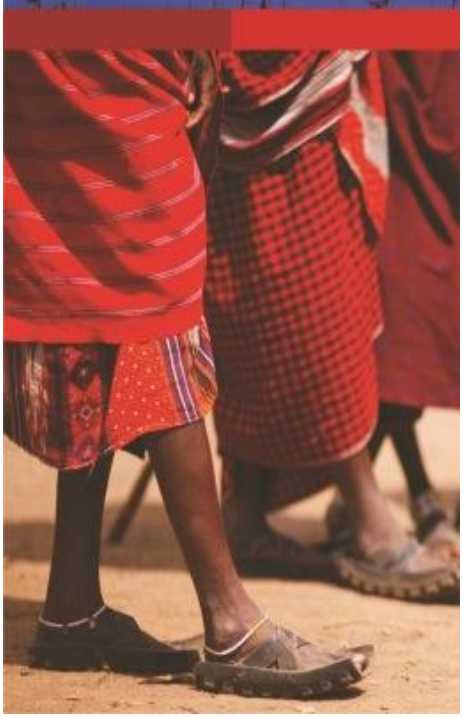

DIGBY WELLS
ENVIRONMENTAL

Wetland Offset and Design

Leeuwpan Coal Mine Wetland Offset Strategy Update

Project Number:

EXX5501

Prepared for:

Exxaro Mpumalanga Coal (Pty) Ltd

January 2019

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Report Type:	**Leeuwpan Coal Mine Wetland Offset Strategy Update**
Project Name:	**Wetland Offset and Design**
Project Code:	**EXX5501**

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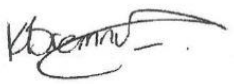
Kieren Bremner Pr. Sci. Nat.	Report Writer		31-01-2019
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EXECUTIVE SUMMARY

Digby Wells Environmental (hereinafter Digby Wells), was appointed by Exxaro Mpumalanga Coal (Pty) Ltd In November 2018 to review and update the Wetland Offset Report compiled by Land Resources International (hereinafter LRI) for the Leeuwpan Coal Mine in Mpumalanga, South Africa. Following this report, LRI submitted an onsite wetland rehabilitation plan for the Leeuwpan Coal Mine's proposed block OI and OL mining development in 2016. Since the submission of the LRI 2016 report, mining of block OI has commenced. Mining of block OL is due to commence on approval of this updated Wetland Offset Report. The Integrated Water Use License (IWUL; no.: 04/B20A/CIJ/4032) for the Exxaro Coal (Pty) Ltd: Leeuwpan Coal Mine OI and OL Expansion was granted provided that wetland offset areas were identified to compensate for the loss of wetlands.

Further to this, an additional pit, Block OI West, has been proposed, the required offsets of which have been included in this report for consideration of inclusion into the Integrated Water Use License. The additional proposed Block OI West, would result in the destruction of 18.36 ha of hillslope seepage wetlands as well as a pan, 2.21 ha in extent.

According to the LRI (2013) report, the wetlands within Block OI were delineated in 2012, with mining activities within Block OI expected to impact on at least 134.62 ha of wetlands (68.4 ha fall within the direct footprint of proposed opencast areas and mining activities within Block OL expected to impact on at least 120.30 ha of wetlands.

On calculation of the hectare equivalents required for the calculation of the required functional and conservation offset targets for both Blocks OI and OL, a total of 87.23 hectare equivalents are expected to be lost. The additional proposed Block OI West will result in an additional loss of 10.51 hectare equivalents. The required functional offset target is thus calculated at 97.7 hectare equivalents and the conservation offset target is 561.4 hectare equivalents.

According to the LRI (2013) report, if it is assumed that the remaining wetlands on site can be rehabilitated so as to increase their present ecological state category by one level, this would imply an approximate 20% gain in functional area. As such, this would result in a gain of about 206.59 hectare equivalents. However, on consideration of the additional loss of wetlands as a result of the proposed Block OI West, the gain would be reduced to 202.48 hectare equivalents.

During the field assessment carried out in December 2018, three portions of wetland that are regarded as destroyed as a result of mining activities were identified as potential sites for rehabilitation. The rationale behind this approach is such that should rehabilitation of these sites be considered, this would provide the potential to restore stream connectivity between upstream and downstream areas that have become fragmented as well as improve the ecological importance and sensitivities of the systems present as a whole. Assuming each of these wetland portions can be rehabilitated to a category E, the direct wetland gain in terms of hectare equivalents may be regarded as 138.29 ha. However, in order to realise both these gains, as well as the 202.48 ha of gains discussed above, it is estimated that a

minimum of 204.10 ha of the surrounding catchment areas will require rehabilitation and a further 87.12 ha of buffers located in selected areas around the mining rights area are recommended to protect the wetlands present and prevent further losses to the wetland systems present. Thus, a total of 631.99 ha have been identified towards achieving the wetland conservation target of 561.4 ha. In terms of functional offset targets, the direct gains in hectare equivalents total 340.77 ha, which may be regarded as more than sufficient to achieve the above-mentioned functional offset target requirement of 97.7 ha.

It must be noted that in terms of the “like-for-like” offset requirement, the conservation offset target falls short of the required hectare equivalents for hillslope seep wetlands, however, consideration as to the potential improvements and rehabilitation of selected wetland systems within the Mining Rights Area were regarded as valuable inclusions within the proposed offset strategy, not only from the perspective of improvements to the present ecological state of the systems as a whole, but also in terms of improvements to ecological importance and service provision within the greater catchment. The value of including the proposed rehabilitation measures within the offset strategy thus serve as grounds for the consideration of an “out-of-kind” offset (to some extent).

In summary the total costs for the rehabilitation measures and interventions considered equals to **R88,524,584.57 (VAT Excl)**. In saying this, the majority of the costs can be assigned to the existing financial provision that would be in place for closure. Based on this only an additional **R 1 503 904.00** would be required for the interventions recommended.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 Introduction

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, assimilation of nutrients, 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 services provided. Wetlands are defined according to the National Water Act, 1998 (Act 36 of 1998) (NWA) 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 owing primarily to a general underestimation of the ecological and economic importance of these systems (Swanepoel and Barnard, 2007). It is approximated 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 contributing factors 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 (Oberholster *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 and landscape-management (Kotze and Breen, 1994; Whitlow, 1992), all practices that alter the hydrological regime impacting these wetland systems (Winter and Llamas, 1993). Historically, wetlands have been perceived to be wastelands (Maltby, 1986). This has resulted in the exploitation, alteration and in many cases the complete destruction of these valuable ecosystems, with an accompanying loss of associated ecosystem goods and services (Begg, 1986). It is now acknowledged that these ecosystems perform functions making them invaluable to the management of both water quantity and quality, and as a result wetlands are regarded as integral components of catchment systems (Jewitt and Kotze, 2000; Dickens *et al*., 2003).

The dilemma facing South Africa is that there is a growing demand for energy (currently in the form of coal) and there is also a need to protect wetland ecosystems. Wetlands are inextricably linked to coal mining in the highveld as coal deposits are often overlain by wetlands. It is imperative that wetlands in South Africa are managed in a sustainable way and that they are not damaged during the process of meeting the needs of the growing South African economy. The purpose of an environmental offset is to maintain existing levels of environmental quality whilst still allowing for further development (Duncan and Morrison 2008). The central idea is to conserve and/or rehabilitate a site nearby to the existing site that is to be developed. The result is that the overall stock of natural assets is not lost. The purpose of this report is to identify the extent of wetland habitat affected by historical, current

and future mining activities, to determine the extent of the offsets required and to identify candidate wetland offset areas to be rehabilitated and regarded as a 'no-go' zone for future development to compensate for the loss of wetlands on site. The South African National Biodiversity Institute (SANBI) and Department of Water and Sanitation (DWS) have recently released the Wetland Offset Calculator (2014) which was used for this assessment.

2 Background of the study

Digby Wells Environmental (hereinafter Digby Wells), was appointed by Exxaro Mpumalanga Coal (Pty) Ltd) In November 2018 to review and update the Wetland Offset Report compiled by Land Resources International (hereinafter LRI) for the Leeuwpan Coal Mine in Mpumalanga, South Africa. The Leeuwpan Phase 1 Wetland Rehabilitation and Planning Report was compiled and submitted in November 2013. Following this report, LRI submitted an onsite wetland rehabilitation plan for the Leeuwpan Coal Mine's proposed block OI and OL mining development in 2016. Since the submission of the LRI 2016 report, mining of block OI has commenced. Mining of block OL is due to commence on approval of this updated Wetland Offset Report.

This report will take into account all wetlands affected to date as well as wetlands to be affected within the blocks OI and OL mining footprint. Management and mitigation for protection of the wetland areas not directly affected by the current and proposed mining activities will be provided.

Due to opencast mining at the Leeuwpan Coal Mine, wetland habitat has been lost and further losses are anticipated. The Integrated Water Use License (IWUL; no.: 04/B20A/CIJ/4032) for the Exxaro Coal (Pty) Ltd: Leeuwpan Coal Mine OI and OL Expansion was granted provided that wetland offset areas were identified to compensate for the loss of wetlands. Thus, this wetlands assessment and Wetland Offset Strategy update will provide a detailed updated description of the baseline environment, the wetlands present in the study area and their ecological conditions, updated offset calculations and the updated rehabilitation interventions that will be required for the wetland offset areas so that the Leeuwpan Coal Mine remains compliant to the terms of the existing IWUL.

3 Terms of Reference

This report aims to provide the following:

- A review and update of the Wetland Offset Report compiled by LRI for Leeuwpan including the following:
  - Review of the previous Rehabilitation Plan Phase 1 Report for Leeuwpan Mine Wetlands;
  - Review of Onsite Wetland Rehabilitation Plan for Leeuwpan Proposed Block OI and OL Mining Development;

- The calculation of offset requirements based on wetlands impacted from the mining footprint and activities to date, as well as the approved mining activities to impact wetlands during the course of the Life of Mine (LOM); and
- Consideration of the existing recommended offsets and compensation locations (LRI, 2016) and the provision of an updated wetland rehabilitation and wetland offset strategy.

4 Locality

The Leeuwpan Coal Mine is located in the Mpumalanga Province, South Africa. The Leeuwpan Mining Rights Area (MRA) is situated along the R50 road south-east of the town of Delmas (Figure 4-1). The MRA covers an estimated 4260 hectares and includes portions of the following farms:

- Witklip 232-IR;
- Witklip 229-IR;
- Wolvenfontein 244-IR;
- Goedgedacht 228-IR;
- Leeuwpan 246-IR;
- De Denne 256-IR;
- Rietkuil 249-IR;
- Moabsvelden 248-IR; and
- Weltevreden 227-IR.

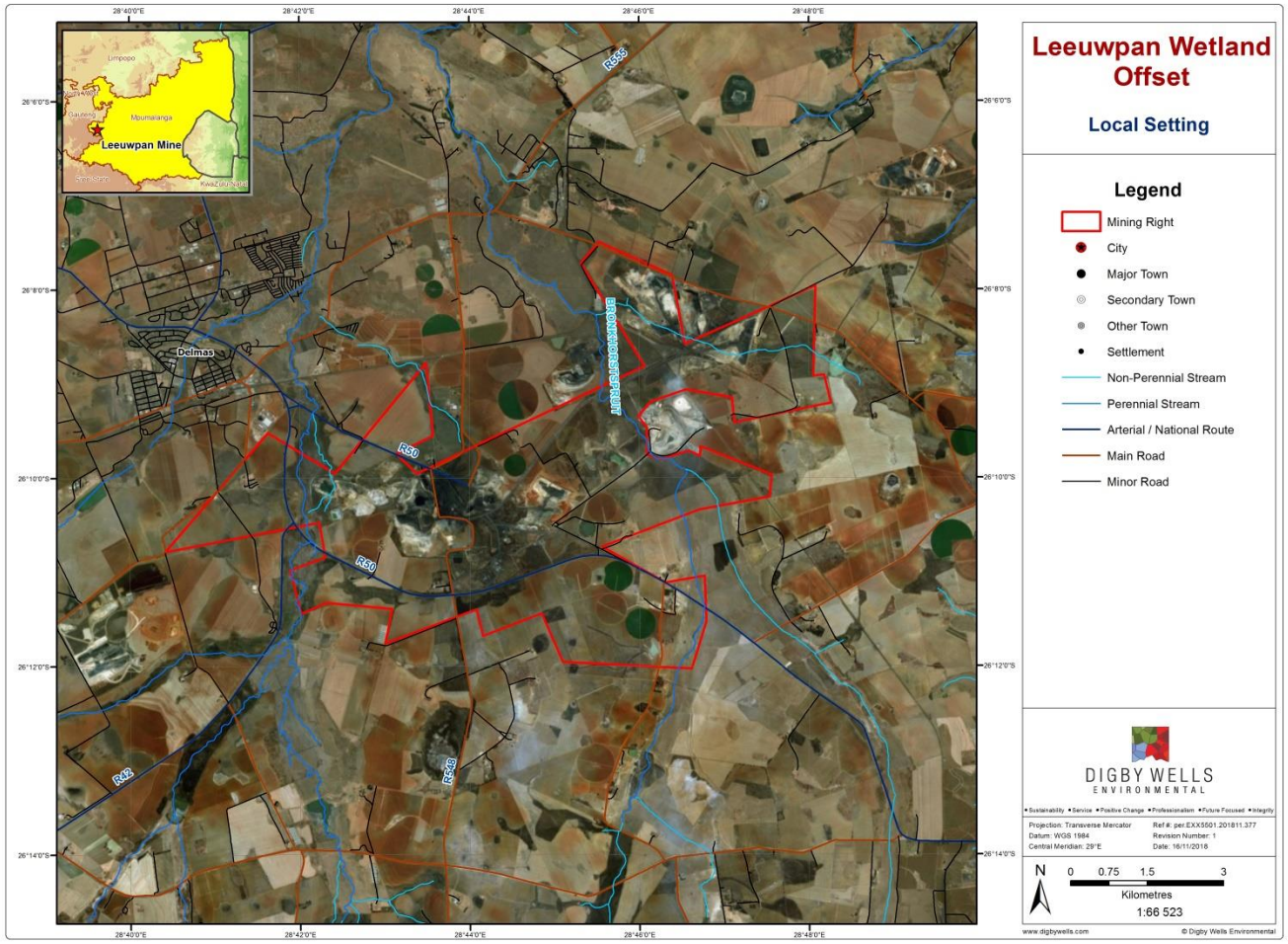

Figure 4-1: Locality of the project area

5 Policy and Legal Framework

The wetlands assessment aims to support the following regulations, regulatory procedures and guidelines:

- Section 24 of the Constitution of the Republic of South Africa ,1996 (Act No. 108 of 1996);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA);
- Section 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);

6 Methodology

6.1 Wetland Assessment

6.1.1 Historical Report Reviews and Desktop Assessment

For the purposes of this project, historical delineations and data results (LRI, 2013) were used as a baseline for the wetland extents, present ecological states and ecological importance and sensitivities prior to any further disturbance as a result of the ongoing mining activities that have taken place within the Leeuwpan Coal Minining rights area since the 2013 wetland assessment. In addition, baseline and background information was researched and used to understand the area on a desktop level prior to fieldwork; this included but was not limited to:

- L04768 Leeuwpan Phase 1 Report (LRI, 2013);
- Onsite Wetland Rehabilitation Plan for the Leeuwpan Coal Mine's proposed block OI and OL mining development;
- National Freshwater Ecosystem Priority Areas (NFEPA; Nel *et al*., 2011);
- Mining and Biodiversity Guidelines;
- Water Management Areas (WMA) and Quaternary Catchments; and
- Mpumalanga Biodiversity Sector Plan (2014).

6.1.1.1 National Freshwater Ecosystem Priority Areas

The NFEPA project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel *et al.* 2011). The spatial layers include the nationally delineated wetland areas that are classified into hydrogeomorphic (HGM) NFEPA

project types and ranked in terms of their biodiversity importance. These layers were assessed to evaluate the importance of the wetland areas located within the project area.

Whilst being an invaluable tool, it is important to note that the NFEPA's were delineated and studied at a desktop and low resolution level. Thus, the wetlands delineated via the ground-truthing work done through this study may differ from the NFEPA data layers. The NFEPA assessment does, however, hold significance from a national perspective. As mentioned above, the NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity and Table 6-1 below indicates the criteria considered.

Table 6-1: NFEPA Wetland Classification Ranking Criteria

Criteria	Rank
Wetlands that intersect with a RAMSAR site.	1
▪ Wetlands within 500 m of an IUCN threatened frog point locality; ▪ Wetlands within 500 m of a threatened 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
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

6.1.1.2 Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by the South African Biodiversity Institute (SANBI), the Department of Environmental Affairs (DEA), the

Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum in 2013. The purpose of the guideline was to provide the mining sector with a manual to integrate biodiversity into the planning process thereby encouraging informed decision-making around mining development and environmental authorisations. The aim of the guideline is to explain the value for mining companies to consider biodiversity management throughout the planning process. The guideline highlights the importance of biodiversity in managing the social, economic and environmental risk of the proposed mining project. The country has been mapped into biodiversity priority areas including the four categories listed in

Table 6-2 below, each with associated risks and implications.

Table 6-2: Mining and Biodiversity Guideline Categories (SANBI, 2013)

Category	Risk and Implications for Mining
Legally protected	Mining prohibited; unless authorised by ministers of both the DEA and DMR.
Highest Biodiversity Importance	Highest Risk for Mining: the EIA process must confirm significance of the biodiversity features that may be seen as a fatal flaw to the proposed project. Specialists must provide site-specific recommendations for the application of the mitigation hierarchy that informs the decision making processes of mining licences, water use licences and environmental authorisations. If granted, authorisations should set limits on allowed activities and specify biodiversity related management outcomes.
High Biodiversity Importance	High Risk for Mining: the EIA process must confirm the significance of the biodiversity features for the conservation of biodiversity priority areas. Significance of impacts must be discussed as mining options are possible but must be limited. Authorisations may set limits and specify biodiversity related management outcomes.
Moderate Biodiversity Importance	Moderate Risk for Mining: the EIA process must confirm the significance of the biodiversity features and the potential impacts as mining options must be limited but are possible. Authorisations may set limits and specify biodiversity related management outcomes.

6.1.1.3 Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan (MBSP) is a spatial tool that forms part of the national biodiversity planning tools and initiatives that are provided for in national legislation and policy. The MBSP was published in 2014 by the Mpumalanga Tourism and Parks Agency (MTPA) and comprises a set of maps of biodiversity priority areas accompanied by contextual information and land-use guidelines for use in land-use and development

planning, environmental assessment and regulation, and natural resource management. Strategically the MBSP enables the province to:

- Implement the NEM:BA, 2004 provincially, and comply with requirements of the National Biodiversity Framework, 2009 (NBF) and certain international conventions;
- Identify those areas of highest biodiversity that need to be considered in provincial planning initiatives, and
- Address threat of climate change (ecosystem-based adaptation).

The publication includes terrestrial and freshwater biodiversity areas that are mapped and classified in Protected Areas (PAs), Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) or Other Natural Areas (ONAs). Wetlands in Mpumalanga Province have been extensively degraded and, in many cases, irreversibly modified and lost through a combination of inappropriate land-use practices, development and mining. Wetlands represent ecosystems of high value for delivering, managing and storing good quality water for human use, and they are vulnerable to harmful impacts. It is therefore in the interest of national water security that all wetlands are protected by law. The management objectives of these areas are summarised below.

Table 6-3: Mpumalanga Biodiversity Sector Plan Categories

Map category	Definition	Desired management objectives
PA	Those areas that are proclaimed as protected areas under national or provincial legislation, including gazetted protected environments.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
CBAs	Areas that are required to meet biodiversity targets, for species, ecosystems or ecological processes. CBA Wetlands are those that have been identified as FEPA wetlands that are important for meeting biodiversity targets for freshwater ecosystems.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.

Map category	Definition	Desired management objectives
ESAs	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services. ESAs Wetlands are those that are non-FEPA and ESA Wetland Clusters are clusters of wetlands embedded within a largely natural landscape that function as a unit, and allow for the migration of species such as frogs and insects between individual wetlands.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.
ONAs	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some authorisation may still be required for high-impact land-uses.
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximise ecological functionality and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

6.1.2 Wetland Ecological Health Assessment (WET-Health)

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 level 1 WET-Health assessment was done on selected wetlands earmarked for rehabilitation in accordance with the method described by Kotze *et al.* (2007) to determine the current integrity (health) of the relevant HGM units. Level 1 was selected due to the large size of the proposed wetland rehabilitation areas, as well as due to the restricted site access in some areas due to safety constraints and current mining activities throughout the Project

area. A Present Ecological State (PES) analysis was conducted for each site both prior to the proposed rehabilitation (current condition) as well as post proposed rehabilitation (the estimated condition target). 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.

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described above.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of the impact of individual activities and then separately assessing the *intensity* of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall *magnitude* of impact. The rationale behind the application of the WET-Health tool to the proposed rehabilitation areas is to determine the potential gains in hectare equivalents within each wetland, should the integrity of each HGM unit be improved though the proposed rehabilitation efforts at each site. The impact scores and Present State categories are provided in Table 6-4.

Table 6-4: 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

Impact Category	Description	Combined Impact Score	PES Category
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

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (Table 6-5).

Table 6-5: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland. In this instance, scores for both pre and post rehabilitation have been calculated.

As mentioned above, the WET-Health results of the wetland assessment conducted in 2013 have been utilised in this report for the historically delineated wetlands found throughout the mining rights area, with the exception of the rehabilitation areas considered and further discussed in Section 10.

6.1.3 Ecological Importance and Sensitivity

Further to the application of the WET-Health tool, the historical wetland assessment made use of the Ecological Importance and Sensitivity (EIS) tool to assess the various wetland systems' abilities to resist disturbance and the capability of each 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 to assess the current and target EIS values for the proposed wetlands to be rehabilitated.

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 DWS 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 may provide; and
- **Importance in terms of Basic Human Benefits:** this suite of criteria considers the subsistence uses and cultural benefits of the wetland system.

These determinants are assessed for the wetlands 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 system, as defined in Table 6-6.

Table 6-6: Interpretation of Overall EIS Scores for Biotic and Habitat Determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median
Very high Systems 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 Systems that are considered to be ecologically important and sensitive. The biodiversity of these systems 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

Ecological Importance and Sensitivity Category (EIS)	Range of Median
Moderate Systems 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 Systems 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

6.2 Offset Strategy

Offset areas are considered in order to preserve and protect lost and/or threatened biodiversity. The offset areas are defined by the International Council on Mining and Metals (ICMM) as "Sustainable conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to aspire to no net loss in biodiversity. Before developers contemplate offsets, they should have first sought to avoid and minimise harm to biodiversity." Most important for offsets are paragraphs 7 and 10 of the International Finance Corporation (IFC) Performance Standard 6, reproduced below:

"7. As a matter of priority, the client should seek to avoid impacts on biodiversity and ecosystem services. When avoidance of impacts is not possible, measures to minimize impacts and restore biodiversity and ecosystem services should be implemented. Given the complexity in predicting projects impacts on biodiversity and ecosystem services over the long term, the client should adopt a practice of adaptive management in which the implementation of mitigation and management measures are responsive to changing conditions and the results of monitoring throughout the project's lifecycle.

10. For the protection and conservation of biodiversity, the mitigation hierarchy includes biodiversity offsets, which may be considered only after appropriate avoidance, minimization, and restoration measures have been applied, A biodiversity offset should be designed and implemented to achieve measureable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity; however, a net gain is required in critical habitats. The design of a biodiversity offset must adhere to the "like-for-like or better" principle and must be carried out in alignment with best available information and current practices. When a client is considering the development of an offset as part of the mitigation strategy, external experts with knowledge in offset design and implementation must be involved."

Important associated definitions and details provided by the IFC include the following:

- "Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimization and restoration measures have been taken;
- Measurable conservation outcomes for biodiversity must be demonstrated in situ (on-the-ground) and on an appropriate geographic scale (e.g., local, landscape level, national, regional);
- The principle of "like-for-like or better" indicates that biodiversity offsets must be designed to conserve the same biodiversity values that are being impacted by the project (an "in-kind" offset). In certain situations, however, areas of biodiversity to be impacted by the project may be neither a national or local priority, and there may be other areas of biodiversity with like values that are a higher priority for conservation and sustainable use and under imminent threat or need of protection or effective management. In these situations, it may be appropriate to consider an "out-of-kind"

offset that involves “trading up” (i.e., where the offset targets biodiversity of higher priority than that affected by the project) that will, for critical habitats, meet the requirements of paragraph 17 of this Performance Standard; and

- No net loss is defined as the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimize the project’s impacts, to undertake on-site restoration and finally to offset significant residual impacts, if any, on an appropriate geographic scale (e.g., local, landscape-level, national, regional). ICMM indicates that there is not only a biodiversity advantage to biodiversity offsets, but also a good business case for offsets. The ICMM states that “Offsets could offer a means of ensuring continued access to resources, securing licence to operate and given increasing interest from investors in offsets for risk management purposes) continued access to finance.

6.2.1 Offset calculations

The wetland offset requirements calculated and described in the “LRI (2013) Phase 1: Determination of Offset Requirements” report, were reviewed and the results deemed suitable for the provision of an indication of the functional value and habitat intactness of the wetlands present both prior to- and post-development.

In this report, both the functional and ecosystem conservation ratios were determined, the greater of which was used in this report to ensure compliance of the Wetland Offset Strategy and to update the Wetland Rehabilitation Plan.

6.2.2 Wetland Offset Strategy and Impacts

The potential wetland offset locations identified by Wetland Consulting Services in 2013 consisted of wetland units similar in type and functioning to the wetland units to be either impacted on or destroyed due to the proposed mining activities. An additional consideration for the potential offset locations was the level of risk posed by the areas being mined in the future.

In this report, the state of the wetland systems impacted within, as well as in the immediate vicinity of the Leeuwpan Coal Mine, was considered. Consideration as to the potential improvements and rehabilitation of selected wetland systems within the Mining Rights Area were regarded as valuable inclusions within the proposed offset strategy, not only from the perspective of improvements to the present ecological state of the systems as a whole, but also in terms of improvements to ecological importance and service provision within the greater catchment.

Thus, while the principle of “like-for-like” discussed above, was considered as far as possible, the value of including the proposed rehabilitation measures within the offset strategy serve as grounds for the consideration of an “out-of-kind” offset (to some extent) that involves “trading up” and improving the biodiversity, restoring stream connectivity and improving the functioning of each of the systems as a whole. In addition to this, is the added benefit that the Leeuwpan Coal Mine, is already in possession of the surface rights to these

proposed rehabilitation areas and thus, may be more likely to follow through on these commitments in the long term.

This report provides information pertaining to the planning and framework of the strategy and the required measures to achieve the set objectives. The WET-RehabPlan was considered in order to support the formulation of the strategy in order to assist in undertaking a well-planned and well-informed Wetland Offset and Compensation Strategy that is integrated into the broader management of the wetland and catchment, and which produces sustainable outcomes (WRC, 2008). Methodologies described by the Water Research Commission (2008) pertaining to mitigation banking have been considered for this study. Two methods which were considered for compensatory credits (WRC, 2008) include:

- Restoration - This is defined as the re-establishment or rehabilitation of a wetland with the goal of returning natural or historic functions and characteristics to a former or degraded wetland. This process improves wetland function, and in some cases increases wetland area; and
- Enhancement - This process attempts to heighten, intensify or improve wetland ecological functions. This process will not yield an increase in wetland area, but does improve wetland function.

6.2.3 Hectare equivalents

In order to allow for the quantification of wetland losses due to development and the gains due to wetland offsets and rehabilitation, as well as the comparison between the two, a unit of measure is required to use as a common currency for evaluating impacts and assessing the adequacy of offset proposals. This is achieved through use of the '**hectare equivalent'**.

A hectare equivalent is a quantitative expression of the ecological integrity of a wetland hydrogeomorphic (HGM) unit under a given landuse. It represents the common currency that enables the wetland functional area restored to the landscape by restoration, rehabilitation and artificial creation to be compared to that removed from the landscape by a development. Most environmental authorities advocate a no-net-loss of resources approach, be it to biodiversity or wetland functioning, and the hectare equivalent provides the conceptual means of judging whether these rehabilitation objectives have been satisfied.

'Hectare equivalent' is a measure of wetland functional area obtained through a conversion of the wetland health (PES) rating and the wetland aerial extent (hectares). This is done by converting the overall health (PES) score to an intactness score and then multiplying by the wetland area (in hectares) to obtain a measure of functional area:

((10-PES score)/10) X wetland area = hectare equivalent

As an example, a 10 ha wetland with a PES score of 3 (category C – moderately modified) would be equal to:

((10-3)/10) X 10 = 7 hectare equivalents

In essence, this reflects that a wetland which is moderately modified (PES category C) is only expected to be performing 70 % of the function that the wetland could have performed under pristine conditions.

7 Baseline Environment

7.1 Drainage and Quaternary Catchment

The water resources of South Africa are divided into quaternary catchments, which are regarded as the principal water management units in the country (DWAF 2011). A quaternary catchment is a fourth order catchment in a hierarchical classification system in which the primary catchments are the major units. The primary drainages are further grouped into or fall under Water Management Areas (WMA) and Catchment Management Agencies (CMA). The Department of Water and Sanitation (DWS) has established nine WMAs and nine CMAs as contained in the National Water Resource Strategy 2 (2013) in terms of Section 5 subsection 5(1) of the National Water Act, 1998 (Act No. 36 of 1998). The establishment of these WMAs and CMAs is to improve water governance in different regions of the country, to ensure a fair and equal distribution of the Nations water resources, while making sure that the resource quality is sustained.

Figure 7-1 and Figure 7-2 indicate the water resource management classification associated with the project area. The project area falls within the Olifants Water Management Area (WMA 4) and it is associated with primary drainage B. The affected quaternary catchment is B20A. According to the WRC (2012), the freshwater resources within this catchment area have been classified with a PES rating of D (largely modified), moderate Ecological Importance (EI) and high Ecological Sensitivity (ES). The Brokhorstspruit and its associated tributaries were identified as the main river reaches draining this site.

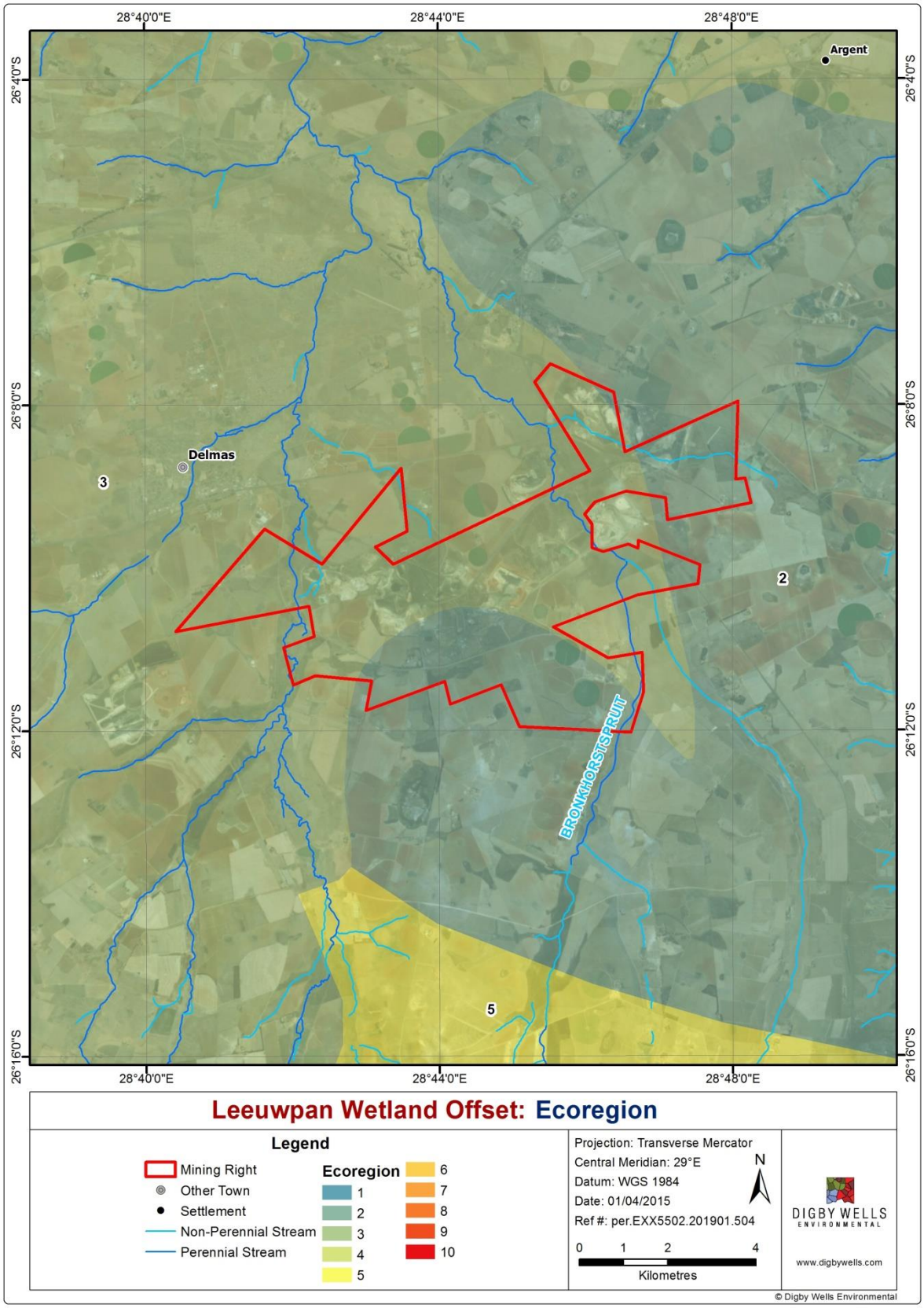

Figure 7-1: Ecoregion

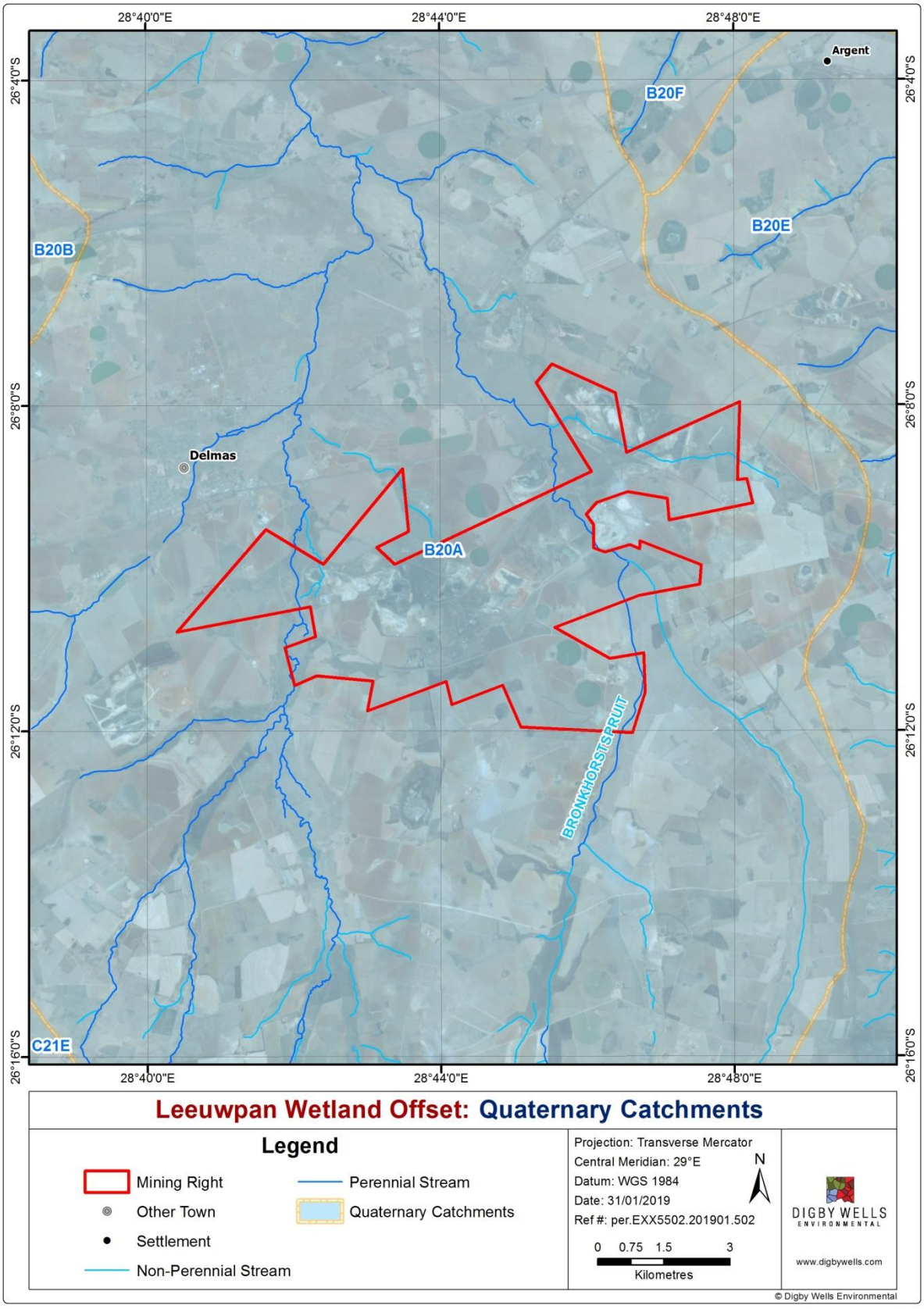

Figure 7-2: Quaternary catchments

7.2 Regional Vegetation

The project area falls within the Grassland Biome (Mucina and Rutherford, 2012), one of the nine South African plant Biomes and the second most bio-diverse biome in South Africa. The Grassland Biome is situated primarily on the central plateau of South Africa, and the inland areas of Kwa-Zulu-Natal and the Eastern Cape provinces. This biome is rich in flora and fauna diversity but is under threat due to rapid urbanisation and expansion of mining and industrial activities.

The project area occurs in the Eastern Highveld Grassland, with small portions occurring within the Eastern Temperate Freshwater Wetlands and the Soweto Highveld Grassland regional vegetation types (Mucina and Rutherford, 2012). Table 7-1 lists the species characteristic of the Eastern Highveld Grassland, Table 7-2 lists species characteristic of Eastern Temperate Freshwater Wetlands and Table 7-3 lists species characteristic of the Soweto Highveld Grassland.

Table 7-1: Plant Species Characteristic of the Eastern Highveld Grasslands

Plant Form	Species
Graminoids	*Aristida aequiglumis, A. congesta, A. junciformis subsp. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. capensis, E. curvula, E. gummiflua, E. patentissima, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata subsp. eckloniana, Andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris, Urelytrum agropyroides*
Herbs	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides subsp. latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*
Geophytic herbs	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula var. pilosissima, Ledebouria ovatifolia*
Succulent Herbs	*Aloe ecklonis*

Table 7-2: Plant species characteristic of the Eastern Temperate Freshwater Wetlands

Type	Plant form	Species
Marshes	Megagraminoid	*Cyperus congestus* (d)
	Graminoids	*Agrostis lachnantha* (d), *Carex acutiformis* (d), *Eleocharis palustris* (d), *Eragrostis plana* (d), *E. planiculmis* (d), *Fuirena pubescens* (d), *Helictotrichon turgidulum* (d), *Hemarthria altissima* (d), *Imperata cylindrica* (d), *Leersia hexandra* (d), *Paspalum dilatatum* (d), *P. urvillei* (d), *Pennisetum thunbergii* (d), *Schoenoplectus decipiens* (d), *Scleria dieterlenii* (d), *Setaria sphacelata* (d), *Andropogon appendiculatus*, *A. eucomus*, *Aristida aequiglumis*, *Ascolepis capensis, Carex austro-africana*, *C. schlechteri*, *Cyperus cyperoides*, *C. distans*, *C. longus*, *C. marginatus*, *Echinochloa holubii*, *Eragrostis micrantha*, *Ficinia acuminata*, *Fimbristylis complanata*, *F. ferruginea*, *Hyparrhenia dregeana*, *H. quarrei, Ischaemum fasciculatum*, *Kyllinga erecta*, *Panicum schinzii*, *Pennisetum sphacelatum*, *Pycreus macranthus*, *P. nitidus*, *Setaria pallide-fusca*, *Xyris gerrardii*.
	Herbs	*Centella asiatica* (d), *Ranunculus multifidus* (d), *Berkheya radula*, *B. speciosa*, *Berula erecta* subsp. *thunbergii*, *Centella coriacea*, *Chironia palustris*, *Equisetum ramosissimum*, *Falckia oblonga, Haplocarpha lyrata, Helichrysum difficile*, *H. dregeanum*, *H. mundtii*, *Hydrocotyle sibthorpioides, H. verticillata*, *Lindernia conferta*, *Lobelia angolensis, L. flaccida*, *Mentha aquatica*, *Monopsis decipiens*, *Pulicaria scabra*, *Pycnostachys reticulata*, *Rorippa fluviatilis* var. *fluviatilis*, *Rumex lanceolatus*, *Senecio inornatus*, *S. microglossus*, *Sium repandum*, *Thelypteris confluens*, *Wahlenbergia banksiana*.
	Geophytic herbs	*Cordylogyne globosa*, *Crinum bulbispermum*, *Gladiolus papilio*, *Kniphofia ensifolia*, *K. fluviatilis*, *K. linearifolia*, *Neobolusia tysonii, Satyrium hallackii* subsp. *hallackii*.
Reed & sedge beds	Megagraminoids	*Phragmites australis* (d), *Schoenoplectus corymbosus* (d), *Typha capensis* (d), *Cyperus immensus*.
	Graminoid	*Carex cernua*.
Water bodies	Aquatic herbs	*Aponogeton junceus*, *Ceratophyllum demersum*, *Lagarosiphon major*, *L. muscoides*, *Marsilea capensis*, *Myriophyllum spicatum, Nymphaea lotus*, *N. nouchali* var. *caerulea*, *Nymphoides thunbergiana*, *Potamogeton thunbergii*.

Type	Plant form	Species
	Carnivorous herb	*Utricularia inflexa*.
	Herb	*Marsilea farinosa subsp. farinosa.*

Table 7-3: Plant species characteristic of the Soweto Highveld Grassland

Plant Form	Species
Graminoids	*Andropogon appendiculatus, Brachiaria serrata, Cymbopogon pospischilii, Cynodon dactylon, Elionurus muticus, Eragrostis capensis, E. chloromelas, E. curvula, E. plana, E. plana, E. paniculmis, E, racemose, Heteropogon contortus, Hyparrhenia hirta, Setaria nigrirostris, S. sphacelata, Themeda triandra, Tristachya leucothrix, Andropogon schirensis, Aristida adscensionis, A. bipartite, A. congesta, A. junciformis* subsp. *galpinii, Cymbopogon caesius, Digitaria diagonalis, Diheteropogon amplectens, Eragrostis micrantha, E. superba, Harpochloa falx, Microchloa caffra, Paspalum dilatatum*
Herbs	*Hermannia depressa, Acalypha angustata, Berkheya setifera, Dicoma anomala, Euryops gilfillanii, Geigeria aspera* var. *aspera, Graderia subintegra, Haplocarpha scaposa, Helichrysum miconiifolium, H. nudifolium* var. *nudifolium, H. rugulosum, Hibiscus pusillus, Justicia anagalloides, Lippia scaberrima, Rhynchosia effuse, Schistostephium crataegifolium, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata*
Geophytic herbs	*Haemanthus humilis* subsp. *hirsutus, H. montanus*
Herbaceous climber	*Rhynchosia totta*
Low shrubs	*Anthospermum hispidulum, A. rigidum* subsp. *Pumilum, Berkheya annectens, Felicia muricata, Ziziphus zeyheriana*

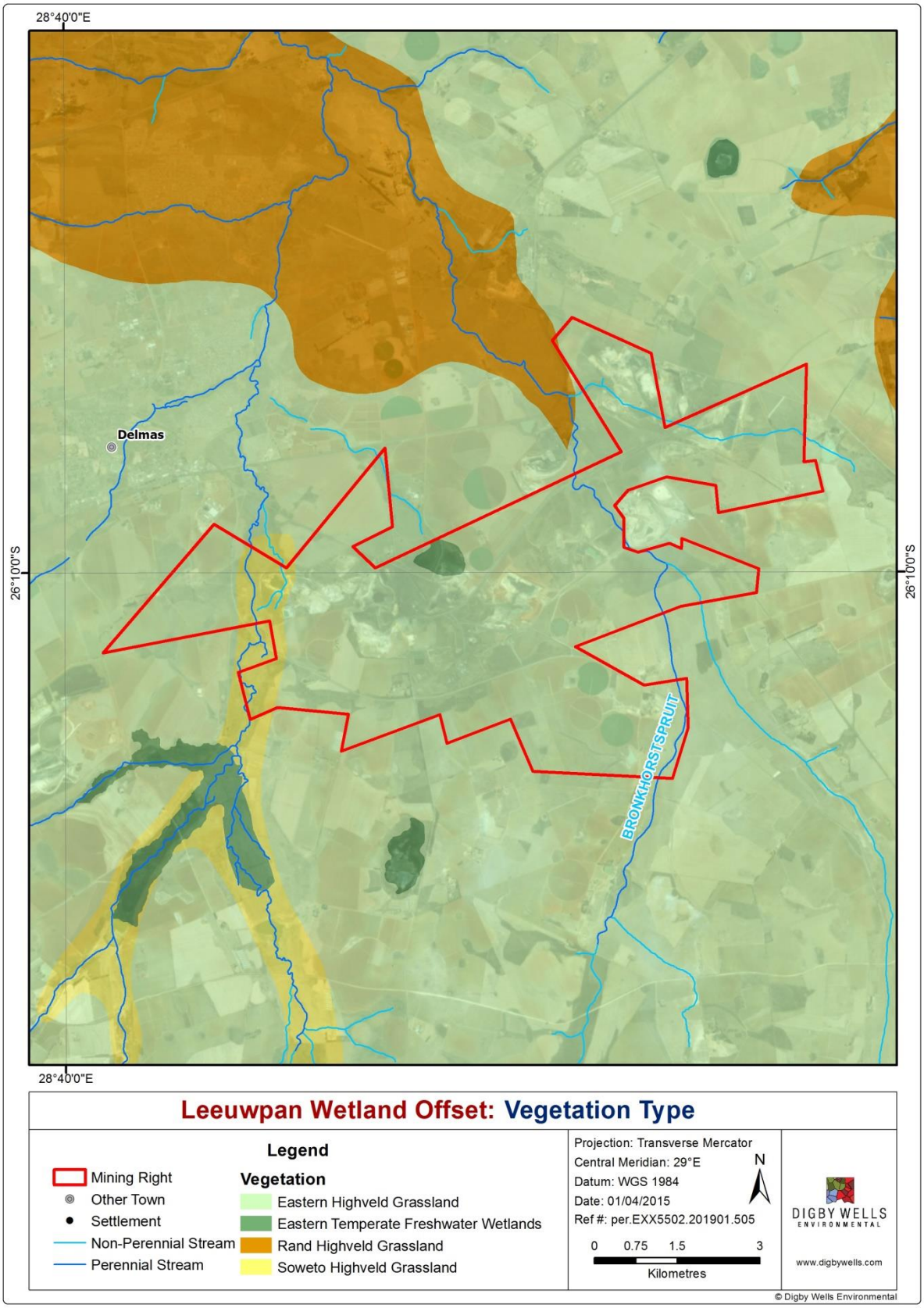

Figure 7-3: Regional vegetation

7.3 National Freshwater Ecosystem Priority Areas (NFEPAs)

The NFEPA project provides information of wetland and river ecosystems for integrating into freshwater ecosystem and biodiversity planning and decision-making processes. The assessor considered the strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources contained therein to evaluate the importance of the wetland areas located within the project area (Nel *et al.* 2011).

Figure 7-4 demonstrates the distribution of NFEPA wetlands within the project area.

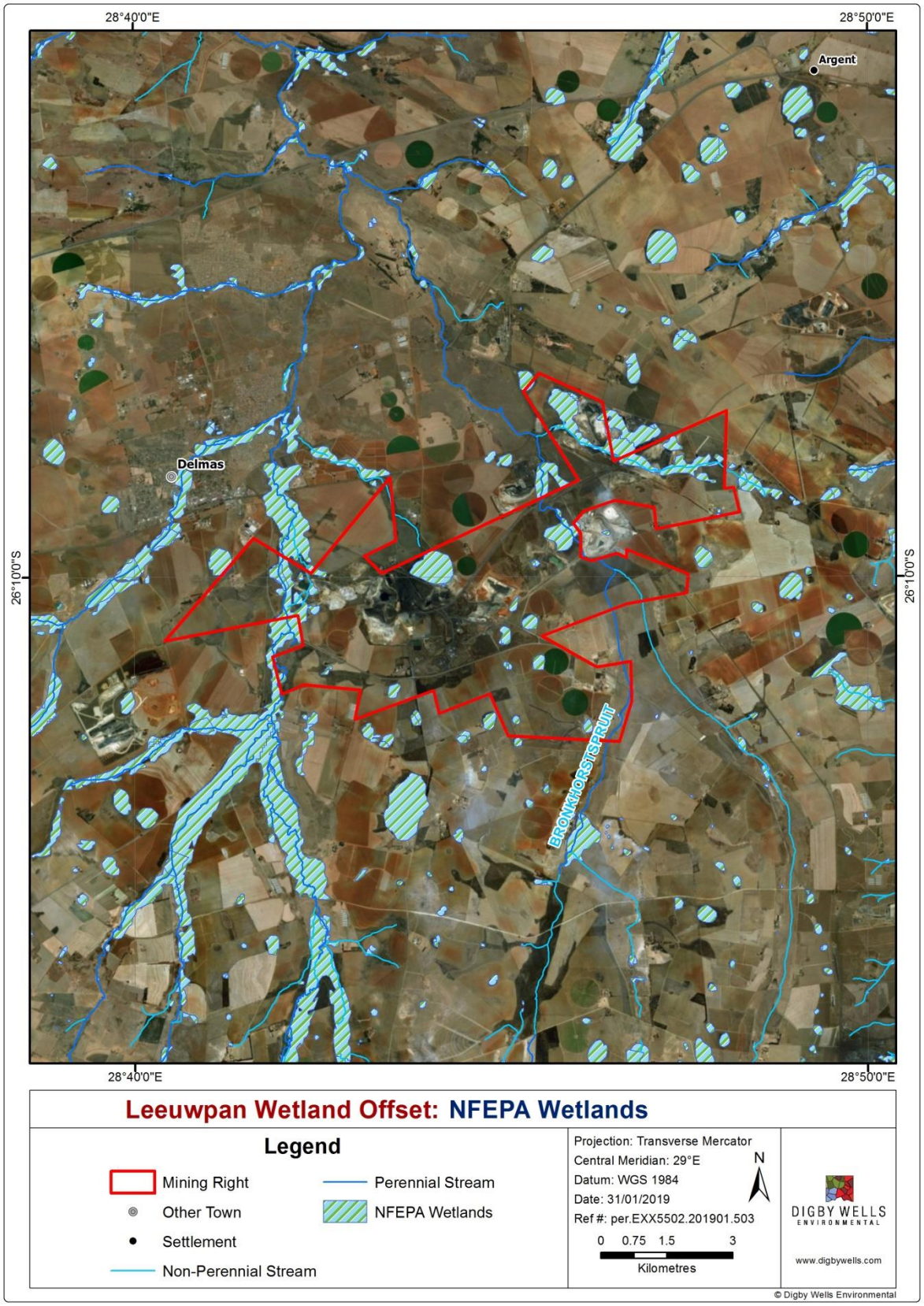

Figure 7-4: NFEPA Wetlands

7.4 Mining and Biodiversity Guidelines

The Mining and Biodiversity Guideline (2013) can be seen as a cumulative finding of all available biodiversity and ecological related information with a final mapped area. The assessment looks at NFEPA and regional biodiversity plans such as the MBSP. This is shown in Figure 7-5 below.

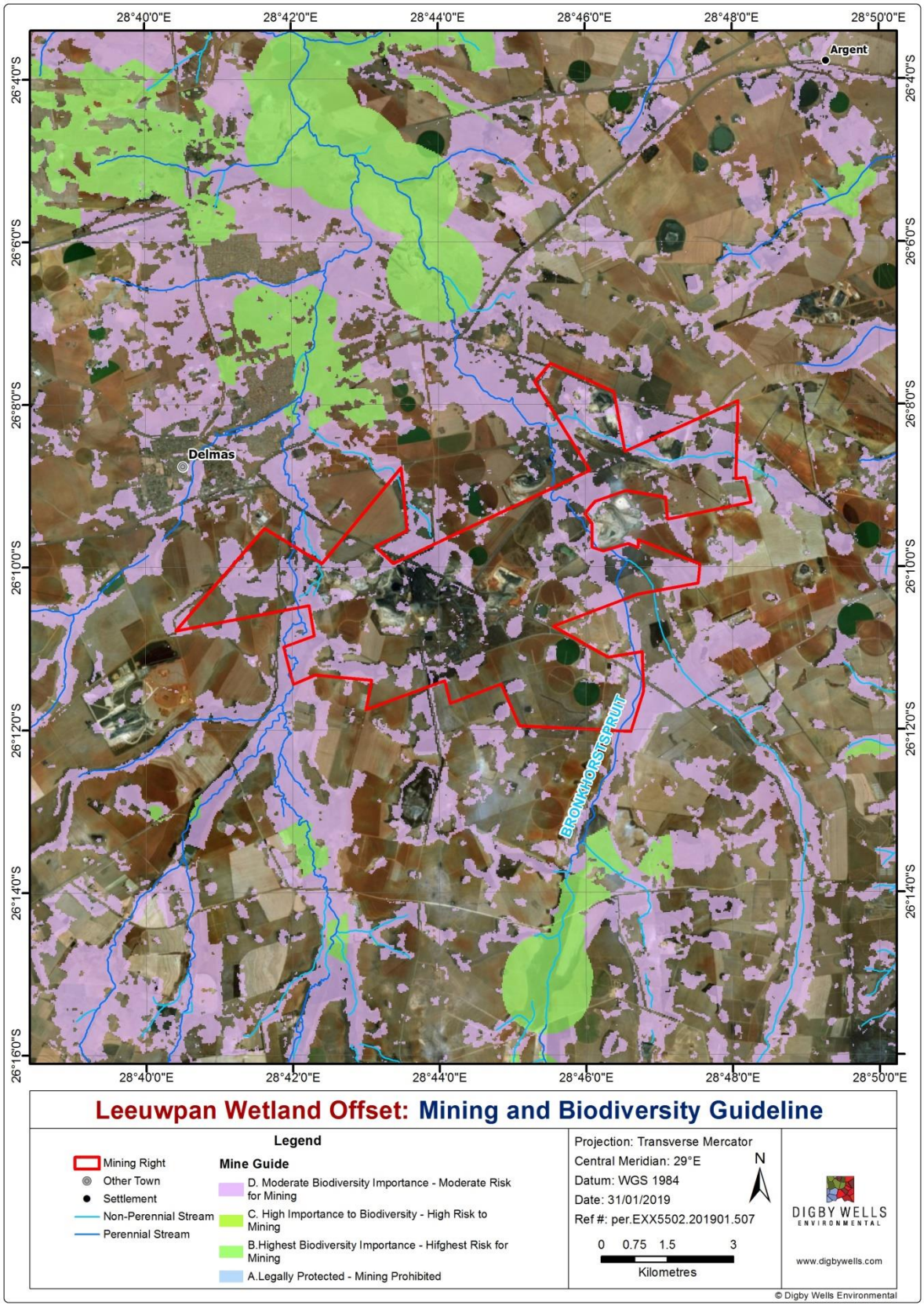

Figure 7-5: Mining and Biodiversity Guideline

7.5 Mpumalanga Biodiversity Sector Plan

The MBSP (2013) is a spatial tool that forms part of the national biodiversity planning. The terrestrial MBSP has delineated two small portions of the project area as ‘CBA Optimal’ and a further two portions as ‘CBA Irreplaceable’. According to the guidelines from the MSBP, CBAs must be kept in a natural state with no further loss of habitat; where only low-impact, biodiversity-sensitive land-uses are appropriate.

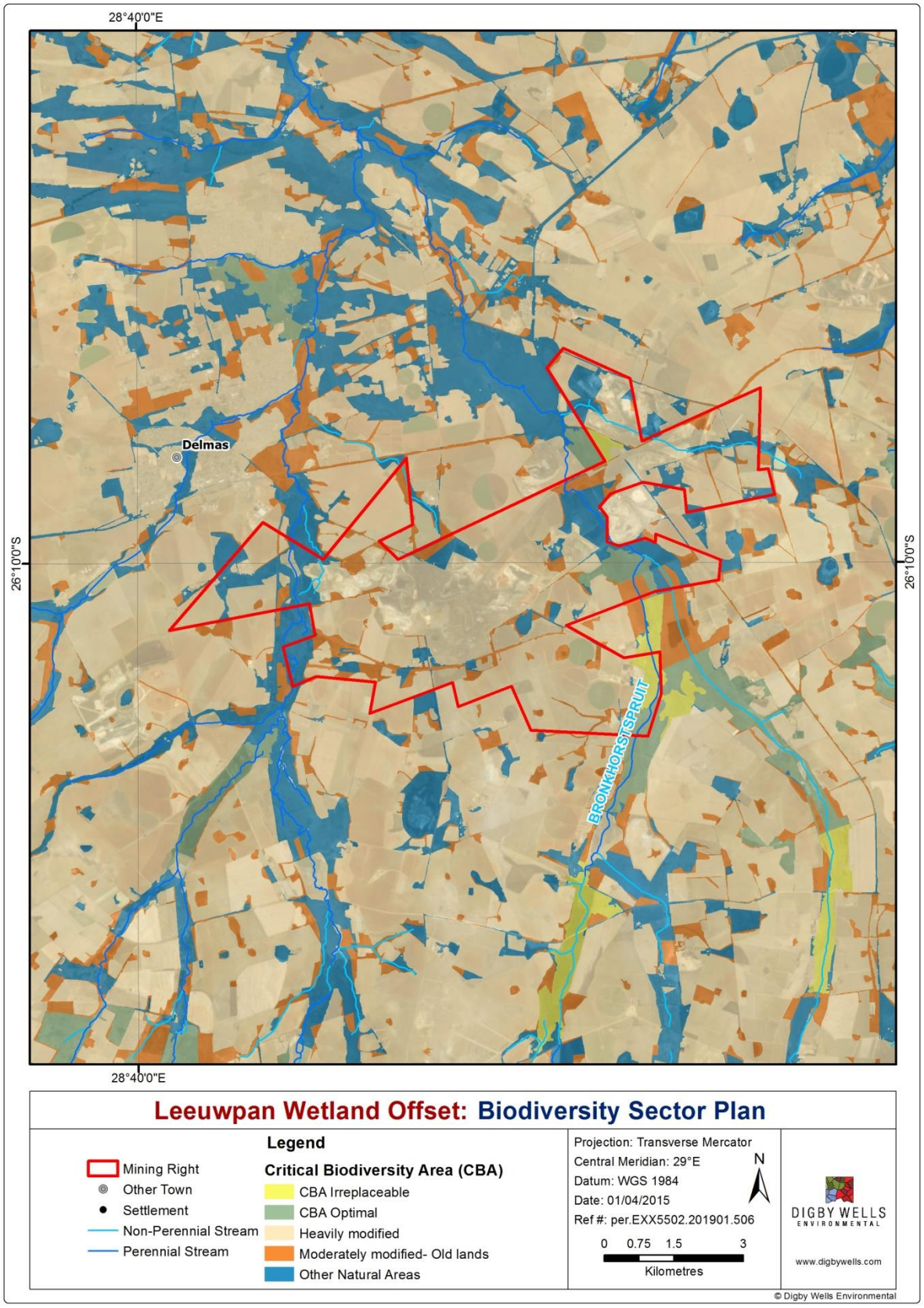

Figure 7-6: Mpumalanga Biodiversity Sector Plan

8 Wetland Assessment Review

8.1 Wetland delineation, classification, PES and EIS

8.1.1 Block OI

According to the LRI (2013) report, the wetlands within Block OI were delineated in 2012, with mining activities within Block OI expected to impact on at least 134.62 ha of wetlands (68.4 ha fall within the direct footprint of proposed opencast areas.

Wetlands are dominated by extensive hillslope seepage wetlands, though three pans also occur. The pans have also been significantly altered by agricultural activities, with two of the pans being utilised as irrigation dams. It is noted that the Red Data listed Greater Flamingo was recorded on several occasions from these pans, and they may thus be regarded as of increased importance in terms of the maintenance of biodiversity.

The wetlands were considered to be largely to seriously modified (PES category D and E). The north eastern seepage wetland was considered moderately modified (PES category C). EIS of these wetland systems were found to be of Low/Marginal to Moderate in terms of importance and sensitivity.

8.1.2 Block OL

According to the LRI (2013) report, the wetlands within Block OI were delineated in 2012, with mining activities within Block OL expected to impact on at least 120.30 ha of wetlands.

The wetlands systems present were found to be dominated by extensive hillslope seepage wetlands. One portion of a valley bottom wetland was also identified within Block OL. All of the hillslope seepage wetlands were found to have been significantly impacted by cultivation, as well as existing mining activities.

Wetlands were found to be moderately to largely modified (PES category C and D), with relatively Low/Marginal to Moderate ecological importance and sensitivity.

8.1.3 Block OI West

The wetlands which occur within the Block OI West form part of the historical wetland delineation carried out by Wetland Consulting Services (Pty) Ltd in 2012. The proposed Block OI West is expected to impact on at least 20.57 ha of wetlands.

These systems are comprised of portions of two hillslope seep wetlands and a pan wetland. The wetlands were observed to be impacted by severe alien vegetation encroachment, cultivation as well as infrastructure developments related to the existing mine activities.

Both the hillslope wetlands were found to be seriously modified (PES category E), with relatively Low/Marginal ecological importance and sensitivity, while the pan wetland was found to be largely modified (PES category D), with a Moderate to Low ecological importance and sensitivity.

8.2 Hectare Equivalents

The hectare equivalents determined for each of the individual hydro-geomorphic wetland units within Block OI, Block OL and the proposed Block OI West are presented in the tables below.

Table 8-1: Hectare equivalents to be lost within Block OI (LRI, 2013).

HGM Unit	Current/Pre-mining				
	Type	Area (ha)	PES	EIS	Hectare equivalents
H1	Hillslope seepage	41.98	C	C	14.69
H2	Hillslope seepage	6.83	E	D	2.05
H3	Hillslope seepage	9.28	E	D	2.78
H4	Hillslope seepage	6.29	E	D	1.89
H6	Hillslope seepage	9.57	D	D	4.79
H7	Hillslope seepage	24.56	D	D	9.82
H9	Hillslope seepage	21.28	E	D	3.19
PAN1	Pan	8.29	D/E	D	3.32
PAN2	Pan	4.16	D	C	2.08
PAN3	Pan	2.38	E	D	0.71
TOTAL		134.62			45.32

Table 8-2: Hectare equivalents to be lost within Block OL (LRI, 2013).

HGM Unit	Current/Pre-mining				
	Type	Area (ha)	PES	EIS	Hectare equivalents
H1	Hillslope seepage	41.98	C	C	14.69
H5	Hillslope seepage	33.09	D	D	14.89
H8	Hillslope seepage	13.00	C	C	9.10
UVB1	Hillslope seepage	32.23	D	D	3.22
TOTAL		120.30			41.91

Table 8-3: Hectare equivalents to be lost within Block OI West.

HGM Unit	Current/Pre-mining (Wetland assessment: WCS, 2012)			
	Area (ha)	PES	EIS	Hectare equivalents
Hillslope seeps	18.36	E	D	9.18
Pan	2.21	D	D	1.33
Total	**20.57**			**10.51**

In total, for both Blocks OI and OL, as well as the proposed Block OI West, 97.7 hectare equivalents are expected to be lost.

8.3 Offset calculations and offset targets for Blocks OI, OL and OI West

According to the LRI (2013) "Phase 1: Determination of Wetland Offset Requirements – Appendix A", the required functional offset target for Blocks OI and OL would be 87.23 hectare equivalents and the required conservation offset target is 549 hectare equivalents. The additional proposed Block OI West will result in an additional loss of 10.51 hectare equivalents. The required functional offset target, taking the proposed Block OI West into consideration is thus calculated at 97.7 hectare equivalents and the conservation offset target is 561.4 hectare equivalents.

The results of the wetland offset calculations are presented in the tables below.

Table 8-4: Results of the wetland offset calculation for Block OI (LRI, 2013).

HGM Unit	Current/Pre-mining					Functional Offset Target	Ecosystem Conservation Target		
	Type	Area (ha)	PES	EIS	Hectare equivalents	Functional Hectare Equivalents	Habitat Hectare Equivalent	Offset multiplier (SANBI)	Ecosystem Conservation Target
H1	Hillslope seepage	41.98	C	C	14.69	14.69	10.50	9.98	104.69
H2	Hillslope seepage	6.83	E	D	2.05	2.05	1.37	6.48	8.85
H3	Hillslope seepage	9.28	E	D	2.78	2.78	0.93	6.51	6.04
H4	Hillslope seepage	6.29	E	D	1.89	1.89	1.26	6.48	8.15
H6	Hillslope seepage	9.57	D	D	4.79	4.79	1.91	6.45	12.35
H7	Hillslope seepage	24.56	D	D	9.82	9.82	9.58	6.27	60.06
H9	Hillslope seepage	21.28	E	D	3.19	3.19	0.64	6.72	4.29
PAN1	Pan	8.29	D/E	D	3.32	3.32	1.66	6.36	10.54
PAN2	Pan	4.16	D	C	2.08	2.08	1.66	9.11	15.15
PAN3	Pan	2.38	E	D	0.71	0.71	0.71	9.77	6.97
TOTAL		134.62			45.32	**45.32**	30.21	7.41	**237.09**

Table 8-5: Results of the wetland offset calculation for Block OL (LRI, 2013).

HGM Unit	Current/Pre-mining					Functional Offset Target	Ecosystem Conservation Target		
	Type	Area (ha)	PES	EIS	Hectare equivalents	Functional Hectare Equivalents	Habitat Hectare Equivalent	Offset multiplier (SANBI)	Ecosystem Conservation Target
H1	Hillslope seepage	41.98	C	C	14.69	14.69	10.50	9.98	104.69
H5	Hillslope seepage	33.09	D	D	14.89	14.89	14.89	6.27	93.36
H8	Hillslope seepage	13.00	C	C	9.10	9.10	7.80	9.65	75.23
UVB1	Hillslope seepage	32.23	D	D	3.22	3.22	3.22	11.99	38.63
TOTAL		120.30			41.91	**41.91**	36.41	9.47	**311.91**

Table 8-6: Results of the wetland offset calculation for the proposed Block OI West

HGM Unit	Current/Pre-mining				Functional Offset Target	Ecosystem Conservation Target		
	Area (ha)	PES	EIS	Hectare equivalents	Functional Hectare Equivalents	Habitat Hectare Equivalent	Ecosystem Conservation Ratio	Ecosystem Conservation Target
Hillslope seeps	18.36	E	D	9.18	9.18	7.3	1.4	9.9
Pan	2.21	D	D	1.33	1.33	1.8	1.4	2.5
Total	20.57			10.51	10.51	9.1	2.8	12.4

9 Opportunities for onsite rehabilitation

The project area is characterised by multiple wetland systems, including pans, hillslope seepage wetlands and valley bottom wetland systems. Should mining activities proceed as planned, and the proposed Block OI west is approved, roughly 1012.4 hectares are expected to remain (LRI, 2013).

The required functional offset target is 97.7 hectare equivalents and the conservation offset target is 561.4 hectare equivalents should offsets be approved for Blocks OI, OL and OI West. According to the LRI (2013) report, if it is assumed that the remaining wetlands on site can be rehabilitated so as to increase their present ecological state category by one level, this would imply an approximate 20% gain in functional area. As such, this would result in a gain of about 202.48 hectare equivalents.

From the field assessment carried out in December 2018, three portions of wetland that are regarded as destroyed as a result of mining activities were identified as potential sites for rehabilitation. The rationale behind this approach is such that should rehabilitation of these sites be considered, this would provide the potential to restore stream connectivity between upstream and downstream areas that have become fragmented as well as improve the ecological importance and sensitivities of the systems present as a whole. The present ecological state of each of these areas to be rehabilitated was calculated by applying the WET-Health tool to the entire portion of each of the selected wetlands within the mining rights area prior to rehabilitation of the destroyed wetland portions. The WET-Health tool was then applied taking into consideration the proposed rehabilitation efforts and the hectare gains were calculated according to the associated hectare equivalents expected to be

gained from each rehabilitated portion. Assuming each of these wetland portions can be rehabilitated to a category E, the direct wetland gain in terms of hectare equivalents may be regarded as 138.29 ha. However, in order to realise both these gains, as well as the 202.48 ha described above, it is estimated that a minimum of 204.10 ha of the surrounding catchment areas will require rehabilitation and a further 87.12 ha of buffers located in selected areas around the mining rights area are recommended to protect the wetlands present and prevent further losses to the wetland systems present. Thus, a total of 631.99 ha have been identified towards achieving the wetland conservation target of 561.4 ha. In terms of functional offset targets, the direct gains in hectare equivalents total 340.77 ha, which may be regarded as more than sufficient to achieve the abovementioned functional offset target requirement of 97.7 ha.

It must be noted that in terms of the "like-for-like" offset requirement, the conservation offset target falls short of the required hectare equivalents for hillslope seep wetlands, however, as discussed above in Section 6.2.2, consideration as to the potential improvements and rehabilitation of selected wetland systems within the Mining Rights Area were regarded as valuable inclusions within the proposed offset strategy, not only from the perspective of improvements to the present ecological state of the systems as a whole, but also in terms of improvements to ecological importance and service provision within the greater catchment. The value of including the proposed rehabilitation measures within the offset strategy thus serve as grounds for the consideration of an "out-of-kind" offset (to some extent).

The results of both the LRI (2013) assessment and the December 2018 assessment have been merged and are presented below.

Table 9-1: Remaining extent of wetland habitat within the mining rights area in the post-mining scenario, the 20% gains and the required functional offset targets (LRI, 2013), as well as the expected gains as a result of the proposed rehabilitation activities described and the conservation offset targets.

Wetland Type	Extent remaining	20% gain	Proposed rehabilitation gain	Required functional offset	Required conservation offset
Channelled valley bottom	77.77	15.55	29.68	-	-
Hillslope seepage	598.67	119.73	Potential hillslope seep gains assuming a potential category E PES can be attained 81.16	87.07	487.61
Pan	56.36	11.27	27.45	7.44	35.16
Unchannelled valley bottom	279.60	55.92	-	3.22	38.63
Recommended buffers			87.12		
Required catchment rehabilitation			204.10		

Wetland Type	Extent remaining	20% gain	Proposed rehabilitation gain	Required functional offset	Required conservation offset
Total	**1012.4**	**202.48**	**138.29** (direct wetland gain) **291.22** (indirect wetland conservation gain)	**97.74**	**561.4**

9.1 Impact Assessment

Various impacts were identified within each of the wetland areas observed within the mining rights area, with a particular emphasis on wetland offset and rehabilitation opportunities. In order to formulate an effective offset strategy, taking into consideration the current land uses, an assessment of impacts to the wetland units will consider the threat to the future capacity of the wetland units to provide goods and services.

Identified impacts, primarily as a result of the current land-uses, considered for the offset strategy includes:

- Cultivation;
- Lack of culverts;
- Dams and berms;
- Livestock grazing and trampling;
- Alien and invasive plants; and
- Current mining activities

10 Rehabilitation Interventions towards Offsets

The Section below provides details with respect to the Offsets that can be gained, interventions that can be adopted and associated costs of adopting such interventions. It must be noted that a large portion of the costs presented below can be offset against the existing rehabilitation provision that is currently in place. A summary is provided for in Section 10.3 for which costs should be catered for under the existing financial provision.

10.1 Rehabilitation Offset Areas Affected by Mining

The entire mining right was evaluated to determine where offsets could be achieved on site first prior to looking at off site offsets. The sections below look at rehabilitation interventions that can be implemented to aid in the improvement of wetland functionality within the catchment and system connectivity, which could contribute to the overall offset that is potentially required.

10.1.1 Option 1 – Pan Offsets Requirements

Within this area there is a pan that is approximately 96.67 ha in extent of which 54.89 ha has been impacted upon as a result of mining activities. The overall functionality of this pan

system is an F. The main impacts contributing to this categorisation are impacts to the hydrological health of the wetland as a result of excavation, reduced roughness and the formation of gullies and artificial drainage channels.

The proposed rehabilitation measures are as follows:

- Contaminated soils be assessed and removed. These soils should either be rehabilitated in situ or disposed of at a registered land fill site;
- Prior to re-profiling of the pan system, all alien invasive trees need to be removed;
- Removal of all debris within the pan;
- Re-profiling of the pan catchment (South portion) needs to be re-profiled towards the centre of the pan;
- The northern section of the pan currently has trenches that need to be filled to prevent drainage of the pan system to the surrounding areas. This would also improve connectivity within the pan system;
- Grazing/Agricultural activities are also undertaken within the North Eastern portion of the pan. It is recommended that these grazing activities are stopped to aid in increasing surface roughness within the pan and thus providing greater flood attenuation and water storage surface
- Wetland sub and topsoil to be open casted mined at Block OI can be stripped and utilised as the wetland soil material within the south pan catchment. It is important that this wetland soil utilised should be stripped from the OI development and is utilised immediately to ensure that maintenance of the soil integrity and associated seed bank;
- The wetland topsoil and subsoil needs to be stripped separately and transported separately to avoid mixing of these soil to avoid the overall potential reduction in the capability of these wetland soils;
- Seeding then can be undertaken utilising appropriate hydrophilic plant species (Refer to Section 11.4, for species list);
- Once the rehabilitation has commenced this area must be designated as a no-go zone;
- On-going monitoring of Alien Invasive Plant species and removal of such species according to the Alien Invasive Management Plan; and
- An appropriate buffer (of at least 50 m) around the pan should be investigated and implemented. The above mentioned rehabilitation interventions should apply to the buffer accordingly;;

Should all of these intervention measures be implemented it is expected that overtime with implementing the correct monitoring measures the overall condition of the wetland can be improved from a Class F to a Class E.

Refer to Table 10-1, for the costs associated with Option 1 and the pan system.

Table 10-1: Summary of Costs for Option 1

Measures	Quantity	Unit	Rate	Amount
Clean up footprint	306000	m²	R13.04	R3,991,012.61
Removal of Alien Invasive Tree Species	3	ha	R8,284.55	R27,339.00
Reprofiling of Surface (assuming 50% requires profiling)	27	ha	R2,512.00	R68,941.78
Backfilling of trench	1500	m³	R18.80	R28,204.95
Placement of soil	548900	m²	R23.80	R13,066,436.93
Seeding	55	Ha	R26,539.92	R1,456,776.25
Total				**R 18,638,711.52**

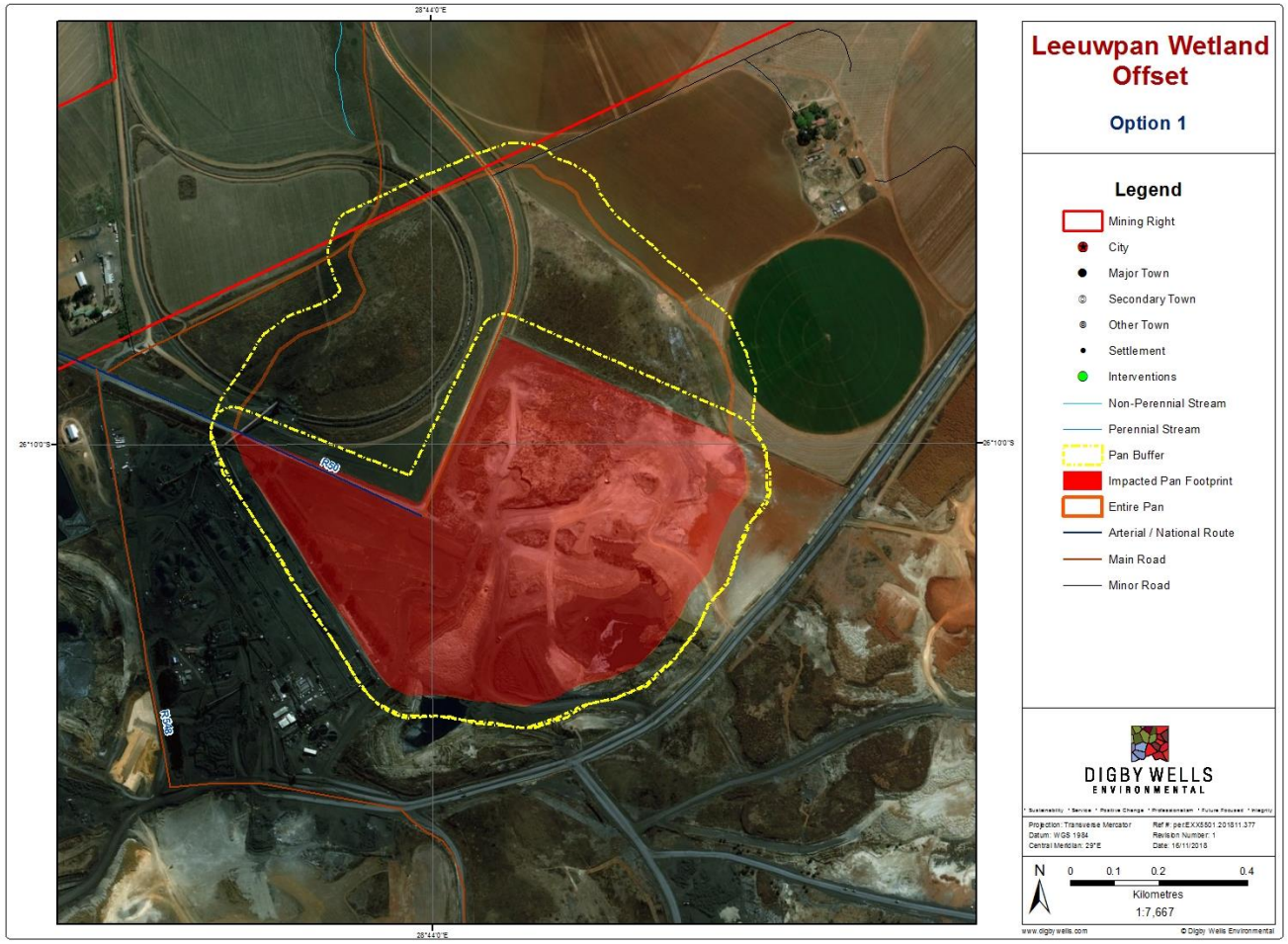

Figure 10-1: Option 1 – Pan Rehabilitation

10.1.2 Option 2 - Weltevreden Unchannelled Valley Bottom System Area

This area has significantly been impacted upon as a result of mining activities through open cast mining methods and stockpiling activities. The unchannelled valley bottom system occurring in the Weltevreden area comprises of a total of 64.3 ha. Of this 59.4 ha (Western and Eastern areas inclusive) has been impacted upon. Inclusive of the impacts within this system, are extensive stockpiling and dumping activities, Excavation activities, access roads a stream diversion, which may be regarded as disconnected from the upstream portion as well as the downstream portion of the system. These activities have resulted in fragmentation of the upstream and downstream portions of this system, resultinng in a loss of connectivity, stream integrity and overall contribution of water services to the downstream catchment.

A collapsed culvert on the lower end of the river diversion as well as stockpiling directly adjacent to the river diversion has is resulting in sedimentation of the downstream portions of the system.

The resulted impacts have caused moderate to severe deviations in the hydrological and geomorphological functioning of the system as well as substantial loss in the natural vegetation structures present. This system may be regarded as a category F.

It must be noted that Exxaro is not required by virtue of the Water Use Licence that is held for this area to be considered as a loss of wetlands, thus resulting in offsets for the impacts that have occurred here not being required. However in the interest of maintaining stream connectivity and enhance the overall connectivity of the system as a whole it is deemed appropriate to consider the rehabilitation of this area as an offset for the Leeuwpan Coal Mine.

The ultimate aim for the rehabilitation of this area is to take into consideration the rehabilitation of the surrounding catchment areas, which historically comprised largely of hillslope seepage wetland on either side of the channel.

While the reinstatement of the hillslope seepage wetlands cannot be granted, the contribution of surface flow to the unchannelled valley bottom system is regarded as an important contribute to the formation and functioning of this system. Any rehabilitation efforts will thus rely heavily on rehabilitation of the surrounding area.

The following rehabilitation interventions have been considered:

- Contaminated soils be assessed and removed. These soils should either be rehabilitated in situ or disposed of at a registered land fill site;
- Prior to re-profiling of the unchannelled valley bottom wetland and surrounding catchment all Alien Invasive Plants including Pampas Grasses observed should be removed;
- Removal of all debris within the system and fuelling systems noted in the vicinity of the system should be removed;

- The access road needs to be ripped and profiled according;
- It is recommended that when the road is removed, that this is area is connected to the historically unchannelled valley bottom system (river diversion connection). This should be considered as wetland species have already started to establish within this area as a result of water being present;
- Eastern Section of System;
  - Re-profiling of the eastern section of the catchment towards the unchannelled valley bottom wetland needs to be undertaken (This is depicted in Figure 10-2);
  - Backfilling of the open pits;
  - The diversion is a critical component of the entire system, that should remain in place as this forms the connectivity between the eastern and western portions of the unchannelled valley bottom system;
  - Should additional wetland soils be required, these soils can be acquired from the hillslope seepage and unchannelled valley bottom wetlands portions to be mined out in block OL;
- Western Section of the System:
  - Rehabilitation of a portion of the North section of the unchannelled valley bottom wetland inclusive of the unchannelled valley bottom wetland and diversion to be rehabilitated;
  - Re-profiling of the western section of the catchment towards the unchannelled valley bottom wetland needs to be undertaken (This is depicted in Figure 10-2);
  - Removal of the soil stockpiles directly adjacent to the river diversion;
  - Removal of the access road and collapsed culvert, as well as the sediment deposits directly downstream of said culvert;
- The wetland topsoil and subsoil needs to be stripped separately and transported separately to avoid mixing of these soil to avoid the overall potential reduction in the capability of these wetland soils;
- Seeding then can be undertaken utilising appropriate hydrophilic plant species (Refer to Section 11.4, for species list);
- Once the rehabilitation has commenced this area must be designated as a no-go zone;
- On-going monitoring of Alien Invasive Plant species and removal of such species according to the Alien Invasive Management Plan; and
- An appropriate buffer (of at least 50 m) running parallel to the river diversion should be implemented

Should these interventions be implemented this system has the potential to improve from a category F to a category E.

It must be noted that a separate Wetland Rehabilitation Plan is in the process of being compiled and will provide further detail with respect to rehabilitation that will be undertaken within portions of this area. The above interventions are a summary of what measures are required.

Table 10-2, provides details with respect to the estimated costs for the associated intervention that could be adopted as noted above.

Table 10-2: Summary of Costs for Option 2

Measures	Quantity	Unit	Rate	Amount
Option 2 Weltevreden				
Clean up footprint (Assuming 20% of footprint needs to be cleared)	518600	m²	R13.04	R6,763,853.39
Re-profiling of Surface (assuming 50% requires profiling)	130	ha	R2,512.00	R325,680.52
Placement of soil (assuming 50% will require soil)	648250	m²	R23.80	R15,431,440.59
Seeding	259	Ha	R26,539.92	R6,881,801.46
Option 2 Weltevreden - Surrounding Catchment				
Clean up footprint (Assuming 30% of footprint needs to be cleared)	178200	m²	R13.04	R2,324,177.93
Removal of Alien Invasive Species	5	ha	R8,284.55	R41,422.73
Re-profiling of Surface (assuming 50% requires profiling)	59	ha	R2,512.00	R149,212.67
Removal of Road	47000	m²	R7.89	R370,701.73
Placement of soil (assuming 50% will require soil)	297000	m²	R23.80	R7,070,015.97
Seeding	59	Ha	R26,539.92	R1,576,471.29
Total				**R 40,934,778.29**

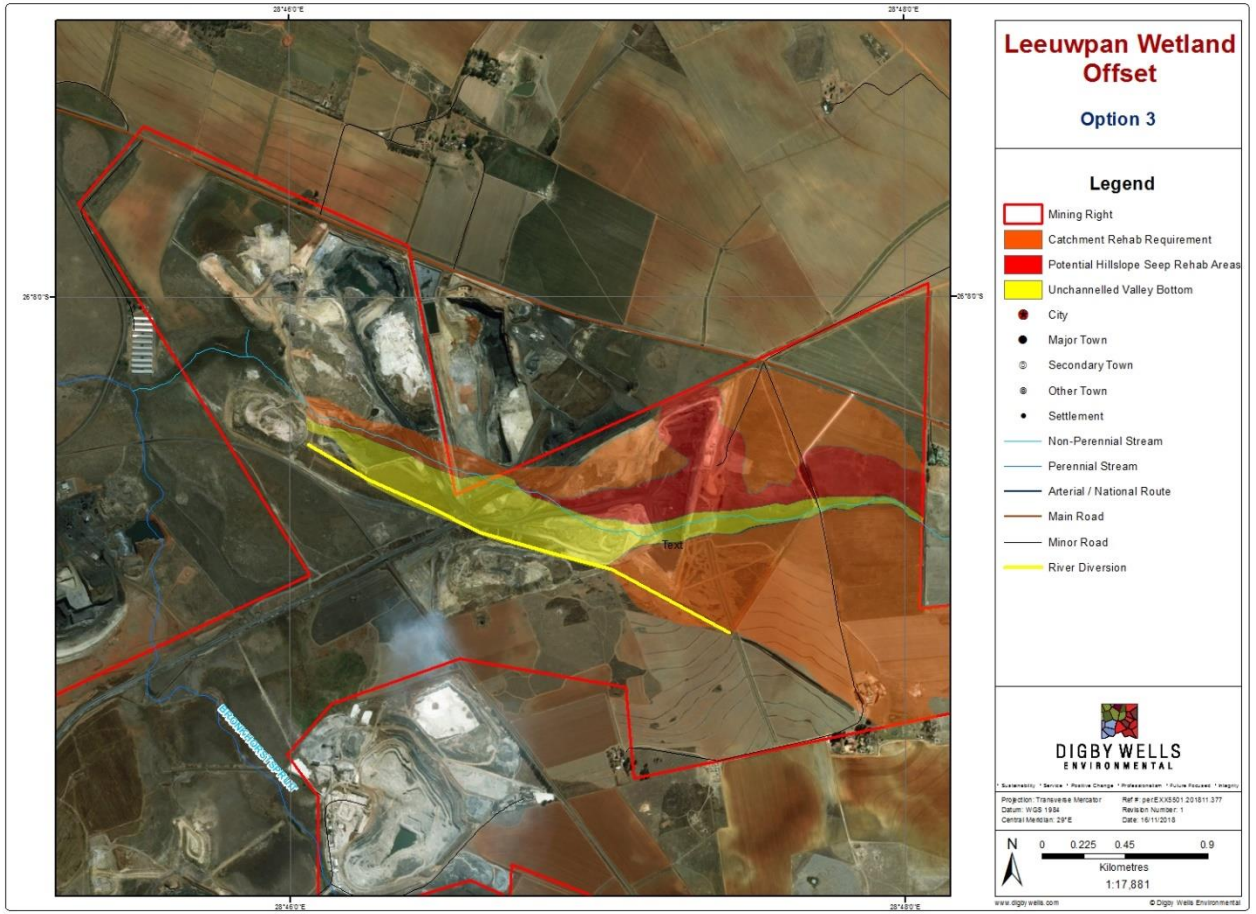

Figure 10-2: Option 2 Rehabilitation Interventions

10.1.3 Option 3 - Western Historical Mining Area and Water Storage Facility

This section is located in the western portion of the mining right. Historical mining activities have taken place within this area and partial rehabilitation has been undertaken. There is a water storage facility that is also located within this area and it is assumed that this structure will remain post closure for water management purposes.

It was difficult to determine the historical extent of the wetlands that would have occurred in this area, however it is anticipated that should this area be appropriately rehabilitated, the resultant land use may contribute to the integrity and functionality of the surrounding remaining wetland system.

There is a river diversion that runs adjacent to this area to the west, which connects the upstream portion to the downstream portion of the wetland that would have existed within this area prior to mining. It is recommended that the diversion remains in place and profiling be undertaken within this historical mining area. It is recommended that re-profiling on either side of the diversion is undertaken and stabilisation of the banks is achieved through vegetation of hydrophilic species as recommended in the species plan.

It should be noted that during the site assessments, not water was evident and thus the integrity of the diversion should be questions from a functional point of view. Surface water was observed in the original channel directly upstream and downstream of the confluence of the diversion channel, thus supporting the suspicion that the surrounding areas may have provided some hillslope seepage function. Based on the above site observations the following rehabilitation interventions are recommended:

- Diversion to remain, however corrective action is required to ensure flow of water from upstream to downstream ensuring connectivity of the system;
- Removal of perimeter berm that runs in a northerly direction (adjacent to the river diversion) which then turns in a easterly direction around the remaining open pit;
- Stockpiles remaining in this area should be utilised to backfill and profile this and the surrounding areas. The soil that was utilised to create the berm can be used as the growth medium to rehabilitated the profiled footprint;
- Profiling of the area should be done in a north North-West direction with a gentle profile to avoid erosion issues forming (refer to Figure 10-3 for profiling direction).
- Concurrent rehabilitation of this area and surrounds to the east should be undertaken to prevent sedimentation and erosion and contamination and the ingress of contaminants into this rehabilitated area;
- Seeding then can be undertaken utilising appropriate hydrophilic plant species (Refer to Section 11.4, for species list);
- Once the rehabilitation has commenced this area must be designated as a no-go zone; and

- On-going monitoring of Alien Invasive Plant species and removal of such species according to the Alien Invasive Management Plan.

Based on the above the gain is 108 ha of potential hillslope seepage areas, however, as the potential integrity of this area cannot be guaranteed at this stage, any overall gain will need to be evaluated during monitoring assessments that should occur on an annual basis during rehabilitation and into the mine closure phase.

Refer to Table 10-3, for the cost for Option 3 Interventions.

Table 10-3: Summary of Costs for Option 3

Measures	Quantity	Unit	Rate	Amount
Clean up footprint (Assuming 20% of footprint needs to be cleared	216000	m^2	R13.04	R2,817,185.37
Removal of Perimeter Berm	49600	m^3	R18.80	R932,643.75
Re-profiling of Surface (assuming 50% requires profiling)	54	ha	R2,512.00	R135,647.88
Placement of soil (assuming 40% will require soil)	432000	m^2	R23.80	R10,283,659.60
Seeding	108	Ha	R26,539.92	R2,866,311.44
Total				**R 17,035,448.04**

Figure 10-3: Option 3, Hillslope Seep Catchment

10.2 Surrounding Interventions On-site

This section below provides information with respect to specific on-site interventions that could be implemented in order to ensure that the necessary offsets can be achieved. Refer to Figure 10-4 for the location of the on-site interventions that can be implemented.

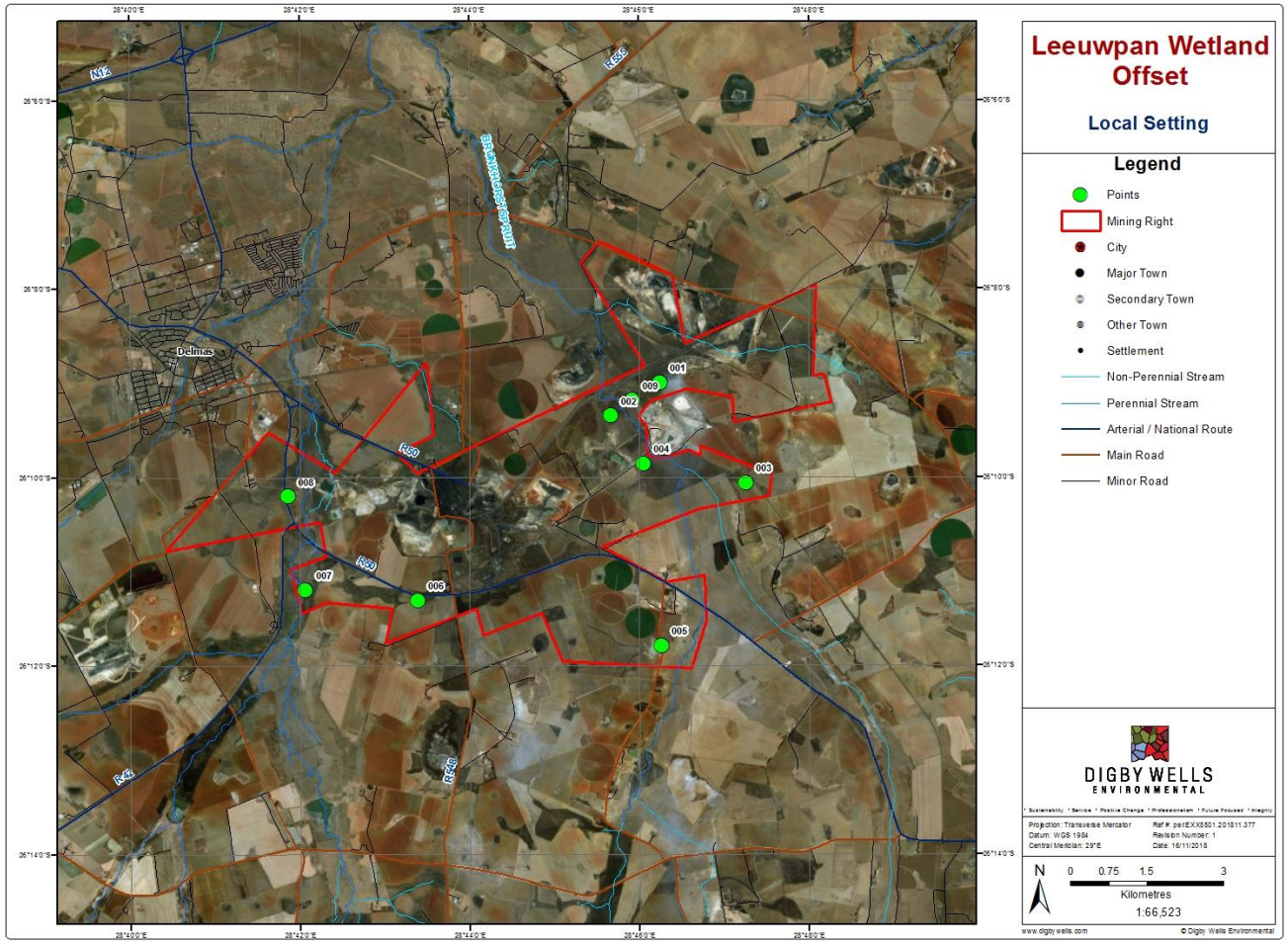

Figure 10-4: On-site Interventions

10.2.1 Intervention 1

There is a berm, borrow bit and road located within a hillslope seep. These impacts have resulted in fragmentation of habitat. It is recommended that the road be removed within thus wetland. It should be ripped and re-profiled in accordance with the surrounding landscape and seeding undertaken as recommended.

The borrow pit should be backfilled making use of the adjacent berm and reseeded accordingly. In addition there are remains of a fence that bisects the wetland and should be removed.

Table 10-4, provides details with respect to the associated costs for Intervention 1.

Table 10-4: Summary of Costs for Intervention 1

Measures	Quantity	Unit	Rate	Amount
Removal of Berm and Fill Borrow Pit	696	m^3	R18.80	R13,087.10
Removal of Road	1200	m^2	R7.89	R9,464.73
General Clean Up	1200	m^2	R13.04	R15,651.03
Ripping of Area	1200	m^2	R23.80	R28,565.72
Removal of Fence	399	m	R14.57	R5,814.94
Seeding	0.17	Ha	R26,539.92	R4,450.74
Total				**R 77,034.26**

10.2.2 Intervention 2

Intervention 2 is for an unchannelled valley bottom system and the PES is a C. There are several berms that are located within this wetland. There is a large berm that runs in an east-west direction through this wetland. From the site assessment it was noted that there is already wetland vegetation that has established with several sensitive species, inclusive of this Crinum. All species of Crinum are considered to be Protected Plants in Section 69 (1)(a) of the Mpumalanga Conservation Act No. 10 of 1998. It is suggested that this berm remain in place based on the surrounding sensitivities, however if water flow needs to be improved to the downstream areas, additional channels through the berm can be constructed, but must be done so utilised minimal machinery (by hand). The other small remaining berms can be removed also by hand.

A number of edge effects have already impacted this wetland, including sedimentation, vehicular disturbance, dumping of debris and soil compaction. It is recommended that the portion of mining and access road to the west of this wetland be rehabilitated and

implemented as a buffer zone to protect this wetland. The wetland and this buffer zone must be designated as a no-go zone. The hectare gain (Offset Protection Area) with taking the above into account potentially will be 121.6 ha, which includes an additional buffer zone of 55.1ha. There is a small portion of agricultural fields that should be removed and is 3.1 ha is size.

Table 10-5, provides details with respect to the associated costs for Intervention 2.

Table 10-5: Summary of Costs for Intervention 2

Measures	Quantity	Unit	Rate	Amount
Removal of Berms and infilling of box cuts	32871	m^3	R18.80	R618,083.32
Cuts through Larger Berm	5772	m^3	R18.80	R108,532.66
Removal of Road	5100	m^2	R7.89	R40,225.08
General Seeding	3	Ha	R26,539.92	R77,984.90
Rehabilitation of Buffer Area (Profiling)	55	ha	R2,512.00	R138,411.08
Rehabilitation of Buffer Area (Soil Placement assuming 60% of Area)	330600	m^2	R23.80	R7,869,856.16
Rehabilitation of Buffer Area (Seeding)	55	Ha	R26,539.92	R1,462,349.64
Removal of Agricultural Lands	3	ha	R8,671.83	R26,969.38
Vegetation of Agricultural Lands	3	Ha	R26,539.92	R82,539.15
Total				**R 10,424,951.37**

10.2.3 Intervention 3

This intervention is located within a hillslope seep wetland within the mining rights area located to the South East of the Silica Mine. There are agricultural fields within this wetland, in addition there is a fences that intersect this wetland should be removed in addition to the removal of the agricultural fields. During the site assessment there was not active planting of crops, however the area seem to have been ploughed. The purpose of this intervention is to improve the overall biodiversity and species richness. The potential gain could be 16.48 ha of hillslope seepage wetlands.

Table 10-6, provides details with respect to the associated costs for Intervention 3.

Table 10-6: Summary of Costs for Intervention 3

Measures	Quantity	Unit	Rate	Amount
Removal of Agricultural Fields	10	ha	R8,671.83	R87,585.46
Removal of Fence	1330	m	R14.57	R19,383.15
Seeding	10	Ha	R26,539.92	R268,053.20
Total				**R 375,021.80**

10.2.4 Intervention 4

There are two roads that run towards the Silica Mine which provides access to this mine and Waste Rock Dump. It was noted that during the site assessment that these roads have fragmented the wetland located within this area. It is recommended that appropriately designed culverts be installed at roughly 30 m intervals (4 culverts) to allow flow of surface water for the road that runs to the Waste Rock Dump. For the access road to the offices at least two double portal culverts should be installed. At closure it is recommended that the roads are removed, but this is dependent on closure of the Silica Mine and may be the responsibility of that mine to do.

The buffer mentioned in intervention 002 is envisage to play a two-fold role in protecting the remaining portion of the hillslope seepage wetland adjacent to the unchannelled valley bottom wetland. Edge effects from emanating the OL Pit should be mitigated as far as possible with the implementation of an erosion berm. This erosion berm should not enter the wetland located within the vicinity of intervention 4. The erosion berm should be along the edge of the OL Pit. The erosion berm should be seeded with stoloniferous grasses, such as *Cynodon Dactylon*. It is recommended that this berm be put into place to avoid the wetland from further degradation, desiccation and edge effects.

Any gains will be counteracted by the development of the OL pit, as such any interventions in the vicinity of intervention 4 are regarded as valuable with respect to maintaining connectivity.

Table 10-7, provides details with respect to the associated costs for Intervention 4.

Table 10-7: Summary of Costs for Intervention 4

Measures	Quantity	Unit	Rate	Amount
Instillation of Culverts (6 Culverts)	125	m	R1,764.00	R220,500.00
Instillation of Berm	12900	m^3	R14.76	R190,398.29
Total				**R 410,898.29**

10.2.5 Intervention 5

There is a culvert that should be cleared out to improve surface water flow and increase the wetness signature through the wetland area. In addition to this in the vicinity of the road crossing and culvert, a notable portion of soil dumping and disturbance was observed and opportunistic alien invasive species have established. These alien species should be removed and the areas re-profiled and seeded with stoloniferous wetland species.

Table 10-8, provides details with respect to the associated costs for Intervention 5.

Table 10-8: Summary of Costs for Intervention 5

Measures	Quantity	Unit	Rate	Amount
Clearing out Culvert				R11,025.00
Removal of Alien Invasive Tree Species				R6,959.02
Re-profiling of Area				R2,260.80
Seeding				R23,885.93
Total				**R 44,130.75**

10.2.6 Intervention 6

There is a combination of building rubble and general waste that has been disposed of within a hillslope seep wetland. It is recommend that the rubble is removed and the trenches backfilled, this should be followed by reseeding with suitable wetland grass species. This will promote water distribution, wetness signature and promote vegetation establishment and recolonization. In addition, this will increase the diffuse flow of water across the wetland and decrease the rate of passage of water through the wetland.

Lastly Alien Invasive Plant species should be removed within this wetland and in the general vicinity of the hillslope seep.

Table 10-9, provides details with respect to the associated costs for Intervention 6.

Table 10-9: Summary of Costs for Intervention 6

Measures	Quantity	Unit	Rate	Amount
Removal of Alien Invasive Tree Species	c	ha	R8,284.55	R12,178.28
Clean Up of Rubble	5200	m²	R13.04	R67,821.13
Profiling of Area	3	ha	R2,512.00	R6,279.99
Seeding	3	Ha	R26,539.92	R66,349.80

Total				**R 154,629.21**

10.2.7 Intervention 7

In this area, the wetland that has been impacted upon by a trench, a channel that had been dug and rocks placed within the wetland. This wetland is a channelled valley bottom wetland and has a current PES of D. Removal of the rock; trench and channel would potentially improve the class to a C, but can only be achieved if grazing is restricted within the channel to prevent further development of erosion. It is recommended that the work undertaken within this area is done by hand.

Table 10-10, provides details with respect to the associated costs for Intervention 7.

Table 10-10: Summary of Costs for Intervention 7

Measures	Quantity	Unit	Rate	Amount
General Clean Up	380	m^2	R13.04	R4,956.16
Infilling of Trench and Channel	2568	m^3	R18.80	R48,286.88
Total				**R 53,243.04**

10.2.8 Intervention 8

This wetland is a category C, hillslope seepage wetlands. If interventions are adopted is not anticipated that the category would increase to a B, but the ecological service provision can be improved. It is recommend that areas of disturbance and dumping be re-profiled and rehabilitated and that alien invasive species, such as blue gums and wattle observed within this wetland are removed. Cosmos was also noted in certain areas, which can also be removed.

Table 10-11, provides details with respect to the associated costs for Intervention 8.

Table 10-11: Summary of Costs for Intervention 8

Measures	Quantity	Unit	Rate	Amount
Removal of Alien Invasive Tree Species	8	ha	R8,284.55	R67,021.98
Profiling of Borrow Pit	4	ha	R2,512.00	R8,942.71
Seeding	4	Ha	R26,539.92	R94,482.12
Total				**R 170,446.81**

10.2.9 Intervention 9

There is a powerline servitude that runs towards the Silica mine. It is recommended that those culverts are inserted along the servitude to allow water flow through the system and provide connectivity between and lateral flow.

Table 10-12, provides details with respect to the associated costs for Intervention 9.

Table 10-12: Summary of Costs for Intervention 9

Measures	Quantity	Unit	Rate	Amount
Installation of Culverts (6 Culverts)	125	m	R1,764.00	R220,500.00
Total				**R 220,500.00**

10.3 Summary of Costs

Table 10-13 below, provides a summary of the costs and which costs are can be partitioned towards the rehabilitation provision that should be currently in place. The assumptions for the costs are based on the following:

- Large earthmoving costs have been excluded, such cost as backfilling of voids and removal or associated stockpiles;
- Costs have been provided in certain sections for general clean up and profiling where required; and
- The costs provided are provisional costs and need to be aligned with the updated financial provision that is currently underway.

In summary the total costs for the rehabilitation measures and interventions considered equals to **R88,317,293.38 (VAT Excl)**. In saying this, the majority of the costs can be assigned to the existing financial provision that would be in place. Based on this an additional **R 1 503 904.00** would be required for the interventions recommended.

Table 10-13: Summary of Costs

Area/Intervention	Estimated Costs	Offset Against Financial Provision
Rehabilitation Offset Areas (Option 1, 2 and 3)	R76,608,937.85	Yes
Intervention 1	R77,034.26	No – Additional Cost
Intervention 2	R10,424,951.37	Yes
Intervention 3	R375,021.80	No – Additional Cost
Intervention 4	R410,898.29	No – Additional Cost
Intervention 5	R44,130.75	No – Additional Cost
Intervention 7	R152,629.21	No – Additional Cost
Intervention 8	R53,243.04	No – Additional Cost
Intervention 9	R170,446.81	No – Additional Cost
Intervention 10	R 220,500.00	No – Additional Cost
Sub-total	**R88,317,293.38**	

11 General Rehabilitation Guidelines

11.1 Erosion Control

When vegetation cover is insufficient to hold the sediment during high rainfall events, erosion gullies form in wetlands. The aim of implementing erosion control measures on site is to eliminate all gulley and headcut erosion and to ensure that all wetland area is vegetated with no exposed substrate.

Gabion baskets or Reno mattresses are used for embankment stability and scour lining for erosion control. A Gabion basket is a flexible wire basket that is filled with rock to form a permeable structure allowing drainage yet preventing erosion. Reno mattresses are used to line the channel/wetland floor where it is susceptible to erosion. It is advisable that Gabion structures are considered in any areas where road or bridge crossings are resulting in erosion as a result of sheet runoff during high rainfall periods. Examples of gabions are represented in Figure 11-1.

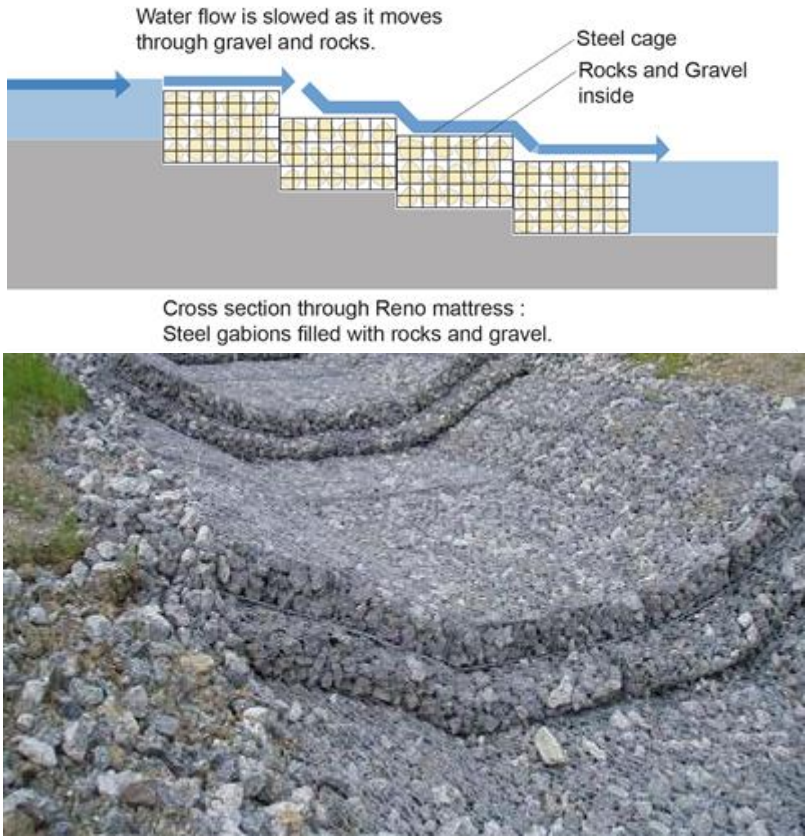

Figure 11-1: Example of Gabion and Reno structures

11.2 Alien Plant Control

Alien species in South Africa are categorised according to the Alien and Invasive Species Lists, 2016 (GN R 864 in *GG* 40166 of 29 July 2016) of the NEMBA (Act 10 of 2004).

The national list of invasive plant species listed in NEMBA represents the following categories:

- Category 1a: Species requiring compulsory control;
- Category 1b: Invasive species controlled by an invasive species management programme;
- Category 2: Invasive species controlled by area, and
- Category 3: Invasive species controlled by activity.

Not only are landowners under legal obligation to remove alien invasive plant species, but these plants are also detrimental to the ecological functioning of landscapes and this is particularly true for wetlands.

Grey Poplars (*Populus x canescens*) invade rivers, streams and wetlands, colonising area that would naturally be colonised by native hydrophilic vegetation (Bromilow 2010). This is typical of pioneer invaders. *P. canescens* spreads through coppicing in response to damage to the tree (when young vigorous shoots are produced from the base of the adult tree). This coppicing ability hampers effective removal through mechanical control unless adult trees are ring-barked and the entire root system is removed.

Stands of *Acacia mearnsii* and *Eucalyptus camaldulensis* were found in stands throughout the mining rights and also on the edges of wetlands.

In addition to alien tree species, dense stands of alien forbs, mostly: *C. bipinnatus* and smaller areas of *B. pilosa* were identified in the wetland areas during the December 2018 assessment. *C. bipinnatus* is highly invasive and colonises areas that would otherwise be left for native wetland-dependant plants to be established. *C. bipinnatus* produces a large amount of seed and is difficult to control. Table 11-1 lists alien plant species that should be controlled on site.

Table 11-1: List of alien plant species to be removed

Species	NEMBA Category	Control mechanism
Acacia mearnsii	2	Chemical control for juveniles: Glyphosate (ammonium)-680g/kg WG of Roundup Max 680 WG (L6790). Strip bark and cut to stumps for adult trees. Monitor regularly and remove seedlings before individuals

Species	NEMBA Category	Control mechanism
		reach seed-bearing height.
Cosmos bipinnatus		It is recommended that plants are mechanically removed (pulling) or burned. The substrate is likely to have a substantial seedbank and as a result, regular hand-hoeing during the growing season (autumn) is necessary. Individuals should be removed before they reach flowering or seed-bearing size.
Eucalyptus camaldulensis	1b	Mechanical control for juveniles in the form of hand-pulling. Adults can be cut to stumps and treated with a herbicide: Fluroxypyr 80 + Picloram 80 g/L ME (Plenum)
Pinus patula	2	Mechanical control in the form of felling.
Populus X canescens	2	Picloram (as potassium salt) 240g/L SL (Access) is registered for *P. canescens.* It is recommended that control of trees takes place after the rainy season between April and November and herbicide usage should be restricted within the water course.

In order to effectively eradicate and control the alien trees identified, the program cycle takes three years consisting of an initial clearing and then two follow-up interventions, after which an evaluation takes place as to the requirement for further treatments.

The importance of this cycle is:

- To ensure that the trees have been effectively treated in the initial clearing;
- That the follow-up treatments are conducted effectively;
- That any existing or new emergent seedlings are dealt with timeously and
- That there is employment continuity for the team that removes the species, as well as skills and knowledge retention.
- Where possible, biocontrol agents and mechanical removal should be utilised instead of herbicides. Herbicide usage should be restricted within the water course.

11.3 Buffers

Buffer zones are a requirement of the NWA to facilitate the protection of the delineated wetland areas within the project area. The purpose of the establishment of buffer zones is to

minimise the anthropogenic impacts associated with the proposed development on the receiving water resources. A buffer zone is defined as:

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

The following justifications have been provided for the establishment of buffer zones, some of which are listed below:

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

The NWA stipulates that suitable buffers should be placed around wetlands. In order to improve both functionality as well as the various conservation efforts of the candidate offset wetlands, it is imperative that the buffer strips around them are reinstated. Where possible, farming should be excluded from these zones to promote the natural assimilative capacity of wetland vegetation.

An estimated 87.12 ha of buffer area has been identified and is expected to be sufficient for the offset requirements for the wetland systems present. However, alien plant invasion is expected, due to disturbance of the soil and this should be monitored. Any alien seedlings that establish should be removed before they grow to seed-bearing size.

11.4 Re-vegetation

The project area is situated in the grassland biome. Wetland-dependant plant species that occur naturally in wetlands in the region are listed in Table 11-2 and examples of some of these species is represented in Figure 11-2. It is recommended that a specific seed-mix is applied to the areas where alien plants have been removed, over areas where rehabilitation efforts take place and areas where erosion control measures have been implemented. It is advisable that all plants used for revegetation are native highveld grassland species. Seed may be harvested from species that have been recorded on site during the winter months to save on costs.

In addition to the application of a mixed-seed spray, individual "plugs" of *I. cylindrica* and *C. dactylon* should be planted over approximately 10% of wetland area. Since these species are stoloniferous, they have a high soil stabilising capacity.

Table 11-2: Grass and sedge species recommended for re-seeding

Species	Common Name	Degree of wetland tolerance
Agrostis lachnantha	African Bent Grass	Permanent hydrophyte

Andropogon appendiculatus	Blue Grass / Blougras	Facultative hydrophyte
Andropogon eucomis	Snowflake Grass	Permanent hydrophyte
Cynodon dactylon	Couch Grass	Facultative hydrophyte
Eragrostis gummiflua	Gum Grass	Facultative hydrophyte
Imperata cylindrica	Cottonwool Grass	Permanent hydrophyte
Juncus effusus	Common Rush	Permanent hydrophyte
Setaria sphacelata	Golden Bristle Grass	Permanent hydrophyte
Sporobolus africanus	Spear Grass	Facultative hydrophyte

Figure 11-2: Examples of species to be used for revegetation

11.5 Signage

An important companion to the declaration of an offset area is a means of notifying the public in the form of signage. It is recommended that a sign is placed in a suitable area on the boundary of the wetland to identify the offset wetland and also to educate the public about the importance of wetlands. An example of signage that can be used is represented in Figure 11-3. This sign can be translated to Zulu and Xhosa so that it can be understandable to the local community.

Figure 11-3: Example of signage

12 Monitoring

After rehabilitation interventions have been implemented, monitoring of wetlands is necessary, to ensure that the objectives for rehabilitation are met and that ecological functionality is restored. This should be undertaken by a suitably qualified wetlands specialist. Monitoring will benefit the managers of the wetlands, as practical objectives can be set, which can provide tangible feedback into the wetland offset strategy. The objectives are to monitor the following:

- Wetland extent – impacts such as damming and infilling can result in a loss of wetland area, whereas seepage may cause an increase in wetland extent;
- Wetland Integrity – A basic level 1 health assessment is necessary to detect changes to the health of vegetation (including alien invasion), hydrology and geomorphology of the wetlands associated with the site. This allows for the determination of the Present Ecological State (PES); and
- Wetland functionality – The EIS of the wetlands should be regularly determined in order to detect any alteration to functionality.

Monitoring should take place bi-annually for the duration of the rehabilitation phase and into the closure phase, or for a minimum of 5-7 years, depending on the effectiveness of rehabilitation interventions.

Vegetation monitoring is necessary to detect a transition from hydrophytic to dryland species, which will be indicative of wetland desiccation. Further to this, the site should be monitored for alien plant species establishment. These plants are easier to control when

they are removed as seedlings, before they become seed-bearing and are allowed to spread across the landscape.

It is recommended that the stratified random sampling technique is employed across transects through the wetland areas and that species are recorded as they are encountered. The GPS location of the edge of hydrophytic plants should be recorded and the area of alien bushclump cover should be determined. Alien species should be monitored for up to five years unless no recruitment is recorded for one year.

Fixed-point photography should be undertaken at specific points on either side of each transect, facing the wetland area at 1.5 m from the ground. Monitoring of vegetation should take place annually between November and February, according to the Minimum Requirements for Biodiversity Assessments (Mpumalanga Parks and Tourism Agency (MPTA) which states that floristic surveys must be conducted during the growing season of all species that may potentially occur.

13 Conclusion

Digby Wells Environmental (hereinafter Digby Wells), was appointed by Exxaro Mpumalanga Coal (Pty) Ltd) In November 2018 to review and update the Wetland Offset Report compiled by Land Resources International (hereinafter LRI) for the Leeuwpan Coal Mine in Mpumalanga, South Africa. Following this report, LRI submitted an onsite wetland rehabilitation plan for the Leeuwpan Coal Mine's proposed block OI and OL mining development in 2016. Since the submission of the LRI 2016 report, mining of block OI has commenced. Mining of block OL is due to commence on approval of this updated Wetland Offset Report. The Integrated Water Use License (IWUL; no.: 04/B20A/CIJ/4032) for the Exxaro Coal (Pty) Ltd: Leeuwpan Coal Mine OI and OL Expansion was granted provided that wetland offset areas were identified to compensate for the loss of wetlands.

Further to this, an additional pit, Block OI West, has been proposed, the required offsets of which have been included in this report for consideration of inclusion into the Integrated Water Use License. The additional proposed Block OI West, would result in the destruction of 18.36 ha of hillslope seepage wetlands as well as a pan, 2.21 ha in extent.

According to the LRI (2013) report, the wetlands within Block OI were delineated in 2012, with mining activities within Block OI expected to impact on at least 134.62 ha of wetlands (68.4 ha fall within the direct footprint of proposed opencast areas and mining activities within Block OL expected to impact on at least 120.30 ha of wetlands.

On calculation of the hectare equivalents required for the calculation of the required functional and conservation offset targets for both Blocks OI and OL, a total of 87.23 hectare equivalents are expected to be lost. The additional proposed Block OI West will result in an additional loss of 10.51 hectare equivalents. The required functional offset target is thus

calculated at 97.7 hectare equivalents and the conservation offset target is 561.4 hectare equivalents.

According to the LRI (2013) report, if it is assumed that the remaining wetlands on site can be rehabilitated so as to increase their present ecological state category by one level, this would imply an approximate 20% gain in functional area. As such, this would result in a gain of about 206.59 hectare equivalents. However, on consideration of the additional loss of wetlands as a result of the proposed Block OI West, the gain would be reduced to 202.48 hectare equivalents.

During the field assessment carried out in December 2018, three portions of wetland that are regarded as destroyed as a result of mining activities were identified as potential sites for rehabilitation. The rationale behind this approach is such that should rehabilitation of these sites be considered, this would provide the potential to restore stream connectivity between upstream and downstream areas that have become fragmented as well as improve the ecological importance and sensitivities of the systems present as a whole. Assuming each of these wetland portions can be rehabilitated to a category E, the direct wetland gain in terms of hectare equivalents may be regarded as 138.29 ha. However, in order to realise both these gains, as well as the 202.48 ha of gains discussed above, it is estimated that a minimum of 204.10 ha of the surrounding catchment areas will require rehabilitation and a further 87.12 ha of buffers located in selected areas around the mining rights area are recommended to protect the wetlands present and prevent further losses to the wetland systems present. Thus, a total of 631.99 ha have been identified towards achieving the wetland conservation target of 561.4 ha. In terms of functional offset targets, the direct gains in hectare equivalents total 340.77 ha, which may be regarded as more than sufficient to achieve the above-mentioned functional offset target requirement of 97.7 ha.

It must be noted that in terms of the “like-for-like” offset requirement, the conservation offset target falls short of the required hectare equivalents for hillslope seep wetlands, however, consideration as to the potential improvements and rehabilitation of selected wetland systems within the Mining Rights Area were regarded as valuable inclusions within the proposed offset strategy, not only from the perspective of improvements to the present ecological state of the systems as a whole, but also in terms of improvements to ecological importance and service provision within the greater catchment. The value of including the proposed rehabilitation measures within the offset strategy thus serve as grounds for the consideration of an “out-of-kind” offset (to some extent).

In summary the total costs for the rehabilitation measures and interventions considered equals to **R88,524,584.57 (VAT Excl)**. In saying this, the majority of the costs can be assigned to the existing financial provision that would be in place for closure. Based on this only an additional **R 1 503 904.00** would be required for the interventions recommended.

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