NANZA CONSULTING

PROPOSED SHAYAMOYA HOUSING DEVELOPMENT, KOKSTAD, KWAZULU-NATAL

Wetland Health and Functionality Assessment Report

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SPECIALIST REPORT DETAILS

This report has been prepared as per the requirements of Section 13 of Government Notice No. R. 982 dated 4 December 2014 (Environmental Impact Assessment Regulations) under sections 24(5), 24M and 44 of the National Environmental Management Act, 1998 (Act 107 of 1998).

I, **Stephen Burton** declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Economic Development, Tourism, and Environmental Affairs (EDTEA).

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GREATER KOKSTAD LOCAL MUNICIPALITY

PROPOSED SHAYAMOYA HOUSING DEVELOPMENT, KOKSTAD, KWAZULU-NATAL

WETLAND DELINEATION AND HEALTH ASSESSMENT

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1 INTRODUCTION

SiVEST Environmental Division has been appointed by **Greater Kokstad Local Municipality,** to undertake a Wetland Assessment for the proposed Shayamoya Housing Development. The project consists of the provision of low-cost housing for the residents of Shayamoya, which is located on the outskirts of Kokstad in the Greater Kokstad Local Municipality.

2 TERMS OF REFERENCE

The terms of reference of this study are to:

- Delineate wetland units falling within the project area;
- Divide and describe the wetlands into Hydro-Geomorphic (HGM) Units;
- Determine the current health and Present Ecological Status (PES) of all wetland units within the Project Area using the WET-Health tool (Level 1) **Macfarlane *et al*. (2009)**;
- Determine the current conservation importance of all wetland units within the Project Area; using the WET-EcoServices tool (level 2) developed by **Kotze *et al*. (2009)**;
- Calculate the Ecological Importance and Sensitivity (EIS) Scores of all wetland units within the Project Area (**DWAF, 1999**);
- Identify potential impacts of the proposed development on the integrity of the wetland units; and
- Provide mitigation and management measures to minimise the severity/magnitude of the impacts on the wetlands units.

3 SITE DESCRIPTION

The site is located to the East of Kokstad town, and is surrounded by formal and informal low-cost housing. Portions of the proposed housing development areas are currently under informal housing. The site is bounded by the Mzintlava River to the east, a tributary of the Mzintlava to the west, and informal and formal low-cost housing to the south and north. The current waste landfill site for Kokstad falls between the various portions of land that are proposed for housing, but it is in the process of being decommissioned. In general, the site is heavily degraded, with the greatest impacts resulting from the development of informal housing, as well as overgrazing by livestock, and illegal dumping of building rubble, and general waste. The wetlands within the investigation area are all heavily impacted by the dumping of spoil material, excavation of wetland material, dumping of waste, livestock grazing, and the lack of waterborne sewerage reticulation within the area.

The study area is situated within the quaternary catchment T32C. The study site falls within the newly defined Water Management Areas (WMAs) of South Africa, as stated in Government Notice No. 1056 (16th of September 2016), within the Mzimvubu to Keiskamma WMA. The project is located in Kokstad, which is situated near the southern boundary of KwaZulu-Natal. The geographical coordinates are: 30°32' 9.7"S, 29° 26' 13.56"E (see **Figure 1** below).

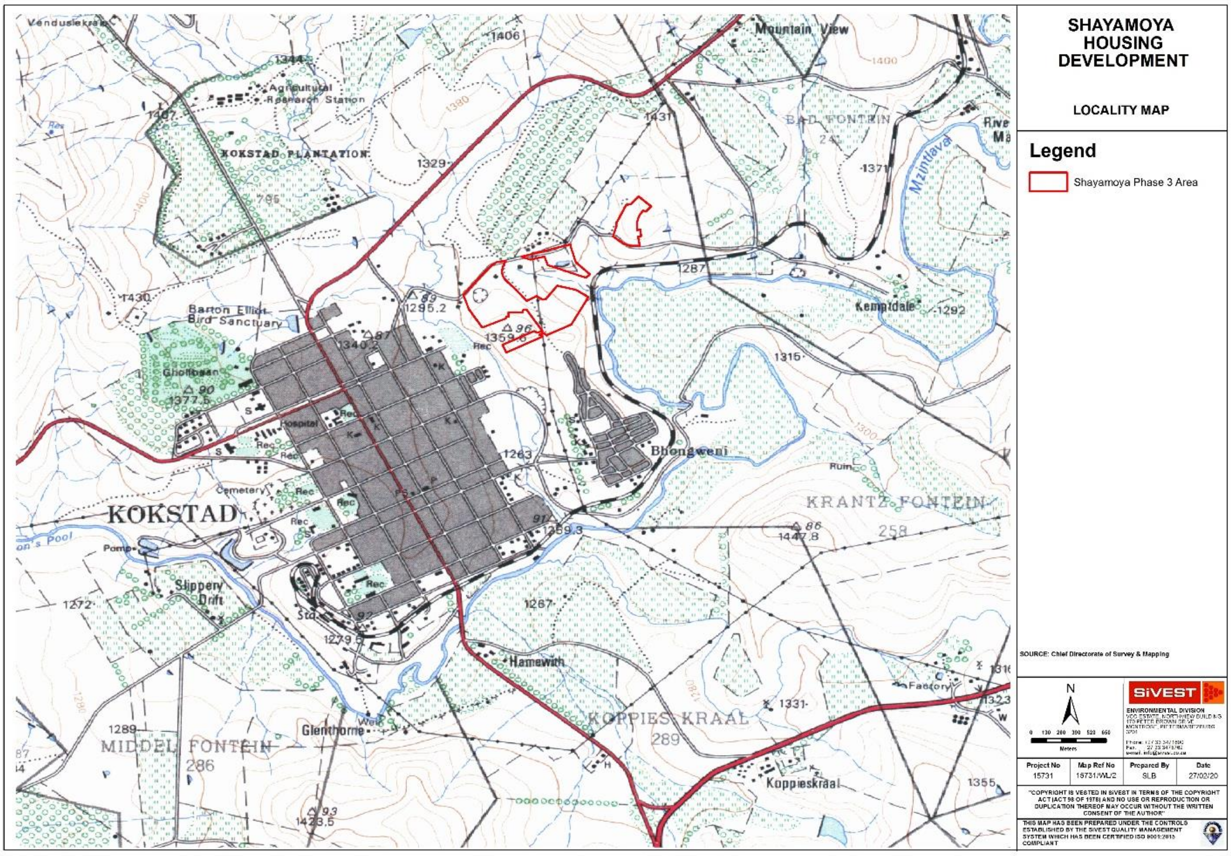

Figure 1: Site Locality Map

4 CONCEPTUAL FRAMEWORK

4.1 Wetland Delineation

Wetlands are defined as those areas that have water on the surface or within the root zone for extended periods throughout the year such that anaerobic soil conditions develop which favour the growth and regeneration of hydrophytic vegetation (plants which are adapted to saturated and anaerobic soil conditions).

In terms of Section 1 of the National Water Act (Act No. 36 of 1998), wetlands are legally defined as:

(1)…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.

Soils characterised by prolonged anaerobic soil conditions are referred to as hydric or hydromorphic soils. Hydric soils develop and occur under anaerobic conditions and are characterised by the chemical reduction of common soil minerals (e.g. iron and manganese) under saturated conditions. The result is the gleying (loss of mineral colours) of the soil matrix and under temporary and seasonal saturation the formation of mottles, which are mineral oxide precipitates of reduced minerals that precipitate out of solution during the drying of the soil in the dry season.

These soil wetness features are referred to as redoximorphic features. Wetland delineations are based primarily on the presence of soil wetness indicators/redoximorphic features. These features must occur within 50 cm of the surface soil profile for an area to be considered a wetland (**Collins, 2005**).

Typical redoximorphic features are (**Collins, 2005**):

- A reduced matrix - occurs when the iron and manganese in soils are reduced and the soils appears grey/pale (colour appears washed out).
- Redox depletions - the "grey" (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur. These can occur as:
    - Iron depletions - low chroma bodies with clay contents similar to that of the adjacent matrix. Iron depletions are often referred to as grey mottles.
    - Clay depletions - low chroma bodies containing less iron, manganese and clay than the adjacent soil matrix.

- Redox concentrations - Accumulation of iron and manganese oxides. These can occur as:
    - Nodules - firm, irregular shaped bodies that are uniform when broken.
    - Concretions - harder, regular shaped bodies;
    - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours;
    - Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

It is important to note that there are normally three wetness or saturation zones to every wetland. Each zone is based on the degree and duration (period of time) of inundation and saturation of the soils. (**DWAF, 2005**). The three wetness zones are defined below.

- The Permanent zone: The permanent zone usually reflects soils that indicate inundation and/or saturation cycles, which last more or less throughout the year.
- The Seasonal zone: The seasonal zone may only reflect soils that indicate inundation and/or saturation cycles for a significant period during the rainy season.
- The Temporary zone: The temporary zone reflects soils that indicate the shortest period(s) of inundation/saturation that are long enough, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation.

The diagnostic criteria for the identification of the three wetness zones are summarised in **Table 1** below.

Table 1: Relationship between degree of wetness (wetland zone), soil-physio-chemistry and vegetation (after Kotze *et al*., 1994)

	Degree of wetness		
	Temporary	**Seasonal**	**Permanent / Semi-permanent**
Soil Depth (0cm – 10cm)	Matrix chroma: 1-3 Few / no mottles Low / intermediate OM Non-sulphuric	Matrix chroma: 0-2 Many mottles Intermediate OM Seldom sulphuric	Matrix chroma: 0-1 Few / no mottles High OM Often sulphuric
Soil Depth (40cm – 50cm)	Few / many mottles Matrix chroma: 0-2	Many mottles Matrix chroma: 0-2	No / few mottles Matrix chroma: 0-1
Vegetation	Predominantly grass species	Predominantly sedges and grasses	Predominantly reeds and sedges

Vegetation distribution within wetlands is very closely linked to the flooding/saturation regime. The distribution of wetland plants is related to their tolerance of different flooding conditions, and their distribution within a system can be used as an indication of the wetness of an area.

Most plants generally require soil oxygen for their growth and metabolism and are not tolerant of anaerobic conditions for prolonged periods. Thus, these terrestrial plants generally occur on drier and/or elevated ground. Plants that tolerate and thrive in saturated, anoxic soil conditions are referred to as hydrophytes and have developed special adaptations to extract oxygen from the atmosphere and transport the oxygen to their roots.

Wetland plants are divided into 5 categories based on their expected frequency of occurrence in wetlands. These groups are:

- **Obligate Wetland Plants** - occur almost exclusively in wetlands under natural conditions (>99% of occurrences);
- **Facultative Wetland Plants** - usually occur in wetlands but can occasionally be found on dry land (67-99% of occurrences);
- **Facultative Plants** - equally likely to grow in wetlands and non-wetlands (34-66% of occurrences);
- **Facultative Upland/Dry-land Plants** - usually occur outside of wetlands but occasionally found in wetlands (1-34% of occurrences); and
- **Obligate Upland/Dry-land Plants** - occur almost exclusively outside of wetlands under natural conditions (<1% of occurrences).

Typically, indicators of soil wetness based on soil morphology correspond closely with vegetation distribution, since hydrology affects soils and vegetation in systematic and predictable ways. However, in systems where the hydrological regime has been modified due to human activities, vegetation distribution will not vary with the varying soil morphology.

The response of vegetation to alteration of hydrological conditions is rapid (months/years), whereas the response of soil morphology to such alteration is slow (centuries). Therefore, the lowering of the water table or reduction of surface flows, may lead to rapid establishment of terrestrial vegetation, whereas the soil morphology will retain indicators of wetness for a lengthy period.

For this reason, soil morphology forms the basis of wetland delineation nationally. This methodology of assessment mirrors international protocols, mainly because it provides a long-term indication of the "natural" hydrological regime. However, it is important to note that where soil wetness indicators cannot be used to identify the current hydrological conditions either through extensive disturbance or through certain soil types that do not retain clear redoximorphic features, the terrain and vegetation indicators will have to be utilised.

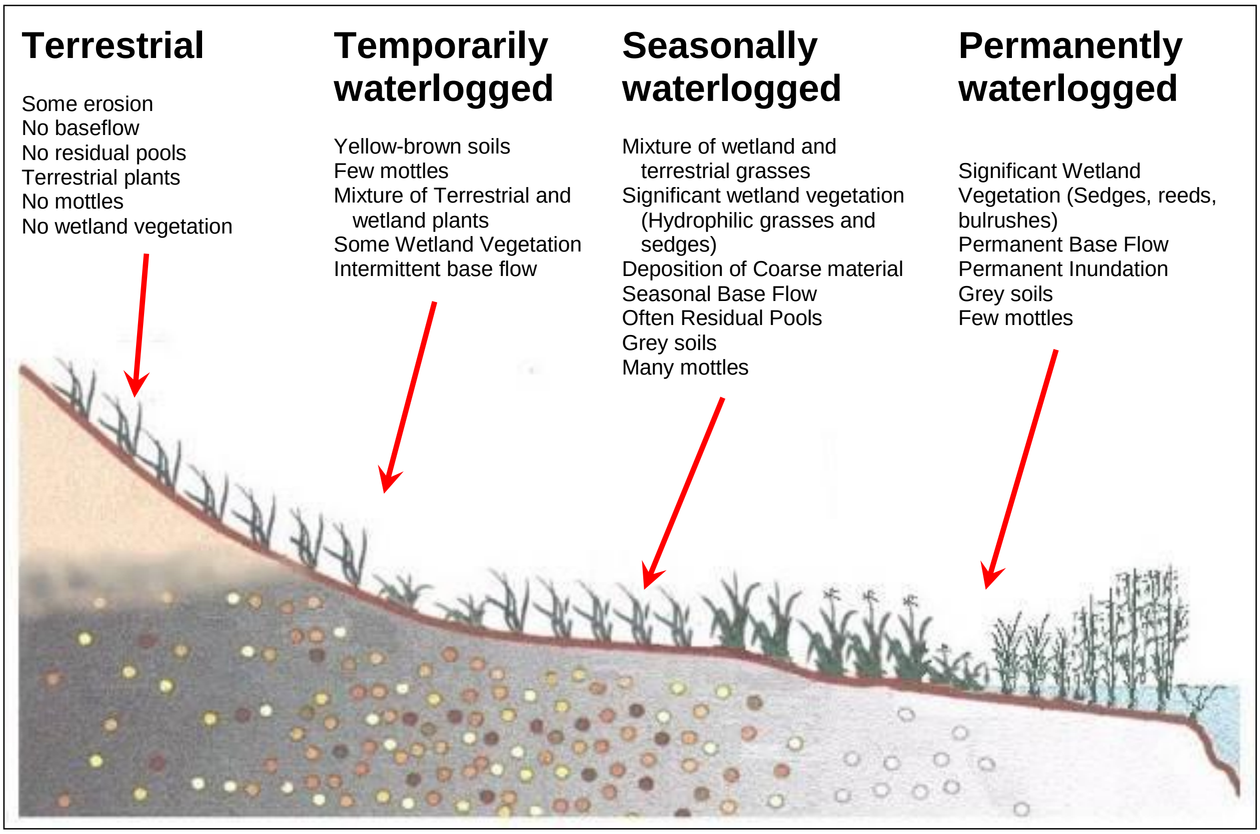

Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change along a gradient of decreasing wetness, from the middle to the edge of the wetland. (Reproduced from Kotze (1996), DWAF Guidelines).

4.2 Wetland Classification

Any features meeting the criteria above within the study area will be delineated and classified using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems hereafter referred to as the "Classification System" (Ollis et. al., 2013). A summary of Levels 1 to 4 of the classification system are discussed further below.

Inland wetland systems (non-coastal) are ecosystems that have no existing connection to the ocean which are inundated or saturated with water, either permanently or periodically (Ollis et. al., 2013). Inland wetland systems were divided into four levels by the Freshwater Consulting Group in 2009 and revised in 2013. Level 1 describes the connectivity of the system to the ocean, level 2 the regional setting (ecoregion), level 3 the landscape setting, level 4A the hydro-geomorphic (HGM) type and level 4B the longitudinal zonation.

The level 3 classification has been divided into four landscape units. These are:

a) **Slope** – located on the side of a mountain, hill or valley that is steeper than lowland or upland floodplain zones.

b) **Valley Floor** – gently sloping lowest surface of a valley, excluding mountain headwater zones.

c) **Plain** – extensive area of low relief. Different from valley floors in that they do not lie between two side slopes, characteristic of lowland or upland floodplains**.**

d) **Bench** (hilltop/saddle/shelf) - an area of mostly level or nearly level high ground, including hilltops/crests, saddles and shelves/terraces/ledges.

Level 4 HGM types (which is commonly used to describe a specific wetland type) have been divided into 8 units. These are described as follows:

- **Channel** (river, including the banks) - an open conduit with clearly defined margins that (i) continuously or periodically contains flowing water. Dominant water sources include concentrated surface flow from upstream channels and tributaries, diffuse surface flow or interflow, and/or groundwater flow.
- **Channelled valley-bottom wetland** - a mostly flat valley-bottom wetland dissected by and typically elevated above a channel (see channel). Dominant water inputs to these areas are typically from the channel, either as surface flow resulting from overtopping of the channel bank/s or as interflow, or from adjacent valley-side slopes (as overland flow or interflow).
- **Unchannelled valley-bottom wetland** - a mostly flat valley-bottom wetland area without a major channel running through it, characterised by an absence of distinct channel banks and the prevalence of diffuse flows, even during and after high rainfall events.
- **Floodplain wetland** - the mostly flat or gently sloping wetland area adjacent to and formed by a Lowland or Upland Floodplain river, and subject to periodic inundation by overtopping of the channel bank.
- **Depression** - a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates. Dominant water sources are precipitation, ground water discharge, interflow and (diffuse or concentrated) overland flow.
- **Flat** - a near-level wetland area (i.e. with little or no relief) with little or no gradient, situated on a plain or a bench in terms of landscape setting. The primary source of water is precipitation.
- **Hillslope seep** - a wetland area located on (gentle to steep) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope.
- **Valley head seep** - a gently-sloping, typically concave wetland area located on a valley floor at the head of a drainage line, with water inputs mainly from subsurface flow.

Any of the above mentioned wetland forms may occur within the study area. The types of wetlands identified by the study are addressed later in the report.

4.3 Wetland Health Assessment

For the purposes of this study, wetland health is defined as a measure of the deviation of a wetland from its natural or reference condition (**Macfarlane *et al*., 2009**) and is designed to provide a rapid assessment of the present ecological status of a wetland.

The health of a wetland from an ecological perspective is generally dependent on the hydrological and geomorphological health of the wetland as well as the state of the vegetation, and these three components are intimately linked. Thus, when describing wetland health, it is beneficial to discuss the hydrological, geomorphological and ecological health of the wetland separately and then explain how these three components are linked.

In South Africa, the WET-Health tool (**Macfarlane *et al*., 2009**) has been developed to assess wetland health. WET-Health assesses the impacts of human activities on three components of wetland health; hydrology, geomorphology and vegetation. These components are assessed separately to produce three scores which indicate how much the wetland deviates from the natural reference condition.

WET-Health uses a method that calculates the magnitude of an impact of an activity as the product of the extent of the impact and the intensity of the impact. The magnitude of impact scores for different activities is combined in a structured way to produce an overall magnitude of impact score for hydrology, geomorphology and vegetation.

4.4 Wetland Ecosystem Services Assessment

Wetlands are among the most globally threatened and important ecosystems, providing a number of important ecosystem goods and services to society (Millennium Ecosystem Assessment, 2005). **Table 2** below lists the common direct and indirect ecosystem goods and services typically provided by South African wetlands.

Table 2: Table of the wetland functions included in WET-EcoServices (Kotze *et al*., 2009)

<table>
<tr><td rowspan="15">Ecosystem services supplied by wetlands</td><td rowspan="9">Indirect benefits</td><td rowspan="8">Hydro-geochemical benefits</td><td colspan="2">Flood attenuation</td></tr>
<tr><td colspan="2">Stream flow regulation</td></tr>
<tr><td rowspan="5">Water quality enhancement benefits</td><td>Sediment trapping</td></tr>
<tr><td>Phosphate assimilation</td></tr>
<tr><td>Nitrate assimilation</td></tr>
<tr><td>Toxicant assimilation</td></tr>
<tr><td>Erosion control</td></tr>
<tr><td colspan="2">Carbon storage</td></tr>
<tr><td colspan="3">Biodiversity maintenance</td></tr>
<tr><td rowspan="6">Direct benefits</td><td colspan="3">Provision of water for human use</td></tr>
<tr><td colspan="3">Provision of harvestable resources[2]</td></tr>
<tr><td colspan="3">Provision of cultivated foods</td></tr>
<tr><td colspan="3">Cultural significance</td></tr>
<tr><td colspan="3">Tourism and recreation</td></tr>
<tr><td colspan="3">Education and research</td></tr>
</table>

[2] Many different resources may be derived from wetlands, including the following:

- **Grazing for livestock;**
- **Plants for crafts and construction;**
- **Food, with fish being particularly important; and**
- **Medicines**

In environmental decision making worldwide it has become important to determine the level and importance of the Goods and Services provided by individual ecosystems under threat; in order to evaluate the importance of said systems to society. Within the South African context the WET-EcoServices tool developed by **Kotze *et al.* (2009)** has been designed to rapidly assess the ecosystem services of individual wetlands in South Africa.

WET-EcoServices assesses a wide range of ecosystem services based on a range of wetland characteristics that are likely to affect the extent to which the wetland modifies flow and alters biogeochemical processes. The assessment is undertaken by determining the likely "effectiveness" or ability of a wetland to deliver an ecosystem service as well as providing a measure of the extent to which the wetland is delivering an ecosystem service referred to as "opportunity".

5 METHODS

5.1 Wetland Delineation

The outer temporary boundaries of the wetlands onsite were delineated using the method contained within the DWAF guideline '*A practical field procedure for the identification and delineation of wetlands and riparian areas*' **(DWAF, 2005)**. This guideline document stipulates that consideration be given to four specific wetland indicators required to determine the outer edge of the temporary boundary of a wetland.

These indicators are:

- **Terrain Unit** - identify those parts of the landscape where wetlands are most likely to occur e.g. valley bottoms and low lying areas.
- **Soil Form** - identify the soil forms associated with prolonged and frequent saturation.
- **Soil Wetness** - identify the soil morphological "signatures" that develop in soils characterised by prolonged and frequent saturation.
- **Vegetation** - identify the presence of 'hydrophilic and hydrophytic vegetation associated with frequently saturated soils.

In practice, the soil wetness indicator is the most important indicator for determining the outer boundary of wetlands and the other three indicators are better used in a confirmatory role. This is mainly due to the fact that soil wetness indicators remain in wetland soils, even if they are degraded or desiccated, thereby providing an indication of the natural extent of wetlands.

In this study the presence of soil wetness indicators within the top 50 cm of the soil profile were used to delineate the outer temporary wetland boundary. Where the soil was too hard to sample with a hand-held auger, contour elevation, valley morphology and the presence of breaks in slopes was used to determine the outer boundary of the wetland. Vegetation could not be used to delineate the wetland boundary due to the time of year.

Soil sampling was carried out along transects across the valley bottom and low-lying areas within the project site. At each sample point, soil was sampled at 0-10 cm and 40-50 cm. The value and chroma were recorded for each sample according to the 7.5 YR Munsell Soil Colour Chart, as well as the degree and colour of mottling.

A conventional handheld Global Positioning System (GPS) was used to record the location of the soil sampling points along each transect. The GPS points were then imported into ArcGIS 10 and the outer temporary wetland boundary along each transect determined. The boundary points were then combined to form a single continuous boundary using contour information, aerial photography and knowledge on the hydraulic conductivity of the soils. The GPS is expected to be accurate up to 3 metres.

5.2 Wetland Classification

Any features meeting this criteria within the study area were delineated and classified using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems hereafter referred to as the "Classification System" (Ollis et. al., 2013). This was achieved by observing the topographical and geomorphic setting, and the general hydrology of the wetland units.

5.3 Wetland Health Description and Present Ecological Status (PES)

The current (pre-development) and post-development health of the affected wetland systems was determined using the *WET-Health* tool developed by **Macfarlane *et al*.** (**2009**). A Level 1 assessment was utilised in accordance with the requirements set out by DWA.

Firstly, the wetlands identified onsite were classified into individual hydro-geomorphic units as per the proposed Wetland Classification System (Ollis et. al., 2013). Thereafter, specific information required to be entered into the predesigned Level 1 WET-Health spread sheet was gathered during the site visit and desktop analysis using ArcView GIS 10.

Once all the required information was entered into the spread sheet, the magnitude of the all the impacts on the hydrological, geomorphological and vegetation health of the wetland was calculated. The WET-Health tool scores wetland health for each component of health on a scale of 0 (no discernible modifications) to 10 (critically impacted), which is subsequently translated into one of six PES Categories ranging from A to F, with A representing completely unmodified and F representing modifications that have reached a critical level (**Macfarlane *et al*., 2009**) (**Table 3**).

Changes in hydrology are evaluated by assessing:

(i) changes to water input volumes and pattern (effects on the alteration of the wetland's catchment), and
(ii) changes to water distribution and retention patterns of water passing through the wetland (effects of onsite alterations) (**Macfarlane *et al*., 2009**).

Water inputs to a wetland from the catchment are considered in terms of the <u>quantity of water</u> inputs and the <u>size of the flood peaks</u> which are combined to provide an indication of the impacts of catchment activities on wetland water inputs.

Present geomorphic state is assessed by evaluating:

(i) Activities and impacts which are known to commonly influence geomorphic process (i.e. activities that alter geomorphic processes), and
(ii) Direct on-site impacts which provide clues to changes to geomorphic processes (indicators of geomorphic change) (**Macfarlane *et al*., 2009**).

Present vegetation state is assessed by evaluating the degree to which current vegetation composition has deviated from the perceived natural or reference condition (**Macfarlane *et al*., 2009**). The assessment of the deviation is based on what '*should not be there*' rather than on the composition of indigenous plants that '*should be there*' (**Macfarlane *et al*., 2009**). The evaluation is simplified by defining '*disturbance classes*' which represent areas of similar vegetation characteristics and disturbance history (**Macfarlane *et al*., 2009**).

The overall health was determined by combining the three health scores into one health value. This is calculated from the formula that weighs hydrology higher than geomorphology and vegetation where the hydrology score is multiplied by 3 while the other scores are multiplied by 2 and the sum of the three is divided by 7. The anticipated trajectory of change in hydrological, geomorphological and ecological health is then calculated.

Table 3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands (Source: Macfarlane *et al*., 2009)

Description	Impact Score Range	PES 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**
Seriously modified. 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**
Citically modified. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8-10**	**F**

5.4 Wetland Ecosystem Services Assessment

The current (pre-development) and post-development value of the affected wetland units was determined using the *WET-EcoServices* tool developed by **Kotze *et al.* (2009)**. Specific information required to be entered into the predesigned WET-EcoServices spread sheet was gathered during the field visit and during a desktop analysis using ArcView GIS 10. Once all the required information was entered into the spread sheet, the effectiveness, opportunity and overall functional scores for each the ecosystem services provided by the wetland units was generated. Each overall functional score was then rated according to the rating scale in **Table 4** below.

Table 4: Ranking scale for wetland services based on WET-EcoServices scores

Score	0-0.8	0.9-1.6	1.7-2.4	2.5-3.2	3.3-4.0

Level at which a service is being provided	Low	Moderately Low	Intermediate	Moderately High	High

Thereafter, the overall functional scores were contextualised in light of the size of the wetland and the wetland's catchment to provide an indication of the importance of the wetland systems.

The overall importance of the surface water management and water quality enhancement services was determined by combining the WET-EcoServices 'level of service' score with the size of the wetland and its catchment. The individual size of the wetland units and their catchments are rated separately on a scale of 1-5 (**Table 5**) and averaged to provide a wetland: catchment size ratio (**Table 6**). The wetland: catchment size rating is then combined with the 'level of service' rating to provide an overall importance rating (**Table 7**). The carbon storage score is considered independent of catchment size and therefore only combined with wetland size (**Table 8**). The biodiversity maintenance score is considered independent of wetland and catchment size. Thus, for biodiversity, the WET-EcoServices score is considered to give a true reflection of the importance score.

Table 5: Wetland and catchment size rating categories

Score	Rating	Wetland Size	Catchment Size
1	Small	<1ha	<10ha
2	Medium-Small	1-5ha	10-100ha
3	Medium	5-10ha	100-1000ha
4	Medium-Large	10-20ha	1000-10000ha
5	Large	>20ha	>100 000ha

Table 6: Ranking scale for the Wetland: catchment size ratio scores

		Catchment Size				
		Low (1)	Moderately -low (2)	Intermediate (3)	Moderately-high (4)	High (5)
Wetland Size	Small (1)	1	1.5	2	2.5	3
	Medium-small (2)	1.5	2	2.5	3	3.5
	Moderate (3)	2	2.5	3	3.5	4
	Medium-large (4)	2.5	3	3.5	4	4.5
	Large (5)	3	3.5	4	4.5	5

Table 7: Ranking scale for the importance of the surface water and water quality enhancement services

Score	2-3	3.5-5	5.5-6.5	7-8.5	9-10
Importance Ratings	Low	Moderately Low	Intermediate	Moderately High	High

Table 8: Ranking scale for the importance of carbon storage services

Score	1-1.5	1.6-2.5	2.6-3.4	3.5-4.4	4.5-5
Importance Ratings	Low	Moderately Low	Intermediate	Moderately High	High

5.5 Wetland Ecological Importance and Sensitivity (EIS)

The *ecological importance* of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales (**DWAF, 1999**). While the *ecological sensitivity* refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (**DWAF, 1999**). The ecological importance and sensitivity (EIS) can be calculated according to the determinants listed in **Table 9** below and attributing a score[1] to each. Once calculated

[1] **Score guideline:** Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0
Confidence rating: Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

the EIS category (EISC) can be determined (**Table 10**). The category ranges from A to D, with A being Very High and D being Low/Marginal.

Table 9: EIS Score sheet (after DWAF, 1999)

Determinant	Score	Confidence
Primary Determinants		
1. Rare & Endangered Species		
2. Populations of Unique Species		
3. Species/taxon Richness		
4. Diversity of Habitat Types or Features		
5. Migration route/breeding and feeding site for wetland species		
6. Sensitivity to Changes in the Natural Hydrological Regime		
7. Sensitivity to Water Quality Changes		
8. Flood Storage, Energy Dissipation & Particulate/Element Removal		
Modifying Determinants		
9. Protected Status		
10.Ecological Integrity		
TOTAL		
MEDIAN		
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE		

Table 10: Environmental Importance and Sensitivity categories for biotic and habitat determinants (after DWAF, 1999)

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level.	**>3 and <=4**	**A**
High Wetlands that are considered to be ecologically important and sensitive.	**>2 and <=3**	**B**
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale.	**>1 and <=2**	**C**
Low/marginal Wetlands that are not ecologically important and sensitive at any scale.	**>0 and <=1**	**D**

6 RESULTS AND DISCUSSION: WETLAND DELINEATION, CLASSIFICATION AND DESCRIPTION

A wetland delineation assessment was undertaken for the proposed project area. The final wetland delineation and HGM Units are provided in **Figure 6** below.

Seven (7) wetland units, are located within the investigation area. The wetland units and their HGM category (prior to modification) are provided in **Table 11** below.

Table 11: Wetland units within the Development Area and their hydro-geomorphic designations

Wetland HGM Unit	Hydro-Geomorphic Type (Under natural conditions)	HGM Abbreviation
1	Channelled Valley Bottom Wetland	CVBW
2	Unchannelled Valley Bottom Wetland	UnVBW
3	Unchannelled Valley Bottom Wetland	UnVBW
4	Unchannelled Valley Bottom Wetland	UnVBW
5	Unchannelled Valley Bottom Wetland	UnVBW
6	Channelled Valley Bottom Wetland	CVBW
7	Unchannelled Valley Bottom Wetland	UnVBW

6.1 Channelled Valley Bottom Wetlands

The wetland systems on site are generally extensive, and historically every valley bottom within the hilly study site would have had a wetland system. In some cases the valley bottoms have been purposefully drained through the creation of drainage ditches. However, the area also has a number of systems (Mzintlava River and tributary, HGM 6 & 1 respectively) that drain relatively large areas that would naturally have developed channels as the volumes are greater (see **Figure 3** below). As the area drains towards the lower valley systems the volume of water that the wetlands can hold is exceeded, and canalised flow develops (rivers and streams). In general, the channelled valley bottom system within the project area have been impacted upon through the hardening of surface within the catchments, and through direct impacts of subsistence and commercial farming practices. Much of the riparian vegetation that would have inhabited the systems has been cleared for timber, or to make way for crop production, and thus the hydrological regime has been altered. Additionally, the planting of crops within the catchment, and the wetland itself, leads to increased erosion and sedimentation, as well as erosion of the channel. The vegetation is infested with alien invasive species, and the surrounding grassland is used for cattle grazing where crops are not produced. Livestock generally leads to increased alien invasive species infestations through the increased manure levels that often occur where cattle drink and cross the systems.


Figure 3: HGM unit 1 is a naturally Channelled Valley Bottom Wetland.

6.2 Unchannelled Valley Bottom Wetlands

Unchannelled valley bottom wetlands are by far the most common system within the area, and are extensive in nature. The valley bottoms are generally of a gentle gradient along their length, and thus perfect conditions exist for the creation of valley bottom wetlands (see **Figure 4** below). As with the channelled systems discussed above, the unchannelled valley bottom systems have been impacted upon by the clearing of the wetlands and catchments for subsistence, and commercial crop production, and through the creation of drains in order to maximise crop production. In addition, clay harvesting (see **Figure 5** below) for brick making has had a significant impact on HGM unit 4.

Figure 4: HGM unit 5 is a prime example of an Unchannelled Valley Bottom Wetland system.

Figure 5: HGM unit 4 is currently being used as a source of clay for the creation of basic building blocks.

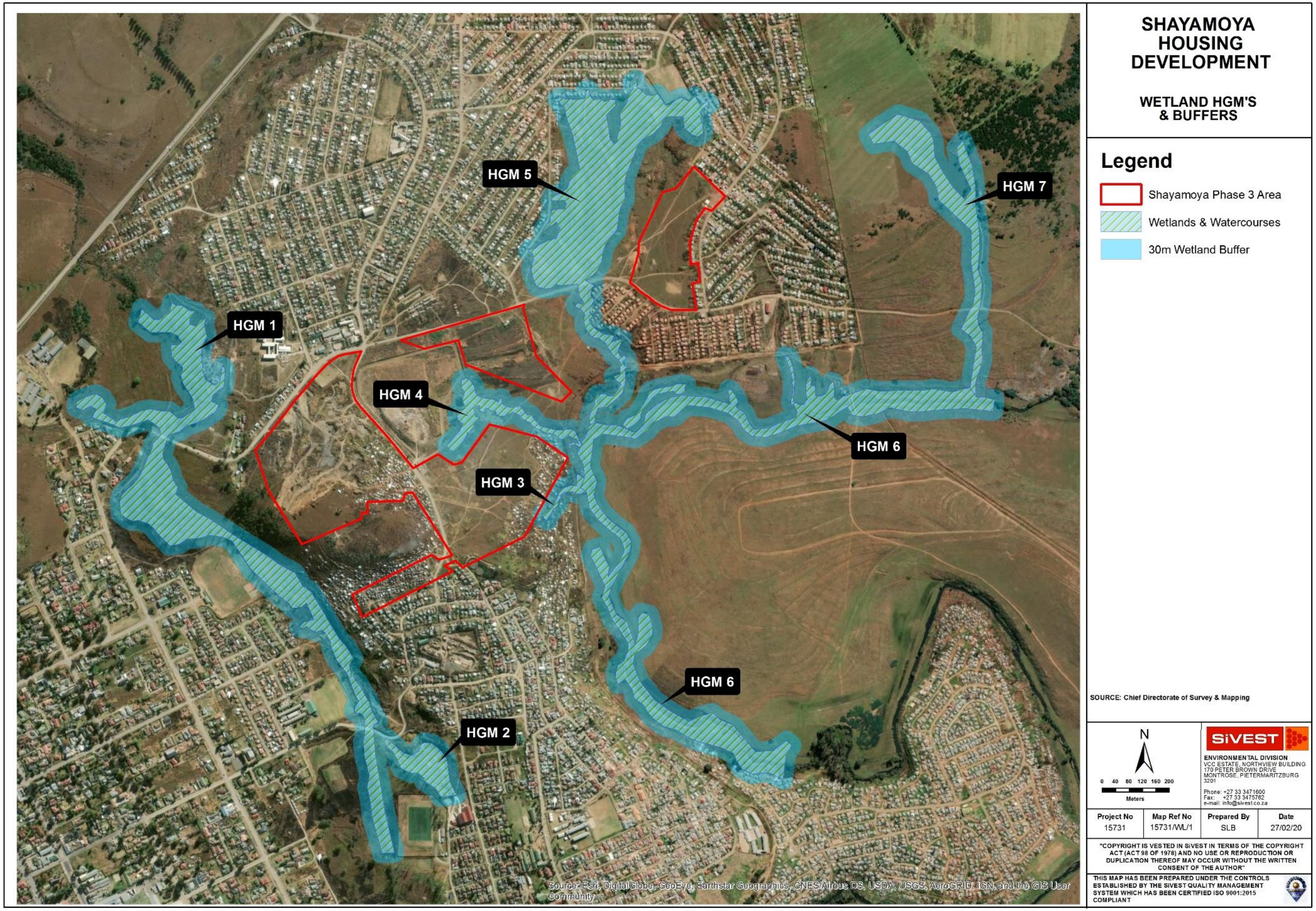

Figure 6: Final Wetland Delineation Map of HGM Units, and associated buffers.

7 RESULTS: WETLAND HEALTH (PES)

In order to predict the potential impacts that a particular activity will have on a wetland system, it is important to first obtain a clear understanding of the current baseline health of the affected wetland. Thereafter, the effect of potential impacts i.e. the degree of change in a system, can be more scientifically and pragmatically assessed.

The formal health assessment of the wetland units indicates that most wetland units are **Largely Modified** resulting from past and current land uses and activities. While wetland HGM unit 4 is **Seriously Modified** through changes within the catchment and the destruction of wetland soils for brick making.

A summary of the Present Ecological Status (PES) based on results from the WET-Health Tool is provided in **Table 12** below.

Table 12: WET-Health Score

	MODULE				
Unit	**Hydrology Impact Score and Class**	**Geomorphology Impact Score and Class**	**Vegetation Impact Score and Class**	**Combined Impact Score**	**PES Category**
1	4.2 (D)	3.1 (C)	5.8 (D)	4.34	D (Largely Modified)
2	3.8 (C)	4.6 (D)	6.1 (E)	4.69	D (Largely Modified)
3	4.7 (D)	4.4 (D)	5.7 (D)	4.90	D (Largely Modified)
4	4.8 (D)	7.8 (E)	7.1 (E)	6.31	E (Seriously Modified)
5	5.7 (D)	3.2 (C)	4.7 (D)	4.70	D (Largely Modified)
6	5.1 (D)	3.6 (C)	5.1 (D)	4.67	D (Largely Modified)
7	4.1 (D)	3.7 (C)	4.3 (D)	4.04	D (Largely Modified)

8 RESULTS: WETLAND ECO-SERVICES AND IMPORTANCE

An understanding of a wetland's health does not necessarily give an indication of the wetland's value, although health and value are inextricably linked. For this reason, it is important to undertake an assessment of the importance of the ecosystem services provided by a wetland unit to gain an understanding of the conservation value of said wetland unit.

8.1 Wetland Units Eco-services

The wetland units were assessed as being of medium to moderately-high importance in terms of ecosystem service provision. The ability of the wetlands to trap additional sediment is of medium importance, while its tourism and cultural services are of low importance. The wetlands ability to attenuate floods and stream flow are generally considered of medium importance. Similarly, the ability of the wetlands to store carbon, and maintain biodiversity is of medium importance. The phosphate, Nitrate and toxicant removal ability is of medium high importance.

8.2 Wetland EIS Scores

During the site visit, minimal faunal activity was noted, and the possibility of wetland faunal and avi-faunal species being present at different times of the day and season is probably limited. The confidence levels for the assessment were generally moderate. The EIS score, based on the **DWAF** (**1999**) scoring method, are summarised in **Table 13**, below. The assessed units all fall into an EIS **Category C**, which corresponds to a Moderate importance and sensitivity in terms of the wetland.

Table 13: EIS Scores for the assessed wetland units

	HGM UNIT 1		HGM UNIT 2		HGM UNIT 3		HGM UNIT 4		HGM UNIT 5		HGM UNIT 6	
	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence	Score	Confidence
PRIMARY DETERMINANTS												
1. Rare & Endangered Species	0	2	0	2	0	2	0	2	0	2	0	2
2. Populations of Unique Species	2	2	2	2	2	2	2	2	2	2	2	2
3. Species/taxon Richness	2	3	2	3	2	3	2	3	2	3	2	3
4. Diversity of Habitat Types or Features	2	3	2	3	2	3	2	3	2	3	2	3
5. Migration route/breeding and feeding site for wetland species	1	3	1	3	1	3	1	3	1	3	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	3	3	3	3	3	3	3	3	3	3	3	3
7. Sensitivity to Water Quality Changes	3	3	3	3	3	3	3	3	3	3	3	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	1	3	1	3	1	3	1	3	1	3	1	3
MODIFYING DETERMINANTS												
9. Protected Status	0	4	0	4	0	4	0	4	0	4	0	4
10. Ecological Integrity	1	3	1	3	1	3	1	3	1	3	1	3
TOTAL	**15**	**29**	**15**	**29**	**15**	**29**	**15**	**29**	**15**	**29**	**15**	**29**
MEDIAN	**1.5**	**3**	**1.5**	**3**	**1.5**	**3**	**1.5**	**3**	**1.5**	**3**	**1.5**	**3**
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**C**		**C**		**C**		**C**		**C**		**C**	

	HGM UNIT 7	
	Score	Confidence
PRIMARY DETERMINANTS		
1. Rare & Endangered Species	0	2
2. Populations of Unique Species	2	2
3. Species/taxon Richness	2	3

4. Diversity of Habitat Types or Features	2	3
5. Migration route/breeding and feeding site for wetland species	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	3	3
7. Sensitivity to Water Quality Changes	3	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	1	3
MODIFYING DETERMINANTS		
9. Protected Status	0	4
10. Ecological Integrity	1	3
TOTAL	**15**	**29**
MEDIAN	**1.5**	**3**
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**C**	

9 POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

The following potential impacts and mitigations are predicted based on the layout for the proposed housing development.

9.1 Construction Phase Potential Impacts

No housing may be built within the wetland areas, but certain services may need to cross the wetland areas. It is preferable that the crossing of wetlands by services is avoided. If the avoidance of wetlands proves to be financially or technically unfeasible, wetlands may need to be crossed.

Direct disturbances to the wetlands associated with the construction of services (water, sewer and electricity) include the excavation of a trench within the wetland and the compaction of the wetland vegetation and soils by heavy vehicles involved in the excavations and the laying of the pipes, or cables. Indirect disturbances arising from these direct impacts include erosion, sedimentation and alien plant encroachment.

Approvals:
A water use license is required to establish services within the wetland as per Section 21 (c) and (i) of the National Water Act. This license is required prior to construction commencing.

9.1.1 Impacts to the Wetland Habitats

During the construction phase, wetland habitat may be temporarily cleared. Clearing of habitat will mean degradation of the wetland habitat to accommodate the service infrastructure. Clearance will entail removal of indigenous vegetation resulting in loss of wetland habitat. Biota inhabiting the wetland habitat will therefore also be displaced.

Disturbance due to edge effects are also likely to take place given the proximity of the existing informal settlements as well as existing roads across the wetlands. Edge effect impacts afford opportunities for alien vegetation to colonise the wetland habitat.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 14** below.

Table 14. Rating for Construction Impacts to the Wetland Habitat

IMPACT TABLE	
Environmental Parameter	**Wetland**
Issue/Impact/Environmental Effect/Nature	Impacts associated with clearance and edge effects to the wetland habitat
Extent	*Site*
Probability	*Probable*
Reversibility	*Partly reversible*
Irreplaceable loss of resources	*Significant loss of resources*
Duration	*Permanent*
Cumulative effect	*Medium cumulative Impact*

<table>
<tr><th colspan="3">IMPACT TABLE</th></tr>
<tr><th>Environmental Parameter</th><th colspan="2">Wetland</th></tr>
<tr><td>Intensity/magnitude</td><td colspan="2">High</td></tr>
<tr><td>Significance Rating</td><td colspan="2">Pre-mitigation significance rating is medium and negative. With the implementation of mitigation measures, the impact can be minimised to low.</td></tr>
<tr><td></td><td>Pre-mitigation impact rating</td><td>Post mitigation impact rating</td></tr>
<tr><td>Extent</td><td>1</td><td>1</td></tr>
<tr><td>Probability</td><td>3</td><td>1</td></tr>
<tr><td>Reversibility</td><td>2</td><td>1</td></tr>
<tr><td>Irreplaceable loss</td><td>3</td><td>1</td></tr>
<tr><td>Duration</td><td>4</td><td>1</td></tr>
<tr><td>Cumulative effect</td><td>3</td><td>2</td></tr>
<tr><td>Intensity/magnitude</td><td>3</td><td>2</td></tr>
<tr><td>Significance rating</td><td>- 48 (medium negative)</td><td>- 14 (low negative)</td></tr>
<tr><td>Mitigation measures</td><td colspan="2">Design & routing:
• Unavoidable services crossings should be located within already disturbed areas like existing road crossings and located across the narrowest portions of the wetland.
• The services must be routed so that the wetland is crossed at right angles to the direction of flow.

Site setup and construction phase:
• Disturbance to the wetland soils along the services crossings should be restricted to an established construction right-of-way (ROW) corridor. The ROW corridor within the wetlands should be as narrow as practically possible and should be demarcated and fenced off during the site setup phase to the satisfaction of the ECO.
• The construction ROW should comprise the trench footprint, a narrow one-way running track and soil stockpile zones.
• Excavations within the wetland should be undertaken by hand.
• All wetland areas outside of the demarcated ROW must be considered no-go areas.
• Ideally, excavations within the onsite wetlands should be undertaken between the months of April and September.</td></tr>
</table>

IMPACT TABLE	
Environmental Parameter	**Wetland**
	Rehabilitation and monitoring: • The disturbed areas within the wetland and/or buffers must be rehabilitated after the water pipes are established. Compacted areas must be ripped and seeded immediately. An indigenous grass seed mix should be used as recommended by a wetland specialist. • Adhere to the requirements of the wetland rehabilitation plan if prepared. • The environmental control officer must be present during the establishment of the construction ROW, the excavation of the trench and the rehabilitation of the wetland to guide these processes. • The disturbed area should be monitored for erosion once a month during the first wet season after construction. • The re-instated wetland areas must be monitored post-construction by the municipality to manage and control alien vegetation in the wetland.

9.1.2 Impacts to the Geomorphology of the Wetlands

During the construction phase, soil removal, sedimentation and erosion potential impacts can be expected with the preparation of the site and related construction activities. Physical degradation to the wetland habitat is likely to take place by means of clearance, levelling and compaction due to movement of vehicles. With these construction activities, the geomorphology of the wetland is likely to be altered. Ancillary impacts can also be expected in terms of consequent potential erosion and sedimentation impacts. Flattened and exposed soil surfaces and excavation pits / trenches may be vulnerable to increased run-off after rainfall events which can lead to erosion and sedimentation impacts. Where the onset of erosion arises, the structural integrity of the wetlands may be compromised. Moreover, resultant sedimentation can take place where additional sediment loads are washed into the wetland.

Further development within the wetland will severely affect the functionality of the system especially with excavation of the wetland soils within the wetlands.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 15** below.

Table 15. Rating for Construction Impacts to the Geomorphology of the Wetlands

IMPACT TABLE		
Environmental Parameter	**Wetland**	
Issue/Impact/Environmental Effect/Nature	Impacts associated with levelling, compaction and excavation of wetland soils, and the potential increased run-off, erosion and sedimentation impacts knock-on effects.	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Irreversible*	
Irreplaceable loss of resources	*Significant loss of resources*	
Duration	*Permanent*	
Cumulative effect	*High cumulative Impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is high and negative. With the implementation of mitigation measures, the impact can be minimised to low.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	4	1
Irreplaceable loss	3	2
Duration	4	1
Cumulative effect	4	2
Intensity/magnitude	3	1
Significance rating	- 57 (high negative)	- 8 (low negative)
Mitigation measures	**Preventing Temporary Increased Run-off, Sedimentation and Erosion Impacting the Wetlands** – A construction and operation phase storm water management plan must accompany the pipeline installation. Importantly, the storm water management plan must account for increased run-off and sedimentation. As such, attenuation facilities are to be implemented if and where required. Additionally, appropriate drainage structures at the storm water outlet points are to be implemented with energy dissipating structures as well as sediment trapping devices to prevent sedimentation exiting the site during construction. This can be in the form of silt nets. **Site setup and construction phase:** • Disturbance to the wetland soils for services crossing the wetlands should be restricted to	

IMPACT TABLE	
Environmental Parameter	**Wetland**
	an established construction right-of-way (ROW) corridor. The ROW corridor within the wetlands should be as narrow as practically possible and should be demarcated and fenced off during the site setup phase to the satisfaction of the ECO. • Excavations for services within the wetland should be undertaken by hand. • All wetland areas outside of the ROW must be considered no-go areas. • Ideally, excavations within the onsite wetlands should be undertaken between the months of April and September. **Rehabilitation and monitoring:** • Compacted areas must be ripped and seeded immediately. An indigenous grass seed mix should be used as recommended by a wetland specialist. • Adhere to the requirements of the wetland rehabilitation plan if prepared. • The environmental control officer must be present during the establishment of the construction ROW, the excavation of the trench and the rehabilitation of the wetland to guide these processes. • The disturbed area should be monitored for erosion once a month during the first wet season after construction. • The re-instated wetland areas must be monitored post-construction by the municipality to manage and control alien vegetation in the wetland.

9.1.3 Impacts to the Hydrology of the Wetlands

Currently, the hydrology of the wetland is being affected by the presence and further encroachment of settlements surrounding the wetland in the greater catchment area. The catchment hydrology is affected due to transformation of the catchment area from a natural to an artificial environment, characterised by hardened surfaces (foundations of houses and compacted dirt roads) with little to no vegetation to provide surface roughness in aid of controlling surface run-off. Additionally, the vertical drainage properties are affected by compaction and hardened impermeable surfaces. Sub-surface drainage is therefore also impacted as a result. Increased run-off flood peaks and alteration of the hydrology of the wetland is the current status quo. With further implementation of hardened surfaces for the proposed construction of houses and associated infrastructure (roads and services), a further increase in flood peaks during and following rainfall events are likely whilst surfaces remain exposed following clearance and compaction during construction. Increased flood peaks are therefore likely to be higher in intensity.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 16** below.

Table 16. Rating for Construction Impacts to the Hydrology of the Wetlands

IMPACT TABLE		
Environmental Parameter	**Wetland**	
Issue/Impact/Environmental Effect/Nature	Impacts associated with accelerated run-off and associated increased flood peaks to the watercourses	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With the implementation of mitigation measures, the impact can be minimised to low.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	4	2
Intensity/magnitude	2	1
Significance rating	- 30 (medium negative)	- 11 (low negative)
Mitigation measures	**Preventing Increased Run-off and associated Erosion Impacting on the Wetland** – Adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with increased/accelerated run-off and potential erosion. The use of silt fencing and potentially sandbags or hessian "sausage" nets along the boundaries of the construction areas can be used to slow run-off entering the wetlands and the associated buffer zones, thereby also decreasing the likelihood	

IMPACT TABLE	
Environmental Parameter	**Wetland**
	of increased flood peaks and consequent potential erosion and sedimentation impacts. An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with increased run-off and associated erosion. An Environmental Control Officer (ECO) must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor increased run-off and associated erosion impacts. Where additional mitigation measures are stipulated by the ECO in order to control increased run-off and erosion, this is to be undertaken accordingly.

9.1.4 Impacts to Water Quality

During the construction process, potential contamination impacts can be expected as a result of stored oils, fuels, and other hazardous substances or materials being transported *via* stormwater run-off and / or direct leaks from construction vehicles and machinery. Should this occur, contamination impacts are likely to occur.

Water quality impacts can also result from workers using the wetland for various purposes (such as for sanitation). Usage of sanitary substances (for example, soap) in the wetland can alter the chemical balance or water quality thereby causing pollution to the wetland system. Additionally, usage of the wetland for urine and faecal waste is another potential negative water quality impact. Use of water for building purposes can also lead to impaired water quality.

Mixing cement and cleaning construction tools in the wetland can furthermore affect the water quality. Impacts to the water quality may affect any organisms or vegetation inhabiting these systems *via* contamination impacts.

Lastly, water quality can be impaired as a result of sedimentation. Additional sediment loads emanating from construction areas that are contained in run-off entering watercourses can be regarded as pollution, and therefore requires mitigation.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 17** below.

Table 17. Rating for Construction Impacts to the Water Quality of the Wetlands

IMPACT TABLE		
Environmental Parameter	**Wetland**	
Issue/Impact/Environmental Effect/Nature	Potential impacts associated with the leakage / spillage of oils, fuels and other potentially hazardous substances from construction vehicles / machinery and workers; as well as sedimentation *via* run-off polluting the wetlands.	
Extent	*Local*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative Impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With the implementation of mitigation measures, the impact can be minimised to low.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	3	1
Significance rating	- 45 (medium negative)	- 11 (low negative)
Mitigation measures	**Storage of Oils, Fuels and Hazardous Substances / Liquids** – All oils, fuels and hazardous substances or liquids must not be stored within 100m from the full extent of the wetlands and the associated buffer zones. Where these items are stored within the proposed development area, a designated storage area will be required and the storage area must be adequately bunded to contain any spillage from containers. Emergency spill kits must be available to clean up and remove accidental spills. **Preventing Soil and Surface Water Contamination** – All vehicles and machinery operating on the site are to be checked for oil, fuel or any other fluid leaks before entering the nearby construction area. All vehicles and machinery must be regularly serviced and maintained before being	

IMPACT TABLE	
Environmental Parameter	**Wetland**
	allowed to enter the construction area. No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place within 100m of the wetlands and the associated buffer zones. The construction site is to contain sufficient safety measures throughout the construction process. Safety measures include (but are not limited) oil spill kits and the availability of fire extinguishers. Additionally, fuel, oil or hazardous substances storage areas must be bunded to 110% capacity to prevent oil or fuel contamination of the ground and / or nearby wetlands and the associated buffer zones. No cement mixing is to take place in the wetlands and the associated buffer zones. In general, any cement mixing in the construction area is to take place over a bin lined (impermeable) surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground. Cement / concrete can also be trucked in by readymix cement vehicles. Importantly, no mixing of cement or concrete is allowed directly within the wetland and associated buffer zone. No "long drop" toilets are allowed on the study site. Suitable temporary chemical sanitation facilities are to be provided. Temporary chemical sanitation facilities must be placed at least 100 meters from the wetlands and the associated buffer zones. Temporary chemical sanitation facilities must be checked regularly for maintenance purposes and cleaned often to prevent spills. **Preventing Sedimentation Impacting on Surface Water Resources** – Adequate structures must be put into place (temporary or permanent where necessary in extreme cases) to deal with sedimentation. The use of silt fencing and potentially sandbags or hessian "sausage" nets along the boundaries of the construction area can be used to prevent and / or reduce sediments entering the wetland and the associated buffer zone.

IMPACT TABLE	
Environmental Parameter	**Wetland**
	An appropriate construction storm water management plan formulated by a suitably qualified professional must accompany the proposed development to deal with sedimentation. An Environmental Control Officer (ECO) must be appointed during the construction phase to oversee construction activities undertaken by contractors. The ECO must also monitor sedimentation impacts. Where additional mitigation measures are stipulated by the ECO in order to control sedimentation, this is to be undertaken accordingly.

9.2 Decommissioning Phase Potential Impacts

9.2.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. Similar potential impacts can therefore be expected to occur and the stipulated mitigation measures (where relevant) must be employed as appropriate to minimise impacts.

9.3 Direct Disturbance Impacts

Continued disturbance and a lack of management over the lifetime of a development is a problem that exists throughout South Africa where there is limited budget for the management and preservation of wetlands and often no 'buy-in' from local residents in terms of the conservation of important environmental systems and habitats.

Some direct impacts on wetlands arising from a lack of management and protection within open spaces onsite include the establishment of informal crossings, illegal refuse dumping, and vegetation clearing and trampling. These disturbances result in the disturbance of the wetland soils and plants which encourages the proliferation of alien invasive and pioneer species that are better adapted to survive in disturbed soil and moisture conditions. In addition, the extermination and/or hunting of fauna (e.g. frogs, chameleons, snakes and antelope) is a common impact where access to open spaces is unrestricted. Over time, these impacts left unattended will contribute to the gradual reduction in the current health and value of the wetlands onsite.

Recommendations:

- An environmental education programme should be conducted within the beneficiary community to educate and inform the beneficiaries of the value and correct use of the wetland conservation areas.

- Wetland conservation signs should be established along the wetland boundaries to inform the local residents of the wetland conservation areas, their value to society and certain prohibitions regarding the use of the wetland areas.

10 ASSUMPTIONS, UNCERTAINTIES AND LIMITATIONS

With regards to the assessment of the importance of the wetland unit, it is important to note that the WET-EcoServices tool utilised in this assessment is a rapid assessment that gives a general indication of the level of ecosystem services provided by wetland.

This assessment is considered satisfactory for the level of assessment required for inclusion in the EIA Process and for the purposes of feeding into an application brought for obtaining a Water Use Licence.

Similarly, the WET-Health assessment tool utilised to determine the present state of the wetland units is also a rapid assessment tool. This assessment is also considered satisfactory for the purposes of this assessment. It is also important to note that the two assessments were used to assess the state and importance of the wetland units that may be impacted upon.

11 SUMMARY AND WAY FORWARD

SiVEST were appointed by Greater Kokstad Local Municipality to undertake a specialist wetland health and functionality assessment for the proposed Shayamoya Housing Development Phase 3. The project consists of the provision of housing and associated services within the Shayamoya area of Kokstad.

An assessment of the Present Ecological State of the wetlands reveals that most HGM units are **Largely Modified**, while wetland HGM unit 4 is **Seriously Modified** through changes within the catchment and the removal of wetland soils for brick making.

An assessment of the current importance of the wetland unit in terms of ecosystem service provision indicates that wetland units provide medium to moderately-high levels of wetland functioning.

The EIS score indicates that the assessed unit falls into EIS **Category C**, which corresponds to a Moderate importance and sensitivity.

All seven wetlands on site have been impacted upon by crop production, livestock grazing, and changes to their hydrology (increased hardened surfaces) and geomorphology (clay removal for brick making) thus leading to an associated infestation by alien vegetation. The current layout takes cognisance of the wetland systems, and thus no housing is proposed within the wetland areas, or the 30m buffer that is recommended here. It must be noted that some informal housing has already been built within the wetland buffer areas, and it is recommended that the municipality try to negotiate for the removal of these houses if possible.

Any development of this nature within 500m of a wetland requires a water use license from the Department of Water and Sanitation, and it is recommended that a meeting be sought to discuss the project with the Department of Water and Sanitation to determine any license requirements relating to the project.

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