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ENVIRONMENTAL

Wetland Assessment for Areas Associated with the Weltevreden Site

Wetland Assessment

Project Number:

NOR1982

Prepared for:

Northern Coal (Pty) Ltd

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Crystal Rowe	Report Compiler		2014-07-28
Andrew Husted	Review		2014-07-28

EXECUTIVE SUMMARY

Digby Wells & Associates (DWA) was appointed by Northern Coal (Pty) Ltd to undertake a wetland study on the farm Weltevreden in the Belfast area, Mpumalanga. An opencast mine, comprised of three pits and associated infrastructure, is intended for the area. A Wetland Assessment Report has already been completed in 2008, by Digby Wells and the purpose of the current assessment is to update this report. The aim of the study is to delineate wetland areas, classify wetlands, describe the Present Ecological State (PES), functionality and sensitivity of wetlands and to provide an impacts assessment to determine the potential impacts of the development and operation of the proposed opencast mine on wetlands on site.

The study area falls within the Komati River catchment (X11D), which is in a moderately modified state. Three wetlands have been identified by NFEPA, two of which are regarded as important for the maintenance of biodiversity. In addition, Mpumalanga C-Plan classifies wetlands on site as ‘natural’ but does not regard any of them as critical for meeting the objectives of this plan.

The wetlands on site were delineated making use of the four primary indicators, namely: soil form, soil wetness features, vegetation and terrain. Based on this, 160.3 ha of wetland areas was delineated, the majority of which was classified as hillslope seepage. The remaining wetlands were hillslope seeps leading to channels, hillslope seeps leading to pans and a single pan / depression.

Wetlands were largely allocated a PES of C, as well as D; with the major impacts related to damming, overgrazing and trampling by livestock, as well as the presence of roads that cause compaction of sediments and reduced flow of water through the wetland. 60% of wetlands were assigned an Ecological Importance and Sensitivity (EIS) of C and the remainder were assigned an EIS of D (40% of wetlands on site).

The primary impacts associated with the proposed opencast mine is direct loss of wetland habitat. This will cause a reduction in available habitat for flora and fauna and will also result in a loss of eco-services provided. Further to this, the risk of hydrocarbon spills and contamination of surface water from mining activity is regarded as highly significant as the major degradation to wetlands can occur. The 100m buffer, as stipulated by the National Water Act (No. 36 of 1998) has been recommended for all wetlands on site. Fortunately the Weltevreden pan and its narrow catchment have been excluded from the current mine plan.

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1 Introduction

The general conservation status of freshwater ecosystems worldwide is poor and continues to decline at a rapid rate, with rivers and wetlands among the most threatened of all ecosystems (Vitousek *et al.*, 1997, Revenga *et al*., 2000). According to Moyle and Williams (1990) and Jensen *et al*. (1993) this decline is a result of severe alteration caused by human activities. With an ever increasing human population as well as economic development, an increase in the demand for water is inevitable, as well as an increase in pollution to freshwater ecosystems. The sectors which are responsible for this are the domestic, agricultural, recreational and industrial sectors as they all depend on fresh flowing water (Roux *et al*., 1996).

According to Jungwirth *et al.* (2000) and Muhar *et al*. (2000) aquatic ecosystems are heavily degraded on a global level by these human activities and impacts. As a result it is important for both conservation and management of freshwater systems to determine which basic processes, functions and structures make up the ecological integrity of these ecosystems. In spite of the fact that conservation of biological diversity has been the main aim of conservation biology, the phrase “biological integrity” has formed the cornerstone of all these programs. The ability of a biological system to function and maintain itself in the face of changes in environmental conditions is referred to as biological or biotic integrity (Angemeier and Karr, 1994).

South Africa has a diverse assortment of natural resources which does not include water (Ashton, 2007). One of the primary reasons for the scarcity of our water resources is that the excessive human population growth and development has resulted in unbalancing the availability of and state of water resources locally and on a global scale (Davies & Day, 1998). Water resources in South Africa are currently considered to be finite which suggests that in South Africa as a result of the excessive use of water resources will result in a water shortage that will progress into a water crisis unless the adequate management actions are taken to address this area of concern (Davies & Day, 1998).

There have been some significant changes over the past few years to the priorities and approaches to management of water resources in South Africa (Ashton *et. al*, 2005). Culmination in the promulgation of the Water Services Act (WSA: Republic of South Africa, 1997) and the National Water Act (NWA: Republic of South Africa, 1998) may be attributed to the process of reform of the policy on water resources and water services (Ashton *et. al*, 2005).

According to the National Water Act (Act 36 of 1998), a water resource is not only considered to be the water that can be extracted from a system and utilized but the entire water cycle. This includes evaporation, precipitation and entire aquatic ecosystem including the physical or structural aquatic habitats, the water, the aquatic biota, and the physical, chemical and ecological processes that link water, habitats and biota. The entire ecosystem is acknowledged as a life support system by the National Water Act. According to van Wyk *et al.* (2006) the “resource” is defined to include a water course, surface water, estuary and aquifer, on the understanding that a water course includes rivers and springs, the channels in which the water flows regularly or intermittently, wetlands, lakes and dams into or from which water flows, and where relevant, the banks and bed or the system.

Basic human needs, societal well-being and economic growth and development are supported by river ecosystem goods and services. A range of processes which support human well-being are included as ecosystem services such as the maintenance of water quality, waste disposal as well as those services relating to recreational and spiritual needs (van Wyk *et al.,* 2006). The Act requires that sufficient water is to be reserved to maintain as well as sustain the ecological functioning of the country's aquatic ecosystems which include rivers, wetlands, groundwater and estuarine systems. If the country's water resources continue to be abused and deteriorate, this will result in an unavoidable loss of key ecosystem services that support social and economic development (Postel and Richter, 2003; Driver et al., 2005; MEA, 2005; Dudgeon et al., 2006; Dasgupta, 2007). The diverse goods and services provided for by water resource are acknowledged by the National Water Act. This ingrains the democratic principles necessary to safeguard equity in access to these resources. The aim is that society should be able to use as well as protect an agreed upon suite of goods and services derived from the water resource. The water law provides for an integrated, adaptive process for water resource management.

The optimal use of natural resources for sustainable economic activity is essential in developing countries (Howarth and Farber, 2002). Biodiversity is a vital component for maintaining ecological processes and thus in ensuring sustainability of the ecosystem goods and services which is vital for successful water resource management (MacKat *et al.,* 2004) South Africa's National Biodiversity Strategy and Action Plan (DEAT, 2005) acknowledges that there is cause for significant concern due to the declining status of ecosystems that degradation of ecosystems leads to a reduction in ecosystem services. This may result in a reduced capacity to generate clean water and a loss of food production due to land degradation.

The overall framework for environmental governance in South Africa has been created by South Africa's Constitution (Act 108 of 1996) by establishing the right to an environment that is not harmful to health and well-being, by balancing the right to have the environment protected with rights to valid social and economic development and by allocating environmental functions to a wide range of government agencies in all spheres and requiring co-operation between government agencies and spheres of government (DEAT, 2005). National legislation has been promulgated to govern national competencies, one of which is water (National Water Act).

Therefore the approach adopted within South Africa by freshwater surface ecosystem regulators to balance the use of aquatic ecosystems includes ascertaining the current state and or availability of ecosystem resources, allocating ecological, social and or economic values to the resource to enable the sustainable use and or protection of the resources. In this study the surface aquatic ecosystems associated with the proposed Northern Coal mining activity, consisting of the associated wetland areas as well as the Klein Komati River, have been addressed. The South African River Health Programme (RHP) primarily makes use of biological indicators (e.g. fish communities, riparian vegetation, aquatic invertebrate fauna) to assess the condition or health of river systems. These methodologies were developed for lotic systems (rivers and streams) and are not applicable to lentic ecosystems (dams, lakes, pans etc.). Due to the lentic nature of the system assessed, only a wetland assessment was conducted. The delineation of the wetland areas was done in accordance with the DWAF (2005) methodology.

Wetlands are highly susceptible to the degradation of quality and a reduction in quantity as a result of anthropogenic resource use activities, (Mitsch and Gosselink, 1993; Brinson, 1993; Bernaldez et al., 1993, Diederichs and Ellery, 2001) land-surface-development (Gibbs, 2000) and landscape-management (Kotze and Breen, 1994; Whitlow, 1992) practices that alter their hydrological regime impacting these systems (Winter and Llamas, 1993). Historically wetlands have been perceived to be wastelands (Maltby, 1986) and this has resulted in the exploitation, alteration and in many cases the complete destruction of these valuable ecosystems, with an accompanying loss of associated ecosystem goods and services (Begg, 1986). It is now acknowledged that these ecosystems perform functions making them invaluable to the management of both water quantity and quality, and as a result wetlands are regarded as integral components of catchment systems (Jewitt and Kotze, 2000; Dickens *et al*., 2003).

The aim of the study is to delineate the associated wetland areas of the study area. The following tasks were identified in order to meet the project objectives:

- Conduct a desktop and field investigation of the wetlands within the study areas;
- Assess, classify, delineate and map the identified wetlands;
- Describe the general functions of the wetlands;
- Determine the Present Ecological State (PES) and Ecological Importance and Sensitivity
- (EIS) of the wetlands on site; and
- Provide a report with maps of wetlands, detailing all the information.

This report presents the approach adopted, the results of the approach as well as a discussion of the significance and relevance of the determined results. Additionally, management options have also been provided to protect and manage ecosystems and areas of ecological importance.

1.1 Terms of Reference

Digby Wells & Associates (DWA) was appointed by Northern Coal (Pty) Ltd to undertake a wetland study on the farm Weltevreden in the Belfast area, Mpumalanga. This study is for the proposed opencast mining operation, inclusive of three opencast pits, intended for the study area. Information generated from this survey would be used to delineate, classify and map the wetlands at Weltevreden. A wetland assessment had already been completed by

Digby Wells in 2008 and the primary objective of this study is to update the former report. Studies that have previously been completed for the area and were used to update this report include:

- Pan Biodiversity Assessment of Weltevreden Pan. Digby Wells, 2014.
- Wetland Delineation: Wetlands and aquatic systems associated with Weltevreden, Belfast, Mpumalanga. Digby Wells, 2008.

The National Water Act 36 of 1998 is important in that it provides a framework to protect water resources against over exploitation and to ensure that there is water for social and economic development, human needs and to meet the needs of the aquatic environment. The Act recognises both wetlands and rivers as water resources and are both protected under the Act. This study addresses selected regulations and regulatory procedures of the South Africa Departments of Water Affairs and Forestry and the Department of Environmental Affairs and Tourism.

2 Study Area

The study area is situated in the Mpumalanga Province, in the Highlands Local Municipality between the N4 and R33 roads. The site consists of maize fields, stands of *Eucalyptus spp.*, pans and grasslands (Figure 2-1). Evidence of agricultural activities that took place on the site (cattle grazing) is evident. A rocky area is present to the north of the pans. Approximately 219 ha will be mined using open cast methods.

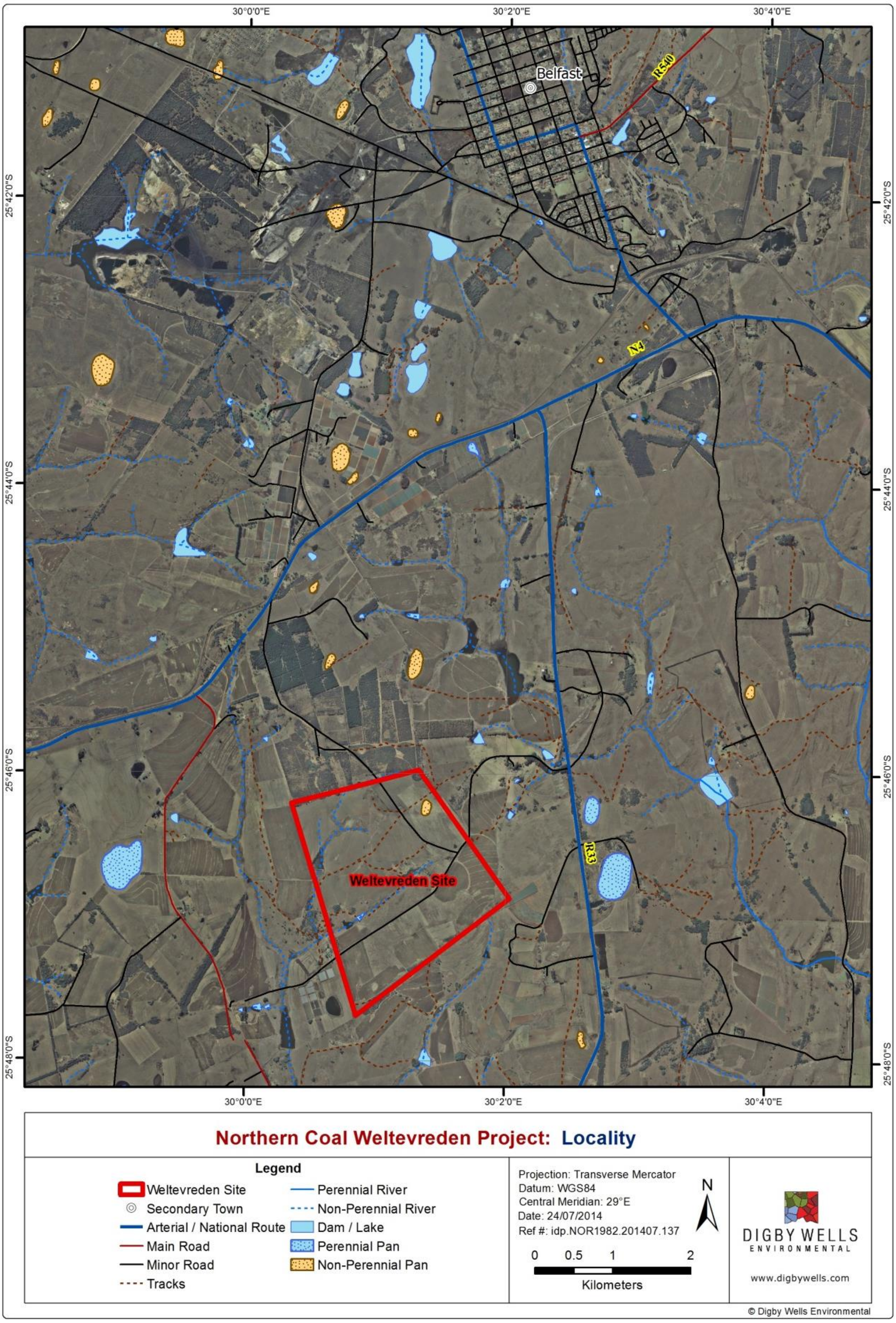


Figure 2-1: Locality

2.1 Drainage and Quaternary Catchments

The study area is situated within the Komati River quaternary catchment (X11D); which has been allocated a Present Ecological State (PES) of 'moderately modified' (C). The affected watercourse is the Klein Komati River which flows into the Komati River. Figure 2-2 represents the quaternary catchments for the Weltevreden site.

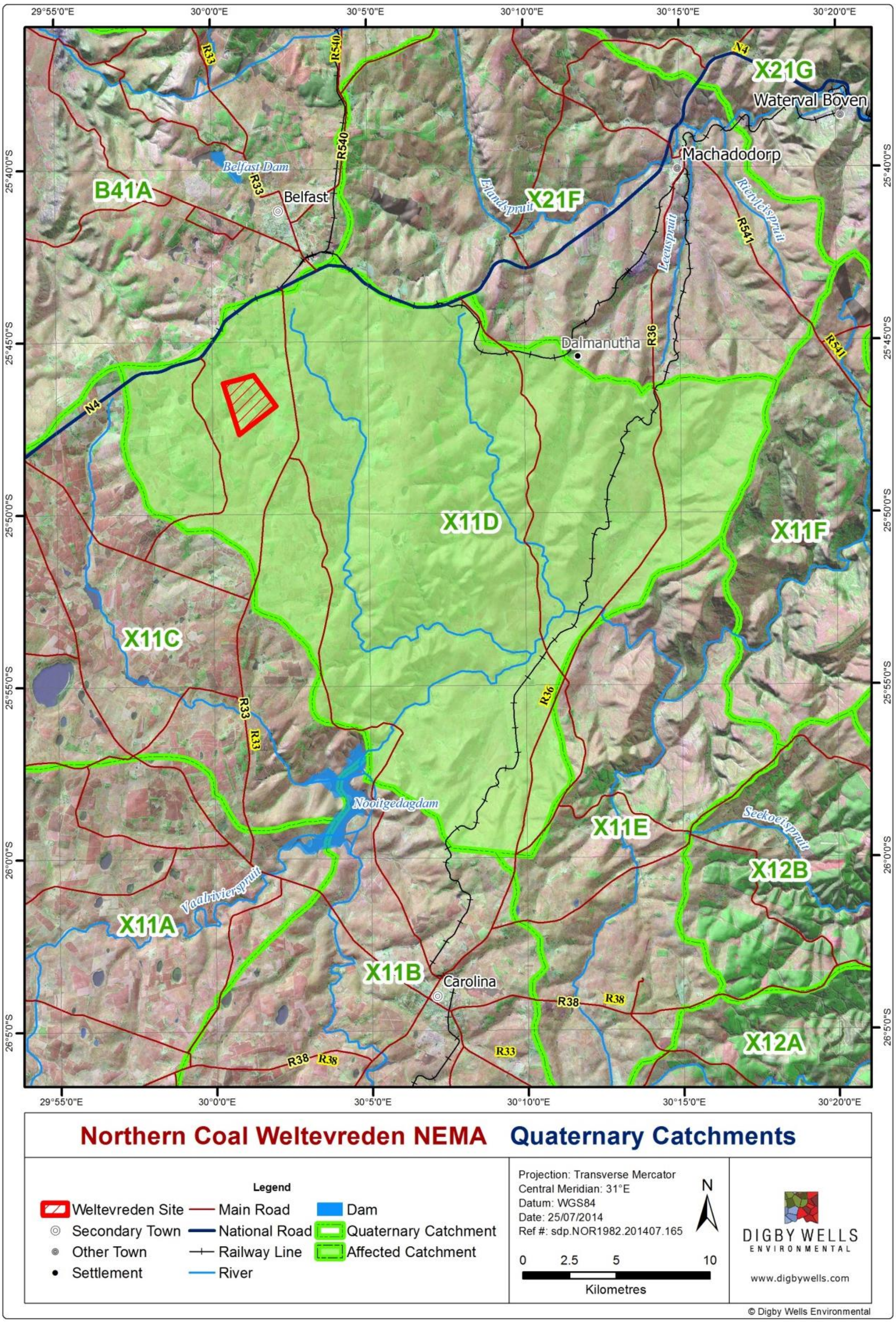


Figure 2-2: Quaternary Catchments

2.2 National Freshwater Ecosystem Priority Areas (NFEPA)

The National Freshwater Ecosystem Priority Areas (NFEPA) strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources were considered to evaluate the importance of the wetland areas located within the Northern Coal mining project area (Nel *et al.* 2011).

Spatial layers (FEPA's) used include the wetland classification and ranking. The identified wetland areas play important functions such as the enhancement of water quality, attenuation of floods and biodiversity support.

The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. Table 2-1 below indicates the criteria which were considered for the ranking of wetland areas. Three wetland units have been identified by NFEPA, as listed in Table 2-2 and represented in Figure 2-3. Both the Weltevreden pan and the northern seep have been assigned an NFEPA ranking of two. This implies that these wetland units are (or are within proximity to) important for the maintenance of biodiversity and may be regarded as necessary habitat for an IUCN-listed threatened frog species, threatened waterbirds or other important biodiversity features. The rank 6 wetland is not regarded to be as significant.

The identification of wetland and aquatic NFEPA's takes place on a large scale and as a result, not all wetland units present on a site are always identified.

Table 2-1: NFEPA wetland classification ranking criteria

Criteria	Rank
Wetlands that intersect with a RAMSAR site.	1
Wetlands within 500 m of an IUCN threatened frog point locality; Wetlands within 500 m of a threatened waterbird point locality; Wetlands (excluding dams) with the majority of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

Table 2-2: NFEPA wetlands for the Weltevreden site

Wetland Unit	HGM Unit	NFEPA rank
Bench, Depression	Weltevreden Depression / Pan	2
Slope, Seep	Seep	2
Slope, Seep	Seep	6

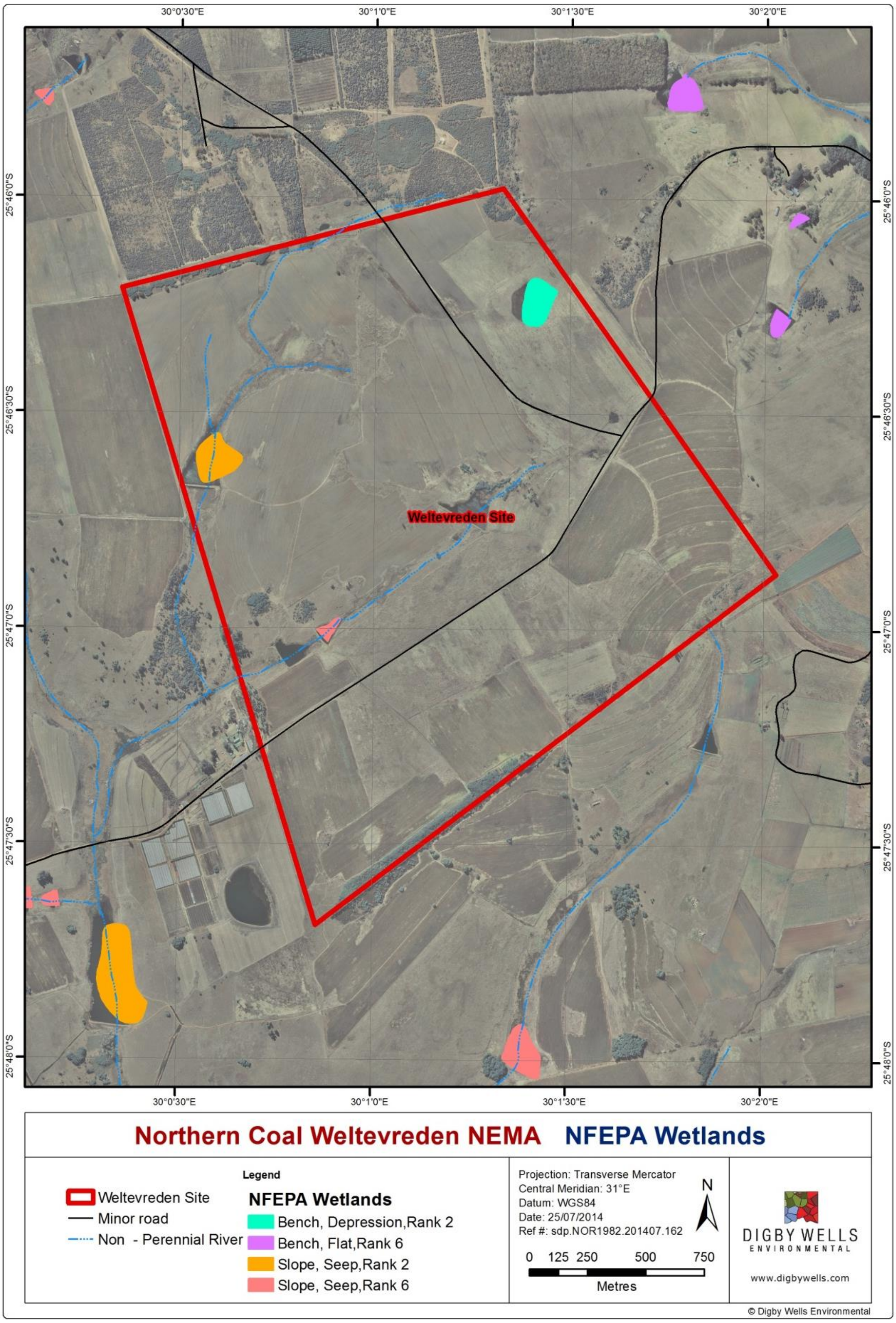


Figure 2-3: NFEPA wetlands associated with the study area

2.3 Mpumalanga Conservation Plan (C-Plan)

The Mpumalanga Biodiversity Conservation Plan (MBCP) is a plan developed conjointly by the Mpumalanga Tourism and Parks Agency (MTPA) and Department of Agriculture and land Administration (DALA) to guide conservation and land-use decisions in the province in order to support sustainable development. The MTPA recognises that wetlands are specialised systems that perform ecological functions that are crucial for human and environmental welfare. Figure 2-4 indicates that the Mpumalanga C-plan does not recognise any areas that are critical or irreplaceable in the study area and that the majority of wetlands are classified as natural.

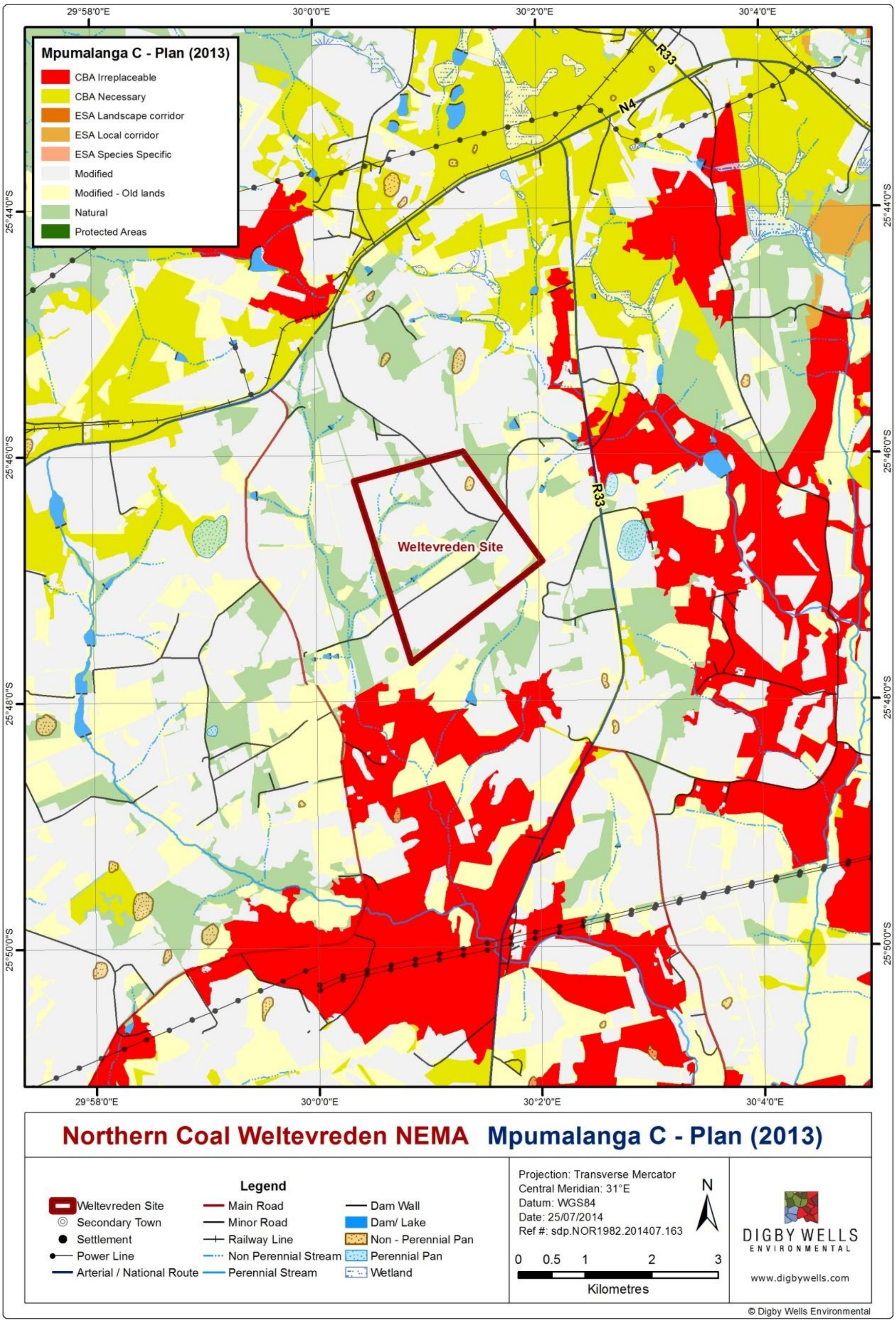


Figure 2-4: Mpumalanga C-Plan

3 Expertise of the Specialist

The Digby Wells Biophysical Department is comprised of a team of qualified and experienced environmental scientists. Members specialise in their respective fields and the senior members are registered as Professional Natural Scientists. Appendix A lists the detailed Curriculum Vitae (CV) for specialists involved in this study.

4 Aims and Objectives

The aim for this component of the study was to delineate the associated wetland areas. The following tasks were identified in order to meet the project objectives:

- Conduct a desktop and field investigation of the wetlands within the study areas;
- Assess, classify, delineate and map the identified wetlands;
- Describe the general functions of the wetlands;
- Determine the Present Ecological State and Ecological Importance and Sensitivity of the wetlands on site; and
- Provide a report with maps of wetlands, detailing all the information.

5 Methodology

5.1 Wetland Identification and delineation

Maps were generated from 1:50 000 topographic maps and aerial photographs, onto which the wetland areas were identified and preliminary wetland boundaries were delineated at the desktop level. The identified wetlands were temporarily classified according to their Hydro-geomorphic (HGM) Unit determinants based on modification of the system proposed by Brinson (1993), and modified for use by Marneweck and Batchelor (2002) and subsequently revised by Kotze *et al.* (2004). The HGM Unit system of classification focuses on the hydro-geomorphic setting of wetlands which incorporates geomorphology; water movement into, through and out of the wetland; and landscape / topographic setting. Once wetlands have been identified, they are categorised into HGM Units as in Figure 5-1. HGM Units are then assessed individually for habitat integrity.

The initial site investigation was undertaken in November 2013 for orientation and to assess wetland integrity during the wet-season. This time of year is ideal for field investigations, as it coincides with the flowering-time of many of the plant species that occur in wetlands and animals are also most active. This also coincides with the time recommended by the Mpumalanga Parks and Tourism Agency (MTPA). An additional site visit was conducted in April 2014 in order to confirm the boundaries of wetlands on site. The site visit included a concise evaluation of the current impacts on the wetland habitat on site, as well as the features that contribute to ecological integrity and functionality.

Floodplain		Valley bottom areas with a well-defined stream channel stream channel, gently sloped and characterised by floodplain features such as oxbow depression and natural levees and the alluvial (by water) transport and deposition of sediment , usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom with a channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from the channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by 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.
Isolated hillslope seepage		Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.
Pan/Depression		A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (ie. It is inward draining). It may also receive subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

Figure 5-1: Wetland HGM Units (modified from Brinson 1993; Kotze 1999 and Marneweck and Batchelor 2002)

5.2 Wetland Delineation

In accordance with the DWAF guidelines (DWAF 2005) the wetland delineation procedure considers four attributes to determine the limitations of the wetland. These attributes are discussed according to the DWAF guidelines in further detail later on in this section. Further descriptions on the four attributes are presented in Appendix B. The four attributes are:

- Terrain Unit Indicator – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator – identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- Vegetation Indicator – identifies hydrophilic vegetation associated with frequently saturated soils.

In accordance with the definition of a wetland in the NWA, vegetation is the primary indicator of a wetland, which must be present under normal circumstances; however, the soil wetness indicator tends to be the most important in practice. The remaining three indicators are then used in a confirmatory role. The reason for this, is that the response of vegetation to changes in the soil moisture regime or management are relatively quick and may be transformed, whereas the morphological indicators in the soil are significantly more permanent and will hold the indications of frequent and prolonged saturation long after a wetland has been drained (perhaps several centuries) (DWAF 2005).

5.3 Wetland Ecological Health Assessment

A PES analysis was conducted to establish baseline integrity (health) for the associated wetlands. In order to determine the integrity (health) of the characterized HGM units for the project area, the WET-Health tool was applied. According to Macfarlane *et al.* (2007) the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules in order to attempt to estimate similarity to or deviation from natural conditions. The Present Ecological State (PES) is determined according to Table 5-1.

Table 5-1: Impact scores and Present Ecological State categories used by WET-Health

Description	Combined Impact Score	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 has	1-1.9	B

Description	Combined Impact Score	PES Category
taken place.		
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 has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable.	6-7.9	E
Modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

5.4 Wetland Ecological Importance and Functionality Assessment

In order to assess the importance of wetlands identified on site from an ecological perspective, taking into account aspects related solely to the maintenance of ecological diversity and functionality, the EIS tool was used. For this methodology, a series of determinants are assessed using a ranking scale of 0-4 (Table 5-2), from which the median of each determinant is used to allocate an ecological management class.

Table 5-2: Criteria used for determining the EIS of wetlands

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

5.5 Wetland Functional Assessment

The onsite wetlands were grouped according to homogeneity and assessed utilising the functional assessment technique, WET-EcoServices, developed by Kotze *et al.* (2007) to provide an indication of the benefits and services. As a result of this, scores are not wetland area specific but do however provide an indication of the ecological services offered by the different wetland systems as a whole for this project area.

5.6 Impact Assessment

The impacts of the development and operation of the proposed underground coal mining project on the receiving wetlands areas within the project area were assessed at different stages of the development of the mine according to the methodology indicated in Table 5-3.

A clearly defined rating scale is used to assess each impact in terms of severity, spatial extent and duration (which determines the consequence) and in terms of the frequency of the activity and the frequency of the related impact (which determines the likelihood of occurrence). The overall impact significance, is then determined via a significance rating matrix (Table 5-3) utilising the scores obtained for consequence and likelihood of occurrence, in order to assign a final impact rating.

Table 5-3: Impact Assessment methodology

Rating	Severity	Spatial scale	Duration	Probability
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.

Rating	Severity	Spatial scale	Duration	Probability
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem functions. Rehabilitation requires intervention of external specialists and can be done in less than a month.	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

6 Results

6.1 Wetland delineation

The wetland delineation was completed using the four wetland indicators: terrain indicator, soil form, soil wetness characteristics and wetland vegetation. Section 6.1.1 to 6.1.3 describes the presence of these four indicators on site. Three major HGM units were recorded on site, namely: valley bottom wetlands without a channel, hillslope seeps and pan / depressions. The hillslope seeps were either isolated as small patches along slopes, or were linked to other HGM units. Table 6-1 represents the areas of HGM units recorded on site and Figure 6-1 shows their distribution. A total of 160.3 ha of wetland habitat were delineated on site, largely made up of hillslope seeps (65.7 ha).

Table 6-1: Wetland units delineated on site

HGM Unit	Area (ha)	Proportion of total wetlands on site (%)
Valley Bottom without a Channel	41.5	25.9
Hillslope seepage wetlands connected to watercourses	65.7	41
Hillslope seepage wetlands connected to pans	2.9	1.8
Isolated hillslope seepage wetlands	48.8	30.4
Pans	1.4	0.9
Total	**160.3**	**100**

A 100m buffer has been assigned for surface infrastructure and the opencast pits, in accordance with the NWA (Act 36 of 1998). The buffer zones are a requirement in order to facilitate the protection of the delineated wetland areas within the project area. The purpose of the establishment of buffer zones is to minimise the anthropogenic impacts associated with the proposed development on the receiving water resources. A buffer zone is defined as:

"*the strips of undeveloped, typically vegetated land (composed in many cases of riparian habitat or terrestrial plant communities) which separate development or adjacent land uses from aquatic ecosystems (rivers and wetlands).*"

A number of explanations have been provided for the establishment of buffer zones, some of the reasons are listed below:

- Reducing the impacts of adjacent land uses on water resource quality and the associated biodiversity, and;
- Sustaining or improving the ability of the water resources to provide goods and services to the current and future water end users within the catchment area.

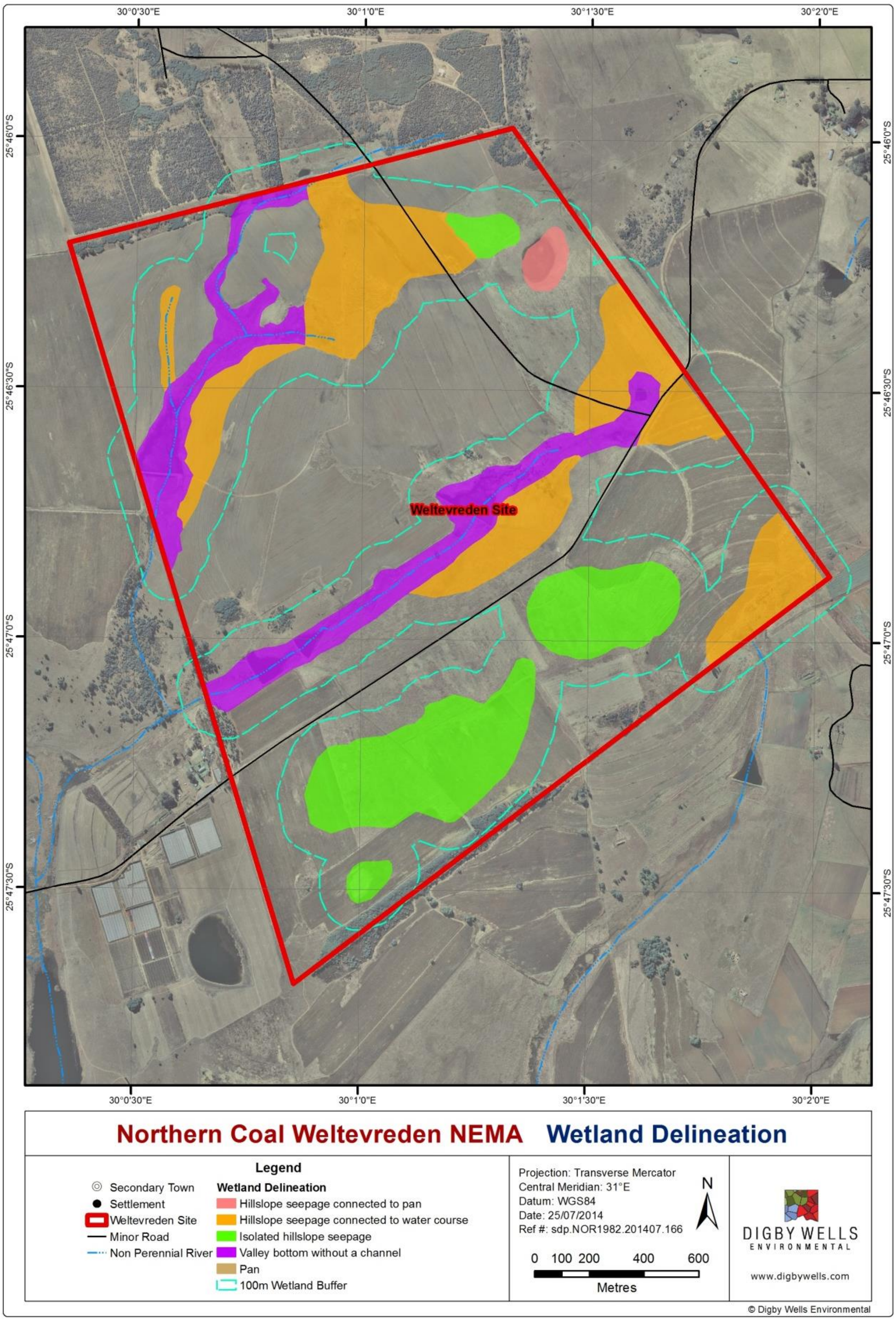


Figure 6-1: Wetland delineation

6.1.1 Vegetation Indicator

Typha capensis (Common Bulrush), a common species of the permanent wetland, colonised channels of the valley bottom type wetlands and formed mono-specific stands in certain areas with the exception of the alien forb: *Verbena bonariensis* (Common Vervain). In addition, *Utricularia* sp. and *Limosella africana* were found in the permanently wet zone. Species that are associated with the seasonal and temporary zones were of particular significance as the edges of where these occur were marked to determine the edge of wetlands. Table 6-2 lists the plant species that were used as indicators of wet conditions on site and Figure 6-2 represents examples of these. Two plant Species of Special Concern (SSC) were recorded in wetland habitat (see Flora and Fauna Report, Digby Wells 2014), namely: *Boophone disticha* (Tumbleweed) and *Eucomis autumnalis* (Pineapple Flower).

Table 6-2: Plant species used as indicators of wetlands

Family	Species	Common Name	Description
Cyperaceae	*Cyperus esculentus*	Yellow Nut Sedge	Associated with streams of the valley bottom systems, this species is an indicator of seasonal wetland conditions.
	Cyperus longus	Waterbiesie	Associated with streams of the valley bottom systems, this species is an indicator of the permanent zone.
	Schoenoplectus corymbosus		This species was found on the edge of open water of the valley bottom systems.
Juncaceae	*Juncus effusus*	Soft Rush	This widespread species had colonised the ephemeral depression on site. *J. effusus* can be a native invader where overgrazing has taken place, as is the case at Weltevreden pan.
Poaceae	*Agrostis lachnantha*	Bent Grass	This facultative hydrophyte was found in hillslope seep wetlands, linked to the channel, in association with *Imperata cyclindrica.*
	Andropogon eucomus	Snowflake Grass	A facultative hydrophytic grass that is found in the temporary zone of wetlands associated with hillslope seeps linked to the channel.
	Andropogon huillensis	Large Silver Andropogon	*A. huillensis* grows in seasonal to permanent wetland zones and was found in hillslope seeps linked to the channel.
	Eragrostis gummiflua	Gum Grass	This facultative hydrophyte is found in disturbed areas of rocky grassland and also on the edges of wetlands.
	Imperata cylindrica	Cotton Wool	*I. cylindrica* is a characteristic

		Grass	feature of hillslope seeps and formed monospecific patches in isolated seeps on site. This grass turns a deep red during winter and is typically easy to distinguish from the dry Highveld grassland surrounds.
Typhaceae	*Typha capensis*	Common Bulrush	The most dominant bulrush in South Africa, this species is typical of the permanent wetland zone where shallow water is found throughout the year.

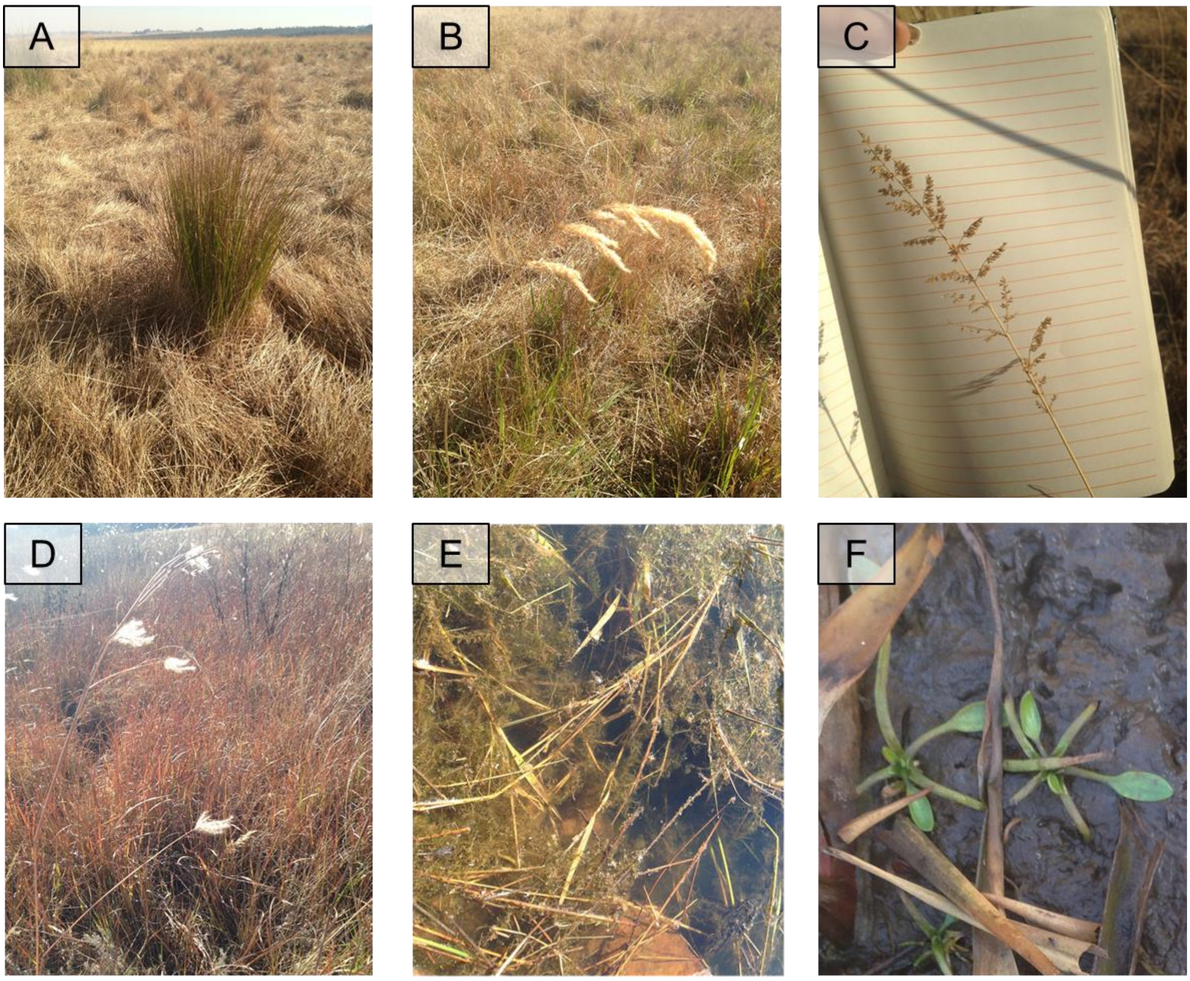


Figure 6-2: Vegetation indicators: A: *Juncus effusus* (Soft Rush); B: *Agrostis lachnantha* (Bent Grass); C: *Eragrostis gummiflua* (Gum Grass); D: *Andropogon huillensis* (Large Silver Andropogon); E: *Utricularia* sp. and F: *Limosella aricana* (Mudwort)).

6.1.2 Soil Indicator

Soil samples were taken (where possible) as transects across wetlands in order to determine boundaries. Soil forms that are characteristic of wetlands and were present in on site were: Dresden (Dr1), Longlands (Lo1), and Katspruit (Ka) (Digby Wells Soils Report, 2009). These soil types, as well as the E-horizon, are recognised by DWAF (2003) as wetland soils. With regard to soil wetness features, mottling and characteristic gleyed G horizon were used as indicators. Figure 6-3 shows examples of soils associated with wetlands on site.

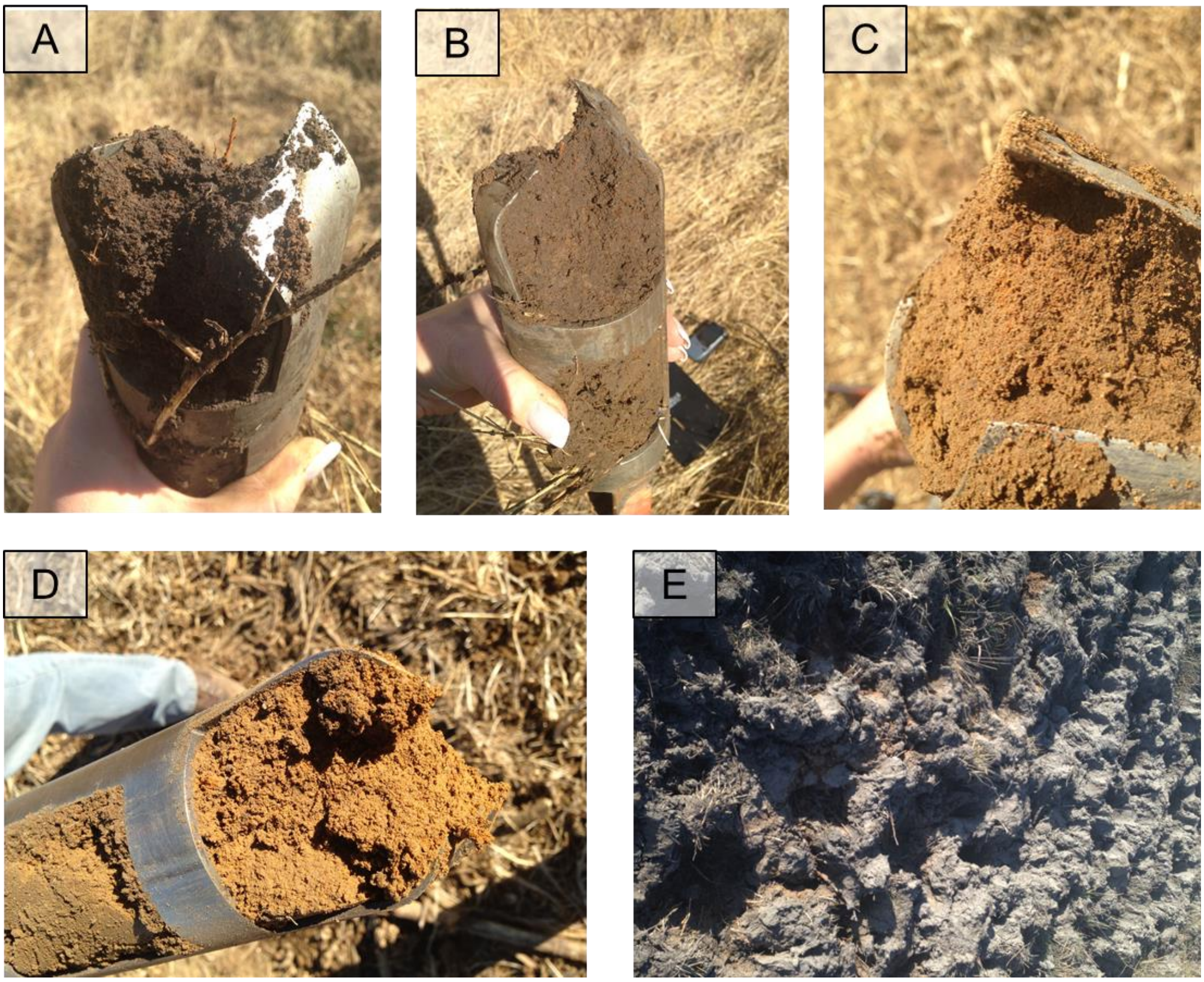


Figure 6-3: Soil indicators (A and B: soil mottling in the permanent zone of the Weltevreden Pan; C and D: E-horizon soil in the seasonal zone of the valley bottom system that is indicative of the seasonal wetland and E: characteristic gleying)

6.1.3 Terrain Indicator

As aforementioned, the landscape of the study area is studied on a desktop level prior to field investigation in order to determine potential wetlands on site. Aspects of elevation and slope are identified and later ground-truthed in the field. Isolated hillslope seeps and some pan / depression wetlands do not necessarily occur at the lowest point in the landscape and in such cases, soil and vegetation indicators are used to confirm their presence. Wetlands identified are classified into HGM units based on geomorphology and hydrology. Table 6-3 provides descriptions of the HGM units that are present on site.

Table 6-3: Descriptions of HGM units observed on site

Wetland HGM Unit	Descriptions
Pan /Depression	 Pans are shallow ephemeral systems and generally occur over shales and unconsolidated surficial sandstones in South Africa (Allan *et al.* 1995). Their formation is dependent on a number of factors, including climate, geological susceptibility, disturbance to the surface via animals, salt-weathering, a lack of integrated drainage systems and deflation processes (Goudie and Thomas 1985). They are inward draining systems and as a result, their catchment is regarded as sensitive. The Wetevreden pan was fed primarily by surface water and was characterised by a narrow catchment and an absence of seeps leading into it.

Valley bottom without a channel	 The valley bottom wetlands without channels are located at the lowest position in a landscape where the water drained from the local slopes accumulate. Water expressed in the hillslope seepage wetlands may also drain towards the valley bottom wetlands. These wetland systems play important functions such as sediment trapping, flood attenuation and nutrient-cycling. The valley bottom without a channel wetland on site receives extensive amounts of sediment and flow from the surrounding cultivated slopes. This allows an opportunity for contact between solute-laiden water and the wetland vegetation, thus providing an opportunity for flood and contaminant (nutrients, pesticides, herbicides) attenuation. Extensive areas of these wetlands remain saturated as stream channel input is spread diffusely across the valley bottom, even at low flows (Kotze *et al.,* 2007). These wetlands also tend to have a high organic content. Facultative wetland indicator plant species, comprising a mixture of grasses and sedges are evident as longitudinal bands within a relatively narrow zone along the valley bottoms. Facultative wetland plant species usually grow in wetlands (67-99% of occurrences) but occasionally are found in non-wetland areas. Lateral seep zones form part of the adjacent hillslope seepage wetlands, this is a characteristic for all the valley bottom wetlands. The primary drivers for these systems, owing to the shallow gradients along the valley bottoms are diffuse horizontal surface flow and interflow. There is generally a clear distinction in the transition in the vegetation structure between the mixed grass-sedge meadow zones that characterise these wetlands to the more intermittently wet grassland habitats associated with the adjacent hillslope seepage wetlands (Kotze *et al*., 2007).

Seepage wetland	 Seepage wetlands are usually associated with a perched groundwater table, where precipitation that occurs within the greater catchment is temporarily stored within the soil profile as a result of impervious strata in the soil profile. The impervious strata within the soil profile is normally made up of an unweathered parent material or swelling clays typically associated with granites, sandstones or shales. Hillslope seepage wetlands are expressed were the soil profile is shallow enough such that impervious layer and the water stored within the soil profile are expressed on the surface. The soils in the area must be waterlogged long enough for oxygen to be depleted through a chemical process of reduction which results in the presence of radoximorphic features in the soil. Hillslope seepage wetlands are created and maintained by infiltration processes that occur in the surrounding non-wetland areas within the catchment. Hillslope seepage wetlands connected to watercourses are wetland systems which are directly linked on the surface to watercourses. This type of system typically contributes to flow in the watercourses, even if this contribution is only on a seasonal basis. Hillslope seeps may be isolated (as frequently observed on the Weltevreden site) or linked to a stream channel or depression. Isolated hillslope seeps identified on site were colonised by *Imperata cylindrica* (Cottom Wool Grass).

6.2 Wetland Functionality

Extensive literature searches have revealed that very few practitioners have quantified the benefits of wetland functionality. In addition to this, it appears likely that the functions of the wetlands are variable depending on the characteristics of the wetlands and landscape.

The general features of the wetlands were assessed in terms of functioning and the overall importance of each hydrogeomorphic unit was then determined at a landscape level. The level of functioning supplied by each of the hydrogeomorphic units for various ecological services is presented in Table 6-4. The results from the “WET-EcoServices” tool are presented below in Figure 6-4.

HGM Units were rated according to the following scale:

- <0.5 Low
- 0.5-1.2 Moderately Low
- 1.3-2.0 Intermediate

- 2.1-2.8 High
- >2.8 Very High

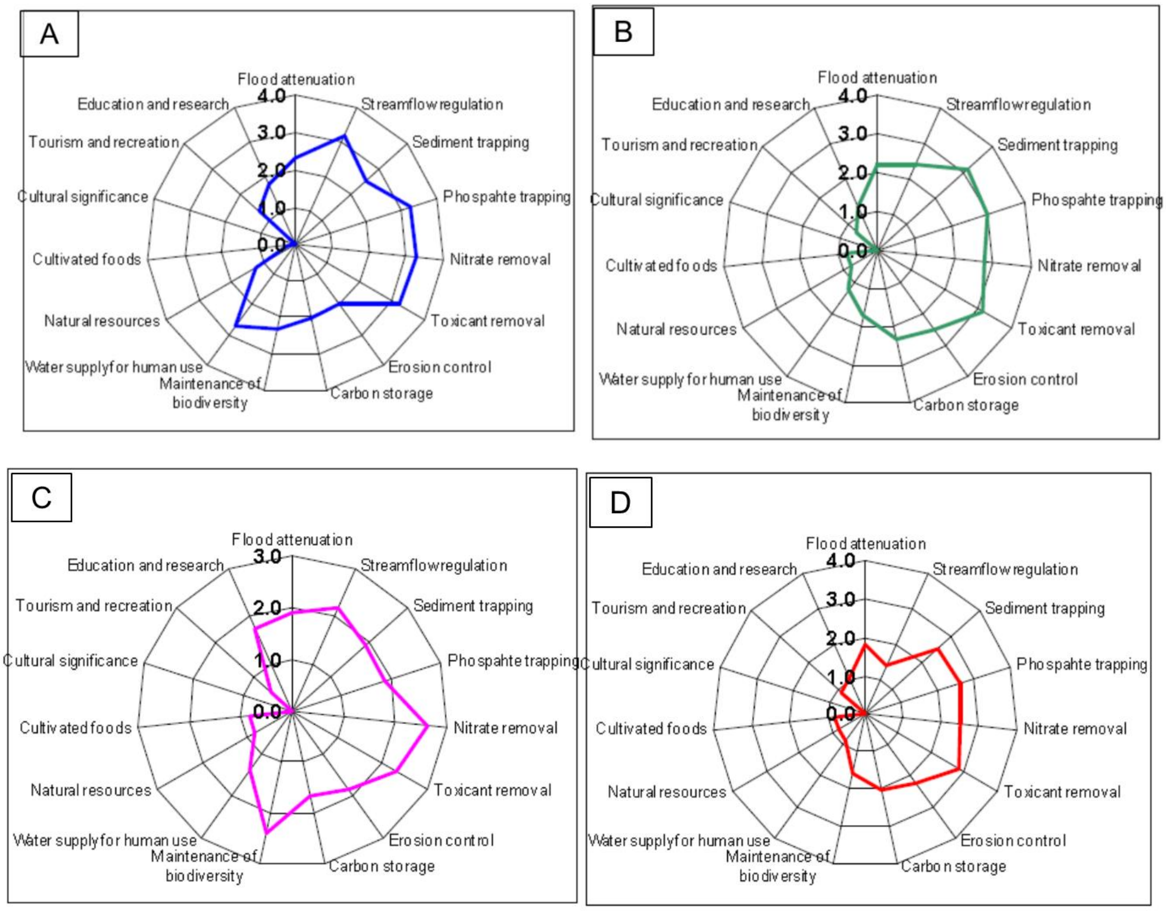
The hillslope seepage wetlands connected to the watercourse, isolated hillslope seepage wetlands and valley bottom wetlands scored moderately high for water quality enhancement; including sediment trapping, phosphate trapping, nutrient processing and toxicant removal. Water quality enhancement is regarded as the most significant eco-service provided by wetlands on site. It is important to consider the proximity of the agricultural land to the wetlands and the use of the wetlands by livestock. Additionally, the proposed mining activities may limit the quantity of water recharging the wetland areas as well as impact on the quality of available water, thus it may be assumed that the functioning of the wetland areas to offer services in terms of water quality improvement may become more important as mining operations progress.

As a result of the reduction in quantity of water recharging wetland areas, it may be assumed that certain wetland areas will be lost. Regardless of this, it is imperative that the loss of wetlands area is minimal so as to maintain the ecological services offered. The valley bottom wetlands receive water inputs from adjacent slopes via runoff and interflow from the hillslope seeps. Hillslope seeps receive water from groundwater sources through perched aquifers. As a result of the proposed opencast mining activities, there will be alterations in underground water dynamics, as well as the removal of surface drainage areas. This in turn will limit the quantity of water leading to the wetlands downstream. Pans receive water inputs from runoff from the surrounding catchment area and lateral seepage from adjacent hillslope seeps. As a result of this, it is highly recommended that wetlands downstream of the mining operation be recharged artificially.

Table 6-4: List and scoring of eco-services provided by HGM units on site

Summary Sheet	Valley bottom without a channel	Hillslope seep connected to pan	Hillslope seep connected to watercourse	Isolated hillslope seep	Pans
	Overall score	**Overall score**	**Overall score**	**Overall score**	**Overall score**
Flood attenuation	2.3	1.9	2.2	1.8	1.8
Stream – flow regulation	3.2	2.2	2.4	1.4	2.0
Sediment trapping	2.5	1.9	3.1	2.5	1.9
Phosphate trapping	3.2	1.9	3.0	2.5	2.6
Nitrate removal	3.3	2.6	2.8	2.5	2.6
Toxicant removal	3.2	2.3	3.1	2.8	2.3

Erosion control	2.0	1.8	2.5	2.2	0.8
Carbon storage	2.0	1.7	2.3	2.0	1.3
Maintenance of biodiversity	2.3	2.4	1.7	1.6	2.7
Water supply for human use	2.7	1.4	1.2	0.9	2.0
Natural Resources	1.2	0.8	0.8	0.8	1.0
Cultivated foods	0.2	0.8	0.8	0.8	0.2
Cultural significance	0.0	0.0	0.0	0.0	0.0
Tourism and recreation	1.3	0.6	0.7	0.9	1.1
Education and research	1.8	1.8	1.3	1.0	1.8



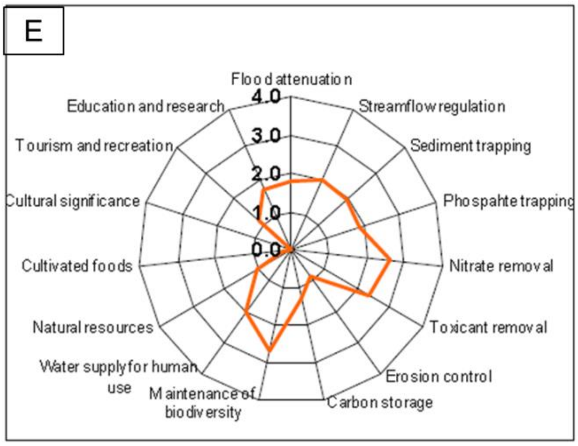


Figure 6-4: Radial plots of Eco-services provided by wetlands on site (A: valley bottom without a channel; B: hillslope seep connected to the watercourse; C: hillslope seep connected to a pan; D: isolated hillslope seep and E: pan / depression)

6.3 Wetland Present Ecological State (PES)

All of the wetlands within the study area have been modified to some extent with 76.3% of the wetlands being moderately modified (PES C) and 23.7% regarded as largely modified (PES D). Figure 6-5 represents examples of impacts on wetlands on site.

The general features of the identified wetland units within the project were assessed in terms of impacts on the integrity of these systems. The identified impacts are associated with activities such as livestock farming, crop cultivation (Maize) and damming. Damming is regarded as the major impact on site. Some of the impacts identified within the project area during the site investigations include:

- **Overgrazing and trampling by livestock:** This was particularly observed in the pan, where paths had forms due to livestock trampling. Further to this, *Juncus effusus* had become dominant as other species present had been overgrazed. Trampling of vegetation results in a decrease in surface roughness; which in turn increases the rate of infiltration and can also promote erosional processes;
- **Eutrophication from the use of pesticides and fertilisers:** Evidence of this was observed in valley bottom wetlands; where colonies of *Utricularia* sp. had begun to form dense mats. Although the current scenario is not regarded as a major impact, mat-forming water plants may establish if the nutrient load of the wetlands increases and owing to the exponential growth habits of these plants, flow may be impeded;
- **Damming:** 5.44% of valley bottom wetlands on site were made up of dams. The result is shortening and diversion of natural channels as well as the trapping of sediment. Sediment trapped in dams is critical for the maintenance of habitats and physical processes downstream. Furthermore, when the sediment load downstream is not replenished, erosional processes are promoted and the stream or river may

become deeply incised. Damming may also hamper the transfer of genetic material through streams and rivers in the form of fish and invertebrates and

- **Local farm roads crossing wetlands:** This causes compaction of sediments which hampers water flow through the wetlands.

Figure 6-5 represents examples of impacts on hydrology, geomorphology and vegetation.

Figure 6-5: Examples of current impacts on wetlands on site (A: damming across a channel; B: alien bushclumps in the catchment of a valley bottom wetland and C: cattle path through an overgrazed pan)

6.4 Wetland Ecological Importance and Sensitivity (EIS)

The highest ecological importance and sensitivity scores (rated as C – moderate) are associated with approximately 60% of the wetlands within the study area. These have the highest EIS scores predominantly as a result of their functioning to retain water and support adjacent wetland areas through interflow seepage. These wetland areas are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetland areas are not usually sensitive to flow and habitat modifications and in addition to this, these wetland areas play a small role in moderating the quantity and quality of water of major rivers. Approximately 40% of all the wetlands within the study area have been rated low to marginal (rated as D) and these areas are no longer ecologically important and sensitive at any scale. The reason being, these areas are currently being disturbed and functioning altered through agricultural practices as well as with the destruction of wetland areas by road and drainage channel construction.

Figure 6-6 represents both the PES and EIS of the identified wetlands on site.

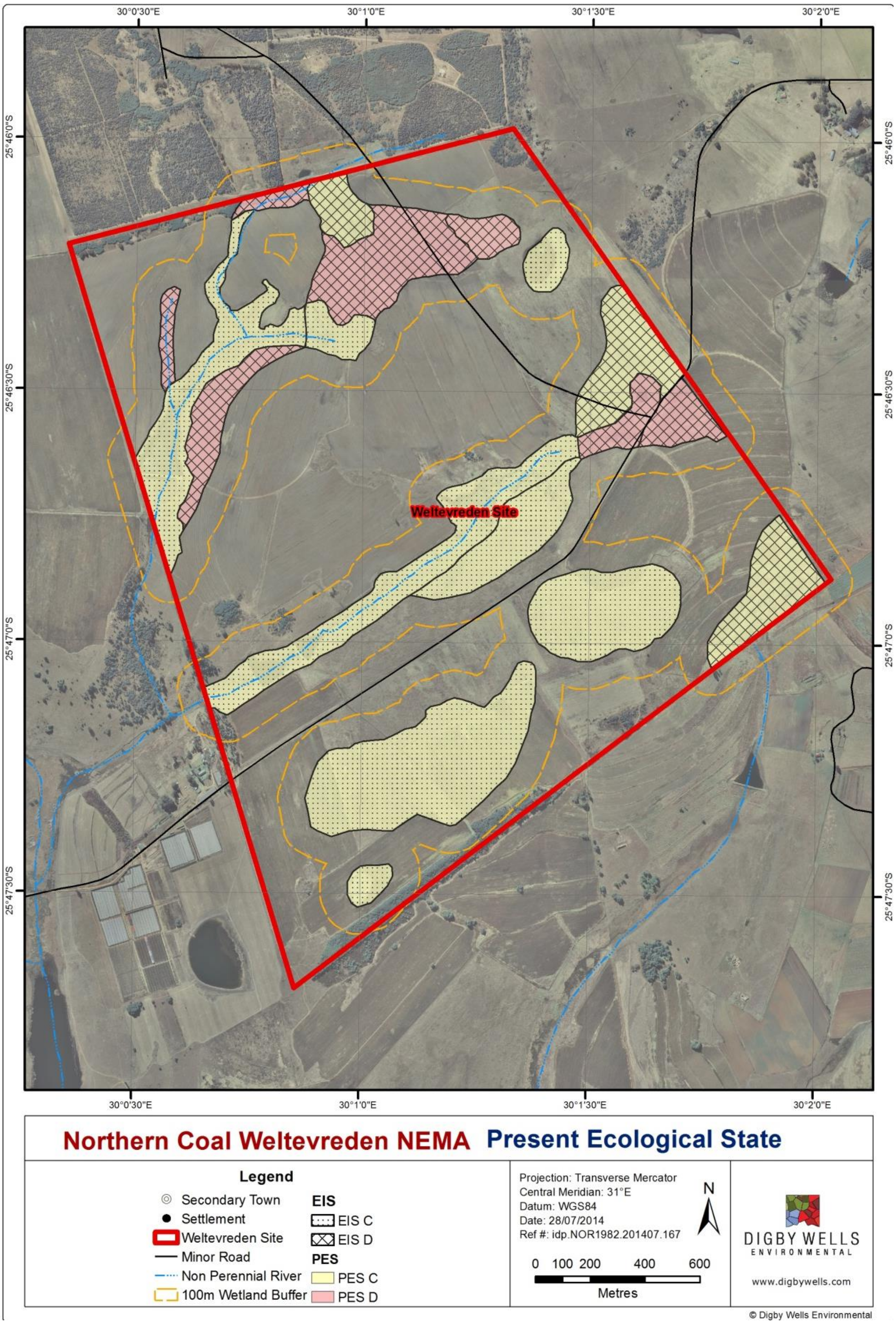


Figure 6-6: Present Ecological State and Ecological Importance and Sensitivity

7 Impacts Assessment

As aforementioned in Section 5.6, the impacts of the proposed opencast mine will be assessed using a standard rating table. The general approach for impacts assessment is to adhere to the mitigation hierarchy, as represented in Figure 7-1. The aim is to strive to avoid damage or loss of ecosystems and services that they provide and where they cannot be avoided, to reduce and mitigate impacts (DEA, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. Developments related to the proposed opencast mine to consider for the impacts assessment include: opencast pits, Pollution Control Dams (PCD's), diesel storage tank, coal stockpile, haul road and additional mining infrastructure.

MITIGATION HIERACHY		
	Avoid or prevent	Refers to considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option, but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the latter steps in the mitigation.
	Minimise	Refers to considering alternatives in the project location, sitting, scale, layout, technology and phasing that would minimize impacts on biodiversity and ecosystem services. In cases where there are environmental constraints, every effort should be made to minimize impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure. Although rehabilitation may fall short of replicating the diversity and complexity of natural systems.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative effects on biodiversity after every effort has been made to minimise and then rehabilitate impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Figure 7-1: Mitigation hierarchy

The proposed mine plan, as represented will result in loss of 57.51 ha of wetland habitat, primarily of hillslope seeps. The pan / depression wetland and the 100m buffer around it have been excluded from the mine plan in order to avoid impacts on this wetland. Impacts on the valley bottom wetland have been avoided as far as possible but seeps leading to the wetland will be lost.

Figure 7-2 represents the area of wetland that coincides with the proposed opencast pits.

Table 7-1: Area of wetland anticipated to be lost to the proposed opencast mine

HGM unit	Areas anticipated to be lost (ha)
Hillslope seepage connected to water course	34.71
Isolated hillslope seepage	22.56
Valley bottom without a channel	0.24
Total	**57.51**

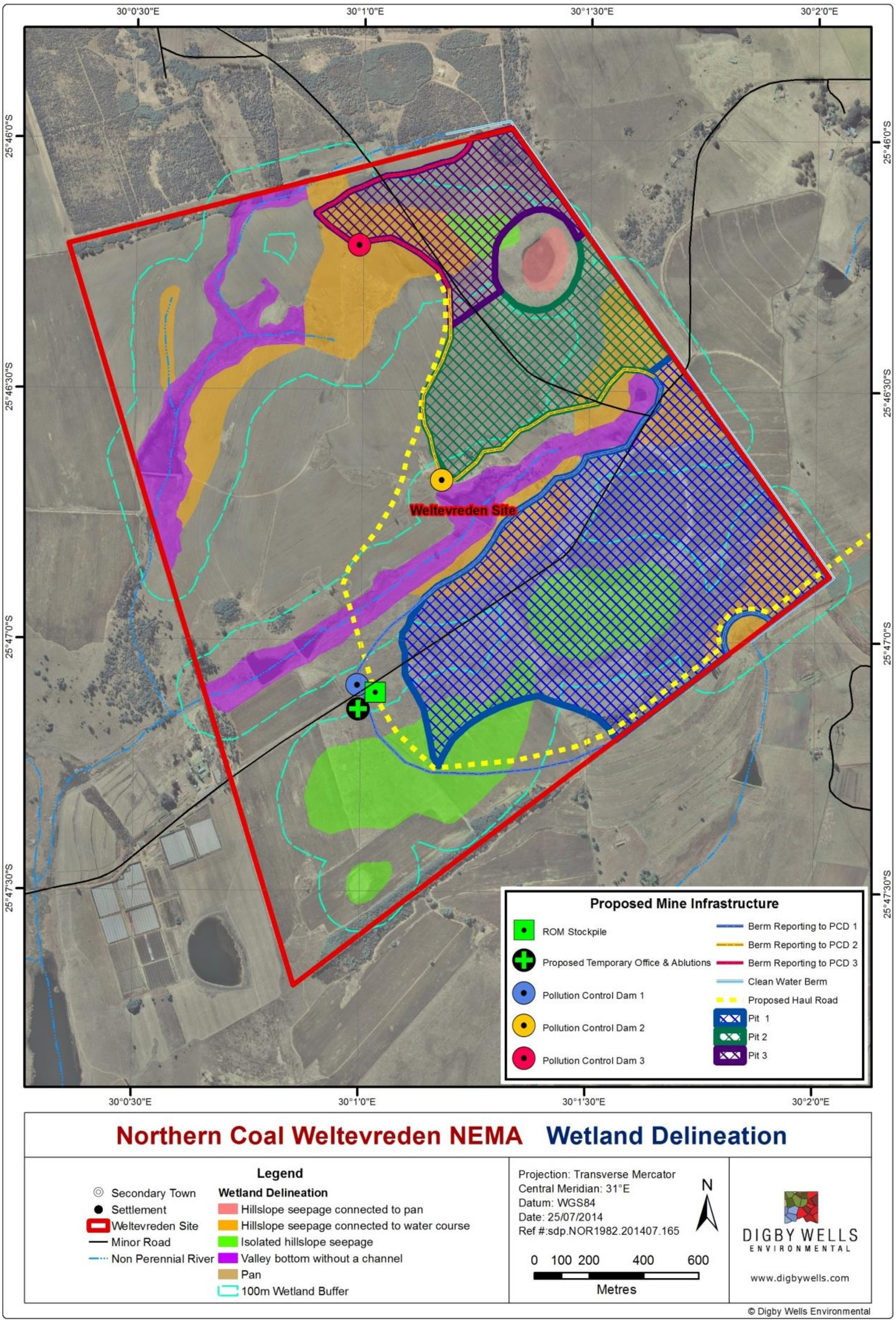


Figure 7-2: Impacts Assessment

7.1 Issue 1: Loss of wetland area

A loss of hillslope seep wetland, leading to the valley bottom system is expected due to opencast mining. Owing to the fact that the valley bottom systems are fed via groundwater linkages, as well as surface water, the loss of aquifer-driven hillslope seeps will impact on hydrology of these wetlands. The following impacts are expected to result from the direct loss of wetland areas:

- Impact 1: Loss of hillslope seeps
- Impact 2: Loss of valley bottom systems

7.1.1 Impact 1 - Loss of hillslope seeps

Loss of seeps leading to wetlands, as aforementioned, will result in a loss of a water input into valley bottom wetlands. As a consequence the valley bottom wetlands may reduce in area. Although wetlands on site are regarded to be in a poor ecological condition, the loss of these systems will remove the potential for any opportunities to improve their ecological status at all.

Loss of wetlands will also reduce the area available for waterbirds that may utilise wetlands, such as Grey Heron (*Ardea cinerea)* and Purple Heron (*Ardea purpurea)* (See Flora and Fauna Report, Digby Wells 2014) as well as other wetland-dependant fauna such as amphibians. Clearing of vegetation will result in loss of wetland plants and potentially SSC.

The proposed haul road and mining infrastructure currently transects the hillslope seepage area to the south of the study area. The opencast mining operations will cause an interruption to both ground and surface water dynamics and so it may be assumed that this isolated hillslope seepage wetland to the south of the opencast mining area will be lost. In spite of hillslope seepage areas normally being associated with groundwater discharges, flow through may be supplemented by surface water contributions. In addition to this, these units contribute to some surface flow attenuation. As a result of this, any unnecessary destruction of the wetland area to the south of the mining activities should be avoided as these wetlands still provide ecological functions such as water quality enhancement.

7.1.2 Impact 2 - Loss of Valley Bottom Wetlands

Only 0.24 ha of valley bottom wetland is anticipated to be lost. The impacts on hydrology and geomorphology are regarded as minimal.

Proposed Mitigation

There is no mitigation for loss of wetland habitat. It is highly recommended that the 100m buffer be implemented for all wetland areas in order to reduce the potential impact.

Issue 1	**Loss of habitat**				
Parameters	***Severity***	***Spatial scale***	***Duration***	***Probability***	***Significance***
Impact 1	**Loss of hillslope seeps**				
Pre- Mitigation	Serious (4)	Local (3)	Permanent (6)	Certain (7)	Medium-High (80)
Post-Mitigation	No mitigation				
Impact 2	**Loss of valley bottom wetlands**				
Pre-Mitigation	Minor (2)	Local (3)	Permanent (6)	Highly Probable (6)	Medium – Low (66)
Post-Mitigation	No Mitigation				

7.2 Issue 2: Loss of wetland integrity and functionality

Although wetlands on site are not in a pristine condition, their ecological integrity and functionality should be preserved and, if possible, improved. Failure to responsibly manage polluted water and potentially hazardous substances on site will result in contamination of water resources. Global research has place much focus on the treatment of water that has been polluted by hydrocarbons and heavy metals related to mining (Wang et al. 2011) by using technologies such as bioremediation and phytoremediation to remove contaminants.

The following impacts on wetland integrity and functionality are expected to occur:

7.2.1 Impact 3: Chemical contamination of surface water

Contamination of wetland areas with waste water from the coal mine area will result in the loss of biodiversity, especially of very sensitive species. The severity of the loss of biodiversity as a result of water contamination is regarded as significant due to the cumulative loss of wetland areas and the associated biodiversity within the region. The potential of the impact being imposed onto the system as a result of the operation of the mine is likely.

Proposed Mitigation

The mine should implement measures to separate contaminated mine water from clean rain water to ensure that the contaminated water is contained and does not spill into the surrounding wetland areas therefore impacting on their integrity.

The establishment of vegetated buffer strips must be constructed to function as a protective barrier between the dirty water containment structures and the delineated wetland areas in order to protect the integrity of wetlands. The vegetated buffer strips will function as filters that intercept overland spill overs, trap sediments and other contaminants, reduce overland flow velocities thus enhancing sedimentation and infiltration. In addition, the overflow of contaminated water into the surrounding wetland areas should be prevented at all costs.

Diesel storage tanks should be bunded and or placed in sunken catchpits with bunded area adequately lined and covered with loose sand that is large enough to contain a significant spill, should it occur. Any possible spillage must be returned to the source via vertical pumps. In the unlikely event of any spillages outside bunded areas, as well as contaminated storm-water, flow to an emergency storage dam, for recycling back into the process. Furthermore, all bunded areas must be designed to contain a minimum of 150% of any tank volume inside its perimeter, in case of a failure of such a tank. Additionally, it is recommended that the placement of the tank be in the same area suggested for the mining infrastructure.

Impact 2	**Loss of wetland integrity and functionality**				
Parameters	***Severity***	***Spatial scale***	***Duration***	***Probability***	***Significance***
Issue 3	**Chemical contamination of surface water**				
Pre- Mitigation	Very significant (7)	Local (3)	Permanent (7)	Certain (7)	Medium-High (110)
Post-Mitigation	Minor (2)	Local (3)	Immediate (1)	Unlikely (3)	Low (15)

7.3 Cumulative Impacts

Due to the inappropriate management of water resources in the Komati River catchment, the PES has been moderately modified. A major anticipated impact on the greater wetland catchment is water contamination from mining activities. It is imperative that water contamination is avoided at all costs, in valley bottom systems specifically; as these link up to the greater stream network and may cause further degradation to the catchment. Misuse of water resources due to mining has been observed in the Olifants catchment, where water quality has undergone severe degradation.

The cumulative impact of the proposed opencast mine is regarded as moderate, as the study area is not regarded as particularly significant from an ecological perspective. Owing to a history or poor land management, the natural habitat on site has been transformed.

7.4 Impact mitigation hierarchy

The mitigation hierarchy process has been considered for this project and the details pertaining to the relevant sections and the associated recommendations are presented in Table 7-2.

Table 7-2: The details pertaining to the mitigation hierarchy for the project

Stage	Description
Avoid	When possible wetland areas have been avoided. This processes resulted in the mine plan being altered so that selected wetland areas can be avoided. Areas that were allocated a poor EIS or PES score were included into the mine plan, with more sensitive areas being excluded. In addition to this, where possible existing infrastructure such as roads have been included into the mine design and selected infrastructure such as the PCDs and site offices have also been placed outside of the wetland areas.
Minimise	Realistically there is no mitigation for the mining (opencast) of wetlands, these impacts would have to be offset. Where impacts could be minimised, mitigation measures have been prescribed.
Rehabilitate	No formal rehabilitation plan has been included for this specialist study. Details pertaining to site rehabilitation will be included in the Rehabilitation Plan for the mine.
Offset	No formal offset strategy has been formulated for the project. It is recommended that the impacts to the wetland areas be offset by managing and enhancing the ecological state and services being offered by the remaining wetland areas within the project area.

8 Discussion

The Weltevreden study area is located within the quaternary catchment X11D; which is the Komati River catchment. The major watercourse impacted upon is the Klein Komati River and the quaternary catchment has been assigned a PES of C – moderately modified. Three wetland units have been identified by NFEPA, namely the Weltevreden Pan and two isolated seep; which have been allocated ranks 2, 2, and 6 respectively. Further to this, no necessary or irreplaceable areas were identified, according to the Mpumalanga C-Plan, in order to meet their objectives.

Wetlands on site make up a total area of 160.3 ha, which is largely attributable to extensive hillslope seep area. HGM units on site were comprised of: valley bottom without a channel, a single pan / depression and hillslope seeps (either linked to channels, pans or were isolated).

Agricultural practices such as overgrazing and trampling, pasture conversions, damming and crop planting in wet areas are largely responsible for the current impacts on the biodiversity and water quality of the wetlands in the study area. While it is evident from the study that these impacts have affected the ecological state of the wetlands, in addition to this, impacts such as road and drainage channel construction and damming have seriously affected the underlying hydrology (key driver) supporting the wetland areas. All of the wetlands within the study area have been modified to some extent with 76.3% of the wetlands being moderately modified (PES C) and 23.7% regarded as largely modified (PES D). The Weltevreden Pan was allocated a PES of C (moderately modified).

The primary ecological service provided for by the wetland areas is the enhancement of water quality. The specific services offered for each wetland unit according to Kotze *et al.* (2007) are presented in Table 6-4.

The major impact anticipated from the proposed activity is direct loss of wetlands, particularly hillslope seeps that lead to channels.

The cumulative impacts of the proposed development should be considered, owing to large-scale mining development in the Mpumalanga Province. If valley bottom wetlands are avoided, the cumulative impact is regarded as moderate. Further to this, the mitigation hierarchy should be adhered to and efforts should be made to avoid and reduce impacts to wetlands on site.

9 Recommendations

- It is recommended that direct impacts to the wetland areas be restricted to the opencast area. Additionally, the functioning of the wetland areas should be artificially created so as to ensure the survival of the remaining wetland areas as well as their ability to offer ecological services in the way of water quality enhancement continues. Mitigation measures for the proposed mining activities are discussed below.

- DWAF has guidelines for drinking and live-stock watering water qualities as well for aquatic ecosystems which should be incorporated into catchment management strategies. It is recommended that water quality monitoring guidelines be included, which will be water quality requirements to maintain sustainable ecological functioning in the river/wetland. Surface water quality will become a greater issue because of the proposed opencast mining. Issues such as storm water runoff carrying coal particles into natural streams, dust from opencast mines settling in wetlands and rivers, increased total dissolved solids, increased pH and increased electrical conductivity all impact on wetland functioning by disturbing natural sediments in wetlands and directly impacting and faunal and floral organisms critical to proper wetland functioning.
- In order to minimize the impact of excessive sedimentation to the wetland areas it is recommended that earth piles be vegetated and gabions used in areas of high runoff potential to trap lose sediment. Additionally it is recommended to construct berms, approximately 1.0m – 1.5m high for the length of area between the opencast workings/soil stock piles and the wetland areas. The purpose of these berms would be to intercept flows containing suspended soils and create a depositional environment, inhibiting sediment introduction into the downslope wetland areas. It is also recommended that current agricultural fields on the periphery of the opencast area be rehabilitated to natural grasslands. This will minimise areas where lose sediment is available a result of the agricultural practices and in addition create areas which will contribute to erosion control and sediment trapping required for the mining activities.
- The coal should be stored and carefully managed to minimise dust emissions, water can be sprayed onto them, so that wind doesn't blow particles of coal onto adjacent systems and/or neighboring properties. An optional mitigation measures to prevent the remote possibility of groundwater contamination is with the installation of an impermeable liner under the stockpiles as a contingency against the possibility that coal from untested portions of the mine could contaminate water to a greater degree than the existing tests indicate. A detrimental effect of such a measure is the volume of contaminated surface runoff collected by the drainage systems. The use of impermeable liners is technically feasible but would represent substantial and possibly, unnecessary expense. It is situated above an already disturbed area and this disturbed area can be rehabilitated to minimize runoff from the stockpile into the surrounding landscape. This can be achieved through vegetating the area and/or the use of gabions as well as berms.
- Formulate a wetland offset strategy for the wetland areas which will be mined. This strategy could place emphasis on the management and enhancement of the ecological services and overall state of the wetland areas within the project boundary area,.

10 Conclusions

It can be concluded that the findings from this wetland assessment show that no change in wetland area, PES, EIS or ecological services has taken place since the initial surveys took place for the report submitted in 2008 and that the former findings have been confirmed.

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Appendix A: CV's of the Specialists

Ms Crystal Rowe

Flora and Fauna Ecologist and Wetland Specialist

Biophysical Department

Digby Wells Environmental

EDUCATION

2011: BSc Honours (Botany) – Nelson Mandela Metropolitan University

2008-2001: Undergraduate BSc – Nelson Mandela Metropolitan University

EMPLOYMENT

June 2013 – Present: Digby Wells Environmental

December 2011 – June 2013: Natural Scientific Services CC

EXPERIENCE

June 2013 – Present: Digby Wells Environmental

Crystal was appointed by Digby Wells Environmental chiefly as a Flora and Fauna Ecologist but also to assist in conducting wetland assessment studies. Crystal's flora background aids in her understanding on wetlands from a floral perspective. The wetland assessment studies include in particular the delineation of wetland boundaries, classification of wetland units according to the HGM Classification System, integrity description of the identified wetland units, functional assessment of the identified wetland units and subsequent compilation of management recommendations mitigation against the impacts. In addition, Crystal has also completed a course in Tools for Wetland Assessments at Rhodes University (2011).

December 2011 – June 2013: Natural Scientific Services CC

Field work and report compilation for Biodiversity Baseline Assessments, Wetland Assessments (WA) and Impact Assessments (IA).

PROJECT EXPERIENCE

Wetland Assessments

- Wetland assessments throughout South Africa
- Wetland studies in Northern Mozambique, and;
- Wetland studies in Sierra Leone.

Mr. Andrew Husted

Operations Manager

United Kingdom: Office Manager

Digby Wells Environmental

Education

2006 – 2007: BSc Masters in Aquatic Health – University of Johannesburg (UJ)

2005 – 2006: BSc Hons. Zoology – Aquatic Health – Rand Afrikaans University (RAU)

2005 – 2003: BSc Natural Science – Zoology & Botany (RAU)

Professional Registration

South African Council for Natural Scientific Professions (Membership No. 400213/11)

Accredited: South African Scoring System version 5 (SASS5)

Employment

August 2007 – Present: Digby Wells Environmental

January 2006 – June 2007: Econ@UJ, as an aquatic ecologist

Experience

Andrew is currently in the role of Operations Manager for the London office. This is a new endeavour to establish and develop a sustainable office as the company's global footprint continues to grow. The primary responsibilities for the role include client liaison, project management, staff management and office management.

He has been tasked with managing projects on local and international levels. This has included the management of specialist studies which have either contributed to a larger study or have been required for a strategic assessment. In addition to this, Andrew has managed large scale mining projects on an international level.

His experience has included managing a multi-disciplinary department of scientists providing specialist services in support of national and international requirements as well as best practice guidelines, primarily focussing on the mining sector. In addition to managing the department, Andrew was also expected to provide specialist technical input, most notably focusing on water resource management. Information pertaining to the technical expertise of Andrew include the following:

- Aquatic ecological state assessments of rivers and dams;
- Instream Flow Requirement or Ecological Water Requirement studies for river systems;
- Ecological wetland assessment studies, including the integrity (health) and functioning of the wetland systems;

- Wetland offset strategy designs;
- Wetland rehabilitation plans;
- Monitoring plans for rivers and other wetland systems;
- Toxicity and metal analysis of water, sediment and biota.
- Fish telemetry assessment which included the translocation of fish as well as the monitoring of fish in order to determine the suitability of the hosting system.

Training

- Wetland and Riparian Delineation Course for Consultants (Certificate of Competence) – DWAF 2008
- The threats and impacts posed on wetlands by infrastructure and development: Mitigation and rehabilitation thereof – Gauteng Wetland Forum 2010
- Ecological State Assessment of Lentic Systems using Fish Population Dynamics – University of Johannesburg/Rivers of Life 2010
- Soil Classification and Wetland Delineation – Terra Soil Science 2010
- Wetland Rehabilitation Methods and Techniques - Gauteng Wetland Forum 2011
- Application of the Fish Response Assessment Index (FRAI) and Macroinvertebrate Response Assessment Index (MIRAI) for the River Health Programme 2011
- Tools for a Wetland Assessment (Certificate of Competence) – Rhodes University 2011

Publications

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Appendix B: Wetland Delineation Methodology

Wetland delineation

In accordance with the definition of a wetland in the National Water Act (NWA), vegetation is the primary indicator of a wetland, which must be present under normal circumstances. However, the soil wetness indicator tends to be the most important in practices. The remaining three indicators are then used in a confirmatory role. The reason for this is that the response of vegetation to changes in the soil moisture regime or management are relatively quick and may be transformed, whereas the morphological indicators in the soil are significantly more permanent and will hold the indications of frequent and prolonged saturation long after a wetland has been drained (perhaps several centuries) (DWAF, 2005). In accordance with DWAF guidelines (2005) the wetland delineation procedure considers four attributes to determine the limitations of the wetland. The four attributes are:

Terrain Unit Indicator

Terrain Unit Indicator (TUI) areas include depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of topographical maps, aerial photographs and engineering and town planning diagrams (these are most often used as they offer the highest degree of detail needed to accurately delineate the various zones of the wetland) (DWAF, 2005).

Soil Form Indicator

Hydomorphic soils are taken into account for the Soil Form Indicator (SFI) which will display unique characteristics resulting from prolonged and repeated water saturation (DWAF, 2005). The continued saturation of the soils results in the soils becoming anaerobic and thus resulting in a change of the chemical characteristics of the soil. Iron and manganese are two soil components which are insoluble under aerobic conditions and become soluble when the soil becomes anaerobic and thus begin to leach out into the soil profile. Iron is one of the most abundant elements in soils and is responsible for the red and brown colours of many soils. Resulting from the prolonged anaerobic conditions, iron is dissolved out of the soil, and the soil matrix is left a greying, greenish or bluish colour, and is said to be “gleyed”. Common in wetlands which are seasonally or temporarily saturated is a fluctuating water table, these results in alternation between aerobic and anaerobic conditions in the soil (DWAF, 2005). Iron will return to an insoluble state in aerobic conditions which will result in deposits in the form of patches or mottles within the soil. Recurrence of this cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Thus, soil that is gleyed and has many mottles may be interpreted as indicating a zone that is seasonally of temporarily saturated (DWAF, 2005).

Soil Wetness Indicator

In practice, the Soil Wetness Indictor (SWI) is used as the primary indicator (DWAF, 2005). Hydromorphic soils are often identified by the colours of various soil components. The frequency and duration of the soil saturation periods strongly influences the colours of these components. Grey colours become more prominent in the soil matrix the higher the duration and frequency of saturation in a soil profile (DWAF, 2005). A feature of hydromorphic soils are coloured mottles which are usually absent in permanently saturated soils and are most prominent in seasonally saturated soils, and are less abundant in temporarily saturated soils (DWAF, 2005). In order for a soil horizon to qualify as having signs of wetness in the temporary, seasonal or permanent zones, a grey soil matrix and/or mottles must be present.

Vegetation Indicator

If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (DWAF, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineated wetland areas. In this assessment the SWI has been relied upon to delineated wetland areas in addition, the identification of indicator vegetation species and the use of plant community structures has been used to validate these boundaries. As one moves along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas plant communities undergo distinct changes in species composition. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (DWAF, 2005).

The health of wetlands

Table B-11-1: Health categories used by WET-Health for describing the integrity of wetlands

i) Description	ii) Score	iii) Category
iv) Unmodified, natural	v) 0 – 1	vi) A
vii) *Largely natural* with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	viii) 1.1 – 2	ix) B
x) *Moderately modified.* A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	xi) 2.1 – 4	xii) C
xiii) *Largely modified.* A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	xiv) 4.1 - 6	xv) D
xvi) The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	xvii) 6.1 – 8	xviii) E
xix) Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	xx) 8.1 – 10	xxi) F