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Wetland verification study

for

KUTALO ROBERT STRACHAN STATION ON PORTION 103 OF THE FARM DRIEFONTEIN 87 IR (SOUTH GERMISTON X 25)

March 2017

Compiled by: Mr Bertus Fourie (M.Sc. Aquatic Health, Cert. Sci. Nat)

DECLARATION OF INDEPENDENCE

I, **Bertus Fourie,** declare that -

- I am subcontracted as specialist consultant by Galago Environmental cc. for the aquatic ecosystem delineation.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), regulations and any guidelines that have relevance to the proposed activity; I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Bertus Fourie

SACNASP Reg. No: 300025/13

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Glossary of terms:

Buffer zone- The area of land next to a body of water, where activities such as construction are restricted in order to protect the water.

Detritus- Decaying organic matter found in the top layer of soil or mixed with wetland waters; a food source for many small wetland organisms.

Endangered species- Any species of plant or animal that is having trouble surviving and reproducing. This is often caused by loss of habitat, not enough food, or pollution. Endangered species are protected by the government in an effort to keep them from becoming extinct.

Ecosystem- A network of plants and animals that live together and depend on each other for survival.

Emergent- Soft stemmed plants that grow above the water level.

Erosion- Process in which land is worn away by external forces, such as wind, water, or human activity.

Freshwater- Water without salt, like ponds and streams.

Gleyed soil- Mineral wetland soil that is or was always wet; this results in soil colours of grey, greenish grey, or bluish grey.

Habitat- The environment in which an organism lives.

Hydric soil- Soil that is wet long enough for anoxic (oxygenless) conditions to develop. The water in the soil forces air out. This soil type is found in wetlands.

Hydrocarbon Oils, fuels and paints made using fossil fuels (including crude oils, coal etc.)

Hydrophyte- A plant, which grows in water.

Mesotrophic soil- Soils with a moderate inherent fertility. An indicator of soil fertility is its base status, which is expressed as a ratio relating the major nutrient cations (calcium, magnesium, potassium and sodium) found there to the soil's clay percentage.

Organic material- Anything that is living or was living; in soil it is usually made up of nuts, leaves, twigs, bark, etc.

Organism- A living thing.

Peat- Organic material (leaves, bark, nuts) that has decayed partially. It is dark brown with identifiable plant parts, and can be found in peatlands and bogs.

Pollution- Waste, often made by humans, that damages the water, the air, and the soil.

Precipitation- Rain, sleet, hail, snow.

Riparian- Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized 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

Redoximorphic conditions- a soil property, associated with wetness, which results from the reduction and oxidation of iron and manganese compounds in the soil after saturation with water and desaturation, respectively. Mottling are common redoximorphic features of soils.

Runoff- Rainwater that flows over the land and into streams and lakes; it often picks up soil particles along the way and brings them into the streams and lakes.

Salinity- The amount of salt in water.

Saturation-The condition in which soil contains as much water as it can hold.

Silt- One of three main parts of soil (sand, silt, and clay); silt is small rock particles that are between .05 mm and .002 mm in diameter.

Submerged aquatic vegetation- Plants that live entirely under water.

Top soil- The top layer of soil; it is full of organic material and good for growing crops.

Water table- The highest level of soil that is saturated by water.

Watershed - All the water from precipitation (rain, snow, etc.) that drains into a particular body of water (stream, pond, river, bay, etc.)

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."

Acronyms:

AECO	Aquatic Environmental Control Officer
ASPT	Average Score Per Taxon
CERM	Comprehensive Ecological Reserve Methodology
DSS	Decision Support System
DWA	Department of Water Affairs
DWS	Department of water and sanitation
EC	Ecological Category
ECO	Environmental control officer
EIS	Ecological Importance and Sensitivity
EWR	Environmental Water Requirements
FRAI	Fish Response Assessment Index
FROC	Fish reference of occurrence

GSM	Gravel, Sand, Mud
GDARD	Gauteng Department of Agriculture and Rural Development
IERM	Intermediate Ecological Reserve Methodology
IHAS	Invertebrate Habitat Assessment System
IHI	Index of Habitat Integrity
MIRAI	Macro-Invertebrate Response Assessment Index
MVIC	Marginal Vegetation in Current
MVOOC	Marginal Vegetation out of Current
NFEPA	National Freshwater Ecosystem Priority Areas
PES	Present Ecological State
REC	Recommended Ecological Category
REMC	Recommended Ecological Management Class
RERM	Rapid Ecological Reserve Methodology
RHP	River Health Programme
SASS5	South African Scoring System (Version 5)
SIC	Stones in current
SOG	Soap, oil and grease
SOOC	Stones out of current
TPH	Total petroleum hydrocarbons
TWQR	Target water quality range
VEGRAI	Vegetation Response Assessment Index
Wetland IHI	Wetland index of habitat integrity tool
WMA	Water Management Area
WUL	Water use licence (approved license)
WULA	Water use licence application (license application)

1. Introduction

Galago Environmental CC was appointed to delineate possible edges of aquatic ecosystems (including riparian and wetland areas) at KUTALO ROBERT STRACHAN STATION, SOUTH GERMISTON X 25 on Portion 103 of the farm DRIEFONTEIN 87 IR (henceforth known as the "study site"), scheduled for residential development. The investigation into the possible occurrence of wetlands on the neighbouring properties (up to 500 meters extended study area (ESA)) as in terms of General Notice 1199 of the National Water Act, 1998 (Act No. 36 of 1998) was also done (albeit desktop derived). Also included in the scope of work is to propose mitigation measures to ensure that aquatic ecosystem integrity and functionality is kept at optimum.

An aquatic ecosystem is defined as "an ecosystem that is permanently or periodically inundated by flowing or standing water or which has soils that are permanently or periodically saturated within 0.5m of the soil surface" (Ollis *et al.* 2013). This term is further defined by the definition of a watercourse. In the National Water Act, 1998 (Act No. 36 of 1998) a watercourse is defined as:

(a) A river or spring;

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

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

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

Different inland (freshwater) watercourses occur in South Africa and are defined by their topographical location, water source, hydroperiod, soils, vegetation and functional units (Ollis, *et al*., 2013). The following illustration presents the types and typical locations of different inland aquatic systems found in South Africa (Figure 1).

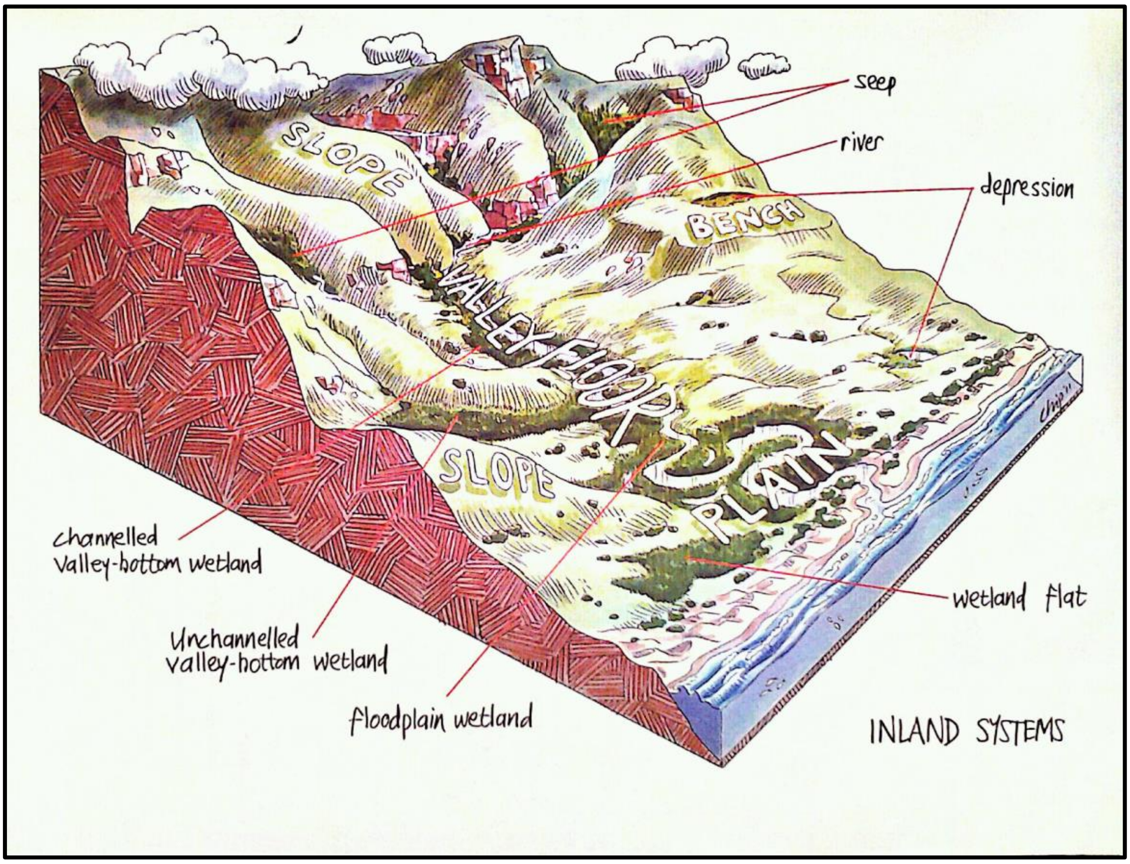


FIGURE 1: THE TYPES AND LOCATION OF INLAND AQUATIC ECOSYSTEMS (OLLIS, *ET AL*., 2013)

This definition of a watercourse is important especially if an area of increased hydrological movement is found, but cannot be classified as either a wetland or riparian area. Important to note is that according to the National Water Act, 1998 (Act No. 36 of 1998), wetlands are defined 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."*

It is very important that this definition is applied to both natural and manmade wetlands. Wetlands are very important in South Africa. Almost 50% of wetlands have been lost in South Africa and the conservation of the remaining wetlands is very important (WRC 2011) Wetlands provide many services to the ecosystem they are located in (Kotze, *et al*. 2007). One of the most important services provided by wetlands is that of the impeding and holding back of floodwater to be released more constantly as well as slow water release through dry periods (Collins, 2005). Other very important functions that wetlands provide are as a source of habitat to many different species of fauna and flora. Wetlands also lead to an increase in the overall biodiversity of the area and ecological functioning (Collins, 2005).

Wetland conditions are formed when the prolonged saturation of water in the soils create different niche conditions for various fauna and flora. The source of water feeding into a wetland is very important, as it is an indication of the type and in many cases can provide an indication of the condition of the wetland.

As South Africa is a signatory of the Ramsar Convention for the conservation of important wetlands, we are committed to the conservation of all our wetlands. The Convention on Wetlands came into force for South Africa on 21 December 1975. South Africa presently has 21 sites designated as Wetlands of International Importance, with a surface area of 554,136 hectares (www.ramsar.org).

Although the term wetland describes the main *functions* provided by the wetland, there are actually many different hydrogeomorphic *types* of wetlands in South Africa.

The word "riparian" is drawn from the Latin word "riparious" meaning "bank" (of the stream) and simply refers to land adjacent to a body of water or life on the bank of a body of water (Wagner & Hagan, 2000).

The National Water Act, 1998 (Act No. 36 of 1998) also defines riparian areas as: "Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized 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"

The delineation of the riparian edge does not follow the same methodology, as is the case with wetlands. The riparian edge is demarcated using the physical structure of the vegetation found in the riparian area, as well as the micro topographical location of the riparian characteristics. In riparian areas, the increased water available to the plants (living in this area) has created a habitat with greater vegetation growth potential. This boundary of greater growth is used to delineate the riparian edge (Figure 2).

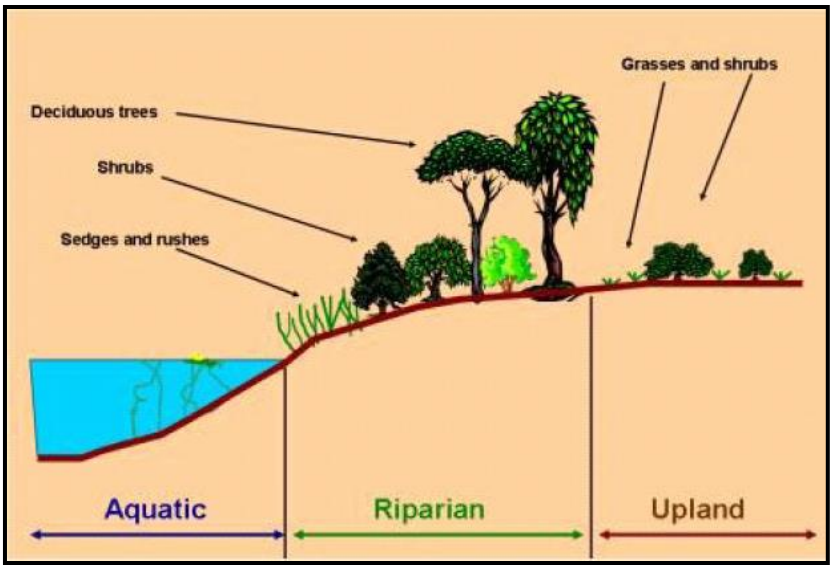


FIGURE 2: SKETCH INDICATING A CROSS SECTION OF RIPARIAN ZONATION COMMONLY FOUND IN SOUTH AFRICA – WWW.EPA.GOV/

The delineation guideline, Department of Water Affair's: Practical field procedure for identification and delineation of wetlands and riparian areas, Edition 1 September 2005, and revision 2 of 1998 was used. **The site visit was conducted in June 2014 and March 2017.** This identification and delineation of possible wetlands and riparian habitat is also done to mitigate any possible future contraventions of the National Water Act, 1998.

It is also important to note that when working within the Gauteng province, reports are written in line with the Gauteng Department of Agriculture and Rural Development's (GDARD) minimum requirements for biodiversity assessments. This document provides guidelines for the minimum mitigation measures when development is proposed for all biodiversity assessments, including wetlands.

1.1. Buffers as per GDARD guidelines

The Minimum requirements for Biodiversity Assessments, 2014 of the Gauteng Department of Agriculture and Rural Development (GDARD, 2014) state that different buffers must be applied to sites inside and outside the urban edge (Table 1).

TABLE 1: BUFFER REQUIREMENTS AS PER GDARD, 2014

	Wetlands	Riparian areas
Inside urban edge	30 meters	32 meters
Outside urban edge	50 meters	100 meters

Buffer areas are seen as part of the aquatic ecosystem and may not be developed or affected in any way by the construction activities and is rated the same sensitivity as the system. Buffers are 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. Buffers are in essence a fabricated ecotone. This ensures the wetland functioning is kept at an optimum and the services provided by wetlands are maintained. To ensure the buffer is maintained it must be fenced off prior to the physical construction of the site and the building contractors of the site contractually bound to the conservation of the area.

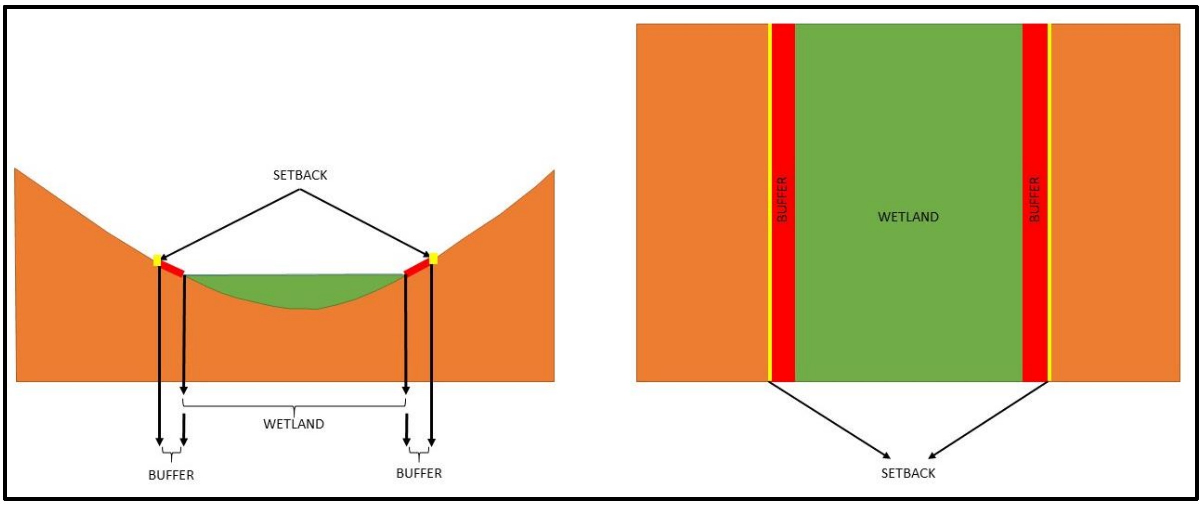


FIGURE 3: LAYOUT OF A TYPICAL BUFFER AROUND A WETLAND WITH THE SETBACK LINE CLEARLY DEFINED

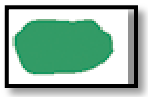
It must be noted that in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the EIA Regulations of 2014: Section 12 of Regulation 983, buildings or infrastructure exceeding 100m^2 that occurs within 32 meters of a wetland must be authorised through a Basic Assessment process. Thus, the 32 meters can be used as a buffer guide for developments in provinces that does not give clear minimum guidelines for biodiversity assessments.

Although the term wetland describes the main *functions* provided by the wetland, there are actually many different hydrogeomorphic *types* of wetlands in South Africa. The following table (Table 2) from Kotze, et al. 2007 illustrates the type of wetland as well as the hydrological source of the wetland. Important is Table 3 concerning the regulatory benefits provided by the wetland types.

TABLE 2: THE WETLAND HYDROGEOMORPHIC (HGM) TYPES TYPICALLY SUPPORTING INLAND WETLANDS IN SOUTH AFRICA (FROM KOTZE, *ET AL.* 2007)

Hydrogeomorphic (HGM) types		Description	Source of water maintaining wetland	
			Surface	Subsurface
Floodplain		Valley bottom areas with a well-defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/***
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes	***	*/***
Hillslope seepage linked to a stream		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defines stream channel connecting the area directly to a stream channel.	*	***

Hydrogeomorphic (HGM) types		Description	Source of water maintaining wetland	
			Surface	Subsurface
channel				
Isolated hillslope seepage		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel	*	***
Depression (including Pans)		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/***	*/***



Precipitation is an important water source and evapotranspiration an important output in all of the above settings.

indicates wetland

Water source:

* Contribution usually small

*** Contribution usually large

*/ *** Contribution may be small or important depending on the local circumstances

*/ *** Contribution may be small or important depending on the local circumstances.

TABLE 3: THE REGULATORY BENEFITS POTENTIALLY PROVIDED BY WETLANDS (FROM KOTZE ET AL. 2007)

Wetland Hydrogeomorphic types (HGM)	Regulatory benefits potentially provided by wetland							
	Flood Attenuation		Stream-flow regulation	Enhancement of Water Quality				
	Early Wet Season	Late wet season		Erosion control	Sediment Trapping	Phosphates	Nitrates	Toxicants
Floodplain	**	*	0	**	**	**	*	*
Valley bottom- channelled	*	0	0	**	*	*	*	*
Valley bottom unchannelled	*	*	*?	**	**	*	*	**
Hillslope seepage connected to a stream	*	0	*	**	0	0	**	**
Isolated hillslope seepage	*	0	0	**	0	0	**	*
Pan/ Depression	*	*	0	0	0	0	*	*

Rating: 0 Benefit unlikely to be provided to any significant level

* Benefit likely to be present as least to some degree

** Benefit very likely to be present (and often supplied to a high level)

1.2. Scope of work

The scope of this project is:

- Delineation of aquatic ecosystems,
- Determine where possible the present ecological score (PES) of the aquatic systems,
- Assessment of the impacts ratings,
- Recommend mitigation measures

2. Assumptions and limitations

To determine the riparian or wetland boundary, indicators (as discussed above) are used. If these are not present during the site visit, it can be assumed that they were dormant or absent and thus if any further indicators are found during any future phases of the project, the author cannot be held responsible due to the indicators variability. Even though every care was taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time, and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bona fide* information sources, as well as deductive reasoning. No biomonitoring or physical chemical aspects of water found on the study were done. The safety of the delineator is of priority and thus in areas deemed, as unsafe limited time was spent.

If the location of the study site is on and near underlying granitic geology the possible presence of cryptic wetlands must be investigated by a suitably qualified soil scientist with field experience.

Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage.

The condition, quantity, and quality of the water found in the study site were not established as it is outside the scope and extent of the study. As aquatic systems are directly linked to the frequency and quantity of rain it will influence the systems drastically. If during dry months or dry seasons studies are done, the accuracy of the report's findings could be affected.

Galago Environmental can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

3. Site location and description

The study site lies west of the Kutalo Station, and northwest of Henderson Road in Germiston, Gauteng (Figure 4). The site is ±4.769ha in extent.

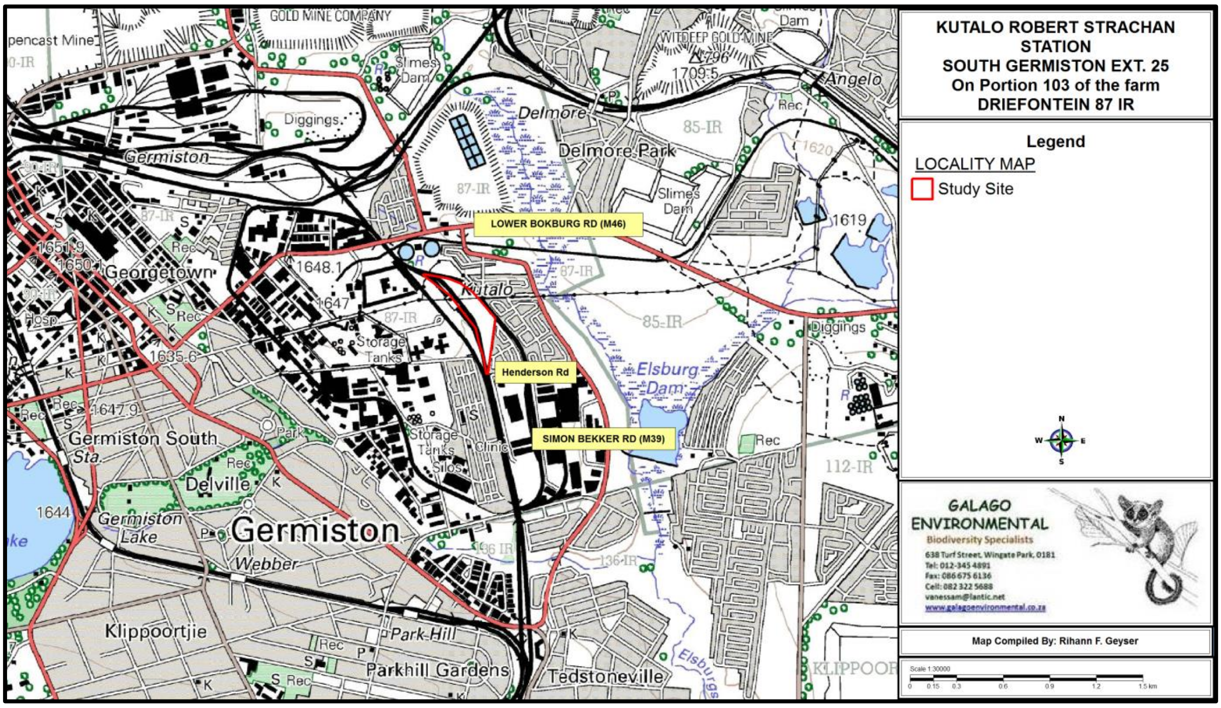


FIGURE 4: STUDY SITE LOCATION

3.1. Proposed Activities

The proposed development for the site is Residential development.

3.2. Regional description and vegetation

Mucina & Rutherford (2006) classified the area as **Soweto Highveld Grassland (**Figure 5**)**, which covers a relatively large area in Gauteng but can also be found in neighbouring provinces. The landscape forms part of the Highveld plateau, having gently undulating slopes and is dominated almost entirely by the grass *Themeda triandra.* Various other grass species are present and herbs that are especially fire resistant, usually by becoming dormant in the winter months. These herbaceous plants re-sprout in the spring after the first rains. Rainfall is about 660 mm per annum and falls predominantly in the summer months as thunderstorms.

It is a warm-temperate region with strongly seasonal summer rainfall and very dry winters including frequent winter frosts.

The Soweto Highveld Grassland is considered endangered. Its conservation target is 24% and it is poorly conserved (only 1%) in statutory reserves and a few private nature reserves. Almost 50% of the unit has already been transformed by cultivation, plantations, urbanization and dam-building.

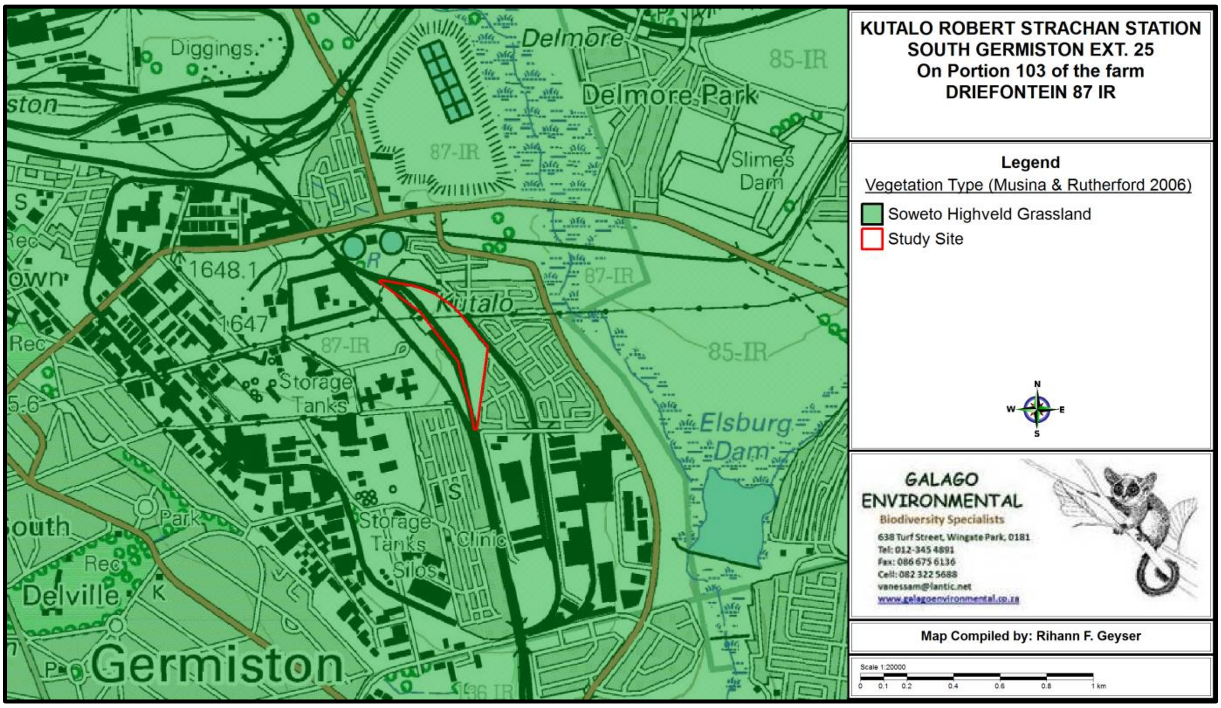


FIGURE 5: THE VEGETATION TYPES OF THE STUDY AREA

3.3. Ecoregion description

The study area falls in the Highveld water management area (WMA no 11) (**FIGURE 6**) as described in the Level 1 Ecoregions by the Department of Water Affairs and Forestry (DWAF, 2005):

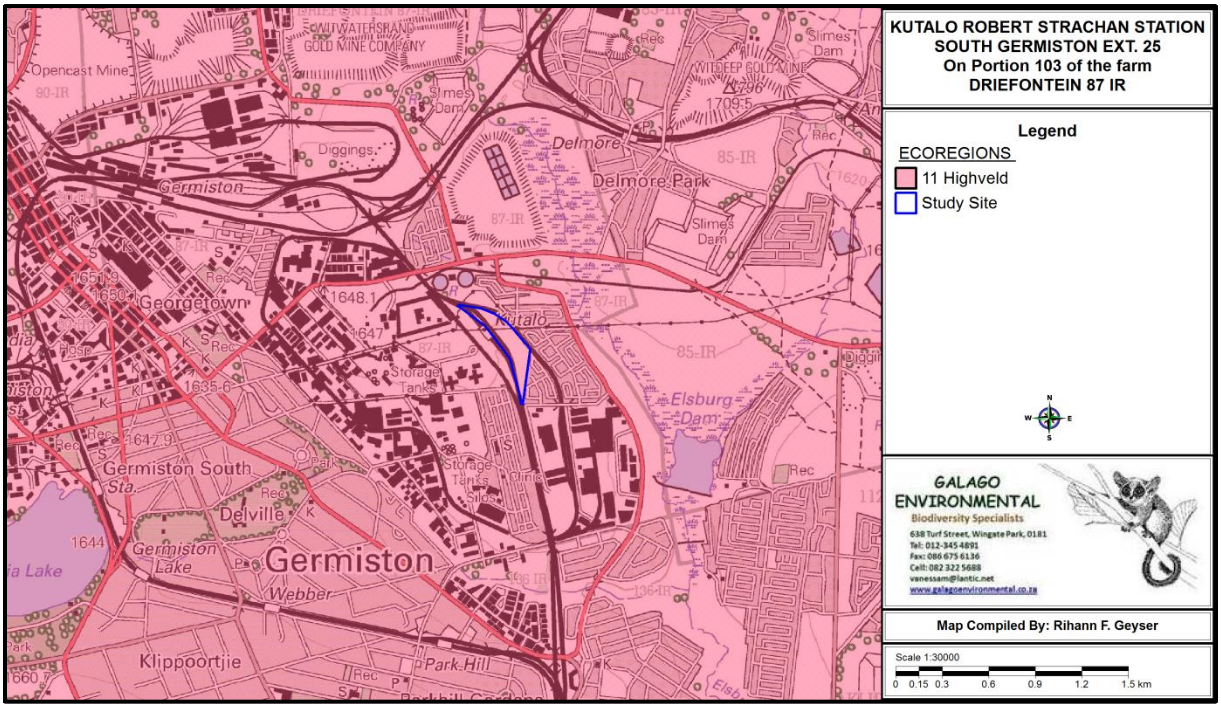


FIGURE 6: ECOREGIONS OF THE STUDY SITE

The site falls within the Highveld Ecoregion as described in the Level 1 Ecoregions by the Department of Water Affairs and Forestry (DWAF, 2005):

3.3.1. Primary boundary determinants:

Plains with a moderate to low relief, as well as various grassland vegetation types (with moist types present towards the east and drier types towards the west and south), define this high lying region.

3.3.2. General:

Several large rivers have their sources in the region, e.g. Vet, Modder, Riet, Vaal, Olifants, Steelpoort, Marico, Crocodile (west), Crocodile (east) and the Great Usutu. The level 1 description of the Water Management Area, as from DWAF, 2007 lists the system as part of the Crocodile (West) River and is characterised by the following:

This is generally a low laying, dry to arid, hot region with virtually no perennial streams originating in the area itself. Perennial rivers that traverse this region include the Crocodile (west), Marico, Mokolo, Lephalala, and Mogalakwena.

- Mean annual precipitation: Low to arid.
- Coefficient of variation of annual precipitation: Moderately high to high
- Drainage density: Mostly low but with some areas in the north having a high drainage density.
- Stream frequency: Mostly low to medium, but high in north-eastern areas.

- Slopes <5%: Generally >80% of the area.
- Median annual simulated runoff: Very low to low.
- Mean annual temperature: High to very high

3.4. Catchment description

The site lies in quaternary catchment C22B The study site drains to the Vaal River via the Elsburg and Natalspruit. See **FIGURE 7** below for the Google Earth description of the site, as provided by the Department of Water Affair's Resource Quality Services (RQS) department.

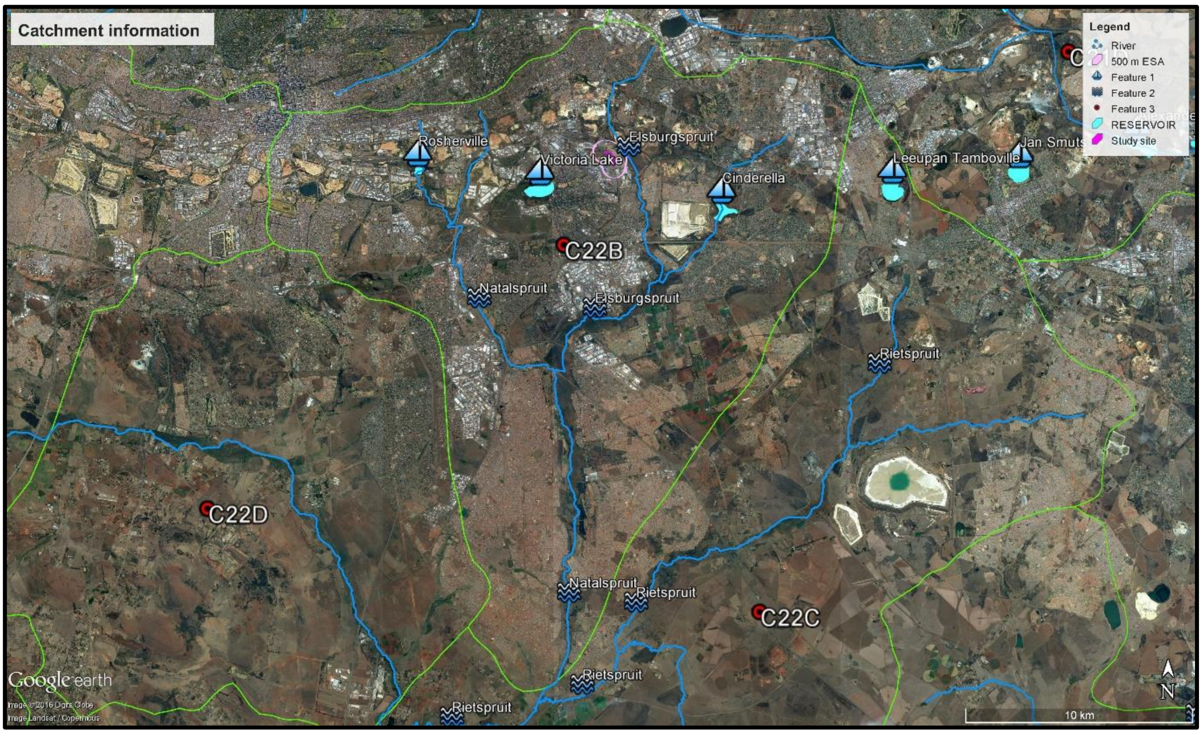


FIGURE 7: THE CATCHMENT AND HYDROLOGICAL DATA FOR THE STUDY SITE, AS AVAILABLE FROM DWA RQS SERVICES.

3.5. Geology and land types

Land type information for the site was obtained through the Department of Agriculture's Global Information Service (AGIS[1]). The study site lies within the **B** land type (Figure 8).

[1] Data obtained January 2014. www.**agis**.agric.za/

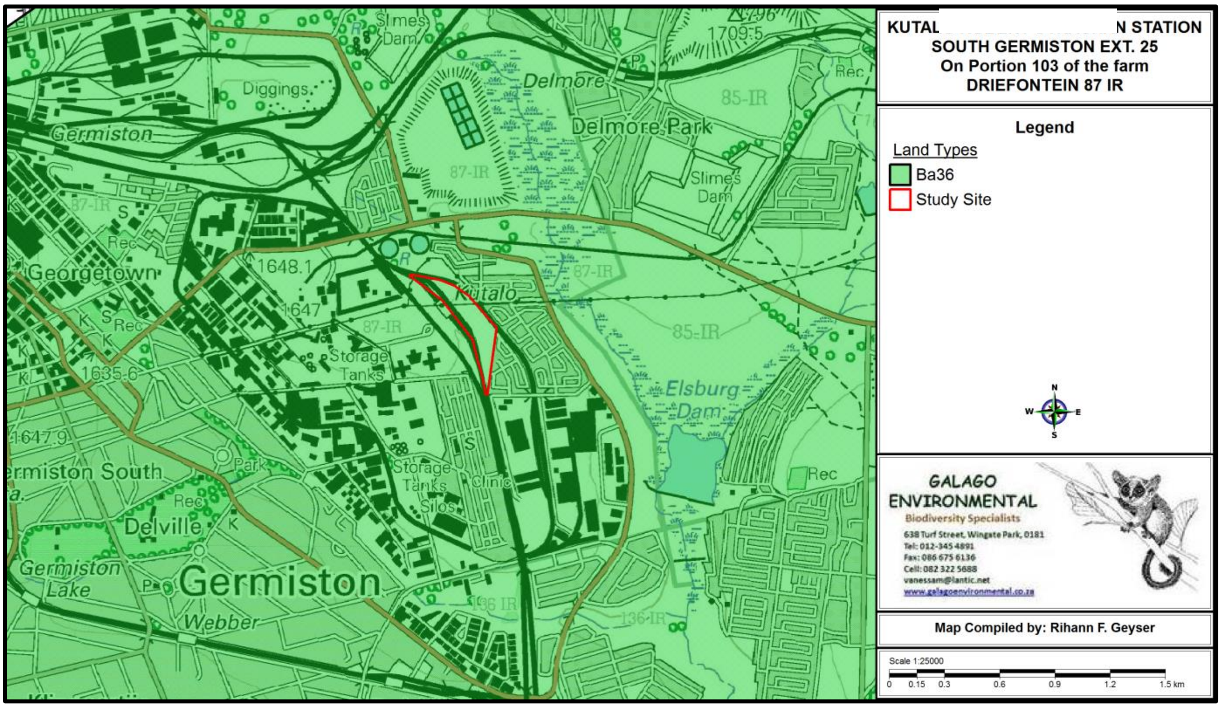


FIGURE 8: LAND TYPES OF THE STUDY SITE

3.6. Catchment condition assessment

Wetlands in South Africa with its high evapo-transpiration rates (which are usually nearly double the regional rainfall) (Schultze 1997), depend on catchments to provide runoff and groundwater flows. Catchments of wetlands can be defined as the action of collecting water in an area, from the highest topographical point to the lowest collection point (and in the case of the wetland found on site, a valley bottom wetland and isolated hillslope seepage system) (SANBI, 1999). The condition of a wetland's catchment thus has a profound impact on the nature of the flows entering the wetland. Therefore the extent of the catchment is determined and its condition assessed by identifying possible impacts and sources of pollution. The wetland and riparian area of the study site forms part of a larger HydroGeomorphic (HGM) drainage network and thus share a larger catchment (Table 4 for the catchment use descriptions and proportional percentage).

TABLE 4: THE PERCENTILE LAND USE OF THE CATCHMENT OF THE STUDY SITE

Catchment land use	
Agriculture	0
Housing	40
Industrial	40
Roads	15
Natural (disturbed)	5
Natural (reference condition)	00
Total	**100**

4. Methods for classification of aquatic ecosystem, the delineation and Present Ecological State (PES) calculation

4.1. Classification of aquatic ecosystems

To determine the classification of aquatic ecosystems is a very important aspect of the delineation process as wetlands and riparian systems require different delineation methods. To classify the systems the dichotomous key as found in the "Classification system for wetlands and other aquatic ecosystems in South Africa" (Ollis, *et al.,* 2013) is used. Four keys have been developed for the classification of aquatic ecosystems:

- Landscape Units (Key 1)
- Hydrogeomorphic Units (Key 2)
- Hydrological regime
- Key 3a for river flow types and,
- Key 3b for hydroperiod category

4.2. Wetland Delineation methods

To delineate *any* wetland the following criteria are used as in line with Department of Water Affairs (DWA): A practical field procedure for identification and delineation of wetlands and riparian areas, Edition 1 September 2005. These criteria are:

a) **Wetland (hydromorphic) soils** that display characteristics resulting from prolonged saturation such as grey horizons, mottling streaks, hard pans, organic matter depositions, iron and manganese concretion resulting from prolonged saturation,
b) The presence, at least occasionally, of **water loving plants (hydrophytes)**,
c) A **high water table** that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil, and
d) **Topographical location** of the wetland in relation to the landscape.

Also read with the guide is a draft updated report of the abovementioned guideline. The draft is used, as it provides a guideline to delineation of wetland areas: *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas,* prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. DWA (2008) Draft report. These criteria will mainly indicate a systematic as well as functional change in the aquatic ecosystem.

Wetlands occur throughout most topographical locations, with even the small depression wetlands occurring on the crest of the landscape. The topographical location of possible wetlands is purely an indication of the actions and movement of water in the landscape and is not a definitive delineator (Figure 9).

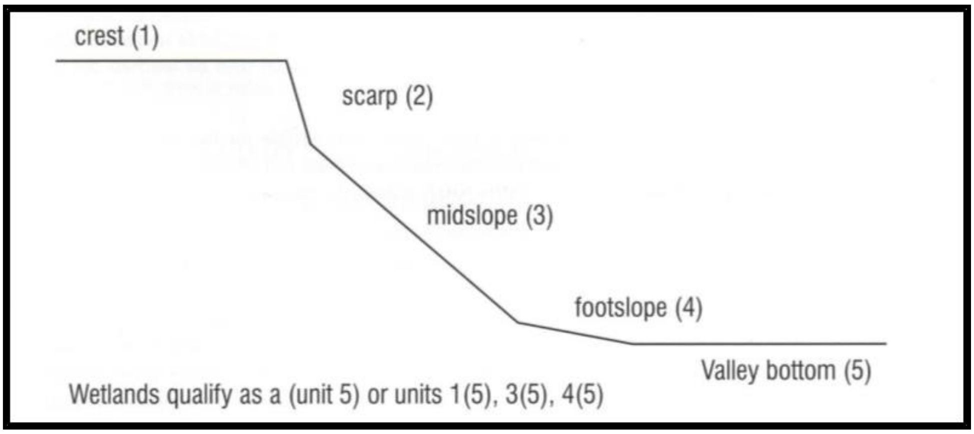


FIGURE 9: DESCRIPTION OF THE TOPOGRAPHY OF AN AREA (FROM DWAF, 2005)

Changes in the presence and frequency of mottling in the soils are the main methods of delineation. This is, as mottles are usually not influenced by short-term changes in the hydrology and vegetation of the wetland (Figure 10). Mottling is formed when anaerobic conditions (increased water saturation) lead to redoximorphic conditions (iron is leached from the soil) and is precipitated in the increased saturation areas of the soil profile.

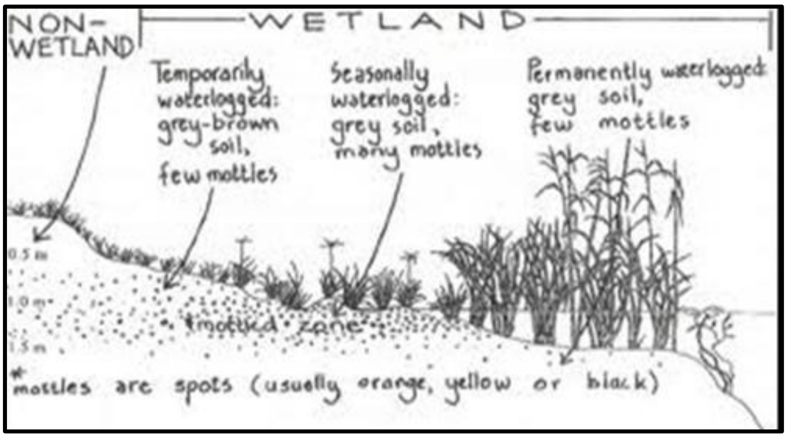


FIGURE 10: CROSS SECTION THROUGH A WETLAND WITH SOIL WETNESS AND VEGETATION INDICATORS. SOURCE: DONOVAN KOTZE, UNIVERSITY OF KWAZULU NATAL (FROM WWW.WATERWISE.CO.ZA)

4.3. Delineation of riparian edge

To delineate *any* riparian area the following criteria are used as in line with Department of Water Affairs (DWA) requirements: *A practical field procedure for identification and delineation of wetlands and riparian areas, DWA Edition 1 September 2005.*

Also read with the guide is a draft updated report of the abovementioned guideline. The draft is used, as it provides a guideline to delineation of riparian areas with specific emphasis on recent alluvial deposits: "*Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas",* prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare., DWA (2008) (Draft report).

These criteria mainly used will indicate a system as well as individual change in the riparian area. The delineation process requires that the following be taken into account and deliberated:

- topography associated with the watercourse;
- vegetation; especially changes in the composition of communities found on site,
- alluvial soils and deposited materials.

Also of importance are the changes in the catchment of the area. Any changes in the use, extent of use as well as alien vegetation changes will influence the river condition and the riparian characteristics. Historical imagery, Google Earth as well as the site visit is used to detect and enumerate any changes. The outer boundary of the riparian area is defined as: "the point where the indicators are no longer discernible" (DWA, 2008). Using the desktop delineation GPS points, sampling took place firstly to truth if the desktop GPS points did in fact represent a riparian area. Secondly using vegetation and topographic indicators, the riparian vegetation was identified and demarcated. A second delineation of the non-riparian area was done.

4.4. Wetland Present Ecological State (PES) calculation method

The present ecological state (PES) of the wetland was determined using the methodology as described by Macfarlane DM, *et al.* 2007. The method encompasses the use of two aspects to determine the PES. Firstly, a site visit where all possible impacts are noted and the scale of the impacts area measured. The information along with the delineation of the wetland is then collated and calculated into three Level 2 suites of WET-Health Microsoft Excel programs.

These suites of programs then provide the PES in the form of Health category ratings from A (best) to F (worst). See the tables below for a layout and description of the category ratings per assessment (Macfarlane *et. al.* 2007).

4.5. Riparian Present Ecological State (PES) calculation method

The South African River Health Program (RHP) under the Department of Water Affairs has developed a suite of programs to allow for the calculation of the ecological category for river and riparian areas. Included in this suite of programs is VEGRAI (Riparian Vegetation Response Assessment Index in River Eco classification as developed by Kleynhans *et al* (2007). This program is Microsoft Excel driven, and allows for two levels of calculations. For the study site, it was chosen to conduct a level 3 assessment[2]. The program does not give an indication on the impacts itself, but rather an indication on the *extent* of the impacts on the riparian areas. The program provides results in ranges and allows results to be allocated a Present Ecological State (PES) category. See Table 5 below.

TABLE 5: THE DESCRIPTION OF THE HEALTH CATEGORY

DESCRIPTION	IMPACT SCORE RANGE	HEALTH CATEGORY
Unmodified/ natural	0-0.9	**A**
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**
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**
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	**D**
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**
Modifications have reached a critical level and the ecosystem processes have been modifiedcompletely with an almost complete loss of natural habitat and biota.	8 – 10	**F**

[2] Level 3 assessment is a basic assessment of the riparian vegetation composition, structure and impacts. The upper and lower marginal zones are combined in level 3 whereas the level 4 the zones are separately assessed.

4.6. Wetland Ecological Services (WET-EcoServices)

To determine and assess the ecological goods and services provided by a wetland, WET-EcoServices (Kotze *et al*., 2007) be used to assess the goods and services that individual wetlands provide, thereby aiding in formed planning and decision making.

It is designed for a class of wetlands known as palustrine wetlands (marshes, floodplains, vleis or seeps). The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing). The first step is to characterise wetlands according to their hydro-geomorphic setting (see Table 1).

The program then entails two aspects assessed namely: Level 1, based on existing knowledge or at Level 2, based on a field assessment of key descriptors. The wetland goods and services are also determined by the topographical location and hydrological inputs and regimes of the system (Table 2).

4.7. Ecological importance and sensitivity (EIS) calculation

EIS calculations are compiled to determine how important a specific wetland system is as well as give an indication of the sensitivity of the system. The method was originally designed for floodplain systems, but is being applied for other aquatic ecosystems. Ecological importance is defined as “an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales”. Ecological sensitivity is defined as “the system’s ability to resist disturbance and its capability to recover from disturbance once it has occurred” (Duthie *et al*., 1999). The Ecological Importance and sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC)

In the method outlined here, a series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The median score for the biotic and habitat determinants is interpreted and translated into a recommended ecological management class (REMC) as indicated in Table 6. Although the method was designed for floodplain wetlands, it is generally widely applied to all wetland types.

TABLE 6: EIS INTERPRETATION GUIDE

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

4.8. Historical aerial imagery

National Geo-spatial Information (NGI) is the government component (Department of Rural Development and Land Reform) responsible for aerial photography and has an archive of aerial photographs dating back to the 1930's. The user, although unable to make accurate measurements on the photograph, is able to perform his or her own interpretation of what exists on the ground. Aerial photographs are also an historic record of what existed at the time the photograph was taken.

The photography is at a variety of scales and has provided complete coverage of the country since the 1950's. These are all vertical aerial photographs taken from aircraft. Photography is continuously re-flown to provide new photography for ongoing map revision and for sale to users. The data set was obtained from the department in 2012.

The photos are divided into job numbers, strings (or line numbers) and finally photo numbers.

5. Results

During the site visit no wetland conditions were observed on site. A drainage channel, for storm water from the train station was observed on site (Figure 11). A channelled valley bottom wetland was observed to the east of the study site (not on site but within the 500m ESA). As this wetland is not on site, and outside the scope of the project no PES and EIS calculations will be completed for the wetland.

FIGURE 11: THE AQUATIC ECOSYSTEMS OF THE STUDY SITE

5.1. Wetland indicators as in line with DWA 2005

The following indicators were not observed on site, negating wetland conditions:

5.1.1. Wetland (hydromorphic) soils and anaerobic conditions in the soil

Not observed, even at the lowest point of the drainage line.

5.1.2. The presence, at least occasionally, of water loving plants (hydrophytes)

The site was completely transformed by alien vegetation and cultivation. No hydrophytes of wetland concern were observed.

5.1.3. Topographical location in relation to the landscape.

The site drains in the direction of the channelled valley bottom wetland to the east.

5.1.4. Open standing water or water near the surface

Not observed.

5.2. Historical and Current use of the property

Google Earth's Timeline function was used as reference imagery (Accessed July 2015). Google Earth imagery from 2001 (Figure 12) to early 2016 (Figure 13) is available and was used to determine the historical land use and whether the site was extensively altered in the past or to detect large changes in the land use of the catchment. The maps are also used to identify areas where possible aquatic ecosystems occur. From these images, it is clear to see the site is impacted and degrade with no clear signs of aquatic ecosystems.

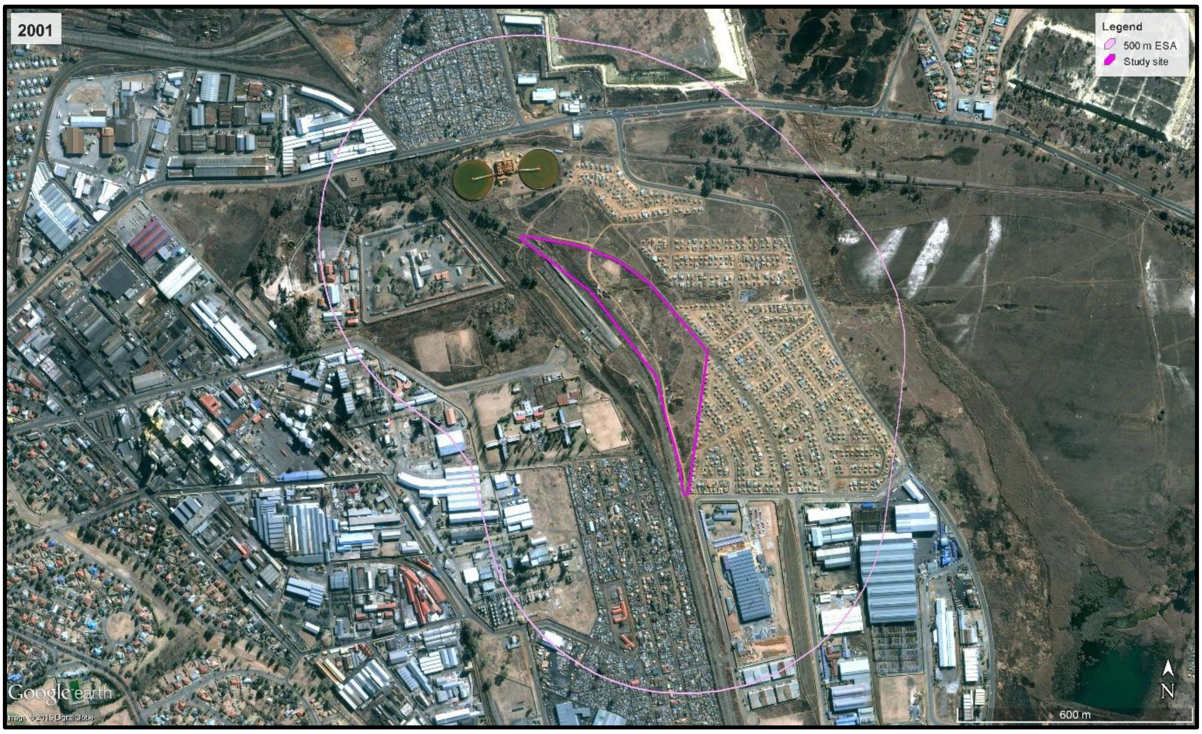


FIGURE 12: THE OLDEST USABLE GOOGLE EARTH IMAGE OF THE SITE FROM 2001

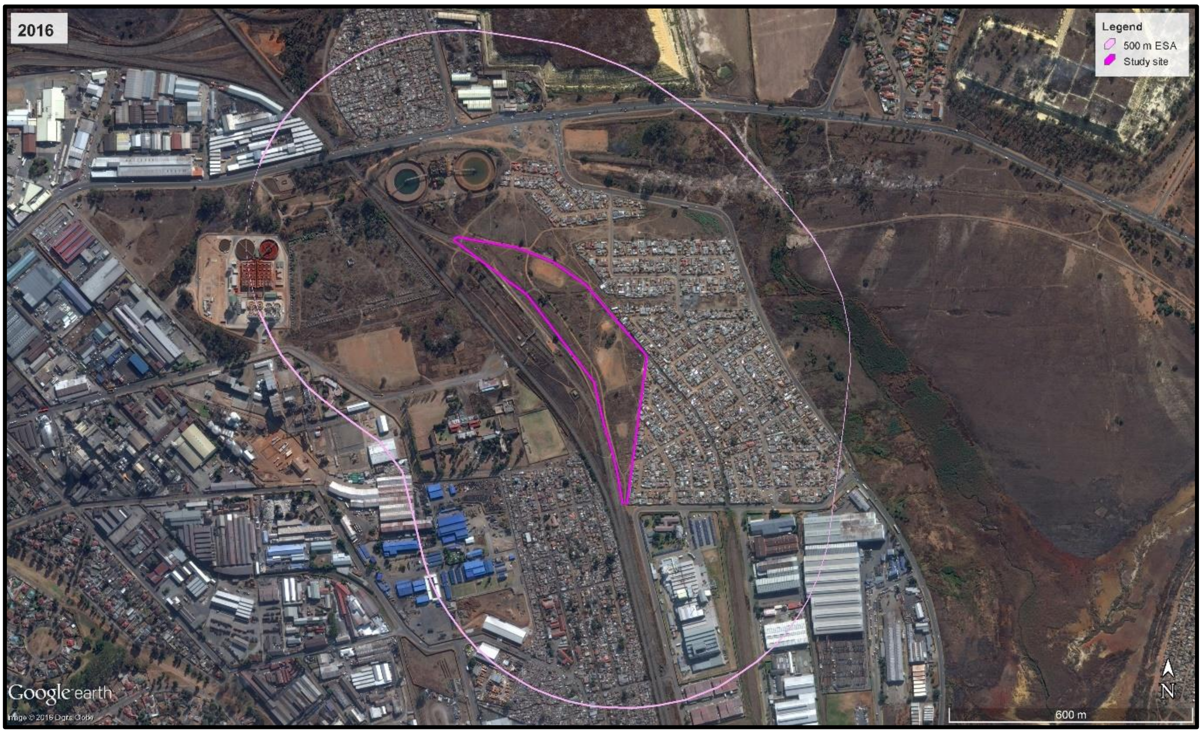


FIGURE 13: GOOGLE EARTH IMAGE FROM 2016

6. Discussion, Impact assessment and general mitigation measures

No aquatic ecosystems were observed on site. Storm water management must take cognisance of this fact. It is suspected that storm water will be directed in the direction of the channelled valley bottom wetland to the east of the site. Sustainable urban drainage designs must be applied to the storm water designs.

6.1. General mitigation measures

The following general mitigation measures are proposed[3]:

- An alien vegetation eradication programme should be implemented on the site to remove the alien vegetation from the wetland areas.
- An environmental control officer (ECO), specialising in aquatic systems (AECO) must be appointed throughout the project to ensure the longevity of the impacted aquatic system.

[3] The contractor appointed for construction must be contractually bound to the requirements and mitigating measures listed in this document and any other documents relating to the construction (ecological management plan, rehabilitation plant etc.).

- 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.
- The ramps for the in- and out flows from the construction site must be lined with Reno mattresses and or gabions to prevent structure undermining and to ensure flow is dispersed and mitigated. Vertical steps should not exceed 200 mm, to ensure aquatic fauna movement and migration.
- The use of gabion structures, well keyed into the surrounding bank walls and secured to the ground is recommended.
- If any construction activity must occur within the riparian areas then it must commence from upstream proceeding downstream with proper sedimentation barriers in place to prevent sediments and pollution moving downstream from the site. This includes non-perennial systems.
- The removal and translocation of impacted hydrophytes must be done prior to construction commencing.
- Due to the perennial nature of the system, construction should preferably commence during the dry months.
- All sensitive areas together with the associated buffer zones should be fenced during the construction phase to prevent any human activity from encroaching onto these areas. Monitoring of the fences is of paramount importance to ensure no infringement of the fences occurs.
- Removal of debris and other obstructing materials from the site must take place and erosion-preventing structures must be constructed. This is done to prevent damming of water and increasing flooding danger.
- Removed soil and stockpiling of soil must occur outside the extent of the watercourse to prevent siltation and increased runoff during construction. This includes the buffer zones and 1:100 year flood lines.
- Proper toilet facilities must be located outside the sensitive areas: The impact of human waste on the system is immense. Chemical toilets must be provided which should always be well serviced and spaced as per occupational health and safety laws, and placed outside the buffer and 1:100 year flood lines.
- Spill kits must be stored on site: In case of accidental spills of oil, petroleum products etc., good oil absorbent materials must be on hand to allow for the quick remediation of the spill. The kits should also be well marked and all personnel should be educated to deal with the spill. Vehicles must be kept in good working order and leaks must be fixed immediately on an oil absorbent mat. The use of a product such as Sunsorb is advised.
- No plant machinery may be stored or left near the aquatic areas, when not in use.

- Frequent inspection of the site must be done to ensure that no harmful practices occur on site.
- A photo collection must be taken from fixed demarcated spots to detect changes in the construction area over time. These photographs must be dated and should include the entire site.
- No construction personnel are allowed to collect, harvest or kill any species of fauna and flora on the site.
- Any species of fauna encountered during the construction phase should be moved to a safe location where no harm can be bestowed on the species.
- If water is sprayed on the construction surface for any reason during the construction process, utmost care must be taken to ensure the runoff water does not pollute the system or any of the associated catchment areas. A storm water cut-off drain should be constructed between the construction area and the aquatic system to ensure that storm water flowing through the construction area cannot flow into the aquatic system. The water from the cut-off drain must be collected in a sedimentation pond before entering the aquatic system.
- Any new erosion gullies must be remediated immediately.
- Construction should commence during the dry season or when flows are at their lowest where reasonably possible.
- Regular inspection of erosion preventing devices is needed.
- Construction camps: Plant parking areas and material stockpiles must be located outside the extent of the wetland.
- Access routes should be demarcated and located properly so that no damage to the system can occur. These roads must be adhered to at all times. A large turning place must be provided for larger trucks and machinery. No grading of temporary access roads is allowed as this will create dust and water runoff problems.
- Increased runoff due to removal of vegetation and increased soil compaction must be managed to ensure the prevention of siltation and the maximum stream bank stability.
- The velocity of storm water must be attenuated and spread. As far as possible the link between the stream and the local environment must be maintained. This is to ensure water movement into the soils and ensuring the survival of associated vegetation.
- Storm water leaving the site downstream must be clean and of the same quality as in situ before it enters the construction site (upstream). Preconstruction measures must be in place to ensure sediments are trapped.

- The overall alluvial characteristics of the drainage line (balance between sand, gravel, and stone) must be similar to before construction to ensure natural systems of flooding and sedimentation deportation and conveyance occur.

7. Conclusion and recommendations

No wetland conditions were observed on site. A channelled valley bottom wetland was however observed within the 500 m ESA. A drainage line was found from the Kutalo Station into the study site. This drainage line must be incorporated into the storm water designs with sustainable urban drainage components worked into the designs.

The GDARD minimum requirements (GDARD, 2014) were used for this project as guide (inside urban edge). All environmental assessments (including biodiversity assessments) must always be based on the three main aspects of the National Environmental Management Act, 1998 (Act No. 107 of 1998). These main aspects are the social, the economic, and the environmental aspects of the proposed development. It is also of concern that these aspects must be in balance and that if one outweighs another, good reasoning be sought to ensure the balance is restored.

7.1. Environmental laws

The following environmental laws could be applicable to the study site. These are only recommendations and to ensure compliance, a lawyer specialising in environmental law should be consulted:

- National Environmental Management Act, 1998 (Act No. 107 of 1998)
- The National Water Act, 1998 (Act No. 36 of 1998) with specific reference paid to Section 21 of the National Water Act, 1998 (Act No.36 of 1998)
- The National Water Act, 1998 (Act No. 36 of 1998) General Notice 1199 - development within 500 meters of a wetland
- The National Water Act, 1998 (Act No. 36 of 1998) General Notice 1198 - Rehabilitation of a wetland area
- Regulation No. 543 – 545, 2010 of the National Environmental Management Act, 1998 (Act No. 107 of 1998)
- National Environment Management Protected Areas Act, 2003 (Act No. 57 of 2003);
- National Environment Management Waste Act, 2008 (Act No. 59 of 2008);
- National Veld and Forest Fire Act, 1998 (Act No.101 of 1998);
- Mountain Catchment Act, 1970 (Act No. 63 of 1970);
- National Heritage Recourses Act, 1999 (Act No. 25 of 1999);
- World Heritage Convention Act, 1999 (Act No. 49 of 1999);
- Municipal Systems Act, 2000 (Act No. 32 of 2000);

- Integrated Coastal Management Act, 2008 (Act No. 24 of 2008);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- Land Use Planning Ordinance 15 of 1985 and the planning ordinances depending on the province in South Africa where construction will take place

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