FRESHWATER AND TERRESTRIAL ECOLOGICAL IMPACT ASSESSMENT

PROPOSED BOEKENHOUTSKLOOF BONNIEVALE INFORMAL SETTLEMENT UPGRADE, UPGRADE OF ACCESS ROAD BY CONSTRUCTING A CULVERT BRIDGE OVER THE NON-PERENNIAL RIVER AND WATER AND SEWERAGE PIPELINE CONNECTIONS TO MUNICIPAL SERVICES.

Prepared for: Langeberg Municipality

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1. INTRODUCTION AND BACKGROUND

Eco Impact Legal Consulting (Pty) Ltd (Eco Impact) is appointed by the Langeberg Municipality to assess the impacts of the proposed upgrade of the informal settlement infrastructure, road upgrade over the Non-perennial River and bulk sewerage and water pipeline construction on the Freshwater Ecology.

Langeberg Municipality proposes the development of approximately 438 Residential Zone I erven, 4 Government and Municipal Zoned erven, 3 Open Space erven and Roads. Sewage will be removed by means of a waterborne gravity sewer network connected to the existing municipal network via a proposed sewer pump station, south east of the development. The gravity sewer network will consist of 160mm diameter uPVC sewer pipes and 1,0m diameter concrete sewer manholes. The estimated length of the network is 2 580m and approximately 45 manholes will be constructed. The development will be supplied with potable water from the existing Municipal water treatment works by means of a new 200mm ND UPVC pipeline (total estimated length 1 300m). The storm water will be directed in the roads reserves by means of the road geometry, kerbs and storm water pipes through-out the development where it will be discharged in a controlled manner into the existing water course. To achieve the above, concrete storm water pipes ranging from 375mm to 525mm in diameter (total estimated length = 580m) with associated catch pits and junction boxes will need to be installed. The southern ravine will need to be crossed to access the development. An anticipated culvert size of approximately 4 x 3,0m x 1,8m will need to be installed for the crossing of the ravine to accommodate the 1:100 year flood.

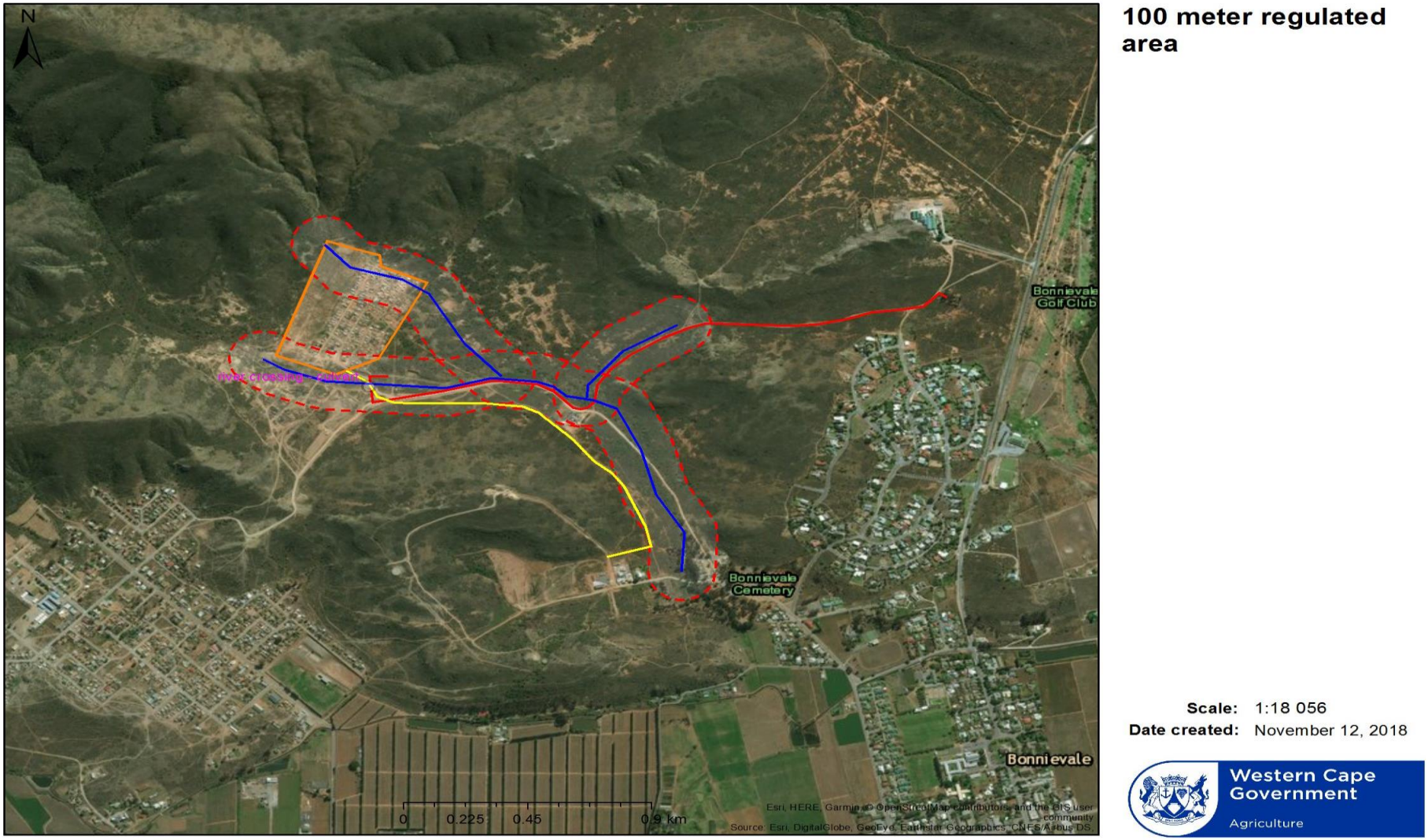

Figure 1: The water uses falling within the regulated zones that require authorization in terms of the National Water Act. **Orange Square – Upgrade of informal area; Yellow Line- Water Pipeline; Red line – Sewerage pipeline; Pink dot – culvert over non-perennial River.**

2. LEGISLATIVE REQUIREMENTS

National Water Act, 1998 (Act No. 36 of 1998)

The National Water Act guides the management of water in South Africa. The Act aims to regulate the use of water and activities that may impact on water resources through the categorisation of "listed water uses" encompassing water extraction and flow attenuation within catchments as well as the potential contamination of water resources, where the Department of Water and Sanitation (DWS) is the administering body in this regard. In terms of the proposed development and its nature, a specialist assessment is needed to provide Breede Gouritz Catchment Management Agency (BGCMA) as DWS administrator with the necessary information related to the proposed projects water uses and the potential impacts on the water resources of the area. It is the client's intention to register and license all water uses related to this project.

3. METHOD OF ASSESSMENT, ASSUMPTIONS AND LIMITATIONS OF THE STUDY

Input into the overall project was driven by the following Terms of Reference, which required the specialist to:

- Identify and describe freshwater ecosystems in the study area based on existing data and an onsite survey;
- Place freshwater ecosystems in a regional context and describe freshwater ecosystem-dependent fauna and flora species present;
- Classify, describe and map freshwater ecosystems in terms of their ecological sensitivity and functional value;
- Comment on and map freshwater ecosystem sensitivity in terms of ecologically important habitats, ecological corridors and linkages with other ecological systems;
- Undertake a site walk-down with other specialists,
- Identify potential impacts of the proposed project on freshwater ecosystems;
- Assess the direct, indirect and cumulative impacts (pre and post-mitigation) of the final location of infrastructure (and alternatives, if applicable) on freshwater ecosystems in the study area using the prescribed impact assessment methodology;
- Recommend practicable mitigation measures to avoid and/or minimise/reduce impacts and enhance benefits;

3.1. Freshwater Ecological Assessment sites and site selection

The sites were visually assessed. Intermediate Habitat Assessment Integrity Assessment (IHIA) the Riparian Vegetation Response Assessment (VEGRAI) and the Ecological Importance and Sensitivity (EIS) was used to assess the risks to the freshwater ecology at the impact area.

3.2. Visual Assessment of Aquatic Assessment Points

Each site was selected in order to identify current conditions, with specific reference to impacts from surrounding activities where applicable. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the systems identified, was identified by observing conditions and relating them to professional experience. Photographs of each site were taken to provide visual records of the conditions at the time of assessment. Factors which were noted in the site-specific visual assessments included the following:

- Upstream and downstream significance of each point, where applicable;
- Significance of the point in relation to the study area;
- stream morphology;
- instream and riparian habitat diversity;
- stream continuity;

- erosion potential;
- depth flow and substrate characteristics;
- signs of physical disturbance of the area; and
- other life forms reliant on aquatic ecosystems.

3.3. Intermediate Habitat Integrity Assessment (IHIA)

It is important to assess the habitat of riverine systems in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the sites was assessed based on the application of the Intermediate Habitat Integrity Assessment for (Kemper; 1999). The Intermediate Habitat Integrity Assessment (IHIA) protocol, as described by Kemper (1999), was used using the site specific application protocols. This is a simplified procedure, which is based on the Habitat Integrity approach developed by Kleynhans (1996). The IHIA is conducted as a first level exercise, where a comprehensive exercise is not practical. The Habitat Integrity of each site was scored according to 12 different criteria which represent the most important (and easily quantifiable) anthropogenically induced possible impacts on the system. The instream and riparian zones were analysed separately, and the final assessment was then made separately for each, in accordance with Kleynhans' (1999) approach to Habitat Integrity Assessment. Data for the riparian zone is, primarily interpreted in terms of the potential impact on the instream component. The assessment of the severity of impact of modifications is based on six descriptive categories with ratings. Analysis of the data was carried out by weighting each of the criteria according to Kemper (1999). By calculating the mean of the instream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitats of the sites. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F).

Table 1: Classification of Present State Classes in terms of Habitat Integrity [Based on Kemper 1999]

Ecological Category	**Description**	**Score (% of total)**
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A 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	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible.	0-19

3.4. Riparian Vegetation Response Assessment Index (VEGRAI)

Riparian vegetation is described in the NWA (Act No 36 of 1998) as follows: "riparian habitat" includes the physical structure and associated vegetation of the areas associated with a

watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans et al, 2007). Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Table 2: Descriptions of the A-F ecological categories

Ecological Category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A 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	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible.	0-19

The level of aquatic assessment undertaken was considered to be adequate for this study.

Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) of riparian areas is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on a local scale to a more broader scale; 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).

Table 3: List of the EIS categories used in the assessment tool (Kleynhans & Louw, 2007)

EISC	General description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of	>1-≤2

	biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	
Low/marginal	Quaternaries/delineations which are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 4: Rating scheme used for the assessment of riparian EIS (Kleynhans & Louw, 2007)

Score	Channel Type	Conservation context			Vegetation and Habitat Integrity	Connectivity	Threat status of Vegetation Type
0	Ephemeral Stream	Non-FEPA river	No status	None/ Excluded	No natural remaining	None	No Status
1	Stream non-perennial		Upstream management area	Available	Very poor	Very poor	Least threatened
2	Stream-perennial flow		Rehab FEPA		Poor	Low	Vulnerable
3	Minor river-non-perennial flow		Fish corridor	Earmarked for conservation	Moderately modified	Moderate	Near Threatened
4	Minor river-perennial flow		Fish support area		Largely natural	High	Endangered
5	Major river-perennial flow	FEPA river	River FEPA	Protected	Unmodified / natural habitat	Very high	Critically Endangered

4. RESULTS OF THE LITERATURE REVIEW

The site is located in the Breede River catchment (Department of Water and Sanitation (DWS) Primary Drainage Region H), within the Breede-Gouritz Water Management Area (WMA). This WMA falls under the administration of the BGCMA. The proposed water uses would pass through sections of the H50B quaternary catchment. H50B is drained primarily by the Breede River. The natural vegetation on site is classified as Breede Shale Renosterveld, Least Threatened (Terrestrial Areas) and Cape Lowland Alluvial, Critically Endangered (associated with the Non-perennial Rivers). The impacted areas are however mostly transformed and disturbed as a result of existing roads (formal and informal) and squatter activities.

Two biodiversity conservation mapping initiatives are of relevance to the freshwater ecosystems within the study area; the Western Cape Biodiversity Spatial Plan mapping initiatives that were undertaken on a regional basis and the National Freshwater Ecosystem Priority Areas (NFEPA) mapping initiative. No NFEPA rivers or wetland area was identified in the proposed impact area. The closest NFEPA is a Non-perennial River east of the town of Bonnievale which is a tributary of the Bree River which is situated south of Bonnievale (Refer to figure 1).

The Non-perennial River that will be impacted was identified as an Aquatic Ecological Support Area (ESA) and the terrestrial areas surrounding the impacted zones as Terrestrial Critical Biodiversity Areas (CBA) in the latest Western Cape Biodiversity Spatial Plan (2017).

The ESA identified are not essential for meeting biodiversity targets, but play an important role in supporting the functioning of protected areas or CBAs, and are often vital for delivering ecosystem services. The objective of these ESA's is to be maintained in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.

The CBA areas identified on site is areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure. The objective for these CBA areas is to maintain it in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

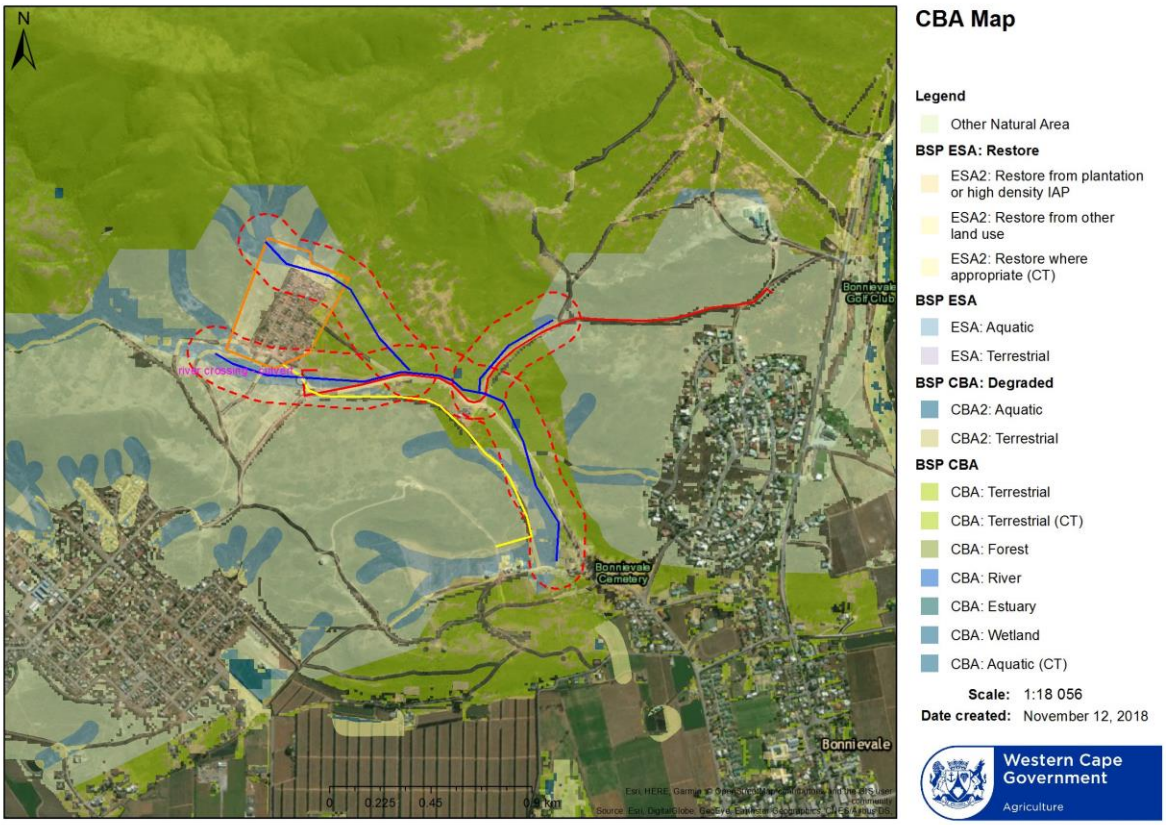

Figure 2: Western Cape Biodiversity Spatial Plan mapping initiative.

The non-perennial river on the southern side of the informal area will be impacted by the proposed developments:

- erven within the regulated area
- sewerage pipeline will cross twice
- sewage pump station
- the box culvert to be constructed at the river crossing
- water pipeline will cross once

This river starts west and north west of the impacted areas inside the mountains that surround the development. It flows in the catchment basin where the development is situated in an eastern and southern direction through the town of Bonnievale. The physiographical characteristics of the Ecoregion, in terms of terrain morphology, are typically characterised by a diverse topography of closed hills and mountains with a moderate to high relief (slopes with a gradient of >3.69 - 5% are predominant within the Ecoregion). The study area for the proposed development area is thus somewhat atypical of the Ecoregion within which it falls, being located in a relatively non-mountainous part of the landscape. The rainfall seasonality and the vegetation types that occur within the Ecoregion are highly variable. The climate of the study area can be referred to as a local steppe climate and classified as “BSk” (cold semi-

arid climate) with little rainfall throughout the year, according to Köppen- Geiger system[1]. This non-perennial river is not a tributary of the Bree River or connected to any other river system. It is the author's view that this river historically flooded out into the floodplain of the Bree River which is now transformed by cultivated vineyards and cultivated agricultural fields. The non-perennial river through the town of Bonnievale is formalised.

The same applies to the non-perennial river on the northern side of the informal area and this non-perennial river will be impacted by the erven within the regulated area.

Photo 1: Non-perennial River catchment and ecological condition immediately upstream of the proposed informal settlement, culvert and road construction.

The non-perennial river upstream of the proposed developments is impacted by small farming activities and is in a poor to moderate ecological state due to over grazing and silt removal that took place in the river. The natural vegetation in the water course is dominated by *Galenia Africana*. The non-perennial river in the impacted area and study area are crossed three times by formal and informal roads. The middle section of the non-perennial river were the sewerage pipeline will crosses it for the second time downstream of the informal settlement is in a good ecological state. The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.

Vachellia karoo is common and the dominant species in the river channel and valleys. The floodplain area is dominated by *Galenia africana*. From the relatively dense growth of shrubs within the floodplain, it is evident that the floodplain does not get inundated frequently.

[1] Schulze RE (ed) (2006). South African Atlas of Climatology and Agrohydrology. *WRC Report No. 1489/1/06*. Water Research Commission, Pretoria.

Photo 2: Non-perennial River in middle section of pipeline route.

The non-perennial river flows in between two hills before it enters the town of Bonnievale. The river at this point is of a poor ecological status impacted by residential activities and Eucalyptus trees.

Photo 3: Lower catchment area of the Non-perennial River before it enters the town of Bonnievale.

5. FRESHWATER ECOLOGICAL ASSESSMENT RESULTS

A photographic record of each site was made in order to provide a visual record of the condition of each assessment site as observed during the field assessment. The photographs taken are presented, followed by a table summarising the observations for the various criteria made during the visual assessment undertaken at each point.

5.1 Activities Impacting on the Non-Perennial River

5.1.1. Culvert and road upgrade, sewerage and water pipeline crossing the non-perennial river next to the informal area to be upgrade.

Photo 4: Propose upgrade of road crossing and informal area.

Photo 5: Informal road to be upgraded with culvert.

Photo 6: Downstream view of culvert crossing.

Photo 7: Upstream view of culvert crossing.

Table 5: Descriptions of the location of proposed culvert and road crossing in relation to mapped non-perennial river

Characteristics	Impacted site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the infrastructure will cross the non-perennial river.	The site is situated upstream where the infrastructure will cross the non-perennial river.	The site is situated downstream where the infrastructure will cross the non-perennial river.

Riparian zone characteristics	The riparian zone at this point is totally destroyed and consists of an informal road.	Limited riparian at this point and it is impacted by small farming activities and silt removal that took place in the river. The natural vegetation in the water course is dominated by *Galenia Africana*.	Limited riparian at this point and it is dominated by pioneer plants and *Galenia Africana.*
Depth characteristics	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.
Flow conditions	No water was flowing during time of site visit.	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Water clarity	No water was flowing during time of site visit.	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Stones habitat characteristics	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.
Vegetation habitat characteristics	None. Informal road surface	Limited riparian at this point and it is impacted by small farming activities and silt removal that took place in the river. The natural vegetation in the water course is dominated by *Galenia Africana*.	Limited riparian at this point and it is dominated by pioneer plants and *Galenia Africana.*
Other habitat characteristics	None as result of informal road.	The non-perennial river upstream of the proposed developments is impacted by small farming activities and is in a poor to moderate ecological state due to over grazing and silt	The non-perennial river upstream of the proposed developments is impacted by small farming activities and is in a poor to moderate ecological

		removal that took place in the river.	state due to over grazing and silt removal that took place in the river.
Erosion potential	Low erosion potential if the proposed mitigation measures below are implemented.	Low erosion potential if the proposed mitigation measures below are implemented.	Low erosion potential if the proposed mitigation measures below are implemented.

5.1.2. Non-perennial river where sewerage pipeline will cross for the second time

Photo 8: Upstream view of proposed sewerage pipeline crossing.

Photo 9: Downstream view of proposed sewerage pipeline crossing.

Photo 10: Proposed sewerage crossing.

Photo 11: Proposed sewerage crossing. Non-perrenial river vissible on the left of picture.

Table 6: Descriptions of the location of sewerage pipe in relation to mapped non-perennial river

Characteristics	Impact site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of

	impacts on the surrounding area.		impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the sewerage pipeline will cross the non-perennial river.	The site is situated upstream where the pipeline will cross the non-perennial river.	The site is situated downstream where the pipeline will cross the non-perennial river.
Riparian zone characteristics	The riparian zone at this point is destroyed as a result of an informal road crossing.	*Vachellia karoo* is common and the dominant species in the river channel and valleys. The floodplain area is dominated by *Galenia africana*.	*Vachellia karoo* is common and the dominant species in the river channel and valleys. The floodplain area is dominated by *Galenia africana*.
Depth characteristics	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.
Flow conditions	No water was flowing during time of site visit. From the relatively dense growth of shrubs within the floodplain, it is evident that the floodplain does not get inundated frequently.	No water was flowing during time of site visit. From the relatively dense growth of shrubs within the floodplain, it is evident that the floodplain does not get inundated frequently.	No water was flowing during time of site visit. From the relatively dense growth of shrubs within the floodplain, it is evident that the floodplain does not get inundated frequently.
Water clarity	No water was flowing during time of site visit.	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Stones habitat characteristics	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.	The potentially affected river reach is characterised by a single channel, approximately 10 to 20m wide at this point, which has a bed comprising mostly sand that covers alluvial rocks.
Vegetation habitat characteristics	None. Informal road surface.	*Vachellia karoo* is common and the	*Vachellia karoo* is common and the

		dominant species in the river channel and valleys. The floodplain area is dominated by *Galenia africana*.	dominant species in the river channel and valleys. The floodplain area is dominated by *Galenia africana*.
Other habitat characteristics	*Vachellia karoo* is common and the dominant species in the river channel and valleys. The floodplain area is dominated by *Galenia africana*.	*Vachellia karoo* is common and the dominant species in the river channel and valleys. The floodplain area is dominated by *Galenia africana*.	*Vachellia karoo* is common and the dominant species in the river channel and valleys. The floodplain area is dominated by *Galenia africana*.
Erosion potential	Low erosion potential if the proposed mitigation measures below are implemented.	Low erosion potential if the proposed mitigation measures below are implemented.	Low erosion potential if the proposed mitigation measures below are implemented.

5.2 Habitat Assessment Of The Whole Non-Perennial River

Instream Habitat Integrity

Weights	14	13	13	13	14	10	9	8	6		
REACH	Water abstraction	Flow modification	Bed modification	Channel modification	Water quality	Inundation	Exotic macrophytes	Exotic fauna	Solid waste disposal	Total Score (%)	Classification
Impacted Site	0	18	18	18	3	2	2	2	2	67.6	C: Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.

None	Small	Moderate	Large	Serious	Critical

Riparian Zone Habitat Integrity

Weights	13	12	14	12	13	11	12	13		
REACH	Vegetation removal	Alien encroachment	Bank erosion	Water abstraction	Flow modification	Channel modification	Water quality	Inundation	Total Score (%)	Classification
Impacted Site	4	3	3	0	18	18	2	2	75.52	C: Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.

None	Small	Moderate	Large	Serious	Critical

From the results of the application of the IHIA to the impacted site, it is evident that the rivers reach is modified and that the loss of natural habitat, biota and basic ecosystem functions is extensive. Instream impacts included a large impact from flow modifications, inundation as well as bed and channel modifications. Overall, the site achieved a 67.6 % score for instream integrity.

Riparian impacts included a large impact from flow modifications, and bed and channel modifications. Overall, the site achieved a 75.2 % score for instream integrity.

The site obtained an overall IHIA rating of 71. 4%, which indicates the loss of natural habitat, biota and basic ecosystem functions is moderate. (Class C conditions).

5.3. Riparian Vegetation Response Assessment Index (VEGRAI)

Table 8: The overall VEGRAI score of the impacted area

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	60,0	22,5	3,3	2,0	60,0
NON MARGINAL	70,0	43,8	3,5	1,0	100,0
2.0					160,0
LEVEL 3 VEGRAI (%)				66,3	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				3,4	

The score attained for the VEGRAI indicated that the riparian system falls into the category C.

This indicates that the loss of natural habitat, biota and basic ecosystem functions is moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.

5.4. Ecological Importance and Sensitivity (EIS)

Table 9: Results of the EIS assessment for the affected watercourse

Component	Score	Confidence	Comments/description
Channel type	3	5	Channelled non-perennial river.
Conservation context	0	5	No Status
Vegetation and habitat Integrity	3	5	Largely modified
Connectivity	0	5	Not connected. Downstream connection is lost.
Threat Status of Vegetation Type	5	5	Vegetation has endangered conservation status
EIS Category	**2.2**		**High Importance**

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale. The median of the resultant score is calculated to derive the EIS category.

The non-perennial river is considered to be of high ecological importance.

6. TERRESTRIAL ECOLOGICAL ASSESSMENT (BOTANICAL) RESULTS

Sections of the proposed sewerage and water pipelines are located in a Critical Biodiversity (CBA) and Ecological Support areas (ESA). The sections of the proposed infrastructure inside the CBA and ESA identified areas is however disturbed with no to limited vegetation cover as a result of the road infrastructure. The pipelines will be constructed in the informal roads and the reserves that will result to no or limited vegetation clearing. The last north eastern section of the sewerage pipeline to be constructed will impact on a small section of indigenous vegetation. No threatened or protected species or conservation worthy plants were recorded in this section.

Photo 16: Terrestrial Ecology section impacted by the sewerage pipeline construction

7. IMPACT ASSESSMENT OF THE ACTIVITIES

Nature of impact: Loss of freshwater ecology habitat
Discussion: Habitat destruction is the alteration of a natural habitat to the point that it is rendered unfit to support the species dependent upon it as their home territory. Many organisms previously using the area are displaced or destroyed, reducing biodiversity. Modification to habitats as a result of small scale farming activities and roads with the total transformation of the non-perennial river downstream through Bonnievale town are the main causes of habitat destruction in this case. Additional causes of habitat destruction include overgrazing. The non-perennial riverine systems have very low flows as part of their annual hydrological cycles and are particularly susceptible to changes in habitat condition. The proposed development project has the potential to lead to habitat loss and/or alteration of the aquatic and riparian resources on the study area. It is however important to note that the freshwater ecology, and especially aquatic habitats of most of the systems has been seriously to critically impaired or impacted already as a result of existing infrastructure and as such the risk to the receiving environment as a result of the proposed project is reduced to some degree.

Cumulative impacts:

Riparian zone

Earthworks in the vicinity of drainage systems leading to increased runoff and erosion and altered runoff patterns.
Construction of the pipelines and culverts altering stream flow patterns and water velocities.
Alien invasive vegetation encroachment.
Erosion and incision of riparian zone.

Instream zone

Loss of aquatic refugia.
Altered substrate conditions due to the deposition of silt
Altered depth and flow regimes in the major drainage systems
Alien vegetation proliferation

Mitigation:

Essential mitigation measures:

- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of aquatic habitats in the area.
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the project;
- On-going aquatic ecological monitoring must take place on a 6 monthly basis by a suitably qualified assessor.

Recommended mitigation measures

- Permit only essential construction personnel within 32m of all riparian systems;
- Restrict construction activities to the drier summer months, if possible, to avoid sedimentation and siltation of riparian features in the vicinity of the proposed development and aim for completion in early spring at which time revegetation should take place allowing for a full summer growing season to become established.

Criteria	Without Mitigation	With Mitigation	No-Go Alternative Without Mitigation	With Mitigation
Extent	2	1	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	5	5		
Magnitude	2	2		
Probability	4	2		
Significance	36-Medium	16-Low		
Status	Medium significance if not mitigated	No significance if mitigated		
Reversibility	0%			
Irreplaceable loss of resources	2- Partly Replaceable			
Can impacts be mitigated?	2-Partly, but impact on subsurface geological layers during excavations is inevitable.			

Nature of impact:

Disturbance to subsurface geological layers.

Discussion:

Construction and excavation activities will affect the underlying geological layers on site to some extent.

Cumulative impacts:

It is not anticipated that the impact will be high as the affected substrata is very shallow and the integrity of the underlying ground structures will thus not be sacrificed.

Mitigation:
Due to the nature of the impacts, not much can be done to mitigate the impact, only the severity of it can be managed. Mitigation and management for affecting geology is to ensure that removal of soil is kept to a minimum – removal of soil should only be in areas where infrastructure will be established. Disturbance through the river must preferably be in summer and definitely not when the river flows. The pipe and culvert must be laid and constructed and the area compacted in one time and the area must be immediately filled, shaped, compacted and rehabilitated.

Criteria	Without Mitigation	With Mitigation	No-Go Alternative Without Mitigation	With Mitigation
Extent	2	1	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	5	5		
Magnitude	2	2		
Probability	4	2		
Significance	36-Medium	16-Low		
Status	Medium significance if not mitigated	No significance if mitigated		
Reversibility	0%			
Irreplaceable loss of resources	2- Partly Replaceable			
Can impacts be mitigated?	2-Partly, but impact on subsurface geological layers during excavations is inevitable.			

Nature of impact:
Degradation / loss of naturally occurring / indigenous flora and habitats.

Discussion:
Special precaution is to be taken during the construction of the infrastructure that falls within the regulated area as determined in the NWA. Construction activities must be controlled to ensure that the river and its buffer areas are not negatively impacted.

Cumulative impacts:
Loss of significantly impacted upon vegetation and habitat.

Mitigation:

- Undertake construction activities only in identified and specifically demarcated areas.
- Invasive vegetation to be removed during construction to be disposed of at landfill site in such a manner that seeds must not be able to spread from the disposal site or during transportation.
- At no point may construction equipment stand unauthorised within or near the river.
- All excess sediment removed from the watercourses must be utilised as part of the building activities or be removed from site. At no point may this material be dumped on site or within any of the other freshwater features identified within the surrounding area. Topsoil will have a high density of alien invasive seeds which will need to be controlled into the operational phase.
- One culvert crossings are proposed over the river to gain access. Care must be taken when constructing the culverts to ensure that the design accommodates a 1 in 100 year flood event and that the base levels are maintained so that no erosion or ponding of water occurs surrounding the crossing.
- Soil surrounding the wingwalls must be suitably backfilled and sloped (minimum of a 1:3 ratio) and concrete aprons as well as gabion mattresses should be installed both up and downstream for energy dissipation and sediment trapping.
- All soils within the river surrounding the culvert must be loosened on completion of works to allow for revegatation.

Criteria	Without Mitigation	With Mitigation	No-Go Alternative	
			Without Mitigation	With Mitigation
Extent	3	2	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	2	1		
Magnitude	4	2		
Probability	4	2		
Significance	36 - Medium Significance	10 - Low Significance		
Status	Medium significance if not mitigated	No significance if mitigated		
Reversibility	30%	70%		
Irreplaceable loss of resources	2 - Resource may be partly destroyed			
Can impacts be mitigated?	2 - Partly mitigable			

Nature of impact:
Damage to existing infrastructure.

Discussion:
Construction activities will impact upon existing sewer pipelines that may occur along the pipeline route as well as when connected to the existing sewer line.

Cumulative impacts:
Damage or loss of existing infrastructure. Damage and loss of private property adjacent to the proposed activity. Spillage of sewerage into the natural environment.

Mitigation:

- Care should be taken when conducting construction activities in close proximity to infrastructure and private property;
- Should any damage occur to existing infrastructure or private property as a result of construction activities; the relevant service provider / landowner must be contacted and the repair/replacement must be commissioned to the satisfaction of the service provider / landowner. Should spillage occur, the BGCMA and DEA&DP: Pollution and chemical management directorate must be informed immediately.

Criteria	Without Mitigation	With Mitigation	No-Go Alternative	
			Without Mitigation	With Mitigation
Extent	3	2	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	1	1		
Magnitude	2	0		
Probability	4	3		
Significance	24 - Low Significance	9 - Low Significance		
Status	Low Significance if not mitigated	No significance if mitigated		
Reversibility	90%			
Irreplaceable loss of resources	1 - Resource will not be lost			
Can impacts be mitigated?	1 - Completely mitigable			

Nature of impact:
Waste management.

Discussion:
General construction waste will be generated during the construction phase. Poor waste management practices on site may lead to dumping and windblown litter creating a negative visual impact and nuisance for adjacent landowners / users as well as impacting the natural environment.

Cumulative impacts:
- Dumping;
- Windblown litter causing nuisance;
- Pollution / degradation of the natural environment.

Mitigation:
- All waste generated on site shall be collected and disposed of at a registered landfill facility;
- All safe disposal certificates and waste manifests from service providers to be kept and maintained;
- All staff to receive training on correct waste management practices.

Criteria	Without Mitigation	With Mitigation	No-Go Alternative	
			Without Mitigation	With Mitigation
Extent	2	1	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	2	1		
Magnitude	2	2		
Probability	3	2		
Significance	18 - Low Significance	8 - Low Significance		
Status	Low Significance if not mitigated	No significance if mitigated		
Reversibility	90%			
Irreplaceable loss of resources	1 - Resource will not be lost			
Can impacts be mitigated?	1 - Completely mitigable			

Nature of impact:
Infrastructure failure.

Discussion:
Infrastructure failure will result in the spillage of raw sewerage into the receiving environment.

Cumulative impacts:
Pollution of the receiving environment as well as offensive odours from the spillage causing a nuisance to adjacent landowners / users.

Mitigation:
- Regular inspection and maintenance of the sewer pipeline.
- Infrastructure failure reported or identified to be fixed as a priority.
- Spillage of raw sewerage to be mitigated and remediated where required.
- Should any damage occur to existing infrastructure or private property as a result of construction activities; the relevant service provider / landowner must be contacted and the repair/replacement must be commissioned to the satisfaction of the service provider / landowner. Should spillage occur, the BGCMA and DEA&DP: Pollution and chemical management directorate must be informed immediately.

Criteria	Without Mitigation	With Mitigation	No-Go Alternative	
			Without Mitigation	With Mitigation
Extent	3	2	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	2	1		
Magnitude	4	4		
Probability	2	2		
Significance	18 - Low Significance	14 - Low Significance		
Status	Low Significance	Low Significance		
Reversibility	60%			
Irreplaceable loss of resources	2 - Resources may be partly destroyed			
Can impacts be mitigated?	2 - Partially			

Cumulatively, if adequately mitigated the potential impacts of the proposed activities to be undertaken will be of low negative significance and will in the short term just require some rehabilitation of the disturbed areas and longer term monitoring and control of the growth of alien invasive plants, erosion and waste accumulation.

8. CONCLUSION

Eco Impact Legal Consulting (Pty) Ltd was appointed to undertake a Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) analysis of the freshwater and riparian resources as part of the Water Use Authorization application.

The proposed project form part of service delivery to the proposed upgrade of the informal settlement project and the upgrade of water and sewerage pipelines and new road crossing is required.

Based on the impact assessment it is evident that there are six possible impacts on the freshwater ecology of the area observed. In considering the impacts and mitigation, it is assumed that a high level of mitigation will take place without high prohibitive costs. From the table it is evident that prior to mitigation, the impacts on the loss of freshwater ecology habitat, disturbance to subsurface geological layers, degradation / loss of naturally occurring / indigenous flora and habitats are medium level impacts, which can be mitigated and will be reduced to low level impacts. The other tree impacts identified all has low impacts that is reduce to very low with the proposed mitigation measures.

Habitat Assessment

From the results of the application of the IHIA to the impacted site, it is evident that the rivers reach is modified and that the loss of natural habitat, biota and basic ecosystem functions is extensive. Instream impacts included a large impact from flow modifications, inundation as well as bed and channel modifications. Overall, the site achieved a 67.6 % score for instream integrity.

Riparian impacts included some impact from flow modifications, as well as bed and channel modifications. Overall, the site achieved a 75.2 % score for instream integrity.

The site obtained an overall IHIA rating of 71. 4%, which indicates the loss of natural habitat,

biota and basic ecosystem functions is moderate (Class C conditions).

Riparian Vegetation Response Assessment Index (VEGRAI)

The score attained for the VEGRAI indicated that the riparian system falls into the category C. This indicates that the loss of natural habitat, biota and basic ecosystem functions is moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.

Ecological Importance and Sensitivity (EIS)

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale. The median of the resultant score is calculated to derive the EIS category.

The non-perennial river is considered to be of high ecological importance.

This assessment concluded that the proposed development can be authorized provided that the mitigation measures are included in the Environmental Management Programme, monitored by an Environmental Control Officer and adhered to. The ESA will be maintained in a functional, near-natural state if the mitigation measures are adhered to. Some habitat loss will occur which is acceptable. The underlying biodiversity objectives and ecological functioning will not be compromised. The terrestrial ecology loss is limited and of low significant as a result of the proposed location inside the informal gravel tract and the sections of vegetation to be disturbed is limited and outside any CBA or ESA area.

The CBA will be maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas will be rehabilitated.

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APPENDIX A: ABBREVIATED CURRICULUM VITAE AND DECLARATION OF INDEPENDENCE OF FRESHWATER SPECIALIST

Name:	Nicolaas Willem Hanekom (Pri.Sci.Nat)
Profession:	Ecological Scientist
Nationality:	South African
Years' experience	26 Years
Academic Qualifications	• National Diploma, Nature Conservation (Cape Technikon) • B. Tech Degree in Nature Conservation (Cape Technikon) • M.Tech in Nature Conservation (Cape Peninsula University of Technology) • Completed various Environmental Management Courses • Qualified Environmental Management System ISO 14001: 2004 Audit: Internal Auditor Course Based on ISO 19011:2002 (Centre for Environmental Management North West University)
Areas of specialisation:	• Ecosystem (terrestrial and aquatic) monitoring and assessments • Design of monitoring programmes for ecosystems (terrestrial and aquatic) • Environmental Impact Assessments • River classification and environmental water requirements • Wetlands Delineation • River and Wetlands management • Water Use Authorization Applications • Water quality management • River Health Assessments
Countries of Work Experience:	South Africa (Northern Cape, Western Cape, Free State, Mpumalanga, Gauteng)
Employment Record	• Student at Bontebok National Park (1992) • Assistant Reserve Manager at Gariep Dam Nature Reserve, Free State (1993 - 1998) • Reserve Manager, Conservation Services Manager for Western Cape Nature Conservation Board (1998 - 2006) • External Lecturer at Cape Peninsula University of Technology (2003 - 2005) • Director: Environmental Management at Cape Lowlands Environmental Services (2006 – 2010) • Director, Environmental Management and lead Environmental Impact Assessment Practitioner at Eco Impact (Pty) Ltd (2010 – to date)
Professional membership, accreditations and courses	• South African Council for Natural Scientists Professions Pri.Sci.Nat (Ecological Science) • Riparian vegetation identification and health assessment. Internal Western Cape Nature Conservation short course presented by Dr C Boucher (Stellenbosch University) in 2000. • SASS5 Aquatic Biomonitoring Training Course. 2 to 5 September 2013. Ground Truth Water and Environmental Engineering consultancy in partnership with the Department of Water Affairs. • Workshop on "Section 21(c) and (i) Water Use Training: Understanding Watercourses and Managing Impacts to their Characteristics". 10 May 2017. Presented by Dr Wietsche Roets of the Department of Water and Sanitation (Sub-Directorate: Instream Water Use).

Summary of experience	1992: South African National Parks. Student at Bontebok National Park with management and monitoring actions related to the Breede River. 1993 -1998: Free State Nature Conservation. Ecological management and monitoring actions related to the Gariep Dam, Orange and Caledon Rivers. 1998 -2006: CapeNature. Ecological management and monitoring actions related to the Berg River Estuary, Verlorenvlei, Lamberts bay's Jackalsvlei, Wadrift Soutpanne, Oliphant's River mouth, Rocherpan Nature Reserve, etc. Review and assessment of EIA applications, inclusive of Freshwater ecology. Did some site visits with Department of Water Affairs and Forestry (Hester Lyons) to confirm the presence of aquatic ecological features during EIA water use registration applications. 2006 to date: Cape Lowland Environmental Services and Eco Impact Legal Consultant. Ecological (Freshwater and aquatic) Specialist input, assessment, monitoring and reports.
Publications and assessment reports	Just to name a few. Was involved in many Ecological Assessments, monitoring and inputs in EIA applications. • Elandskloof Farm 475 Citrusdal Biodiversity Baseline Survey. August 2010. This Biodiversity Assessment Covering Terrestrial and Aquatic Aspects to Inform Decisions Regarding The Proposed Elandskloof Weir Flood Damage Project On Farm 475, In The Citrusdal Area. • Cape Solar Energy Electricity Generation Facility. Farm 187/3 & 187/13 Kenhardt. Biodiversity And Ecological Baseline Survey. January 2011. (Included Terrestrial and aquatic ecological assessments and water use authorization applications) • Prieska Photvoltaic Power Generation Project. Prieska Commonage Northern Cape. Biodiversity And Ecological Baseline Survey. July 2011. (Included Terrestrial and aquatic ecological assessments and water use authorization applications) • Witteklip Erf 123 Extension, Vredenburg. Biodiversity Baseline Survey. Updated - October 2012 (Included Terrestrial and aquatic ecological assessments and water use authorization applications) • Baseline Biodiversity Survey And Wetland Delineation for ECCA Holdings: Cape Bentonite Mine on Erf 1412 Near Heidelberg. Prepared for: Shangoni Management Services Pry (Ltd). October 2014. • Freshwater Impact Assessment Laingsburg Flood Damage Repairs & Storm Water Infrastructure. 18 February 2016. • Ecological Assessment for Swartland Municipality - Upgrades To Voortrekker/Bokomo Road And Voortrekker/Rozenburg Road Intersections and Upgrade to the Diep River Bridge, Malmesbury on A Portion Of Erf 327, Malmesbury (Road) Erf 1530, Diep River Bridge Crossing, and Erf 1528, Property South of Diep River where Road Widening and Turning Circle Will Be Constructed. March 2016. (Freshwater Ecology Inputs and Water Use Registration) • Freshwater Impact Assessment. McGregor Bridge, Robertson Bridge and Willem Nels River Maintenance Management Plan. 24 June 2016. (Freshwater Ecology assessment and input as well as Water Use Registration)

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