PROPOSED DEVELOPMENT OF A DAM AND ASSOCIATED INFRASTRUCTURE ON PORTION 3 & PORTION 5 OF THE FARM VAN DER WATTSKRAAL 394, NEAR RIVIERSONDEREND, WESTERN CAPE PROVINCE

SPECIALIST FISH ASSESSMENT

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Prepared for:
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1. Introduction

1.5 Background and context

This report has been prepared on behalf of EnviroAfrica *cc* as part of a freshwater assessment of the likely impacts to indigenous fish populations in two unnamed tributaries of the Riviersonderend River, Western Cape Province. The assessment relates to potential impacts arising from dam and associated infrastructure development on Portion 3 and 5 of Farm 394 Van der Wattskraal located north of the N2 near the town of Riviersonderend. To meet the requirements for additional water to provide irrigation for 55 ha of orchards, it is proposed that water the Eksteenkloof Weir on Farm 234 (damaged during a flood) be rehabilitated and that water be abstracted over the winter high-flow period from this weir, piped approximately 300 m to an adjacent tributary and stored in a dam to be constructed for this purpose.

1.1 Terms of Reference

The Terms of Reference for the freshwater fish survey were as follows:

- Undertake a fish survey of the watercourses likely to be affected by the proposed development;
- Include in the survey at least one site below and one site above the proposed weir by means of electrofishing;
- Assess the condition of the non-perennial watercourse to confirm whether there is habitat for fish and if so, include a third survey site;
- Based on the above assessments, advise on what the likely impact of the weir will be on native fish populations.

1.2 Approach to the Study

The above TOR were met by completing the following tasks

- Documentation on the indigenous fish species present in the catchment were collated and reviewed. Historical fish distribution records were examined;
- A site visit was undertaken on the 20th December 2017 during which time sites in the immediate vicinity of the proposed weir rehabilitation site, as well as the upstream and downstream reaches, were sampled by means of electrofishing;
- This report presents the findings of the above fish survey and reports on the potential impacts of the proposed activities on the indigenous fish communities and recommends mitigation strategies.

1.3 Limitations of the Study

No hydrological information or abstraction levels were supplied for this assessment. The assessment of the potential instream and aquatic habitat effects of abstraction are of a general rather than quantitative nature. Any mitigation measures aimed at preserving the integrity of freshwater fish populations in the Eksteenkloof river and downstream of the proposed weir would necessarily need to account for potential changes to the natural flow regime prior to abstraction.

2. Site location and description

2.5 General description

The two watercourses of interest to this assessment are adjacent first-order tributaries flowing directly off the south-facing slopes of the Riviersonderend Mountain into the mainstem of the Riviersonderend River itself. These watercourses are located in the Breede Water Management Area (WMA) and the Riviersonderend sub-WMA, quaternary catchment H60K (**Figure 2.1**). The aforementioned WMAs fall entirely within the Fynbos Biome of the Cape Fold Freshwater Ecoregion biodiversity hotspot of South Africa. Although there are no fish sanctuary areas located within catchment H60K, fish sanctuaries are located in neighbouring quaternary catchments H60E, H60F and H60H where threatened fish species are known to be present (**Figure 2.1**) (Nel et al. 2011).

2.6 Location of the study sites

The two watercourses potentially impacted by the proposed development – Watercourse 1 and 2 (as denoted in van de Haar (2017)) – are perennial and seasonal respectively (**Figure 2.2**). The proposed location of the Hut storage dam site is on seasonal Watercourse 2, whereas the proposed location of the abstraction weir is on Watercourse 1 where it emerges from Eksteenkloof (Weir B, **Figure 2.3** (e)). A second weir (Weir A, **Figure 2.3** (a)) is located on Watercourse 1 roughly two kilometers upstream of the remains of the Eksteenkloof Weir (Weir B).

In total, eight sites were sampled on the 20th November 2017. A single site was visited on seasonal watercourse (Watercourse 2, EK07), but no fish were found and no further sampling was undertaken here. Seven sites were sampled on Watercourse 2 – on each upstream (EK01-A) and downstream (EK01-B) of Weir A, at a road crossing in Eksteenkloof (EK02), at the site of the proposed weir rehabilitation (Weir B, EK03), and at two additional sites downstream (EK04, EK05) and one close to the confluence of the Riviersonerend mainstem (**Table 2.1**, **Figure 2.2**).

Watercourse 2 varies in width from ~ 1 m in Eksteenkloof to 2-3 m wide in its lower reaches near the Riviersonderend confluence. The weir in the upper reaches (Weir A) impacts both the quantity and quality of water immediately downstream. However, river condition improves about a kilometer downstream from this weir as a result of seepage from local catchment areas.

Table 2.1 Coordinates and description of each of the sites selected for the fish survey of the Eksteenkloof River.

Site Code	Description	Coordinates
EK01-A	Eksteenkloof Weir A – upstream	34°04'57.35"S, 20°01'10.98"E
EK01-B	Eksteenkloof Weir A - downstream	34°04'59.12"S, 20°01'14.15"E
EK02	Eksteenkloof road crossing	34°05'04.12"S, 20°01'26.68"E
EK03	Eksteenkloof Weir B (proposed rehabilitation)	34°05'29.15"S, 20°01'58.30"E
EK04	Eksteenkloof Weir – downstream	34°05'33.07"S, 20°02'01.37"E
EK05	Eksteenkloof Weir – downstream	34°05'52.51"S, 20°02'06.12"E
EK06	Riviersonderend confluence	34°06'33.59"S, 20°02'42.87"E
EK07	Hut Dam site	34°05'29.99"S, 20°02'10.75"E

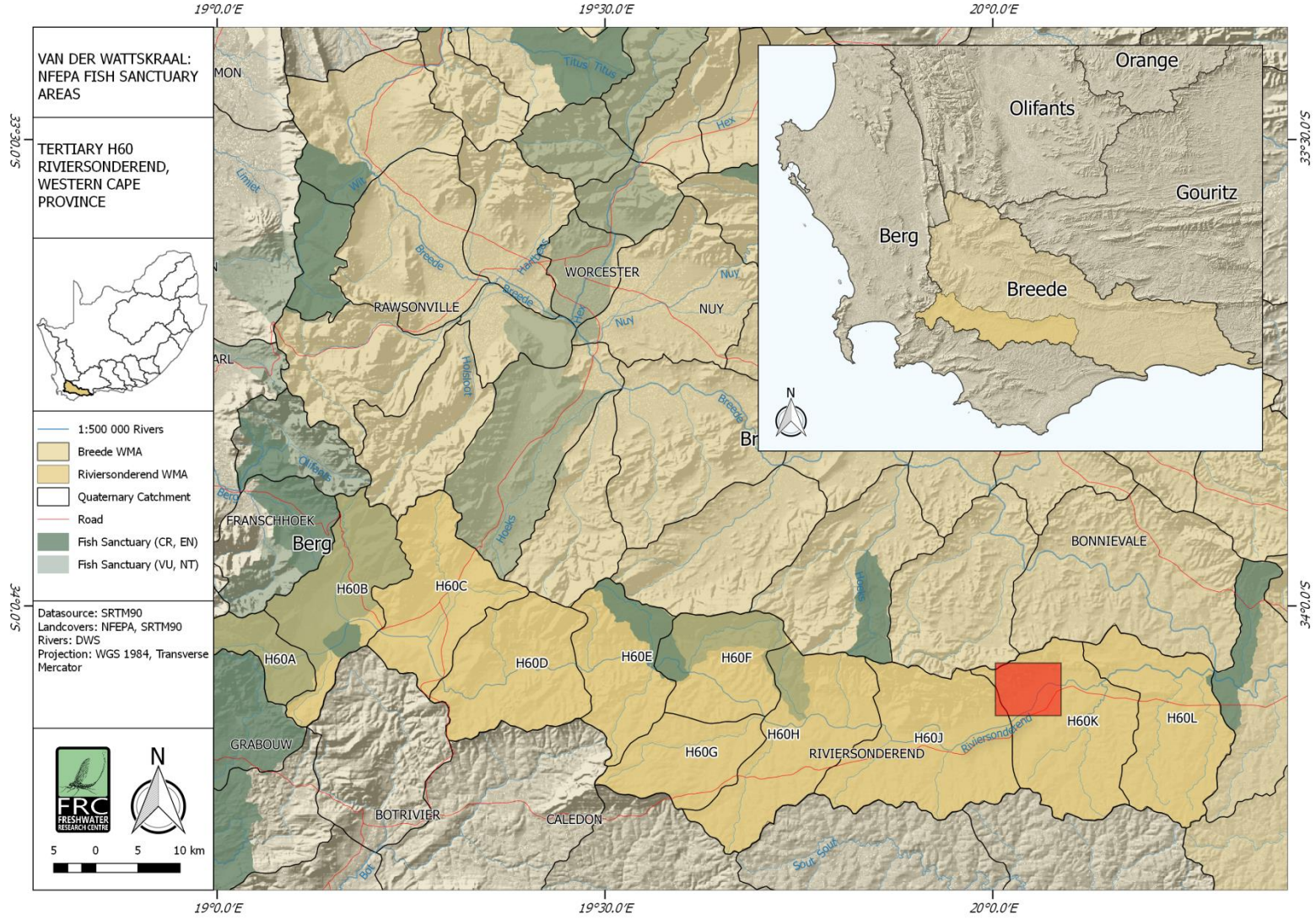

Figure 2.1 National Freshwater Ecosystem Priority Area (NFEPAs) Fish Sanctuaries for Critically Endangered and Endangered (CR, EN), and Vulnerable and Near Threatened (VU, NT) species in the Breede River Basin/Riviersonderend area in the vicinity of Van der Wattskraal (red square).

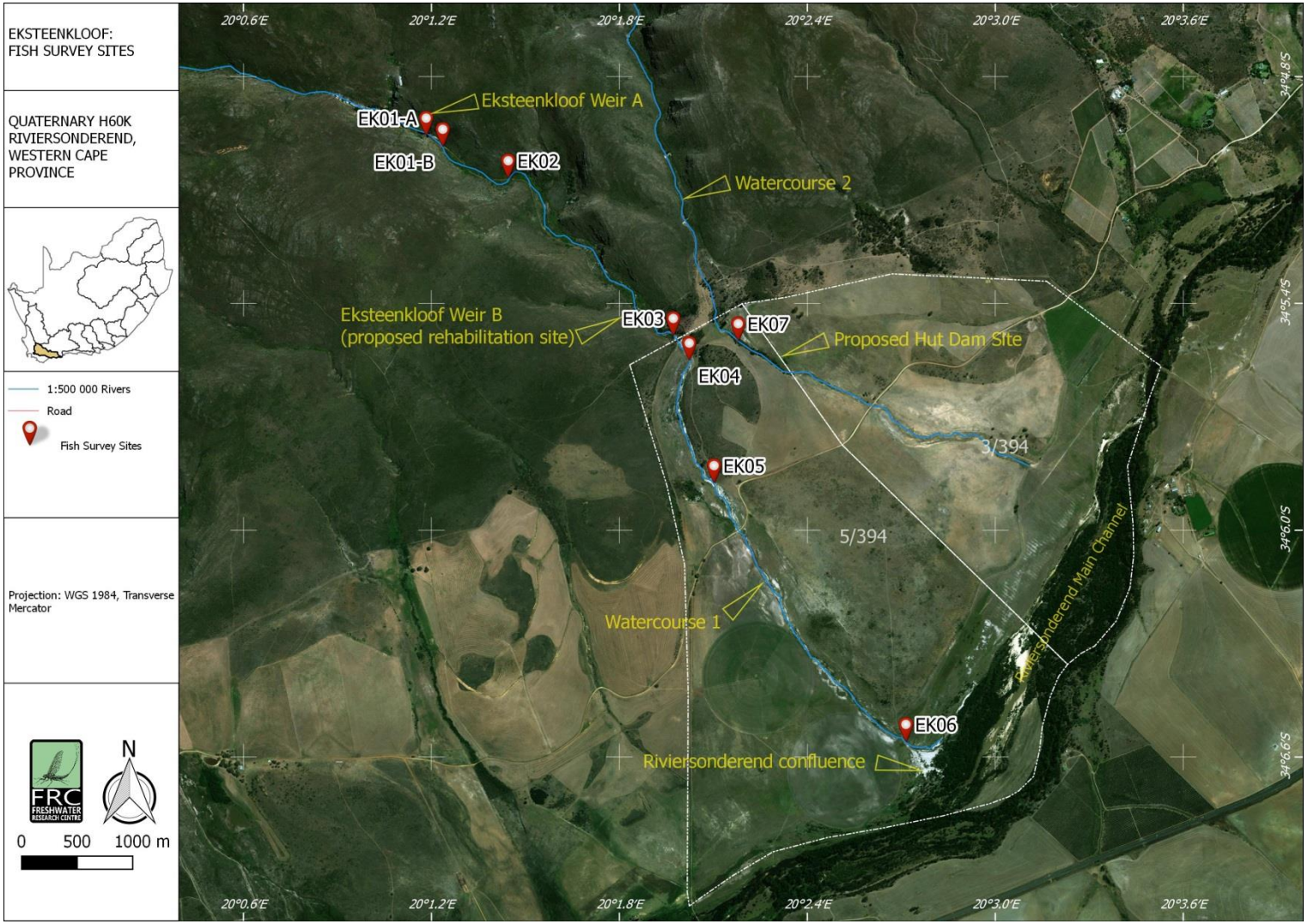

Figure 2.2 Aerial image showing the location of the surveyed sites with the sites of the proposed weir rehabilitation and dam site.

Figure 2.3 Sites sampled by means of electrofishing on the 20th December 2017: (a) EK01-A Eksteenkloof Weir A (upstream site), (b) EK01-B (downstream site), (c) EK02, (d) EK03 (Weir B site), (e) Eksteenkloof Weir B, (f) EK04, (g) EK05, (h) EK06.

3. Methods and Results

3.5 Fish Survey Methods

A fish survey of the river upstream and downstream of the Eksteenkloof Weir was conducted on the 20th December 2017 on Farm 234 and Portion 3 and 5 of Farm 394. A total of eight sites were sampled (Figure 2.2). At each site, continuous backpack electrofishing was conducted along the shoreline and thalweg of the river using a pulsed-DC current delivered from a SAMUS-725G portable electrofisher with a maximum output power of 650 watts, a maximum output voltage of 1000 V and an output frequency set at 50 Hz. Electrofishing was conducted from the downstream end of the reach, moving in an upstream direction. Current was delivered to the water at roughly 5 second intervals. The total number of shock intervals and the total number of each species caught at each site were recorded at the end of each sampling period. Relative abundance estimates were used as an index of overall abundance in the form of Catch Per Unit Effort (CPUE), which was calculated as the number of fish belonging to each species collected per number of shocking intervals (CPUE, no. of fish/shock). A sub-sample of fish were collected and preserved for taxonomic verification and the remainder were returned to the water.

3.6 Fish Survey Results

A total of 52 Cape kurper (*Sandelia capensis*) and 48 Cape galaxias (*Galaxias zebratus*) were collected from Watercourse 1 (the Eksteenskloof River) (**Figure 3.1**). No alien invasive fish species were recorded along the surveyed reach. The highest relative abundances of Cape kurper were collected from the reservoir behind Weir A (Site EK01-A) (Figure 3.2). Relative abundances of Cape galaxias increased from downstream of the Eksteenkloof Weir A (Site EK01-A) to Weir B (EK03) where highest relative abundances in the reach were recorded. Only Cape kurper were recorded from the most downstream site (Site EK06) where temperatures were higher and water quality conditions were impaired as a result of farming activities along the banks.

Figure 3.1 (a) Cape kurper and (b) Cape galaxias collected from Watercourse 1.

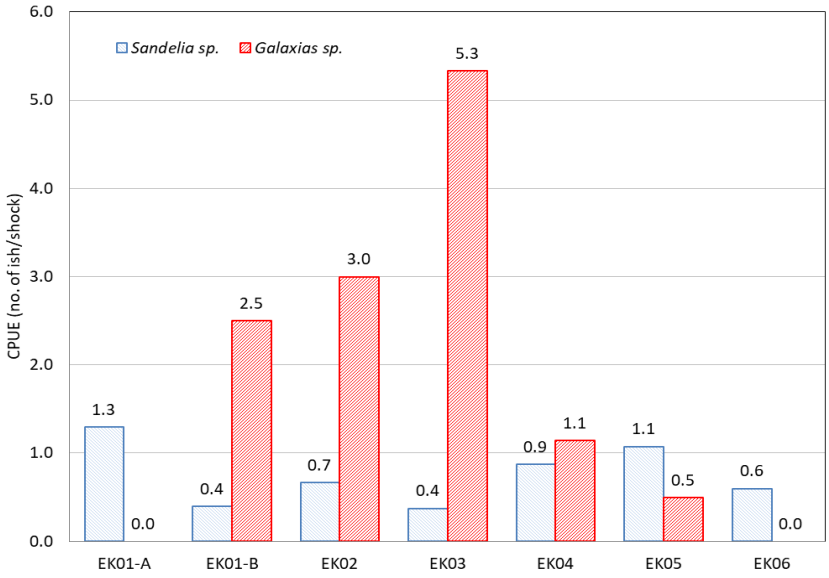

Figure 3.2 Results of the Fish Survey reported as CPUE in number of fish/shock interval.

4. Conservation importance and sensitivity

4.5 Regional context

The Cape Fold Freshwater Ecoregion (CFE) is home to an assemblage of range-restricted endemic freshwater fishes, the majority of which face a high risk of extinction as a result of a combination of habitat destruction, water abstraction and invasion by introduced alien fish species (Ellender et al. 2017). Many of these populations are now highly fragmented – having been restricted to less than 20% of their former home range– and are now confined to un-invaded and un-impacted mountain tributaries (Van Der Walt et al. 2016). Within the Breede River system – which falls within the aforementioned ecoregion – there are twenty freshwater and estuarine fish species recorded beyond the upper limit of estuarine influence. Approximately half of these are indigenous and of these, four are primary freshwater fishes. The remainder, (11 species) are introduced alien species (Table 4.1).

Based on current taxonomic groupings, two – the witvis *Barbus andrewi* and the Breede River redfin *Pseudobarbus burchelli*) – are endemic to the Breede River system itself, while another two (Cape galaxias *Galaxias zebratus* and Cape kurper *Sandelia capensis*) are Western Cape endemics. The remaining indigenous species comprise those that regularly migrate between the sea and freshwater,

Phylogenetic analyses have shown that three of the genera, i.e. *Pseudobarbus*, *Galaxias* and *Sandelia*, conceal species complexes suggesting that the diversity of freshwater fishes in the CFE has been vastly underestimated (Chakona et al. 2013). Due to the recency of the findings, morphological taxonomic revisions are not yet available and the conservation status of the newly identified lineages have also yet to be assessed by the IUCN.

4.6 Fishes of Eksteenkloof

The freshwater fishes collected from the Watercourse 1 are likely to belong to the “Riversonderend” lineage of *Galaxias* and *Sandelia* (*Galaxias* sp. “zebratus Riviersonderend” and *Sandelia* sp. “capensis Riviersonderend”) (Ellender et al. 2017; Chakona et al. 2013). Neither of these species have been assessed by the IUCN as a result of the recency of the phylogenetic studies and the lack of a morphological taxonomic revision.

Table 4.1 Fish species expected in Riviersonderend and Breede River Basins and their conservation status. Fish species expected (Exp.) and observed (Obs.) in this study are highlighted with asterisks *.

Scientific Name	Common name	Conservation status	Exp.	Obs.
Indigenous species				
Anguilla marmorata	Madagascan mottled eel	Not Assessed	*	
Anguilla mossambica	African longfin eel	Not Assessed	*	
Barbus andrewi	Berg-Breede River whitefish	Endangered	*	
Galaxias sp. “zebratus Breede”	Cape galaxias	Data Deficient/Not assessed		
*Galaxias “*zebratus Riviersonderend”	Cape galaxias	Data Deficient/Not assessed	*	*
Mugil cephalis	Flathead mullet	Least concern		
Myxis capensis	Freshwater mullet	Least concern	*	
Pseudobarbus burchelli cf. Breede	Breede River redfin	Not Assessed		
Pseudobarbus burchelli cf. Tradouw	Tradou redfin	Critically Endangered		
Pseudobarbus skeltoni	Giant redfin	Not Assessed		
Sandelia sp. “capensis Breede”	Cape kurper	Data deficient/Not assessed		
Sandelia sp. “capensis Riviersonderend”	Cape kurper	Data deficient/Not assessed	*	*
Alien species				
Carassius auratus	Goldfish	Introduced alien		
Clarias gariepinus	Sharptooth catfish	Introduced alien		
Cyprinius carpio	Common carp	Introduced alien		
Lepomis macrochirus	Bluegill sunfish	Introduced alien	*	
Micropterus dolomieu	Smallmouth bass	Introduced alien	*	
Micropterus punctulatus	Largemouth bass	Introduced alien		
Oncorrhynchus mykiss	Rainbow trout	Introduced alien		
Oreochromis mossambicus	Mozambique tilapia	Introduced alien	*	
Salmo trutta	Brown trout	Introduced alien		
Tilapia sparrmanii	Banded tilapia	Introduced alien	*	
Tinca Tinca	Tench	Introduced alien		

The assumption is made here therefore that both species collected from Watercourse 1 have a relatively narrow distribution within the Riversonderend system and that they have moderately-high conservation value. The loss of populations of both species from Watercourse 1 would not represent an existential threat to the lineages, but would reduce the overall resilience of the species to further environmental change should additional population loss occur.

Of the two species, Cape kurper are more tolerant of impaired water quality conditions and higher temperatures, hence their presences in the lower, more impacted reaches of Watercourse 1. Cape galaxias on the other hand are Gondwanan relicts and more sensitive to higher temperatures and poor water quality and are likely also sensitive to changes in flow – hence their absence from the back-up waters of Weir A – the upper weir in Eksteenkloof.

No alien fish species were present in the Watercourse 1, possibly due to the absence of suitable habitat and the fact that the river may become disconnected from the main channel during certain parts of the year. Many other tributaries throughout the Breede River system are invaded by species listed in Table 4.1. Watercourse 1 should be considered of moderate conservation importance. The absence of other indigenous species (e.g. redfin minnow, *Pseudobarbus*) is likely attributable to the fact species belonging to this genus require higher flows and larger water volumes than are available in in this watercourse.

5. Assessment of impacts and mitigation measures

This study was undertaken subsequent to the completion of the freshwater study (van de Haar 2017) and should therefore be read in conjunction with that study where a detailed description of the proposed activities is available (Section 4.1). The impacts of the proposed development on Watercourse 1 of relevance to the fish populations present in this watercourse are assessed in relation to those impacts identified in the aforementioned report and are described below.

5.5 Assessment of the Direct Construction Phase Impacts

5.5.1 Impact 1 – Loss of aquatic habitat associated with Watercourse 1

Minimal loss of aquatic habitat (10.5 m^2) is expected to occur in Watercourse 1 with very low significance (-ve) for indigenous fish populations.

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	Low	Local	Permanent	Definite	Very Low (-ve)
With mitigation	NA	NA	NA	NA	NA

5.5.2 Impact 2 – Disturbance of aquatic habitat due to edge effects

Edge effects of construction related activities on fish populations are likely to be low (-ve) with and without mitigation since fish populations are mobile and will likely move away from the area immediately impacted by construction. Any mortality as a direct result of construction are likely to be compensated for by immigration from up- or downstream areas. Mitigation measures recommended in van de Haar (2017) apply.

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	Low	Local	Short term	Probable	Low (-ve)
With mitigation	Low	Local	Short term	Probable	Low (-ve)

5.5.3 Impact 3 – Alteration of hydrological regime

Alteration of the hydrological regime in Watercourse 1 during the construction phase is expected to have medium intensity and significance (-ve) without mitigation and low intensity and significance with mitigation. In both instances the duration will be short term and populations are likely to stabilize fairly quickly after the completion of construction. Mitigation measures recommended in van de Haar (2017) apply.

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	Medium	Local	Short term	Probable	Medium (-ve)
With mitigation	Low	Local	Short term	Probable	Low (-ve)

5.5.4 Impact 4 – Increased runoff, erosion and sedimentation

The impact of increased runoff as a result of compaction is expected to be very low (-ve) due to being localized and affecting only a small proportion of the catchment. The impacts associated with increased erosion, the mobilization of sediments and sedimentation in the river bed of Watercourse 1 are expected to be medium. The agreement to undertake construction activities during the summer low-flow period should mitigate against most impacts, in all other instances, the mitigation measures recommended in van de Haar (2017) apply.

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	Medium	Local	Short term	Probable	Medium (-ve)
With mitigation	Low	Local	Short term	Probable	Low (-ve)

5.5.5 Impact 5 – Water quality impairment

The intensity of the impacts associated with water quality impairment are likely to be high (-ve) and long term without mitigation. Cement slurry is toxic to fish as a result of its high pH value and indigenous fish populations in the Western Cape are adapted to very low pH values. The significance is rated as medium since, in the event of a cement spill, recolonization from upstream will occur and in the long term, populations will recover to previous levels. Mitigation measures recommended in van de Haar (2017) apply.

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	High	Local	Long term	Highly probable	Medium (-ve)
With mitigation	Medium	Local	Short term	Probable	Low

5.5.6 Impact 6 – Loss of aquatic habitat

The intensity of the impacts associated with habitat loss (riffle and aquatic vegetation) as a result of construction activities is expected to be high (-ve), but the significance is expected to be medium since the impacts will be localized and subsequent flooding and baseflows – if these are maintained throughout the operational phase – are likely to re-sort bed elements post-construction phase.

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	High	Local	Long term	Definite	Medium (-ve)
With mitigation	NA	NA	NA	NA	NA

5.6 Assessment of Direct Operational Phase Impacts

5.6.1 Impact 1 – Alteration of hydrological regime

The intensity of the impacts associated with the alteration of the hydrological regime during the operational phase is expected to be very high (-ve) without effective mitigation, since the river downstream of the weir is likely to be dewatered over the summer low-flow period. Should this occur, approximately 55% and 56% respectively of the downstream Cape Galaxias and Cape kurper populations in Watercourse 1 is expected to be lost. Reduced summer flow volumes will also contribute to water quality impairment and reduce the capacity of the river to buffer fish populations against high temperatures. Without mitigation, no recovery of populations will occur and the loss will likely be permanent. Minor loss of lotic (flowing-water) habitat will occur upstream of the weir which will negatively impact Cape Galaxias, but will benefit Cape kurper. Even with mitigation (i.e. Ecological Water Requirement releases), impacts are likely to manifest. The significance of these impacts will depend on the volumes of the proposed abstraction, the percentage of the Mean Annual Runoff (MAR) allocated for the Ecological Reserve and on the degree to which the provisions for summer releases are observed and monitored.

Thus in addition to the mitigation measures recommended in van de Haar (2017), it is here recommended that:

(a) *an accurate estimate of the natural MAR (nMAR) for Watercourse 1 be calculated and Ecological Reserve allocations be based on this value*
(b) *both the abstraction and downstream release volumes from the weir be monitored and that these figures be made available for review by the relevant authorities (DWS/BGCMA) upon request*
(c) *Operating rules should be determined based on the natural hydrology of the catchment i.e. months of peak flow, outside of which no abstraction is to take place. These should be balanced against irrigation needs and available for review.*

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	Very high	Local	Permanent	High	High (-ve)
With mitigation	High	Local	Permanent	High	Medium (-ve)

5.6.2 Impact 2 – Erosion and sedimentation

The significance of the impacts associated with increases in velocity and turbulence immediately downstream of release structures during the operational phase and consequent erosion and sedimentation is expected to be medium (-ve) because of the localized nature of the impact and the likely recovery of the river downstream. Mitigation measures recommended in van de Haar (2017) apply.

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	Medium	Local	Permanent	Highly probable	Medium (-ve)
With mitigation	Low	Local	Permanent	Low probability	Very Low (-ve)

5.6.3 Impact 3 – Loss of aquatic habitat

The proposed weir will reduce flood peaks which will reduce the flushing of fines from stones-in-current. Scouring flows will be reduced, the onset of winter flows will be delayed and the frequency intensity and duration of high flows will be reduced. These changes will negatively impact the quality and quantity of aquatic habitat. Fish populations will be affected by the loss of habitat complexity, i.e. feeding, spawning, rearing and predation cover habitats. The significance of these impacts to the indigenous fish populations is deemed Medium (-ve).

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	Medium	Local	Long term	Definite	Medium (-ve)
With mitigation	NA	NA	NA	NA	NA

5.6.4 Impact 3 – Alien Invasive Species

The risks of increasing the lentic (standing water) habitat in both Watercourse 1 and Watercourse 2 is that it provides suitable habitat for the introduction and spread of alien fishes such as bass and bluegill sunfish which predate on indigenous fish populations. Every effort should be made to reduce the risk of such introductions. As a mitigation, farm managers and owners need to be made aware of these risks and discourage the introduction of alien fishes into the new water bodies through signage discouraging the introduction of alien fish species particularly at Weir B on Watercourse 1.

Alternatives	Intensity	Extent	Duration	Probability	Significance
Watercourse 1					
Without mitigation	Very high	Local	Long term	Medium	High (-ve)
With mitigation	Medium	Local	Long term	Medium	Medium (-ve)

5.7 Cumulative Impacts

Foothill rivers such as the Eksteenkloof are heavily impacted by water abstractions and habitat modifications throughout the Riviersonderend and Breede River catchments. As a result of these impacts and the presence of alien fishes in the main stem rivers, indigenous fish populations have been lost from up to 80 % of their of their former distribution ranges. The proposed development, if not properly mitigated, will likely contribute cumulatively to the impacts on fish populations elsewhere in the catchment.

5.8 Conclusion and recommendation

Watercourse 1 on remaining extent of Farm 234, Riviersonderend, provides habitat for two lineages of Cape galaxias (*Galaxias* sp. “zebratus Riviersonderend”) and Cape kurper (*Sandelia* sp. “capensis Riviersonderend”). As a result of the uncertainty around their taxonomic status, their conservation status is still unclear. They are limited to the Riviersonderend catchment and therefore have a limited distribution range. Populations are threatened elsewhere in the catchment by the dewatering of rivers over the summer period for irrigation and by habitat modification for flood attenuation. The populations present in Watercourse 1 are relatively healthy and unimpacted by alien fish species invasions. It is the view of the specialist that the most severe impacts that may result from the dewatering of the river downstream of Weir B during the summer months can be avoided by implementing the Ecological Reserve – provided that flows are monitored and the provisions of the Ecological Reserve are strictly adhered to.

6. References

Chakona, A.; Swartz, E. and Gouws, G. 2013. Evolutionary drivers of diversification and distribution of a southern temperate stream fish assemblage: testing the role of historical isolation and spatial range expansion. *PloS One,* 8**:** e70953.

Ellender, B.R.; Wasserman, R.J.; Chakona, A.; Skelton, P.H. and Weyl, O.L. 2017. A review of the biology and status of Cape Fold Ecoregion freshwater fishes. *Aquatic Conservation: Marine and Freshwater Ecosystems,* 27**:** 867-879.

Nel, J.L.; Driver, A.; Strydom, W.F.; Maherry, A.; Petersen, C.; Hill, L.; Roux, D.J.; Nienaber, S.; van Deventer, H.; Swartz, E. and Smith-Adao, L.B. 2011. Atlas of Freshwater Ecosystem Priority Areas in South Africa: maps to support sustainable development of water resources. *WRC Report No. TT 609/14*. Water Research Commission, Pretoria.

van de Haar, N. 2017. Proposed development of a dam and associated infrastructure located on Portion 3 and Portion 5 of the farm Van Der Wattskraal 394, near Riviersonderend withign the Western Cape Province. Freshwater Assessment. Prepared by Enviroswift (Pty) Ltd for EnviroAfrica cc. 61 pp.

Van Der Walt, J.A.; Weyl, O.L.F.; Woodford, D.J. and Radloff, F.G.T. 2016. Spatial extent and consequences of black bass (Micropterus spp.) invasion in a Cape Floristic Region river basin. *Aquatic Conservation: Marine and Freshwater Ecosystems,* 26**:** 736-748.