Client

Erin de Vigne (Pty) Ltd

NEMA SECTION 24 G RECTIFCATION APPLICATION FOR A WEIR AND PIPELINE ON FARM 781, BOTRIVIER

SPECIALIST REPORT: AQUATIC ECOSYSTEMS

Submitted to

PHS Consulting

FreshwaterConsulting cc

Prepared by

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DECLARATION OF SPECIALIST INDEPENDENCE

I, Justine Ewart-Smith, as a member of Freshwater Consulting cc, hereby confirm my independence as a specialist and declare that I do not have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which PHS Consulting was appointed undertake this assessment, other than fair remuneration for work performed in assessing aquatic ecosystems within the Huiskloof River Catchment.

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STATEMENT OF COMPETENCE

Title: Dr

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1 INTRODUCTION

1.1 Background

In 2010, Mr Ted Adam, the owner of Portion 3 of Farm 781, constructed a weir on the Huiskloof River which lies within the Bot River catchment. The weir, which is situated on Portion 1 of Farm 781, was constructed to divert flow from the river to Portion 3 of Farm 781 via a pipeline approximately 2.5 km long that was constructed at the same time. The pipeline runs from the diversion weir along the southern bank of the Huiskloof River channel until it reaches the R43 where it crosses the river channel immediately upstream of the culvert under the road through which the Huiskloof River flows. Immediately downstream of the culvert, the pipeline turns north east away from the river to a storage dam on Portion 3 of Farm 781 for irrigation purposes.

Construction of the diversion weir and pipeline included two listed activities in terms of the 2006 and 2010 environmental impact (EIA) regulations[1] and amended in 2014 and most recently in April 2017 (GN 327, Gazette Number 40772).

As such, construction of the diversion weir and pipeline were identified by DEA&DP as unlawful and subject to authorisation in terms of NEMA. They should also have been subject to authorization in terms of the National Water Act (NWA) (Act 36 of 1998): *Section 21 (c): impeding or diverting the flow of water in a watercourse and (i) altering the bed, banks, course and or characteristics of a watercourse.*

Consequently, Mr Paul Slabbert of PHS Consulting was contracted by Mr Adams to undertake the 24G application to DEA&DP for the rectification and/or authorisation for the above activities. Freshwater Consulting cc was in turn appointed by PHS Consulting to provide a specialist assessment of the implications of the unlawful activities from an aquatic ecosystem perspective.

1.2 Terms of Reference

Through consultation with PHS Consulting, the following terms of reference form the basis of this assessment:

1. Undertake an evaluation of the present and recent past Ecological Condition and Conservation Importance of the affected riverine ecosystem– the assessment of past condition is based on available information only;

[1] Section 24, National Environment Management Act (NEMA) (Act 107 of 1998)

2. Undertake an evaluation of the impacts to the river associated with the weir, particularly in terms of changes in habitat, biotic response and morphological changes to the river bed and banks;

3. Undertake an evaluation of the extent to which the pipeline footprint and crossing may have impacted the river, particularly in terms of morphological changes to the river bed and banks and potential impacts to the riparian and instream habitat;

4. Make recommendations as to how these impacts, if any, can be redressed on the site bearing in mind that removal of these structures is not considered a viable option.

1.3 Definitions

All reference to wetlands and watercourses in this document are based on the following definitions of wetlands and water courses, as stipulated in the National Water Act (NWA) (Act 36 of 1998):

"watercourse'' means -

(a) a river or spring;

(b) a natural channel in which water flows regularly or intermittently;

(c) a wetland, lake or dam into which, or from which, water flows; and

(d) any collection of water which the Minister may, by notice in the Gazette, declare to be watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;

"wetland'' means -

land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

1.4 Assumptions and limitations

In the absence of *in situ* data on the condition of the Huiskloof River and its associated wetlands or any photographs of these ecosystems prior to construction of the weir and pipeline , the retrospective impacts to the Huiskloof River and associated wetlands was somewhat limited. Also, assessment of current condition was based on a once-off site visit and collection of water quality and macroinvertebrate data at the end of the wet season when the impacts of abstraction would be less severe than at the end of the dry season when the system would be most stressed by abstraction. Nevertheless, it is Freshwater Consulting cc's option that these limitations do not significantly impact on the outcome this assessment.

1.5 Use of this Report

This report reflects the professional judgement of its author. It is Freshwater Consulting's policy that the full and unedited contents thereof should be presented to the client and included in any application to

relevant authorities. Any summary of the findings should only be produced with the approval of the author.

1.6 Activities informing this assessment

Input into this study was informed by the following activities:

- A desk-top assessment of spatial information within quaternary catchment G40G. In particular information on the latest spatial biodiversity plans for the region were sourced, together the National Freshwater Ecosystem Priority (NFEPA) data.
- Perusal of aerial imagery from Google Earth both before and after the construction of the weir and pipeline.
- A site visit in September 2017 to identify affected ecosystems. The Huiskloof River was assessed to determine its ecological condition and importance together with the collection of data as follows:
    - Habitat Integrity assessment of the potentially affected river reaches;
    - SASS5 aquatic macroinvertebrate bioassessment upstream and downstream of the weir on the Huiskloof River;
    - *In situ measurement of* pH, electrical conductivity (EC), Dissolved Oxygen and temperature upstream and downstream of the weir on the Huiskloof River.

1.7 Study location

The study area extends over several properties, including Farm 1/781, RE/474, RE/4/781, 59/781, RE/4/781 and 3/781 which straddle the R43 between the town of Bot River about 4.5 km north and Hermanus to the South (Figure 1.1 and Figure 1.2). The weir and pipeline are situation within or adjacent to the channel and wetlands of the Huiskloof River (Figure 1.2), which confluences with the Bot River in its lower reaches before it reaches the Bot River Estuary (Figure 1.1).

2 ASSESSMENT APPROACH AND METHODOLOGIES

This section outlines the various data sources and assessment methodologies applied to freshwater ecosystems within this study as a baseline for the retrospective assessment of impacts associated with the construction of the weir and pipeline within the study area.

2.1 NFEPA classification

FEPAs (Freshwater Ecosystem Priority Areas) are strategic priorities for conserving freshwater ecosystems and supporting the sustainable use of water resources (Driver *et al* 2011). They were developed as part of the National Freshwater Ecosystem Priority Areas (NFEPA) programme. FEPAs have been determined for different river and wetland types throughout South Africa, on the basis of a number of criteria that included ensuring that there is an adequate extent of conservation of different river and wetland ecosystem types, that they represent adequate habitats to support threatened fish species and their

migration corridors; that free-flowing rivers (i.e. rivers without major dams) are prioritised as FEPAs, that water supply areas in high-water yielding sub-quaternary catchments are maintained and that ecological connectivity between systems is maintained as far as possible. The NFEPA data was used in this assessment to inform river condition and to determine whether any of the affected watercourses are identified as FEPAs.

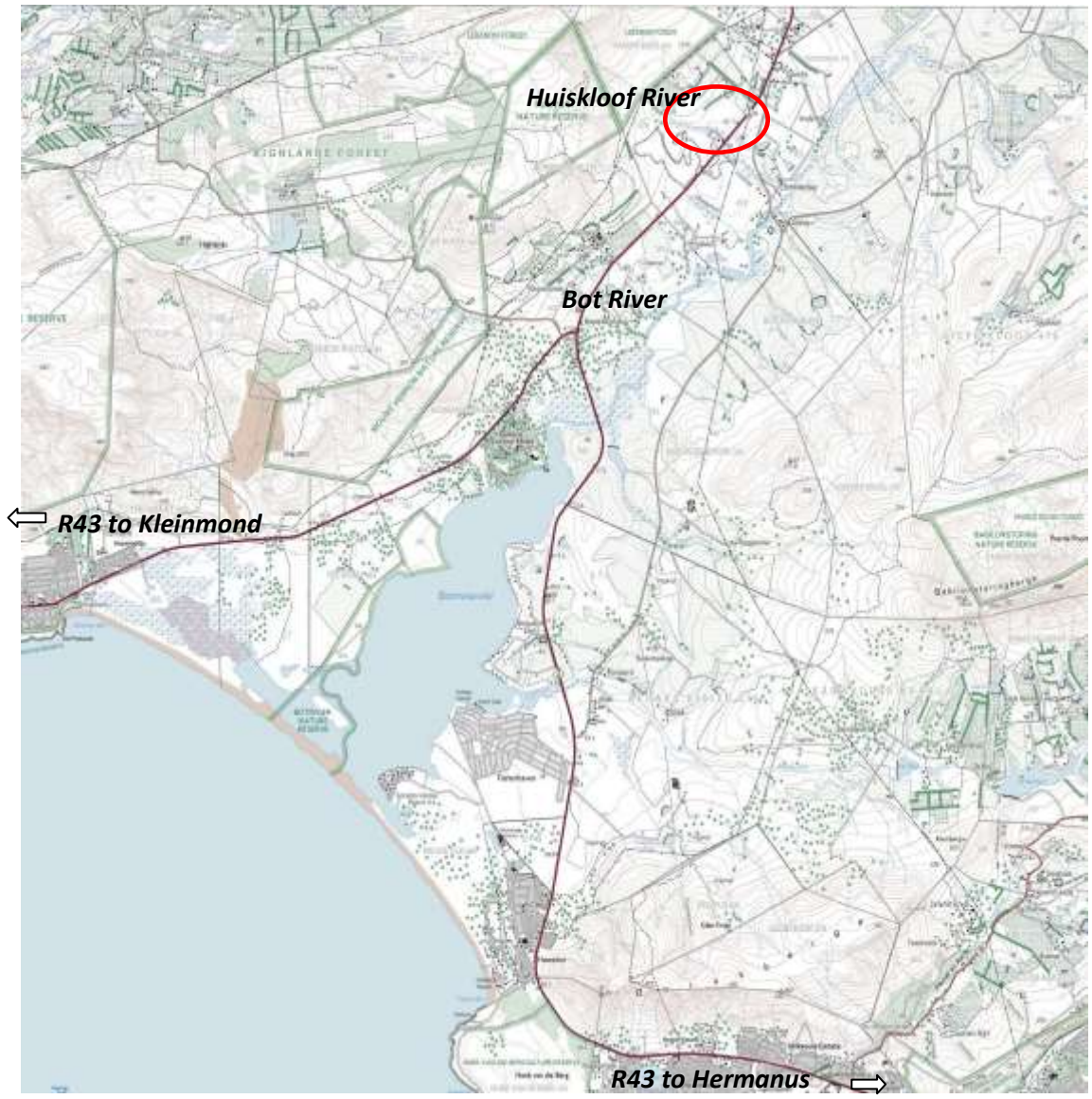

Figure 1.1 The Study Area (red) is located in DWS quaternary catchment G40G on the Huiskloof River which is a tributary of the Bot River that flows into the Bot River Estuary.

Figure 1.2 The Study Area showing the location of the weir and pipeline route (blue). The relevant property boundaries are shown in red (source: Cape Farm Mapper).

2.2 Western Cape Biodiversity Spatial Plan

The Western Cape Biodiversity Spatial Plan (WCBSP) is the outcome of a systematic biodiversity planning exercise developed at a relatively finescale (1:10 000 to 1:50 000) that is used to guide development through identification of both terrestrial and aquatic conservation priorities. The WCSBP defines five broad biodiversity priority categories ranging from Core Biodiversity Areas (CBAs) through to Ecological Support Areas (ESAs) through to highly modified areas rated as No Natural Remaining (NNRs) areas. Each category is given a desired management objective and these spatial data were used to inform the desirability of water resource development and make recommendations within this assessment.

2.3 Assessment of ecological condition of freshwater ecosystems

The Index for Habitat Integrity (IHI) for rivers described in DWAF (1999) was used to assess the ecological condition of the Huiskloof River within this study. This assessment results in the assignment of a specific river reach to one of six PES broad Habitat Integrity categories ranging between Category A (unmodified system) and Category F (critically modified)(Table 2.1).

Habitat Integrity refers to the degree of naturalness of a freshwater ecosystem. It involves an assessment of a number of key criteria, relating to the present condition of a system, compared to the probable natural condition.

Habitat Integrity assessments involve the following procedures:

The habitat integrity assessment is based on a qualitative assessment of a number of pre-weighted criteria, with each criterion being scored between 1 and 25 and the final Habitat Integrity score being calculated as a percentage. The criteria are: water abstraction; flow modification; bed modification; channel modification; water quality; inundation; exotic macrophytes; exotic fauna; solid waste disposal; indigenous vegetation removal; encroachment of exotic vegetation; bank erosion; channel modification.

The calculated overall habitat integrity scores for each reach are grouped, to allow classification of subregions into Habitat Integrity categories (Table 2.1).

Table 2.1 Descriptions of habitat condition for different baseline categories and percentage scores, relative to natural (Kleynhans and Louw 2007)

Baseline Category	Baseline Score (%)	Description of the habitat
A A/B	92-100 87-92	Still in a Reference Condition.
B B/C	82-87 77-82	Slightly modified from the Reference Condition. A small change in natural habitats and biota has taken place but the ecosystem functions are essentially unchanged.
C C/D	62-77 57-62	Moderately modified from the Reference Condition. Loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged.
D D/E	42-57 37-42	Largely modified from the Reference Condition. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E E/F	22-37 17-22	Seriously modified from the Reference Condition. The loss of natural habitat, biota and basic ecosystem functions is extensive.

Wetlands were assessed using the Wetland Index of Habitat Integrity methodology of DWAF (2007). This methodology was designed specifically for the assessment of PES in South African floodplain and channelled valley bottom wetlands. The methodology is based on a comparison of current attributes of the wetland, which are scored against those of a desired baseline or reference condition, resulting in the assignment of a wetland to the same categories described in Table 2.1. The approach involves scoring different components separately for key drivers of wetland condition i.e. Hydrology, Geomorphology and Water quality, together with an evaluation of the change in vegetation characteristics from reference conditions. The methodology is applicable to natural wetlands only.

2.4 Assessment of the Ecological Importance and Sensitivity (EIS) of freshwater ecosystems

The Ecological Importance and Sensitivity (EIS) methodology derived by DWAF (1999) was used to determine the EIS of the Huiskloof River and its associated seep and Valley Bottom wetland habitat. According to this methodology, ecological **importance** of freshwater ecosystems is defined as "an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales" and "**sensitivity**" as "the extent to which the biota is able to accommodate change in the major physic-chemical features of the system".

Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity of rivers. In terms of this assessment, ecological importance and sensitivity is a general and unrefined estimation. It is strongly biased towards the potential importance and sensitivity of the particular stream delineation, as it would expect to be under unimpaired conditions. This means that the present ecological status or condition (PES) is generally not considered in determining the

ecological importance and sensitivity *per se.* Each river reach is allocated to one of four EIS categories ranging from "very high" to "low/marginal.

The following components are rated in an EIS assessment:

- The presence of rare and endangered species, unique species (i.e. endemic or isolated populations) and communities, intolerant species and species diversity should be taken into account for both the instream and riparian components of the river;
- Habitat diversity;
- Biodiversity in its general form;
- The importance of the particular river or stretch of river in providing connectivity between different sections of the river;
- The presence of conservation or relatively natural areas along the river section;
- The sensitivity (or fragility) of the system and its resilience (i.e. the ability to recover following disturbance) of the system to environmental changes;

The above biotic and abiotic determinants are scored, and the median score is calculated to derive the EIS category. These categories are defined in Table 2.3

Table 2.3 Ecological importance and sensitivity categories (taken from DWAF 1999).

Ecological Importance And Sensitivity Categories	General Description
Very high	Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.
High	Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use.
Low/marginal	Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.

2.5 SASS5 Bioassessment

The South African Scoring System version 5 (SASS5) is a widely used approach for the assessment of macroinvertebrate communities in South African rivers. This method provides an excellent index of species richness and water quality in perennial rivers with relatively natural habitats. Thus, SASS5 was only considered suitable for application to sites within the Seweweekspoort River were water flows throughout the year.

The SASS5 protocol uses a kick-sampling technique that disturbs the streambed so that invertebrates are dislodged from the substratum and vegetation, and retained on a hand-held 950µm-mesh sieve (attached to a 300mm x 300mm frame). The sample was placed in a basin and each taxon recorded, at the level of invertebrate family. The abundance grouping of each family was recorded, where "1" is given to a single appearance of a taxon, "A" accorded where individuals number 1-10, "B" for 11-100 individuals, "C" for 101-1000 individuals, and "D" for > 1000 individuals.

The SASS5 protocol allocates a predetermined score for each taxon according to its sensitivity to water quality perturbation. Sensitive taxa are allocated high weighting (maximum of 15) while taxa more common to degraded/disturbed systems receive low weightings.

SASS5 scores, Average Scores Per Taxon (ASPTs)[2] – calculated by dividing the SASS5 score by the number of taxa - and total number of taxa were calculated for each biotope.

Interpretation of SASS5 data made use of the Biological Bands developed by Dallas (2007), which allow SASS5 data to be interpreted relative to reference condition sites in similar river reaches, in the same ecoregions. The biological bands allow data to be categorised from Category A to F with Category A being natural or reference condition systems.

3 DESCRIPTION OF THE WEIR AND PIPELINE ROUTE ON FARM 781

Figure 3.1 shows the location of the Weir and the pipeline route constructed in 2010 in relation to the Huiskloof River. These structures are discussed below.

[2] ASPTs are particularly useful as indicators of water quality of an aquatic system, as a low score will indicate that the community is dominated by species resistant to anthropogenic perturbations such as pollution, while high scores indicate the occurrence of more sensitive and, often rare, species, that would be expected to occur in undisturbed systems.

3.1 The weir on the Huiskloof River

In order to secure a share of a registered water use for Farm 3/781, Mr Adam commissioned the construction of a weir on the Huiskloof River for the diversion of the allocated discharge of 130 000 cubic meters per annum (i.e. 15% of the MAR) (P. Slabbert, pers. Comm.) (Figure 3.2). The weir itself is located immediately downstream of the point where three tributaries of the Huiskloof River merge to form a single channel. At this point, the river profile flattens considerably and the river changes from a foothill cobble bed system to a channelled –valley bottom wetland (see section 4 for a description). Thus the weir was constructed on bedrock (Figure 3.2a) within the channel which forms a rocky outcrop characterising a distinct inflection in channel slope.

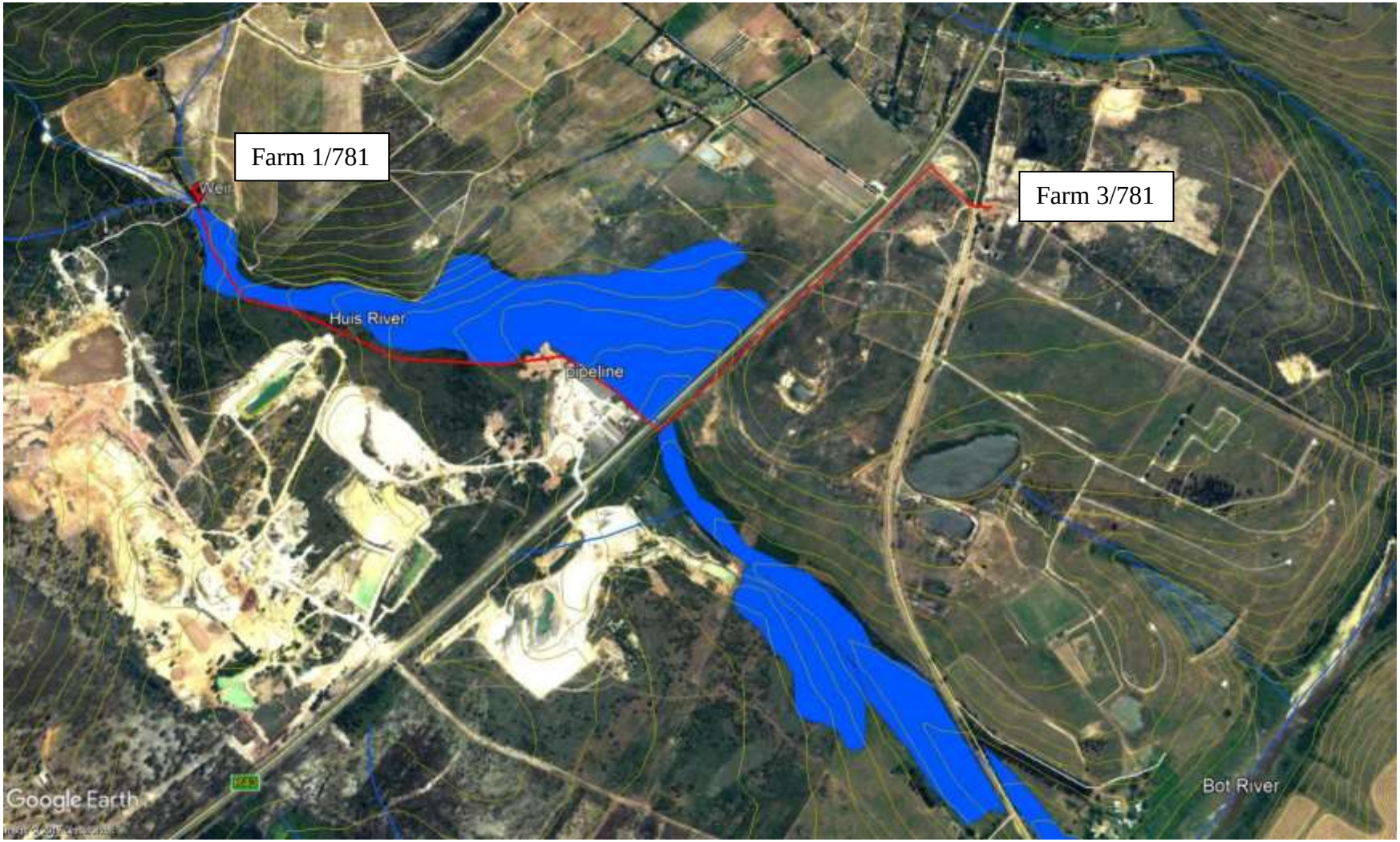

Figure 3.1 The location of the weir on the Huiskloof River, together with the pipeline constructed in 2010 to divert water from the Huiskloof River to Portion 3 of Farm 781 for irrigation purposes.

The weir consists of a wall about 1.7 m in height from the base at the downstream side of the weir (Figure 3.2a and Figure 3.3). The width of the wall is about 5 m from the left bank with an overflow of about 1. 5 m wide in the centre of the active channel. Beyond the active channel is a concrete pool that houses the offtake pipe for the diversion of runoff from the channel. At the base of the weir wall is a concrete shelf approximately 2 m wide from the wall which acts as scour protection immediately downstream of the structure. The approximate dimensions of the structure are shown in Figure 3.3.

Figure 3.2 The weir constructed on the Huiskloof River in 2010 a) showing the bedrock outcrop on which the weir is situated thus minimising the risk of erosion an b) looking upstream from the active channel

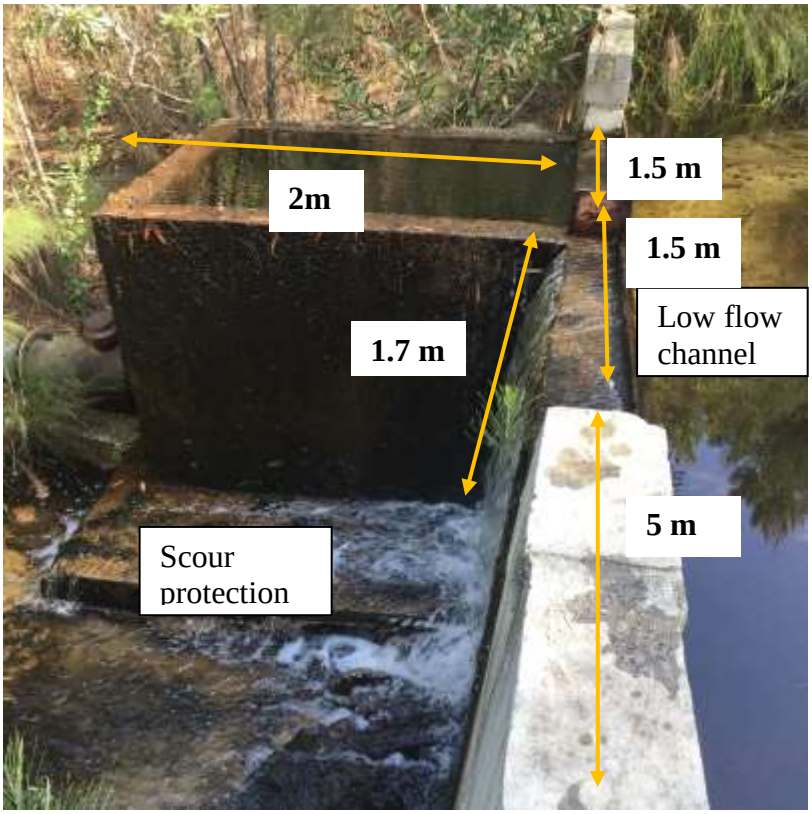

Figure 3.3 Dimensions of the weir structure as viewed from the right bank looking across the active channel.

3.2 The Pipeline Route

The pipeline carrying diverted runoff from the Huiskloof River to Farm 3/781 is 200 mm in diameter. The pipeline leads from the weir structure (Figure 3.4a) towards the upper slopes along the left (southern) bank of the Huiskloof River. It largely extends beyond the riparian edge of the Huiskloof River until it reaches the quarry near the R43. Here the quarry encroaches into wetland habitat and the pipeline route abuts the outer edge of the quarry until it reaches the R43 (Figure 3.1). At this point, the pipe crosses the active channel of the Huiskloof River within a concrete structure (Figure 3.4b). On the downstream end of the culvert below the R43, the pipeline route heads away from the channel until it reaches a storage dam on Farm 3/781 (Figure 3.1). The total length of the pipeline route is approximately 3km from the weir on the Huiskloof River the storage dam on Farm 3/781.

Figure 3.4 The 200mm diameter pipeline extends from a) the pool structure associated with the weir for diversion of runoff from the Huiskloof River and b) then crosses the active channel of from Huiskloof River immediately upstream of the culvert below the R43.

3.3 Construction related activities

Based on communications with Mr P. Slabbert and Mr T. Adam it is reputed that:

- Construction of the weir and pipeline took place at the end of summer when discharge is at its lowest. Construction was completed before the onset of the winter rains.
- The pipeline route involved the excavation of a trench with a minimum depth of 1.5 m below the surface with a width of approximately 1 m.
- Excavation involved working in 100 m sections using a 30T excavator. Excavated material was placed alongside the trench. Thereafter the pipe was laid within the trench and then excavated material was backfilled to cover the pipe. Therefore each 100 m section was excavated and backfilled within a period of 2 days.

4 DESCRIPTION OF AFFECTED AQUATIC ECOSYSTEMS

4.1 Catchment Description

The Huiskloof River is situated in Department of Water and Sanitation (DWS)'s quaternary catchment G40G within the Breede-Gouritz Water Management Area. The catchment falls within the Cape Fold Mountain Ecoregion described as a region dominated by high mountains with high relief, low mountains with high relief, closed hills with moderate relief and open hills with high relief (Kleynhans *et al.* 2005) The upper catchment is mountainous and is dominated by Kogelberg Sandstone Fynbos with acidic soils derived from sandstones while the lower catchment is dominated Elim Ferricrete Fynbos with soils derives from Bokkeveld Shale, Cape Granite, ferricrete and silcrete (Mucina and Rutherford 2006). Based on Cape Nature's 2016 assessment of threat status (Pool-Standvliet *et al.* 2017), both the Kogelberg Sandstone Fynbos and Elim Ferricrete Fynbos vegetation types are listed as "Critically Endangered".

The Huiskloof River rises in the Kogelberg (Houwhoek) Nature Reserve as three tributaries that flow in a south easterly direction through a largely natural landscape (Figure 4.1). Within the foothills, these tributaries enter farmlands dominated by vineyards where they merge to form the Huiskloof River. Downstream of this point, the slope flattens and the river flows for about 1.7 km as a broad, Channelled Valley Bottom Wetland fed by a seep from the north until it reaches the R43 where all flow is directed below the road via a relatively narrow culvert. The Huiskloof River downstream of the R43 continues as a narrow channel (about 1.5 m wide) flanked by wetland habitat that is hydrologically isolated from the channel, heavily invaded by alien trees and is thus no longer functional wetland habitat. Approximately 1.5 km for the R43, the Huiskloof River joins the Bot River. From immediately upstream of the point at which the foothill tributaries merge to form the Huiskloof River, to its confluence with the Bot River, this system is surrounded by cultivated lands with a number of quarries that impact variously on the river itself.

The Huiskloof River joins the Bot River a short distance upstream (about 6 km) of the point where it enters the Bot-Klein Estuary System (Figure 1.1). This system is ranked as the 8th most important estuary in South Africa in terms of its size, habitat, and biodiversity attributes (Van Niekerk and Turpie 2012). Despite its importance, this system is impacted by a number of anthropogenic activities – reduction in freshwater flows due to abstraction for agricultural and domestic use being listed as one of the most significant impacts.

Figure 4.1 The Huiskloof River catchment showing the three upper tributaries that rise in the Houwhoek Nature Reserve and merge within Farm 1/781 to form the Huiskloof River which continues as a channelled valley bottom wetland (Blue area) fed by seep wetlands (green area).

4.2 NFEPA classification of the Study Area

Figure 4.2 indicates that the Huiskloof River and associated seep and valley bottom wetlands are rated as priority wetlands for conservation within the NFEPA wetland layer. The NFEPA data incorrectly classified these wetlands as floodplains but groundtruthing confirmed that the Huiskloof River is a natural Channelled Valley Bottom wetland fed by seep habitats (Ollis *et al*. 2013) downstream of the weir. NFEPA wetlands are those systems that that should be protected to meet biodiversity targets (Nel *et al*. 2011).

4.3 Critical Biodiversity Areas and Ecological Support Areas

The upper reaches of the Huiskloof River are protected by their location within either the Hottentots-Holland Mountain Catchment area or the Houwhoek Nature Reserve (Figure 4.3). Downstream of these protected areas, the Huiskloof River falls largely within an Aquatic Critical Biodiversity Area (CBA1) with patches rated as Ecological Support Areas (ESA2). According to the land use guidelines described in the Western Cape Biodiversity Spatial Plan (WCBSP) handbook (Pool-Stanvliet *et al.* 2017), the desired management objective for CBA1 aquatic and terrestrial habitats is to maintain them "in a natural or near-nature state with no further loss of natural habitat. Degraded areas should be rehabilitated". The guidelines indicate further that "only low-impact, diversity-sensitive land uses are appropriate" (Pool-Standvliet *et al.* 2017). With regards the ESA2 areas, the management objective is to restore and or manage these areas to minimize impact on ecological processes and ecological infrastructure.

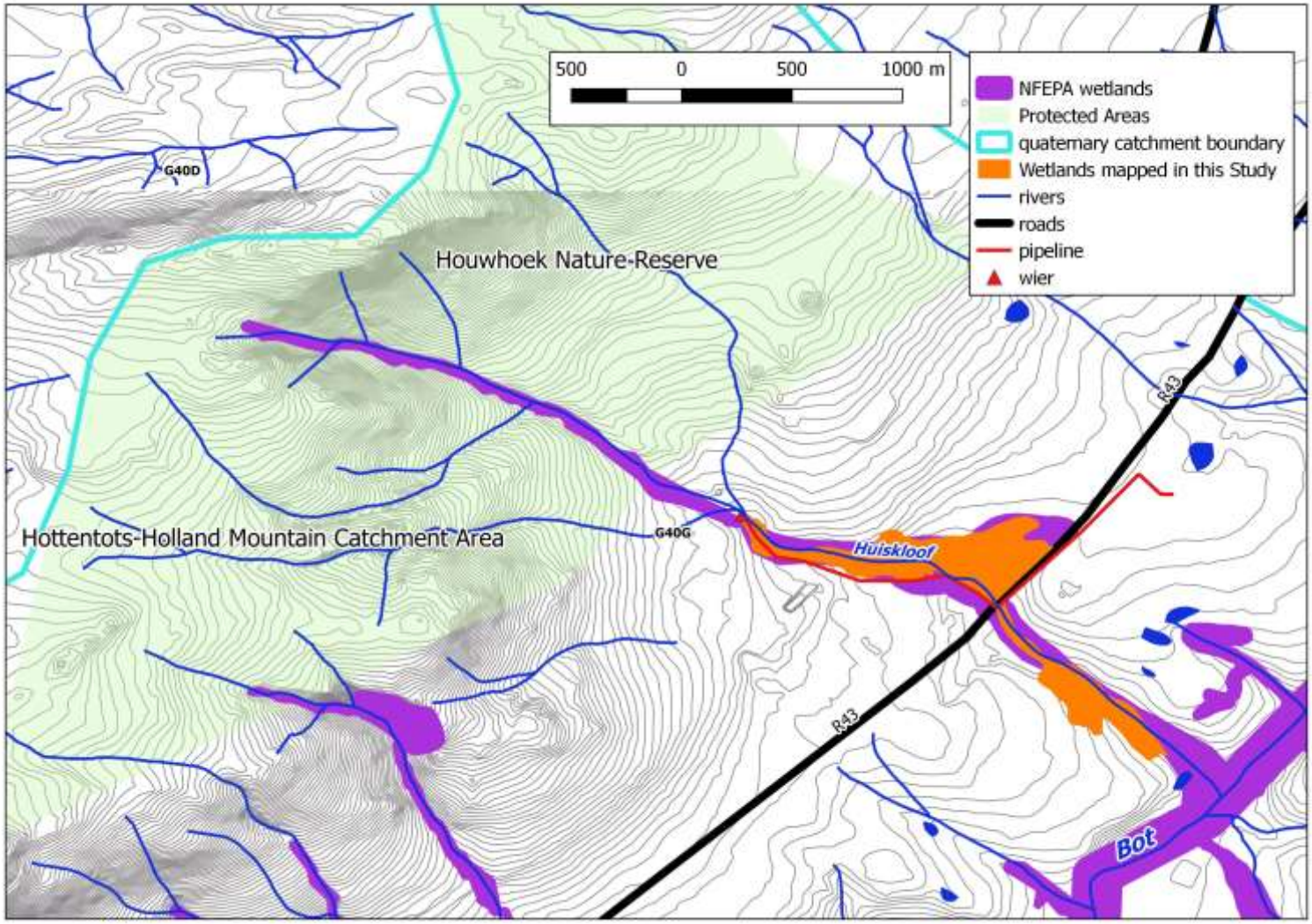

Figure 4.2 NFEPA Wetlands identified within the study area suggesting that the wetlands associated with the Huiskloof River are conservation priorities for meeting biodiversity targets.

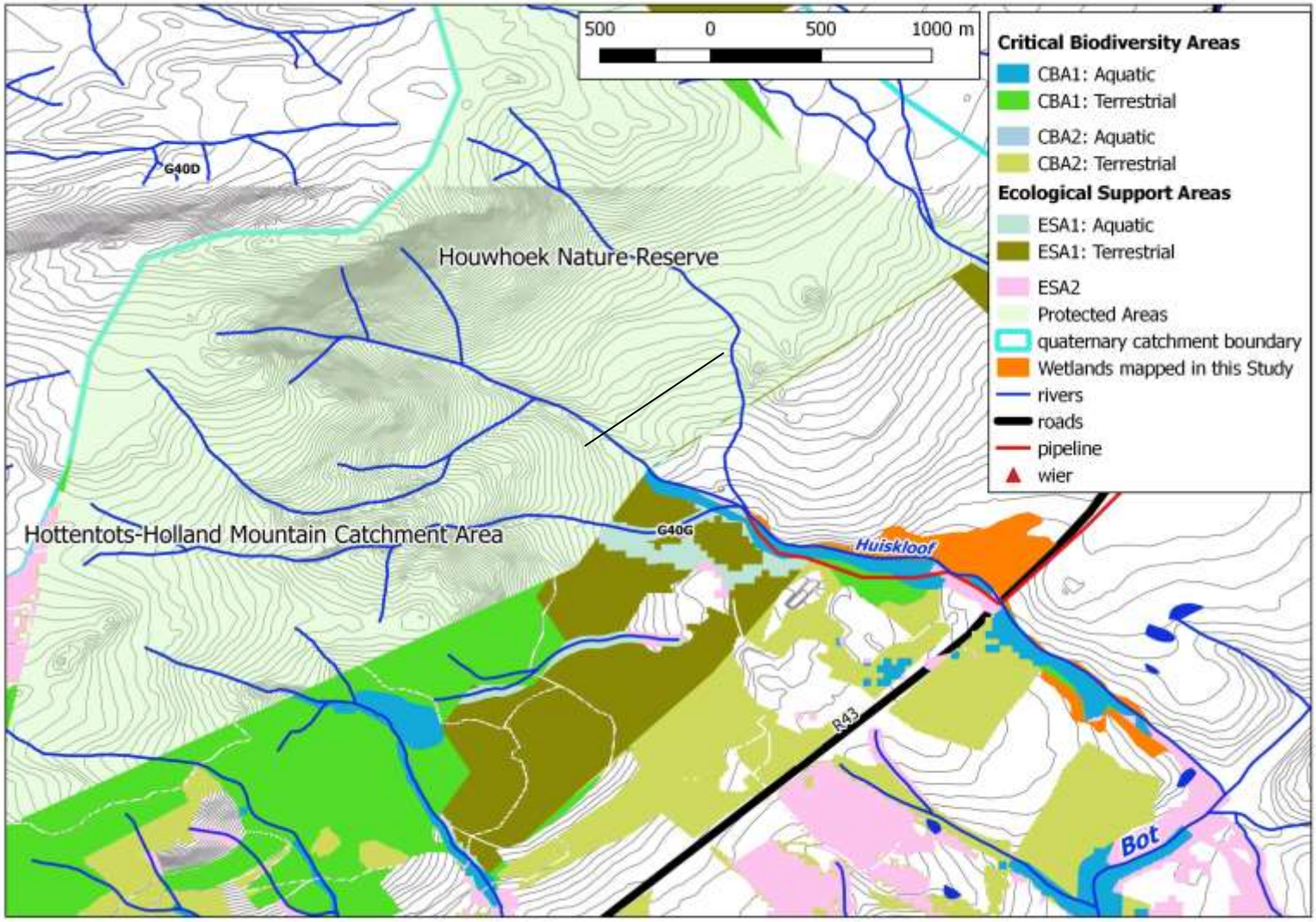

Figure 4.3 The Huiskloof River within the study area is largely rated as a Critical Biodiversity Area (CBA1) with patches identified as Ecological Support Areas (ESA2).

4.4 Description of the Huiskloof River in the study area

4.4.1 The Huiskloof River upstream of the weir

Three tributaries labelled Tributary A, B and C in Figure 4.4 merge immediately upstream of the weir to form the Huiskloof River. The southernmost tributary (Tributary A) flows predominantly through alien trees such as pines. Immediately upstream of its confluence with Tributary B, it flows as a narrow, sandy stream with occasional cobbles through dense pines. Green filamentous algae suggests that the system may be enriched with little or no natural features.

The northern most tributary (Tributary C) has been diverted to maximise areas for cultivation and is impeded by 2 instream dams and an offtake at the point of diversion. Most of the riparian fringe has been lost to accommodate farming in the immediate surrounds and the little remaining vegetation along this channel consists of a few sedges but mostly alien trees, particularly Beef woods (*Pinus sp.)* (Figure 4.5). The channel passes via pipes below a small dirt road crossing the river and merges with Tributary B immediately upstream of the weir.

Figure 4.4 The three tributaries which form the Huiskloof River as they flow through Farm 1/781

Figure 4.5 Tributary C immediately upstream of its confluence with the Huiskloof River. This stream is severely impacted by surrounding agricultural activities, loss of natural riparian vegetation, loss of instream habitat and change in low flows due to abstraction and the presence of two instream farm dams.

Tributary B (Figure 4.4) is the main channel that contributes to the flow of the Huiskloof River. Similar to Tributary C, this system has been impacted by loss of riparian and instream habitat, although flows are not as severely impacted. The riparian fringe for most of its length is dominated by beef wood trees that have excluded almost all natural vegetation resulting in a largely sterile channel (Figure 4.6). Naturally this system would have been characterised as a transitional river with features of both mountain streams and foothill cobble-bed rivers. Although some bedrock steps provide some habitat, sedimentation due to loss of riparian vegetation is excessive (Figure 4.6). However, the system recovers somewhat immediately upstream of the point where it merges with the other two tributaries. Here, the channel margin is dominated by indigenous vegetation typical of transitional Fynbos streams, including *Calopsis paniculata*, *Prionium seratum* (Palmiet), *Osmatopsis sp*. and *Psoralea pinnata* either side of a narrow cobble and bedrock channel.

Figure 4.6 Tributary B downstream of the Houwhoek Nature Reserve where it has lost most of its instream and riparian habitat as its flows through dense alien trees alongside a gravel road that impinges on riparian fringe.

4.4.2 The Huiskloof River downstream of the weir to the R 43

Downstream of the weir constructed in 2010, the slope of the Huis River flattens somewhat and widens into a Channelled-Valley Bottom wetland with multiple channels that support dense stands of Palmiet (*Prionium serratum*) together with the tall white daisy (*Osmatopsis sp.)* and the Erica, *Calopsis paniculata* in the wetter areas. Along the drier margins, the channel characterised by *Berzelia sp*, together with *Pteridium aquilinum* and stands of *Psoralea pinnata* which give way to dense invasion by alien trees, mostly pines (*Pinus sp*) (Figure 4.7). The system at this point is about 50 m wide but increases to about 100 m as it approaches the R43 downstream with a total area of 14.13 ha. Immediately prior to entering the culvert beneath the R43, the active channel is crossed by the pipeline (Figure 3.4b). Under natural conditions, this system would have been fed by the large seep habitat of about 17.42 ha that joins this system along its right bank. However, under present day conditions, this system is bisected by an offtake channel that carries runoff from an old weir near the centre of the system to an off-channel storage facility downstream of the R43. Thus, the abstraction of water at this point as well as changes in the hydrological functioning of the system due to channelization through the seep has altered the natural character of this system.

Near the R43, the main channel is situated along the right bank and is dominated by *Typha capensis,* possibly due to poor quality runoff from the adjacent quarry which may promote the proliferation of this species. Despite these surrounding impacts to the wetland and changes in its hydrogeomorphological character associate with abstraction and diversion of flows, the remaining valley bottom habitat is dominated by a diversity of indigenous plants including *Wachendorfia thyrsiflora,* patches of sedges such as *Scirpus nodosa* and *Juncus kraussi* with *Calopis paniculata Osmatopsis sp*., *Pteridium aquilinum* and the wetland grass, *Pennisetum macrurum* (Figure 4.8). However, invasion by alien trees such as *Acacia sp.* and *Pinus sp.* is more prolific downstream of the old abstraction weir.

Figure 4.7 The Channelled-Valley Bottom wetland characteristic of the Huiskloof River immediately downstream of the weir. While the wetland is dominated by a diversity of indigenous plant species, the dry margins are dominated by alien invasive trees.

Figure 4.8 The Channelled-Valley Bottom wetland of the Huiskloof River immediately upstream of the R43. The quarry encroaching in the wetland habitat is evident along the right bank of the river (to the left of the picture).

4.4.3 The Huiskloof River downstream of the R43 to its confluence with the Bot River

The Huis River passes the R43 through a culvert about 5 m wide and thus the naturally broad wetland habitat becomes confined to a narrow channel that is separated from the surrounding wetland through down-cutting of the channel bed (Figure 4.9). The once functional valley bottom wetland habitat is now heavily infested with alien trees, mainly *Acacia sp.* and *Pinus* sp. It is likely that only the biggest floods inundate the once extensive Valley bottom and thus is now largely dry supporting few wetland functions. This system is about 9 ha in area but there are a number of dams that encroach into the valley bottom on the right bank between a quarry and the river system.

Figure 4.9 The Huiskloof River downstream of the R43 is characterised as a narrow channel hydrologically isolated from the wetland habitat that would naturally surrounded this system. The remnant valley bottom component is heavily invaded with alien tires (Acacia sp.).

4.5 *In situ* water chemistry

The results of once-off water quality data collected both upstream and downstream of the diversion weir on the Huiskloof River during September 2017 are presented in the Table 4.1 below. These data suggest that the water quality of the Huiskloof River is typical of pristine Fynbos mountain streams with acid waters and low Electrical Conductivity (EC) indicative of low dissolved salt concentrations. Despite abstraction from the Huiskloof River at the weir, there appears to be no apparent flow related water quality impacts to this system. This is not surprising considering that changes in flow volume impact water quality when pollutants form part of the flow volume, which is not the case in the Huiskloof River within this reach, despite cultivation within the immediate catchment.

Table 4.1 Results of once-off water quality analysis collected in September 2017 from the Huiskloof River

Site	*In situ* pH	*In situ* EC ($uScm^{-1}$)	Dissolved 0_2 (mg/l)	Temp. (^0C)
Upstream of weir	5.51	169.9	10.5	15.6
Downstream of weir	5.54	192.8	11.5	15.8

4.6 SASS results

In terms of the macroinvertebrate fauna upstream of the diversion weir on the Huiskloof River, the system is rated as a ***Category B*** (see Table 2.1 for a definition) suggesting it is largley pristine but with only a slight change from natural (Table 4.2; Figure 4.10). Thus despite loss of a large section of habitat upstream of this reach as it flows through alien vegetation, the habitat immediatley upstream of the weir supports a relatively intact aquatic fauna. Downstream of the weir, the system is rated as a ***Category A*** in terms of macroinvertebrate fauna suggesting that the system is natural with a diversity of habitat types and excellent water quality. Thus, the Huiskloof River downstream of the weir supports a large number of sensitive and endemic macronvertebrate taxa indicative of a pristine river despite loss of flows associated with abstraction at the diversion weir. Besides macroinvertrates within the Huiskloof River, a few individuals of the Cape Galaxius (*Galaxius zebratus*) were captured at the site below the weir suggesting that the Huiskloof River is an important habitat for indigenous fish that are increasingly threatened by loss of habitat associated with abstraction.

Table 4.2 SASS data for a site on the main Huiskloof River Tributary (Tributary B) immediately upstream of the weir and for a site downstream of the weir together with the interpretation of both SASS and derived ASPT scores with regards to Dallas' (2007) Biological Bands for the Cape Fold Mountains Ecoregion within which these sites fall.

Site	SASS score	Total number of families	ASPT	Category
Upstream of weir	144	22	6.66	B
Downstream of weir	191	26	7.35	A

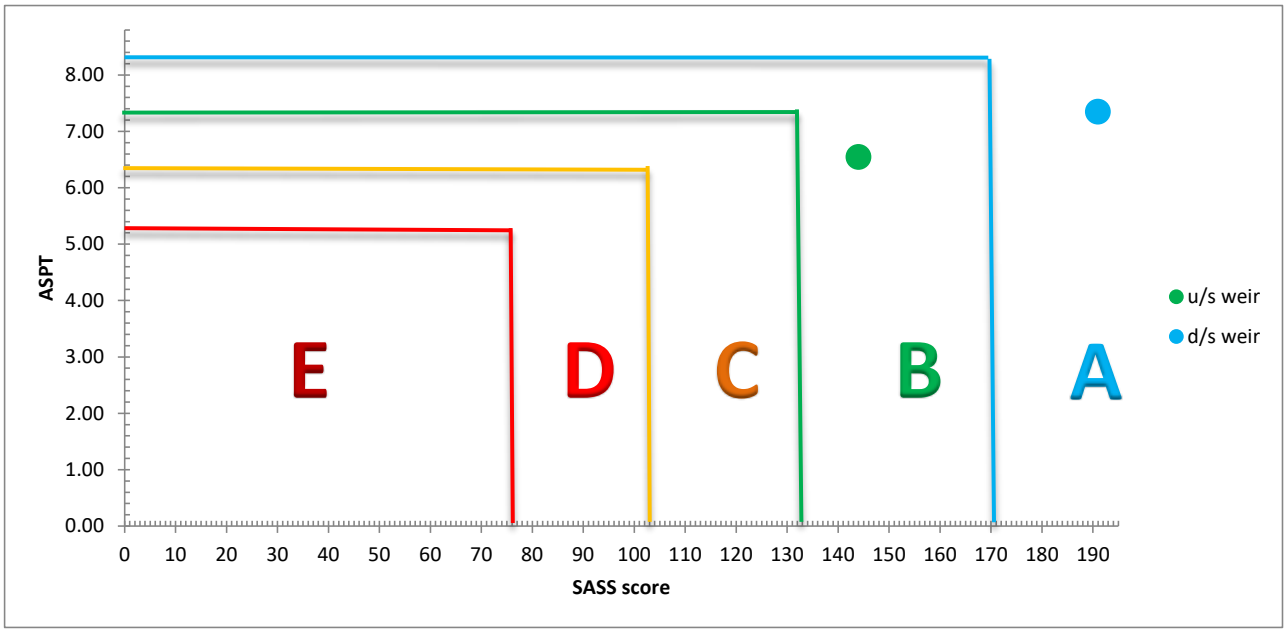

Figure 4.10 Biological bands (after Dallas 2007) depicting condition in terms of macroinvertebrate communities upstream and downstream of the weir on the Huiskloof River.

4.7 Habitat Integrity and overall PES

The Instream and Riparian status of the Huiskloof River tributaries upstream of the diversion weir are given in Table 4.3.

Of the three tributaries that merge to form the Huiskloof River system, Tributary C is the most impacted, largely due to abstraction of runoff, change in flow conditions and severe channel and bed alterations associated with encroachment of surrounding farm lands and invasion by aliens. This system is rated as a ***Category D*** in terms of its ecological condition suggesting that it is largely modified from its natural condition with a significant loss of natural habitat, biota and basic ecosystem functioning (Table 4.3). Despite significant loss of both instream and riparian habitat along Tributary B due to invasion by aliens and encroachment of farming activities along the left bank of the channel, this system was rated as a ***Category B/C*** because the system still supports a diverse aquatic biota with areas that are largely unaffected. Nevertheless, it should be noted that the trajectory of change is negative if aliens in this area are not appropriately managed as the remaining instream and riparian habitat will be lost to alien encroachment. Tributary A, although not surrounded by farming activities, is significantly impacted by the invasion of alien trees and the associated loss of the channel and instream integrity. This system was therefore rated as a ***Category C*** suggesting that loss of habitat integrity has occurred but some ecosystem functions remain (Table 4.3).

Table 4.3 Results of the Index of Habitat Integrity assessment for the Huiskloof River within the study area. Each criterion is scored between 0 and 25 with 0 indicating no modification and 25 indicating a critical modification.

Catchment name	Bot River	Bot River	Bot River
River name	Huiskloof Tributary A	Huiskloof Tributary B	Huiskloof Tributary C
Geomorphological zone	Transitional River	Transitional River	Transitional River
Water abstraction	0	0	16
Inundation	1	1	5
Water Quality	8	0	5
Flow modifications: Floods	0	0	5
Flow modifications: Low flows	0	0	12
Presence of exotic macrophytes	0	0	0
Channel Modification	20	16	20
Bed modification	20	16	20
Exotic encroachment	20	20	20
Presence of exotic fauna	0	0	0
Presence of solid waste	3	0	2
Removal of indigenous vegetation	13	13	16
Erosion	8	5	8
Instream score (%)	73.6	82.96	60.68
Riparian score (%)	64.96	72.72	50.6
Overall score (%)	**69.28**	**77.84**	**55.64**
Habitat Integrity	**C**	**B/C**	**D**

The Channelled Valley Bottom Wetland between the weir and R43 was rated overall as a ***Category B*** in terms of its Present Ecological State indicative of a system that is largely intact. The overall score was derived from the following individual PES components:

- Hydrology: PES of 64.7% - Category C (moderately modified);
- Geomorphology: PES of 83.0% - Category B (slightly modified);
- Water Quality: PES of 99.0% - Category A (unmodified);
- Vegetation alteration: PES of 90% -Category A/B (very slight modifications).

Despite some hydrological alterations to this system associated with abstraction, as well as hydraulic and geomorphic changes due to the diversion weirs and offtake channels near the centre of the habitat (see section 4.4.2 for a description) this system supports a highly diverse and intact wetland ecosystem with good water quality, functional geomorphic processes and a largely intact vegetation community, particularly upstream of the old offtake weir and diversion channel.

However, the condition of this system deteriorates considerably downstream of the R43, largely due to the hydrological changes to the system imposed by the road crossing which completely impedes the broad diffuse swathe of wetland by forcing all flow via a single culvert below the R43. Concentration of flows has led to hydraulic changes through down cutting of the channel. This has resulted in the loss of inundation of the surrounding valley bottom wetland habitat where "drying out" of this habitat has led to severe invasion by alien trees and thus complete loss of the wetland function. Consequently, this habitat was rated as a ***Category D*** in terms of its Present Ecological Status indicating that it is largely modified with a considerable loss of natural habitat, and basic ecosystem functions.

The overall score was derived from the following individual PES components:

- Hydrology: PES of 47.3% - Category D (largely modified);
- Geomorphology: PES of 60.0% - Category C/ D (moderately modified);
- Water Quality: PES of 85 .7% - Category B (slightly modified);
- Vegetation alteration: PES of 50% - Category D (largely modified).

4.8 Ecological Importance and Sensitivity

Although the threat status of Cape Galaxids are rated as 'data deficient' in the IUCN's red databook, populations of this fish species are increasingly marginalised and threatened by habitat loss. This species is endemic to the Fynbos biome and is thus protection of this species is rated on a national scale. Also, a very high diversity of endemic and sensitive macroinvertebrates was recorded in this system during September 2017. Besides its importance for biota, this system supports a diversity of aquatic habitat types and is relatively sensitive to alterations in flow and water quality due its small size. Furthermore, the system is rated as a Critical Biodiversity Area for the protection of aquatic ecosystems and as such is rated as high in terms of conservation priorities. Thus, the Huiskloof River is considered as having a ***very high Ecological Importance and Sensitivity*** (Table 4.4).

Table 4.4 Ecological Importance and Sensitivity of the Huiskloof River.

Determinants	Huiskloof River system
Biotic Determinants	
Rare and endangered biota	4
Unique biota	3
Intolerant biota	4
Species/taxon richness	4
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	3
Refuge value of habitat type	3
Sensitivity of habitat to flow changes	3
Sensitivity of flow related water quality changes	3
Migration route/corridor for instream and riparian biota	2
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	4
RATINGS	**3.2**
EIS CATEGORY	**Very High**

5 ASSESSMENT OF IMPACTS TO THE HUISKLOOF RIVER

The retrospective assessment of impacts associated with unauthorised activities carried out on and adjacent to the Huiskloof River in 2010 take account of the condition and ecological importance and sensitivity of the ecosystem as well as the design of the structures, and construction and operational phase activities. Formal assessments of the significance of identified impacts are provided in Table 5.1 and include assessments with and without implementation of the recommended mitigation measures outlined in Section 6, where applicable.

5.1 Construction of the diversion weir in the Huiskloof River

Poorly designed or incorrectly placed weir structures in rivers can lead to a number of impacts to the downstream environment, particularly instability of the channel margins, gulley formation around the structure, heavy bank erosion and ultimately collapse of the structure (Day *et al.* 2016). Poorly designed weirs can also lead to bank and bed erosion in the downstream system if the stilling basin or apron downstream of the system does not adequately prevent high velocity turbulent flows from eroding the bed. In terms of the diversion weir of the Huiskloof River, it is located on a rocky outcrop with less risk of bank collapse compared with more erodible river banks. Also the spillway structure appears wide enough to ensure that spillway discharge capacity is not exceeded during large flood events such that floodwaters

do not outflank the weir structure. Thus the risk of gulley formation around the structure is limited. Also, the concrete apron at the base on structure is wide enough to prevent down-cutting and erosion of the channel bed downstream.

Nevertheless, the structure does lead to ponding and ***inundation of the upstream channel*** where sediments have settled out (Figure 5.1). Thus, inundation of the active channel has resulted in a change in habitat from fast flowing riffles and runs over stones to standing water over fine silt which has promoted the proliferation of instream vegetation (mostly *Juncus sp.*). Besides the loss of habitat associated with inundation, if not adequately cleared on a regular basis, such vegetation could result in the diversion of flood flows around the structure which could lead to structure failure and associated impacts. While the risk of structure failure associated with vegetation proliferation is easily prevented through routine channel clearance, the loss of instream habitat associated with inundation is a negative impact that is local in extent and of low intensity. Also, habitat loss is limited to the site of the weir but will persist in the long term. It is therefore considered a ***negative impact of low significance*** (Table 5.1).

Figure 5.1 Inundation upstream of the weir has resulted in habitat change with the proliferation of *Juncus sp.* that has been recently removed from the ponded habitat and placed on the riparian margin between the two channels that confluence at this point. In this picture, sampling material is situated on top of the recently removed *Juncus. sp.* plant material.

Associated with the unnatural proliferation of in-channel plant material and need for frequent clearing upstream of the weir is ***disturbance caused during these maintenance operations***. Currently it appears that material is removed from the standing water body but left within the riparian area. This negative impact is a long term impact of low intensity but could affect regionally important downstream habitat if flushed during flood flows and thus is considered an impact of ***Medium significance*** without mitigation. Nevertheless, this impact is easily mitigated (see Section 6) and residual impacts after mitigation would result in a ***negative impact of low significance.***

In-channel weirs lead to ***habitat fragmentation*** that prevents or limits the longitudinal movement of biota in river systems. In terms of the Huiskloof River, the bedrock outcrop on which the weir is located most likely formed a natural barrier to the movement of aquatic biota because the slope of the channel naturally changes and becomes less steep at this point with a naturally acute drop in gradient. Also, the weir is situated at a point where habitat characteristics naturally change from a transitional stream to a Channelled Valley Bottom wetland and thus upstream migration may not be fundamental to the survival of biota supported by the wetland habitat. However, the weir wall is approximately 1.7 m high which is likely higher than the natural drop. Thus the impact is rated at a regional scale because resources important at this scale would be affected. The impact would be of low intensity however, considering the natural change in gradient at this point. Thus fragmentation of the Huiskloof River associate with the weir structure is rated as a ***long term negative impact of medium significance*** that are difficult to mitigate (Table 5.1).

Abstraction of a significant volume of water, resulting in almost complete diversion of the low flows during the dry summer months from the Huiskloof River. While the downstream Channelled Valley Bottom Wetland remains intact in terms of the vegetation community and downstream macroinvertebrate community, in the long term these hydrological changes may result in shrinkage of the wetted area and invasion by alien shrubs that are currently dense within the catchment and are already encroaching into the system along the channel margins. Hydrological changes and invasion by aliens will result in the loss of indigenous vegetation and thus degradation and reduction in the extent of available aquatic habitat. Thus abstraction is considered a long term impact of medium intensity at a regional scale and is therefore rated as a ***negative impact of high significance*** without mitigation (Table 5.1). The implementation of effective mitigation through the provision of summer base flows as detailed in Section 6 would however result in an ***impact of low significance***.

The diversion weir was constructed at the end of the dry season when flows are naturally at a minimum. The immediate area surrounding the site of the weir was previously impacted by the dirt road that crosses the tributaries as they merge to form the Huiskloof River. Also, existing site specific impacts include a berm constructed along the left back of the channel to create a dam within the valley bottom that is invaded with alien beef wood trees (*Casuarina cunninghamiana*). Thus the left bank of the channel which was accessed for construction of the weir was affected by isolated impacts at the site prior to construction.

Nevertheless, it is likely that the Huiskloof River was affected by the following negative construction phase impacts associated with the construction of the diversion weir:

- Loss of riparian vegetation to accommodate access to the river at the site of the diversion weir.
- Disturbance of the channel banks and bed during construction.
- Increased turbidity and thus deterioration in water quality downstream of the construction site due to construction activities within the channel.

Considering the small footprint, low intensity of construction and relatively short duration of disturbance to the area and surrounds with no evidence of impacts six years following construction activities, this impact would likely have been short-term, of low intensity at a local scale. These impacts are therefore considered of ***very low significance*** (Table 5.1).

5.2 The pipeline from the diversion weir to Farm 3/781

The pipe passes through a section of the marginal fringe of the valley bottom wetland immediately downstream of the weir (Figure 4.1) and then follows the channel on its right bank, until reaches the R43. Then it crosses the channel within a concrete structure (Figure 3.4b), passing through the remnants of Valley Bottom wetland adjacent to the active channel downstream before heading away from the river altogether. Construction of the pipeline would have resulted in ***disturbance of wetland habitat*** during construction activities. These construction phase impacts were likely of low intensity and endured in the short to medium term resulting in impacts of ***low significance*** (Table 5.1)

The pipeline was placed at least 1.5 m below the surface which is below the depth of wetland functional habitat and thus there are unlikely to be any long term hydrological or geomorphological impacts associated with the pipeline through a the marginal wetland. Thus, ***the loss of wetland vegetation to accommodate the footprint of the pipeline*** was therefore a negative impact that persisted in the short term. Also, the pipe route through the wetland extends for approximately 300 m with a width of approximately 1 m and a disturbance footprint of approximately 2 m created by the excavator. Thus a total of 0.52% of the valley bottom wetland along the wetland margins is considered an impact of low intensity but at a regional scale considering the ecological importance of this system (Table 5.2). The impact is therefore a ***negative impact of low significance*** (Table 5.1).

The construction of the pipeline across the active channel of the valley bottom system immediately upstream of the culvert below the R43 resulted in an ***alteration of the channel banks and bed*** with a local change in channel hydraulics. The structure has little effect on upstream inundation and is low enough to minimise any effect on longitudinal connectivity. Thus the impact is considered a local impact of low intensity but will ensure in the long term. It is therefore rated as a ***negative impact of low significance*** (Table 5.1).

Every two years, sediments are flushed from the pipeline into the Huiskloof River channel immediately downstream of the culvert below the R43. This results in excessive inputs of sediment in the river system that smothers the natural habitat. ***Discharge of sediments into the river*** is likely to affect a considerable length of river downstream and the impact would be of medium intensity because natural functions would be altered. Thus, this impact is considered a negative impact of high significance without mitigation (Table 5.1). This impact is however readily mitigatable and with the implementation of measures described in Section 6, would result in a long term ***impact of low significance*** (Table 5.1).

Table 5.1 Summary of impacts to the Huiskloof River and wetlands associated with construction of the weir and pipeline. All impacts are negative unless indicated ("+ve"). Significance and confidence levels are indicated by VL (=very low), L (=low), M (=medium) or H (=high).

Description of impact	Extent	Duration	Intensity	Significance without mitigation	Significance with mitigation	Probability	Confidence
Weir structure within the Huiskloof River							
Channel inundation and loss of instream habitat	local	long term	low	L	N/A	Highly probable	M
Habitat disturbance	regional	long term	low	M	L	probable	M
Habitat fragmentation	regional	long term	low	M	M	probable	M
Abstraction of water from the Huiskloof River	regional	long term	medium	H	L	Highly probable	M
Construction related impacts including disturbance of the channel banks and bed, increased turbidity.	local	short term	low	VL	N/A	Highly probable	M
Pipeline for the transfer of diverted flow from the weir to 3/781							
Disturbance of wetland habitat	regional	short term	low	L	N/A	Highly probable	M
Loss of wetland vegetation	regional	Short term	low	L	N/A	Highly probable	M

Alteration of the channel bed and banks	local	Long term	low	L	N/A	Highly probable	M
Discharge of sediments into the Huiskloof River	regional	long term	medium	H	L	Highly probable	M

Table 5.2 Extent of aquatic habitat between the weir and the R43 indicating the area affected.

Wetland habitat	Property	Extent	Area impacted by pipeline	Percentage affected (%)
Channelled Valley bottom wetland	781/1 & RE/474	11.65 ha	0.06 ha	0.52 %
Seep habitat feeding into valley bottom	59/781	14.36 ha	0.00 ha	0.00 %

6 PROPOSED MITIGATION / RECTIFICATION MEASURES

While the infrastructural development within the Huiskloof River should have received authorisation prior to construction in accordance with the relevant legislation, it is evident that most of the associated negative impacts, relative to the local characteristics of the site prior to construction are of low significance (Table 5.1).

Nevertheless, there are negative impacts of medium and high significance that could be offset by the implementation of various rectification measures as follows:

1) Removal of instream vegetation within the ponded area immediately upstream of the weir

This should be undertaken at the end of the dry season each year before the onset of winter rains. This will reduce the risk of diversion of flood flows that could lead to structure failure. However, removal should be undertaken by hand, taking care to minimise disturbance of the remaining in-channel habitat and riparian fringe. Also, vegetation removed from standing water should be disposed of outside of the river and its riparian fringe to prevent flushing of material into the valley bottom wetland downstream.

2) Abstraction of baseflows during the dry summer months

Abstraction of baseflows from the river is an impact of high significance that should be mitigated through the alteration of the weir structure to ensure that the river receives flows prior to diversion. This will ensure that the downstream environment receives flows when it is most stressed while allowing excess runoff during the wetter winter period to be diverted the existing off-channel dam on Farm 3/781 where it can be stored and used during the dry season. Changes in the structure of the weir to ensure the default release of environmental flows will promote the surety of such releases, unlike manual manipulation of water diversion. This can easily be achieved by raising of the weir wall slightly where flow currently enters

the diversion pond along the left bank. Thus it is strongly recommended that such changes be made to the weir structure to maximise surety of environmental flow requirements of the wetland habitat downstream.

3) Discharge of sediments into the Huiskloof River

Also, inundation of the channel with sediments associated with periodic discharge from the pipeline is associated with impacts of high significance to the Huiskloof River. To offset these impact it is recommended that flushing of sediments take place immediately prior to the onset of winter rains each year such that the volume of accumulated sediments is minimised and those that have accumulated over a year are flushed and distributed through the system. This will minimise the intensity of the impact and prevent accumulation of sediments and associated loss of habitat and geomorphological changes to the system.

With the exception of habitat fragmentation, implementation of these recommended measures would minimise negative impacts with only impacts of low significance remaining (Figure 5.1). While habitat fragmentation remains a residual impact of medium significance, the structure is stable and removal would result in undesirable negative impacts with the risk of long term erosion of the channel banks. It is therefore recommended that the structure be retained with the implementation of mitigation measures, particularly with regards to the provision of environmental flows.

7 CONCLUSIONS AND RECOMMENDATIONS

This report has assessed the extent of impacts to freshwater ecosystems that have been associated with the unauthorised construction of a diversion weir and pipeline on the Huiskloof River. With the implementation of measures highlighted in this report, it is likely that the majority of impacts can be mitigated with residual impacts of low ecological significance. While habitat fragmentation is the only residual impact of medium significance, if is recommended that the weir be retained as removal could result in impacts of higher significance. It is strongly recommended that all measures identified to offset impacts be implemented accordingly. In particular, it is recommended that the weir structure be altered to ensure default provision of environmental flows to the downstream system during the dry summer months.

It is strongly recommended that the Breede Gourtiz Catchment Management Agency (BGCMA) verify abstraction in the Huiskloof River catchment as a whole. This process needs to take into account both the required ecological reserve for the river systems, and the rights of individual landowners and would need to address issues such as the rate and timing of abstraction throughout the year. Addressing flow issues within this catchment is imperative to the long term protection of an aquatic ecosystem rated as a Critical Biodiversity Area of high ecological importance.

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APPENDIX A: PROTOCOL FOR THE ASSESSMENT OF IMPACTS ON AQUATIC ENVIRONMENTS

The evaluation of impacts in this report is based on an evaluation of the nature of each impact and the significance assigned to each impact is based on an assessment of the extent, intensity and duration as described below:

Nature of the impact:

- Description of the **type of effect** the activity would have on the affected environment.

Extent:

- Reflects the importance of the environment on a **local** (site area), **regional** (south western Cape) or a **national** scale: impacts on threatened wetlands or streams, or those that provide ecosystem functions on a regional or national scale are considered to constitute a regional or national scale impact. Thus an impact on an important freshwater ecosystem potentially impacted by the development is considered to be of regional significance, due to the fact that its deterioration or destruction adds to the cumulative impacts that threaten these ecosystems at a regional scale.

Duration:

- **Short term** (0-5 years);
- **Medium term** (6-15 years);
- **Long term** (>15 years with the impact ceasing after full implementation of all development components with mitigations);
- **Permanent** (mitigation, either human or natural, will not occur in such a way or in such a time span that the impact can be considered transient).

Intensity:

- **Negligible** (the impact is so small that effects on the natural functioning of the environment are not detectable at all);
- **Low** (affects the environment such that natural functions or processes are not affected – or not degraded significantly more than their present state);
- **Medium** (affected environment is altered but natural functions or processes continue, albeit in a modified/ increasingly modified way);
- **High** (natural functions or processes are altered to the extent that they will temporarily or permanently cease).

Probability of occurrence:

- **Improbable** (low likelihood of the impact occurring);
- **Probable** (distinct possibility of the impact occurring);
- **Highly probable** (the impact will most likely occur).

Significance of impact:

1 **Very Low** (the impact should not have an influence on the decision provided that recommended measures to mitigate negative impacts are implemented). A very low significance would result from the following categories of impacts:

- EITHER of low intensity at a local level and endure in the medium term;
- OR of low intensity at a regional level and endure in the short term;
- OR of low to medium intensity at a local level and endure in the short term;

2 **Low** (where the impact should not have an influence on, or require to be significantly accommodated in the development design). A low significance would result from the following categories of impacts:

- EITHER of low intensity at a regional level and endure in the medium term;
- OR of low intensity at a national level in the short term;
- OR of high intensity at a local level and endure in the short term;
- OR of medium intensity at a regional level in the short term;
- OR of low intensity at a local level and endure in the long term;
- OR of medium intensity at a local level in the short term (excluding cumulative impacts);

3 **Medium** (where the impact could have an influence on the environment which will require modification of the development design or alternative mitigation). A medium significance would result from the following categories of impacts:

- EITHER of high intensity at a local level and endure in the medium term;
- OR medium intensity at a regional level in the medium term;
- OR of high intensity at a regional level in the short term;
- OR of medium intensity at a national level and endure in the short term;
- OR of medium intensity at a local level and endure in the long term;
- OR of low intensity at a national level in the medium term;
- OR of low intensity at a regional level in the long term

4 **High** (where the impact could have a no-go implication for the development or a component of the development, regardless of any possible mitigation). A high significance would result from the following categories of impact:

- EITHER of medium intensity at a regional level in the medium term;
- OR of high intensity at a national level in the short term;
- OR of medium intensity at a national level in the medium term;
- OR of low intensity at a national level in the long term;
- OR of high intensity at a local level in the long term;

- OR of medium intensity at a regional level in the long term

5 **Very High** would strongly influence the decision and further steps should be investigated to avoid the impact). A very high significance would result from the following categories of impact:

- EITHER of high intensity at a regional level and endure in the medium term;
- OR of high intensity at a national level in the medium term;
- OR of medium intensity at a national level in the long term