

ANNEXURES

ANNEXURE A: Description of Assessment Methods

A1 Present Ecological State (PES) Assessment

Present Ecological State (PES) is a measure of the deviation of the ecological integrity / health / condition of a definable ecosystem unit from its reference state.

Wetland PES:

The PES of the wetland HGM units was assessed using the Level 1 WET-Health assessment tool developed by Macfarlane *et al.* (2008). Data collection involved the desktop review of the extent and intensity catchment land cover impacts and the onsite identification and recording of observable wetland impacts.

The desktop catchment review was undertaken using 2015 aerial photography for the area and supplemented by 2015 Google Earth imagery. This imagery review was undertaken using QGIS software. Thereafter, the data collected was used to complete the relevant sections of the Level 1 WET-Health tool. No catchment hydrological modelling was undertaken.

Onsite impacts were recorded using a hand-held GPS. The GPS points were imported into QGIS software and the impacts and associated disturbance units were mapped. Thereafter, the data collected was used to complete the relevant sections of the Level 1 WET-Health tool.

The magnitude of 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 are then used to assign the wetland into one of six ecological state categories as shown in Table 1 below.

Table 1. 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

River PES:

The IHI (Index of Habitat Integrity) 1996, version 2 (Kleynhans, 2012) was used to assess habitat integrity and is based on an interpretation of the deviation from the reference condition for the river reach assessed and involves the assessment of both instream and riparian habitat components. Specification of the reference state is followed by an impact-based approach, whereby the extent and intensity of anthropogenic impacts are interrogated to interpret the level of modification to the primary drivers of river health, namely hydrology, geomorphology and physico-chemical conditions. Naturally, the severity of impacts on habitat integrity will vary according to the natural characteristics of different rivers, with particular river types being inherently more sensitive to certain types of impacts than others. The IHI assessment involved the assessment and rating of a range of criteria for instream and riparian habitat (see Box 1, below) scored individually (using the same impact magnitude rating scale from Wetland PES – Table 2). This assessment is informed by a site visit to a specific section or reach of the river but is refined based on a desktop review of reach and catchment-scale impacts based on available aerial photography and land cover information.

Table 2. 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

Box 1. Criteria assessed in the Index of Habitat Integrity (after Kleynhans, 1996).

- **Water abstraction:** Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
- **Flow modification:** Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
- **Inundation:** Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon *et al.*, 1992).
- **Bed modification:** This has a direct bearing on the amount and availability of substrate characteristics of available habitats. Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included.
- **Bank erosion:** Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.
- **Channel modification:** Maybe the result of a change in flow which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included. Any densification of woody exotic species would lead to channel shape change through increased sediment deposits. This has serious implications for more extensive bank over-topping during flood events with increased scouring along outer edges of the Dry Bank. It is the extremes, i.e. drought or very wet events, which are particularly crucial sensitive periods to be considered.

- **Water quality:** Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
- **Inundation:** Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon *et al.*, 1992).
- **Exotic macrophytes:** Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
- **Exotic fauna:** The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
- **Solid waste disposal:** A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
- **Vegetation removal:** Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river. Refers to physical removal for farming, firewood and overgrazing. Includes both exotic and indigenous vegetation.
- **Exotic vegetation:** Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone.
- **Connectivity:** Relates to changes that influence the movement of aquatic biota, both laterally onto adjacent floodplain areas and longitudinal movement upstream and downstream. These modifications can affect the life-history stage requirements and recolonization options for instream biota.

A2 Ecological Importance and Sensitivity (EIS) Assessment

The Ecological Importance and Sensitivity (EIS) of wetland and riverine ecosystems is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007).

The EIS assessment was undertaken using a tool devised by Eco-Pulse that is an integration and adaptation of published Resource Directed Measures (RDM) EIS tools (e.g. DWAF riverine and wetland EIS tools). The EIS assessment involved the rating of a number of ecological criteria together with the methods of data collection are provided in Table 3 below.

Table 3. EIS criteria and data collection methods.

EIS Criteria	Method of Data Collection & Analysis
Biodiversity Supply Criteria:	
Habitat rarity or threat status at provincial and/or national levels.	<ul style="list-style-type: none"> • Review of the threat status of the relevant NFEPA wetland vegetation group. • Review of the threat status of the relevant KZN wetland vegetation type. • Review of plant community type and species composition from Eco-Pulse (2015).
Provides habitat for threatened or rare/endemic species at provincial and/or national scales.	<ul style="list-style-type: none"> • Review of KZN Terrestrial Systematic Conservation Plan. • Review of relevant Red Data books – habitat preferences and species ranges. • Review of habitat type description from Eco-Pulse (2015).
Unusual or unique species, populations or habitats at provincial and/or national scales.	<ul style="list-style-type: none"> • Review of KZN Terrestrial Systematic Conservation Plan. • Review of relevant Red Data books – habitat preferences and species ranges. • Review of habitat type description from Eco-Pulse (2015).
Species and/or habitat diversity / richness.	Based on onsite observations. No formal floral and faunal surveys were undertaken.
Important ecological corridor or ecological linkage in landscape (Refuge value).	<ul style="list-style-type: none"> • Review of municipal, provincial and national conservation plans. • Review of aerial photography in QGIS to identify whether the site forms an important ecological corridor and linkage.

EIS Criteria	Method of Data Collection & Analysis
Present ecological state of habitat / ecosystem.	See Section 2.1 above.
Ecological viability.	Review of aerial photography in QGIS to identify connectivity and degree of fragmentation.
Biodiversity Demand Criteria:	
Regional and/or National Conservation Planning Importance.	Review of available municipal, provincial and national terrestrial and freshwater ecosystem conservation plans.
Sensitivity Criteria:	
Intolerant biota.	<ul style="list-style-type: none"> Review of plant community type and species composition from Eco-Pulse (2015). Review of relevant Red Data books – habitat preferences and species ranges. Review of habitat type description from Eco-Pulse (2015).
Sensitivity to changes in floods.	<ul style="list-style-type: none"> Review of wetland HGM type.
Sensitivity to changes in low flows/dry season.	<ul style="list-style-type: none"> Review of wetland HGM type.
Sensitivity to changes in sediment inputs and turbidity.	<ul style="list-style-type: none"> Review of wetland HGM type and vegetation structure and robustness.
Sensitivity to changes in water quality.	<ul style="list-style-type: none"> Review of catchment geology in QGIS to ascertain potential nutrient status of soils and watercourses. Review of plant community type and species composition from Eco-Pulse (2015). Review of relevant Red Data books – habitat preferences and species ranges. Review of habitat type description from Eco-Pulse (2015).
Erosion risk / vulnerability.	<ul style="list-style-type: none"> Review of catchment geology and slope gradients in QGIS to ascertain runoff potential and erosion risk. Onsite identification of the extent and intensity of headcuts and gullies as part of the PES assessment.
Sensitivity of ecology to edge disturbances.	<ul style="list-style-type: none"> Review of plant community type and species composition from Eco-Pulse (2015). Review of relevant Red Data books – habitat preferences and species ranges. Review of habitat type description from Eco-Pulse (2015).

Scores for these criteria were then rated on a scale of 0-4 (low to high) and integrated in a rational way to provide an overall EIS score. The EIS score was then interpreted using Table 4, below.

Table 4. EIS score rating categories.

Score	EIS Rating	Importance Description
0.0 – 0.5	Very Low	Not important
0.6 – 1.0	Low	Low importance
1.1 – 1.5	Moderately-Low	Mild importance
1.6 – 2.4	Moderate	Moderately important
2.5 – 2.9	Moderately-High	Important
3.0 – 3.4	High	Very/highly important
3.5 – 4.0	Very High	Critically important

A3 Ecosystem Services (Functional) Importance Assessment

The supply of ecosystem goods and services of the wetland was assessed using a revised version of the WET-EcoServices assessment tool (Kotze *et al.*, 2016). This approach relies on a combination of desktop and on-site indicators to assess the importance of a range of common wetland ecosystem services. A level 2 (detailed) assessment was conducted that assessed a suite of services/benefits by assigning a score to each service based on a rating system that rates a range of pre-defined variables affecting the importance of services provided by the wetland system. The results are captured in tabular form as a list of services/goods with the level of supply and demand rated on a scale of 0 - 4. The following rating shown in Table 5 is used to describe the level of importance of supply and demand.

Table 5. Classes for determining the likely level to which a service is being supplied or demanded.

Score	Supply/Demand/Importance Ratings	Importance Description
0.0 – 0.5	Very Low	Not important
0.6 – 1.0	Low	Low importance
1.1 – 1.5	Moderately-Low	Mild importance
1.6 – 2.4	Moderate	Moderately important
2.5 – 2.9	Moderately-High	Important
3.0 – 3.4	High	Very/highly important
3.5 – 4.0	Very High	Critically important

Since the importance of wetland goods and services is dictated not only by the supply (service availability) of a particular good/benefit but also on the need or demand (user requirement) for such a benefit, the overall importance of the ecosystem service is ultimately derived from a combination of supply and demand scores. For example, a wetland may supply a particular service at a high level; however this service may not be in great demand, limiting the importance of the benefit to society. The results of the assessment were therefore interpreted to reflect the perceived importance of each of the ecosystem goods and services assessed.

ANNEXURE B: Impact Significance Assessment Methods

For the purposes of this assessment, the assessment of potential impacts was undertaken using the "Impact Assessment Methodology for EIAs" designed by Eco-Pulse Consulting (2015). This assessment was informed by baseline aquatic information contained in this report relating to the importance and sensitivity of habitats, information on the proposed development activity provided by the client and experience with impacts resulting from similar development projects.

Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: (i) the measurable characteristics of the impact (e.g. intensity, extent and duration), (ii) the importance societies/communities place on the impact (or resource being affected), and (iii) the probability / likelihood of the impact occurring.

In light of this understanding, significance can only be assessed if one knows the importance or value of the environmental change/impact. Thus, end point or eventual / ultimate impacts that can be valued like impacts to water resources, ecosystem services and biodiversity conservation are the only impacts that can be assessed in terms of significance and are referred to as ultimate consequences of an activity. Put another way, the significance of an impact to the environment or ecosystem can only be assessed in terms of the measurable changes to ecosystem services, resources and biodiversity associated with that system or component being assessed.

The approach adopted is to identify and describe all potential primary and secondary (indirect) impacts resulting from the proposed construction and operational activities. As a starting point the extent of the impact is defined upfront. Thereafter, remaining impact rating criteria are scored based on the predefined extent of impacts. Intensity is rated as the realistic consequence (end-point) of an activity under the various mitigation scenarios. The rating of intensity has been specifically defined for specialist terrestrial and aquatic impacts so as to reduce ambiguity that could arise in the assessment process. Probability rates the likelihood of the impact (s) being assessed occurring across the predefined extent of the anticipated impacts and has been specifically linked to expected probabilities of occurrence. Finally, impact duration rates the time period or lifecycle of a specific impact. Table 32 below summarises the rating criteria and scoring system applied in rating the significance of project-related impacts.

The assessment of impact significance is based on the basic risk formula: **Risk = consequence x probability** but has been customised to accommodate the rating criteria included in the assessment process:

$$\text{Impact significance} = \text{consequence (impact intensity + impact extent + impact duration)}^1 \times \text{impact probability}$$

¹ Note: Whilst this describes the basic formula used to calculate impact significance, additional weightings and rules have been introduced to train the model to better align with scores based on expert-opinion. This essentially reduces the significance scores in situations where (i) low intensity impacts occur over a broad extent or (ii) where high intensity scores at a localised scale.

Table 6. Criteria and numerical values for rating environmental impacts.

Score	Rating	Description
Extent (E) – relates to the expected extent of the impact in spatial and population terms		
10	National	<p>The effects of an impact are experienced over a very large geographic area. Given the extent of impacts, they are likely to be relevant at a national scale.</p> <p>Water resource impacts:</p> <ul style="list-style-type: none"> • Water resources are affected across a very extensive geographic area (e.g. spanning a number of water management areas / crossing international boundaries); and / or • Indirect impacts continue to affect water resources far from the development site (e.g. impacts continue to be experienced > 100km downstream). <p>Habitat impacts:</p> <ul style="list-style-type: none"> • The extent of direct impacts results in extensive impacts to water resources relative to the remaining extent (e.g. affecting >100ha wetlands / >10km watercourses); and / or • The extent of direct impacts is high relative to the extent of affected habitat types (e.g. affecting >10% of a remaining ecosystem type); and / or • The proposed development affects large areas (e.g. > 1000 ha) across a broad geographic area and affecting a range of habitat types. <p>Species Impacts:</p> <ul style="list-style-type: none"> • Impacts affect a large proportion of the population of an important species at a national level (e.g. >10% of species population affected); and / or • The proposed development will affect a wide range of important species populations across a very large geographic area. <p>Social impacts:</p> <ul style="list-style-type: none"> • Impacts will affect a society at a national scale (e.g. large number of stakeholders across multiple district municipalities / provinces).
8	Regional	<p>The effects of an impact are experienced over a large geographic area. Given the extent of impacts, they are likely to be relevant at a regional scale.</p> <p>Water resource impacts:</p> <ul style="list-style-type: none"> • Water resources are affected across a broad geographic area (e.g. extending across a large number of quaternary catchments); and / or • Indirect impacts continue to affect water resources a considerable distance from the development site (e.g. 10 - 100km downstream). <p>Habitat impacts:</p> <ul style="list-style-type: none"> • The extent of direct impacts results in large-scale impacts to water resources relative to the remaining extent, (10-100ha wetlands / 1-10km watercourses); and / or • The extent of direct impacts is notable relative to the extent of affected habitat types (e.g. affecting 1 - 10% of a remaining ecosystem type); and / or • The proposed development affects a large area (100 – 1000ha) and typically extends across a range of habitat types. <p>Species Impacts:</p> <ul style="list-style-type: none"> • Impacts affect a large proportion of the population of an important species at a regional level (e.g. 1 - 10% of species population affected); and / or • The proposed development will affect a wide range of important species populations across a large geographic area. <p>Social impacts:</p> <ul style="list-style-type: none"> • Impacts will affect a society at a regional scale (e.g. large number of communities and stakeholders across a number of local municipalities).
4	Local	<p>The effects of an impact are experienced over a limited geographic area. Given the extent of impacts, they are likely to be relevant at a local scale.</p> <p>Water resource impacts:</p> <ul style="list-style-type: none"> • Water resources are affected within a localised geographic area (e.g. single quaternary catchment); and / or • Indirect impacts continue to affect water resources some distance from the development site (e.g. 1 - 10km downstream). <p>Habitat impacts:</p>

Score	Rating	Description
		<ul style="list-style-type: none"> The extent of direct impacts results in localised impacts to water resources relative to the remaining extent, (1 - <10ha wetlands / 100m - <1km watercourses); and / or The extent of direct impacts is limited relative to the extent of affected habitat types (e.g. affecting <1% of a remaining ecosystem type); and / or The proposed development affects a moderately large area (10 – 100ha) but may extend across a wide range of habitat types. <p>Species Impacts:</p> <ul style="list-style-type: none"> Impacts affect species populations that are important at a local scale (e.g. < 1% of population affected); and / or The proposed development will affect a number of important species across a local geographic area. <p>Societal impacts:</p> <ul style="list-style-type: none"> Impacts will affect society at a local scale (e.g. a number of communities across a single local municipality).
2	Surrounding Area	<p>The effects of an impact are experienced over a very small area. Given the extent of impacts, they are likely to be relevant at a very localised scale.</p> <p>Water resource impacts:</p> <ul style="list-style-type: none"> Water resources are affected within a small geographic area (e.g. single quiney catchment); and / or Indirect impacts affect water resources a limited distance downstream of the development site (e.g. <1km downstream). <p>Habitat impacts:</p> <ul style="list-style-type: none"> Direct impacts affects a small area proportion of water resources (e.g. 0.1-1ha wetlands / 10 – <100m watercourses); and / or The proposed development affects a small localised area (1 – 10ha) and is often confined to a very few habitat types. <p>Species Impacts:</p> <ul style="list-style-type: none"> Impacts affect populations of important species beyond the site level; <p>Social impacts:</p> <ul style="list-style-type: none"> Impacts will affect society at a very local scale (e.g. a number of households within a single community).
0	Site	<p>The effects of an impact are confined to a very small footprint. Given the extent of impacts, they are likely to be relevant at a site scale.</p> <p>Water resource impacts:</p> <ul style="list-style-type: none"> Impacts are largely confined to the development footprint with limited downstream impact (<100m downstream effect). <p>Habitat impacts:</p> <ul style="list-style-type: none"> Direct impacts are typically confined to a single water resource or few water resources within a small focal area (typically <0.1ha wetlands / 10m watercourses); and / or The proposed development affects a small area (<1ha) and is typically confined to very few habitat types. <p>Species Impacts:</p> <ul style="list-style-type: none"> Impacts are very localised and are unlikely to affect important species beyond the site level; <p>Social impacts:</p> <ul style="list-style-type: none"> Impacts will affect society at a very local scale (single or few households within a single local community)
<p>Intensity (I) – defines the severity and importance of the impact to water resources / habitats / species or human populations within defined impact extent</p>		

Score	Rating	Description
10	High	<p>Water resource impacts:</p> <ul style="list-style-type: none"> Loss of regulating and supporting services critical to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or Loss will compromise the ability to meet water resource management objectives. <p>Habitat impacts:</p> <ul style="list-style-type: none"> Loss of largely intact critically endangered habitat; and / or Loss of particularly unique / especially important special habitat features. <p>Species impacts:</p> <ul style="list-style-type: none"> Loss of or seriously compromises persistence of viable populations of critically endangered species; and / or Loss of or seriously compromises viable landscape-level corridors. <p>Social Impacts:</p> <ul style="list-style-type: none"> Loss of human life; and / or Marked deterioration in human health; and / or Loss of ecosystem services that are critical to support / protect livelihoods of dependant / vulnerable communities; and / or
8	Moderately-High	<p>Water resource impacts:</p> <ul style="list-style-type: none"> Loss of regulating and supporting services important to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs) ; and / or Loss is very likely to compromise the ability to meet water resource management objectives. <p>Habitat impacts:</p> <ul style="list-style-type: none"> Serious modification (2 or more classes) of critically endangered habitat; and / or Loss of largely intact endangered habitat types; and / or Loss of moderately modified critically endangered habitat types (and with reasonable rehabilitation potential) ; and / or Loss of habitat that has special habitat attributes (e.g. high habitat diversity / species richness). <p>Species impacts:</p> <ul style="list-style-type: none"> Loss of or seriously compromises persistence of viable populations of endangered species; and / or Loss of regionally important species populations (e.g. at municipal scale). <p>Social Impacts:</p> <ul style="list-style-type: none"> Loss of human livelihoods; and / or Some deterioration in human health; and / or Loss of ecosystem services that are important (highly valued but not critical to) supporting / protecting vulnerable communities. Alternative options / resources are not available to meet community needs without incurring significant costs.
4	Moderate	<p>Water resource impacts:</p> <ul style="list-style-type: none"> Loss of regulating and supporting services important to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or Loss could compromise the ability to meet water resource management objectives. <p>Habitat impacts:</p> <ul style="list-style-type: none"> Moderate modification (1 classes) of critically endangered habitat / serious modification (2 classes) of endangered habitat; and / or Loss of largely intact vulnerable habitat types; and / or Loss of moderately modified endangered habitat types (and with reasonable rehabilitation potential). <p>Species impacts:</p> <ul style="list-style-type: none"> Loss of or seriously compromises persistence of viable populations of vulnerable / endemic / specially protected species; and / or Loss of or seriously compromises viable corridors that are locally important for species movement. <p>Social Impacts:</p> <ul style="list-style-type: none"> Notable impact on human livelihoods; and / or

Score	Rating	Description
		<ul style="list-style-type: none"> Moderate reduction in the availability of ecosystem services that are important for supporting / protecting vulnerable communities; and / or Loss of ecosystem services that are moderately valued by local communities. Alternative options / resources are available but limited.
2	Moderately-Low	<p>Water resource impacts:</p> <ul style="list-style-type: none"> Loss of regulating and supporting services which are not particularly important for water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or Loss is unlikely to compromise the ability to meet water resource management objectives. <p>Habitat impacts:</p> <ul style="list-style-type: none"> Moderate modification (1 classes) of endangered habitat / serious modification (2 classes) of vulnerable habitat; and / or Loss of largely intact least-threatened habitat types; and / or Loss of moderately modified vulnerable habitat types (and with reasonable rehabilitation potential). <p>Species impacts:</p> <ul style="list-style-type: none"> Reduction in populations of vulnerable / endemic / specially protected species (without compromising viability of locally occurring populations) ; and / or Loss of populations of locally important species. <p>Social Impacts:</p> <ul style="list-style-type: none"> Limited but identifiable impact on human livelihoods; and / or Moderate reduction in the availability of ecosystem services with a noticeable but limited impact to livelihoods.
0	Low	<p>Water resource impacts:</p> <ul style="list-style-type: none"> Loss of regulating and supporting services which are not particularly important for water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or Loss will not compromise the ability to meet water resource management objectives. <p>Habitat impacts:</p> <ul style="list-style-type: none"> Loss of highly degraded threatened vegetation types (and with low rehabilitation potential); and / or Moderate modification (1 classes) of vulnerable habitat; and / or Loss of moderately modified least threatened habitat types. <p>Species impacts:</p> <ul style="list-style-type: none"> Limited impact to any locally important species populations. <p>Social Impacts:</p> <ul style="list-style-type: none"> None / very limited impact on human livelihoods; and / or None / limited reduction in the availability of ecosystem services with very limited impact to livelihoods.
Duration (D) – relates to the duration of the impact in time (consideration should be given to reversibility which may reduce the duration of impact)		
5	Permanent	The impact will continue indefinitely (>30 years) and is essentially regarded as irreversible.
4	Long-term	The impact and its effects will continue over the long-term (10 - 30 years).
3	Medium-term	The impact and its effects will persist for a number of years (1 – 10).
2	Short-term	The impact and its effects will persist for a number of months after the impact has occurred (2 -12 months) but is unlikely to persist for more than a year.
1	Immediate	The impact and its effects will cease within days or weeks after the impact has occurred (0 – 2 months).
Probability (P) – relates to the expected likelihood and frequency of the impact causing event occurring		
1	Definite	More than 80% likelihood of occurrence. The impact is typically recorded under similar conditions and settings.
0.9	Highly Probable	The impact has a 50-80% chance of occurring and thus expected to occur. The impact is known to occur regularly in similar conditions and settings.

Score	Rating	Description
0.8	Probable	The impact has a 20-50% chance of occurring and thus is quite likely to occur. The impact is known to occur quite frequently in similar conditions and settings (less than once in 10 years).
0.7	Possible	The impact has a 5-20% chance of occurring. This impact could occur and is known to occur irregularly under the similar conditions and settings (less than once in 20 years).
0.6	Unlikely	The possibility of the impact occurring is low with less than 5% chance of occurring. The impact has little chance of materialising (less than once in 50 years).

Table 7. Impact significance categories and definitions.

Impact Significance	Impact Significance Score Range	Definition
High	18 - 25	Totally unacceptable and fatally flawed. Impact should be avoided and limited opportunity for offset/compensatory mitigation. The proposed activity should only be approved under special circumstances.
Moderately High	15 - 17	Generally unacceptable and should ideally be avoided. If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms. Strict conditions and high levels of compliance and enforcement will be required. The potential impact will affect a decision regarding the proposed activity and require that the need and desirability for the project be clearly substantiated to justify the associated ecological risks.
Moderate	11 - 14	Impact may be acceptable under special circumstances but should ideally be reduced to moderately low significance levels. If authorised, offsets should be considered to compensate for residual impacts. Strict conditions and high levels of compliance and enforcement are generally required. The potential impact should influence the decision regarding the proposed activity and requires a clear and substantiated need and desirability for the project to justify the risks.
Moderately Low	8 - 10	Acceptable with moderately-low to moderate risks provided that specific/generic mitigation applied and routine inspections undertaken. The potential impact may not have any meaningful influence on the decision regarding the proposed activity.
Low	0 - 7	The potential impact is very small or insignificant and should not have any meaningful influence on the decision regarding the proposed activity. Basic duty of care must be ensured.

A confidence rating was also given to the impacts rated in accordance with the table below:

Table 8. Confidence ratings used when assigning impact significance ratings.

Level of confidence	Contributing factors affecting confidence
Low	A low confidence level is attributed to a low-moderate level of available project information and somewhat limited data and/or understanding of the receiving environment.
Medium	The confidence level is medium, being based on specialist understanding and previous experience of the likelihood of impacts in the context of the development project with a relatively large amount of available project information and data related to the receiving environment.
High	The confidence level is high, being based on a sound understanding of the state, functioning and sensitivity of the receiving environment, high availability of project-related data and good understanding of similar impact scenarios.

ANNEXURE C: Impact Significance Assessment Spreadsheet

Construction Phase Impact Significance Assessment							
Realistic Poor Mitigation Scenario							
No.	Nature of Impact	Status	Extent	Intensity	Duration	Probability	Significance
Impact to Water Quantity & Quality (Regulating Services)							
C1	Direct loss and/or modification of habitat	Negative	Site	Moderately-Low	Permanent	Definite	Low
C2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Moderate	Medium-term	Definite	Moderately-Low
C3	Water quality impacts	Negative	Surrounding Area	Low	Short-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Moderate	Permanent	Definite	Moderately-Low
Impact to Freshwater Ecosystem / Habitat Conservation							
C1	Direct loss and/or modification of habitat	Negative	Site	Moderately-High	Permanent	Definite	Moderately-Low
C2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Moderate	Medium-term	Definite	Moderately-Low
C3	Water quality impacts	Negative	Surrounding Area	Moderately-Low	Short-term	Possible	Low
Combined Impacts		Negative	Site	Moderately-High	Permanent	Definite	Moderately-Low
Impact to Species Conservation							
C1	Direct loss and/or modification of habitat	Negative	Site	Low	Permanent	Definite	Low
C2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Low	Medium-term	Possible	Low
C3	Water quality impacts	Negative	Surrounding Area	Moderately-Low	Medium-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Medium-term	Possible	Low
Impact to Subsistence & Human Livelihoods (Direct Use Values)							
C1	Direct loss and/or modification of habitat	Negative	Site	Low	Permanent	Definite	Low

C2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Low	Medium-term	Probable	Low
C3	Water quality impacts	Negative	Surrounding Area	Low	Short-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Low	Medium-term	Probable	Low
Realistic Good Mitigation Scenario							
No.	Nature of Impact	Status	Extent	Intensity	Duration	Probability	Significance
Impact to Water Quantity & Quality (Regulating Services)							
C1	Destruction and modification of aquatic habitat	Negative	Site	Moderately-Low	Permanent	Definite	Low
C2	Flow modification and erosion / sedimentation:	Negative	Surrounding Area	Moderately-Low	Short-term	Definite	Low
C3	Alteration of water quality	Negative	Site	Low	Short-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Moderate	Short-term	Possible	Low
Impact to Freshwater Ecosystem / Habitat Conservation							
C1	Direct loss and/or modification of habitat	Negative	Site	Moderate	Permanent	Definite	Moderately-Low
C2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Moderately-Low	Short-term	Definite	Low
C3	Water quality impacts	Negative	Surrounding Area	Moderately-Low	Short-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Permanent	Probable	Low
Impact to Species Conservation							
C1	Direct loss and/or modification of habitat	Negative	Site	Moderately-Low	Permanent	Definite	Low
C2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Moderately-Low	Short-term	Probable	Low
C3	Water quality impacts	Negative	Surrounding Area	Moderately-Low	Short-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Permanent	Possible	Low
Impact to Subsistence & Human Livelihoods (Direct Use Values)							

C1	Direct loss and/or modification of habitat	Negative	Site	Moderately-Low	Short-term	Definite	Low
C2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Moderately-Low	Short-term	Probable	Low
C3	Water quality impacts	Negative	Surrounding Area	Moderately-Low	Short-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Short-term	Possible	Low

Operational Phase Impact Significance Assessment							
Realistic Poor Mitigation Scenario							
No.	Nature of Impact	Status	Extent	Intensity	Duration	Probability	Significance
Impact to Water Quantity & Quality (Regulating Services)							
O1	Direct loss and/or modification of habitat	Negative	Site	Moderately-Low	Long-term	Probable	Low
O2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Moderately-low	Long-term	Probable	Low
O3	Water quality impacts						Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Long-term	Probable	Low
Impact to Freshwater Ecosystem / Habitat Conservation							
O1	Direct loss and/or modification of habitat	Negative	Site	Moderately-Low	Long-term	Probable	Low
O2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Moderately-Low	Long-term	Probable	Low
O3	Water quality impacts						Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Long-term	Probable	Low
Impact to Species Conservation							
O1	Direct loss and/or modification of habitat	Negative	Site	Low	Long-term	Probable	Low
O2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Moderately-Low	Long-term	Probable	Low

O3	Water quality impacts						Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Long-term	Probable	Low
Impact to Subsistence & Human Livelihoods (Direct Use Values)							
O1	Direct loss and/or modification of habitat	Negative	Site	Low	Long-term	Probable	Low
O2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Low	Long-term	Probable	Low
O3	Water quality impacts	Negative	Surrounding Area	Moderately-Low	Long-term	Probable	Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Long-term	Probable	Low
Realistic Good Mitigation Scenario							
No.	Nature of Impact	Status	Extent	Intensity	Duration	Probability	Significance
Impact to Water Quantity & Quality (Regulating Services)							
O1	Direct loss and/or modification of habitat	Negative	Site	Low	Long-term	Possible	Low
O2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Low	Long-term	Possible	Low
O3	Water quality impacts	Negative	Surrounding Area	Low	Long-term	Probable	Low
Combined Impacts		Negative	Surrounding Area	Low	Long-term	Possible	Low
Impact to Freshwater Ecosystem / Habitat Conservation							
O1	Direct loss and/or modification of habitat	Negative	Surrounding Area	Low	Long-term	Possible	Low
O2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Low	Long-term	Possible	Low
O3	Water quality impacts	Negative	Surrounding Area	Low	Long-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Moderate	Long-term	Possible	Low
Impact to Species Conservation							
O1	Direct loss and/or modification of habitat	Negative	Site	Low	Long-term	Possible	Low

O2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Low	Long-term	Possible	Low
O3	Water quality impacts	Negative	Surrounding Area	Low	Long-term	Possible	Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Long-term	Possible	Low
Impact to Subsistence & Human Livelihoods (Direct Use Values)							
O1	Direct loss and/or modification of habitat	Negative	Site	Low	Long-term	Probable	Low
O2	Flow, erosion and/or sedimentation impacts	Negative	Surrounding Area	Low	Long-term	Possible	Low
O3	Water quality impacts	Negative	Surrounding Area	Low	Long-term	Probable	Low
Combined Impacts		Negative	Surrounding Area	Moderately-Low	Long-term	Possible	Low

ANNEXURE D: DWS Risk Assessment Spreadsheet



RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I Water Use Risk Assessment Protocol)

Project Name:	PS0-1 Road Upgrade	
Date:	26-Jun-17	
Name of Assessor(s):	Mr. Andrew Briggs (Cand.Sci.Nat.)	SACNASP Registration No. 116886
	Mr. Ryan Edwards (Pr.Sci.Nat.)	
Name of Reviewer:	Mr. Ryan Edwards (Pr.Sci.Nat.)	SACNASP Registration No. 400089/13

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

No.	Phase(s)	Activity	Stressor (Aspect)	Impact	Severity													Control measures	Revised Risk Rating	Borderline LOW / MODERATE Rating Classes	PES & EIS of Affected Watercourse			
					Flow Regime	Physico & chemical (water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Deflection	Likelihood					Significance	Risk Rating	Confidence Level
1	Construction	Resurfacing and widening of road.	Physical disturbance (infilling)	Destruction of aquatic vegetation, disturbance of soils and habitat.	0	0	3	3	1.5	1	2	4.5	5	5	5	1	16	72	Moderate	80	Refer to impact assessment report	55	Low	C
			Eroded sediment and erosive runoff.	Erosion and sedimentation	0	0	1	1	0.5	2	2	4.5	2	3	5	2	12	54	Low	70	Refer to impact assessment report	54	Low	C
			Fuel and/or oil leakage from heavy machinery and hazardous road resurfing substances	Decrease in water quality	0	1	0	1	0.5	2	1	3.5	2	2	5	3	12	42	Low	70	Refer to impact assessment report	42	Low	C
2	Operation	Operation of upgraded road	Post-construction disturbance of freshwater habitat during maintenance.	Destruction of aquatic vegetation, disturbance of soils and habitat.	0	0	2	2	1	1	2	4	1	2	5	1	9	36	Low	70	Refer to impact assessment report	36	Low	C
			Stormwater discharge.	Erosion and sedimentation.	0	0	1	1	0.5	2	2	4.5	3	3	5	1	12	54	Low	70	Refer to impact assessment report	54	Low	C