REPORT

Wetland Mitigation Strategy for Belfast Expansion Project (BEP)

Exxaro Coal Mpumalanga (Pty) Ltd.

Submitted to:

Vinny Moodley
PO Box 9229
Pretoria
0001

Submitted by:

Golder Associates Africa (Pty) Ltd.

Building 1, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand, 1685, South Africa

P.O. Box 6001, Halfway House, 1685

+27 11 254 4800

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1 x electronic copy to Exxaro Coal Mpumalanga (Pty) Ltd.

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1.0 INTRODUCTION AND BACKGROUND

Exxaro Coal Mpumalanga Proprietary Limited (Exxaro) proposes to expand their existing Belfast Implementation Project (BIP) located south of the N4 highway 10km south west of eMakazeni (Belfast) The proposed expansion is referred to as the Belfast Expansion Project (BEP), and includes the expansion of the existing BIP opencast mine, construction and operation of a decline shaft and its associated infrastructure, construction and operation of a conveyor and/or haul road, and the establishment of a discard dump. The proposed infrastructure and associated activities are located adjacent to watercourses, with some crossing wetlands.

Exxaro has appointed Golder Associates Africa (Pty) Ltd. (Golder) to provide assistance with the Integrated Water Use License Application (IWULA), Integrated Water and Waste management Plan (IWWMP) and associated specialist studies, including a wetland baseline and impact assessment study, and a high-level wetland rehabilitation strategy to address the direct wetland losses predicted for the project.

1.1 Purpose of this report

Since direct and indirect loss of wetland habitat are predicted for the proposed BEP development, and particularly for the opencast mining and conveyor alternatives components, a wetland rehabilitation strategy is required. The aim of the strategy is the provision of a framework for the delivery of an appropriate wetland offset, in an effort to address residual impacts on wetland habitat, i.e. those impacts outstanding once the various options to avoid and minimise wetland loss, as documented in the wetland impact assessment (Golder, 2021a), have been explored.

The objective of this strategy document, which serves as a precursor to a rehabilitation plan, is to provide a summary of the potential wetland losses, and identify opportunities for offset of those losses, to present to the DWS as part of the IWULA to secure their approval for the proposed approach. Once the authorities are satisfied that the approach has the potential to appropriately compensate for the wetland losses associated with the development, a full wetland rehabilitation plan consisting of detailed design and management interventions for wetland rehabilitation will need to be developed by a wetland ecologist and environmental engineer.

This report describes the results of the baseline wetland assessment of wetlands within the BEP study area, and the outcome of the application of the South African National Biodiversity Institute's (SANBI) wetland offset calculator (Macfarlane *et al.*, 2014), in order to determine the required offset targets for the predicted Project losses.

It also provides details of the required wetland rehabilitation intervention and management measures that will be required to achieve the offset requirement, and recommendations for additional work to be completed as part of the wetland rehabilitation plan at a later stage in the Project.

2.0 PROJECT LOCATION AND EXTENT

The BEP area forms part of the Belfast resource, which is situated in the province of Mpumalanga, on the farms Leeubank, Zoekop and Blyvooruitzicht (Figure 1). It is approximately 5 819 ha in extent and mostly comprises undeveloped agricultural land and semi-natural and natural grassland and lies adjacent to the recently developed BIP opencast mine.

2.1 Project Description

The BEP is an expansion to the existing BIP. The existing BIP has an approved Water Use License (WUL) number 05/X11D/ABCFGIJ/2613. Proposed infrastructure and activities which are being applied for as part of the current BEP WULA includes:

- Development of the BEP Opencast Mine footprint;

- Development of the BEP underground mine footprint;
- Development of the Decline shaft and associated infrastructure;
- Construction of the Conveyor and/or haul road; and
- Establishment of the Discard dump.

The locations of the proposed infrastructure and activities are shown on Figure 2.

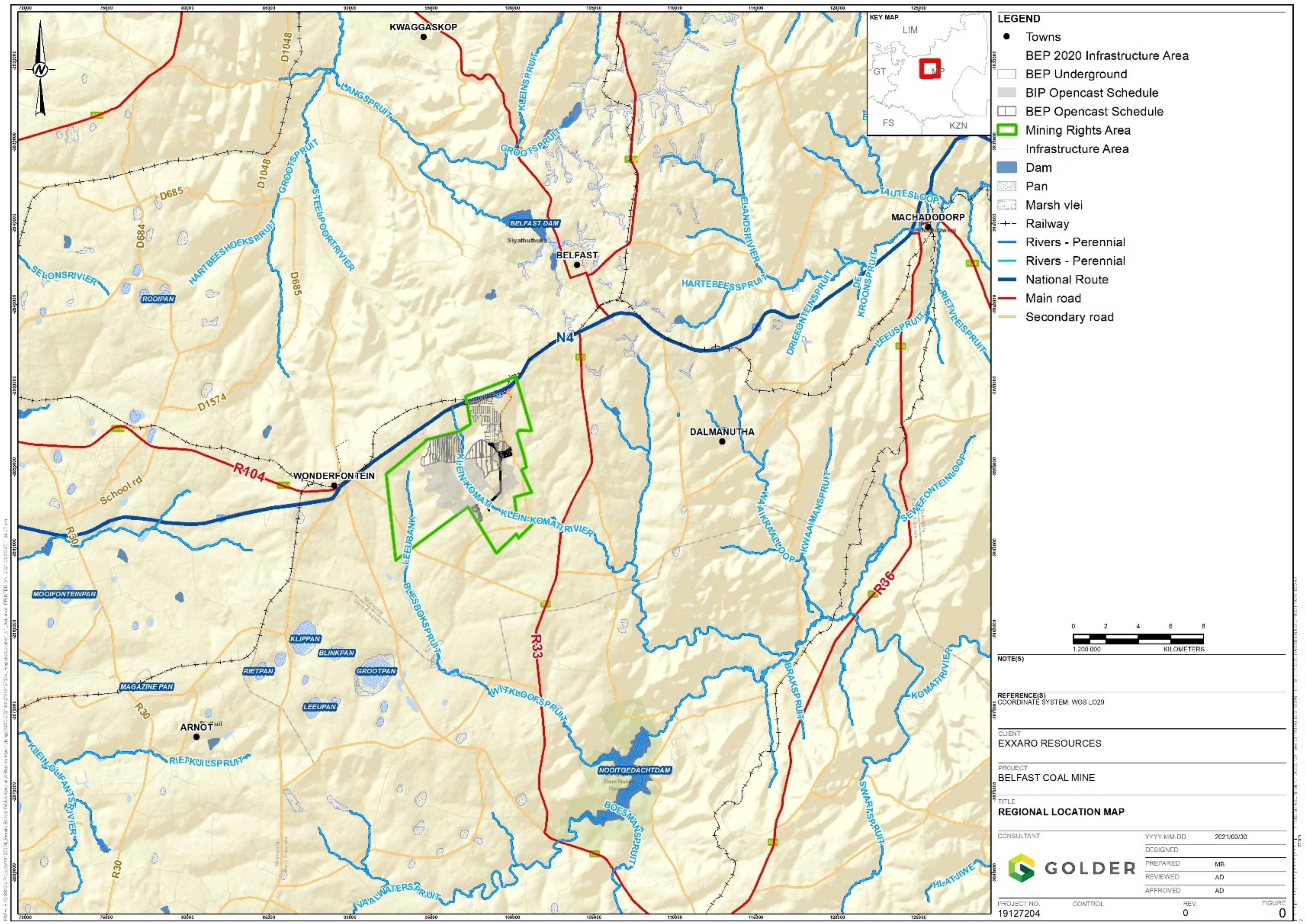

Figure 1: Regional setting of the Belfast Mining Rights Area

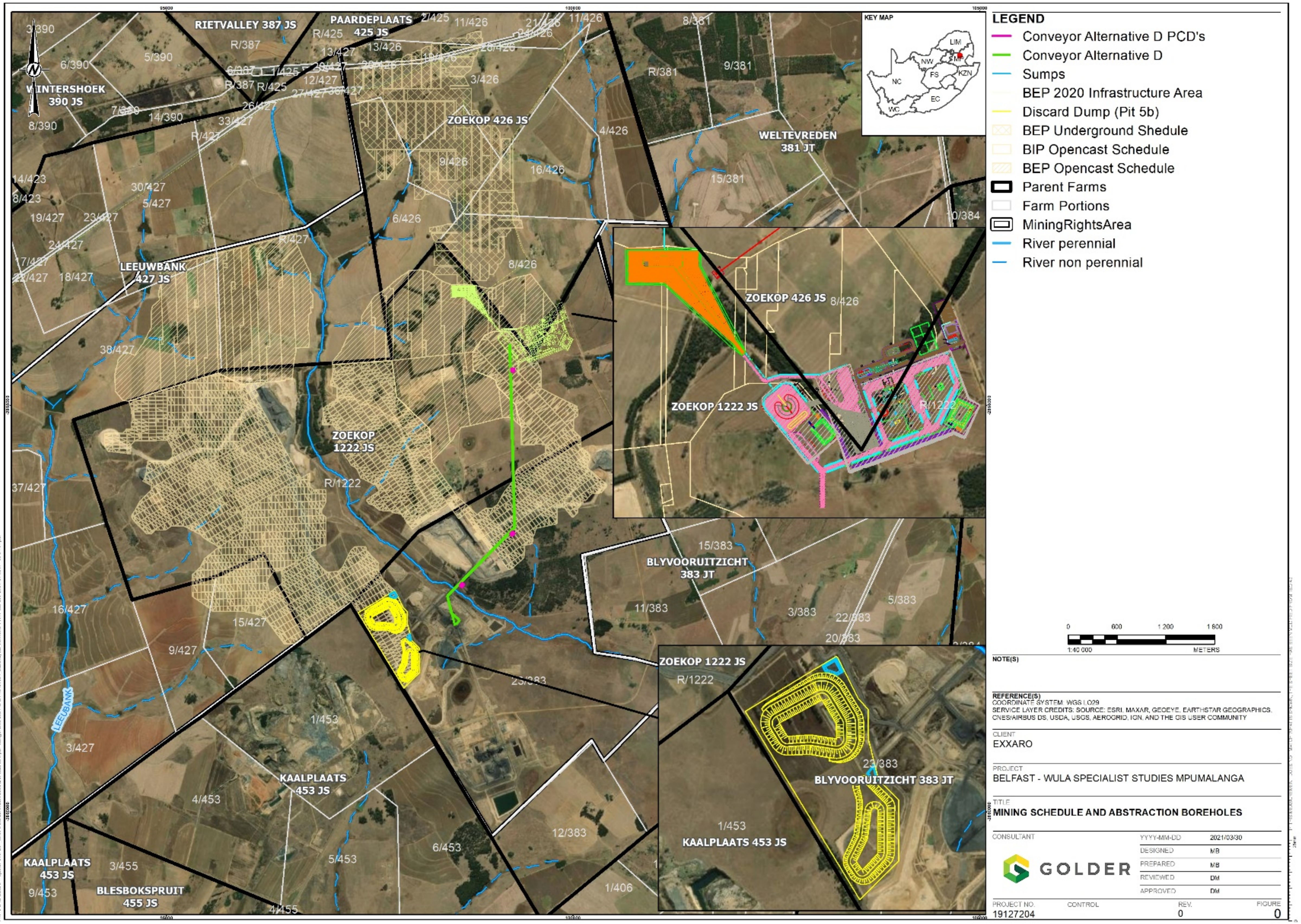

Figure 2: Proposed BEP activities and Infrastructure

3.0 APPLICABLE LEGISLATION, GUIDELINES AND STANDARDS

3.1 National Legislation

The national legislation governing watercourses in South Africa is the National Water Act, 1998 (Act No. 36 of 1998) (NWA). In terms of the NWA, wetlands are defined as "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*".

3.2 National Guidelines

The draft National Wetland Offset Guidelines (Macfarlane *et al*., 2014) provide guidance on a comprehensive approach for reducing potential impacts on wetlands, and includes methodologies for wetland offset site selection, compensation ratios and hectare equivalents used to determine the size and functionality of wetland offset. These guidelines were key in the development of the wetland mitigation/offset strategy described in this document.

4.0 APPROACH AND METHODS

4.1 Wetland Baseline

4.1.1 Delineation and Classification

The wetlands of the Mining Rights Area (MRA) were originally delineated and classified as part of the North Block Complex (NBC) Belfast Ecological Baseline and Impact Assessment (Golder, 2011), and updated by WCS (2014). This dataset has been in use since that time and no revision of the delineation or classification was considered necessary for this assessment.

4.1.2 Present Ecological Status (PES)

A PES assessment was conducted for all hydro-geomorphic wetland units in the Study Area in order to establish a baseline of the current state of the wetlands, and to provide an indication of the conservation value and sensitivity of the wetlands.

The Level 2 WET-Health assessment as described in Macfarlane *et al.* (2008) was applied for the determination of the PES score for each wetland unit. The PES score is reflected in the placement of each wetland unit into a PES category. A description of the PES scores and linked impact categories is provided in Table 1

Table 1: Impact scores and categories of Present Ecological State used by WET-Health for describing the integrity of wetlands (Macfarlane *et al*., 2008)

Impact Category	Description	Impact Score Range	Present Ecological State Category
None	Unmodified, or approximates natural condition	0 – 0.9	A
Small	Largely natural with few modifications, but with some loss of natural habitats	1 – 1.9	B
Moderate	Moderately modified, but with some loss of natural habitats	2 – 3.9	C
Large	Largely modified. A large loss of natural habitat and basic ecosystem function has occurred	4 – 5.9	D
Serious	Seriously modified. The losses of natural habitat and ecosystem functions are extensive	6 – 7.9	E

Impact Category	Description	Impact Score Range	Present Ecological State Category
Critical	Critically modified. Modification has reached a critical level and the system has been modified completely with almost complete loss of natural habitat	8 – 10.0	F

4.1.3 Ecological Importance and Sensitivity (EIS)

The EIS of wetlands within the BEP project area was determined using the methodology developed by Rountree *et al.* (2013). It is a rapid scoring system to evaluate:

- Ecological Importance and Sensitivity;
- Hydrological Functions; and
- Direct Human Benefits.

The scoring assessment incorporates:

- EIS score derived using aspects of the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999);
- Hydro-function importance score derived from the WET-EcoServices tool for the assessment of wetland ecosystem services Kotze *et al.* (2009); and
- Direct human benefits score derived from the WET-EcoServices tool for the assessment of wetland ecosystem services Kotze *et al.* (2009).

The highest score of the three derived scores (each with range 0 – 4) was then used to indicate the overall importance category of the wetland (Table 2).

Table 2: Ecological importance and sensitivity categories

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

4.2 Mitigation Strategy

4.2.1 Target wetland site selection

A field survey of wetlands within the BEP project area that would not be lost as a result of the proposed opencast mining activity, and as such present opportunities for wetland rehabilitation, was conducted from 03 to 04 June 2021. Criteria for selection of wetlands as offset receiving areas included:

- Wetlands within the Belfast MRA, within which Exxaro can exert control over implementation of rehabilitation interventions, and land-use management practices;
- Wetlands within the same catchment as those from which wetland losses will be incurred; and
- Wetlands of the same HGM type as those being lost.

During the survey, data on the location and extent of existing drivers of change, such as drainage channels, crop encroachment, headcut erosion, flow impoundments (dams/road crossings), and presence of alien and invasive species (AIS) particularly Eucalyptus and Wattle trees was gathered. This information informed the calculation of the current PES of these offset areas, as well as the future predicted PES score for the areas, once the recommended management measures for the identified problems are addressed.

4.2.2 Wetland Function and Ecosystem Calculations

Hectare equivalents and the required wetland offset targets were calculated using the South African best practice guidelines on wetland offsets (Macfarlane *et al.* (2014).

Both functional and ecosystem conservation offset targets were calculated for the BEP project area, based on the extent of wetlands that will be lost or disturbed. No species of conservation concern targets were calculated, since no significant impacts on wetland species of conservation concern are predicted (Golder, 2021a), and it is anticipated that the proposed rehabilitation of wetlands in the BEP area, will improve their capacity for biodiversity support.

4.2.2.1 Functional Hectare equivalents

The combined WET-Health score for wetland units is on a scale of 0 (pristine) to 10 (critically modified) (Table 3). The wetland health can be expressed in terms of 'hectare equivalents' of intact wetland, which provides a common currency for comparing different wetlands as well as baseline and post-rehabilitation scenarios.

Hectare equivalents (ha-eq) are calculated using the following formula (Cowden & Kotze, 2008):

(Pristine PES Score – Baseline PES Score)/10 x Total Wetland Size (ha).

For example, a wetland of 100 hectares with a baseline PES score of 6 translates to a hectare equivalent score of (10-6)/10 x 100 ha = 40 hectare equivalents of healthy wetland.

The SANBI wetland offset calculator applies an adjustment factor that accounts for the risk of offset failure. Since all offset activities proposed in this strategy are related to rehabilitation/protection, an adjustment factor of 0.66 was applied to all predicted functional hectare equivalents for the current study.

4.3 Study Assumptions and limitations

Key assumptions and limitations associated with the wetland rehabilitation strategy outlined in this document are summarised as follows:

- The objective of this strategy document, which serves as a precursor to a rehabilitation plan, is to provide a summary of the potential wetland losses, and opportunities for offset of those losses, to present to the

DWS as part of the IWULA to secure their approval for the proposed approach. Once the authorities are satisfied that the approach presented in this document has the potential to appropriately compensate for the wetland losses associated with the development, a full wetland rehabilitation plan consisting of detailed design and management interventions for wetland rehabilitation will need to be developed by a wetland ecologist and environmental engineer.

- The potential indirect losses of wetland habitat associated with drawdown / streamflow reduction due to underground mining and associated dewatering have not been quantified, and these losses will need to be taken into consideration in the development of the wetland rehabilitation plan for the BEP.

5.0 BEP WETLAND BASELINE

5.1 Conservation Context

5.1.1 National and Provincial Conservation Plans

At a national level, the NEMBA Threatened Ecosystems, (2011) recognises both Eastern Highveld Grassland and Eastern Temperate Freshwater Wetlands as 'Vulnerable' ecosystems. Accordingly, the entire study area is mapped as Vulnerable. It is noted however, that this is a high-level, pre-development scale of analysis. The study area, as well as most of the surrounding landscape is characterised by a complex land cover matrix, dominated by modified habitats/land units that comprise *inter alia*; cultivated fields, alien tree plantations and mining infrastructure. Natural grassland and wetland habitats typically occur in small, elongated land parcels that are typically associated with drainage areas or rocky areas, and embedded within the overall modified landscape matrix. In many instances, these natural habitat patches are disturbed and characterised by secondary vegetation.

The character of on-site habitats is better reflected in the fine-scale mapping presented in the Mpumalanga Biodiversity Sector Plan (Lotter *et al*., 2019) (Figure 4). The MBSP (2019) indicates that the majority of the study area is 'Heavily modified' and 'Moderately modified – old lands' (Figure 4). Most of the remaining land is classified as 'Other Natural Areas'. Smaller areas of habitat classified as 'CBA Optimal' are present in the north and south-west of the study area, while patches of 'CBA Irreplaceable' habitat are present in the south-east corner (Figure 4).

With regard to the proposed Project footprints, most of each project footprint is delineated as 'Heavily modified' and 'Moderately modified – old lands', with smaller embedded patches of 'Other natural areas' also present. An area of 'CBA Optimal' land is located in the north of the study area. Land immediately to the west of the proposed discard dump, outside the study area, is also designated 'CBA Optimal'.

In terms of the MBSP (2019), land designated as 'CBA Optimal' is optimally located to meet Mpumalanga's various biodiversity conservation targets. Although land designated as 'Other natural areas' has not been identified to meet biodiversity pattern or process targets (provided CBA and ecological support areas are not lost), they are still important repositories of species and as ecological infrastructure (MBSP, 2019).

5.1.2 Important Bird Areas

The Belfast MRA falls within the Steenkampsberg Important Bird Area (IBA), which extends from Verlorein Vlei in the north, to south of the N4 Highway.

Several other regionally threatened, range-restricted and biome-restricted species are known to be present in the IBA (Marnewick, *et al*., 2015). Several of these species have been recorded in the study area since the initial baseline study (Golder, 2011) and throughout the pre and post-construction monitoring done for BIP, including Greater Flamingo (*Phoenicopterus roseus*) – Near Threatened, Blue Korhaan (*Eupodotis caerulescens*) - Near Threatened, Secretarybird (*Sagittarius serpentarius*) – Vulnerable, Southern-Bald Ibis (*Geronticus calvus*) -

Endangered, Grey-Crowned Crane (*Balearica regulorum*) – Endangered, and Cape Vulture (*Gyps coprotheres*) – Endangered (Zinn, 2021).

These were mostly observed in moist grassland and wetland and dry mixed grassland habitats. The infrequent observation of these species indicates that they move periodically through the study area to forage and are dependent on accessing resources across the broader lanscape.

5.1.3 Strategic Water Source Areas

South African Strategic Water Source Areas (SWSAs) are defined by le Maitre *et al.,* (2018) as areas of land that either:

(a) supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or

(b) have high groundwater recharge and where the groundwater forms a nationally important resource; or

(c) areas that meet both criteria (a) and (b).

The location of the BEP MRA in relation to the nearest SWSAs is shown in Figure 5.

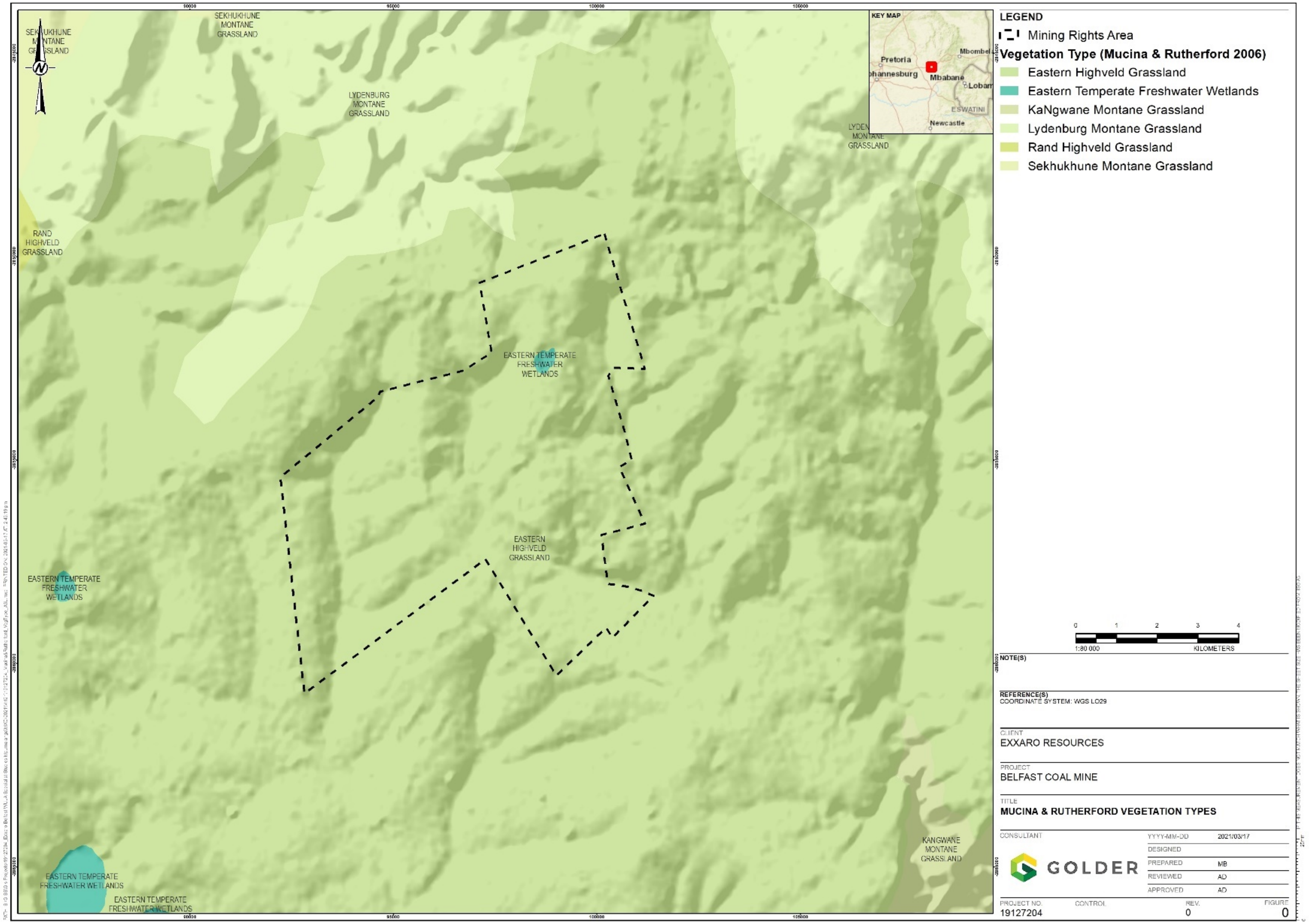

Figure 3: Study area in relation to Mucina and Rutherford's (2011) regional vegetation types

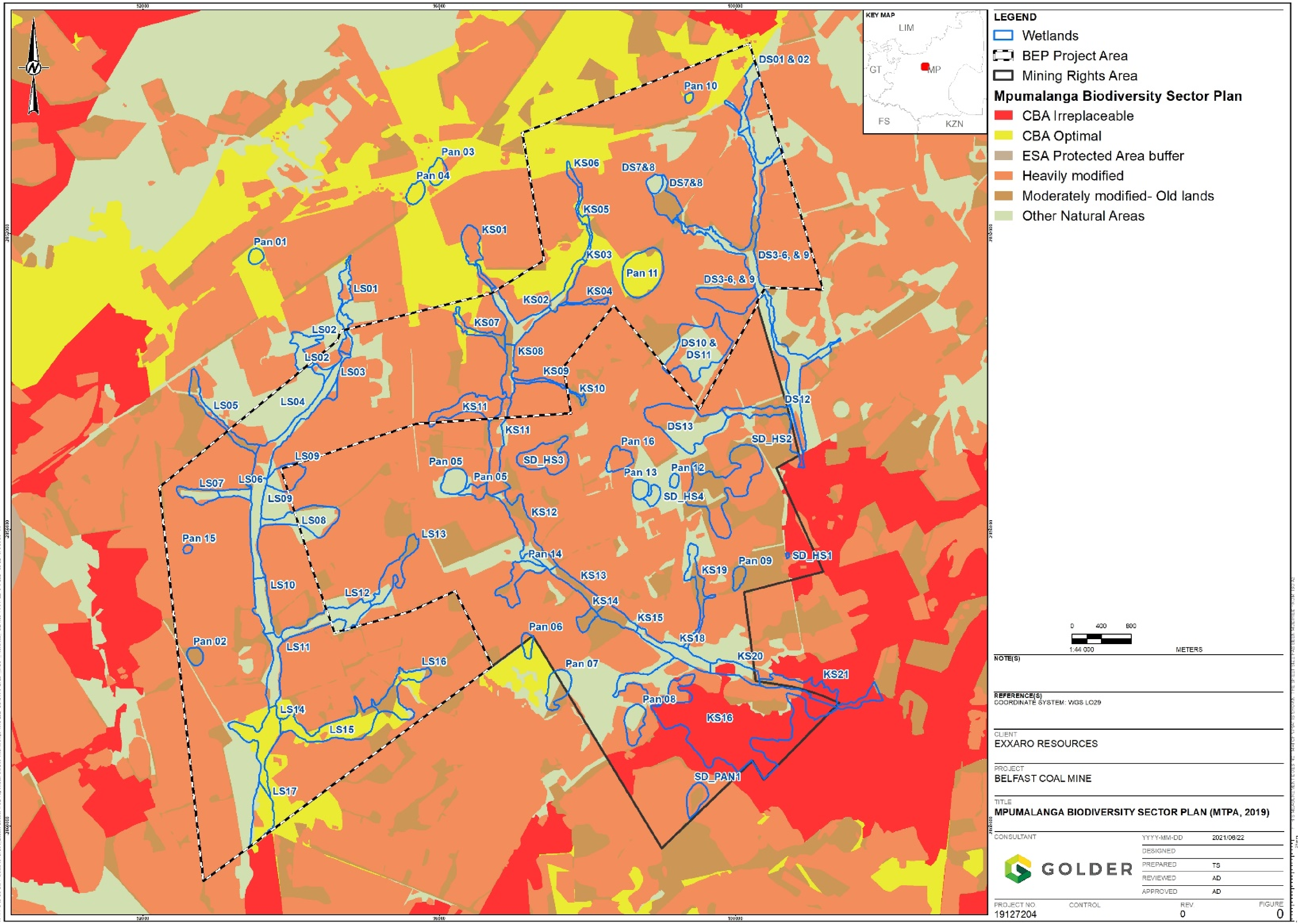

Figure 4: Belfast Mining Rights Area in relation to the Mpumalanga Biodiversity Sector Plan (2019)

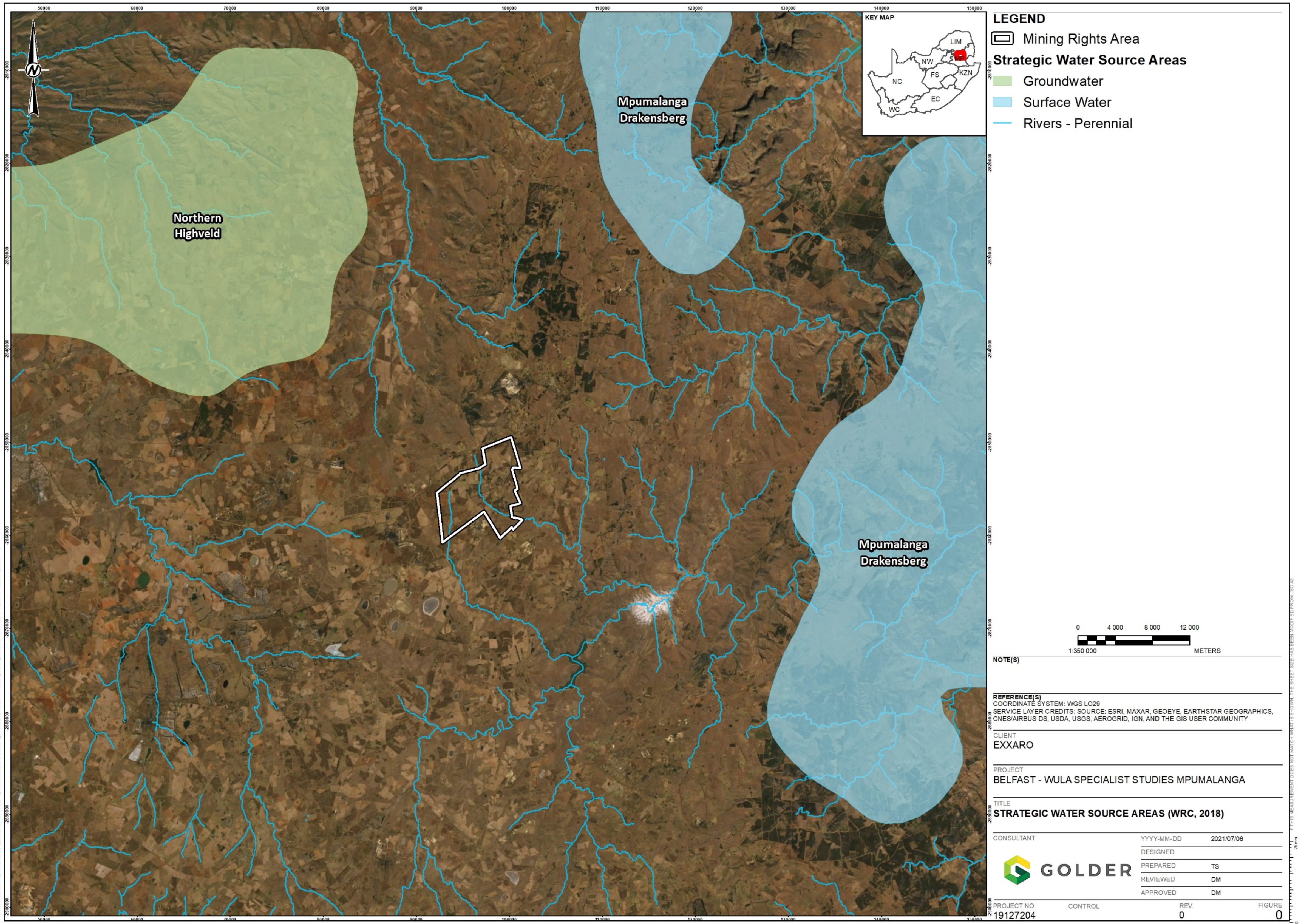

Figure 5: Belfast MRA in relation to Strategic Water Resource Areas

5.2 Wetland Delineation & Classification

The BEP project area (the Study Area) is approximately 3,126 ha, and is characterised by undulating topography dominated by agricultural cultivation and pasture land uses, interspersed with remnant areas of valley bottom wetlands, hillslope seepages, and dry grasslands, within which cultivation is not possible due to wet conditions or shallow soils. Wetlands in the Study Area are associated with the three main riparian systems and are named based on their association with the relevant system.

All of the wetlands that have been delineated and classified within the original Belfast (BIP and BEP) mining right area (Golder, 2011) are shown on Figure 6, and include the following wetland types, or HGM units:

- Valley bottom with a channel;
- Valley bottom without a channel;
- Hillslope seepage (linked to a stream channel);
- Isolated hillslope seepage; and
- Pans and Depressions, the distinction being that a pan has a discernible basin.

Since the impact of loss/disturbance of some wetlands that currently lie within the Study Area has already been authorised for the existing BIP project. These wetlands are DS13, KS19, KS14, SDHS3, KS11 (Main), and Pan 05, and were therefore not included in this study.

Similarly, several wetlands that extend into the BEP project area already form part of the wetland rehabilitation plan for the currently mining Belfast Implementation Project (GroundTruth, 2016, 2019) were not considered for the rehabilitation strategy, these are LS08, LS012, and LS16. LS17 was also excluded due to its location on the opposite side of the road boundary.

5.3 Present Ecological Status

The wetlands within the Study Area exist in a landscape that is highly transformed. The majority of the wetland's catchments have been modified through intensive agricultural cultivation practises, and more recently, some have been affected by opencast mining in the BIP project area.

The bulk of the wetlands within the Study Area are in a Moderately Modified (PES C) to Largely Modified (PES D) condition, with just three pans considered to be in Good (PES B) to Pristine (PES A/B) condition (Table 3). The distribution of the wetlands in the Study Area, in relation to their PES score, is shown on Figure 7.

The degradation of wetland habitat that has occurred in these systems is mostly associated with the intensive cultivation practises in the catchments of the wetlands and in some instances in the wetlands themselves, large impoundments as a result of farm dams and less intense impoundments as a result of farm access tracks, drainage gullies and subsequent erosion, plantations of eucalyptus and wattle, and in-wetland infestations by alien and invasive weed species.

The relatively steep valley-side gradient of parts of the study area makes the hillslope seep and unchannelled valley bottom wetlands susceptible to erosion, especially where those wetlands are also subject to grazing by livestock, partially dammed, or traversed by dirt tracks. These factors lead to the formation of preferential flow paths, resulting in desiccation of adjacent wetland habitat.

Table 3: PES scores and categories, 2021

Wetland HGM Unit	Wetland type	Area	PES Score	PES Category
DS Main, upstream of DS09 (including 03-06, and 09)	Channelled valley bottom	59.24	3.3	C
DS01 & 02	Unchannelled valley-bottom	9.43	3	C
DS03-06, & 09 (HSS)	Hillslope seepage	18.84	2.95	C
DS07	Hillslope seepage	12	3.7	C
DS08	Pan	4.39	3	C
DS10, DS11	Isolated hillslope seepage	41.7	3.3	C
DS12	Hillslope seepage	15.11	4.4	D
DS3-6, & 9 (main)	Channelled valley bottom	59.24	3.3	C
KS02 (Main)	Channelled valley bottom	16.02	4.6	D
KS03 (Main)	Channelled valley bottom	7.72	3.8	C
KS04	Hillslope seepage	2.61	5.4	D
KS05	Unchannelled valley-bottom	4.66	2.8	C
KS06	Hillslope seepage	2.25	3.9	C
KS07	Unchannelled valley-bottom	6.39	5.3	D
KS08	Channelled valley bottom	8.82	4.6	D
KS09	Unchannelled valley-bottom	2.77	4.6	D
KS10	Hillslope seepage	0.95	3.2	C
KS11	Hillslope seepage	19.32	3.6	C
KS15	Channelled valley bottom	8.76	2.95	C
LS02	Hillslope seepage	10.67	3.2	C
LS03	Hillslope seepage	2.11	3.1	C
LS04 (Main)	Channelled valley bottom	24.36	4.1	D
LS05	Unchannelled valley bottom	11.69	4.8	D
LS06, LS07	Unchannelled valley bottom	12.64	2.7	C
LS09 (HSS)	Hillslope seepage	13.53	5.2	D
LS09 (main)	Channelled valley bottom	18.84	2.95	C
LS10 (main)	Channelled valley bottom	12.47	2.95	C
LS11 (main)	Channelled valley bottom	14.01	2.95	C
LS14 (main)	Channelled valley bottom	24.54	4.95	D
LS15	Channelled valley bottom	31.2	3.4	C
LS16	Unchannelled valley bottom	17.6	2.8	C

Wetland HGM Unit	Wetland type	Area	PES Score	PES Category
Pan06	Pan	3.86	2.95	C
Pan07	Pan	12.51	0.95	A/B
Pan08	Pan	11.04	2.95	C
Pan11	Pan	27.79	1.45	B
Pan12	Pan	1.87	1.45	B
Pan13	Pan	4.76	2.95	C
Pan16	Pan	8.59	4.95	D
Resettlement site HGM1	Hillslope seepage	2.72	5.5	D
Resettlement site HGM2	Isolated hillslope seep	4.4	4.3	D
Resettlement site HGM3	Depression	0.4	2.2	C
Resettlement site HGM4	Hillslope seepage	3.27	4.3	D

5.4 Ecological Importance and Sensitivity

The EIS of the wetlands in the Study Area varies widely (Table 4), largely as a function of their size and ecological integrity, which affects their capacity to deliver biodiversity and water-related ecosystem services, and subsequently the ability of people to benefit from those services. The distribution of the wetlands in the Study Area, in relation to their EIS score, is shown in Figure 8.

The channelled valley bottom wetlands associated with the main channels of the three riparian systems are of moderate to high importance and sensitivity, largely due to their hydro-functional importance which relates to the role they play in flood attenuation, sediment trapping, and nitrate, phosphate and toxicant assimilation from their adjoining cultivated catchment areas.

The hillslope seeps and unchanneled valley bottoms that form tributaries to the main systems are generally of low/marginal to moderate importance and sensitivity, which is typically a function of their small size, and the extent to which they have been dammed or subjected to crop encroachment, which limits their capacity to supply ecosystem services.

With the exception of the pan at DS08, which has been partially dammed, and Pan 16, which has been impacted by cultivation, all other pans within the study area are of high ecological importance or sensitivity – primarily as a result of their role in delivery of biodiversity-related ecosystem services, that is, support of threatened plant species or populations of unique species, migration/feeding/breeding sites for fauna, and the regional context of their ecological integrity given the extent of loss/modification of pan systems in the region.

Table 4: EIS scores and categories, 2021

Wetland HGM Unit	Wetland type	Area	EIS Score	EIS Category
DS Main, upstream of DS09 (including 03-06, and 09)	Channelled valley bottom	59.24	2	Moderate
DS01 & 02	Unchannelled valley bottom	9.43	2.3	High
DS07	Hillslope seepage	12	1.6	Moderate

Wetland HGM Unit	Wetland type	Area	EIS Score	EIS Category
DS08	Pan	4.39	1.9	Moderate
DS10, DS11	Isolated hillslope seepage	41.7	1	Low/marginal
DS12	Hillslope seepage	15.11	2	Moderate
DS03-06, & 09 (HSS)	Hillslope seepage	18.84	1	Low/marginal
DS03-06, & 09 (main)	Channelled valley bottom	59.24	2	Moderate
HGM1	Hillslope seepage	2.72	1.4	Low/marginal
HGM2	Isolated hillslope seep	4.4	1.4	Low/marginal
HGM3	Depression	0.4	1.2	Low/marginal
HGM4	Hillslope seepage	3.27	1.4	Low/marginal
KS02 (Main)	Channelled valley bottom	16.02	1.9	Moderate
KS03	Channelled valley bottom	7.72	1.9	Moderate
KS04	Hillslope seepage	2.61	1	Low/marginal
KS10	Hillslope seepage	0.95	1.2	Low/marginal
KS11	Hillslope seepage	19.32	0.9	Low/marginal
KS15	Channelled valley bottom	8.76	2	Moderate
KS15	Channelled valley bottom	8.76	2	Moderate
LS02	Hillslope seepage	10.67	1	Low/marginal
LS03	Hillslope seepage	2.11	1.4	Moderate
LS04 (Main)	Channelled valley bottom	24.36	1.8	Moderate
LS05	Unchannelled valley bottom	11.69	1.9	Moderate
LS06, LS07	Unchannelled valley bottom	12.64	2	Moderate
LS09 (HSS)	Hillslope seepage	13.53	1.8	Moderate
LS09 (main)	Channelled valley bottom	18.84	1	Low/marginal
LS10 (main)	Channelled valley bottom	12.47	2	Moderate
LS11 (main)	Channelled valley bottom	14.01	2	Moderate
LS14 (main)	Channelled valley bottom	24.54	2	Moderate
LS15	Channelled valley bottom	31.2	2	Moderate
LS16	Unchannelled valley bottom	17.6	2	Moderate
Pan06	Pan	3.86	2	Moderate
Pan07	Pan	12.51	3	High
Pan08	Pan	11.04	3	High
Pan11	Pan	27.79	2	Moderate

Wetland HGM Unit	Wetland type	Area	EIS Score	EIS Category
Pan12	Pan	1.87	2	Moderate
Pan13	Pan	4.76	3	High
Pan16	Pan	8.59	1	Low/marginal

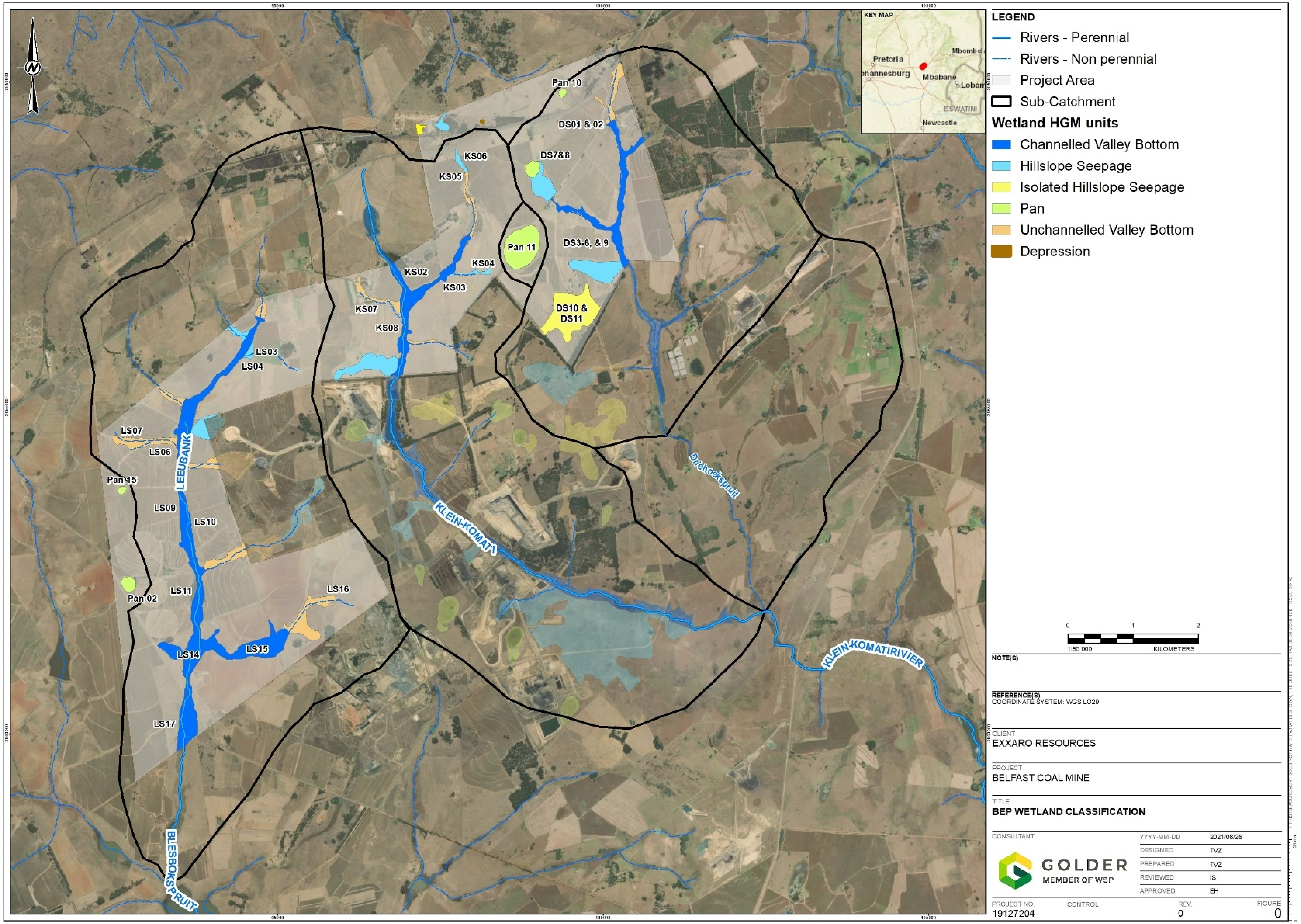

Figure 6: Wetland classification in the BEP project area

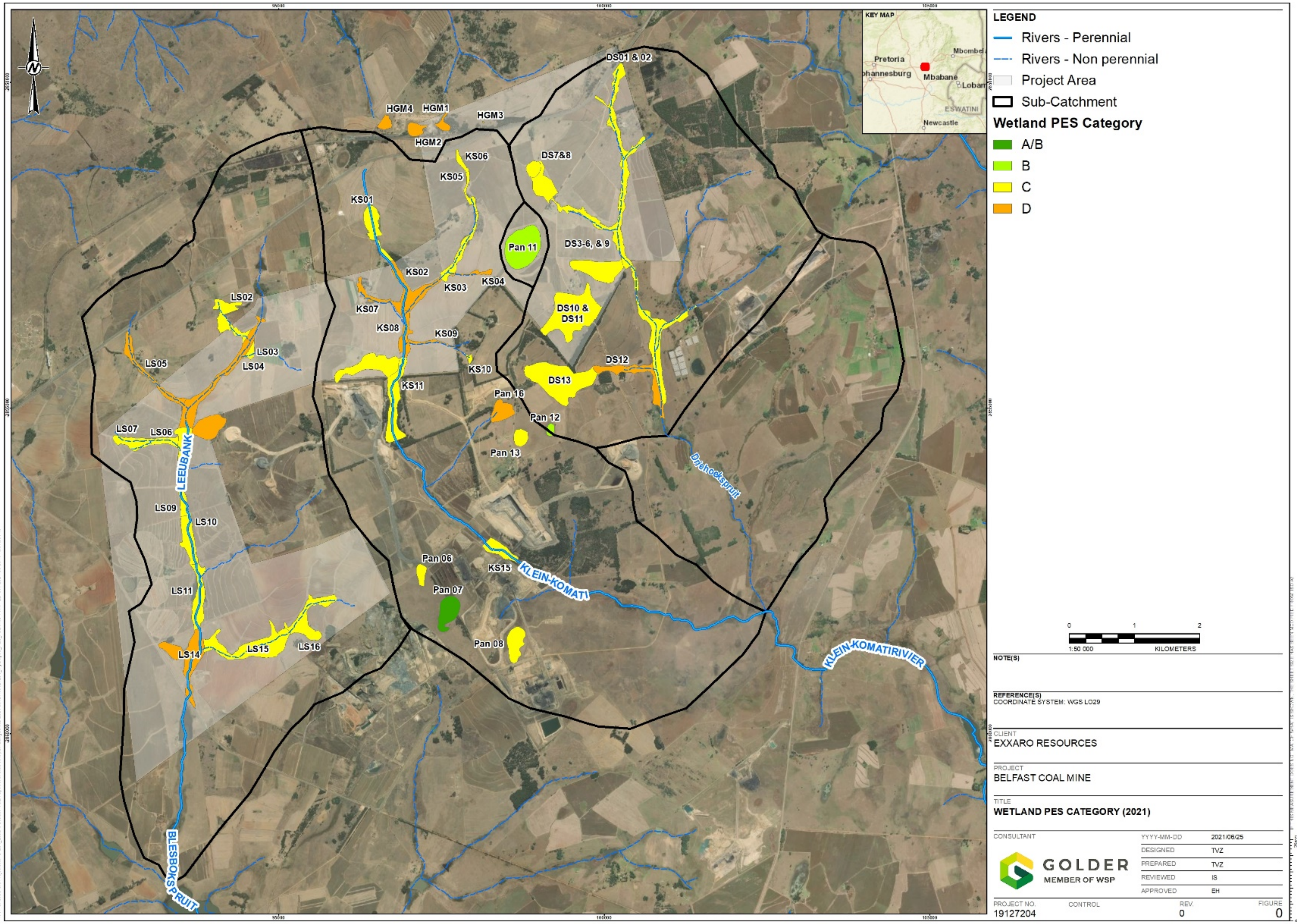

Figure 7: PES categories of wetlands in BEP project area

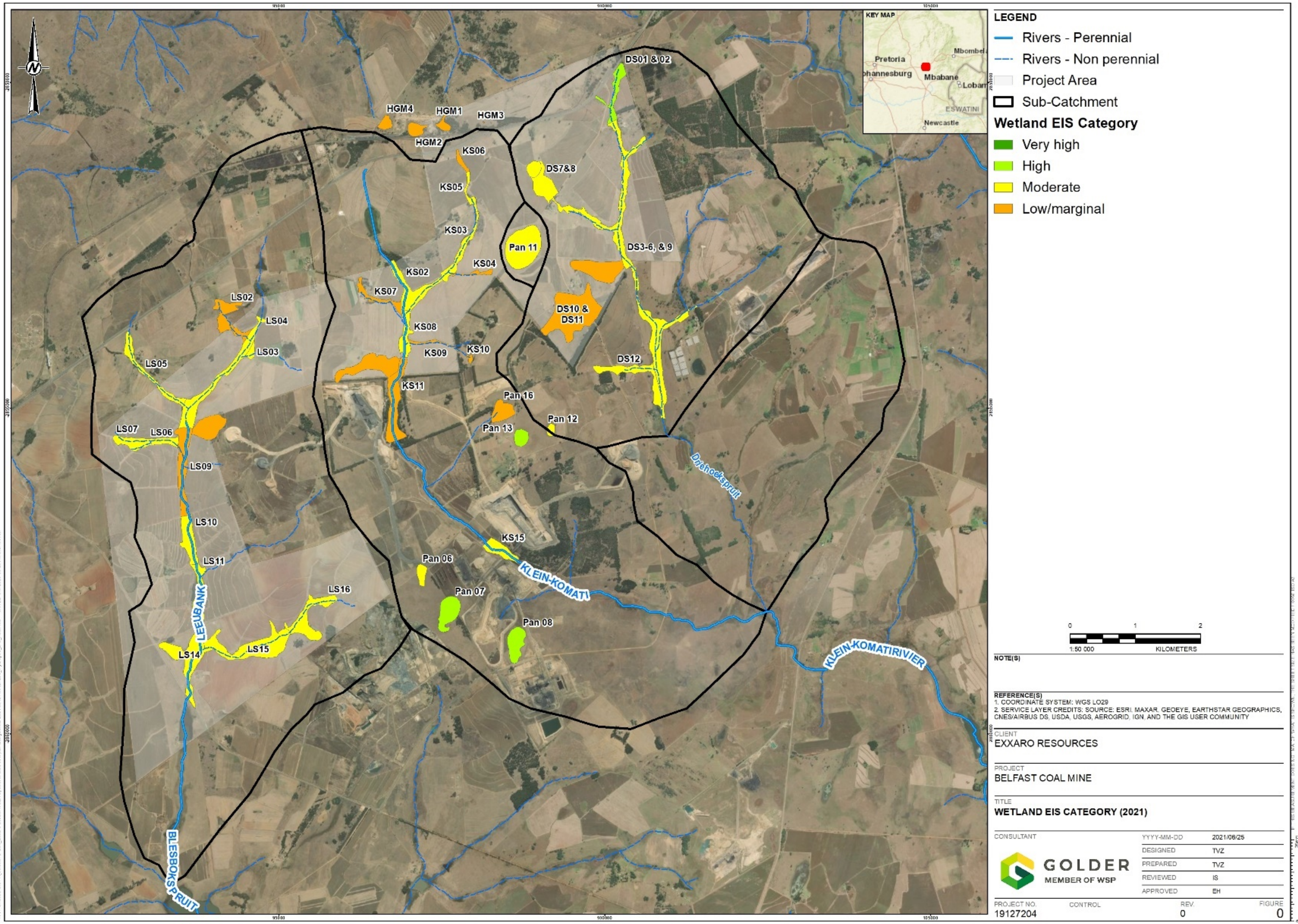

Figure 8: EIS categories of wetlands in BEP project area

6.0 OFFSET REQUIREMENTS

Since direct loss of wetland habitat cannot be mitigated, these losses must be offset. The results of the application of wetland functional and ecosystem hectare equivalent calculations for direct and indirect wetland losses as a result of the BEP project using the revised SANBI and DWS offset guidelines (Macfarlane *et al.,* 2014) for the currently proposed mine plan, and targets for rehabilitation, are presented in the following sections.

It should be noted that at this point, indirect losses, particularly those associated with loss of stream flow / reductions in pan water levels due to dewatering of underground mining, cannot be quantified at present. Additional studies will be required to quantify these losses so that they can be addressed in the wetland rehabilitation plan for the BEP project.

6.1 Predicted Losses

6.1.1 Direct Losses

Construction and operation of the BEP opencast area will result in the direct loss of approximately 51.17 ha of wetland habitat (Table 5), and disturbance of adjacent wetland habitats by construction activities and machinery (Figure 9). The associated calculated functional and ecosystem losses, expressed in hectare equivalents of wetland habitat, are also summarised in Table 5.

Table 5: Direct wetland loss as a result of the Belfast Expansion Project opencast pits

Wetland HGM Unit	Total area (ha)	Wetland type	PES Score	Area of loss (ha)	Functional loss (ha-eq)	Ecosystem Conservation Target
Pan 16	8.59	Pan	4.95	8.60	4.34	5.2
KS10	0.95	Hillslope seepage	3.2	0.95	0.65	0.7
KS09	2.77	Unchannelled valley bottom	4.6	1.16	0.63	1.0
DS10, DS11	41.7	Isolated hillslope seep	3.3	22.00	14.74	25.6
DS13	40.62	Hillslope seepage	3.4	0.02	0.01	20.7
KS07	6.39	Unchannelled valley bottom	5.3	4.70	2.21	3.1
KS11	19.32	Hillslope seepage	3.6	13.74	8.80	14.2
Total				**51.17**	**31.38**	**70.5**

Construction and operation of the conveyor alternatives (Figure 9) will result in an additional direct loss of between 0.39 and 1.02 ha of functional wetland habitat, with an ecosystem conservation target of between 8.9 to 28.6 ha (Table 6). Option D has been identified as being the preferred option for BEP.

Table 6: Direct wetland loss as a result of the Belfast Expansion Project conveyor options

Option	Wetland HGM Unit	Wetland type	PES Score	Loss (ha)	Functional loss (ha-eq)	Total functional loss (ha-eq)	Ecosystem target (ha-eq)	Total ecosystem target
A	KS18	Channelled valley bottom	2.95	0.29	0.20	**0.62**	3.0	**8.9**
	SD_HS2	Isolated hillslope seep	2.2	0.54	0.42		5.9	

Option	Wetland HGM Unit	Wetland type	PES Score	Loss (ha)	Functional loss (ha-eq)	Total functional loss (ha-eq)	Ecosystem target (ha-eq)	Total ecosystem target
B	KS16	Hillslope seepage	4.4	0.23	0.13	**0.73**	11.1	**28.6**
	KS18	Channelled valley bottom	2.95	0.21	0.15		6.5	
	SD_HS2	Isolated hillslope seep	2.2	0.58	0.45		11.0	
C	KS18	Channelled valley bottom	2.95	0.24	0.17	**0.60**	8.9	**23.2**
	SD_HS2	Isolated hillslope seep	2.2	0.55	0.43		14.4	
D	KS15	Channelled valley bottom	2.95	0.39	0.28	**0.28**	16.8	**16.8**

6.1.2 Indirect Losses

Wetlands downslope of opencast

The remaining wetland systems downstream of those being mostly/partially lost as a result of proposed opencast mining activities (Figure 9) will suffer a loss in water supply form recharge/interflow soils (Table 7), which is anticipated to have a negative effect on their ecological integrity (PES score) (Golder, 2021b).

Using a broad assumption that the PES scores of those remnant wetlands would drop by one PES category, based on the precautionary principle, the predicted ha-eq of the remaining wetlands is 40.85. Since the currently remaining area has a ha-eq value of 45.23, an estimated additional 4.38 ha-eq (45.23 – 40.85) of wetland functional loss could occur due to the interruption of hydrology/hydropedology as a result of opencast mining upslope; however further studies are required for this loss to be accurately quantified.

Table 7: Indirect functional and ecosystem losses as a result of opencast mining in catchment of affected wetlands

Wetland HGM Unit	Wetland type	PES Score	Remaining area	Remaining area (ha-eq)	Predicted PES score	Predicted ha-eq	Ecosystem target (ha-eq)
KS09	Unchannelled valley bottom	4.6	1.61	0.87	6	0.644	0.6
DS10, DS11	Isolated hillslope seep	3.3	19.7	13.2	4	11.82	12.1
DS13	Hillslope seepage	3.4	40.6	26.8	4	24.36	20.7
KS07	Unchannelled valley bottom	5.3	1.69	0.79	6	0.676	0.8
KS11	Hillslope seepage	3.6	5.58	3.57	4	3.348	4.1
Indirect functional /ecosystem loss				**45.23**		**40.85**	**38.3**
				4.38			

Wetlands being undermined

The proposed BEP underground schedule will directly undermine Pan 11, KS 05 and KS 06, and parts of the western extent of Pan DS07, and DS08 (Figure 9). Other systems in close proximity to the undermining footprint include HGM1, HGM2 and HGM3 at the resettlement village, as well as the hillslope seep DS 3-6 & 9.

Dewatering associated with underground mining is predicted to result in reduction in streamflow in the below-listed systems and could also affect water levels in undermined pans (Golder, 2021c):

- Klein-Komati upper eastern tributary (KS06 to KS03), with knock-on effects on Klein-Komati main system;
- KS04 hillslope seep, with knock-on effects on the Klein-Komati main system;
- DS7 hillslope seep and downstream tributary (DS3-6 hillslope seep) of the Driehoekspruit main system;
- Pan 11; and
- Pan DS08.

The effects of dewatering and subsequent reduction in streamflow on the Driehoekspruit and Klein-Komati systems, and drop of pan water levels are therefore likely to result in additional indirect loss of wetland habitat. At present, the magnitude of that impact cannot be calculated. Prior to commencement of underground mining, a detailed baseline dataset on pan water levels, stream flows, and rainfall in the affected wetlands must be gathered, against which the predicted water losses can be quantified and the exact nature of the impact determined. This will then inform the requirement for supplementation of the systems in which water losses will be experienced with treated mine water to offset the loss.

This notwithstanding, additional measures to mitigate the indirect loss of wetland function as a result of reduced wetland integrity due to water losses will likely be required. The intensity of the required measures will only become apparent once the losses are quantified, and as such these losses and targets will need to be incorporated into the wetland rehabilitation plan for the BEP.

6.1.3 Summary

Based on the current estimations of direct and indirect wetland functional losses, and the ecosystem conservation targets as a result of the proposed opencast mining activity are as follows:

- Wetland functional loss (direct and indirect): 35.76 ha-eq.
- Ecosystem conservation target: 108.8 ha-eq.

Depending on the selected conveyor route, the following additional wetland functional losses, and ecosystem conservation targets may be incurred:

- Wetland functional loss: between 0.39 and 1.02 ha-eq.
- Ecosystem conservation target: between 8.9 to 28.6 ha-eq.

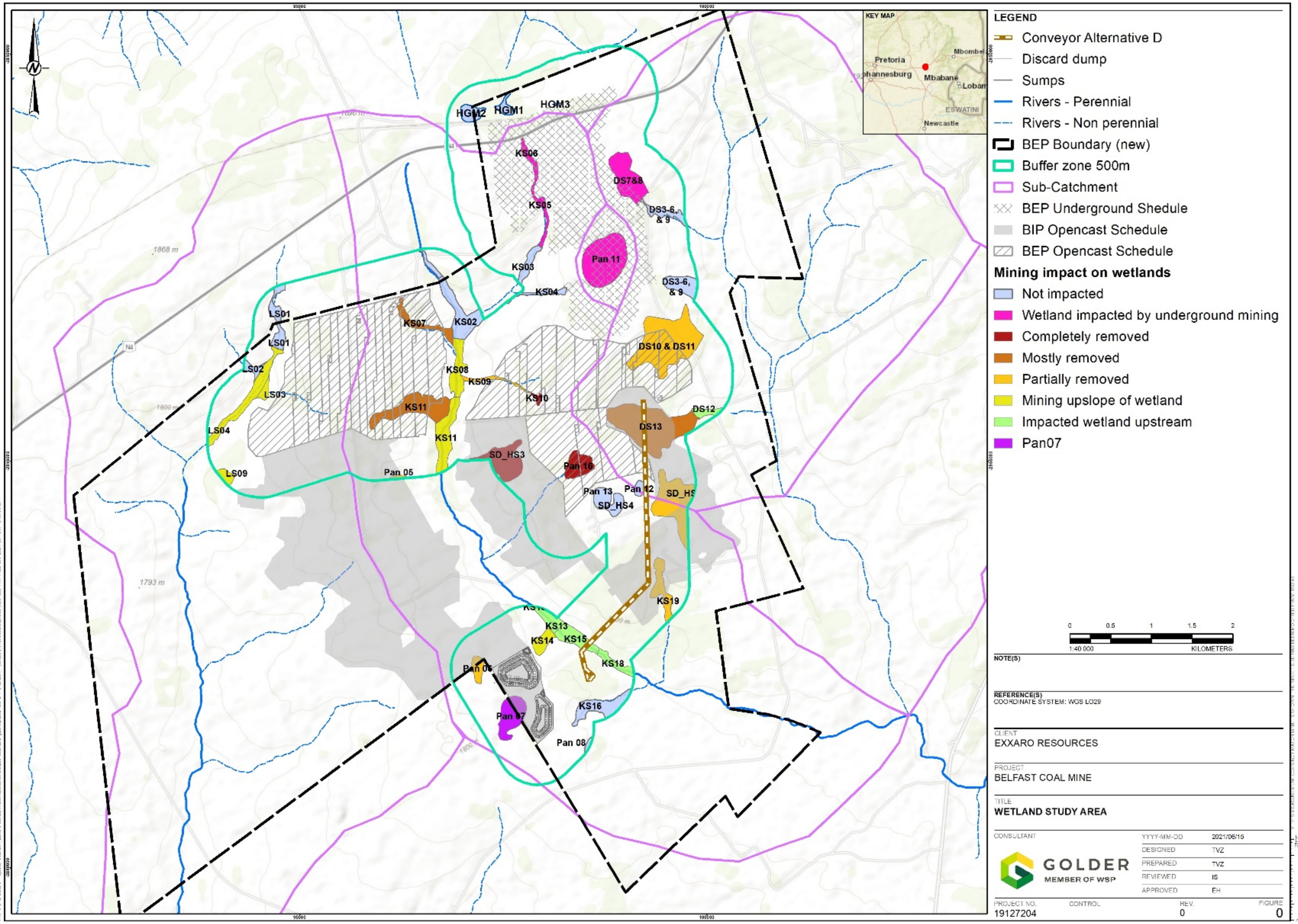

Figure 9: Wetlands that will be impacted by BEP

7.0 WETLAND REHABILITATION STRATEGY

7.1 Targets for Receiving Areas

A total of 321.32 ha of wetland habitat will remain in the BEP project area, further to the loss of wetlands to the opencast footprint. The results of the application of wetland functional and ecosystem hectare equivalent calculations for identified wetland offset receiving areas, are summarised in Table 8 and Table 9.

Several wetlands have been included despite the likelihood that (as yet unquantified) indirect losses of water due to dewatering of the proposed underground mining area may occur – these are indicated on Table 8 with an asterisk. It is assumed that the loss in stream flow that will be experienced by these remnant wetlands will be addressed via supplementation with treated mine water, and as such, an opportunity for improvement of the existing PES of the wetlands in question remains.

Table 8: Functional gains potentially achievable in remaining wetlands within BEP project area

HGM Unit	Total area	Wetland type	PES Score	Predicted PES score	Predicted ha-eq	Risk adjusted ha-eq
DS01 & 02	9.43	Unchannelled valley bottom	3.0	2.7	1.2	0.8
DS03-6, & 9 (main)	59.24	Channelled valley bottom	3.3	2.0	7.7	5.1
DS3-6, & 9 (HSS)*	18.84	Hillslope seepage	2.95	2.7	0.5	0.3
DS07*	12.0	Hillslope seepage	3.7	2.0	2.0	1.33
DS08*	4.39	Pan	3.0	2.7	0.1	0.1
KS02	16.02	Channelled valley bottom	4.6	4.6	0.0	0.0
KS03*	7.72	Channelled valley bottom	3.8	3.5	0.2	0.2
KS04*	2.61	Hillslope seepage	5.4	2.7	0.7	0.5
KS05*	4.68	Unchannelled valley bottom	2.8	1.5	0.6	0.4
KS06*	2.25	Hillslope seepage	3.9	2.6	0.3	0.2
KS08	8.8	Channelled valley bottom	4.6	3.3	1.1	0.8
KS09 (remaining)	1.6	Unchannelled valley bottom	4.6	4.6	0	0
KS11 (remaining)	5.6	Hillslope seepage	3.6	3.6	0	0
LS02	2.75	Hillslope seepage	3.2	2.0	0.3	0.2
LS03	2.11	Hillslope seepage	3.1	2.0	0.2	0.2
LS04	24.36	Channelled valley bottom	4.1	3.6	1.2	0.8
LS05	11.69	Unchannelled valley bottom	4.8	3.5	1.5	1.0
LS06, LS07	12.64	Unchannelled valley bottom	2.7	1.6	1.4	0.9
LS09 (HSS)	13.53	Hillslope seepage	5.2	3.3	2.6	1.7
LS09 (main)	18.84	Channelled valley bottom	2.95	1.95	1.9	1.2
LS10 (main)	12.47	Channelled valley bottom	2.95	1.95	1.2	0.8
LS11 (main)	14.01	Channelled valley bottom	2.95	1.95	1.4	0.9
LS14 (main)	24.54	Channelled valley bottom	4.95	3.95	2.5	1.6
LS15	31.2	Channelled valley bottom	3.4	2.0	4.4	2.9
Total					**32.2**	**21.3**

Table 9: Ecosystem conservation targets for the BEP project area

HGM Unit	Total area (ha)	Wetland type	Habitat Intact-ness (%)	Wetland habitat contribution (ha-eq)	Adjustment Factor	Ecosystem Conservation target (ha-eq)
DS01 & 02	9.43	Unchannelled valley bottom	70	6.6	1.5	9.9
DS3-6, & 9 (main)	59.24	Channelled valley bottom	64	37.9	1.5	56.9
DS3-6, & 9 (HSS)	18.84	Hillslope seepage	42	7.9	1.5	11.9
DS07	12.0	Hillslope seepage	61	11.5	1.5	17.2
DS08	4.39	Pan	60	2.6	1.5	4.0
KS02	16.02	Channelled valley bottom	68	10.9	1.5	16.3
KS03	7.72	Channelled valley bottom	45	3.5	1.5	5.2
KS04	2.61	Hillslope seepage	22	0.6	1.5	0.9
KS05	4.68	Unchannelled valley bottom	78	3.7	1.5	5.5
KS06	2.25	Hillslope seepage	52	1.2	1.5	1.8
KS08	8.8	Channelled valley bottom	56	4.9	1.5	7.4
KS09 (remaining)	1.6	Unchannelled valley bottom	33	0.5	1.5	0.8
KS11 (remaining)	5.6	Hillslope seepage	49	2.7	1.5	4.1
LS02	2.75	Hillslope seepage	60	1.7	1.5	2.5
LS03	2.11	Hillslope seepage	94	2.0	1.5	3.0
LS04	24.36	Channelled valley bottom	49	11.9	1.5	17.9
LS05	11.69	Unchannelled valley bottom	44	5.1	1.5	7.7
LS06, LS07	12.64	Unchannelled valley bottom	80	10.1	1.5	15.2
LS09 (HSS)	13.53	Hillslope seepage	58	7.8	1.5	11.8
LS09 (main)	18.84	Channelled valley bottom	77	14.5	1.5	21.8
LS10 (main)	12.47	Channelled valley bottom	77	9.6	1.5	14.4
LS11 (main)	14.01	Channelled valley bottom	77	10.8	1.5	16.2
LS14 (main)	24.54	Channelled valley bottom	77	18.9	1.5	28.3
LS15	31.2	Channelled valley bottom	74	23.1	1.5	34.6
Total						**308.8**

The potential functional gains and ecosystem conservation targets for offset receiving areas are currently estimated as follows:

- Wetland functional gain: 21.3 ha-eq.
- Ecosystem conservation opportunity: 308.8 ha-eq.

It is noted that there is a potential opportunity to achieve additional gains within the BEP study area through more intensive rehabilitation of the upper reaches of the Klein-Komati system (i.e. removing dams in KS02, KS03 and KS08); however, these properties would first need to be purchased by Exxaro; or, landowner agreements for the proposed rehabilitation works secured, so that significant changes to dams in the upper reaches of this system could be considered in the full wetland rehabilitation plan, and subsequently applied for in the WUL that will be required for implementation of the plan.

7.2 Rehabilitation Objectives

A range of problems undermining wetland ecological integrity and affecting the surface and shallow sub-surface hydrological processes in the three major wetland systems in the BEP project have been identified (Section 5.3). Addressing these issues via the construction of wetland rehabilitation structures, or interventions, and implementing management practices such as grazing management and AIS tree control, within the wetlands themselves and their catchments, are the basis of the proposed rehabilitation strategy. Addressing the identified rehabilitation objectives for each of the wetland receiving areas (Table 10**Error! Reference source not found.**) via the ultimate wetland rehabilitation and management plan for the BEP. The wetlands proposed for rehabilitation interventions and/or management are shown in Figure 10.

Table 10: Rehabilitation Objectives

Rehabilitation objective	DS01 & 02	DS03-06 & 09 (HSS)	DS03-06 & 09 (main)	DS07	DS08	KS02	KS03	KS04	KS05	KS06	KS08	LS (main)	LS02	LS03	LS04	LS05	LS06 & 07	LS15
Deactivate channels	✓		✓			✓	✓				✓	✓	✓	✓	✓	✓	✓	✓
Fill in excavation								✓										
Formalise dam spillway									✓									
Grazing management				✓	✓													
Lower dam wall, formalise spillway	✓		✓			✓	✓				✓				✓			✓
Pull crops back from HGM unit		✓	✓					✓		✓							✓	✓
Put culverts under road crossings to promote diffuse flow	✓									✓		✓						
Reduce abstraction from dams															✓			
Reduce/remove AIS trees in catchment			✓			✓	✓	✓	✓		✓	✓			✓	✓		✓
Remove AIS in HGM unit	✓		✓	✓					✓			✓				✓		
Remove dam			✓		✓								✓		✓	✓	✓	

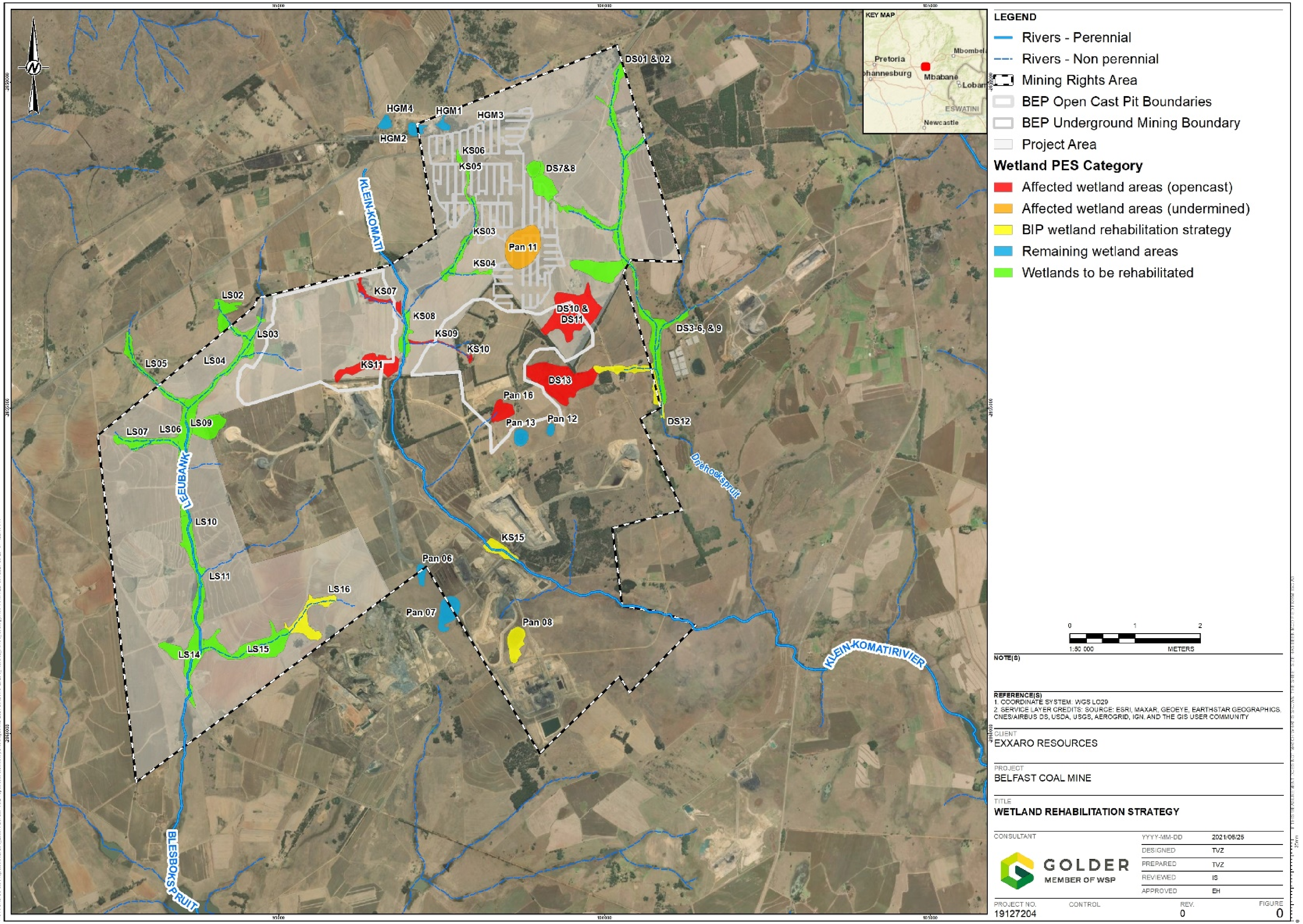

Figure 10: BEP wetlands proposed for wetland rehabilitation interventions and management.

8.0 CONCLUSION AND RECOMMENDATIONS

Based on the current estimations of direct and indirect wetland functional losses, and the ecosystem conservation targets as a result of the proposed opencast mining activity are as follows:

- Wetland functional loss (direct and indirect): 35.76 ha-eq.
- Ecosystem conservation target: 108.8 ha-eq.

Depending on the selected conveyor route, the following additional wetland functional losses, and ecosystem conservation targets may be incurred:

- Wetland functional loss: between 0.39 and 1.02 ha-eq.
- Ecosystem conservation target: between 8.9 to 28.6 ha-eq.

Additional indirect losses are also anticipated as a result of drawdown / loss of stream flow to systems within the area of influence of the proposed underground mining area, which have not yet been quantified.

The potential functional gains and ecosystem conservation targets for offset receiving areas are currently estimated as follows:

- Wetland functional gain: 21.3 ha-eq.
- Ecosystem conservation opportunity: 308.8 ha-eq.

Therefore, it is currently anticipated that a minimum of 14.46 ha-eq of wetland functional gain will need to be secured offsite; i.e. beyond the Belfast MRA. However, the ecosystem conservation target can be comfortably achieved within the Belfast project area.

It is noted that there is an opportunity to achieve additional gains within the BEP study area through more rehabilitation of the upper reaches of the Klein-Komati system; however, these properties would first need to be purchased by Exxaro; or, landowner agreements for the proposed rehabilitation works secured, so that changes to dams in the upper reaches of this system (lowering or removing dam walls) could be achieved.

There are several gaps in the current understanding of potential impacts on wetlands as a result of the BEP infrastructure and activities, which will need to be addressed via further studies, and in the full wetland rehabilitation plan. Recommended studies to address these gaps are listed as follows:

- The current annual wetland monitoring programme (measuring PES and EIS of wetlands in the study area) that is in place for the Exxaro BIP opencast should be extended to include all of the wetlands in the upper catchment which will now be subjected to impacts from the proposed BEP.
- Additional wetland vegetation and PES monitoring points should be placed in wetlands that will now be subjected to impacts from the proposed BEP, and baseline data gathered at these locations during the wet season, to ensure that residual impacts are properly quantified and addressed accordingly.
- Water levels in Pan 11 and Pan DS07 must be monitored using permanent piezometers and reported annually. Reports for each year should present the cumulative results and identify any trends in flows/water levels, in order to develop a baseline against which any potential losses as a result of mining can be measured; and determine the required water volumes for supplementation with treated mine water, should significant losses become evident.
- Stream flows in the Klein-Komati and Driehoekspruit tributaries that will be affected by streamflow reductions, must be monitored using permanent piezometers and reported annually. Reports for each year should present the cumulative results and identify any trends in flows/water levels, in order to develop

a baseline against which losses as a result of underground mining can be measured, and determine the required water volumes for supplementation with treated mine water, should significant losses become evident.

- It will also be important to monitor rainfall and catchment streamflow at selected control sites, so that the potential changes in rainfall patterns can be factored into any changes in surface or ground water levels.

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Signature Page

Golder Associates Africa (Pty) Ltd.

Aisling Dower
Ecologist

Warren Aken
Environmental Team Lead

AD/WA/mc

Reg. No. 2002/007104/07
Directors: RGM Heath, MQ Mokulubete, MC Mazibuko (Mondli Colbert), GYW Ngoma

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APPENDIX A

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