BROAD SCALE WETLAND IMPACT ASSESSMENT

ESKOM SHONGWENI 2 X 500 MVA 400/132KV SUBSTATION AND THE ±40KM HECTOR - SHONGWENI 400KV POWERLINE AND ASSOCIATED INFRASTRUCTURE WITHIN THE JURISDICTION OF ETHEKWINI METROPOLITAN MUNICIPALITY IN THE KWAZULU-NATAL PROVINCE

DRAFT REPORT FOR COMMENT

June 2017

Malachite Specialist Services (Pty) Ltd

MALACHITE SPECIALIST SERVICES

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Malachite Specialist Services (2017) Broad Scale Wetland Impact Assessment: Eskom Shongweni 2 X 500 Mva 400/132Kv Substation and the ±40km Hector - Shongweni 400kV Powerline and Associated Infrastructure within the jurisdiction of eThekwini Metropolitan Municipality, KwaZulu-Natal. Malachite Specialist Services (Pty) Ltd, Durban.

Declaration

I **Rowena Harrison,** declare that -

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998) (NEMA), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the NEMA Act, regulations and all other applicable legislation;
- As a registered member of the South African Council for Natural Scientific Professions in terms of the Natural Scientific Professions Act, 2003 (Act No. 27 of 2003), I will undertake my professional duties in accordance with the Code of Conduct of the Council, as well as any other societies of which I am a member;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this report are true and correct; and
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B-(1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist:
Date:

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EXECUTIVE SUMMARY

Malachite Specialist Services (Pty) Ltd was appointed by Nsovo Environmental Consulting to undertake a wetland impact assessment for the proposed development of the Eskom Shongweni 2 x 500 MVA 400/132 kV substation and the approximately 40km Hector-Shongweni 400kV powerline and associated infrastructure. The project is located within the jurisdiction of the eThekwini Metropolitan Municipality in KwaZulu-Natal. Three powerline corridor alternatives as well as three substation site alternatives were assessed. The substation sites are named E, F and G and the powerline corridor alternatives 1, 2, and 3.

The terms of reference for the study were as follows:

- Identify and delineate any wetland areas at a desktop level within the three corridor alternatives and three substation locations according to the Department of Water Affairs[1] "Practical field procedure for the identification and delineation of wetlands and riparian areas".
- Determine the Present Ecological Status (PES) of any identified wetlands using the WET-Health Level 1 (desktop) approach.
- Identify current and possible negative impacts on any identified wetlands from the proposed project. Recommend mitigation measures to lessen the impact of the proposed project on wetlands delineated within the study area and the implementation of suitable rehabilitation measures.

The wetland assessment involved desktop investigations for the presence of wetland systems within three proposed powerline corridors as well as three alternative substation sites. This investigation made use of aerial imagery, NFEPA wetlands data as well as a fly-over of the study area. These wetland systems were classified as either being Channelled Valley Bottom or Seep systems. Further to this, one Unchannelled Valley Bottom wetland and one Wetland Flat System were identified.

A level 1 (desktop level) assessment was undertaken on all the Seep wetlands and Channelled Valley Bottom wetlands as well as the single Unchannelled Valley Bottom and Wetland Flat System. This was undertaken to determine the general impacts to the wetlands within the study area and the effects these

[1] Department of Water Affairs (DWA) is now named the Department of Water and Sanitation (DWS).

impacts have had on the health of the wetland types. These impacts have generally given scores of moderately and largely modified (PES Category C and D). The major modifications to the catchments associated with the wetland systems include:

- agricultural activities (sugarcane cultivation and agricultural dams)
- infrastructural development
- residential and urban development
- erosion
- widespread encroachment of alien invasive species

A 30m buffer has been calculated for the wetland systems and is considered appropriate for the protection of the ecosystem services provided by these wetlands. The above buffer width is recommended during both the construction and operational phase of the proposed project, particularly with regards to the positioning of the towers associated with the powerline as well as the creation of any access roads. This buffer is based on a desktop analysis of the study area coupled with a fly-over and must be refined once the final corridor has been selected. This will be achieved through a walk down conducted to delineate and assess the affected wetland systems.

All alternative substation sites are situated within 500m of a number of wetland systems. The proposed size of each of the substation alternative is 800m x 800m. This means that all proposed substation alternatives will all have an impact on identified wetland systems. The position of the wetland systems must be taken into consideration with regards to the layout of the chosen substation site.

The impact assessment identified the following potential negative impacts associated with the proposed project on the wetland systems; (i) soil compaction leading to erosion, sedimentation and degradation of wetland systems; (ii) pollution of wetlands and soil as a result of the construction phase of the project and (iii) disturbance within the wetland systems thereby increasing the encroachment of alien invasive species and the loss of natural habitat for fauna and flora.

Several general and specific measures are proposed to mitigate these impacts on the receiving environment. Provided the mitigation measures specified in this report are implemented and the continued monitoring and rehabilitation of any disturbed areas is undertaken, the proposed powerline is expected to have a limited negative effect on the receiving environment including water resources. This will be ensured should the 30m buffer be adhered to and the use of existing access roads as far as possible is undertaken. Further to this, the position of the substation must take into consideration wetland systems and specified buffers.

Due to the broad scale nature of the project, as well as the desktop approach to the wetland assessment, any of the three proposed corridors and three alternative substation sites can be utilised from a wetland perspective. Once a final corridor has been chosen, a walk down must be conducted to delineate any wetlands along the powerline corridor and the appropriate buffer applied to the wetland systems assessed. This buffer must be utilised in planning the position of the towers so that risks to the wetland systems can be minimised.

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1. INTRODUCTION AND BACKGROUND

PROJECT BACKGROUND AND LOCALITY

Malachite Specialist Services (Pty) Ltd was appointed by Nsovo Environmental to undertake a wetland impact assessment for the proposed development of the Eskom Shongweni 2 x 500 MVA 400/132 KV substation and the approximately 40km Hector-Shongweni 400kV powerline and associated infrastructure.

The proposed development is located within the 2930DC and 2930DD quarter degree squares, within the jurisdiction of the eThekwini Metropolitan Municipality in KwaZulu-Natal. Three corridor options and three alternative substation localities form part of the assessment, namely substations E, F and G and corridor alternatives 1, 2 and 3 (**Figure 1**).

The wetland impact assessment forms part of the Environmental Assessment in compliance with the National Environmental Management Act (Act 107 of 1998) and the Environmental Impact Assessment (EIA) Regulations, 2014, GN R. 983, R. 984 and R.985; as well as the Water Use Licence Application (WULA) in terms of the National Water Act (Act 36 of 1998).

The primary aim of the study is to provide a description of the current ecological integrity and impacts pertaining to any wetland systems that may be impacted as a result of the proposed project as well as providing appropriate management recommendations to mitigate any identified impacts on the delineated wetland systems.

RATIONALE FOR THE ECOLOGICAL ASSESSMENT

South Africa comprises a region of high biodiversity with high levels of endemism (Bates *et al*., 2014). According to the National Environmental Management: Biodiversity Act (NEMBA) (Act No.10 of 2004), biodiversity is defined as:

"the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems"

An ecosystem is a complex, self-sustaining natural system centred on the interaction between the structural components of the system (biotic and abiotic). Functional aspects of an ecosystem include productivity and energy flow, cycling of nutrients and limiting factors. Effective conservation of biodiversity is paramount for the provision of ecosystem services including clean water, food and medicinal properties. The degradation of the ecological integrity of a system has a direct negative impact on the system's ability to provide these essential ecosystem goods and services.

Ecosystems are particularly susceptible to anthropogenic activities such as urban and infrastructural developments. On a global scale habitat loss and fragmentation has had the greatest influence on terrestrial ecosystems (Garden *et al*., 2007). Due to their susceptibility, a holistic approach is required in order to effectively integrate the activity and the receiving environment in a sustainable and progressive way.

According to the National Environmental Management: Biodiversity Act, 2004 (Act no.10 of 2004), the applicant is responsible for:

i. The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not solely by listed activities as specified in the EIA regulations);
ii. Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities; thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity;
iii. Limit further loss of biodiversity and conserve endangered ecosystems;
iv. A person may not carry out any restricted activity involving a specimen of a listed Threatened or Protected species without a permit issued in terms of Chapter 7; and
v. Such activities include any that are "of a nature that may negatively impact on the survival of a listed Threatened or Protected species".

The present impacts on biodiversity within the eThekwini Metropolitan Municipality include:

i. Habitat loss due to urban sprawl and rural settlements.
ii. A recent survey of alien plant species in managed areas within the eThekwini Metropolitan identified 130 invasive alien species of which 79 are formally listed under the Conservation of Agricultural Resources Act No. 43 of 1983 (CARA) (eThekwini Municipality Integrated Development Plan 2012/13 to 2016/17).

iii. Sites of Conservation Value are threatened by rural human settlements.
iv. Loss of sensitive sites due to mismanagement/ lack of appropriate protection.
v. Aquatic ecosystems are in a poor state. During a bio-monitoring survey conducted in 2010, 40% of the monitoring sites in the eThekwini Rivers were considered to be in a poor condition, with only 3% considered near natural. Impacts pertaining to the degradation of watercourses included spills, illegal discharge, solid waste dumping, sand mining, flow reduction through dams, removal of riparian flora and eutrophication.
vi. Poor compliance to environmental legislation lack of political support, education and awareness campaigns to encourage people to implement sustainable practices (eThekwini Municipality Integrated Development Plan 2012/13 to 2016/17).

This combination of factors has resulted in habitat transformation and the subsequent reduction in suitable habitats for floral and faunal species. As such the implementation of mitigation measures to reduce the impact of the project on the receiving environment will increase the ability of the area to assist in the maintenance of biodiversity and conservation targets within the eThekwini Metropolitan Municipality.

SCOPE OF THE ASSESSMENT

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

- Identify and delineate any wetland areas at a desktop level within the three corridor alternatives and three substation locations according to the Department of Water Affairs[2] "Practical field procedure for the identification and delineation of wetlands and riparian areas".
- Determine the Present Ecological Status (PES) of any identified wetlands using the WET-Health Level 1 (desktop) approach.
- Identify current and possible negative impacts on any identified wetlands from the proposed project. Recommend mitigation measures to lessen the impact of the proposed project on wetlands delineated within the study area and the implementation of suitable rehabilitation measures.

Typically, surface water attributed to wetland systems, rivers and riparian habitats comprise an important component of natural landscapes. These

[2] Department of Water Affairs (DWA) is now named the Department of Water and Sanitation (DWS).

systems are often characterised by high levels of biodiversity and fulfil various ecosystems functions. As a result, these systems are protected under various pieces of legislation including; the National Water Act, 1998 (Act No. 36 of 1998) and the National Environmental Management Act, 1998 (Act No. 107 of 1998).

ASSUMPTIONS AND LIMITATIONS

It is difficult to apply pure scientific methods within a natural environment without limitations or assumptions. The following apply to this study:

i. The findings, results, observations, conclusions and recommendations provided in this report are based on the author's best scientific and professional knowledge as well as available information regarding the perceived impacts on the wetlands.
ii. Wetland mapping was undertaken at a very broad desktop level and did not involve any ground-truthing of wetland boundaries. The actual delineation exercise must be undertaken once the final powerline corridor and substation have been chosen.
iii. The assessment of the present ecological state (PES), was undertaken at a very broad desktop scale and does not represent individual wetland systems. The assessment of the PES, functional integrity and Ecological Importance and Sensitivity (EIS) must be undertaken once the final corridor and substation have been chosen and wetlands which will be affected by this route delineated and assessed.
iv. The assessment of impacts and recommendation of mitigation measures was based on the assessor's working knowledge and experience with similar development projects. No construction work methodology was provided.

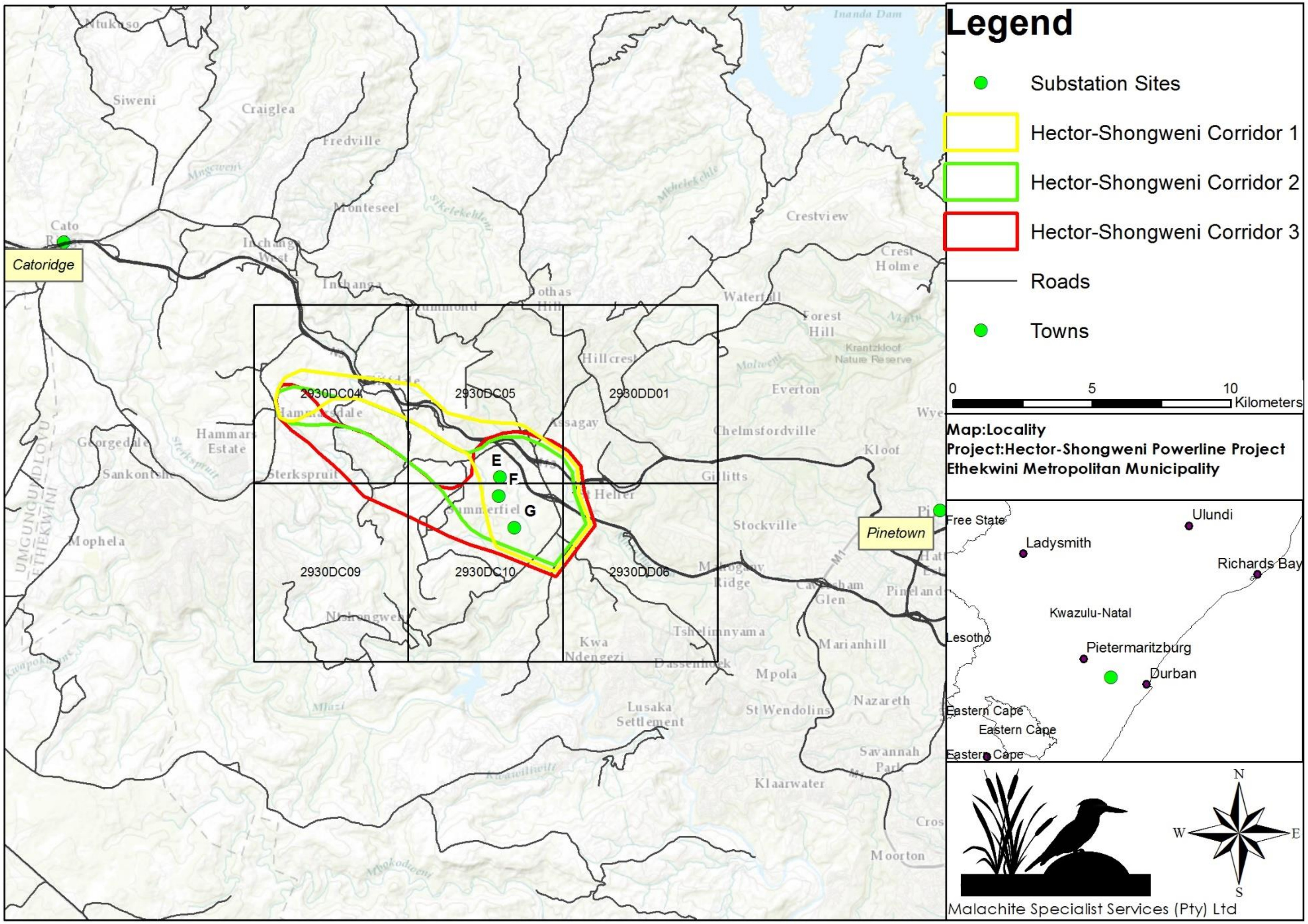


FIGURE 1. SITE LOCALITY OF THE PROPOSED HECTOR-SHONGWENI POWERLINE PROJECT CORRIDOR

2. METHODOLOGY

Assessment techniques and tools

The following techniques and tools were used in the assessment.

Baseline data

The desktop study conducted for the proposed project involved the examination of aerial photography, Geographical Information System (GIS) databases including the National Freshwater Ecosystem Priority Areas (NFEPA) and South African National Wetland maps as well as literature reviews of the study site, to determine the likelihood of wetland systems within each of the proposed substation sites and powerline corridor areas. The study made use of the following data sources:

- Google Earth™ satellite imagery was used at the desktop level.
- Relief dataset from the Surveyor General was used to calculate slope and the desktop mapping of watercourses.
- The NFEPA dataset from (Driver, *et al*., 2011) was used in determining any priority wetlands.
- Geology dataset was obtained from AGIS[3].
- Vegetation type dataset from Mucina and Rutherford, 2006 and Scott-Shaw and Escott, 2011 was used in determining the vegetation type of the study area.
- A fly-over of each of the three alternative corridors was undertaken on the 22nd to the 24th of May 2017.

Wetland Definition & Delineation Technique

For the purpose of this assessment, wetlands are considered as those ecosystems defined by the National Water Act 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."*

These habitats are found where the topography and geological parameters impede the flow of water through the catchment, resulting in the soil profiles of

[3] Land type information was obtained from the Department of Agriculture's Global Information Service (AGIS) January 2014 – www.agis.agric.za

these habitats becoming temporarily, seasonally or permanently wet. Further to this, wetlands occur in areas where groundwater discharges to the surface forming seeps and springs. Soil wetness and vegetation indicators change as the gradient of wetness changes (**Figure 2**).

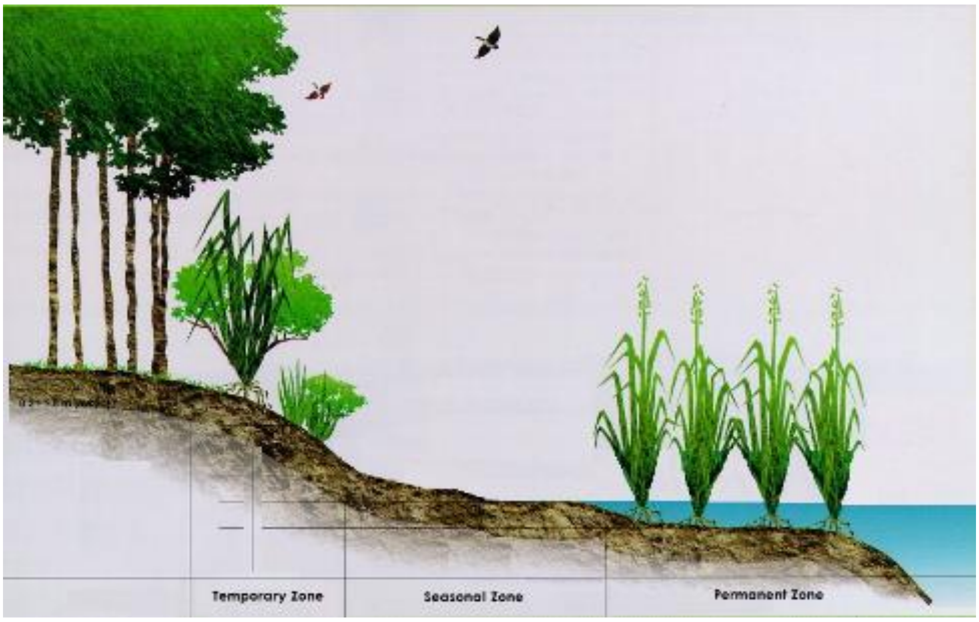


FIGURE 2. INCREASING SOIL WETNESS ZONES IDENTIFIED WITHIN VARIOUS WETLAND SYSTEMS

Based on definition presented in the National Water Act, three vital concepts govern the presence of a wetland namely:

i. Hydrology- Land inundated by water or displays saturated soils when these soils are biologically active (the growth season).
ii. Hydric soils- Soils that have been depleted of oxygen through reduction resulting in the presence of redoximorphic features.
iii. Hydrophytic vegetation- Plant species that are adapted to growing in saturated soils and subsequent anaerobic conditions (hydrophytes).

The conservation of wetland systems is vital as these habitats provide numerous functions that benefit not only biodiversity but provide an array of ecosystem services (Rebelo *et al.,* 2015). These services are further divided into direct and indirect and are detailed in **Table 1**.

Table 1: Direct and indirect benefits of wetland systems (Kotze *et al.*, 2005)

WETLAND GOODS AND SERVICES	
DIRECT	**INDIRECT**
Hydrological Water purification Flood reduction Erosion control Groundwater discharge	*Socio-economic* Socio-cultural significance Tourism and recreation Education and Research
Biodiversity conservation	Water supply
Chemical cycling	Provision of harvestable resources

The study site was assessed at a desktop level using available GIS data and aerial imagery of the site. These were used to identify the presence of wetland areas that could potentially be affected by the proposed powerline project.

Wetland Health and Functional Integrity Assessment Techniques

A Level 1 (Desktop Screening Level) Wet-Health Assessment was undertaken to determine the general health of the broad scale classification of identified wetland units.

Detailed methodology for the health is given in Appendix A.

Assessment of Impact Significance

Significance scoring both assesses and predicts the significance of environmental impacts through evaluation of the following factors; probability of the impact; duration of the impact; extent of the impact; and magnitude of the impact. The significance of environmental impacts is then assessed taking into account any proposed mitigations. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required[4]. Each of the above impact factors have been used to assess each potential impact using ranking scales.

[4] *Impact scores given "with mitigation" are based on the assumption that the mitigation measures recommended in this assessment are implemented correctly and rehabilitation of the site is undertaken. Failure to implement mitigation measures during and after construction will keep the impact at an unacceptably high level.*

Unknown parameters are given the highest score (5) as significance scoring follows the Precautionary Principle. The Precautionary Principle is based on the following statement:

> *'When the information available to an evaluator is uncertain as to whether or not the impact of a proposed development on the environment will be adverse, the evaluator must accept as a matter of precaution, that the impact will be detrimental. It is a test to determine the acceptability of a proposed development. It enables the evaluator to determine whether enough information is available to ensure that a reliable decision can be made.'*

TABLE 2: SIGNIFICANCE SCORING USED FOR EACH POTENTIAL IMPACT

PROBABILITY	DURATION
1 - very improbable 2 - improbable 3 - probable 4 - highly probable 5 - definite	1 - very short duration (0-1years) 2- short duration (2-5 years) 3 - medium term (5-15 years) 4 - long term (>15 years) 5 - permanent/unknown
EXTENT	**MAGNITUDE**
1 - limited to the site 2 - limited to the local area 3 - limited to the region 4 - national 5 - international	2 – minor 4 – low 6 – moderate 8 – high 10 – very high

The following formula was used to calculate impact significance:

Impact Significance: (Magnitude + Duration + Extent) x Probability

The formula gives a maximum value of 100 points which are translated into 1 of 3 impact significance categories; Low, Moderate and High as per **Table 3.**

TABLE 3: IMPACT SIGNIFICANCE RATINGS

SIGNIFICANCE POINTS	SIGNIFICANCE RATING
0 - 30 points	Low environmental significance
31 - 59 points	Moderate environmental significance
60 -100 points	High environmental significance

The impact assessment is discussed in more detail in Section 5.

3. BASELINE BIOPHYSICAL DESCRIPTION

CLIMATE

The eThekwini area is characterised by a summer rainfall pattern with sporadic rainfall events in the winter months. The mean annual precipitation is approximately 973mm. Frost is infrequent and often occurring in valleys where cold air is trapped. The wettest time of the year is February with an average of 127mm and the driest is July with 26mm (**Table 4**). The seasonality of precipitation is a driving factor behind the hydrological cycles of rivers and drainage lines within the area. Typically, rivers and drainage lines have a higher flow rate during the summer months.

Temperatures are also relatively high with maximum temperatures ranging from 22.9^{0}C in July to 28.4^{0}C in February. The region is coldest in July with minimum temperatures of 9.8^{0}C on average (**Table 5**) (Mucina and Rutherford, 2006; Climatological data; BRU Ya13).

TABLE 4: MEAN ANNUAL RAINFALL

	Annual	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean annual rainfall	973	126	127	114	70	55	33	26	42	68	91	111	110

TABLE 5: TEMPERATURES AND EVAPORATION FOR THE AREA

	Annual	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean Temp (°C)	20.5	23.9	24.2	23.3	21.2	18.8	16.5	16.3	17.4	19.1	20.1	21.6	23.0
Max Temp (°C)	25.5	28.0	28.4	27.7	26.2	24.7	23.1	22.9	23.4	24.2	24.7	25.9	27.3
Min Temp (°C)	15.4	19.8	20.0	18.9	16.2	12.9	9.9	9.8	11.4	14.1	15.6	17.3	18.8
Evap. (A Pan mm)	1690	183	160	160	126	108	90	100	120	132	161	165	185

VEGETATION STRUCTURE AND COMPOSITION

The study area is located within three broad vegetation types within the Savanna and the Grassland Biomes (Mucina and Rutherford, 2006). The three broad vegetation types include, KwaZulu Natal Sandstone Sourveld, Moist

Coast Hinterland Grassland and Dry Coast Hinterland Grassland. Patches of the Highveld Alluvial Vegetation type and the Scarp Forest vegetation type are interspersed within these broad vegetation types (**Figure 3**).

KwaZulu-Natal Sandstone Sourveld

This vegetation type is distributed on elevated coastal inland sandstone plateaus with altitudes of between 500m to 1100m above sea level. The vegetation consists of short, species rich grassland with scattered low shrubs. Proteaceae trees and shrubs can also be locally common. The dominant topographical features are flat or rolling plateau tops and steep slopes forming table mountains. This vegetation type is considered Endangered with only 0.2% conserved (Mucina and Rutherford, 2006).

The Dry Coast Hinterland Grassland

Dry Coast Hinterland Grassland is distributed within the KwaZulu-Natal and Eastern Cape Provinces. Other vegetation units often associated with the Hinterland Grassland include the KwaZulu-Natal Hinterland Thornveld, Bisho Thornveld and Eastern Valley Bushveld (Scott-Shaw and Escott, 2011). Dry Coast Hinterland veld is comprised of Sourveld wiry grassland assemblages dominated by *Aristida junciformis* (Ngongoni Grass), however veld in a healthy condition are dominated by *Themeda triandra* and *Tristachya leucothrix* (Scott-Shaw and Escott, 2011). The mono-dominance displayed by this vegetation unit is associated with a low species diversity. This vegetation unit is typically associated with undulating plains and hilly landscape within the drier coast hinterland valleys (in the rain-shadow of the rain-bearing frontal weather systems) (Scott-Shaw and Escott, 2011). Patches of wooded vegetation is often confined to valleys and ridgelines embedded within the Sub Escarpment Grassland assemblages. Termitaria support bush clumps within this grassland unit including *Acacia* spp, *Cussonia spicata*, *Ehretia rigida, Grewia occidentalis* and *Coddia rudis*. Herbaceous species richness is not as abundant as adjoining vegetation units namely KwaZulu-Natal Sandstone Sourveld and Moist Coast Hinterland Grassland. This vegetation type is considered Vulnerable (Mucina and Rutherford, 2006).

The Moist Coast Hinterland Grassland

The Moist Coast Hinterland Grassland is distributed within the KwaZulu-Natal and Eastern Cape Provinces. Hinterland veld is comprised of tall dense Sourveld grassland assemblages with mono-dominance associated with low species diversity. The mono-dominance is by *Aristida junciformus* (Ngongoni Grass), however veld in a healthy condition are dominated by *Themeda triandra* and

Tristachya leucothrix (Scott-Shaw and Escott, 2011). As with the Dry Coast Hinterland Grassland, this vegetation unit is typically associated will rolling and hilly landscapes. Patches of wooded vegetation is often confined to valleys and ridgelines embedded within the Sub Escarpment Grassland assemblages. This vegetation unit is statutorily conserved in Vernon Crookes and Entumeni Nature Reserve and is considered Vulnerable (Mucina and Rutherford, 2006).

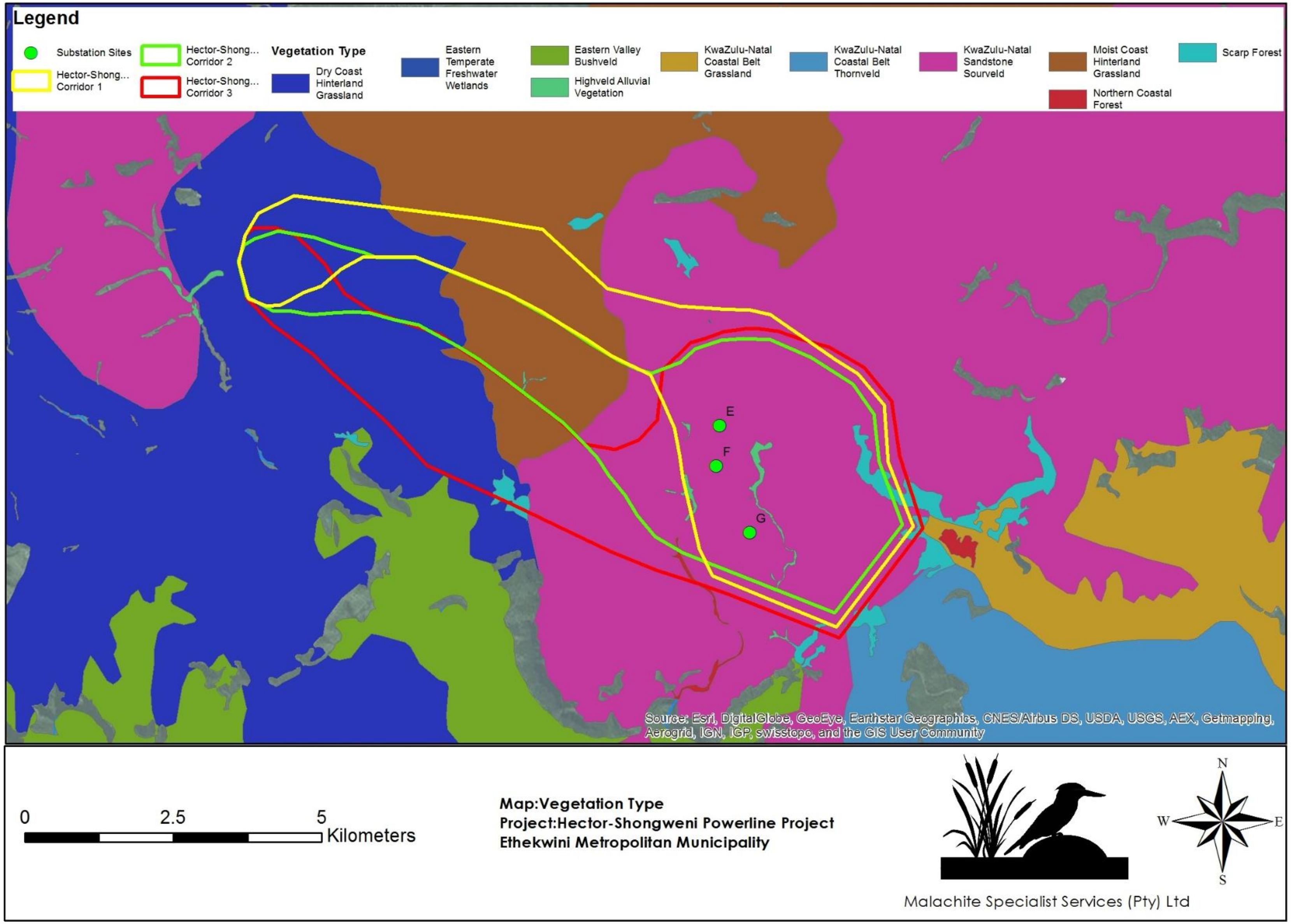


FIGURE 3: VEGETATION TYPES ASSOCIATED WITH THE STUDY AREA

GEOLOGY AND TOPOGRAPHY

The geology of the proposed study area is associated with the Karoo Supergroup (including significant Dwyka tillites and intrusive Karoo dolerites). Dominant rock types of these formations include sandy shales, siltstone and sandstone. Shallow sandy soils are derived from Natal Group Sandstone (Scott-Shaw and Escott, 2011). Common soil forms include Glenrosa, Mispah and Oakleaf soils as well as compact clayey soils of the Katspruit form.

The main topographical unit within the proposed study area consists of moderately undulating plains and ridgelines with rolling hills which are characteristic of the study area. These topographical units often give rise to wetlands and watercourse systems.

CHARACTERISTICS AND WATERCOURSES

The three powerline corridor alternatives traverse the North Eastern Coastal Belt Ecoregion and the South-Eastern Uplands Ecoregion (**Figure 4**). Further to this, the route alternatives are located within the following three quaternary catchments:

- U60C
- U60D
- U60F

These three quaternary catchments are located within the Mgeni Sub Water Management Area and the Mvoti to Umzimkulu Water Management Area (WMA). The Mvoti to Umzimkulu WMA lies along South Africa's eastern coast, primarily within KwaZulu-Natal. The landscape is characterised by rolling terrain with the Drakensberg escarpment forming the main topographical feature (National Water Resource Strategy, 2004). The Mvoti to Umzimkulu WMA is comprised of a diverse economic sector with forestry, agriculture (both subsistence and commercial) and eco-tourism forming the primary land use activities.

The quaternary catchments are associated with a Moderate ecological sensitivity status (www.dwa.gov.za/war/systems.html). The Wekeweke Rivers and the Mhlatuzana Rivers are the main watercourses within the three corridor alternatives.

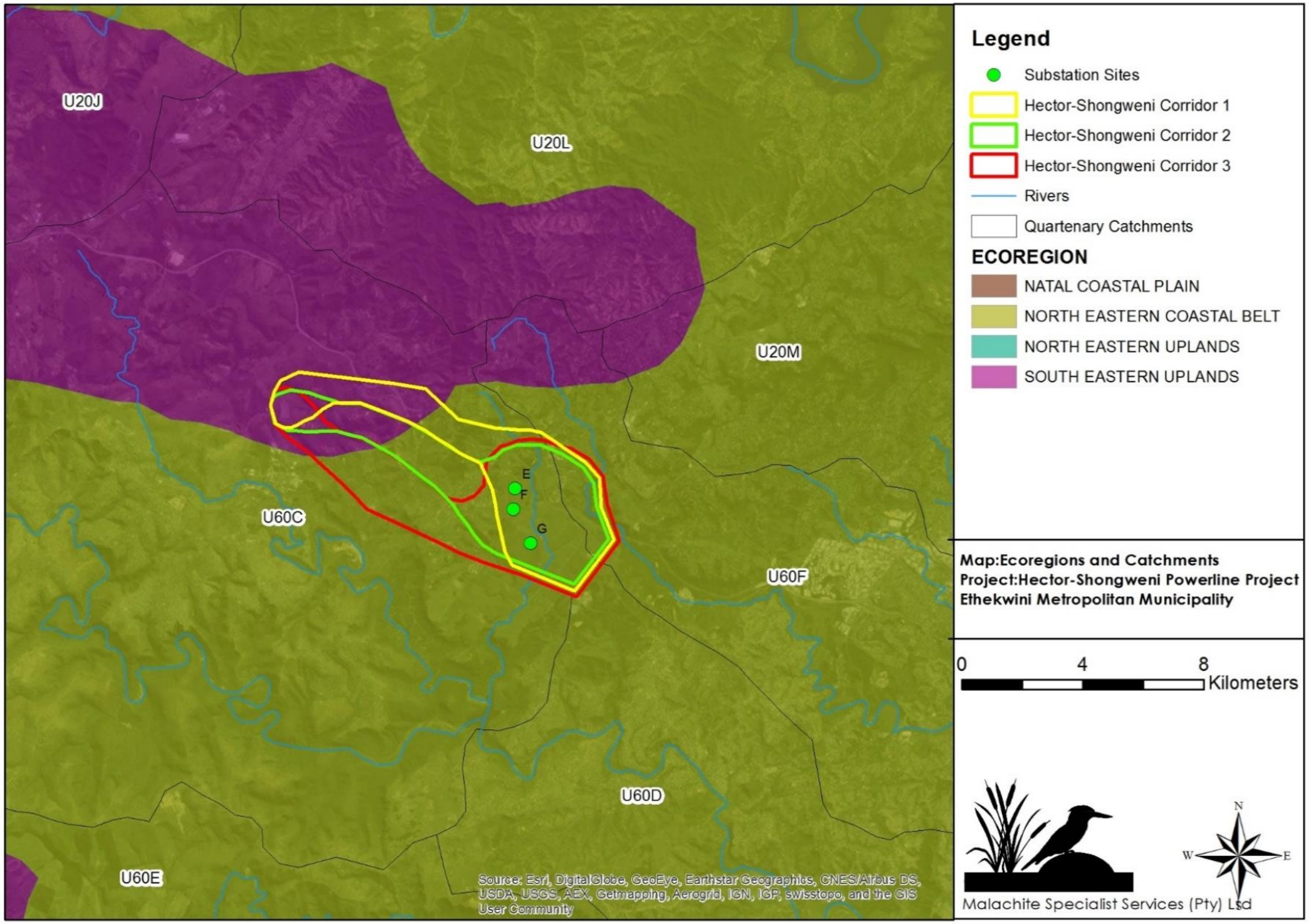


Figure 4: Ecoregions of South Africa (DWAF 2005)

NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREAS (NFEPA)

The NFEPA project was developed to provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or FEPAs (Driver, *et al*., 2011).

An examination of the NFEPA database revealed that a number of FEPA wetlands were identified throughout the proposed corridors. Wetlands have been classified as both natural and artificial in nature and consist of Seeps, Channelled Valley Bottom wetlands as well as a Wetland Flat. Artificial wetlands are agricultural dams. Natural wetlands are classified as FEPA wetlands due to their moderately modified to largely natural condition (**Figure 5, 6 and 7**).

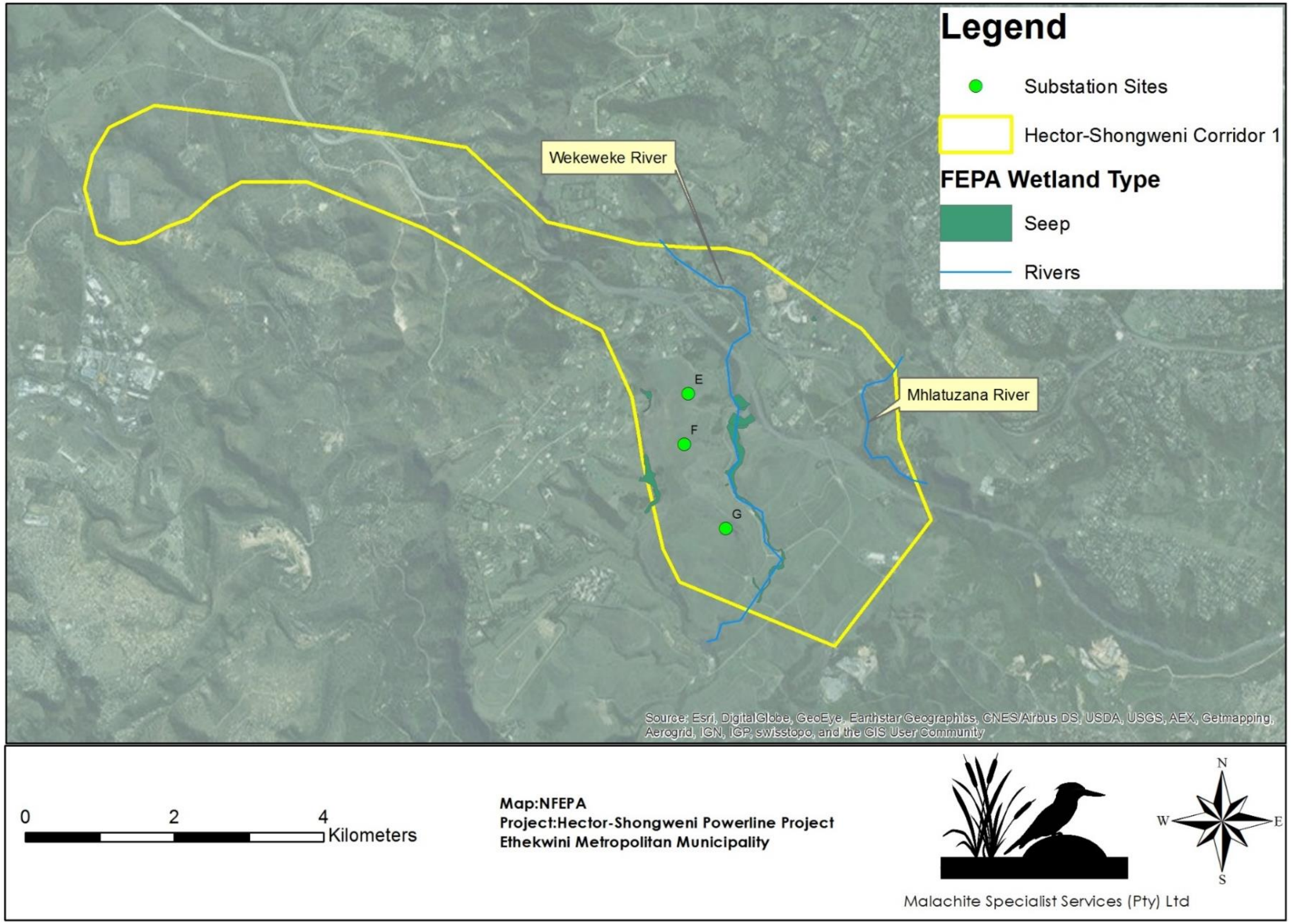


FIGURE 5: FEPA WETLANDS WITHIN CORRIDOR ALTERNATIVE 1

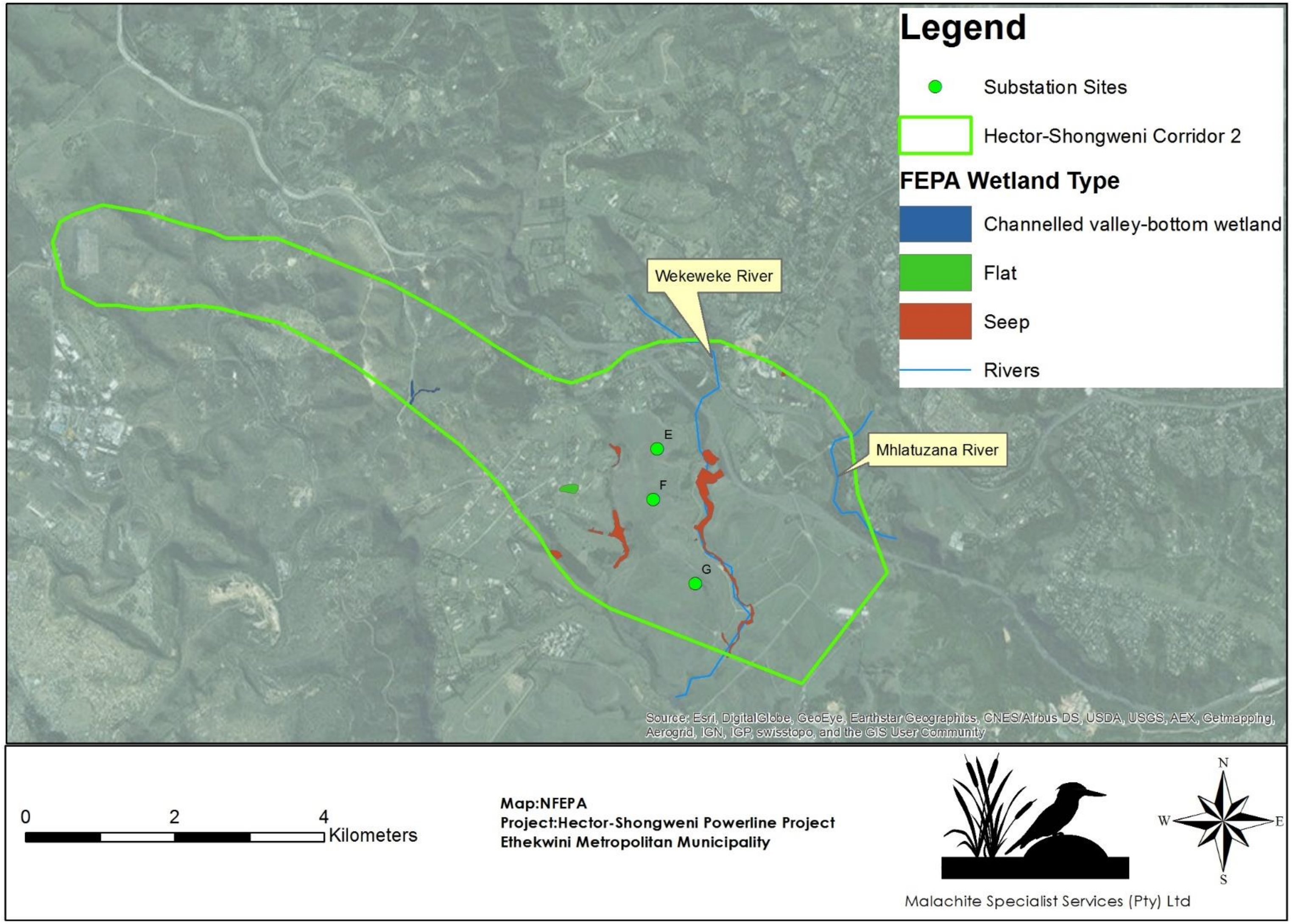


FIGURE 6: FEPA WETLANDS WITHIN CORRIDOR ALTERNATIVE 2

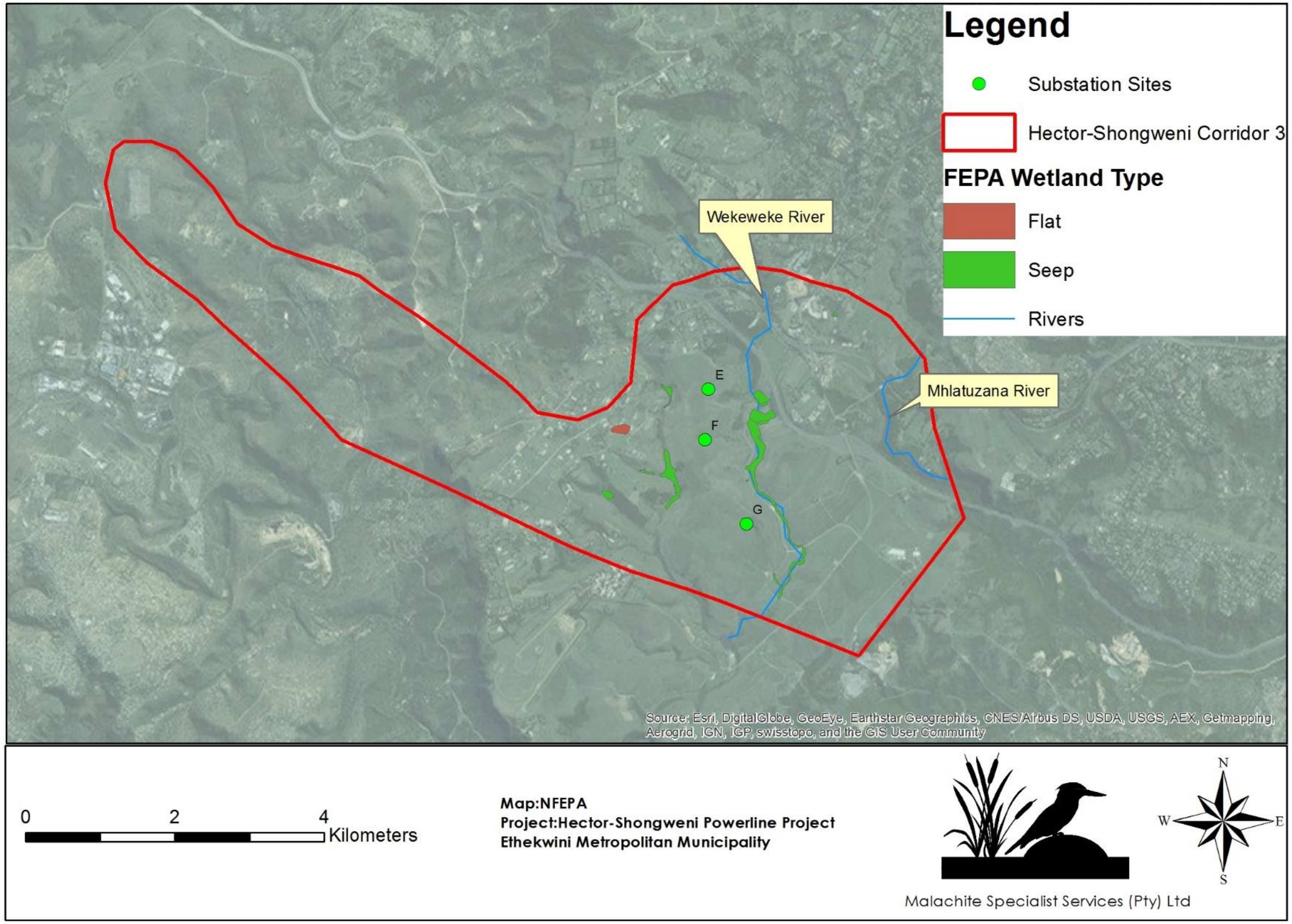


FIGURE 7: FEPA WETLANDS WITHIN CORRIDOR ALTERNATIVE 3

4. ASSESSMENT RESULTS

WETLAND DELINEATION

The South African classification system categorises wetland systems based on the characteristics of different Hydrogeomorphic Units. An HGM unit is a recognisable physiographic wetland-unit based on the geomorphic setting, water source of the wetland and the water flow patterns (Macfarlane *et al.*, 2008). There are five broad recognised wetland systems based on the abovementioned system and are depicted in the diagram below (**Figure 8**). The classification of these wetlands is then further refined as per the 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis *et al.*, 2013).

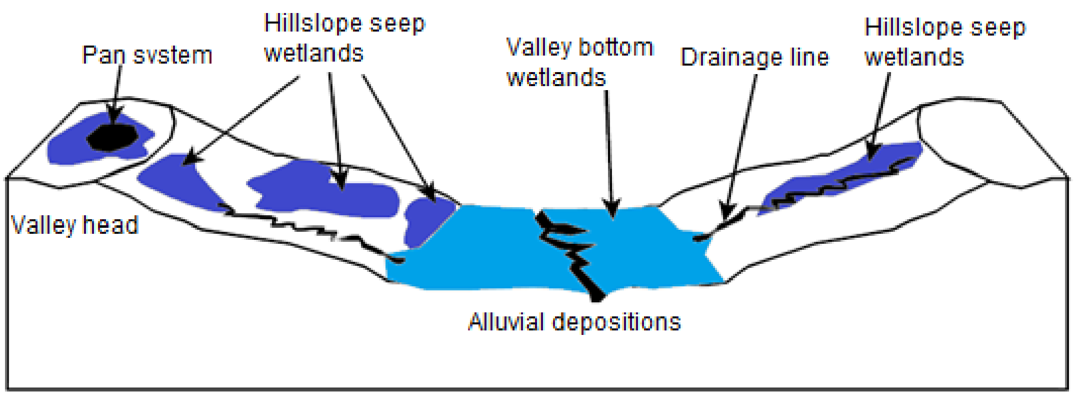


FIGURE 8: DIAGRAMMATIC REPRESENTATION OF COMMON WETLAND SYSTEMS IDENTIFIED IN SOUTHERN AFRICA (BASED ON KOTZE *ET AL.*, 2007 AND OLLIS *ET AL.*, 2013)

A desktop investigation into the presence of wetlands was undertaken for the three powerline corridor alternatives as well as the three alternative substation sites. This desktop assessment was based on the NFEPA data as well as a detailed study of the aerial imagery of these areas. These wetlands have been classified as either being Channelled Valley Bottom and Seep systems. Further to these systems, one Unchannelled Valley Bottom wetland and one Wetland Flat system were identified. These wetlands are presented in **Figures 9 to 12.**

Channelled valley bottom wetlands are characterised by their location on valley floors and the presence of a river or stream channel flowing through the wetland. Dominant water inputs to these wetlands are derived from the channels flowing through the wetland either as surface flows resulting from flooding or as subsurface flow. Water generally moves through the wetland as diffuse surface flow although occasionally as short-lived concentrated flows during flood events (Ollis *et al.*, 2013).

Unchannelled valley bottom wetlands are characterised by their location on valley floors and the absence of distinct channel banks and the prevalence of diffuse flows. These wetlands are generally formed when a river or stream channel loses confinement and spreads out over a wider area causing the concentrated flow, associated with a river channel, to change to diffuse flow (Ollis *et al.,* 2013).

Seepage wetlands are characterised by their association with topographic positions that either cause groundwater to discharge to the land surface or rain-derived water to seep down-slope as subsurface interflow. Water movement through the seep is primarily attributed to interflow, with diffuse overland flow often being significant during and after rainfall events.

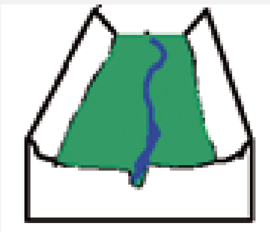
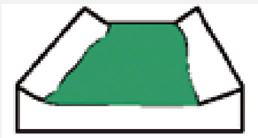
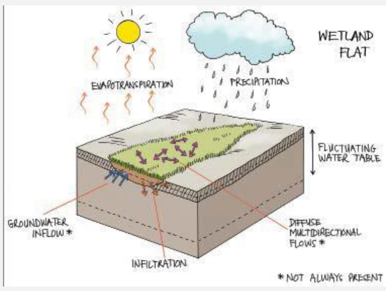
Flat wetlands are relatively discrete wetland areas of mostly level or nearly level high ground. This wetland type is generally situated in a hilltop or crest position flanked by down-slopes in all directions. The gradient associated with this area is moderately undulating and links into the Hillslope Seep system (Kotze *et al.,* 2008; Ollis *et al*., 2013).

A description of each wetland type is given in **Table 6**.

TABLE 6: WETLAND HYDROGEOMORPHIC (HGM) TYPES (KOTZE *ET AL.*, 2008; OLLIS *ET AL.*, 2013)

HGM UNIT	DESCRIPTION	SOURCE OF WATER MAINTAINING THE WETLAND[5]	
		SURFACE	SUBSURFACE
Seep 	Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***

[5] 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

HGM Unit	Description	Source of water maintaining the wetland[5]	
		Surface	Subsurface
Channelled Valley bottom 	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Unchannelled Valley bottom 	Valley bottom areas with no clearly defined stream channel usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Flat 	Flat wetlands are relatively discrete wetland areas of mostly level or nearly level high ground. This wetland is situated in a hilltop or crest position flanked by down-slopes in all directions. The gradient associated with this area is moderately undulating and links into the Hillslope Seep system.	*	***

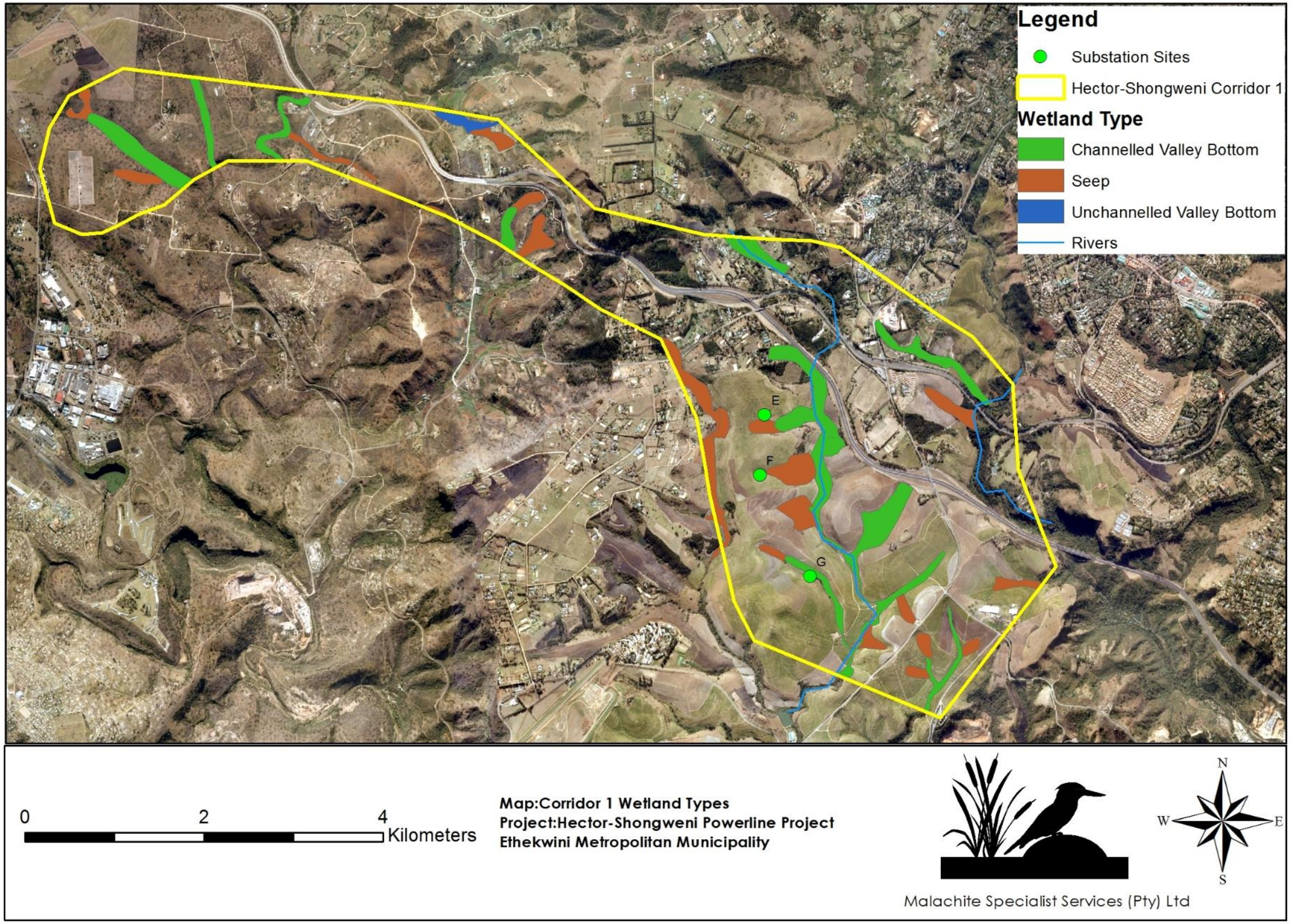


FIGURE 9: WETLANDS DELINEATED WITHIN CORRIDOR ALTERNATIVE 1

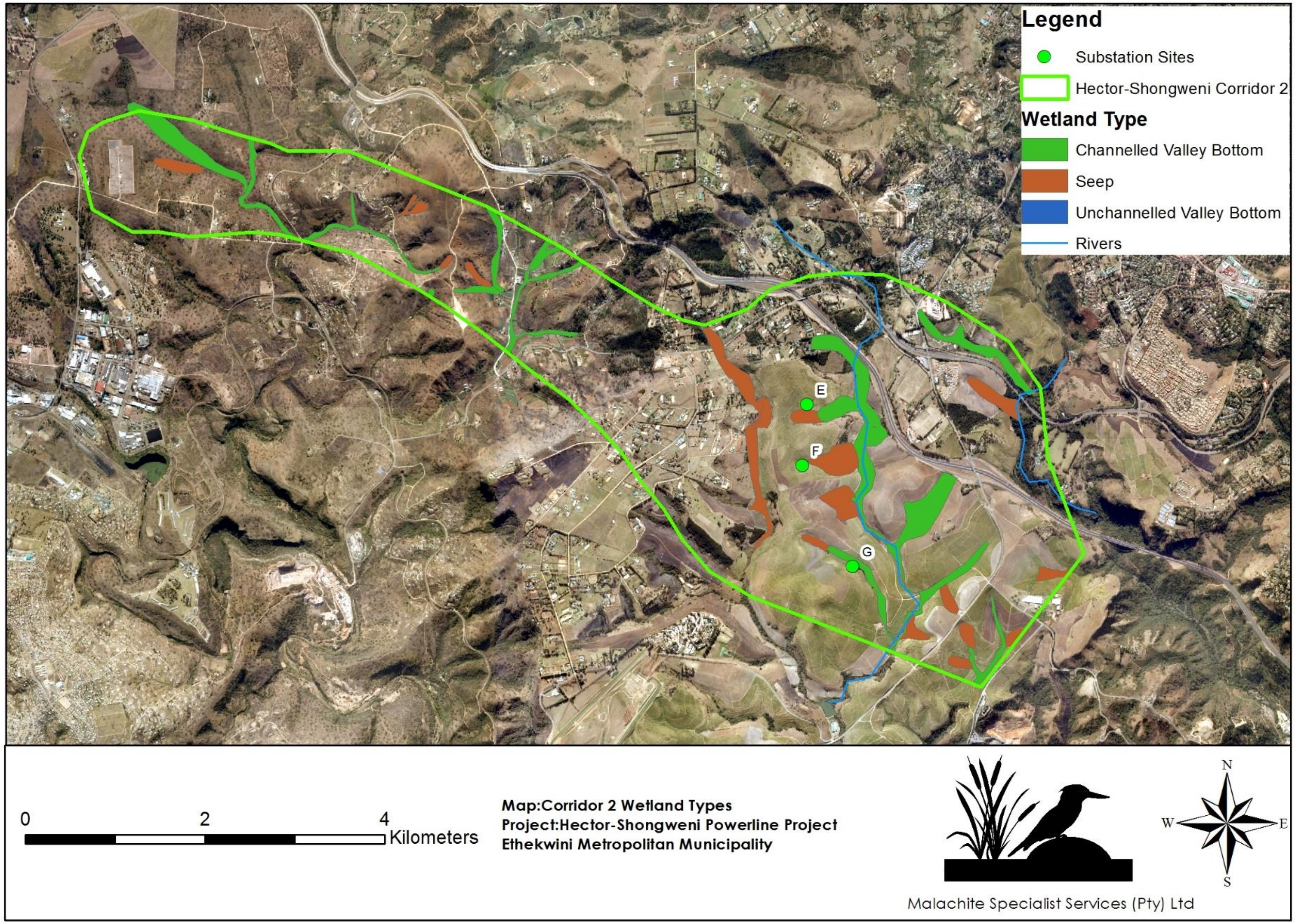


FIGURE 10: WETLANDS DELINEATED WITHIN CORRIDOR ALTERNATIVE 2

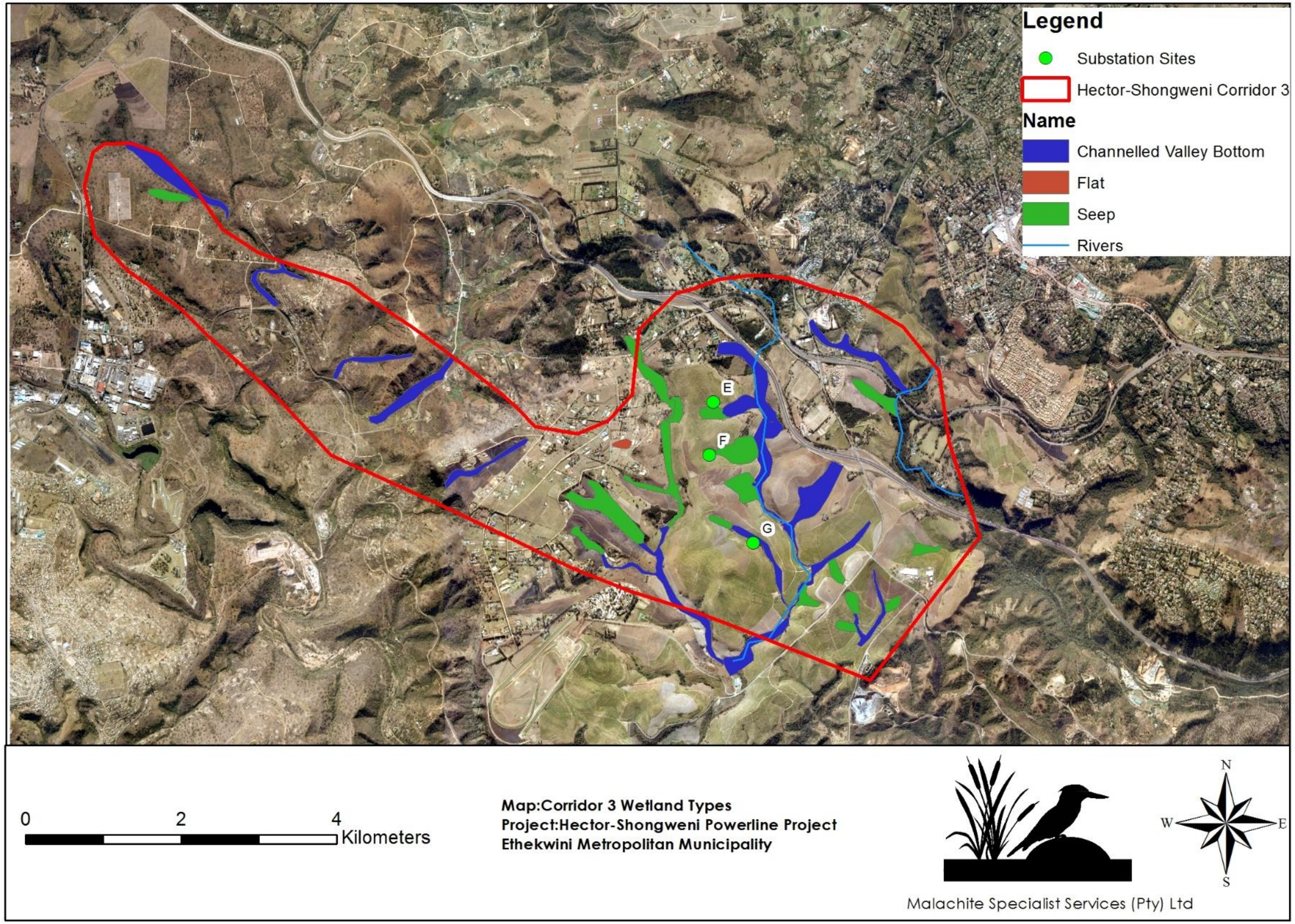


FIGURE 11: WETLANDS DELINEATED WITHIN CORRIDOR ALTERNATIVE 3

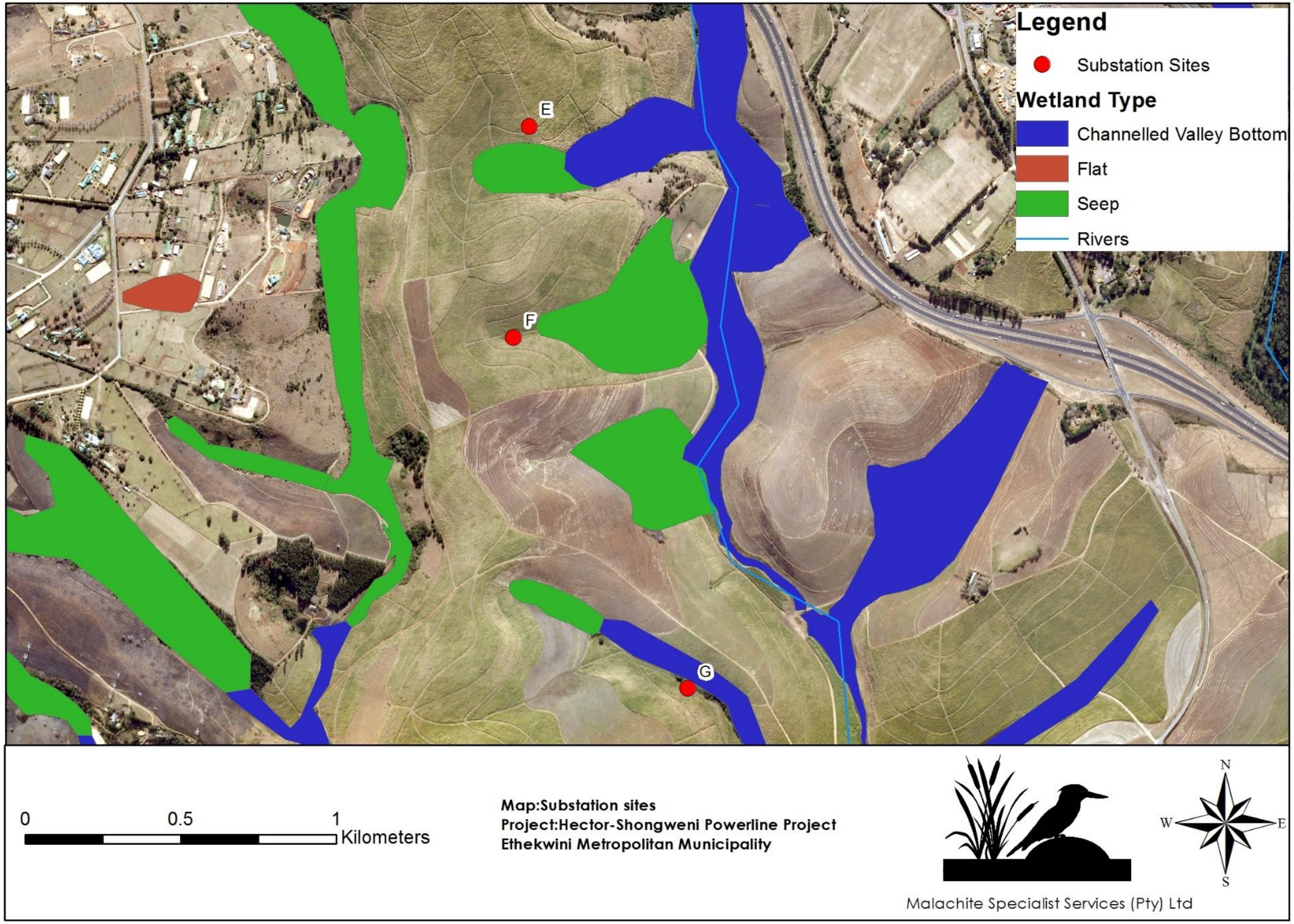


FIGURE 12: WETLANDS DELINEATED AROUND THE SUBSTATION SITES

PRESENT ECOLOGICAL STATE (PES)

An assessment on the health of all the identified Seep and Channelled Valley Bottom wetlands cannot be undertaken at this time, due to the large quantity of wetland systems identified within the three powerline corridor alternatives and three substation site alternatives. These assessments must be undertaken once a final route has been selected for the proposed powerline and a walk-down conducted to delineate and assess the wetlands along this route.

A level 1 assessment was therefore undertaken at the desktop level on all the Seep wetlands and Channelled Valley Bottom wetlands as well as the single Unchannelled Valley Bottom and Wetland Flat Systems. This was undertaken to determine the general impacts to the wetlands within the study area and the effects these impacts have had on the wetland types. These impacts have generally given scores of moderately and largely modified (Pes Category C and D; **Table 7**).

TABLE 7: SUMMARY OF PES SCORE

HGM WETLAND TYPE	HYDROLOGY	GEOMORPHOLOGY	VEGETATION	PES SCORE (CATEGORY)
Seep Complex	6.5	5.0	5.6	(5.00) (D)
Channelled Valley Bottom Complex	5	5.2	5.3	(4.51) D
Unchannelled Valley Bottom	4	4.8	4.2	(4.28) D
Flat	4	3.8	4.5	(4.08) C

The major modifications to the catchments associated with the wetland systems include:

- agricultural activities including sugarcane cultivation, agricultural dams;
- infrastructural development;
- residential and urban development;
- erosion; and
- widespread encroachment of alien invasive species.

The Seep systems have been largely impacted as a result of sugarcane cultivation as well as the development of infrastructure including both roads and urban development. The aerial investigation of the area indicated a number of Seep wetlands that have been drained to create more favourable conditions for sugarcane production. These drains are known as 'herring-bone' drains and are easily visible through the aerial photography. These drains largely affect the hydrological flow of the seepage systems and this negatively impacts sediment movement, both which have knock-on effects to the vegetation communities of these wetlands. This has made the Seeps vulnerable to the encroachment of alien invasive species.

The Channelled Valley Bottom systems have also been impacted by both agricultural and urban activities. These have caused negative changes in the hydrological flow through the valley bottom systems and increased the formation of erosion gullies. Road networks over and adjacent to these systems have an impact on both the physical characteristics of the wetlands as well as the water quality.

The Unchannelled Valley Bottom wetland is situated within Corridor Alternative 1. This system has been impacted by the creation of agricultural dams within the wetland unit. The damming of wetland systems has long term negative impacts on the hydrology, geomorphology and vegetation dynamics of these systems. Dams cause a decrease in the quantity of water reaching downstream wetland areas as well as the increase in flooding of the upstream wetland systems. This results in changes to the hydrological flow of channels and associated wetland systems. Further to this, impoundments act as sediment sinks, reducing the sediment load of water released downstream of the dam, resulting in water that is regarded as 'sediment hungry' which contributes to the formation of erosion gullies. Sedimentation of wetlands is destructive to many faunal species affecting their habitat, breeding and feeding cycles.

The Wetland Flat system is located within Corridor Alternative 3. This system has been classified as moderately modified (PES Category C). Modifications are largely associated with infrastructural development, particularly roads. Road surfaces alter the flow dynamics of water through wetland systems, channelling it along the road alignment. This changes the flow from a diffuse flow toward a more channelled path allowing for the faster movement of water and eventually leading to the creation of erosion gullies. In addition to this, road surfaces are recognised as a source of various pollutants which can originate from a wide variety of sources and negatively impact water quality within a wetland system.

Other impacts within the catchments of all identified wetlands include the conversion of the vegetation dynamics and specifically the encroachment of invasive alien plant species. Alien species generally out-compete indigenous species for water, light, space and nutrients as they are adaptable to changing conditions and are able to easily invade a wide range of ecological niches (Bromilow, 2010). Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs (Zedler, 2004). Such changes on the ecology of the wetlands have had a detrimental impact on the ability of all the wetland systems to maintain both floral and faunal biodiversity.

PHOTOGRAPH 1: SUGARCANE CULTIVATION IMPACTS PARTICULARLY TO SEEP SYSTEMS

PHOTOGRAPH 2: RESIDENTIAL AND INFRASTRUCTURAL DEVELOPMENT IMPACTS ON WETLAND SYSTEMS

PHOTOGRAPH 3: AGRICULTURAL DAMS WHICH AFFECT WETLAND SYSTEMS

5. BUFFERS REQUIREMENTS

Buffer zones outside the boundary of wetlands are required to ensure that the ecotones between aquatic and terrestrial environments are effectively managed and conserved. These ecotones have a high ecological significance and have been shown to perform a wide range of functions, and on this basis, have been proposed as a standard measure to protect water resources and associated biodiversity (Macfarlane *et al*., 2016). These functions include:

- Maintaining basic aquatic processes through maintaining channel stability as well as regulating microclimate and water temperature;
- Reducing impacts on water resources from upstream activities and adjoining land uses through stormwater attenuation, sediment and toxicant removal;
- Providing habitat for aquatic and semi-aquatic species (species with a bi-phasic life cycle);
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits

The buffer tool aims to provide a method for determining appropriate buffer widths for developments associated with wetlands, rivers or estuaries. It takes into account a number of different factors in determining the buffer width including the impact of the proposed activity on the water resource, climatic factors, topographical factors and the sensitivity of the water resource.

The results calculated show that a <u>30m buffer</u> is appropriate for the protection of the ecosystem services provided by the wetland systems. The above buffer width is recommended during both the construction and operational phase of the proposed project particularly with regards to the positioning of the towers associated with the powerline as well as the creation of any access roads. This buffer is based on a desktop analysis of the study area and can be refined once the final corridor has been chosen and a walk down conducted to delineate and assess the affected wetland systems.

4. CONSIDERATION OF ALTERNATIVES

SUBSTATION SITE E:

Substation site alternative E is the most northerly substation site and is situated within an area cultivated for sugarcane. An investigation of aerial imagery as well as the fly-over identified a Seep and Channelled Valley Bottom wetland system approximately 50m to the south of the proposed centre point of the substation site. Further to this, a Seep system is situated approximately 400m to the west of the proposed centre point of the site.

SUBSTATION SITE F:

This site alternative is situated to the south of site alternative E within an area utilised for sugarcane cultivation. The investigation of aerial imagery as well as the fly-over identified a Seep and Channelled Valley Bottom wetland system approximately 80m to the east of the proposed centre point of the site as well as a Seep system approximately 500m to the west of the proposed centre point of the site.

SUBSTATION SITE G:

This is the southernmost substation alternative and is also situated within an area used for the cultivation of sugarcane. The centre point of the substation site is situated directly adjacent to a Channelled Valley Bottom system, with a second Channelled Valley bottom system identified approximately 500m east of the proposed centre point of the site.

The proposed size of each of the substation alternatives is 800m x 800m. This means that all proposed substation alternatives will have an impact on identified wetland systems.

CORRIDOR ALTERNATIVES

Due to the broad scale nature of the project, as well as the desktop approach to the wetland assessment, any of the three proposed corridors can be utilised from a wetland perspective. Once a final corridor has been chosen a walk down must be conducted to delineate any wetlands along the powerline corridor and the appropriate buffer applied to the wetland systems assessed. This buffer must be utilised in planning the position of the towers so that risks to the wetland systems can be minimised.

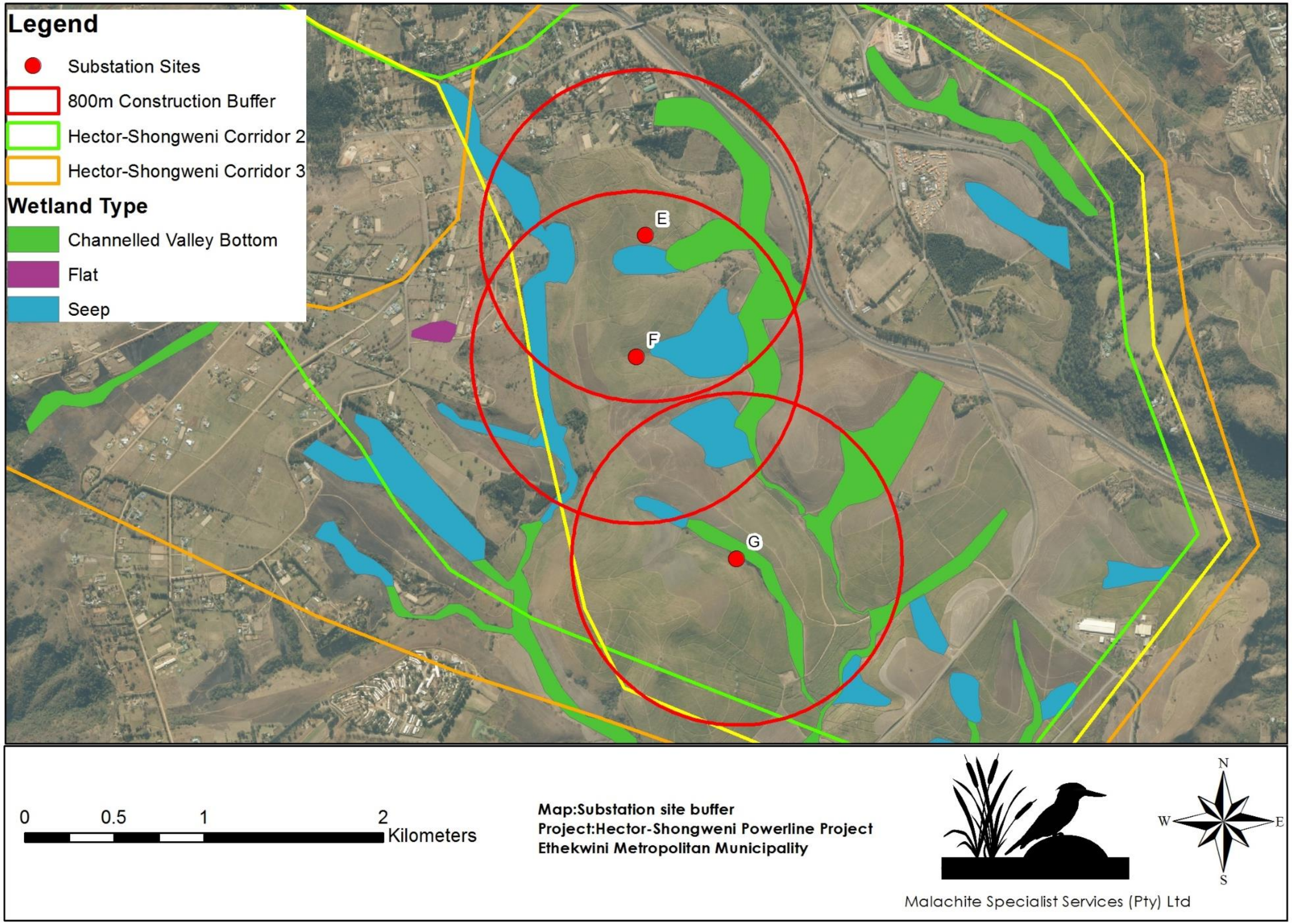


FIGURE 13: WETLANDS IDENTIFIED WITHIN THE 800M CONSTRUCTION BUFFER FOR THE SUBSTATION SITE

5. IMPACT DESCRIPTION, ASSESSMENT & MITIGATION

Any development activity in a natural system will have an impact on the surrounding environment, usually in a negative way. The purpose of this phase of the study was to identify and assess the significance of the impacts caused by the proposed powerline project and to provide a description of the mitigation required to limit the identified negative impacts on the receiving environment.

The impact assessment identified the following potential negative impacts associated with the proposed project on the wetland systems; (i) soil compaction leading to erosion, sedimentation and degradation of wetland systems; (ii) pollution of wetlands and soil as a result of the construction phase of the project and (iii) disturbance within the wetland systems thereby increasing the encroachment of alien invasive species and the loss of natural habitat for fauna and flora. Several general and specific measures are proposed to mitigate these impacts on all wetland systems.

SOIL EROSION, SEDIMENTATION AND DEGRADATION WITHIN WATER RESOURCE SYSTEMS

IMPACTS ASSOCIATED WITH THE CONSTRUCTION PHASE OF THE ACTIVITIES										
Impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
	With out	With	With out	With	With out	With	With out	With		
Construction Phase										
Soil erosion and sedimentation	4	3	2	2	2	1	8	6	48 (moderate)	27 (low)
Operational Phase										
Degradation of water resources	2	1	5	5	2	1	4	2	22 (low)	8 (low)

Description of impact

Construction activities (i.e. excavations and vegetation clearing) expose soil to environmental factors including rainfall and wind. The exposure to these factors will result in the removal of topsoil and this subsequently leads to soil erosion and the deposition of sediment in the downslope watercourses. This increased high-suspended particulate matter within the wetlands can accumulate within the watercourses, particularly during the wetter months. Sedimentation poses a risk to the geomorphological/functional integrity of wetland and watercourse systems, reducing the ecological integrity of the water resource outside of the impacted area.

The risk and potential impact of soil erosion will be moderate during the construction (removal of vegetation and creation of excavations) phase and this impact will decrease significantly during the operational phase provided rehabilitation of impacted areas is undertaken.

Mitigation Options

- Whichever corridor alternative and substation site is authorised, the enforcement of a buffer and the placement of towers outside of wetland systems will significantly reduce the impact of the proposed powerline corridor on the wetland systems.
- The creation of access roads must take all wetlands and watercourses into consideration and these systems must be avoided.
- The development footprint is to be limited to what is absolutely essential in order to minimise environmental damage along the powerline corridor.
- No stockpiling of any materials may take place adjacent to any of the water resources. Erosion control measures must be implemented in areas sensitive to erosion, particularly in areas prone to erosion and where erosion has already occurred. These measures include but are not limited to - the use of sand bags, hessian sheets, silt fences, retention or replacement of vegetation and geotextiles such as soil cells which must be used in the protection of slopes.
- Do not allow surface water or stormwater to be concentrated, or to flow down slopes without erosion protection measures being in place.
- The entire construction area must not be stripped of vegetation prior to commencing construction activities.
- All disturbed areas must be rehabilitated as soon as construction in an area is complete or near complete and not left until the end of the project to be rehabilitated.
- Any channel banks that will be affected must be re-profiled as per the original soil horizon structure and re-vegetated with indigenous species.
- Make use of existing access roads as much as possible and plan additional access routes to avoid vegetation communities.
- Minimise the extent of the work footprint as far as possible.

Pollution of water resources and soil

Impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
Impacts associated with the construction phase of the activities										
	Without	With	Without	With	Without	With	Without	With		
Construction Phase										
Pollution of water resources and soil	5	4	2	2	2	1	8	4	60 (moderate-high)	28 (low)
Operational Phase										
Pollution of water resources and soil	2	1	5	5	2	1	6	4	26 (low)	10 (low)

<u>Description of the impact</u>

Sediment release from a construction site into the downstream aquatic environment is one of the most common forms of waterborne pollution. Furthermore, mismanagement of waste and pollutants including hydrocarbons, construction waste and other hazardous chemicals will result in these substances entering and polluting the sensitive natural downstream environments either directly through surface runoff during rainfall events, or sub-surface water movement.

Further to this, the linked nature of the wetlands and associated watercourses will result in pollutants being carried downstream from the construction site having consequences on further downstream users including aquatic faunal species. An increase in pollutants will lead to changes in the water quality of the wetlands, affecting their ability to act as ecological corridors in the larger landscape and reducing their ability to maintain biodiversity.

<u>Mitigation Options</u>

- Do not locate the construction camp or any depot for any substance which causes or is likely to cause pollution within a distance of 100m of the delineated water resources.
- All waste generated during construction is to be disposed of at an appropriate facility and no washing of paint brushes, containers, wheelbarrows, spades, picks or any other equipment adjacent to the watercourses is permitted.
- Proper management and disposal of construction waste must occur during the construction of the development.

- No release of any substance i.e. cement, oil, that could be toxic to fauna or faunal habitats within the watercourses.
- Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil must be removed and the affected area rehabilitated immediately.
- A spill contingency plan must be drawn up for the construction phase.

ALIEN INVASIVE SPECIES

Impacts associated with the encroachment of alien invasive species										
Impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
	Without	With	Without	With	Without	With	Without	With		
Construction Phase										
Spread of Alien invasive species	5	4	2	2	2	1	8	6	60 (high)	36 (moderate)
Operational Phase										
Spread of Alien invasive species	5	4	5	5	2	2	8	4	75 (high)	40 (moderate)

Description of the impact

The removal of vegetation along the powerline corridor and substation site will lead to disturbance within the area having a negative impact on the functionality of the vegetation community associated with the wetland systems. Alien invasive species occur throughout the study area and these species will further encroach into disturbed areas. Alien species generally out-compete indigenous species for water, light, space and nutrients as they are adaptable to changing conditions and are able to easily invade a wide range of ecological niches (Bromilow, 2010). Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs (Zedler, 2004).

Mitigation Options

- Protect as much indigenous vegetation as possible.
- An alien invasive management programme in terms of the National Environmental Management: Biodiversity Act must be incorporated into an Environmental Management Programme for both the construction and

operational phase as extirpation of alien invasive vegetation is an on-going activity. Areas which have been disturbed will be quickly colonised by invasive alien plant species.

6. CONCLUSION

The wetland assessment involved desktop investigations for the presence of wetland systems within three proposed powerline corridors as well as three alternative substation sites. This investigation made use of aerial imagery, NFEPA wetlands data as well as a fly-over of the study area classified wetlands as either being of the Channelled Valley Bottom and Seep system. Further to this, one Unchannelled Valley Bottom wetland and one Wetland Flat System were identified.

A 30m buffer has been calculated for the wetland systems and is considered appropriate for the protection of the ecosystem services provided by the wetlands. The above buffer width is recommended during both the construction and operational phase of the proposed project, particularly with regards to the positioning of the towers associated with the powerline as well as the creation of any access roads. This buffer is based on a desktop analysis of the study area coupled with a fly-over and must be refined once the final corridor has been chosen. This will be achieved through a walk down conducted to delineate and assess the affected wetland systems.

All alternative substation sites are situated within 500m of a number of wetland systems. The proposed size of each of the substation alternative is 800m x 800m. This means that all proposed substation alternatives will all have an impact on identified wetland systems. The position of the wetland systems must be taken into consideration with regards to the layout of the chosen substation site.

The impact assessment identified the following potential negative impacts associated with the proposed project on the wetland systems; (i) soil compaction leading to erosion, sedimentation and degradation of wetland systems; (ii) pollution of wetlands and soil as a result of the construction phase of the project and (iii) disturbance within the wetland systems thereby increasing the encroachment of alien invasive species and the loss of natural habitat for fauna and flora.

Several general and specific measures are proposed to mitigate these impacts on the receiving environment. Provided the mitigation measures specified in this report are implemented and the continued monitoring and rehabilitation of any disturbed areas is undertaken, the proposed powerline is expected to have a limited negative effect on the receiving environment including water resources.

This will be ensured should the 30m buffer be adhered to and the use of existing access roads as far as possible is undertaken. Further to this, the position of the substation must take into consideration wetland systems and buffers.

Due to the broad scale nature of the project, as well as the desktop approach to the wetland assessment, any of the three proposed corridors and three alternative substation sites can be utilised from a wetland perspective. Once a final corridor has been chosen, a walk down must be conducted to delineate any wetlands along the powerline corridor and the appropriate buffer applied to the wetland systems assessed. This buffer must be utilised in planning the position of the towers so that risks to the wetland systems can be minimised.

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8. APPENDICES

APPENDIX A – WETLAND AND RIPARIAN ASSESSMENT METHODOLOGY

WETLAND DELINEATION TECHNIQUE

For the purpose of this assessment, wetlands are considered as those ecosystems defined by the National Water Act 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."*

The desktop study conducted during the initial Scoping Phase assessment involved the assessment of aerial photography, GIS databases including the NFEPA and South African National Wetland maps as well as literature reviews of the study site in order to determine the likelihood of wetland areas within the area.

ASSESSMENT OF THE WETLAND'S PRESENT ECOLOGICAL STATE (PES)

The Present Ecological State (PES) for wetlands which is defined as '*a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition'* is also an indication of each wetland's ability to contribute to ecosystem services within the study area. This was assessed according to the methods contained in the Level 2 WET-Health: *A technique for rapidly assessing wetland health* (Macfarlane, *et al.*, 2009)

This document assesses the health status of a wetland through evaluation of three main factors -

- ***Hydrology:*** *defined as the distribution and movement of water through a wetland and its soils.*
- ***Geomorphology:*** *defined as the distribution and retention patterns of sediment within the wetland.*
- ***Vegetation:*** *defined as the vegetation structural and compositional state.*

The WET-Health tool evaluates the extent to which anthropogenic changes have impacted upon the functional integrity or health of a wetland through assessment of the above-mentioned three factors. The deviation from the natural condition is given a rating based on a score of 0-10 with 0 indicating no impact and 10 indicating modifications have reached a critical level. Since hydrology, geomorphology and vegetation are interlinked their scores are then aggregated to obtain an overall PES health score These scores are then used to place the wetland into one of six health classes (A – F; with A representing completely unmodified/natural and F representing severe/complete deviation from natural as depicted in **Table 8**.

TABLE 8: HEALTH CATEGORIES USED BY WET-HEALTH FOR DESCRIBING THE INTEGRITY OF WETLANDS

DESCRIPTION	IMPACT SCORE	HEALTH CATEGORY
Unmodified, natural.	0 – 1.0	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 - 2.0	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2.1 - 4.0	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4.1 - 6.0	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6.1 - 8.0	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.1 - 10.0	F

Due to differences in the pattern of water flow through various hydro-geomorphic (HGM) types, the tool requires that the wetland is divided into distinct HGM units at the outset. Ecosystem services for each HGM unit are then assessed separately. A Level 1 WET-Health assessment was undertaken for the wetlands identified. A Level 1 assessment is a desktop assessment and is undertaken at a broad scale to determine the overall impacts on wetland systems