Freshwater Assessment for the Proposed Expansion and Construction of Ash and Rehabilitation Dams at Majuba Power Station, Mpumalanga Province

for

Advisian

February 2019

by

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Declaration of Specialist Independence

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;
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- I do not have any influence over decisions made by the governing authorities;
- I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;
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14 February 2019

EXCECUTIVE SUMMARY

Majuba Power Station needs to construct and extend the ash and rehabilitation dams for its ash disposal facility (ADF). These dams are used for the purposes of storm water management at the ADF area. The proposed construction of new dams and expansion of existing dams requires various permits, amongst which are an environmental authorisation and a water use licence.

The planned activities involve the modification of existing pollution control dams (AD1 and AD2), which are man-made dams designed specifically to capture seepage and runoff originating from the ADF. The size of AD1 will be reduced to accommodate a return water dam (RD1) immediately adjacent to it. The size of AD2 will be increased. The dams are not connected to a larger natural drainage network. Water from these dams is continuously recycled as part of the process requirements for the power station and is therefore not discharged into the receiving environment. In addition, a new return water dam (RD2) is to be constructed to the west of the ADF. This dam is planned to be constructed within the upper reaches of a non-perennial drainage line that flows away from the ADF in a westerly direction.

The area of interest falls entirely within quaternary catchment C11J in the Vaal Water Management Area. All watercourses draining the project area and its immediate vicinity ultimately flow into the Geelklipspruit River which flows in a north-westerly direction and joins the Vaal River. Surface water resources falling within the project area and potentially affected by the development include:

- Existing pollution control dams AD1, AD2 (both of which will be enlarged) and AD3 (which is not affected by the development);
- A non-perennial river originating from the vicinity of AD3 and RD2, draining westwards outside of the boundary of the property;
- A non-perennial tributary located to the north of the property that falls outside of the property, draining in a northerly direction; and
- An unchanneled valley bottom wetland located to the east of the ADF and AD1.

The Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the non-perennial drainage lines are considered to be Moderately Modified (C) and Low (D), respectively. The PES of the unchanneled valley bottom wetland is Moderately Modified, yet the EIS is considered to be High due to its important biodiversity and hydro-functional attributes. Buffer zones of 20 m and 50 m were therefore determined for the drainage lines and wetland, respectively.

Given that the AD1 and AD2 dams fall well outside of any nearby watercourses and their associated buffer, construction and operational impacts related to the expansion of these dams can be considered to be minor to negligible.

The most significant potential impact relates to the construction of RD2, which is planned to be constructed in the upper reaches of an existing non-perennial drainage line that falls within the ESKOM property boundary. This drainage line feeds into the non-perennial tributary that drains to the west of the ESKOM property boundary. Impacts to the broader drainage channel are also however considered to be low given the modified state and low EIS of the channel and the fact that the dam will be constructed in its upper most reaches.

While the EIS of the channelled valley bottom wetland is High, all construction activities fall well outside the conservative 50 m buffer for this wetland. Impacts to the wetland are therefore also considered to be negligible. Furthermore, expansion of the storage capacity of the dams is likely to reduce the risk of spillages or overflows occurring at each of the dams which is of long-term benefit to the surrounding environment and adjacent watercourses in particular.

It is therefore the view of this author that the expansion of AD1 and AD2 and the construction of RD2 pose minor to negligible impacts to water resources and that these activities should be authorised.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Majuba Power Station (Majuba) is a six (6) unit coal fired power plant that has an installed capacity of 4110MW of energy. The units are a mixture of three (3) dry cooled units each with installed capacity of 665MW and three (3) wet cooled units each producing 716MW.

Majuba Power Station needs to construct and extend the ash and rehabilitation dams for its ash disposal facility (ADF). These dams are used for the purposes of storm water management at the ADF area. The proposed construction of new dams and expansion of existing dams require various permits, amongst which are the environmental authorisation and the water use licence. The required environmental authorisation will assist in ensuring compliance to environmental legislation and protection to the environment. The overall objective of the larger project is therefore to:

1. Undertake an environmental impact assessment (EIA) process and produce an environmental impact assessment report (EIR) that will consider construction and operational impacts that will be submitted to the Competent Authority, with assessment of significant impacts, and refinement of alternatives to be put forward;
2. Provide adequate and relevant information to assist the authorities in their decision-making process; and
3. Develop an Environmental Management Programme (EMPr) for all the phases of the development (construction, operation, decommissioning) in close conjunction with Eskom project team.

1.2 SCOPE OF WORK

The impact of the development on freshwater resources (surface water and wetlands) has been identified as a specific specialist study that should be evaluated during the EIA process. The objectives of this report include the following:

- A desktop delineation of freshwater resources potentially affected by the development;
- A desktop assessment of relevant freshwater spatial biodiversity and conservation plans for the study area;
- Characterisation of the baseline state of aquatic and wetland ecosystems associated with the proposed development;
- Identify sensitive features, (e.g. habitats, species of conservation concern, unique features etc.) that may be negatively impacted upon by the proposed development;
- Assess the significance of potential impacts on aquatic and wetland ecosystems;
- Identify potential mitigation measures that can be implemented in order to reduce the significance of impacts;

- Reassess the significance of impacts after implementation of mitigation measures; and
- Comment on the ecological sustainability and viability of the prospecting right from the perspective of aquatic and wetland ecosystems.

1.3 KEY LEGISLATIVE REQUIREMENTS

1.3.1 National Environmental Management Act (NEMA, 1998)

The main aim of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) is to provide for co-operative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA regulations, the applicant is required to appoint an environmental assessment practitioner (EAP) to undertake the EIA, as well as conduct the public participation process.

The objective of the Regulations is to establish the procedures that must be followed in the consideration, investigation, assessment and reporting of the activities that have been identified. The purpose of these procedures is to provide the competent authority with adequate information to make decisions which ensure that activities which may impact negatively on the environment to an unacceptable degree are not authorized, and that activities which are authorized are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

In accordance with the provisions of Sections 24 (5) and Section 44 of the NEMA the Minister has published Regulations (GN R. 982) pertaining to the required process for conducting EIA's in order to apply for, and be considered for, the issuing of an Environmental Authorisation (EA). These Regulations provide a detailed description of the EIA process to be followed when applying for EA for any listed activity. The Regulations differentiate between a simpler Basic Assessment Process (required for activities listed in GN R. 983 and 985) and a more complete EIA process (activities listed in GN R. 984). In the case of this project there are activities triggered under GN R. 984 and as such a full EIA process is necessary.

A Scoping and EIA process is reserved for activities which have the potential to result in significant impacts which are complex to assess. Scoping and EIA accordingly provides a mechanism for the comprehensive assessment of activities that are likely to have more significant environmental impacts.

1.3.2 National Water Act (NWA, 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) aims to protect water resources, through:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and
- A reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): "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".

Wetlands are generally characterised by one or more of the following attributes (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

2 DESKTOP REVIEW

A variety of sources were consulted in order to gain a broad overview of the freshwater resources present in the study area as well as the associated PES of these resources. The approach to the desktop review included, *inter alia*, the following:

- A review of all layout or planning information relevant to the development (including the construction and operational phases);
- Consultation with the relevant authorities, as required, to determine the full scope of freshwater specialist work required by relevant permit/authorisation/licensing processes;
- Desktop identification of any watercourses that may be affected by the proposed development;
- Assessment of all watercourses from the perspective of provincial and regional systematic biodiversity plans;
- Examination of existing maps of the area including historical images;

- Review of existing databases for land use, climatic, water resource and aquatic ecosystem health data; and
- Compilation of sensitivity maps to inform concept footprints and layouts depicting affected and potentially affected watercourses.

2.1 AQUATIC ECOSYSTEMS

The area of interest falls entirely within quaternary catchment C11J in the Vaal Water Management Area. All watercourses draining the project area and its immediate vicinity ultimately flow into the Geelklipspruit River which flows in a north-westerly direction and joins the Vaal River (Figure 1). Surface water resources falling within the project area and potentially affected by the development are indicated in Figure 2 and include:

- Existing pollution control dams AD1, AD2 (both of which will be enlarged) and AD3 (which is not affected by the development);
- A non-perennial river originating from the vicinity of AD3, draining westwards outside of the boundary of the property;
- A non-perennial tributary located to the north of the property that falls outside of the property, draining in a northerly direction; and
- A series of wetland seeps located to the east of the ADF and AD1.

The existing pollution control dams (AD1-3) were all identified as wetlands by various desktop conservation planning resources (e.g. NFEPA). Based on the field visit these wetlands have all however been confirmed as man-made pollution control dams that receive stormwater from the ash dump (Figure 3). Reference to these dams as wetlands has therefore been corrected in subsequent maps.

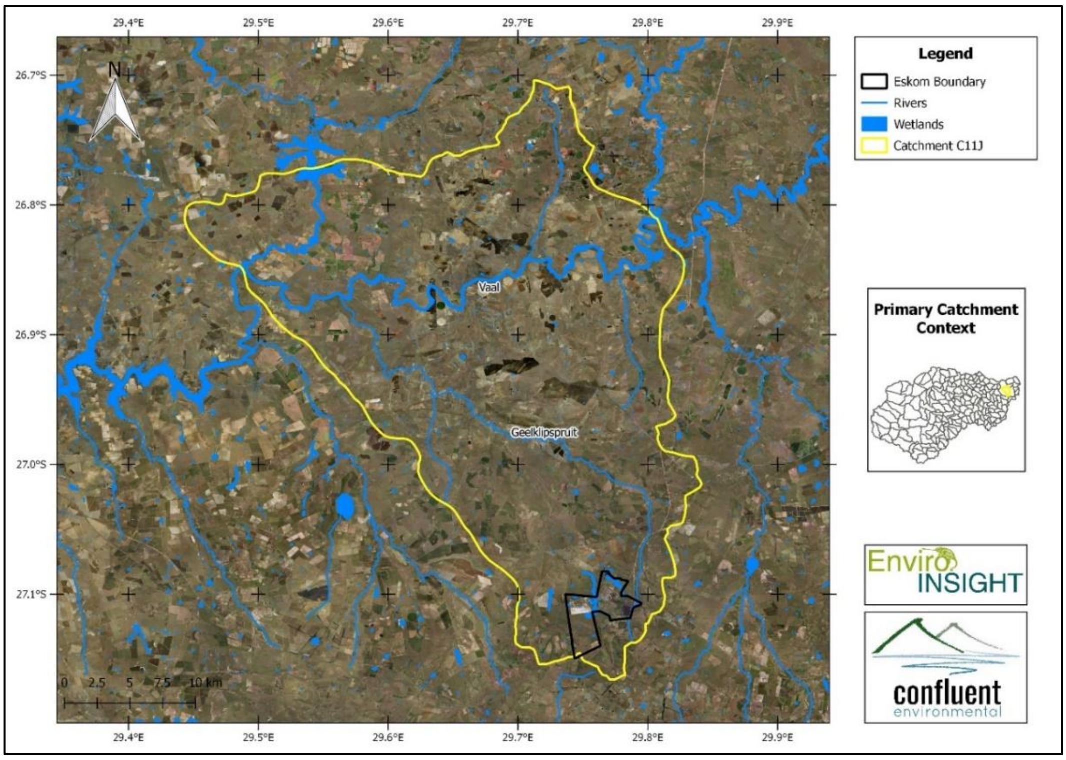

Figure 1: Location of Majuba power station property boundary within quaternary catchment C11J.

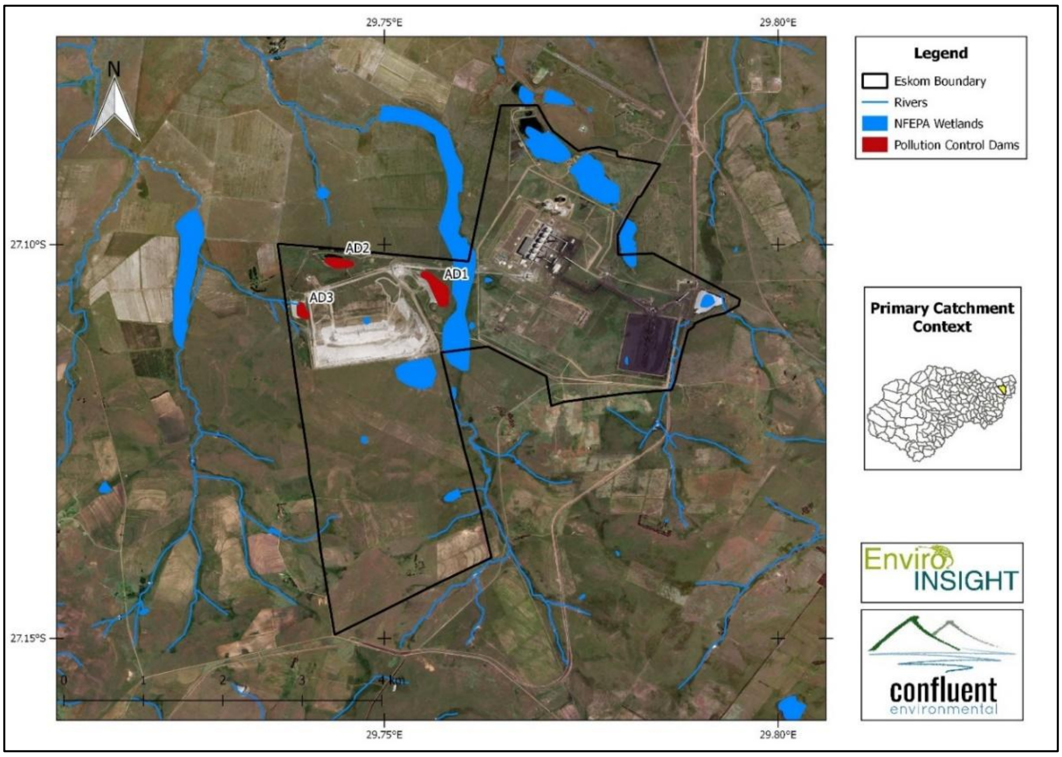

Figure 2: Freshwater resources potentially affected by the development

Figure 3: Photographs illustrating stormwater canals entering AD1 and AD2 (left and middle, respectively) and the dam wall at AD3 (right).

2.1.1 Desktop Present Ecological State

The Mpumalanga Highveld Wetland map (SANBI, 2012) provides geospatial information of the extent, distribution, condition and type of freshwater ecosystems in the Mpumalanga Highveld coal belt, in order to support informed and consistent decision-making by regulators in relation to the water-biodiversity-energy nexus. The majority of wetlands throughout the broader catchment area have been categorised as being in a near natural state (PES of A/B) (Figure 4). It must be stressed however that these assessments were performed at a low level of confidence and field verification of the PES was therefore conducted as part of this assessment. The non-perennial watercourse draining to the west of the ADF (originating from the vicinity of AD3) is classified as a seep wetland, also with a PES of A/B.

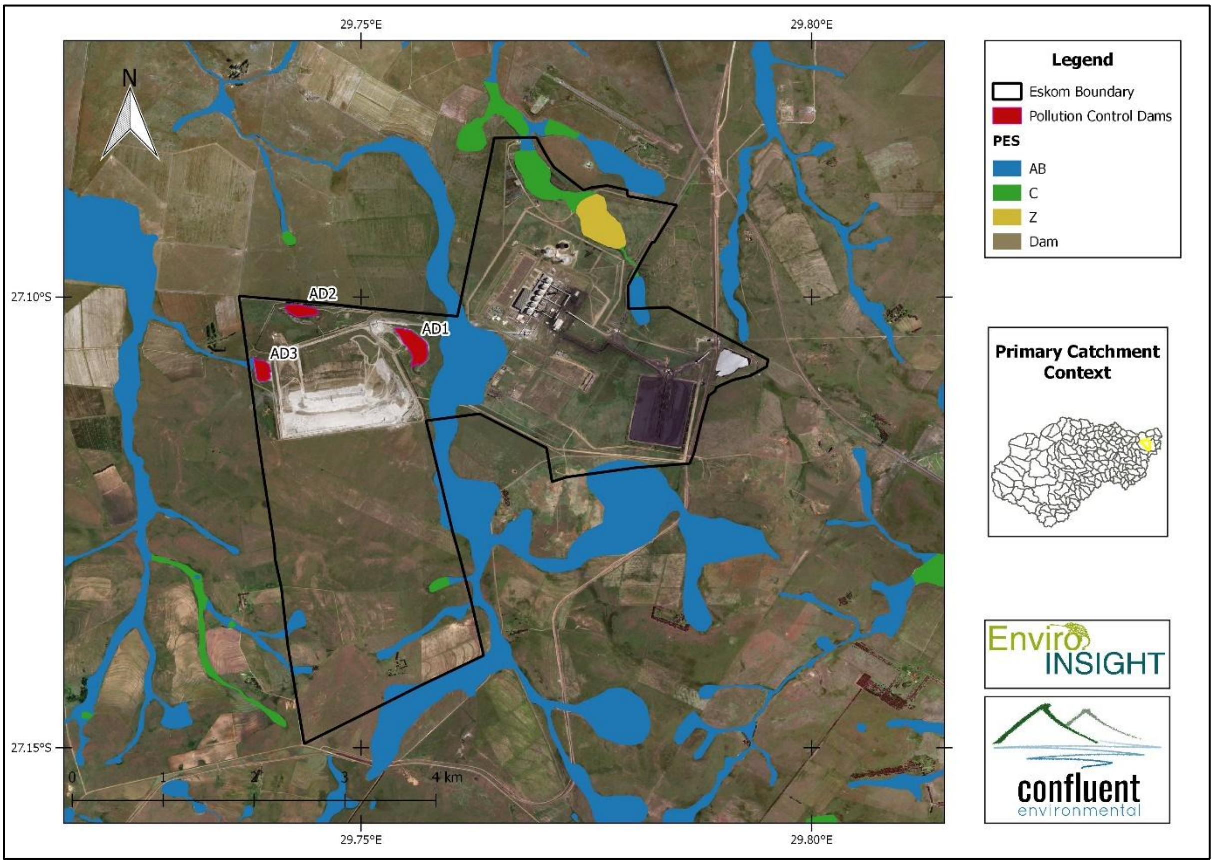

Figure 4: Desktop Present Ecological State (PES) of wetlands within and adjacent to the property boundary of the Majuba power station.

Potentially affected rivers are non-perennial in nature and have not been assessed at a desktop level for PES and EIS. The PES of the Geelklipspruit has however been assessed at a C (Moderately Modified). Modifications are largely due to moderate alterations in in-stream and riparian habitat and large modifications in water quality (DWS, 2014). The ecological importance of the Geelklipspruit is regarded as high mainly due to the high concentration of wetland and riparian habitats associated with the sub-quaternary river reach (DWS, 2014).

2.2 CONSERVATION AND BIODIVERSITY PLANS

2.2.1 NFEPA

The National Freshwater Ecosystem Priority Areas (NFEPA) database (Nel et al., 2011) forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel et al., 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEM:BA) (Act 10 of 2004) biodiversity goals, informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel et al., 2011).

The study area forms part of the Geelklipspruit sub-quaternary catchment which has been classified as a river FEPA (Figure 5). River FEPAs have been prioritised for conserving freshwater ecosystems and associated biodiversity and should therefore be managed and maintained in a good ecological condition to protect water resources for human users. The recommended condition for all river FEPAs is an A or B ecological category (Nel et al., 2011). It is therefore important that the PES of non-perennial rivers draining the vicinity of the project area is managed to achieve this management goal. None of the wetlands potentially affected by the development have been classified as wetland FEPAs.

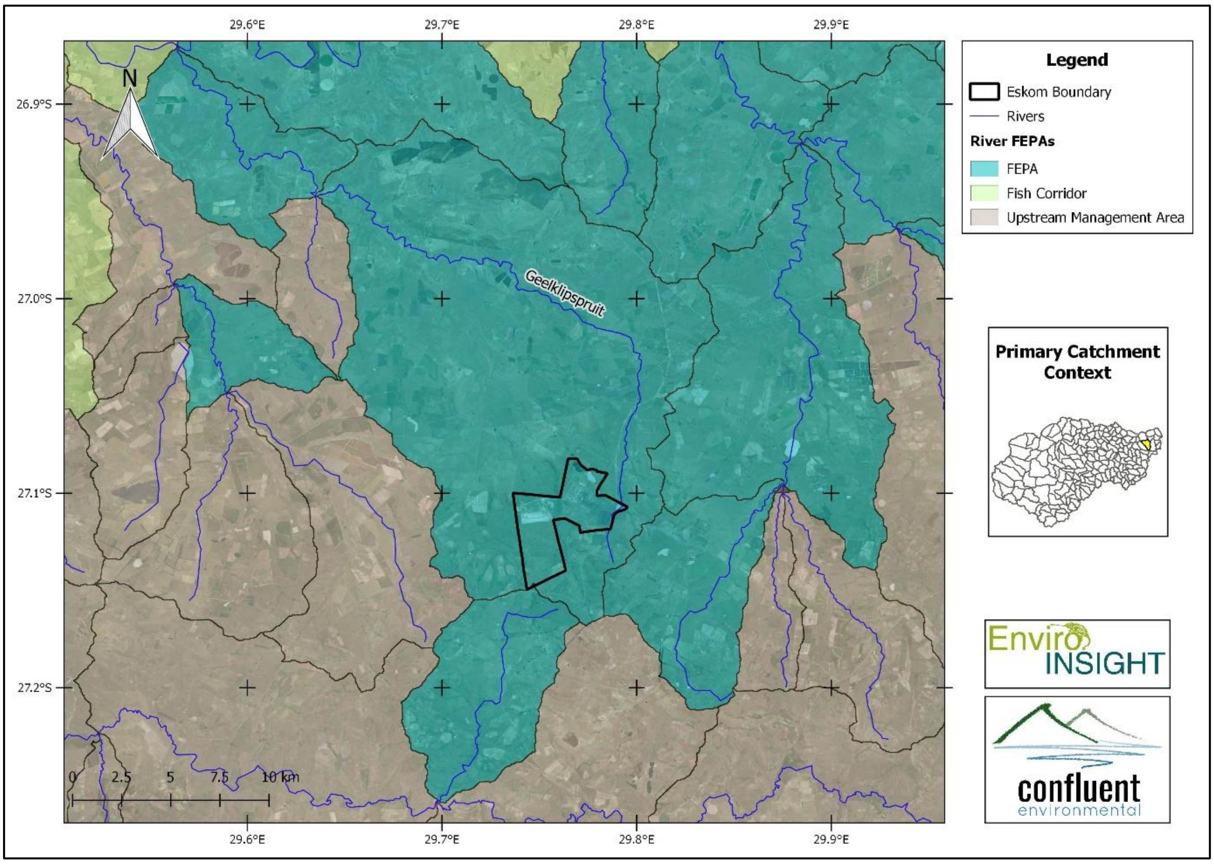

Figure 5: Freshwater Ecosystem Priority Area map for the study area.

2.2.2 Mpumalanga Freshwater Assessment

The Mpumalanga Biodiversity Sector Plan (MBSP) freshwater assessment (MTPA, CSIR and SANBI, 2011) serves as an important land-use decision support tool, and the foundation for the development of any Bioregional

Plans within Mpumalanga. These maps have been developed using, primarily, NFEPA products and are, therefore, closely related. Classification of the Biodiversity Classification categories in the study area is as follows:

- Critical Biodiversity Area (CBA): Together with protected areas, ensures that a viable representative sample of all ecosystem types and species can persist. The management objective for these areas is for them to remain in a largely natural condition.
- Ecological Support Area (ESA): Ensures the long-term ecological functioning of the landscape as a whole. Must retain ecological processes, which often requires at least semi-natural ecological condition.
- Other Natural Areas (ONA): Allows for range of other land uses, including intensive land uses. Determined by other spatial planning tools

Much of the land surface area within and adjacent to the project area is heavily modified, either through power generation (and associated activities) or through the transformation of land for dryland agriculture (Figure 6). Natural areas surrounding these land use activities are regarded as ESAs. From a freshwater perspective, only the large seep wetland to the east of the ADF has been categorized as an ESA wetland. The non-perennial drainage lines located to the north and west of the ADF fall within ESAs. It is therefore important that the ecological function of all wetland and river habitats in these ESAs are either not negatively compromised by the development or impact is minimized as much as possible.

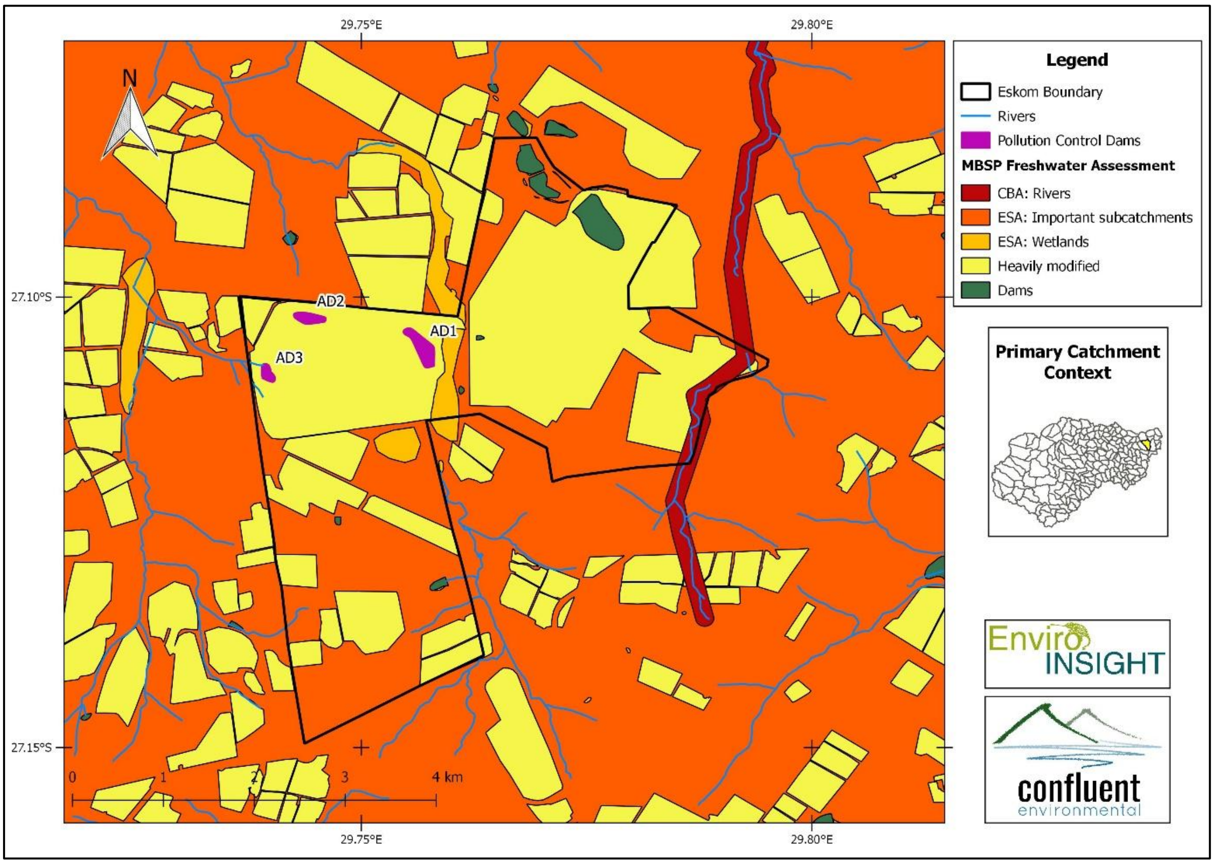

Figure 6: Mpumalanga Biodiversity Sector Plan for the study area.

3 DEVELOPMENT PLANS

An EIA process was undertaken for the continuous ADF, with associated pollution control dams (PCDs). There was, however, a change of scope during the detailed designs, which requires two new Rehabilitation Dams (RD) and extension of the two existing ash dams (AD), as per specifications shown in Table 1 below. The development will essentially expand the existing footprint of AD1 but create two new dams within this expanded footprint. This will result in a decrease in size of AD1 and the creation of the new rehabilitation dam (RD1). The footprint of AD2 will be increased while RD2 is a new dam. Figure 7 shows the proposed location of these ash and rehabilitation dams.

Table 1: Specifications for the expansion of existing dams (AD1 and AD2) and construction of new dams (RD1 and RD2)

PCD description	PCD current status	Current Dam wall height	New/increased dam height (Max height)*	Surface footprint change	Final footprint size	Final Volume/Storage Capacity
Ash Dam 1* (AD1)	Existing	Compartment wall = not existing	Compartment wall =7.6 m* (new)	Existing = -/+110 000m² Decrease by = **69 500 m²**	40 500m²	150 000m³
Rehabilitation Dam 1*(RD1)	New	Dam wall = 5m	Dam wall = 2m (increase)	New size = **80 000 m²**	80 000m²	240 000 m³
Ash Dam 2 (AD2)	Existing	3.1 m	1.7 m *	Existing = 95 000 m² Increase by = **65 000 m²**	160 000m²	390 000 m³
Rehabilitation Dam 2 (RD2)	New	N/A	4.85 m *	New reduced size = **19 300 m²**	19 300 m²	65 000m³

Figure 7: Map illustrating the footprint of a new rehabilitation dam (RD1) and expansions to existing dams (AD1, AD2 and RD2).

4 METHODS

The approach to this assessment comprised of a combined desktop and field-based assessment of potentially affected watercourses. A site visit was conducted on the 7th of November 2018, with the objective of verifying, identifying and classifying aquatic resources and determining the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of potentially affected water resources. Assessments of the PES were habitat based as a lack of flowing water made biotic based assessment (e.g. SASS5) unsuitable.

Based on this field assessment the impacts associated with the proposed development on aquatic ecosystem health (rivers and wetlands) were assessed. This was done according to the impact assessment methodology outlined in the Appendix to this report.

4.1 ASSESSMENT OF RIVER HABITATS

4.1.1 Present Ecological State

An important factor that influences the diversity and abundance of aquatic communities is the condition of the surrounding physico-chemical habitat. Habitat loss, alteration, or degradation generally results in a decline in species diversity. The PES of watercourses will be assessed using the Index of Habitat Integrity (IHI; Kleynhans, 1996). The IHI is regarded as the most appropriate method for assessing riverine habitats as it is not dependent on flow in the watercourse and therefore produces results that are directly comparable across perennial and non-perennial systems. The IHI was developed as a rapid assessment of the severity of impacts on criteria affecting habitat integrity within a river reach. Instream (water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; rubbish dumping) and riparian (vegetation removal, invasive vegetation, bank erosion, channel modification, water abstraction, inundation, flow modification, physico-chemistry) criteria are assessed as part of the index. Each of the criteria are given a score (from 0 to 25, corresponding to no and very high impact, respectively – Table 2) based on their degree of modification, along with a confidence rating based on the level of confidence in the score.

Weighting scores are used to assess the extent of modification for each criterion (x):

$$Weighted\ Score = \frac{IHI_x}{25} \times Weight_x$$

Where;

IHI = rating score for the criteria (Table 2); *25* = maximum possible score for a criterion; and *Weight* = Weighting score for the criteria (Table 3). The estimated impacts of all criteria calculated this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components, respectively. An IHI class indicating the present ecological state of the river reach is then determined based on the resulting score (ranging from Natural to Critically Modified – Table 4).

Table 2: Descriptive classes for the assessment of habitat modifications (Kleynhans, 1996)

Impact Class	Description	Score
None	No discernible impact, or the modification is located in a way that has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not affected.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

Table 3: Criteria and weights used for the assessment of instream and riparian zone habitat integrity

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
TOTAL	**100**		**100**

Table 4: Index of habitat integrity (IHI) categories and descriptions

Integrity Class	Description	IHI Score (%)
A	Unmodified, natural.	> 90
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 – 90
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 – 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 – 19

4.1.2 Ecological Importance and Sensitivity

The ecological importance of a river is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Resh et al. 1988; Milner 1994). The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term.

The ecological importance and sensitivity (EIS) of river habitats was assessed by a method developed by Kleynhans (1999). In summary, several biological and aquatic habitat determinants are assigned a score ranging from 1 (low importance or sensitivity) to 4 (high importance or sensitivity). These determinants include the following:

- **Biodiversity support:**
  - Presence of Red Data species;
  - Presence of unique instream and riparian biota;
  - Use of the ecosystem for migration, breeding or feeding.
- **Importance in the larger landscape:**
  - Protection status of the watercourse;
  - Protection status of the vegetation type;
  - Regional context regarding ecological integrity;
  - Size and rarity of the watercourse types present;
  - Diversity of habitat types within the watercourse.
- **Sensitivity of the watercourse:**
  - Sensitivity of watercourse to changes in flooding regime;
  - Sensitivity of watercourse to changes in low flow regime, and
  - Sensitivity to water quality changes.

The median value of the scores for all determinants is used to assign an EIS category according to Table 5.

Table 5: Ecological importance and sensitivity categories. Interpretation of median scores for biotic and habitat determinants.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1	D

4.2 ASSESSMENT OF WETLAND HABITATS

4.2.1 Desktop Analysis

The wetland assessment involves a preliminary desktop analysis to identify the possible location of wetlands and important land use activities that may be potentially impacting the wetlands (as presented in this scoping report). The desktop analysis will be undertaken using recent aerial photography for the area (Chief Directorate: National Geo-spatial Information) and were supplemented by the most recent and historical Google Earth imagery. In addition, historical orthophotos were interrogated to assess changes to identified wetlands over time.

4.2.2 Site Visit

The site visit verified locations of wetlands identified by the desktop analysis. Wetlands occurring within the project area were categorised into discrete hydrogeomorphic units (HGMs) based on their geomorphic characteristics, source of water and pattern of water flow through the wetland unit. HGMs were classified according to Ollis et al. (2013). The outer edge of wetlands potentially affected by the development was delineated and mapped using a handheld GPS according to the following four indicators (DWAF, 2008):

- The presence of wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation such as grey horizons, mottling streaks, hard pans, organic matter depositions, iron and manganese concretion resulting from prolonged saturation (soil indicator);
- The presence of water loving plants (hydrophytes) (vegetation indicator);

- A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil; and
- Topographical location of the wetland in relation to the surrounding landscape (terrain indicator).

4.2.3 Present Ecological State

Desktop and field data (e.g. description of current onsite impacts) were used to populate the Level 1 WET-Health tool (Macfarlane et al., 2008) which was used to derive the PES of the wetland HGM units. The magnitude of observed impacts on the hydrological, geomorphological and vegetation components of the wetland was calculated and combined as per the tool to provide a measure of the overall condition of the wetland on a scale from 1-10. Resultant scores were then used to assign the wetland into one of six PES categories as shown in Table 6 below.

Table 6: Wetland Present Ecological State categories and impact descriptions.

Ecological Category	Description	Impact Score
A	Unmodified, natural.	0 – 0.9
B	Largely natural with few modifications / in good health. A small change in natural habitats and biota may have taken place but the ecosystem functions are still predominantly unchanged.	1 – 1.9
C	Moderately modified / fair condition. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	2 – 3.9
D	Largely modified / poor condition. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	4 – 5.9
E	Seriously modified / very poor condition. The loss of natural habitat, biota and basic ecosystem functions is extensive.	6 – 7.9
F	Critically modified / totally transformed. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota.	8 - 10

4.2.4 Ecological Importance and Sensitivity

According to Rountree and Kotze (2013) the EIS for wetlands should be based on a combination of three suites of importance criteria, namely:

1. Ecological Importance and Sensitivity (EIS), incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWS (Kleynhans, 1999) and thus enabling consistent assessment approaches across water resource types;
2. Hydro-functional importance, which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide (Kotze et al., 2008); and
3. Importance in terms of basic human benefits – this suite of criteria considers the subsistence uses and cultural benefits of the wetland system (Kotze et al., 2008).

In summary, several determinants representative of each of the three importance criteria (Table 7) are assigned a score ranging from 0 (low importance or sensitivity) to 4 (high importance or sensitivity). The average score for each of the three criteria is calculated, with the highest average score being used to determine the overall EIS category of the wetland system according to Table 5.

Table 7: Determinants for three different importance criteria that are scored (from 0 to 4) in order to determine the overall EIS category for a wetland system.

Ecological Importance & Sensitivity	Hydro-Functional Importance	Direct Human Benefits
Presence of Red Data Species	Flood attenuation	Water for human use
Populations of Unique Species	Streamflow regulation	Harvestable resources
Migration Sites	Sediment trapping	Cultivated foods
Protections Status of Wetland	Phosphate assimilation	Cultural heritage
Protection Status of Vegetation Type	Nitrate assimilation	Tourism and recreation
Regional Context of Ecological Integrity	Toxicant assimilation	Education and research
Size and Rarity of Wetland Type Present	Erosion control	
Diversity of Habitat Types	Carbon storage	
Sensitivity to Changes in Floods		
Sensitivity to Changes in Low Flows		
Sensitivity to Changes in Water Quality		

4.3 BUFFER ZONE DETERMINATION

Buffer zones have been defined as a strip of land with a use, function or zoning specifically designed to act as barriers between human activities and sensitive water resources with the aim of protecting these water resources from adverse negative impacts. Appropriate buffers were estimated based on buffer zone guidelines developed by Macfarlane and Bredin (2017). These guidelines estimate required buffer zone widths based on a combination of input parameters which include, *inter alia*, the nature of the activity and associated impacts, basic climatic and soil conditions, the PES and EIS of potentially affected watercourses and the implementation of appropriate mitigation measures. For the purposes of sensitivity mapping, the implementation of appropriate mitigation measures has been considered in the determination of buffer zone widths.

5 ASSUMPTIONS & LIMITATIONS

- The PES and EIS assessments undertaken are largely qualitative and results are open to professional opinion and interpretation. An effort has been made to substantiate scoring of important criteria where applicable.
- Given the lack of flowing water in the non-perennial drainage lines, even though it was in the wet season (November), the PES was determined by an assessment of in-stream and riparian habitat integrity only.

- This assessment was based on conditions that were present at the time of the site visit. While PES and EIS assessments have taken seasonality into account it is possible that seasonal hydrological changes may influence the outcome of results presented here.

6 AQUATIC BASELINE

6.1 NON-PERENNIAL DRAINAGE LINES

6.1.1 Present Ecological State

The PES of both potentially affected drainage lines is Moderately Modified (PES: C), and while loss of natural habitat and biota has occurred, their basic ecosystem function remains unchanged (Table 8 and

Table 9). Specific impacts relevant to each watercourse are described in the sections below.

Table 8: Instream IHI scores for the Northern and Western drainage lines

Modification	Northern Drainage	Western Drainage
Water abstraction	**11** – Abstraction from farm dams	**5** – Minor abstraction due to watering of cattle
Flow modification	**15** – Farm dams located within the stream affect flow and flood volumes.	**8** – Evidence of increased flows due to stormwater originating from ADF
Bed modification	**5** – Minor sediment inputs	**10** – Sediment inputs lead to muddy substrate
Channel modification	**9** – Incised channel due to bank erosion	**6**– Some channel incision
Physico-chemistry	**10** –High salinity	**15** – High salinity and nutrient inputs (from cattle grazing)
Inundation	**9 –** Inundation of stretches of aquatic habitat due to the presence of farm dams.	**0 –** None
Alien macrophytes	**0 –** None	**0** – None
Alien aquatic fauna	**0 –** None	**0** – None
Rubbish dumping	**0 –** None	**0 –** None
IHI score[1]	**64 (C)**	**67 (C)**

Table 9: Riparian IHI scores for the Northern and Western drainage lines

Modification	Northern Drainage	Western Drainage
Vegetation removal	**18** – Riparian buffer largely absent	**18** – Riparian buffer largely absent
Invasive vegetation	**5** – Low levels of invasive vegetation	**5** – Low levels of invasive vegetation
Bank erosion	**10** - Some signs of bank erosion, due to lack of riparian vegetation	**8** – Some bank erosion due to lack of riparian vegetation
Channel modification	**14 –** Incised channel largely cuts the river off from the adjacent riparian zone.	**10** – Reduction of flows by farm dams has altered the channel morphology
Water abstraction	**0** – None	**0** – None
Inundation	**0** – None	**0** – None
Flow modification	**5** –Minimal impacts due to flow modification	**5** – Minimal impacts due to flow modification
Physico-chemistry	**6** – Signs of livestock affecting water quality riparian zone	**6** – Signs of livestock affecting water quality riparian zone
IHI Score[1]	**61 (C)**	**63 (C)**

6.1.1.1 Drainage to North of AD2

This is a poorly defined channel that drains into a man-made dam and eventually into the Geelklipspruit (Figure 8). The dam captures most of the surface runoff derived from the drainage line and therefore modifies natural flow in the channel. The drainage line is located within a grazing area which is dominated by grassland pasture. The channel is ephemeral and will only likely flow during heavy rainfall events. The channel does show signs of gully erosion presumably due to the combination of periodic high flows and over-grazing (Figure 8). The channel offers limited habitat for aquatic biota and other wildlife as it is not associated with any high quality in-stream or riparian habitat. There was evidence of high salt concentrations in the dam as indicated by a thin salt crust on exposed sediments. This can partly be explained by the concentration of water in the shallow dam and high evaporation rates. However, given the connectivity between AD2 and the drainage line via the spillway, seepage or spillage of high salt content water contained in the dam cannot be ruled out. Wind driven contamination of the dam by ash from the dumps is also very likely an important contribution of high total dissolved solids in the dam.

Figure 8: Drainage to north of Majuba property (left) and dam into which the drainage flows (right).

6.1.1.2 Drainage to West of RD2

This drainage line feeds into the non-perennial tributary that drains to the west of the ESKOM property boundary. The site visit confirmed the presence of aquatic habitat within the uppermost reach of the indicated drainage line, part of which falls within the footprint of the proposed RD2. This habitat has been formed due to excavation of the channel, forming a narrow, deep pit that was filled with water at the time of the visit. The margins of the pit are dominated by *Typha capensis* (Figure 9). This excavated section is isolated and there is no distinctive channel that connects this artificial wetland habitat to the larger hydrological network draining to the west of the ADF.

The lower section of the drainage line outside of the ESKOM property contained water at the time of the visit, which was largely confined to a series of shallow, stagnant pools. The presence of coarse cabbage weed (*Lagarasiphon major*) suggests the permanent presence of water in this section. No standing water was present further downstream. *In-situ* water quality measurement revealed very high conductivity readings (Table 10), the source of which is likely to be a combination of possible seepage from the pollution control dam located just north of the proposed location of RD2, as well as wind-driven contamination by ash from the dumps. The drainage provides marginal to moderate habitat for aquatic biota and consists primarily of stagnant pools dominated by aquatic vegetation and some patches of boulder substrate. The substrate was however dominated by a muddy bottom. The stream is heavily utilized by cattle as was evident by the extensive trampling of the stream bed, banks and riparian zone. There was minor channel incision in parts of the channel indicating periodic inputs of high flows that presumably originate from stormwater runoff from hardened surfaces within the ash disposal facility. Given these impacts the PES of the drainage line is regarded as moderately modified, with some loss and change of natural habitat and biota having occurred, but with basic ecosystem functions still predominantly unchanged.

Table 10: In-situ water quality measurements taken from drainage to west of AD2

Parameter	Measurement
pH	7.53
Dissolved Oxygen	6.45 mg/L
Electrical Conductivity	3543 µS/cm
Temperature	16.02 °C

Figure 9: Photographs of instream habitat (A), cabbage weed (*Lagarasiphon major*) (B), and excavated pits (C and D) in the watercourse draining to the west of the Majuba ADF.

6.1.2 Ecological Importance & Sensitivity

The EIS of both drainage lines can be regarded as low, as, due to their ephemeral nature and limited habitat availability, they offer very little in terms of biodiversity support. The ephemeral nature of the drainage lines also translates into a relatively low sensitivity towards modifications in flow and water quality. The location of the drainage lines (at their uppermost portion of their respective sub-quaternary catchments) provides very limited function in terms of migration routes and connectivity of water resources at a catchment scale (Table 11).

Table 11: Ecological Importance and Sensitivity of drainage lines potentially afected by the development

EIS Criteria	Score
Presence of Rare & Endangered Species	**1** – The drainage is unlikely to offer habitat for rare or endangered habitat
Populations of Unique Species	**1** - Low probability of unique taxa being present on a local scale
Species/Taxon Richness	**1** - Low diversity of terrestrial and aquatic fauna is expected on a local scale.
Diversity of Habitat Types or Features	**1** - Low diversity of vegetation and geomorphological structure and low patchiness/interspersion (uniformity).
Migration Route or Breeding and Feeding Site for Wetland Species	**0** - The drainage is a marginally/low important link in terms of connectivity for the survival of biota upstream and downstream and has a marginal sensitivity to modification
Sensitivity to flow	**2** - The drainage is ephemeral and of a small size and is therefore moderately sensitive to modifications in increased flow.
Sensitivity to Water Quality	**1** - The drainage is ephemeral and is therefore insensitive to modifications in water quality.
Protection Status	**1** - The drainage falls within an Ecological Support Area and is considered important for meeting biodiversity targets for ecosystems, species and ecological processes at a provincial level.
EIS Score	**1 (Low EIS)**

6.2 WETLANDS

6.2.1 Present Ecological State

6.2.1 Wetland to East of AD1

A large unchanneled valley bottom wetland occurs to the west of AD1 (Figure 4). The wetland receives concentrated channelised flow during the high flow season and water exits via a distinct channel further downstream. This wetland has been impacted by the existing power station infrastructure, which includes two road crossings and seepage and overflows from the adjacent AD1 dam. Cattle grazing occurs within the portion of wetland that falls outside of the ESKOM boundary. The PES of the wetland is therefore C (Moderately Modified) (Table 12).

Table 12: WET-Health scores for the unchanneled valley bottom wetland

Hydrology	Geomorphology	Vegetation	Overall
80 % (B/C)	96 % (A)	52 % (D)	77 % (C)

6.2.2 Ecological Importance and Sensitivity

Given its relatively large size and hydrogeomorphological characteristics, the unchanneled valley bottom wetland is of High Importance and Sensitivity, both with respect to ecological attributes and hydro-functional importance (Table 13). The wetland is likely to provide suitable breeding and foraging habitat for a wide variety of wetland dependent species. From a landscape perspective, the large size of the wetland in combination with the relative scarcity of these wetland types is also an important feature. These wetland types dissipate and slow concentrated upstream flow inputs and therefore provide very important provisioning and regulating services, particularly with respect to regulating streamflow, attenuating floods and enhancing water quality. The position of this wetland downstream of numerous ESKOM activities is therefore very important in terms of broader catchment ecosystem services.

Table 13: Ecological Importance and Sensitivity importance criteria.

Ecological Importance & Sensitivity	Score
Biodiversity Support	
Presence of Red Data Species	**3** – One or more endangered or red data species expected
Populations of Unique Species	**3** – Large size will favour populations of unique wetland species
Migration, Breeding or Feeding Sites	**3** – Offers year-round potential for breeding and feeding for wetland species
Average	**3**
Landscape Scale	
Protection Status	**1** – Not protected; Ecological Support Area
Protection Status of Vegetation Type	**1** - Mesic Highveld Grassland – Group 8 (Not Protected)
Regional Context of the Ecological Integrity	**2** – Moderately modified from natural
Size and rarity of wetland types present	**3 –** Large wetland relatively rare within a regional context.
Diversity of Habitat Types	**2** – Moderate diversity of vegetation and geomorphological structure.
Average	**1.8**
Sensitivity of Wetland	
Sensitivity to Changes in Low Flows	**3** - The wetland receives regular inflows and is sensitive to modifications in low flow conditions.
Sensitivity to Changes in Water Quality	**2** – Moderately sensitive to changes in water quality.
Sensitivity to Changes in Floods	**2** – Sensitive to changes in floods
Average	**2**
Score	**3 (High)**
Hydro-functional Importance	
Flood attenuation	3
Streamflow regulation	4
Water quality enhancement – Sediment trapping	4
Water quality enhancement – Phosphate assimilation	4
Water quality enhancement – Nitrate assimilation	4
Water quality enhancement – Toxicant assimilation	4
Water quality enhancement – Erosion control	4
Carbon storage	3
Score	**3.75 (High)**
Direct human benefits	
Subsistence benefits – Water for human use	**2** – Limited potential for utilisation of water resource
Subsistence benefits – Harvestable resources/cultivated foods	**1** – Limited harvestable resources
Cultural benefits – Cultural heritage	**1**
Cultural benefits – Tourism and recreation	**3** – Good birding location

Education & Research	**2** – The presence of the wetland within ESKOM property does present some education and research opportunities
Score	**1.8 (Low)**
Overall EIS Score	**3.75 (High)**

7 SENSITIVITY MAP

Given the nature of the activity and the PES and EIS of potentially affected watercourses a buffer zone of 20 m is recommended for the ephemeral drainage lines, while a larger 50 m buffer is recommended for the unchanneled valley bottom wetland (Figure 10). According to the sensitivity map, the majority of development activities will take place well outside the recommended buffer area for each of the potentially affected watercourses. The exception is the upper section of the watercourse draining to the west of Majuba, over which RD2 will be constructed.

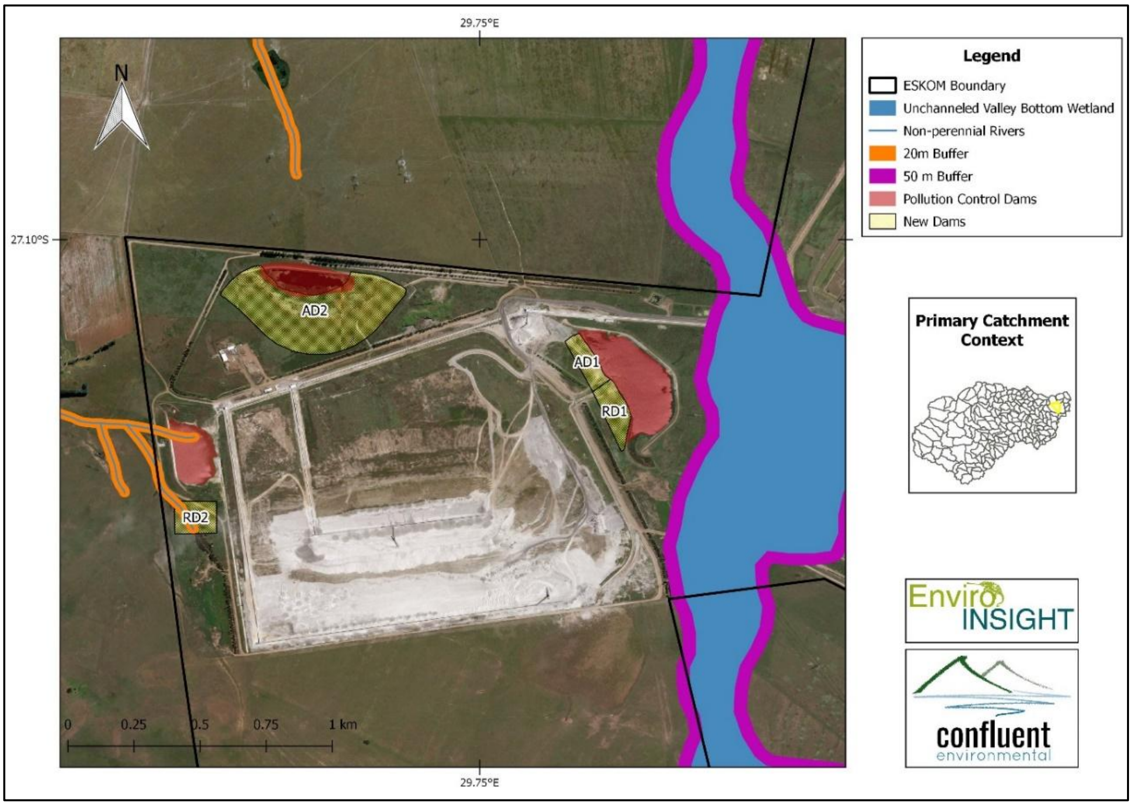

Figure 10: Sensitivity map for freshwater watercourses adjacent to the Majuba ash dump facility

8 IMPACT ASSESSMENT

8.1 POTENTIAL IMPACTS

The planned activities involve the extension of existing pollution control dams (AD1 and AD2), which are man-made dams designed specifically to capture seepage and runoff originating from the ADF. As no natural water resources are associated with these dams (Figure 7), their planned expansion is unlikely to result in any negative impacts from an aquatic perspective. Furthermore, construction activities will occur well outside the designated buffer areas of nearby water resources (Figure 10). Both dams do however have a spillway which, if over-topped, could lead to water from the dams draining into these watercourses. Expansion of the dams will minimize the possibility of this happening.

The most significant impact is related to the construction of RD2 which is planned to occur in the upper reaches of the non-perennial drainage line draining to the west of the proposed dam. While this section of the drainage will provide some habitat to some aquatic biota and possibly birds, its very close proximity to the ash dump renders it as low value in terms of biodiversity importance and hydrological function (Table 11). Given its ephemeral nature and position within the catchment, the loss of aquatic habitat that falls within the footprint of the dam can be regarded as a relatively minor impact.

A description of each identified impact, as well as measures that should be implemented to mitigate these impacts, is described in the section below.

8.2 CONSTRUCTION PHASE IMPACTS

8.2.1 Water Quality Impacts

- Impairment of water quality due to spillage of water contained in the existing dams as a result of construction activities;
- Spills, leakages or inadequate treatment and disposal of sewage effluent; and
- Hydrocarbon spillage from trucks and vehicles close to the watercourse can severely contaminate the associated watercourses. Serious spills can seriously affect mortality rates of aquatic and terrestrial fauna that utilise watercourses as breeding and foraging habitat.

8.2.1.1 Mitigation

- Water contained in the AD1 and AD2 should be prevented from seeping, spilling or discharging into the receiving environment during construction activities. This could be achieved through pumping water out of the dams during excavation of the expanded areas, or alternatively, planning construction appropriately (e.g. through use of coffer dams);

- No vehicles or machinery are allowed within the buffer areas or watercourse. Predetermined areas should be designated where vehicles and machinery are to be stored, repaired and refueled within a bunded area;
- Implementation of rapid response emergency spill procedures to deal with spills immediately, including the provision of a spill kit and training of staff to deal with such instances;
- Vehicles and equipment must be regularly serviced and maintained, but this should be done away from watercourse areas, and should be done in protected areas where any drips would be contained;
- Any spillages must be cleaned up immediately to prevent further contamination;
- Routine water quality monitoring should be implemented in watercourses where regular sampling is possible. Results should be used to rapidly identify and remedy any potential sources of contamination;
- Chemical toilets to be provided on-site at 1 toilet per 10 persons;
- Chemical toilets to be located outside the designated buffer of nearby water resources.

Table 14: Construction phase impacts to water quality

	Without Mitigation	With Mitigation
Intensity	Extremely High	Very low
Duration	Short term	Brief
Extent	Local	Limited
Probability	Almost Certain	Unlikely
Significance	**Moderate (-)**	**Negligible (-)**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

8.2.2 Aquatic Habitat Impacts

- Loss of aquatic habitat that falls within the footprint of the RD2 dam;
- Deterioration of downstream aquatic habitat due to poor waste management, dumping of construction materials etc; and
- Destruction of habitat outside of the footprint of the expanded/new dams due to disturbance by construction vehicles.

8.2.2.1 Mitigation

- The footprint of the new and expanded dams should be clearly demarcated and access controlled such that construction vehicles and heavy machinery do not enter aquatic habitats that fall outside of the footprint of the dam.

Table 15: Construction phase impacts to aquatic habitat

	Without Mitigation	With Mitigation
Intensity	Moderate	Low

Duration	Permanent	Permanent
Extent	Limited	Limited
Probability	Certain	Certain
Significance	**Moderate (-)**	**Minor (-)**
Reversibility	Low	Low
Irreplaceability	Low	Low
Confidence	High	High

8.2.3 Erosion & Sedimentation Impacts

- Transport of sediment further downstream as a result of disturbance and erosion of soil during the construction process; and
- Transport of sediment originating from stockpiled materials excavated from the footprint of the dams.

8.2.3.1 Mitigation Measures

- Earthworks and vegetation clearing should be left open for as short a time as possible during the construction phase;
- Erosion control berms should be installed on slopes draining in direction of drainage lines;
- Revegetation after clearance should commence directly after the construction phase; and
- Alterations to the storm water management should allow for the use of detention ponds

Table 16: Construction phase impacts to sedimentation and erosion

	Without Mitigation	With Mitigation
Intensity	Moderate	Low
Duration	Short term	Brief
Extent	Local	Limited
Probability	Likely	Unlikely
Significance	**Minor (-)**	**Negligible (-)**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

8.3 OPERATIONAL PHASE IMPACTS

8.3.1 Water Quality

- Deterioration of water quality in downstream water resources due to seepage or accidental discharge of high salinity water from the dams;

8.3.1.1 Mitigation

- All dams should be equipped with sensors to monitor water levels and give an alarm in the event that there may be a risk of breaching the dam wall;
- Dams should be appropriately lined to prevent seepage of poor quality water into the receiving environment;
- Watercourses located downstream of return and ash dams should be monitored on a routine basis to detect any changes in ecological state and water quality and effect appropriate corrective actions. Monitoring should include the collection and analysis of water quality samples, assessment of habitat quality and where possible, biomonitoring, using recognised indicators such as diatoms (e.g. in the drainage line below RD2).

Table 17: Operational phase impacts to water quality

	Without Mitigation	With Mitigation
Intensity	Very high	High
Duration	Ongoing	Medium Term
Extent	Local	Local
Probability	Likely	Unlikely
Significance	**Moderate (-)**	**Minor (-)**
Reversibility	Medium	High
Irreplaceability	Low	Low
Confidence	Medium	Medium

8.3.2 Reduction in flows

- Reduced flows into the downstream watercourse due to loss of surface runoff proportional to the footprint of new dam infrastructure (e.g. RD2).

8.3.2.1 Mitigation

This impact cannot be mitigated. However, considering the location (right at the top of the drainage line) and size of the proposed RD2 dam, the reduction of surface runoff to downstream habitats is minimal.

Table 18: Operational phase impacts to flow reduction

	Without Mitigation	With Mitigation
Intensity	Negligible	Cannot be mitigated
Duration	Permanent	
Extent	Limited	
Probability	Certain	
Significance	**Minor (-)**	
Reversibility	Medium	

Irreplaceability	Low	
Confidence	Medium	

8.4 CUMULATIVE IMPACTS

Cumulative impacts associated with the development can be described as negligible. Considering that stormwater and surface runoff originates from the ash dump and surrounds, the presence and enlargement of these dams, with minimal impacts to aquatic water resources should be viewed in a positive light. Increased capacity of dams will reduce the risk of dams overflowing and releasing contaminated water into the receiving environment.

9 CONCLUSION

Majuba Power Station needs to construct and extend the ash and rehabilitation dams for its ash disposal facility (ADF). These dams are used for the purposes of storm water management at the ADF area. The proposed construction of new dams and expansion of existing dams require various permits, amongst which are the environmental authorisation and the water use licence.

The planned activities involve the modification of existing pollution control dams (AD1 and AD2), which are man-made dams designed specifically to capture seepage and runoff originating from the ADF. The size of AD1 will be reduced to accommodate a return water dam (RD1) immediately adjacent to it. The size of AD2 will be increased. The dams are not connected to a larger natural drainage network. Water from these dams is continuously recycled as part of the process requirements for the power station and is therefore not discharged into the receiving environment. The planned modifications to AD1 and AD2 and construction of RD1 is therefore unlikely to impact on any natural water resources.

The most significant potential impact relates to the construction of RD2, which is planned to be constructed in the upper reaches of an existing drainage line that falls within the ESKOM property boundary (Figure 7). This drainage line feeds into the non-perennial tributary that drains to the west of the ESKOM property boundary. Given the modified nature and low EIS of the drainage line the construction of RD2 is unlikely to present significant negative impacts. While the EIS of the channelled valley bottom wetland is High, all construction activities for AD1 and RD1 fall well outside the conservative 50 m buffer for this wetland. Impacts to the wetland are therefore also considered to be negligible. Furthermore, expansion of the storage capacity of the dams is likely to reduce the risk of spillages or overflows occurring at each of the dams which is of long-term benefit to the surrounding environment and adjacent watercourses in particular.

It is therefore the view of this author that the expansion of AD1 and AD2 and the construction of RD1 and RD2 pose minor to negligible impacts to water resources and that these activities should be authorised.

10 REFERENCES

Duthie, A. (1999). *IER (Floodplain Wetlands) Determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC).* Resource Directed Measures for Protection of Water Resources: Wetland Ecosystems. Department of Water Affairs and Forestry.

DWAF (Department of Water Affairs and Forestry) (2008). Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas, prepared by M. Rountree, A.L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

DWS (Department of Water and Sanitation). (2014). A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: [C1]. Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx accessed on [July 2018].

Kleynhans, C.J. (1996). A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo system, South Africa) *Journal of Aquatic Ecosystem Health* **5**:41-54 1996.

Kleynhans, C.J. (1999). Resource Directed Measures for Protection of Water Resources: River Ecosystems. R7: Assessment of Ecological Importance and Sensitivity.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. (2008). *WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands*. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

Macfarlane, D., Kotze, D., Ellery, W., Walters, D., Koopman, V., Goodman, P. and Goge, M. (2008). *WET-Health: A technique for rapidly assessing wetland health. Wetland Management Series.* WRC Report TT 340/08. Water Research Commission, Pretoria.

Milner A.M. (1994). System recovery. In: Calow P and Petts GE (eds.): The rivers handbook. Vol. 2. Blackwell Scientific Publications. London.

MTPA, CSIR, SANBI. MBSP Freshwater Assessment 2011 [Vector] 2011. Available from the Biodiversity GIS website, downloaded on 23 November 2018

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). *Technical Report for the National Freshwater Ecosystem Priority Areas project.* WRC Report No. 1801/2/11. Water Research Commission, Pretoria, South Africa.

Ollis, D.J., Snaddon, C.D., Job, N.M. and Mbona, N. (2013). *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems.* SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria

Resh, V.H., Brown, A.P., Covich, M.E., Gurtz, H.W., Li, G.W., Minshall, S.R., Reice, A.L., Sheldon, J.B., Wallace and Wissmar, R.C. (1988). The role of disturbance theory in stream ecology. Journal of the North American Benthological Society. 7: 433-455.

Rountree, M.W. and Kotze, D. (2013). Appendix A3: EIS Assessment IN: Rountree, M.W., H. Malan and B. Weston (eds) Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study. Report No 1788/1/13. Water Research Commission, Pretoria.

SANBI (2014). Mpumalanga Highveld Wetlands 2012 [vector geospatial dataset] 2014. Available from the Biodiversity GIS website, downloaded on 23 November 2018

11 APPENDICES

Appendix 1: Significance Rating Methodology

Individual impacts for the construction and operational phase were identified and rated according to criteria which include their intensity, duration and extent. The ratings were then used to calculate the consequence of the impact which can be either negative or positive as follows:

Consequence = *type x (intensity + duration + extent)*

where type is either negative (i.e. -1) or positive (i.e. 1). The significance of the impact was then calculated by applying the probability of occurrence to the consequence as follows:

Significance = *consequence x probability*

The criteria and their associated ratings are shown in Table 19.

Table 19: Categorical descriptions for impacts and their associated ratings

Rating	Intensity	Duration	Extent	Probability
1	Negligible	Immediate	Very limited	Highly unlikely
2	Very low	Brief	Limited	Rare
3	Low	Short term	Local	Unlikely
4	Moderate	Medium term	Municipal area	Probably
5	High	Long term	Regional	Likely
6	Very high	Ongoing	National	Almost certain
7	Extremely high	Permanent	International	Certain

Categories assigned to the calculated significance ratings are presented in Table 20.

Table 20: Value ranges for significance ratings, where (-) indicates a negative impact and (+) indicates a positive impact

Significance Rating	Range	
Major (-)	-147	-109
Moderate (-)	-108	-73
Minor (-)	-72	-36
Negligible (-)	-35	-1
Neutral	0	0
Negligible (+)	1	35
Minor (+)	36	72
Moderate (+)	73	108
Major (+)	109	147

Each impact was considered from the perspective of whether losses or gains would be irreversible or result in the irreplaceable loss of biodiversity of ecosystem services. The level of confidence was also determined and rated as low, medium or high (Table 21).

Table 21: Definition of reversibility, irreplaceability and confidence ratings.

Rating	Reversibility	Irreplaceability	Confidence
Low	Permanent modification, no recovery possible.	No irreparable damage and the resource isn't scarce.	Judgement based on intuition.
Medium	Recovery possible with significant intervention.	Irreparable damage but is represented elsewhere.	Based on common sense and general knowledge
High	Recovery likely.	Irreparable damage and is not represented elsewhere.	Substantial data supports the assessment