Widening of Conrad Bridge, City of Johannesburg, Gauteng.

Wetland/Riparian Delineation and Functional Assessment
June 2015

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- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
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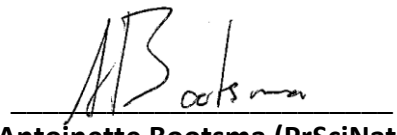

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10.06.2015
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Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as information available at the time of study. Therefore the author reserves the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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EXECUTIVE SUMMARY

Limosella Consulting was appointed by Envirolution Consulting to undertake a wetland and/or riparian delineation and functional assessment for the proposed widening of Conrad Road, bridge and associated roads and lanes, located in Randburg, City of Johannesburg, Gauteng Province.

The terms of reference for the study were as follows:

- Delineate the wetland/riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake the functional assessment of wetlands/riparian areas within the area assessed;
- Recommend suitable buffer zones; and
- Discuss potential impacts, mitigation and management procedures relevant to the conserving wetland/riparian areas on the site.

One riparian area was recorded on site. The stream currently flows from south to north. It is likely that this riparian area previously had characteristics similar to a valley bottom wetland and that the increased urbanisation has led to an increase in water flow into the stream which ultimately reshaped the stream and now shares more characteristics with a river than a wetland.

The EIS score of 1.0 falls into a category characterised by **Moderate** ecological importance and sensitivity. These watercourses are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers

The riparian area is greatly disturbed by current and historical anthropogenic activities as well as increase urbanisation and associated increased in hardened surfaces within the catchment. The vegetation cover of the riparian is therefore largely different from historical conditions and the majority of the woody and the non-woody vegetation is exotic. The combined EC scores for the riparian area on the study site is an **E - Seriously modified**. The loss of natural habitat, biota and basic ecosystem functions is extensive. The combined QHI score for the riparian area on the study site is an **E - Seriously modified**. The loss of natural habitat, biota and basic ecosystem functions is extensive. Mitigation and rehabilitation discussed in the accompanying report (Limosella 2015) should be closely implemented and monitored in order to prevent further degradation of this (and downstream) section of the Braamfontein Spruit.

Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (Regulation 1199 of 2009 in terms of the National Water Act, 1998). Development activities close to wetlands are excluded from General Authorisation (GA) for Section 21 (c) and (i) water uses (published in Government Gazette No. 389). In this instance the Department of Water Affairs should be contacted regarding the application for a Water Use License.

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1 INTRODUCTION

The City of Johannesburg has identified that Conrad Bridge in Blairgowrie, Randburg needs to be widened to improve traffic flow as well as to resolve bank erosion of the Braamfonteinspruit.

Limosella Consulting was appointed by Envirolution Consulting to undertake a wetland and/or riparian delineation and functional assessment for the proposed widening of Conrad Bridge which is located in Randburg, City of Johannesburg, Gauteng Province. Fieldwork was conducted on the 28th of May 2015.

1.1 Terms of Reference

The terms of reference for the study were as follows:

- Delineate the wetland/riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake the functional assessment of wetlands and/or riparian areas within the area assessed;
- Recommend suitable buffer zones; and
- Discuss potential impacts, mitigation and management procedures relevant to the conserving wetland/riparian areas on the site.

1.2 Assumptions and Limitations

The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during the course of converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.

Furthermore, the assessment of wetlands is based on environmental indicators such as vegetation, that are subjected to seasonal variation as well as factors such as fire and drought. Although background information was gathered, the information provided in this report was mainly derived from what was observed on the study site at the time of the field survey. A Red Data scan, fauna and flora, and aquatic assessments were not included in the current study. Description of the depth of the regional water table and geohydrological processes falls outside the scope of the current assessment.

1.3 Definitions and Legal Framework

This section outlines the definitions, key legislative requirements and guiding principles of the wetland study and the Water Use Authorisation process.

The National Water Act, 1998 (Act No. 36 of 1998) [NWA] provides for Constitutional water demands including pollution prevention, ecological and resource conservation and sustainable utilisation. In terms of this Act, all water resources are the property of the State and are regulated by the Department of Water Affairs (DWA). The NWA sets out a range of water use related principles that are to be applied by DWA when taking decisions that significantly affect a water resource. The NWA defines a water resource as including a watercourse, surface water, estuary or aquifer. A watercourse includes a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake, pan or dam, into which or from which water flows; any collection of water that the Minister may declare to be a watercourse; and were relevant its beds and banks.

The NWA defines a wetland as "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil." In addition to water at or near the surface, other distinguishing indicators of wetlands include hydromorphic soils and vegetation adapted to or tolerant of saturated soils (DWA, 2005).

Riparian habitat often perform important ecological and hydrological functions, some similar to those performed by wetlands (DWA, 2005). Riparian habitat is also the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005). It is defined by the NWA 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".

Water uses for which authorisation must be obtained from DWA are indicated in Section 21 of the NWA. Section 21 (c) and (i) is applicable to any activity related to a wetland:
Section 21(c): Impeding or diverting the flow of water in a watercourse; and
Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

Authorisations related to wetlands are regulated by Government Notices R.1198 and R.1199 of 18 December 2009. GN 1198 and 1199 of 2009 grants General Authorisation (GA) for the above water uses on certain conditions:
GN R.1198: Any activity in a wetland for the rehabilitation of a wetland for conservation purposes.
GN R.1199: Any activity more than 500 m from the boundary of a wetland.

These regulations also stipulate that these water uses must the registered with the responsible authority. Any activity that is not related to the rehabilitation of a wetland and which takes place within 500 m of a wetland are excluded from a GA under either of these regulations. Wetlands situated within 500 m of

proposed activities should be regarded as sensitive features potentially affected by the proposed development (GN 1199). Such an activity requires a Water Use Licence (WUL) from the relevant authority.

In addition to the above, the proponent must also comply with the provisions of the following relevant national legislation, conventions and regulations applicable to wetlands and riparian zones:

- Convention on Wetlands of International Importance - the Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP).
- National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA].
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- National Environment Management Protected Areas Act, 2003 (Act No. 57 of 2003).
- Regulations GN R.982, R.983, R. 984 and R.985 of 2014, promulgated under NEMA.
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983).
- Regulations and Guidelines on Water Use under the NWA.
- South African Water Quality Guidelines under the NWA.
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 287 of 2002).

1.4 Locality of the study site

The section of Conrad Road which is proposed to be upgraded is the bridge area. Conrad Bridge is located between the suburbs of Oeder Park in the North, Blairgowrie in the west and Craighall Park in the east (Figure 1). The approximate coordinates of the bridge are 26° 6'51.41"S and 28° 1'9.46"E.

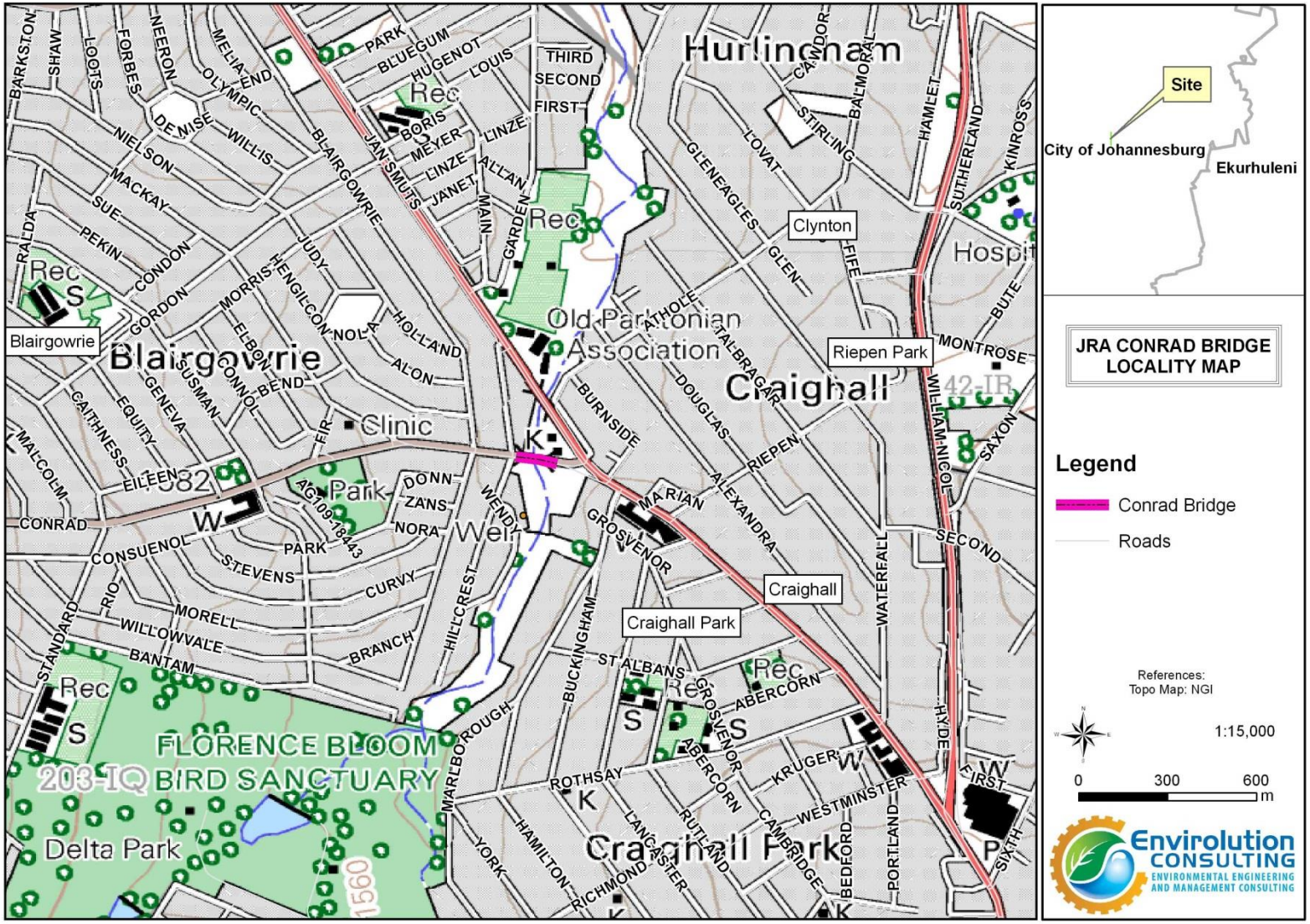

Figure 1: Locality Map

1.5 Description of the Receiving Environment

A review of available literature and spatial data formed the basis of a characterisation of the biophysical environment in its theoretically undisturbed state and consequently an analysis of the degree of impact to the ecology of the study site in its current state.

Quaternary Catchments:

As per Macfarlane et al, (2009) one of the most important aspects of climate affecting a wetland's vulnerability to altered water inputs is the ratio of Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) (i.e. the average rainfall compared to the water lost due to the evapotranspiration that would potentially take place if sufficient water was available).The site is situated in the Quaternary Catchment A21C, Water Management Area 3 (Crocodile Marico) and drains into the Jukskei River. In this catchment, the precipitation rate is lower than the evaporation rate with a Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) of 0.31. Consequently, watercourses in this area are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

Regional Vegetation:

According to the Vegetation Map of South Africa, Lesotho and Swaziland, the site is situated in the Egoli Granite Grassland, a protected grassland type currently under severe pressure from urbanisation (Mucina & Rutherford, 2006). Where transformation has altered the plant species community structure of Egoli Granite Grassland, by for example agriculture or urbanisation, this grassland type is no longer conservation worthy as an entity, although specific rare, or medicinally valuable bulb species may still be recorded. In its disturbed state, the vegetation is usually dominated by the grass *Hyparrhenia hirta*.

Geology and soils:

The site is underlain by the Halfway House Granite (GDACE, 2002). Soils are classified as unconsolidated referring to an Anthropic subgroup (disturbed deposits). In this soil form, the soil structure has been sufficiently disturbed by anthropogenic activities to have lost any recognisable subsoil layers that might have been present (Fey, 2005).

Hydrology:

The GDARD (Gauteng Department of Agriculture and Rural Development) spatial layer indicates a watercourse classified as the Braamfontein Spruit flowing under the bridge as well as extending farther north towards the south east (Figure 2).

Gauteng Conservation Plan

The Gauteng Conservation Plan (Version 3.3) (GDARD, 2011) classified areas within the province on the basis of its contribution to reach the conservation targets within the province. Critical Biodiversity Areas (CBAs) contain irreplaceable, important and protected areas (terms used in C-Plan 2) and are areas needed to reach the conservation targets of the Province. In addition 'Ecological Support Areas' (ESAs), mainly around riparian areas and other movement corridors were also classified to ensure sustainability in the long term. Landscape features associated with ESAs is essential for the maintenance and generation of biodiversity in sensitive areas and requires sensitive management where incorporated into C-Plan 3.

The majority of the proposed road is located on both important areas and ecological support areas(Figure 3).

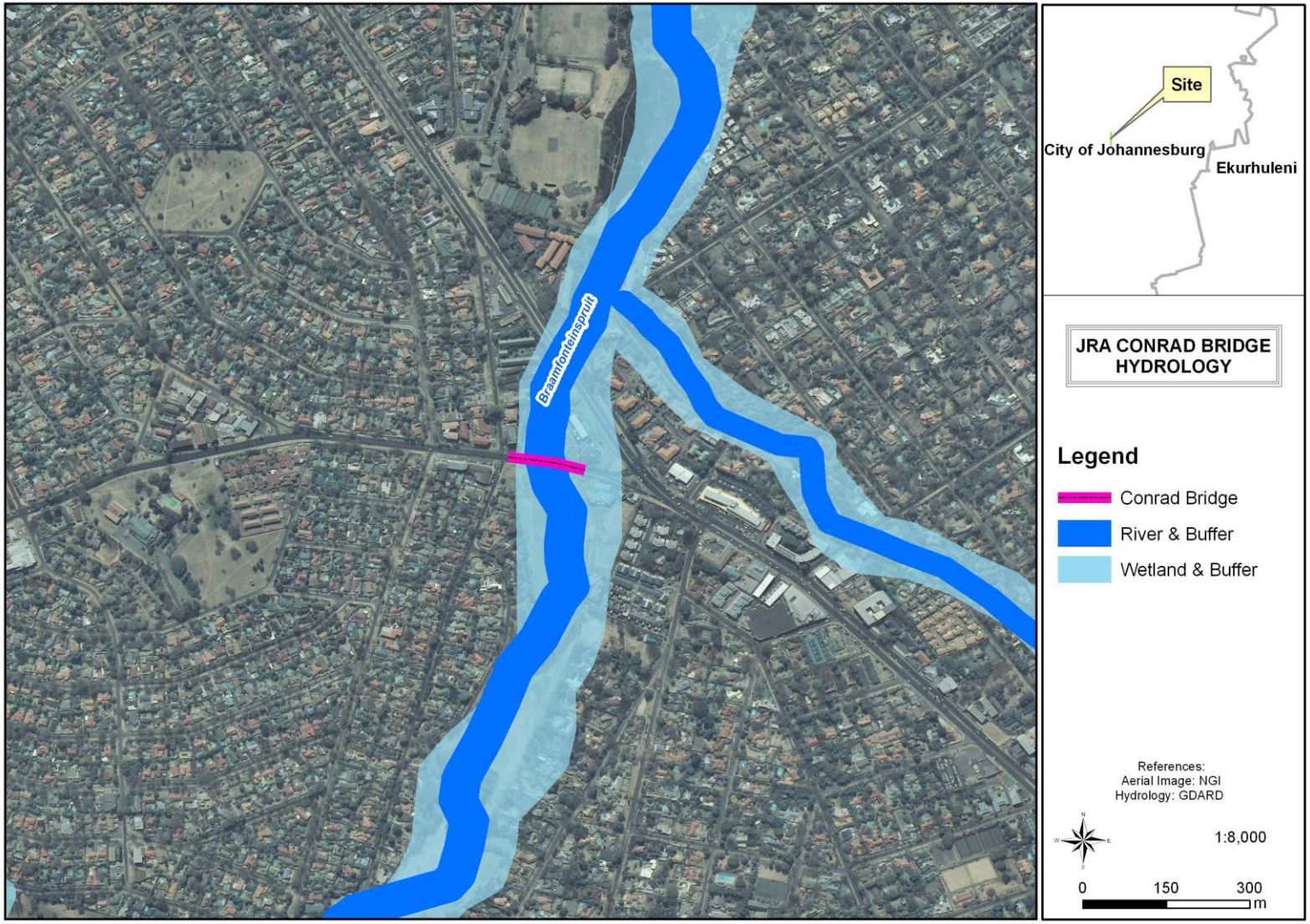

Figure 2: Regional hydrology

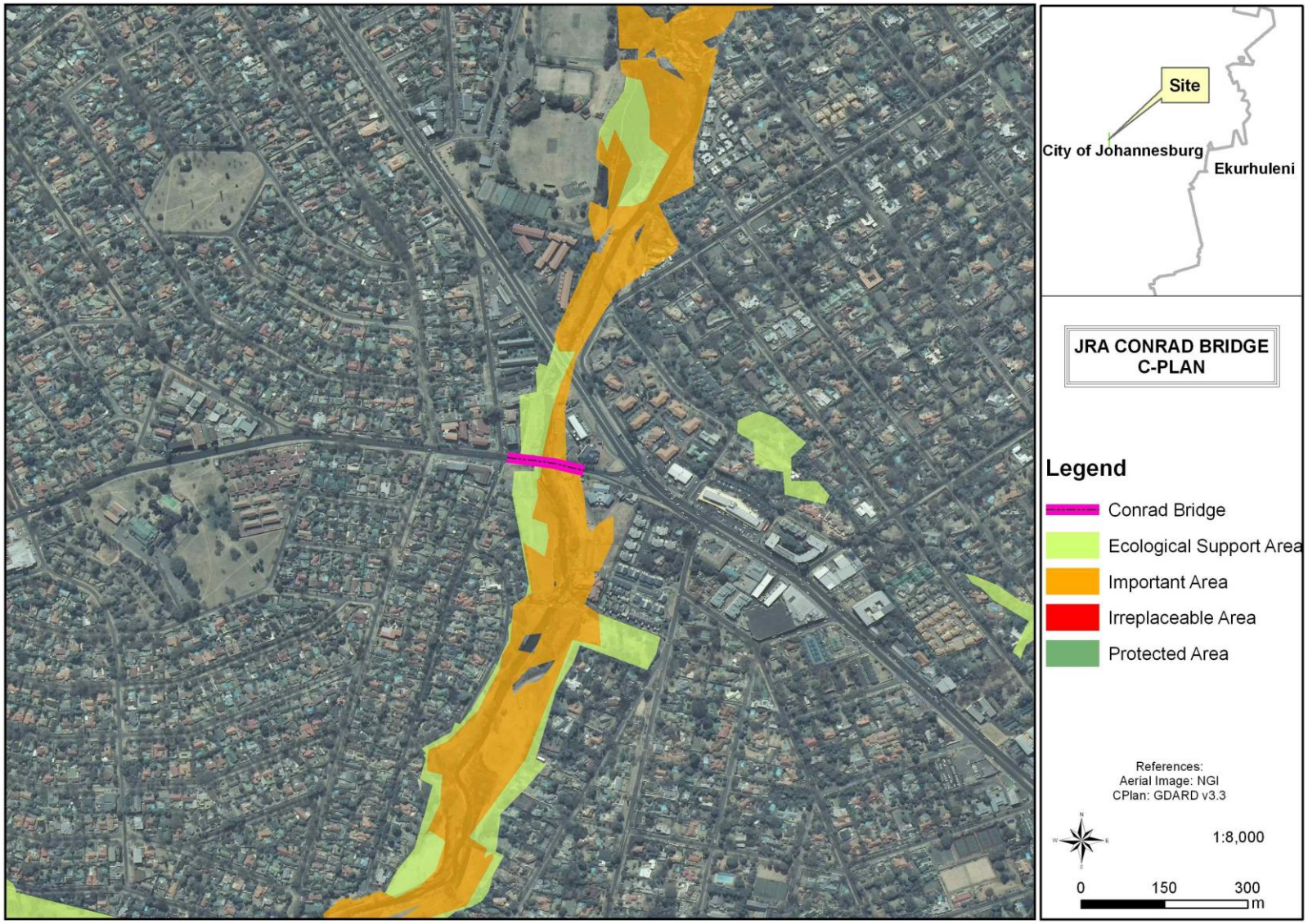

Figure 3: Gauteng Conservation Areas alone the proposed road.

2 METHODOLOGY

The delineation method documented by the Department of Water affairs and Forestry in their document "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008), and the Minimum Requirements for Biodiversity Assessments (GDACE, 2009) as well as the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et ll,* 2013) was followed throughout the field survey. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas such as soil and vegetation forms as well as the terrain unit indicator.

A hand held Garmin Montana 650 was used to capture GPS co-ordinates in the field. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field survey.

2.1 Wetland and Riparian Delineation and classification

Wetlands are identified based on the following characteristic attributes (DWAF, 2005) (Figure 4):

- The presence of plants adapted to or tolerant of saturated soils (hydrophytes);
- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation; and
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing within 50cm of the soil surface.

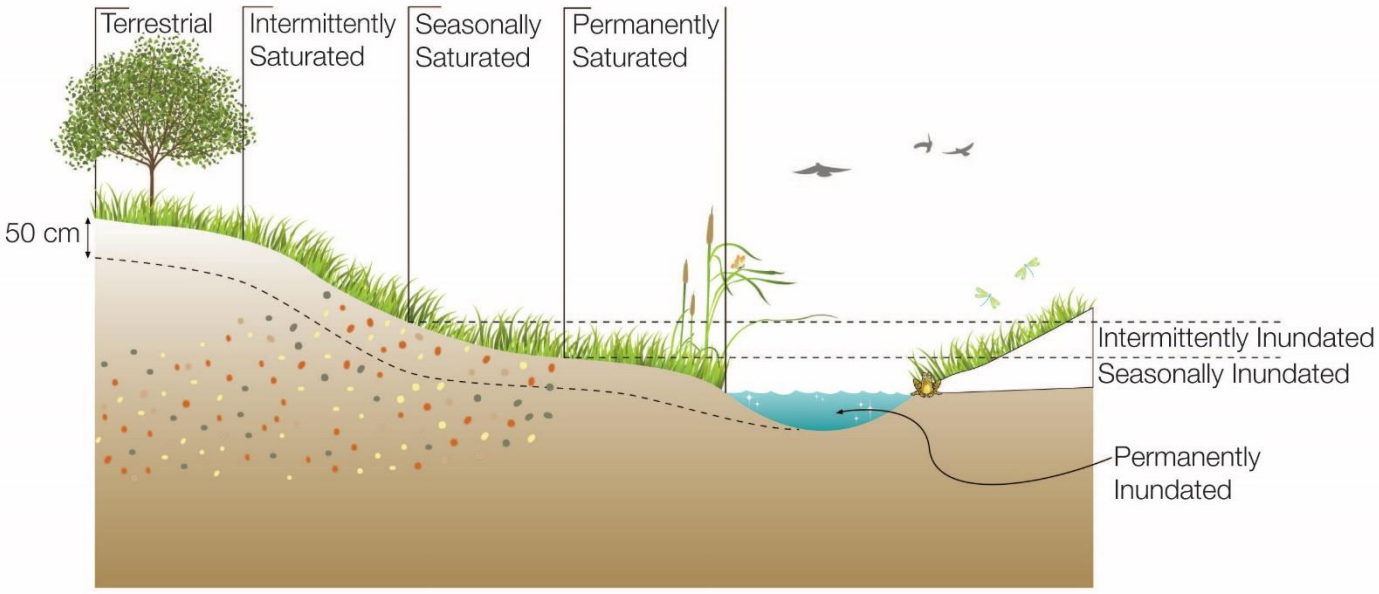

Figure 4: Typical cross section of a wetland (Ollis, 2013)

The Terrain Unit Indicator

The terrain unit indicator (Figure 5) is an important guide for identifying the parts of the landscape where wetlands might possibly occur. Some wetlands occur on slopes higher up in the catchment where groundwater discharge is taking place through seeps. An area with soil wetness and/or vegetation indicators, but not displaying any of the topographical indicators should therefore not be excluded from being classified as a wetland. The type of wetland which occurs on a specific topographical area in the landscape is described using the Hydrogeomorphic classification which separates wetlands into 'HGM' units. The classification of Ollis, *et al*. (2013) is used, where wetlands are classified on Level 4 as either Rivers, Floodplain wetlands, Valley-bottom wetlands, Depressions, Seeps, or Flats (Figure 6).

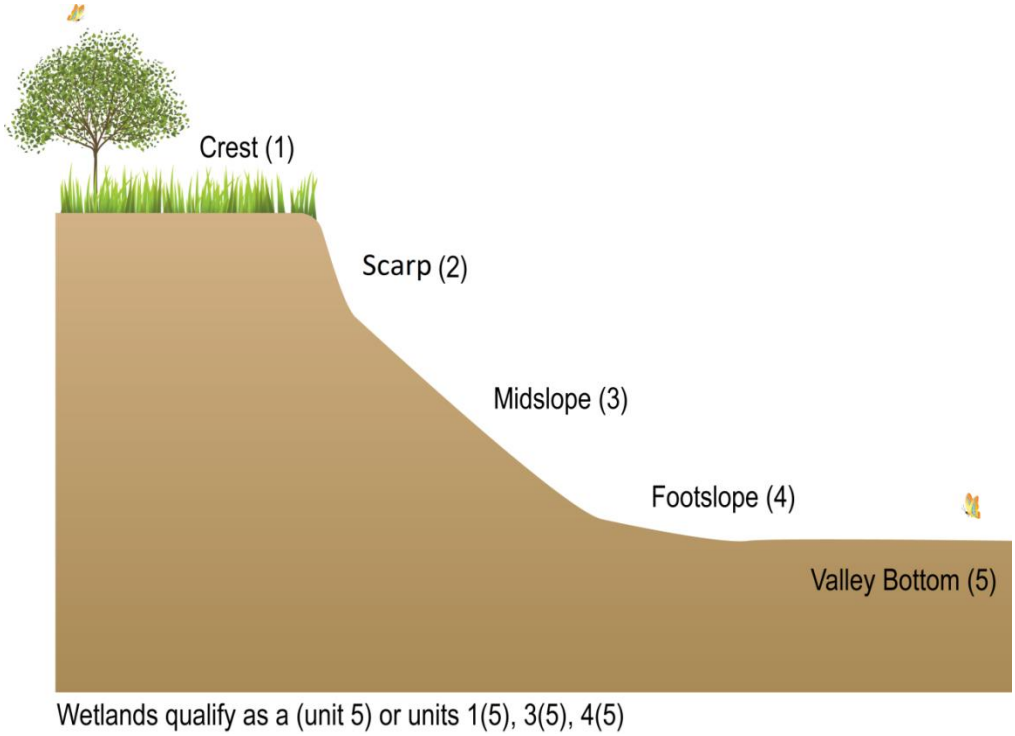

Figure 5. Terrain units (DWAF, 2005).

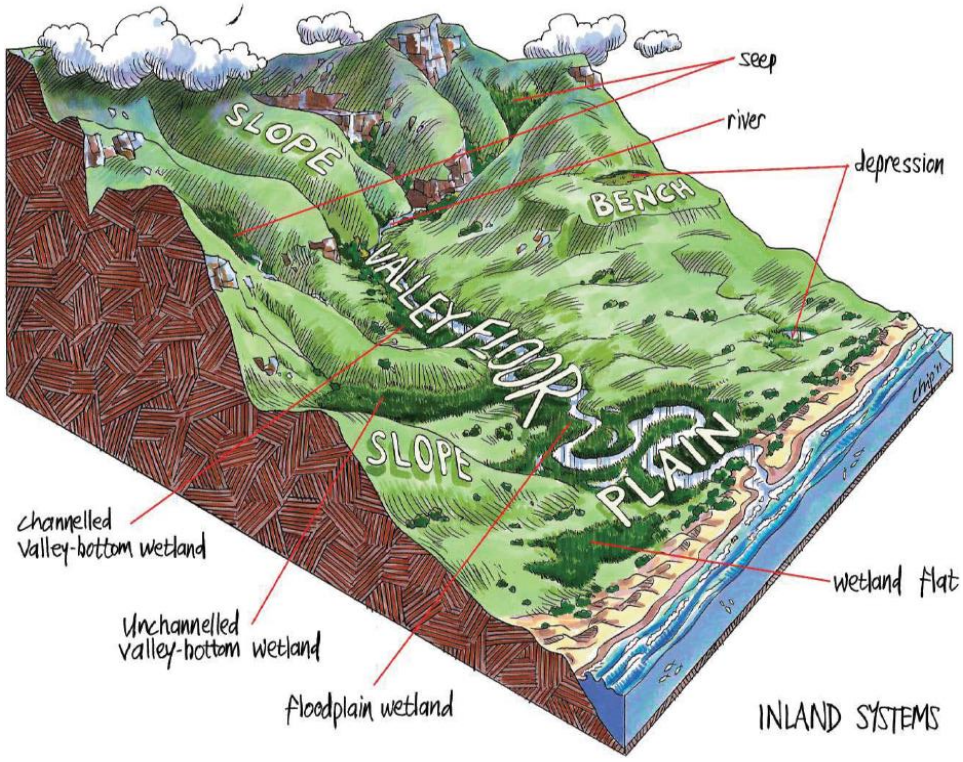

Figure 6: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)

Difficult to Delineate Wet Areas

Table 1 summarises the types of difficult wetland/ wetland-like areas and the best approach to take in such circumstances.

Table 1: List of types of sites that are difficult to delineate. (Jobs, 2009)

Type of "difficult site"	Approach
Some or all, wetland indicators are present but is a non-natural wetland (e.g. some dams, road islands)	• Decide on the relative permanence of the change and whether the area can now be said to be functioning as a wetland. • Time field observations during the wet season, when natural hydrology is at its peak, to help to differentiate between naturally-occurring versus human-induced wetland. • Decide appropriate policy/management i.e. can certain land uses be allowed due to "low" wetland functional value, or does the wetland perform key functions despite being artificial.
Indicators of soil wetness are present but no longer a functioning wetland (e.g. wetland has been drained)	• Look for evidence of ditches, canals, dikes, berms, or subsurface drainage tiles. • Decide whether or not the area is currently functioning as a wetland.
Indicators of soil wetness are present but no longer a functioning wetland (e.g. relic / historical wetland)	• Decide whether indicators were formed in the distant past when conditions were wetter than the area today. • Obtain the assistance of an experienced soil scientist.
Some, or all, wetland indicators are absent at certain times of year (e.g. annual vegetation or seasonal saturation)	• Thoroughly document soil and landscape conditions, develop rationale for considering the area to be a wetland. • Recommend that the site be revisited in the wet season.
Some, or all, wetland indicators are absent due to human disturbance (e.g. vegetation has been cleared, wetland has been ploughed or filled)	• Thoroughly document landscape conditions and any remnant vegetation, soil, hydrology indicators, develop rationale for considering the area to be wetland. • Certain cases (illegal fill) may justify that the fill be removed and the wetland rehabilitated.

Riparian Indicators

Riparian habitat is classified primarily by identifying riparian vegetation along the edge of the macro stream channel. The macro stream channel is defined as the outer bank of a compound channel and should not be confused with the active river bank. The macro channel bank often represents a dramatic change in the energy with which water passes through the system. Rich alluvial soils deposit nutrients making the riparian area a highly productive zone. This causes a very distinct change in vegetation structure and composition along the edges of the riparian area (DWAF, 2008). The marginal zone includes the area from the water level at low flow, to those features that are hydrologically activated for the greater part of the Year (WRC Report No TT 333/08 April, 2008). The non-marginal zone is the combination of the upper and lower zones (Figure 7).

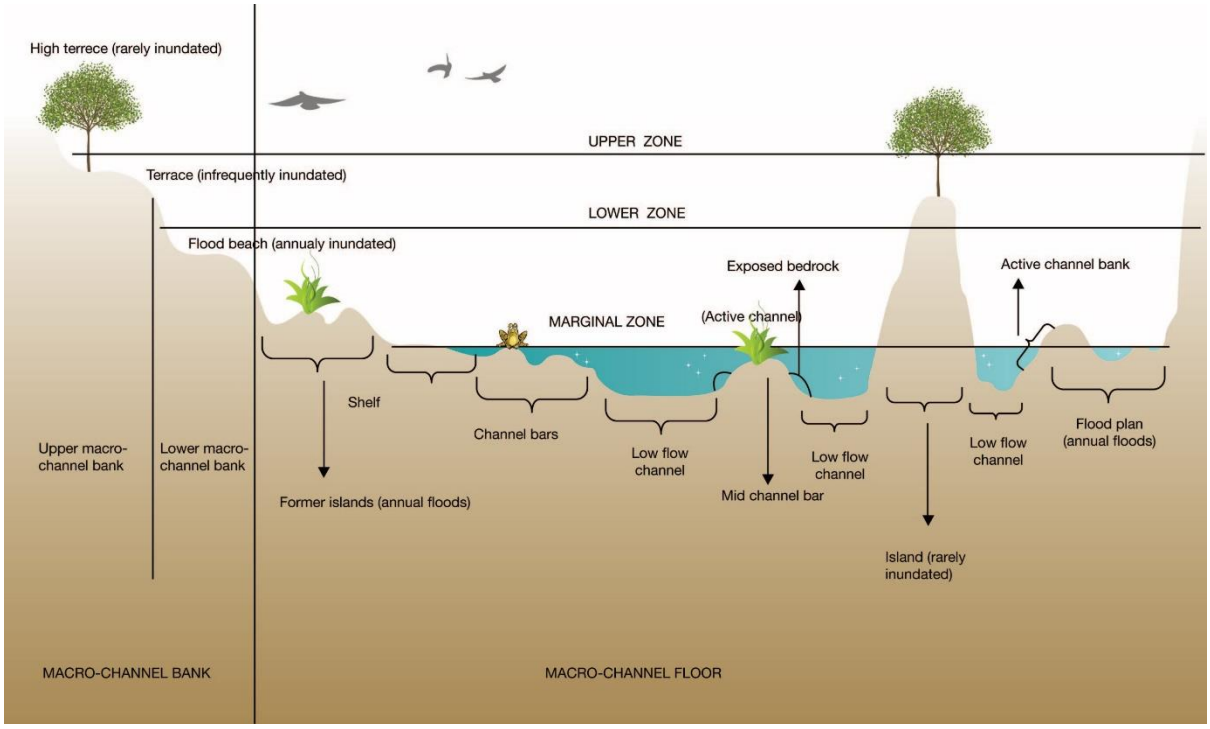

Figure 7: Schematic diagram illustrating an example of where the 3 zones would be placed relative to geomorphic diversity (Kleynhans *et al*, 2007)

The vegetation of riparian areas is divided into three zones, the marginal zone, lower non-marginal zone and the upper non-marginal zone (Table 2). The different zones have different vegetation growth.

Table 2: Description of riparian vegetation zones (Kleynhans *et al*, 2007).

	Marginal	(Non-marginal) Lower	(Non-marginal) Upper
Alternative descriptions	Active features Wet bank	Seasonal features Wet bank	Ephemeral features Dry bank
Extends from	Water level at low flow	Marginal zone	Lower zone
Extends to	Geomorphic features / substrates that are hydrologically activated (inundated or moistened) for the Greater part of the year.	Usually a marked increase in lateral Elevation.	Usually a marked decrease in lateral elevation
Characterized by	See above ; Moist substrates next to water's edge; water loving- species usually vigorous due to near permanent access to soil moisture	Geomorphic features that are hydrologically activated (inundated or moistened) on a Seasonal basis. May have different species than marginal zone	Geomorphic features that are hydrological activated (inundated or moistened) on an Ephemeral basis. Presence of riparian and terrestrial species Terrestrial species with increased stature

Riparian Area:

A riparian area can be defined as a linear fluvial, eroded landform which carries channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone (Figure 8) (Kotze, 1999).

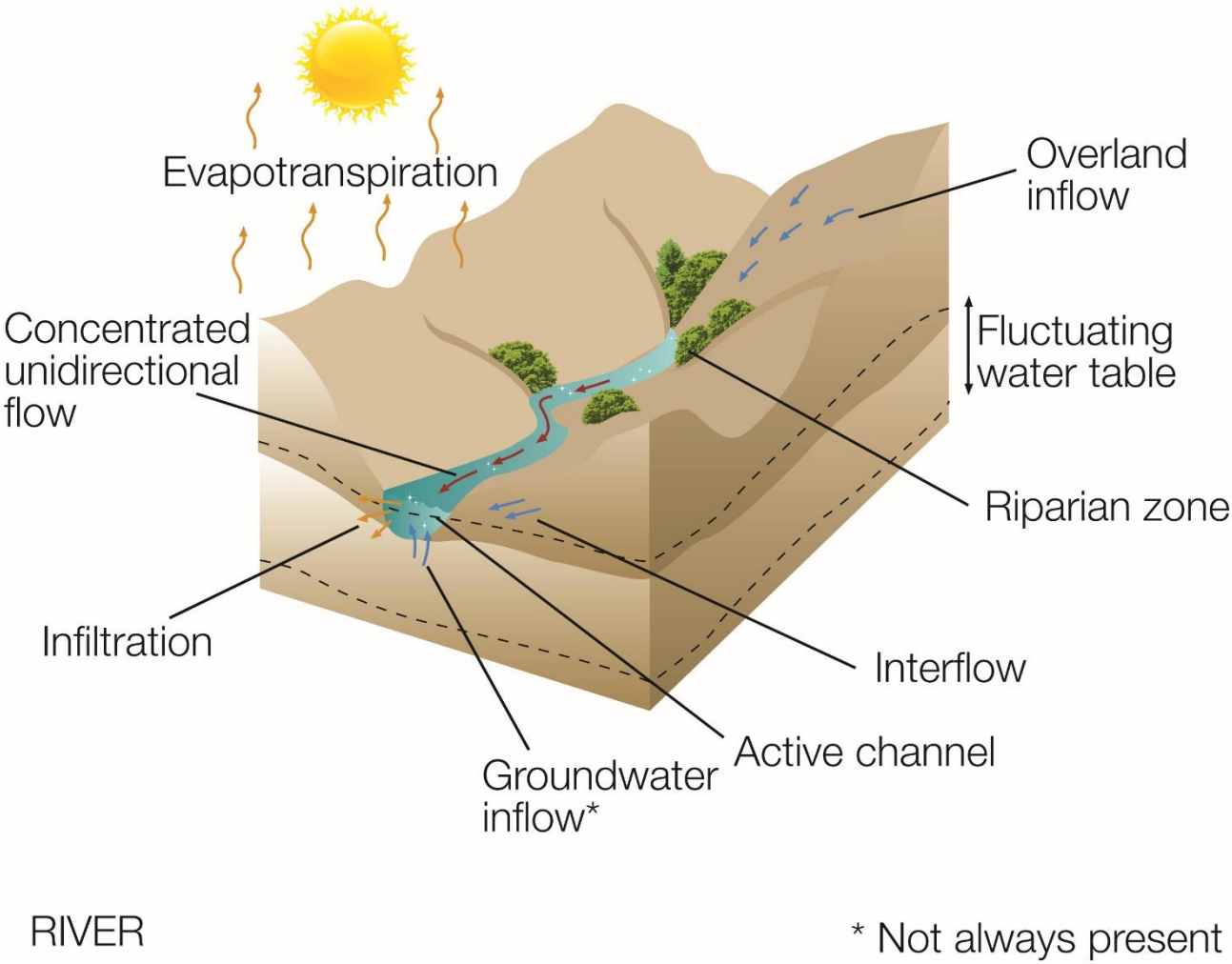

Figure 8: A schematic representation of the processes characteristic of a river area (Ollis *et al*, 2013).

Riparian areas can be grouped into different categories based on their inundation period per year. Perennial rivers are rivers with continuous surface water flow, intermittent rivers are rivers where surface flow disappears but some surface flow remains, temporary rivers are rivers where surface flow disappears for most of the channel (Figure 9). Two types of temporary rivers are recognized, namely “ephemeral” rivers that flow for less time than they are dry and support a series of pools in parts of the channel, and “episodic” rivers that only flow in response to extreme rainfall events, usually high in their catchments (Seaman et al, 2010). The riparian areas recorded on site are thus classified as episodic streams due to the high elevation of these streams.

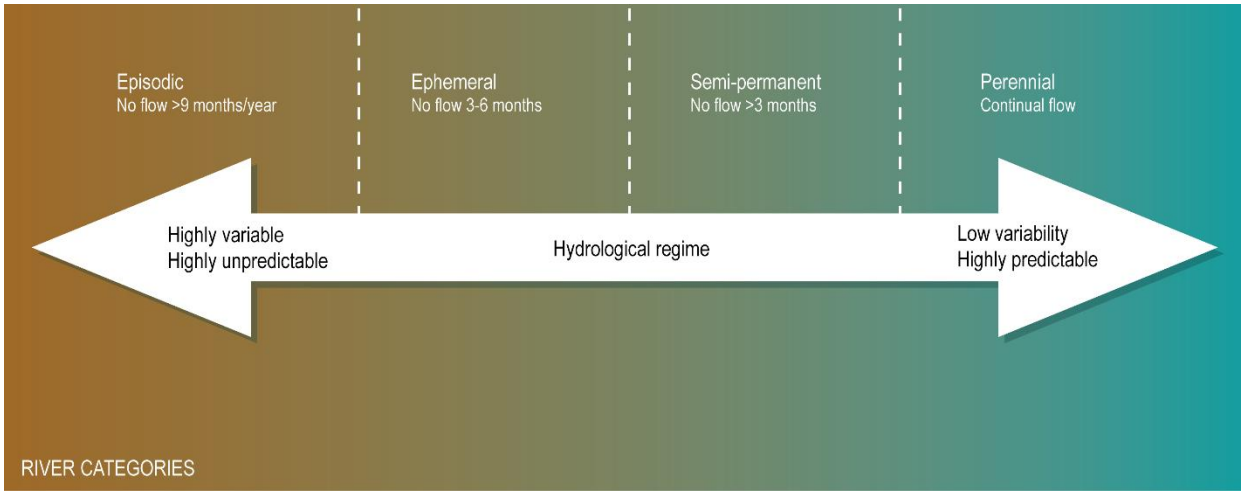

Figure 9: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed (Seaman *et al*, 2010).

2.2 Buffer Zones

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A development has several impacts on the surrounding environment and on a wetland. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments.

Local government policies require that protective buffer zones be calculated from the outer edge of the temporary zone of a wetland, or edge of the riparian habitat (CoCT, 2008; GDACE, 2009). The buffer zone identified in this report serves to highlight an ecologically sensitive area in which activities should be conducted with this sensitivity in mind. Although research is underway to provide further guidance on appropriate defensible buffer zones, there is no current standard other than the generic recommendation of 32m for riparian areas inside the urban edge and 100 m outside the urban edge (GDARD, 2012). Since the proposed activities will take place within the watercourse area with no alternative options available it is important to comply with the mitigations and use best practice methods within this sensitive area.

2.3 Riparian Functionality, Status and Sensitivity

2.3.1 Present Ecological Category (EC): Riparian

In the current study, the Ecological Category of the riparian areas were assessed using a level 3 VEGRAI (Riparian Vegetation Response Assessment Index) (Kleynhans et al, 2007) (Appendix B; Appendix C). Appendix B lists the VEGRAI calculations that determine the Ecological Category (EC) for the riparian area. Table 3 below provides a description of each EC category.

Table 3: Generic ecological categories for EcoStatus components (modified from Kleynhans, 1996 & Kleynhans, 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.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

2.3.2 Quick Habitat Integrity Model (Riparian)

To accommodate a less-detailed process, a desktop habitat integrity assessment (using the Quick Habitat Integrity model) that allows for a coarse assessment was developed. This assessment rates the habitat according to a scale of 0 (close to natural) to 5 (critically modified) according to the following metrics (Seaman *et al*, 2010):

- Bed modification.
- Flow modification.
- Introduced In-stream biota.
- Inundation.
- Riparian / bank condition.
- Water quality modification.

2.4 Wetland Functionality, Status and Sensitivity

Wetland functionality is defined as a measure of the deviation of wetland structure and function from its natural reference condition. The natural reference condition is based on a theoretical undisturbed state extrapolated from an understanding of undisturbed regional vegetation and hydrological conditions. In the current assessment the hydrological, geomorphological and vegetation integrity was assessed for the

wetland unit associated with the study site, to provide a Present Ecological Status (PES) score (Macfarlane *et al*, 2007) and an Environmental Importance and Sensitivity category (EIS) (DWAF, 1999). The impacts observed for the affected wetlands on the study site are summarised for each wetland under section 3.2. These impacts are based on evidence observed during the field survey and land-use changes visible on aerial imagery.

The allocations of scores in the functional and integrity assessment are subjective and are thus vulnerable to the interpretation of the specialist. Collection of empirical data is precluded at this level of investigation due to project constraints including time and budget. Water quality values, species richness and abundance indices, surface and groundwater volumes, amongst others, should ideally be used rather than a subjective scoring system such as is presented here.

The functional assessment methodologies presented below take into consideration subjective recorded impacts to determine the scores attributed to each functional Hydrogeomorphic (HGM) wetland unit. The aspect of wetland functionality and integrity that are predominantly addressed include hydrological and geomorphological function (subjective observations) and the integrity of the biodiversity component (mainly based on the theoretical intactness of natural vegetation) as directed by the assessment methodology.

In the current study the wetland was assessed using, WET-Health (Macfarlane *et al*, 2007) and EIS (DWAF, 1999).

2.4.1 Present Ecological Status (PES) – WET-Health

A summary of the three components of the WET-Health namely Hydrological; Geomorphological and Vegetation Health assessment for the wetlands found on site is described in Table 4. A Level 1 assessment was used in this report. Level 1 assessment is used in situations where limited time and/or resources are available.

Table 4: Health categories used by WET-Health for describing the integrity of wetlands (Macfarlane *et al*, 2007)

Description	Impact Score Range	PES Score	Summary
Unmodified, natural.	0.0.9	A	Very High
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B	High
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C	Moderate
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D	Moderate
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E	Low
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost	8.10	F	Very Low

Description	Impact Score Range	PES Score	Summary
complete loss of natural habitat and biota.			

A summary of the change class, description and symbols used to evaluate wetland health are summarised in Table 5.

Table 5: Trajectory class, change scores and symbols used to evaluate Trajectory of Change to wetland health (Macfarlane *et al*, 2007)

Change Class	Description	Symbol
Improve	Condition is likely to improve over the over the next 5 years	(↑)
Remain stable	Condition is likely to remain stable over the next 5 years	(→)
Slowly deteriorate	Condition is likely to deteriorate slightly over the next 5 years	(↓)
Rapidly deteriorate	Substantial deterioration of condition is expected over the next 5 years	(↓↓)

2.4.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Wetland Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits relevant to a HGM unit. Both PES and EIS form part of a larger reserve determination process documented by the Department of Water Affairs.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

The Ecological Importance and Sensitivity of the seepage wetland is represented are described in the results section. Explanations of the scores are given in Table 6.

Table 6: Environmental Importance and Sensitivity rating scale used for the estimation of EIS scores (DWAF, 1999)

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

3 RESULTS

3.1 Land Use, Cover and Ecological State

The Conrad Bridge crosses over the Braamfontein Spruit. This watercourse is surrounded by residential and business infrastructure. The area south of Conrad Bridge has seen an increase in development adjacent to the stream on the eastern side of the stream from 2001 – 2010 (Google Earth Timeline Function) while an open area remains undeveloped west of the stream. This open section together with some vacant areas south is used as a hiking route and links up with Delta Park in the south. The surrounding area is largely urbanised with only small undeveloped areas such as parks.

3.1.1 Soil and Vegetation Indicators

Soil

The area is located on a region with unconsolidated soil. In this region unconsolidated soils are often associated with anthropogenic activities. In this soil form, the soil structure has been sufficiently disturbed to have lost any recognisable subsoil layers that might have been present (Fey, 2005). Wind-blown dust as well as sediment from stormwater makes up the majority of the soil layer and no significant soil indicators were thus present in the area. The soil was characterised by sandy white soils. Sandy deposits were also recorded within the stream. Exposed bedrock within the stream channel was prominent in the area.

Vegetation

The vegetation of the area was dominated by *Pennisetun clandestinum* (Kikuyu Grass) as can be expected in a park. The majority of the indigenous vegetation was thus replaced with lawn and only some large trees remain adjacent to the stream channel (Figure 11). These trees include *Salix babylonic, Morus alba and Celtis africana.* Some wetland like vegetation such as *Plantego lanceolata* was recorded in-between the Kikuyu lawn while the vegetation of the stream and adjacent areas was mostly dominated by exotic species such as *Arundo donax, Canna indica* and *Amaranthus hybridis.* Instream vegetation was sparse especially where bedrock and boulders were prominent. Some of the sand deposits where the sand formed small islands in the stream were also dominated by Kikuyu Grass.

Figure 10: Vegetation associated with the riparian area.

3.2 Wetland/Riparian Classification and Delineation

One riparian area was recorded on site (Figure 12). The stream currently flows from south to north. It is likely that this riparian area previously had characterised similar to a valley bottom wetland and that the increased urbanisation has led to an increase in water flow into the stream which ultimately reshaped the stream and now shares more characteristics with a river than a wetland. The watercourse has been significantly impacted, these impacts include the following (Figure 13):

- Erosion is prominent in numerous section of the river bank and only small section such as areas adjacent to buildings have adequate erosion protection.
- Large amounts of litter and other debris were recorded in and adjacent to the stream and the stream also had a strong sewerage smell suggesting possible pollution upstream.
- A dam wall was constructed upstream from the bridge which is significantly higher than the stream area at the bridge. This dam wall is likely to protect against erosion during high rainfall events

however erosion protection structure should be implemented should the bridge expansion continue.

- Various water input areas were recorded adjacent to the stream that allow water from the surrounding area to enter the stream. This further contributes to pollution with input of foreign materials and hydrocarbons.
- The majority of the indigenous vegetation has been removed and replaced by mowed lawn which is not as effective as robust vegetation to assist in trapping sediment and to reduce stormwater velocity.

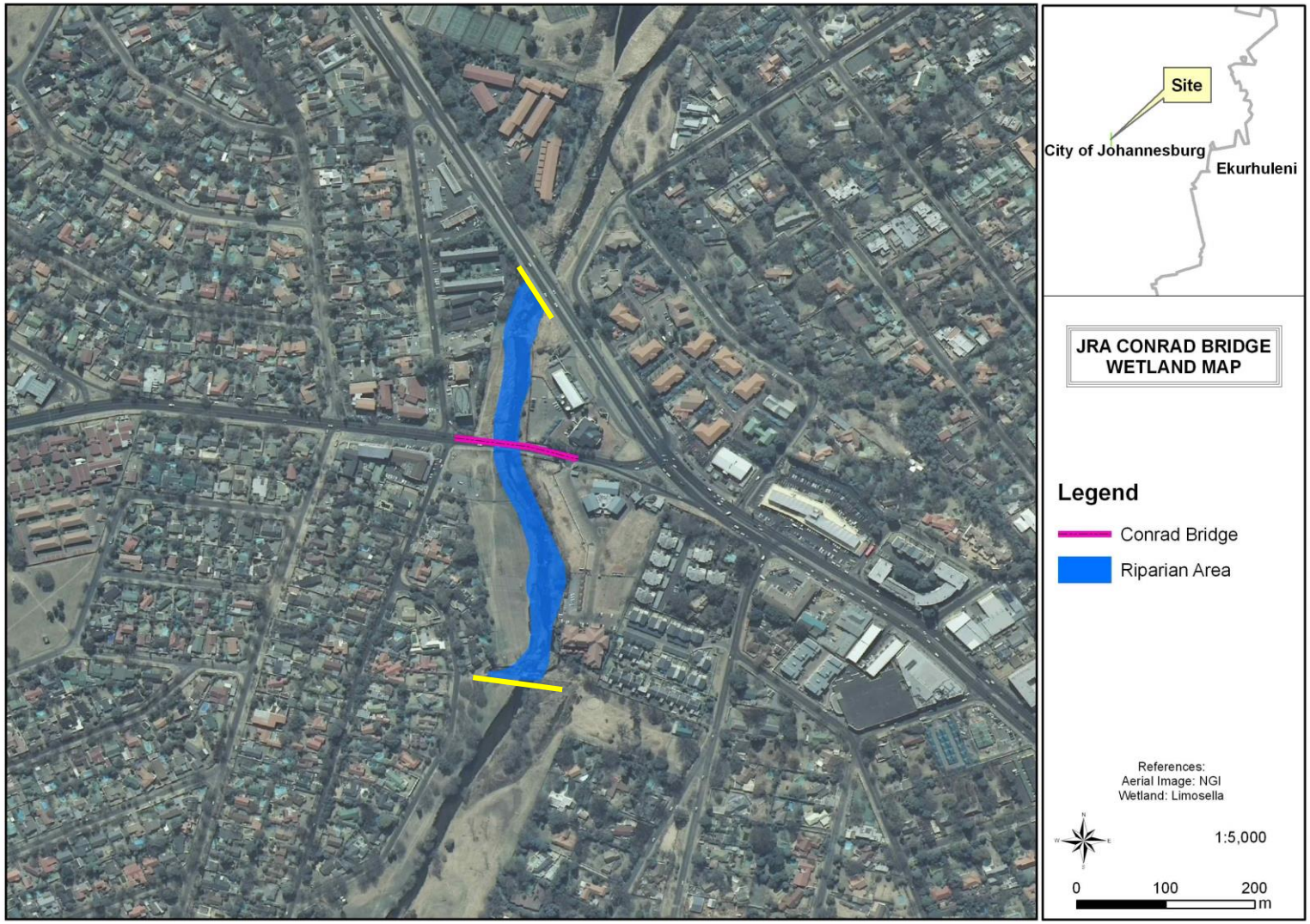

Figure 11: The riparian area delineated in proximity to the proposed road and bridge widening. Yellow lines demarcate the extent of delineation

Figure 12: Various impacts associated with the stream.

Ecological Importance and Sensitivity (EIS)

Although the EIS is ideally suited for wetlands it can be of use in the case of riparian areas as well, although some changes to the scores are often necessary to reflect an accurate indication of the ecological importance and sensitivity of the riparian area. The EIS score of **1.0** falls into a category characterised by **Moderate** ecological importance and sensitivity. These watercourses are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers (DWAF, 1999) (Table 7).

Table 7: Combined EIS scores obtained for the Riparian area on the study site. (DWAF, 1999).

WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Ecological importance & sensitivity	1.7	3.0
Hydro-functional importance	0.8	3.0
Direct human benefits	0.7	4.0
Overall EIS score	**1.0**	

Details for the components assessed in the combined EIS score are presented in Appendix B.

Ecological Category (EC):

The riparian area is greatly disturbed by current and historical anthropogenic activities as well as increased urbanisation and the associated increased in hardened surfaces within the catchment. As a response, the vegetation cover of the riparian is largely changed from historical conditions and the majority of the woody and the non-woody vegetation is exotic.

The combined EC scores for the riparian area on the study site is an **E - Seriously modified**. The loss of natural habitat, biota and basic ecosystem functions is extensive.

The VEGRAI ecological category and is summarised in the table below (Table 8):

Table 8: Results and brief discussion of the Ecosystem Services provided by the Non-Perennial areas on the study site (Kleynhans *et al*, 2008).

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	38.3	24.0	2.5	2.0	100.0
NON MARGINAL	23.3	8.8	2.5	1.0	60.0
2.0					160.0
LEVEL 3 VEGRAI (%)				**32.7**	
VEGRAI EC				**E**	
AVERAGE CONFIDENCE				**2.5**	

The combined QHI score for the riparian area on the study site is an **E - Seriously modified**. The loss of natural habitat, biota and basic ecosystem functions is extensive.

The quick habitat integrity (QHI) score is summarised in the table below (Table9):

Table 9: QHI for the non-perennial riparian areas on the study site (Seaman *et al*, 2010).

QUATERNARY CATCHMENT	RIVER	Bed modification (0-5)	Flow modification (0-5)	Introduced instream biota(0-5): only enter value if rating is higher than any of the other metrics	Inundation (0-5)	Riparian/Bank condition (0-5)	Water quality modification (0-5)	DESKTOP HABITAT INTEGRITY	INSTREAM EC%	INSTREAM EC	Vegetation Rating (0-5)	ECOSTATUS %	ECOSTATUS EC	CONFIDENCE (1-5)
A21B	**Non-Perennial 1**	**4**	**4**		**4**	**4**	**5**	**26.0**	**26.0**	**E**	**5**	**20.7**	**E**	**4:MODERATE-HIGH**

3.3 Impacts and Mitigations

Infrastructure development and associated activities could have several impacts on a watercourse. The development changes habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of stormwater, and therefore the hydrological regime of the area. Given that mitigation measures are adhered to, no impact to downstream water resources are expected to result from the proposed development. Detailed rehabilitation and mitigation measures are presented in the accompanying rehabilitation report (Limosella, 2015). General mitigation measures should address the following aspects:

- The bridge (and any other related structure) should be constructed on a straight section of the stream, and not in a curve where either the natural eroding (outside bank) or sedimentation (inside) bank will put it under pressure, or where its failure might accelerate the natural erosion processes.
- The riparian area together with its associated buffer zones should be fenced during the construction phase to prevent any human activity from encroaching onto these areas, other than that which is essential to bridge construction. Monitoring of the fences is important to ensure no infringement of the fences occurs.
- The bridge design should endeavour to span the riparian area with inchannel wetland conditions and associated buffer zone, and should be outside the 1: 100 year floodline.
- Due to the perennial nature of the system, construction should preferably commence during the dry months.
- Loss of vegetation and associated biodiversity can be mitigated by the use of indigenous plant species in the landscaping.
- Input of sediment during construction activities should be prevented at all cost. Mitigation for this potential impact includes top-soiling and establishment of vegetation as soon as possible after construction.
- Establishment and encroachment of alien invasive species should be monitored regularly and control of alien species should be done where necessary. Details regarding the identification and legislation associated with alien invasive species can be obtained from http://www.agis.agric.za;
- The use of cement lined channels must be avoided at all costs and lining must be done with Loffel stones (or Amourflex stones) or similar products. This is to prevent the loss of habitat to aquatic organisms living in the system.
- Where any hard structures (concrete, gabion or otherwise) are used, it should be well keyed into the surrounding bank walls and secured to the ground.
- Indigenous hydrophytes (e.g. reeds) should be established on the banks of the river as this could help stabilise the banks and limit sedimentation.
- Limit the removal of naturally occurring vegetation to only that which is absolutely necessary.
- Pollution of the surface and groundwater. Mitigation for this potential impact includes:
    - In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs must be informed immediately;
    - Store all litter carefully so it cannot be washed or blown into the water course;
    - Provide bins for construction workers and staff at appropriate locations, particularly where food is consumed;
    - The construction site should be cleaned daily and litter removed;

- Construction vehicles are to be maintained in good working order so as to reduce the probability of leakage of fuels and lubricants;
- A walled concrete platform, dedicated store with adequate flooring or bermed area should be used to accommodate chemicals such as fuel, oil, paint, herbicide and insecticides, as appropriate, in well-ventilated areas;
- Storage of potentially hazardous materials should be above any 100-year flood line or the functional wetland boundary (and its associated buffer zone). These materials include fuel, oil, cement, bitumen etc.;
- Surface water draining off contaminated areas containing carbofuels (eg oils, diesel etc) would need to be channelled towards a sump which will separate these chemicals and oils;
- Concrete is to be mixed on mixing trays only, not on exposed soil;
- Concrete and tar shall be mixed only in areas which have been specially demarcated for this purpose;
- After all the concrete / tar mixing is complete all waste concrete / tar shall be removed from the batching area and disposed of at an approved dumpsite;
- Stormwater shall not be allowed to flow through the batching area. Cement sediment shall be removed from time to time and disposed of in a manner as instructed by the Consulting Engineer;
- All construction materials liable to spillage are to be stored in appropriate structures with impermeable flooring; Portable septic toilets are to be provided and maintained for construction crews. Maintenance must include their removal without sewage spillage;
- Under no circumstances may ablutions occur outside of the provided facilities; and
- No uncontrolled discharges from the construction crew camps to any surface water resources shall be permitted. Any discharge points need to be approved by the relevant authority.

<u>During bridge construction:</u>

- No activities should take place in the watercourses and associated buffer zone. Where the above is unavoidable, only the footprint of the ridge should be considered. This is subjected to authorization by means of a water use license.
- Construction in and around watercourses must be restricted to the dryer winter months.
- A temporary fence or demarcation must be erected around the works area to prevent access to sensitive environs.
- Prevent pedestrian and vehicular access into the wetland and buffer areas as well as riparian areas.
- Consider the various methods of construction and take cognisance of that which will have the least impact on watercourses
- An aquatic environmental control officer (AECO), specialising in aquatic systems should be appointed to ensure that any impacts on the aquatic system are mitigated as soon as possible.
- Access roads and bridges should span the riparian area
- After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land shall be left in a condition as close as possible to that prior to use
- The bridge design should be able to accommodate large debris during flooding to prevent that the bridge gets blocked and washed away.

The mitigation measures proposed above are intended to prevent further degradation to water courses as a result of the construction of the pedestrian bridge. It is important to note that this section aims to highlight areas of concern. The details of the mitigation measures that are finally put in place should ideally be based on these issues, but must necessarily take into consideration the physical and economic feasibility of mitigation. It is important that any mitigation be implemented in the context of an Environmental Management Plan to in order to ensure accountability and ultimately the success of the mitigation.

4 CONCLUSION

A riparian area was recorded on site. The stream currently flows from south to north. It is likely that this riparian area previously had characteristics similar to a valley bottom wetland and that the increased urbanisation has led to an increase in water flow into the stream which ultimately reshaped the stream and now shares more characteristics with a river than a wetland.

The EIS score of **1.0** falls into a category characterised by **Moderate** ecological importance and sensitivity. These watercourses are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers

The riparian area is greatly disturbed by current and historical anthropogenic activities as well as increase urbanisation and associated increased in hardened surfaces within the catchment. As a response the vegetation cover of the riparian is largely changed from historical conditions and the majority of the woody and the non-woody vegetation is exotic. The combined EC scores for the riparian area on the study site is an **E - Seriously modified**. The loss of natural habitat, biota and basic ecosystem functions is extensive. The combined QHI score for the riparian area on the study site is an **E - Seriously modified**. The loss of natural habitat, biota and basic ecosystem functions is extensive.

Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (Regulation 1199 of 2009 in terms of the National Water Act, 1998). Development activities close to wetlands are excluded from General Authorisation (GA) for Section 21 (c) and (i) water uses (published in Government Gazette No. 389). In this instance the Department of Water Affairs should be contacted regarding the application for a Water Use License.

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APPENDIX A: GLOSSARY OF TERMS

Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area
Hydrophyte	any plant that grows in water or on a substratum that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats
Hydromorphic soil	soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils)
Seepage	A type of wetland occurring on slopes, usually characterised by diffuse (i.e. unchannelled, and often subsurface) flows
Sedges	Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.
Soil profile	the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991)
Wetland:	"*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." (National Water Act; Act 36 of 1998).
Wetland delineation	the determination and marking of the boundary of a wetland on a map using the DWAF (2005) methodology. This assessment includes identification of suggested buffer zones and is usually done in conjunction with a wetland functional assessment. The impact of the proposed development, together with appropriate mitigation measures are included in impact assessment tables

Appendix B: Functional Assessment Data

Table 10: Ecological Importance and Sensitivity Calculations

ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Biodiversity support	1.67	4.00		
Presence of Red Data species	0	4.00	Highly unlikely due to prolonged disturbance	Endangered or rare Red Data species presence
Populations of unique species	0	4.00	None recorded	Uncommonly large populations of wetland species
Migration/breeding/feeding sites	1	4.00	Recorded some species	Importance of the unit for migration, breeding site and/or a feeding.
Landscape scale	0.4	4.00		
Protection status of the wetland	1	4.00	All wetlands are protected under the NWA	National (4), Provincial, private (3), municipal (1 or 2), public area (0-1)
Protection status of the vegetation type	0	4.00	Untransformed Soweto Highveld Grassland is regionally important however vegetation onsite completely transformed	SANBI guidance on the protection sutatus of the surrounding vegetation
Regional context of the ecological integrity	1	4.00	Majority of wetland in this region is disturbed	Assessment of the PES (habitat integrity), especially in light of regional utilisation
Size and rareity of the wetland type/s present	0	4.00	Wetland is not rare or very large	Identification and rareity assessment of the wetland types
Diversity of habitat types	0	4.00	Habitat has been greatly transformed	Assessment of the variety of wetland types present within a site.
Sensitivity of the wetland	1.67	4.00		
Sensitivity to changes in floods	1.00	4.00	Somewhat	floodplains at 4; valley bottoms 2 or 3; pans and seeps 0 or 1.
Sensitivity to changes in low flows/dry season	2	4.00	Somewhat	Unchannelled VB's probably most sensitive
Sensitivity to changes in water quality	2	4.00	Water quality has been greatly impacted	Esp naturally low nutrient waters - lower nutients likely to be more sensitive

ECOLOGICAL IMPORTANCE & SENSITIVITY	**1.7**	**4.0**	The assessment was not done in the appropriate season to confirm the presence of charismatic/important species. Therefore confidence levels are low	

Table 11: Hydrological Functional Importance Calculations

HYDRO-FUNCTIONAL IMPORTANCE			**Score (0-4)**	**Confidence (1-5)**	**Motivation**	**Scoring Guideline**
Regulating & supporting benefits	Flood attenuation		1	2	The majority of the vegetation is exotic and is not robust	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
	Streamflow regulation		1	2		Sustaining streamflow during low flow periods
	Water Quality Enhancement	Sediment trapping	1	2		The trapping and retention in the wetland of sediment carried by runoff waters
		Phosphate assimilation	1	4	Large amounts of foreign material enters system	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality
		Nitrate assimilation	1	4		Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality
		Toxicant assimilation	1	4		Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality
		Erosion control	0	2	Erosion is prevalent throughout river area	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
	Carbon storage		0	3	No peat is expected to occur in this watercourse	The trapping of carbon by the wetland, principally as soil organic matter
HYDRO-FUNCTIONAL IMPORTANCE			**0.8**	**2.5**		

Table 12: Direct Human Benefits Calculations

DIRECT HUMAN BENEFITS		Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Subsistence benefits	Water for human use	0	4	Water us contaminated and not suitable for human use	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
	Harvestable resources	0	4	None current	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
	Cultivated foods	0	4	None current	Areas in the wetland used for the cultivation of foods
Cultural benefits	Cultural heritage	0	4	None expected	Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
	Tourism and recreation	4	4	The area is used as a park and hiking area	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
	Education and research	0	4	None known	Sites of value in the wetland for education or research
DIRECT HUMAN BENEFITS		**0.7**	**1.0**		