, Anthony Emery, other bird and Blue Swallows specialist and the EAP visited the site on Tuesday 24 January 2017. We were able to establish that Blue Swallows were definitely present at the site. A single bird was seen higher up the valley, and a pair was seen from where we were standing at the proposed dam sites.

Dr Whyte concluded that the vegetation communities that will be inundated by the proposed dam only represent marginal foraging areas for the swallows, and in an ecological context, would represent only a small fraction of the birds' total foraging range. This was later proven to be correct and the Blue Swallows were seldom observed at or near the dam basin. He also said that he does not believe that the shrublands offer the swallows any suitable habitat for nesting sites, as they prefer climax -, mist-belt grasslands, large areas of which still exist at higher altitudes above and adjacent to the dam sites (this was also proven to be correct as no nesting sites have been found at or near the dam basin during observation over 4 breeding seasons). Refer to Appendix 6.1 for an Assessment of the impact of the proposed "Bruintjieslaagte" dam on the avifaunal populations in the immediate area of the site in the Schoeman's kloof valley, Mpumalanga province by Dr Ian Whyte, 12 and 13 April 2017.

Two separate sightings (1 male and a pair) were observed on the 22 November 2016 by Mr A. Emery and Dr L. Taylor; a single male was observed on the 7 December 2016 by Mr. A. Emery and Miss. L. Cohen; a single female, a single male and a pair performing courtship flight behavior were seen on the 24 January 2017 by Mrs. R.Theron, Miss J. Newenham, Dr I Whyte, Mr. H. Kammeyer (EAP) and Mr. A. Emery; and four were seen flying on the 14 March 2017 by Dr. G. Batchelor, Mrs R. Luyt (MDARDLEA) and Mr. H.Kammeyer (EAP).

Mr Emery reported that the pair performing courtship flight behaviour was observed near the proposed dam footprint on the north-eastern grassland slopes approximately 350m to the northwest of the proposed dam wall and approximately 60m higher in altitude. The pair seen on the 22 November 2016 was seen near an open grassland wetland area above the proposed dam footprint. This area may provide the birds with a suitable mud collection point. The remaining sightings were of birds foraging in areas upstream of the dam footprint or within the dam footprint. No nesting sites were found within the proposed dam footprint.

Numerous aardvark burrows were found, both within the proposed dam footprint and in the areas surrounding the proposed development.

- **Comprehensive surveys**

Mr Nicholas Theron coordinated more comprehensive surveys undertaken by the Kruger to Canyons Biodiversity Programme on 29 and 30 October 2017 where two full days were spent on site by Jen Newenham, Dr Garth Batchelor, Johan Gouws and Allisson Gouws. A follow up survey was undertaken by Nicholas Theron on 30 November 2017 where the slopes on the eastern side of the river where comprehensively surveyed. The slopes on the western side of the river have not been surveyed due to their inaccessibility.

There were a total of 30 sightings; 19 on 29 October over 12 hours and nine on 30 October over 12 hours. There was only 1 sighting on 30 November over 7 hours.

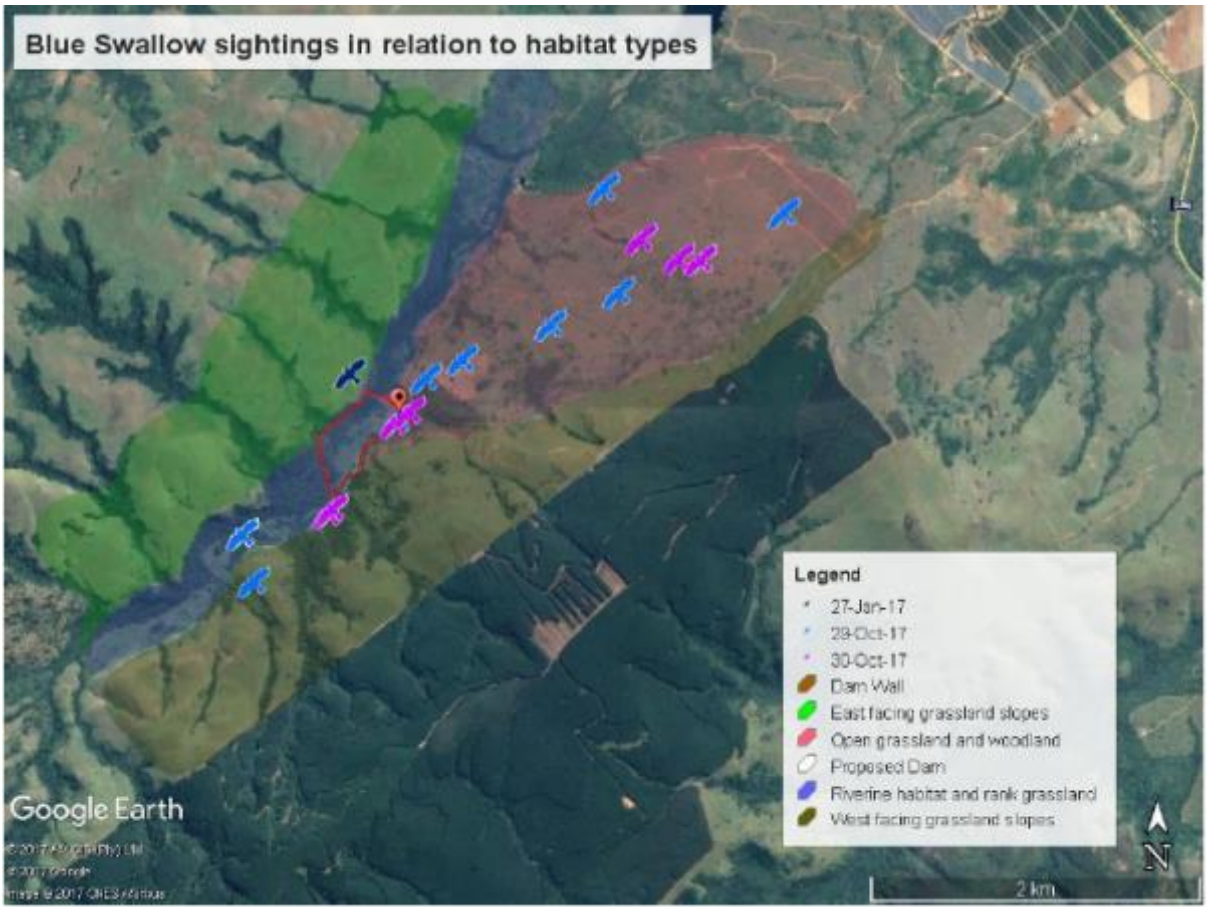
The majority of sightings were of the birds en-route as they flew or were foraging. The female was confirmed in 6 of the individual sightings with the male record on 1 occasion and the pair together once. A nest site was discovered along the walls of a profile pit that was dug as part of the geotechnical assessemt for developing the dam wall. The nest has been abandoned due to soil slipping from the sides and filling the nest. However, the birds were observed visiting the pit nest on three occasions during the first day and at times may have been resting in the hole on the nest. The habitat surrounding the pit nest comprises rank grassland associated with seasonal wetlands and with scattered shrubs and bush clumps. Habitats in which the birds were recorded included gently undulating open grassland (some of which were likely old lands), open grassland with scattered tall woodland, riverine areas with open rank grassland and bush habitat with tall trees associated with seasonal streams and drainage lines.

41% of sightings were evenly spread between the rank grassland associated with riverine vegetation and the open woodland and grassland habitat types. There was only one sighting on the grasslands on the eastern side of the river on 29 October 2017 where a single bird was observed flying at the base of a grassy hill. No sightings in these areas were made during the transect that was walked on 30 November 2017. There is also only one confirmed sighting along the grassland slopes on the western side of the river which was made on 27 January 2017 when a courtship display was witnessed.

Mr Theron concluded that the site differs in many respects to what one would normally associate as Blue Swallow habitat and is atypical in many respects. The vegetation type is a savannah rather than grassland vegetation type with the area falling within the Legogote Sour Bushveld. The birds also seem to prefer areas that are more woodland types and avoid the surrounding grassland slopes.

This definitely seems to be the case in terms of the west facing grasslands where considerable time was spent but no sightings were recorded. These areas are also very steep and not the normal undulating grasslands they usually associate with. The soils here are also very rocky and shallow and the chances of sinkholes occurring or there being aardvark activity is very low. This was corroborated by the fact that no Aardvark activity was encountered on these slopes. The grassland slopes on the west bank seem to be more undulating and they are also east and north-east facing which Blue Swallow are known to prefer for nesting. Scanning these hillsides did reveal what looked to be limited Aardvark activity and there is a possibility suitable nests may form along the various drainage lines, although much of these are heavily wooded. The most Aardvark activity was encountered in the open woodland and grassland areas. These areas are associated with deep soil profiles which are normally very productive and therefore usually cultivated. While documenting Blue swallows in the 1990s in Mpumalanga all the Blue Swallow sites were associated with deep soil profiles. And it is possible that the deep red soils are the reason why the Blue Swallows

are here (Batchelor pers obs). The Bruintjieslaagte Blue Swallows occur at an altitude of 1200 – 1400m which is lower than the 1600 m at Kaapsehoop where Blue swallow used to occur, but within the 1 400 – 1 600 m range in which the species are known to occur in the Graskop area.



Report Nicholas Theron, Map 2: Blue Swallow sightings represented in Google Earth with the various habitat types also depicted.

Although on the surface the site does not look suitable for Blue Swallow they do occur and have possibly bred successfully. This seems to be as a consequence of certain environmental and anthropogenic factors that combined have fortuitously created suitable habitat for a species that is considered to be a mistbelt grassland specialist. It could be that the horseshoe shape of the valley has created a micro climate that traps mist thus providing suitable moisture while certain current and historical management practises have led to the availability of open habitat in what is mostly open woodlands and grassland. These include areas where game occur and are contributing to keeping woody species out and the habitat open. The role fire plays in this landscape should also be carefully considered and may be playing an important role in controlling woody species from encroaching into these areas.

- **Blue Swallow Conclusions and Recommendations based on the Blue Swallow Working Group's report**

In general, the habitat in the area seems largely atypical, if not unsuitable for Blue swallow but yet they exist here. This does seem to be as a consequence of a number of anthropogenic factors and the persistence of Blue Swallows at the site may be very reliant on suitable habitat being maintained by specific management practises. As such this site is very different but also special and the landowners should as much as possible be supported in terms of providing relevant knowledge and inputs to ensure the persistence of the species at the site.

Based on the above the following recommendations can be made:

1. The opinion that the dam should not negatively affect Blue Swallow remains unchanged as long as the dam is constructed in the winter months from May – August and this aspect must be strictly adhered to.
2. Blue Swallow should continue to be monitored on site and transects through the grasslands on the western bank should be undertaken.
3. Artificial nest sites should be chosen and dug as soon as possible so that if suitable cavities do not exist it will give the Blue Swallows time to breed this season. Sites in the open woodland grasslands and grassland areas may be suitable because they are accessible and occur in an area where the birds are regularly shown to forage. These nests should be dug based on designs used in KZN but it may be necessary to somehow stabilise the walls if the soil proves too sandy and prone to collapsing.
4. A relevant Blue Swallow Conservation and Management plan be developed for the site focussed on important aspects such as burning and grazing as well as control of alien invasive plants to ensure suitable habitat at the site is maintained and/or improved.

- **Earlier Blue Swallow comments and findings as previously reported on**

Positive comments were received from Birdlife SA during September 2017 supporting the need for monitoring of the swallows. Mr J Booth – Birdlife SA stated that i*f monitoring results shows that there will be no material impact on the breeding and feedings grounds of this blue swallow population (as has thus far been established), we will not oppose the construction of the dam in the months when blue swallows are absent.*

In MTPA's comments dated 22 September 2017 they conclude that they are satisfied that the dam site only represents marginal foraging areas and that it is not suitable habitat for breeding. They also support the monitoring efforts proposed as mitigation.

- **Monitoring of Blue Swallows during 2018/2019 and 2019/2020 breeding seasons (Appendix 6.3-6.7)**

It was clearly established during 2016/2017 and 2017/2018 breeding seasons that there were no nesting sites at or near the proposed dam site and that impact of the proposed dam on the Blue Swallows would be insignificant.

As a mitigation measure it was however recommended that the construction of the dam wall should not be undertaken during the breeding period of the Blue Swallows. This is a feasible mitigation measure as the dam construction should anyway be done during the low-flow winter month period when the diversion of the natural water flow of the river can be managed and when the construction of the dam wall will not be disrupted by rainfall.

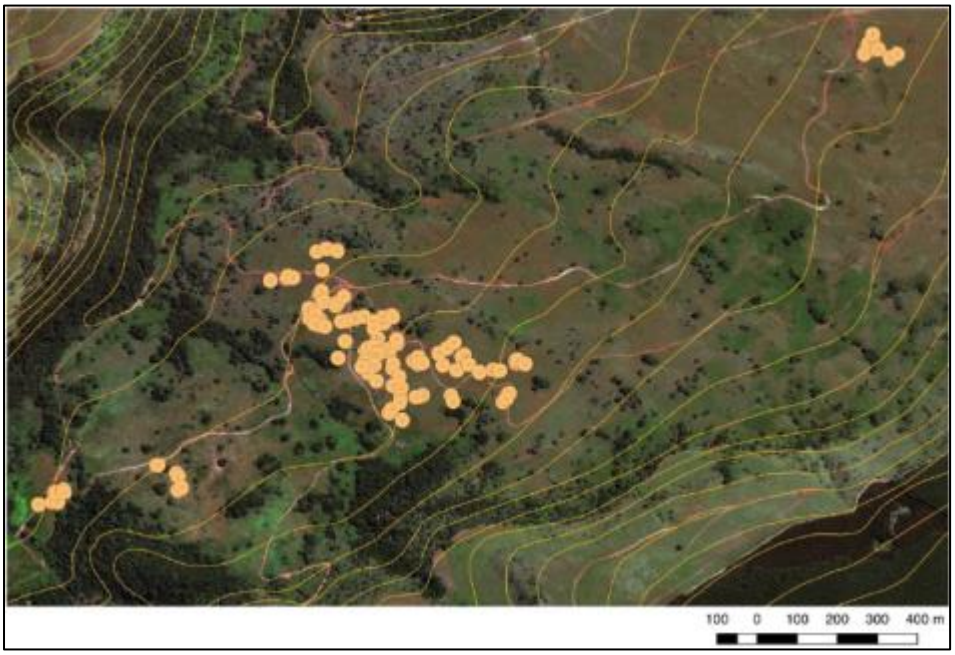
Dr Garth Batchelor continued with the monitoring of the Blue Swallows during the 2018/2019 breeding season and with specific focus on finding breeding sites in the deep soils in the valley up- and downstream of the proposed dam site. Artificial breeding sites were also dug in the deep soils northeast (downstream) of the proposed dam site. Please refer to the report Follow-up Survey of Status and Breeding of the Blue Swallow (*Hirundo atrocaerulea*) on Bruintjieslaagte towards a revised application for an Environmental Authorization for a dam on the Devil's Creek on the farm Bruintjieslaagte, 15 February 2019, Dr GR Batchelor and PC Viljoen.

Firstly, six holes similar to the test pit in which a nest had previously been found were excavated with a "back actor". These resembled the soil profile pit in which a Blue Swallow pair had made a nest at the dam wall location the previous summer. Cavities were dug out in

the NW, NE and SE corners of the pits to provide shelter from the weather for a potential nest.

Secondly, termite holes or natural holes were located and mapped. These hole sites were all in the deep soils and are most probably the results of both earlier termite activity and more recent termite use. These deep, red soils were mapped and delineated using satellite imagery and GIS.

Photo GR Batchelor



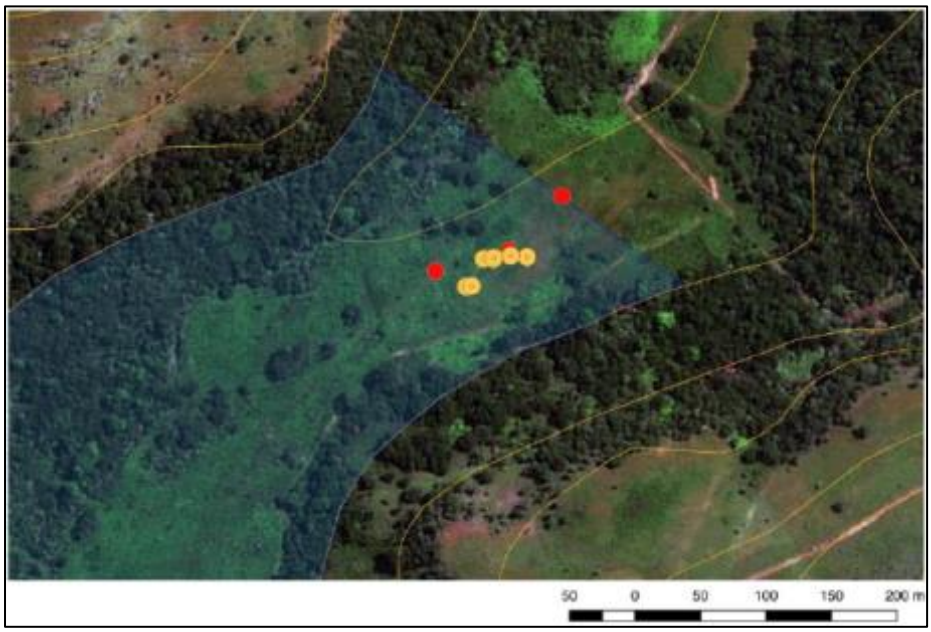
15 February 2019, Dr GR Batchelor and PC Viljoen Report - Fig. 8. Potential termite and "aardvark" nest holes.

In an attempt to locate new nests, two approaches were followed: direct observation of Blue Swallows and the location of potential nest sites. To date no active nest has been located notwithstanding the many hours that have been spent observing.

Potential nest site prospecting has, however, been witnessed on three occasions this summer. A female Blue Swallow was seen prospecting two separate "aardvark" holes on

14 January 2019 in Area 07. She was seen to fly into a hole on two separate occasions then move to another hole approximately 100 m away and fly into another "aardvark" hole. No nests have been constructed in either of these holes.

At the time of the reporting, February 2019, the newly excavated holes have not yet been used by the Blue Swallows for nesting. The Blue Swallows have, however, been seen on a number of occasions flying in the vicinity and low over the some of the pits. Shortly after construction, a pair of Black Saw-wing Swallows excavated a burrow in one of the pits where they successfully bred. A pair of Little Bee-eaters also excavated a hole in an adjacent pit and also fledged young. At times, over 12 Black Saw-wing Swallows were seen interacting above two of the holes and on one occasion appeared to be chasing away a female Blue Swallow from a pit.



15 February 2019, Dr GR Batchelor and PC Viljoen Report - Fig. 9. Potential nest holes near the proposed dam wall in dam basin

On 17 October 2018 a total of *10* adult Blue Swallows were seen perched together just above the ground on sticks in light rain. There were five adult males and five adult females. This is the first time that these swallows have been observed together in a "cluster", thus providing an opportunity to obtain a minimum number for this site. It is suggested that they had recently returned to the valley after their migration south from Central Africa as they had not yet moved into their respective breeding territories.

Photo taken by Dr GR Batchelor: Male Blue Swallow taken on 17 October 2018.

Photo by Dr GR Batchelor: Part of a group of 10 Blue Swallows seen on 17 October 2018.

Dr Garth Batchelor made a number of visits to the Devil's Creek valley above the waterfall during the spring, summer and autumn of 2018/19 to make observations on the Blue Swallow population and reported on 9 May 2019 as follows:

- **Blue Swallow report May 2019**

a) Blue Swallow Population size

Ten adult Blue Swallows were recorded at the beginning of the breeding season on 17 October 2018 on high lying ground below the proposed dam site. On the 4 April 2019 12 possibly 13 Blue Swallows were recorded close to where the 10 Blue Swallows were recorded on 17th October 2018. Two of the Blue Swallows recorded in April 2019, were juvenile birds clearly having been fledged during the past season.

b) Number of breeding pairs

It would appear that there are a minimum of 5 breeding pairs of Blue Swallows on Bruintjieslaagte.

c) Foraging Areas

Like all swallows, Blue Swallows, hunt for insects over a large area depending on where there are emergences. It is evident that there are large termite populations in the deep soils downstream of the proposed dam as reported in our report. Over 120 large termite tunnels were counted in 5ha. On 4 April, Blue Swallows were seen feeding over large areas together with House Martins. They were seen hunting for insects low over the grass and also very high up in the air. It is considered highly unlikely that the inundation caused by the dam will significantly affect the food availability of the Blue Swallows. This area is highly over grown with rank vegetation.

d) Mud Collection Sites

The deep "Hutton Soils" in most of the 5 valleys downstream of the proposed dam have a very high clay content and appear to be ideal for swallow nests. The soils coincide with the high termite densities and are also where the Aardvark holes are. These soils are also found in the dam basin but as mentioned the basin represents a small fraction of the available deep soil habitat. The vegetation in the dam basin has also become very rank making it unsuitable for mud collection.

e) Nesting Sites

There is no conclusive evidence of where these birds are breeding. There was one attempted breeding in a soil test pit that failed. Pairs have been seen displaying over both the artificial holes dug for them and also over Antbear holes during the past season. Some of the latter are very deep and it was not possible to look deep into them. However, according to Dr David Allan,(pers. comm.). most nests he has observed are between 1- 2m below the entrance and are clearly visible. What is surprising are the few young/fledged birds observed both this season and also in the past. From the high number of Antbear and large termite holes present in the valleys below the dam, potential nesting sites don't appear to be limiting. Further observations are suggested.

f) Construction Period

Dam construction should not take place between 1 November and the end of 31 March.

Photo Dr GR Batchelor: Adult male Blue Swallow foraging over grassland

- **Monitoring Report 3 October 2019**

Two monitoring surveys were undertaken, one on 17 September 2019 prior to the arrival back of the Blue Swallows and the other on 2 October 2019 shortly after their arrival back.

The first visit focussed on ensuring that potential nest holes (constructed nest holes and Aardvark burrows), were accessible to the Blue Swallows in all the deeps soil patches. The known Aardvark holes on the deep soil patches, 04,05,06,07 and 08 were checked and entrances trimmed and spider webs removed. These included the cluster of 35 holes in the newly created buffalo camp which were also trimmed and cleaned. All swallows seen were identified and behaviour noted. The five excavated "Blue Swallow" holes are all showing signs of wall collapse, the bigger holes more so than the narrower ones.

The palatable grass cover has been grazed short by the game over much of the deep soil areas exposing the aardvark holes which are the traditional nesting sites of the Blue Swallows. No Blue Swallows were observed on 17 September but at least 10 Saw-wing Swallows were seen coursing along the tree lines along the ridges.

On the 2nd visit on 1 October, two fresh Black Saw-wing Swallow holes were active and appeared to contain eggs judging from their behaviour. 2 female Blue Swallows were seen foraging with the Saw-wings along a ridge to the north east of the excavated holes near the game dip station. A pair of Greater-striped Swallows and a Black Swift were all foraging together. In the Buffalo camp, two female Blue Swallows were seen at 11h30 foraging again with a flock of at least ten Saw-wing Swallows around a Sycamore Fig tree. There was clearly an emergence of tiny flying insects from the fig tree as the Swallows hunted insects around the tree for over ten minutes. These Blue Swallows could have been the ones earlier observed along the ridge line. These two female Blue Swallows soon disappeared.

A mixed flock (male and female) of 10 Blue Swallows was recorded at 11h40 flying high along the wooded ridge to the south of the proposed dam wall. They were clearly feeding, flying backwards and forwards above the ridge. These swallows then flew south westwards until they were out of sight but returned at 12h50 to the fig tree where the Saw-wings were seen foraging. They again disappeared from sight in an easterly direction. From their behaviour and equal numbers between males and females it was clear that they had not yet started to breed.

- **Monitoring Report 14 October 2019**

It was decided to revisit the grassland/deep soil valleys downstream of the proposed dam site during the first period of overcast rainy weather after the return of the Blue Swallows. The reason for this being that it was anticipated that nest repairing would take place

immediately after the first rains. 3 days of overcast rainy weather was projected from 15 to 17 October. The temperatures were cool (11-18C) and less than 5 mm rain actually fell.

In contrast to the behaviour of the Blue Swallows observed on 2nd October, when a mixed flock (male and female) of 10 Blue Swallows was recorded flying high along the wooded ridge to the south-east of the proposed dam wall, the Blue Swallows were either flying singly or in pairs. They were also flying close to the ground. The latter could be because of the cold weather.

On both the 10th and 11th October, Blue Swallows were seen over Zone 07, the grasslands above the artificial nest holes next to the buffalo camp fence. At 09h35, 2 Blue Swallows, a male and a female, were sighted by GB and SvR over the upper sections of the grasslands in Zone 07. A period of 5 hours was spent in the area but no further sightings were made. The weather was cold and overcast. On 11 October two pairs of Blue Swallows were observed repeatedly flying over the upper section of Zone 07 by SvR from 08h00 to 12h00. On the same day, three Blue Swallows were seen in Zone 08. This is the grassland strip to the south, southeast, of the first feeding station after coming up the hill. Two Blue Swallows were on a muddy road at 07h34 but were not seen collecting mud. I was quite far away from them so could not see clearly even with a telescope. This apparently same pair few off and returned at 11h16 and appeared to be inspecting various holes about 20m from where they had previously been seen on the road. I did not go back to the area not wanting to disturb them. The sex of the third Blue Swallow seen in this zone was not determined as it was too distant.

- **Blue Swallow Monitoring Summary 2019/20**

Four visits were made to the grasslands over the past summer season where the Blue Swallows had previously been recorded. The visits took place prior to their return in August and again three times during their expected breeding season (October to April). 12 Blue Swallows were again recorded on the grasslands downstream of the proposed Bruintjieslaagte dam site. No Blue Swallow nests were located. The excavations made in an attempt to provide nesting sites for the Blue Swallows were not used by Blue Swallows but were utilized by Little Bee-eaters and Black Saw-wing Swallows.

Prior to the return of the Blue Swallows, on 17 September, 87 natural earthen holes which were considered to be suitable as nest holes for Blue Swallows were cleared of vegetation and marked with steel rods which were numbered.

After the return of the Blue Swallows in October, the plateaux were visited on five occasions, on the 2nd and 10th October,6th November, 6th February and 27th February. During the November survey the grassland patches to the north of the N4 on the Mathews Phosa College property were also surveyed but no suitable nesting sites were located.

- **Results of 2019/20 surveys**

2 October 2019:

Shortly after ascending the hill from the existing dam a pair of Blue Swallows was seen flying over the first valley with deep soil. These swallows flew south and disappeared. After entering the newly established buffalo camp, 5 Blue Swallows were recorded foraging over a fig tree together with over 10 Black Saw wing Swallows. There was an emergence of small flying ants coming out of the grass on which they were feeding.

At approximately 09h15 a group of 12 Blue Swallows was seen flying along the slope of the hill towards the proposed dam site. They were also apparently feeding on insects in the updraft along the hill slope. After flying south out to view, they returned after several minutes

and came to feed on the flying ants that were still emerging from the fig tree in the Buffalo Camp where the earlier 5 swallows had been seen.

10 October 2019:
A pair of Blue Swallows was seen flying low over the grassland to the north of the Buffalo Camp fence. There are a number of potential nest holes in the vicinity but the birds did not appear too enter any and appeared not yet to be breeding. No other Blue Swallows were observed on this visit.

6 November 2019:
The entire plateau was surveyed for 5 hours but no sign of a Blue Swallow was recorded.

6 February 2020:
The entire plateau was surveyed for 5 hours but no sign of a Blue Swallow was recorded.

27 February 2020:
The entire plateau was again surveyed for 5 hours but no sign of a Blue Swallow was recorded.

Both Little Bee-eaters and Black Saw-wing Swallows were seen to be entering the artificially created nest pits in the grasslands adjacent to the Buffalo Camp.

- **Blue Swallows Discussion**

Blue Swallows were again recorded on the grasslands on the Bruintjieslaagte plateau in October but not again this summer. No breeding was recorded. This is the 5th consecutive year that they have been recorded but still no definitive record of successful breeding in the area has been observed. All the sightings this past season have been on the higher slopes away from the Devil's Creek.

- **Blue Swallow Environmental Impact Assessment conclusions and recommendations:**

1. The Blue Swallows are infrequent visitors to the lower Devil's Creek valley and game camp plateau north of the proposed dam site.
2. Blue Swallows are mostly observed flying and foraging high over the area and over the western ridge of the valley.
3. Blue Swallows were spotted flying over the artificial nesting pits, termite and aardvark holes in the game camp but no nesting occurred over the observed 4 breeding seasons in this area.
4. Although these artificial nesting pits, termite and aardvark holes is typical of other observed breeding sites elsewhere, the swallows did not select any during the last 4 breeding seasons but continued to use more suitable and preferred breeding sites higher up in the valley in the higher altitude grasslands.
5. Possible reasons could be these sites are at a lower altitude of 1100m with consequential effects that the plateau is very hot during the mid-summer months, very dry soil and collapsing walls of the artificial pits, exposed pits with no vegetation cover from direct sun and rainfall, less frequent mist at this altitude, higher average temperature and lower rainfall. Competition from Little Bee-eaters and Black Saw-wing Swallows using the pits successfully for nest and breeding could also be a contributing factor.
6. Blue Swallows were seen feeding over large areas together with House Martins.
7. 5 Blue Swallows were recorded foraging over a fig tree together with over 10 Black Saw Wing Swallows. There was an emergence of small flying ants coming out of the grass on which they were feeding.

8. 2 female Blue Swallows were seen foraging with the Saw-wings along a ridge to the north east of the excavated holes near the game dip station. A pair of Greater-striped Swallows and a Black Swift were all foraging together.
9. In contrast to the more typical behaviour of the Blue Swallows observed flying high along the wooded ridges Blue Swallows were observed either flying singly or in pairs close to the ground during colder and misty days when the upper part of the valley is covered in mist.
10. *10* adult Blue Swallows were seen perched together just above the ground on sticks in light rain. There were five adult males and five adult females (17 October 2018).
11. 12 Blue Swallows was seen flying along the slope of the hill towards the proposed dam site. They were also apparently feeding on insects in the updraft along the hill slope (2 October 2019).
12. There are no nesting sites in or near the dam basin area.
13. The proposed dam site is not a preferred foraging area for the Blue Swallows.
14. The vegetation loss with the construction of the dam and flooding of an area of approximately 12 hectare is insignificant taken into account that several thousand hectare of grasslands is available for preferred foraging of the Blue Swallows.
15. As a mitigation measure the construction of the dam should be done outside the breeding period. Dam construction should not take place between 1 November and the end of 31 March (Dr Garth Batchelor).
16. The monitoring of the Blue Swallows in the grasslands on the Devil's Creek plateau grasslands should continue.
17. The searching for possible nest sites should extended to higher altitude grasslands.
18. Dr Garth Batchelor confirmed that it is not possible to develop a management plan for the Blue Swallows as part of the Bruintjieslaagte dam EIA application. The Blue Swallows are infrequent visitors to the lower Devil's Creek valley and no nesting sites as yet have been found. As a precautionary mitigation measure the construction of the dam will be done during the winter period, which is outside the breeding season of the Blue Swallow. The operational period of the dam will have no negative impact on the Blue Swallows.

Fish

Dr. Palmer sampled a small barb species (Genus: *Enteromius*) in the reach between a waterfall and existing dam (downstream of proposed dam site) in the Devils Creek during the initial EIA aquatic specialist study that he referred to tentatively as *Enteromius cf. motebensis*. He indicated that this species is a member of the '*anoplus'* group of fish species, and that there is currently taxonomic uncertainty of this group. Personal communication between Dr. Palmer and Prof. Paul Skelton (SAIAB) indicated that this species could be one of three lineages of the '*anoplus'* group that has been recorded in the wider area:

➢ Lineage A (*north motebensis*) that stretches from the Free State across into Mpumalanga
➢ Lineage D reaching down into Kwazulu-Natal uplands
➢ Lineage E 'upper Mpumalanga'

Dr. Palmer also indicated that the IUCN classifies the conservation status of *E. motebensis* as "Vulnerable", but this refers to a population that is centered in the Waterberg and that the conservation status of the '*motebensis'* population recorded in Devil's Creek is unknown and should be treated as equivalent to *E. motebensis* until further information is available.

The individuals sampled by Dr. Kotze in this reach of the Devils Creek during August 2017 had various morphological attributes that coincides with the more common and widespread *Enteromius anoplus*. Dr. Kotze however acknowledged that there is currently great uncertainty regarding this entire group of species ('*anoplus'* group) as they are all

morphologically very similar and identification based on external characteristics is almost impossible and should be confirmed through genetic analyses.

The Mpumalanga Tourism and Parks Agency (MTPA) conducted some genetic analyses of this "*anoplus group*" of species and included samples from the Devils Creek population. Based on the genetic study results the MTPA reported the following:

- The taxonomy of various species within the *Enteromius* genus is insufficiently known resulting in difficulties in the identification of these species (Van Ginneken *et al.,* 2017). There are furthermore often very little morphological differences between species of certain groups of small barbs which make it difficult to identify these species with certainty. This is especially true for the "Chubbyhead barbs" group (*Enteromius anoplus/motebensis*) and a study done by Engelbrecht (1996) indicated that this group may potentially contain some new (undescribed) species. He also emphasised the importance of conserving genetic diversity and indicated the importance of the role of phylogenetic studies to identify genetically unique fish populations.
- Twenty fish of the "Chubbyhead group of barbs" from ten different localities were included in the MTPA study. The genetic results indicated that the populations from the Devils Creek population (previously thought to be *Enteromius anoplus)* **may be a different species** and most probably not *E. anoplus*. The phylogram indicated the presence of eight (potentially nine) distinct lineages, highlighting the possibility that there may in fact be eight to nine different fish species within the "Chubbyhead barb" group analysed as part of this assessment.
- The Devils Creek population shows a greater genetic variation and interbreeding has not yet taken place. This upper catchment population with its greater genetic variation **should be conserved at all cost**.
- The genetic study's results furthermore emphasised that it is of national (if not international) importance to gain a clear understanding of the status and ecology of the various populations (and potentially undescribed species) within the "Chubbyhead barb" group of South Africa, especially in areas where their existence is currently threatened by rapid development or spread of alien species.

A recent IUCN assessment of red list of threatened species as conducted by Woodward (IUCN, 2017), only considered specimens from the Marico and Crocodile (West) region (Limpopo catchment), North-West and Gauteng Provinces as *Enteromius motebensis* (previously *Barbus motebensis*). Woodward indicated that all records formerly attributed to *Barbus motebensis* **east of these regions** were identified as genetically distinct by Engelbrecht and van der Bank (1997) and were separately assessed as *Enteromius nov. sp. "ohrigstad".* Further genetic research by da Costa (2012) indicates a potential for *B. motebensis* to incorporate populations ascribed to *Barbus anoplus* "Lineage A", which comprises specimens from the Highveld tributaries of the Vaal and upper Orange River. However, given the widespread nature of this putative lineage and significant genetic variation within samples ascribed to it (da Costa 2012), this so called "Highveld" lineage currently lacks sufficient taxonomic support to justify an unambiguous expansion of the currently defined *E. motebensis* range. Given this genetic uncertainty, and using a catchment-based approach, Woodward consider only historical records of *B. motebensis* and *B. anoplus* from the western Limpopo tributaries to be *E. motebensis 'sensu stricto'* in his assessment. Based on this assessment *E. motebensis* was classified as Near Threatened.

Based on all information available at present, it is therefore not yet possible to confirm the exact taxonomic barb species (*Enteromius*) that occurs within the Devils Creek,

Mpumalanga. It has however become increasingly clear that this species should be afforded high conservation status and all actions must be taken to preserve this population.

Morphologically this species exhibits characteristics of *Enteromius anoplus* (Chubbyhead barb) and *Enteromius motebensis* (Marico Barb), and hence previously referred to as *Enteromius cf anoplus/motebensis*. For the purposes of the current study and this report this species will be referred to as ***Enteromius "devils creek"*** (abbreviated: EDEV).

One of the mitigation measures recommended as part of the ongoing EIA for the proposed Bruintjieslaagte Dam was the translocation and introduction of this species to the Devils Creek **upstream** of the existing waterfall and **upstream** of the full-supply level of the proposed dam site. A specialist study was conducted to determine the potential viability of the above-mentioned mitigation measure (translocation) (see report DC-A-18 by Dr. P. Kotze, Clean Stream Biological Services for details).

The following primary conclusions and recommendations were made regarding the potential translocation action (see the **Specialist Aquatic Assessment of *Enteromius Cf. Anoplus/Motebensis* (*Enteromius "Devils Creek"*) Habitat in the Devils Creek (Mpumalanga) October 2018** by Dr. P. Kotze):

- The habitats observed in **reach A (potential translocation zone upstream of waterfall and proposed dam)** were found to be very **similar to reach B (original occurrence zone downstream of waterfall)**.
- The **most suitable** sites (high suitability) for potential **translocation** of EDEV in reach A was identified to be **site A5 and A6**. Site A6 was especially suitable and contained similar habitats than the artificial pool in reach B where the highest abundance of EDEV was observed. **Should translocation of EDEV be considered in future from reach B to reach A, it is strongly recommended that they should be relocated to sites A6 and A5**.
- Should translocation of EDEV be considered in future, it is essential that it must be conducted under close supervision by the aquatic division of MTPA. Monitoring (biomonitoring, water quality, etc.) will also be required on a regular basis over the long term to determine the success and continued existence of EDEV in the Devils Creek.
- Should translocation of EDEV as a mitigation measure for the construction of the proposed Bruintjieslaagte Dam be approved, it is essential that the success of the translocation to reach A should first be confirmed (through continued monitoring) before any construction activities (or other developments) take place. It was again stressed that no activities should be allowed that may potentially threaten the future existence of the EDEV population in the Devils Creek.

Fish translocation:

MTPA (Dr. F Roux and aquatic team) translocated 207 individuals of EDEV from reach B (below waterfall) to reach A (above the waterfall) during March 2019 (Dr. F. Roux, 31 May 2019). MTPA indicated that as part of the EIA process, the success of the translocation must be established, a management plan must be compiled and long-term monitoring must be conducted.

The objective of the follow-up survey conducted in May 2019, February 2020 and May 2020 were to determine the survival of the fish in reach A after translocation.

***Entemorius* Results, Conclusions & Recommendations:**

The following summary from the Follow-Up Survey of Devils Creek (Mpumalanga) to determine survival of *Enteromius* "Devils Creek" (EDEV) after translocation, May 2019 – Clean Stream Biological Services Pty Ltd, Dr P Kotze. Refer to Appendix 7.4 for the full report:

May 2019 survey (2 months after translocation)

- The primary aim of this survey was to determine whether any *Enteromius cf. "Devils Creek"* (EDEV) individuals survived the translocation effort (done in March 2019 by MTPA).
- A fish survey was therefore conducted on the 14th of May 2019. Electrofishing was applied in all suitable habitats from the proposed dam wall area (March 2019 translocation area) to the habitat site A6 (most optimal EDEV habitat site). Care was taken during sampling to limit disturbance of collected fish and they were immediately returned into slow habitat directly after sampling.
- Ten individuals of EDEV were sampled at three separate sites in the sampling reach during the May 2019 survey.
- A total of 207 individuals were translocated during March 2019 (Dr. F. Roux MTPA response letter dated 31 May 2019), and hence 4% of the translocated individuals were sampled between the dam wall and sites A6 during the follow-up survey in May 2019. The relative abundance (catch per unit effort-CPUE) of EDEV observed in reach A during May was 10 individual/hour. As can be expected, this is significantly lower than the relative abundance observed in reach B in August 2017 (93.6 individual/hr) and September 2018 (27.8 individuals/hr).
- It was promising to note that at least some of the EDEV individuals survived the translocation from below the waterfall to above the waterfall. This is an early indication that the physical habitat conditions (velocities, depth, cover, substrate) as well as physico-chemical conditions (water quality) above the waterfall and upstream of the proposed dam wall was adequate over this period to sustain these individuals. It can furthermore also be assumed that adequate food sources were available for the maintenance of the adult EDEV individuals that were translocated.
- It was established during the May 2019 survey that the fish was released during the March translocation project in the vicinity of the proposed Bruintjieslaagte Dam wall (*pers. comm.* Mr. Shawn van Ryn: Joubert en Seuns (Pty) Ltd). The EDEV habitat study recommended that the fish should be introduced upstream of the dam basin (area to be impacted by the proposed development) and especially at sites A5 and A6 (Report DC-A-18). Site A6 was especially suitable and contained similar habitats than the artificial pool in reach B where the highest abundance of EDEV was observed.
- The May 2019 survey also revealed that some individuals have already moved some distance upstream of the translocation sites over this 2-month period. During the May 2019 survey EDEV was however only sampled within the proposed dam basin area and not yet upstream of the dam (Reach A: sites A1 to A6). EDEV was therefore not yet established in an area that will not be impacted by the proposed dam. Some sections between the current distribution and recommended translocation area (sites A5 and A6) may also be difficult to pass during upstream dispersal as a result of high velocities (such as the conditions observed at habitat sites A1, A2 and A4.
- Since EDEV is a limnophilic species (prefers slow to standing water), it can be expected that this species would more easily migrate/re-colonize with the flow of the stream

(downstream) than against the flow (upstream). Some of the translocated individuals may therefore have colonized the area directly downstream of the proposed dam wall and the waterfall (high rainfall and flows two weeks after translocation may also have resulted in a higher dispersal in a downstream rather than upstream direction). The area downstream of the proposed dam wall is the highest risk area during especially the construction phase of the dam (high turbidity, altered water quality and habitat alterations can be expected due to construction activities).

- It is again emphasised that before any construction activities commence, a viable population of EDEV must be established in the Devils Creek upstream of the proposed dam basin (full-supply level). The following recommendations were therefore made after the May 2019 survey:
  - The EDEV population within the Devils Creek in both reaches A (above the waterfall) and reach B (below the waterfall) should not be further disturbed by sampling or any other activities (including construction) for a period extending at least to November/December 2019. This will be essential to provide adequate recovery time for the original EDEV population in reach B where individuals were collected for relocation, and also give the translocated population in reach A a proper chance to establish.
  - A fish survey should be conducted in the 2019/20 summer season (preferably after December 2019) in both reaches A and B to determine the status of EDEV in the Devils Creek after this recovery period. This survey should also cover the area between the waterfall and the proposed dam wall.
  - Although promising results were gained during the May 2019 survey it was too soon after translocation to establish the long-term success of this action and continued monitoring will be required to verify the success of the translocation.

The following are the results of the **Follow-Up Surveys of Devils Creek (Mpumalanga) to determine survival of *Enteromius "Devils Creek"* (EDEV) after translocation for February 2020, May 2020:**

February 2020 survey (11 months after translocation)

- A follow-up survey was conducted during February 2020, 11 months after translocation, aimed at determining the survival and spatial distribution of translocated EDEV upstream of the prosed dam wall site.
- Flow was very high at the time of the survey, with high velocities limiting sampling success and accessibility, creating dangerous conditions within the river channel.
- Very limited sampling could be performed in some areas and **no fish was caught** in reach A (from proposed dam wall/relocation site to habitat site A6) during this survey. This data was of low confidence and was thought to be due to high velocities limiting sampling success.
- **Condition at recommended translocation sites A5 and A6 was found to still be suitable** (provide slow flowing habitat with cover) **for EDEV, even under high flows**.
- It was also evident, based on the observation made during the February 2020 high flow survey, that many sections within reach A (recommended conservation zone) will not be passable by EDEV due to high velocities and high gradients. Based on available information for the small Enteromius group of fish species (that should include EDEV) the maximum recommended velocity that they are thought to be able to negotiate over short distances is 1.5 m/s and a maximum direct drop of 120mm between pools can be negotiated through jumping (Bok *et al.,* 2007). It was evident from visual observation

made during February 2020 that these values were exceeded in many areas within this reach and may therefore be impassable by EDEV individuals. **It was therefore again stressed that it unlikely that EDEV will be able to naturally distribute upstream form the translocated site (at the proposed dam wall) to the recommended conservation reach and sites (especially sites A5 and A6) without intervention.**

- A single EDEV individual was sampled in reach B (below waterfall) where limited sampling could again be performed due to high flows.
- It was recommended that the survey should be repeated after flows receded and if sampling conditions improved.

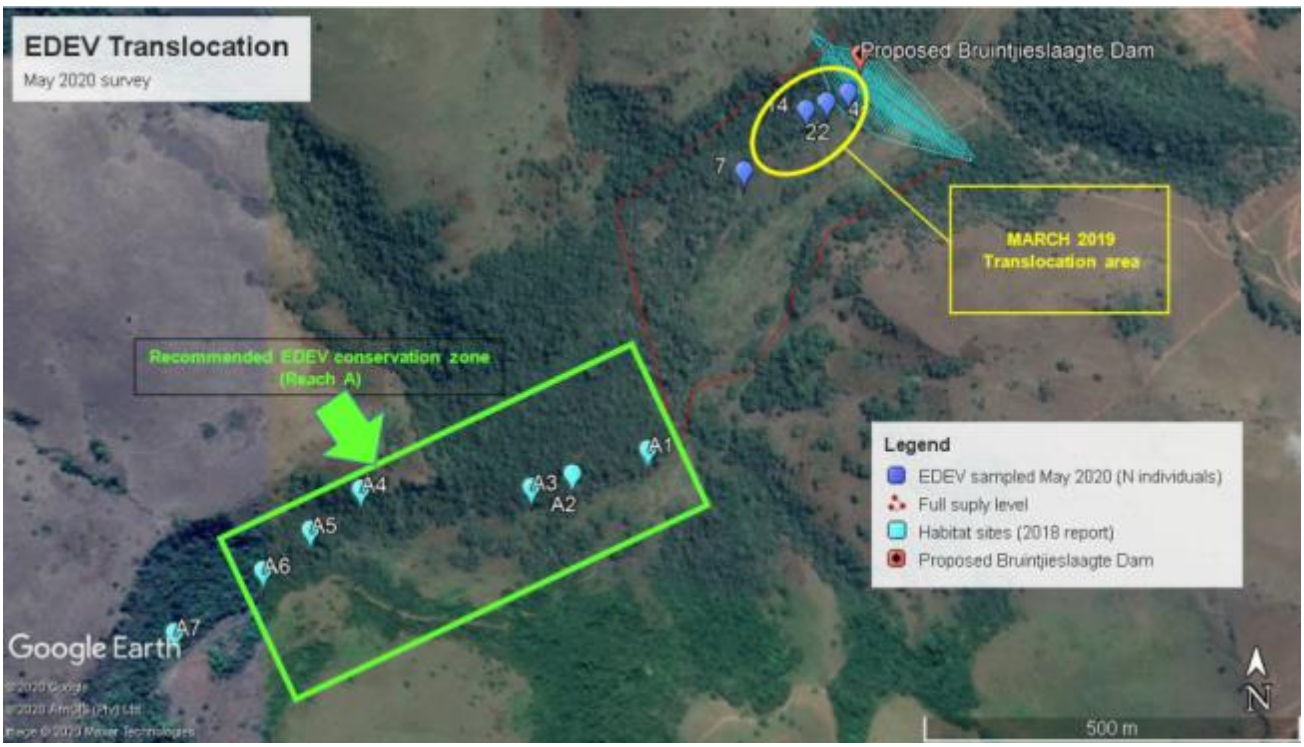
Plate 1: Photographic views of sites A5 (left) and A6 (right), identified as most suitable sites for potential translocation of EDEV in reach A (September 2018)

May 2020 survey (14 months after translocation)

- Sampling **conditions were notably better** during the May 2020 follow-up survey (low-moderate flow).
- **Forty-seven (47) EDEV individuals were sampled** upstream of the proposed dam wall during the May 2020 survey. The number of fish sampled equates to 23% of the total number introduced (207 individuals) (Table 1). Although one can never expect that all fish in a reach will be sampled during any sampling exercise, this number provides an indication of the relative abundance of fish in relation to the introduced number of fish. Once 100% is exceeded (more than 207 individuals sampled during any survey) it will be a definite indication that successful reproduction has occurred. **The current percentage therefore do not yet provide proof of successful reproduction post translocation**.
- The minimum total length (TL) of the EDEV individuals translocated in March 2019 was 35mm. Kindler *et al.* (2015) indicated the that the length of *E. motebensis* individuals at maturity was estimated as 37.5 mm TL for males and 44.5 mm TL for females. **The translocated EDEV individuals were therefore mostly mature adults that would have been able to reproduce.** Previous studies also indicated that *B. motebensis* has an extended spawning season, with spawning starting in spring and lasting until the end of summer in March. The spawning season coincide with changes in a variety of environmental variables, i.e. increasing day-length, increasing temperature and increasing water flow. **The fact that the translocation was done in March 2019 (end of 2019 spawning season) it can be estimated that the translocated fish may have only started spawning from September 2019 to March 2020 if conditions were suitable. Any juveniles present in the reach at the time of the February of May 2020 surveys would therefore have been very small.**
- The individuals sampled during May 2020 in the translocation zone ranged from 30mm to 110mm in length (total length) (Plate 4). **No juveniles or fish larvae were observed**

during the survey. Since fish larvae are small and may escape through the fish scoop nets, a SASS5 net (0.5mm mesh size) was also used during the survey to scoop suitable slow habitats. No fish larvae were sampled and **although some small individuals (30mm) were sampled, it is not yet a clear indication that successful breeding has occurred after translocation**. Based on literature of the Chubbyhead Barb group of fish (including *E. anoplus* and *E. motobensis*), it is estimated that EDEV individuals will reach a length of between 30mm and 40mm (fork length) after the first year (Cambray and Bruton, 1985; Kleynhans, 1987; Kindler *et al.* 2015). Growth however depends on various environmental factors (such as food, temperature etc.). **The presence of small individuals less than 30mm during any future survey would therefore be an indication that successful breeding has occurred after translocation.**

The May 2020 survey therefore provided promising results that EDEV managed to survive a full annual cycle in the reach upstream of the waterfall. It is especially good to note that they manage to find refuge areas in times of high flow (as observed in February 2020).



- **Of some concern is the fact that the translocated fish is currently (one year after translocation) still only present within the translocated area, in close proximity to the proposed dam wall and have not colonized the conservation zone.** The current EDEV population **only occurs within the full-supply level of the proposed dam**, and hence within a river section that will be transformed by the proposed dam (inundation, transformed form lotic to lentic ecosystem). Although EDEV is likely to survive and potentially thrive in the inundated slow-pool habitat that will be created by the dam (water quality and habitat permitting), **there is concern that construction activities may eradicate these individuals**. **It is therefore essential that a healthy population of the EDEV must be established upstream of any potential impacts (especially construction activities) in the conservation zone.** Should the proposed activity

include disturbance of the riverbed upstream of the proposed dam wall (such as collection of construction material from river bed) the current EDEV population will be at high risk and potentially be eradicated.

- Should EDEV colonise the inundated dam area successfully after construction, **it will remain essential (critical) that no other fish species (indigenous or exotic) be introduced into this dam or the river upstream of this dam. The presence of especially predatory species will nullify the potential success of the translocation effort to conserve this species**.
- Although only one year has passed since translocation, **it is evident that the fish have not distributed successfully towards the area upstream of the full-supply level (reach A).** It was again observed (during February and May 2020) that sections of the river upstream of the translocation area may include areas with high velocities and gradients that EDEV may not be able to negotiate (even under low flows). These rapid/run areas therefore create natural migration barriers that prevent the distribution of the species towards the upper reaches (conservation zone). A waterfall/glide directly upstream of habitat site A6 will most likely be a migration barrier that will also prevent the species to spread past that point (hence EDEV would most likely only occur downstream of habitat site A6).
- Various EDEV individuals were sampled in reach B (below waterfall) during the May 2020 survey indicating **that the original EDEV population below the waterfall is still in a healthy state**.

Plate 2: Photographic views of actual translocation sites in reach A (May 2019)

Plate 3: Photographic views of selected sites above waterfall where EDEV individuals were samples (May 2020 survey).

Plate 4: Photographic views of selected EDEV individuals sampled in vicinity of translocation area during May 2020 survey (14 months after translocation).

Plate 5: Photographic views of recommended translocation sites A5 (top) and A6 (bottom) during May 2020 (no fish present).

Plate 6: Photographic views of site in reach B (below waterfall) and selected EDEV individuals sampled during May 2020 survey.

Management recommendations:

The following management recommendations specific to the Devil's Creek *Enteromius sp*. from the **Follow-Up Surveys of Devils Creek (Mpumalanga) to determine survival of *Enteromius "Devils Creek"* (EDEV) after translocation - May 2019, February 2020, May 2020, Clean Stream Biological Services Pty Ltd**. The report is attached under Appendix 7.4d and included under section 4 of the EIR.

Should the proposed Bruintjieslaagte dam development be approved, it is strongly recommended that the following management actions should be included in the environmental management plan / ROD:

- No further development of the catchment area of the Devils Creak should be allowed upstream of the waterfalls (within the proponents' property).

- The upstream catchment area (especially of the conservation reach) should ideally be managed as a nature reserve to allow natural processes to continue and to maintain good water quality and habitat characteristics. Clearing of vegetation within this catchment may result in increased turbidity and siltation of critical EDEV habitats.
- No clearing of riparian vegetation or any disturbance of the conservation reach (from site A6 to full-supply level) should be allowed. Marginal and overhanging vegetation provided essential cover features that are critical for the survival of EDEV.
- The creation of artificial habitats for EDEV (similar to Plate 6) could be considered in the direct area of the dam inflow (at full-supply level) but no further natural riverine habitat above the full supply level should be disturbed.
- Annual fish monitoring surveys should be compulsory during all phases of the proposed development (pre-construction, construction, operational and decommissioning). The objective of the fish monitoring surveys should include (but not be limited) to the following:
  - Monitor the status of the translocated EDEV population upstream of the waterfall (especially from Bruintjieslaagte dam wall to habitat site A6 (conservation zone).
  - Establish if any other fish species have colonised the Bruintjieslaagte dam and conservation reach.
  - Monitor the status of the fish population (especially EDEV) in the Bruintjieslaagte section downstream of the waterfall (during construction and operational phase).
  - Monitoring (fish) surveys should be performed bi-annually during construction phase and annually (during the low flow season) during operational phase.
- It is strongly recommended that more detailed ecological and genetic studies should be performed on the EDEV population within the Devils Creek in future.
- Before any construction occurs at the dam wall, a fish survey should be conducted in the reach stretching from the proposed Bruintjieslaagte Dam wall to the waterfall (high risk area to be impacted by construction activities). Any EDEV individuals collected during this survey should be translocated to the recommended translocation sites A5 and A6 within the conservation zone.
- Should any disturbance be planned within the current area where translocated EDEV was sampled (dam basin area), an attempt should also be made to move some of these individuals to the recommended translocation sites A5 and A6 within the conservation zone.
- It is furthermore recommended as a precautionary measure to improve the survival of the species that some EDEV individuals should be kept in aquarium facilities off-site during the construction phase, and returned to the river once the system is stabilised after construction (preferably to be done by MTPA/conservation authority).

Mitigation measures during construction period

1. Before any construction occurs at the dam wall, a fish survey should be conducted in the reach stretching from the proposed Bruintjieslaagte Dam wall to the waterfall (high risk area to be impacted by construction activities). Any EDEV individuals collected during this survey should be translocated to the recommended translocation sites A5 and A6 within the conservation zone.
2. Install a pipe off sufficiently large diameter prior to site clearance and construction of the dam wall to divert the total clean flow of the Devil's Creek past/through the construction area.
3. The pipe must be installed on the eastern embankment a few metres outside the right embankment of the stream. The natural stream and embankments must not be disturbed during the installation of the pipe.

4. Plan construction period for the low-flow periods and also outside the Blue Swallow Breeding season – April to end-October (Dr Garth Batchelor provided period).
5. ECO must monitor the turbidity of the water downstream of the dam wall construction area and downstream of the waterfall weekly during construction period. If high turbidity is observed instruct the contractor to revise construction practice to prevent/reduce turbidity of the water.
6. ECO must monitor the fish below the waterfall and upstream of the Koedoeshoek dam on a weekly basis during the construction period. Immediately report if fish mortality if observed, investigates reasons and ensure that corrective action is implemented.
7. The Ecological Water Requirement (EWR) as specified by IWR, Stephen Mallory must be released from the Bruintjieslaagte dam during the filling period of the dam after construction is completed.

Monthly Ecological Flow Requirement (l/s)

Month	Dam	
	Bruintjieslaagte	**Koedoeshoek**
Oct	35	34
Nov	59	48
Dec	82	61
Jan	99	77
Feb	219	95
Mar	108	74
Apr	82	61
May	54	47
Jun	44	39
Jul	38	35
Aug	32	33
Sep	30	32

Mitigation measures during the operational period

1. The monthly Ecological Water Requirement (EWR) as specified by IWR Stephen Mallory, must be released from the Bruintjieslaagte dam as well as the Koedoeshoek dam on an ongoing basis. EWR flow must be measured and submitted to the Department of Water and Sanitation and/or IUCMA annually or as specified in the water use licence. Please note that during normal rainfall periods the natural flow in the Devil's Creek will be sufficient as the dams will overflow. Releasing additional flow to meet the EWR will only be required during dry and low-flow periods.
2. Environmental Awareness. Awareness of the potential problems of introducing fish into the new impoundment should be fostered among staff working on the farm. The aim of the awareness programme should be to prevent introductions of unwanted aliens taking place.
3. The applicant must commit and ensure that no exotic fish species is introduced into the Bruintjieslaagte dam.
4. Annual SASS 5 and fish monitoring programme must be implemented to monitor the impact of the dam on the aquatic ecosystem. Report must be submitted to the MTPA, Aquatic Systems.

Hydrology, Ecological Water Requirement (EWR), Yield or Water Available from Dams

The Ecological Water Requirement (EWR) was determined by Dr Palmer based on the stream characteristics and fish species present and this flow downstream of the dam will be maintained during the construction as well as operational periods. This mitigation measure will reduce the potential impact on the fish species to low.

The original purpose of hydrology and yield study was to undertake a yield analysis of a proposed dam on the farm Bruintjieslaagte on the Devils Creek River, which is a tributary of the Crocodile River in Mpumalanga. The scope of work was later expanded to include a lower dam referred to as the Koedoeshoek Dam and well as the development of operating rules for the dams so as not to impact on downstream users.

Catchment	**MAR (natural)**	**EWR**		
	million m^3/annum	**million m^3/annum**	**% of MAR**	**Ecological Category**
Bruintjieslaagte	6.66	2.29	34.4%	B
Koedoeshoek	8.57	1.59	18.6%	C

Dam	**Full supply capacity (m^3)**	**Full supply area (ha)**
Bruintjieslaagte	842 000	12.7
Koedoeshoek	850 000	9.6

Dam	**Yield (million m^3/annum)**	
	Historical	70% assurance
Bruintjieslaagte	0.74	1.2
Koedoeshoek	0.90	1.4

The EWR will be released from both dams with the Bruintjieslaagte EWR flowing into the Koedoeshoek Dam and the release from the Koedoeshoek Dam flowing into the Crocodile River. Since the only user on the Devils Creek is Joubert and Sons (the applicant), only the EWR needs to be met. There will be no impact on the Crocodile River flow since the abstraction from the Devils Creek is in exchange for allocated abstractions from the Crocodile River.

The proposed Bruintjieslaagte Dam is located favourably in a catchment with high runoff and very little water use upstream of the dam. A dam with a full supply capacity of 842 000 m^3 will be able to yield an estimated 1.2 million m^3/annum at 70% assurance after meeting a B class ecological Reserve.

The proposed operating rule is to release water from the Bruintjieslaagte Dam according to a minimum monthly release rule. This will ensure that the EWR low flows are always met. The water will flow into the Koedoeshoek Dam from which a release must also be made to meet the EWR downstream on this existing dam. The recommended releases are lower than those from Bruintjieslaagte Dam due to the lower ecological category.

Given the above operating rule, the yield of the Koedoeshoek Dam is 1.4 million m^3/annum at 70% assurance.

An analysis of the low flow shows that the EWR low flows will always be met. While there is an impact of this development in that the abstractions for irrigation will reduce the flow in the

Devils Creek catchment, the only water user in this catchment is the applicant. Provided the EWR is met there should be no objections to this development.

The water abstracted from the dams will be offset by reduced abstractions out of existing allocations from of the Crocodile River. Hence there will be no impact on the Crocodile River. The abstractions made out of the dams must the monitored together with the releases out of the dam in order to ensure compliance with the EWR. See the hydrology section.

Archaeology

An Archaeological Impact Assessment and heritage study was undertaken by Kudzala Antiquity CC.

Archaeologically significant sites were recorded during the survey and comprise of Late Iron Age (1650-1820's) *stone-walled enclosures* and a historic stone-walled enclosure. The Late Iron Age sites are relatively far apart but forms part of a single occupation unit of which two sections will be affected by the expected construction of the dam wall and overflow and water level of the dam.

As part of mitigation measures, it was recommended that the affected archaeological sites be mapped and recorded by archaeological excavation, pending a successful permit application from SAHRA.

Kudzala Antiquity conducted the mitigation and obtained a permit from SAHRA for the destruction of some of the stonewall structures.

Kudzala Antiquity did a detailed mapping of the site and archaeological excavations.

The mitigation of sites BL 2 and BL 4A and B was completed with the archaeological documentation thereof and Joubert en Seuns Citrus (Pty) Ltd applied for a demolition permit for sites BL 2 and BL 4A and B from the South African Heritage Resources Agency (SAHRA). Refer to Appendix 11.

Positive and negative aspects in summary

Positive aspects of the proposed dam project:

- A new area for the Blue Swallows (*Hirundo atrocaerulea*) was discovered during the site investigations for the dam and the applicant supported further work to study and protect the Blue Swallows. Three years of monitoring is now available and it is evident that with a high level of certainty that there are no breeding sites at or near the dam footprint.
- The applicant is in the process of proclaiming a nature reserve on Portions of the Farms Rietvly 295 JT, Mooiland 294 JT, Geluk 299 JT, Bruintjeslaagte 465 JT, Koedoeshoek 301 JT, and Loopfontein 298 JT. This is as a result of the work done for this application.
- Additional storage capacity for irrigation water is created in the Crocodile River catchment and it will make water available for use during drought or low-flow periods.
- The footprint area of the dam is small relative to the large natural area and the ecological impact of the dam is small after mitigation.
- No fish was found in the Devil's Creek upstream from the waterfall and the upper catchment where the dam would be located.
- Extensive work has been conducted with regards to the *Enteromius cf* (EDEV). Positive results were obtained in the most recent surveys after the translocation and specific management measures were drafted. These are proposed to be included as specific conditions to the EA if considered favourably.
- Mitigation measures are available to mitigate the impact on aquatic species, specifically fish downstream from the waterfall during the construction and operational periods.

- A Water Use Licence has been issued by the Department of Water and Sanitation for the proposed dam.

Negative aspects of the proposed dam project:

- The dam is located in an area that is classified as "critical biodiversity" in terms of the MBSP 2014.
- It was observed when the Blue Swallows is foraging that they fly up and down in the Devil's Creek valley and over/near the proposed dam site. To reduce the potential impact it is proposed that construction must be during the period April to end October. (This corresponds with the low-flow period which is favourable for dam construction and the construction period is specified as a condition in the EMPr).
- The *Enteromius anoplus/motebensis* fish species identified below the waterfall and existing dam is likely a new species and the proposed dam may impact on the fish if not mitigated during the construction and operational periods.
- A section of an Archaeological site (stone walled structures) will be lost due to the dam construction.

Based on the studies, impact assessment and mitigation measures it was clearly established that the risk of a negative impact on the Blue Swallows from the proposed dam as located in Devil's Creek, is not significant and that the construction of the dam can be allowed.

Additional information gained during the assessment by the MTPA Biodiversity Stewardship team during the October/November 2017 survey and the work done by Dr Batchelor was taken into account in the EIR.

Based on the aquatic assessment it was confirmed that there are no fish species upstream of the waterfall and therefore in the stream where the dam will be constructed. The EWR water flow below the dam (and therefore below the waterfall) will be maintained during the construction as well as operational periods. Providing that the water flow will be maintained the impact on the fish species will be insignificant.

Extensive work has been conducted with regards to the *Enteromius cf* (EDEV). Positive results were obtained in the most recent surveys after the translocation and specific management measures were drafted. These are proposed to be included as specific conditions to the EA if considered favourably.

Further summary of Application, Specialist Studies and Impact Assessment:

Need and Desirability

The applicant is a well-known and established farmer in the area and has large areas under cultivation. Foreign revenue of approximately R100 million is earned annually on citrus exports. The farming activities provide 350 fulltime job opportunities and approximately 900 addition temporary job opportunities during the picking season. The dam is proposed as an additional irrigation storage dam that will be utilised to irrigate the nearby citrus orchards, especially during drought periods.

Irrigation water is normally abstracted from the Crocodile River for the irrigation of the citrus orchards. During drought periods and a low water level of the Kwena dam, abstraction from the Crocodile River is limited. It is the intention of the applicant to create additional storage capacity for irrigation purposes so that water is available during drought periods and to allow for an alternative abstraction point other than directly from the Crocodile River.

There is an existing dam downstream from the proposed dam also located on the Devil's Creek. This dam is located on the farm Koedoeshoek 301JT. The Devil's Creek is a

perennial river and there is sufficient flow in the river for the Koedoeshoek dam as well as the proposed dam on Bruintjieslaagte.

There is insufficient storage capacity in the Inkomati (Crocodile) catchment and the IUCMA, Water Affairs and the City of Mbombela is evaluating alternatives for dams to provide higher water security for the area. This private initiative to construct the dam will add approximately 840 000m^3 of storage capacity at a cost of approximately R 15 million.

Citrus orchards are highly reliant on irrigation and if water is not available for irrigation it would severely affect the size and quality of the crop. The value of the citrus exports is approximately R 100 million per year and the quality of the citrus is critical for success in this highly competitive market. The farming activities is providing fulltime work for approximately 350 people and temporary working during the harvesting period for approximately 900 people.

Water Availability and Water Use Rights

Please note that there will not be an increase requested for the abstraction water use rights. The purpose of the dam is to provide water security during drought periods. Water will likely be released from the dam to flow to the Koedoeshoek dam from where it will be abstracted and linked to the irrigation system. The Koedoeshoek abstraction point is an alternative to the Crocodile River and is measured.

The proposed dam is located in the X21E quaternary catchment with a natural flow of 56.0 million m^3/annum. The Mean Annual Runoff for the Bruintjieslaagte dam catchment was determined by IWR Water Resources, Stephen Mallory, to be 6.66 million m^3/annum, the Ecological Water Requirement (EWR) as 2.29 million m^3/annum and the potential yield (water available for abstraction) from the Bruintjieslaagte dam as 1.2 million m^3/annum.

Water use rights from the Crocodile River in Schoemanskloof, as confirmed by the Crocodile River Major Irrigation Board, is 4 211 200 m^3/annum. As can been seen the allocation is far in excess of the volume of 1.2 million m^3/annum that will be available for abstraction from the Bruintjieslaagte dam.

A Water use licence for the dam (storage of water) was issued by the Department of Water and Sanitation. Refer to Appendix 5.

River Ecosystems and Ecological Water Requirements

A *River Ecosystems Assessment Report, Bruintjieslaagte dam - Devil's Creek – Schoemanskloof, Nepid Consultants, Dr Rob Palmer, 13 April 2017 draft 1.1.* was compiled to address the aquatic aspects of the project (Refer to Appendix 9). This formed the basis of the aquatic assessment and the additional fish study and work regarding the *Entemorius* cf. EDEV followed.

The potential zones of direct influence of the proposed dam options on river ecosystems comprise:

- Devil's Creek within the proposed Full Supply Levels of the two dam options. The length of river that will be inundated is estimated at 0.7 km, similar to the existing dam.
- Devil's Creek between the proposed dam options and the top end of the existing dam, a distance of 2.9 km.

The potential zones of indirect Influence of the proposed dam options on river ecosystems comprise:

- Upper portion of Devil's Creek, upstream of the proposed Full Supply Level. No fish were recorded upstream of the waterfall, so the proposed dam option is not expected to affect the upstream migration of any species of fish.
- Lower portion of Devil's Creek between the existing dam and the confluence with the Crocodile River, a distance of 2.2 km.

The present state of water quality in Devil's Creek upstream of the existing dam was classified with a high level of confidence, as Category A. All metrics were considered unmodified, except for turbidity, which is likely to be slightly elevated for short periods during high flows because of timber production, particularly during harvesting.

The Present Ecological State of aquatic macroinvertebrates was rated, with high confidence, as Category A/B, with a MIRAI score of 92%. A total of 34 SASS5 taxa were recorded, and these gave a Total SASS5 Score of 241, and an average score of 7.1.

Fourteen sensitive taxa were recorded, including *Oligoneuridae* and *Blephariceridae*, both of which have a sensitivity rating of 15/15, which indicates excellent quality water. Mayflies included members of the genus *Demoreptus*, which is also highly sensitive to water quality deterioration. The fauna was characterised by absence of alien taxa and moderate abundance of *Blephariceridae*, *Heptageniidae*, *Leptoceridae* and *Corduliidae*.

Population densities were low to moderate, and no taxa were rated as abundant or very abundant, which is also indicative of unmodified conditions. Water pennies (*Psephenidae*) were present, but at lower abundance than expected. All other taxa were present in abundances expected under natural conditions.

Fish – Present Ecological Status:

Nine species of fish were recorded in Devil's Creek during baseline surveys between February and April 2017.

Reach A: Upstream of Waterfall (area for new dam)

No fish were recorded despite the suitability of in-stream habitats. The apparent absence of fish in this reach is attributed to the waterfall, and therefore considered natural. This was confirmed by Dr. Pieter Kotze during the August 2017 survey.

Reach B: Waterfall to Existing Dam

Two fish species were sampled during the August 2017 survey namely *Amphilius uranoscopus* and *Enteromius cf. anoplus/motebensis*. Although Dr. Palmer only recorded *E. cf. motebensis* at this site, he expected and considered the possible presence of *A. uranoscopus* in this reach throughout his report. This species was also present in a relative high abundance within this reach was during August 2017. *Amphilius uranoscopus* is also the most flow dependant species of concern (a rheophilic species) and should be the primary indicator species in setting ecological flows for reach B. This species is also intolerant to water quality changes (including increased turbidity) and care should be taken especially during construction activities in the upstream catchment to limit sedimentation and increased turbidity.

Impoundment

High numbers of juvenile *Coptodon rendalli* were recorded in the upper reaches of the existing impoundment. This species is unlikely to have been present in Devil's Creek before impoundment, but the impoundment has created ideal habitat. How this species colonised the impoundment is unknown, but however this took place, there is a high probability this species will also colonise proposed impoundment.

Reach C: Existing Dam to Confluence

Dr Palmer recorded eight species of fish in this section of the river. The abundance of fish was low, and dominated by juveniles, indicative of post-drought recovery. The composition was dominated by cichlids, which were not expected in this river under natural conditions, so they appear to have benefited from the drought conditions. Only one flow-dependent fish species, namely *Chiloglanis pretoriae*, comprising a single individual, was recorded despite the availability fast-flowing habitats, and this further confirms that fish composition and abundance had not yet recovered from the effects of the drought.

Dr Kotze recorded four indigenous and one alien fish species in this section of the river during August 2017. Dr. Palmer recorded eight indigenous species (including these four sampled in August) during the summer season at this site. Due to the close proximity of this site to the Crocodile River, it expected that the species diversity at this site may vary greatly over time as fish from the Crocodile River may use the lower section of the Devils Creek as a refuge area (avoiding unfavourable conditions or utilising suitable conditions). Although there is a high probability that *A. uranoscopus* may also be present in this reach, *Chiloglanis pretoriae* was confirmed at the site by Dr. Palmer (Nepid 2017). It is therefore recommended that adequate environmental flows should be maintained to at least cater for the requirements of *C. pretoriae* in the lower reaches of the Devils Creek, as these should be adequate to also sustain the other expected species.

Ecological Importance and Sensitivity (EIS) of Devil's Creek within the potential zone of impact was rated as High.

The Desktop Ecological Flow Requirement for a Category B ecological state below the new dam is an annual volume of 2.405 million m^3/annum.

Median environmental low flow requirements ranged between 0.036 and 0.106 m^3/s in September and February respectively. These flows will provide good wetted perimeter (5.8 m) and small areas with current speeds that exceed 0.34 m/s. The recommended flows are therefore suitable for maintaining flow-dependent fish species, such as *Amphilius* spp and *Chinoglanis pretoriae.*

See specific information pertaining to the Enteromius cf (EDEV) above, under the main issues.

River Ecosystem Impact Assessment:

Potential Impact	Impacts Before Mitigation						Impacts After Mitigation					
Construction Phase												
	I	D	E	P	Total	Significance	I	D	E	P	Total	Significance
Disturbance of Riverine Habitats	-7	7	2	7	**-112**	**Major (-)**	-7	7	1	7	**-105**	**Moderate (-)**
Impact of Water Quality Deterioration on River Ecosystems	-6	2	3	7	**-77**	**Moderate (-)**	-1	2	3	7	**-42**	**Minor (-)**
Operational Phase												
Inundation of Riverine Habitats	-7	7	1	7	**-105**	**Moderate (-)**	-7	7	1	7	**-105**	**Moderate (-)**
Impact of Altered Water Quality on River Ecosystems	-5	7	3	7	**-105**	**Moderate (-)**	-4	7	3	7	**-98**	**Moderate (-)**
Impact of Altered Hydrology on River Ecosystems	-6	5	4	7	**-105**	**Moderate (-)**	-2	5	3	7	**-70**	**Minor (-)**
Impact of Alien and/or Translocated Fish	-4	7	3	7	**-98**	**Moderate (-)**	-4	7	3	4	**-56**	**Minor (-)**
Bed Armouring	-2	7	3	6	**-72**	**Minor (-)**	-2	7	3	6	**-72**	**Minor (-)**

Mitigation measures for the aquatic ecosystem:

- Stream Diversion: Prior to construction of the dam wall a pipeline with sufficient capacity to carry dry season flows should be installed to divert the stream during construction to ensure that turbidity in the river downstream of construction is not impacted. The pipeline should be sized to carry at least 119 ℓ/s, a recommendation based on the 10th percentile natural flows. The outlet of the pipe should be positioned in the river to prevent erosion, and stabilised with gabions if necessary.
- Environmental Flow Requirements: Environmental flows as specified should be released at all times from the impoundment, including the period when the impoundment first fills. During normal rainfall years (non-drought), the recommended monthly low flows for the 50% time of exceedance should be implemented and monitored at J-02. This means that the minimum flows should vary seasonally between 0.036 m^3/s (September), and 0.106 m^3 /s (in February). During drought years, the recommended monthly low flows for the 90% time of exceedance should be implemented and monitored at J-02. This means that the minimum flows during drought periods should vary seasonally between 0.017 m^3/s (September), and 0.046 m^3/s (in February). The natural seasonal flow variability should be maintained, and in particular, winter low flows should not exceed summer low flows.
- Environmental Awareness. Awareness of the potential problems of introducing fish into the new impoundment should be fostered among staff working at the dam as well as the irrigation scheme. The aim of the awareness programme should be to prevent introductions of unwanted aliens taking place. It should be noted that translocation of fish is regulated by provincial and national legislation.

Wetland Delineation, Present Ecological Status and Functional Assessment for wetland and riverine areas

A comprehensive riparian, wetland and terrestrial ecology assessment was done by Mr Anthony Emery and Dr Llew Taylor. Refer to Appendix 10. Conservation-important plant species that may occur on site are listed in the Emross Consulting and Taylor Environmental Report. Of all the plant species on the MTPA list only *Eucomis autumnalis* (Common Pineapple Lily) was identified on the site. As a mitigation measure the ECO (ecologist) will survey the site and identify, rescue and relocate conservation important plant species prior to the start of construction. The footprint area of the dam is small (12.7 ha) relative to similar habitat in the Devil's Creek catchment.

The method employed in this investigation is adapted from that suggested by the Mpumalanga Tourism and Parks Agency (MTPA), entitled "Minimum requirements for EMPRs when applying for authorisation for an activity that may have a detrimental effect on the environment". The riverine and riparian vegetation was assessed during field surveys in November and December 2016 using the VEGRAI 3 technique, along three transects of 154, 669 and 826m, respectively. An Ecological Category (EC) and Present Ecological Status (PES) for the riparian vegetation state was determined. A field survey was undertaken to identify any wetland areas on the site and to delineate the wetlands. GPS positions were taken at each survey point. The PES, Ecological Sensitivity and Functional Assessment was carried out using the Manual for the Assessment of Wetland Index of Habitat Integrity and WET-EcoServices. The ecological sensitivity of the area is based on available data and the results obtained in the field during the site visits in November and December 2016 and January and March 2017. The sensitivity is determined on a descriptive scale from Very Low to High. The significance of the impact of the proposed dam, in terms of construction, on the wetland, was estimated using the extent (spatial scale), magnitude and duration (time scale) of each impact. Mitigation measures were proposed.

A total of 60 species of plants were collected and identified along a 154m terrestrial and upper non-marginal zone transect, and 1495m marginal zone transect, in the area and along part of the Devil's Creek River on the footprint of the proposed site DP1. The only plant of conservation-importance collected was *Eucomis autumnalis* (Declining) along the terrestrial portion of the transects. The rest of the plants collected were determined to be of Least Concern, with the presence of 32 to be likely, the presence of 25 unlikely and three undetermined. Eight prominent species of alien plants collected included *Solanum mauritianum* (Bugweed), *Rubus cuneifolius* (American Bramble), *Bromus catharticus* (Rescue Grass), *Arundo donax* (Giant Reed), *Phaeoceros laevis* (Smooth hornwort), *Persicaria lapathifolia* (Pale Persicaria), *Ricinus communi*s (Castor-oil Bush) and *Lantana camara* (Lantana).

As a result of the historic and present anthropogenic activity in the area, in terms of landuse and impact (vegetation removal, water quantity and water quality), the presence of alien vegetation and perceived change from the reference state (non- woody and woody cover and abundance in the marginal and non-marginal zones), it is estimated that the marginal vegetation has changed by 22.5% and the non- marginal vegetation by 26.3%, giving an overall VEGRAI Level 3 score of 76.1%, classified as an Ecological Category of a high C, or Moderately Modified.

The Present Ecological Status (PES) may thus be described as being characterized by a system that has *experienced a moderate loss of habitats, biota and basic ecosystems functioning*. These figures represent the conditions along the more impacted right bank of the Devil's Creek River at site DP1. The relatively inaccessible left bank is less impacted and probably reflects conditions more closely associated with a *PES of B* (largely natural with few modifications).

The wetlands (4,1ha) delineated for site DP1 included:
(1) a broad seasonal wetland (Wetland A, 1,8ha),
(2) a permanent wetland (Wetland B, 0,8ha), situated below Wetland A,
(3) a temporary wetland (Wetland C, 0,8ha), separated from Wetland B by a rocky outcrop,
(4) a permanent wetland (Wetland D, 0,1ha) forming a narrow line into the Devil's Creek River and into which Wetland A drains, and
(5) a temporary wetland (Wetland E, 0,6ha), situated downstream of Wetland D and above the riparian area of the Devil's Creek River.

The overall Present Ecological Status (PES) of the wetlands at site DP1 using the Wetland-IHI Assessment was estimated to be *Unmodified, Natural*, with a score of 92,4% (Category A). The score for the vegetation alteration was 93,5% (A), for hydrology 96% (A), geomorphology 86% (B) and water quality 97% (A). The key characteristics of the assessed wetlands were (1) its small size relative to its overall catchment, (2) its channelled nature and the (3) pristine state of its catchment. These factors reduced its overall significance relative to the impact that construction of the dam site DP1 will have on ecosystem services and function. Its most significant ecosystem services related to erosion control, biodiversity maintenance and carbon storage. Streamflow regulation and flood attenuation services were identified as intermediate services.

Terrestrial Ecology:
The vegetation was examined along four transects across / along the terrestrial zone of the footprint of the proposed dam. Representative plants visible across these transects were collected and/or identified and recorded. Information on the terrestrial flora as included in the initial report, and appropriate to the subsequent study and reporting, is also included here. Information from Whyte (2017) and incidental observations made during the initial study in November and December 2016, and January and March 2017, for the avifauna was employed in the subsequent study. Incidental observations were made on other biota

(mammals, reptiles and amphibians). In addition, appropriate information was derived from Palmer (2017) on the amphibians.

Conservation-important biota as listed in a Species Status Report by the Mpumalanga Tourism and Parks Agency (MTPA) (November 2016) for relevant farms within topographic grid reference 2530BC, were specifically considered. The information and data derived above was subjected to an ecological sensitivity analysis.

The terrestrial area of the footprint of the proposed dam was divided into (1) Marginally Degraded Forested Woodland, (2) Secondary Grassland and (3) Riparian-Mistbelt Forest Ecotone The marginally degraded forested woodland comprises patches of forest and grassland, with a total surface area of 1.63ha.Twenty-three species of dominant plants were identified, including the alien *Solanum mauritianum*. Twenty-four species of birds were identified for the forested patches.

Refer to the Blue swallow information that is discussed separately as one of the main points.

The area is impacted both historically and at present by anthropogenic activity (historical walled structures implying the use of the area for natural resource utilization and at present the presence of a gravel road through the area). The only conservation-important biotic components identified (flying over the area of the dam footprint) was *Hirundo atrocaerulea* (Blue Swallow) and *Polemaetus bellicosus* (Martial Eagle). Whyte (2017) remarks that the vegetation communities that will be impacted represent only marginal foraging areas for the swallows and would also only represent a small fraction of the birds' total foraging area.

The Secondary Grassland comprises a small unbroken area of 1.86ha with seventeen species of dominant plants identified along the transect. Twenty-eight species of birds were identified for the grasslands / savanna area. Historical anthropogenic activity included contouring and the construction of earthen canals and berms. Anthropogenic activity is likely to have been the cultivation of crops and stock farming. The only conservation-important biotic components identified (flying over the area of the dam footprint) was *Hirundo atrocaerulea* (Blue Swallow) and *Polemaetus bellicosus* (Martial Eagle).

The Riparian-Mistbelt Forest Ecotone comprises 11.26ha of a combination of the riparian zone including wetlands (permanent, seasonal, temporary), ecotone and the adjacent terrestrial mistbelt forest. Sixty-two species of plants were identified along the transect and other transects employed during the initial study. Alien plants included *Ricinus communis*, *Rubus cuneifolius*, *Solanum mauritianus* and *Verbena bonariensis*. Forty-two species of birds were identified for the area. Historical anthropogenic activity includes contouring and the construction of earthen canals and berms. Anthropogenic activity is likely to have been the cultivation of crops and stock farming.

The conservation-important biotic components identified was *Hirundo atrocaerulea* (Blue Swallow) and *Polemaetus bellicosus* (Martial Eagle) (flying overhead) and the plant *Eucomis autumnalis* (Common Pineapple Lily) (Declining). MBSP (MTPA, 2014) classified the area of the terrestrial assessment as Other Natural Areas, CBA Optimal and CBA Irreplaceable. *The ecological sensitivity of the Marginally Degraded Forested Woodland and Secondary Grassland was considered to be medium and the ecological sensitivity of the Riparian-Mistbelt Forest Ecotone medium to medium-high.*

The impact of the loss of the vegetation in the Marginally Degraded Forested Woodland (area specific), Secondary Grasslands (area specific) and Riparian-Mistbelt Forest Ecotone (local extent) were all found to be of low magnitude, long term duration and may be

considered to be of low significance. Mitigation measures are recommended for the negative impacts.

The impacts considered for the proposed dam included an:

1. Impact on the riparian vegetation at site DP1 and the Devil's Creek River (determined to be of Low significance);
2. Impact on the wetlands and wetland ecosystem services associated with site DP1 and the Devil's Creek River (Low significance);
3. Impact of the potential for increased invasion by alien plant species (Medium significance);
4. Impact of loss of habitat for conservation-important fauna and disruption to the life-history cycles (Medium significance);
5. Impact of disruption to fauna due to construction activities (dust, noise, chemical pollutants) (Low significance).

Avifauna study

In the early stages of the Environmental Impact Assessment (EIA) process, Blue Swallows *(Hirundo atrocaerulea)* had unexpectedly been recorded in the area of the proposed dam site. This was a new locality for this species, as it was previously not known to occur there. This species is Red Data listed as Critically Endangered (Taylor, Peacock & Wanless 2015). This initiated a visit to the site to confirm their presence at the site and to make recommendations (Whyte 2017). Subsequently, it was then decided that a more comprehensive avifauna study/impact assessment for the dam area should be conducted.

A total of 77 species was recorded during different site visits. This was fewer than might have been expected, which is certainly due to the late timing of the survey. The species recorded were all those which would have been expected to occur on the site, and none were of particular conservation interest. The species list must be seen as minimal as it is expected that many more species would be shown to occur at the site over time.

The general conclusion is that, in the broader perspective, the impacts on the avifauna of the area will be low. Some species, particularly those dependent upon the indigenous riparian vegetation may have small numbers displaced. These include the Apalises, Cape batis, Greenbacked Camaroptera, Ashy Flycatcher, Terrestrial Brownbul, Grey Cuckooshrike, Yellow-fronted Tinkerbird, Knysna Turaco, These species are common to relatively common but none, given the small size of the impacted area, are at any particular risk and populations could be expected to remain intact in the area.

Other species may benefit from the presence of the dam and the stabilised flow in the downstream area of the new dam. These include African Black Duck, Pied Wagtail, the Kingfishers, Egyptian Geese, White-throated and Wire-tailed Swallows.

The Red Data species are also believed to be at no particular risk - the Blue Swallow being the main species to be considered here. The mist-belt grasslands appear to be in a pristine state. The major consideration is the disturbance factor when these birds return from migration.

There are only limited options for the implementation of meaningful mitigation measures. The construction phase will be high impact in a limited area over a limited time period, but the following two measures can be implemented.

The first of these will be crucial:

1. The construction phase (and therefore the disturbance) must be entirely complete before the advent of summer and the arrival of the migrant species, particularly the Blue Swallows.
2. The pushed out trees and bush should be burned inside the dam before inundation to prevent further impacts and disturbances away from the dam site.

Palaeontology

A desktop Palaeontological Impact Assessment was done by Prof Marion Bamford and she concluded:

The rocks in the area are ancient sediments of the Timeball Hill Formation, Pretoria Group with nearby volcanic granites and gneisses of the Mpuluzi, Nelspruit and Kaapvaal plutons. They do not contain any fossils because they are igneous in origin and too old for body fossils. Microbial mats have been reported from slightly younger rocks, and also from the rocks of the Barberton Greenstone Belt which are mostly igneous and very old but microfossils have been found in the Fig Tree Formation. These rocks are too far away to be affected.

There is a very small chance that trace fossils (ripple marks and microbial mats) could occur in the Bushveld Complex rocks but have not been recorded from this particular Formation.

The palaeosensitivity map is probably inaccurate for this area. It is concluded that the project may continue as far as the paleontology is concerned and no further impact assessments are required.

Project Team

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Expertise:
Heinrich Kammeyer is the owner of Enpact Environmental Consultants CC. Qualifications include a degree in Chemical Engineering, MBL and a Masters Environmental Engineering. The Environmental Consulting Business which was started in 2004 has completed more than 200 Environmental Impact Assessment Applications to date. Experience in Environmental Impact Assessments, over the past 16 years, spans a wide range including residential and business developments, tourism developments, roads, water and sewer, renewable power generation, concentrated farming and waste management facilities. In addition he also has extensive experience in waste management licences as well as water use licence applications.

Maryke André has 13 years' experience in the EIA consulting industry with Enpact Environmental Consultants. Qualifications include a Btech Nature Conservation degree. Experience in Environmental Impact Assessments spans a wide range of projects including residential and business developments, tourism developments, infrastructure projects (roads, water, sewer and renewable power generation), concentrate farming and waste management facilities. We also deals extensively with the compilation of waste management and water use licence applications.

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Bruintjieslaagte Dam – Devil's Creek - Schoemanskloof

1. Introduction and Motivation

1.1 Background

Enpact Environmental Consultants CC was appointed by Joubert Familie Trust to do the environmental impact assessment process in order for the applicant to apply for environmental authorisation to construct an irrigation storage dam of a capacity and area size that meets the thresholds as listed in the EIA Regulations, 2014 as amended.
A new application for the Bruintjieslaagte dam was submitted to the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA) on 21 November 2019.

The initial environmental application was submitted to MDARDLEA on 16 February 2017. The Scoping Report and Environmental Impact Assessment Report respectively were submitted to Interested and Affected Parties and the Regulating Authorities for comments during 2017. During 2018 and 2019 updated Environmental Impact Assessment Reports were submitted for information and comment.

During the specialist investigations and the initial Environmental Impact Assessment two very important environmental aspects were identified which required further specialist studies and assessment.

Firstly Blue Swallows (*Hirundo atrocaerulea*), listed as critically endangered within the borders of South Africa, were spotted flying over the project area by Anthony Emery of Emross Consulting and Dr L Taylor , the terrestrial/wetland specialist consultants in November 2016. Subsequently Blue Swallows were observed flying over the site by EAP and other bird specialist on another 3 separate field visits between December 2016 and March 2017. Further assessment and monitoring of the Blue Swallows were subsequently done over another three breeding seasons. It was determined with a high level of confidence that there are no nesting sites at or near the dam site and that the Blue Swallows are only very infrequent visitors to the proposed dam area. The detail of the Blue Swallow surveys over 4-seasons is reported and assessed in this Environmental Impact Assessment Report.

Secondly Dr Rob Palmer of Nepid Consulting, the aquatic specialist sampled a small barb species (Genus: *Enteromius*) in the reach between a waterfall and existing dam (downstream of proposed dam site) in the Devils Creek during the initial EIA aquatic specialist study that he referred to tentatively as *Enteromius cf. motebensis*. Dr Pieter Kotze of Clean Stream Biological Services was requested to further assess of fish in the Devils Creek River. Dr Kotze reported that the fish sampled in this reach of the Devils Creek during August 2017 had various morphological attributes that coincides with the more common and widespread *Enteromius anoplus.* The Mpumalanga Tourism and Parks Agency then requested that fish from the Devils Creek population must be included in the MTPA's DNA assessment where fish from the "Chubbyhead group of barbs" from ten different localities were included in the MTPA study. As a precautionary and mitigation measure MTPA (Dr. F Roux and aquatic team) translocated 207 individuals of *Enteromius Devils Creek*(EDEV) from reach B (below waterfall) to reach A (above the waterfall) in March 2019. During May 2020 Dr Kotze confirmed that the translocation was successful and that 47 EDEV individuals were sampled upstream of the proposed dam wall. The detail of the various assessments from 2017 to 2020 of the *Enteromius Devils Creek* (EDEV) is reported and assessed in this Environmental Impact Assessment Report.

A new and third application which *includes* a Scoping Report with public participation (site notice and newspaper notice) was submitted. The Scoping Report and Plan of Study were accepted by the MDARDLEA on 11 February 2020.

This provided the applicant team with 106 days in which to conclude the Environmental Impact Assessment Report (EIR). The timeline was however impacted by the regulations around the Covid-19 pandemic. Directions Regarding Measures to Address, Prevent and Combat the Spread of COVID-19 Relating to National Environmental Management Permits and Licences were issued under the Disaster Management Act (Act 57 of 2002). There was a period between 27 March 2020 and 5 June 2020 where the application process could not proceed. With the lifting of the restrictions the application process recommenced after 5 June 2020 and it should be finalised before end of August 2020.

The Environmental Impact Assessment Report (EIR) was prepared and evaluated on information provided to the consultant by the applicant and specialists and all the additional work done. The final EIR submitted to the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA) will also include comments received from Interested and or Affected Parties (I&AP's).

The Environmental Impact Assessment Report (EIR) will be made available to registered I&AP's for comments. It is in the EIR where the potential impacts are fully considered and assessed and where mitigation measures are proposed.

This Environmental Impact Assessment Report was compiled in terms of the National Environmental Act, 1998 and Environmental Impact Assessment Regulations, 2014. The environmental impact assessment evaluates the aspects and potential impacts of the proposed development on the natural and social environment.

The Environmental Impact Assessment Report contains the following information:

- Detailed description of the proposed activity;
- Description of the property on which the activity is to be undertaken;
- Description of the process undertaken to reach the proposed development footprint within the site;
- Description of the environment that may be affected by the activity;
- Details on the public participation process;
- The need and desirability of the proposed activity;
- Evaluation of alternatives;
- Specialist reports and findings;
- Description of environmental issues that were identified;
- Assessment of environmental issues;
- Environmental impact statement with key findings of the environmental impact assessment;
- Environmental Management Programme (EMPr).

The Environmental Impact Assessment Report is first made available for comment to Interested and Affected Parties which includes State Departments and relevant authorities. The report will then be submitted to the Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) for consideration in order to reach a decision on the application.

1.2 Description of activity

The applicant, Joubert Familie Trust, proposes to construct a dam for the storage of water for irrigation purposes on the Devil's Creek, a tributary of the Crocodile River located in Schoemanskloof. The dam will be located on the Bruintjieslaagte 465JT farm. There is an existing irrigation storage dam, Koedoeshoek dam downstream from the proposed dam also in the Devil's Creek.

The dam wall length will be approximately 340 m and dam wall height 23.6 m. The dam storage capacity will be approximately 842 308 m^3 and the surface area at full supply level (FSL) approximately 12.7 hectare. The overflow will be 60m wide and the freeboard level is 4 m.

Main features of the proposed dam:

Maximum wall h eight (from preliminary design drawings)	23.6m
Full Supply Level	CL 1109.00m
NOC Level	CL 1113.00m
NOC crest width	3m
Crest length (from survey)	340m
Upstream slope gradient	1(V):3(H)
Downstream slope gradient	1(V):2(H)
Gross storage capacity	± 842 308 m^3
Water surface area at FSL	±12.7 ha
Total freeboard (to NOC)	4,0m
Type of spillway	Uncontrolled side channel
Outlet works encased in concrete	1x500mm dia. steel pipe

Table 1.2.1 Dam features

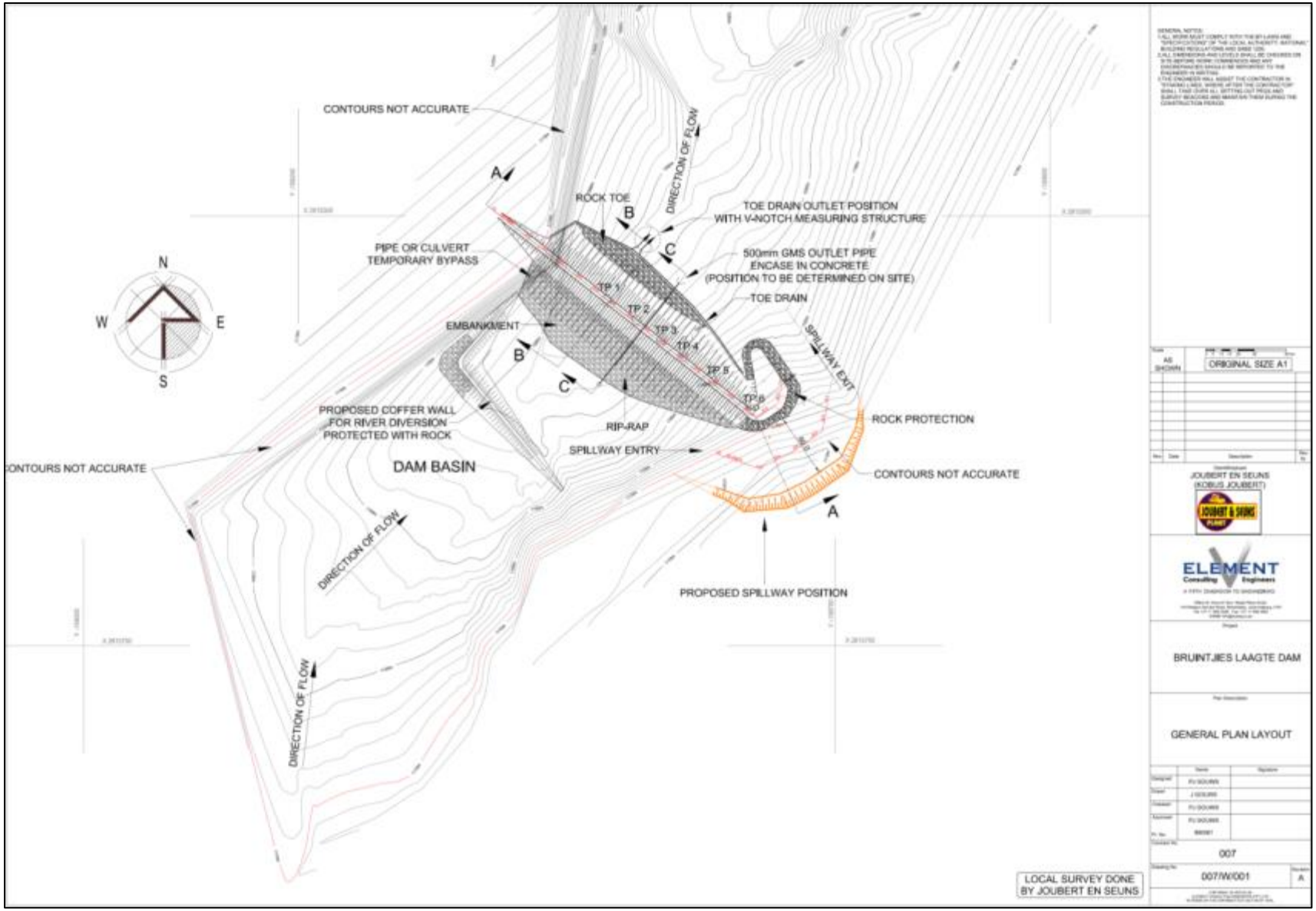

Figure 1.2.1 General layout of dam

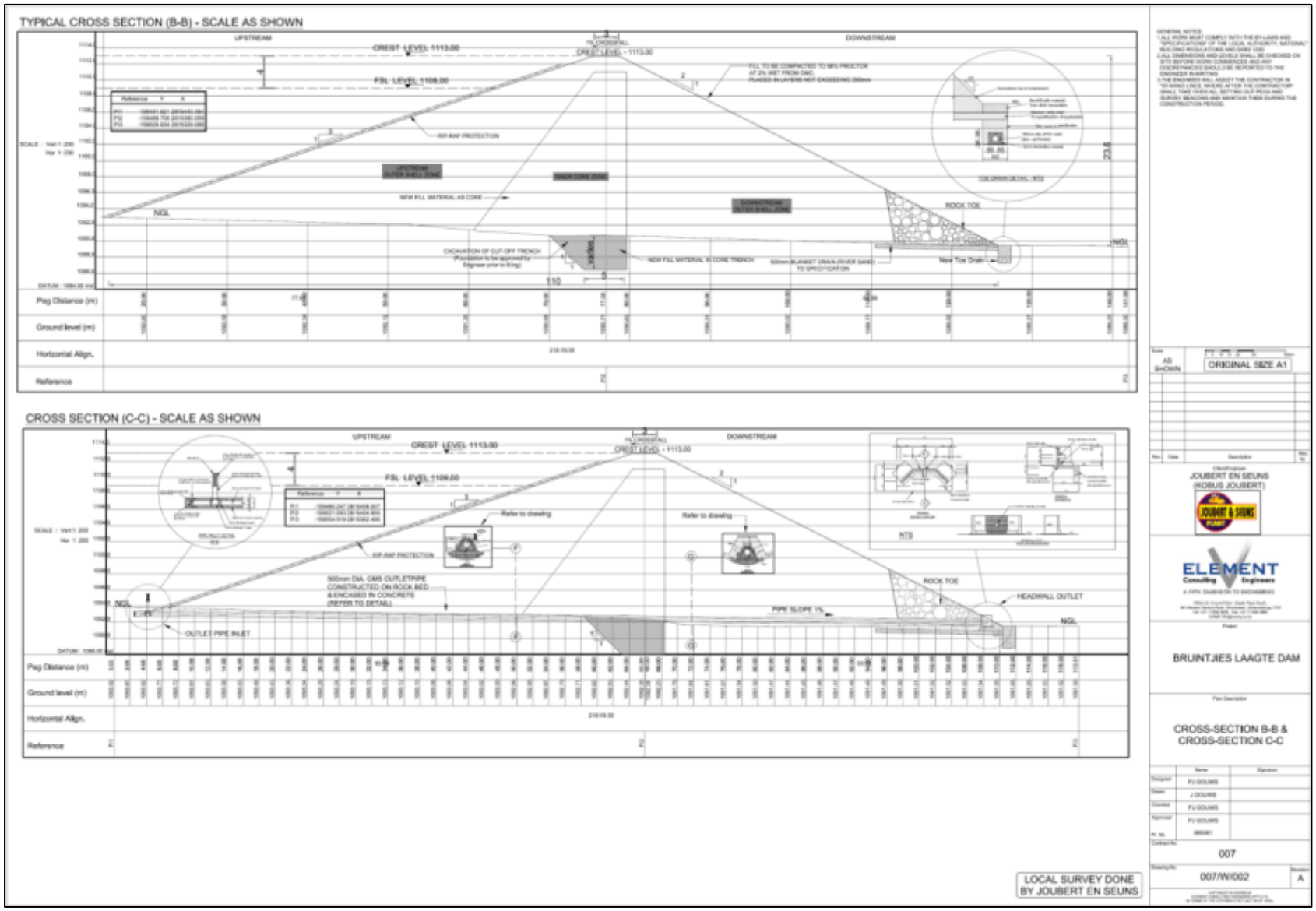

Figure 1.2.2 Typical cross section of the dam

2. Need and desirability of the activity

2.1 Need and Desirability

Irrigation water is normally abstracted from the Crocodile River for the irrigation of the citrus orchards. During drought periods and a low water level of the Kwena dam, abstraction from the Crocodile River is limited. It is the intention of the applicant to create additional storage capacity for irrigation purposes so that water is available during drought periods.

There is an existing dam downstream from the proposed dam also located on the Devil's Creek. This dam is located on the farm Koedoeshoek 301JT. The Devil's Creek is a perennial river and there is sufficient flow in the river for the existing as well as the proposed dam.

There is insufficient storage capacity in the Inkomati (Crocodile) catchment and the IUCMA, Water Affairs and the City of Mbombela Municipality is evaluating alternatives for dams to provide higher water security for the area. This private initiative to construct the dam will add approximately 840 000m^3 of storage capacity at a cost of approximately R15 million.

Citrus orchards are highly reliant on irrigation and if water is not available for irrigation it would severely affect the size and quality of the crop. Citrus is exported and the quality of the citrus is critical for success in this highly competitive market.

Please note that there will not be an increase requested in the abstraction water use rights. The dam is purely an alternative abstraction point rather than directly from the Crocodile River. The purpose of the dam is to provide water security during drought periods.

Detailed studies have been done to determine the aquatic and ecological status and other aspects of the site and surrounds. The assessment and review of this information lead to further blue swallow monitoring as well as fish translocation (*Enteromius sp.*) and monitoring. The results further motivate the desirability of the proposed dam.

Note also that a water use licence was issued by the DWS on 29 March 2019 (Appendix 5) which included an authorisation for the storage of water, taking of water and other uses associated with the dam wall structure. The licencing process was one separate from the EIA.

2.2 Benefit to society

The Joubert & Sons farming activities is providing work for many workers and the large quantities of citrus exported are earning foreign revenue. They are one of the larger citrus farming enterprises in the country and export in excess of 9000 tons to the northern hemisphere each year.

A loss of trees or export quality citrus caused by a shortage of irrigation water will be highly detrimental. This would cause significant job losses and income for many workers associated with the farming and exporting activities.

3. Site Specifications

3.1 Locality of proposed activity

The dam will be located on the farm Bruintjieslaagte 465 JT, on the Devil's Creek in Schoemanskloof, City of Mbombela Local Municipality, Mpumalanga. The dam site is located south west of the N4 Schoemanskloof road on the Devil's Creek that is a tributary to the Crocodile River. The dam site is approximately 5 km from the confluence with the Crocodile River.

Refer to the locality map under Appendix 1.

3.2 Local authority

The development area falls under the jurisdiction of the City of Mbombela Local Municipality.

3.3 Land use zoning

The farm and project site is zoned for agriculture.

3.4 Existing land use

The farm Bruintjieslaagte 465 JT is natural grassland with game farming on a section of the farm. There is no cultivation of citrus on the Bruintjieslaagte farm and this farm will remain uncultivated in future. It is proposed to form part of a proclaimed nature reserve.

3.5 Surrounding land use

The prominent land uses within 1 km from the site:

Natural area	Low density residential	Medium density residential	High density residential	Informal residential
Retail	Commercial & warehousing	Light industrial	Medium industrial	Heavy industrial
Power station	Office/consulting room	Military or police base/station/compound	Casino/entertainment complex	Hospitality facilities
Open cast mine	Underground mine	Spoil heap or slimes dam	Quarry, sand or borrow pit	Dam or reservoir
Hospital/medical center	School	Tertiary education facility	Church	Old age home
Sewage treatment plant	Train station or shunting yard	Railway line	Major road (4 lanes or more)	Airport
Harbour	Sport facilities	Golf course	Polo fields	Filling station
Landfill or waste treatment site	Plantation	Agriculture	River, stream or wetland	Nature conservation area
Mountain, koppie or ridge	Museum	Historical building	Graveyard	Archaeological site
Other land uses (describe):				

4. Site Assessment – Physical Characteristics

4.1 Topography

Open valley in a mountainous area with steep slopes. Devil's Creek, with several tributaries, draining the catchment area towards the north and Crocodile River. The watershed is on approximately 2000m-, the dam at 1100m- and the confluence with the Crocodile River at 870m- above sea-level.

Figure 4.1.1 Topography of dam catchment

For the following two sections of the report the most significant aspects will be addressed first and with the latest information namely the Blue Swallows and the *Enteromius* fish. The findings and description of the rest of the biophysical characteristics will follow.

4.2 Blue Swallows

Blue Swallows (*Hirundo atrocaerulea*), listed as critically endangered within the borders of South Africa, were spotted flying over the project area by Anthony Emery of Emross Consulting and Dr L. Taylor of Taylor Environmental, the terrestrial/wetland specialist consultants during the first site visit in November 2016.

The discovery of Blue Swallows at Bruintjieslaagte was a very exciting considering the species conservation status in South Africa. The site differs in many respects to what one would normally associate as Blue Swallow habitat and is atypical in many respects. The vegetation type is a savannah rather than grassland vegetation type with the area falling within the Legogote Sour Bushveld.

Although on the surface the site does not look suitable for Blue Swallow they do occur and have bred successfully. This seems to be as a consequence of certain environmental and anthropogenic factors that combined have fortuitously created suitable habitat for a species that is considered to be a mistbelt grassland specialist. It could be that the Devil's Creek valley has created a micro climate that traps mist thus providing suitable moisture while certain current and historical management practises have led to the availability of open habitat in what is mostly open woodlands and grassland.

4.2.1 Confirming of Blue Swallow sightings

To confirm that the sightings made by Anthony Emery was in fact that of Blue Swallows, Dr Ian White, Anthony Emery, other bird and Blue Swallows specialist and the EAP visited the site on Tuesday 24 January 2017. We were able to establish that Blue Swallows were

definitely present at the site. A single bird was seen higher up the valley, and a pair was seen from where we were standing at the proposed dam sites.

Dr Whyte concluded that the vegetation communities that will be inundated by the proposed dam only represent marginal foraging areas for the swallows, and in an ecological context, would represent only a small fraction of the birds' total foraging range. This was later proven to be correct and the Blue Swallows were seldom observed at or near the dam basin. He also said that he does not believe that the shrublands offer the swallows any suitable habitat for nesting sites, as they prefer climax -, mist-belt grasslands, large areas of which still exist at higher altitudes above and adjacent to the dam sites (this was also proven to be correct as no nesting sites have been found at or near the dam basin during observation over 4 breeding seasons). Refer to Appendix 6.1 for an Assessment of the impact of the proposed "Bruintjieslaagte" dam on the avifaunal populations in the immediate area of the site in the Schoeman's kloof valley, Mpumalanga province by Dr Ian Whyte, 12 and 13 April 2017.

Two separate sightings (1 male and a pair) were observed on the 22 November 2016 by Mr A Emery and Dr L. Taylor; a single male was observed on the 7 December 2016 by Mr A Emery and Miss. L. Cohen; a single female, a single male and a pair performing courtship flight behaviour were seen on the 24 January 2017 by Mrs R Theron, Miss J Newenham, Dr I Whyte, Mr H Kammeyer (EAP) and Mr A Emery; and four were seen flying on the 14 March 2017 by Dr G Batchelor, Mrs R Luyt (MDARDLEA) and Mr H Kammeyer (EAP).

Mr Emery reported that the pair performing courtship flight behaviour was observed near the proposed dam footprint on the north-eastern grassland slopes approximately 350m to the northwest of the proposed dam wall and approximately 60m higher in altitude. The pair seen on the 22 November 2016 was seen near an open grassland wetland area above the proposed dam footprint. This area may provide the birds with a suitable mud collection point. The remaining sightings were of birds foraging in areas upstream of the dam footprint or within the dam footprint. No nesting sites were found within the proposed dam footprint. Numerous aardvark burrows were found, both within the proposed dam footprint and in the areas surrounding the proposed development.

4.2.2 Comprehensive Blue Swallow work

Mr Nicholas Theron coordinated more comprehensive surveys undertaken by the Kruger to Canyons Biodiversity Programme on 29 and 30 October 2017. Refer to Appendix 6.2. Two full days were spent on site by Ms Newenham, Dr G Batchelor, J Gouws and A Gouws. A follow up survey was undertaken by Nicholas Theron on 30 November 2017 where the slopes on the eastern side of the river where comprehensively surveyed. The slopes on the western side of the river have not been surveyed due to their inaccessibility.

There were a total of 30 sightings; 19 on 29 October over 12 hours and nine on 30 October over 12 hours. There was only 1 sighting on 30 November over 7 hours.

The majority of sightings were of the birds en-route as they flew or were foraging. The female was confirmed in 6 of the individual sightings with the male record on 1 occasion and the pair together once. A nest site was discovered along the walls of a profile pit that was dug as part of the geotechnical assessment for developing the dam wall. The nest has been abandoned due to soil slipping from the sides and filling the nest. However, the birds were observed visiting the pit nest on three occasions during the first day and at times may have been resting in the hole on the nest. The habitat surrounding the pit nest comprises rank grassland associated with seasonal wetlands and with scattered shrubs and bush clumps. Habitats in which the birds were recorded included gently undulating open grassland (some of which were likely old lands), open grassland with scattered tall woodland, riverine areas

with open rank grassland and bush habitat with tall trees associated with seasonal streams and drainage lines.

41% of sightings were evenly spread between the rank grassland associated with riverine vegetation and the open woodland and grassland habitat types. There was only one sighting on the grasslands on the eastern side of the river on 29 October 2017 where a single bird was observed flying at the base of a grassy hill. No sightings in these areas were made during the transect that was walked on 30 November 2017. There is also only one confirmed sighting along the grassland slopes on the western side of the river which was made on 27 January 2017 when a courtship display was witnessed.

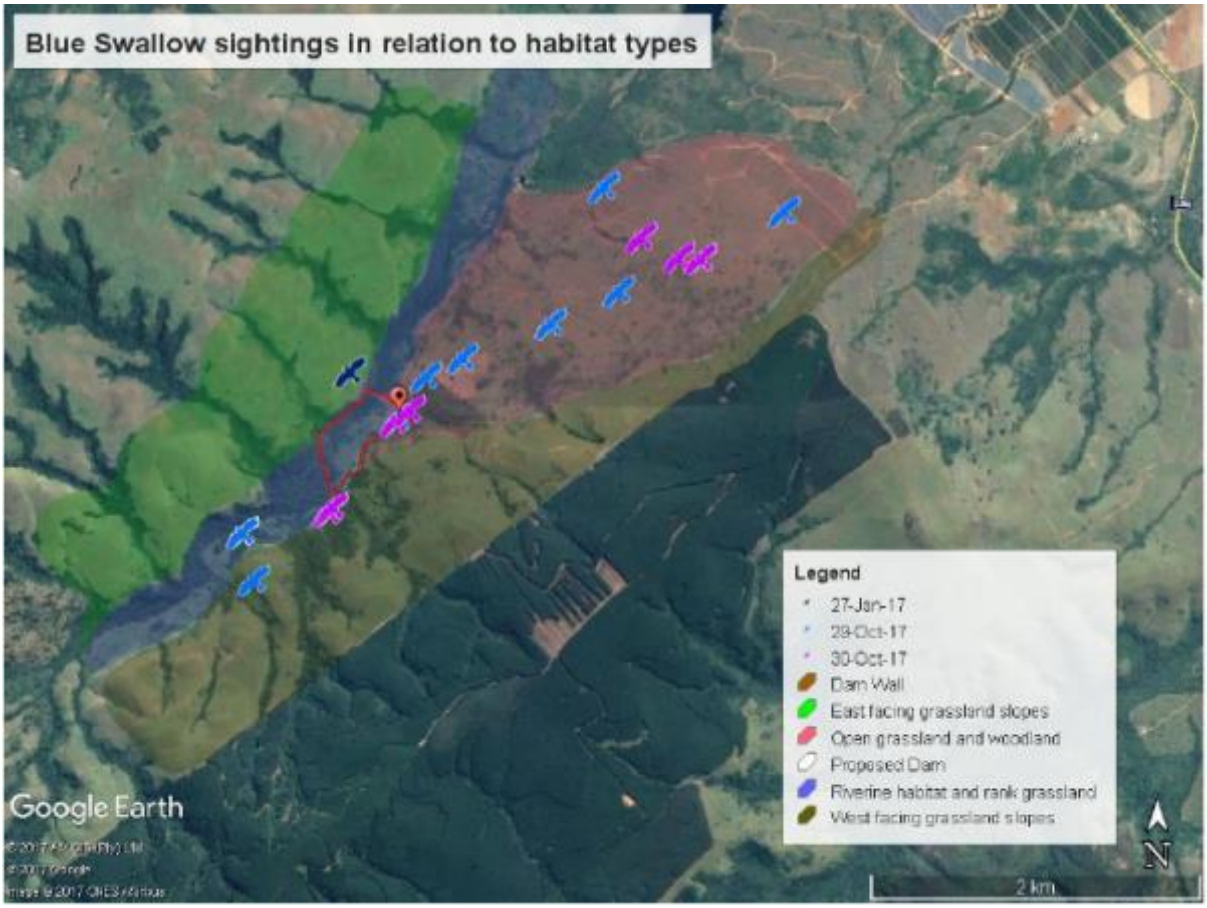

Figure 4.2.1 Blue Swallow sightings represented in Google Earth with the various habitat types also depicted

Mr Theron concluded that the site differs in many respects to what one would normally associate as Blue Swallow habitat and is atypical in many respects. The vegetation type is a savannah rather than grassland vegetation type with the area falling within the Legogote Sour Bushveld. The birds also seem to prefer areas that are more woodland types and avoid the surrounding grassland slopes.

This definitely seems to be the case in terms of the west facing grasslands where considerable time was spent but no sightings were recorded. These areas are also very steep and not the normal undulating grasslands they usually associate with. The soils here are also very rocky and shallow and the chances of sinkholes occurring or there being aardvark activity is very low. This was corroborated by the fact that no Aardvark activity was encountered on these slopes. The grassland slopes on the west bank seem to be more undulating and they are also east and north-east facing which Blue Swallow are known to prefer for nesting. Scanning these hillsides did reveal what looked to be limited Aardvark activity and there is a possibility suitable nests may form along the various drainage lines,

although much of these are heavily wooded. The most Aardvark activity was encountered in the open woodland and grassland areas. These areas are associated with deep soil profiles which are normally very productive and therefore usually cultivated. While documenting Blue swallows in the 1990s in Mpumalanga all the Blue Swallow sites were associated with deep soil profiles. And it is possible that the deep red soils are the reason why the Blue Swallows are here (Batchelor pers. obs.). The Bruintjieslaagte Blue Swallows occur at an altitude of 1200 – 1400m which is lower than the 1600 m at Kaapsehoop where Blue swallow used to occur, but within the 1 400 – 1 600 m range in which the species are known to occur in the Graskop area.

Although on the surface the site does not look suitable for Blue Swallow they do occur and have possibly bred successfully. This seems to be as a consequence of certain environmental and anthropogenic factors that combined have fortuitously created suitable habitat for a species that is considered to be a mistbelt grassland specialist. It could be that the horseshoe shape of the valley has created a micro climate that traps mist thus providing suitable moisture while certain current and historical management practises have led to the availability of open habitat in what is mostly open woodlands and grassland. These include areas where game occur and are contributing to keeping woody species out and the habitat open. The role fire plays in this landscape should also be carefully considered and may be playing an important role in controlling woody species from encroaching into these areas.

Blue Swallow Conclusions and Recommendations based on the Blue Swallow Working Group's report:

In general, the habitat in the area seems largely atypical, if not unsuitable for Blue swallow but yet they exist here. This does seem to be as a consequence of a number of anthropogenic factors and the persistence of Blue Swallows at the site may be very reliant on suitable habitat being maintained by specific management practises. As such this site is very different but also special and the landowners should as much as possible be supported in terms of providing relevant knowledge and inputs to ensure the persistence of the species at the site. Based on the above the following recommendations can be made:

- ➔ The opinion that the dam should not negatively affect Blue Swallow remains unchanged as long as the dam is constructed in the winter months from May – August and this aspect must be strictly adhered to.
- ➔ Blue Swallow should continue to be monitored on site and transects through the grasslands on the western bank should be undertaken.
- ➔ Artificial nest sites should be chosen and dug as soon as possible so that if suitable cavities do not exist it will give the Blue Swallows time to breed this season. Sites in the open woodland grasslands and grassland areas may be suitable because they are accessible and occur in an area where the birds are regularly shown to forage. These nests should be dug based on designs used in KZN but it may be necessary to somehow stabilise the walls if the soil proves too sandy and prone to collapsing.
- ➔ A relevant Blue Swallow Conservation and Management plan be developed for the site focussed on important aspects such as burning and grazing as well as control of alien invasive plants to ensure suitable habitat at the site is maintained and/or improved.

Earlier Blue Swallow comments and findings as previously reported on:

Positive comments were received from Birdlife SA during September 2017 supporting the need for monitoring of the swallows. Mr J Booth – Birdlife SA stated that i*f monitoring results shows that there will be no material impact on the breeding and feedings grounds of this blue swallow population (as has thus far been established), we will not oppose the construction of the dam in the months when blue swallows are absent.*

In MTPA's comments dated 22 September 2017 they conclude that they are satisfied that the dam site only represents marginal foraging areas and that it is not suitable habitat for breeding. They also support the monitoring efforts proposed as mitigation.

4.2.3 Blue Swallow Monitoring feedback

Monitoring of Blue Swallows during 2018/2019 and 2019/2020 breeding seasons

It was clearly established during 2016/2017 and 2017/2018 breeding seasons that there were no nesting sites at or near the proposed dam site and that impact of the proposed dam on the Blue Swallows would be insignificant. Refer to the surveys by Dr G Batchelor under Appendix 6.3 – 6.7 for the reports from which the information was abstracted.

As a mitigation measure it was however recommended that the construction of the dam wall should not be undertaken during the breeding period of the Blue Swallows. This is a feasible mitigation measure as the dam construction should anyway be done during the low-flow winter month period when the diversion of the natural water flow of the river can be managed and when the construction of the dam wall will not be disrupted by rainfall.

Dr Garth Batchelor continued with the monitoring of the Blue Swallows during the 2018/2019 breeding season and with specific focus on finding breeding sites in the deep soils in the valley up- and downstream of the proposed dam site. Artificial breeding sites were also dug in the deep soils northeast (downstream) of the proposed dam site. Please refer to the report Follow-up Survey of Status and Breeding of the Blue Swallow (*Hirundo atrocaerulea*) on Bruintjieslaagte towards a revised application for an Environmental Authorization for a dam on the Devil's Creek on the farm Bruintjieslaagte, 15 February 2019, Dr GR Batchelor and PC Viljoen.

Firstly, six holes similar to the test pit in which a nest had previously been found were excavated with a "back actor". These resembled the soil profile pit in which a Blue Swallow pair had made a nest at the dam wall location the previous summer. Cavities were dug out in the NW, NE and SE corners of the pits to provide shelter from the weather for a potential nest.

Secondly, termite holes or natural holes were located and mapped. These hole sites were all in the deep soils and are most probably the results of both earlier termite activity and more recent termite use. These deep, red soils were mapped and delineated using satellite imagery and GIS.

In an attempt to locate new nests, two approaches were followed: direct observation of Blue Swallows and the location of potential nest sites. To date no active nest has been located notwithstanding the many hours that have been spent observing.

Photo 4.2.1: Artificial nests dug (Photo: Dr GR Batchelor)

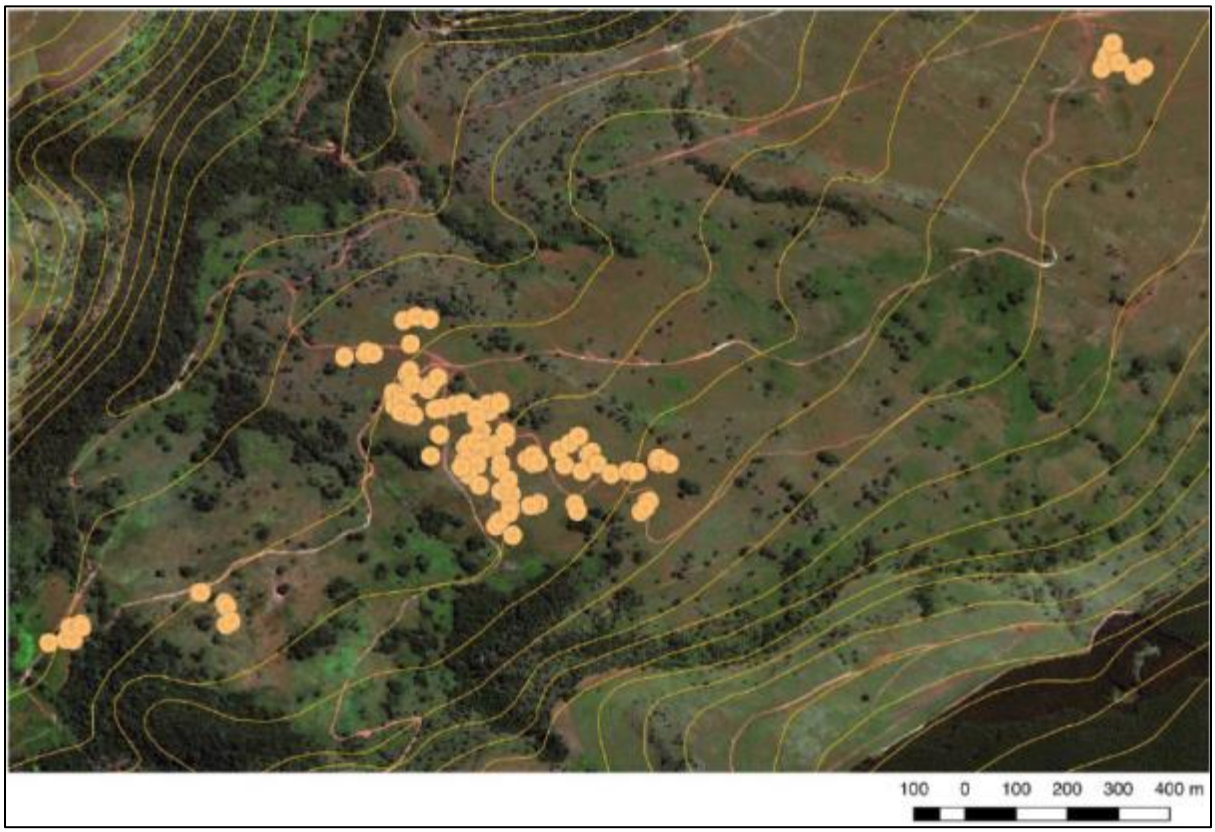

Figure 4.2.2 Potential termite and "aardvark" nest holes

Potential nest site prospecting has, however, been witnessed on three occasions this summer. A female Blue Swallow was seen prospecting two separate "aardvark" holes on 14 January 2019 in Area 07. She was seen to fly into a hole on two separate occasions then move to another hole approximately 100 m away and fly into another "aardvark" hole. No nests have been constructed in either of these holes.

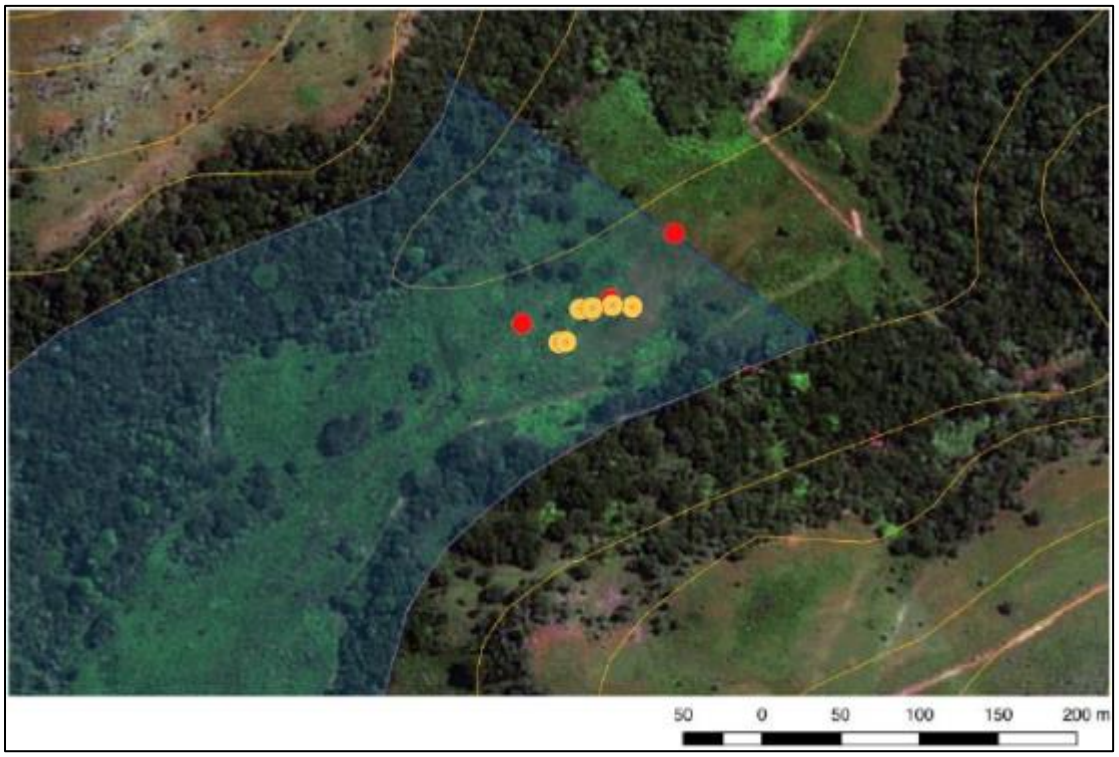

Figure 4.2.3 Potential nest holes near the proposed dam wall in dam basin

At the time of the reporting, February 2019, the newly excavated holes have not yet been used by the Blue Swallows for nesting. The Blue Swallows have, however, been seen on a number of occasions flying in the vicinity and low over the some of the pits. Shortly after construction, a pair of Black Saw-wing Swallows excavated a burrow in one of the pits where they successfully bred. A pair of Little Bee-eaters also excavated a hole in an adjacent pit and also fledged young. At times, over 12 Black Saw-wing Swallows were seen interacting above two of the holes and on one occasion appeared to be chasing away a female Blue Swallow from a pit.

On 17 October 2018 a total of *10* adult Blue Swallows were seen perched together just above the ground on sticks in light rain. There were five adult males and five adult females. This is the first time that these swallows have been observed together in a "cluster", thus providing an opportunity to obtain a minimum number for this site. It is suggested that they had recently returned to the valley after their migration south from Central Africa as they had not yet moved into their respective breeding territories.

Photo 4.2.2: Male Blue Swallow taken on 17 October 2018 (**Photo: Dr GR Batchelor)**

Photo 4.2.3: Part of a group of 10 Blue Swallows seen 17 October '18 (Photo: Dr GR Batchelor)

Dr Garth Batchelor made a number of visits to the Devil's Creek valley above the waterfall during the spring, summer and autumn of 2018/19 to make observations on the Blue Swallow population and reported on 9 May 2019 as follows:

a) Blue Swallow Population size

Ten adult Blue Swallows were recorded at the beginning of the breeding season on 17 October 2018 on high lying ground below the proposed dam site. On the 4 April 2019 12 possibly 13 Blue Swallows were recorded close to where the 10 Blue Swallows were

recorded on 17th October 2018. Two of the Blue Swallows recorded in April 2019, were juvenile birds clearly having been fledged during the past season.

b) Number of breeding pairs

It would appear that there are a minimum of 5 breeding pairs of Blue Swallows on Bruintjieslaagte.

c) Foraging Areas

Like all swallows, Blue Swallows, hunt for insects over a large area depending on where there are emergences. It is evident that there are large termite populations in the deep soils downstream of the proposed dam as reported in our report. Over 120 large termite tunnels were counted in 5ha. On 4 April, Blue Swallows were seen feeding over large areas together with House Martins. They were seen hunting for insects low over the grass and also very high up in the air. It is considered highly unlikely that the inundation caused by the dam will significantly affect the food availability of the Blue Swallows. This area is highly over grown with rank vegetation.

d) Mud Collection Sites

The deep "Hutton Soils" in most of the 5 valleys downstream of the proposed dam have a very high clay content and appear to be ideal for swallow nests. The soils coincide with the high termite densities and are also where the Aardvark holes are. These soils are also found in the dam basin but as mentioned the basin represents a small fraction of the available deep soil habitat. The vegetation in the dam basin has also become very rank making it unsuitable for mud collection.

e) Nesting Sites

There is no conclusive evidence of where these birds are breeding. There was one attempted breeding in a soil test pit that failed. Pairs have been seen displaying over both the artificial holes dug for them and also over Antbear holes during the past season. Some of the latter are very deep and it was not possible to look deep into them. However, according to Dr David Allan (pers. comm.), most nests he has observed are between 1- 2m below the entrance and are clearly visible. What is surprising are the few young/fledged birds observed both this season and also in the past. From the high number of Antbear and large termite holes present in the valleys below the dam, potential nesting sites don't appear to be limiting. Further observations are suggested.

f) Construction Period

Dam construction should not take place between 1 November and the end of 31 March.

Photo 4.2.4 Adult male Blue Swallow foraging over grassland (Photo: Dr GR Batchelor)

Monitoring Report 3 October 2019:
Two monitoring surveys were undertaken, one on 17 September 2019 prior to the arrival back of the Blue Swallows and the other on 2 October 2019 shortly after their arrival back.

The first visit focussed on ensuring that potential nest holes (constructed nest holes and Aardvark burrows), were accessible to the Blue Swallows in all the deeps soil patches. The known Aardvark holes on the deep soil patches, 04,05,06,07 and 08 were checked and entrances trimmed and spider webs removed. These included the cluster of 35 holes in the newly created buffalo camp which were also trimmed and cleaned. All swallows seen were identified and behaviour noted. The five excavated "Blue Swallow" holes are all showing signs of wall collapse, the bigger holes more so than the narrower ones.

The palatable grass cover has been grazed short by the game over much of the deep soil areas exposing the aardvark holes which are the traditional nesting sites of the Blue Swallows. No Blue Swallows were observed on 17 September but at least 10 Saw-wing Swallows were seen coursing along the tree lines along the ridges.

On the 2nd visit on 1 October, two fresh Black Saw-wing Swallow holes were active and appeared to contain eggs judging from their behaviour. 2 female Blue Swallows were seen foraging with the Saw-wings along a ridge to the north east of the excavated holes near the game dip station. A pair of Greater-striped Swallows and a Black Swift were all foraging together. In the Buffalo camp, two female Blue Swallows were seen at 11h30 foraging again with a flock of at least ten Saw-wing Swallows around a Sycamore Fig tree. There was clearly an emergence of tiny flying insects from the fig tree as the Swallows hunted insects around the tree for over ten minutes. These Blue Swallows could have been the ones earlier observed along the ridge line. These two female Blue Swallows soon disappeared.
A mixed flock (male and female) of 10 Blue Swallows was recorded at 11h40 flying high along the wooded ridge to the south of the proposed dam wall. They were clearly feeding, flying backwards and forwards above the ridge. These swallows then flew south westwards until they were out of sight but returned at 12h50 to the fig tree where the Saw-wings were seen foraging. They again disappeared from sight in an easterly direction. From their behaviour and equal numbers between males and females it was clear that they had not yet started to breed.

Monitoring Report 14 October 2019:
It was decided to revisit the grassland/deep soil valleys downstream of the proposed dam site during the first period of overcast rainy weather after the return of the Blue Swallows. The reason for this being that it was anticipated that nest repairing would take place immediately after the first rains. 3 days of overcast rainy weather was projected from 15 to 17 October. The temperatures were cool (11-18C) and less than 5 mm rain actually fell.

In contrast to the behaviour of the Blue Swallows observed on 2nd October, when a mixed flock (male and female) of 10 Blue Swallows was recorded flying high along the wooded ridge to the south-east of the proposed dam wall, the Blue Swallows were either flying singly or in pairs. They were also flying close to the ground. The latter could be because of the cold weather.

On both the 10th and 11th October, Blue Swallows were seen over Zone 07, the grasslands above the artificial nest holes next to the buffalo camp fence. At 09h35, 2 Blue Swallows, a male and a female, were sighted by GB and SvR over the upper sections of the grasslands in Zone 07. A period of 5 hours was spent in the area but no further sightings were made. The weather was cold and overcast. On 11 October two pairs of Blue Swallows were observed repeatedly flying over the upper section of Zone 07 by SvR from 08h00 to 12h00. On the same day, three Blue Swallows were seen in Zone 08. This is the grassland strip to the south, southeast, of the first feeding station after coming up the hill. Two Blue Swallows were on a muddy road at 07h34 but were not seen collecting mud. I was quite far away from

them so could not see clearly even with a telescope. This apparently same pair few off and returned at 11h16 and appeared to be inspecting various holes about 20m from where they had previously been seen on the road. I did not go back to the area not wanting to disturb them. The sex of the third Blue Swallow seen in this zone was not determined as it was too distant.

4.2.4 Blue Swallow Monitoring Summary 2019/20

Four visits were made to the grasslands over the past summer season where the Blue Swallows had previously been recorded. The visits took place prior to their return in August and again three times during their expected breeding season (October to April). 12 Blue Swallows were again recorded on the grasslands downstream of the proposed Bruintjieslaagte dam site. No Blue Swallow nests were located. The excavations made in an attempt to provide nesting sites for the Blue Swallows were not used by Blue Swallows but were utilized by Little Bee-eaters and Black Saw-wing Swallows.

Prior to the return of the Blue Swallows, on 17 September, 87 natural earthen holes which were considered to be suitable as nest holes for Blue Swallows were cleared of vegetation and marked with steel rods which were numbered.

After the return of the Blue Swallows in October, the plateaux were visited on five occasions, on the 2nd and 10th October,6th November, 6th February and 27th February. During the November survey the grassland patches to the north of the N4 on the Mathews Phosa College property were also surveyed but no suitable nesting sites were located.

2 October 2019:
Shortly after ascending the hill from the existing dam a pair of Blue Swallows was seen flying over the first valley with deep soil. These swallows flew south and disappeared. After entering the newly established buffalo camp, 5 Blue Swallows were recorded foraging over a fig tree together with over 10 Black Saw wing Swallows. There was an emergence of small flying ants coming out of the grass on which they were feeding.

At approximately 09h15 a group of 12 Blue Swallows was seen flying along the slope of the hill towards the proposed dam site. They were also apparently feeding on insects in the updraft along the hill slope. After flying south out to view, they returned after several minutes and came to feed on the flying ants that were still emerging from the fig tree in the Buffalo Camp where the earlier 5 swallows had been seen.

10 October 2019:
A pair of Blue Swallows was seen flying low over the grassland to the north of the Buffalo Camp fence. There are a number of potential nest holes in the vicinity but the birds did not appear too enter any and appeared not yet to be breeding. No other Blue Swallows were observed on this visit.

6 November 2019:
The entire plateau was surveyed for 5 hours but no sign of a Blue Swallow was recorded.

6 February 2020:
The entire plateau was surveyed for 5 hours but no sign of a Blue Swallow was recorded.

27 February 2020:
The entire plateau was again surveyed for 5 hours but no sign of a Blue Swallow was recorded.

Both Little Bee-eaters and Black Saw-wing Swallows were seen to be entering the artificially created nest pits in the grasslands adjacent to the Buffalo Camp.

Blue Swallow Monitoring Discussion

Blue Swallows were again recorded on the grasslands on the Bruintjieslaagte plateau in October but not again this summer. No breeding was recorded. This is the 5th consecutive year that they have been recorded but still no definitive record of successful breeding in the area has been observed. All the sightings this past season have been on the higher slopes away from the Devil's Creek.

Blue Swallow Environmental Impact Assessment Conclusions and Recommendations

1. The Blue Swallows are infrequent visitors to the lower Devil's Creek valley and game camp plateau north of the proposed dam site.
2. Blue Swallows are mostly observed flying and foraging high over the area and over the western ridge of the valley.
3. Blue Swallows were spotted flying over the artificial nesting pits, termite and aardvark holes in the game camp but no nesting occurred over the observed 4 breeding seasons in this area.
4. Although these artificial nesting pits, termite and aardvark holes is typical of other observed breeding sites elsewhere, the swallows did not select any during the last 4 breeding seasons but continued to use more suitable and preferred breeding sites higher up in the valley in the higher altitude grasslands.
5. Possible reasons could be these sites are at a lower altitude of 1100m with consequential effects that the plateau is very hot during the mid-summer months, very dry soil and collapsing walls of the artificial pits, exposed pits with no vegetation cover from direct sun and rainfall, less frequent mist at this altitude, higher average temperature and lower rainfall. Competition from Little Bee-eaters and Black Saw-wing Swallows using the pits successfully for nest and breeding could also be a contributing factor.
6. Blue Swallows were seen feeding over large areas together with House Martins.
7. 5 Blue Swallows were recorded foraging over a fig tree together with over 10 Black Saw Wing Swallows. There was an emergence of small flying ants coming out of the grass on which they were feeding.
8. 2 female Blue Swallows were seen foraging with the Saw-wings along a ridge to the north east of the excavated holes near the game dip station. A pair of Greater-striped Swallows and a Black Swift were all foraging together.
9. In contrast to the more typical behaviour of the Blue Swallows observed flying high along the wooded ridges Blue Swallows were observed either flying singly or in pairs close to the ground during colder and misty days when the upper part of the valley is covered in mist.
10. *10* adult Blue Swallows were seen perched together just above the ground on sticks in light rain. There were five adult males and five adult females (17 October 2018).
11. 12 Blue Swallows was seen flying along the slope of the hill towards the proposed dam site. They were also apparently feeding on insects in the updraft along the hill slope (2 October 2019).
12. There are no nesting sites in or near the dam basin area.
13. The proposed dam site is not a preferred foraging area for the Blue Swallows.
14. The vegetation loss with the construction of the dam and flooding of an area of approximately 12 hectare is insignificant taken into account that several thousand hectares of grasslands is available for preferred foraging of the Blue Swallows.
15. As a mitigation measure the construction of the dam should be done outside the breeding period. Dam construction should not take place between 1 November and the end of 31 March (Dr Garth Batchelor).
16. **The monitoring of the Blue Swallows in the grasslands on the Devil's Creek plateau grasslands should continue.**
17. **The searching for possible nest sites should extended to higher altitude grasslands.**

18. **Dr Garth Batchelor confirmed that it is not possible to develop a management plan for the Blue Swallows as part of the Bruintjieslaagte dam EIA application. The Blue Swallows are infrequent visitors to the lower Devil's Creek valley and no nesting sites as yet have been found. As a precautionary mitigation measure the construction of the dam will be done during the winter period, which is outside the breeding season of the Blue Swallow. The operational period of the dam will have no negative impact on the Blue Swallows.**

The last three measures are also included in the impact assessment and the EMPr.

4.3 *Enteromius cf* (EDEV) fish population

Following are the results of the **Follow-Up Surveys of Devils Creek (Mpumalanga) to determine survival of *Enteromius "Devils Creek"* (EDEV) after translocation - May 2019, February 2020, May 2020, Clean Stream Biological Services Pty Ltd**. The report is attached under Appendix 7.5 and also summarises the events that went before.

4.3.1 *Enteromius* Background

MTPA indicated that as part of the EIA process, the success of the translocation must be established, a management plan must be compiled and long-term monitoring must be conducted.

Dr. Palmer sampled a small barb species (Genus: *Enteromius*) in the reach between a waterfall and existing dam (downstream of proposed dam site) in the Devils Creek during the initial EIA aquatic specialist study that he referred to tentatively as *Enteromius cf. motebensis*. He indicated that this species is a member of the '*anoplus'* group of fish species, and that there is currently taxonomic uncertainty of this group. Personal communication between Dr. Palmer and Prof. Paul Skelton (SAIAB) indicated that this species could be one of three lineages of the '*anoplus'* group that has been recorded in the wider area:

- ➢ Lineage A (north *motebensis*) that stretches from the Free State across into Mpumalanga
- ➢ Lineage D reaching down into Kwazulu-Natal uplands
- ➢ Lineage E 'upper Mpumalanga'

Dr. Palmer also indicated that the IUCN classifies the conservation status of *E. motebensis* as "Vulnerable", but this refers to a population that is centered in the Waterberg and that the conservation status of the '*motebensis'* population recorded in Devil's Creek is unknown and should be treated as equivalent to *E. motebensis* until further information is available.

The individuals sampled by Dr. Kotze in this reach of the Devils Creek during August 2017 had various morphological attributes that coincides with the more common and widespread *Enteromius anoplus*. Dr. Kotze however acknowledged that there is currently great uncertainty regarding this entire group of species ('*anoplus'* group) as they are all morphologically very similar and identification based on external characteristics is almost impossible and should be confirmed through genetic analyses.

The Mpumalanga Tourism and Parks Agency (MTPA) conducted some genetic analyses of this "*anoplus group*" of species and included samples from the Devils Creek population. Refer to fish section in the EIR and Appendix 7.2. Based on the genetic study results the MTPA reported the following:

- The taxonomy of various species within the *Enteromius* genus is insufficiently known resulting in difficulties in the identification of these species (Van Ginneken *et al.,* 2017). There are furthermore often very little morphological differences between species of certain groups of small barbs which make it difficult to identify these species with

certainty. This is especially true for the "Chubbyhead barbs" group (*Enteromius anoplus/motebensis*) and a study done by Engelbrecht (1996) indicated that this group may potentially contain some new (undescribed) species. He also emphasised the importance of conserving genetic diversity and indicated the importance of the role of phylogenetic studies to identify genetically unique fish populations.

- Twenty fish of the "Chubbyhead group of barbs" from ten different localities were included in the MTPA study. The genetic results indicated that the populations from the Devils Creek population (previously thought to be *Enteromius anoplus)* **may be a different species** and most probably not *E. anoplus*. The phylogram indicated the presence of eight (potentially nine) distinct lineages, highlighting the possibility that there may in fact be eight to nine different fish species within the "Chubbyhead barb" group analysed as part of this assessment.
- The Devils Creek population shows a greater genetic variation and interbreeding has not yet taken place. This upper catchment population with its greater genetic variation **should be conserved at all cost**.
- The genetic study's results furthermore emphasised that it is of national (if not international) importance to gain a clear understanding of the status and ecology of the various populations (and potentially undescribed species) within the "Chubbyhead barb" group of South Africa, especially in areas where their existence is currently threatened by rapid development or spread of alien species.

A recent IUCN assessment of red list of threatened species as conducted by Woodward (IUCN, 2017), only considered specimens from the Marico and Crocodile (West) region (Limpopo catchment), North-West and Gauteng Provinces as *Enteromius motebensis* (previously *Barbus motebensis*). Woodward indicated that all records formerly attributed to *Barbus motebensis* **east of these regions** were identified as genetically distinct by Engelbrecht and van der Bank (1997) and were separately assessed as *Enteromius nov. sp. "ohrigstad".* Further genetic research by da Costa (2012) indicates a potential for *B. motebensis* to incorporate populations ascribed to *Barbus anoplus* "Lineage A", which comprises specimens from the Highveld tributaries of the Vaal and upper Orange River.

However, given the widespread nature of this putative lineage and significant genetic variation within samples ascribed to it (da Costa 2012), this so called "Highveld" lineage currently lacks sufficient taxonomic support to justify an unambiguous expansion of the currently defined *E. motebensis* range. Given this genetic uncertainty, and using a catchment-based approach, Woodward consider only historical records of *B. motebensis* and *B. anoplus* from the western Limpopo tributaries to be *E. motebensis 'sensu stricto'* in his assessment. Based on this assessment *E. motebensis* was classified as Near Threatened.

Based on all information available at present, it is therefore not yet possible to confirm the exact taxonomic barb species (*Enteromius*) that occurs within the Devils Creek, Mpumalanga. It has however become increasingly clear that this species should be afforded high conservation status and all actions must be taken to preserve this population.

Morphologically this species exhibits characteristics of *Enteromius anoplus* (Chubbyhead barb) and *Enteromius motebensis* (Marico Barb), and hence previously referred to as *Enteromius cf anoplus/motebensis*. For the purposes of the current study and this report this species will be referred to as ***Enteromius "devils creek"*** (abbreviated: EDEV).

One of the mitigation measures recommended as part of the ongoing EIA for the proposed Bruintjieslaagte Dam was the translocation and introduction of this species to the Devils Creek **upstream** of the existing waterfall and **upstream** of the full-supply level of the proposed dam site. A specialist study was conducted to determine the potential viability of the above-mentioned mitigation measure (translocation) (see the **Specialist Aquatic Assessment of *Enteromius Cf. Anoplus/Motebensis* (*Enteromius "Devils Creek"*)**

Habitat in the Devils Creek (Mpumalanga) October 2018 by Dr. P. Kotze, Clean Stream Biological Services under Appendix 7.3 for details).

The following primary conclusions and recommendations were made regarding the potential translocation action in this report:

- The habitats observed in **reach A (potential translocation zone upstream of waterfall and proposed dam)** were found to be very **similar to reach B (original occurrence zone downstream of waterfall)**.
- The **most suitable** sites (high suitability) for potential **translocation** of EDEV in reach A was identified to be **site A5 and A6**. Site A6 was especially suitable and contained similar habitats than the artificial pool in reach B where the highest abundance of EDEV was observed. **Should translocation of EDEV be considered in future from reach B to reach A, it is strongly recommended that they should be relocated to sites A6 and A5**.
- Should translocation of EDEV be considered in future, it is essential that it must be conducted under close supervision by the aquatic division of MTPA. Monitoring (biomonitoring, water quality, etc.) will also be required on a regular basis over the long term to determine the success and continued existence of EDEV in the Devils Creek.
- Should translocation of EDEV as a mitigation measure for the construction of the proposed Bruintjieslaagte Dam be approved, it is essential that the success of the translocation to reach A should first be confirmed (through continued monitoring) before any construction activities (or other developments) take place.
- It was again stressed that no activities should be allowed that may potentially threaten the future existence of the EDEV population in the Devils Creek.

Figure 4.3.1 Devils Creek study area indicating proposed dam site, existing barriers and 2017 fish sampling sites

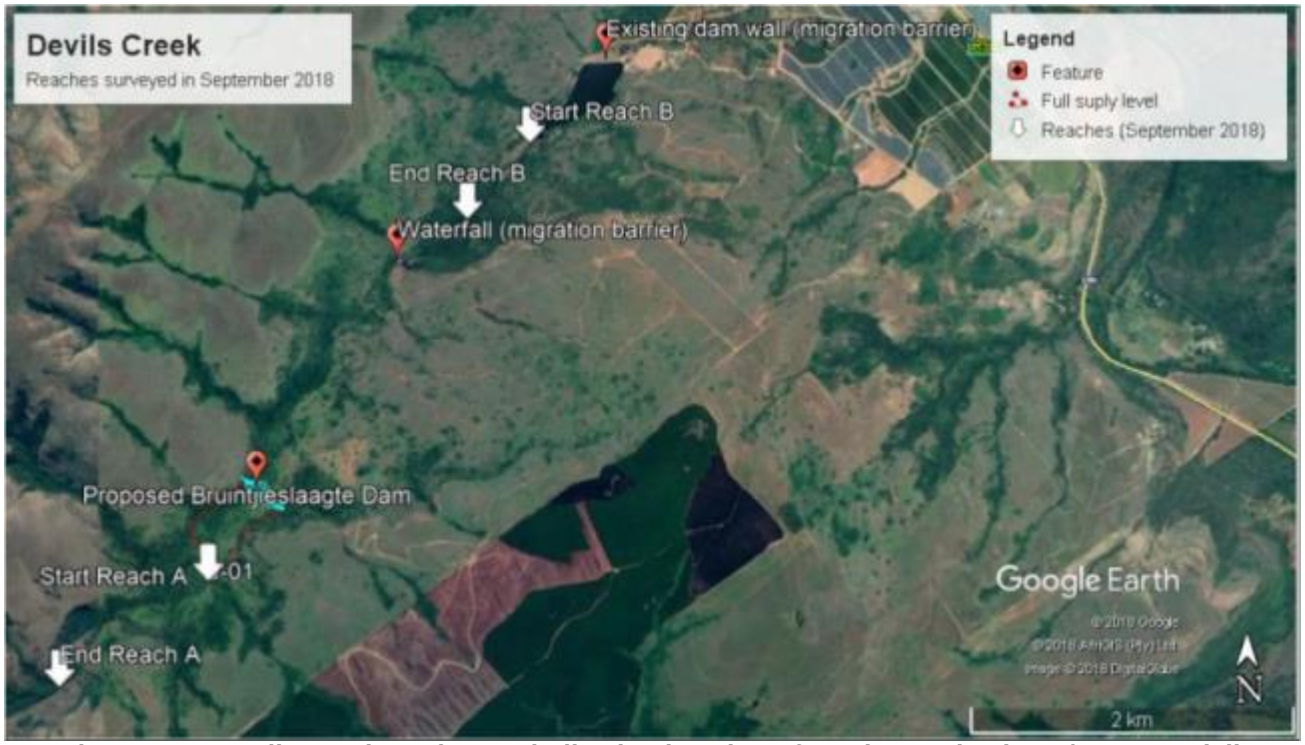

Figure 4.3.2 Devils Creek study area indicating location of reach A and B (2017/2018 specialist studies)

Figure 4.3.3 Devils Creek reach B (between waterfall and existing dam) indicating habitat sites where EDEV was sampled and detailed habitat descriptions were done during 2018 specialist study

Figure 4.3.4 Devils Creek reach A (above waterfall and full-supply level) indicating various habitat sites (sampling points) where detailed habitat assessments were done during 2018 specialist study

4.3.2 *Entemorius cf* EDEV Translocation

MTPA (Dr. F Roux and aquatic team) translocated 207 individuals of EDEV from reach B (below waterfall) to reach A (above the waterfall) during March 2019 (Dr. F. Roux, 31 May 2019). MTPA indicated that as part of the EIA process, the success of the translocation must be established, a management plan must be compiled and long-term monitoring must be conducted.

4.3.3 Follow-up surveys to determine survival of the *Entemorius cf* EDEV fish translocation

The objective of the follow-up survey conducted in May 2019, February 2020 and May 2020 were to determine the survival of the fish in reach A after translocation.

4.3.4 *Entemorius cf* EDEV survey results and conclusion

<u>May 2019 survey (2 months after translocation)</u>
The following summary from the Follow-Up Survey of Devils Creek (Mpumalanga) to determine survival of *Enteromius* "Devils Creek" (EDEV) after translocation, May 2019 – Clean Stream Biological Services Pty Ltd, Dr P Kotze. Refer to Appendix 7.4 for the full report:

- The primary aim of this survey was to determine whether any *Enteromius cf*. "Devils Creek" (EDEV) individuals survived the translocation effort (done in March 2019 by MTPA).
- A fish survey was therefore conducted on the 14th of May 2019. Electrofishing was applied in all suitable habitats from the proposed dam wall area (March 2019 translocation area) to the habitat site A6 (most optimal EDEV habitat site). Care was taken during sampling to limit disturbance of collected fish and they were immediately returned into slow habitat directly after sampling.

- Ten individuals of EDEV were sampled at three separate sites in the sampling reach during the May 2019 survey.
- A total of 207 individuals were translocated during March 2019 (Dr. F. Roux MTPA response letter dated 31 May 2019), and hence 4% of the translocated individuals were sampled between the dam wall and sites A6 during the follow-up survey in May 2019. The relative abundance (catch per unit effort-CPUE) of EDEV observed in reach A during May was 10 individual/hour. As can be expected, this is significantly lower than the relative abundance observed in reach B in August 2017 (93.6 individual/hr) and September 2018 (27.8 individuals/hr).
- It was promising to note that at least some of the EDEV individuals survived the translocation from below the waterfall to above the waterfall. This is an early indication that the physical habitat conditions (velocities, depth, cover, substrate) as well as physico-chemical conditions (water quality) above the waterfall and upstream of the proposed dam wall was adequate over this period to sustain these individuals. It can furthermore also be assumed that adequate food sources were available for the maintenance of the adult EDEV individuals that were translocated.

Photo 4.3.1 Photographic views of actual translocation sites in reach A (May 2019)

- It was established during the May 2019 survey that the fish was released during the March translocation project in the vicinity of the proposed Bruintjieslaagte Dam wall (pers. comm. Mr. Shawn van Ryn: Joubert en Seuns (Pty) Ltd). The EDEV habitat study recommended that the fish should be introduced upstream of the dam basin (area to be impacted by the proposed development) and especially at sites A5 and A6. Site A6 was especially suitable and contained similar habitats than the artificial pool in reach B where the highest abundance of EDEV was observed.
- The May 2019 survey also revealed that some individuals have already moved some distance upstream of the translocation sites over this 2-month period. During the May 2019 survey EDEV was however only sampled within the proposed dam basin area and not yet upstream of the dam (Reach A: sites A1 to A6). EDEV was therefore not yet

established in an area that will not be impacted by the proposed dam. Some sections between the current distribution and recommended translocation area (sites A5 and A6) may also be difficult to pass during upstream dispersal as a result of high velocities (such as the conditions observed at habitat sites A1, A2 and A4.

- Since EDEV is a limnophilic species (prefers slow to standing water), it can be expected that this species would more easily migrate/re-colonize with the flow of the stream (downstream) than against the flow (upstream). Some of the translocated individuals may therefore have colonized the area directly downstream of the proposed dam wall and the waterfall (high rainfall and flows two weeks after translocation may also have resulted in a higher dispersal in a downstream rather than upstream direction). The area downstream of the proposed dam wall is the highest risk area during especially the construction phase of the dam (high turbidity, altered water quality and habitat alterations can be expected due to construction activities).
- It is again emphasised that before any construction activities commence, a viable population of EDEV must be established in the Devils Creek upstream of the proposed dam basin (full-supply level). The following recommendations were therefore made after the May 2019 survey:
  - The EDEV population within the Devils Creek in both reaches A (above the waterfall) and reach B (below the waterfall) should not be further disturbed by sampling or any other activities (including construction) for a period extending at least to November/December 2019. This will be essential to provide adequate recovery time for the original EDEV population in reach B where individuals were collected for relocation, and also give the translocated population in reach A a proper chance to establish.
  - A fish survey should be conducted in the 2019/20 summer season (preferably after December 2019) in both reaches A and B to determine the status of EDEV in the Devils Creek after this recovery period. This survey should also cover the area between the waterfall and the proposed dam wall.

- Although promising results were gained during the May 2019 survey it was too soon after translocation to establish the long-term success of this action and continued monitoring will be required to verify the success of the translocation.

The following are the results of the **Follow-Up Surveys of Devils Creek (Mpumalanga) to determine survival of *Enteromius "Devils Creek"* (EDEV) after translocation for February 2020, May 2020, Clean Stream Biological Services Pty Ltd (Appendix 7e)**.

<u>February 2020 survey (11 months after translocation)</u>

- A follow-up survey was conducted during February 2020, 11 months after translocation, aimed at determining the survival and spatial distribution of translocated EDEV upstream of the prosed dam wall site.
- Flow was very high at the time of the survey, with high velocities limiting sampling success and accessibility, creating dangerous conditions within the river channel.
- Very limited sampling could be performed in some areas and **no fish was caught** in reach A (from proposed dam wall/relocation site to habitat site A6) during this survey. This data was of low confidence and was thought to be due to high velocities limiting sampling success.
- **Condition at recommended translocation sites A5 and A6 was found to still be suitable** (provide slow flowing habitat with cover) **for EDEV, even under high flows**.

- It was also evident, based on the observation made during the February 2020 high flow survey, that many sections within reach A (recommended conservation zone) will not be passable by EDEV due to high velocities and high gradients. Based on available information for the small *Enteromius* group of fish species (that should include EDEV) the maximum recommended velocity that they are thought to be able to negotiate over short distances is 1.5 m/s and a maximum direct drop of 120mm between pools can be negotiated through jumping (Bok *et al.,* 2007). It was evident from visual observation made during February 2020 that these values were exceeded in many areas within this reach and may therefore be impassable by EDEV individuals. **It was therefore again stressed that it unlikely that EDEV will be able to naturally distribute upstream form the translocated site (at the proposed dam wall) to the recommended conservation reach and sites (especially sites A5 and A6) without intervention.**
- A single EDEV individual was sampled in reach B (below waterfall) where limited sampling could again be performed due to high flows.
- It was recommended that the survey should be repeated after flows receded and if sampling conditions improved.

Figure 4.3.5 Number and location of EDEV individuals sampled in May 2019 in relation to proposed dam wall, dam basin and habitat sites in Reach A

<u>May 2020 survey (14 months after translocation)</u>

- Sampling **conditions were notably better** during the May 2020 follow-up survey (low-moderate flow).
- **Forty-seven (47) EDEV individuals were sampled** upstream of the proposed dam wall during the May 2020 survey. The number of fish sampled equates to 23% of the total number introduced (207 individuals). Although one can never expect that all fish in a reach will be sampled during any sampling exercise, this number provides an indication of the relative abundance of fish in relation to the introduced number of fish. Once 100% is exceeded (more than 207 individuals sampled during any survey) it will be a definite indication that successful reproduction has occurred. **The current percentage therefore do not yet provide proof of successful reproduction post translocation**.

Table 4.3.1 *Enteromius "devils creek" (*EDEV) sampled during follow-up surveys upstream of waterfall (from proposed dam site to habitat site A6)

SCIENTIFIC NAME	Number of individuals sampled	% of translocation number
May 2019	10	4%
February 2020	*n/a*	*n/a*
May 2020	47	23%

Photo 4.3.2 Photographic views of selected sites above waterfall where EDEV individuals were samples (May 2020 survey)

Photo 4.3.3 Photographic views of selected EDEV individuals sampled in vicinity of translocation area during May 2020 survey (14 months after translocation)

- The minimum total length (TL) of the EDEV individuals translocated in March 2019 was 35mm. Kindler *et al.* (2015) indicated the that the length of *E. motebensis* individuals at maturity was estimated as 37.5 mm TL for males and 44.5 mm TL for females. **The translocated EDEV individuals were therefore mostly mature adults that would have been able to reproduce.** Previous studies also indicated that *B. motebensis* has an extended spawning season, with spawning starting in spring and lasting until the end of summer in March. The spawning season coincide with changes in a variety of environmental variables, i.e. increasing day-length, increasing temperature and increasing water flow. **The fact that the translocation was done in March 2019 (end of 2019 spawning season) it can be estimated that the translocated fish may have only started spawning from September 2019 to March 2020 if conditions were suitable. Any juveniles present in the reach at the time of the February of May 2020 surveys would therefore have been very small.**
- The individuals sampled during May 2020 in the translocation zone ranged from 30mm to 110mm in length (total length). **No juveniles or fish larvae were observed during the survey.** Since fish larvae are small and may escape through the fish scoop nets, a SASS5 net (0.5mm mesh size) was also used during the survey to scoop suitable slow habitats. No fish larvae were sampled and **although some small individuals (30mm) were sampled, it is not yet a clear indication that successful breeding has occurred after translocation**. Based on literature of the Chubbyhead Barb group of fish (including *E. anoplus* and *E. motobensis*), it is estimated that EDEV individuals will reach a length of between 30mm and 40mm (fork length) after the first year (Cambray and Bruton, 1985; Kleynhans, 1987; Kindler *et al.* 2015). Growth however depends on various environmental factors (such as food, temperature etc.). **The presence of small individuals less than 30mm during any future survey would therefore be an indication that successful breeding has occurred after translocation.**
- **The May 2020 survey therefore provided promising results that EDEV managed to survive a full annual cycle in the reach upstream of the waterfall**. It is especially good to note that they manage to find refuge areas in times of high flow (as observed in February 2020).

- **Of some concern is the fact that the translocated fish is currently (one year after translocation) still only present within the translocated area, in close proximity to the proposed dam wall and have not colonized the conservation zone.** The current EDEV population **only occurs within the full-supply level of the proposed dam**, and hence within a river section that will be transformed by the proposed dam (inundation, transformed form lotic to lentic ecosystem). Although EDEV is likely to survive and potentially thrive in the inundated slow-pool habitat that will be created by the dam (water quality and habitat permitting), **there is concern that construction activities may eradicate these individuals**. **It is therefore essential that a healthy population of the EDEV must be established upstream of any potential impacts (especially construction activities) in the conservation zone.** Should the proposed activity include disturbance of the riverbed upstream of the proposed dam wall (such as collection of construction material from river bed) the current EDEV population will be at high risk and potentially be eradicated.

Photo 4.3.4 Photographic views of recommended translocation sites A5 (top) and A6 (bottom) during May 2020 (no fish present)

Photo 4.3.5 Photographic views of site in reach B (below waterfall) and selected EDEV individuals sampled during May 2020 survey

- Although only one year has passed since translocation, **it is evident that the fish have not distributed successfully towards the area upstream of the full-supply level (reach A).** It was again observed (during February and May 2020) that sections of the river upstream of the translocation area may include areas with high velocities and gradients that EDEV may not be able to negotiate (even under low flows). These rapid/run areas therefore create natural migration barriers that prevent the distribution of the species towards the upper reaches (conservation zone). A waterfall/glide directly upstream of habitat site A6 will most likely be a migration barrier that will also prevent the species to spread past that point (hence EDEV would most likely only occur downstream of habitat site A6).
- Various EDEV individuals were sampled in reach B (below waterfall) during the May 2020 survey indicating **that the original EDEV population below the waterfall is still in a healthy state**.

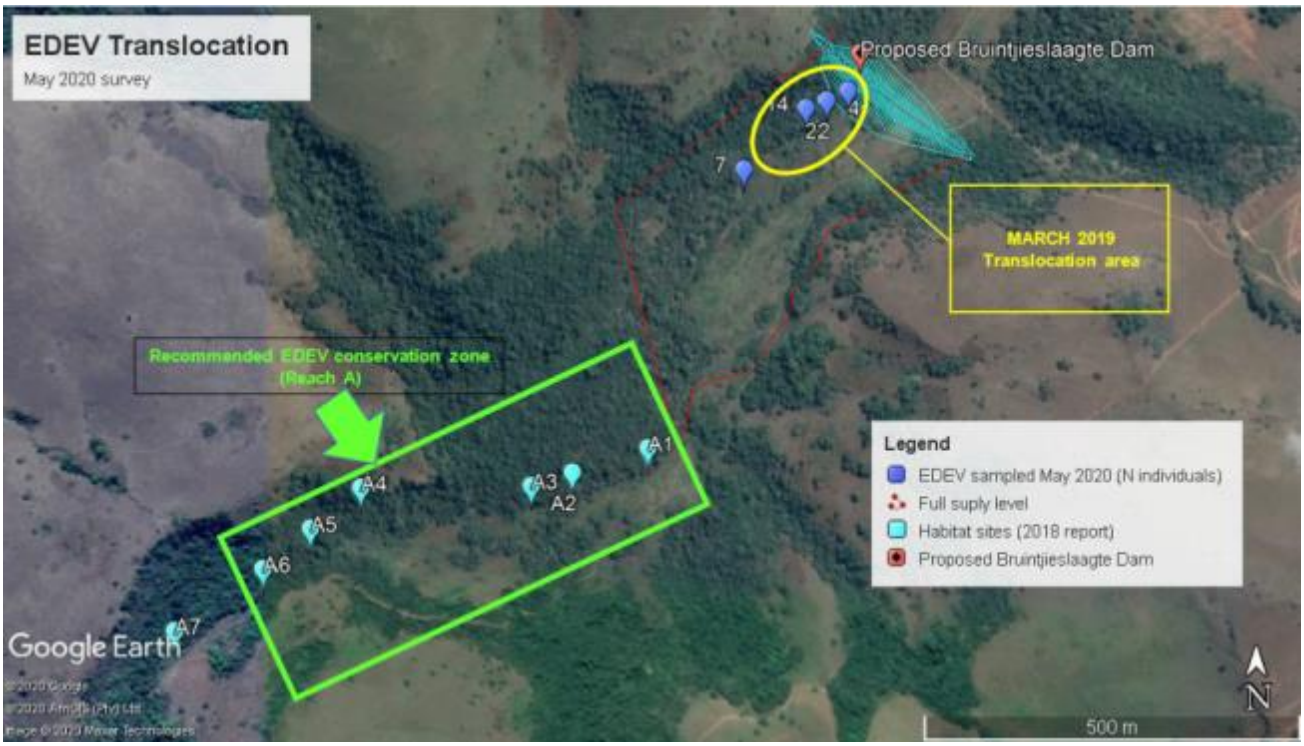

Figure 4.3.6 Number and location of EDEV individuals sampled in May 2020 in relation to proposed dam wall, dam basin and habitat sites in Reach A

Table 4.3.2 Estimated suitability of habitat sites in reach A for translocation of *Enteromius* "devils creek" (EDEV) under flow conditions (≈0.07 m3/s) observed in September 2018

Site no.	Latitude	Longitude	Suitability	Rationale / Comments
A1	-25.4421	30.58204	Not suitable	Too fast and shallow.
A2	-25.4425	30.58089	Not suitable	Too shallow.
A3	-25.4426	30.58027	Moderate	First potentially suitable site upstream of full supply level. Adequate overhanging vegetation. Velocities may however become too high when flow increase.
A4	-25.4426	30.57773	Not suitable	Too fast and shallow
A5	-25.4432	30.57698	High	Suitable under current flow condition (velocity may become problematic under higher flows).
A6	-25.4437	30.57628	High	First optimal site upstream of full supply level. Habitat similar to artificial pool in reach B. Recommended translocation site.
A7	-25.4445	30.57508	Moderate	Potentially too shallow.

Refer to the Management recommendations made in response to the findings listed above by the specialist under the Impact Assessment section 9.2.

4.4 Surface Water Hydrology – Devil's Creek

A *Yield analysis of the proposed Bruintjieslaagte dam as well as existing Koedoeshoek dam, Devils Creek, Mpumalanga, IWR Water Resources* was conducted by *Stephen Mallory, May 2018* (Refer to Appendix 8). Following is an abstract from the report:

4.4.1 Hydrology Introduction

The original purpose of this study was to undertake a yield analysis of a proposed dam on the farm Bruintjieslaagte on the Devils Creek River, which is a tributary of the Crocodile River in Mpumalanga. The scope of work was later expanded to include a lower dam referred to as the Koedoeshoek Dam as well as the development of operating rules for the dams so as not to impact on downstream users.

The location of the proposed and existing dams is shown in Figure 4.4.1.

A yield analysis determines how much water can be abstracted from a dam (or river) on a sustainable basis. This has been done for two scenarios, one in which the water is used continuously and a second scenario in which the water use from the dam is subjected to the catchment operating rules established by the Inkomati-Usuthu Catchment Management Agency (IUCMA).

Figure 4.4.1 Location of the proposed Bruintjieslaagte Dam and existing Koedoeshoek Dam

4.4.2 Water Resources and Catchment Information

The proposed dam, referred to in this report as the Bruintjieslaagte Dam, is located in the X21E quaternary catchment, as indicated in Figure 4.4.2. The relevance of this is that water resources and hydrological information is readily available at quaternary catchment scale from the Inkomati Water Availability Assessment Water Study (DWA, 2009). This information was used to estimate the yield of the proposed dam.

The hydrological information for the X21E catchment, available from the IWAAS study, is summarised in the table below.

Table 4.4.1 Summary of climate and hydrology information for the X21E catchment

Catchment Area (km^2)	Mean Annual Evaporation (MAE)	Mean Annual Precipitation (MAP)	Mean Annual Runoff (MAR)
	mm/annum		million m^3/annum
345	1 447	873	56.0

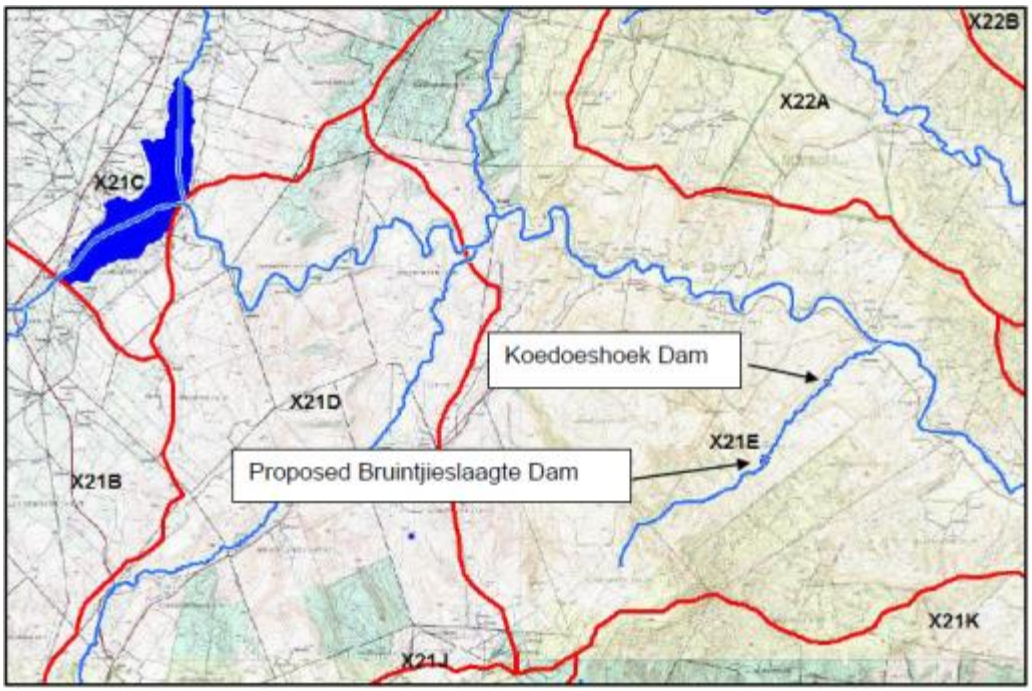

Figure 4.4.2 Location of the proposed Bruintjieslaagte Dam and existing Koedoeshoek Dam within the X21E catchment

4.4.3 Water Resource Analysis

4.4.3.1 Determination of natural flow

It is accepted practice when dealing with sub-catchments within a quaternary catchment to scale the natural hydrology for the quaternary catchment linearly. This is demonstrated in the example below.

X21E catchment area: 345 km^2
Bruintjieslaagte Dam catchment area: 27.1 km^2
X21E MAR: 56.0 million m^3/annum

Bruintjieslaagte Dam MAR = (27.1/345) x 56.0
= 4.40 million m^3/annum **(based on linear scaling)**

This linear scaling assumes that the rainfall in the X21E catchment is uniformly distributed, which clearly it is not. Due to a lack of rainfall gauges it can often be difficult to quantify the MAP in small catchments but fortunately there is a reliable rain gauge at Elandshoogte, not far from the Bruintjieslaagte catchment. See Figure 4.4.3.

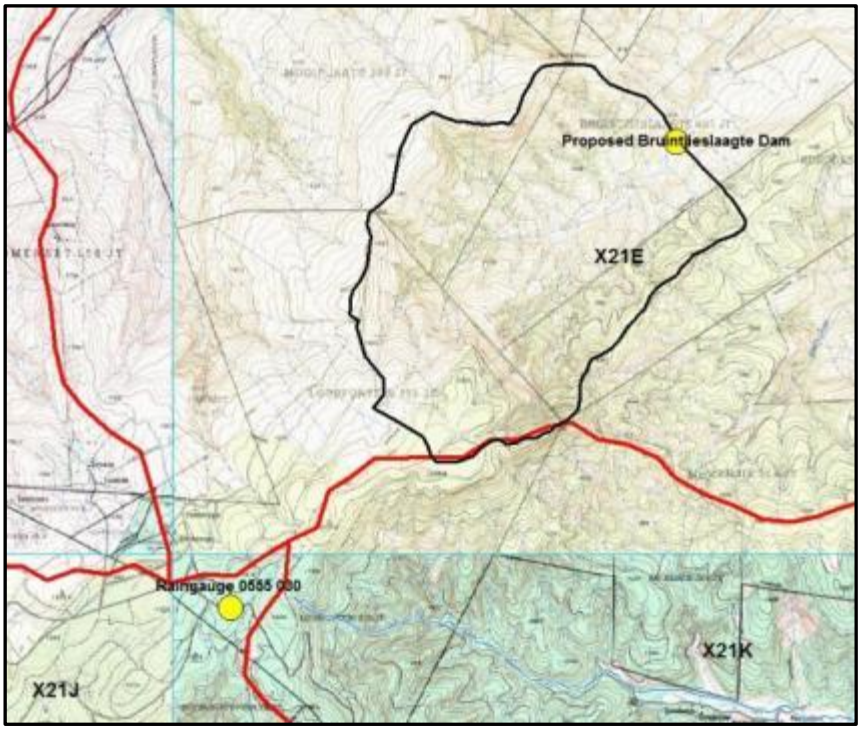

Figure 4.4.3 Location of rain gauges relative to the Bruintjieslaagte catchment

Assuming that the Elandshoogte rain gauge is representative of the rainfall in the Bruintjieslaagte catchment, the runoff from this catchment can be estimate using the equation proposed by Hughes (Hughes, 2004). See Equation 1.

MAR Ratio = Area Ratio * (3.4347 * MAP Ratio – 2.2989) …….. Equation 1

The rainfall and hence MAP ratio for the lower remainder of the Devils Creek catchment down to the confluence with the Crocodile River was assumed to be the same as the X21E catchment MAP and no adjustment was made.

The MAP of the lower Koedoeshoek sub-catchments was assumed to be the same as the MAP for the X21E catchments and hence n MAP ratio of 1 was applied.

The MARs of the three sub-catchments shown in Figure 4.4.4 are given in table below.

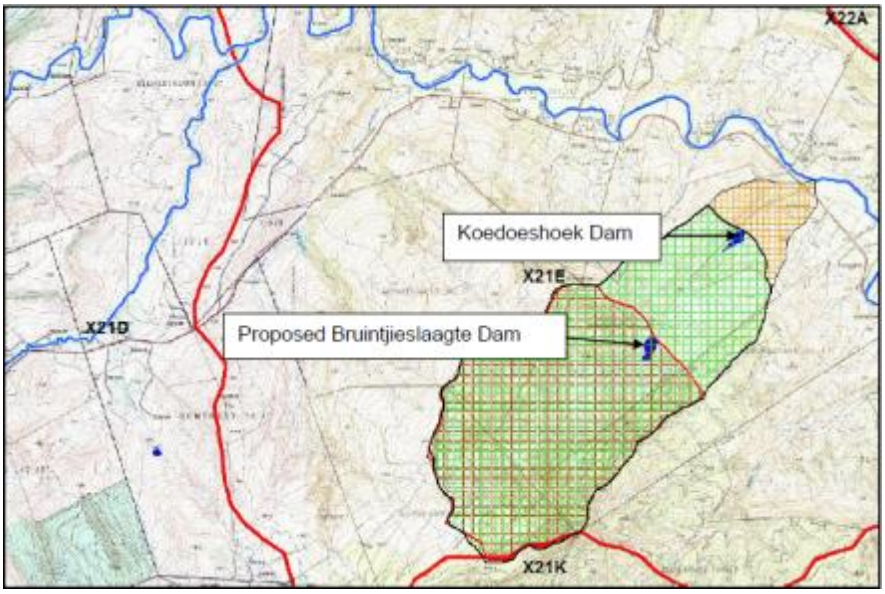

Figure 4.4.4 Sub-catchments of the Devils Creek River

Table 4.4.2 Estimation of MAR of the Devils Creek sub-catchments

Catchment	MAP	Area	Area Ratio	MAP Ratio	Factor	MAR (natural)
	mm/annum	km^2				million m^3/annum
X21E	873	345				56.0
Bruintjieslaagte	968	27.1	0.0786	1.109	0.0119	6.66
Koedoeshoek	873	11.7	0.0339	1.000	0.0339.	1.90
Remainder	800	3.2	0.0093	0.913	0.0085	0.48

It is clear from the above analysis that the MAR of the Bruintjieslaagte catchment is much higher if the higher rainfall is taken into account, as suggested by Hughes (Hughes, 2004).

The time series of natural runoff for the three sub-catchment comprising the Devils Creek catchment are attached as Appendix A to the Yield Analysis report.

4.4.3.2 Existing water use

It is important when estimating the yield of a dam to take into account the existing water use within the catchment of the dam since this will reduce the inflow into the dam and hence reduce the yield. While there is no direct use upstream of the proposed and existing dam there is a significant area of afforestation within the Bruintjieslaagte catchment, estimated at 3.33 km^2 or 12.3% of the catchment and a further 1.0 km^2 in the Koedoeshoek catchment. See Figure 8. There is a large area of irrigated orchards downstream of the Koedoeshoek Dam supplied from this dam. According to the agreement between Joubert and Sons and the Crocodile Irrigation Board 159 ha will be supplied from this dam in exchange for 159 ha previously supplied from the Crocodile River. At an application rate of 6 000 m^3/ha/annum this implies a water requirement of 0.954 million m^3/annum.

It is widely accepted that exotic plantations, and especially Pine and Eucalyptus, reduce the natural runoff from a catchment. The methodology proposed by Mallory and Hughes (2011) was used to estimate this reduction in runoff and this was taken into account when determining the yield of Bruintjieslaagte Dam and the existing Koedoeshoek. The reduction in runoff was estimated to be 0.71 million m^3/annum or 8.6% of the natural MAR.

Figure 4.4.5 Commercial Forestry in the Bruintjieslaagte catchment

4.4.3.3 Ecological Water Requirements

It is a requirement in terms of South Africa's National Water Act to allow some water to remain in the river to sustain its ecological functioning of the river. This water is referred to as the ecological Reserve or ecological water requirement (EWR). The EWR for the Bruintjieslaagte catchment has been estimated by Palmer (Palmer and Birkhead, 2017) and is attached as Appendix B. While the EWR for the short river reach downstream of the Koedoeshoek Dam has not been determined at a high level of confidence, the opinion of Dr Palmer is that this stretch of river will be in C ecological category. The rule for curve for a C category EWR at this point is attached Appendix B-2 (see full specialist report), as determined using the Hughes Desktop model (Hughes and Hannart, 2003).

Table 4.4.3 Summary of Ecological Reserve in terms of MAR

Catchment	MAR (natural)	EWR	
	million m^3/annum	million m^3/annum	% of MAR
Bruintjieslaagte	6.66	2.29	34.4%
Koedoeshoek	8.57	1.590	18.6%

4.4.3.4 Yield analysis

A yield analysis entails determining how much water can be abstracted from a dam (or system of dams) on a sustainable basis. The term 'sustainable' has different connotations to different users. Industrial users generally require water all the time and will not accept periods of reduced or zero water supply. Irrigators, on the other hand, usually accept a reduced assurance in exchange for a greater volume supplied on average over the long term. Since the purpose of the proposed Bruintjieslaagte Dam and existing Koedoeshoek Dam is to irrigate crops (assumed to be Citrus), the yield has been determined at a 70% assurance of supply. It has also been assumed that water use from this dam will be subjected to the operating rules of the Crocodile catchment established by the IUCMA. The historical yield, which is the yield at 100% assurance, has also been determined for comparison purposes.

The yield of a dam depends largely on the size of the dam relative to the inflow. In this case the size of the dam has already been determined as summarised in Table 3.3 while the area capacity curve for the dam is attached as Appendix C (see Appendix 5). This curve is required to estimate evaporation losses from the surface of the dam.

Table 4.4.4 Dam parameters

Dam	Full supply capacity (m^3)	Full supply area (ha)
Bruintjieslaagte	842 000	12.7
Koedoeshoek	850 000	9.6

The yield calculations were carried out using the Water Resources Modelling Platform (Mallory et al, 2013). This is a monthly time step simulation model. It was assumed that water will be released from the two dams for the ecological Reserve as a priority. The release from Bruintjieslaagte Dam will flow into the Koedoeshoek Dam.

The results of the yield analysis are given in Table 4.4.5 below.

Table 4.4.5 Yield results

Dam	Yield (million m^3/annum)	
	Historical	70% assurance
Bruintjieslaagte	0.74	1.2
Koedoeshoek	0.90	1.4

The yield of the Koedoeshoek Dam will be lower than previously with the completion of the Bruintjieslaagte Dam since water will be abstracted from the upper dam, the advantage being that water can be supplies under gravity. There is also potential to generate hydropower with the water before using it for irrigation. The understanding is that this is not

additional water use but replaces water that would have been abstracted from the Crocodile River.

4.4.4 Operating Rule and Low Flow Analysis

An analysis was carried out to assess the impact of the proposed Bruintjieslaagte Dam on the low flow of the Devils Creek River. As part of this process it was necessary to develop a joint operating rule for the two dams and to develop a simplified EWR release rule which can be applied in practice.

a) Operating rule

The assumption was made that the maximum amount of water would be utilized out of the Bruintjieslaagte Dam due to the advantage of elevation. The EWR will be released from both dams with the Bruintjieslaagte EWR flowing into the Koedoeshoek Dam and the release from the Koedoeshoek Dam flowing into the Crocodile River. Since the only user on the Devils Creek is Joubert and Sons (the applicant), only the EWR needs to be met. There will be no impact on the Crocodile River flow since the abstraction from the Devils Creek is in exchange for allocated abstractions from the Crocodile River.

b) Simplified EWR release rule

The EWR is defined as a function of the natural flow. However, estimating the natural flow in real-time is not a trivial matter. Models have been developed to implement the EWR in real-time but it is not reasonable to expect a private dam owner to acquire this expertise. A suggested approach is to simplify the EWR to twelve monthly flow equivalent to the 70% assurance value from the EWR Rule Curve. The recommended releases are given in Table 4.4.6.

Table 4.4.6 Recommended releases for the EWR (l/s)

Month	Dam	
	Bruintjieslaagte	Koedoeshoek
Oct	35	34
Nov	59	48
Dec	82	61
Jan	99	77
Feb	219	95
Mar	108	74
Apr	82	61
May	54	47
Jun	44	39
Jul	38	35
Aug	32	33
Sep	30	32

Figures 4.4.6 and 4.4.7 show the modelled flow out of the two dams together with the EWR. In both cases the EWR is met.

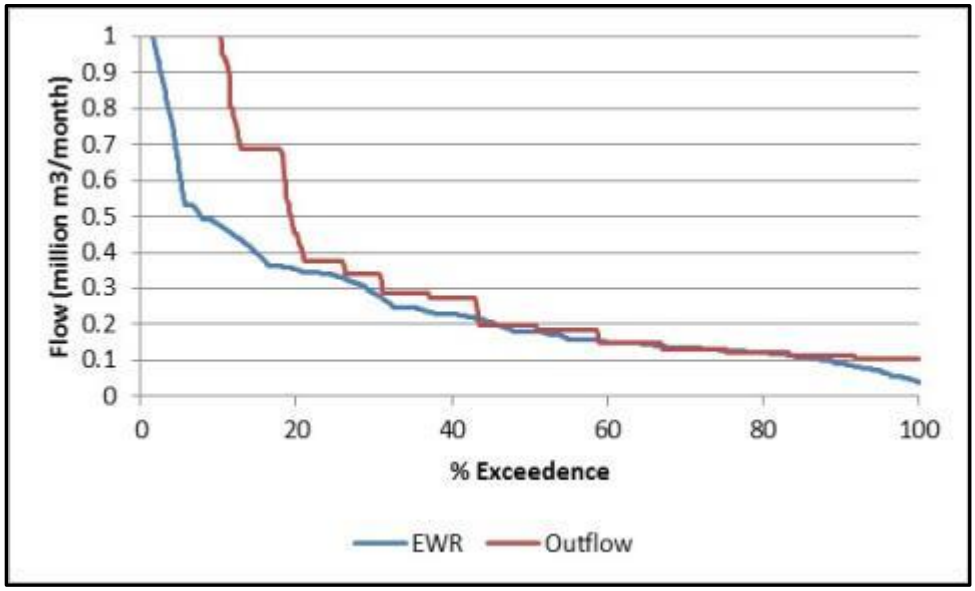

Figure 4.4.6 Outflow and EWR requirements: Bruintjieslaagte Dam

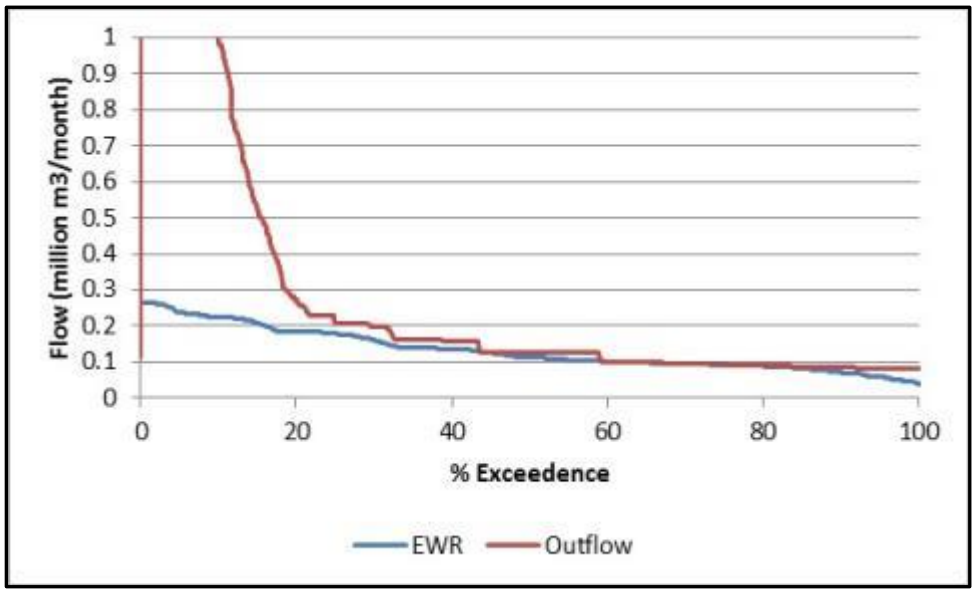

Figure 4.4.7 Outflow and EWR requirements: Koedoeshoek Dam

4.4.5 Hydrological assessment conclusions

The proposed Bruintjieslaagte Dam is located favourably in a catchment with high runoff and very little water use upstream of the dam. A dam with a full supply capacity of 842 000 m^3 will be able to yield an estimated 1.2 million m^3/annum at 70% assurance after meeting a B class ecological Reserve.

The proposed operating rule is to release water from the Bruintjieslaagte Dam according to a minimum monthly release rule. This will ensure that the EWR low flows are always met. The water will flow into the Koedoeshoek Dam from which a release must also be made to meet the EWR downstream on this existing dam. The recommended releases are lower than those from Bruintjieslaagte Dam due to the lower ecological category.

Given the above operating rule, the yield of the Koedoeshoek Dam is 1.4 million m^3/annum at 70% assurance.

An analysis of the low flow shows that the EWR low flows will always be met. While there is an impact of this development in that the abstractions for irrigation will reduce the flow in the Devils Creek catchment, one the main water user in this catchment is the applicant. Provided the EWR is met there should be no objections to this development.

The water abstracted from the dams will be offset by reduced abstractions out of existing allocations from of the Crocodile River. Hence there will be no impact on the Crocodile River. The abstractions made out of the dams must the monitored together with the releases out of the dam in order to ensure compliance with the EWR.

4.5 River Eco Systems and Aquatic Reserve

A *River Ecosystems Assessment Report, Bruintjieslaagte dam - Devil's Creek – Schoemanskloof, Nepid Consultants, Dr Rob Palmer, 13 April 2017 draft 1.1.* was compiled to address the aquatic aspects of the project (Refer to Appendix 9). Following is an abstract:

4.5.1 Aquatic Ecosystems General

The proposed dam is located on the farm Bruintjieslaagte 465JT, in the Schoemanskloof Valley, 40 km west of Nelspruit (Figure 4.5.1). The Study Area for this report was defined as the zones of potential direct and indirect influences on river ecosystems, detailed in Section 2.4.

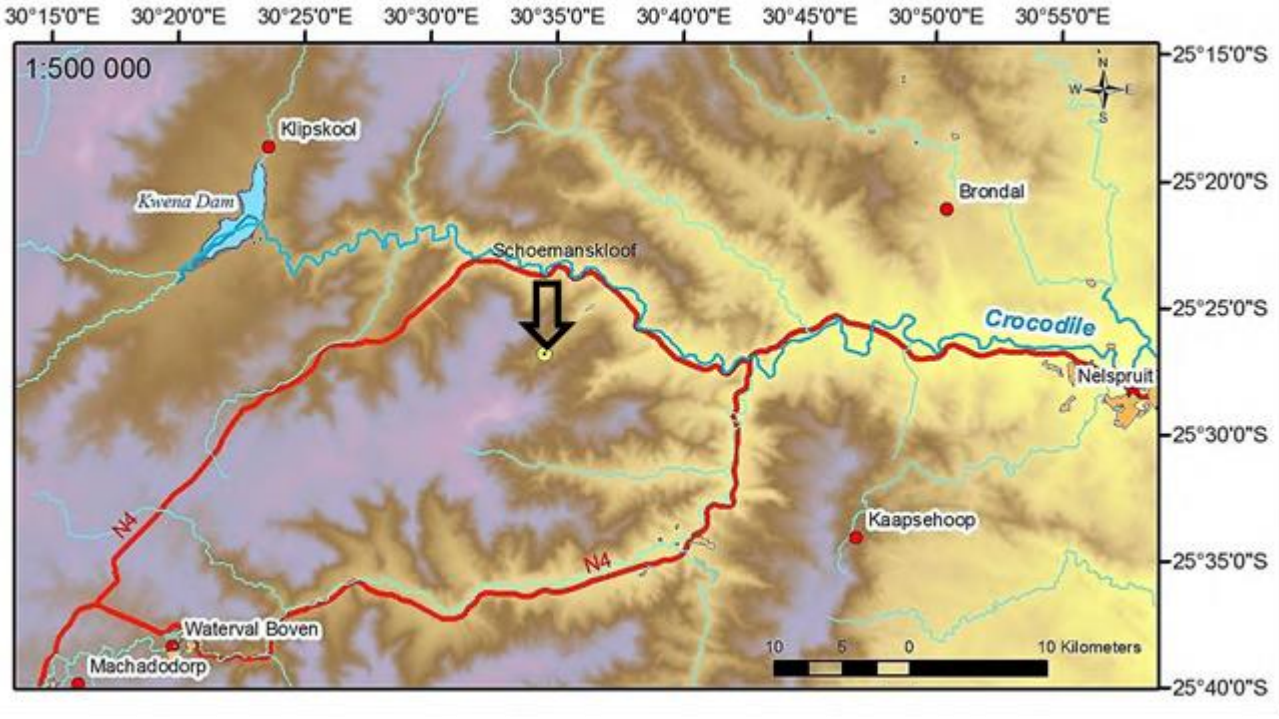

Figure 4.5.1 General Location Map

4.5.2 River Reaches

Three river reaches, A to C, were identified along the length of Devil's Creek for the purposes of this report, as indicated in Figure 4.5.1. The delineation was based on a

waterfall and existing dam, both of which constitute significant barriers to upstream migration of fish (Figure 4.5.2).

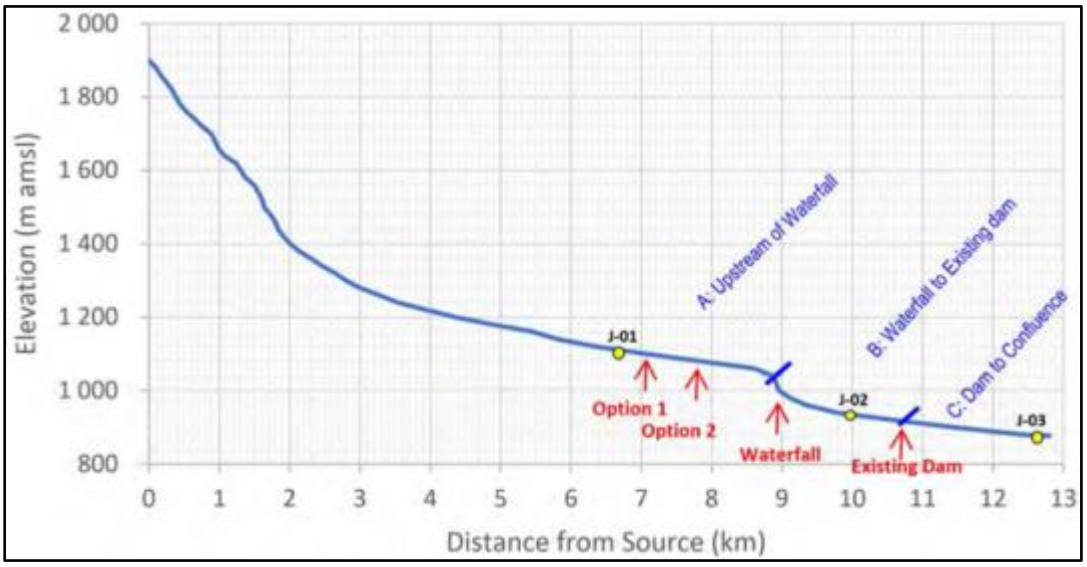

Figure 4.5.2 Longitudinal Profile of Devil's Creek Showing River Reaches

Photo 4.5.1 Fish Migration Barriers in Devil's Creek: Waterfall (A), and Existing Dam (B)

4.5.3 Zones of Influence

The potential zones of direct influence of the proposed dam options on river ecosystems comprise:

- Devil's Creek within the proposed Full Supply Levels of the two dam options. The length of river that will be inundated is estimated at 0.7 km, similar to the existing dam.
- Devil's Creek between the proposed dam options and the top end of the existing dam, a distance of 2.3 or 2.9 km for Options 2 and 1 respectively (Figure 4.5.4).

The potential zones of indirect Influence of the proposed dam options on river ecosystems comprise:

- Upper portion of Devil's Creek, upstream of the proposed Full Supply Level. No fish were recorded at J-01, upstream of the waterfall, so the proposed dam options are not expected to affect the upstream migration of any species of fish. However, it is highly likely that fish will eventually colonise the new impoundment, by whatever

means, and this will facilitate colonisation of Devil's Creek upstream of the proposed Full Supply Level.

- Lower portion of Devil's Creek between the existing dam and the confluence with the Crocodile River, a distance of 2.2 km (Figure 4.5.4).

The total zone of influence of the proposed dam on river ecosystems is therefore 5.2 or 5.8 km portion of Devil's Creek for Options 2 and 1 respectively, plus an unknown length of river upstream of the Full Supply Level. The most likely extent of this stretch would be to the base of the Mountain Headwaters, which is about 3 km.

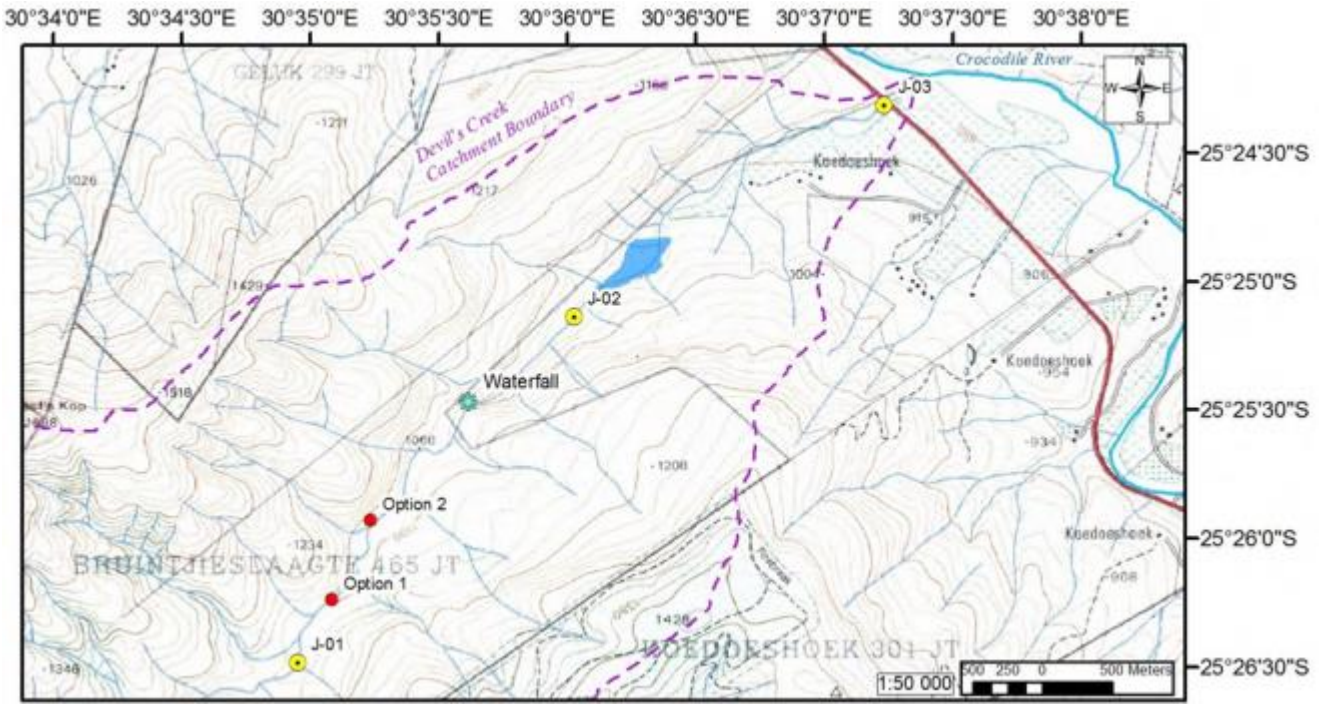

Figure 4.5.3 Topographical Map (extracted from 1:50 000 scale map 2530BC)

4.5.4 River Ecosystem Type

Four geomorphological zones were identified along the length of Devil's Creek, two of which are located within the potential zone of influence of the proposed dam, namely Transitional Stream and a short section of Rejuvenated Mountain Stream. The three sites sampled for this report were located in the Transitional Zone. A detailed ecological classification of the three sites is included in Appendix 6 of the aquatic report. Biotopes were dominated by rapids, riffles, runs and glides. Riparian vegetation cover comprised open and closed-canopy indigenous forest with dense growth of herbs, grasses and shrubs. Alien invasive vegetation was present at all three sites, but prevalent only at SiteJ-03. Marginal and emergent vegetation was dominated by River grass *Cenchrus macrourus*. Bed substrates at all three sites were dominated by large and small cobbles, with smaller patches of coarse gravel, while fine gravel and course sands present along the margins.

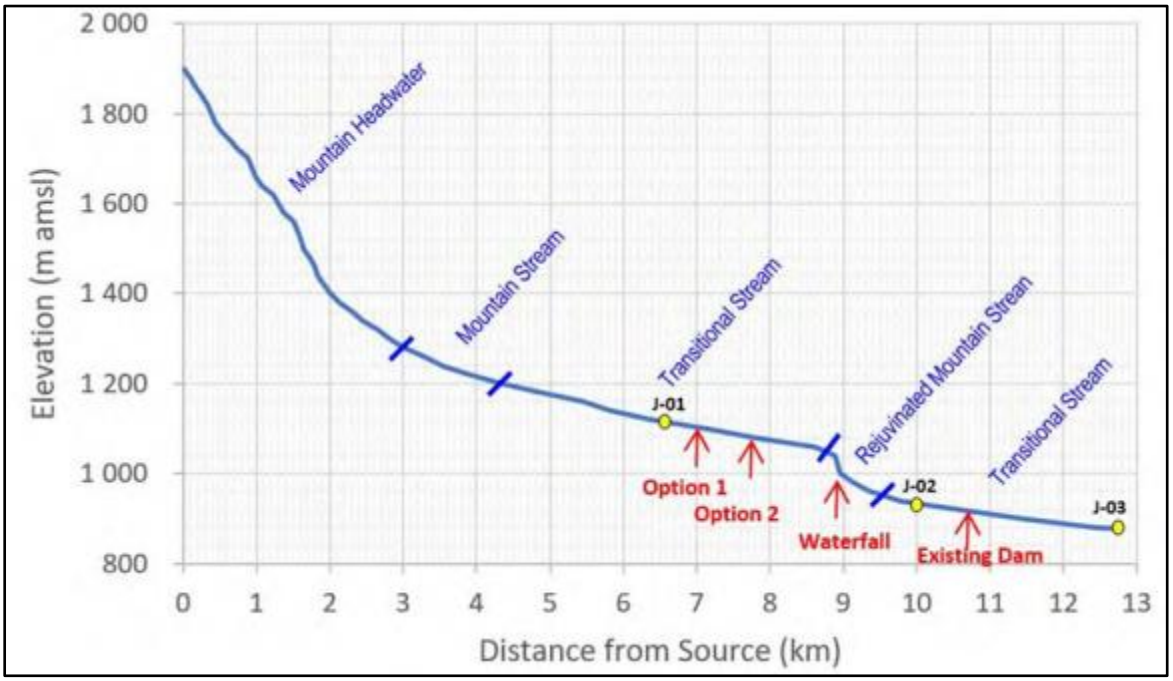

Figure 4.5.4 Longitudinal Profile of Devil's Creek showing Geomorphological Zones

Figure 4.5.5 Google Earth Satellite image showing location of aquatic sampling sites

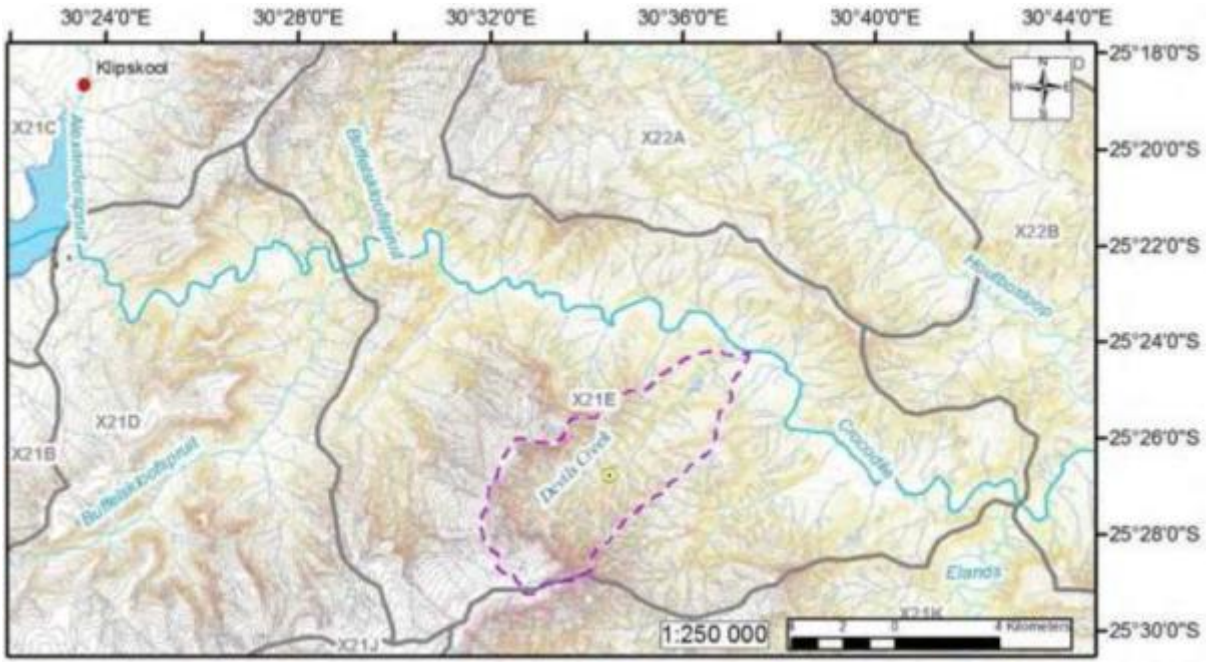

Figure 4.5.6 Quaternary Catchments

4.5.5 Hydrology

Mean Annual Runoff

Extrapolation of data presented in the Water Resources 2012 (WR2012) study indicates that the natural Mean Annual Runoff (nMAR) of Devil's Creek at the confluence with the Crocodile River is 6.47 Mm^3, but there is significant variation between years, ranging between 2.16 Mm^3 in 2007, and 23.41 Mm^3 in 1999. An implication of this is that the aquatic biota that occur naturally in the area are likely to have evolved life history strategies to cope with large variations in flow.

Low Flows - Dry Season

Examination of WR2012 natural monthly flows for Devil's Creek shows that the dry season usually occurs between May and September. The dry season low flows are likely to be maintained mainly by seepage from valley head and hillslope seepage wetlands in the upper catchment. The median natural dry season low flow at the confluence with the Crocodile River is 0.047 m^3/s, but ranges between 0.033 and 0.093 m^3/s at the 90 and 10th percentile respectively.

Wet Season

Examination of WR2012 natural monthly flows for Devil's Creek shows that the wet season usually occurs between November and March. Wet season flows are driven mainly by surface runoff from thunderstorms, which tend to be short-term, extreme events. Wet season low flows cannot be reliably calculated from monthly data because the data include both low and high (peak) flow, but a rough estimate of the likely range of wet season low flows was based on the assumption that half the flow during the wet season was attributed to peak flows, and the remaining half to low (base) flows. As such, the WR2012 data indicate that the median natural wet season low flow at the confluence with the Crocodile River is 0.139 m^3/s, and ranges between 0.070 and 0.808 m^3/s at the 90 and 10th percentile respectively.

4.5.6 Hydraulics

A cross-sectional profile of Devil's Creek at J-02 shows the channel is about 8 m wide and incised by 1.4 m. The median water depth at the profile on 23rd March 2017 was 0.19 m, and the maximum depth was 0.34 m. Flow volume at the profile was estimated at 0.745 m^3/s, while flow volume at a pipe culvert a short distance downstream was estimated at 0.685 m^3/s. The latter is likely to be more accurate than the former. The data were used to generate hydraulic and habitat parameters for macroinvertebrates and fish for water levels between 0 and 0.5 m depth.

4.5.7 Water Quality

a) Conductivity

Conductivities in Devil's Creek during the field surveys in February and March 2017 were very low and ranged between 3 mS/m in the upper reaches at J-01 and J-02, to 5 mS/m in the lower reaches at J-03. These values were recorded during the wet season, and conductivity is expected to be slightly higher during the dry season.

Table 4.5.1 Field Water Quality recorded in 2017

Site	Date	Flow	Conductivity (mS/m)	Spot Water Temperature (ºC)	pH	Turbidity (NTU)
J-01	2017/02/20	V High	3	18.7	8.0	22
J-02	2017/03/22	High	3	21.4	8.1	11
J-03	2017/02/20	V High	5	22.0	7.9	32

b) Water Temperature

Spot water temperatures were recorded during the field surveys, but there is not much that can be read into such values because of natural daily variation, other than to note that water temperatures at Sites J-01 and J-02 reflected natural conditions, whereas temperatures at Site J-03 are likely to be less variable because of the stabilising effect of the existing dam.

c) pH

The pH was slightly alkaline, and ranged between 7.9 and 8.1.

d) Turbidity

Turbidity was moderate (22 to 32 NTU) during the field survey in February 2017, when flow was very high. The values indicate that sediment transport was very low, and this reflects the overall natural state and high vegetation cover in the catchment as a whole. Turbidity during the field survey in March 2017, when flow was moderate, was low (11 NTU).

e) Ionic Composition

Ionic composition was dominated by total alkalinity (TAL) and magnesium. The results indicate unimpacted conditions.

f) Metals

Concentrations of metals were low and mostly below instrument detection limits.

g) Present State of Water Quality

The present state of water quality in Devil's Creek upstream of the existing dam was classified in March 2017, with a high level of confidence, as Category A. All metrics were considered unmodified, except for turbidity, which is likely to be slightly elevated for short periods during high flows because of timber production, particularly during harvesting. Turbidity was recorded at J-01 when the flow was very high on 20th February 2017, and the value was slightly higher than what may be expected under natural conditions.

Table 4.5.2 Physico-chemical Driver Assessment Index for Devil's Creek at J-02 in March 2017

PHYSICO-CHEMICAL EC					
Physico-chemical Metrics	Rank	%wt	Rating	CONFIDENCE	WEIGHTED RATING
pH	3	40	0	5	0.00
SALTS	2	80	0	5	0.00
NUTRIENTS	2	80	0	4	0.00
TEMPERATURE	1	100	0	5	0.00
TURBIDITY	2	80	1	4	0.80
OXYGEN	1	100	0	5	0.00
TOXICS	1	100	0	4	0.00
PHYSICO-CHEMICAL PERCENTAGE SCORE	97				
PHYSICO-CHEMICAL CATEGORY	A				

4.5.8 Aquatic Macroinvertebrates

4.5.8.1 Habitat Suitability

Instream habitats at J-02 in March 2017 were moderately suitable for aquatic invertebrates (59%), and included highly suitable stones-in-current (4/5), and highly suitable marginal vegetation out-of- current (4/5). Marginal vegetation in-current and aquatic vegetation were both absent. Filamentous algae (*Oedogonium sp*.) and the submerged plant *Sphaerothylax algiformis* (*Podostemaceae*) were present on some stones-in-current, but in low abundance (2%), and therefore they did not influence habitat suitability.

4.5.8.2 Present Ecological State

The Present Ecological State of aquatic macroinvertebrates at J-02 in March 2017 was rated, with high confidence, as Category A/B, with a MIRAI score of 92%. A total of 34 SASS5 taxa were recorded, and these gave a Total SASS5 Score of 241, and an average score of 7.1. Detailed results are presented in Appendix 9.

Fourteen sensitive taxa were recorded, including *Oligoneuridae* and *Blephariceridae*, both of which have a sensitivity rating of 15/15, which indicates excellent quality water. Mayflies included members of the genus *Demoreptus*, which is also highly sensitive to water quality deterioration. The fauna was characterised by absence of alien taxa and moderate abundance of *Blephariceridae*, *Heptageniidae*, *Leptoceridae* and *Corduliidae*.

The proportion of air-breathing taxa was moderate (24%), and this suggests that faunal composition had not yet recovered from the drought.

Median longevity of adults was short (<1 month), which also suggests that conditions were in flux, so not yet recovered from the drought.

Despite the abundance of fast-flowing habitat, a large proportion of taxa (63%) had current speed preferences that range between zero and slow, which also indicates that species composition had not yet recovered from the drought.

Blackflies were present in moderate abundance, and dominated by *Simulium vorax*, which is restricted to fast-flowing mountain streams. However, *Simulium hargreavesi* was also present, and this species is typically associated with temporary rivers, and this is further evidence that species composition had not yet recovered from the drought.

A wide range of Functional Feeding Groups were recorded, and included predators (39%), filterers (19%), gatherers (19%), scrapers (11%), and shredders (10%), and this is indicative of unmodified conditions.

Population densities were low to moderate, and no taxa were rated as abundant or very abundant, which is also indicative of unmodified conditions. Water pennies (*Psephenidae*) were present, but at lower abundance than expected. All other taxa were present in abundances expected under natural conditions.

4.5.9 Fish

The following section is also abstracted from the *River Ecosystems Assessment Report, Nepid Consultants, Dr Rob Palmer, 13 April 2017 draft 1.1.*

After this investigation an additional fish study, DNA testing and follow-up surveys after translocation of the *Enteromius* "Devils Creek" (EDEV) population was conducted. These are separately discussed in the report.

4.5.9.1 Fish Habitat

Flow-depth classes at all three sites sampled in Devil's Creek were typical of a transitional stream, and dominated by fast (>0.3m/s) and shallow (<0.5 m) runs, riffles and rapids, and good cover was provided mainly by large cobbles and boulders. Marginal vegetation was sparse, but there was a localised open area at J-02 where marginal grasses provided good cover. Some cover was provided by woody debris and undercut banks, but these habitats were not sampled.

4.5.9.2 Present Ecological State

Nine species of fish were recorded in Devil's Creek during baseline surveys between February and April 2017 (Table 4.5.9.1). Photographs of fish recorded are shown in Appendix 9. The following section details the results at each site sampled.

Site J-01 (Reach A: Upstream of Waterfall)

No fish were recorded at J-01, despite the suitability of instream habitats. The apparent absence of fish in this reach is attributed to the waterfall, and therefore considered natural.

Site J-02 (Reach B: Waterfall to Existing Dam)

The Present Ecological State of fish at J-02 was rated, with low confidence, as Category C, with a FRAI score of 67.3% (Table 4.4.3). The low confidence is attributed to a combination of uncertainty about reference conditions, low abundance of fish that can be attributed to the recent drought, and sampling gear that was limited to the use of a seine net, which is not ideal for sampling in riffles and rapids with fast current speeds. Four species of fish were expected at this site, and all four are likely to still occur in this reach, even though only one species was recorded, namely *Enteromius cf motebensis*. This species has a preference for slow-shallow habitat, and is moderately tolerant of water quality deterioration. Three species with a strong preference for fast- flowing water of high quality were expected but not recorded, despite suitable habitat being present. Their absence is attributed to a combination of recent drought conditions, the sampling gear used, and prevention of upstream migration caused by the existing dam.

Impoundment

High numbers of juvenile *Coptodon rendalli* were recorded in the upper reaches of the existing impoundment (Table 4.4.3). This species is unlikely to have been present in Devil's Creek before impoundment, but the impoundment has created ideal habitat. How this species colonised the impoundment is unknown, but however this took place, there is a high probability this species will also colonise proposed impoundment.

Site J-03 (Reach C: Existing Dam to Confluence)

Eight species of fish were recorded at J-03 (Table 4.5.1). The abundance of fish was low, and dominated by juveniles, indicative of post-drought recovery. The composition was

dominated by cichlids, which were not expected in this river under natural conditions, so they appear to have benefited from the drought conditions. Only one flow-dependent fish species, namely *Chiloglanis pretoriae*, comprising a single individual, was recorded at J-03, despite the availability fast-flowing habitats, and this further confirms that fish composition and abundance had not yet recovered from the effects of the drought. The Present Ecological State of fish at this site was not assessed because this was not needed for this report.

Table 4.5.1 Fish Habitats and Fish Species recorded in Devil's Creek

Site Code	**J-01**	**J-02**	**Dam**	**J-03**
Date	23/03/2017	23//03/2017	23/03/2017	05/04/2017
Flow	High	High	n/a	Moderate
Flow-Depth Classes (1-5)				
Slow-Shallow	1	2	4	3
Slow-Deep	-	-	4	-
Fast-Shallow	4	4	-	4
Fast-Deep	-	-	-	1
Rating: 1=rare (1-5%); 2=sparse (5-25%); 3=common (25-75%); 4=abundant (75-90%); 5=very abundant (>90%)				
Slow = <0.3m/s; Shallow = >0.5m				
Cover (1-5)				
Marginal vegetation	2	3	2	2
Macrophytes	-	-	-	-
Undercut banks & roots	-	-	-	-
Woody debris	-	-	1	-
Bed substrate	3	3	-	3
Fish Species				
Amphilius natalensis		-		-
Amphilius uranoscopus		-		-
Enteromius crocodilensis	-	-	-	2J
Enteromius cf motebensis	-	6J 2A	-	-
Enteromius neefi	-	-	-	2A
Coptodon rendalli	-	-	40J	2J
Oreochromis mossambicus	-	-	-	24J 2A
Pseudocrenilabrus philander	-	-	-	20J 3A
Tilapia sparrmanii	-	-	-	1J 1A
Clarias gariepienus	-	-	-	1J
Chiloglanis pretoriae	-	-	-	1A
Total Abundance	0	8	40	59
Number of Species	0	1	1	8
Present Ecological State	n/a	C (67.3%)	n/a	-

J = Juvenile; A=Adult

4.5.9.3 Fish of Conservation Concern

Enteromius cf motebensis

One fish species of conservation concern was confirmed within the Study Area and is referred to here, tentatively, as *Enteromius cf motebensis*. This species is a member of the '*anoplus*' group, and tentative identity given here is because the taxonomy of this group is uncertain, and it could be one of three lineages of the '*anoplus*' group that has been recorded in the wider area:

- Lineage A (north *motebensis*) that stretches from the Free State across into Mpumalanga
- Lineage D reaching down into Kwazulu-Natal uplands
- Lineage E 'upper Mpumalanga' (Paul Skelton, pers. comm).

The IUCN classifies the conservation status of *E. motebensis* as "Vulnerable", but this refers to a population that is centred in the Waterberg. The conservation status of the '*motebensis*' population recorded in Devil's Creek is unknown, but based on the recommendation of Paul Skelton, should be treated as equivalent to *E. motebensis* until further information is available. *Enteromius cf motebensis* has been recorded in the upper reaches of the Elands River and tributaries, but is otherwise rare in the Crocodile River Catchment.

Amphilius natalensis

*Amphilius natalensis*is fairly widespread in smaller tributaries in the upper Crocodile River catchment and therefore expected in Devil's Creek downstream of the waterfall. The conservation status of *Amphilius natalensis* is referred to as "Data Deficient" by Nel *et al.* (2011), but listed as "Least Concern" by the IUCN (www.iucnredlist.org).

Chiloglanis bifurcus

Chiloglanis bifurcus is classified as "Endangered" by the IUCN, and has been recorded within Quaternary Catchment X21E. However, examination of available records show that this species is restricted to larger systems, such the Elands, Houtbosloop and Crocodile Rivers, and does not occur in smaller river. This species is therefore not expected in Devil's Creek.

Kneria sp. 'kwena'

Kneria sp. 'kwena" classified as "Critically Endangered" by the IUCN, and has been recorded in the adjacent Sterkspruit and Buffelskloofspruit. This raises the possibility that these fish may also occur in Devil's Creek. Closer examination of the distribution records shows that this species is restricted to a narrow elevation range of between 960 and 1,440 m amsl. This species may therefore be expected in Devil's Creek upstream of the waterfall only. No fish were recorded in Devil's Creek upstream of the waterfall, so it is reasonable to conclude that *Kneria* is unlikely to be present in Devil's Creek.

4.5.9.4 Ecological Importance and Sensitivity

Ecological Importance and Sensitivity of Devil's Creek within the potential zone of impact was rated as High.

Table 4.5.2 Ecological Importance and Sensitivity

DETERMINANTS	SCORE	Comments
BIOTA		
Rare & endangered	3	*Enteromius moteb ensis:* Vulnerable
Unique (endemic, isolated, etc.)	2	*Sphaerothylax algiformis* (Podostemaceae)
Intolerant (flow & flow related water quality)	4	Blephariceridae; Psephenidae; Perlidae etc
Species/taxon richness	3	34 SASS5 taxa recorded in one sample
HABITATS		
Diversity of types	3	Waterfall, Cascade, Rapids, Riffles, Backwaters
Refugia	2	Naturally perennial
Sensitivity to flow changes	3	Naturally perennial
Sensitivity to flow related water quality changes	4	Water quality excellent: Conductivity low (3 m S/m)
Migration route/corridor	0	Waterfall restricts migration of fish
Importance of conservation & natural areas	3	Near-Pristine state

DETERMINANTS	SCORE	Comments
MEDIAN	**3**	
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EISC)	**HIGH**	
Scoring: 0 = Zero; 4 = Very High		

4.5.9.5 Ecological Flow Requirements

The Desktop Ecological Flow Requirement for a Category B ecological state at J-02 is an annual volume of 2.405 Mm^3. An analysis of the distribution of *Chiloglanis pretoriae* in the Olifants River catchment found that this species needed a flow of at least 0.2 Mm^3 per annum (Rashleigh *et al.* 2009). The annual environmental flow recommended for Site J-02 is therefore eminently suitable for supporting this species.

Median environmental low flow requirements ranged between 0.036 and 0.106 m^3/s in September and February respectively. These flows will provide good wetted perimeter (5.8 m) and small areas with current speeds that exceed 0.34 m/s. The recommended flows are therefore suitable for maintaining flow-dependent fish species, such as *Amphilius* spp and *Chinoglanis pretoriae.*

4.6 Rapid Fish Assessment Devils Creek

A separate Rapid Fish Assessment: Devil's Creek, Schoemanskloof, Mpumalanga was conducted by Dr. P. Kotze (Clean Stream Biological Services), August 2017. Refer to Appendix 7.1. Following is an abstract from his report. Note that this is the report that was done on which the translocation was based and after which the monitoring reports that is discussed in section 4.2:

4.6.1 Introduction and Background

Dr R. Palmer from Nepid Consulting conducted the specialist aquatic assessment as part of the proposed Bruintjieslaagte Dam Environmental Impact Assessment (EIA) process (Nepid, 2017[1]). Some concerns were raised by the Mpumalanga Tourism and Parks Association (MTPA) regarding the fish section that required further verification. Dr. P. Kotze was requested to conduct an additional fish survey in the study are to verify and further expand on the results gained by Dr. Palmer and attempt to also further address the comments by MTPA.

Terms of reference:

- Conduct fish survey at previously sampled sites/reaches in the Devils Creek River.
- Compile short report on results.
- Where applicable address comments by MTPA regarding fish component.

4.6.2 Results and Discussion

4.6.2.1 Survey sites

The study area was visited on the 10th of August and previously selected sites or river reaches were visited. Fish sampling was performed at three representative sites/reaches of concern (see Table 4.6.2.1 and Figure 4.6.1). Sampling was performed by use of a SAMUS electro fisher.

[1] Nepid (2017). Bruintjieslaagte Dam, Devil's Creek, Schoemanskloof. Specialist Report: River Ecosystems. Dated 13 April 2017, Draft 1.1.

Table 4.6.1 Sampling sites/reaches surveyed

Site name (Reach)	Description	Latitude	Longitude	Approximate reach length (m) / time (minutes) sampled
J-01b (Reach A)	Upstream of waterfall at dam wall site (approx. 110m downstream of J-01)	-25.436656°	30.585292°	100m / 31 minutes
J-02 (Reach B)	Between waterfall and existing dam (at previously sampled site J-02).	-25.419814°	30.599438°	200m/ 50 minutes
J-03 (Reach C)	At R539/N4 Schoemanskloof crossing of Devils Creek. (previously sampled site J-03).	-25.405271°	30.620615°	55m / 24 minutes

Figure 4.6.1 Study area indicating fish sampling sites

Fish survey results (August 2017)

4.6.2.2 Fish habitat assessment

The Habitat Cover Ratings (HCR's) approach was used to evaluate the amount and diversity of cover (habitat) available for fish at each of the sites in the study area during the August 2017 survey (Table 4.6.2.2 and Figure 4.6.2). The HCR's indicated that the diversity of habitats for fish was moderate at all sites, with three of the four velocity-depth classes being present. Site J-01b (Reach A) was dominated by slow-shallow and fast-shallow habitats with substrate (rocks) as the primary cover feature available for fish. The habitat composition at site J-02 was very similar than at site J-01. Site J-03 was also dominated by fast-shallow and slow-shallow habitats, with more varied cover features available for fish. Difference in fish diversity between sites can therefore be expected based on the habitat composition at the sites. The habitat composition at a site plays an important role in determining the expected fish species assemblage of the site, which is furthermore

influenced by other aspects such as prevailing water quality, presence of alien fish species, migration barriers, etc.

Table 4.6.2 Availability and abundance of flow-depth categories and cover features for fish at stream sites (August 2017)

Sites	J-01	J-02	J-03
SLOW-DEEP (>0.5m; <0.3m/s)			
Abundance	1	2	1
Overhanging vegetation	2	2	3
Undercut banks and Root-wads	2	0	3
Substrate	4	3	3
Macrophytes	0	0	1
SLOW-SHALLOW (<0.5m; <0.3m/s)			
Abundance	3	3	3
Overhanging vegetation	2	2	3
Undercut banks and Root-wads	1	2	3
Substrate	4	4	3
Macrophytes	0	0	2
FAST-DEEP (>0.3m; >0.3m/s)			
Abundance	0	0	0
Overhanging vegetation	0	0	0
Undercut banks and Root-wads	0	0	0
Substrate	0	0	0
Macrophytes	0	0	0
FAST-SHALLOW (<0.3m; >0.3m/s)			
Abundance	3	4	3
Overhanging vegetation	2	0	3
Undercut banks and Root-wads	1	1	1
Substrate	4	4	3
Macrophytes	0	0	0

0: none, 4: very high.

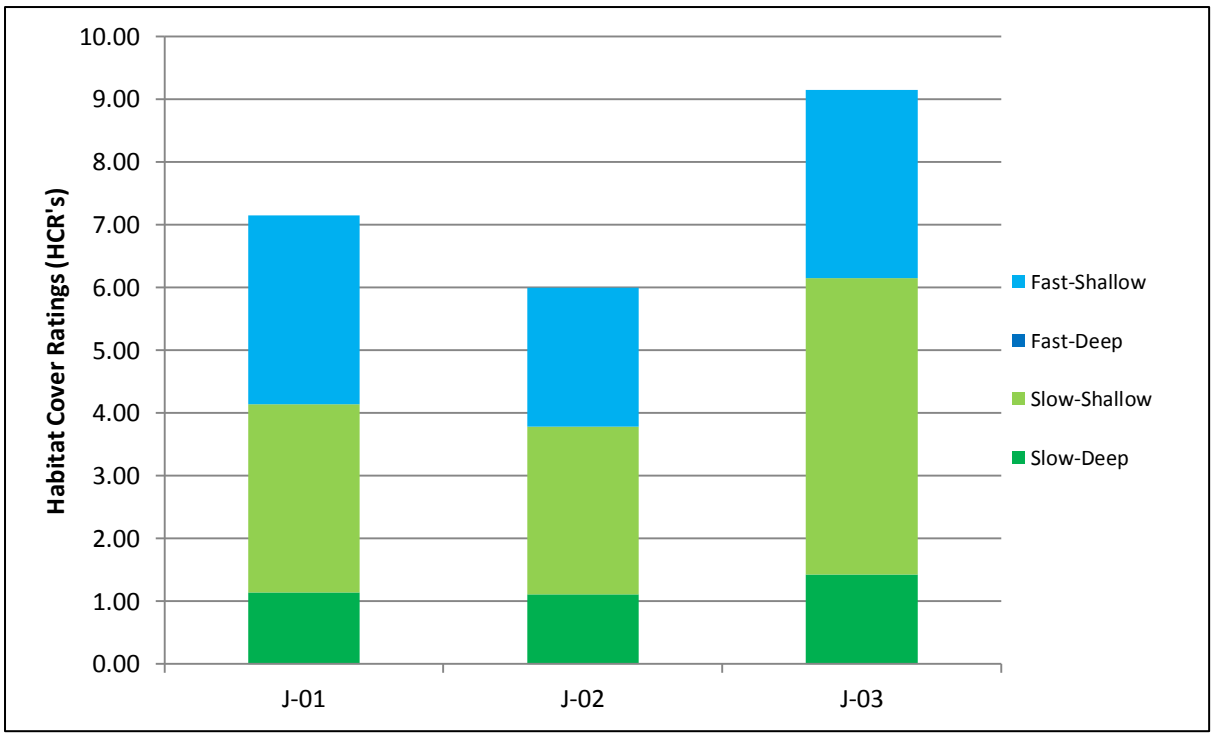

Figure 4.6.2 Availability and diversity of cover for fish at different sampling sites (August 2017)

4.6.3 Fish species composition

During the August 2017 survey conducted in the study area six indigenous and one alien/introduced species were sampled (Table 4.6.3.1).

Table 4.6.3 Indigenous fish species (CPUE: number of individuals/hour using electrofishing) sampled during August 2017 in the study area

SCIENTIFIC NAME	**ENGLISH COMMON NAME**	**J-01**	**J-02**	**J-03**	**TOTAL (all sites)**
Amphilius uranoscopus	Stargazer (Mountain-Catfish)	0.0	10.8	0.0	5.1
Enteromius cf. anoplus/motebensis	Chubbyhead Barb GROUP	0.0	93.6	0.0	44.6
Enteromius crocodilensis (Barbus argenteus)	Rosefin Barb	0.0	0.0	30.0	6.9
Enteromius neefi (Barbus neefi)	Sidespot Barb	0.0	0.0	10.0	2.3
Clarias gariepinus	Sharptooth Catfish	0.0	0.0	17.5	4.0
*Micropterus salmoides**	Largemouth bass (Ex)	0.0	0.0	2.5	0.6
Pseudocrenilabrus philander	Southern mouthbrooder	0.0	0.0	22.5	5.1
*alien/introduced species	**TOTAL**	**0.0**	**104.4**	**82.5**	**68.6**

Site J-01b (Reach A)

No fish was sampled at site J-01b (Table 4.6.3). Adequate sampling effort was applied and although the electrical conductivity (EC) of the water was low, electrofishing was efficient (as observed on other biota such as amphibians and invertebrates). The result gained was similar to that of Dr. Palmer (Nepid, 2017) and the absence of fish form this reach (upstream of waterfall) was confirmed. Dr. Kotze is also in agreement that the absence of fish form this

reach is most probably related to natural causes since the waterfall at the end of this reach creates a natural migration barrier to fish movement in the Devils Creek.

Site J-02 (Reach B)

Two fish species were sampled at site J-02 during the August 2017 survey (Table 4.6.3), namely *Amphilius uranoscopus* and *Enteromius cf. anoplus/motebensis*. Although Dr. Palmer only recorded *E. cf. motebensis* at this site, he expected and considered the possible presence of *A. uranoscopus* in this reach throughout his report. This species was also present in a relative high abundance within this reach was during August 2017 (Plate 1). *Amphilius uranoscopus* is also the most flow dependant species of concern (a rheophilic species) and should be the primary indicator species in setting ecological flows for reach B. This species is also intolerant to water quality changes (including increased turbidity) and care should be taken especially during construction activities in the upstream catchment to limit sedimentation and increased turbidity.

Photo 4.6.1 Plate 1: Posterior section of *Amphilius uranoscopus* sampled at site J-02 during August 2017, indicating typical adipose fin structure of this species

Dr. Palmer also indicated that *A. natalensis* and *C. pretoriae* may also be expected in this reach under reference conditions. The current fish information indicates that it is highly unlikely that they are present within this reach under present conditions. The provision of adequate habitat (water quantity and quality) for *A. uranoscopus* in this reach should however meet the requirements of these expected species should they be present.

Enteromius cf. anoplus/motebensis was very abundant in this reach during August 2017 (most abundant species in study area). Dr. Palmer discussed the uncertainty regarding the identification of this species and correctly followed the conservative and precautionary approach in identifying it as *E. cf. motebensis* (Nepid 2017). The individuals sampled during August 2017 had various morphological attributes that coincides with the generally known *Enteromius anoplus* (see Table 4.6.3.2 and Plates 2 and 3).

It is however acknowledged that there is currently great uncertainty regarding this group of species ('*anoplus*' group) as they are all morphologically very similar and identification based on external characteristics is almost impossible and should be confirmed through genetic analyses. It is therefore strongly recommended that the identification of this species be confirmed by the application of genetic analyses. MTPA is currently in the process of conducting genetic analyses on various population of this group of species in Mpumalanga and it is strongly recommended that a sample of this population at site J-02 should be included in this assessment (MTPA should be contacted for further information in this regard).

Table 4.6.4 Morphological differences in *E. anoplus* and *E. motobensis* (from literature)

	Enteromius anoplus	*Enteromius motebensis*	*Comments*
1	Usually with single pair of short barbels.	Usually 2 pairs of barbels.	Single barbel observed (Plate 2)
2	Males assuming golden breeding dress.	Breeding males develop tubercles on snout.	See plate 3.
3	Lateral line complete? (Plate 3)	Lateral line incomplete.	Complete lateral line (see plate 3)
4	Max length (literature): 120mm.	Max length (literature): 80mm.	Individuals with total length of 94mm sampled.

Shaded = Observed in population of site J-02 in study area

Photo 4.6.2 Plate 2: Single pair of barbels observed in *Enteromius cf. anoplus/motebensis* sampled at site J-02 (August 2017)

Photo 4.6.3 Plate 3: Yellow breeding colours and complete lateral line observed in *Enteromius cf. anoplus/motebensis* sampled at site J-02 (August 2017)

Site J-03 (Reach C)

Four indigenous and one alien fish species were sampled at site J-03 (Reach C) during August 2017. Dr. Palmer recorded eight indigenous species (including these four sampled in August) during the summer season at this site. Due to the close proximity of this site to the Crocodile River, it expected that the species diversity at this site may vary greatly over time as fish from the Crocodile River may use the lower section of the Devils Creek as a refuge area (avoiding unfavourable conditions or utilising suitable conditions). Although there is a high probability that *A. uranoscopus* may also be present in this reach, *Chiloglanis pretoriae* was confirmed at the site by Dr. Palmer (Nepid 2017). It is therefore recommended that adequate environmental flows should be maintained to at least cater for the requirements of *C. pretoriae* in the lower reaches of the Devils Creek, as these should be adequate to also sustain the other expected species.

4.6.3.1 Species of conservation concern

Enteromius cf. motebensis
See detailed discussion above regarding *E. cf. anoplus/motebensis*. The potential presence of *E. motebensis* in the study area should be confirmed through the application of genetic analyses.

Amphilius natalensis
The Amphilius species sampled in the study area during August 2017 was positively identified as *A. uranoscopus*. It is highly unlikely that *A. natalensis* is also present in the Devils Creek. Catering for the requirements of *A. uranoscopus* will also be adequate for the protection of *A. natalensis*, should they be present.

Chiloglanis bifurcus
As indicated by Dr. Palmer, it is highly unlikely that *Chiloglanis bifurcus* would be present in the Devils Creek, due to especially its preference for larger river systems (such as the Crocodile River) rather than smaller tributary streams. Should the proposed dam not influence the ecological flows as set for the Crocodile River EWR site (EWR3: Poplar Creek), the proposed development should not impact on this species (in terms of flow modification).

Kneria sp. 'kwena'
This species was not sampled in the study area during the current (August 2017) or previous surveys, and as indicated by Dr. Palmer it is highly unlikely to be present (due to their narrow elevation range preference).

4.6.3.2 General observations

Alien fish species
The presence of the alien Largemouth Bass (*Micropterus salmoides*) was confirmed at site J-03 during August 2017. This is an aggressive predatory species that may cause the eradication of especially small indigenous species (such as *Enteromius cf. anoplus/motebensis*). The further spreading and introduction of this and other alien species should be prohibited in this system. Unconfirmed reports of other alien species (Rainbow trout, Common carp) in the existing dam in the Devil Creek indicate that alien species may currently pose a threat to the indigenous fish assemblage of this stream (especially the *E. cf. anoplus/motebensis* population in reach B). Should the population be confirmed as *E. motebensis* (with a high conservation status), a management plan should be compiled for this species. The possible relocation of this species to Reach A (upstream of proposed dam) should also be further investigated (to avoid potential impact by alien fish as well as the activities related to the proposed dam).

Migration barriers
The waterfall within the upper reaches of the Devils Creek creates a natural migration barrier for fish movement, resulting in an absence of fish from the upper reaches (reach A). The proposed dam will therefore not impact on the natural migratory cycles of any fish species. An existing dam within the middle reaches however also created a permanent migration barrier that cannot be negotiated by any fish species. There is however no significant value in addressing this impact due to the short river reach present between the existing dam and the waterfall. This may furthermore also open access to unwanted predatory species (if not currently present in the existing dam and reach B).

Ecological Flow Requirements
1. The following statement is made in Nepid (2017) regarding Ecological Flow Requirements:
   "The Desktop Ecological Flow Requirement for a Category B ecological state at J-02 is an annual volume of 2.405 Mm^3. The analysis of the distribution of Chiloglanis pretoriae

in the Olifants River catchment found that this species needed a flow of at least 0.2 Mm^3 per annum (Rashleigh et al. 2009). The annual environmental flow recommended for Site J-02 is therefore eminently suitable for supporting this species".

It is uncertain whether the comparison of the total annual volume of different catchments (different catchment size, stream sizes, etc.) is valid to justify the said EWR for the indicator fish species.

2. *Amphilius uranoscopus* should be the primary indicator species (for reach B) and although its requirements may be very similar than *C. pretoriae*, this species is slightly bigger and may require slightly deeper habitats. Mention is made in Nepid (2017) that "small areas with current speeds exceeding 0.34 m/s will be available" (dry season). Only 1% fast-shallow and 4% very fast shallow habitats will be provided during the dry season maintenance flow of 36 l/s. It can be assumed that this will cause high stress on the *A. uranoscopus* population in reach B.

3. It can be assumed that the proposed dam will remove all high flows (floods) from reach B (and possibly reach C). This may reduce the flushing of sediments from substrates. *A. uranoscopus* especially requires clean rocky substrate and these should be maintained within this reach.

4. The discussion in Nepid (2017) refers to the EWR at site J-02, while the tables refer to J-01. It is uncertain which is correct. The EWR should be applicable at site J-02.

5. It is essential that should water be piped from the proposed dam that the EWR's within reach B be is still maintained.

4.6.4 DNA Analysis Study for *Enteromius motebensis/anoplus*, MTPA

Enteromius motebensis/anoplus of the Devils Creek River, Mpumalanga Tourism and Parks Agency by Dr Francois Roux, February 2018 (refer to Appendix 7.2):

4.6.4.1 Introduction

Fish species from upper (mountain) catchments are often unique but they are increasingly threatened by human impacts such as water abstraction, introduction of alien and invasive species and mining to mention but a few. In an attempt to adequately conserve these small, often overlooked species (especially those occurring in the small upper-catchment streams) it is critical to improvement our taxonomic knowledge and understanding of these species. With the development of genetic and molecular DNA analysis, it has become especially clear that the fish diversity of these (often isolated) headwater refugia need our urgent attention (Ellender *et al.*, 2017).

The taxonomy of various species within the *Enteromius*[2] genus is insufficiently known resulting in difficulties in the identification of these species (Van Ginneken *et al.*, 2017). There are furthermore often very little morphological differences between species of certain groups of small barbs which make it difficult to identify these species with certainty. This is especially true for the "Chubbyhead barbs" group (*Enteromius anoplus/motebensis*) and in a study done by Engelbrecht (1996) indicated that this group may potentially contain some new (undescribed) species. He also emphasised the importance of conserving genetic diversity and indicated the importance of the role of phylogenetic studies to identify genetically unique fish populations.

[2] Previously *Barbus*

Human activity in the Devils Creek area prompted the need to do the genetic study on the chubby head barb which occurs in the Devils Creek River in order to make well informed decisions on the future conservation of this species which may be a new species.

4.6.4.2 Material and Methods

4.6.4.2.1 Specimen selection

Twenty fish of the "Chubbyhead group of barbs" were collected at each of ten localities (Table 4.6.4.1). Five fish of each of the 10 localities were used for the collect of fin clips that were then preserved in absolute alcohol. A photograph of each fish was taken and the fish was then preserved in 10% formalin in a labelled plastic bottle. The fish samples and fin clips were taken to the University of Johannesburg for genetic analyses.

Table 4.6.5 Sample collection numbers and locality information of specimens collected for DNA analysis

Fish no:	Locality	Coordinates	Collected	Collector	Species
AH001	Potspruit	S 25°09'41.19" E 30°12'31.40"	25/08/17	A.Hoffman	BANO?BMOT?
AH002	Potspruit	S 25°09'41.19" E 30°12'31.40"	25/08/17	A.Hoffman	BANO?BMOT?
AH003	Potspruit	S 25°09'41.19" E 30°12'31.40"	25/08/17	A.Hoffman	BANO?BMOT?
AH004	Potspruit	S 25°09'41.19" E 30°12'31.40"	25/08/17	A.Hoffman	BANO?BMOT?
AH005	Potspruit	S 25°09'41.19" E 30°12'31.40"	25/08/17	A.Hoffman	BANO?BMOT?
AH006	Klein Dwars	S 25°13'10.05" E 30°01'30.01"	25/08/17	A.Hoffman	BANO?BMOT?
AH007	Klein Dwars	S 25°13'10.05" E 30°01'30.01"	25/08/17	A.Hoffman	BANO?BMOT?
AH008	Klein Dwars	S 25°13'10.05" E 30°01'30.01"	25/08/17	A.Hoffman	BANO?BMOT?
AH009	Klein Dwars	S 25°13'10.05" E 30°01'30.01"	25/08/17	A.Hoffman	BANO?BMOT?
AH010	Klein Dwars	S 25°13'10.05" E 30°01'30.01"	25/08/17	A.Hoffman	BANO?BMOT?
AH011	Groot Dwars	S25°04'44,22" E30°07'08,17"	24/08/17	A.Hoffman; F. Roux	BANO?BMOT?
AH012	Groot Dwars	S25°04'44,22" E30°07'08,17"	24/08/17	A.Hoffman; F. Roux	BANO?BMOT?
AH013	Groot Dwars	S25°04'44,22" E30°07'08,17"	24/08/17	A.Hoffman; F. Roux	BANO?BMOT?
AH014	Groot Dwars	S25°04'44,22" E30°07'08,17"	24/08/17	A.Hoffman; F. Roux	BANO?BMOT?
AH015	Groot Dwars	S25°04'44,22" E30°07'08,17"	24/08/17	A.Hoffman; F. Roux	BANO?BMOT?
AH016	Kareekraalspruit	S 25°26'27" E 30°12'43"	10/06/17	A.Hoffman; F. Roux	BANO?BMOT?
AH017	Kareekraalspruit	S 25°26'27" E 30°12'43"	10/06/17	A.Hoffman; F. Roux	BANO?BMOT?
AH018	Kareekraalspruit	S 25°26'27" E 30°12'43"	10/06/17	A.Hoffman; F. Roux	BANO?BMOT?
AH019	Kareekraalspruit	S 25°26'27" E 30°12'43"	10/06/17	A.Hoffman; F. Roux	BANO?BMOT?
AH020	Kareekraalspruit	S 25°26'27" E 30°12'43"	10/06/17	A.Hoffman; F. Roux	BANO?BMOT?
AH021	TKO spruit	S 25°09'33.67" E 30°10'22.37"	25/08/17	A.Hoffman	BANO?BMOT?

Fish no:	Locality	Coordinates	Collected	Collector	Species
AH022	TKO spruit	S 25°09'33.67" E 30°10'22.37"	25/08/17	A.Hoffman	BANO?BMOT?
AH023	TKO spruit	S 25°09'33.67" E 30°10'22.37"	25/08/17	A.Hoffman	BANO?BMOT?
AH024	TKO spruit	S 25°09'33.67" E 30°10'22.37"	25/08/17	A.Hoffman	BANO?BMOT?
AH025	TKO spruit	S 25°09'33.67" E 30°10'22.37"	25/08/17	A.Hoffman	BANO?BMOT?
AH026	Buffelskloofspruit	S 25°26'16" E 30°26'53"	20/07/17	A.Hoffman; F. Roux	BANO
AH027	Buffelskloofspruit	S 25°26'16" E 30°26'53"	20/07/17	A.Hoffman; F. Roux	BANO
AH028	Buffelskloofspruit	S 25°26'16" E 30°26'53"	20/07/17	A.Hoffman; F. Roux	BANO
AH029	Buffelskloofspruit	S 25°26'16" E 30°26'53"	20/07/17	A.Hoffman; F. Roux	BANO
AH030	Buffelskloofspruit	S 25°26'16" E 30°26'53"	20/07/17	A.Hoffman; F. Roux	BANO
AH031	Orighstadrivier	S 24°53'25.84 E 30°35'17.95	19/10/17	F. Roux	BANO?BMOT?
AH032	Orighstadrivier	S 24°53'25.84 E 30°35'17.95	19/10/17	F. Roux	BANO?BMOT?
AH033	Orighstadrivier	S 24°53'25.84 E 30°35'17.95	19/10/17	F. Roux	BANO?BMOT?
AH034	Orighstadrivier	S 24°53'25.84 E 30°35'17.95	19/10/17	F. Roux	BANO?BMOT?
AH035	Orighstadrivier	S 24°53'25.84 E 30°35'17.95	19/10/17	F. Roux	BANO?BMOT?
AH036	Devils Creek	S 25°25'11.3" E 30°35'57.9"	19/10/17	F. Roux	BANO
AH037	Devils Creek	S 25°25'11.3" E 30°35'57.9"	19/10/17	F. Roux	BANO
AH038	Devils Creek	S 25°25'11.3" E 30°35'57.9"	19/10/17	F. Roux	BANO
AH039	Devils Creek	S 25°25'11.3" E 30°35'57.9"	19/10/17	F. Roux	BANO
AH040	Devils Creek	S 25°25'11.3" E 30°35'57.9"	19/10/17	F. Roux	BANO
AH041	Kaaloog se Loop	S 25°46'35.82" E 26°26'02.28"	13/07/17	A.Hoffman	BMOT
AH042	Kaaloog se Loop	S 25°46'35.82" E 26°26'02.28"	13/07/17	A.Hoffman	BMOT
AH043	Kaaloog se Loop	S 25°46'35.82" E 26°26'02.28"	13/07/17	A.Hoffman	BMOT
AH044	Kaaloog se Loop	S 25°46'35.82" E 26°26'02.28"	13/07/17	A.Hoffman	BMOT
AH045	Kaaloog se Loop	S 25°46'35.82" E 26°26'02.28"	13/07/17	A.Hoffman	BMOT
AH046	Koffiespruit	S 25°59'40" E 28°39'46"	10/07/17	A.Hoffman	BANO
AH047	Koffiespruit	S 25°59'40" E 28°39'46"	10/07/17	A.Hoffman	BANO
AH048	Koffiespruit	S 25°59'40" E 28°39'46"	10/07/17	A.Hoffman	BANO
AH049	Koffiespruit	S 25°59'40" E 28°39'46"	10/07/17	A.Hoffman	BANO
AH050	Koffiespruit	S 25°59'40" E 28°39'46"	10/07/17	A.Hoffman	BANO

4.6.4.2.2 Genetic analysis

A set of 50 CO1 sequences of the specimens collected were generated by the African Centre for DNA Barcoding at the University of Johannesburg following internationally recognised standard methods.

A DNA matrix of 44 CO1 aligned sequences and three outgroups was formed and the matrix used to assemble a phylogenetic matrix.

The outgroups used are from previous similar studies and were *Labiobarbus lineatus* (KC631200), *Labiobarbus spilopleura* (JX074185) and *Labiobarbus fasciatus* (KU692576).

4.6.4.3 Results

The genetic results indicated that the populations from the Potspruit and the TKO Spruit may be the same species. The populations from the Kareekraalspruit and Orighstad River also seem to be the same species but different from the Potspruit/TKO Spruit species. There is furthermore strong evidence that these two species may also be different species than the other populations sampled.

The Devilscreek, Buffelskloof and Koffiespruit population, previously thought to be *Enteromius anoplus*, may also be three different species and most probably not *E. anoplus*. The phylogram indicated the presence of eight (potentially nine) distinct lineages, highlighting the possibility that there may in fact be eight to nine different fish species within the "Chubbyhead barb" group analysed as part of this assessment.

4.6.4.4 Discussion

CO1 is a universally accepted DNA barcode method for assessing animal groups (Hebert *et al*., 2003). Work done by Adeoba *et al*. (2018) confirmed that CO1 can be reliably used to distinguish between different species of the African Cyprinidae group of fish.

The Devils Creek population shows a greater genetic variation and interbreeding has not yet taken place. This upper catchment population with its greater genetic variation should be conserved to all cost. An in-depth morphological study on specimens of this population and fish of other similar populations, which will be supported by the findings of the genetic work, could lead to a practical key for the identifications of the possible different species.

Furthermore should specimens of *Enteromius anoplus* from the type locality, which is near Laingsburg in the Buffels River, Gouritz River system and the other populations be included in the genetic work done to indicate the relationship between that of the type locality and the other populations.

The results from the current study furthermore emphasised that it is of national (if not international) importance to gain a clear understanding of the status and ecology of the various populations (and potentially undescribed species) within the "Chubbyhead barb" group of South Africa, especially in areas where their existence is currently threatened by rapid development or spread of alien species.

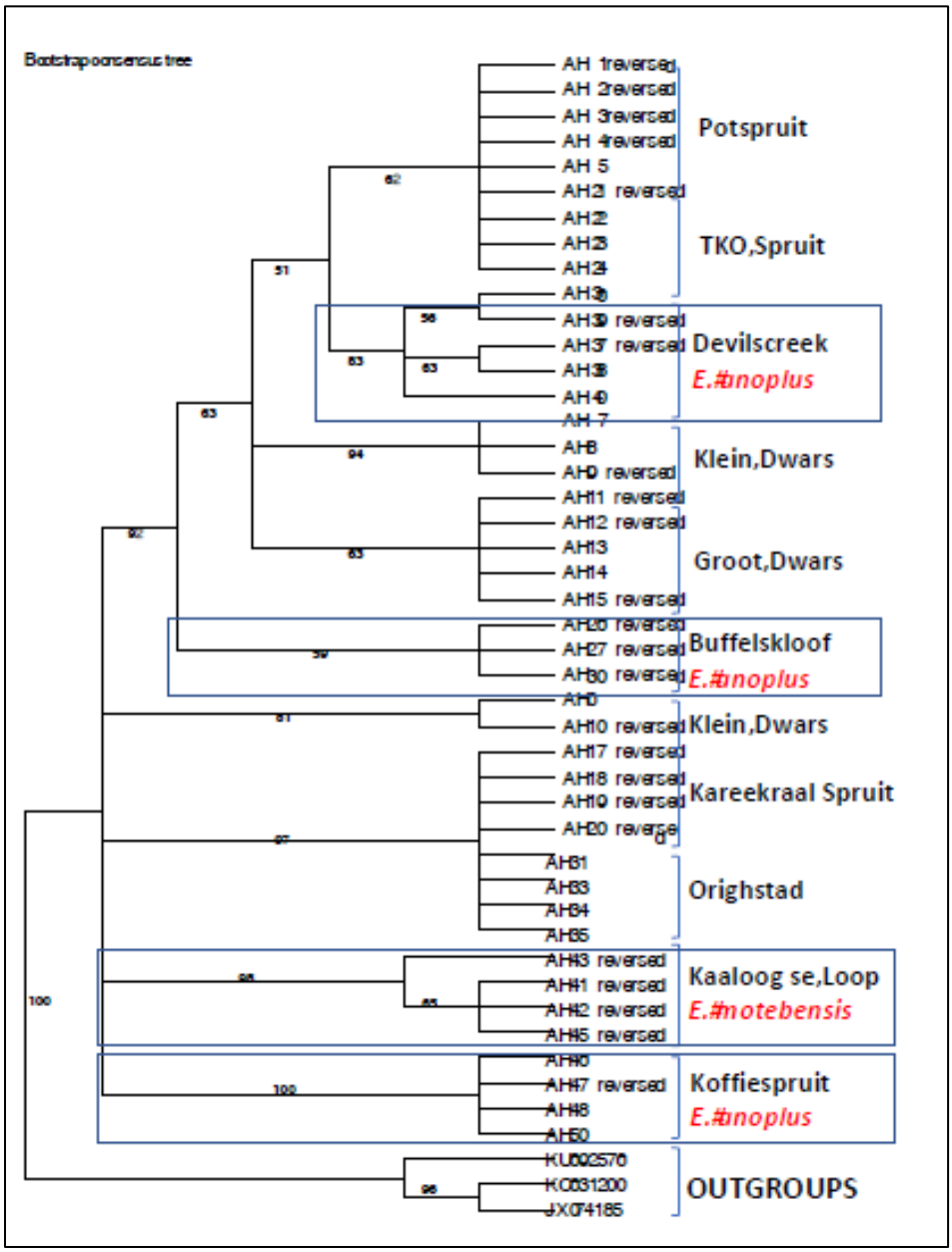

Figure 4.6.3 Maximum-likelihood phylogram based on partial sequences of the CO1 gene.

****Bootstrap support values were attained using a heuristic tree search and 1000 replicates. The boxed populations are clades that were identified as either E. anoplus or E. motebensis in the past.**

4.7 Wetland, Riparian and Terrestrial Ecology

The Mpumalanga Biodiversity Sector Plan (2014) classifies the site as a Critical Biodiversity Area in terms of Terrestrial Ecology and as an Important Sub-catchment - ESA Strategic Water Source Area.

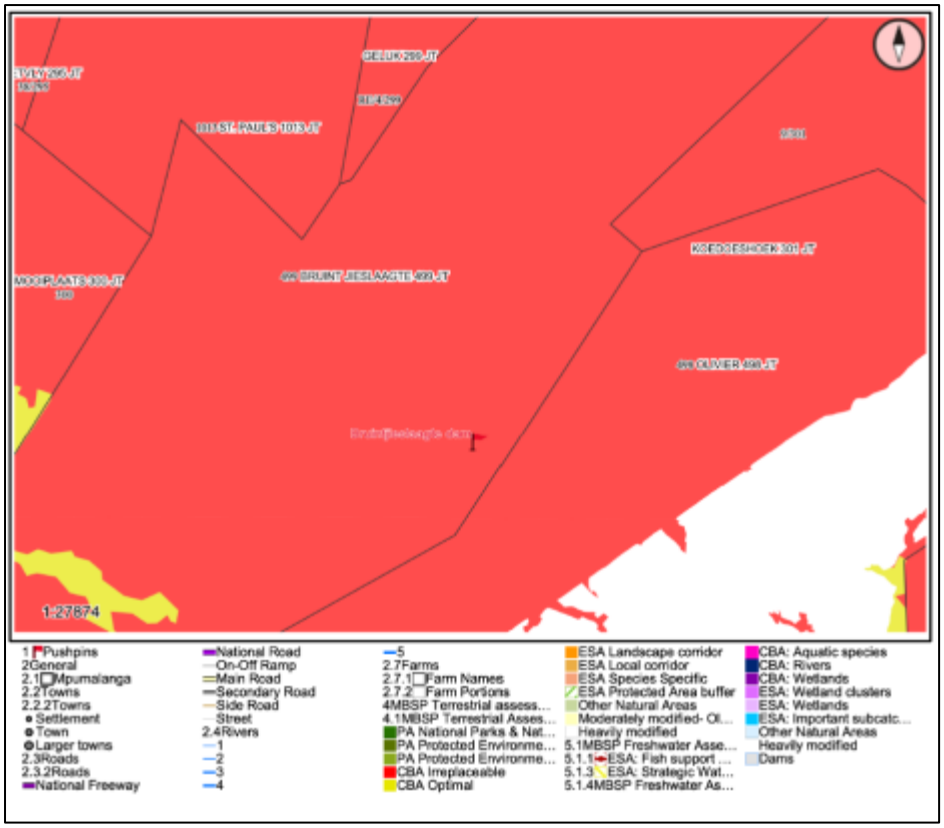

Figure 4.7.1 MBSP Terrestrial Assessment - Critical Biodiversity

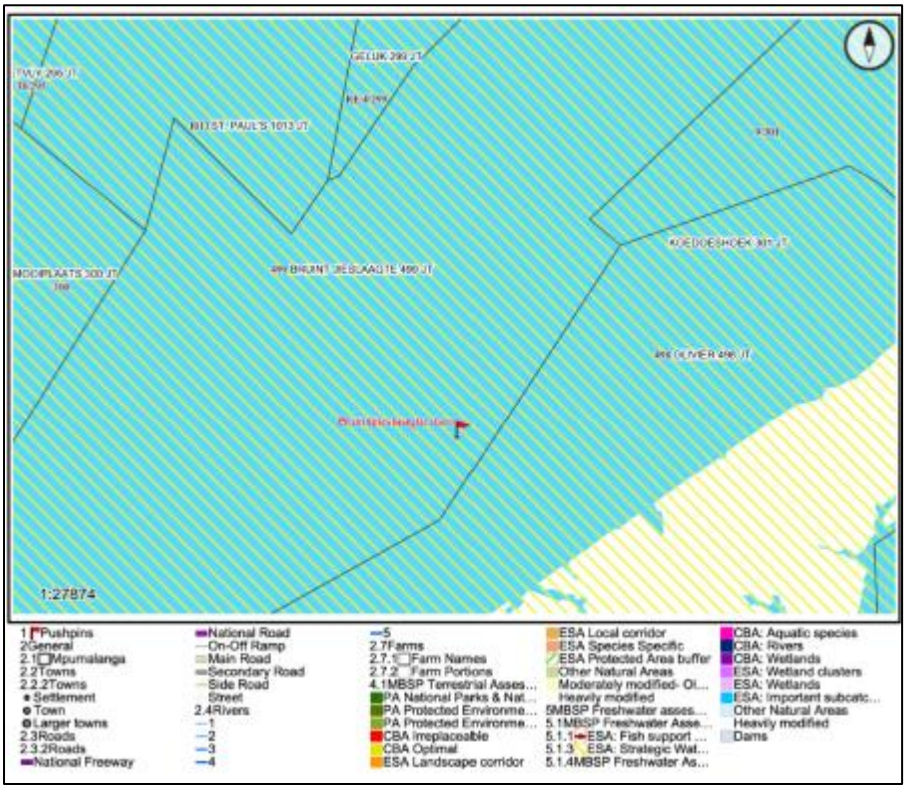

Figure 4.7.2 MBSP Aquatic Assessment - Important Sub-catchment - ESA Strategic Water Source Area

A Wetland Delineation, Present Ecological Status and Functional Assessment for wetland and riverine areas and terrestrial assessment for the proposed new dam upstream of the existing dam on the Devil's Creek River on the farm Bruintjieslaagte 465JT was done by EMROSS Consulting Pty Ltd and Taylor Environmental CC, 2017 (Refer to Appendix 10). This study was done to determine the ecological state of the site.

- **Wetland delineation, PES and Functional Assessment for wetland and riverine areas summary**

The method employed in this investigation is adapted from that suggested by the Mpumalanga Tourism and Parks Agency (MTPA), entitled "Minimum requirements for EMPRs when applying for authorisation for an activity that may have a detrimental effect on the environment". The riverine and riparian vegetation was assessed during field surveys in November and December 2016 using the VEGRAI 3 technique, along three transects of 154, 669 and 826m, respectively. An Ecological Category (EC) and Present Ecological Status (PES) for the riparian vegetation state were determined. A field survey was undertaken to identify any wetland areas on the site and to delineate the wetlands. GPS positions were taken at each survey point. The PES, Ecological Sensitivity and Functional Assessment were carried out using the Manual for the Assessment of Wetland Index of Habitat Integrity and WET-EcoServices. The ecological sensitivity of the area is based on available data and the results obtained in the field during the site visits in November and December 2016 and January and March 2017. The sensitivity is determined on a descriptive scale from Very Low to High. The significance of the impact of the proposed dam, in terms of construction, on the wetland, was estimated using the extent (spatial scale), magnitude and duration (time scale) of each impact. Mitigation measures were proposed.

A total of 60 species of plants were collected and identified along a 154m terrestrial and upper non-marginal zone transect, and 1495m marginal zone transect, in the area and along part of the Devil's Creek River on the footprint of the proposed site DP1. The only plant of conservation-importance collected was *Eucomis autumnalis* (Declining) along the terrestrial portion of the transects. The rest of the plants collected were determined to be of Least Concern, with the presence of 32 to be likely, the presence of 25 unlikely and three undetermined. Eight prominent species of alien plants collected included *Solanum mauritianum* (Bugweed), *Rubus cuneifolius* (American Bramble), *Bromus catharticus* (Rescue Grass), *Arundo donax* (Giant Reed), *Phaeoceros laevis* (Smooth hornwort), *Persicaria lapathifolia* (Pale Persicaria), *Ricinus communis* (Castor-oil Bush) and *Lantana camara* (Lantana).

As a result of the historic and present anthropogenic activity in the area, in terms of landuse and impact (vegetation removal, water quantity and water quality), the presence of alien vegetation and perceived change from the reference state (non- woody and woody cover and abundance in the marginal and non-marginal zones), it is estimated that the marginal vegetation has changed by 22.5% and the non- marginal vegetation by 26.3%, giving an overall VEGRAI Level 3 score of 76.1%, classified as an Ecological Category of a high C, or Moderately Modified. The Present Ecological Status (PES) may thus be described as being characterized by a system that has experienced a moderate loss of habitats, biota and basic ecosystems functioning. These figures represent the conditions along the more impacted right bank of the Devil's Creek River at site DP1. The relatively inaccessible left bank is less impacted and probably reflects conditions more closely associated with a PES of B (largely natural with few modifications).

The wetlands (4,1ha) delineated for site DP1 included:
(1) a broad seasonal wetland (Wetland A, 1,8ha),
(2) a permanent wetland (Wetland B, 0,8ha), situated below Wetland A,
(3) a temporary wetland (Wetland C, 0,8ha), separated from Wetland B by a rocky outcrop,

(4) a permanent wetland (Wetland D, 0,1ha) forming a narrow line into the Devil's Creek River and into which Wetland A drains, and
(5) a temporary wetland (Wetland E, 0,6ha), situated downstream of Wetland D and above the riparian area of the Devil's Creek River.

The overall Present Ecological Status (PES) of the wetlands at site DP1 using the Wetland-IHI Assessment was estimated to be Unmodified, Natural, with a score of 92,4% (Category A). The score for the vegetation alteration was 93,5% (A), for hydrology 96% (A), geomorphology 86% (B) and water quality 97% (A). The key characteristics of the assessed wetlands were (1) its small size relative to its overall catchment, (2) its channelled nature and the (3) pristine state of its catchment. These factors reduced its overall significance relative to the impact that construction of the dam site DP1 will have on ecosystem services and function. Its most significant ecosystem services related to erosion control, biodiversity maintenance and carbon storage. Streamflow regulation and flood attenuation services were identified as intermediate services.

- **Terrestrial Ecology Assessment Summary**

The vegetation was examined along four transects across / along the terrestrial zone of the footprint of the proposed dam. Representative plants visible across these transects were collected and/or identified and recorded. Information on the terrestrial flora as included in the initial report, and appropriate to the subsequent study and reporting, is also included here. Information from Whyte (2017) and incidental observations made during the initial study in November and December 2016, and January and March 2017, for the avifauna was employed in the subsequent study. Incidental observations were made on other biota (mammals, reptiles and amphibians). In addition, appropriate information was derived from Palmer (2017) on the amphibians.

Conservation-important biota as listed in a Species Status Report by the Mpumalanga Tourism and Parks Agency (MTPA) (November 2016) for relevant farms within topographic grid reference 2530BC, were specifically considered. The information and data derived above was subjected to an ecological sensitivity analysis.

The terrestrial area of the footprint of the proposed dam was divided into:
(1) Marginally Degraded Forested Woodland,
(2) Secondary Grassland and
(3) Riparian-Mistbelt Forest Ecotone

The marginally degraded forested woodland comprises patches of forest and grassland, with a total surface area of 1.63ha.Twenty-three species of dominant plants were identified, including the alien Solanum mauritianum. Twenty-four species of birds were identified for the forested patches.

Blue Swallows, listed as critically endangered within the borders of South Africa, were observed flying over the site on 4 separate field visits between November 2016 and March 2017. No nesting sites were found within the proposed dam footprint, although numerous aardvark burrows (potential breeding sites) were found, both within the proposed dam footprint and in the surrounding areas. The most likely nesting areas would be where the birds were seen displaying breeding flight behaviour and other areas within the undisturbed grasslands and outside of the wetland areas. Of the total dam catchment area of 34 510ha, the proposed dam will impact 14.7ha (0,04%), all of which represents suitable foraging habitat and 8,4ha of which represents low potential breeding habitat.

The area is impacted both historically and at present by anthropogenic activity (historical walled structures implying the use of the area for natural resource utilization and at present the presence of a gravel road through the area). The only conservation-important biotic

components identified (flying over the area of the dam footprint) was *Hirundo atrocaerulea* (Blue Swallow) and *Polemaetus bellicosus* (Martial Eagle). Whyte (2017) remarks that the vegetation communities that will be impacted represent only marginal foraging areas for the swallows and would also only represent a small fraction of the birds' total foraging area.

The Secondary Grassland comprises a small unbroken area of 1.86ha with seventeen species of dominant plants identified along the transect. Twenty-eight species of birds were identified for the grasslands / savanna area. Historical anthropogenic activity included contouring and the construction of earthen canals and berms. Anthropogenic activity is likely to have been the cultivation of crops and stock farming. The only conservation-important biotic components identified (flying over the area of the dam footprint) was *Hirundo atrocaerulea* (Blue Swallow) and *Polemaetus bellicosus* (Martial Eagle).

The Riparian-Mistbelt Forest Ecotone comprises 11.26ha of a combination of the riparian zone including wetlands (permanent, seasonal, temporary), ecotone and the adjacent terrestrial mistbelt forest. Sixty-two species of plants were identified along the transect and other transects employed during the initial study. Alien plants included *Ricinus communis, Rubus cuneifolius, Solanum mauritianus and Verbena bonariensis*. Forty-two species of birds were identified for the area. Historical anthropogenic activity includes contouring and the construction of earthen canals and berms. Anthropogenic activity is likely to have been the cultivation of crops and stock farming.

The conservation-important biotic components identified was *Hirundo atrocaerulea* (Blue Swallow) and *Polemaetus bellicosus* (Martial Eagle) (flying overhead) and the plant *Eucomis autumnalis* (Common Pineapple Lily) (Declining). MBSP (MTPA, 2014) classified the area of the terrestrial assessment as Other Natural Areas, CBA Optimal and CBA Irreplaceable. The ecological sensitivity of the Marginally Degraded Forested Woodland and Secondary Grassland was considered to be medium and the ecological sensitivity of the Riparian-Mistbelt Forest Ecotone medium to medium-high.

The impact of the loss of the vegetation in the Marginally Degraded Forested Woodland (area specific), Secondary Grasslands (area specific) and Riparian-Mistbelt Forest Ecotone (local extent) were all found to be of low magnitude, long term duration and may be considered to be of low significance. Mitigation measures are recommended for the negative impacts.

4.7.1 Riparian Vegetation and Wetland Assessment

4.7.1.1 Introduction

The vegetation at site DP1 site may be described as Northern Mistbelt (or Mpumalanga Mistbelt) Forest (FOZ4) (NMF), situated in the north-south orientated North Eastern and Mpumalanga escarpments. The tall moist evergreen forest occurs in the mistbelt at altitudes up to 1800 m (site DP1 at approximately 1110m), and semideciduous forest occurs as scrub or regrowth forest on the lower slopes and foothills and as riverine forest along the upper reaches of the main river systems (Geldenhuys, 2002). In the region of the site DP1 the mistbelt is surrounded by Lydenburg Montane Grasslands and Legogote Sour Bushveld.

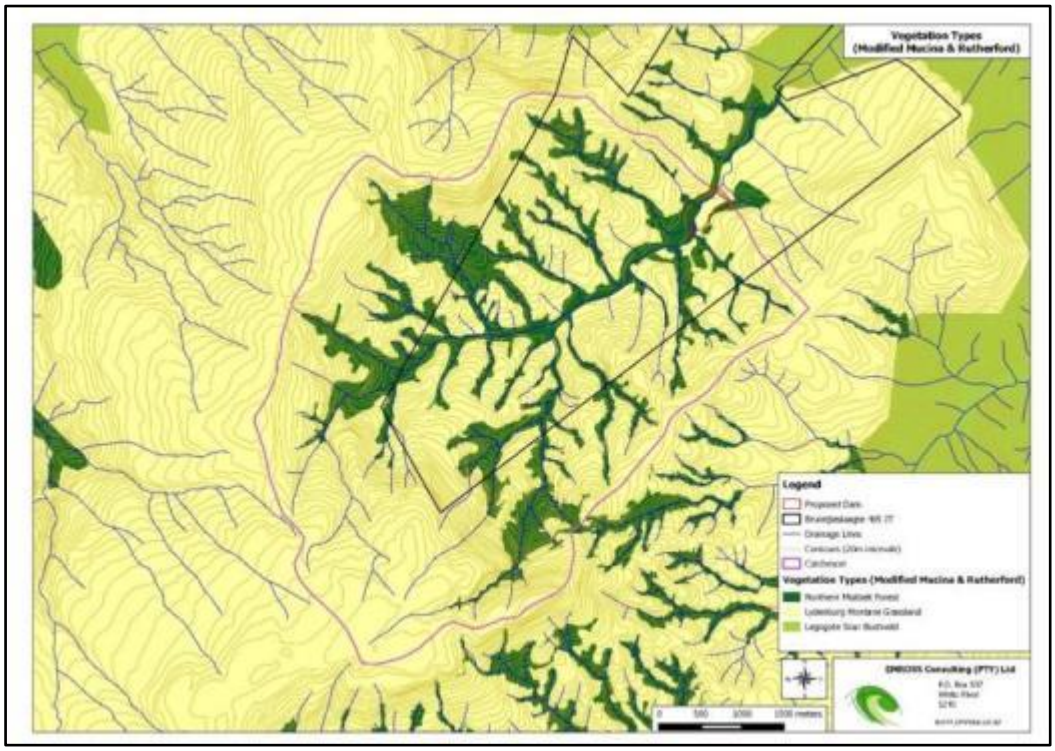

Figure 4.7.3 Vegetation, catchment and site map for proposed dam DP1

Biogeographically Important Taxa (Southern distribution limit, Endemic of Barberton Centre) includes *Anthocleista grandifloraS, Faurea galpinii* (tall trees), *Psychotria zombamontana*, *Coptosperma rhodesiacumS* (tall shrubs), Duvernoia adhatodoidesB, *Ensete ventricosum* (megaherbs), *Strelitzia caudata* (soft shrubs) and *Plectranthus swynnertonii* and *Sphaerocionium capillare* (herbs). Endemic Taxa include *Cryptocarya transvaalensis*, *Ochna gamostigmata* (tall trees), *Dombeya pulchra, Heteropyxis canescens* (small trees), *Mystacidium brayboniae* (epiphytic herb), *Pavetta barbertonensis* (tall shrub) and *Streptocarpus davyi, S. fenestra-dei, S. micranthus, S. parviflorus, S. roseo-albus, S. wilmsii* (geophytes) and *Clivia caulescens* (herbs).

In terms of Conservation Status the NMF is considered Least Threatened, with a Target of 30%. About 10% is statutorily conserved in Blyde River Canyon, Lekgalameetse, Songimvelo, Makobulaan, Malalotja, Nelshoogte, Barberton and Starvation Creek Nature Reserves. More than 25% enjoys protection in privately owned nature reserves, including for instance the Wolkberg Wilderness Area, and In- De-Diepte, Sudwala, Mac Mac, Buffelskloof and Mount Sheba areas. Aliens such as Solanum mauritianum, Caesalpinia decapetala, Acacia mearnsii and Lantana camara can be locally of concern.

Pine and eucalypt plantations and commercial farming areas surround the forests in many areas. All the forests were subjected to timber harvesting in the past, mainly for Small-leaved Yellowwood (*Afrocarpus falcatus*) and Broad-leaved Yellowwood (*Podocarpus latifolius*) (many saw pits are scattered throughout the forests in the mistbelt). Encroaching subsistence agriculture, firewood collection in communal areas, and selective harvesting of bark are viewed as serious threats (Geldenhuys, 2002).

Geology includes shales, quartzite, dolomite, granite and diabase. Highly weathered, clayey soils mainly of Avalon and Hutton soil forms are present, derived from shales (Pretoria Group), quartzite (Black Reef Formation), dolomite (Chuniespoort Group), granite (Nelspruit Basement) and diabase (Mokolian intrusives).

Annual rainfall varies from 1800 mm at higher altitude to 600 mm at lower altitudes. It is a summer rainfall area with a high incidence of mist precipitation at higher altitudes.

The Lydenburg Montane Grasslands (LMG) is classified as Vulnerable. The conservation target is 27%, with 2.4% formally protected within reserves (Gustav Klingbiel, Makobulaan, Mt Anderson, Ohrigstad Dam, Sterkspruit and Verlorenvlei) as well as in a number of private conservation areas (Buffelskoof, Crane Creek, In-de-Diepte, Kaalboom, Kalmoesfontein, Mbesan, Mondi Indigenous Forest, Mt Sheba, Waterval). The level of transformation is relatively high at 23% with mostly alien plantations (20%) and cultivated lands (2%). Erosion potential very low (74%) and low (12%) (Mucina and Rutherford 2006).

4.7.1.2 Description of the catchment

The catchment includes 19 short, steep-sloped 10 single channel streams and riverine valleys and adjacent high altitude (> 1117m amsl) grasslands. The 10 streams feed into a 20 stream, which comprises the main discharge of Devil's Creek into the Crocodile River, approximately 5.96km to the north-east. Historic anthropogenic activity in these upper catchment areas was limited to low impact crop cultivation and stock grazing. To the south of the affected stream is a large plantation. There is significant active anthropogenic activity downstream, including an in-stream dam and citrus farming.

The marginal zone of the 20 stream is narrow (single channel) to broader (braided channels) and is characterized by small chutes, riffles and boulder-bed and alluvial in-stream pools.

Photo 4.7.1 The marginal zone and section of non-marginal zone

The lower non-marginal zone along the Left Bank (LB) is short and steep and characterized by dense riverine woody vegetation. The zone is primarily undisturbed by anthropogenic activity and relatively inaccessible. The zone along the Right Bank (RB) is relatively flat and broader. There is historical anthropogenic activity along the RB. There is clear evidence of contouring and the construction of earthen canals and berms. The anthropogenic activity is likely to have been the cultivation of crops and stock farming.

As a result of the anthropogenic activity in the area and the concomitant changes to the riparian vegetation, it is estimated that the marginal vegetation has changed by 22.5% and the non-marginal vegetation by 26.3%, giving an overall VEGRAI Level 3 score of 76.1%, classified as an Ecological Category of a high C, or Moderately Modified. The Present Ecological Status (PES) may thus be described as being characterized by a system that has experienced a moderate loss of habitats, biota and basic ecosystems functioning.

Photo 4.7.2 Upper non-marginal and terrestrial zones adjacent to the Right Bank of the stream in the impact area of the dam

These figures represent the conditions along the more impacted right bank of the Devil's Creek River at site DP1. The relatively inaccessible left bank is less impacted and probably reflects conditions more closely associated with a PES of B (largely natural with few modifications).

4.7.1.3 Wetland delineation and the Wetland-IHI of the footprint of site

The wetlands were delineated from 28 final auger points within the proposed dam footprint (Figure 4.7.4). The delineation identified one HydroGeomorphic Unit (HGM unit) namely a valley bottom with a channel (HGM 1) covering an area of 4.1 ha.

The valley bottom consists of five wetland areas, namely,

(1) A broad seasonal wetland, 1.8 ha (Wetland A),
(2) A permanent wetland, 0.8 ha (Wetland B), situated below Wetland A,
(3) A temporary wetland, 0.8 ha (Wetland C), separated from Wetland B by a rocky outcrop,
(4) A permanent wetland, 0.1 ha (Wetland D) forming a narrow line into the Devil's Creek River and into which Wetland A drains, and,
(5) A temporary wetland, 0.6 ha (Wetland E), situated downstream of Wetland D and above the riparian area of the Devil's Creek River.

Wetland A (1.8ha):
This is a seasonal wetland that drains into wetlands B and D and into the Devil's Creek River. The wetland has been impacted historically by cultivation and an old farm road. The historic cultivation has impacted on the species diversity of the vegetation of the wetland. Alien plants *Lantana camara* (Lantana) and *Solanum mauritianum* (Bugweed) are present within the wetland. There is a farm road situated directly above the wetland and the remnants of an old farm road that went through the wetland. The roads do not have a significant impact on the functioning of the wetland system. Below the road there are remnants of a small furrow draining the wetland into Wetland D. This has an insignificant impact on Wetland A.

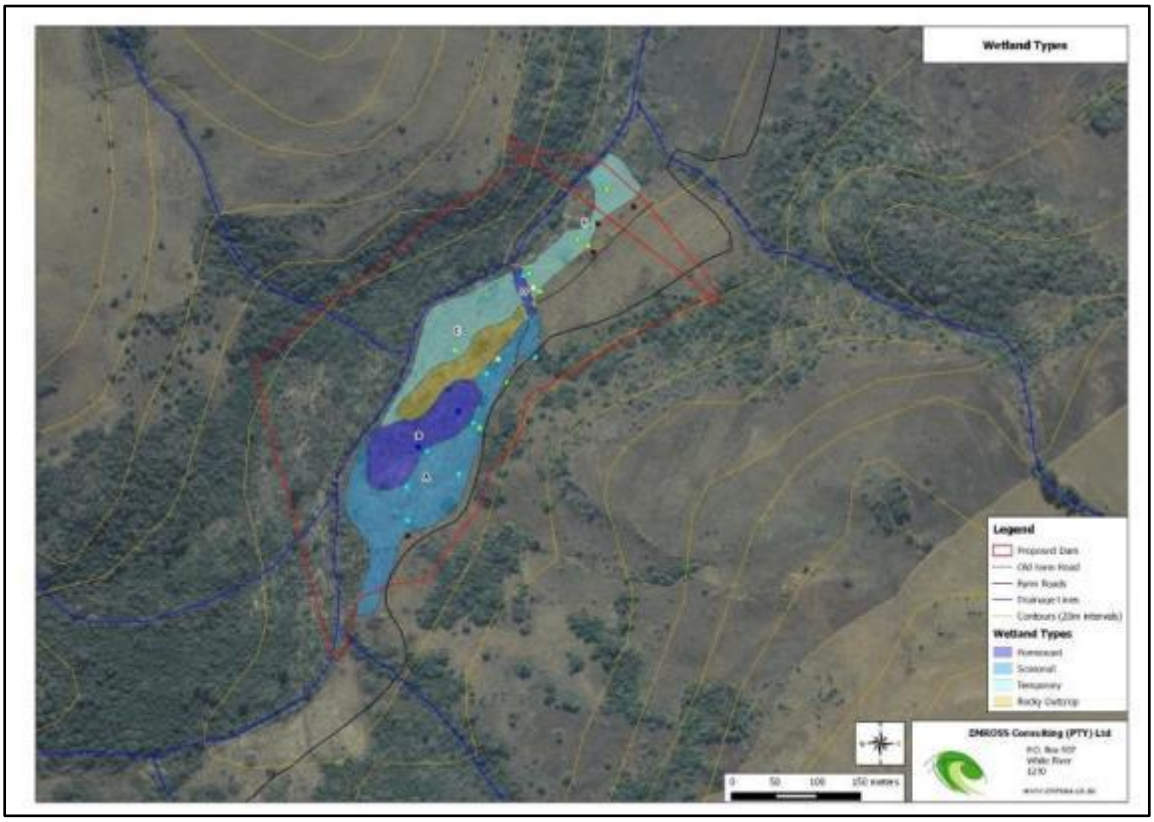

Figure 4.7.4 Wetlands delineation map

Wetland B (0.8ha):
This is a permanent wetland which is partially cut off from Wetland C by a rocky outcrop. The wetland drains into the lower section of Wetland A and into the Devil's Creek River. The wetland is relatively undisturbed.

Wetland C (0.8 ha):
This is a temporary wetland situated between a rocky ridge and the Devil's Creek River. The wetland is undisturbed.

Wetland D (0.1ha):
This is a channelled permanent wetland. The wetland has been impacted by an old farm road that crossed over the wetland area. The wetland drains wetlands A, B and C into the Devils' Creek River.

Wetland E (0.6 ha):
This is a temporary wetland that is situated above the riparian area of the Devil's Creek River. The wetland has been impacted by an old road running just above the wetland. The wetland is impacted by alien vegetation *L. camara* and *S. mauritianum*.

4.7.1.4 Wetland Ecological Functional Assessment

Wetlands provide a wide range of functional and ecosystem services to society. The level to which these services are provided depend on the type, size and environmental and social context of the wetland. The WET-EcoServices (Kotze et al, 2009) is a technique developed to assess the ecosystem services supplied by a wetland. The technique identifies and assesses indirect benefits such as flood attenuation, streamflow regulation, sediment trapping, erosion control, biodiversity maintenance and nitrate, phosphate and toxin

assimilation. Direct benefits such as the provision of water, harvestable resources and cultivated food, cultural significance, tourism and recreation, and education and research, are also considered.

The key characteristics of the assessed wetland were (1) its small size relative to its overall catchment, (2) its channelled nature and the (3) pristine state of its catchment. These factors reduced its overall significance. Its most significant ecosystem services related to erosion control, biodiversity maintenance and carbon storage (Table 4.5.1). Streamflow regulation and flood attenuation services were identified as intermediate services.

Table 4.7.1 Summary of Ecosystem Goods and Services and their importance for the Wetlands of the DP1

Ecosystem Services	Importance Score	Importance	Comment
Flood attenuation	1.5	Intermediate	Driven by slope of wetland and catchment and rainfall intensity.
Streamflow regulation	1.7	Intermediate	Driven by links to stream network.
Sediment trapping	1.0	Moderately Low	Limited services provided during flood events.
Nitrate removal	1.2	Moderately Low	Limited services provided during flood events.
Toxicant removal	1.6	Intermediate	Limited services provided during flood events.
Erosion control	3.3	High	Provided by wetland vegetation on erodible soils.
Carbon storage	2.3	Moderately High	Provided by hydrological zones and limited disturbance.
Biodiversity maintenance	2.6	Moderately High	Wetlands in high biodiversity area
Water supply	0.8	Moderately Low	Small size of wetland and no human use of wetland.
Natural resources	0.0	Low	Inaccessible access and no demand and small size of wetland.
Cultivated food	0.0	Low	Inaccessible access and no demand and small size of wetland.
Cultural significance	0.0	Low	None
Tourism and recreation	0.0	Low	Inaccessible access.
Education and research	0.0	Low	Inaccessible access.
Threats	0.0	Low	None
Opportunities	0.0	Low	None

4.7.1.5 The Present Ecological Status of the wetlands at dam site

The overall Present Ecological Status (PES) of the wetlands at DP1 using the Wetland-IHI Assessment was estimated to be Unmodified, Natural, with a score of 92,4% (Category A) (Table 4.7.2). The score for the vegetation alteration was 93,5% (A), for hydrology 96% (A), geomorphology 86% (B) and water quality 97% (A).

Table 4.7.2 Present Ecological Status (PES) of Wetlands using the Wetland-IHI Assessment

Driver	Score (%)	Category	Description	Confidence
Vegetation alteration	93,5	A	Unmodified, natural.	3,9
Hydrology	96	A	Unmodified, natural	3,7
Geomorphology	86	B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	3,0
Water quality	97,0	A	Unmodified, natural	3,0
Overall	92,4	A	Unmodified, natural	3,4

4.7.2 Terrestrial Ecology

Based on available information and data collected for the four transects, the terrestrial area of the footprint of the proposed dam was divided into (1) Secondary Grassland, (2) Riparian-Mistbelt Forest Ecotone and (3) Marginally Degraded Forested Woodland.

Type	Area - hectare
Riparian-Mistbelt Forest Ecotone	6.67
Wetlands	4.08
Wooded Low-Level Rocky Outcrop	0.51
Marginally Degraded Forest Woodland	1.63
Secondary Grassland	1.86
Total	14.75

4.7.2.1 Marginally Degraded Forested Woodland (1.63ha)

Plants identified include the trees and woody shrubs *Acacia sieberiana* (Paperbark Thorn), *Celtis africana* (White-stinkwood), Combretum kraussii (Forest Bushwillow*), Cussonia spicata* (Cabbage-tree), *Dalbergia armata* (Thorny-rope), *Diospyros whyteana* (Bladdernut), *Englerophytum natalense (Silver-leaved Milk plum), Euclea crispa (Guarri), Flehmingia grahamiana* (Stain-pod), *Psychotria capensis* (Bird-berry), *Searsia pyroides* (Common wild-currant) and *Syzygium cordatum* (Waterberry). Non- woody forbs and shrubs include *Dietes iridioides* (Small Forest Iris), the alien *Passiflora subpeltata* (White Passionflower) and *Triumfetta pilosa* (Burweed). Dominant graminoids include *Setaria sphacelata* (Golden Bristle Grass), *Themeda triandra* (Red Grass) and *Cymbopogon plurinodis* (Narrow-leaved Turpentine Grass). The alien *Solanum mauritianum* (Bugweed) was also found along the transect. Other than those already mentioned above, plants collected and / or identified along T4 included *Allophylus africanus* (African False Currant), *Bridelia micrantha* (Mitzeeri), *Canthium inerme* (Turkey-berry) and *Protorhus longifolia* (Red Beech). Generally speaking, the plants are all expected in the area because they are all found in a combination of conditions and environments that are riverine, mountain grasslands, at the base of escarpments and afromontane forests.

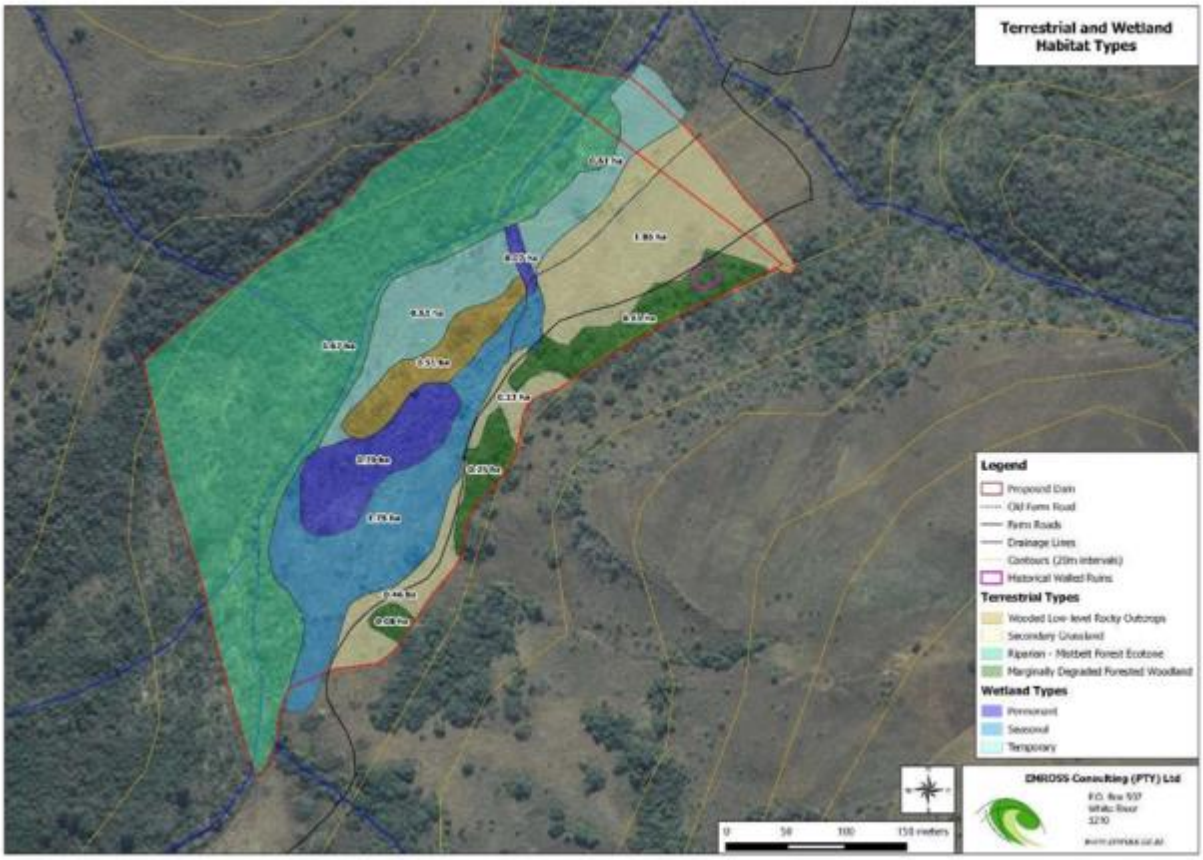

Figure 4.7.1 Footprint of the proposed dam and associated wetland and terrestrial areas

Canopy and understorey trees that are likely to be found in the area, albeit that the area is on the fringes of the distribution for most of these, include *Xymalos monospora* (Lemonwood), *Podocarpus latifolius* (Broad-leaved Yellowwood), *Combretum kraussii* (Forest Bushwillow), *Cryptocarya transvaalensis* (Mountain Wild-quince), *Schefflera umbellifera* (False Cabbage-tree), *Syzygium gerrardii* (Forest Waterberry), *Olea capensis subsp. macrocarpa* (Ironwood), *Psydrax obovata subsp. elliptica* (Mountain Quar), *Pterocelastrus galpinii* (Red Candlewood), *Psychotria zombamontana* (Red Bird-berry), *Canthium kuntzeanum* (Mountain Turkey-berry), *Gymnosporia harveyana* (Black Forest Spikethorn), *Peddiea africana* (Poison Olive), *Pavetta inandensis* (Forest Brides-bush) and *Sclerochiton harveyanus* (Blue-lips).

The area of the marginally degraded forested woodland (a total of 0.94ha) is characterized by very dense tall and short woody indigenous vegetation in a band along its eastern edge. The band of vegetation is broken by patches dominated by grasses (total of 0.69ha). Alien vegetation is present in the area. The area is impacted on its western side by historical and present-day anthropogenic activity, including a gravel road and a number of old walled structures. A stone-walled settlement exists in the terrestrial environment. It is probable that this settlement could be of the Bokoni people that were known to inhabit densely forested locations in ravine steep-sloped valley sides during times of conflict during the 18th Century.

All the plants found in the area are considered to be of Least Concern (redlist.sanbi.org; July 2017). None of the conservation-important plants as listed in the Species Status Report by the Mpumalanga Tourism and Parks Agency (MTPA) (November 2016) were found in the area.

4.7.2.2 The Secondary Grassland (1.86 ha)

The Transect T2, within the Secondary Grassland (1.86ha), begins from the gravel road and ends at the beginning of the non-marginal zone of the Devil's Creek river. Plants collected and / or identified along the transect include the trees and woody shrubs *Combretum kraussii*, *Dalbergia armata*, *Halleria lucida* (Tree Fuchsia), *Lippia javanica* (Fever-tea) and *Vachellia sieberiana*. Forbs, grasses and other non-woody plants included *Artemisia afra* (Wild Wormwood), *Bowkeria cymosa* (Escarpment Shell-flower), *Dietes irioides* (Small Forest Iris), *Eragrostis plana* (Tough Love Grass), *Gerbera ambigua*, *Hyparrhenia cymbaria*, *Cymbopogon plurinodis*, *Pteridium aquilinum* (Bracken Fern), *Rhoicissus tomentosa* (Wild Grape), *Senecio* sp, *Setaria sphacelata* and *Themeda triandra*.

There is historical anthropogenic activity in the secondary grassland area, including contouring and the construction of earthen canals and berms. The anthropogenic activity is likely to have been the cultivation of crops and stock farming (See Appendix A of the specialist report as well).

All the plants found in the area are considered to be of Least Concern (redlist.sanbi.org; July 2017). None of the conservation-important plants as listed in the Species Status Report by the Mpumalanga Tourism and Parks Agency (MTPA) (November 2016) were found in the area.

4.7.2.3 The Riparian – Mistbelt Forest Ecotone (11.26 ha including wetlands)

The riparian zone (non-marginal and marginal) associated with the Devil's Creek River is relatively flat and narrow along the right bank and extremely narrow and steep along the left bank. Access to the vegetation is extremely limited along the left bank. Given that the narrow riparian zone and dense mistbelt forest vegetation on the steep terrestrial slopes along the left bank are very closely associated, the area along the Devil's River is considered as a unit and is termed the Riparian-Mistbelt Forest Ecotone.

The woody vegetation in the ecotone is similar to that found in the marginally degraded forested woodland and also includes additional species as found in the riparian zone namely the woody *Buddleja salviifolia* (Sagewood), *Caledendron capense* (Cape-chestnut), *Calpurnia aurea* (Common Calpurnia), *Cassinopsis ilicifolia* (Lemonthorn) *Cliffortia nitidula* (Starry Rice-bush), *Clutea pulchella* (Lightning-bush), *Diospyros lycioides* (Quilted Bluebush), *Diospyros mespilliformis* (Jackal-berry), *Dombeya rotundifolia* (Wild Pear), *Hypericum revolutum* (Curry Bush), *Kigelia africana* (Sausage Tree), *Premnia mooiensis* (Skunk-bush), *Pentanisia prunelloides* (Broad- leaved Pentanisia), *Pterocarpus angolensis* (Kiaat), *Pterolobium stellatum* (Redwing), *Rhamnus prinoides* (Shiny-leaf), *Rhynchosia clivorum* (Shaggybush), *Rotheca myricoides* (Cat's Whiskers), *Scolopia zeyheri* (Thorn-pear), *Searsia dentata* (Nana- berry), *Senegalia caffra* (Common Hook-thorn), *Solanum anguivi* (Forest Bitterberry), *Strychnos mitis* (Yellow Bitterberry) and *Trimeria grandifolia* (Wild Mulberry).

Non-woody plants other than those already stated include *Asparagus virgatus* (Broom Asparagus), *Berkheya setifera* (Buffalo-tongue Thistle), *Dioscorea dregeana* (Wild Yam), *Hypoestes forskaolii* (White Ribbon Bush), *Scabiosa columbaria* (Wild Scabious), *Scadoxus puniceus* (Blood Flower), *Tragia cf ruprestis*, *Cyperus fastigiatus* (Tall slender sedge),

Schoenoplectus corymbosus (Tall cylindrical sedge), *Typha capensis* (Short Bulrush), *Sphagnum* sp, *Thelypteris confluens* (Scaly Lady Fern), *Aristida congesta* (Tassel Three-awn), *Phragmites australis* (Common Reed), and *Sporobolus fimbriatus* (Dropseed Grass).

Alien plant species found included *Ricinus communis* (Castor-oil Bush), *Rubus cuneifolius* (American Bramble), *Solanum mauritianum* and *Verbena bonariensis* (Purple Top).

As a result of the anthropogenic activity in the area and the concomitant changes to the riparian vegetation, it is estimated that the marginal vegetation has changed by 22.5% and the non-marginal vegetation by 26.3%, giving an overall VEGRAI Level 3 score of 76.1%, classified as an Ecological Category of a high C, or Moderately Modified. The Present Ecological Status (PES) may thus be described as being characterized by a system that has experienced a moderate loss of habitats, biota and basic ecosystems functioning. These figures represent the conditions along the more impacted right bank of the Devil's Creek River at site DP1. The relatively inaccessible left bank, and adjacent terrestrial zone is less impacted and probably reflects conditions more closely associated with a PES of B (largely natural with few modifications).

The only conservation-important plant that was identified was Eucomis autumnalis (Common Pineapple Lily) (Declining).

Nestled approximately in the centre of the footprint, surrounded by the temporary, seasonal and permanent wetlands is an area with a number of Low-level Rocky Outcrops dominated by woody vegetation. The vegetation is similar to that found in the Marginally Degraded Forested Woodland and Riparian-Mistbelt Forest Ecotone. One species found in the outcrop examined that had not been identified from any of the other areas was *Brachylaena transvaalensis* (Forest Silver-oak).

4.7.2.4 The Avifauna

Blue Swallows (*Hirundo atrocaerulea*) are classified globally as Vulnerable and nationally as Critically Endangered and South Africa's most endangered bird species (Hockey *et al*, 2005). The total global population is estimated between 1169 and 1338 pairs (Birdlife International, 2016), with South Africa's population being estimated at less than 40 pairs in 2011/12 (Birdlife International, 2016). The greatest threats to the birds are the destruction and fragmentation of their sour grassland habitat by commercial forestry and agriculture.
The Blue Swallow is an intra-Africa migratory species which breeds in the eastern highlands of South Africa and Zimbabwe, western Swaziland and Mozambique, highlands of Malawi, northeaster Zambia, south-western Tanzania, and southeaster Democratic Republic of Congo. It winters in north-eastern Democratic Republic of Congo, south Uganda northern Tanzania and western Kenya (Hockey *et al*, 2005).

In South Africa the birds are normally present from October to March with departure date dependent on breeding success (Hockey *et al*, 2005). Nests are a half-bowl of grass and evenly applied mud and lined with dry grass, feathers or fine roots. The nests are attached to the sides of Aardvark (*Orycteropus afer*) burrows, mine shafts, dongas, river banks or potholes. Within Mpumalanga the birds are known to nest near Kaapsehoop, Longtom Pass, and the grasslands near Graskop. Currently there are only 4 known nesting pairs within Mpumalanga (Lotter, *pers. comm*.).

Blue Swallows were observed flying over the site on 4 separate field visits. It is the first known recording of Blue Swallows within the 2530BC quarter degree square and the first for

the mountains above Schoemanskloof (South African Bird Atlas Project 2, http://sabap2.adu.org.za/).

Two separate sightings (1 male and a pair) were observed on the 22 November 2016 by Mr A. Emery and Dr L. Taylor, a single male was observed on the 7 December 2016 by Mr. A. Emery and Miss. L. Cohen, a single female, a single male and a pair performing courtship flight behaviour were seen on the 24 January 2017 by Mrs R. Theron, Miss J Newenham, Dr, I Whyte, Mr H Kammeyer and Mr A Emery and four were seen flying on the 14 March 2017 by Dr G Batchelor, Mrs R Luyt and Mr H Kammeyer.

The pair performing courtship flight behaviour was observed near the proposed dam footprint on the north-eastern grassland slopes approximately 350m to the northwest of the proposed dam wall and approximately 60m higher in altitude. The pair seen on the 22 November 2016 were seen near an open grassland wetland area above the proposed dam footprint. This area may provide the birds with a suitable mud collection point. The remaining sightings were of birds foraging in areas upstream of the dam footprint or within the dam footprint.

No nesting sites were found within the proposed dam footprint. Numerous aardvark burrows were found, both within the proposed dam footprint and in the areas surrounding the proposed development. The proposed dam will impact 14.7ha of the dam catchment area of 34 510ha (0.04%). The proposed dam site will impact on 14.7ha of foraging habitat and approximately 8.4 ha of low potential breeding habitat.

The birds forage on aerial insects by flying low over open intact mistbelt grasslands, particularly doing repeated flights up and down valleys. The valley and surrounding grasslands are therefore important for foraging. The dam will impact approximately 650m of the 6km long main valley above the waterfall.

In addition, the report on the avifauna at the site of the proposed dam by Whyte (2017) is also considered here. The methods employed by Whyte (2017) are described in the author's report on page 2.

Seven habitats were recognized, namely:
(1) the area of the footprint,
(2) the riparian zone from the existing dam to the to the footprint and above the footprint,
(3) grassland and / or savanna in the immediate area surrounding the dam,
(4) indigenous forest patches in the immediate area surrounding the dam,
(5) the existing lower man-made dam,
(6) aerial or species recorded flying overhead which might not be associated with a particular habitat and
(7) anthropogenic habitats.

Habitats (1), (2) and (6) may be considered synonymous with the Riparian-Mistbelt Forest Ecotone habitats (1), (3) and (6) with the Secondary Grassland and habitats (4) and (6) with the Marginally Degraded Forested Woodland Habitats (5) and (7) are not relevant to the footprint and immediate surrounds of the proposed dam.

A total of 60 species of birds were recorded (12 and 13th April 2017) for all seven habitats, with:

- 15 for the footprint (1),
- 34 for the riparian zone (2),

- 28 for the grassland / savanna (3),
- 24 for the forest patches (4) and
- 7 for the overhead environment (6).

A total of 13 species were recorded in habitats (5) and (7). The birds recorded were found in one to five of the habitats, depending on the species (Whyte, 2017). It must be noted that an additional 14 species of birds, including *Hirundo atrocaerulea* (Blue Swallow) was recorded on 24th January 2017. Whyte (2017) reports that a total of 58 other species of birds may be potentially present in the area, at some time or the other.

Two conservation-important bird species found in the area of the footprint was *Hirundo atrocaerulea* (Critically Endangered) and *Polemaetus bellicosus* (Martial Eagle) (Endangered). Other species of conservation importance that may be present include *Stephanoaetus coronatus* (Crowned Eagle) (regionally Vulnerable), *Sagittarius serpentarius* (Secretary Bird) (regionally Vulnerable) and *Alcedo semitorquata* (Half-collared Sunbird) (Near Threatened) (Whyte, 2017).

4.7.2.5 Other Vertebrata and Invertebrata

According to the Species Status Report, as derived from the Mpumalanga Parks and Tourism Agency (MTPA), for grid reference 2530BC, the following conservation- important vertebrates may be found on or near site DP1 on the Farm Bruintjieslaagte 465JT, or on neighbouring Farms Koedoeshoek 301JT, Geluk 299JT, Loopfontein 298JT, McKenzie 475JT, Mooiplaats 300JT, Olivier 498JT or St Paul's 1013JT, namely the fish *Chiloglanis bifurcus* (Incomati Suckermouth) and *Amphilius uranoscopus* (Common Mountain Catfish) (Lotter, pers. comm.) and mammals *Mellivora capensis* (Honey Badger) (Endangered, EN) and *Ourebia ourebi* (Oribi) (Near Threatened, NT). In addition, the butterfly *Aloeides nubilulus* (Cloud Copper) (EN) is also listed as present in the region (Lotter, *pers. comm.*). The present study did not include determining the fish species found in the Devil's Creek River, and no Honey Badgers or Oribis were observed. A significant number of burrows that may that of *Orycteropus afer* (Aardvark) were present throughout site DP1.

No further observations on other Vertebrata or Invertebrata were observed during the subsequent survey in June 2017, over and above that as reported for the initial study in Section 4.5.2. The only amphibian collected on the footprint was *Hadrophryne natalensis* (Natal Cascade Frog) (LC) (Palmer and Birkhead, 2017).

The conservation-important Mammalia, Reptilia, Amphibia and Invertebrata (in particular the Insecta) as listed in the Species Status Report by the Mpumalanga Tourism and Parks Agency (MTPA) (November 2016) for farms in the Quarter Degree Grid 2530BC include the following species:

(1) The bats *Cloeotis percivali* (Short-eared Trident Bat) (Critically Endangered, Cr) (Sudwalaaskraal 271JT), *Hipposideros caffer* (Sundevall's Roundleaf Bat) (Data Deficient, DD) (Sudwalaaskraal 271JT), *Miniopterus fraterculus* (Lesser Long-fingered Bat) (Near Threatened, NT) (Sudwalaaskraal 271JT), *Miniopterus natalensis* (Natal Long-fingered Bat) (NT) (Sudwalaaskraal 271JT), *Myotis tricolor* (Temminck's Myotis) (NT) (Sudwalaaskraal 271JT) , *Rhinolophus cohenae* (Cohen's Horseshoe Bat) (NE) (Mooifontein 292JT, Rietvalei 25JT, Sudwalaaskraal 271JT), *Rhinolophus clivosus* (Geoffroy's Horseshoe Bat) (NT) (Sudwalaaskraal 271JT) and *Rhinolophus dalingi* (Darling's Horseshoe Bat) (NT) (Sudwalaaskraal 271JT).

(2) Other mammals include *Cercopithecus mitis labiatus* (Samango Monkey) (Endangered, EN) (Uitkyk 264JT), *Leptailurus serval* (Serval) (NT) (Uitkyk 264JT), *Lycaon pictus* (African Wild Dog) (EN) (Elandshoogtr 270JT), *Mellivora capensis* (Honey Badger) (NT) (Geluk 299JT, Mooiplaats 300JT, Uitkyk 264JT), *Oeotragus oreotragus* (Klipspringer) (LC) (Uitkyk 264JT), *Orycteropus afer* (Aardvark) (LC) (Mooifontein 292JT) and *Ourebia ourebi* (Oribi) (EN) (Elandshoogte 270JT, In De Middel 293JT, Koedoeshoek 301JT, Loopfontein 298JT, Olivier 498JT, Sappi 307JT, Somerset 150 JT, Sudwalaaskraal 271JT, Weltevreden 257JT).

(3) The reptiles listed include *Afroedura multiporis haackei* (Multi-pored Rock Gecko) (LC in RSA, EN in Mpumalanga) (Elandshoek 302JT) and *Platysaurus intermedius wilhelmi* (Wilhelm's Flat Lizard) (LC, NT).

(4) The only invertebrate considered is the butterfly *Aloeides nubulis* (Cloud Copper) (EN) (information from M. Lotter, pers. comm.).

4.7.2.6 Conservation-importance of the footprint of site DP1

The conservation-status of the footprint of site DP1, as considered by MPTA (2014) in the MBSP (2014), is classified as CBA Irreplaceable. This would also be the case for sites DP2 and DP3 as described in Section 1. It is also noteworthy to state that the area in the lower reaches of the Devil's Creek River, before the river passes under the Road R539, and into the Crocodile River, is also considered CBA Irreplaceable and an ESA Protection Area Buffer. At present this area is heavily modified by anthropogenic activity (citrus farming). The area between the R539 and the Crocodile River is classified as Heavily Modified, and is also under citrus cultivation. The area upstream of all three sites does include one (188,917ha) that is classified as CBA Optimal. A further area (527,275ha) to the west of this is also classified as CBA Optimal. An area to the east of the three sites (246,924ha) is under forestation and thus classified as Heavily Modified.

4.7.2.7 Ecological Sensitivity Analysis for site DP1

In order to determine the Ecological Sensitivity of site DP1 and its environs, an analysis was undertaken for (1) the area upstream of site DP1 (which would include site DP3 nearly adjacent to site DP1), (2) site DP1 itself and (3) downstream of site DP1 (including site DP2 and the existing in-stream dam) as far as the confluence of the Devil's Creek River with the Crocodile River (Table 4.7.1).

The Ecological Sensitivity of the area upstream of site DP1 is considered to be Medium-High to High, with high ecological significance and ecological functions varying from that with few modifications to unmodified. Given the proposed in-stream dam, the existing dam downstream of that and the heavily modified areas in the lower reaches of the Devil's River as far as the confluence with the Crocodile River, it is essential that the entire catchment above site DP1 be maintained in a near-unmodified to unmodified state in the future. It should be a requirement of the Environmental Authorization for the present project that this be the case. In addition, given that there is the presence of *H. atrocaerulea* in the catchment, the Environmental Authorization, and hence Environmental Management Plan, must include measures to protect the Blue Swallows in the catchment.

In the case of site DP1 the Ecological Sensitivity is considered to be Medium to Medium-High, with medium to high ecological significance and ecological functions varying from medium to largely natural with few modifications. Although there is evidence of historical anthropogenic activity at site DP1, the riparian vegetation is diverse. In order to mitigate against the loss of plants of conservation-importance that are present on the footprint of site DP1, it is essential that a conservation-important plant (*Eucomis autumnalis* and *Encephalartos humulis*, amongst others) walk-through and rescue plan be established and

implemented prior to construction. In addition, the management plan to protect the Blue Swallow must also include the area around site DP1.

Downstream of site DP1 the Ecological Sensitivity is considered to be Low to Medium-Low. There is significant anthropogenic activity, which includes an area in which indigenous game animals are stocked, the existing in-stream dam in the Devil's Creek River is present and citrus farming to the confluence of the Devil's Creek River with the Crocodile River.

Table 4.7.1 Ecological Sensitivity Analysis for the area upstream, the footprint at site DP1 and the area downstream, in Devil's Creek River

Part of development site and environs	Ecological sensitivity	Description	Comment
Upstream (Devil's Creek River) of the wetted area of site DP1	Medium-High to High	High ecological significance with ecological functions varying from that with few modifications to unmodified.	(1) Large catchment area of nearly 35 500ha of undisturbed, natural NMF and LMG (PES not determined). (2) Potential foraging and breeding areas for *Hirundo.atrocaerulea* (Blue Swallow). (3) MBSP (MTPA, 2014) classification of area as CBA Optimal and CBA Irreplaceable.
The wetted area of site DP1	Medium to Medium-High	Medium to high ecological significance, with ecological functions varying from medium to largely natural with few modifications.	(1) Footprint of proposed dam small (14,7ha), (2) RB VEGRAI Level 3 score of 76,1%, EC of high C, Moderately Modified, (3) Presence of *Eucomis autumnalis* (Pineapple Lily), Declining, (4) LB not assessed due to inaccessibility, steep sloped, narrow marginal and non-marginal zone, probably EC of B, Largely Natural with few modifications, (5) Five wetland areas (4,1ha) along RB, including permanent, seasonal and temporary ones, (6) Reduced significance of wetlands because (i) wetlands of small size, (ii) channelled nature and (iii) pristine state of the large catchment (34510ha), (7) Wetland-IHI PES score of 92,4%, EC of A, Unmodified, natural. (8) Presence of *Hirundo atrocaerulea* (Blue Swallow), Endangered. (9) MBSP (MTPA, 2014) classification of area as CBA Irreplaceable

Part of development site and environs	Ecological sensitivity	Description	Comment
Downstream (Devil's Creek River) of the dam wall of site DP1	Low to Medium-Low	Low to medium ecological significance with ecological functions largely modified to highly transformed and dominated by agriculture development.	1) Based on a visual comparison with the wetted area of site DP1, the area downstream in all likelihood will have a VEGRAI Level 3 EC of C or D, implying Moderately (upper reaches) to Largely (lower reaches) Modified conditions, where as much as a large loss of habitats, biota and basic ecosystem function has occurred. (2) Although the MBSP classifies the area as CBA Irreplaceable and an ESA Protection Area Buffer upstream of the R539 and Heavily Modified downstream of the R539, the rapid increase in citrus farming in the area recently would make the latter classification more realistic. (3) There is an existing In-stream dam in the Devil's Creek River in this area.

4.7.2.8 Ecological Sensitivity - Terrestrial Assessment

Based on the initial field surveys of November and December 2016, and the subsequent survey conducted in June 2017, and other relevant information as described in Section 4, the terrestrial areas Marginally Degraded Forested Woodland, Secondary Grassland and Riparian-Mistbelt Forest Ecotone as demarcated during the subsequent study was subjected to an ecological sensitivity analysis. Both the Marginally Degraded Forested Woodland and Secondary Grassland on the footprint of the proposed dam are considered to have medium ecological sensitivity, where ecological functions are moderately modified. In the case of the Riparian-Mistbelt Forest Ecotone the ecological sensitivity is considered to be medium to medium-high, where ecological functions vary from medium to largely natural with few modifications.

Table 4.7.2 The Terrestrial Ecological Sensitivity Analysis for the dam footprint area

Part of development site and environs	Ecological sensitivity	Description	Comment
Marginally Degraded Forested Woodland	Medium	Medium Ecological Significance. Ecological functions moderately modified.	1) Area comprises patches of forest and grassland, with a total surface area of 1.63ha. (2) Twenty-two species of dominant plants identified along the transects T1 and T4. Alien *Solanum mauritianum* present. (3) Twenty-four species of birds identified for the forested patches (Whyte, 2017). Birds identified overhead not considered. (4) The area is impacted both historically and at present by anthropogenic activity (historical walled structures implying the use of the area for natural resource utilization and at present the presence of a gravel road through the area). (5) The only conservation-important biotic component identified (flying over the area of the dam footprint) was *Hirundo.atrocaerulea* (Blue Swallow). (6) Whyte (2017) remarks that the vegetation communities that will be impacted represent only

Part of development site and environs	Ecological sensitivity	Description	Comment
			marginal foraging areas for the swallows and would also only represent a small fraction of the birds' total foraging area. (7) MBSP (MTPA, 2014) classification of the area in parts as Other Natural Areas, CBA Optimal and CBA Irreplaceable.
Secondary Grassland	Medium	Medium Ecological Significance. Ecological functions moderately modified.	(1) Small unbroken area of 1.86ha. (2) Seventeen species of dominant plants identified along transect T2. (3) Twenty-eight species of birds identified for the grasslands / savanna area of the footprint of the proposed dam (Whyte, 2017). Birds identified overhead not considered. (4) Historical anthropogenic activity including contouring and the construction of earthen canals and berms. Anthropogenic activity is likely to have been the cultivation of crops and stock farming. (5) The only conservation-important biotic component identified (flying over the area of the dam footprint) was *Hirundo.atrocaerulea* (Blue Swallow). (6) Whyte (2017) remarks that the vegetation communities that will be impacted represent only marginal foraging areas for the swallows and would also only represent a small fraction of the birds' total foraging area. (7) MBSP (MTPA, 2014) classification of the area as CBA Irreplaceable
The Riparian-Mistbelt Forest Ecotone	Medium to Medium-High	Medium to high ecological significance, with ecological functions varying from medium to largely natural with few modifications.	(1) Area comprises 11.26ha of a combination of the riparian zone including wetlands (permanent, seasonal, temporary), ecotone and the adjacent terrestrial mistbelt forest. (2) Sixty-two species of plants were identified along transect T3, and other transects employed during the initial study. Aliens included *Ricinus communis*, *Rubus cuneifolius*, *Solanum mauritianus* and *Verbena bonariensis*. (3) Forty-two species of birds were identified for the area (Whyte, 2017). Birds identified overhead not considered. (4) Historical anthropogenic activity including contouring and the construction of earthen canals and berms. Anthropogenic activity is likely to have been the cultivation of crops and stock farming. (5) The conservation-important biotic components identified was *Hirundo.atrocaerulea* (Blue Swallow) (flying overhead) and *Eucomis autumnalis* (Common Pineapple Lily) (Declining). (6) Whyte (2017) remarks that the vegetation communities that will be impacted represent only marginal foraging areas for the swallows and would also only represent a small fraction of the birds' total foraging area. (7) RB VEGRAI Level 3 score of 76,1%, EC of high C, Moderately Modified, (8) LB not assessed due to inaccessibility, steep sloped, narrow marginal and non-marginal zone, probably EC of B, Largely Natural with few

Part of development site and environs	Ecological sensitivity	Description	Comment
			modifications, (9) Five wetland areas (4,1ha) along RB, including permanent, seasonal and temporary ones, (10) Reduced significance of wetlands because (i) wetlands of small size, (ii) channelled nature and (iii) pristine state of the large catchment(34510ha) (11) Wetland-IHI PES score of 92,4%, EC of A, Unmodified, natural. (12) MBSP (MTPA, 2014) classification of area as CBA Irreplaceable.

4.8 Avifauna

An assessment of the impact of the proposed "Bruintjieslaagte" dam on the avifaunal populations in the immediate area of the site in the Schoeman's kloof valley, Mpumalanga province was done by Dr *Ian Whyte, 12 and 13 April 2017 (Refer to Appendix 6.1).* Following is abstracts from the specialist report:

In the early stages of the Environmental Impact Assessment (EIA) process concerned with the development of this new "Bruintjieslaagte" Dam, Blue Swallows *(Hirundo atrocaerulea)* had unexpectedly been recorded in the area of the proposed dam site. This was a new locality for this species, as it was previously not known to occur there. This species is Red Data listed as Critically Endangered (Taylor, Peacock & Wanless 2015). This initiated a visit to the site to confirm their presence at the site and to make recommendations (Whyte 2017). Subsequently, it was then decided that a more comprehensive avifauna study/impact assessment for the BLG area should be conducted.

4.8.1 Timing of the survey

It is recognised that the optimum time to conduct such monitoring is in the early summer months (November and early December) as all of the migrant species have by then arrived for the austral summer, and breeding and territorial calling and displays for most species are at their peak. Surveying on the BLG site was conducted on 12th and 13th April 2017, but at this late stage of the summer, the breeding activities of most species had been concluded, and calling and territorial displays were no longer part of the birds' activities. Bird calls are the major source of data on such surveys, as the bird does not have to be seen to be recorded. The birds also did not respond readily to recorded sounds, so detecting the various species was far less effective, which affected the quality of the survey.

This survey was therefore not conducted at the optimum time, so in order to gain a more representative list of species occurring on the site, other data sources were accessed. These include a list from an earlier visit to the site by me on Tuesday 24th January 2017 which was submitted to the South African Bird Atlas Project (SABAP), a list from Mr Anthony Emery compiled during his earlier visits, and data accessed from the SABAP database submitted by other independent observers. Some of the data from this database originate from the earlier Bird Atlas Project (SABAP**1**) which used quarter degree squares (QDGC) as the basic mapping units. The Government Survey map reference for the Bruintjieslaagte site is the 1:50 000 Quarter degree square map 2530BC Boshalte. The SABAP**1** data was derived

from the whole area while data from SABAP**2** were recorded pentad. A pentad is a 3 x 3 subdivision of a QDGC. Relevant pentad numbers for BLG are 2525_3030 and 2525_3035. The SABAP**1** data may therefore not be entirely representative of the avifauna of BLG, but the majority of these species will almost certainly be recorded there over time.

4.8.2 Habitat types

From an avian perspective, seven habitat types were identified. These are:

- The area of the "footprint" of the dam, or the area that will be inundated when the dam is full, and includes the dam wall construction.
- The riparian zone both upstream and downstream as far as the existing dam (± 2.7 km).
- The grassland and/or savanna in the immediate area surrounding the dam.
- Indigenous forest patches in the immediate area surrounding the dam.
- The existing lower man-made dam.
- Aerial or species recorded flying overhead which might not be associated with a particular habitat.
- Other habitats: Anthropogenic habitats (habitats created or altered by man such as living areas, office complexes with lawns, orchards and gardens).

The extensive mist belt grassland above the dam site was not included in the survey, as they lie at higher altitudes which are above the area of impact.

4.8.3 Birds recorded during the survey

A total of just 60 species was recorded during the two surveying days (see Table 4.8.1.). This was fewer than might have been expected, which is certainly due to the late timing of the survey. The species recorded were all those which would have been expected to occur on the site, and none were of particular conservation interest. The species list must be seen as minimal as it is expected that many more species would be shown to occur at the site over time.

In Table 4.8.1, the right hand column indicates the number of habitats in which each species was recorded. This serves as an indication of abundance. Low recording rates are an indication of rarity, cryptic habits or a high degree of habitat specificity (e.g.). High recording rates indicate conspicuous, common species which occur over a wide range of habitats (e.g. Dark-capped Bulbul, Sombre Greenbul, Black-backed Puffback and Red-eyed Dove).
Totals on the bottom line of the table indicate the species richness of each habitat. Clearly, the riparian zones, followed by the savanna / grasslands are the most important in terms of species richness.

The following 14 additional species were recorded during my earlier visit on 24th January 2017 but not during this survey. They have not been included in Table 1 as they were not recorded in the habitats specified in the above table, but are included in the section on "Status":

- Cuckoo, African Emerald
- Cuckoo, Black
- Cuckoo, Red-chested
- Eagle, Martial
- Goose, Egyptian

- Grassbird, Cape
- Martin, Common House
- Neddicky
- Pigeon, African Olive
- Swallow, Barn
- Swallow, Blue
- Swift, Black
- Swift, Palm
- Waxbill, Common

In addition, a list of species recorded by Mr Anthony Emery on his respective visits to the site included another three not recorded by me. They too are included in the section on "Status": Swallow, Lesser-striped; Dove, Laughing; and Sunbird, Amethyst.

Table 4.8.1 Bird Species recorded during survey

No.	SPECIES	Footprint	Riparian	Savanna/Grassland	Forest Patches	Lower Dam	Overhead	Other	HABITAT TOTALS
1	Apalis, Bar-throated	1	1	1	1				4
2	Apalis, Yellow-breasted	1	1	1	1				4
3	Barbet, Black-collared		1		1				2
4	Batis, Cape		1		1				2
5	Bee-eater, European						1		1
6	Boubou, Southern	1	1		1				3
7	Brownbul, Terrestrial				1				1
8	Bulbul, Dark-capped	1	1	1	1	1		1	6
9	Bush-shrike, Olive		1		1				2
10	Bush-shrike, Orange-breasted		1	1					2
11	Buzzard, Jackal			1			1		2
12	Camaroptera, Green-backed	1	1		1				3
13	Canary, Cape			1					1
14	Canary, Yellow-fronted			1					1
15	Cisticola, Lazy			1					1
16	Cuckooshrike, Grey		1						1
17	Dove, Red-eyed	1	1	1	1				4
18	Drongo, Fork-tailed	1	1	1					3
19	Duck, African Black		1						1
20	Firefinch, African	1	1	1					3
21	Flycatcher, Ashy		1						1
22	Goshawk, African				1			1	2
23	Greenbul, Sombre	1	1		1				3
24	Honeyguide, Scaly-throated				1				1
25	Ibis, Hadeda					1	1	1	3
26	Kingfisher, Brown-hooded		1						1
27	Masked-weaver, Southern	1		1					2

No.	SPECIES	Footprint	Riparian	Savanna/Grassland	Forest Patches	Lower Dam	Overhead	Other	HABITAT TOTALS
28	Mousebird, Red-faced			1					1
29	Mousebird, Speckled		1						1
30	Nightjar, Fiery-necked			1					1
31	Olive-pigeon, African		1				1		2
32	Oriole, Black-headed		1		1				2
33	Pipit, African			1					1
34	Prinia, Tawny-flanked	1		1	1				3
35	Puffback, Black-backed	1	1	1	1			1	5
36	Robin-chat, Cape				1				1
37	Robin-chat, Red-capped				1				1
38	Saw-wing, Black		1		1		1	1	4
39	Scimitarbill, Common		1	1					2
40	Scrub-robin, White-browed			1	1				2
41	Sparrow, South. Grey-headed							1	1
42	Spurfowl, Natal	1	1	1					3
43	Spurfowl, Swainson's		1	1					2
44	Starling, Red-winged		1					1	2
45	Sunbird, Malachite		1						1
46	Swallow, White-throated					1	1		2
47	Tchagra, Black-crowned		1	1					2
48	Tinkerbird, Yellow-fronted		1		1				2
49	Turaco, Knysna		1		1				2
50	Turaco, Purple-crested		1		1				2
51	Turtle-dove, Cape	1		1					2
52	Wagtail, Cape							1	1
53	Wagtail, Pied					1			1
54	Waxbill, Swee			1					1
55	Weaver, Golden			1					1
56	White-eye, Cape		1		1				2
57	Whydah, Pin-tailed			1				1	2
58	Widowbird, Red-collared	1		1					2
59	Wood-dove, Emerald-spotted		1	1					2
60	Woodpecker, Olive		1						1
	SPECIES TOTALS:	**15**	**34**	**28**	**24**	**4**	**6**	**9**	

4.8.4 Status of red data species which occur or possibly occur on Bruintjieslaagte

The World Conservation Union (IUCN) has defined seven categories of vulnerability (Gärdenfors et al. 1994; IUCN 1994). These are as follows: *"Extinct"; "Extinct in the wild"; "Critically Endangered"; "Endangered"; Vulnerable"; "Near-Threatened"* and *"Least Concern"*. The first two categories are not applicable to this report, but the remaining categories are of

relevance here. The Red Data Lists have recently been updated by Taylor, Peacock & Wanless (2015). Four Red data species have been recorded on BLG. Their status on the plantation is discussed in a bit more detail.

4.8.4.1 Critically Endangered Species (CR)

Blue Swallow *(Hirundo atrocaerulea)*

Justification for Red list classification: This species satisfies the population size criteria for Regionally Critically Endangered (population numbers <250 individuals and a decline of at least 25% is predicted in the next three years (note statement was made in 2017).

In the early stages of the Environmental Impact Assessment (EIA) process concerned with the development of this new "Bruintjieslaagte" Dam, Blue Swallows (*Hirundo atrocaerulea*) had unexpectedly been recorded in the area of the proposed dam site. This was a new locality for this species, as it was previously not known to occur there. This species is Red Data listed as Critically Endangered (Taylor, Peacock & Wanless 2015). This initiated a visit to the site to confirm their presence at the site which was achieved. We were able to establish that Blue Swallows were definitely present at the site. A single bird was seen higher up the valley, and a pair was seen from where we were standing at the proposed dam site. It was possible that the single bird was one of the pair seen later. The conclusion drawn from this visit (Whyte 2017) was that the vegetation communities that will be inundated by a dam constructed at either of the proposed sites, only represent marginal foraging areas for the swallows, and in an ecological context, would represent only a small fraction of the birds' total foraging range. I do not believe that the shrub-lands offer the swallows any suitable habitat for nesting sites, as they prefer climax, mist-belt grasslands, large areas of which still exist at higher altitudes above and adjacent to the dam sites. While we watched these birds at the site, it was these higher level grassland which they were favouring for their foraging. During a later visit by others, four birds were seen - probably two adults and two juveniles (Kammeyer pers. comm.).

This has now become an extremely important site for this species, as the birds have showed a steady decline wherever they have occurred in Mpumalanga. From my personal observations, it would seem that the problem is not a local one, as most pairs in the area regularly raised two broods to the fledgling stage per year. Each year however, fewer birds returned from their migration to the Central African "great lakes" area. It is therefore not suspected that local conditions, or the management of the grasslands, play any part in the decline, but that some factor elsewhere on their migratory travels has reduced the numbers of these birds.

Hopefully this "Bruintjieslaagte" area will prove to be crucial to the survival of this species in Mpumalanga, and as it seems that there are still fairly large areas of what appears to be suitable habitat, more pairs of the species may be found to occur there.

4.8.4.2 Endangered Species (EN)

Martial Eagle (*Polemaetus bellicosus)*

Justification for Red list classification: *The regional population of the Martial Eagle is estimated at c. 800 mature individuals and is believed to be undergoing continuous population decline of >20% over a period of two generations. In addition, there appears to have been a suspected population size reduction of >30% over the last three generations where the reduction or its causes may not have ceased or may not be understood or may not be reversible. For these reasons it is listed as regionally Endangered.*

An adult (probably a male) was seen upstream of the dam on 24th January 2017. It had recently fed as its crop was full. May be a breeding resident, but would likely have a much

wider home range, so might not nest on Bruintjieslaagte. Given the wide ranging habits of this species, the proposed new dam site would represent only a tiny fraction of its home range, so it is unlikely that the dam will have any negative consequences for this species. Indeed, as Monitor lizards (*Varanus* spp.) make up a large proportion of their prey, it is likely that the dam may prove beneficial.

No other species on the "Endangered" list were recorded during the survey or are known to possibly occur there.

4.8.4.3 Vulnerable Species (V)

No species on the "Vulnerable" list were recorded during the survey, though it is probable that the following two species will be found to occur there:

Crowned Eagle (Stephanoaetus coronatus)

Justification for Red list classification: *The regional population of this species meets the criterion for regionally Vulnerable (population size estimated to number <1 000 mature individuals). In addition, the regional population is projected to undergo a continuous decline that may exceed 10% over the next three generations.*

Crowned Eagles are known (from SABAP data) to occur in the wider QDGC, but they were not recorded in these surveys. Their nesting biology in the Lowveld is currently under study by the Crowned Eagle Working Group which is based in Nelspruit. This is a forest species, and though a small patch of riparian forest would be lost to the proposed dam, this species prefers to breed in tall trees higher up the slopes and not in river valley bottoms. Given the wide ranging habits of this species, the proposed new dam site would represent only a tiny fraction of its home range, so it is unlikely that the dam will have any negative consequences for this species.

Secretary Bird (Sagittarius serpentarius)

Justification for Red List classification: *The regional population of this species satisfies the criteria for regionally Vulnerable, having undergone a population size reduction of >30% over the past ten years; this reduction and its causes may not have ceased, is not fully understood and may not be reversible. Trends are based are based on data from direct observation, a decline in area of occupancy, extent of occurrence and/or quality of habitat, and levels of exploitation. In addition, the population size is estimated to number <10 000 individuals and is projected to undergo a continuing decline of at least 10% within the next three generations.*

This species is a Highveld grassland species which will almost certainly visit this area from time to time, but has not been recorded during these surveys. Riparian or other forest patches do not form part of their normal habitat, so it is unlikely that the dam will have any negative consequences for this species.

4.8.4.3 Near-Threatened Species (NT)

Half-collared Kingfisher (Alcedo semitorquata)

Justification for Red List classification: *As is the case for several other river specialists, this species is suspected to have undergone population declines due to a reduction in the extent and quality of its sensitive riverine habitat. Declines appear to have approached 30% over the last ten years, and the regional population is suspected to be fewer than 10 000 mature individuals, occupying a range that maybe .2 000km2, qualifying the species as Near Threatened.*

Half-collared Kingfishers were not recorded during these surveys, but it has been recorded in SABAP's database for the larger QDGC. As its habitat usually is on quiet, flowing streams

and rivers, is very likely to occur here. As with the Giant Kingfisher, it is a fish eater, so will probably benefit from the development of the proposed new dam. Many small Tilapia were seen in the existing dam downstream, so the food supply should be ensured, and seepage and releases from the dam will ensure a more consistent flow in the stream below the dam wall.

4.8.4.4 Species of Least Concern (LC)

All other species recorded on BLG fall into this category.

4.9 Cultural and Historical Features

4.9.1 Description and findings

An Archaeological Impact Assessment and heritage study was undertaken by Kudzala Antiquity CC in respect of the proposed construction of an irrigation dam on the farm Bruintjieslaagte 465 JT located in Schoemanskloof and within the City of Mbombela in the Mpumalanga Province. The study was done with the aim of identifying sites which are of heritage significance on the identified project area and assess their current preservation condition, significance and possible impact of the proposed action. This forms part of legislative requirements as appears in section 38 of the National Heritage Resources Act (Act No. 25 of 1999) and the National Environmental Management Act (NEMA, 17 of 1998). Refer to Appendix 11.1.

The survey was conducted on foot and with the aid of a motor vehicle in an effort to locate archaeological remains and historic sites, structures and features. An archival study which includes the scrutiny of previous heritage surveys of the area formed the baseline information against which the survey was conducted. It is not within the expertise of this report or the surveyor to comment on possible paleontological remains which may be located in the study area.

A total of seven archaeologically significant sites were recorded during the survey. They were numbered BL1-7 and comprise of Late Iron Age (1650-1820's) stone-walled enclosures and a historic stone-walled enclosure. The Late Iron Age sites are relatively far apart but forms part of a single occupation unit of which two sections (sites BL 2 and BL 4) will be affected by the expected water level of the proposed dam. Upon completion, the water level of the dam is expected to rise to a level where sites BL2 and BL4 will be submerged. As a result of this the affected sites will have to be properly documented and certain features of these sites archaeologically excavated in an effort to mitigate the expected impact of the dam's construction.

In terms of the archaeological component of the Act (Act No. 25 of 1999, Section 35) seven sites were located and documented and management and mitigation measures recommended in this report. As part of mitigation measures, it was recommended that the affected archaeological sites be mapped and recorded by archaeological excavation, pending a successful permit application from SAHRA. This was already implemented.

In terms of the built environment in the area (Section 34 of the Act) no significant buildings were identified.

The later phases of the Iron Age (AD 1600-1800's) are represented by various tribes including Ndebele, Swazi, BaKoni, and Pedi, marked by extensive stonewalled settlements found throughout the escarpment and particularly around Machadodorp, Lydenburg, Badfontein, Sekhukuneland, Roossenekal and Steelpoort. The BaKoni were the architects of a unique archaeological stone building complex who by the 19th century spoke seKoni which was similar to Sepedi. The core elements of this tradition are stone-walled enclosures, roads and terraces. These settlement complexes may be divided into three basic features:

homesteads, terraces and cattle tracks. Researchers such as Mike Evers (1975) and David Collett (1982) identified three basic settlement layouts in this area. Basically these sites can be divided into simple and complex ruins. Simple ruins are normally small in relation to more complex sites and have smaller central cattle byres and fewer huts. Complex ruins consist of a central cattle byre, which has two opposing entrances and a number of semi-circular enclosures surrounding it. The perimeter wall of these sites is sometimes poorly visible. Huts are built between the central enclosure and the perimeter wall. These are all connected by track-ways referred to as cattle tracks. These tracks are made by building stone walls, which forms a walkway for cattle to the centrally located cattle byres.

A combination of these features occurs on a few dispersed sites on the farm Bruintjieslaagte, some of which are located near the proposed construction site of an irrigation dam. Though spatially clustered and some distance separating individual sites, it forms part of one large settlement. The individual sites range from simple enclosures, which consist of single or two concentric stonewalled circles found in isolated small settlements, to complex sites with large central enclosures which have smaller enclosures attached to their outer walls. The walls are built with undressed locally occurring stone. Walls on average are 0.5 to approximately 1 meter high, although as often only the foundation stones are left.

Table 4.9.1 General description of located sites and field rating

Site No.	Description	Type of significance	Degree of significance	NHRA heritage resource & rating
BL 1	Historic stone-walled Dwelling	Historic architecture	Archaeological: Medium Historic: Low	Structures (Sect. 34). Medium. **GPB.**
BL 2	LIA stone-walled Enclosures	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**
BL 3	LIA stone-walled enclosure	Archaeological	Archaeological: Medium Historic: Medium	Archaeological (Sect. 35). Medium. **GPB.**
BL 4 &BL 4B	LIA stone-walled Enclosures	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**
BL 5	LIA stone-walled Enclosures	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**
BL 6	LIA stone-walled enclosures & terraces	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**
BL 7	LIA site perimeter	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**

LIA – Late Iron Age: GPA – Generally Protected Areas High/medium significance: GPB – Generally Protected Areas Medium Significance.

Table 4.9.2 Site Condition Assessment and Management Recommendations

Site no.	Type of Heritage Resource	Integrity of cultural material	Preservation condition of site	Quality of archaeological/ historic material	Quantity of site features	Recommended conservation management
BL 1	Historic Architecture	Fair	Fair	Archaeology: Not known Historically: Poor	1	None. Not located near project area.
BL 2	LIA stone-walled enclosures	Fair	Fair-Good	Archaeology: Fair Historically: Fair	2	Older than 60 years, mitigation before destruction
BL 3	LIA stone-walled Enclosure	Poor	Poor	Archaeology: Poor Historically: Poor	1	None. Not located in the project area.
BL 4 & BL 4B	LIA stone-walled enclosures	Fair	Fair-Good	Archaeology: Fair Historically: Fair	2	Older than 60 years, mitigation before destruction
BL 5	LIA stone-walled Enclosure	Fair	Fair	Archaeology: Fair Historically: Fair	1	None. Not located in the project area.
BL 6	LIA stone-walled enclosures & Terraces	Fair	Fair-Poor	Archaeology: Fair Historically: Fair	4	None. Not located in the project area.
BL 7	LIA site perimeter	Poor	Poor	Archaeology: Poor Historically: Poor	1	None. Not located near project area.

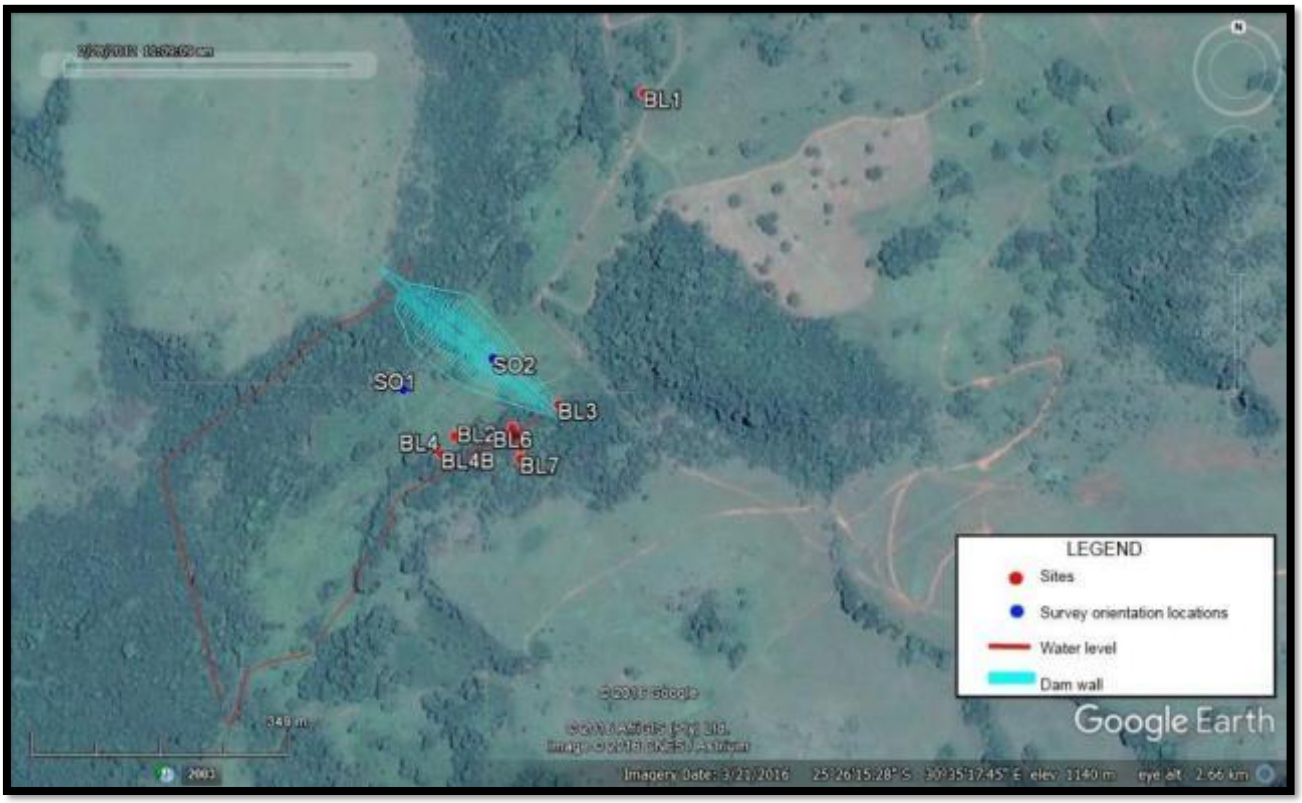

Figure 4.9.1 Location of archaeological sites

Photo 4.9.1 Photos of typical stonewall structures

4.9.2 Summary of findings and recommendations

In terms of the archaeological component of the Act (Act no. 25 of 1999, Section 35) seven sites were located and documented and management and mitigation measures were recommended in this report.

As part of mitigation measures, it is recommended that the affected/ impacted archaeological sites be mapped and recorded by archaeological excavation, pending a successful permit application from SAHRA. In terms of the built environment in the area (section 34 of the Act) no significant buildings were identified. It is not within the expertise of this report or the surveyor to comment on possible palaeontological remains which may be located in the study area.

The bulk of archaeological remains are normally located beneath the soil surface. It is therefore possible that some significant cultural material or remains were not located during this survey and will only be revealed when the soil is disturbed. Should excavation or large scale earth moving activities reveal any human skeletal remains, broken pieces of ceramic pottery, large quantities of sub-surface charcoal or any material that can be associated with previous occupation, a qualified archaeologist should be notified immediately. This will also temporarily halt such activities until an archaeologist has assessed the situation. It should be noted that if such a situation occurs it may have further financial implications.

4.9.3 Archaeological Mitigation Report

An Archaeological Impact Assessment and Permit Application and Mitigation in terms of section 38 of the NHRA were required and was undertaken by Kudzala Antiquity.

The proposed dam position would negatively impact on some parts of this site and archaeological mitigation was recommended. This was approved by SAHRA comment (Case ID: 12231) and a permit application for mitigation was approved by SAHRA and issued on 17 July 2018 (Permit ID: 2750). Refer to Appendix 11.3.

The *Archaeological Mitigation Report: The Archaeological documentation of a Late Iron Age stonewalled complex located on the farm Bruintjieslaagte 465 JT, Mpumalanga was done in March 2019* by Mr Celliers. Refer to Appendix 11.2 for the full report.

In terms of this the sites were subjected to a Phase 2 archaeological excavation.
The main aim of the investigation and mitigation of sites BL 2 and BL 4A and 4B was to document the settlement as the sites will be destroyed when the proposed irrigation dam will be constructed.

The stone walled sites were earmarked for archaeological testing by systematic excavation. Systematic archaeological excavation proposes to extract cultural material or identify features within the sites which will assist in reconstructing the lifestyle and identity of the people who built and occupied the living space. It tells us more about the time-space utilization of the settlement.

The spatial organization at both sites BL 2 and BL 4A and B reflect the layout of the Badfontein walling (Huffman, 2007). These sites were investigated in detail by Collett (1979, 1982) and he divided them into groups of complex layout which consists of a central cattle pen with two opposing entrances and semi-circular walling attached around where houses were situated. This was then often encircled by a larger outer wall. These were interspersed with agricultural terracing.

Photo 4.9.2 Photo of Site BL2 view from inside the central inner enclosure towards the south-east

The second group of stone walling was simple in layout and would often consist of single circular or oval stone walling only and spatially removed from the more complex core structures. These probably served as outlying stock enclosures. Site BL 2 conforms to the more complex type and probably served as a stock enclosure with attached living space or enclosures for smaller stock such as goats or sheep. In contrast site BL 4A conforms to the simple layout and was probably a stock enclosure with attached BL 4B a housing enclosure with adjacent terracing.

Economic subsistence at both sites is uncertain as no bone or other waste material such as charcoal was found which would indicate domestic food consumption and preparation.
The absence of animal bone or waste material (or any middens) on the sites means that no assumptions could be made about the collection of food or possible hunting practises and diet derived from such.

The presence of an upper grinding stone at site BL 2 and the terraces at BL 4B does confirm that at least part of the diet comprised grains.

No iron artefacts such as agricultural hoes or metal objects were found. There was also no evidence of permanent platforms, for example built of stone, for the storage of grain in baskets or clay caskets inside the living space areas. Such structures usually occur near living space areas near hearths where food was prepared.

It is probable that the events of the Difaqane (Mfecane) during the early 1820's when large scale conflict threatened the security of BoKoni resulted in the abandonment of this and many other similar sites in the area. Consequently it is possible that this site may have been occupied for only a short period which may explain the paucity of cultural material found there.

	
Trench BL 2-1. The trench reached sterile soil at 350mm which was well below the foundation of the wall.	BL 4A-1. The trench at a depth of 450mm where it joins the wall. Rocks which tumbled from the wall are exposed. At this level the red clay soil continued and reached a sterile bottom.

Photo 4.9.3 Detailing archaeological sites

The mitigation of sites BL 2 and BL 4A and B is completed with the archaeological documentation thereof and Joubert en Seuns Citrus (Pty) Ltd applied for a demolition permit for sites BL 2 and BL 4A and B from the South African Heritage Resources Agency (SAHRA).

Refer to the report for more detail and photos of the process.

4.10 Palaeontology

A Palaeontological Impact Assessment for the proposed construction of a dam wall on farm Bruintjieslaagte 465JT, in the Schoemanskloof Valley Mpumalanga Province, desktop study, 18 April 2017 was done by Prof Marion Bamford (Refer to Appendix 12). Following is an abstract from the report:

A desktop palaeontological impact assessment has been requested for the proposed construction of an irrigation dam wall on the farm Bruintjieslaagte 465 JT. The farm is located in the Schoemanskloof valley approximately 40km west of Nelspruit, Mpumalanga.

4.10.1 Project location and geological setting

The site for the proposed dam wall lies on ancient rocks of the Timeball Hill Formation, Pretoria Group.

4.10.2 Geology

The rocks in this region have been well studied as they are amongst the oldest rocks in the world. To the south east in a northeast – southwest orientation are the oldest rocks, those of the Barberton Greenstone Belt. To the west in a more north-south orientation are the Bushveld Complex rocks of the Chuniespoort and Pretoria Supergroups, while in between are the granite batholiths and plutons of the mid Archean.

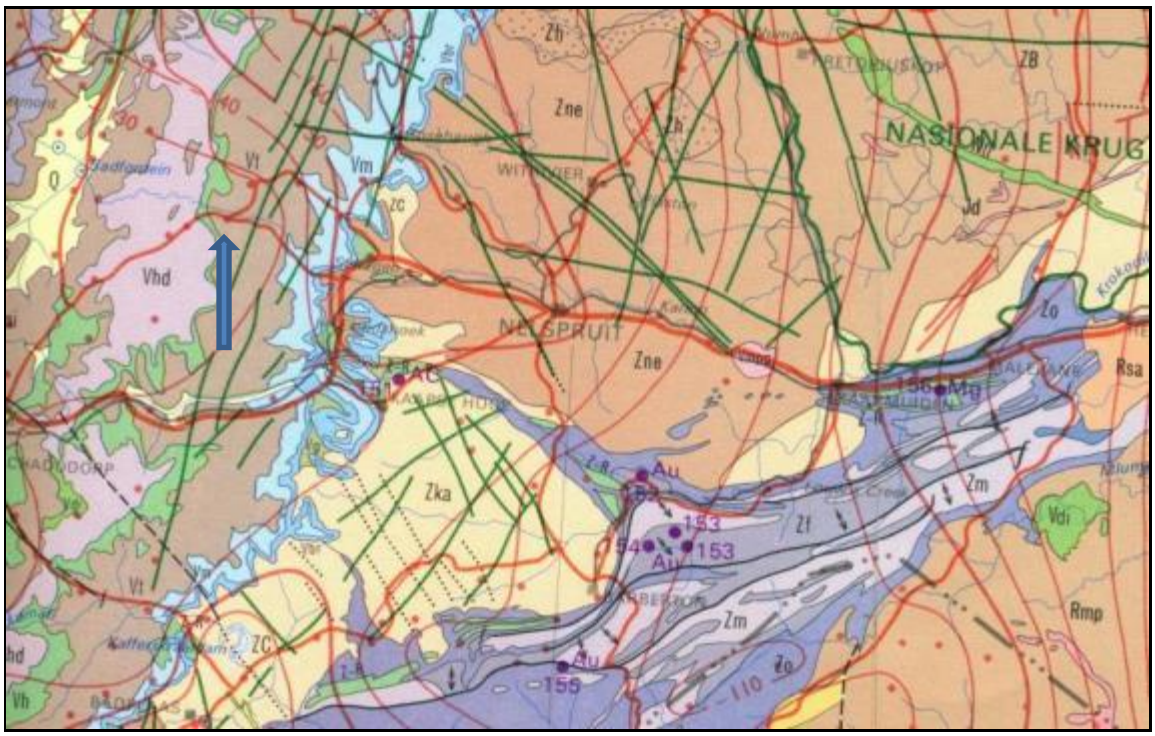

Figure 4.10.1 Geological map of the area around Schoemanskloof Valley

(about 40km to the west of Nelspruit, where the Farm Bruintjieslaagte465JT is located)

The approximate location of the proposed project is indicated with the arrow. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

4.10.3 Palaeontology description

To the west are rocks of the Pretoria Group and the site is on the shale, quartzite, conglomerate, breccia and diamictites of the Timeball Hill Formation, Pretoria Group. There are two models proposed for the formation of the Pretoria Group, that of sedimentation in a shallow marine setting or deposition in a closed basin, but there are no invertebrate fossils to support the models. More recent workers have suggested that initially there was a closed basin (Rooihooghte to Strubenkop Formations) followed by alternating transgressive and regressive cycles in a shallow marine setting (Erikssen et al., 2006), or deep marine (Erikssen et al., 2012).

Trace fossils, in the form of microbial mats that have formed on or preserved ripple marks, have been found in the Daspoort and Magaliesberg Formations (underlying and overlying the Silverton Formation, respectively; Erikssen et al., 2012; Parizot et al., 2005) but they do not provide localities. According to the authors the trace fossils would have formed on the shores of the sea (Erikssen et al., 2012), but no body fossils have been found as the rocks are too old. To date no microbial mats have been reported from the Silverton Formation or from the Timeball Hill Formation so the SAHRIS palaeosensitivity map (Figure 4.8.2.) is questionable.

The Black Reef Formation and Malmani Subgroup banded ironstone and dolomites, although formed by the chemical activities of ancient algae, photosynthesis and oxygen production, are not known to have preserved fossil algae near Nelspruit.

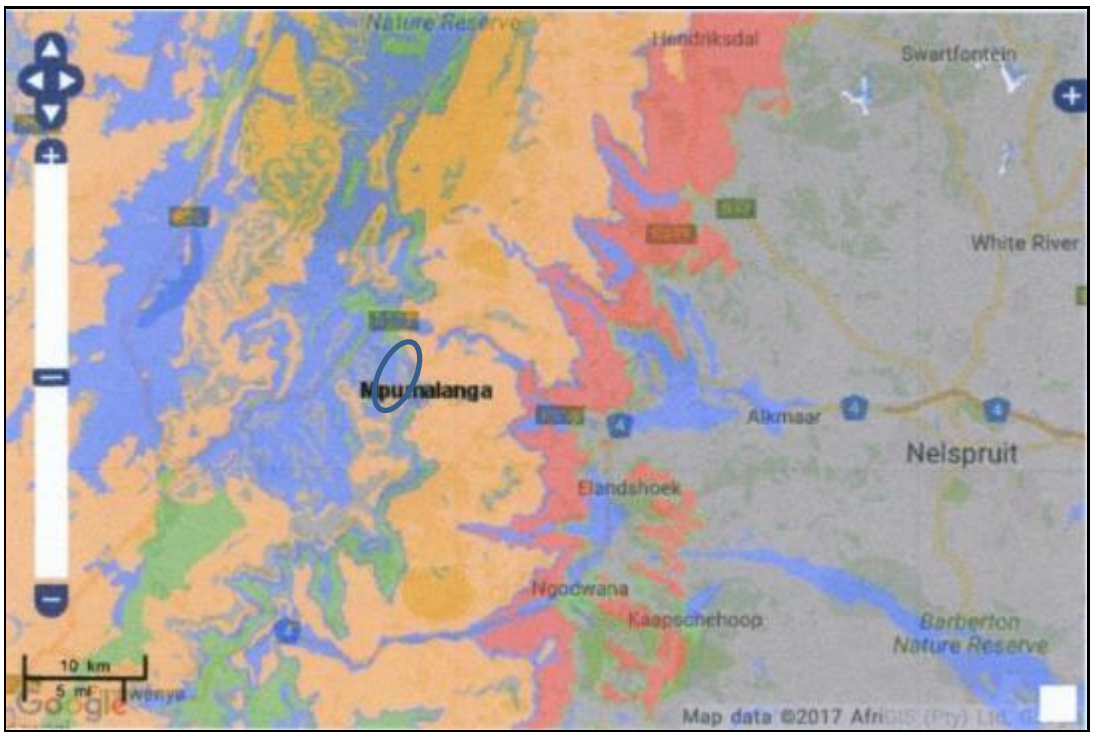

Figure 4.10.2 SAHRIS palaeosensitivity map

The proposed site for the dam wall is within the oval outline. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Batholiths and plutons do not preserve any fossils as they are igneous in origin. These particular ones, the Mpuluzi and Nelspruit batholiths are also too old to preserve fossils even if any life forms were around as they are over 3300 Ma. At this time there were only single-celled algae or bacteria present (Knoll, 1984).

There are also no records of fossils from the Quaternary alluvium in this region.

4.10.4 Palaeontology Conclusion and Recommendation

It is extremely unlikely that any fossils occur in the sites for the proposed dam wall because mostly the rocks are much too old and volcanic in origin. Although there are rare reports of microbial mats from similar aged rocks, none has been reported from this particular Formation.

As far as the palaeontology is concerned the proposed development can go ahead. Any further palaeontological assessment would be unnecessary.

4.11 Geology and soil conditions

A *Preliminary design report: Construction of a new earthfill dam on the farm Bruintjieslaagte 465 JT, Element Consulting Engineers, Mpumalanga Province, project no. 1601781 April 2017* was conducted and following are abstracts of section 6 of the report (refer to Appendix 4).

According to the available geological information, the portion of interest (including the catchment area) is underlain by shale and quartzite of the Pretoria formation, Transvaal Super-group. Based on rock outcrops which were visually observed on either bank of the river, it is anticipated that rock may be present in the riverbed and along the entire centre line

at both banks, at a depth of approximately 3m. This will allow for adequate founding of the new embankment.

During the preliminary investigation, a TLB excavator was used, which limited deep and proper foundation investigations. During the detail design an adequate excavator will be used.

During the site visit conducted on the 3rd of February 2017, soil samples were taken by the client and sent for testing of basic foundation indicators by Letaba Labs (Pty) Ltd, in order to determine the specific material properties. Strength and permeability testing to be done during detail design. Two samples were taken, one on the centreline of the proposed embankment and another within the dam basin. These materials were also mixed and tested to give an average representative sample. These results were evaluated during the preliminary design phase.

The following table gives a summary of the results from the materials testing, along with ideal material parameters.

Table 4.11.1 Soil properties

SOIL PROPERTIES	IDEAL MATERIAL FOR DIFFERENT EMBANKMENT ZONES		TEST RESULTS
	CORE / INNER	OUTER	
Grading	More than 60% through 0,425mm sieve	More than 40% through 0,425mm sieve	91% Passing
Clay content (%) < 0,002mm	10 - 30	< 10	14.7
Plasticity Index (PI) (%)	12 - 24	4 - 12,5	12
Liquid Limit (LL) (%)	30 - 60	< 30	31
Maximum Dry Density (MDD) (kg/m³) *	1590 – 1830	1750 - 1990	1746
Linear Shrinkage (%)	4 - 10	0 - 5	5.7
Optimum Moisture Content (W) (%) *	14 - 22	10 - 16	16.4
MDD PIxW	2 - 11	13 - 28	9.68

The above preliminary results indicate that the material on site is adequate for placement in the core as well as throughout the entire embankment.

5. Other considerations

5.1 Water Use Rights

A total of 4 211 200 m^3/annum of irrigation water use rights are available from the Crocodile River for the Joubert & Seuns farming activities in Schoemanskloof.

As agreed between the Crocodile River Major Irrigation Board (CRMIB) and the landowner the 159.1 hectare or 1 272 800 m^3 of Koedoeshoek water use rights is now allocated to the abstraction point at the Koedoeshoek dam where it will be abstracted and measured.

Table 5.1.1 Water Use Rights

Farm	Water (ha)	m^3 /a
Remaining Extent of Portion 3 of the Farm Mooiland 294	20.2	161600
Portion 5 of Farm Rietvly 295	47.5	380000
Remaining Extent of the Farm Mooiland 294	21.2	169600
Remaining Extent of Portion 9 of Koedoeshoek 301	159.1	1272800
Remaining extent of Portion 3 of the Farm Geluk 299	40	320000
Remaining extent of Portion 4 of the Farm Geluk 299	44.1	352800
Bruintjieslaagte 465	7.1	56800
Portion 1 of the Farm In De Middel 293	2.9	23200
Portion 1 of the Farm Geluk 299	50	400000
Remaining extent of Portion 1 of the Farm Rietvlei 295	37	296000
Remaining extent of Portion 8 of the Farm Rietvlei 295	50	400000
Remaining extent of Portion 10 of the Farm Rietvlei 295	6.5	52000
Portion 2 In de Middel 293 JT	35.8	286400
Remaining extent of Portion 2 of the farm Montrose	5	40000
	526.4	**4211200**

As indicated in the hydrology and yield assessment report the mean annual runoff (MAR) from the Devil's Creek for the Bruintjieslaagte dam is 6 600 000 m^3/annum and the yield (water available for abstraction) from the proposed 842 000 m^3 capacity dam is approximately 1 200 000 m^3/annum.

The hydrology and yield report included the total Devil's Creek catchment in the updated assessment. The report now also includes the Koedoeshoek dam as well as the remainder of Devil's Creek below Koedoeshoek dam. The potential yield of the Koedoeshoek Dam was calculated 1.4 million m^3/annum which means that the total potential yield from Devil's Creek is 2.6 million m^3/annum after allowing for the Ecological Water Requirements (EWR) in Devil's Creek. As abstraction from Devil's Creek is alternative to abstracting from the Crocodile River there will be no impact on downstream water users from the Crocodile River.

A water use licence was issued by the DWS on 29 March 2019 which included an authorisation for the storage of water - section 21(b).

5.2 Access to the construction site

There are existing roads from the farm Koedoeshoek over Bruintjieslaagte to the dam construction site. These roads can be utilised but some upgrading maybe be required to accommodate the larger construction vehicles.

6. Consideration of alternatives

6.1 Locality alternatives

The Devil's Creek, a tributary of the Crocodile River was identified as the potential water source for the dam. There is an existing dam and the Devil's Creek is a perennial river with sufficient flow for both the storage dams. The Bruintjieslaagte farm is owned by the applicant and the dam would provide irrigation water under gravitational pressure for the orchards near the dam. Electricity costs for pumping will be saved.

Please note that the Devil's Creek catchment and the proposed dam site are located mainly on the farm Bruintjieslaagte and that the existing dam is located downstream on the farm Koedoeshoek. These farms are owned by the applicant. The other nearby catchments and

rivers draining towards the Crocodile River are located on property owned by others. It is therefore the preferred and logical option to consider the Devil's Creek for the dam.

Large areas of Citrus orchards, owned by the applicant, are located near the Devil's Creek catchment. It is therefore ideal to have irrigation water under gravitational pressure available for irrigation.

6.2 Locality alternative - Raising the wall of the existing dam

The raising of the wall of the Koedoeshoek dam was proposed as an alternative. The option was further investigated and it was concluded as follows:

- The Koedoeshoek dam was constructed in 2004 and insufficient information is available on the geology and construction methods employed for the construction of the wall. The engineers indicated that it will be a very high safety risk to increase the wall height of the Koedoeshoek dam and that it is not recommended.
- Raising the wall height of the Koedoeshoek dam will flood a larger area below the waterfall and therefor habitat for the fish species *Enteromius motebensis/anoplus*. The risk of losing this population of fish is significantly increased and the raising of the dam wall is not recommended.

Figure 6.2.1 Alternative dam positions

6.3 Layout alternatives within the site

Different positions for the dam wall were investigated by the engineers and the applicant. Originally 3 positions were investigated to determine the technical feasibility of the sites i.e. Dam capacity, geotechnical, dam wall construction and overflow structure. The position 3 was discarded and positions 1 and 2 were further investigated. The sites for the 2 dam positions were surveyed and based on this information; position 1 (slightly revised) was confirmed as the preferred technical option.

The ecology for the alternatives 1 and 2 were also investigated. The riparian and terrestrial ecology is similar for the alternative sites and there is no difference in the aquatic ecology. It is therefore not scientifically possible to differentiate between these two alternatives.

Alternative Dam P1 was, after investigation, confirmed as the preferred site.

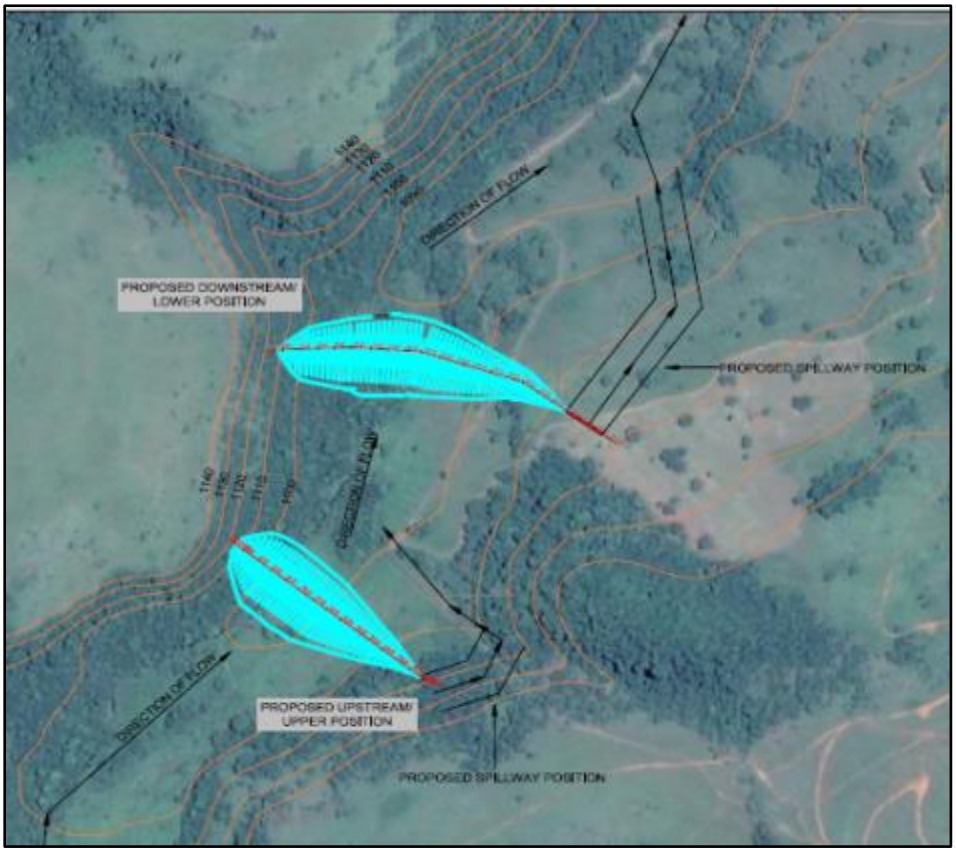

Figure 6.3.1 Alternative dam wall positions

The upstream position (P1 on other map) is the preferred option.

Figure 6.3.2 Preferred dam wall site and footprint area - full supply level (FSL)

6.4 No-go alternative

The "no-go" alternative would entail that a dam will not be constructed and that the area included in the application is not transformed into a dam.

Irrigation water is normally abstracted from the Crocodile River for the irrigation of the citrus orchards. With the recent drought and the low water level of the Kwena dam abstraction from the Crocodile River was limited. It is the intention of the applicant to create additional storage capacity for irrigation purposes so that water is available during drought periods.

There is an existing dam downstream from the proposed dam also located on the Devil's Creek. This dam is located on the farm Koedoeshoek 301JT. The Devil's Creek is a perennial river and there is sufficient flow in the river for the existing as well as the proposed dam.

There is insufficient storage capacity in the Inkomati (Crocodile) catchment and the IUCMA, Water Affairs and the City of Mbombela Municipality is evaluating alternatives for dams to provide higher water security for the area. This private initiative to construct the dam will add approximately 840 000m^3 of storage capacity at a cost of approximately R15 million.

Citrus orchards are highly reliant on irrigation and if water is not available for irrigation it would severely affect the size and quality of the crop. Citrus is exported and the quality of the citrus is critical for success in this highly competitive market.

It was found in the specialist studies that water is available in Devil's Creek to support the dam and that the ecological impact of the dam is acceptable.

The opportunity cost (reduced risk of financial loss) of building the dam should exceed the environmental cost (loss of ecology).

The no-go alternative is not preferred or recommended.

7. Public Participation Process

7.1 Introduction

In order to afford the Interested and Affected Parties (I&AP's) the opportunity to become involved and be part of the process a public participation process, the terms of the 2014 EIA Regulations will be followed.

During the process I&AP's will be given the opportunity to raise issues of concern that would be recorded and included in the Scoping Report and/or the Environmental Impact Assessment Report. All identified and registered I&AP's will be consulted during the public participation process. (Refer to Appendix 4).

7.2 Identification of Interested and Affected Parties

At the start of the assessment effort was made to identify all potential interested and affected parties. This included people who may be affected by the activity and includes the ward councillor representative of the community, adjacent and downstream landowners, environmental organisations as well as all relevant authorities.

Other parties requesting to be included on the Register for Interested and Affected Parties during the public participation were added. Refer to Appendix 4.1 for the list of I&AP's.

7.3 Newspaper and Site Notices

A notice in the prescribed format was placed in the Lowvelder of 22 November 2019. A site notice was placed at the entrance to the Bruintjieslaagte farm (at the Farm Stall) on 22 November 2019. Refer to Appendix 4.3.

The notices informed potentially interested and/or affected parties of the process and the opportunity to review the Scoping Report that was available for comment.

7.4 Public Participation Meeting

A public participation meeting was not scheduled.

No requests for a meeting were received during the Scoping phase or the previous EIA commenting periods.

7.5 Scoping Report

The Scoping report and Plan of Study was made available to the Interested and Affected parties, with the request to register and comment on the Scoping Report. The Scoping Report was made available during November 2019 to January 2020 for a 30-day period. The relevant State Departments that may have jurisdiction over the area or type of activity were included in the list of interested and affected parties.

The comments received during the scoping phase have been included in the submission of the Scoping Report to the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA). We received comments from Sappi and amendments were made to the information in the EIR as required. Refer to Appendix 4.2.1.

Comments received from the MDARDLEA on 13 December 2019 were incorporated in the final Scoping Report.

The Scoping Report was approved by MDARDLEA on 11 February 2020 with comments. These have been included and addressed in the EIR. Refer to Appendix 13.

7.6 Environmental Impact Assessment Report

The Environmental Impact Assessment (EIA) report comprises an overview of the proposed activity (dam), specialist studies and impact assessment. The specialist studies are attached to the EIA Report.

The environmental impacts of the proposed dam has been assessed and rated and mitigation and management measures were defined.

Refer to Appendix 4.2.2 for the issues and response report that includes all the comments for the earlier EIA processes.

This Environmental Impact Assessment Report (EIR) is available for public review before it will be submitted to the MDARDLEA.

7.7 Environmental Authorisation

On review of the information submitted the Department will either decide to grant or deny Environmental Authorisation for the proposed activity. If authorisation is granted the Environmental Authorisation would include conditions that will apply to the activities.

The Authorisation or decision will be communicated to all registered I&AP's as soon as received from DARDLEA in line with Chapter 2 of the EIA Regulations, 2014.

7.8 Schedule of Tasks

Table 7.8.1 Schedule of tasks

Schedule of Tasks	Timing
Specialist studies	Completed 2017
Swallow surveys, monitoring reports	2017 - 2020
Enteromius (EDEV) surveys, translocation and follow-up surveys	2018 - 2020
Scoping report for public review	November 2019 to January 2020
Submit Scoping Report to MDARDLEA	January 2020
Scoping Report Approved by MDARDLEA	11 February 2020
COVID-19 Lockdown regulations/special requirements	27 March – 5 June 2020
EIR available for review/comments	July and August 2020
Final EIR to MDARDLEA	August 2020

7.9 Authority Liaison

An application with the relevant documentation was submitted to the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs in November 2019.

A site visit with the MDARDLEA official, Robyn Luyt was already done on 14 March 2017 under the initial Scoping and EIA process. The Devil's Creek catchment, proposed dam site areas, archaeological features and general site characteristics were viewed and discussed.

The draft Scoping Report was made available to MDARDLEA on 22 November 2019. MDARDLEA's comments on the draft Scoping Report and Plan of Study for environmental impact assessment was received on 13 December 2019. Comments were incorporated in this final Scoping Report and Plan of Study.

The Scoping report was accepted on 11 February 2020 with comments. Refer to the Issues and Response Report for a detailed response to the comments received.

8. Environmental Legislation and Policy

8.1 The National Environmental Management Act, 1998 (Act No.107 of 1998)

The Environmental Impact Assessment Regulations, 2014, published under Section 24(5) of the National Environmental Management Act (NEMA) of 4 December 2014, as amended is applicable.

The Scoping and Environmental Impact Assessment is undertaken in terms of the EIA regulations published in the Government Notice No. R982, R983 and R984 under Section 24(5) of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

R.984, 2014: Activity 16 - The development of a dam where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high water mark of the dam covers an area of 10 hectares or more.

R.983, 2014: Activity 12 - The development of —
(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or
(ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs
(a) within a watercourse.

R.983, 2014: Activity 19 - The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from (i) a watercourse.

R.983, 2014: Activity 27 - The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for — (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.

R.985, 2014: Activity 12: The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.
(ii) Within critical biodiversity areas identified in bioregional plans.

R.985, 2014: Activity 14 – The development of – (iv) dam or weirs where the dam or weir, including infrastructure and water surface area exceeds 10 square metres in size In Mpumalanga - Outside urban areas, in: (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.

The Scoping and Environmental Impact Assessment application process is required.

As required by the EIA Regulations an environmental authorisation from the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs would be required before the applicant can commence with the proposed activities.

8.2 The National Water Act, 1998 (Act No. 36 of 1998)

Agricultural water use rights are available and will be utilised. A Water use licence is required in terms of the National Water Act and the application process would be a process separate from the EIA. Enpact Environmental Consultants was appointed to do the water use licence application and such was submitted to the IUCMA. Correspondence between the EAP and IUCMA is taking place to finalise the application.

Water use licences are required for the following uses:
Section 21 (a) – Taking water from a water resource for irrigation purposes;
Section 21 (b) – Storing of water, dam capacity 842 000 m^3;
Section 21 (c) – impeding or diverting the flow of water in a water course;
Section 21 (i) – altering the bed, banks, course or characteristics of a watercourse.

A water use licence was issued by the Department of Water and Sanitation on 29 March 2019 which included an authorisation for the storage of water - section 21(b). Refer to Appendix 5.

8.3 National Heritage Act

Section 38 of the National Heritage Resources Act, 1999 (Act no.25 of 1999) stipulates that: 38(1)(c) any development or other activity which will change the character of a site – (i) exceeding 5000 m^2 in extent would require the approval from the relevant heritage authority.

In addition section 34 (1) No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by relevant provincial resources authority.

An Archaeological Impact Assessment and Permit Application and Mitigation in terms of Section 34 and 38 of the NHRA were done. Refer to the relevant sections of the EIR for a detailed discussion of the findings and mitigation.

8.4 Other relevant legislation

Legislation aimed at the protection of natural resources:

Other legislation includes:

- Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983)
- Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)
- The Constitution, 1996 (Act No. 108 of 1996)
- The National Forest Act, 1998 (Act No. 84 of 1998)
- The Mpumalanga Conservation Act, 1998 (Act No. 10 of 1998)
- The National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998)
- Promotion of Access to Information Act, 2000 (Act No. 2 of 2000)
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)

The main objective of the legislation listed above is to ensure a safe and healthy environment as well as the sustainable use of natural resources.

The applicant has to apply for the necessary permits in terms of the relevant legislation for the removal of conservation important plants and animals and must exercise any conditions prescribed by such legislation.
The Mpumalanga Conservation Act, 1998 and NEMBA, 2004 pertaining to biodiversity were also taken into consideration by the specialist that conducted the biodiversity assessment.

9. Environmental Issues and Potential Impacts

9.1 Assessment Methodology

The following criteria and rating mechanism is used for the evaluation of significance of potential environmental impacts.

9.2 Impact Assessment Rating Criteria

Table 9.2.1 Impact assessment criteria

Nature of Potential Impact	Rating or Category	Description of Impact on the Environment
Extent	Site	Limited to the site and its immediate surroundings
	Local	Up to 5km from the project site
	Regional	Beyond 5km of site. Up to 20km radius from the project site
	Provincial/National	Will affect beyond 20km from the site
Duration	Short term	0 - 5 years. Construction and early operation.
	Medium term	Operational phase up to 25 years
	Long term	Operational phase longer than 25 years
	Permanent	Impact will continue after the operational phase
Intensity	Very low	Limited damage to a small area. Natural, cultural or social functions or processes are not affected/negligible.
	Low	Where the affected environment is altered but natural, cultural or social functions or processes are only marginally affected.

Nature of Potential Impact	Rating or Category	Description of Impact on the Environment
	Medium	Natural, cultural or social functions or processes is notably altered but can continue although in a modified way.
	High	Where the natural, cultural or social functions or processes are severely altered to the Extent that they temporarily/permanently cease.
	Very high	Where the natural, cultural or social functions or processes are altered in such a way that they will permanently cease. Irreparable damage.
Probability	Unlikely	Less than 20% probability that impact may occur.
	Probable	There is a good chance that the impact may occur.
	High Probability	It is most likely that the impact will occur, more than 50% probability that impact may occur.
	Definite	More than 90% probability that impact may occur.
Significance	Very low	Impact likely to be very low and mitigation is not required
	Low	Impact likely to have little real effect or Mitigation is easily achieved or little will be required.
	Medium	Moderate impact and could influence decision if not mitigated or Mitigation is both feasible and fairly easily possible. Modification of the project design or alternative action may be required.
	High	Mitigation essential to reduce to acceptable level or Mitigation difficult, time-consuming and/expensive and it may affect the decision to continue or approve.
	Very High	No possible mitigation or mitigation is extremely difficult, time consuming and/or expensive. Decision to approve will be affected.

Environmental impacts are assessed with reference to the nature, extent, duration, intensity and probability of identified impacts. The significance of the potential impact is a qualitative assessment based on the rating of the different criteria. The significance of impacts before and after mitigation will be indicated in the report.

9.3 Environmental Impact Assessment

This section assesses the identified environmental aspects and potential impacts of the proposed Bruintjieslaagte dam.

Table 9.3.1 Impact assessment summary

Impact description	Period	Extent	Duration	Intensity	Probability	Significance pre-mitigation	Significance post mitigation
Air pollution – dust	Construction	Local	Short	Low	Probable	Low	Low
Air pollution – smoke	Construction	Local	Short	Medium	Probable	Medium	Medium
Geology Excavation of soil for dam wall	Construction	Local	Short	Medium	Probable	Medium	Low
Impact on wetland ecosystem services	Construction Operations	Local	Long term	Low	Probable	Low	Low
Impact on riparian vegetation at dam site	Construction	Site	Long term	Low	Definite	Low	Low
Impact of loss of habitat for conservation important fauna and disruption of life-history cycles	Construction	Site	Short	Medium	Probable	Medium	Low
Impact on vegetation in marginally degraded forested woodland	Construction Operations	Site	Long term	Low	Definitely	Low	Low

Impact description	Period	Extent	Duration	Intensity	Probability	Significance pre-mitigation	Significance post mitigation
(1.63ha)							
Impact on secondary grassland (1.86ha)	Construction	Site	Long term	Low	Definitely	Low	Low
Impact on vegetation in riparian mistbelt forest ecotone (11.26 ha)	Construction Operations	Site	Long term	Low	Probable	Low	Low
Invasion of weeds and alien vegetation	Construction Operations	Site	Long term	Medium	Probable	Medium	Low
Impact on fauna	Construction	Site	Short	Medium	Probable	Low	Low
Loss of habitat – avifauna general	Construction Operations	Local dam site	Long term	Low	Probable	Low	Low
Loss of habitat – Blue swallow	Construction Operations	Local dam site	Long term	Low	Improbable	Low	Low
Disruption of breeding cycle – Blue swallow	Construction	Local dam site	Short	Medium	Improbable	Medium	Low
Loss of archaeological site							
BL 1	Construction	Site	Short	Low	Unlikely	Low	Low
BL 2	Construction	Site	Long term	High	Definite	High	Medium
BL 3	Construction	Site	Short	Low	Unlikely	Low	Low
BL 4 &BL 4B	Construction	Site	Long term	High	Definite	High	Medium
BL 5	Construction	Site	Short	Low	Unlikely	Low	Low
BL 6	Construction	Site	Short	Low	Unlikely	Low	Low
BL 7	Construction	Site	Short	Low	Unlikely	Low	Low
Palaeontology impact	Construction	Local	Long term	Low	Unlikely	Low	Low
Socio- Economic Water quality –suspended solids	Construction	Regional	Short	Low	Unlikely	Low	Low
Socio-economic Water quantity in Crocodile River	Operations	Regional	Long term	Low	Unlikely	Low	Low

Impact assessment from specialist report:

Potential Impact	Impacts Before Mitigation						Impacts After Mitigation					
Construction Phase												
	I	D	E	P	Total	Significance	I	D	E	P	Total	Significance
Disturbance of Riverine Habitats	-7	7	2	7	**-112**	**Major (-)**	-7	7	1	7	**-105**	**Moderate (-)**
Impact of Water Quality Deterioration on River Ecosystems	-6	2	3	7	**-77**	**Moderate (-)**	-1	2	3	7	**-42**	**Minor (-)**
Operational Phase												
Inundation of Riverine Habitats	-7	7	1	7	**-105**	**Moderate (-)**	-7	7	1	7	**-105**	**Moderate (-)**
Impact of Altered Water Quality on River Ecosystems	-5	7	3	7	**-105**	**Moderate (-)**	-4	7	3	7	**-98**	**Moderate (-)**
Impact of Altered Hydrology on River Ecosystems	-6	5	4	7	**-105**	**Moderate (-)**	-2	5	3	7	**-70**	**Minor (-)**
Impact of Alien and/or Translocated Fish	-4	7	3	7	**-98**	**Moderate (-)**	-4	7	3	4	**-56**	**Minor (-)**
Bed Armouring	-2	7	3	6	**-72**	**Minor (-)**	-2	7	3	6	**-72**	**Minor (-)**

Biophysical impacts

9.3.1 Topography

The construction of a dam will require excavation and construction of the 20m high dam wall and overflow structure. This will impact on the site topography but the impact on the topography of the catchment area will be small and insignificant.

9.3.2 Air quality

Construction
The removal of the vegetation, excavation and construction activities of the dam wall will cause dust pollution during the construction period. The impact will be for a short duration and will not result in a significant air pollution impact.

Nature of Impact	Period	Extent	Duration	Intensity	Probability	Significance before mitigation	Significance after mitigation
Air pollution – dust	Construction	Local	Short	Low	Probable	Low	Low
Air pollution smoke, burning of trees to prevent impact on avifauna	Construction	Local	Short	Medium	Probable	Medium	Medium

Removal of trees and scrubs inside the dam footprint is required. Due to the volume of biomass and secondary impact on avifauna it is recommended that the trees and scrubs should be burned on site inside cleared footprint area of the dam. Smoke will be generated during the burning period.

The impact will be for a short duration and should not cause significant air pollution.

A few mitigation measures can be implemented to manage the impact and may include:
- Utilise water spraying during construction if and when excessive dust is generated.
- Fast-burn stripped vegetation to minimise smoke generated.
- Closely monitor such activities.

Operations:
There will be no air quality impact during the operational period of the dam.

9.3.3 Geology and soil conditions

Nature of Impact	Period	Extent	Duration	Intensity	Probability	Significance before mitigation	Significance after mitigation
Excavation of soil for dam wall	Construction	Local	Short	Medium	Probable	Medium	Low

Construction:
Soil will be excavated from the dam basin to construct the dam wall. The expected volume of earth fill required for the forming of the dam wall is estimated at approximately 220 000m³.

The impact will be in the dam footprint area and soil will not be excavated from outside the footprint area.

The impact is there for low and the main mitigation is that soil will only be excavated from the dam footprint area.

Mitigation measures may include:

- Clear footprint area of vegetation cover and stockpile topsoil separately.
- Utilise topsoil for rehabilitation of transformed areas and to establish vegetation cover on the outside embankment.

- Excavation of material for the dam wall must only be from within in the footprint area of the dam and not from outside areas.

9.3.4 Surface Water and Aquatic Ecology impacts and management

Following is an unmodified impact assessment from Nepid Consultants, Dr Rob Palmer (Refer to Appendix 7.1 for the full report):

Potential Impact	**Impacts Before Mitigation**						**Impacts After Mitigation**					
Construction Phase												
	I	D	E	P	**Total**	**Significance**	I	D	E	P	**Total**	**Significance**
Disturbance of Riverine Habitats	-7	7	2	7	**-112**	**Major (-)**	-7	7	1	7	**-105**	**Moderate (-)**
Impact of Water Quality Deterioration on River Ecosystems	-6	2	3	7	**-77**	**Moderate (-)**	-1	2	3	7	**-42**	**Minor (-)**
Operational Phase												
Inundation of Riverine Habitats	-7	7	1	7	**-105**	**Moderate (-)**	-7	7	1	7	**-105**	**Moderate (-)**
Impact of Altered Water Quality on River Ecosystems	-5	7	3	7	**-105**	**Moderate (-)**	-4	7	3	7	**-98**	**Moderate (-)**
Impact of Altered Hydrology on River Ecosystems	-6	5	4	7	**-105**	**Moderate (-)**	-2	5	3	7	**-70**	**Minor (-)**
Impact of Alien and/or Translocated Fish	-4	7	3	7	**-98**	**Moderate (-)**	-4	7	3	4	**-56**	**Minor (-)**
Bed Armouring	-2	7	3	6	**-72**	**Minor (-)**	-2	7	3	6	**-72**	**Minor (-)**

I – Intensity; D – Duration; E – Extent; P – Probability

9.3.4.1 Disturbance of Riverine Habitats

Nature of Impact: Bulk earthworks and stream diversion during construction are certain to have permanent localised negative impacts on riverine habitats and associated aquatic biota.
Intensity: Complete Destruction (-7).
Duration: Permanent (7).
Extent: Site (2).
Probability: Definite (7).

Significance before mitigation: **Major**

Mitigation:
An Environmental Compliance Office (ECO) should be appointed before any construction starts. The ECO should be responsible for ensuring that contractors and subcontractors comply with the Environmental Management Plan.

Demarcate Work Areas. Construction activities in riparian zones should be minimised, and all support operations should be done outside the riparian zone. A buffer zone of at least 50 m from the edge of the riparian zone is recommended for all activities that are not needed within the riparian zone. The Full Supply Area should be demarcated where necessary, and work activities should be focussed in this area, where feasible

Protect Stream Banks. Reasonable steps should be taken to protect and maintain a riparian corridor on either side of the river channel to ensure that stream banks are not destabilised and to ensure that sediment transport into the river is minimised. All areas close to the river that are disturbed by bulk earthworks during construction should be protected to minimise elevated turbidity in the river. Sediment barriers in the form of berms and/or silt fences made from geotextiles and/or indigenous grasses should be placed strategically around disturbed areas to minimise sediment transport and maintain water quality.

Rehabilitate Disturbed Areas. Rehabilitation of disturbed areas outside the area of inundation should aim to recreate the same mix of habitats, including stream substrates that were present prior to disturbance. Seeding of grasses is a priority, particularly along drainage lines, streams and river banks.

Stream Diversion. The length of the stream diversion should be minimised as far as practically possible.

Significance after mitigation: **Moderate**

9.3.4.2 Impact of Water Quality Deterioration on River Ecosystems

Nature of Impact:
Turbidity in Devil's Creek is likely to increase during construction and this will impact directly on macroinvertebrates and fish, particularly predatory species that rely on sight for feeding, and indirectly by affecting instream habitats. Concentrations of suspended solids below 80 mg/ℓ suspended solids are unlikely to affect the fish community, but there is evidence to suggest that concentrations between 80 and 400 mg/ℓ have detrimental impacts on fish, and that concentrations exceeding 400 mg/ℓ could seriously harm the fish community (Alabaster and Lloyd 1987). Elevated turbidity also reduces light penetration and this affects primary production, which in turn affects the diversity and abundance of aquatic biota.

Water quality in the river downstream is also expected to deteriorate because of washing and maintenance of equipment and vehicles, stormwater runoff from disturbed areas, as well as discharge from batching plants and accidental spills of hazardous substances, such as hydrocarbons and cement.

Intensity: Critical (-6). Devil's Creek is currently in a largely natural state and turbidity is low and there are numerous macroinvertebrate taxa that are highly sensitive to changes in water quality. Sensitive species of fish, such as *Amphilius* spp. and *Chiloglanis pretoriae,* are also likely to occur downstream of the waterfall, even though they were not recorded in this reach during the baseline survey. Of particular concern is the impact that elevated turbidity during construction could have on *E. cf EDEV,* which appears to be restricted within Devils Creek to the short reach of river between the waterfall and the top end of the existing dam.

Duration: Short-term (2). This impact is expected to persist for the duration of the construction phase.

Extent: Local (3). Increased turbidity and altered water quality during construction is expected extend no further than to the top end of the existing dam, and is therefore rated as local.

Probability: Definite (7).

Significance before mitigation: **Moderate**

Mitigation:
Stream Diversion. Prior to construction a pipeline with sufficient capacity to carry dry season flows should be installed to divert the stream during construction to ensure that turbidity in the river downstream of construction is not impacted. The pipeline should be sized to carry at least 119 ℓ/s, a recommendation based on the 10th percentile natural flows. The outlet of the pipe should be positioned in the river to prevent erosion, and stabilised with gabions if necessary.

Construction Schedule. Construction of the dam should be restricted to the low rainfall period (i.e. June to August).

Manage Stormwater. Stormwater runoff from access roads and all construction areas should be directed to buffer zones before reaching rivers and streams. Temporary silt fences downstream of disturbed areas should be constructed, where appropriate. Drainage ditches or sandbag bunds should prevent straight run-off of wash water, especially cement, from entering the rivers or drainage lines.

House Keeping. Standard practises for good housekeeping should be applied. Site tools and equipment such as pumps, compressors and generators should be placed on bermed impermeable sheeting (e.g. polyethylene or other similar material) to prevent hydraulic fluid or fuel leaks from contaminating soil or ground water.

Washing and Maintenance. No washing of vehicles or equipment should be located within 50 m of the river. Washing and maintenance of vehicles and equipment should be conducted in the areas designated for this purpose.

Refuelling. Diesel/fuel should be stored on an impermeable surface and surrounded by a bund wall, in order to ensure that accidental spillage does not pollute local soil or water resources. No refuelling should be allowed within 50 m of the river.

Significance after mitigation: **Minor**

Operational Phase

9.3.4.3 Inundation of Riverine Habitats

Nature of Impact: There appear to be no fish upstream of the waterfall, where the dam is proposed, but various flow-dependent taxa will be permanently eliminated *from the area of inundation*, and replaced with taxa that occur in standing water. Taxa that are certain to be impacted include the following:

- Flow-dependent macroinvertebrates, such as stoneflies, mountain midges, water pennies, caddisflies, oligoneurid mayflies, flat-headed mayflies and blackflies.
- River weed *Sphaerothylax algiformis* (Podostemaceae)
- Natal cascade Frog *Hadromophryne natalensis.*

Intensity Complete destruction (-7).

Duration: Permanent (7).

Extent: Site (1). Closure of the proposed dam is expected to inundate 0.7 km of riverine habitat.

Probability: Definite (7).

Significance before mitigation: **Moderate**

Mitigation: No mitigation possible.

Significance after mitigation: **Moderate**

9.3.4.4 Impact of Altered Water Quality on River Ecosystems

Nature of Impact: Initial filling of the impoundment will increase concentrations of nutrients and organic matter because of the decomposition of inundated vegetation, and this is likely to have negative impacts on biodiversity in the river downstream during the first few

years (i.e. the period of maturation). In the long-term impoundments tend to reduce the natural seasonal variation in downstream water temperatures, and may delay early season water temperature increases that provide spawning cues in fish. Temperature variability provides a range of thermal optima, and is considered to be one of the most important factors for maximizing aquatic biodiversity. The low biodiversity commonly reported downstream of impoundments may be attributed, in part, to a reduction in daily and seasonal temperature variation. Furthermore, impoundments create conditions suitable for the development of phytoplankton and zooplankton, so water discharged downstream tends to support large populations of filter-feeding macroinvertebrates, such as caddisflies and blackflies, that feed on plankton. Water released from the bottom of the impoundment may also contain anoxic compounds, such as elevated manganese, iron and hydrogen sulphide, particularly in summer when the impoundment is likely to stratify.

Intensity: Serious (-5). Devil's Creek supports a high diversity of macroinvertebrates that are sensitive to water quality deterioration. Aquatic biota are particularly sensitive to impacts which occur when water temperatures are high and flows are low (i.e. summer drought).

Duration: Permanent (7). Maturation of an impoundment of this size is likely to take up to five years, after which conditions stabilise, but the long-term changes to water temperature and plankton discharged downstream are permanent.
Extent: Local (3). Altered water quality during operation is expected extend no further than to the top end of the existing dam, and is therefore rated as local.

Probability: Definite (7).

Significance before mitigation: **Moderate**

Mitigation: Clear woody vegetation. Woody vegetation within the Full Supply Level should be removed, where feasible, before closure. The material should be either used or burnt. The ash should be removed as far as feasible to reduce impacts kin nutrient levels.

Significance after mitigation: **Moderate**

9.3.4.5 Impact of Altered Hydrology on Aquatic Ecosystems

Nature of Impact: Operation of the proposed dam is expected to have direct negative impacts on the downstream aquatic ecosystem because of alterations in flow patterns, particularly low flows. There are no significant tributaries between the proposed dam and the confluence with the Crocodile River, so all environmental flow requirements will need to be met from releases from the proposed and existing dam. The impoundment will change the timing, size and frequency of flow events in the river downstream. Altered flow patterns lead to changes in sediment dynamics and habitat availability, and this affects species composition and abundance. Sensitivity is high because of the high proportion of flow-dependent macro-invertebrates. Various components of the flow regime are expected to be changed, as follows:

- **Filling Period.** The time for the impoundment to become operational following closure is a critical period because there is usually a strong motivation not to supply the downstream water requirements until the dam has filled sufficiently to start supplying users (i.e. at least filed the dead storage). Flow stoppage would be highly detrimental to all flow-dependent riverine species.

- **Total Annual Flows.** Total annual flows are expected to decline because of increased evaporation and increased consumptive use associated with the irrigation development.

- **Low flows.** Low flows are likely to be altered, but these could be managed to provide the recommended Environmental Water Requirement (EWR). However, the impacts are likely to be negative if the dam is managed without supplying the EWR.

- **High Flows.** Dams typically reduce or eliminate small to medium-sized high flows, but the proposed dam has a small capacity relative to runoff, so high flows are unlikely to be affected significantly.

- **Seasonal Flow Patterns.** Dams typically delay or even eliminate seasonal variation in downstream flow, because the impoundments first need to fill before they can spill. The consequences of unseasonal releases on river flora and fauna are unknown, but are likely to be detrimental because reproductive and other life cycle cues may be affected. Little change in flow seasonality is anticipated if the EWR is supplied, but detrimental impacts can be expected if the EWR is not provided. The timing of large floods is unlikely to be delayed because of the limited capacity of the dam.

Intensity: Critical (-6). Devil's Creek supports a high proportion of flow- dependent taxa that are sensitive to changes ion flow patterns.

Duration: Project Life (5). The duration of the filling period is unknown, but is likely to take several months. However, altered flow patterns are likely to persist for the duration of irrigation use (i.e. project life).

Extent: Municipal (4). Hydrology is likely to be altered at least as far as the confluence with the Crocodile River (i.e. 5.5 km), but there could also an impact on water availability further downstream. Under natural conditions Devil's Creek Catchment would have contributed, on average, about 3% of flow to the Crocodile River at their confluence, but under present conditions the proportional contribution from Devils Creek Catchment has increased because of use in the Crocodile River catchment.

Probability: Definite (7).

Significance before mitigation: **Moderate**

Mitigation:
Environmental Flow Requirements.
Environmental flows as specified in Table 5-7 should be released at all times from the impoundment, including the period when the impoundment first fills. During normal rainfall years (non-drought), the recommended monthly low flows for the 50% time of exceedance should be implemented and monitored at J-02. This means that the minimum flows should vary seasonally between 0.036 m3/s (September), and 0.106 m^3 /s (in February). During drought years, the recommended monthly low flows for the 90% time of exceedance should be implemented and monitored at J-02. This means that the minimum flows during drought periods should vary seasonally between 0.017 m^3/s (September), and 0.046 m^3/s (in February). The natural seasonal flow variability should be maintained, and in particular, winter low flows should not exceed summer low flows.

Significance after mitigation: **Minor**

9.3.4.6 Impact of Alien and/or Translocated Fish

Nature of Impact:
The proposed impoundment could enable alien fish species, such as *Micropterus salmoides* to become established in Devil's Creek, and this could impact on macroinvertebrates, as well

as indigenous fish downstream of the waterfall. Furthermore, indigenous species that have a preference for standing water, such as *Coptodon rendalli*, are expected to colonise the impoundment, as they have done in the existing impoundment. The mechanism of such colonisations is assumed be in the form of fish eggs attached to waterfowl.

Intensity:
Large (-4). There are currently no records of fish in Devil's Creek upstream of the waterfall, so the environmental sensitivity is rated as high.

Duration: Permanent (7).

Extent: Local (3).
Alien and/or translocated fish that are expected to colonise the new impoundment could move upstream as far as the base of the Mountain Headwaters, which is about 3 km.
However, translocated species with a preference for standing water are likely to remain in the impoundment, and not move upstream.

Probability:
Highly probable (6). There is a high probability that *Coptodon rendalli*, or other indigenous species with preference for standing water, will colonise the impoundment.

Significance before mitigation: **Minor**

Mitigation:
Environmental Awareness. Awareness of the potential problems of introducing fish into the new impoundment should be fostered among staff working at the dam as well as the irrigation scheme. The aim of the awareness programme should be to prevent introductions of unwanted aliens taking place. It should be noted that translocation of fish is regulated by provincial and national legislation.

Significance after mitigation: **Minor**

9.3.4.7 Bed Armouring

Nature of Impact:
The proposed dam is expected to have a direct negative impact on the quality of downstream aquatic habitats, as water released from the dam is likely to be clear because of sedimentation within the reservoir. Clear water has the capacity to carry more sediment than turbid water. The release of clear water is therefore likely to increase erosion in the river downstream of the dam, a process referred to as "bed armouring". Geomorphological and biotope diversity in the river directly downstream of the dam is therefore likely to be reduced. Particle size diversity and the size and diversity of tributary bars are likely to be reduced. These changes are likely to lead to an impoverished section of river because reduced particle size diversity reduces the range of habitats available for plants, invertebrates and fishes, and this is likely to lead to reduced biological diversity and abundance. Furthermore, wave action and fluctuating water levels are also likely to lead to armouring of the impoundment shoreline.

Intensity:
Minor (-2).
The river downstream of the proposed dam has a steep gradient and is geomorphologically stable.

Duration: Permanent (7).

Extent: Local (3).

Altered sediment transport is expected extend no further than to the top end of the existing dam, and is therefore rated as local.

Probability: Highly probable (6).

Significance before mitigation: **Minor**

Mitigation: No mitigation feasible.

Significance after mitigation: **Minor**

Mitigation Measures:

- Stream Diversion: Prior to construction of the dam wall a pipeline with sufficient capacity to carry dry season flows should be installed to divert the stream during construction to ensure that turbidity in the river downstream of construction is not impacted. The pipeline should be sized to carry at least 119 ℓ/s, a recommendation based on the 10th percentile natural flows. The outlet of the pipe should be positioned in the river to prevent erosion, and stabilised with gabions if necessary.
- Construction Schedule. Construction of the dam should be planned for the low-flow period (this will now correspond with the time stated by Dr Batchelor for the Blue Swallows).
- ECO must monitor the turbidity of the water downstream of the dam wall construction area and downstream of the waterfall weekly during construction period.
- Environmental Flow Requirements: Environmental flows as specified should be released at all times from the impoundment, including the period when the impoundment first fills. During normal rainfall years (non-drought), the recommended monthly low flows for the 50% time of exceedance should be implemented and monitored at J-02. This means that the minimum flows should vary seasonally between 0.036 m^3/s (September), and 0.106 m^3 /s (in February). During drought years, the recommended monthly low flows for the 90% time of exceedance should be implemented and monitored at J-02. This means that the minimum flows during drought periods should vary seasonally between 0.017 m^3/s (September), and 0.046 m^3/s (in February). The natural seasonal flow variability should be maintained, and in particular, winter low flows should not exceed summer low flows.
- Environmental Awareness. Awareness of the potential problems of introducing fish into the new impoundment should be fostered among staff working at the dam as well as the irrigation scheme. The aim of the awareness programme should be to prevent introductions of unwanted aliens taking place. It should be noted that translocation of fish is regulated by provincial and national legislation.
- An Annual SASS 5 and fish monitoring programme must be implemented to monitor the impact of the dam on the aquatic ecosystem.

9.3.5 Impact on the *Enteromius cf* (EDEV) found between the waterfall and Koedoeshoek dam

Nature of Impact	Period	Extent	Duration	Intensity	Probability	Significance before mitigation	Significance after mitigation
Water turbidity	Construction	Local	Short	Medium	Probable	Medium	Low
Ecological water flow	Construction	Local	Short	Medium	Probable	Medium	Low
Ecological water flow	Operations	Local	Long-term	Medium	Probable	Medium	Low

No fish were found in the upper reaches of the Devil's Creek above the waterfall. Mitigation measures were defined to lower the risk on fish downstream from the dam during the

construction and operational periods. Only two fish species were identified between the waterfall and existing, Koedoeshoek dam. Dr Pieter Kotze conducted a further fish assessment in response to the MTPA concerns about the assessment done by Dr Rob Palmer after the drought and during a high water flow period.

The MTPA was involved in a collaboration project with SAIAB to establish genetic lineages of various *Enteromius* species and included the Devil's Creek population in the test work. The genetic results indicated that the populations from the Devils Creek population (previously thought to be *Enteromius anoplus)* **may be a different species** and most probably not *E. anoplus*. The phylogram indicated the presence of eight (potentially nine) distinct lineages, highlighting the possibility that there may in fact be eight to nine different fish species within the "Chubbyhead barb" group analysed as part of this assessment.

The Devils Creek population shows a greater genetic variation and interbreeding has not yet taken place. This upper catchment population with its greater genetic variation **should be conserved at all cost**.

The potential impacts are rated as medium significance before mitigation.

One of the mitigation measures recommended as part of the ongoing EIA for the proposed Bruintjieslaagte Dam was the translocation and introduction of this species to the Devils Creek **upstream** of the existing waterfall and **upstream** of the full-supply level of the proposed dam site. A specialist study was conducted to determine the potential viability of the above-mentioned mitigation measure (translocation) (see the **Specialist Aquatic Assessment of *Enteromius Cf. Anoplus/Motebensis* (*Enteromius "Devils Creek"*) Habitat in the Devils Creek (Mpumalanga) October 2018** by Dr. P. Kotze, Clean Stream Biological Services under Appendix 7.3 for details).

Mitigation measures already implemented includes the DNA study, habitat suitability report and translocation of a sample of the population. Refer to the detail under section 4.2 of the report.

The follow-up surveys provided key information that is noteworthy under the impact assessment. Keeping in mind that the translocation took place to the dam basin area and not Sites A5 and A6 as recommended in the EDEV habitat, the following can be highlighted:

- **Conditions at the recommended translocation sites A5 and A6 was found to still be suitable** (provide slow flowing habitat with cover) **for EDEV, even under high flows**.
- It was also evident, based on the observation made during the February 2020 high flow survey, that many sections within reach A (recommended conservation zone) will not be passable by EDEV due to high velocities and high gradients. Based on available information for the small *Enteromius* group of fish species (that should include EDEV) the maximum recommended velocity that they are thought to be able to negotiate over short distances is 1.5 m/s and a maximum direct drop of 120mm between pools can be negotiated through jumping (Bok *et al.,* 2007). It was evident from visual observation made during February 2020 that these values were exceeded in many areas within this reach and may therefore be impassable by EDEV individuals. **It was therefore again stressed that it unlikely that EDEV will be able to naturally distribute upstream form the translocated site (at the proposed dam wall) to the recommended conservation reach and sites (especially sites A5 and A6) without intervention.**
- **With the May 2020 survey forty-seven (47) EDEV individuals were sampled** upstream of the proposed dam wall during the May 2020 survey. The number of fish sampled equates to 23% of the total number introduced (207 individuals). Although one can never expect that all fish in a reach will be sampled during any sampling exercise, this number provides an indication of the relative abundance of fish in relation to the introduced number of fish. Once 100% is exceeded (more than 207 individuals sampled during any

survey) it will be a definite indication that successful reproduction has occurred. **The current percentage therefore do not yet provide proof of successful reproduction post translocation**.

- **No juveniles or fish larvae were observed during the survey.** Since fish larvae are small and may escape through the fish scoop nets, a SASS5 net (0.5mm mesh size) was also used during the survey to scoop suitable slow habitats. No fish larvae were sampled and **although some small individuals (30mm) were sampled, it is not yet a clear indication that successful breeding has occurred after translocation**. Based on literature of the Chubbyhead Barb group of fish (including *E. anoplus* and *E. motobensis*), it is estimated that EDEV individuals will reach a length of between 30mm and 40mm (fork length) after the first year (Cambray and Bruton, 1985; Kleynhans, 1987; Kindler *et al.* 2015). Growth however depends on various environmental factors (such as food, temperature etc.). **The presence of small individuals less than 30mm during any future survey would therefore be an indication that successful breeding has occurred after translocation.**
- **The May 2020 survey therefore provided promising results that EDEV managed to survive a full annual cycle in the reach upstream of the waterfall**. It is especially good to note that they manage to find refuge areas in times of high flow (as observed in February 2020).
- **Of some concern is the fact that the translocated fish is currently (one year after translocation) still only present within the translocated area, in close proximity to the proposed dam wall and have not colonized the conservation zone.** The current EDEV population **only occurs within the full-supply level of the proposed dam**, and hence within a river section that will be transformed by the proposed dam (inundation, transformed form lotic to lentic ecosystem). Although EDEV is likely to survive and potentially thrive in the inundated slow-pool habitat that will be created by the dam (water quality and habitat permitting), **there is concern that construction activities may eradicate these individuals**. **It is therefore essential that a healthy population of the EDEV must be established upstream of any potential impacts (especially construction activities) in the conservation zone.** Should the proposed activity include disturbance of the riverbed upstream of the proposed dam wall (such as collection of construction material from river bed) the current EDEV population will be at high risk and potentially be eradicated.
- Should EDEV colonise the inundated dam area successfully after construction, **it will remain essential (critical) that no other fish species (indigenous or exotic) be introduced into this dam or the river upstream of this dam. The presence of especially predatory species will nullify the potential success of the translocation effort to conserve this species**.
- Various EDEV individuals were sampled in reach B (below waterfall) during the May 2020 survey indicating **that the original EDEV population below the waterfall is still in a healthy state**.

<u>Management recommendations</u>:

The following management recommendations specific to the Devil's Creek *Enteromius sp*. from the **Follow-Up Surveys of Devils Creek (Mpumalanga) to determine survival of *Enteromius "Devils Creek"* (EDEV) after translocation - May 2019, February 2020, May 2020, Clean Stream Biological Services Pty Ltd**. The report is attached under Appendix 7.4d and included under section 4 of the EIR.

Should the proposed Bruintjieslaagte dam development be approved, it is strongly recommended that the following management actions should be included in the environmental management plan / ROD:

- No further development of the catchment area of the Devils Creak should be allowed upstream of the waterfalls (within the proponents' property).

- The upstream catchment area (especially of the conservation reach) should ideally be managed as a nature reserve to allow natural processes to continue and to maintain good water quality and habitat characteristics. Clearing of vegetation within this catchment may result in increased turbidity and siltation of critical EDEV habitats.
- No clearing of riparian vegetation or any disturbance of the conservation reach (from site A6 to full-supply level) should be allowed. Marginal and overhanging vegetation provided essential cover features that are critical for the survival of EDEV.
- The creation of artificial habitats for EDEV (similar to Plate 6) could be considered in the direct area of the dam inflow (at full-supply level) but no further natural riverine habitat above the full supply level should be disturbed.
- Annual fish monitoring surveys should be compulsory during all phases of the proposed development (pre-construction, construction, operational and decommissioning). The objective of the fish monitoring surveys should include (but not be limited) to the following:
  - Monitor the status of the translocated EDEV population upstream of the waterfall (especially from Bruintjieslaagte dam wall to habitat site A6 (conservation zone).
  - Establish if any other fish species have colonised the Bruintjieslaagte dam and conservation reach.
  - Monitor the status of the fish population (especially EDEV) in the Bruintjieslaagte section downstream of the waterfall (during construction and operational phase).
  - Monitoring (fish) surveys should be performed bi-annually during construction phase and annually (during the low flow season) during operational phase.
- It is strongly recommended that more detailed ecological and genetic studies should be performed on the EDEV population within the Devils Creek in future.
- Before any construction occurs at the dam wall, a fish survey should be conducted in the reach stretching from the proposed Bruintjieslaagte Dam wall to the waterfall (high risk area to be impacted by construction activities). Any EDEV individuals collected during this survey should be translocated to the recommended translocation sites A5 and A6 within the conservation zone.
- Should any disturbance be planned within the current area where translocated EDEV was sampled (dam basin area), an attempt should also be made to move some of these individuals to the recommended translocation sites A5 and A6 within the conservation zone.
- It is furthermore recommended as a precautionary measure to improve the survival of the species that some EDEV individuals should be kept in aquarium facilities off-site during the construction phase, and returned to the river once the system is stabilised after construction (preferably to be done by MTPA/conservation authority).

Mitigation measures during construction period

- Before any construction occurs at the dam wall, a fish survey should be conducted in the reach stretching from the proposed Bruintjieslaagte Dam wall to the waterfall (high risk area to be impacted by construction activities). Any EDEV individuals collected during this survey should be translocated to the recommended translocation sites A5 and A6 within the conservation zone.
- Install a pipe off sufficiently large diameter prior to site clearance and construction of the dam wall to divert the total clean flow of the Devil's Creek past/through the construction area.
- The pipe must be installed on the eastern embankment a few metres outside the right embankment of the stream. The natural stream and embankments must not be disturbed during the installation of the pipe.

- Plan construction period for the low-flow periods and also outside the Blue Swallow Breeding season – April to end-October (Dr Garth Batchelor provided period).
- ECO must monitor the turbidity of the water downstream of the dam wall construction area and downstream of the waterfall weekly during construction period. If high turbidity is observed instruct the contractor to revise construction practice to prevent/reduce turbidity of the water.
- ECO must monitor the fish below the waterfall and upstream of the Koedoeshoek dam on a weekly basis during the construction period. Immediately report if fish mortality if observed, investigates reasons and ensure that corrective action is implemented.
- The Ecological Water Requirement (EWR) as specified by IWR, Stephen Mallory must be released from the Bruintjieslaagte dam during the filling period of the dam after construction is completed.

Table **9.3.2 Monthly Ecological Flow Requirement (l/s)**

Month	Dam	
	Bruintjieslaagte	**Koedoeshoek**
Oct	35	34
Nov	59	48
Dec	82	61
Jan	99	77
Feb	219	95
Mar	108	74
Apr	82	61
May	54	47
Jun	44	39
Jul	38	35
Aug	32	33
Sep	30	32

Mitigation measures during the operational period:

- The monthly Ecological Water Requirement (EWR) as specified by IWR Stephen Mallory, must be released from the Bruintjieslaagte dam as well as the Koedoeshoek dam on an ongoing basis. EWR flow must be measured and submitted to the Department of Water and Sanitation and/or IUCMA annually or as specified in the water use licence. Please note that during normal rainfall periods the natural flow in the Devil's Creek will be sufficient as the dams will overflow. Releasing additional flow to meet the EWR will only be required during dry and low-flow periods.
- Environmental Awareness. Awareness of the potential problems of introducing fish into the new impoundment should be fostered among staff working on the farm. The aim of the awareness programme should be to prevent introductions of unwanted aliens taking place.
- The applicant must commit and ensure that no exotic fish species is introduced into the Bruintjieslaagte dam.
- An Annual SASS 5 and fish monitoring programme must be implemented to monitor the impact of the dam on the aquatic ecosystem. Report must be submitted to the MTPA, Aquatic Systems.

9.3.6 Riparian, Wetlands and Terrestrial Ecology

Following is the Impact Assessment as abstracted from Emross Consulting and Taylor Environmental report, Dr L R Taylor and Anthony Emery (Appendix 10):

Criterion	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance
Impact on the riparian vegetation at site DP1 and the Devil's Creek	Local	Low	Long Term	High Probability	Sure	Long Term	Low
Impact on the vegetation in the Marginally Degraded Forested Woodland	Area specific	Low	Long Term	High Probability	Sure	Long Term	Low
Impact on the Secondary Grassland	Area Specific	Low	Long Term	High Probability	Sure	Long Term	Low
Impact on the vegetation in the Riparian- Mistbelt Forest Ecotone	Local	Low	Long Term	Highly Probable	Sure	Long Term	Low
Impact on the wetlands and wetland ecosystems services associated with site DP1 and the Devil's Creek River	Local	Low	Long Term	Probable	Sure	Long Term	Low
Impact of increased invasion by alien plant species at site DP1 and the Devil's Creek	Local	Medium	Long Term	High probability	Sure	Long Term	Medium
Impact of the potential loss of habitat for conservation-important fauna and disruption to life-history cycles	Site specific	Medium	Long Term	Sure	Highly Probable	Long Term	Medium
Impact of disruption to fauna due to construction activities	Site specific	Medium	Short Term	Sure	High Probability	Long Term	Low

9.3.6.1 Impact on the riparian vegetation

Although the VEGRAI Level 3 score of 76,1% (EC of high C, Moderately Modified) for the right bank riparian vegetation and probable EC of B (Largely Natural with few modifications) for the left bank implies high biodiversity and good ecosystems functioning, and should therefore be protected (classified as CBA Optimal and Irreplaceable), the footprint (wetted area) of site DP1 includes only 14,7ha (0,04%) of the total catchment area of 34510ha. The fact that the catchment above the dam is considered to be undisturbed and natural, and hence includes riverine ecosystems in good order, suggests that the impact of damming site and losing riparian vegetation may be considered to be of local extent, low magnitude, long term duration and low significance.

Mitigation Measures:

- It is essential that the entire catchment above site DP1 be maintained in a near-unmodified to unmodified state in the future. It should be a requirement of the Environmental Authorisation for the present project that this be the case. In order to mitigate against the loss of plants of conservation- importance that are present on the footprint of site DP1, it is essential that a conservation-important plant (*Eucomis autumnalis* and *Encephalartos humulis*, amongst others) walk-through and rescue plan be established and implemented prior to construction.

9.3.6.2 Impact on the wetlands and wetland ecosystem services

Similarly to that expressed in Section 9.2.5.1 above, although the Wetland-IHI PES score for the five permanent, seasonal and temporary wetlands (4,1ha) at site DP1 is 92,4%, with an EC of A, and described as unmodified and natural, and should therefore be protected (classified as CBA Optimal and Irreplaceable), the footprint (wetted area) of site DP1 includes only 14,7ha (0,04%) of the total catchment area of 34510 ha.

The impact on the wetlands and wetland ecosystems services associated with site DP1 and the Devil's Creek River may thus also be considered to be of local extent, low magnitude, long term duration and low significance.

Mitigation Measures:

- Although significance of the wetlands may be reduced due to the relative size of the catchment compared to the wetted area (footprint) of the dam site, it is important that wetland ecosystem services and function be maintained in a good state. Consideration must be given to erosion control, biodiversity maintenance and high carbon storage, as well as to the maintenance of base flow throughout the year, where possible. The exception should only be during drought conditions.
- Natural flood attenuation services should also be maintained and protected and the hydrological regime must not be significantly altered, other than what the new dam and its normal maintenance and management may create.

Criterion	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance
Impact on the riparian vegetation at site DP1 and the Devil's Creek	Local	Low	Long Term	High Probability	Sure	Long Term	Low

It is recommended that:

- Strict erosion control measures be implemented during construction,
- That all areas exposed during construction that are not part of the wetted area be rehabilitated with indigenous vegetation as soon as possible after use and that the hardening of surfaces be avoided as far as possible. Such areas must be cleared and loosened after use and rehabilitated with indigenous vegetation.

9.3.7 Terrestrial Ecology

Assessment table by Emery and Taylor.

Criterion	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance
Impact on the riparian vegetation at site DP1 and the Devil's Creek	Local	Low	Long Term	High Probability	Sure	Long Term	Low
Impact on the vegetation in the Marginally Degraded Forested Woodland	Area specific	Low	Long Term	High Probability	Sure	Long Term	Low
Impact on the Secondary Grassland	Area Specific	Low	Long Term	High Probability	Sure	Long Term	Low
Impact on the vegetation in the Riparian- Mistbelt Forest Ecotone	Local	Low	Long Term	Highly Probable	Sure	Long Term	Low
Impact on the wetlands and wetland ecosystems services associated with site DP1 and the Devil's Creek River	Local	Low	Long Term	Probable	Sure	Long Term	Low
Impact of increased invasion by alien plant species at site DP1 and the Devil's Creek	Local	Medium	Long Term	High probability	Sure	Long Term	Medium
Impact of the potential loss of habitat for conservation-important fauna and disruption to life-history cycles	Site specific	Medium	Long Term	Sure	Highly Probable	Long Term	Medium
Impact of disruption to fauna due to construction activities	Site specific	Medium	Short Term	Sure	High Probability	Long Term	Low

9.3.7.1 Impact on the terrestrial vegetation on the footprint of site DP1

The Marginally Degraded Forested Woodland comprises a relatively small are of patches of forest and grassland, with a total surface area of 1.63ha, and lies within the eastern edge of the footprint. Part of this area lies above and outside the footprint.

Twenty-two species of dominant plants were identified along the transects T1 and T4, with no plants of conservation-importance found. The alien plant *Solanum mauritianum* is significantly present within the area. The area is impacted both historically and at present by anthropogenic activity (historical walled structures implying the use of the area for natural resource utilization and at present the presence of a gravel road through the area). The area is considered to be of medium ecological significance and the MBSP (MTPA, 2014) classification of the area in parts is Other Natural Areas, CBA Optimal and CBA Irreplaceable. The fact that the catchment above site DP1 is considered to be undisturbed and natural, and hence includes woodlands and Mistbelt Forest in good order, suggests that the impact on the loss of the vegetation in the Marginally Degraded Forested Woodland is

area specific, of low magnitude and long term duration and may be considered to be of low significance.

The Secondary Grassland is a very small unbroken area of 1.86ha in which seventeen species of dominant plants identified along transect T2. Historical anthropogenic activity included contouring and the construction of earthen canals and berms, as well as the likelihood of the cultivation of crops and stock farming. The area is considered to be of medium ecological significance and the MBSP (MTPA, 2014) classification of the area is CBA Irreplaceable. The fact that the catchment above site DP1 is considered to be undisturbed and natural, and hence includes significant areas of Lydenburg Montane grasslands suggests that the impact on the loss of the vegetation in the Secondary Grassland is area specific, of low magnitude and long term duration and may be considered to be of low significance.

The Riparian-Mistbelt Forest Ecotone area comprises 11.26ha of a combination of the riparian zone including wetlands (permanent, seasonal, temporary), ecotone and the adjacent terrestrial mistbelt forest. Sixty-two species of plants were identified along transect T3, and other transects employed during the initial study. Aliens included *Ricinus communis, Rubus cuneifolius, Solanum mauritianus* and *Verbena bonariensis*. Historical anthropogenic activity including contouring and the construction of earthen canals and berms. Anthropogenic activity is likely to have been the cultivation of cropsand stock farming.

The RB VEGRAI Level 3 score is 76,1%, an EC of high C, described as Moderately Modified. The LB was only briefly examined due its steep sloped inaccessibility and narrow marginal and non-marginal zone. The classification along the LB is probably an EC of B, described as Largely Natural with few modifications.

There are five wetland areas (4.1ha) along the RB, including permanent, seasonal and temporary ones. The significance of the wetlands is reduced because (i) the wetlands are of a small size, (ii) have a channelled nature and (iii) the large catchment (34510ha) is pristine, providing an un-impacted environment for the resident biota. The Wetland- IHI PES score of 92.4% gave an EC of A, described as unmodified, natural. The ecological sensitivity was considered to be medium to medium-high and the MBSP (MTPA, 2014) classification of the area as CBA Irreplaceable. The fact that the catchment above site DP1 is considered to be undisturbed and natural, and hence includes significant areas of undisturbed riparian habitat and mistbelt forest suggests that the impact on the loss of the vegetation in the Riparian-Mistbelt Forest Ecotone is local, of low magnitude and long term duration and may be considered to be of low significance.

Mitigation Measures:

- As stated earlier, this reasoning can only be justified on condition that in terms of mitigation, it is essential that the entire catchment above site DP1 be maintained in a near-unmodified to unmodified state in the future. It should be a requirement of the Environmental Authorisation for the present project that this be the case.
- In order to mitigate against the loss of plants of conservation-importance that are present on the footprint of site DP1, it is essential that a conservation-important plant walk-through and rescue plan be established and implemented prior to construction. This will include *Eucomis autumnalis* and *Encephalartos humulis*, amongst others. This is best achieved by undertaking the walk-through and rescue plan in stages as the densely vegetated footprint transformed during the construction phase is made more accessible. Should any plants of conservation-status be found in these circumstances, construction must be halted and appropriate rescue protocols employed.

Potential impact on the terrestrial vegetation on the footprint at site DP1:

Criterion	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance
Impact on the vegetation in the Marginally Degraded Forested Woodland	Area specific	Low	Long Term	High Probability	Sure	Long Term	Low
Impact on the Secondary Grassland	Area Specific	Low	Long Term	High Probability	Sure	Long Term	Low
Impact on the vegetation in the Riparian-Mistbelt Forest Ecotone	Local	Low	Long Term	Highly Probable	Sure	Long Term	Low

9.3.7.2 Impact of the potential for increased invasion by alien plant species (As assessed by Emery and Taylor)

Eight species alien plants, including *Solanum mauritianum* (Bugweed), *Rubus cuneifolius* (American Bramble), *Bromus catharticus* (Rescue Grass), *Arundo donax(*Giant Reed), *Phaeoceros laevis* (Smooth hornwort), *Persicaria lapathifolia* (Pale Persicaria), *Ricinus communi*s (Castor-oil Bush) and *Lantana camara* (Lantana) were found along the three transects on site. There is no doubt that there will be other alien plants on site and in the area.

Given the potential for the expansion of the stands of these alien plants on site and in the region as a result of the increased wetted area due to the presence of the proposed dam, the impact of the potential for the increased invasion by alien plant species at the dam site and the Devil's Creek may be considered to be of local extent, medium magnitude, long term duration and medium significance.

Criterion	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance
Impact of increased invasion by alien plant species at site DP1 and the Devil's Creek	Local	Medium	Long Term	High probability	Sure	Long Term	Medium

Mitigation Measures:

- An alien plant eradication program must be implemented for the Devil's Creek and its catchment area. A program of this nature also serves as an "offset" action to improve the biodiversity, ecological state and ecosystems services condition of the river system.

9.3.7.3 Impact of loss of habitat for conservation-important fauna and disruption to life-history cycles

This impact assessment is summarised from the terrestrial specialist report excluding the conservation-important Blue Swallows and avifauna assessment as it is assessed separately in the next section and with updated information.

No conservation-important fauna other than avifauna were found on the footprint during the initial and subsequent studies and all the field visits.

Hence the impact of loss of habitat for conservation-important fauna, in particular the Blue Swallows, may be considered to be of site-specific extent, medium magnitude, long term duration and medium significance before mitigation.

Criterion	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance
Impact of the potential loss of habitat for conservation-important fauna and disruption to life-history cycles	Site specific	Medium	Long Term	Sure	Highly Probable	Long Term	Medium

It is also possible that construction activities, including the generation of dust, noise due to the use of machinery and the spillage of chemical pollutants to the environment may have an effect on resident biota.

Criterion	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance
Impact of disruption to fauna due to construction activities	Site specific	Medium	Short Term	Sure	High Probability	Long Term	Low

Mitigation Measures:

- Allow animals to escape from construction area and don't kill snakes, aardvark or any other animal found. ECO to assist in capturing of animals found on the construction site and releasing of animals outside construction area.
- ECO (ecologist) to survey site and identify, rescue and relocate conservation important plant species prior to start of construction.
- ECO to identify trees and other plant species and obtain the required permits for destruction or relocation from the DAFF or MTPA.
- Ahead of any construction or excavation, topsoil and vegetation must be stripped from the required footprints and kept to be spread over areas that need to be rehabilitated on completion of construction.
- Boundaries of construction area must be demarcated before start of construction.
- Construction camp must be located at least 50m away from any stream.
- After the construction period the construction camp area must be cleared from all concrete, buildings and hardened surface and rehabilitated. Area must be ripped, topsoil spread and indigenous grass replanted (topsoil with grass residue should re-establish vegetation cover but if not hydro seeding must be done).
- Fuel for construction vehicles must be stored in tanks on concrete bunded areas.
- Construction vehicles must be refuelled in a dedicated area on a hardened surface where spillage of diesel can be contained.
- Clean and rehabilitate accidental spillage of fuel or lubricants.
- Monitor dust generated during construction and movement of vehicles and use water spraying to reduce dust if required.
- Strict measures must apply where materials in powder form, such as cement, lime, concrete additives, etc. are stored, handled or used, and for the proper disposal of packaging of any such materials.
- Limit disturbances to the demarcated construction sites and footprints.
- The collection of firewood or any other plant resources by construction staff is prohibited.

- Make use of existing roads and tracks. If upgrading of roads are required for construction vehicles it must be done in consultation with the ECO.
- All reasonable steps to avoid spreading of any fires must be taken.
- Burning of woody material must be done inside the footprint area of the dam.
- Engineering designs, methods and specifications should be strictly adhered to.
- Target and control alien invasive plants at the construction site and dam area in general.

In addition to the above measures, the applicant is in the process of applying for a nature reserve to be proclaimed over Portions of the Farms Rietvly 295 JT, Mooiland 294 JT, Geluk 299 JT, Bruintjieslaagte 465 JT, Koedoeshoek 301 JT, and Loopfontein 298 JT. The application is currently in Phase 3a, refer to the table below for a layout of the process that must be followed:

Table 9.3.3 Biodiversity Stewardship Implementation Procedure

THE BIODIVERSITY STEWARDSHIP IMPLEMENTATION PROCEDURE			
Phase	**Name**	**Description**	**Progess**
Pre – Implementation Preparation	*Spatial identification of biodiversity stewardship priority sites*	• Use MPAES to identify candidate sites for stewardship and protected area expansion. • Establish criteria for prioritising biodiversity stewardship implementation within the identified biodiversity priority areas. • Prioritise properties against these criteria and produce a map or list of priority stewardship sites.	**Complete**
Phase 1	*Site identification and landowner interactions*	• Identify priority sites from the map or list of priority stewardship sites. • Prepare for the initial visit, introduce and explain the stewardship options to the landowner. • Request a site assessment.	**Complete**
Phase 2	*Biodiversity assessment and socioeconomic/institutional and review of the site*	• Perform a biodiversity assessment (desktop and field) of the property. **MTPA have indicated that there is enough biodiversity information available for the properties in order to support the application. Sustineri has been advised to proceed with development of the Management Plan.** • Perform a socio-economic/institutional assessment – **this is not necessary as the study area falls within biomes and vegetation types of conservation importance and regarded as Priority 1 areas for protection in the NPAES and MPAES (pers. comm. Brian Morris, MTPA 7 Auguest 2019).** • Present findings to the Protected Area Expansion Committee (Review Panel). • Give feedback to the landowner and agree on the category allocation.	**Complete**
Phase 3a	*Contract negotiation and draft management plan development (with landowner)*	• Prepare for negotiations using findings from the Biodiversity Assessment. • Draft initial contract agreement. • Identify what socio-economic issues will be addressed and how. • Consult legal expertise and finalise all the legal documents. • Negotiate the content of the Management and Zonation Plan.	**In progress**
Phase 3b	*Site approvals and cost analysis*	• Obtain conservation agency approvals through the relevant approval procedures. • Negotiate the content of the management plan with the landowner. • Conduct initial public participation with stakeholders.	-
Phase 4	*MEC submission and formal proclamation*	• Submit all relevant documentation and information to the MEC for approval (only for Nature Reserve and Protected Environment categories). • Advertise proposed declarations. • Finalise declaration in Government Gazette.	-
Phase 5	*Provide support to protected area and annual audit*	• Conduct audit based on management activities in plan. • Provide follow-up support and monitoring. • Identify what ongoing socio-economic development support will be provided and how.	-

9.3.8 Avifauna including Blue Swallow

Nature of Impact	Period	Extent	Duration	Intensity	Probability	Significance before mitigation	Significance after mitigation
Loss of habitat – avifauna general	Construction Operations	Local dam site	Long term	Low	Probable	Low	Low
Loss of habitat – Blue swallow	Construction Operations	Local dam site	Long term	Low	Improbable	Low	Low
Disruption of breeding cycle – Blue swallow	Construction	Local dam site	Short	Medium	Improbable	Medium	Low

The impact assessment below is abstracted from the avian specialist report by Dr I Whyte and with the updated information available from the Blue Swallow work and monitoring surveys by Dr Batchelor.

Dr Ian Whyte stated that the general conclusion in the broader perspective is that the impacts on the avifauna of the area will be low. Some species, particularly those dependent upon the indigenous riparian vegetation may have small numbers displaced. These include the Apalises, Cape batis, Greenbacked Camaroptera, Ashy Flycatcher, Terrestrial Brownbul, Grey Cuckooshrike, Yellow-fronted Tinkerbird, Knysna Turaco, These species are common to relatively common but none, given the small size of the impacted area, are at any particular risk and populations could be expected to remain intact in the area.

Other species may benefit from the presence of the dam and the stabilised flow in the downstream area of the new dam. These include African Black Duck, Pied Wagtail, the Kingfishers, Egyptian Geese, White-throated and Wire-tailed Swallows.

The Red Data species are also believed to be at no particular risk - the Blue Swallow being the main species to be considered here. The mist-belt grasslands appear to be in a pristine state, which might be expected if Blue Swallows are still to be found there, so the habitat is not a cause for concern.

The major consideration is the disturbance factor when these birds return from migration. That is the reason why it is crucial that the construction work on the dam wall, and the disturbances associated with that work to be completed before the swallows return.

Mitigation Measures by Dr Whyte:
I believe that there are only limited options for the implementation of meaningful mitigation measures. The construction phase will be high impact in a limited area over a limited time period, but the following two measures can be implemented. The first of these will be crucial.

- The construction phase (and therefore the disturbance) must be entirely complete before the advent of summer and the arrival of the migrant species, particularly the Blue Swallows which will arrive in.
- The pushed out trees and bush should be burned inside the dam before inundation to prevent further impacts and disturbances away from the dam site.

Impact on Endangered Species:

a) Blue Swallow (Hirundo atrocaerulea)

The *justification for Red list classification is that this species satisfies the population size criteria for Regionally Critically Endangered (population numbers <250 individuals and a decline of at least 25% was predicted for the next three years from 2017.*

The Bruintjieslaagte site has become an extremely important site for this species, as the birds have showed a steady decline wherever they have occurred in Mpumalanga. It appears that there are still fairly large areas of what appears to be suitable habitat. From Dr Whyte's personal observations, it would seem that the problem is not a local one, as most pairs in the area regularly raised two broods to the fledgling stage per year. Each year however, fewer birds returned from their migration to the Central African "great lakes" area. It is therefore not suspected that local conditions, or the management of the grasslands, play any part in the decline, but that some factor elsewhere on their migratory travels has reduced the numbers of these birds.

Monitoring, habitat investigation and follow up Surveys of the Status and breeding of the Blue Swallows (*Hirundo atrocaerulea*) on Bruintjieslaagte was done by mainly by Dr Garth Batchelor. A number of visits were made to the Devil's Creek valley above the waterfall during the spring, summer and autumn of 2017 to 2020 to make observations on the Blue Swallow population.

The recommendations of the Blue Swallow Working Group that the birds must continue to be monitored and that artificial nests be dug was implemented.

No breeding was recorded through the monitoring efforts. Dr Batchelor stated that this is the 5th consecutive year that they have been recorded but still no definitive record of successful breeding in the area has been observed. All the sightings this past season have been on the higher slopes away from the Devil's Creek. Refer to Appendix 6 for all the reports related to Blue Swallows. The following statements regarding impact assessment and recommendations are based on the work done by Dr Batchelor:

- The Blue Swallows are infrequent visitors to the lower Devil's Creek valley and game camp plateau north of the proposed dam site.
- Blue Swallows are mostly observed flying and foraging high over the area and over the western ridge of the valley.
- Blue Swallows were spotted flying over the artificial nesting pits, termite and aardvark holes in the game camp but no nesting occurred over the observed 4 breeding seasons in this area.
- Although these artificial nesting pits, termite and aardvark holes is typical of other observed breeding sites elsewhere, the swallows did not select any during the last 4 breeding seasons but continued to use more suitable and preferred breeding sites higher up in the valley in the higher altitude grasslands.
- Possible reasons could be these sites are at a lower altitude of 1100m with consequential effects that the plateau is very hot during the mid-summer months, very dry soil and collapsing walls of the artificial pits, exposed pits with no vegetation cover from direct sun and rainfall, less frequent mist at this altitude, higher average temperature and lower rainfall. Competition from Little Bee-eaters and Black Saw-wing Swallows using the pits successfully for nest and breeding could also be a contributing factor.
- Blue Swallows were seen feeding over large areas together with House Martins.

- 5 Blue Swallows were recorded foraging over a fig tree together with over 10 Black Saw Wing Swallows. There was an emergence of small flying ants coming out of the grass on which they were feeding.
- 2 female Blue Swallows were seen foraging with the Saw-wings along a ridge to the north east of the excavated holes near the game dip station. A pair of Greater-striped Swallows and a Black Swift were all foraging together.
- In contrast to the more typical behaviour of the Blue Swallows observed flying high along the wooded ridges Blue Swallows were observed either flying singly or in pairs close to the ground during colder and misty days when the upper part of the valley is covered in mist.
- *10* adult Blue Swallows were seen perched together just above the ground on sticks in light rain. There were five adult males and five adult females (17 October 2018).
- 12 Blue Swallows was seen flying along the slope of the hill towards the proposed dam site. They were also apparently feeding on insects in the updraft along the hill slope (2 October 2019).
- There are no nesting sites in or near the dam basin area.
- The proposed dam site is not a preferred foraging area for the Blue Swallows.

The vegetation loss with the construction of the dam and flooding of an area of approximately 12 hectare is insignificant taken into account that several thousand hectare of grasslands is available for preferred foraging of the Blue Swallows.

The following in terms of recommended mitigation:

- As a mitigation measure the construction of the dam should be done outside the breeding period. Dam construction should not take place between 1 November and the end of 31 March (Dr Garth Batchelor).
- The monitoring of the Blue Swallows in the grasslands on the Devil's Creek plateau grasslands should continue. The searching for possible nest sites should extended to higher altitude grasslands.
- Dr Garth Batchelor confirmed that it is not possible to develop a management plan for the Blue Swallows as part of the Bruintjieslaagte dam EIA application. The Blue Swallows are infrequent visitors to the lower Devil's Creek valley and no nesting sites as yet have been found. As a precautionary mitigation measure the construction of the dam will be done during the winter period, which is outside the breeding season of the Blue Swallow.

The operational period of the dam will have no negative impact on the Blue Swallows.

b) Martial Eagle (*Polemaetus bellicosus)*

The impact assessment is abstracted from Dr Whyte's report:

An adult (probably a male) was seen upstream of the dam on 24th January 2017. It had recently fed as its crop was full. May be a breeding resident, but would likely have a much wider home range, so might not nest on Bruintjieslaagte. Given the wide ranging habits of this species, the proposed new dam site would represent only a tiny fraction of its home range, so it is unlikely that the dam will have any negative consequences for this species. Indeed, as Monitor lizards (*Varanus* spp.) make up a large proportion of their prey, it is likely that the dam may prove beneficial.

Vulnerable Species (V):

No species on the "Vulnerable" list were recorded during the survey, though it is probable that the following two species will be found to occur there:

c) Crowned Eagle (*Stephanoaetus coronatus*)

Crowned Eagles are known (from SABAP data) to occur in the wider QDGC, but they were not recorded in these surveys. Their nesting biology in the Lowveld is currently under study by the Crowned Eagle Working Group which is based in Nelspruit. This is a forest species, and though a small patch of riparian forest would be lost to the proposed dam, this species prefers to breed in tall trees higher up the slopes and not in river valley bottoms. Given the wide ranging habits of this species, the proposed new dam site would represent only a tiny fraction of its home range, so it is unlikely that the dam will have any negative consequences for this species.

d) Secretary Bird (Sagittarius serpentarius)

This species is a Highveld grassland species which will almost certainly visit this area from time to time, but has not been recorded during these surveys. Riparian or other forest patches do not form part of their normal habitat, so it is unlikely that the dam will have any negative consequences for this species.

Near-Threatened Species (NT):

e) Half-collared Kingfisher (Alcedo semitorquata)

Half-collared Kingfishers were not recorded during these surveys, but it has been recorded in SABAP's database for the larger QDGC. As its habitat usually is on quiet, flowing streams and rivers, is very likely to occur here. As with the Giant Kingfisher, it is a fish eater, so will probably benefit from the development of the proposed new dam. Many small Tilapia were seen in the existing dam downstream, so the food supply should be ensured, and seepage and releases from the dam will ensure a more consistent flow in the stream below the dam wall.

Status and impact on other birds recorded in the Bruintjieslaagte dam area:

Unless specifically stated, the dam is expected to have no, or negligible impact on the species below:

Apalis, Bar-throated, *Apalis thoracica.* Common breeding resident occurring especially in the indigenous forest patches and riparian vegetation. Replaces the next species at higher altitudes.
Apalis, Yellow-breasted, *Apalis flavida.* Common breeding resident throughout especially in the indigenous forest patches and riparian vegetation. Replaces the next species at lower altitudes.
Barbet, Black-collared, *Lybius torquatus.* Common breeding resident found in a wide variety of habitats.
Barbet, Crested, *Trachyphonus vaillantii.* Common breeding resident, found in a wide variety of habitats.
Batis, Cape, *Batis capensis.* Common breeding resident found in the forest patches and riparian areas, but due to the general availability of sufficient similar habitats close by, is unlikely to be affected by the development of the proposed dam.
Bee-eater, European, *Merops apiaster.* Common non-breeding Palearctic migrant present in summer. An aerial forager and so is not dependent upon BLG's habitats
Boubou, Southern, *Laniarius ferrugineus.* Common breeding resident. Favouring riparian zones and forest patches, but due to the general availability of sufficient similar habitats close by, is unlikely to be affected by the development of the proposed dam.
Brownbul, Terrestrial, *Phyllastrephus terrestris.* Fairly common breeding resident. Favours riparian zones and forest patches, but due to the general availability of sufficient similar habitats close by, is unlikely to be affected by the development of the proposed dam.

Bulbul, Dark-capped, *Pycnonotus tricolor.* A very common breeding resident occurring in all habitats.
Bush-shrike, Olive, *Telophorus olivaceus.* Rather uncommon breeding resident. Favours riparian and forest patches, but due to the general availability of sufficient similar habitats close by, is unlikely to be affected by the development of the proposed dam.
Bush-shrike, Orange-breasted, *Telophorus sulfureopectus.* Common breeding resident. Favours forest patches and savanna.
Buzzard, Jackal, *Buteo rufofuscus.* Uncommon breeding resident. Favours high altitude grasslands and savanna.
Camaroptera, Green-backed, *Camaroptera brachyuran.* Very common breeding resident. Favours forest and riparian patches and savanna. Unlikely to be affected by the development of the proposed dam.
Canary, Cape, *Serinus canicollis.* Common breeding resident. Favours savanna and grassland.
Probably at the edge of its range here as it is usually found at higher altitudes.
Canary, Yellow-fronted, *Crithagra mozambicus.* A very common breeding resident. Favours savanna and grassland.
Cisticola, Lazy, *Cisticola aberrans.* Rather uncommon breeding resident. Favours rocky slopes in savanna and grassland.
Cuckoo, African Emerald, *Chrysococcyx cupreus.* Fairly common breeding intra-African migrant occurring in the indigenous forest patches and riparian vegetation. A brood parasite of Camaropteras.
Cuckoo, Black, *Cuculus clamosus.* An uncommon breeding intra-African migrant occurring in the indigenous forest patches and riparian vegetation. A brood parasite of the Boubou shrikes.
Cuckoo, Red-chested, *Cuculus solitaries.* Common and conspicuous breeding intra-African migrant. Primarily a brood parasite of the Cape Robin.
Cuckooshrike, Grey, *Coracina caesia.* Probably a rather rare breeding resident occurring especially in the indigenous forest patches with tall trees. Probably at the edge of its range here as it is usually found at higher altitudes.
Dove, Cape Turtle-, *Streptopelia capicola.* Common and widespread breeding resident.
Dove, Emerald-spotted Wood-, *Turtur chalcospilos.* Common and widespread breeding resident.
Dove, Laughing, *Spilopelia senegalensis.* Common and widespread breeding resident.
Dove, Red-eyed, *Streptopelia semitorquata.* Common breeding resident, usually associated with tall trees
Drongo, Fork-tailed, *Dicrurus adsimilis*. Common breeding resident. Favours forest and riparian patches and savanna.
Duck, African Black, *Anas sparsa.* A rather uncommon breeding resident species. Usually found on quiet rivers and occasionally also on dams. Suitable habitat for this species exists on Bruintjieslaagte, but it may benefit from the construction of the new dam which would in all likelihood ensure a constant flow of water down to the existing dam.
Eagle, Martial, *Polemaetus bellicosus* (EN). A rare and endangered raptor (see the "Red Data" section below.). An adult (probably a male) was seen upstream of the dam on 24th January 2017. May be a breeding resident, but would have a wide home range, so might not nest on Bruintjieslaagte.
Firefinch, African, *Lagonosticta rubricata.* Common breeding resident. Favours rank grass at forest fringes, riparian patches and savanna.
Flycatcher, Ashy, *Muscicapa caerulescens.* An uncommon breeding resident. Favours forest and riparian patches, but due to the general availability of sufficient similar habitats close by, is unlikely to be affected by the development of the proposed dam.
Goshawk, African, *Accipiter tachiro*. An uncommon but widespread breeding resident. Favours forest and riparian patches.
Grassbird, Cape, *Sphenoeacus afer.* A fairly common breeding resident. Favours grassland and vlei areas.

Greenbul, Sombre, *Andropadus importunes*. A very common breeding resident occurring in all habitats.
Honeyguide, Scaly-throated, *Indicator variegatus.* Heard in one of the forest patches away from the riparian zone. A rather rare breeding resident species. A brood parasite of the Woodpeckers and Barbets. Will not be affected by the development of the proposed dam.
Ibis, Hadeda, *Bostrychia hagedash*. A common and conspicuous breeding resident. Recorded at the existing dam further downstream so will probably benefit from the establishment of the proposed new dam.
Kingfisher, Brown-hooded, *Halcyon albiventris.* A common breeding resident favouring savanna and forest fringes. An insectivorous species favouring savanna and forest fringes. Will not be affected by the development of the proposed dam.
Kingfisher, Giant, *Megaceryle maximus*. A common breeding resident favouring rivers and dams. A fish eater, so will probably benefit from the development of the proposed new dam. Many small *Tilapia spp*. were seen in the existing dam, so the food supply should be ensured.
Martin, Common House, *Delichon urbicum*. A very common non-breeding Palearctic migrant present in summer. An aerial forager and so is not dependent upon BLG's habitats.
Mousebird, Red-faced, *Urocolius indicus.* Probably a rare breeding resident which is probably at the edge of its range at this altitude. Mainly a frugivore so favours riparian, forest and savanna habitats. Due to the general availability of sufficient similar habitats close by, will not likely be affected by the development of the proposed dam.
Mousebird, Speckled, *Colius striatus.* A fairly common breeding resident. Also mainly a frugivore so favours riparian, forest and savanna habitats. Will not be affected by the development of the proposed dam.
Neddicky, *Cisticola fulvicapilla.* A fairly common breeding resident species favouring savannas. Will not be affected by the development of the proposed dam.
Oriole, Black-headed, *Oriolus larvatus.* Fairly common breeding resident.
Pigeon, African Olive-, *Columba arquatrix.* Fairly common breeding resident. Mainly a frugivore, utilising the fruit of alien invasives such as Bugweed which has led to population increases and range expansion.
Pipit, African, *Anthus cinnamomeus.* A fairly common breeding resident preferring short grass and overgrazed areas.
Prinia, Tawny-flanked, *Prinia subflava.* A common breeding resident in rank grass in riparian and grasslands.
Puffback, Black-backed, *Dryoscopus cubla.* A very common breeding resident species found in most habitats.
Robin, White-browed, Scrub-, *Cercotrichas leucophrys.* A common breeding resident species in bushveld, but less common in the BLG area.
Robin-chat, Cape, *Cossypha caffra*. A rather rare species in the BLG area. Probably at the edge of its range, preferring higher altitudes. A breeding resident.
Robin-chat, Red-capped, *Cossypha natalensis*. A rather rare species in the BLG area. Probably at the edge of its range, preferring lower altitudes. A breeding resident.
Saw-wing, Black (Southern race), *Psalidoprocne holomelaena*. A fairly common breeding intra- African migrant present from August to May. Favours riparian areas around rivers and streams. Breeds in burrows excavated into sandbanks, river banks or erosion gullies, so may benefit from construction of the dam wall.
Scimitarbill, Common, *Rhinopomastus cyanomelas*. Fairly common breeding resident favouring savannas and forest fringes.
Spurfowl, Natal, *Pternistis natalensis.* Common breeding resident in bushveld, savanna and grassland.
Spurfowl, Swainson's, *Pternistis swainsonii.* A common ground bird usually found in grasslands. A breeding resident.
Starling, Red-winged, *Onychognathus morio.* A fairly common species in areas where cliffs (and sometimes buildings) offer nesting ledges. A breeding resident.
Sunbird, Amethyst, *Chalcomitra amethystine.* Common breeding resident occurring

especially in the indigenous forest patches, riparian vegetation and urban gardens.
Sunbird, Malachite, *Nectarinia famosa.* A fairly common species which may breed locally. A vagrant species dependent upon flowering Proteas, its movements dictated by the flowering of these plants. Probably occurs mainly at higher altitudes in the mist belt grasslands where Proteas are more common.
Swallow, Barn, *Hirundo rustica.* A very common non-breeding Palearctic migrant present in summer. An aerial forager and so is not dependent upon BLG's habitats.
Swallow, Blue, *Hirundo atrocaerulea* (CR). A very rare and Critically Endangered species (Taylor, Peacock & Wanless 2015) recorded on Bruintjieslaagte for the first time in January 2017 by Anthony Emery. (See the section on Red Data species below).
Swallow, Lesser Striped, *Hirundo abyssinica.* A common intra-African breeding migrant present in summer. Is often associated with man-made structures such as buildings and bridges which it uses for breeding.
Swallow, White-throated, *Hirundo albigularis.* A rather rare breeding intra-African migrant present in summer months. Favours riverine habitats, often breeding on buildings and bridges close to water.
Swift, African Black, Apus barbatus. A fairly common species in areas where cliffs (and sometimes buildings) offer nesting ledges. A breeding resident.
Swift, African Palm, *Cypsiurus parvus.* Fairly common breeding resident. Dependant on palm trees for breeding, but also known to nest on buildings and bridges. Spends most of the time on the wing.
Tchagra, Black-crowned, *Tchagra senegalus.* Fairly common savanna species which occurring also in grassy/woodland ecotones. A breeding resident.
Tinkerbird, Yellow-fronted, *Pogoniulus chrysoconus.* A fairly common breeding resident species whose range is apparently expanding.
Turaco, Knysna, *Tauraco corythaix.* A rather rare species in the BLG area. Heard in the riparian habitats below the proposed new dam wall. Probably at the edge of its range, preferring higher altitudes. A breeding resident.
Turaco, Purple-crested, *Gallirex porphyreolophus.* A more common species in the BLG area than the previous one. Probably also at the edge of its range, preferring lower altitudes. A breeding resident.
Wagtail, African Pied, *Motacilla aguimp.* A species favouring water in the form of rivers and dams. Recorded only at the existing dam further downstream. The proposed new dam would probably benefit this species. A breeding resident.
Wagtail, Cape, *Motacilla capensis.* Recorded only around anthropogenic (areas altered by man, particularly by the construction of buildings) areas. A breeding resident.
Waxbill, Common, *Estrilda astrild.* A very common breeding resident species found sometimes in large parties in rank grasslands wherever these may occur.
Waxbill, Swee, *Estrilda melanotis.* A common but secretive breeding resident species found in rank grasslands.
Weaver, Golden, *Ploceus xanthops.* An uncommon breeding resident species
Weaver, Southern Masked-, *Ploceus velatus.* A common and widespread breeding resident, usually found in savanna habitats.
White-eye, Cape, *Zosterops viren,* A common and widespread breeding resident, usually found in small parties in a wide variety of habitats.
Whydah, Pin-tailed, *Vidua macroura.* A fairly common breeding resident species, inconspicuous when not in breeding plumage. A brood parasite of firefinches.
Widowbird, Red-collared, *Euplectes arden.* Another fairly common breeding resident species, inconspicuous when not in breeding plumage. Favours rank grasslands
Woodpecker, Olive, *Dendropicos griseocephalus.* A rather rare species in the BLG area. Heard in the riparian habitats below the proposed new dam wall. Probably at the edge of its range, preferring higher altitudes. A breeding resident.

Socio and Socio-economic impacts

9.3.9 Heritage and Archaeology

Nature of Impact	Period	Extent	Duration	Intensity	Probability	Significance before mitigation	Significance after mitigation
Loss of archaeological site:							
BL 1	Construction	Site	Short	Low	Unlikely	Low	Low
BL 2	Construction	Site	Long term	High	Definite	High	Medium
BL 3	Construction	Site	Short	Low	Unlikely	Low	Low
BL 4 &BL 4B	Construction	Site	Long term	High	Definite	High	Medium
BL 5	Construction	Site	Short	Low	Unlikely	Low	Low
BL 6	Construction	Site	Short	Low	Unlikely	Low	Low
BL 7	Construction	Site	Short	Low	Unlikely	Low	Low

In terms of the archaeological component of the Heritage Act (Act no. 25 of 1999, Section 35) seven sites were located and documented and management and mitigation measures were recommended in the Archaeology and Heritage Impact Assessment Report.

In terms of the built environment in the area (Section 34 of the Act) no significant buildings were identified.

The following tables are from the HIA report attached as Appendix 11.1:

Table 9.3.4 Significance rating guidelines for archaeological sites

Field Rating	Grade	Significance	Recommended Mitigation
National Significance (NS)	Grade 1	High Significance	Conservation, nomination as national site
Provincial Significance (PS)	Grade 2	High Significance	Conservation; Provincial site nomination
Local significance (LS 3A)	Grade 3A	High Significance	Conservation, No mitigation advised
Local Significance (LS 3B)	Grade 3B	High Significance	Mitigation but at least part of site should be retained
Generally Protected A (GPA)	GPA	High/ Medium Significance	Mitigation before destruction
Generally Protected B (GPB)	GPB	Medium Significance	Recording before destruction
Generally Protected C (GPC)	GPC	Low Significance	Destruction

Table 9.3.5 General description of located sites and field rating

Site No.	Description	Type of significance	Degree of significance	NHRA heritage resource & rating
BL 1	Historic stone-walled dwelling	Historic architecture	Archaeological: Medium Historic: Low	Structures (Sect. 34). Medium. **GPB.**
BL 2	LIA stone-walled enclosures	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**

Site No.	Description	Type of significance	Degree of significance	NHRA heritage resource & rating
BL 3	LIA stone-walled enclosure	Archaeological	Archaeological: Medium Historic: Medium	Archaeological (Sect. 35). Medium. **GPB.**
BL 4 &BL 4B	LIA stone-walled enclosures	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**
BL 5	LIA stone-walled enclosures	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**
BL 6	LIA stone-walled enclosures & terraces	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**
BL 7	LIA site perimeter	Archaeological	Archaeological: High Historic: High	Archaeological (Sect. 35). High. **GPA.**

Table 9.3.6 Site condition assessment and management recommendations

Site no.	Type of Heritage resource	Integrity of cultural material	Preservation condition of site	Quality of archaeological/ historic material	Quantity of site features	Recommended conservation management
BL 1	Historic Architecture	Fair	Fair	Archaeology: Not known Historically: Poor	1	None. Not located near project area.
BL 2	LIA stone-walled enclosures	Fair	Fair-Good	Archaeology: Fair Historically: Fair	2	Older than 60 years, mitigation before destruction
BL 3	LIA stone-walled enclosure	Poor	Poor	Archaeology: Poor Historically: Poor	1	None. Not located in the project area.
BL 4 & BL 4B	LIA stone-walled enclosures	Fair	Fair-Good	Archaeology: Fair Historically: Fair	2	Older than 60 years, mitigation before destruction
BL 5	LIA stone-walled enclosure	Fair	Fair	Archaeology: Fair Historically: Fair	1	None. Not located in the project area.
BL 6	LIA stone-walled enclosures & terraces	Fair	Fair-Poor	Archaeology: Fair Historically: Fair	4	None. Not located in the project area.
BL 7	LIA site perimeter	Poor	Poor	Archaeology: Poor Historically: Poor	1	None. Not located near project area.

The mitigation measures recommended were the detailed mapping of the sites BL2, BL4 and BL4 B and archaeological excavation of the enclosures pending a successful permit application to SAHRA. Provisionally a shovel tests at both enclosures was recommended to determine the depth of cultural deposit after which 1x1m squares may be excavated if necessary. The precise location of both excavations was to be determined when site clearing has been done.

Refer to the HIA report under Appendix 11.1 as well as the Archaeological Mitigation Report under Appendix 11.2:

The documentation of the sites was achieved by detailed mapping of the stone walled enclosures with the use of a professional land surveyor and specialised equipment (total station).

Sites BL 2 and BL 4A and B were also extensively photographed. The spatial organization derived from this documentation provided some evidence regarding the historical and cultural affiliation of this stone walled site. The site comprises three spatially removed areas (Site BL 2 and BL 4A and B) but represent components of a single site.

- Kudzala Antiquity obtained a permit from SAHRA for the destruction of some of the stonewall structures.
- Kudzala Antiquity did a detailed mapping of the site and archaeological excavations.
- The mitigation of sites BL 2 and BL 4A and B is completed with the archaeological documentation thereof and Joubert en Seuns Citrus (Pty) Ltd applied for a demolition permit for sites BL 2 and BL 4A and B from the South African Heritage Resources Agency (SAHRA).

The bulk of archaeological remains are normally located beneath the soil surface. It is therefore possible that some significant cultural material or remains were not located during the survey and will only be revealed when the soil is disturbed. Should excavation or large scale earth moving activities reveal any human skeletal remains, broken pieces of ceramic pottery, large quantities of sub-surface charcoal or any material that can be associated with previous occupation, a qualified archaeologist should be notified immediately. This will also temporarily halt such activities until an archaeologist has assessed the situation. It should be noted that if such a situation occurs it may have further financial implications.

General mitigation measures:

- The contractors and workers should be notified that archaeological sites might be exposed during the construction work.
- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;
- All discoveries shall be reported immediately to a museum, preferably one at which an archaeologist is available, so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act Section 51(1).

9.3.10 Palaeontology

Nature of Impact	Period	Extent	Duration	Intensity	Probability	Significance before mitigation	Significance after mitigation
Palaeontology impact	Construction	Local	Long term	Low	Unlikely	Low	Low

Based on the geology of the area and the palaeontological record as it is known, it can be assumed that the formation and layout of the basement rocks, dolomites, sandstones, shales, quartzites, basalts and gabbros are typical for the country and do not contain any fossil material. The sediments of the Silverton Formation could contain trace fossils of algal mats and ripple marks in sandstones, however, they have yet to be recorded from the Timeball Hill Formation on which the dam wall will be built.

It is extremely unlikely that any fossils occur in the sites for the proposed dam wall because mostly the rocks are much too old and volcanic in origin. Although there are rare reports of microbial mats from similar aged rocks, none has been reported from this particular Formation.

The surface activities would not impact on the fossil heritage as the rocks are ancient and volcanic so there are no fossils present. The IMPACT is nil.

Excavation for the roads to the dam wall site would penetrate only a few metres below ground surface at the most so there would be minor deterioration of the surface of sites and an impact on any potential fossils. Therefore the SEVERITY/NATURE of the environmental impact would be Low.

There is a very small chance of finding trace fossils on the surface as these have been reported from older and younger Formations, but not where the dam wall would be built. Therefore, the PROBABILITY of affecting any fossils is unlikely or seldom: Low.

As far as the palaeontology is concerned the proposed development can go ahead. Any further palaeontological assessment would be unnecessary.

Mitigation - Chance Find Protocol

1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, plants, insects, bone, coal) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar trace fossils, microbial mats, fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 4 in palaeontology report). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. On a regular basis, to be agreed upon by the developer and the qualified palaeontologist sub-contracted for this project, the palaeontologist should visit the site to inspect the selected material and check the dumps where feasible. The frequency of inspections should be monthly. However, if the onsite designated person is diligent and extracts the fossil material then inspections can be less frequent.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from

the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.

7. If no good fossil material is recovered then the site inspections by the palaeontologist can be reduced to annual events until construction has ceased. Annual reports by the palaeontologist must be sent to SAHRA.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

9.3.11 Visual Impact

The dam construction site is remote from public and other landowners and located in the Devil's Creek valley more than 5 km from the Crocodile River. Due to the topography it is not visible from the N4 or landowners adjacent the Crocodile River. The construction site will only be visible from the Sappi plantations located east from the dam site and the visual impact is of no significance to Sappi.

9.3.12 Traffic

The dam construction site is remote from public and public transportation roads on the Bruintjieslaagte farm which is only accessible to the Applicant.

There is therefore no traffic impact on any other party.

9.3.13 Noise and vibration

The dam construction site is remote from public, farmers and other landowners.

There is therefore no noise or vibration impact on any other landowner during the construction period. Potential impacts on fauna have been assessed and discussed the above sections.

9.3.14 Health and Safety

Due to the location of the dam there is no access for public or any other landowner other than the applicant and the appointed contractor to the dam building site. There is therefore no health and safety risk for other parties or landowners.

The contractor workers will be exposed to the normal health and safety risk of a construction project of this nature. The Health and Safety Act is applicable and the compliance with this Act is outside the scope of this assessment and report. The Applicant and his appointed Contractors must however comply with the Health and Safety Act.

9.3.15 Socio- economic impact

Nature of Impact	Period	Extent	Duration	Intensity	Probability	Significance before mitigation	Significance after mitigation
Water quality – suspended solids	Construction	Regional	Short	Low	Unlikely	Low	Low
Water quantity in Crocodile River	Operations	Regional	Long term	Low	Unlikely	Low	Low

If the water quality (suspended solids, turbidity) is affected during the construction period, it should extend only to the existing dam downstream of the proposed dam and not into the Crocodile River. Mitigation measures will anyway be implemented to reduce the suspended solids in the Devil's Creek water for aquatic reasons. There should therefore be no impact on downstream water users.

It was proven (refer to hydrology section and water use rights) that there is sufficient water in the Devil's Creek catchment to sustain the dam and that a yield of 1.2 million cubic metres per annum of water, after allowing for the Ecological Water Requirement (EWR), is available. The volume of water available for downstream Crocodile River water users will therefore not be affected by the dam.

Water abstraction from the dam will not exceed the allocated water use rights available from the Crocodile River.

Mitigation measures:

- Implement measures as earlier defined to limit the carry-over of suspended solids into the water of the Devil's Creek.
- Monitor water quality (turbidity) downstream from the construction site and below the existing dam and implement further mitigation measures if suspended solids in water are high.
- The operational plan for the dam must allow for on-going release (monthly EWR profile) of the EWR volume of water.
- Cumulative water abstraction from the Bruintjieslaagte dam and/or Koedoeshoek dam and directly from the Crocodile River must not exceed the annual total allocation of irrigation water use rights.

10. Environmental Statement and Findings

Various potential environmental impacts were identified and considered in the EIR.

10.1 The key environmental impacts identified

- Water resources and aquatic ecology, specifically fish;
- Blue Swallows;
- Area classified as Critical Biodiversity Area by the MTPA;
- Wetlands and riverine habitat;
- Archaeology and Heritage.

10.2 Primary positive and negative impacts

Positive aspects of the proposed dam project:

- A new area for the Blue Swallows (*Hirundo atrocaerulea*) was discovered during the site investigations for the dam and the applicant supported further work to study and protect the Blue Swallows. Three years of monitoring is now available and it is evident that with a high level of certainty that there are no breeding sites at or near the dam footprint.
- The applicant is in the process of proclaiming a nature reserve on Portions of the Farms Rietvly 295 JT, Mooiland 294 JT, Geluk 299 JT, Bruintjeslaagte 465 JT, Koedoeshoek 301 JT, and Loopfontein 298 JT. This is as a result of the work done for this application.
- Additional storage capacity for irrigation water is created in the Crocodile River catchment and it will make water available for use during drought or low-flow periods.
- The footprint area of the dam is small relative to the large natural area and the ecological impact of the dam is small after mitigation.
- No fish was found in the Devil's Creek upstream from the waterfall and the upper catchment where the dam would be located.
- Extensive work has been conducted with regards to the *Enteromius cf* (EDEV). Positive results were obtained in the most recent surveys after the translocation and specific management measures were drafted. These are proposed to be included as specific conditions to the EA if considered favourably.
- Mitigation measures are available to mitigate the impact on aquatic species, specifically fish downstream from the waterfall during the construction and operational periods.
- A Water Use Licence has been issued by the Department of Water and Sanitation for the proposed dam.

Negative aspects of the proposed dam project:

- The dam is located in an area that is classified as "critical biodiversity" in terms of the MBSP 2014.
- It was observed when the Blue Swallows is foraging that they fly up and down in the Devil's Creek valley and over/near the proposed dam site even though infrequently. To reduce the potential impact it is still proposed that construction must be during the period April to end October (This corresponds with the low-flow period which is favourable for dam construction and the construction period is specified as a condition in the EMPr).
- The *Enteromius anoplus/motebensis* fish species identified below the waterfall and existing dam is likely a new species and the proposed dam may impact on the fish if not mitigated during the construction and operational periods.
- A section of an Archaeological site (stone walled structures) will be lost due to the dam construction.

10.3 Assumptions and uncertainties

The environmental assessment practitioner accepts that the information contained in this report as provided by the applicant and professional consultants is true and accurate.

To make an assessment of the potential impacts the EAP took into account the findings of the specialists. The EAP also depends on the opinions and feedback from the Interested and Affected Parties and State Departments during the commenting periods provided.

There are no major gaps in knowledge regarding the description of the current state of the environment including the potential impacts on water resources and the other environmental aspects. All sensitive environments were identified by specialists and appropriate mitigation measures were identified. The recommendations of the specialist study were incorporated into the assessment where applicable.

With the DNA testing by the MTPA to confirm whether the *Enteromius* species found is *E. anoplus* or *motebensis* it was found that the classification of the *Enteromius* fish species is not conclusive and that several fish species may exist in the broad category of "Chubbyhead barb group". The MTPA will do further testing but no indication of a time frame was given. This will however not negatively influence the decision making process by the CA.

There is a high level of confidence that the most significant potential negative impacts can be appropriately minimised with the implementation of mitigation measures as proposed.

10.4 Indication of management and monitoring

An Environmental Management Programme (EMPr) has been compiled to ensure that the biophysical and social environments receive due consideration (Refer to Appendix 14 for the EMPr).

The Environmental Management Programme (EMPr) was compiled to ensure that the biophysical and social environments receive due consideration and that it is protected during the undertaking of the activities.

The important measures relating to the Blue Swallows, Entemorius fish and other aquatic impacts are outlined in detail in the impact assessment.

The EMPr is a guideline document that will provide detailed specifications for the management and mitigation of activities that have the potential to impact negatively on the environment. The measures prescribed must aim to result in a cautious approach being applied to on-site environmental management to ensure prevention, minimising and remediation of potential impacts.

11. Conclusion and Recommendations

The "critical biodiversity" in terms of the Mpumalanga Biodiversity Plan was taken into account and several specialist assessments were done to assess the application site. The footprint area of the dam is small relative to similar habitat in the Devil's Creek catchment as well as adjacent farms.

The Blue Swallows were assessed over 4 breeding seasons. The Blue Swallows are infrequent visitors to the lower Devil's Creek valley and game camp plateau north of the proposed dam site. The proposed dam site is not a preferred foraging area for the Blue Swallows. There are no nesting sites in or near the dam basin area. Nesting sites are likely at a higher altitude in the upper reaches of the valley. As a precautionary measure the construction of the dam will be done outside the breeding period of the Blue Swallows during the period April to end-October.

Dr Rob Palmer of Nepid Consulting first sampled a small barb species (Genus: *Enteromius*) in the reach between a waterfall and existing dam (downstream of proposed dam site) in the Devils Creek. There was uncertainty as to the correct species description of the fish even after a further assessment was done by Dr Kotze. Based on all the information available at present, which included a DNA analysis, it is therefore not yet possible to confirm the exact taxonomic barb species (*Enteromius*) that occurs within the Devils Creek, Mpumalanga. It has however become increasingly clear that this species should be afforded high conservation status and all actions must be taken to preserve this population.

Morphologically this species exhibits characteristics of *Enteromius anoplus* (Chubbyhead barb) and *Enteromius motebensis* (Marico Barb), and hence previously referred to as *Enteromius cf anoplus/motebensis*. For the purposes of the current study and this report this species will be referred to as ***Enteromius "devils creek"*** (abbreviated: EDEV).

As a precautionary and mitigation measure MTPA (Dr. F Roux and aquatic team) translocated 207 individuals of *Enteromius Devils Creek*(EDEV) from reach B (below waterfall) to reach A (above the waterfall) in March 2019. During the May 2020 follow-up survey, Dr Kotze confirmed that the translocation was successful and that 47 EDEV individuals were sampled upstream of the proposed dam wall.

There is concern that construction activities may eradicate these individuals. It is therefore essential that a healthy population of the EDEV must be established upstream of any potential impacts (especially construction activities) in the conservation zone. Specific mitigation and management measures were proposed and is supported by the EAP and applicant for the reasons provided in the report.

Conservation important plant species that may occur on site are listed in the Emross Consulting and Taylor Environmental Report. Of all these plant species only *Eucomis autumnalis* (Common Pineapple Lily) was identified on the site. An ECO (ecologist) will survey the site and identify, rescue and relocate conservation important plant species prior to start of construction.

The hydrology study confirmed that sufficient water is available in the Devil's Creek for the proposed Bruintjieslaagte dam as well as the existing Koedoeshoek dam and that after allowance for the Ecological Water Requirement (EWR) there will be no impact on the aquatic ecology or downstream Crocodile River water users.

There are sufficient irrigation water use rights available and there will not be any new abstraction water use rights required for the Bruintjieslaagte dam. The dam is primary a provision for water security during drought periods. If water is required during drought periods water will be released from the Bruintjieslaagte dam into the Koedoeshoek dam from where it will be abstracted and linked to the irrigation system.

A Water use licence for the dam has been issued by the Department of Water and Sanitation.

The dam will only impact on some of the stonewall sites found on the Bruintjieslaagte farm in terms of archaeology. A permit was applied for from SAHRA and the affected sites were surveyed, excavated and documented.

The overall impact of the proposed dam can be mitigated to an acceptable level.

Based on the findings of all the specialist studies, the environmental impact assessment and proposed mitigation measures the EAP supports the Authorisation of the Bruintjieslaagte dam for an indefinite period. Construction should start within a period of five (5) years.

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