PROPOSED LONGLAND TOWNSHIP PRECINCT, JOHANNESBURG, GAUTENG

Wetland Delineation and Functional Assessment

SEF Ref No: 501900

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August 2008

Declaration of Independence

I, Antoinette van Wyk, declare that I –

- Act as the independent ecologist compiling this report;
- Do not have any financial interest in the undertaking of the activity, other that remuneration for the work performed in terms of the Environmental Impact Assessment Regulations, 2005;
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- 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 Environmental Impact Assessment Regulations, 2005; and
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

Signature of the ecologist

Name of Company:
Strategic Environmental Focus Pty LTD

Date:
23 August 2008

Executive Summary

Strategic Environmental Focus (Pty) Ltd, as independent environmental consultants, were appointed by PROFICA to facilitate the environmental process in terms of the Environmental Impact Assessment Regulations for the development of the proposed Longland township precinct on portions of the Farm Witkoppen, Johannesburg, Gauteng. A wetland delineation and functional assessment was required to identify hydrologically and ecologically sensitive areas associated with wetland systems on the site with particular reference to the remainder of Portion 40, known as Magaliessig Extension 12.

The wetland boundaries were determined according to standardised methodology. The presence of wetland conditions were indicated by hydrophytic vegetation and hydromorphic soils. In addition, interpretations from cadastral maps and ortho-rectified aerial photographs with 5m contour data were used to confirm wetland boundaries.

The wetland delineated in this study constitutes 0.72ha of the surface area of the site. The hydro-geomorphic wetland unit identified in the current study is characterised by impacts such as canalisation, alien vegetation, and altered hydrology in the form of a concrete stormwater structure which directs the water flow underneath Monte Casino Boulevard. However, the wetland unit performs ecosystem services by trapping sediments, nutrients and toxicants and has the potential to contribute to flood attenuation in a catchment characterised by increased stormwater flows.

Buffers necessary to protect wetlands and streams should be a minimum of 15 to 30m from the outer edge of the wetland’s temporary zone. Generally, minimum buffer widths towards the lower end of this range may provide for the maintenance of the natural physical and chemical characteristics of aquatic resources. An opportunity exists for the improvement of the hydrological function of the wetland on the site in conjunction with a wetland-sensitive stormwater management plan and engineered interventions.

The following principles should be applied to the management of the wetland on the site:

- It should not be the aim of engineered interventions to return the wetland to its hypothetical original state. Rather interventions should aim to manage hydrological processes in order to maintain the wetland in the best functional condition that is currently feasible;
- Ecological principles must hold sway in determining how best to manage the wetland’s different zones – including the buffer. Ecological principles include:
    - Utilising opportunities to enhance current ecological functions of the wetland;
    - Maintaining the zonation of wetland areas by avoiding canalization and increased water velocity; and

- Making use of soft engineering rather than hard engineering by using natural landscape features and vegetation to direct water flow rather than concrete canals;

- Engineering interventions must enhance rather than further deteriorate the ecological functions of the wetland and must:
  - Promote groundwater recharge by avoiding impermeable structures;
  - Allow for lateral movement of water;
  - Focus on storm water management in terms of flow attenuation and reduced velocity;
  - Avoid stagnant water pools; and
  - Must be based on calculated volumes from the before and after development scenario, taking cognizance of the area of land required to maintain seasonal wetland conditions, while managing storm water impacts.

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1. INTRODUCTION

1.1 Project Description

Strategic Environmental Focus (Pty) Ltd, as independent environmental consultants, were appointed by PROFICA to facilitate the environmental application procedure for the proposed mixed use development on a remainder of Portions of the Farm Witkoppen 194 IQ, Gauteng.

The site earmarked for the proposed development is located within the City of Johannesburg Metropolitan Municipal. A wetland delineation and functional assessment was required to identify hydrologically and ecologically sensitive areas associated with wetland systems on the site with particular reference to the remainder of Portion 40, known as Magaliessig Extension 12.

Authoritative legislation, which list impacts and activities on wetlands (including riparian areas) that requires authorisation are:

- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983);
- Environment Conservation Act, 1989 (Act 73 of 1989);
- National Water Act, 1998 (Act 36 of 1998); and
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).

Wetland and riparian areas perform many functions that are valuable to society including the supply of water and the improvement of water quality. The habitats created by wetlands and rivers are also important for many plant and animal species. Not all wetlands and rivers develop in the same way and may not perform ecosystem services to the same extent. Where areas of human settlement and development threaten to encroach and impact on wetland and river areas, it is important that the wetland and river’s ability to provide various ecosystem services be assessed.

1.2 Terms of Reference

The terms of reference for the current study are as follows:

- Identify the footprint of the wetland areas;
- Indicate the relative functional importance of the wetlands;
- Indicate possible impacts on the wetland areas; and
- Recommend mitigation measures in order to limit the impact of the proposed development on the wetland areas.

1.3 Assumptions and Limitations

The Trimble® GPS Pathfinder XB used for this delineation is accurate to within five meters. Therefore, wetland boundaries plotted digitally may be offset by at least five meters to either side. The findings presented in this report are based on a single day of fieldwork (7th March 2008) and a subsequent follow-up site survey conducted on the 20th August 2008.

1.4 List of Abbreviations

Table 1 lists the abbreviations used in this report.

Table 1: Abbreviations used in the report

Abbreviation	Description
CDSM	Chief Directorate Surveys and Mapping
DWAF	Department of Water Affairs and Forestry
GDACE	Gauteng Department of Agriculture Conservation and Environment
GPS	Global Positioning System
HGM	Hydro-geomorphic
MAP	Mean Annual Precipitation
MDB	Municipal Demarcation Board
PET	Potential Evapotranspiration
SAC	Satellite Application Center
SCWG	Soil Classification Working Group

2. DESCRIPTION OF THE ENVIRONMENT

2.1 Location

The site is situated on a portion of the Remainder of Portions of the Farm Witkoppen 194 IQ, Gauteng. Global Positioning System co-ordinates are 28°0'57.355"E; 26°1'36.268"S. The site was accessed via Monte Casino Boulevard (Figure 1).

2.2 Land Use

The remainder of Portion 40, known as Magaliessig Extension 12, is currently classified as Unimproved Grassland. This section is currently used for grazing (SAC, 1996). The watercourse that transects the site is characterised by artificial structures in the form of a dam and a concrete stormwater control weir.

2.3 Hydrology

A drainage line, classified by CDSM (1996) as a non-perennial river, transects the site. The proposed site is situated in the Crocodile River catchment, Quartenary Catchment A21C, which ultimately drains into the Limpopo River. Table 2 lists relevant hydrological characteristics.

Table 2: Characteristics of Quarternary Catchment A21C relevant to the assessment of wetland health (adapted from Schultze, 1997)

Mean Annual Precipitation (MAP) (mm)	Potential Evaporation (PET)(mm)	Median Annual Simulated Runoff (mm)
694.4	2170.8	41.8

2.4 Geology and Soils

Archaean granite and gneiss of the Halfway House Granite underlies the site (GDACE, 2002). This formation dates back to the Basement Complex that was formed close to the origin of the earth. The basement complex acts as a permeable rock type as water moves easily through these rocks, becoming trapped above the intrusions. This granitic geology of the region supports shallow, coarsely grained, sandy soils poor in nutrients (Mucina & Rutherford, 2006).

The soil classification for the majority of the site includes the Glenrosa soil form (GDACE, 2002). This soil form is described as a potential seasonal to temporary wetland soil. It is characterised by a surface horizon which is maintained by biological activity and underlying rock or saprolite. Saprolite refers to a horizon of weathering rock which still has distinct affinities with the parent rock (Fey, 2005).

A small strip on the western boundary of the site is classified as being underlain by Unconsolidated material. Unconsolidated soil is loosely arranged material (sand, clay, silt or organic matter). In highly transformed areas this characteristic may be the result of anthropogenic activity such as mining, agriculture or engineering projects that have destroyed the upper layers of the soil profile that might have been present in the soils (Fey, 2005)

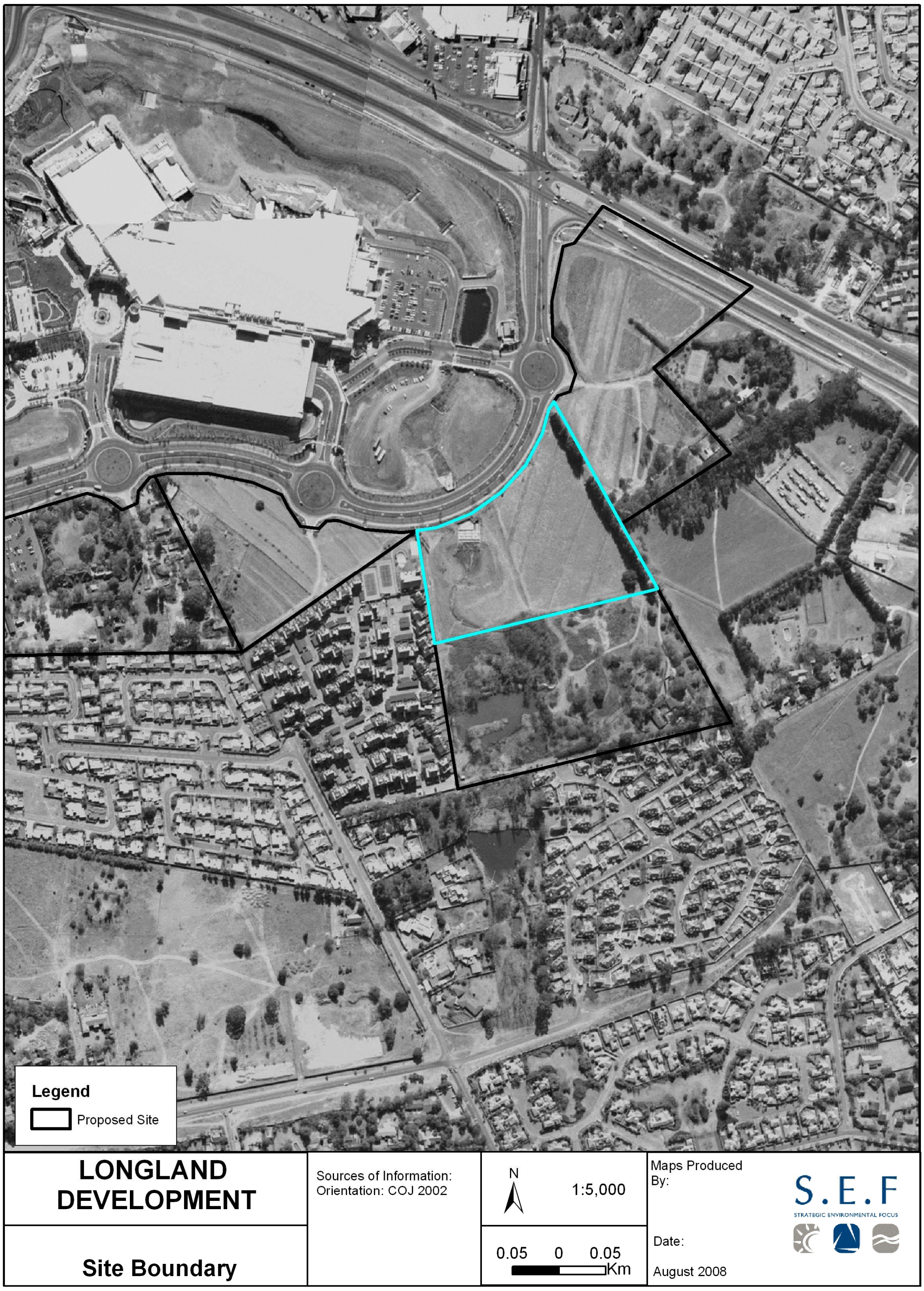


Figure 1: The location of the study site with particular reference to remainder of Portion 40, known as Magaliessig Extension 12

3. RESULTS

3.1 Wetland Vegetation

Vegetation in wetland and riparian areas clearly reflect the presence and flow characteristics of water in the landscape. Indicator species are adapted to growing in saturated soils (hydrophytic plants in the case of wetlands) and woody vegetation that is more vigorous and robust than adjacent vegetation (in the case of riparian areas) (DWAF, 2005). Hydrophytic vegetation associated with the watercourses on the study site clearly indicated wetland conditions.

Hydrophytic plants differ in the degree to which they are dependant on, or limited to, wetland conditions. DWAF (2005) described how different classes of obligate and facultative wetland plants can be used to indicate the perimeter of the three wetland zones:

- The temporary zone of a wetland as the outer edge of a wetland characterised by saturation within 50cm of the soil surface for less than three months in a year. Vegetation characteristic of the temporary wetland zones is often predominantly grass species which occur extensively in non-wetland areas and hydrophytic species which are largely restricted to wetland areas;

- The seasonal zone of a wetland is defined as lying between the temporary and permanent wetland zones, and is saturated for three to ten months in a year. Vegetation in this zone is composed of predominantly hydrophytic sedge and grass species which are restricted to wetland areas; and

- The permanent wetland zone is the inner part of the wetland that is always saturated. Vegetation in this zone is dominated by emergent plants such as reeds and a mixture of rushes and sedges. Submerged or floating aquatic plants may also be present.

A gradient of wetness observed during the present study was reflected by hydrophytic plant species (Table 3, Figure 2). The vegetation in the temporary and seasonal wetland areas was dominated by grass and sedge species.

Table 3: Plant species recorded in the wetland zones in the study site

Species		Zone
Scientific Name	Common Name	
Arundo donanx	Giant Reed	Permanent
Celtis africana	White Stinkwood	Temporary
Chironia purpurascens	Bitterwortel	Temporary
Cynodon dactylon	Couch Grass	Temporary
Cyperus sp.	-	Seasonal and Temporary
Cyperus prolifer	-	Seasonal
Haplocarpa scaposa	Boesmansrietjie	Temporary
Hyperrhenia hirta	Common Thatching Grass	Temporary
Imperata cylindrica	Cotton Wool Grass	Seasonal
Juncus sp.	-	Permanent
Kyllinga alata	-	Seasonal and Temporary
Paspalum dilatatum	-	Seasonal and Temporary
Pennisetum clandestinum	Kikuyu Grass	Seasonal and Temporary
Plantago lanceolata	Narrow-leaved Plantain	Seasonal and Permanent
Persicaria sp.	Knotweed	Permanent
Rhus pyroides	Common Wild Currant	Temporary
*Salix babylonica**	Weeping Willow	Seasonal
*Tagetes minuta**	Kakhi Bush	Seasonal and Temporary
*Verbena bonariense**	-	Seasonal and Temporary
*Verbena tenuisecta**	Fine-leaved Verbena	Temporary
Wahlenbergia krebsii	-	Temporary

* Alien Invasive Species

Figure 2: Vegetation recorded in the wetland zones

3.2 Wetland Soils

According to DWAF (2005), soils associated with riparian areas can often be described as alluvial soils. Soils associated with wetlands characteristically display mottling and gleying within 50cm of the soil surface. Decolouration of the soil occurs when iron and manganese become soluble under anaerobic conditions and are removed from the soil profile by gradual leaching. Once most of the iron has been dissolved out of the soil as a result of prolonged saturated conditions, the soil matrix is left a greyish colour (Fey, 2005; DWAF, 2005).

The permanent zone of a wetland will always have either Champagne, Katspruit, Willowbrook or Rensburg soil forms present, as defined by the Soil Classification Working Group (1991). The seasonal or temporary zones of wetlands have one or more of the following soil forms present: Kroonstad, Longlands, Wasbank, Lamotte, Estcourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Witfontein, Sepane, Tukulu, Montagu; Inhoek, Tstitsikama, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa or Dundee (DWAF, 2005).

Soil samples taken in the low lying areas of the study site showed signs of gleying and mottling consistent with wetland conditions (Figure 3). No alluvial deposits were recorded along the edge of the watercourse.

Interpretation of soil samples was complicated by the fact that the creation of embankments leading to the stormwater control weir along the northern section of the watercourse has disturbed the soil profile. Although mottling and gleying have been recorded on these embankments, they have been excluded from the delineation based on an investigation of the soil profile up to 2m below the current surface of the embankment. The embankments were shown to be dominated by mechanically transported soils. Indications of previous termite activity and transported gravel were recorded down to depths of 1.3-1.5m (Figure 4).

Figure 3: A soil sample displaying differentiation between high and low chroma areas indicative of movement of iron

Figure 4: Suggested evidence of termite activity recorded at approximately 1.5m below the current soil surface

3.3 Wetland Delineation

The National Water Act, 1998 (Act 36 of 1998) [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.*"

Furthermore Cowardin *et al* (1979) describes wetlands as "lands that are sometimes or always covered by shallow water or have saturated soils long enough to support plants adapted for life in wet conditions" and stipulate that, in order for an area to be classified as a wetland, it must meet at least one of the following criteria: 1) at least periodically, the land supports predominantly hydrophytes; 2) the substrate is predominantly undrained hydric soil; and/or 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season.

Wetlands typically occur on the interface between aquatic and terrestrial habitats and therefore display a gradient of wetness – from permanently wet zones through to seasonal and temporary zones. These gradients are represented in their plant species composition, as well as their soil characteristics. The final wetland delineation is shown in Figure 5. The wetland constitutes 0.72ha of the surface area of the study site.

The classification system proposed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (Ewart-Smith *et al*, 2006). The current wetland study follows the same approach by classifying wetlands in terms of a functional unit in line with a level three category recognised in the classification system proposed in Ewart-Smith *et al* (2006).

A single HGM type, namely a channelled valley-bottom wetland was identified as potentially impacted on by the proposed development. HGM units encompass three key elements (Kotze *et al*, 2005):

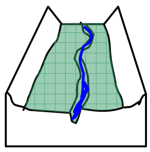
(1) Geomorphic setting - this refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river-borne sediment);
(2) Water source - there are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
(3) Hydrodynamics - this refers to how water moves through the wetland.

Figure 5: The final wetland area delineated on the site

Datasets that closely correspond to the wetland delineated in the current study (such as rivers recorded by the Chief Directorate Surveys and Mapping, 1996) classify hydrological features according to their seasonality, namely perennial and non-perennial rivers. The current study classifies wetlands based on their HGM attributes. These two classification systems should not be confused or used interchangeably. Table 4 presents the criteria for classification of the hydro-geomorphic unit identified in this report.

The wetland has well-defined temporary and seasonal wetland zones and a channel which is directed into an existing concrete stormwater control weir which directs the water flow underneath Monte Casino Boulevard towards Monte Casino (Figure 6). Raw sewage is occasionally released into the wetland from overflowing manholes west of the watercourse. Erosion is evident in the wetland channel.

Table 4: Characteristics of the hydro-geomorphic type Valley bottom with a channel (adapted from Kotze *et al*, 2005)

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
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.	***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source:
- * Contribution usually small
- *** Contribution usually large
- */ *** Contribution may be small or important depending on the local circumstances

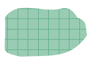
 Wetland

Figure 6: The stormwater control weir located at the outflow of the wetland

3.4 Wetland Functional Assessment

Hydro-geomorphic units are per definition characterised by physical and hydrological features that allow them to perform specific ecosystem services (Table 5). The degree of disturbance and modification of wetlands results in a decrease in the ability to which they are able to perform these ecosystem services. Ecosystem services are further grouped into Indirect and Direct services. These are presented in Table 6.

Table 5: Preliminary rating of the hydrological benefits likely to be provided by a channelled valley bottom wetland given its particular hydro-geomorphic type (Kotze *et al,* 2006)

WETLAND HYDRO-GEOMORPHIC TYPE	HYDROLOGICAL BENEFITS POTENTIALLY PROVIDED BY THE WETLAND							
	Flood attenuation		Stream flow regulation	Erosion control	Enhancement of water quality			
	Early wet season	Late wet season			Sediment trapping	Phosphates	Nitrates	Toxicants[1]
Valley bottom - channelled	+	0	0	++	+	+	+	+

Note: [1]Toxicants are taken to include heavy metals and biocides

Rating:
- 0 Benefit unlikely to be provided to any significant extent
- \+ Benefit likely to be present at least to some degree
- ++ Benefit very likely to be present (and often supplied to a high level)

Table 6: Ecosystem services provided by wetlands (Kotze *et al*, 2005)

Ecosystem system services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits		Flood attenuation
				Streamflow regulation
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
				Toxicant assimilation
				Erosion control
				Carbon storage
				Biodiversity maintenance
	Direct benefits			Provision of water for human use
				Provision of harvestable resources
				Provision of cultivated foods
				Cultural significance
				Tourism and recreation
				Education and research

Wetland prioritisation studies (Venter, 2007) have shown that ecosystem services related to water quality are of particular value in urban areas. The ratio of MAP to PET (refer to the values given in Table 2, Section 2.2) is 0.33. This indicates that the wetland loses more water through evapotranspiration, than it received through precipitation. The functional assessment methodology proposed by Macfarlane *et al,* (2006) classifies the vulnerability of this wetland, based on these values, as Moderately High (Table 7).

Table 7: Hydrological vulnerability based on the MAP:PET ratio (Macfarlane *et al*, 2006)

MAP to PET ratio	>0.6	0.50-0.59	0.40-0.49	0.30-0.39	<0.3
Vulnerability:	Low	Moderately low	Intermediate	Moderately high	High

The functional assessment methodology includes a scoring system whereby values are subjectively awarded to characteristics of wetland systems in order to present the ecosystem services they provide in a graphic manner (Appendix A). It is important to note that this representation does not imply a single overall measure of importance of a wetland area. Rather, it provides a rapid identification of important ecosystem services that need to be considered in a particular development phase (Kotze *et al*, 2005).

The following impacts and pressures are relevant to the wetland on the site:

- Altered hydrology due to dam construction, a stormwater control weir and a roadway crossing;

- Disturbance of the soil profile through the mechanical action of creating the dam, stormwater control weir and roadway crossing;
- Contamination of the watercourse by raw sewage from occasionally overflowing manholes;
- Vegetation cover removal leading to erosion and siltation of the aquatic habitat; and
- Exotic vegetation encroachment.

Although the wetlands are no longer in a pristine state, they remain functional units of a larger natural system. The wetland functional assessment scores reflect the relative functionality of the wetland HGM unit (Figure 7).

The functional assessment scores for Indirect benefits provided by wetland HGM unit was 22.0. The highest scores were obtained for the ecosystem services Flood Attenuation, Streamflow Regulation, Nitrate and Toxicant Removal. This wetland was classified as being moderately modified with some loss of natural habitats (Appendix A).

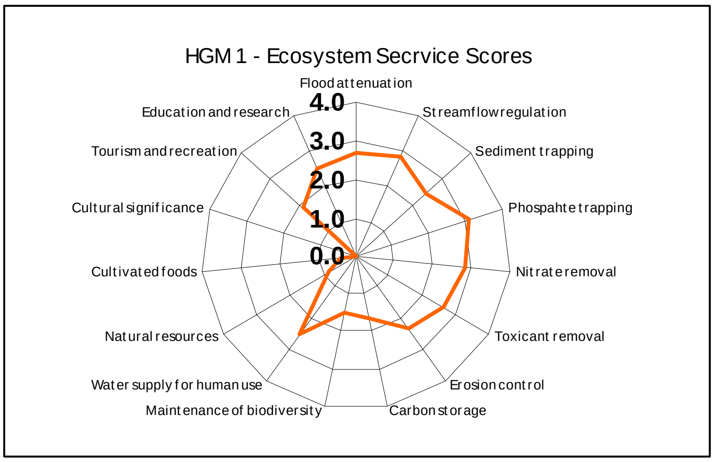


Figure 7: Ecosystem services provided by the wetland HGM unit

The functional assessment scores for Direct benefits provided by the wetland HGM unit were recorded as being 8.0 (Appendix A). This wetland was therefore classified as having a low functionality in terms its ability to provide Direct benefits. The relatively high score obtained for the ecosystem service Water Supply for Human Use is primarily explained by the presence of the dam and current agricultural activities occurring on the site.

3.5 Wetland Buffer

A wetland buffer zone is an area of vegetation which begins from the boundary of a wetland's temporary zone (wetland edge) and extends outward (Water Notes 4, 2000). Local government interests in wetland buffers often include concern for management of stormwater, protection of water supplies, and the protection of property and people from flooding. Protection of vegetated buffers may reduce the severity of water fluctuations and flooding, assist in stabilising river banks, absorb pollutants before they enter the watercourse, and provide ecologically important habitat (Environmental Law Institute, 2008).

A development has several impacts on the surrounding environment and particularly on a wetland. The development changes habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of stormwater, and therefore the hydrological regime of the entire site. A hard impervious surface adjacent to the wetland will block normal water flow to the wetland, while increasing stormwater flow during a rainfall event. The combination of these factors will lead to the degradation and erosion within the wetland (including the downstream wetland areas) (Grundling, 2008). Buffering around the wetland and the design of the stormwater management system must therefore take the abovementioned hydrological processes into consideration.

In the study of Castelle *et al* (1994), four criteria were identified for determining adequate buffer sizes for aquatic resources (Grundling, 2008):

- Resource functional value;
- Intensity of adjacent land use;
- Buffer characteristics; and
- Specific buffer functions required. Generally, smaller buffers are adequate when the buffer is in good condition (e.g. dense native vegetation, undisturbed soils), the wetland or stream has a relatively low functional value (e.g. high disturbance regime, dominance by non-native plants), and the adjacent land use has a low impact potential (e.g. parkland, low density residence).

Castelle *et al* (1994) found a range of buffer widths from 3 to 200 m to be effective, depending on site-specific conditions. They recommended on buffer widths based on the following minimum guidelines:

- 15.2 - 30m for water temperature moderation;
- 10 – 60m for sediment removal and erosion control;
- 5 – 90m for excess nutrient and metal removal; and
- 3 – 106.7m for species diversity.

There are no clear national guidelines for wetland buffer zones at present. DWAF is in the process of compiling comprehensive guidelines. GDACE requires standard buffer zones of 30m around wetlands within the urban edge. Changes to recommended GDACE buffer zones to accommodate the proposed development layout may be considered by the authorities if supporting documentation is provided to indicate that the integrity of the wetland will not be compromised by a reduced buffer zone.

The following issues should be addressed in this regard (S. Chavalala, personal communication, 30 June 2008[1]):

- Scientific support to justify a reduction in the GDACE (2006) buffer zone in terms of the rates of infiltration of water into the soil, surface water runoff rates, and other topographical, or geohydrological parameters that may be relevant;
- Indicate on-site mitigation measures that will prevent wetland degradation or that will enhance wetland buffer functioning;
- Reference should be made to the GDACE Conservation Plan in order to indicate the potential presence of dispersal and migration corridors; and
- Detailed wetland-sensitive stormwater management plans.

[1] Mr. Support Chavalala, Gauteng Department of Agriculture, Conservation and Environment. Support.Chavalala@gauteng.gov.za

Available literature indicates that buffers less than 5 to 10m provide little protection to aquatic resources under most conditions. Buffers necessary to protect wetlands and streams should be a minimum of 15 to 30m. Generally, minimum buffer widths towards the lower end of this range may provide for the maintenance of the natural physical and chemical characteristics of aquatic resources.

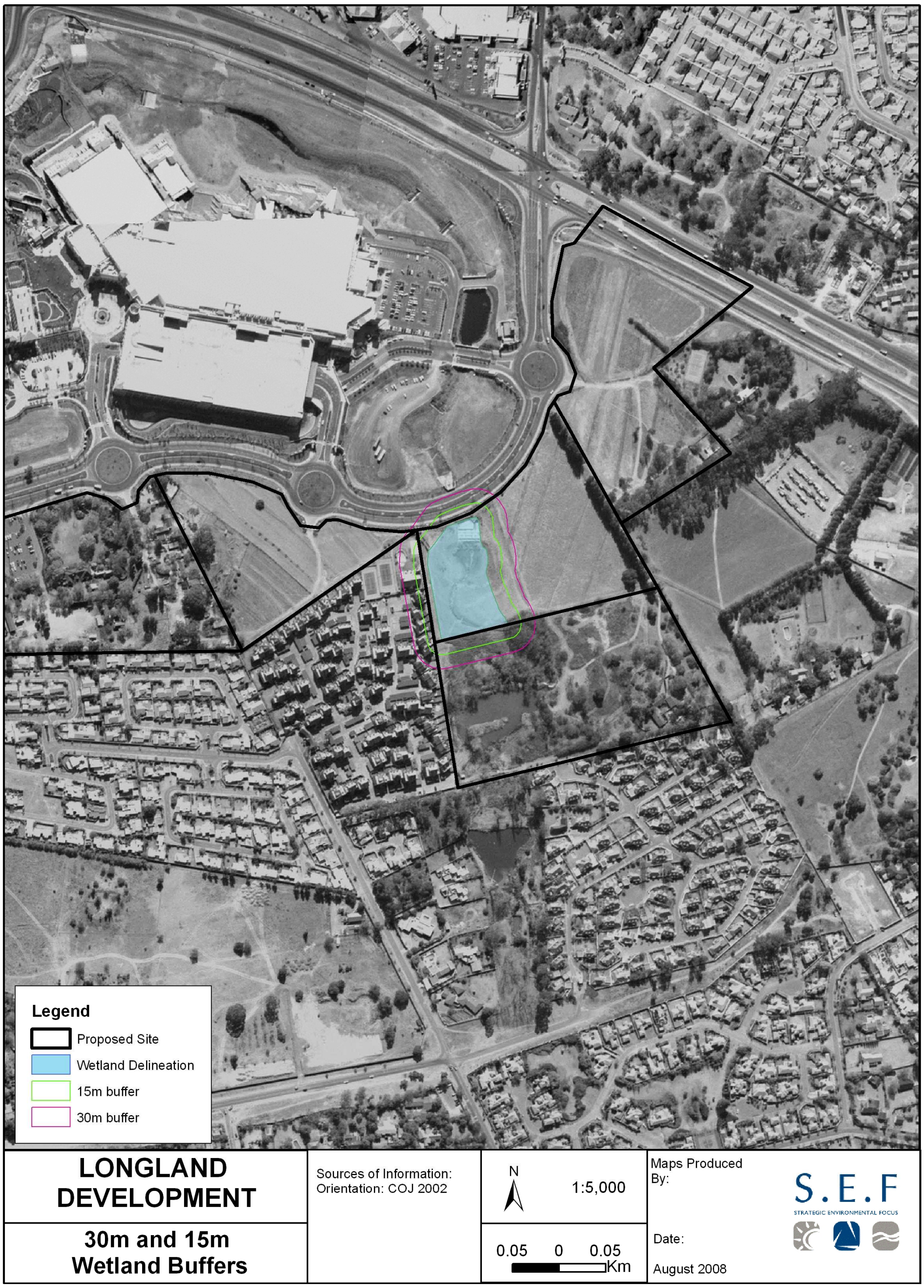


Figure 8: 30m and 15m buffer zones around the wetland area

4. IMPACT DESCRIPTION, ASSESSMENT AND MITIGATION

Activities related to the proposed development will be of limited significance to the integrity of the wetland system if the recommended mitigating measures are implemented during the construction and operational phase (Table 8 and Table 9).

Table 8: Possible impacts during the construction phase

Possible impact	Source of impact
Increased stormwater runoff volume and velocity	Increase of hard impermeable surfaces and reduction of ground cover
Erosion of drainage lines	Increased stormwater runoff volume and velocity
Surface and groundwater water pollution	Activities of workforce, e.g. washing of clothes in the river, concrete mixing and sediment release including hydrocarbon spillages

Table 9: Possible impacts during the operational phase

Possible impact	Source of impact
Altered hydrological regime	Increased stormwater runoff volume and intensity
Decreased biodiversity	Reduction of vegetated land cover

4.1 Construction Phase

4.1.1 Increased stormwater runoff volume and velocity

Extent	Duration	Intensity	Probability of occurrence	Significance without mitigation	Significance with mitigation	Confidence
Local	Short	Medium	Probable	Medium	Low	Medium

Description of the impact

Vegetation clearing resulting from routine construction activities results in large areas of bare soil and hard impermeable surfaces. Stormwater runoff volume consequently increases resulting in erosion and sedimentation of the river. This should be of limited significance if the recommended mitigation measures are implemented.

Mitigation Measures

- Construction on steep slopes will require erosion control measures and correct grassing methods;
- Any erosion formed during the construction phase or during the vegetation establishment period shall be backfilled and compacted, and the areas restored to an acceptable condition (80% vegetation cover);
- Regular monitoring should identify areas where erosion is occurring;
- Disturbed surfaces to be rehabilitated should be ripped, and the area must be backfilled with topsoil or overburden;
- An ecologically sound stormwater management plan must be implemented. Stormwater on the site must be managed so as to reduce the silt loads in the system. Measures must be implemented to distribute stormwater as evenly as possible to avoid point sources of erosion;
- To prevent the erosion of material that is stockpiled for long periods, the material should be retained in a bermed area; and
- Construct an earth bank around any upslope portion of any stockpiles in order to redirect runoff and prevent scouring of stockpiles.

4.1.2 Erosion of drainage lines

Extent	Duration	Intensity	Probability of occurrence	Significance without mitigation	Significance with mitigation	Confidence
Local	Short	Low	Probable	Medium	Low	High

Description of the impact

The clearance of vegetation will reduce the capacity of the land surface to retard the flow of surface water, thus decreasing infiltration and increasing both the quantity and velocity of surface water runoff and erosion. Human activities which disturb the soil structure, such as the compaction of soil along footpaths and vehicle tracks, can result in increased susceptibility to erosion. Roads and pathways created during the construction phase have the potential to become preferred drainage lines, resulting in gully erosion. It is important to note that wetlands immediately outside the study site are also susceptible to erosion caused by activities on the site, as well as access to the site. It is important that they should be considered in stormwater mitigation.

Mitigation Measures

- Appropriate flow diversion and erosion control structures (i.e. earth embankments) must be put in place where soil may be exposed to high levels of erosion due to steep slopes, soil structure etc.;
- Stormwater at the construction crew camps must be managed so as to reduce the silt loads in the drainage channel. Measures must be implemented to distribute stormwater as evenly as possible to avoid point sources of erosion;
- Construction on steep slopes and in soft or erodable material will require erosion control measures and correct grassing methods;
- All construction areas should be suitably top-soiled and vegetated as soon as possible after construction; and
- Disturbed surfaces to be rehabilitated must be ripped, and the area must be backfilled with topsoil or overburden.

4.1.3 Surface and groundwater water pollution

Extent	Duration	Intensity	Probability of occurrence	Significance without mitigation	Significance with mitigation	Confidence
Regional	Short	Medium	Definite	High	Low	High

Description of the impact

Hydrocarbon-based fuels or lubricants spilled from construction vehicles, construction materials that are not properly stockpiled, and litter deposited by construction workers may be washed into the surface water bodies. Should appropriate toilet facilities not be provided for construction workers at the construction crew camps, the potential exists for surface water resources and surroundings to be contaminated by raw sewage. The utilisation of the water courses for disposal of water used for washing will decrease the abundance and diversity of aquatic macroinvertebrates inhabiting the section of the watercourse associated with the proposed development and further downstream. Contaminated runoff from concrete mixing and sediment release including hydrocarbon spillages may lead to the infiltration of toxicants into the groundwater.

Mitigation Measures

- 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 as agreed with the ECO. These materials include fuel, oil, cement, bitumen etc.;
- Surface water draining off contaminated areas containing oil and petrol would need to be channeled 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;
- 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;
- 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 any of the water courses within the study area;
- 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;
- Conduct ongoing staff awareness programs so as to reinforce the need to avoid littering; and
- Backfill must be compacted to form a stabilised and durable blanket and the current load above the sewer lines must at no time be exceeded.

4.2 Operational Phase

4.2.1 Altered hydrological regime

Extent	Duration	Intensity	Probability of occurrence	Significance without mitigation	Significance with mitigation	Confidence
Local	Long	Low	Highly Probable	Medium	Low	High

Description of the impact

The following changes to hydrological processes will potentially decrease the functionality of the wetland:

- The presence of hard impermeable surfaces such as roads, parking areas and roofs, will result in an increase in stormwater runoff volume and velocity;
- Decrease in the sinuosity of the channel by for example canalisation will further increase stormwater runoff velocity;
- The increase of surface water runoff and the decrease of infiltration will result in an increase in erosion potential and sedimentation and a decrease in groundwater recharge;
- A decrease in hydrological zonation (for example by removing the temporary and seasonal zones of the wetland) will reduce the wetland's ability to regulate streamflows and assimilate nitrates and toxicants;
- The reduction of lateral movement of water from the adjacent landscape and the soil profile (for example by creating a canal with impermeable walls) reduces the wetland's ability to remove nitrate and toxicants.
- Reduced surface roughness has a significant influence on the velocity of water flow across the surface of the ground. The greater the surface roughness, the greater the frictional resistance to the movement of water and the greater will be the level to which flow velocity is reduced.

Mitigation Measures

- Ecological principles must hold sway in determining how best to manage the wetland's different zones – including the buffer. Ecological principles include:
    - Utilising opportunities to enhance current ecological functions of the wetland;
    - Maintaining the zonation of wetland areas by avoiding canalization and increased water velocity; and
    - Making use of soft engineering rather than hard engineering by using natural landscape features and vegetation to direct water flow rather than concrete canals;

- Engineering interventions must enhance rather than further deteriorate the ecological functions of the wetland and must:
  - Promote groundwater recharge by avoiding impermeable structures;
  - Allow for lateral movement of water;
  - Focus on storm water management in terms of flow attenuation and reduced velocity;
  - Avoid stagnant water pools; and
  - Must be based on calculated volumes from the before and after development scenario, taking cognizance of the area of land required to maintain seasonal wetland conditions, while managing storm water impacts.

4.2.2 Decreased biodiversity

Extent	Duration	Intensity	Probability of occurrence	Significance without mitigation	Significance with mitigation	Confidence
Local	Permanent	Low	Highly Probable	High	Medium	High

Description of the impact

The cumulative loss of habitat by increased urbanisation enhances the value of remaining areas of natural vegetation as refuges to many species. The specialised habitat created by wetland conditions also potentially forms breeding and foraging habitat for several faunal species. Although this wetland does not appear to house sensitive, or red data species, it does have a biodiversity value in supporting quite a number of species along an environmental gradient.

Mitigation Measures

- Degraded wetlands should be rehabilitated as a matter of priority;
- Pets should be prevented from accessing the wetland habitat;
- Implement a policy within the development, that only indigenous plant species be used in the landscaping of the proposed development; and
- A monitoring program should identify and remove exotic vegetation and maintain open space areas free from invasive species.

5. CONCLUSION AND RECOMMENDATIONS

The wetland and associated buffer zone constitute 0.72ha of the surface area of the study site. The wetland HGM unit that make up the wetland on the northern portion of the site is characterised by impacts such as canalisation, alien vegetation and altered hydrology in the form of a concrete stormwater structure that directs the water flow underneath Monte Casino Boulevard. However, the wetland unit performs ecosystem services by trapping sediments, nutrients and toxicants and has the potential to contribute to flood attenuation in a catchment characterised by increased stormwater flows.

Buffers necessary to protect wetlands and streams should be a minimum of 15 to 30m. Generally, minimum buffer widths towards the lower end of this range may provide for the maintenance of the natural physical and chemical characteristics of aquatic resources. The portion of the wetland that is in contact with the existing concrete stormwater control weir is isolated from the surrounding environment by impermeable surfaces. Therefore, a further reduction in buffer zones along this section of the wetland will not decrease the overall functionality of the wetland. An opportunity exists for the improvement of the hydrological function of the wetland on the site in conjunction with a wetland-sensitive stormwater management plan and engineered interventions.

The following principles should be applied to the management of the wetland on the site:

- It should not be the aim of engineered interventions to return the wetland to its hypothetical original state. Rather interventions should aim to manage hydrological processes in order to maintain the wetland in the best functional condition that is currently feasible;
- Ecological principles must hold sway in determining how best to manage the wetland's different zones – including the buffer. Ecological principles include:
  - Utilising opportunities to enhance current ecological functions of the wetland;
  - Maintaining the zonation of wetland areas by avoiding canalization and increased water velocity; and
  - Making use of soft engineering rather than hard engineering by using natural landscape features and vegetation to direct water flow rather than concrete canals;
- Engineering interventions must enhance rather than further deteriorate the ecological functions of the wetland and must:
  - Promote groundwater recharge by avoiding impermeable structures;
  - Allow for lateral movement of water;
  - Focus on storm water management in terms of flow attenuation and reduced velocity;

- o Avoid stagnant water pools; and
- o Must be based on calculated volumes from the before and after development scenario, taking cognizance of the area of land required to maintain seasonal wetland conditions, while managing storm water impacts.

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Glossary of Terms

Biodiversity: is the number and variety of living organisms on earth, the millions of plants, animals, and micro-organisms, the genes they contain, the evolutionary history and potential they encompass, and the ecosystems, ecological processes, and landscapes of which they are integral parts

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

Delineation (of a wetland): to determine the boundary of a wetland based on soil, vegetation, and/or hydrological indicators (see definition of a wetland)

***Facultative wetland plant (hydrophyte*)**:** a plant species that can grow in a range of wet to drier conditions, i.e. in the seasonal to temporary zone, as well as in non-wetland areas (terrestrial habitat)

Flood Plain: a relatively level alluvial (sand or gravel) area lying adjacent to the river channel, which has been constructed by the present river in its existing regime

Gleying: a soil process resulting from prolonged soil saturation, which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix

Groundwater: subsurface water in the saturated zone below the water table

Habitat: the natural home of species of plants or animals

Hydro-geomorphic (HGM) unit : - encompasses three key elements: (1) geomorphic setting (i.e. the landform, its position in the landscape and how it evolved (e.g. through the deposition of riverborne sediment); (2) water source (i.e. where does the water come from that is maintaining the wetland?) of which there are usually several sources including precipitation groundwater flow, streamflow, etc. but their relative contributions will vary amongst wetlands; and (3) hydrodynamics, which refers to how water moves through the wetland

Hydromorphic soil: a soil that, in its undrained condition, is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils)

Hydrology: the study of the occurrence, distribution and movement of water over, on and under the land surface

Hydromorphy: a process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile

***Obligated wetland plant (hydrophyte*)**:** a plant species that can only grow where water is present for long periods of time, i.e. in the permanent to seasonal wetland zones

Water table: The upper surface of groundwater or that level below which the soil is saturated with water. The water table feeds base flow to the river channel network when the channel bed is in contact with the water table

Wetland (as defined by the National Water Act): 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 under normal circumstances supports or would support vegetation typically adapted to life in saturated soil

Wetland delineation: the determination and marking of the boundary of a wetland. In terms of the delineation procedure described in this document, delineation means marking the outer edge of the temporary zone of wetness

Appendix A: Methodology

The delineation method documented by the Department of Water affairs and Forestry (2005) was followed throughout the field survey. This guideline describes the use of indicators to determine the outer edge of the wetland such as soil and vegetation forms.

A hand held PDA (HP iPAC hx2700) linked to a Trimble® Global Positioning System (GPS) Pathfinder XB, with ArcPad 7.0.1 software, was used to capture GPS co-ordinates in the field.

1:50 000 cadastral maps and georeferenced 1:10 000 ortho-rectified digital aerial photos with 20m interval contour lines were used as reference material for the mapping of the wetland boundaries. These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field surveys.

Kotze *et al*, (2005) was adapted and used to assess the different benefit values of the riparian wetland units. A Level 1 desktop assessment was preformed to determine the wetland's functional benefits. Several characteristics were verified during the field survey to produce a comprehensive initial functional analysis. This technique is not ideally suited to determine the specific level of impact of a current or proposed development and is based more on qualitative data as opposed to quantitative data, which opens it up to subjective misuse (Kotze *et al*, 2005). The authors do, however, highlight the system's value to assist in identifying potential opportunities and constraints relevant for a particular wetland or riparian system. The technique is used increasingly, due to a lack of existing official wetland assessment techniques in South Africa. It therefore fulfils an important role in assessing wetland functions and value, provided that its limitations are thoroughly taken note of throughout the process.Plant names follow Cook (2004).

The assessment of the ecosystem services supplied by the identified wetland units was conducted according to the guidelines as described by Kotze *et al* (2005). A Level 2 assessment was undertaken which examines and rates Direct and Indirect Benefits.

Indirect Benefits

The following natural services were assessed:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage; and

- Maintenance of biodiversity.

Scores for each of the above natural service assessments were allocated a class based on those shown in Table 10. These scores were then added to determine the overall level of natural services for the wetland unit using the classes shown in Table 11.

Table 10: Classes for functional assessment ecosystem service scores

Class Boundary	Class Score
0 - 0.99	1
1 - 1.99	2
2 - 2.99	3
3 - 4	4

Table 11: Classes for the overall level of indirect benefits provided by a wetland unit

Indirect Benefits		
Class Boundaries	**Class**	**Class Description**
Within acceptable range		
30 - 36	**Very High**	Unmodified or approximated natural condition.
24 - 29.9	**High**	Largely natural with few modifications, but with some loss of natural habitats.
18 - 23.9	**Moderate**	Moderately modified, but with some loss of natural habitats.
12 - 17.9	**Low**	Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
Outside acceptable range		
6 - 11.9	**Very Low**	Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
0 - 5.9	**Non Existent**	Critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

<u>Direct Benefits</u>

The following human services were assessed:

- Water supply for human use;
- Natural resources;
- Cultivated foods;

- Cultural significance;
- Tourism and recreation; and
- Education and research.

Scores for each of the above natural service assessments were allocated a class based on those shown in Table 10. These scores were then added to determine the overall level of human services for the wetland unit using the classes shown in Table 12.

Table 12: Classes for the overall level of direct benefits provided by a wetland unit

Direct Benefits		
Class Boundaries	**Class**	**Class Description**
Within acceptable range		
20 - 24	**Very High**	Local people are extremely dependent on the wetland and benefit from it greatly.
16 - 19.9	**High**	Local people have a high level of dependence on the wetland and benefit from it considerably.
12 - 15.9	**Moderate**	Local people are moderately dependent on the wetland and benefit from it from occasionally.
8 - 11.9	**Low**	Local people have a low dependency on the wetland and seldom benefit from it.
Outside acceptable range		
4 - 7.9	**Very Low**	Local people rarely rely on the wetland and almost never benefit from it.
0 - 3.9	**Non Existent**	Local people have no interaction with the wetland and never receive any benefits from it.

Appendix B: Survey Data

Data recorded at Longland, 2008.03.07				
Coordinates (Degrees, minutes, seconds)		Dominant Vegetation	Soil	Wetland
S	E			
26° 01' 38.31"	28° 00' 56.32"	*Kyllinga alata, Verbena bonariense, Eragrostis* sp., *Haplocarpa scaposa, Paspalum dilatatum*	Mottling and gleying within 15cm. Dark, clayey organic soil	Yes
26° 01' 38.88"	28° 00' 56.84"	*Verbena bonariense, Verbena tenuisecta, Eragrostis* sp., *Cynodon dactylon*	Soil less clayey, gleyed and mottled within 15cm	Yes
26° 01' 39.49"	28° 00' 56.29"	*Verbena bonariense, Kyllinga alata, Cyperus* sp., *Imperata cylindrica, Pennisetum clandestinum*	Standing water, darg organic soil, no mottling	Yes
26° 01' 40.06"	28° 00' 55.23"	*Cyperus* sp., *Juncus* sp., *Persicaria* sp., *Eragrostis* spp.	Soils very wet, clear mottling within 30cm	Yes
26° 01' 37.56"	28° 00' 54.22"	*Eragrostis* sp., *Haplocarpa scaposa, Hyperrhenia hirta, Plantago lanceolata, Wahlenbergia krebsii,*	Mottling at about 40cm	Yes
26° 01' 38.64"	28° 00' 57.11"	*Eragrostis* sp., *Haplocarpa scaposa, Hyperrhenia hirta, Plantago lanceolata, Chironia purpurascens*	Mottling at about 40cm	No
26° 01' 37.82"	28° 00' 57.19"	*Setaria sphacelata, Eragrostis curvula, Digitaria eriatha*	No mottling, sand well drained soils	No
26° 01' 41.60"	28° 00' 59.78"	*Setaria sphacelata, Eragrostis curvula, Digitaria eriatha, Tagetes minuta*	No mottling, sand well drained soils	No
26° 01' 41.89"	28° 00' 59.20"	*Setaria sphacelata, Eragrostis curvula, Digitaria eriatha, Tagetes minuta*	Mottling at about 40cm	Yes

26° 01' 42.85"	28° 00' 58.39"	*Cyperus prolifer, Arundo donanx, Celtis africana, Rhus pyroides*	Some mottling within 50cm	Yes
26° 01' 38.31"	28° 00' 56.32"	*Kyllinga alata, Verbena bonariense, Eragrostis* sp., *Haplocarpa scaposa, Paspalum dilatatum*	Mottling and gleying within 15cm. Dark, clayey organic soil	Yes