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Environmental Impact Assessment for the Proposed Temo Coal Rail Loop, Road Diversion and Pipeline Project, near Lephalale, Limpopo Province

Aquatic and Wetland Specialist Report

Project Number:

NAM5335

Prepared for:

Temo Coal (Pty) Ltd

March 2019

Digby Wells and Associates (South Africa) (Pty) Ltd
Co. Reg. No. 2010/008577/07. Turnberry Office Park, 48 Grosvenor Road, Bryanston, 2191. Private Bag X10046, Randburg, 2125, South Africa
Tel: +27 11 789 9495, Fax: +27 11 069 6801, info@digbywells.com, www.digbywells.com

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Report Type:	**Aquatic and Wetland Specialist Report**
Project Name:	**Environmental Impact Assessment for the Proposed Temo Coal Rail Loop, Road Diversion and Pipeline Project, near Lephalale, Limpopo Province**
Project Code:	**NAM5335**

Name	**Responsibility**	**Signature**	**Date**
Manisha Nana	Report Writer		February 2019
Kathryn Roy	Wetland Specialist and Report Writer		March 2019
Byron Bester Pr.Sci.Nat.	Aquatic Specialist and Report Writer		March 2019
Kieren Bremner Pr.Sci.Nat.	Report Reviewer		March 2019

DECLARATION OF INDEPENDENCE

Digby Wells and Associates (South Africa) (Pty) Ltd

Contact person: Kieren Bremner

Digby Wells House	Cell: +27 72 262 4325
Turnberry Office Park	Tel: +27 11 789 9495
48 Grosvenor Road	Fax: +27 11 789 9498
Bryanston	E-mail: kieren.bremner@digbywells.com
2191	

I, Kieren Bremner, as duly authorised representative of Digby Wells and Associates (South Africa) (Pty) Ltd., hereby confirm my independence (as well as that of Digby Wells and Associates (South Africa) (Pty) Ltd.) and declare that neither I nor Digby Wells and Associates (South Africa) (Pty) Ltd. have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of Temo Coal (Pty) Ltd., other than fair remuneration for work performed, specifically in connection with the Environmental Authorisation Application for the proposed infrastructure (including a bulk water pipeline, a rail loop and a road diversion within the approved Mining Right Area) ancillary to the approved mine near Lephalale in the Limpopo Province.

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KJ Bremner

Full name:	Kieren Jayne Bremner
Title/ Position:	Aquatic and Wetland Ecologist
Qualification(s):	MSc Aquatic Health
Experience (years):	11
Registration(s):	South African Council for Natural Scientific Professionals: *Professional Natural Scientist* (Reg. No. 119341)

Specialist Backgrounds:

Kathryn Roy is Flora and Wetland Consultant at Digby Wells Environmental. She received a Bachelor of Science in Ecology and Environmental Science and an Honours degree in Environmental Management from the University of Cape Town. She also has received her MSc in Restoration Ecology through the University of KwaZulu-Natal. She joined Digby Wells in February 2016 to form part of the Mine Closure and Rehabilitation Department where she was responsible for development of site specific rehabilitation plans, working closely with both the botany and soils specialists in Digby Wells. Her previous experience was gained in the Restoration Ecology Branch at the eThekwini Municipality in Durban.

Byron Bester is the Aquatic Ecology Manager at Digby Wells Environmental. He has a broad knowledge of various aspects of aquatic ecosystem assessment throughout South Africa and abroad, including water quality assessment, sediment composition, histopathological fish health assessments and human health risk assessments. He has completed numerous specialist aquatic biodiversity assessments in a wide range of sectors, including mining, industrial, transport infrastructure upgrades, services infrastructure, as well as mixed-use, residential and commercial developments.

Byron is registered by the South African River Health Programme (SA RHP) as an accredited aquatic biomonitoring specialist and by the South African Council for Natural Scientific Professionals as a Professional Natural Scientist (Reg. No.400662/15).

Kieren Jayne Bremner is the Wetlands Manager at Digby Wells Environmental. She has eleven years of environmental consulting experience, where she has been exposed to various sectors of the Environmental Management field, including water use licensing, BAs, EIAs and public participation. She has also had the opportunity to initiate and manage various aquatic biomonitoring programmes and focused largely on wetland and aquatic specialist assessments within the mining and energy production sectors within South Africa.

Kieren is registered by the South African River Health Programme (SA RHP) as an accredited aquatic biomonitoring specialist and by the South African Council for Natural Scientific Professionals as a Professional Natural Scientist (Reg. No. 119341).

EXECUTIVE SUMMARY

Digby Wells Environmental was commissioned by Temo Coal Mining (Pty) Ltd to conduct the aquatic and wetlands specialist studies to inform the Environmental Impact Assessment process being conducted for the proposed development of a road diversion, rail loop and pipeline for the Temo Coal Mine located in Limpopo Province. A total of 49 watercourses (inclusive of the Sandloop River and two artificial systems) were identified in the vicinity of the project area, which are classified predominantly as depression (pan) wetlands. These wetland and aquatic features cover an area of approximately 322.7 hectares. Due to the large number of pans, these were grouped according to the type of impact for assessment purposes.

Present Ecological State

Present Ecological State (PES) scores range from Category A (*Natural*) to Category D (*Largely modified*).

The pans that have been categorised as Category A (*Natural*) have no visible impacts, aside from trampling associated with grazing activities. This may likely be attributed to general access restrictions on farms or game reserves in the vicinity of the proposed project activities.

The main impacts associated with the pans categorised as Category B (*Largely natural*) included erosion, impacts related to grazing activities and encroachment by *Dichrostachys cinerea* and *Senegalia mellifera.* The hydrology of these systems remained unaffected.

The PES values of pans classified as Category C (*Moderately modified*) were affected by the presence of roads, high levels of erosion, and water abstraction, which impacts the hydrology, geomorphic and vegetation characteristics of these systems. In many cases, excessive cattle-grazing activities were noted, which results in trampling impacts and erosion. These activities cause increased sedimentation within the systems due to exposed substrate. Sedimentation alters the natural hydrological and geomorphological functioning of the wetlands. Impaired water quality may also result from additional loading of phosphates and nitrates.

The channelled valley bottom wetland was categorised as a Category D (*Largely modified*) due to the large hydrological (increased water input) and geomorphic impacts (impoundments) that the sewage treatment works has on the system. Proliferation of *Typha capensis* indicates a high nutrient load, which is to be expected due to discharges/seepage of water from the Lephalale Municipality's Paarl Sewage Works observed. The road crossing also has an impact on the wetland in the form of ponding upstream and channelisation downstream.

Although, PES calculations are not intended for use in ephemeral river systems, the tool was applied to the Sandloop River to give an indication of the health of the system. The ephemeral river system is impacted on by the road crossing as well as various impoundments, which impacts on the geomorphology and hydrology of the system.

Ecological Importance and Sensitivity

Ecological Importance and Sensitivity (EIS) scores range from 1.8 (Moderate) to 2.4 (High). The majority of the pans had high biodiversity scores as they are providing habitat for various plant and animal species. Hydrological importance values were low due to the nature of the HGM unit type and direct human benefits were moderate (higher for the pans where water abstraction was observed). The channelled valley bottom scores highly with regards to hydrological importance and function as it is playing a role in phosphate, nitrate and toxicant removal due to the input of sewage.

Although, EIS calculations are not intended for use in ephemeral river systems, the tool was applied to the Sandloop River to give an indication of the ecological importance of the system. It predominantly provides habitat and services for humans, but hydrological importance is low as water is not retained in the system for long periods and therefore there is no assimilation of nutrients or streamflow regulation capabilities.

Impact assessment

Only minor and negligible impacts are expected for this project because the pipeline route predominantly falls within the road servitude. Additionally, the terrain is mostly flat, reducing the likelihood of erosional impacts.

Preferred Pipeline Option

Pipeline Option 3 is the preferred option as it affects the smallest area of aquatic and wetland systems directly and indirectly, with only 0.09 ha directly impacted and 109.7 ha falling within 500m of the route. This is a smaller surface area compared to Option 1 where 0.26 ha of wetlands will be directly impacted, with 144.71 ha within 500m of this route, and Option 2 where 0.15 ha of wetlands will be directly impacted and 128.52 ha within 500m.

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1 Introduction

Biodiversity within inland water ecosystems in southern Africa is both highly diverse and of great regional importance to local livelihoods and economies, as these valuable natural resources (including any associated biota) provide a broad array of goods and services (Dudgeon et al., 2006; Darwall et al., 2009). However, these freshwater systems may well be the most endangered ecosystem in the world, as it threatens any of the 126,000 described species that depend upon these habitats for any critical part of their life cycle, as well as any associated provisioning and/or regulatory ecosystem services (Dudgeon et al., 2006).

The major global threats identified within these species-rich systems include (i) ecosystem destruction, (ii) habitat alteration, (iii) changes in water chemistry and (iv) direct additions and/or losses of aquatic biota (Malmqvist and Rundle, 2002). The magnitude of the threat to and loss of biodiversity in these vulnerable ecosystems is an indicator of the extent to which current practices are unsustainable. Hence, the importance of implementing conservation and management strategies that protect all elements of freshwater biodiversity, which in turn, would help to guarantee water availability in the future (Dudgeon et al., 2006).

The fact that South Africa is a water-scarce country makes these ecosystems even more susceptible to anthropogenic activities and their associated impacts. Consequently, the state (i.e. quality and quantity) of the county's water resources is fully dependant on good land management practices. In order to achieve ecological and socio-economic sustainability, our natural water resources rely upon an integrated ecosystem-based approach to natural resource management (i.e. Integrated Water Resource Management).

1.1 Importance of Wetland Systems

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, assimilation of nutrients, carbon storage, stream-flow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity (Kotze *et. al*., 2007). The Ramsar Convention on Wetlands refers to wetlands as one of the most important life support systems on earth owing to the aforementioned services provided. According to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), wetlands are defined as "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Wetlands in South Africa are poorly conserved primarily due to a general underestimation of the ecological and economic importance of these systems (Swanepoel and Barnard, 2007). According to the National Biodiversity Assessment (2011), 48% of South Africa's wetlands are critically endangered, and thus wetlands are classified as the country's most threatened ecosystem type (Driver *et al.*, 2012). It is further estimated that between 35-50% of all the wetland areas within South Africa have been destroyed as a result of anthropogenic stressors (Swanepoel and Barnard, 2007) and a cumulative loss of these important systems is on-going.

Some of the major factors contributing to the decline of wetlands in South Africa include mining, industrial and agricultural activities as well as poor treatment of waste water from industry and mining (Oberholzer *et. al.,* 2011).

Wetlands are highly susceptible to the degradation of quality and a reduction in quantity as a result of anthropogenic resource use activities, land surface development, landscape-management and all practices that alter the hydrological regime impacting these wetland systems. Historically, wetlands have been perceived to be wastelands (Patrick, 1994). This has resulted in the exploitation, alteration and in many cases the complete destruction of these ecosystems, with an accompanying loss of associated ecosystem goods and services (Patrick, 1994). 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 (Dickens *et al.,* 2003).

The dilemma facing South Africa is that there is a growing demand for energy (in the form of coal) as well as the need to protect wetland ecosystems. Wetlands are inextricably linked to coal mining, as coal deposits are often overlain by wetlands. The need therefore arises to sustainably manage South Africa's wetlands and assess the potential adverse impacts that may arise, whilst ensuring sufficient coal is mined to facilitate economic growth.

1.2 Project Background and Description

Temo currently has an approved mining right (MR) which was authorised by the Department of Mineral Resources on 27 September 2013 (Reference Number: LP 30/5/1/2/2/199 MR). That Project was also authorised in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the Environmental Impact Assessment (EIA) Regulations thereunder, dated 18 June 2010 (which have since been repealed). The Environmental Authorisation was granted by the Limpopo Department of Economic Development, Environment and Tourism (LEDET) on 13 July 2015 (Reference Number: 12/1/9/2-W55).

Temo Mine is located approximately 60km from Lephalale in the Limpopo Province. This project considers applying for Environmental Authorisation, in terms of NEMA, and a Water Use Licence (WUL) in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) to construct a rail loop, road diversion and pipeline.

The farm portions on which the Temo Mine is situated comprise Verloren Valey 246 LQ, Duikerpan 249 LQ, Japie 714 LQ, Hans 713 LQ and Kleinberg 252 LQ. Temo proposes to mine coal using open pit methods and the open pit will be situated entirely within the Farm Verloren Valey 246 LQ.

In reference to this assessment, Temo proposes to divert the dirt road (D175) around the approved mining right area for mining to continue, to construct a rail loop for transportation of coal and construct a water pipeline to service the Temo mine. As detailed below:

- **Diversion of road D175:** The approved open pit area has a road, the D175, which transects the south-western corner of the future pit area and continues to exit the

Mining Right boundary near the north-western corner. To facilitate continued mining and maximise the minable area at the Temo Mine, Temo proposes that the D175 be diverted around the mining area;

- **Proposed Rail Loop:** The purpose of the rail loop is to allow Temo to transport export-grade coal product to the Richards Bay Coal Terminal (RBCT), as well as for domestic use. The rail loop will include a loading loop which will be within the approved Mining Right boundary of the Temo Mine; and
- **Proposed Bulk Water Pipeline:** Construction of a bulk water pipeline (for which three different pipeline routes are proposed) connecting the Temo mine.

The abovementioned proposed developments requires an EIA Report and Environmental Management Programme, in terms of the new EIA Regulations, published in GN R982 dated 04 December 2014 (as amended December 2017

1.3 Terms of Reference

Digby Wells Environmental (hereafter Digby Wells) was commissioned by Temo Coal (Pty) Ltd to conduct an aquatic and wetland specialist study to inform the Environmental Impact Assessment (EIA) process being conducted for the proposed infrastructure development project. The aim of the assessment, through the Scoping and EIA phase, is to provide a report and accompanying maps describing the following:

- Desktop scoping investigation of the potential rivers and/or wetlands within the project area;
- The identification and the delineation of rivers and/or wetlands within the project area;
- A description and characterisation of the identified rivers and/or wetlands;
- Assessment of potential impacts to the rivers and/or wetlands from the activities; and
- Discussion of recommended mitigation measures to be taken into account through the mitigation hierarchy.

1.4 Assumptions, Limitations and Gaps in Knowledge

The following assumptions were made by the author/s at the time of writing:

- The largely arid nature of the study area and the lack of notable riverine watercourses within 3 km of the proposed infrastructure (i.e. NFEPA Rivers layer) supports the notion that a desktop-based aquatic ecology study is sufficient for the environmental authorisation process. Nonetheless, a full study was undertaken by Digby Wells Environmental along the Limpopo River in February 2016, thus all relevant and applicable findings will be included as a supplement to this desktop component.

The following limitations were made by the author/s at the time of writing:

- Access to some of the systems was limited due to the areas being private property and/or game reserves, while in some circumstances, selected areas were not surveyed due to safety concerns. The systems that were not ground-truthed during the field survey were scrutinised at a desktop level and have been demarcated as such for transparency;

- Only the associated rivers and/or wetlands along the proposed pipeline routes were assessed as per the proposal; and
- Due to the large number of pan systems, each pan was not assessed for PES and EIS separately. Similar pans were grouped together when being assessed for PES and EIS based on the impacts to those systems.

1.5 Policy and Legal Framework

The aquatic and wetland assessment aims to support the following regulations, regulatory procedures and associated guidelines:

- Section 19 of the NWA;
- Section 21 (c), (g) and (i) of the NWA;
- Section 24 of the Constitution – Environment (Act No. 108 of 1996);
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2014) (NEMBA);
- Section 5 of the NEMA;
- Department of Water and Forestry (DWAF) guidelines for the delineation of wetlands (2005);
- The Limpopo Conservation Plan Version 2 (2013); and
- The Wetland Management Series published by the Water Research Commission (WRC, 2007).

2 Methodology

2.1 Literature Review and Desktop Assessment

A literature review of existing aquatic and wetland specialist studies, aquatic biomonitoring assessments, as well as any other relevant aquatic studies within the vicinity of the study area was undertaken.

In addition, various sources of information were used to provide indications of ecological conditions of the associated watercourses within the project area, including the a desktop study of ecological conditions, as well as ecological importance and sensitivity (Department of Water and Sanitation, 2014). Any available spatial planning information, including the National Freshwater Ecosystem Priority Area, National Biodiversity Assessment, and Limpopo Conservation Plan, were reviewed to provide regional context of the associated freshwater ecosystems and their conservation importance.

2.2 Delineation and Identification

The delineation procedure considers four attributes to determine the limitations of the wetland or other freshwater resource, in accordance with DWAF guidelines (now Department of Water and Sanitation (DWS, 2005). 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.

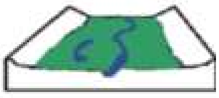
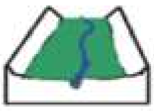
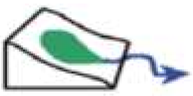
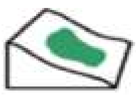
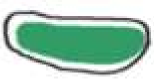
In accordance with the definition of a wetland in the NWA, vegetation is the primary indicator of a wetland, which must be present under normal circumstances. However, the soil wetness indicator tends to be the most important in practice and as such, the remaining three indicators are then used in a confirmatory (or supporting) 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 long-lasting and often hold the indications of frequent and prolonged saturation long after a wetland has been drained, perhaps several centuries (DWAF, 2005).

2.2.1 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 aerial imagery and regional contours (DWAF, 2005).

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 shown in Table 2-1.

Table 2-1: Description of the different Hydrogeomorphic Units for Wetland Classification

Hydromorphic wetland type	Diagram	Description
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 (i.e. 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.

2.2.2 Soil Form Indicator

Hydromorphic 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, which 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 or temporarily saturated (DWAF, 2005).

2.2.3 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). 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. This is however difficult in vertic black soil with very high clay content.

2.2.4 Vegetation Indicator

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. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze and Marneweck, 1999; DWAF, 2005). This is summarised in Table 2-2 below.

Table 2-2: Classification of wetland plant species (DWAF, 2005)

Type	Description
Obligate Wetland species (OW)	Almost always grow in wetlands: >99% of occurrences.
Facultative Wetland species (FW)	Usually grow in wetlands but occasionally are found in non-wetland areas: 67 – 99 % of occurrences.
Facultative species (F)	Are equally likely to grow in wetlands and non-wetland areas: 34 – 66% of occurrences.
Facultative dry-land species (fd)	Usually grow in non-wetland areas but sometimes grow in wetlands: 1 – 34% of occurrences.

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). Areas where soils are a poor indicator (black clay, vertic soils), vegetation (as well as topographical setting) is relied on to a greater extent and the use of the wetland species classification as per Table 2-2 becomes more important.

2.3 Wetland Ecological Health Assessment

According to Macfarlane *et al.* (2009) 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. A WET-Health assessment was done on the wetlands and freshwater resources in accordance with the method described by Kotze *et al.* (2007) to determine the integrity (health) of the characterised HGM units for the project area. A PES analysis was conducted to establish baseline integrity (health) for the associated wetlands and freshwater resources present.

The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions. The overall health score of the wetland is calculated using Equation 1, which provides a score ranging from 0 (pristine) to 10 (critically impacted in all respects). The rationale for this is that hydrology is considered to have the greatest contribution to health. The PES is determined according to Table 2-3.

$$Wetland\ Health = \frac{3(Hydrology) + 2(Geomorphology) + 2(Vegetation)}{7}$$

Equation 1: Overall Wetland Ecological Health Score

Table 2-3: Impact scores and Present Ecological State categories used by Wet-Health

Impact Category	Description	Combined Impact Score	PES Category
None	Unmodified, natural.	0-0.9	**A**
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota has taken place.	1-1.9	**B**
Moderate	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**
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	**D**
Serious	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**
Critical	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**

2.4 Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term.

The methodology outlined by DWAF (1999) and updated in Rountree and Kotze, (2012, in Rountree *et al.* (2012) was used for this study. In this method there are three suites of importance criteria; namely:

- **Ecological Importance and Sensitivity:** incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- **Hydro-functional Importance:** which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland or freshwater resource may provide; and

- **Importance in terms of Basic Human Benefits:** this suite of criteria considers the subsistence uses and cultural benefits of the wetland or freshwater system.

These determinants are assessed for the wetlands and the freshwater resources present on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. It is recommended that the highest of these three suites of scores be used to determine the overall Importance and Sensitivity category of the wetland or freshwater system, as defined in Table 2-4.

Table 2-4: Interpretation of overall Ecological Importance and Sensitivity (EIS) scores for biotic and habitat determinants (Rountree & Kotze, 2012)

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

3 Description of the Environment

3.1 Location

The Temo Coal Mine is located approximately 60 kilometres (km) from Lephalale in the Limpopo Province on various farm portions, namely Verloren Valey 246 LQ, Duikerpan 249 LQ, Japie 714 LQ, Hans 713 LQ and Kleinberg 252 LQ (Figure 3-1, Figure 3-2).

In terms of Quarter Degree Grid Cell references, the proposed infrastructure traverses from east to west across map reference 2327DA, 2327CB and 2327CA.

3.2 Biophysical Description

3.2.1 Climate

The project area is located within the Limpopo ecoregion (predominantly within Level II Ecoregion 1.03) between altitudes ranging from 800-950 m above mean sea level (a.m.s.l.). The climate ranges from temperate and semi-arid in the south to extremely arid in the north. The area within the associated water management area is characterised by a flat topography with grassland, sparse bushveld shrubs and trees. Consequently, in addition to the prevalence of sandy soils in the area, surface runoff is regarded as low despite the presence of some loam and clay soils (Sikosana and de Jager, 2016).

Relative to the country's average mean annual precipitation of 490 mm, this ecoregion experiences moderate rainfall of 300-600 mm that falls predominantly during early- to mid-summer with a high evaporation potential (Kleynhans et al., 2007; Worldwide Fund for Nature - South Africa, 2016). The mean annual temperature ranges between 18-22°C, with mean daily maximum temperatures in February ranging between 28-32°C and mean daily minimum temperatures ranging between 18-24°C in July (Kleynhans et al., 2007).

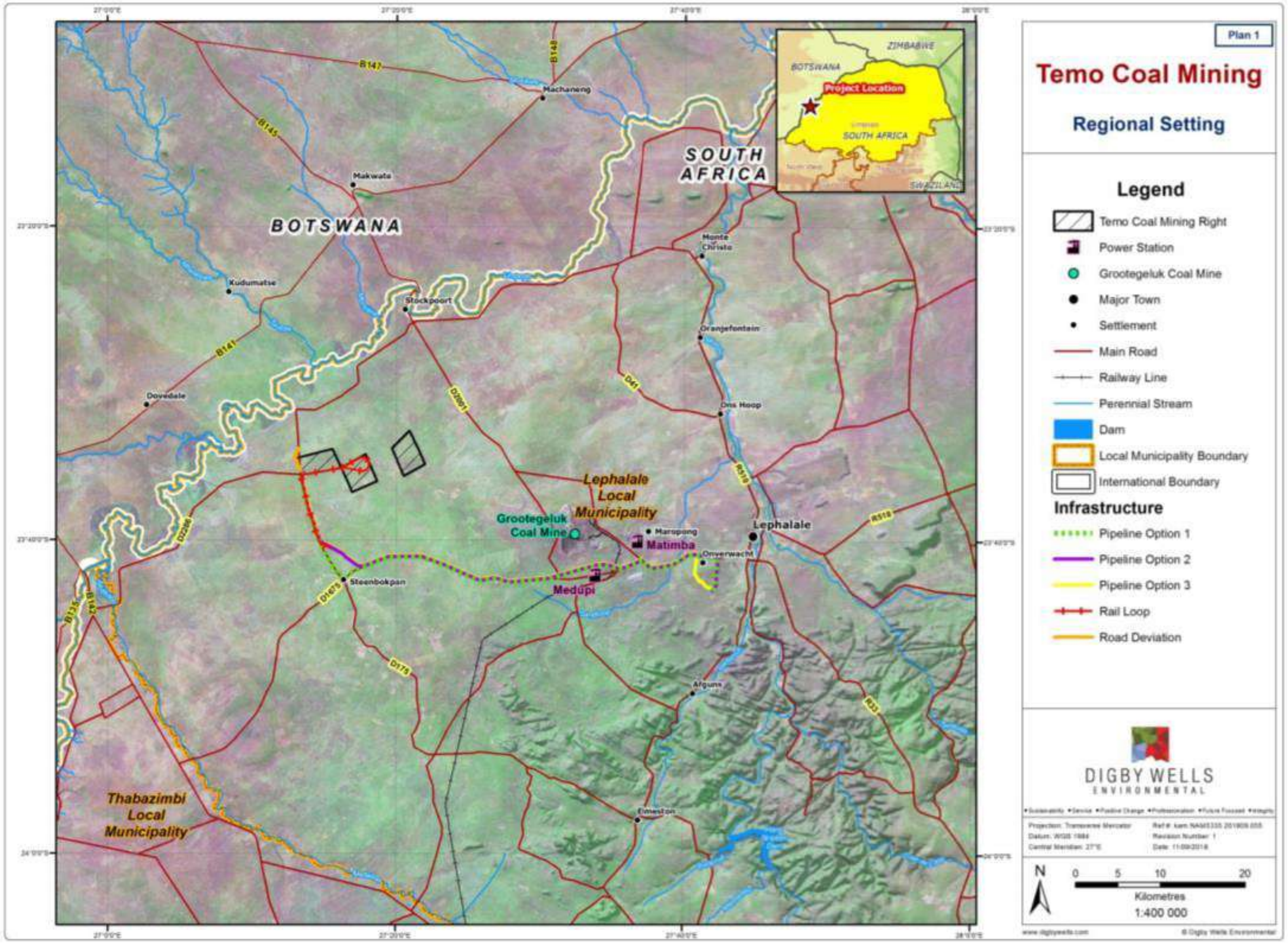


Figure 3-1: Regional setting

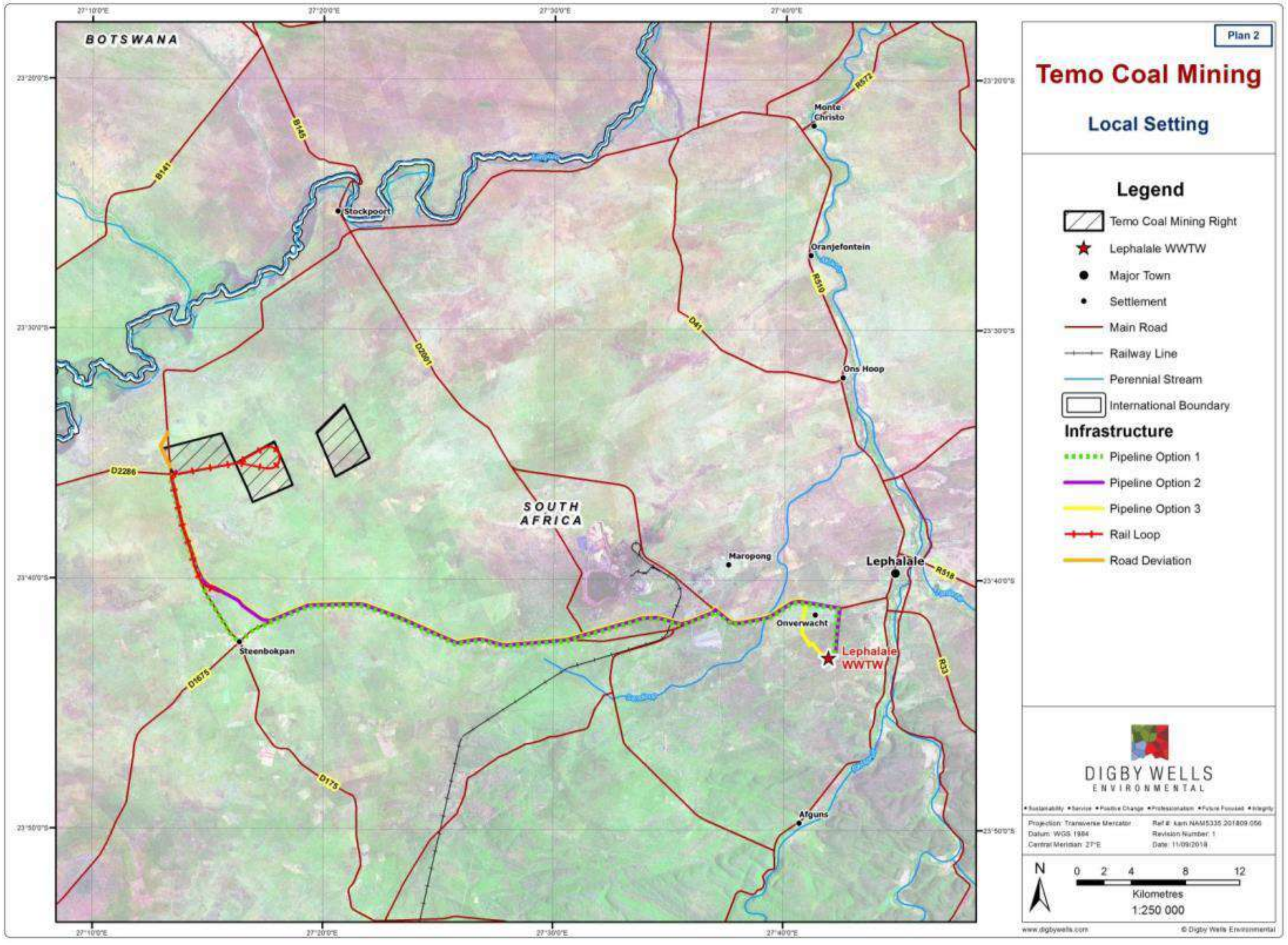


Figure 3-2: Local setting

3.2.2 Regional Vegetation

The project area is located within the Limpopo Sweet Bushveld, as described by Mucina and Rutherford (2012). The landscape features characteristic of this vegetation type includes plains traversed by several tributaries of the Limpopo River. This vegetation type occurs within the Limpopo Province at an altitude of 700 – 1 000 m and consists of short, open woodland (Figure 3-3). Disturbed areas are dominated by thickets of Blue Thorn (*Acacia (Vachellia) erubescens*), Black Thorn (*Acacia (Senegalia) mellifera)* and Sickle Bush (*Dichrostachys cinerea*) (Mucina and Rutherford, 2012). Table 3-1 lists the plant species that occur in the Limpopo Sweet Bushveld (Mucina and Rutherford, 2012).

Table 3-1: Plant Species Characteristic of the Limpopo Sweet Bushveld

Plant Form	Species
Tall trees	*Acacia robusta, A. burkei*
Small Trees	*Acacia erubescens, A. fleckii, A. nilotica, A. Senegal* var. *rostrata*, *Albizia anthelmintica, Boscia albitrunca, Combretum apiculatum, Terminalia sericea*
Tall Shrubs	*Catophractes alexandri, Dichrostachys cinerea, Phaeoptilum spinosum, Rhigozum obovatum, Cadaba aphylla, Combretum hereroense, Commiphora pyracanthoides, Ehretia rigida* subsp. *rigida, Euclea undulata, Grewia flava, Gymnosporia senegalensis*
Low Shrubs	*Acacia tenuispina, Commiphora africana, Felicia muricata, Gossypium herbaceum* subsp. *africanum, Leucosphaera bainesii*
Graminoids	*Digitaria eriantha* subsp. *eriantha, Enneapogon cenchroides, Eragrostis lehmanniana, Panicum coloratum, Schmidtia pappophoroides, Aristida congesta, Cymbopogon nardus, Eragrostis pallens, E. rigidior, E. trichophora, Ischaemum afrum, Panicum maximum, Setaria verticillata, Stipagrostis uniplumis, Urochloa mosambicensis*
Herbs	*Acanthosicyos naudinianus, Commelina benghalensis, Harpagophytum procumbens* subsp. *transvaalense, Hemizygia elliottii, Hermbstaedtia odorata, Indigofera daleoides*
Succulent herbs	*Kleinia fulgens, Plectranthus neochilus*

The Limpopo Sweet Bushveld vegetation type is classified as Least threatened with a conservation target of 19%. However, only less than 1% is statutorily conserved. Approximately 5% is transformed, predominantly by cultivation.

3.2.3 Associated Watercourses

The present study area is located within the Limpopo water management area (WMA 1), which forms part of the Limpopo River basin (i.e. South African portion) and includes parts of Botswana, Zimbabwe and Mozambique (Department of Water Affairs and Forestry, 2004). It is a regarded as a dry catchment with no significant dams (with the exception of the Mokolo

Dam) and a low growth potential for land-use development.

More specifically, the proposed infrastructure traverses across Quaternary Catchment A41E, A42J and A42H in a westerly direction (Figure 3-4). The main systems draining the region are the Matlaba catchment to the west (i.e. Tertiary Catchment A41), which has a catchment area of 6,014 km^2, and the Mokolo catchment to the east (i.e. Tertiary Catchment A42), which has a catchment area of 8,387 km^2. It should be noted that the Mokolo Dam supplies water to the Matimba Power Station, Medupi Power Station, Grootegeluk Coal Mine, the Lephalale Local Municipality (LM), as well as a number of downstream irrigators. The dam has the capacity to meet most of the current requirements, but will in future rely on transfers from other WMAs to meet the water requirements at a sufficiently high assurance of supply (DWS, 2017).

The proposed infrastructure straddles the topography between the Limpopo and Mokolo rivers to the west (approximately 7 km away) and east (approximately 3.5 km away), respectively. While the area is largely void of notable watercourses (excluding a number of temporary pan systems and one channelled valley bottom wetland system), the proposed infrastructure crosses over the non-perennial Sandloop River between the Matimba Power Station and the town of Lephalale (Digby Wells Environmental, 2016).

Table 3-2 provides a summary of the relevant location-specific environmental attributes associated with the project area

Table 3-2: Summary of associated site characteristics within the study area

Map Reference	2327CA | 2327CB | 2327DA
Political Region	Limpopo
Level 1 Ecoregion	1. Limpopo
Level 2 Ecoregion	1.02 | 1.03
Freshwater Ecoregion	Zambezian Lowveld
Geomorphic Province	Limpopo Plains
Vegetation Type	Limpopo Sweet Bushveld
Water Management Area	1. Limpopo
Secondary Catchment	A4
Quaternary Catchment	A41E | A42J | A42H
Watercourse	Sandloop River
Slope Class	E – Lower Foothills
Seasonality	Non-Perennial

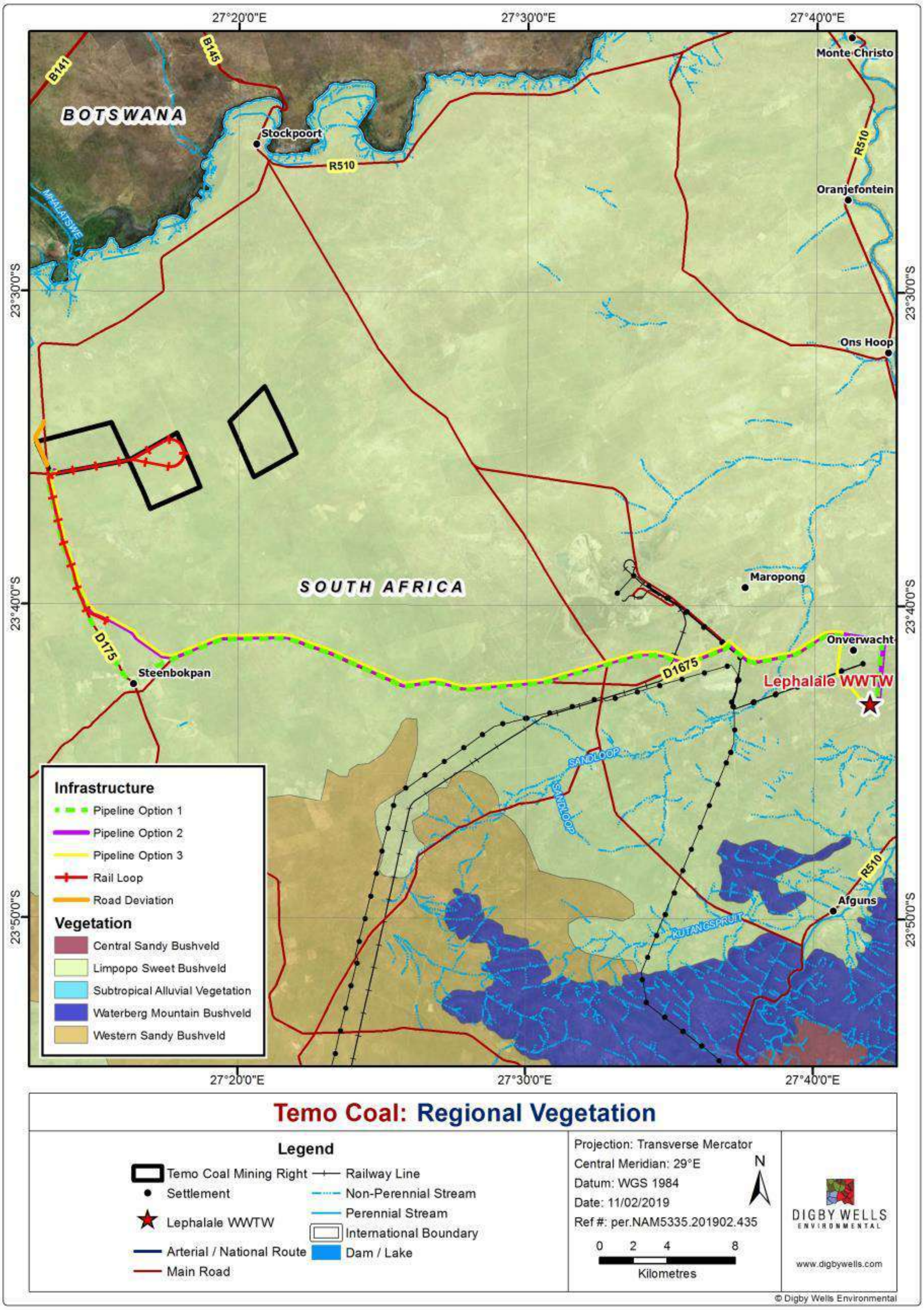


Figure 3-3: Regional Vegetation

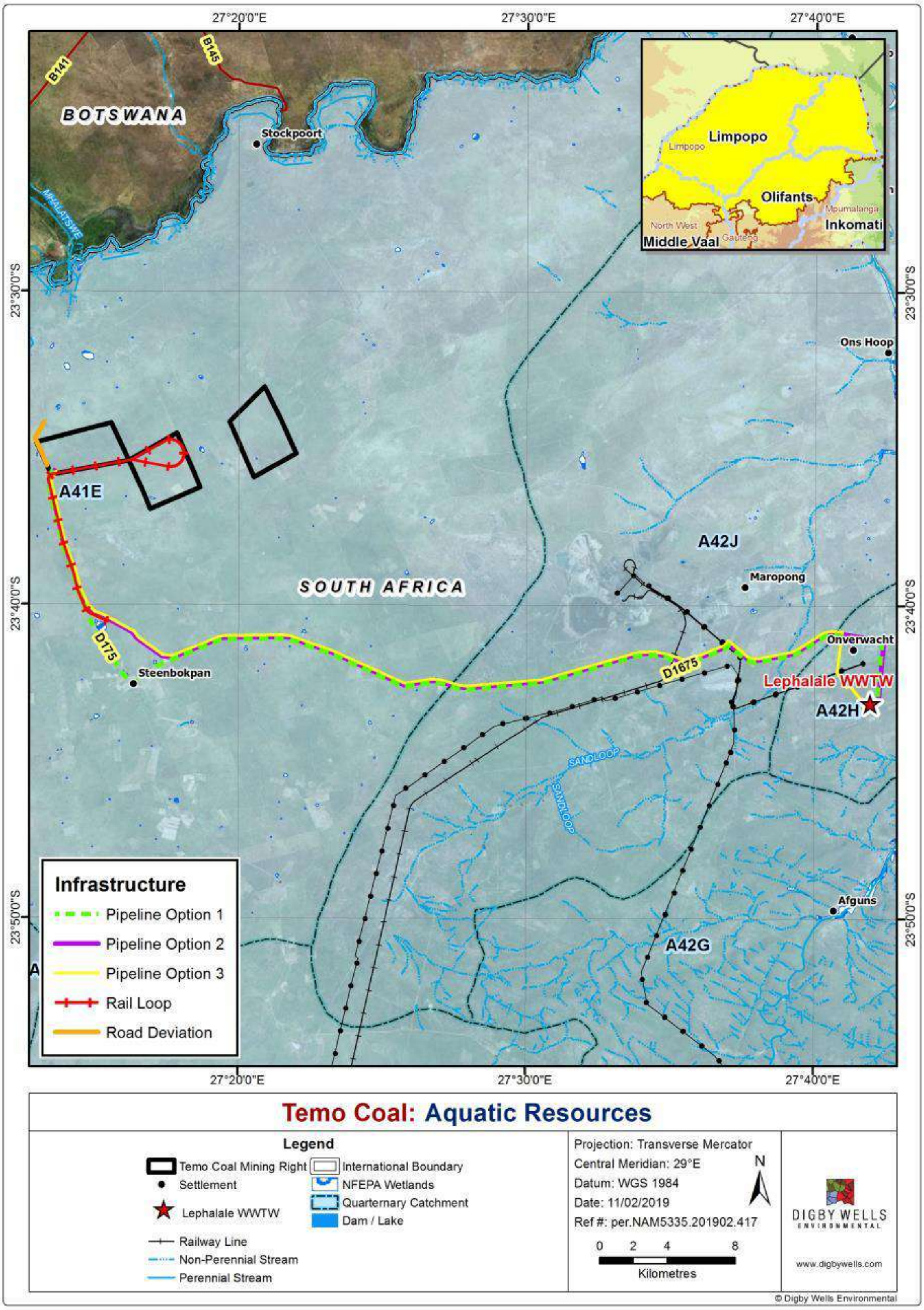


Figure 3-4: Quaternary Catchments

3.3 Bioregional Context

The present project area is located within the Zambezian Lowveld freshwater ecoregion, which represents an overlap region of tropical Zambezian and southern temperate faunas (Darwall et al., 2009). Although not necessarily within the present study area, approximately 120 freshwater fish species are known to inhabit the waters of the Zambezian Lowveld ecoregion, of which 22 are endemic.

Dominant fish within the Zambezian Lowveld ecoregion include cichlids, cyprinids, gobies and mochokid catfishes, with many species found in fresh, brackish and saline waters, while several catadromous species also found in the ecoregion spend part of their life cycle in the freshwater coastal rivers and streams (e.g. several members of the Anguillidae family; Dallas, 2013). In addition, interesting endemics of the ecoregion include several rock catlets (*Chiloglanis* spp.) that live in rocky riffles and rapids, the Sibayi goby (*Silhouettea sibayi*) whose largest known population occurs in Lake Sibaya, and the brightly-coloured turquoise killifish (*Nothobranchius furzeri*) that is limited in distribution to the ephemeral pans of the Gonarezhou National Park in Zimbabwe (Skelton, 1994; cited in Dallas, 2013).

In light of the arid nature of the project area, many of the aforementioned fish species are likely to be absent. However, there is still a possibility of a few opportunistic fish species inhabiting any of the recently inundated areas e.g. killifish within temporary pan systems.

3.4 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA; now Department of Water and Sanitation, or DWS), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

1. Identify Freshwater Ecosystem Priority Areas (hereafter referred to as ‘FEPAs’) to meet national biodiversity goals for freshwater ecosystems; and
2. Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa’s freshwater biodiversity within the context of equitable social and economic development. The second aim is comprised of two separate components: the (i) national component aimed to align DWA (or currently the DWS) and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems, while the (ii) sub-national component is aimed to use three case studies to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes. The project further aimed to maximize synergies and alignment with other national level initiatives, including the National

Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation (Driver et al., 2011).

Based on current outputs of the NFEPA project (Nel et al., 2011; Table 3-4, Figure 3-5), the sub-quaternary catchment associated with the Sandloop River was defined as a FEPA catchment, as a result of both river and wetland ecosystem types, as well as a few wetland clusters. These catchments help to achieve national biodiversity targets, as the ecological condition of the associated systems are currently regarded as being in a good condition (A or B ecological category) and as such, these catchments and adjacent areas should be managed in a way that maintains their ecological condition, so as to conserve freshwater ecosystems and protect water resources for sustainable human use (Nel et al., 2011).

Wetland clusters are groups of wetlands embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands. In many areas of the country, wetland clusters no longer exist because the surrounding land has become too fragmented by human impacts (Driver et al., 2011).

Based on a desktop-based modelled wetland condition and a combination of special features, including expert knowledge (e.g. intact peat wetlands, presence of rare plants and animals, etc.) and available spatial data on the occurrence of threatened frogs and wetland-dependent birds, each of the wetlands within the inventory were ranked in terms of their biodiversity importance and as such, Wetland FEPA's were identified in an effort to achieve biodiversity targets (Driver et al., 2011). Table 3-3 below indicates the criteria that were considered for the ranking of each of these wetland areas.

Table 3-3: NFEPA Wetland Classification Ranking criteria

NFEPA Wetland Criteria	NFEPA 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 water bird 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

NFEPA Wetland Criteria	NFEPA Rank
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

Based on the aforementioned criteria, the landscape comprises of bench depression and bench flat wetlands, hillslope seep and hillslope depression wetlands, valley floor depression wetlands and unchannelled valley-bottom wetlands. The identified wetlands range from Rank 4 to Rank 6. Figure 3-6 shows these NFEPA wetlands in relation to the project area (Note: The wetland extents have been enlarged to improve visibility).

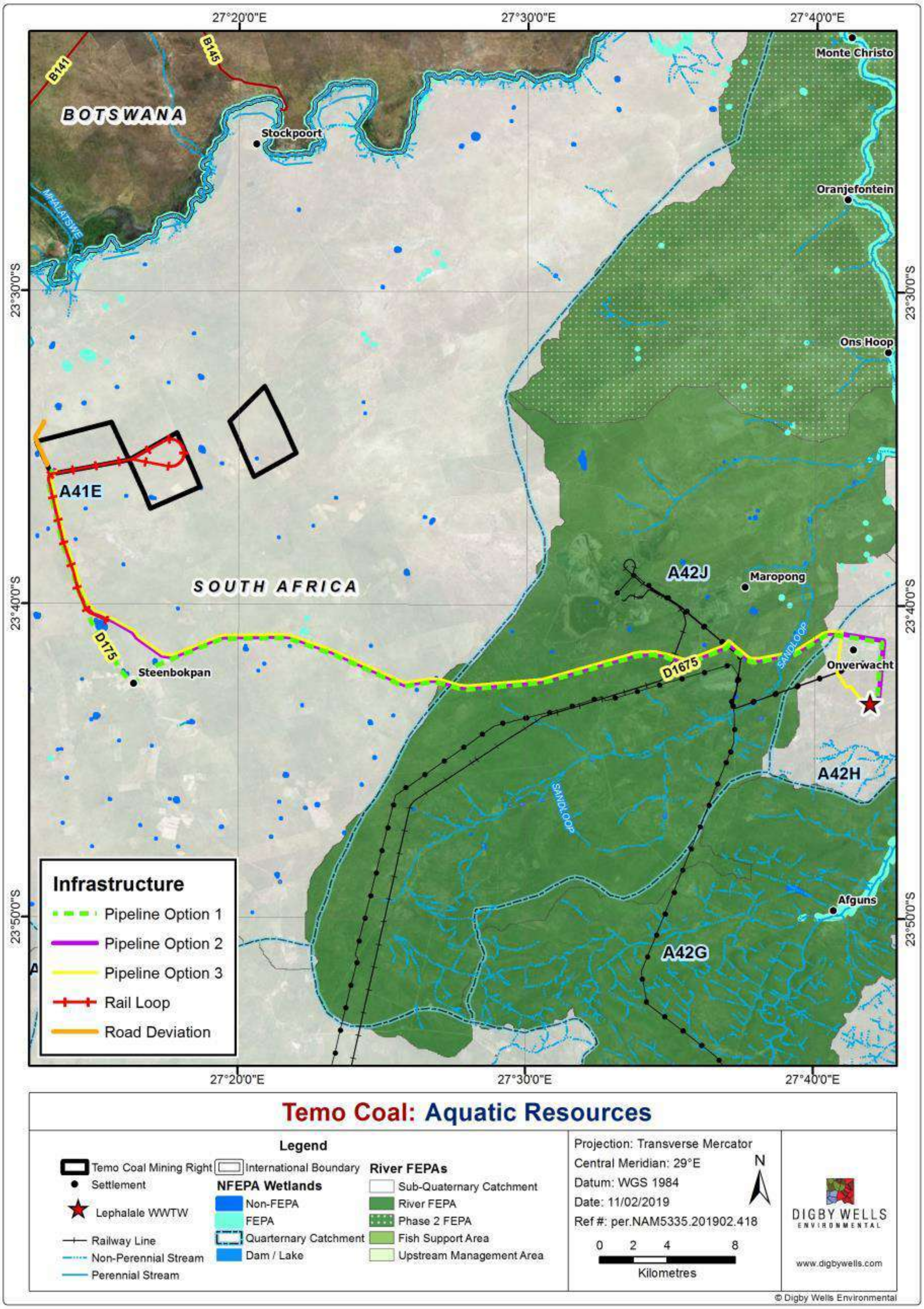


Figure 3-5: FEPA catchment areas and FEPA wetlands

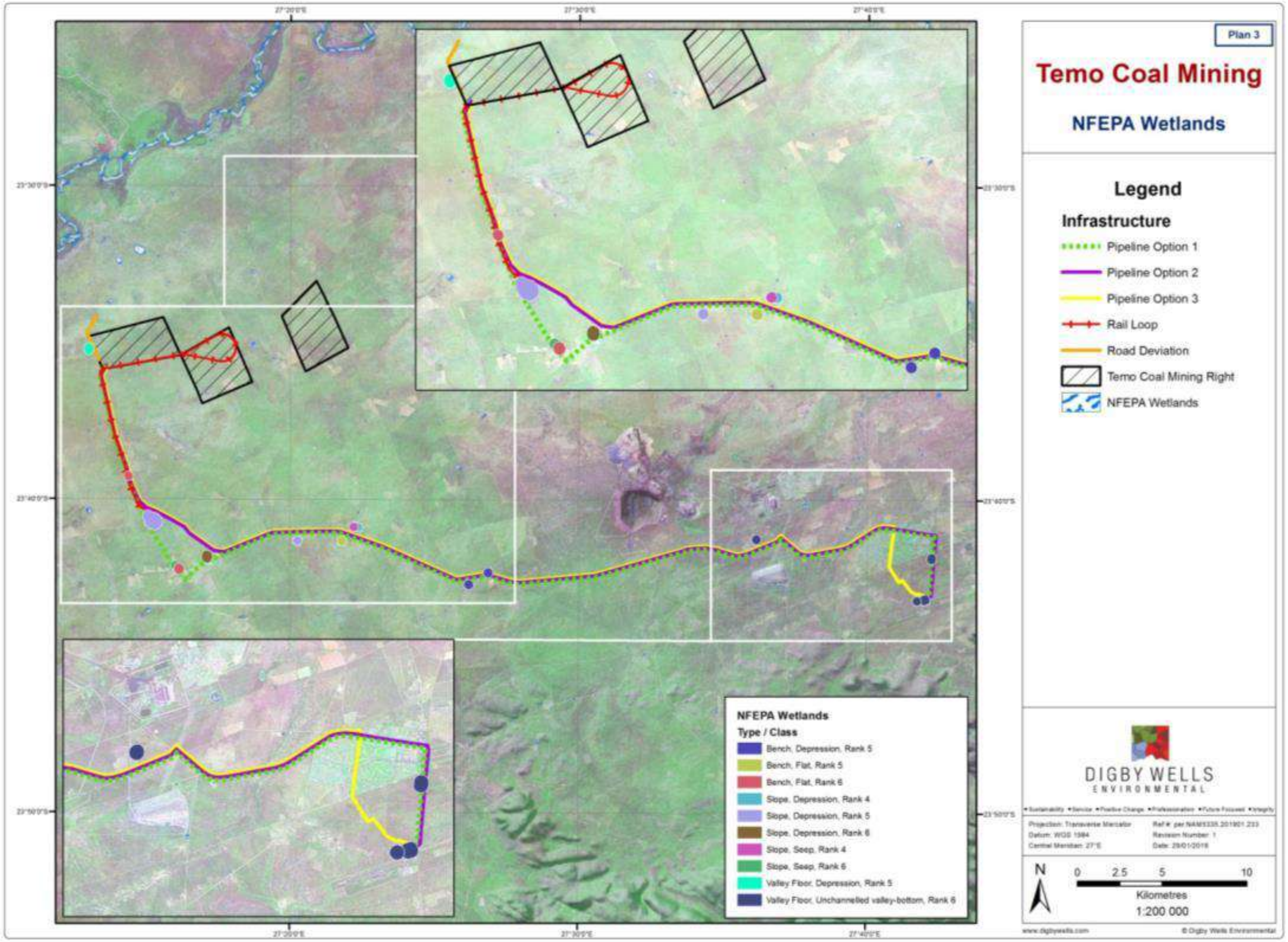


Figure 3-6: NFEPA Wetlands

3.5 National Biodiversity Assessment

The 2011 National Biodiversity Assessment (NBA) was a three-year study led by the South African National Biodiversity Institute (SANBI), in partnership with the Department of Environmental Affairs (DEA) and a wide participation from stakeholders, scientists and biodiversity management experts. In terms of the National Environmental Management: Biodiversity Act (NEMBA, Act 10 of 2004), SANBI is required to monitor and report regularly on the status of the country's biodiversity, which is essentially fulfilled in the purpose and aim of the regularly occurring NBA (i.e. approx. every seven years). The NBA endeavours to capture the challenges and opportunities embedded within the country's rich natural heritage at three separate levels (i.e. genes, species and ecosystems) and across each of the major environments (i.e. terrestrial, freshwater, estuarine and marine environments). Subsequently, the NBA informs the revision and updating of key national biodiversity policies and strategies, including the National Biodiversity Strategy and Action Plan, the National Biodiversity Framework, and the National Protected Area Expansion Strategy (Driver et al., 2012).

In an effort to support a landscape management approach to conserving biodiversity and to facilitate the identification of developing trends over time, two major headline indicators were carried through from the previous NBA (i.e. 2004 study) and assessed within the most recent 2011 study. These are referred to as: (i) Ecosystem Threat Status (ETS), which is a measure of a specific ecosystem's intactness, modifications and/or ability to provide ecosystem services; and (ii) Ecosystem Protection Level (EPL), which describes the extent (or state) of a specific ecosystem's protection, in relation to their location within declared protected areas (i.e. as defined within the Protected Areas Act; Driver et al., 2012).

With respect to the freshwater component of the NBA study, aquatic ecosystems across the country were classified into 1,014 distinct ecosystem types, comprising of 223 river ecosystem types and 791 wetland ecosystem types (J L Nel and Driver, 2012; Worldwide Fund for Nature - South Africa, 2016), of which one river and two wetland ecosystem types were identified to be directly associated with the project area. With respect to the river ecosystem type associated with the assessed section of the Sandloop River (i.e. 1_N_L), these systems are currently classified as Least Threatened, which suggested that more than 60% of the length of these defined river types represent good conditions (i.e. A or B ecological category). In addition, it should be noted that less than 10% of the total length of this riverine ecosystem type was believed to be in a good condition and situated within formally protected areas (Nel & Driver, 2012; Table 2-4). Consequently, the minimum biodiversity protection target of 20%, as defined in the cross-sectoral policy document, was not attained to and these systems were likely to deteriorate further.

Similarly, the channelled valley bottom system and the numerous depression (pan) systems within the vicinity of the proposed infrastructure were defined to be Endangered and Least Threatened, respectively (Table 3-4; Nel & Driver, 2012). Also, each of these wetland ecosystem types were defined to be unprotected within formally recognised areas (i.e. <1% of extent).

Table 3-4: Freshwater ecosystem types, showing National Biodiversity Assessment (NBA) indicators and National Freshwater Ecosystem Priority Areas (NFEPA) categories (Nel et al., 2011; Nel & Driver, 2012)

Type of Watercourse	Freshwater Ecosystem Type	NBA Indicators		NFEPA Category
		ETS*	EPL**	
River	Ephemeral – Limpopo Plain – Lower Foothills (1_N_L)	LT	PP	• River FEPA catchment
Wetland	Central Bushveld Group 4 - Channelled Valley-bottom	EN	NP	• Non-FEPA Wetlands
	Central Bushveld Group 4 - Depression	LT	NP	• FEPA Wetlands • Non-FEPA Wetlands

* **Ecosystem Threat Status: EN** –Endangered (20-35% of ecosystem extent intact), **LT** – Least Threatened (>60% of ecosystem extent intact). **** Ecosystem Protection Level: NP** – Not Protected1 (<1% of extent protected), **PP** – Poorly Protected1 (1-10% of extent protected)..

3.6 The Limpopo C-Plan

In order to facilitate biodiversity conservation within provincial priority areas outside the protected area network, a bioregional plan is developed to inform land-use planning, environmental assessment and authorisations, and natural resource management (Desmet et al., 2013). In light of this, the purpose of the Limpopo Conservation Plan was to develop the spatial component of the provincial bioregional plan, which was recently revised to Version 2, by developing and executing a quantitative systematic spatial biodiversity planning methodology that:

- Addresses the deficiencies of the original provincial plan (i.e. Version 1);
- Takes into account the most up-to-date spatial data and institutional and expert knowledge;
- Aligns the methods and terminology of the plan with the national guidelines for the development of bioregional plans (Government Gazette No.32006, 16 March 2009);
- Takes into account existing spatial biodiversity planning products; and
- Involves skills transfer through working with LEDET staff on the development of the Critical Biodiversity Area (CBA) map and Gap analysis.

The purpose of a conservation plan is to inform land-use planning, environmental assessments and authorisations, and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity. Accompanying the map of the CBAs are land-use guidelines that are compatible with the biodiversity management objective of the CBA category. The important biodiversity areas for the Limpopo C-Plan are defined and summarised below:

- **Protected Areas:** Formal Protected Areas and Protected Areas pending declaration under National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEMPA);
- **Critical Biodiversity Area 1:** Irreplaceable sites. Areas required for biodiversity pattern and/or ecological process targets. No alternative sites are available to meet targets;
- **Critical Biodiversity Area 2:** Best Design Selected sites. Areas selected to meet biodiversity pattern and/or ecological process targets. Alternative sites may be available to meet targets;
- **Ecological Support Areas 1**: Natural, near natural and degraded areas supporting CBAs by maintaining ecological processes;
- **Ecological Support Areas 2:** Areas with no natural habitat that are important for supporting ecological processes; and
- **Other Natural Areas:** Natural and intact but not required to meet targets, or identified as CBA or Ecological Support Area (ESA).

Based on these primary outputs, all three proposed pipeline options fall within areas that are classified as CBA 1, CBA 2 and ESA 1. A portion of the rail loop is within CBA 2. The road deviation and MR are in a 'No Natural Remaining' area (Figure 3-7).

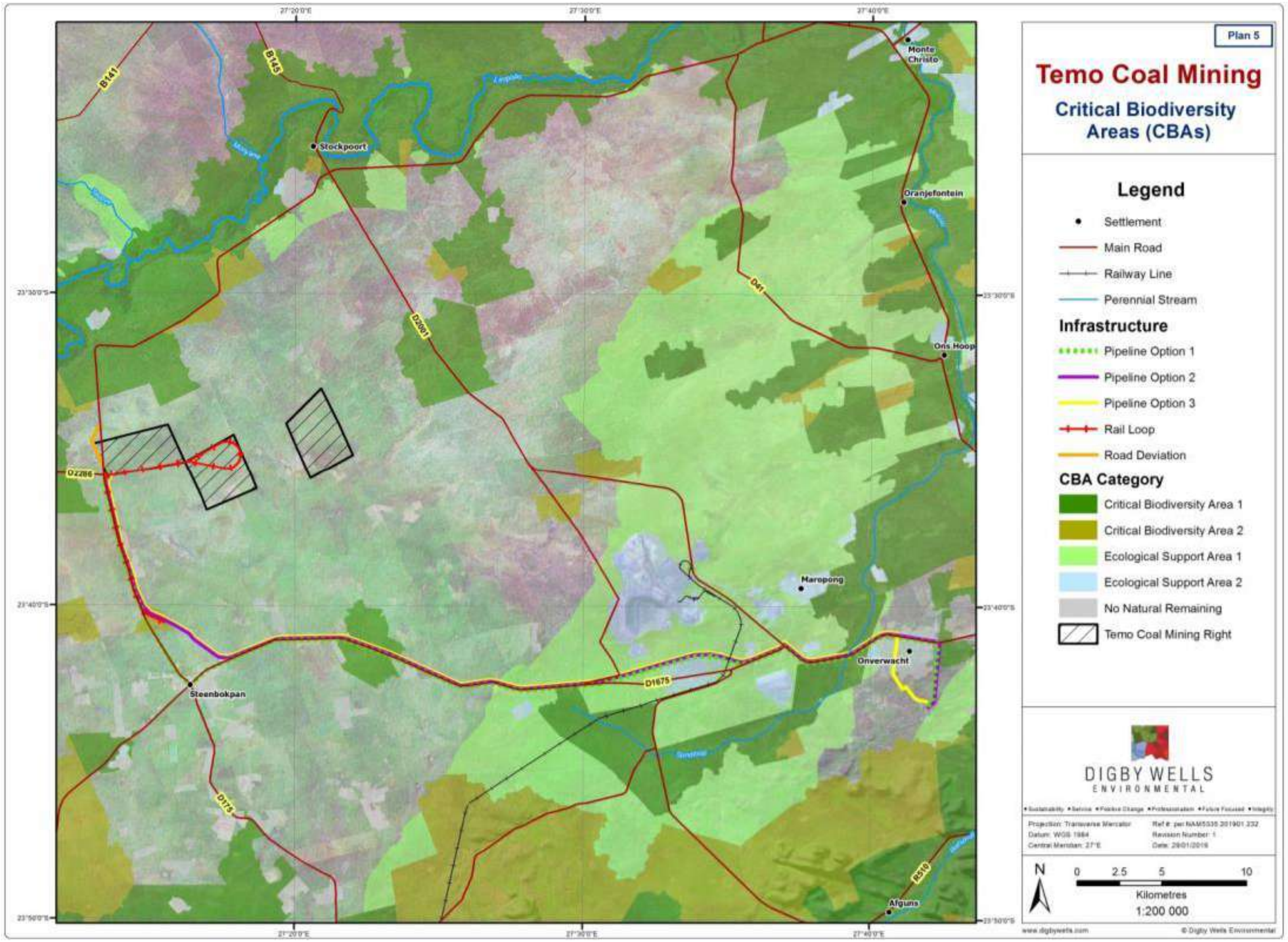


Figure 3-7: Limpopo C-Plan Critical Biodiversity Areas

4 Existing Environment

4.1 Aquatic Environment (Desktop Assessment and Literature Review)

The only SQR delineated within the project area forms the Sandloop River (SQR A42J-00182), which is a first order stream that reports to the Mokolo River. As indicated by the aforementioned NBA classification, the system expresses an ephemeral nature and as such, biological composition is strongly dependent upon the presence of water within the system.

The available desktop information on the considered SQR is presented below (Table 4-1).

Table 4-1: Desktop Information for the A42J-00182SQR (Department of Water and Sanitation, 2014)

Component	Rating
Reach Length (km)	41.84
Stream Order	1
PES	Category C – Moderately modified
EI	Moderate
ES	Low
Default Ecological Category	Category C – Moderately modified

The aforementioned categories have been derived based on the following criterion ratings:

- **Small Impacts:** Bed and channel disturbance, small dams, inundation, roads, urbanisation, and vegetation removal.
- **Moderate Impacts:** Crop cultivations, low water crossings, erosion, overgrazing/trampling, and mining runoff/contamination.
- **Large Impacts:** Livestock grazing pressure.

In light of the inherent ephemeral nature of the watercourse, there is an indication that the biological composition of this system in terms of inhabiting aquatic macroinvertebrate taxa and fish species is only evident at time of inundation. Therefore, the ecological category is largely derived from both the instream habitat integrity during periods of inundation, which is regarded as largely impacted.

In terms of ecological importance, the associated SQR was classified as moderate due primarily to a low biological diversity expected during periods of inundation and a very high importance in relation to the condition and extent of natural riparian-wetland vegetation. Similarly, the ecological sensitivity of the associated SQR was regarded as low, as the species (including riparian/wetland vegetation) expected to colonise these naturally harsh and dynamic systems are generally believed to be well-adapted (e.g. branchiopod crustaceans) or tolerant opportunistic species.

4.2 Wetland delineation and classification

Forty-nine (49) watercourses were observed on site, with a total extent of 322.67 ha (315.66 ha excluding the two artificial systems). Based on the findings of the field assessment (12-13 February 2019), it is evident that the wetlands and freshwater features within the project area consist mostly of pans, followed by ephemeral systems. The pan or depression wetland HGM setting is described as a basin shaped area with a closed elevation contour that usually is not connected to the drainage network (Ellery *et al*, 2009). Pans can receive water both from surface and groundwater flows, which then accumulates in the depression owing to a generally impervious underlying layer, which prevents the water draining away (Goudie and Thomas, 1985; Marshall and Harmse, 1992).

The breakdown of the wetland types per area is detailed in Table 4-2 and illustrated in Figure 4-1 - Figure 4-3.

Table 4-2: Wetland HGM Units

HGM Unit	Verification	Area (ha)
Pan	Desktop	0.06
Pan	Desktop	0.06
Pan	Desktop	0.07
Pan	Desktop	0.07
Pan	Desktop	0.07
Pan	Desktop	0.07
Pan	Desktop	0.09
Pan	Field Verified	0.10
Pan	Desktop	0.12
Pan	Field Verified	0.12
Pan	Desktop	0.12
Pan	Field Verified	0.13
Pan	Desktop	0.14
Pan	Desktop	0.14
Pan	Desktop	0.15
Drain	Field Verified	0.18
Pan	Field Verified	0.19
Pan	Desktop	0.21

Pan	Desktop	0.21
Pan	Field Verified	0.23
Pan	Desktop	0.23
Pan	Desktop	0.25
Pan	Desktop	0.32
Pan	Desktop	0.32
Pan	Field Verified	0.33
Pan	Desktop	0.35
Pan	Desktop	0.36
Pan	Desktop	0.36
Pan	Desktop	0.41
Pan	Field Verified	0.45
Pan	Desktop	0.45
Pan	Desktop	0.46
Pan	Field Verified	0.51
Pan	Desktop	0.58
Pan	Field Verified	0.66
Pan	Desktop	0.72
Pan	Desktop	0.80
Pan	Desktop	0.85
Pan	Desktop	0.95
Pan	Field Verified	1.29
Pan	Field Verified	1.31
Pan	Desktop	1.61
Pan	Desktop	1.81
Pan	Field Verified	2.12
Pan	Field Verified	2.79
Dam	Field Verified	6.83
Pan	Field Verified	26.88
Channelled Valley bottom	Field Verified	30.63
Sandloop River	Field Verified	235.47

Total	322.67

Zones of Regulation of 100 m around each wetland have been assigned according to the regulations on use of water for mining and related activities aimed at the protection of water resources (GN 704 in GG 20119 of 4 June 1999). This zone of regulation is deemed appropriate as the buffer width to protect the wetlands on site.

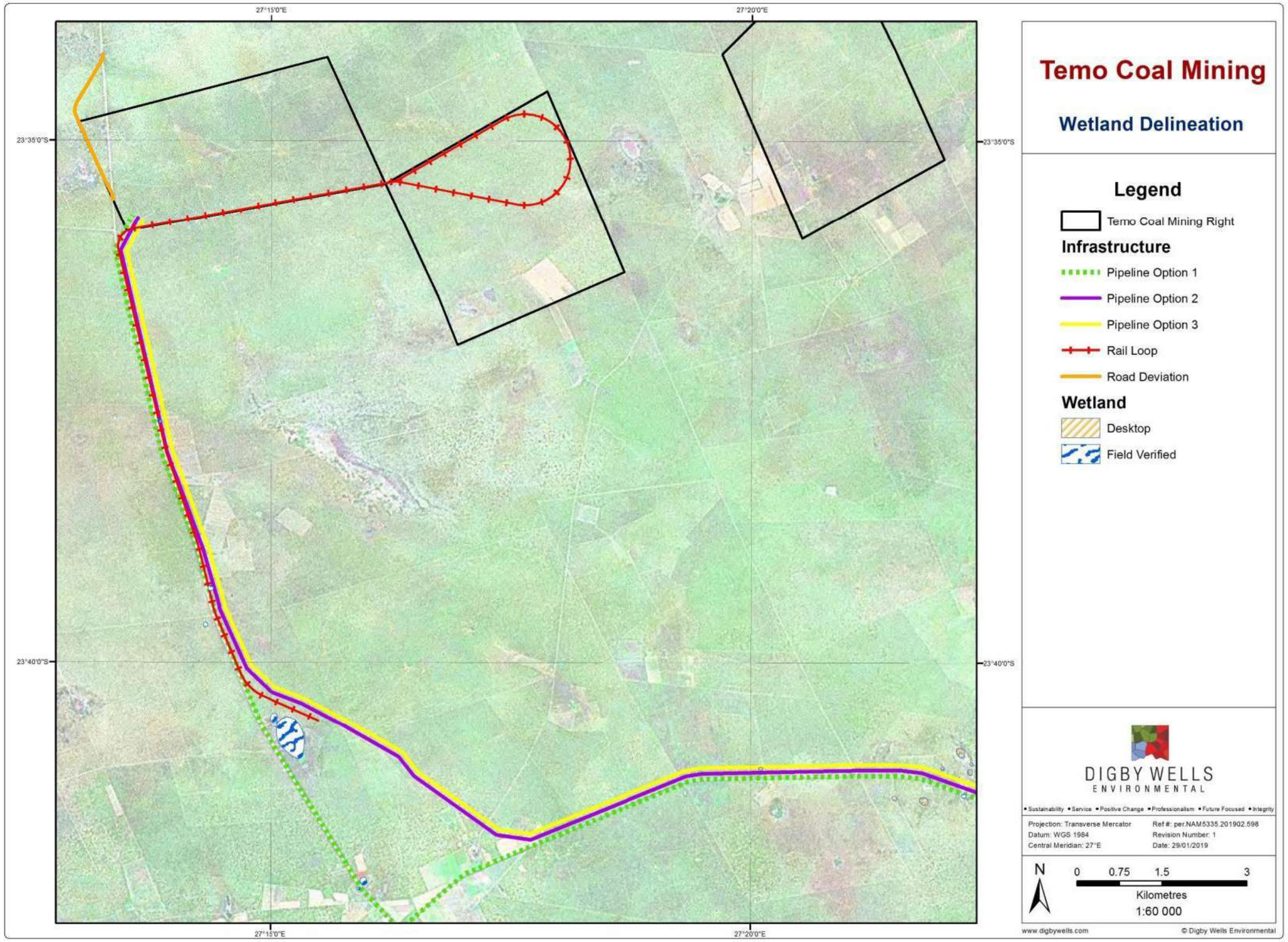


Figure 4-1: Wetland delineation (Section A)

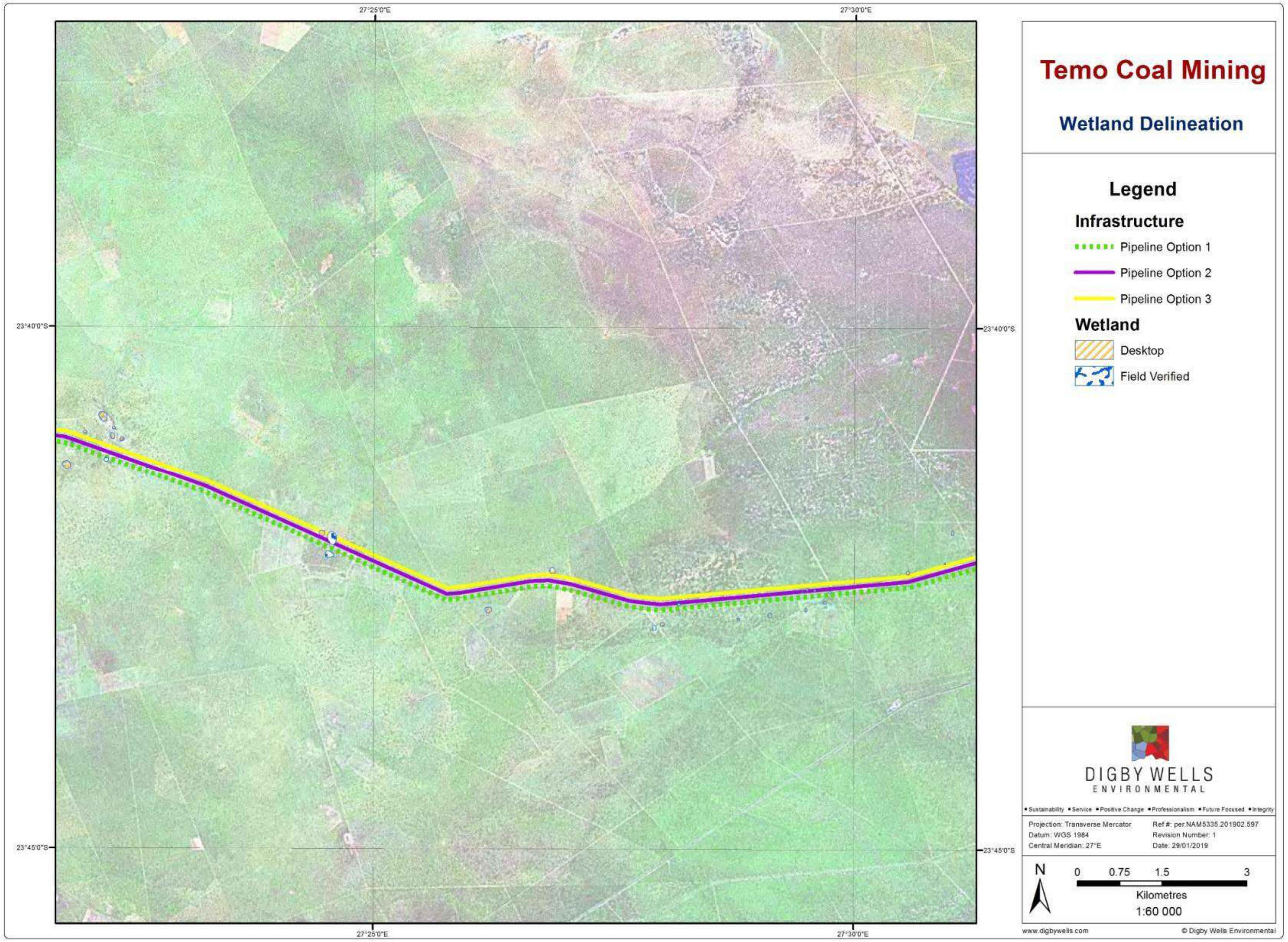


Figure 4-2: Wetland delineation (Section B)

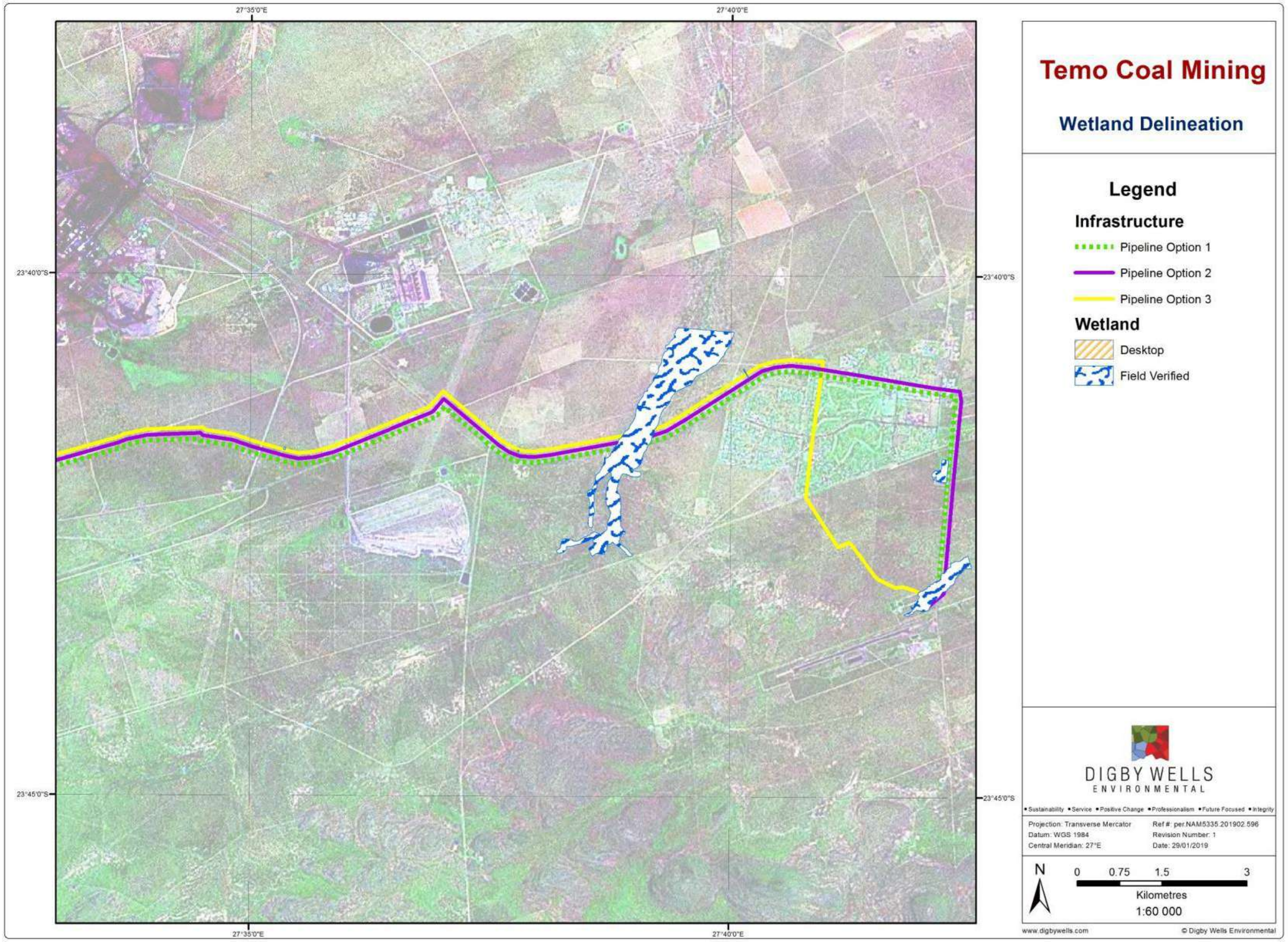


Figure 4-3: Wetland delineation (Section C)

Vegetation diversity was homogenous between the systems and the pans along the pipeline route/s were homogenous in vegetation and structure. In most cases the pans were not vegetated in the centres with grass species, such as *Urochloa mosambicensis, Cenchrus ciliaris, Digitaria eriantha subsp. eriantha, Enneapogon cenchroides, Stipagrostis uniplumis, Bothriochloa radicans* and *Panicum maximum* along the edges. In some cases, there were dense stands of *Senegalia mellifera* and *Dichrostachys cinerea* encircling the pans. Other tree and shrub species included *Grewia flava, Bauhinia petersiana subsp. macrantha, Boscia albitrunca* and *Vachellia (Acacia) nilotica.*

An example of the type of wetland habitat encountered is illustrated in Figure 4-4.

Figure 4-4: Wetland habitat types (A; B: Pans; C: Sandloop system; D: Stormwater outlet)

The Sandloop River, an ephemeral system, is characterised by a sandy channelled area, interspersed with sandstone bedrock with various depressions. Dominant grass species include *Urochloa mosambicensis, Melenis repens* and *Chloris virgata. Grewia flava* and *Acacia nilotica* lined the edges of the system. *Crinum bulbispermum* and various *Cyperus* species were also found within the system.

The channelled valley bottom system was largely impacted by the sewage treatment works, which has impacted on species diversity and structure. *Typha capensis* is the dominant species most likely due to the additional nutrient inputs. Other species also included *Urochloa mosambicensis and Chloris virgata.*

4.3 Present Ecological State (PES)

Due to the large number of pans, these were grouped according to the type of impact for assessment purposes. The pans that have been categorised as Category A (*Natural*) have no visible impacts, aside from trampling associated with grazing activities. This may likely be attributed to general access restrictions on farms or game reserves in the vicinity of the proposed project activities (Figure 4-5).

Figure 4-5: *Natural* pans

The main impacts associated with the pans categorised as Category B (*Largely natural*) included erosion, impacts related to grazing activities and encroachment by *Dichrostachys cinerea* and *Senegalia mellifera*, which although indigenous have the potential to become invasive (Figure 4-6). The hydrology of these systems remained unaffected.

Figure 4-6: *Largely natural* pans

The PES values of pans classified as Category C (*Moderately modified*, Figure 4-7) were affected by the presence of roads, high levels of erosion, and water abstraction, which impacts the hydrology, geomorphic and vegetation characteristics of these systems. In many cases, excessive cattle-grazing activities were noted, which results in trampling impacts and erosion. These activities cause increased sedimentation within the systems due to exposed substrate.

Sedimentation alters the natural hydrological and geomorphological functioning of the wetlands. Impaired water quality may also result from additional loading of phosphates and nitrates.

Figure 4-7:*Moderately modified* pans

The channelled valley bottom wetland (Figure 4-8) was categorised as a Category D (*Largely modified*) due to the large hydrological (increased water input) and geomorphic impacts (impoundments) that the sewage treatment works has on the system. Proliferation of *Typha capensis* indicates a high nutrient load, which is to be expected due to discharges/seepage of water from the Lephalale Municipality's Paarl Sewage Works observed. The road crossing also has an impact on the wetland in the form of ponding upstream and channelisation downstream.

Figure 4-8: Channelled Valley Bottom System

Although, PES calculations are not intended for use in ephemeral river systems, the tool was applied to the Sandloop River to give an indication of the health of the system. The ephemeral system is impacted on by the road crossing as well as various impoundments, which impacts on the geomorphology and hydrology of the system.

Figure 4-9: Sandloop River

Table 4-3 provides the detailed PES scores for the various HGM Units observed. PES scores range from Category A (*Natural*) to Category D (*Largely modified*), whilst Figure 4-10 - Figure 4-12 illustrate the overall PES categories.

Table 4-3: Present Ecological Health Scores

HGM Unit	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Ecological Health Score	PES Score
Pan	0	0.1	0.4	0.11	A
Pan	0	0.5	5.6	1.72	B
Pan	3.5	0.4	1.4	2.01	C
Channelled Valley Bottom	4	5.7	4.2	4.54	D
Sandloop	4	0.3	4.1	2.97	C

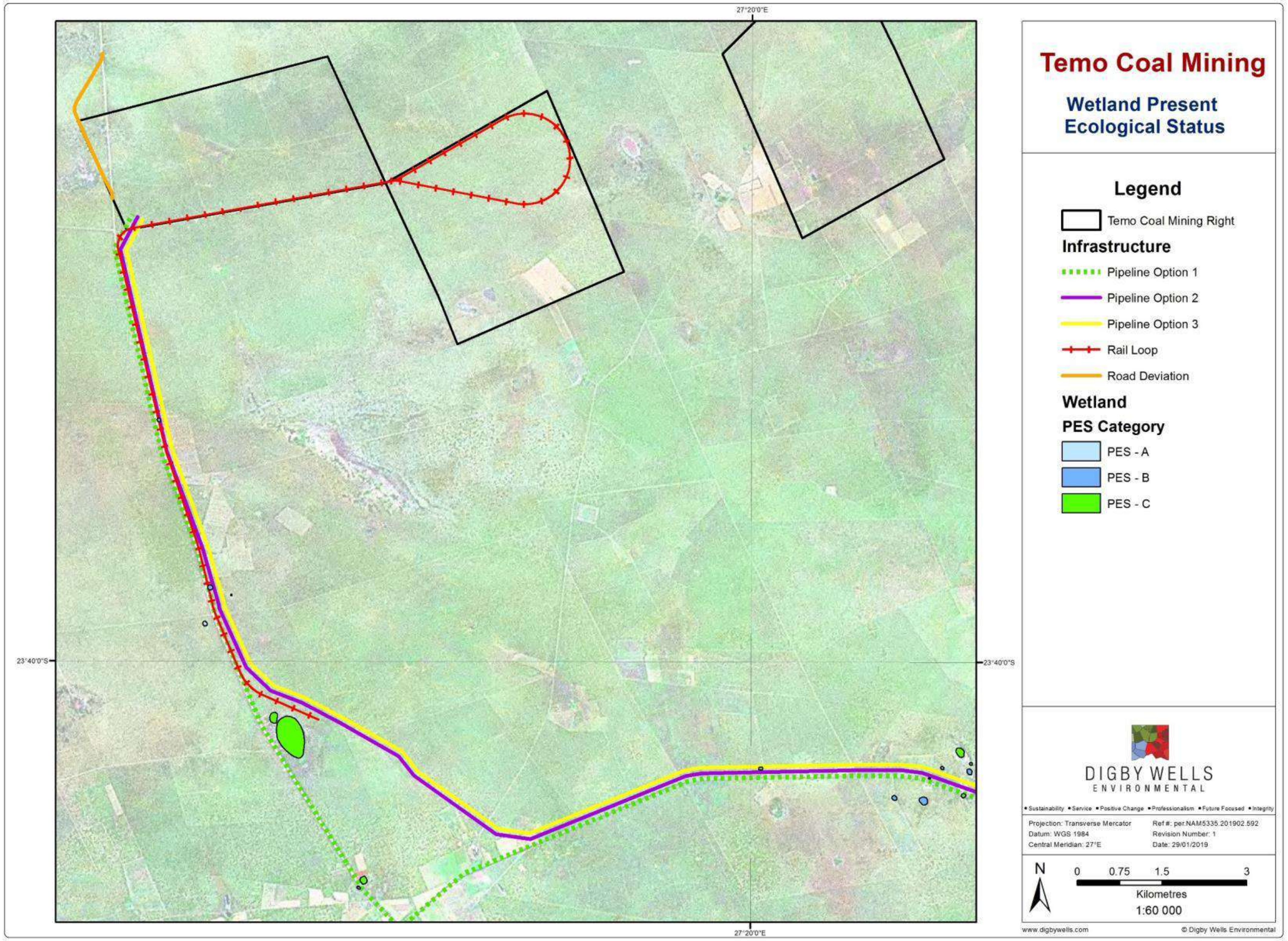


Figure 4-10: Wetland PES values (Section A)

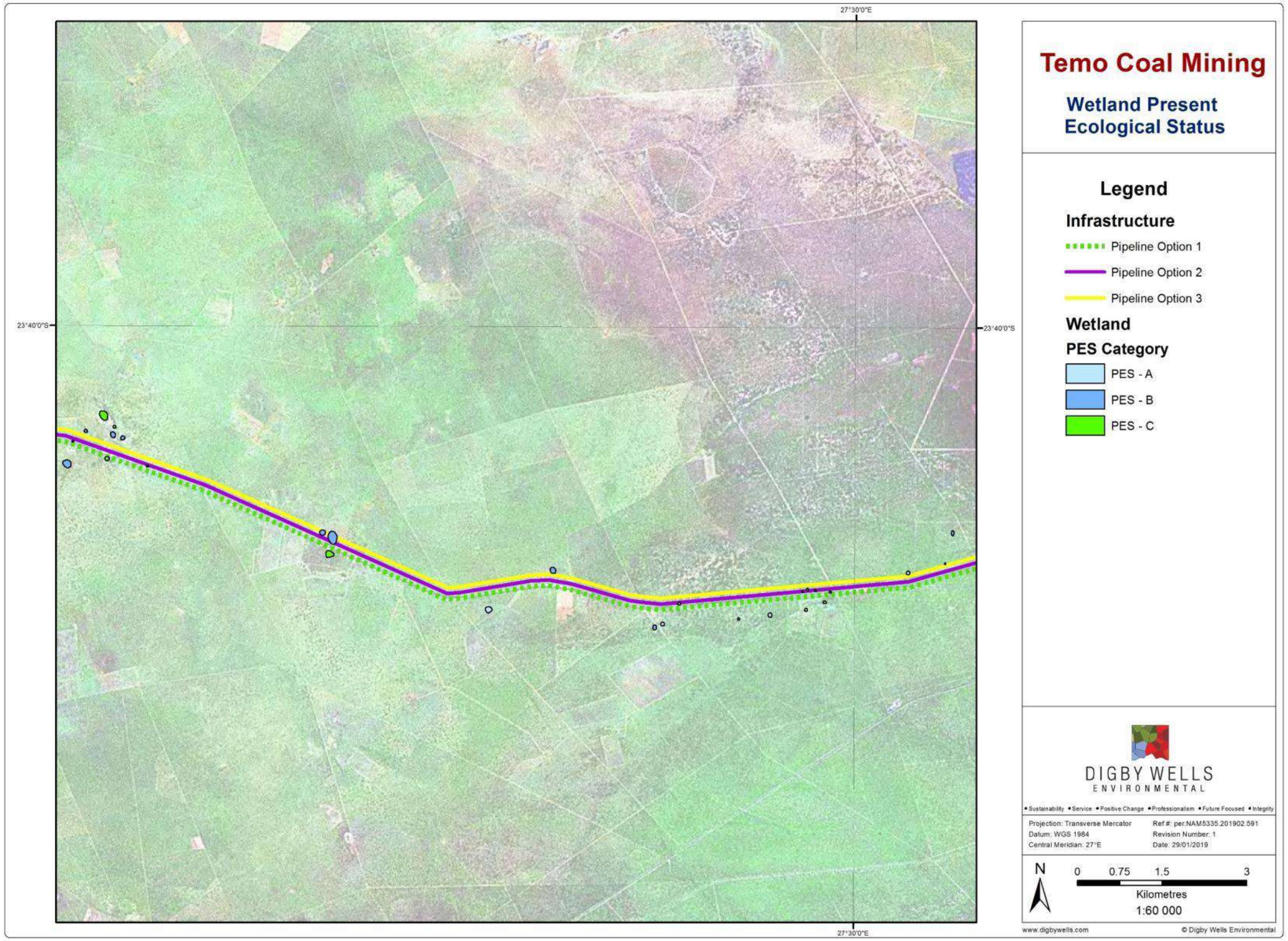


Figure 4-11: Wetland PES values (Section B)

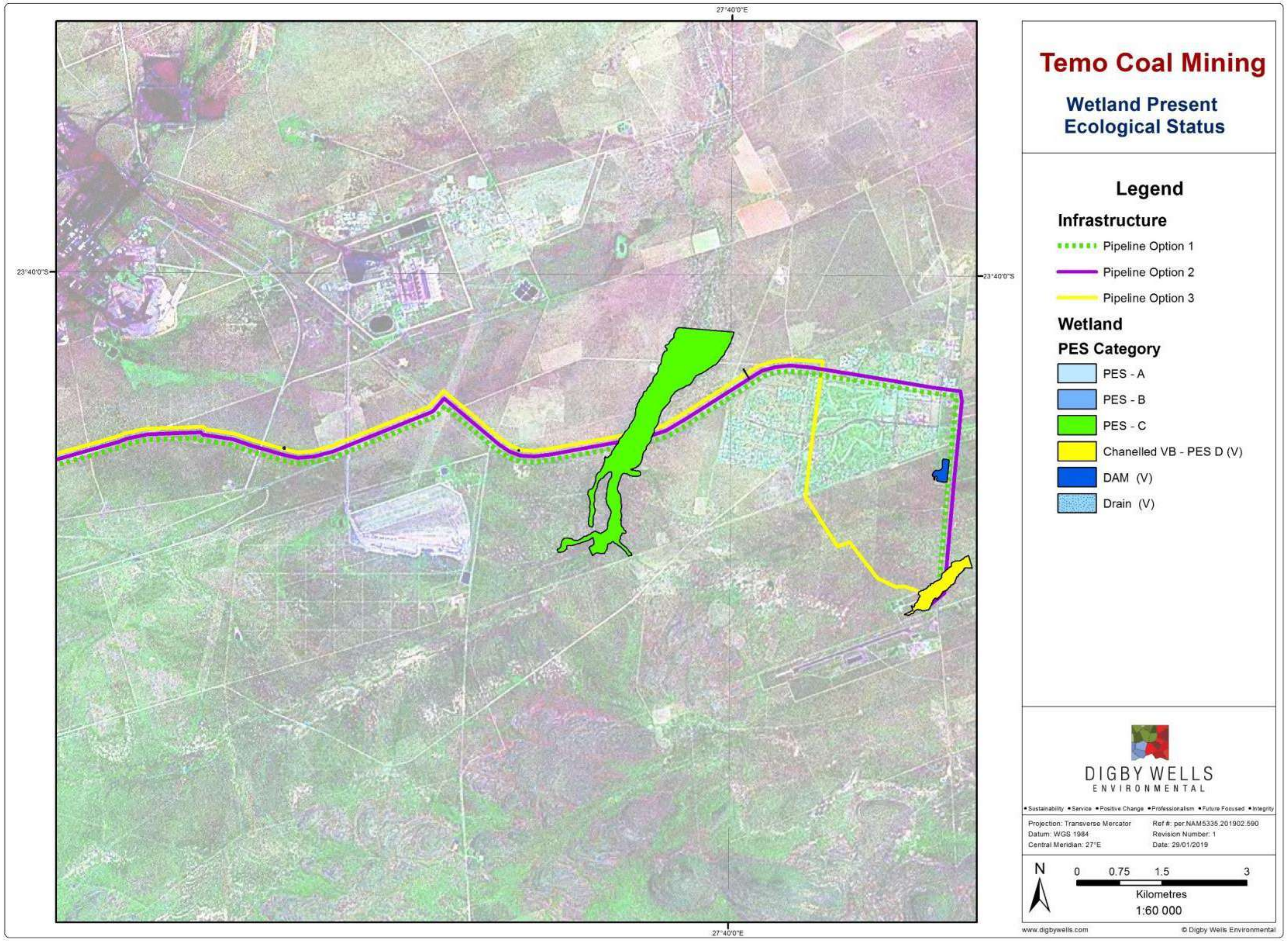


Figure 4-12: Wetland PES values (Section C)

4.4 Ecological Importance and Sensitivity

Table 4-4 indicates the EIS scores for the various HGM Units with the final EIS scores ranging from 1.8 (Moderate) to 2.4 (High).

Table 4-4: EIS Scores

HGM Unit	Ecological Importance & Sensitivity	Hydrological/Functional Importance	Direct Human Benefits	Final EIS Score	Final EIS Category
Pipelines (2019)					
Pan A	2.4	0.8	1	2.4	High
Pan B	2.4	0.8	1.3	2.4	High
Pan C	1.8	0.6	1.3	1.8	Moderate
Channelled Valley Bottom	1.8	2.1	0.7	2.1	High
Sandloop	2	0.5	0.7	2	Moderate

The majority of the pans had high biodiversity scores as they are providing habitat for various plant and animal species. Hydrological importance values were low due to the nature of the HGM unit type and direct human benefits were moderate (higher for the pans where water abstraction was observed). The channelled valley bottom scores highly with regards to hydrological importance and function as it is playing a role in phosphate, nitrate and toxicant removal due to the input of sewage.

Although, EIS calculations are not intended for use in ephemeral river systems, the tool was applied to the Sandloop River to give an indication of the ecological importance of the system. It predominantly provides habitat and services for humans, but hydrological importance is low as water is not retained for long periods in the system and therefore there is no assimilation of nutrients of streamflow regulation capabilities.

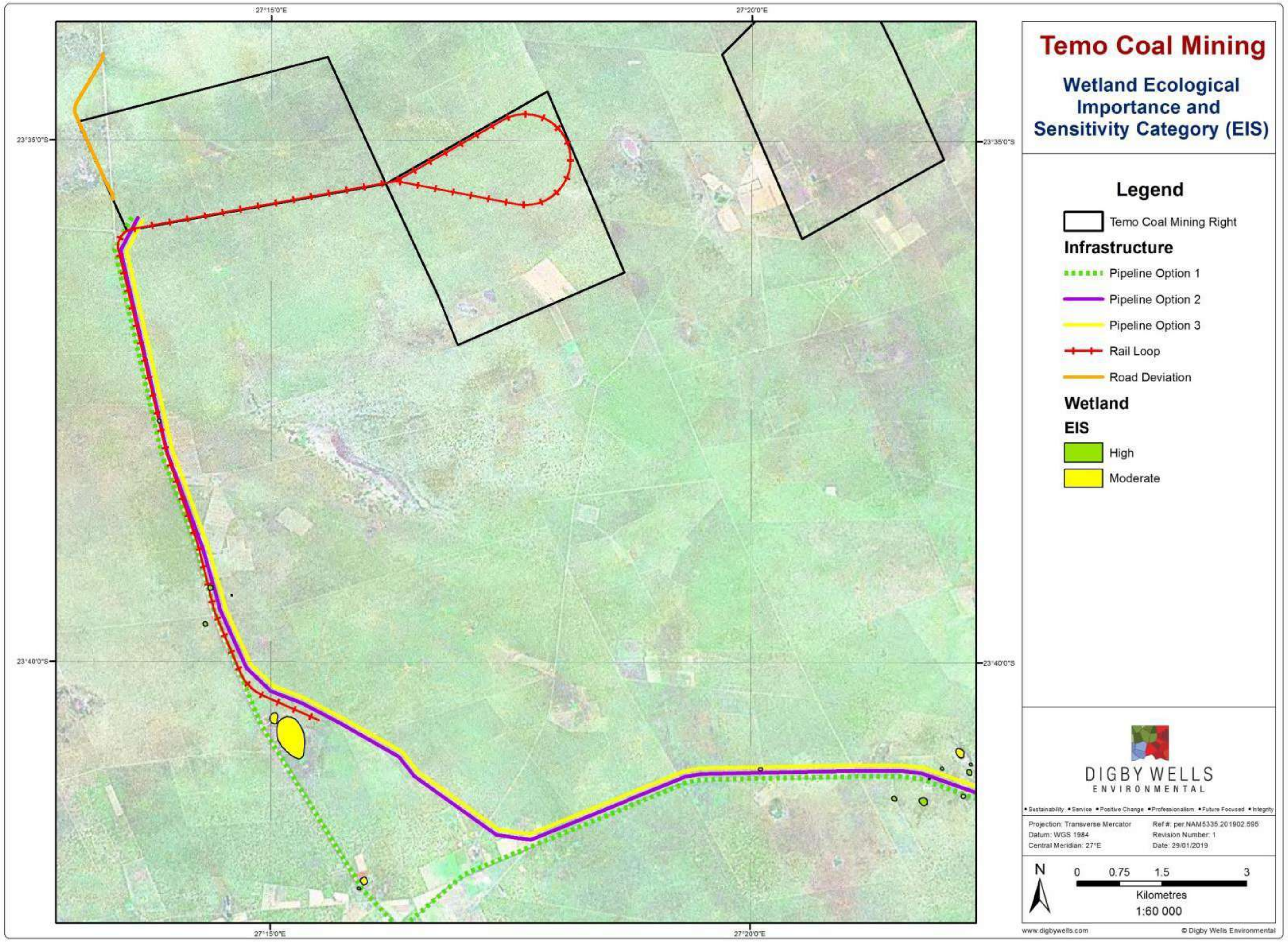


Figure 4-13: Wetland EIS values (Section A)

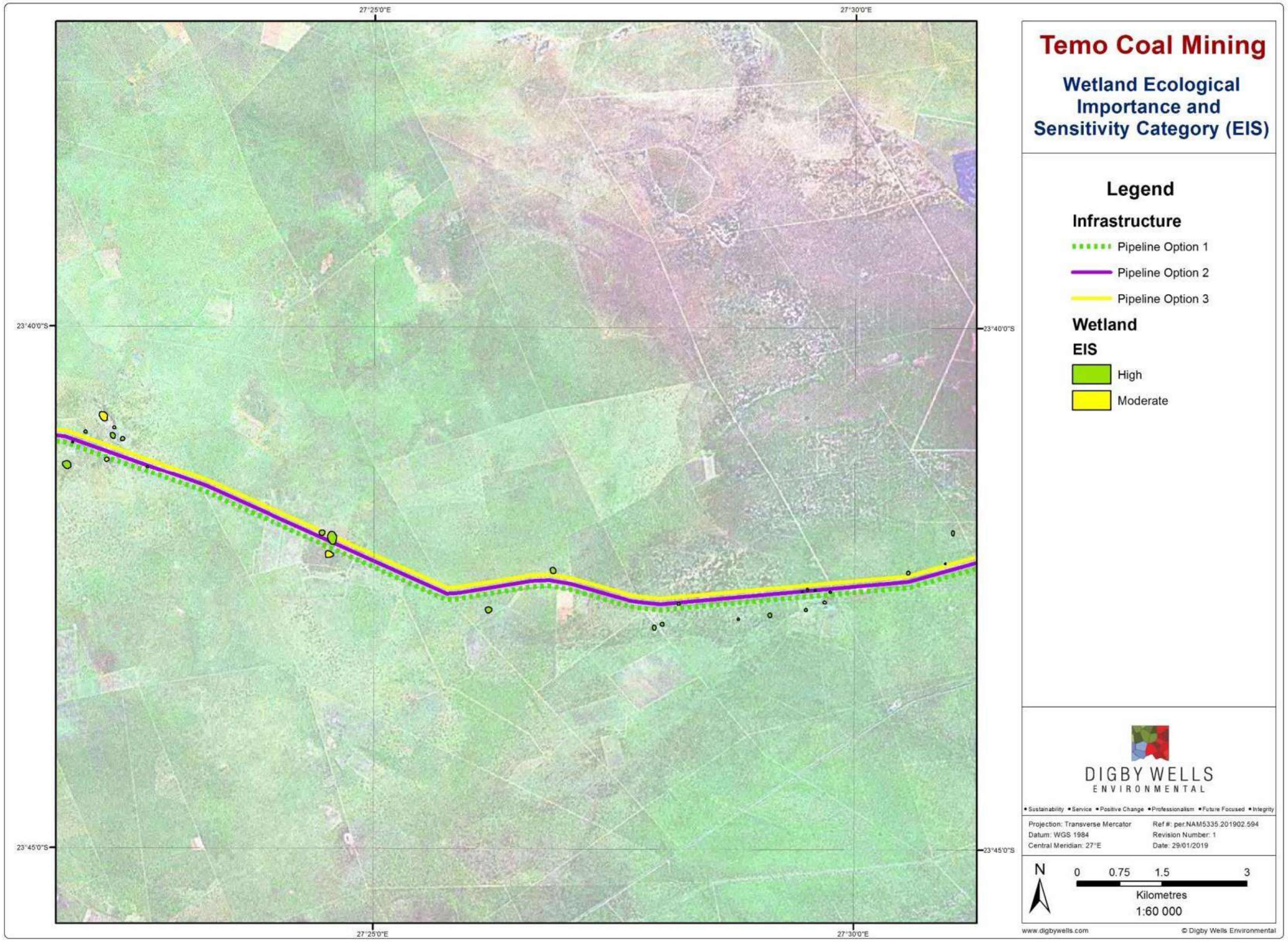


Figure 4-14: Wetland EIS values (Section B)

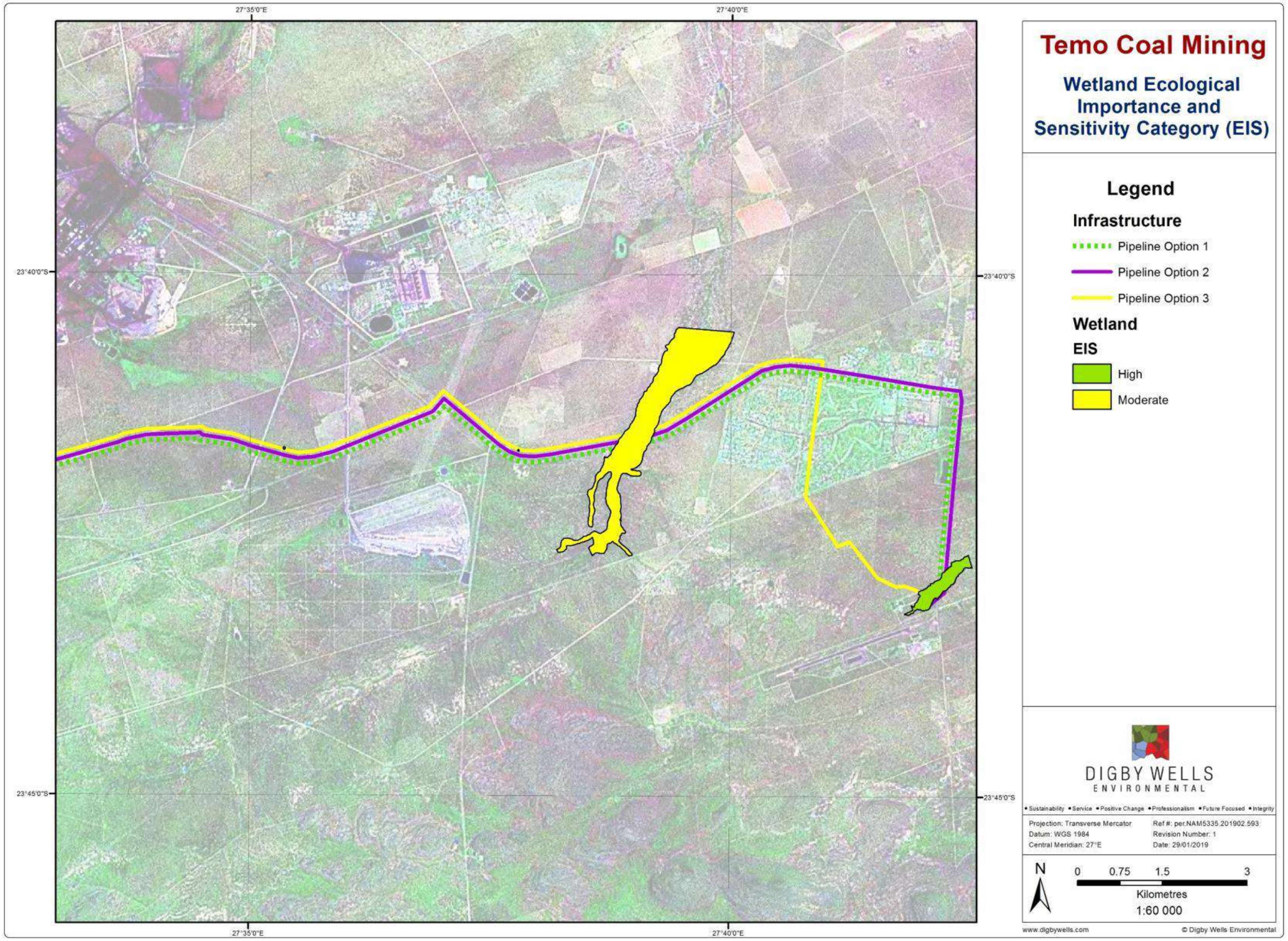


Figure 4-15: Wetland EIS values (Section C)

5 Impact Assessment

Any development in a natural system will impact on the surrounding environment, usually in a negative way. The purpose of this section of the report is to identify and assess the significance of the impacts likely to arise during the project, and provide a short description of the mitigation required to limit the magnitude of the potential impact of the proposed activity and/or development on the natural environment.

5.1 Assessment Criteria

The potential bio-physical impacts likely to affect aquatic ecosystem functionality were assessed without mitigation measures and after the hypothetical implementation of the recommended mitigation measures, which aim at enhancing positive impacts and minimising negative impacts. It is important to note that the pre-mitigation rating takes into consideration the activity as proposed (i.e. there may already be certain types of mitigation measures included in the proposed design layout) and as such, if the potential impact is still considered too high, additional recommendations are proposed and/or fatal flaws to the design are flagged for further investigation.

Based on the established impact/risk assessment formula, details of the impact assessment methodology used to determine the significance of each of the identified impacts expected within the study area is provided below:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

Nature = Positive (+1) or negative (-1) impact

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts

The impact assessment matrix calculates the rating out of 147 (Table 5-2), whereby the *intensity*, *extent*, *duration* and *probability* are each rated according to Table 5-1, which is then categorised into one of the eight significance categories, as shown in Table 5-3. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Table 5-1: Parameter ratings and descriptions for the impact assessment determination

Rating	Intensity/Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources, and/or highly sensitive environments.	Noticeable, on-going benefits, have improved the overall conditions of the baseline.	**International:** The effect will occur across international borders.	**Permanent:** The impact is irreversible, even with management, and will remain after the life of the project.	**Definite:** There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources, and/or moderately sensitive environments.	Great improvement to the overall conditions of a large percentage of the baseline.	**National:** Will affect the entire country.	**Beyond project life:** The impact will remain for some time after the life of the project and is potentially irreversible even with management.	**Almost certain/Highly probable:** It is most likely that the impact will occur. <80% probability.
5	Serious loss or damage to biological or physical resources, and/or highly sensitive environments, limiting ecosystem function.	On-going and widespread benefits to local communities and natural features of the landscape.	**Province/Region:** Will affect the entire province or region.	**Project Life (>15 years):** The impact will cease after the operational life span of the project and can be reversed with sufficient management.	**Likely:** The impact may occur. <65% probability.

Rating	Intensity/Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
4	Serious loss or damage to biological or physical resources or moderately sensitive environments, limiting ecosystem function.	Average-to-intense benefits to some elements of the baseline.	**Municipal:** Will affect the whole municipal area.	**Long term:** 6-15 years and impact can be reversed with management.	**Probable:** Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	**Local:** Local extending only as far as the development site area.	**Medium term:** 1-5 years and impact can be reversed with minimal management.	**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. <25% probability.
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	Low positive impacts experience by a small percentage of the baseline.	**Limited:** Limited to the site and its immediate surroundings.	**Short term:** Less than 1 year and is reversible.	**Rare/Improbable**: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning.	Some low-level benefits felt by a very small percentage of the baseline.	**Very limited/Isolated:** Limited to specific isolated parts of the site.	**Immediate:** Less than 1 month and is completely reversible without management.	**Highly unlikely/None:** Expected never to happen. <1% probability.

Table 5-2: Probability/Consequence Matrix

Probability	Significance																																					
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Consequence	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Table 5-3: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
33	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

5.2 Potential Impacts Identified

The potential impacts to the wetlands and freshwater resources present were assessed considering the three phases of the life of the project: the construction, operation and decommissioning and closure phases and are further described in Table 5-4. The infrastructure associated with the project area includes:

- Pipeline Option 1
- Pipeline Option 2
- Pipeline Option 3
- Rail loop; and
- Road deviation.

Table 5-4: Project Activities

Activity	Phase of Project
Site clearing and increased vehicular movement within the project area; construction of infrastructure including road, rail loop and pipeline	Construction phase
Operational activities, including movement of coal, production of ash and other waste, deposition of ash to the waste dump, operation of railway siding, etc.; increased vehicular movement and thoroughfare.	Operational phase
Removal and decommissioning of all surface infrastructures; Rehabilitation of affected areas	Decommissioning and closure phase

It should be noted that in light of the relatively large distance (>3 kms) that the proposed infrastructure is situated to the other notable riverine systems within the area (i.e. Limpopo and Mokolo rivers), as well as the limited surface runoff and high evaporation potential within the area, it is the opinion of the author/s of the report that the proposed infrastructure is likely to have an insignificant affect upon the Limpopo and/or the Mokolo rivers and as such, these area have been excluded from the impact assessment process.

5.3 Construction Phase

5.3.1 Impact Description

The main activities during the construction phase that could result in impacts to the freshwater ecology of the area include site clearing, soil disturbances, topsoil stockpiling, storage and dumping of construction materials, compaction of soils and crossing of the wetland and river systems.

Associated impacts include erosion and sedimentation, the potential loss of biodiversity and habitat, fragmentation of the systems present and potential loss of catchment yields and surface water recharge to the systems further downstream. Among the impacts associated with the proposed construction phase are minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons. Larger impacts include compaction of soils, potential loss of vegetation and the increased potential for erosion and sedimentation in the vicinity of any cleared areas and resulting in impacts further downstream. Removal of vegetation and disturbance of soils in the vicinity of the construction footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and Alien Invasive Plants (AIPs), further altering the natural vegetation profiles of the freshwater resources encountered in the vicinity of the project footprint.

Table 5-5 summarises potential impacts to the freshwater ecology identified during the construction phase

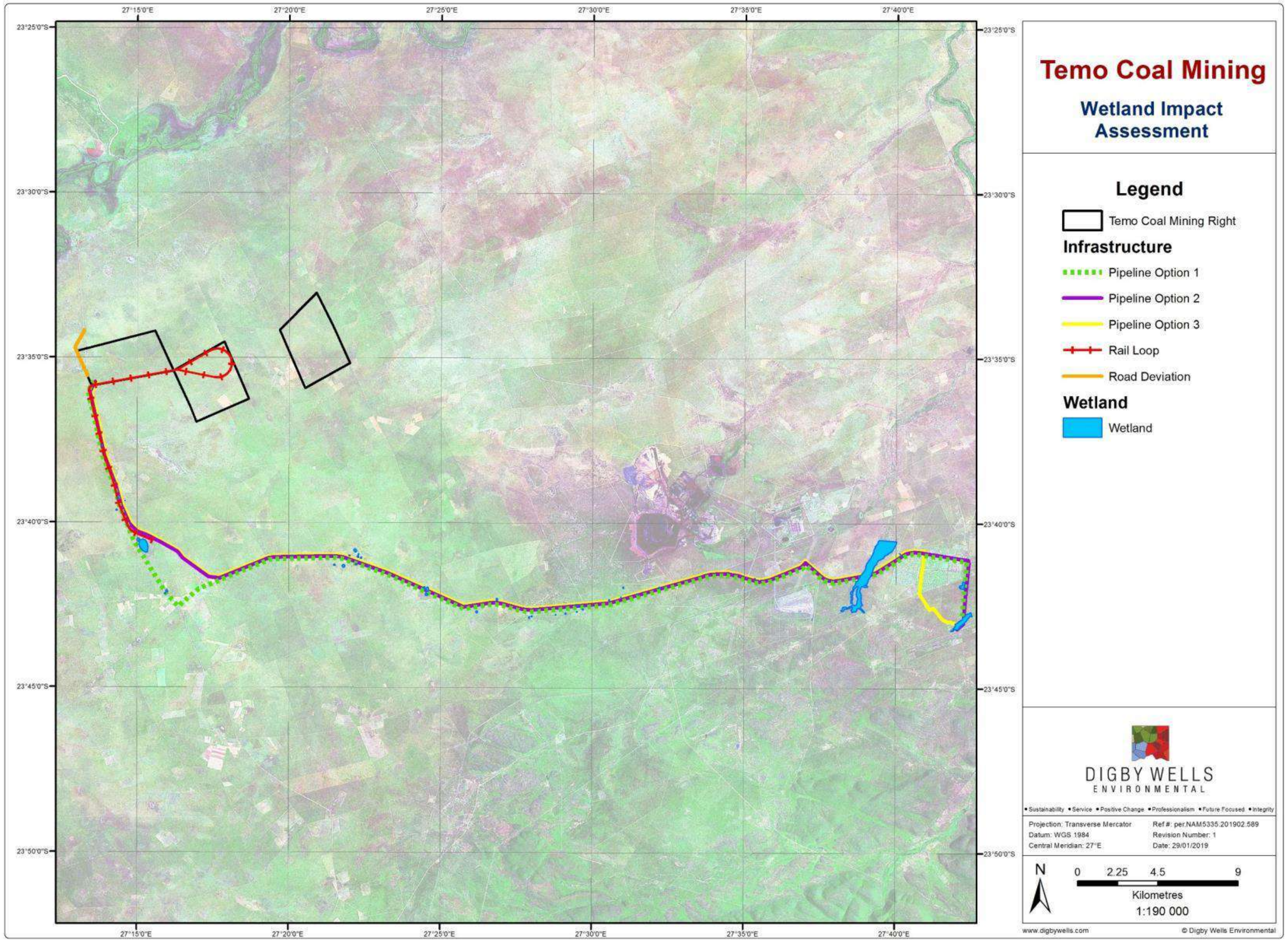


Figure 5-1: Wetland Impact Assessment

Table 5-5: Impact assessment parameter ratings for the construction phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: Removal of vegetation and topsoil, site clearing and excavation activities ***Impact Nature*** ▪ **Direct loss of wetland and other freshwater habitat for infrastructure and the various proposed activities.** ▪ **Loss of connectivity (i.e. in the Sandloop River and the channelled valley bottom system).** ▪ **Onset of erosion.** ▪ **Sedimentation and the potential for the establishment of alien hydrophytic and terrestrial plant species.** ▪ **Deterioration of wetland PES and provision of ecosystem services.**			
Prior to Mitigation/Management			
Duration	Project Life (5)	The impact will cease after the life of the project has been completed.	Minor (negative) – 55
Extent	Local (3)	Increased erosion and general scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect the immediate watercourses.	
Intensity	Moderate environmental effects (3)	Due to the flat terrain and nature of the systems (mostly pans), should no management or mitigation measures be employed, activities could result in moderate medium-term impacts.	
Probability	Likely (5)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered likely.	
Nature	Negative		

Dimension	Rating	Motivation	Significance
Post-Mitigation			
Duration	Project Life (5)	The impact will cease after the life of the project has been completed and rehabilitation has taken place.	Minor (negative) - 40
Extent	Limited (2)	Impacts will be limited only to the local area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity	Minor effects on the biological or physical environment (2)	Should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Probable (4)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still considered probable.	
Nature	Negative		

Table 5-6: Impact assessment parameter ratings for the construction phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: ***Stockpiling and storage of construction materials*** ***Impact Nature*** ▪ **Soil compaction and loss of freshwater habitat areas.** ▪ **Onset of erosion.** ▪ **Sedimentation and the potential for the establishment of alien hydrophytic and terrestrial plant species.** ▪ **Deterioration of wetland PES and provision of ecosystem services.**			
Prior to Mitigation/Management			
Duration	Medium term (3)	The impact will cease after construction has been completed.	Minor (negative) – 45
Extent	Local (3)	Increased erosion and general scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect the immediate watercourses.	
Intensity	Moderate environmental effects (3)	Due to the flat terrain and nature of the systems (mostly pans), should no management or mitigation measures be employed, activities could result in moderate medium-term impacts.	
Probability	Likely (5)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered likely.	
Nature	Negative		
Post-Mitigation			

Dimension	Rating	Motivation	Significance
Duration	Short term (2)	The impact will cease after construction has been completed and any leftover material has been removed.	Negligible (negative) - 24
Extent	Limited (2)	Impacts will be limited only to the local area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity	Minor effects on the biological or physical environment (2)	Should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Probable (4)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still considered probable.	
Nature	Negative		

Table 5-7: Impact assessment parameter ratings for the construction phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: Chemical spills associated with construction activities ***Impact Nature*** ▪ **Impaired water quality** ▪ **Deterioration of wetland PES and provision of ecosystem services.**			
Prior to Mitigation/Management			
Duration	Medium term (3)	The impact will cease after 1-5 years after construction.	Minor (negative) – 45
Extent	Local (3)	Degraded habitat due to water quality deterioration will affect the immediate watercourses.	
Intensity	Moderate environmental effects (3)	Due to the flat terrain and nature of the systems (mostly pans), should no management or mitigation measures be employed, activities could result in moderate medium-term impacts.	
Probability	Likely (5)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered likely.	
Nature	Negative		
Post-Mitigation			
Duration	Short term (2)	The impact will cease after construction has been completed and any contamination has been removed.	Negligible (negative) - 24

Dimension	Rating	Motivation	Significance
Extent	Limited (2)	Impacts will be limited only to the local area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity	Minor effects on the biological or physical environment (2)	Should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Probable (4)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still considered probable.	
Nature	Negative		

5.3.2 Construction Phase Mitigation and Management Measures

The following mitigation and management measures have been prescribed for the construction phase:

- Construction activities should be restricted to the road servitude to limit impacts to the system as a result of vegetation clearing and compaction of soils;
- Stockpiling of soil during the burying of the pipeline should not be placed within wetlands and should be replaced as soon as possible to reduce sedimentation and fragmentation of the systems;
- Ensure that there is no impoundment or ponding of water of the ephemeral system and the channelled valley bottom system;
- Ensure that no incision and canalisation of the ephemeral drainage lines present takes place;
- Ensure a soil management programme is implemented and maintained to minimise erosion and sedimentation;
- Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction;
- Implement and maintain an alien vegetation management programme. This must be put in place so as to prevent further encroachment by invasive species as a result of disturbance to the surrounding terrestrial zones;
- Limit the footprint area of the construction activities to what is absolutely essential in order to minimise impacts (all areas but critically so in freshwater areas);
- If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated;
- All erosion noted within the construction footprint should be remedied immediately and included as part of an ongoing rehabilitation plan;
- Permit only essential personnel within the 100 m zone of regulation for all freshwater features identified;
- All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel;
- No unnecessary crossing of the freshwater features and their associated buffers should take place and the substrate conditions of the ephemeral drainage lines and downstream stream connectivity must be maintained;
- No material may be dumped or stockpiled within any freshwater features;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the construction footprint;

- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly; and
- Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate waste facility.

5.4 Operational Phase

5.4.1 Impact Description

The main activities during the operational phase that could result in impacts to the freshwater ecology of the area are associated with the storm water management systems, maintenance and operational activities, including movement of coal, production of ash and other waste, deposition of ash to the waste dump, operation of railway siding, increased vehicular movement and thoroughfare, waste management of soils and crossing of the wetland and river systems.

Associated impacts include loss of catchment yield and surface water recharge, erosion and sedimentation, the potential loss of biodiversity and habitat and further fragmentation of the systems present. Further to this, the potential for ongoing contamination of the wetland systems and other freshwater resources present are deemed likely based on the ingress of hydrocarbons associated with increased vehicular activity. Removal of indigenous vegetation is likely to give rise to an increased potential for encroachment by robust pioneer species and AIPs, further altering the natural vegetation profiles of the freshwater resources encountered in the vicinity of the project footprint. Hardened surfaces have the potential to result in sheet runoff and there is likely to be a loss in wetland service provision in terms of flood attenuation, sediment trapping and assimilation of toxicants and other pollutants. Storage of water, which is an important service, provided by wetlands in this area, will be compromised. Further alterations to the natural flow regimes will take place and is likely to result in the creation of preferential flow paths over time.

Table 5-8 summarises potential impacts to the freshwater ecology identified during the operational phase.

Table 5-8: Impact assessment parameter ratings for the operational phase

Dimension	Rating	Motivation	Significance
Operational and maintenance activities **Impact Nature** ▪ **Increased vehicular movement along wetlands and riparian zones, resulting in increased sedimentation and potential for onset of erosion.** ▪ **Physical disturbance of soil in wetlands resulting in erosion and sedimentation as a result of recreational activities.**			
Prior to Mitigation/Management			
Duration	Project Life (5)	The impact will cease the after the project has been completed.	Minor (negative) – 55
Extent	Local (3)	Increased erosion and general scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect the immediate watercourses.	
Intensity	Moderate environmental effects (3)	Due to the fact that the project falls mainly within a road servitude, activities could result in only moderate medium-term impacts.	
Probability	Likely (5)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered likely.	
Nature	Negative		
Post-Mitigation			
Duration	Project Life (5)	The impact will cease the after the project has been completed.	Negligible (negative) - 36

Dimension	Rating	Motivation	Significance
Extent	Limited (2)	Impacts will be limited only to the local area and will be rehabilitated accordingly on completion of the operational phase.	
Intensity	Minor effects on the biological or physical environment (2)	Should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Probable (4)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still considered probable.	
Nature	Negative		

Table 5-9: Impact assessment parameter ratings for the operational phase

Dimension	Rating	Motivation	Significance
Operation of the rail loop **Impact Nature** ▪ **Contamination due to transport of the coal.**			
Prior to Mitigation/Management			
Duration	Project Life (5)	The impact will continue for longer than 15 years if not mitigated appropriately.	Minor (negative) – 66

Dimension	Rating	Motivation	Significance
Extent	Local (3)	Degraded habitat due to water quality deterioration and soil contamination will affect the immediate watercourses.	
Intensity	Moderate environmental effects (3)	Due to the flat terrain and nature of the systems (mostly pans), should no management or mitigation measures be employed, activities could result in moderate medium-term impacts.	
Probability	Highly probable (6)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered likely.	
Nature	Negative		
Post-Mitigation			
Duration	Short term (2)	The impact will cease soon after contamination is removed	Negligible (negative) - 24
Extent	Limited (2)	Impacts will be limited only to the local area and will be discovered and rehabilitated during the monitoring of the operational phase.	
Intensity	Minor effects on the biological or physical environment (2)	Should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Probable (4)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still considered probable.	
Nature	Negative		

Table 5-10: Impact assessment parameter ratings for the operational phase

Dimension	Rating	Motivation	Significance
Hardened surfaces, sheet runoff and separation of clean and dirty water ***Impact Nature*** ▪ **Onset of erosion.** ▪ **Loss of catchment yield and surface water recharge**			
Prior to Mitigation/Management			
Duration	Project Life (5)	The impact will continue for longer than 15 years if not mitigated appropriately.	Minor (negative) – 66
Extent	Local (3)	Increased erosion and general scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect the immediate watercourses.	
Intensity	Moderate environmental effects (3)	Due to the flat terrain and nature of the systems (mostly pans), should no management or mitigation measures be employed, activities could result in moderate medium-term impacts.	
Probability	Highly probable (6)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered likely.	
Nature	Negative		
Post-Mitigation			
Duration	Short term (4)	The impact will continue between 6 and 15 years	Negligible (negative) - 32

Dimension	Rating	Motivation	Significance
Extent	Limited (2)	Impacts will be limited only to the local area and will be discovered and rehabilitated during the monitoring of the operational phase.	
Intensity	Minor effects on the biological or physical environment (2)	Should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Probable (4)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still considered probable.	
Nature	Negative		

5.4.2 Operational Phase Mitigation and Management Measures

The following mitigation and management measures have been prescribed for the operational phase:

- Any contamination from the rail loop should be remedied as soon as possible and disposed of at the appropriate waste facility;
- Ensure that as far as possible all operational infrastructures are placed outside of freshwater areas and their associated 100 m zone of regulation;
- Limit the footprint area of the operational activities to what is absolutely essential in order to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas);
- If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated;
- Ensure that no incision and canalisation of the freshwater features present takes place as a result of the proposed operational activities;
- All erosion noted within the operational footprint as a result of any potential surface activities should be remedied immediately and included as part of the ongoing rehabilitation plan;
- A suitable AIP control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones;
- Permit only essential personnel within the 100 m zone of regulation for all freshwater features identified;
- All areas of increased ecological sensitivity should be designated as "No-Go" areas and be off limits to all unauthorised vehicles and personnel;
- No unnecessary crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained;
- No material may be dumped or stockpiled within any of the ephemeral drainage lines in the vicinity of the proposed operational footprint;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads;
- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly;

- Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate waste facility;
- Monitor all systems for erosion and incision.

5.5 Decommissioning and Closure Phase

5.5.1 Impact Description

This phase is characterised by the decommissioning and closure of the mine and associated infrastructure. Among the impacts associated with the proposed decommissioning phase are minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the decommissioning activities.

Larger impacts include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas, resulting in impacts further downstream.

Any temporary storage or dumping of decommissioned infrastructure within freshwater areas or any of the ephemeral drainage lines, has the potential to result in loss of stream connectivity, loss of refuge areas, alterations to the terrain profiles of the areas and the creation of preferential flow paths, which may result in sedimentation, alterations to the vegetation structure of the area, encourage alien vegetation encroachment and result in increased erosion and sedimentation potentials.

Removal of vegetation and disturbance of soils in the vicinity of the decommissioning footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and AIPs, further altering the natural vegetation profiles of the freshwater resources encountered in the vicinity of the decommissioning footprint.

Table 5-11 summarises potential freshwater impacts identified during the decommissioning and closure phase.

Table 5-11: Impact assessment parameter ratings for the decommissioning and closure phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: Decommissioning of infrastructure ***Impact Nature*** ▪ **Onset of erosion.** ▪ **Sedimentation and the potential for the establishment of alien hydrophytic and terrestrial plant species.** ▪ **Deterioration of wetland PES and provision of ecosystem services.**			
Prior to Mitigation/Management			
Duration	Project Life (5)	The impact will cease after the life of the project.	Minor (negative) – 55
Extent	Local (3)	Increased erosion and general scouring from sedimentation, as well as compaction from moving machinery and degraded habitat due to water quality deterioration will affect the immediate watercourses.	
Intensity	Moderate environmental effects (3)	Due to the flat terrain and nature of the systems (mostly pans), should no management or mitigation measures be employed, activities could result in moderate medium-term impacts.	
Probability	Likely (5)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered likely.	
Nature	Negative		
Post-Mitigation			

Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	The impact will cease after the life of the project has been completed and rehabilitation has taken place.	Minor (negative) - 36
Extent	Limited (2)	Impacts will be limited only to the local area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity	Minor effects on the biological or physical environment (2)	Should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Probable (4)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still considered probable.	
Nature	Negative		

Table 5-12: Impact assessment parameter ratings for the decommissioning and closure phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: Rehabilitation of areas where infrastructure has been removed ***Impact Nature*** ▪ **Onset of erosion.** ▪ **Sedimentation and the potential for the establishment of alien hydrophytic and terrestrial plant species.** ▪ **Deterioration of wetland PES and provision of ecosystem services.**			

Dimension	Rating	Motivation	Significance
Prior to Mitigation/Management			
Duration	Project Life (5)	The impact will cease after the life of the project has been completed.	Minor (negative) – 55
Extent	Local (3)	Increased erosion and general scouring from sedimentation, as well as degraded habitat due to water quality deterioration from sloping and shaping will affect the immediate watercourses.	
Intensity	Moderate environmental effects (3)	Due to the flat terrain and nature of the systems (mostly pans), should no management or mitigation measures be employed, activities could result in moderate medium-term impacts.	
Probability	Likely (5)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered likely.	
Nature	Negative		
Post-Mitigation			
Duration	Project Life (5)	The impact will cease after the life of the project has been completed and rehabilitation has taken place.	Minor (negative) - 36
Extent	Limited (2)	Impacts will be limited only to the local area and will be rehabilitated accordingly on completion of the decommissioning phase.	

Dimension	Rating	Motivation	Significance
Intensity	Minor effects on the biological or physical environment (2)	Should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present.	
Probability	Probable (4)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are still considered probable.	
Nature	Negative		

5.5.2 Decommissioning and Closure Phase Mitigation and Management Measures

The following mitigation and management measures have been prescribed for the decommissioning and closure phase:

- Ensure that sound environmental management is in place during the proposed decommissioning phase;
- Ensure that as far as possible all decommissioned infrastructures are placed outside of freshwater areas and their associated 100 m zone of regulation;
- Limit the footprint area of the decommissioning activities to what is absolutely essential in order to minimise impacts as a result of disturbances to soils, compaction of soils and loss of natural vegetation;
- If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated;
- Ensure that no incision and canalisation of the freshwater resources present takes place as a result of the proposed decommissioning activities;
- All erosion noted within the decommissioning area footprint should be remedied immediately and included as part of the ongoing rehabilitation plan;
- A suitable AIP control programme must be put in place for both the decommissioning and closure phases so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones;
- Permit only essential personnel within the zones of regulation for all freshwater features identified;
- All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel;
- Unnecessary crossing of the freshwater features and their associated buffers should not take place and the substrate conditions of the ephemeral drainage lines and downstream stream connectivity must be maintained;
- Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream;
- No material may be dumped or stockpiled within any freshwater areas (or the buffers) in the vicinity of the proposed decommissioning footprint;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the decommissioning area footprint;
- All vehicles must be regularly inspected for leaks;

- Re-fuelling must take place on a sealed surface area away from freshwater systems to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly;
- Appropriate sanitary facilities must be provided for the duration of the decommissioning activities and all waste must be removed to an appropriate waste facility; and
- Monitor all systems for erosion and incision.

5.5.3 Cumulative and Latent Impacts

The proposed infrastructure will not yield much of a cumulative impact as most of the pipeline falls within the road servitude.

6 Monitoring Requirements

Monitoring by a qualified wetland specialist should take place monthly during construction to ensure mitigation measures are adhered to as well as during the decommissioning, rehabilitation and closure phase. The WET-health tool is to be used to re-evaluate PES on an annual basis by a suitably qualified wetland specialist during the operational phase.

The Environmental Control Officer (ECO) must be present on site during construction and must ensure that the river and wetland areas and their associated zones of regulation are clearly demarcated and that no unnecessary clearing of vegetation takes place.

7 Comparison of Alternatives

Closer scrutiny of each of the proposed routes revealed the following:

- Pipeline Route Option 1 was identified as having the largest potential impact of the three proposed routes. A total of 0.26 ha of wetlands will be directly impacted, with 144.71 ha within 500m of this route.
- This is followed by Pipeline Route Option 2, with a total potential impact of 0.15 ha of wetlands that will be directly impacted, with 128.52 ha within 500m of this route.
- Pipeline Route Option 3 may be regarded as having the smallest impact of the three routes. There are a total of 0.09 ha of wetlands that will be directly impacted, with 109.7 ha within 500m of this route.

Pipeline Option 3 is thus the preferred option as it affects the smallest area of wetlands directly and indirectly, with only 0.09 ha directly impacted and 109.7 ha falling within 500m of the route. This, in relation to Option 1, where 0.26 ha of wetlands will be directly impacted, with 144.71 ha within 500m of this route, and Option 2 where 0.15 ha of wetlands will be directly impacted and 128.52 ha within 500m.

8 Conclusion

Digby Wells Environmental was commissioned by Temo Coal Mining (Pty) Ltd to conduct the wetlands specialist studies to inform the EIA for the proposed project.

A total of 49 water courses units were identified in the vicinity of the project area, which are classified predominantly as depression (pan) wetlands. These wetland features cover an area of approximately 322.7 hectares. PES scores range from Category A (Natural) to Category D (Largely modified) and EIS scores range from 1.8 (Moderate) to 2.4 (High).

Impacts of the pipeline routes are minor as a very small area is affected and large portions of the pipelines fall within road servitude. Pipeline Option 3 is the preferred option as it affects the smallest area of wetlands directly and indirectly.

Monitoring by a qualified wetland specialist should take place monthly during construction to ensure mitigation measures are adhered to as well as during the decommissioning, rehabilitation and closure phase. The WET-health tool is to be used to re-evaluate PES on an annual basis by a suitably qualified wetland specialist during the operational phase. During the decommissioning phase wetland monitoring should resume on a monthly basis and for a minimum of three years post-closure.

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