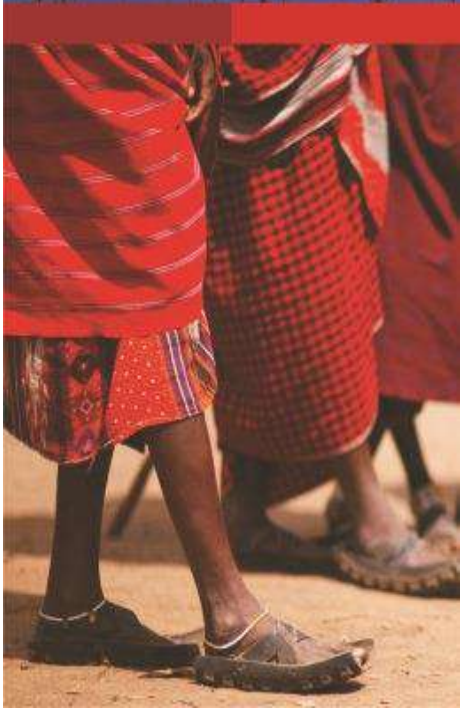

DIGBY WELLS
ENVIRONMENTAL

Environmental Authorisation Process to Decommission a Conveyor Belt Servitude, Road and Quarry at Twistdraai East Colliery, Secunda, Mpumalanga Province

Wetland Impact Assessment Report

Project Number:

SAS5544

Prepared for:

Sasol Mining (Pty) Ltd

February 2019

Digby Wells and Associates (South Africa) (Pty) Ltd
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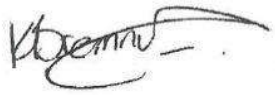
This document has been prepared by Digby Wells Environmental.

Report Type:	**Wetland Impact Assessment Report**
Project Name:	**Environmental Authorisation Process to Decommission a Conveyor Belt Servitude, Road and Quarry at Twistdraai East Colliery, Secunda, Mpumalanga Province**
Project Code:	**SAS5544**

Name	Responsibility	Signature	Date
Kathryn Roy	Report writing		February 2019
Kieren Bremner Pr. Sci. Nat.	Report review		February 2019

EXECUTIVE SUMMARY

Sasol Mining (Pty) Ltd (*hereinafter* Sasol Mining), is aiming to undertake decommissioning activities at Twistdraai East Shaft which requires both an Environmental Authorisation in accordance with the National Environmental Management Act (Act No. 107 of 1998) (NEMA) and a General Authorisation in accordance with the National Water Act (Act No. 36 of 1998) (NWA).

The following activities are to be undertaken, which may require environmental authorisation:

- Decommissioning and rehabilitation of an access road and associated culverts which was constructed between Mynpad Road and the Twistdraai East Shaft which permits access to the Shaft;
- Decommissioning and rehabilitation of the conveyer belt servitude including access road, water supply pipeline and culverts which was previously utilised to transport coal from Twistdraai Colliery to Twistdraai Export Plant; and
    - It must be noted that the decommissioning of the water supply pipelines will only be decommissioned where it daylights over various tributaries. The remaining pipelines which are located beneath ground level will not be disturbed or removed during the decommissioning process.
- Backfilling and rehabilitation of a quarry located near the conveyer belt servitude.

A wetland impact assessment is required as there are various wetland crossings along the conveyor/pipeline servitude and Twistdraai Road. The wetland delineation and sensitivity mapping was completed by Wetland Consulting Services (WCS) in 2018 and therefore only a review of the baseline was completed along with the compilation of suggested rehabilitation measures and an impact assessment.

WCS (2018) delineated a total of 2199 ha of wetland within the Twistdraai Project area. The most prevalent HGM (hydro-geomorphic) type along the servitude are Channelled Valley Bottom Wetlands, followed by Unchannelled Valley Bottom Wetlands. The wetlands exhibited a variety of Present Ecological State (PES) values, ranging from *Largely Natural* (Category B) to *Critically Modified* (Category F). Most wetlands transecting the servitude and road are characterised as *Moderately Modified* (Category C), and *Largely Modified* (Category D). Ecological Importance and Sensitivity (EIS) scores for the various HGM Units ranged from *Low/Marginal* to *High* with the majority of the wetlands along the conveyor being *Moderate*.

Impacts without the implementation of mitigation measures are anticipated to be minor while with the implementation of the proposed mitigation measures the impact is reduced to negligible impacts.

Decommissioning and rehabilitation measures have been suggested for each wetland crossing, and a plant species plan was compiled, including species that spread quickly and

are stoloniferous so as to ensure vegetation cover is established quickly and to assist in the prevention of erosion and the proliferation of alien invasive species.

The rehabilitated areas should be monitored monthly during the decommissioning and rehabilitation phase followed by quarterly for three years thereafter to ensure that vegetation is establishing. Should vegetation not establish, the area may need to be ripped/spiked (to a depth no deeper than 150 mm) and reseeded. Monitoring will then need to continue until vegetation has been established.

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GLOSSARY OF TERMS

Alien invasive vegetation	Plants that do not occur naturally within the area, but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome - usually international in origin.
Catchment	The area contributing to runoff at a particular point in a river feature.
Ecoregion	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Indigenous vegetation	Vegetation occurring naturally within a defined area.
Perennial	Flows all year round.
Wetland	Defined according to the National Water Act, 1998 (Act No. 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."*

LIST OF ACRONYMS

AIP	Alien Invasive Management Plan
BRP	Bioregional Plan
CMA	Catchment Management Agencies
DWA	Department of Water Affairs (currently the Department of Water and Sanitation)
DWAF	Department of Water and Forestry (currently the Department of Water and Sanitation)
DWE	Digby Wells Environmental
DWS	Department of Water and Sanitation
EC	Ecological Class
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMF	Environmental Management Framework
EMO	Environmental Management Officer
EMP	Environmental Management Programme
EMPr	Environmental Management Programme Report
F	Facultative species
FD	Facultative dry-land species
FW	Facultative wetland species
GIS	Geographical Information System
Ha	Hectares
HGM	Hydro-geomorphic
NEM:BA	National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecosystems Priority Areas

NWA	National Water Act, 1998 (Act No. 36 of 1998)
OW	Obligate wetland species
PA	Protected Area
PES	Present Ecological State
REC	Recommended Ecological Category
RQIS	Resource Quality Information Services
SANBI	South African National Biodiversity Institute
SFI	Soil Form Indicator
SWI	Soil Wetness Indictor
TUI	Terrain Unit Indicator
WCS	Wetland Consulting Services
WMA	Water Management Areas
WRC	Water Research Commission
WUL	Water Use Licence

1 Introduction

Sasol Mining (Pty) Ltd (*hereinafter* Sasol Mining), is the holder of a converted new order mining right, which was consolidated from several prospecting and mining rights (known as the Secunda Complex mining right) with Department of Mineral Resources (DMR) reference number: MP 30/5/1/2/3/2/1/138 MR.

Sasol currently operates six coal mines that supply feedstock for their Secunda (Sasol Synfuels) and Sasolburg (Sasolburg Operations) complexes in South Africa. Sasol's underground mining operations are at Bosjesspruit, Brandspruit, Middelbult, Syferfontein and Twistdraai (all in the Secunda area) and Sigma near Sasolburg which consist of Mooikraal (operational) and Sigma defunct which is in closure.

As part of daily management of the various shaft areas, the Secunda Complex has been subdivided with each of Sasol's shaft areas having its own, separate Environmental Management Programme (EMPR). The Twistdraai Colliery's EMPR with DMR reference number: MP 30/5/1/2/3/2/1(138) EM was amended and submitted to the DMR in 2010. The DMR approved the EMPR amendment on 29 February 2012.

The Twistdraai Colliery is made up of three separate shafts, namely:

- Twistdraai West Shaft;
- Twistdraai East Shaft; and
- Twistdraai Central Shaft.

Of these three shafts, two (the Central and West Shafts) have been decommissioned, rehabilitated and renovated for alternative purposes. The Central Shaft was converted into a training facility and accommodation while West Shaft was given back to the farmer. The Twistdraai East shaft is the last shaft to be decommissioned with most of the infrastructure already having been removed. The decommissioning of each of these shafts was undertaken in accordance with its Amended Environmental Management Programme Report (EMPr), approved in 2012 (Ref No. MP 30/5/1/2/3/2/1(138) EM) where no additional listed activities were triggered.

This application relates specifically to the remaining decommissioning activities to be undertaken at Twistdraai East Shaft, which requires both an Environmental Authorisation in accordance with the National Environmental Management Act (Act No. 107 of 1998) (NEMA), and a General Authorisation in accordance with the National Water Act (Act No. 36 of 1998) (NWA).

The following activities are to be undertaken which may require environmental authorisation:

- Decommissioning and rehabilitation of an access road and associated culverts which was constructed between Mynpad Road and the Twistdraai East Shaft which permits access to the Shaft;

- Decommissioning and rehabilitation of the conveyer belt servitude including access road, water supply pipeline and culverts which was previously utilised to transport coal from Twistdraai Colliery to Twistdraai Export Plant; and
  - It must be noted that the decommissioning of the water supply pipelines will only be decommissioned where it daylights over various tributaries. The remaining pipelines which are located beneath ground level will not be disturbed or removed during the decommissioning process.
- Decommissioning and rehabilitation of a mine water supply pipeline located within the conveyor belt servitude.

The proposed project is a decommissioning and rehabilitation project with the aim to ensure all mining infrastructure is removed with minimal impact to the surrounding environment and to ensure the area is rehabilitated to a more natural state. The project aims to have an overall positive impact on the surrounding environment.

A wetland impact assessment is required as there are various wetland crossings along the conveyor servitude route and road.

2 Details of the Specialist

This Specialist Report has been compiled by the following specialists (CVs of the Project Team are included in Table 2-1):

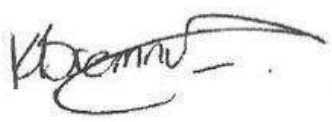
Table 2-1: Details of the Specialist(s) who prepared this Report

Responsibility	**Field Assessment and Report Writer**
Full Name of Specialist	Kathryn Roy
Highest Qualification	MSc Restoration Ecology
Years of experience in specialist field	1.5
Responsibility	**Field Assessment and Technical Review**
Full Name of Specialist	Kieren Jayne Bremner
Highest Qualification	MSc Aquatic Health
Years of experience in specialist field	11
Registration(s):	South African Council for Natural Scientific Professionals: *Professional Natural Scientist* (Reg. No. 119341)

2.1 Declaration of the Specialist

I, Kieren Jayne Bremner, as the appointed specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent:
  - other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
  - am not independent, but another specialist that meets the general requirements set out in Regulation 13 have been appointed to review my work (Note: a declaration by the review specialist must be submitted);
- in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any the requirements may result in disqualification;
- have disclosed/will disclose, to the applicant, the Department and interested and affected parties, all material information that have or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application;
- have ensured/will ensure that information containing all relevant facts in respect of the application was/will be distributed or was/will be made available to interested and affected parties and the public and that participation by interested and affected parties was/will be facilitated in such a manner that all interested and affected parties were/will be provided with a reasonable opportunity to participate and to provide comments;
- have ensured/will ensure that the comments of all interested and affected parties were/will be considered, recorded and submitted to the Department in respect of the application;
- have ensured/will ensure the inclusion of inputs and recommendations from the specialist reports in respect of the application, where relevant;
- have kept/will keep a register of all interested and affected parties that participate/d in the public participation process; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.



Signature of the specialist:

Kieren Jayne Bremner

Full Name and Surname of the specialist:

Digby Wells Environmental

Name of company:

23/01/2019

Date:

3 Assumptions

- The wetland impact assessment is based on a baseline wetland assessment completed by WCS in 2018 therefore a repeat of this work was not deemed necessary;
- It is assumed that the work carried out by WCS is accurate and complete;
- With ecology being dynamic and complex, certain aspects, some of which may be important, may have been overlooked. It is, however, expected that the study area has been accurately assessed and considered, based on the field observations undertaken and the consideration of existing studies and monitoring data in terms of freshwater ecology.

4 Scope and Purpose of this Report

4.1 Baseline Review

A detailed desktop review was undertaken in order to gain background information and historical information on all freshwater features that will potentially be affected by the removal of the decommissioning project, including wetland vegetation types, water management areas, quaternary catchment and sub-quaternary catchments. The review considered the existing specialist study compiled by Wetland Consulting Services (WCS) in 2018.

4.2 Wetland Rehabilitation Measures

- Each crossing point was visited, and rehabilitation measures identified;
- Specific measures have been provided with respect to minimising the impacts associated with the removal of the conveyor and associated infrastructure within the conveyor belt servitude and road at each crossing;
- The report contains measures for rehabilitation based on the anticipated impacts identified during the site assessments; and
- A plant species plan has been compiled indicating species that can be utilised for rehabilitation.

4.3 Impact Assessment

- Based on the findings of WCS and the in-field assessment, a detailed risk/impact assessment on all identified significant risks was conducted;
- Specialist opinion and recommendations on management and mitigation measures (including opportunities and constraints) with regards to the removal of the conveyor, associated infrastructure located within the servitude and road have been provided in order to improve, manage and/or mitigate impacts on the wetland ecology of the area should approval be obtained; and

- Monitoring requirements have been discussed and provisionally proposed.

5 Details of the site visit

The site visit took place on the 3rd of December 2018. Field verification was focussed at the crossing points between the conveyor servitude and wetlands, the quarry and the road. The localities of the project and infrastructure are indicated in Figure 5-1 and Figure 5-2.

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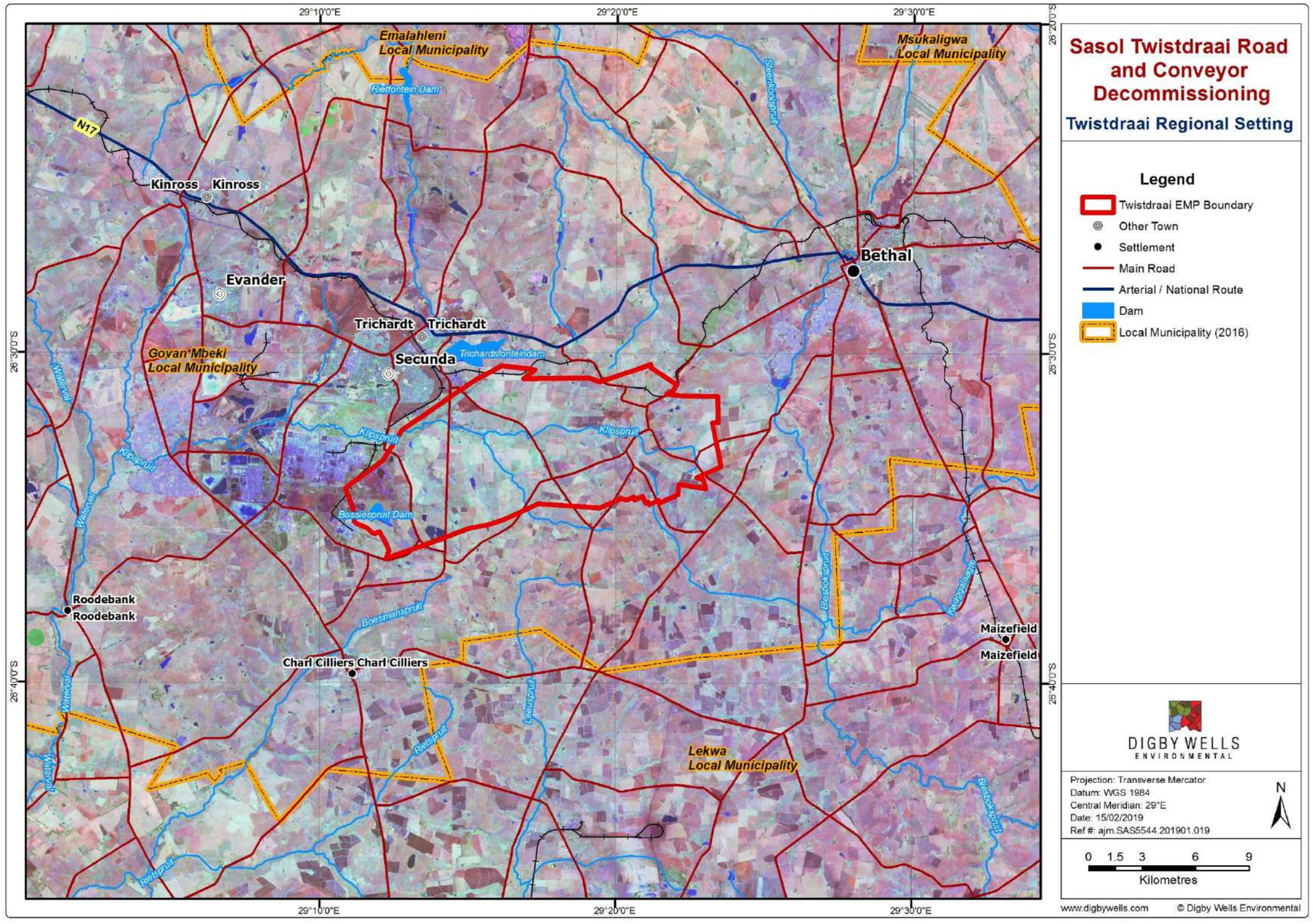

Figure 5-1: Regional Setting

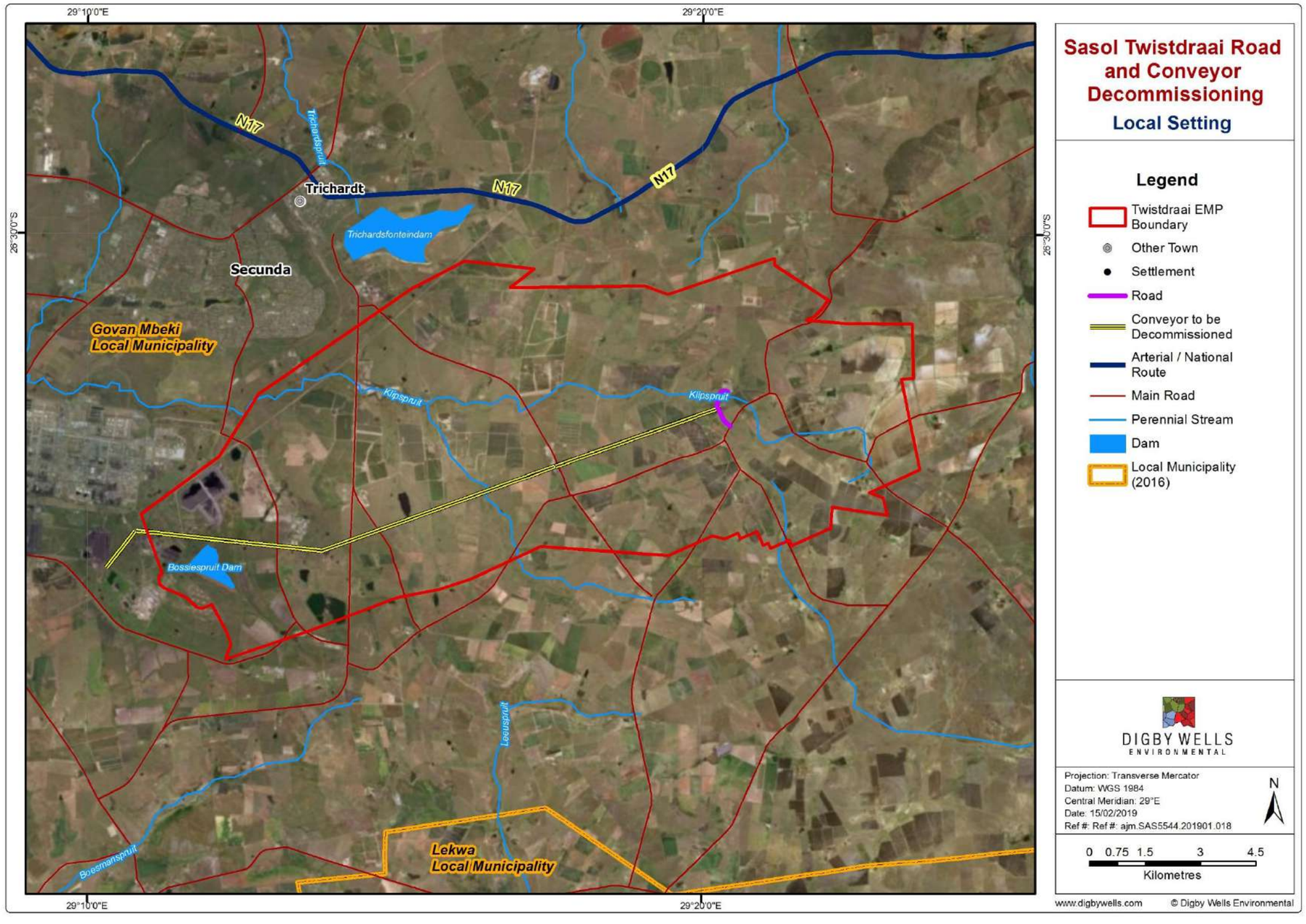

Figure 5-2: Local setting

6 Methodology

6.1 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);
- Department of Water and Forestry (DWAF) Guidelines for the Delineation of Wetlands (2005);
- Wetland Management Series (published by Water Research Commission (WRC, 2007); and
- National Freshwater Ecosystems Priority Areas (NFEPA, Nel *et al.,* 2011).

6.2 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 (FEPA's) 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

Criteria	Rank
▪ 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 (PES) AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition (PES) 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

6.3 Mpumalanga Biodiversity Sector Plan

The 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 importance that need to be considered in provincial planning initiatives, and
- Address the 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 6-2: 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.
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.

Map category	Definition	Desired management objectives
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.

6.4 Wetland Delineation and Sensitivity

The wetland delineation, classification as well as the various sensitivity measures was undertaken by WCS (2018). See appendix A for their report and detailed methodology. This included:

- Wetland Identification, Delineation and Classification in accordance with DWAF guidelines (now Department of Water and Sanitation (DWS) (2005));
- Wetland Ecological Health Assessment (WET-Health) according to Macfarlane *et al*. (2009). A level 1 WET-Health assessment was undertaken; and
- Ecological Importance and Sensitivity (EIS) in accordance with Rountree *et al.* (2012) was used for this study.

6.5 Rehabilitation Measures

Decommissioning and rehabilitation measures and a plant species plan have been provided by Digby Wells and are based on observations made during the site visit on the 3rd of December 2018

6.6 Impact Assessment Methodology

Impacts and risks have been identified by Digby Wells based on a description of the activities to be undertaken. Once impacts have been identified, a numerical environmental significance rating process will be undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a particular environmental impact.

The severity of an impact is determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact is then determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures will be incorporated into the EMP.

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

Significance = CONSEQUENCE X PROBABILITY X NATURE

Where

Consequence = intensity + extent + duration

And

Probability = likelihood of an impact occurring

And

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

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 6-4. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation has been applied; post-mitigation is referred to as the residual impact. The significance of an impact is determined and categorised into one of seven categories (The descriptions of the significance ratings are presented in Table 6-5).

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, (i.e., there may already be some mitigation included in the engineering design). If the specialist determines the potential impact is still too high, additional mitigation measures are proposed.

Table 6-3: Impact assessment parameter ratings

Rating	Intensity/ Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
7	Irreplaceable loss or damage to biological or physical resources or **highly** sensitive environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur.>65 but <80% probability.

Rating	Intensity/ Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.

Rating	Intensity/ Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
3	Moderate loss and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local including the site and its immediat surrounding area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	**Minor loss and/or effects** to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

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

Table 6-4: Probability/consequence matrix

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

Table 6-5: Significance rating description

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

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 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 NWA. 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 indicates the water resource management classification associated with the Project area. The Project area falls within the Vaal WMA and it is associated with primary drainage C. The road, conveyor belt and associated servitude which contain the pipeline and quarry all fall within the C12Dquaternary catchment.

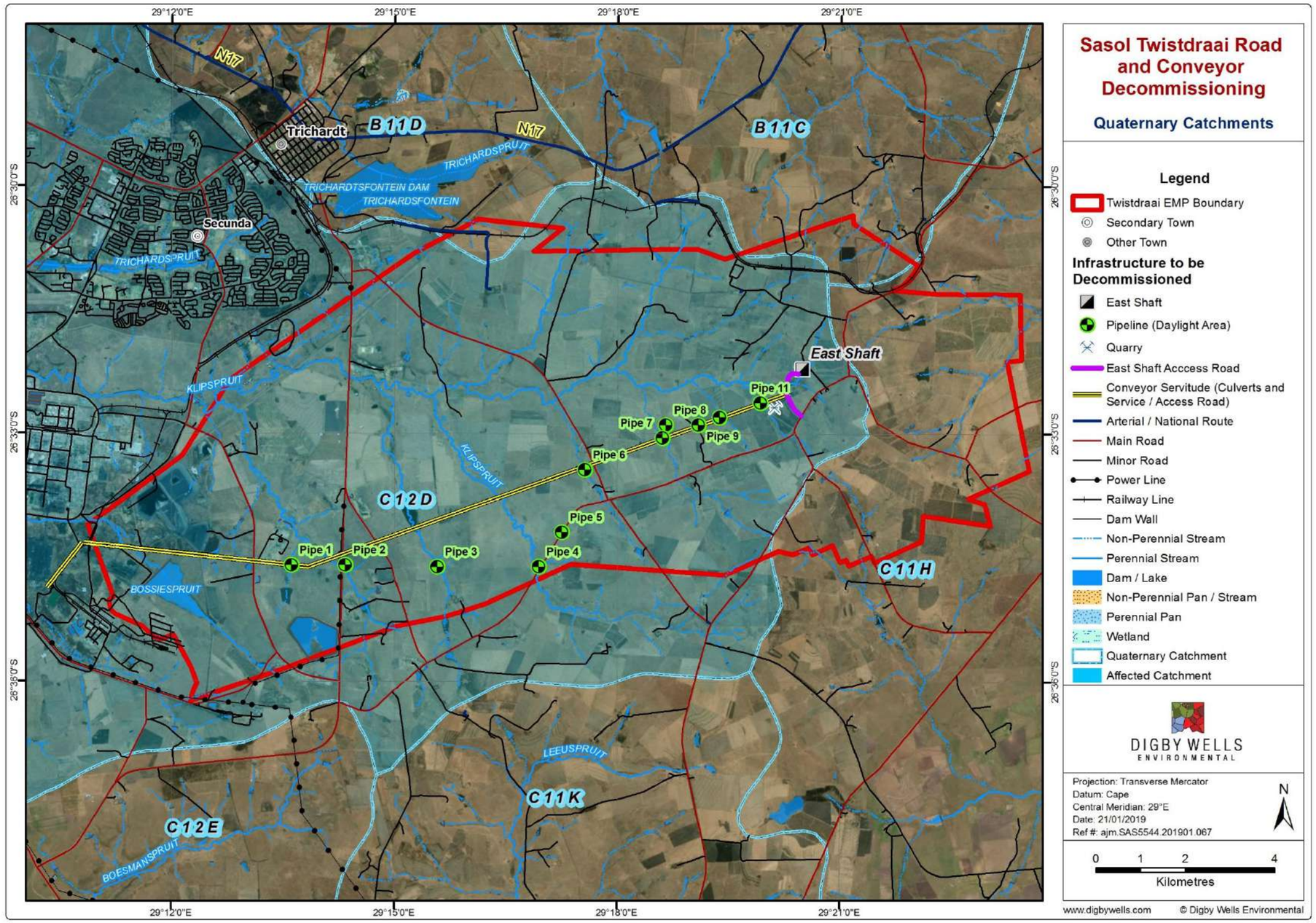

Figure 7-1: Quaternary Catchments

7.2 National Freshwater Ecosystem Priority Areas (NFEPA)

The NFEPA project provides information on wetland and river ecosystems for integrating into freshwater ecosystem, 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 (Nel *et al.* 2011). Figure 7-2 demonstrates the distribution of NFEPA wetlands within the Project area. The wetland types that dominate the landscape around the conveyor servitude and road are artificial flats.

The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. The Project wetlands consist of Rank 6 wetlands.

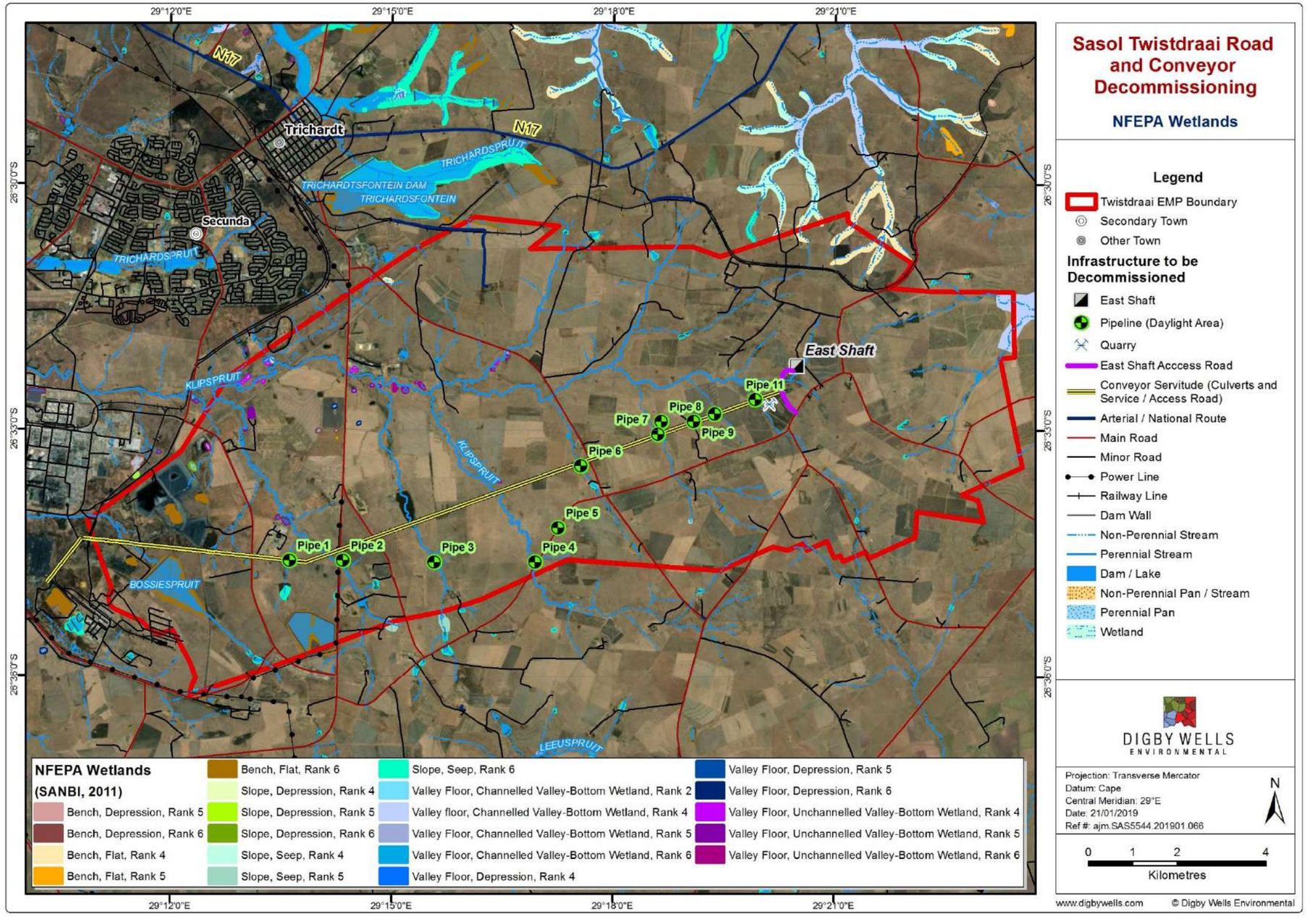

Figure 7-2: NFEPA Wetlands

7.3 Mpumalanga Biodiversity Sector Plan

The MBSP (2014) is a spatial tool that forms part of the national biodiversity planning. The terrestrial MBSP has delineated a considerable area surrounding the pipeline, conveyor and road as 'CBA Irreplaceable' (shown as red) (Figure 7-3). 'CBA Optimal' areas are also found within the Project area (yellow), with pockets of 'Heavily Modified' (dark green) and 'Moderately' Modified (cream) areas. 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.

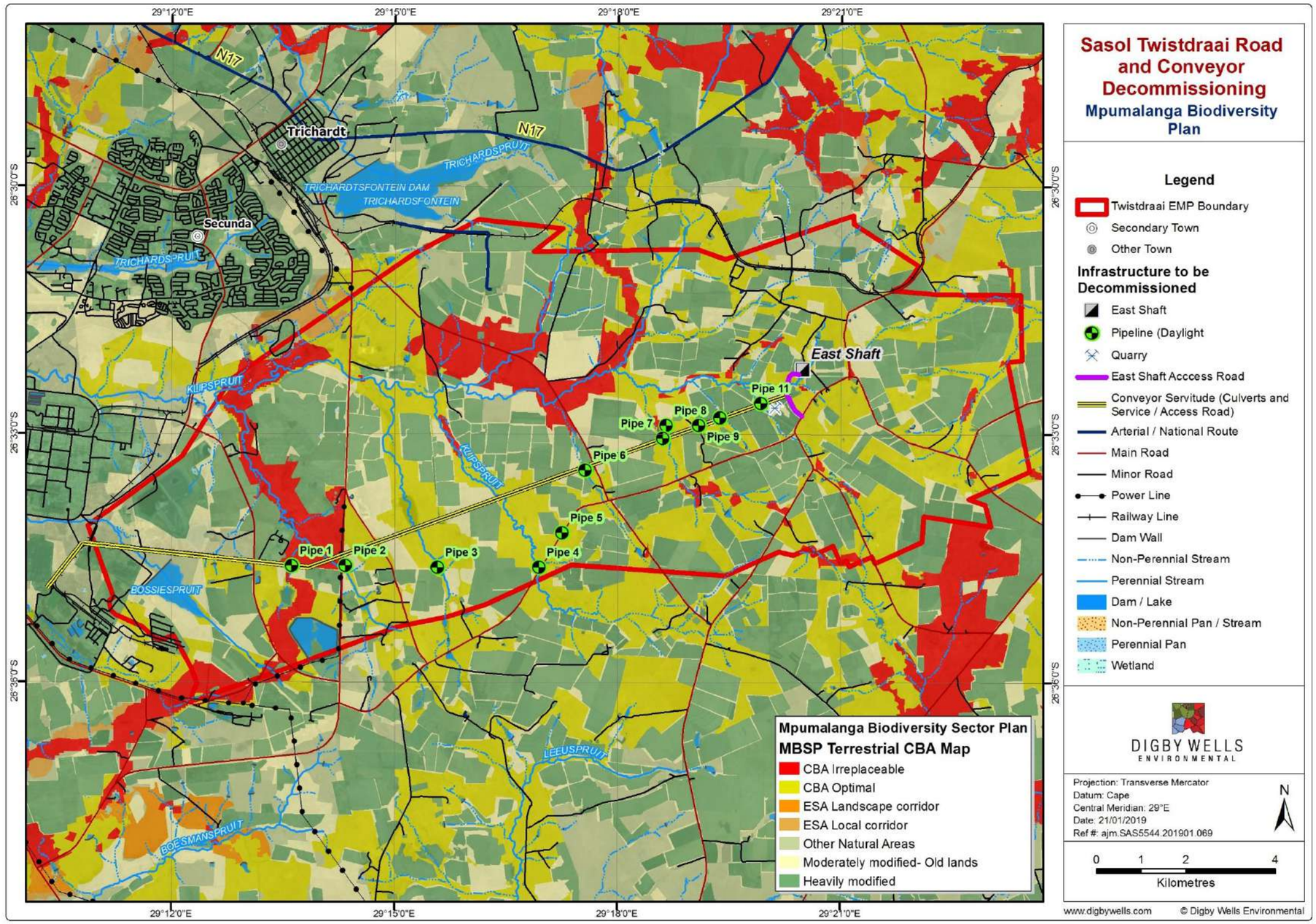

Figure 7-3: Mpumalanga Biodiversity Sector Plan (MBSP)

7.4 Regional Vegetation

The Project area falls within the Grassland Biome (Mucina and Rutherford, 2006), 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 Soweto Highveld Grassland regional vegetation type (Mucina and Rutherford, 2006) (Figure 7-4). It is an endangered vegetation type with a conservation target of 24%. Table 7-1 list the species characteristic of the Soweto Highveld Grassland.

Table 7-1: 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. planiculmis, E. racemosa, Heteropogon contortus, Hyparrhenia hirta, Setaria nigrirostris, S. sphacelata, Themeda triandra, Tristachya leucothrix, Andropogon schirensis, Aristida adscensionis, A. bipartita, 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 effusa, 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*

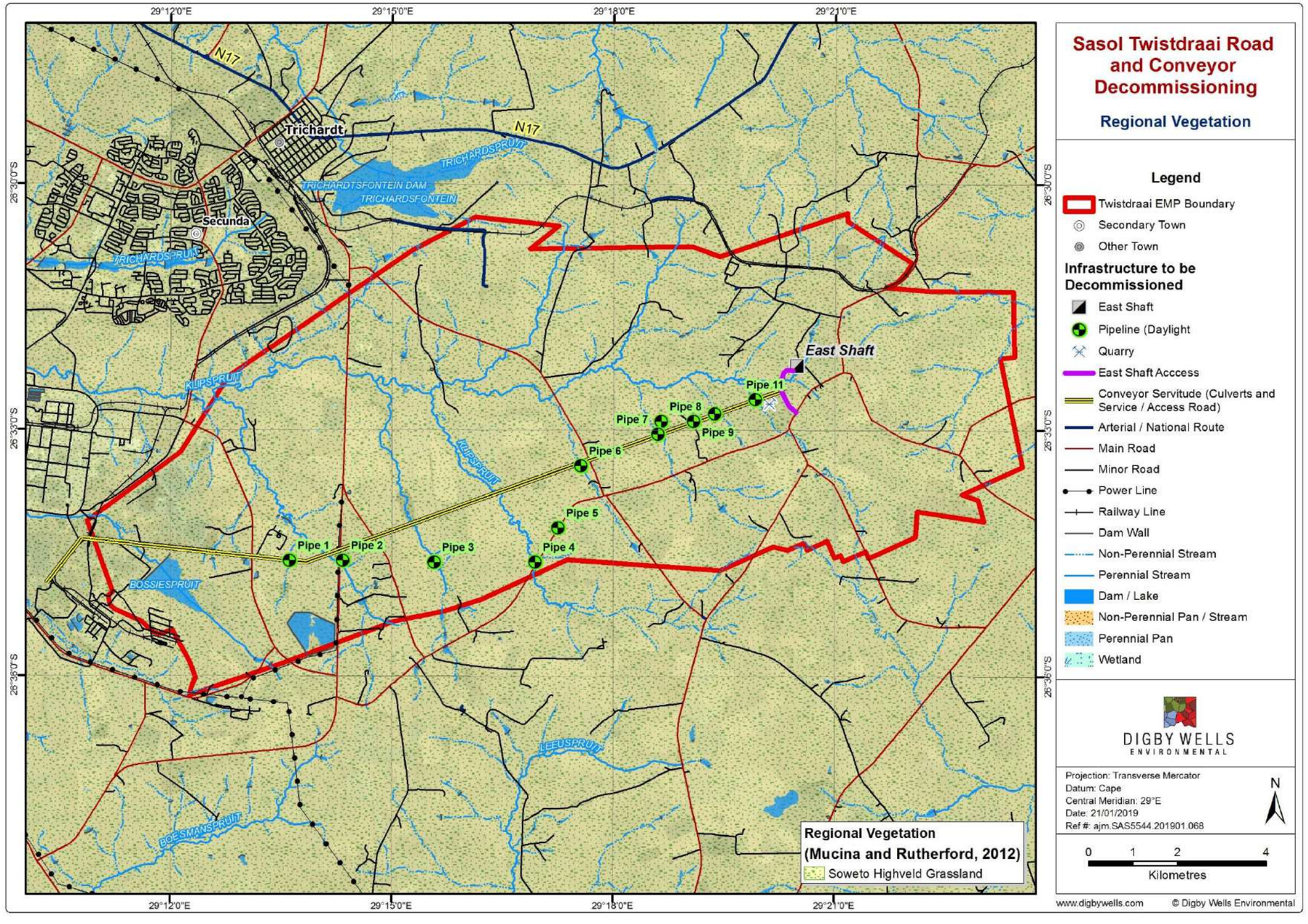

Figure 7-4: Regional Vegetation

8 Existing Environment

WCS completed a wetland delineation for the Project area in 2018. WCS also completed a PES (WET-Health; Macfarlane et al., 2007) and EIS assessment (Rountree et al., 2012). A summary has been provided below, with a focus on the conveyor servitude and road.

8.1 Wetland Delineation and Classification

WCS (2018) delineated a total of 2199 ha of wetland within the Project area. The breakdown of the wetland types per area is detailed in Table 8-1 and illustrated in Figure 8-1. The majority of wetlands that transect the conveyor servitude are Channelled Valley Bottom Wetlands, followed by Unchannelled Valley Bottom Wetlands.

Table 8-1: Wetland HGM Units (WCS, 2018)

Wetland Type	Area (ha)	% of wetland area	% of study area
Artificial Depression	16.63	0.76%	0.12%
Artificial Wetland	3.43	0.16%	0.02%
Channelled Valley Bottom	851.38	38.72%	6.19%
Digging/Excavation	53.04	2.41%	0.39%
Drainage Line	36.32	1.65%	0.26%
Flat	0.78	0.04%	0.01%
Floodplain	574.00	26.10%	4.17%
PCD Dam	17.08	0.78%	0.12%
Seep	166.97	7.59%	1.21%
Sheet Rock	69.67	3.17%	0.51%
Trench	0.09	0.00%	0.00%
Unchannelled Valley Bottom	409.62	18.63%	2.98%
Grand Total	**2199.03**	**100.00%**	**15.98%**

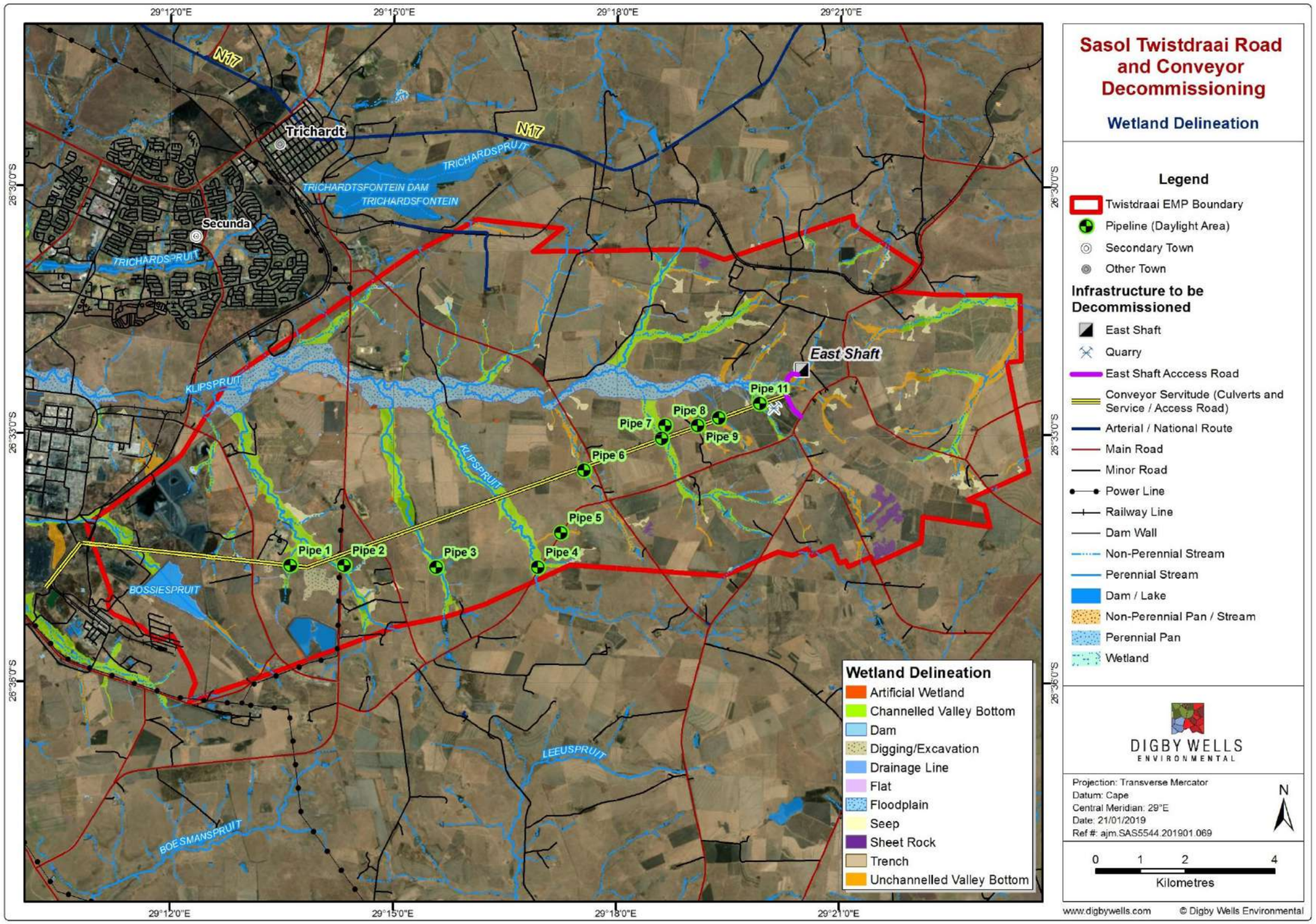

Figure 8-1: Wetland Delineation

8.1.1 Present Ecological State

Table 8-2 indicates the PES scores for the various HGM Units observed as completed by WCS (2018).

The wetlands in the vicinity of the Project area exhibit a variety of PES values, ranging from *Largely Natural* (Category B) to *Critically Modified* (Category F) (Figure 8-2). Most wetlands are characterised as *Moderately Modified (*Category C), followed by *Largely Modified* (Category D). Along the conveyor servitude, the majority of wetlands are *Largely Modified* (Category D), followed by *Moderately Modified (*Category C) with one wetland being classified as *Critically Modified* (Category F).

Impacts to these systems that affected their scores were channel incision, head cut erosion, the impounding nature of roads and dams and upstream pollution.

Table 8-2: Present Ecological Health Scores (WCS, 2018)

Wetland Type	PES B	PES C	PES D	PES E	PES F	Total (ha)
Channelled Valley Bottom	0.00%	6.49%	31.51%	0.22%	2.15%	851.38
Drainage Line	0.03%	1.06%	0.23%	0.41%	0.00%	36.32
Flat	0.04%	0.00%	0.00%	0.00%	0.00%	0.78
Floodplain	0.00%	27.22%	0.00%	0.00%	0.00%	574.00
Seep	0.74%	4.40%	2.32%	0.46%	0.00%	166.97
Sheet Rock	0.35%	2.96%	0.00%	0.00%	0.00%	69.67
Unchannelled Valley Bottom	0.06%	8.37%	11.00%	0.00%	0.00%	409.62
Total (ha)	25.45	1064.64	950.26	23.10	45.30	2108.75
% per PES category	**1.21%**	**50.49%**	**45.06%**	**1.10%**	**2.15%**	**100.00%**

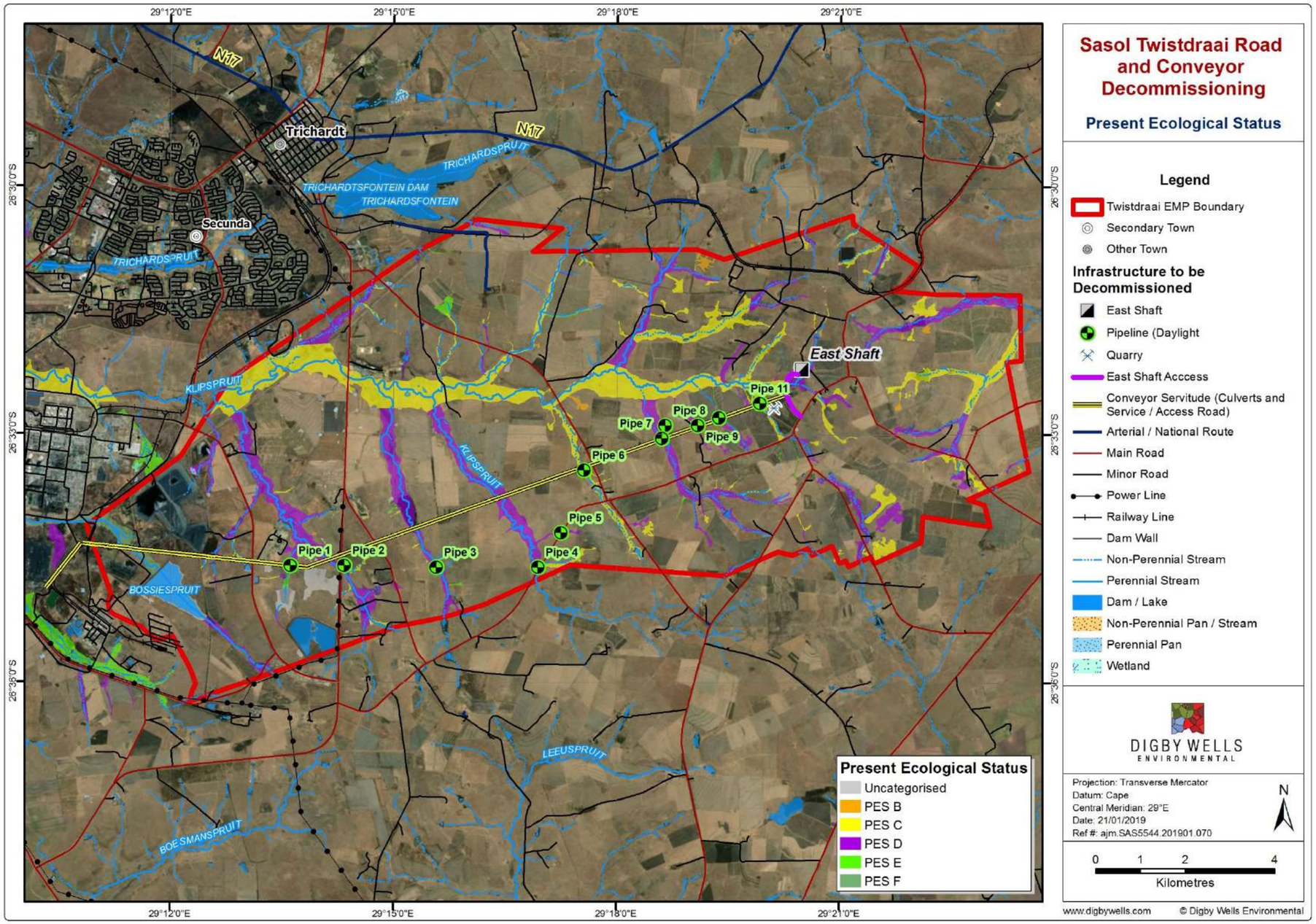

Figure 8-2: Present Ecological State (WCS, 2018)

8.1.2 Ecological Importance and Sensitivity

Table 8-3 indicates the EIS scores for the various HGM Units with the final EIS scores ranging from *Low/Marginal* to *High*. Along the conveyor servitude, the majority of wetlands are characterised as *Moderate*, followed by *Low/Marginal.*

Most of the *High* scoring wetlands were floodplains. The floodplains received this rating due to the threatened status of the vegetation type, the diversity of habitats supported by these floodplain wetlands as well as the large size of these wetlands (WCS, 2018).

The majority of the *Moderate* EIS scores were the valley bottom wetlands. These were important at a landscape scale and sensitive to changes in flow (WCS, 2018). It is predominantly these wetlands that transect the conveyor servitude.

The majority of the *Low/Marginal* importance and sensitivity scores were assigned to the drainage lines, the sheetrock wetlands and the smaller seeps.

Table 8-3: EIS Scores (WCS, 2018)

Wetland Type	High	Moderate	Low/Marginal	Total (ha)
Artificial Depression	0.06%	0.17%	0.55%	16.63
Channelled Valley Bottom	5.26%	33.96%	0.83%	851.38
Drainage Line	0.00%	0.32%	1.39%	36.32
Flat	0.00%	0.04%	0.00%	0.78
Floodplain	27.01%	0.00%	0.00%	574.00
Seep	0.00%	4.16%	3.70%	166.97
Sheet Rock	0.00%	0.00%	3.28%	69.67
Unchannelled Valley Bottom	0.00%	19.14%	0.13%	409.62
Total (ha)	**687.16**	**1228.13**	**210.09**	**2125.38**

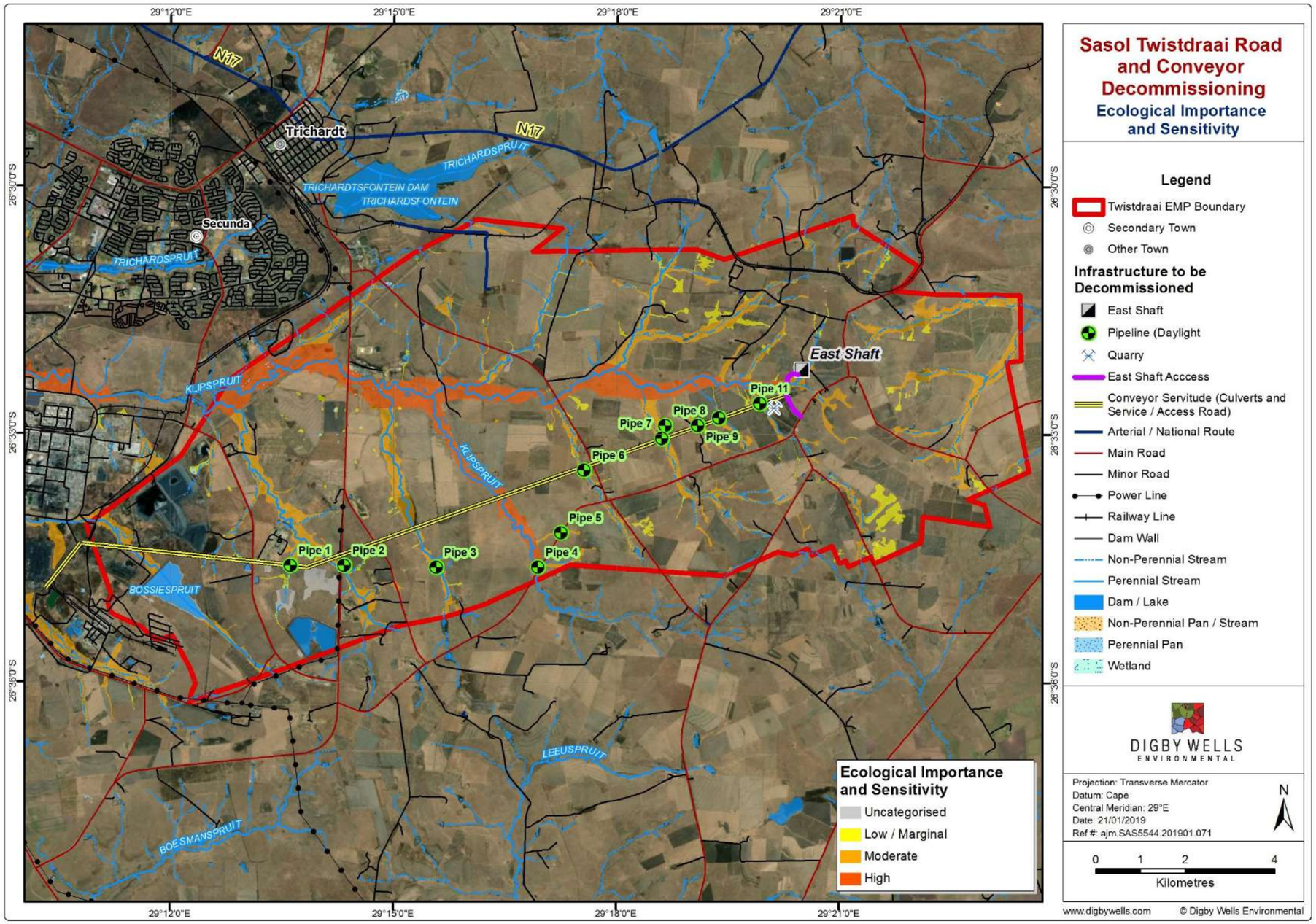

Figure 8-3: Ecological Importance and Sensitivity (WCS, 2018)

8.2 Rehabilitation Measures

Figure 8-4 illustrates the wetland crossing points and infrastructure to be decommissioned. Table 8-4 summarises the existing wetland environment in relation to the conveyor servitude and road and provides rehabilitation measures for each crossing. A plant species plan has also been provided (Table 8-5).

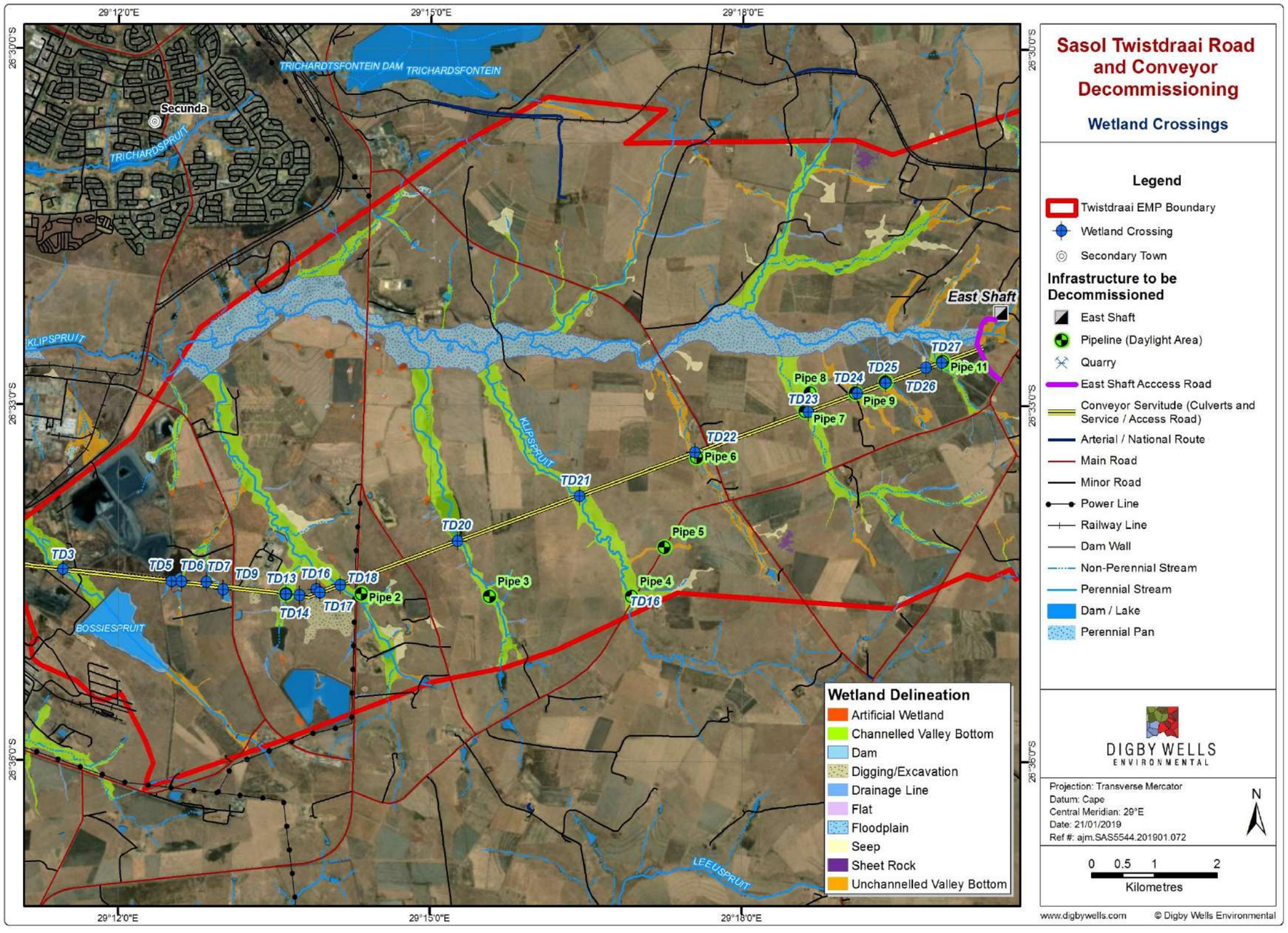

Figure 8-4: Wetland Crossing Points

Table 8-4: Rehabilitation Measures per wetland crossing

Crossing	Photo	Current state	Suggested Rehabilitation measures
TD27		**PES** C **EIS** Moderate **Dominant Species** *Bromus catharticus, Setaria sphacelata, Typha capensis, Helichrysum sp., Paspalum dilatatum, Andropogon appendiculatus.* Invasives*: Cirsium vulgare*	■ Remove all rubble from site; ■ Remove fence; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Remove Alien Invasive Species (AIPs), with a focus on *Cirsium vulgare*; and ■ Rip road crossing to a maximum of 150mm and reseed with species in the plant species plan.
TD26		**PES** D **EIS** Low **Dominant Species** *Bromus catharticus, Setaria sphacelata, Typha capensis, Helichrysum sp., Paspalum dilatatum, Eragrostis chloromelas.* Invasives: *Cirsium vulgare, Cosmos bipinnatus.*	■ Remove fences; ■ Rip road crossing to a maximum of 150mm and reseed with species in the plant species plan ; and ■ Remove AIPs, with a focus on *Cirsium vulgare* and *Cosmos bipinnatus.*

TD25		**PES:** D **EIS** Moderate **Dominant Species** *Bromus catharticus, Cynodon dactylon, Themeda triandra, Paspalum dilatatum.* Invasives: *Cosmos bipinnatus.*	■ Remove the culvert and fences. ■ Remove all rubble and materials from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, with a focus on *Cosmos bipinnatus.*
TD24		**PES** D **EIS** Moderate **Dominant Species** *Bromus catharticus, Setaria sphacelata, Agrostis lacnantha, Helichrysum sp., Paspalum dilatatum, Eragrostis chloromelas, Eleocharis sp., Persicaria sp., Oenothera rosea, Hypoxis sp., Cyperus sp.*, *Schoenoplectus sp.* Invasives: *Cirsium vulgare, Cosmos bipinnatus, Argemone ochroleuca.*	■ Remove the fences; ■ Remove all rubble and materials from site; ■ Reprofile the site to be free draining as water is currently ponding by the road; ■ Rip the road, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, with a focus on *Cosmos bipinnatus.*

TD23		**PES** D **EIS** Moderate **Species** *Bromus catharticus, Typha capensis, Setaria sphacelata, Agrostis lacnantha, Oenothera rosea, Crinum bulbispermum.* Invasives: *Cirsium vulgare, Cosmos bipinnatus.*	■ Remove the culvert and the fences; ■ Remove the water extraction pipe from within the channel; ■ Remove all rubble and materials from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs.
TD22		**PES** C **EIS** Moderate **Dominant Species** *Bromus catharticus, Paspalum dilatatum, Typha capensis, Oenothera rosea, Agrostis lacnantha.* Invasives: *Cosmos bipinnatus, Verbena bonariensis, Argemone ochroleuca*	■ Remove the culvert and the fences; ■ Remove coal contamination and dispose of at an appropriate waste facility; ■ Remove all rubble and materials from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; ■ Due to the steepness of the slope, hessian should be used to cover the slopes during the revegetation process to reduce erosion; and ■ Remove all AIPs, with a focus on *Cosmos bipinnatus* and *Verbena bonariensis.*
TD21		**PES** D **EIS** High **Dominant Species** *Bromus catharticus, Phragmites mauritianus, Typha capensis, Setaria sphacelata, Helichrysum sp., Paspalum dilatatum, Eleocharis sp., Persicaria sp., Erythrina zeyheri.* Invasives: *Cosmos bipinnatus, Argemone ochroleuca*	■ Remove the culvert and fences; ■ Remove coal contamination that has settled in the *Typha capensis* patches and dispose of it at an appropriate facility; ■ Ensure that all rubble and materials are removed from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; ■ Due to the steepness of the slope, hessian should be used to cover the slopes during the revegetation process to reduce erosion; and ■ Remove all AIPs, with a focus on *Cosmos bipinnatus* and *Argemone. ochroleuca*

TD20		**PES** D **EIS** Moderate **Dominant Species** *Helichrysum sp., Persicaria sp., Cyperus sp.*, *Schoenoplectus sp.* Invasives: *Cosmos bipinnatus.*	■ Remove the culvert, fences and the conveyor belts; ■ Remove coal contamination and residues and dispose at the appropriate facility; ■ Ensure that all rubble, rock debris and materials are removed from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, with a focus on *Cosmos bipinnatus*
TD18		**PES** D **EIS** Moderate **Dominant Species** *Bromus catharticus, Juncus effusus, Typha capensis, Eragrostis chloromelas, Andropogon appendiculatus.* Invasives: *Cirsium vulgare.*	■ Remove the culvert, fences and the conveyor belts; ■ Remove coal contamination and any other residues and dispose at the appropriate facility; ■ Ensure that all rubble and materials are removed from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; ■ Erosion berms are required with hessian to reduce sedimentation and erosion; and ■ Remove all AIPs, with a focus on *Cosmos bipinnatus* and *Cirsium vulgare.*
TD 16 17		**PES** Artificial **EIS** Low/Marginal **Dominant Species** *Typha capensis, Setaria sphacelata, Helichrysum sp., Paspalum dilatatum, Eragrostis chloromelas, Andropogon appendiculatus. Alloteropsis semialata, Berkheya rigida.* Invasives: *Cosmos bipinnatus*	■ Remove the fences and conveyor belt; ■ Ensure that all rubble and materials are removed from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, with a focus on *Cosmos bipinnatus*

TD14		**PES** Artificial **EIS** Low/Marginal **Dominant Species** *Bromus catharticus, Helichrysum sp., Paspalum dilatatum, Eragrostis chloromelas, Oenothera rosea, Cyperus sp., Schoenoplectus.* Invasives: *Cosmos bipinnatus*	■ Remove the fences and conveyor belt; ■ Ensure that all rubble and materials are removed from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, with a focus on *Cosmos bipinnatus.*
TD13		**PES** D **EIS** Moderate **Dominant Species** *Bromus catharticus, Phragmites mauritianus Juncus dregeana, Typha capensis, Paspalum dilatatum, Eragrostis chloromelas, Oenothera rosea.* Invasives: *Cirsium vulgare, Argemone ochroleuca*	■ Remove the concrete slab, conveyor belt and fence; ■ Ensure that all rubble and materials are removed from site; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, with a focus on *Cirsium vulgare.*
TD9		**PES** C **EIS** Low/Marginal **Dominant Species** *Typha capensis, Imperata cylindrica, Agrostis lacnantha.*	■ Remove the fence and conveyor belt; ■ Remove the adjacent berms; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs.

TD7		**PES** C **EIS** Low/Marginal **Dominant Species** *Bromus catharticus, Agrostis lacnantha, Eragrostis chloromelas, Helichrysum sp., Paspalum dilatatum, Oenothera rosea, Schoenoplectus sp.* Invasives: *Cosmos bipinnatus, Pennisetum clandestinum*	■ Remove the fence, concrete slab, conveyor belt and any other materials or debris; ■ Remove coal contamination and any other residues and dispose at the appropriate facility; ■ Remove the adjacent berms; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, including *Cosmos bipinnatus* and *Pennisetum clandestinum.*
TD6		**PES** D **EIS** Moderate **Dominant Species** *Bromus catharticus, Cyperus sp., Helichrysum sp., Paspalum dilatatum.* Invasives: *Cosmos bipinnatus, Pennisetum clandestinum.*	■ Remove the fence, concrete slab and conveyor belt; ■ Remove coal contamination and any other residues or pollutants and dispose at the appropriate facility; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, including *Cosmos bipinnatus* and *Pennisetum clandestinum.*
TD5		**PES** C **EIS** Marginal **Dominant Species** *Bromus catharticus, Paspalum dilatatum,*	■ Remove the fence, concrete slab and conveyor belt; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs, including *Cosmos bipinnatus*.

TD3		**PES** F **EIS** Moderate **Dominant Species** *Bromus catharticus, Phragmites mauritianus, Juncus effusus, Typha capensis, Lemna minor.* Invasives: *Cosmos bipinnatus, Datura stramonium.*	■ Remove the fence, pipes and conveyor; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs.
TD2		**PES** D **EIS** Moderate **Dominant Species** *Phragmites mauritianus.* Invasives: *Cosmos bipinnatus.*	■ Remove the fence and conveyor; ■ Reprofile the site to be free draining and to emulate the surrounding wetland area which will aim to ensure that water is not impeded, and the flow resumes a natural pattern; ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs.
TD1 (Road)		**PES** D/C **EIS** Moderate/High **Dominant Species** *Setaria sphacelata, Phragmites mauritianus, Paspalum dilatatum, Cynodon dactylon,* Invasives: *Cirsium vulgare, Datura stramonium*	■ Remove all rock and other debris related to the road crossing; ■ Reprofile the affected road area to emulate the surrounding wetland area, to ensure that water is not impeded, and the flow resumes a natural pattern (restrict activities to the affected road area and ensure no additional disturbance to the original and surrounding wetland surface or substrate); ■ Rip the road crossing, as well as any other area that has been compacted, to a maximum of 150mm and reseed with species listed in the plant species plan; and ■ Remove all AIPs.

Quarry		**Dominant Species** *Hyparrhenia tamba, Hyparrhenia hirta, Cynodon dactylon.*	■ Backfill quarry ■ Shape and profile the site to be free draining ■ Rip 150mm and reseed with species listed in the plant species plan .

8.2.1 Plant Species Plan

Due to the nature of wetland areas, wetland species will naturally colonise the area. The main focus of revegetation at this time is to create a cover to stabilise the area, prevent erosion, reduce the probability of alien species colonising the area and to create a favourable habitat for wetland species to proliferate. Therefore, it is ideal to seed with species that are quick-growing and are stoloniferous.

Table 8-5: Plant Species Plan

Species	Common name	Seeding rate
Cynodon dactylon	Couch Grass	20kg/ha
Digitaria eriantha	Smutsvinger	5kg/ha
Chloris gayana	Rhodes Grass	5kg/ha

9 Impact Assessment

This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation. The potential impacts identified in this section are a result of both the environment in which the proposed project activities takes place, as well as the actual activities.

The following activities for the proposed project that will be assessed are listed in Table 9-1 below.

Table 9-1: Planned activities

Phase	Activities
Decommissioning	Decommissioning of an access road, which was constructed between Mynpad Road and the Twistdraai East Shaft which permits access to the Shaft.
	Decommissioning of the conveyer belt / plinths, on which the conveyer belt is currently located and which was previously utilised to transport coal from Twistdraai Colliery to Twistdraai Export Plant.
	Decommissioning of a mine water supply pipeline located within the conveyor belt servitude.

Rehabilitation	Rehabilitation of the access road, which was constructed between Mynpad Road and the Twistdraai East Shaft which permits access to the Shaft.
	Rehabilitation of the conveyer belt / plinths, on which the conveyer belt is currently located and which was previously utilised to transport coal from Twistdraai Colliery to Twistdraai Export Plant.
	Backfilling and rehabilitation of a quarry located near the conveyer belt.
	Rehabilitation of a mine water supply pipeline located within the conveyor belt servitude.
Post-closure monitoring	Monitoring and maintenance

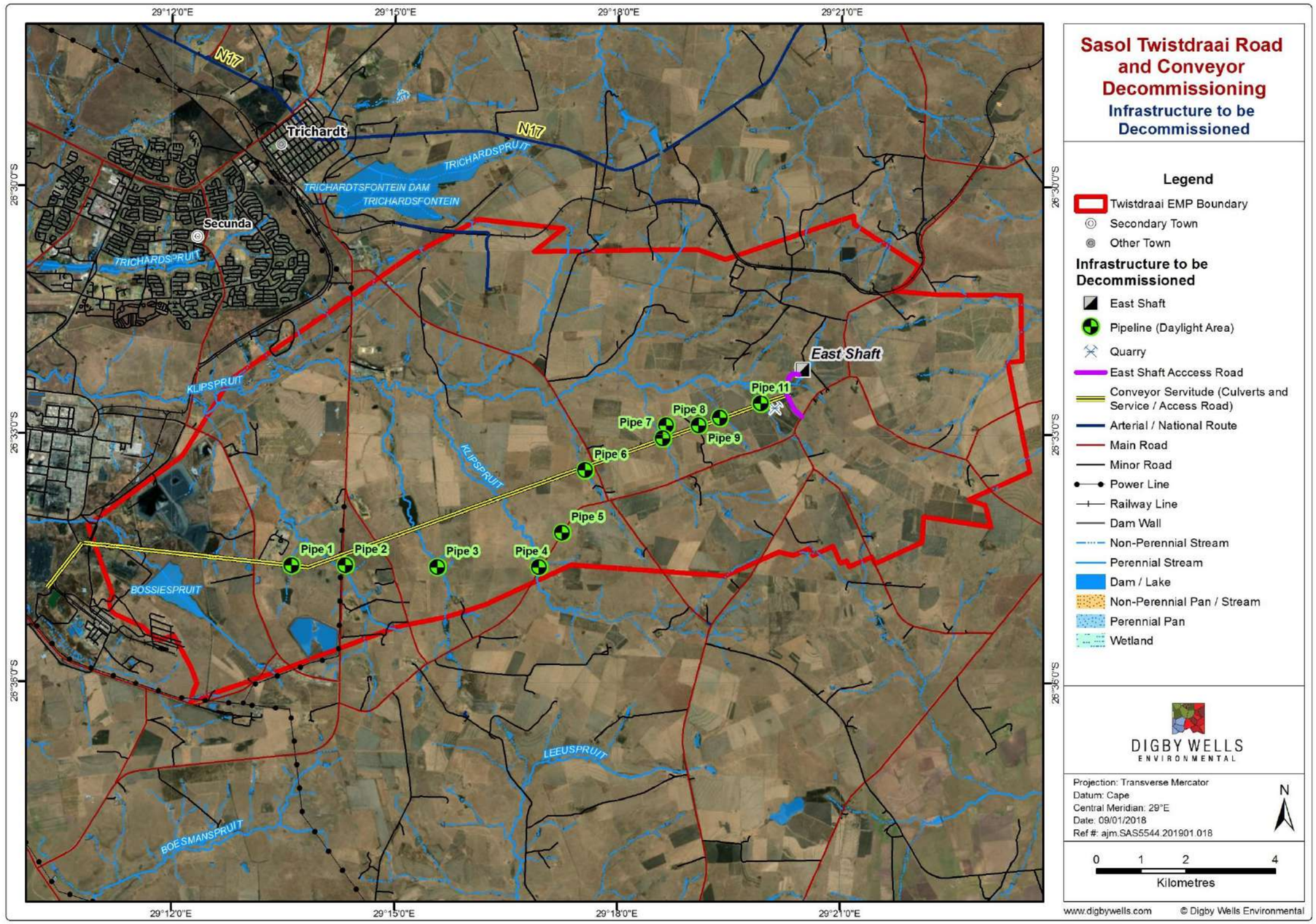

Figure 9-1: Wetland Impact Assessment

9.1 Decommissioning, Closure and Rehabilitation Phase

9.1.1 Decommissioning Phase Impact Description

Impacts associated with the decommissioning phase include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream.

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

Removal of vegetation and disturbance of soils during removal of infrastructure is likely to give rise to an increased potential for erosion and sedimentation. Encroachment by robust pioneer species and alien invasive species is possible, further altering the natural vegetation profiles of the wetlands encountered in the vicinity of the decommissioning footprint.

There are also minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the decommissioning activities.

Table 9-2: Potential Impacts of the Decommissioning Phase – Decommissioning of all infrastructure, including the road, conveyor and pipeline

Dimension	Rating	Motivation	Significance
Activity and Interactions: Decommissioning of all infrastructure, including the road, conveyor and pipeline			
Prior to Mitigation/Management			
Duration	Medium term (3)	The impact will cease 1-5 years after the decommissioning, rehabilitation and closure phase of the project has been completed.	Minor (negative) – 45
Extent	Local (3)	Erosion and general scouring from sedimentation, as well as degraded habitats (due to water quality deterioration as a result of hydrocarbon ingress and increased solids) will affect the local watercourse and river reaches directly downstream.	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	Low to moderate loss (3)	Removal of infrastructure will result in some disturbance, but this is only anticipated to be low/moderate as machinery will mainly be operating within an already disturbed area but downstream impacts are expected.	
Probability	Likely (5)	Should no precautionary measures be implemented, further impacts to the freshwater systems present are considered likely.	
Nature	Negative		
Post-Mitigation			
Duration	Medium term (3)	The impact will cease 1-5 years after the decommissioning, rehabilitation and closure phase of the project has been completed.	Negligible (negative) – 21
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity x type of impact	Minor loss (2)	Removal of infrastructure will result in some disturbance, but this is only anticipated to be minor as machinery will mainly be operating within an already disturbed area.	
Probability	Unlikely (3)	Should the proposed project proceed, and the appropriate management and mitigation measures be implemented, impacts are considered unlikely.	
Nature	Negative		

9.1.2 Decommissioning Phase Mitigation Measures

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

- Limit the footprint area of the decommissioning activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas);

- Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream;
- Ensure that rock is removed carefully, and that no additional wetland area is disturbed in the rehabilitation process;
- No material may be dumped or stockpiled within any wetland areas (or the buffers) in the vicinity of the proposed decommissioning footprint;
- All erosion noted within the decommissioning area footprint should be remedied immediately and included as part of the ongoing rehabilitation plan;
- The use of machinery should be minimised in order to reduce compaction of the wetland soils;
- All vehicles must be regularly inspected for leaks;
- Re-fueling must take place at a diesel facility on a sealed and bunded surface area away from wetlands to prevent ingress of hydrocarbons into topsoil;
- All spills from machinery should be immediately cleaned up and treated accordingly;
- All existing litter and debris should be removed from the freshwater systems and littering should be prohibited on an ongoing basis;
- Appropriate sanitary facilities must be provided for the duration of the rehabilitation activities;
- All waste generated must be removed to an appropriate waste facility;
- Any coal contamination should be removed and discarded at the correct facility;
- Rehabilitation measures should take place as soon as possible after decommissioning; and
- Monitoring should be carried out as specified in the monitoring programme.

9.1.3 Rehabilitation Phase Impact Description

Impacts associated with the rehabilitation phase include potential loss of natural vegetation and the increased potential for erosion and sedimentation in the rehabilitated areas and resulting in impacts further downstream.

Removal of vegetation and disturbance of soils during shaping and ripping is likely to give rise to an increased potential for erosion and sedimentation. Encroachment by robust pioneer species and alien invasive species is possible, further altering the natural vegetation profiles of the wetlands encountered in the vicinity of the rehabilitation footprint.

There are also minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the rehabilitation activities.

Table 9-3: Impact assessment parameter ratings for the Rehabilitation Phase – Rehabilitation measures and site access

Dimension	Rating	Motivation	Significance
Activity and Interactions: Rehabilitation measures such as shaping, ripping and reseeding and site access			
Prior to Mitigation/Management			
Duration	Medium term (3)	The impact will cease 1-5 years after the decommissioning, rehabilitation and closure phase of the project has been completed.	Minor (negative) –50
Extent	Local (3)	Erosion and general scouring from sedimentation due to shaping and reprofiling will affect the local watercourse and river reaches directly downstream.	
Intensity x type of impact	Serious medium term environmental effects (4)	Due to the *Moderate* sensitivity of wetland systems in general and the fact that activities will be taking place within the wetland, causing sedimentation, erosion, water quality changes and compaction, should no management or mitigation measures be employed, activities could result in serious medium-term impacts.	
Probability	Likely 5)	Should no precautionary measures be implemented, further impacts to the freshwater systems present are considered likely.	
Nature	Negative		
Post-Mitigation			
Duration	Medium term (3)	The impact will cease 1-5 years after the decommissioning, rehabilitation and closure phase of the project has been completed.	Negligible (negative) – 21
Extent	Limited (2)	Impacts will be limited only to the project footprint area should rehabilitation take place in adherence to the mitigation measures and should revegetation be successful.	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the freshwater systems present.	
Probability	Unlikely (3)	Should the proposed project proceed, and the appropriate management and mitigation measures be implemented, impacts are considered unlikely.	
Nature	Negative		

Table 9-4: Impact assessment parameter ratings for the Rehabilitation Phase – Backfilling

Dimension	Rating	Motivation	Significance
Activity and Interactions: Backfilling and rehabilitation of a quarry located near the conveyer belt which is within 500m of surrounding wetlands			
Prior to Mitigation/Management			
Duration	Medium term (3)	The impact will cease 1-5 years after the decommissioning, rehabilitation and closure phase of the project has been completed.	Negligible (negative) –40
Extent	Local (3)	Runoff, erosion and sedimentation may affect the local watercourse and river reaches directly downstream.	
Intensity x type of impact	Minor loss (2)	Due to the size and distance from the wetland only a minor impact is expected	
Probability	Likely (5)	Should no precautionary measures be implemented, further impacts to the freshwater systems present are considered likely.	
Nature	Negative		
Post-Mitigation			

Dimension	Rating	Motivation	Significance
Duration	Medium term (3)	The impact will cease 1-5 years after the decommissioning, rehabilitation and closure phase of the project has been completed.	Negligible (negative) – 21
Extent	Limited (3)	Runoff, erosion and sedimentation may only have a limited impact on the local watercourse and river reaches directly downstream, should the mitigation measures be adhered to	
Intensity x type of impact	Minimal to no loss (1)	Due to the size and distance from the watercourses, and should mitigation be adhered to, a minor loss is expected.	
Probability	Unlikely (3)	Should the proposed project proceed, and the appropriate management and mitigation measures be implemented, impacts are considered unlikely.	
Nature	Negative		

9.1.4 Rehabilitation Phase Mitigation Measures

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

- Limit the footprint area of the rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of compaction of soils (all areas but critically so in wetland areas);
- Ensure that no additional wetland area is disturbed in the rehabilitation process;
- No material may be dumped or stockpiled within any wetland areas (or the buffers) in the vicinity of the proposed rehabilitation footprint;
- When reprofiling, ensure that machinery does not disturb additional wetland;
- All erosion noted within the rehabilitation footprint should be remedied immediately and included as part of the ongoing rehabilitation plan;
- The use of machinery should be minimised in order to reduce compaction of the wetland soils;
- Although it is expected that the existing *Phragmites, Typha* and other wetland species will spread and colonise the newly rehabilitated area, it is important to seed the area to promote stabilisation and reduce the possibility of weed infestation,

erosion and/or associated sedimentation of the wetland system both in the immediate surrounds or further downstream;

- Ripping should take place to a maximum depth of 150mm;
- Seeding should take place immediately after ripping to ensure the best chance of survival and should be done by hand to avoid compaction of the soils;
- After ripping and seeding has taken place, the area should be avoided and not driven over;
- As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum;
- Cattle movement should be restricted from the areas that have been repaired until those areas have been reasonably rehabilitated;
- An AIP management plan to be implemented and managed for the life of the proposed decommissioning, rehabilitation, closure and post-closure phases;
- All vehicles must be regularly inspected for leaks;
- Re-fueling must take place at a diesel facility on a sealed and bunded surface area away from wetlands to prevent ingress of hydrocarbons into topsoil;
- All spills from machinery should be immediately cleaned up and treated accordingly;
- All existing litter and debris should be removed from the freshwater systems and littering should be prohibited on an ongoing basis;
- Appropriate sanitary facilities must be provided for the duration of the rehabilitation activities; and
- Monitoring should be carried out as specified in the monitoring programme.

9.1.5 Post-closure Phase Impact Description

As this project is a rehabilitation project, long term positive impacts are deemed highly likely, should the rehabilitation be done correctly and in adherence to the mitigation measures outlined in this report.

Table 9-5: Impact assessment parameter ratings for the Rehabilitation Phase – Removal of cattle from site, ongoing vegetation growth

Dimension	Rating	Motivation	Significance
Activity and Interactions: Removal of cattle from site, ongoing vegetation growth.			
Prior to Mitigation/Management			
Duration	Long term (4)	The impact will continue in the long term.	Minor (positive) 36

Dimension	Rating	Motivation	Significance
Extent	Local (3)o	Improved connectivity will impact the local watercourse and river reaches directly downstream.	
Intensity x type of impact	Low positive impacts (2)	Improved wetland habitat, improved connectivity and a reduction in bare surfaces, could result in low positive impacts.	
Probability	Probable (4)	Positive impacts to the freshwater systems present are considered probable.	
Nature	Positive		
Post-Mitigation			
Duration	Beyond project life (6)	The impact will continue for a period greater than the project life, should rehabilitation take place successfully with adherence to all mitigation measures.	Minor (positive) 66
Extent	Local (3)o	Improved connectivity will impact the local watercourse and river reaches directly downstream.	
Intensity x type of impact	Low positive impacts (2)	Improved wetland habitat, improved connectivity and a reduction in bare surfaces, could result in low positive impacts.	
Probability	Highly probable (6)	Should the proposed project proceed, and the appropriate management and mitigation measures be implemented, positive impacts to the freshwater systems present are considered highly probable.	
Nature	Positive		

9.1.6 Post-closure Phase Mitigation Measures

- Monitoring should be carried out as specified in the monitoring programme to ensure that rehabilitation is taking place;
- Any required maintenance works should be done by hand to reduce disturbance within the wetland;
- Cattle movement must be restricted until rehabilitation has taken place;

- Restrict movement of personnel in the wetland areas.

10 Monitoring Programme

The rehabilitated areas should be monitored by a qualified wetland specialist monthly during the decommissioning and rehabilitation phases then quarterly for a minimum of three years thereafter to ensure that vegetation is establishing. Should vegetation not establish, the area may need to be ripped/spiked (to a depth no deeper than 150 mm) and reseeded. Monitoring will then need to continue until vegetation has established.

PES and EIS will only need to be assessed annually. The remainder of the assessments should be monitoring the rehabilitation to remedy any issues that may arise.

11 Conclusion

WCS (2018) delineated a total of 2199 ha of wetland within the Project area. The most prevalent HGM type along the servitude are Channelled Valley Bottom Wetlands, followed by Unchannelled Valley Bottom Wetlands. The wetlands exhibited a variety of PES values, ranging from Largely Natural (Category B) to Critically Modified (Category F). Most wetlands transecting the servitude and road are characterised as Moderately Modified (Category C), and Largely Modified (Category D). EIS scores for the various HGM Units ranged from Low/Marginal to High with the majority of the wetlands along the conveyor being Moderate.

Impacts are anticipated to be minor; negligible when mitigation measures are adhered to.

Rehabilitation measures have been suggested for each wetland crossing, and a plant species plan was compiled, including species that spread quickly and are stoloniferous so as to ensure vegetation cover is established quickly and to assist in erosion prevention and the proliferation of invasive alien species.

The rehabilitated areas should be monitored monthly during the decommissioning and rehabilitation phase then quarterly for a minimum of three years thereafter to ensure that vegetation is establishing. Should vegetation not establish, the area may need to be ripped/spiked (to a depth no deeper than 150 mm) and reseeded. Monitoring will then need to continue until vegetation has established.

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Appendix A: Baseline wetland delineation and assessment for the Sasol Twistdraai Mine (WCS, 2017)

BASELINE WETLAND DELINEATION AND ASSESSMENT FOR THE SASOL TWISTDRAAI MINE

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By:

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June 2018

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Project Reference No: 1270-2017

DOCUMENT SUMMARY DATA

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1. BACKGROUND

Sasol operates numerous underground coal mining operations in the Secunda area to supply coal to the Sasol Secunda Synfuels Operations. Mining operations include Twistdraai, Brandspruit, Middelbult and Syferfontein, as well as a number of more recent mining developments (Thubelisha Shaft, Impumelelo Mine and Shondoni Shaft), all of which are located in the Secunda region. Some of these underground mines have approached the end of their useful lives, with mineable coal reserves having been exhausted, and are in the process of undergoing closure. As part of the closure process, Jones & Wagener have been appointed by Sasol to undertake a quantitative latent risk assessment for the Twistdraai, Brandspruit and Middelbult Mines to assess risks to surface water resources from surface subsidence.

To this end, Wetland Consulting Services (Pty.) Ltd. (WCS) was appointed by Jones & Wagener to provide the specialist wetland input required for the risk assessments for the three mines. Detailed wetland studies were undertaken for each of the Twistdraai, Brandspruit and Middelbult Mines (findings detailed in 3 separate reports). A detailed assessment of the wetlands within the Twistdraai Mine forms the focus of this report and is required to inform an assessment of the importance and significance of the wetlands affected by the Twistdraai Mine, as well as to determine the significance of the expected impacts to wetlands.

2. SCOPE OF STUDY

The study detailed in this report utilised methodologies that are currently widely accepted within the industry and by the relevant authorities and included sufficient field verification to adequately inform the assessment methodologies used.

The scope of work for this study can be summarised as follows:

- Collation of existing wetland datasets for the study area;
- Desktop mapping of wetlands based on the latest available aerial imagery (1:10000 NGI imagery, ESRI World Imagery Basemap, and Google Earth imagery);
- Verification of wetland boundaries according to the delineation procedure as set out by the "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" document, as described by DWAF (2005).
- Typing of wetlands according to their hydro-geomorphic determinants as detailed in the method by Ollis, Snaddon, Job and Mbona (2013);
- Undertake a desktop biodiversity assessment to determine threatened and conservation important faunal species (mammals, avifauna and herpetofauna) likely to occur within the wetlands on site;
- Determine the Present Ecological State (PES) of wetlands through application of the WET-Health Level I PES assessment methodology;
- Determine the Wetland Importance and Sensitivity (IS) through application of the IS assessment methodology;

- Determine the Target Ecological Category (TEC) for each wetland unit based on the approach described for determining the recommended ecological category (REC) for wetlands;
- Undertake a functional assessment of wetland types recorded within the study area;
- Compilation of a GIS dataset detailing the wetland location, extent, type, PES and EIS; and
- Compilation of a summary report to accompany the GIS dataset.

3. LIMITATIONS & ASSUMPTIONS

- This report has been prepared for the particular purpose outlined in the Background and Scope of Study above and no responsibility is accepted for the use of this report, in whole or in part, in any other context or for any other purpose.
- Wetland boundaries reflect the ecological boundary where the interaction between water and plants influences the soils, but more importantly the plant communities. The depth to the water table where this begins to influence plant communities is approximately 50 centimetres. This boundary, based on plant species composition, can vary depending on antecedent rainfall conditions, and can introduce a degree of variability in the wetland boundary between years and/or sampling period. This variability also affects the suitability of aerial imagery for the identification and delineation of wetland boundaries as the specific time period and season captured by aerial imagery only reflects a single snapshot of the inherent variability in the wetland boundary between years and/or sampling periods. Therefore, the variability in colour signatures on aerial imagery limits to some degree the accuracy with which wetland boundaries can be mapped
- The wetlands systems have been mapped from the most recent aerial imagery available at a scale of 1:5000, though use was also made of alternative imagery sources such as ESRI World Imagery Basemap, and Google Earth imagery. Due to the extent of the area and the mapping scale used, the actual extent of the boundaries of these systems may be underestimated or overestimated in places. This may range from metres to tens of metres but generally is regarded as being of sufficient accuracy for the purposes of this study. While an attempt was made to map and verify all wetlands within the study area, it is likely that some small and/or isolated wetlands may have been missed and not mapped.
- The soils across the study area are dominated by vertic clays which display limited soil wetness indicators, which are used in the delineation of wetland boundaries. Therefore, vegetation indicators played a primary role in determining the wetland boundaries. However, the temporary to seasonal zones of a number of the valley bottom wetlands were cultivated or transformed on site, precluding the use of vegetation indicators in determining wetland boundaries in these areas and thus reducing the confidence of the delineation accuracy in those areas where cultivation (past and present) extends into the wetlands or where the natural vegetation has been significantly disturbed.
- A Digital Elevation Model (DEM) of the study area assisted in mapping of the wetlands, particularly the floodplain wetland boundaries, as the vegetation across large sections of the floodplains included typically terrestrial plant species, and therefore, in such cases, the vegetation was of limited value in locating the floodplain boundaries.
- Reference conditions are unknown. This limits the confidence with which the present ecological category (PES) is assigned.

- Amongst the watercourses identified on site, numerous drainage lines were identified and delineated. These systems represent preferential pathways for surface flow through the landscape. Although not falling within the definition of a wetland, they are still classified as watercourses and have therefore been included in the delineation and assessments. Many of the drainage lines delineated support a vegetation community that differs slightly from the surrounding terrestrial vegetation, but which is not necessarily indicative of sufficient saturation to be associated with wetland habitat. The assessment tools used to assess the PES and IS of the wetlands within the study area were applied to the assessment of the drainage lines to give an indication only of their relative integrity, importance and sensitivity. It must be noted that these tools have been developed specifically to assess wetland ecosystems. However, in the absence of a more appropriate tool to assess the drainage lines, it was decided that the WET-Health PES assessment tool and the Rountree *et al.* (2013) IS assessment tool should be applied. This decision was based on observation during site visits that the drainage lines, in most instances, most closely resemble the valley bottom wetlands delineated on site in terms of landscape setting, flow characteristics, soil type and vegetation structure.
- The PES of artificial wetlands formed within the footprint of surface subsidence was not determined, as the PES methodology is designed to assess the current integrity of a natural wetland compared to its reference condition. Artificial wetlands have no wetland reference condition and therefore cannot be assessed. However, the IS of artificial wetlands created as a result of subsidence was assessed to provide an indication of the potential value of these systems within the landscape.
- The target ecological categories (TEC) set for the individual wetland HGM units are based on the current PES and IS of the wetlands. However, although the set TEC's represent an ecological integrity that should be aimed for in managing the wetlands, it is acknowledged that in certain instances, depending on the nature of current impacts, it may not be practically possible to attain the TEC's set.

4. STUDY AREA

The study area for this assessment is the Twistdraai Mine Mineral Rights Area. The study area extends to the south and east of the town of Secunda. The N17 National Road runs to the north of the study area and a number of tarred and dirt farm and mine roads traverse it. The primary landuse within the study area is agriculture, both cultivation and livestock grazing, and limited mining and road infrastructure. The study area covers an area of approximately 13 763.1 hectares.

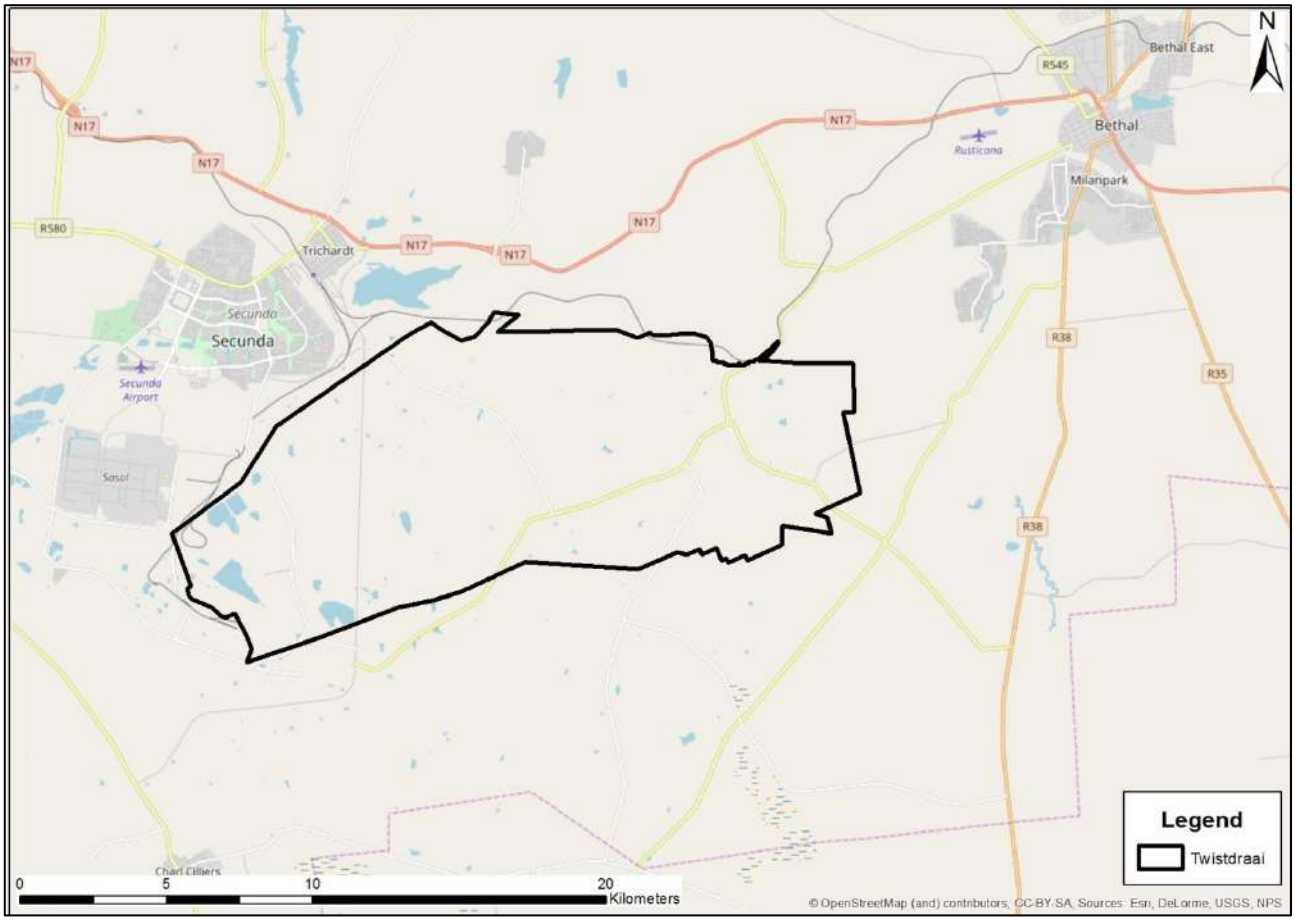

Figure 1. Location and extent of the study area as defined for this study.

4.1 Catchments

The study area is located within primary catchment C (Vaal River catchment) and falls across two quaternary catchments (**Table 1**). Catchment C12D forms part of the headwaters of the Waterval River, a tributary of the Vaal River that enters the Vaal River a short reach upstream of the Vaal Dam. Catchment C11H is drained by the Blesbokspruit, which enters the Vaal River just upstream of Grootdraai Dam

Table 1. Quaternary catchment characteristics for the study area (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Catchment Surface Area (ha)	Mean Annual Rainfall (MAP) in mm	Mean Annual Run-off (MAR) in mm	MAR as a % of MAP
C12D	89 851	667	59.3	8.9 %
C11H	110 277	664	73.2	11.0 %

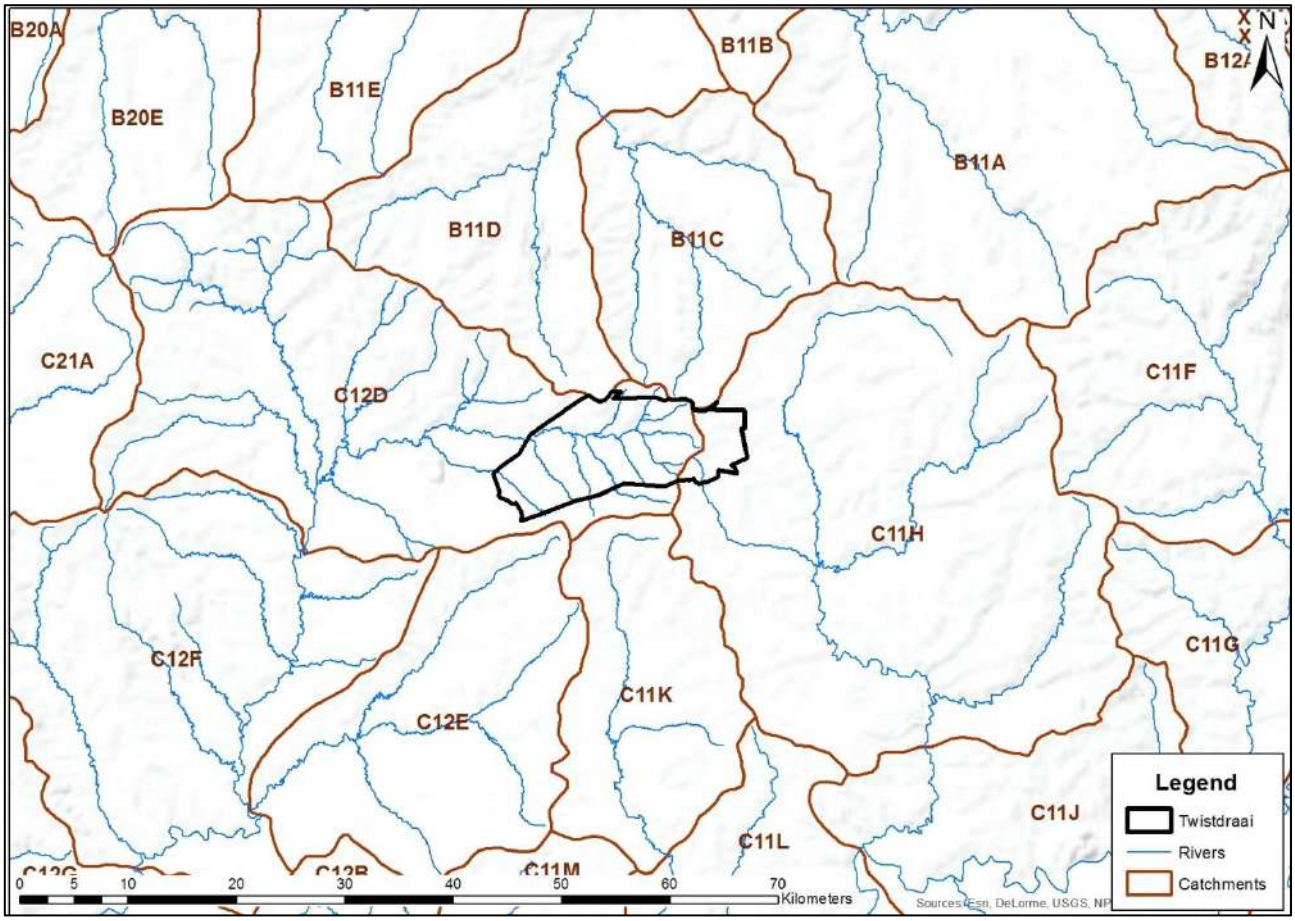

Figure 2. Map showing the study area in relation to quaternary catchment boundaries. The main river draining the study area is the Waterval.

4.2 Freshwater Ecosystem Priority Areas (FEPAs)

The Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel *et al.,* 2011) which represents the culmination of the National Freshwater Ecosystem Priority Areas project (NFEPA), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. The NFEPA project aims to:

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

FEPAs were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat.

FEPAs should be regarded as ecologically important and as generally sensitive to changes in water quality and quantity, owing to their role in protecting freshwater ecosystems and supporting sustainable use of water resources (Driver *et al.*, 2011).

Figure 3. Map showing the MHWet dataset for the study area and highlighting the presence of FEPA wetlands within the study area.

For the Mpumalanga Province, a WRC funded project (Mbona *et al*., 2015), updated the wetland mapping and the classification of FEPAs. An extract from the Mbona *et al.* (2015) dataset (MHWet) is illustrated in **Figure 3** and shows several FEPA wetlands extending across the study area.

4.3 Vegetation Types

A number of vegetation classification systems have been compiled for South Africa. According to the most recent vegetation classification of the country, "*The Vegetation of South Africa, Lesotho and Swaziland*" (Mucina and Rutherford, 2006), the study area (**Figure 4**) falls within the Grassland Biome, Mesic Highveld Grassland Bioregion. At a finer level, the area is categorised as Soweto Highveld Grassland (Gm8). Soweto Highveld Grassland is listed as *Vulnerable* in the National List of Ecosystems that are Threatened and in Need of Protection (GN1002 of 2011).

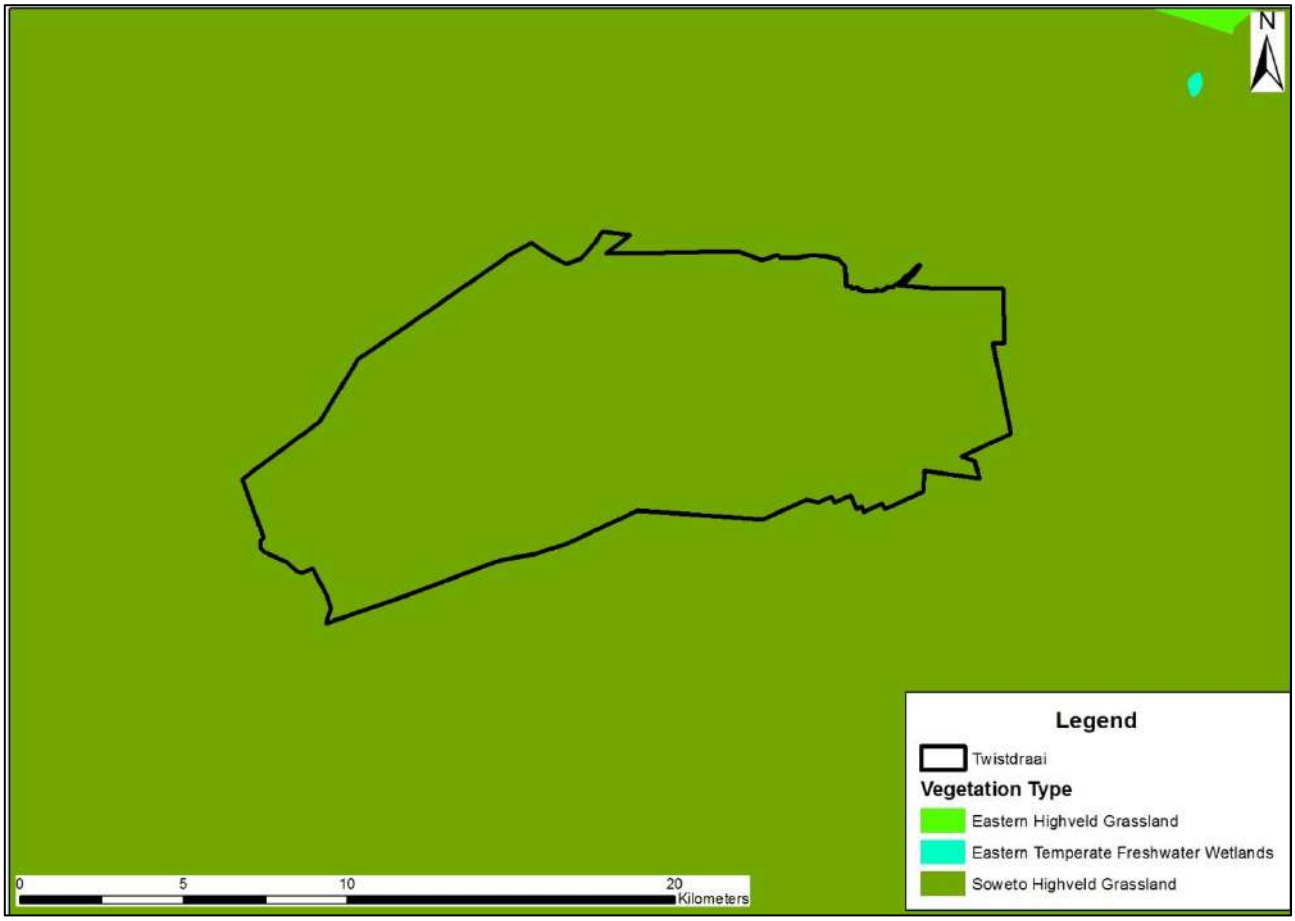

Figure 4. Map showing the vegetation types of the area as per Mucina and Rutherford (2006).

4.4 Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan (MBSP) is a spatial tool that comprises a set of maps of biodiversity priority areas for use in land-use and development planning, environmental assessment and regulation, and natural resource management (MTPA, 2014). One of the key outputs of the MBSP is the identification of biodiversity priority areas. This was achieved through the compilation of maps indicating Critical Biodiversity Areas (CBAs).

Figure 5 illustrates the terrestrial biodiversity assessment of the MBSP for the study area. CBA Irreplaceable areas, the highest biodiversity priorities, are indicated in red. It is clear from the linear nature of many of these CBAs that they are associated with the larger wetlands and rivers of the study area, while large areas of CBAs also occur associated with remaining natural grassland areas in the west of the study area.

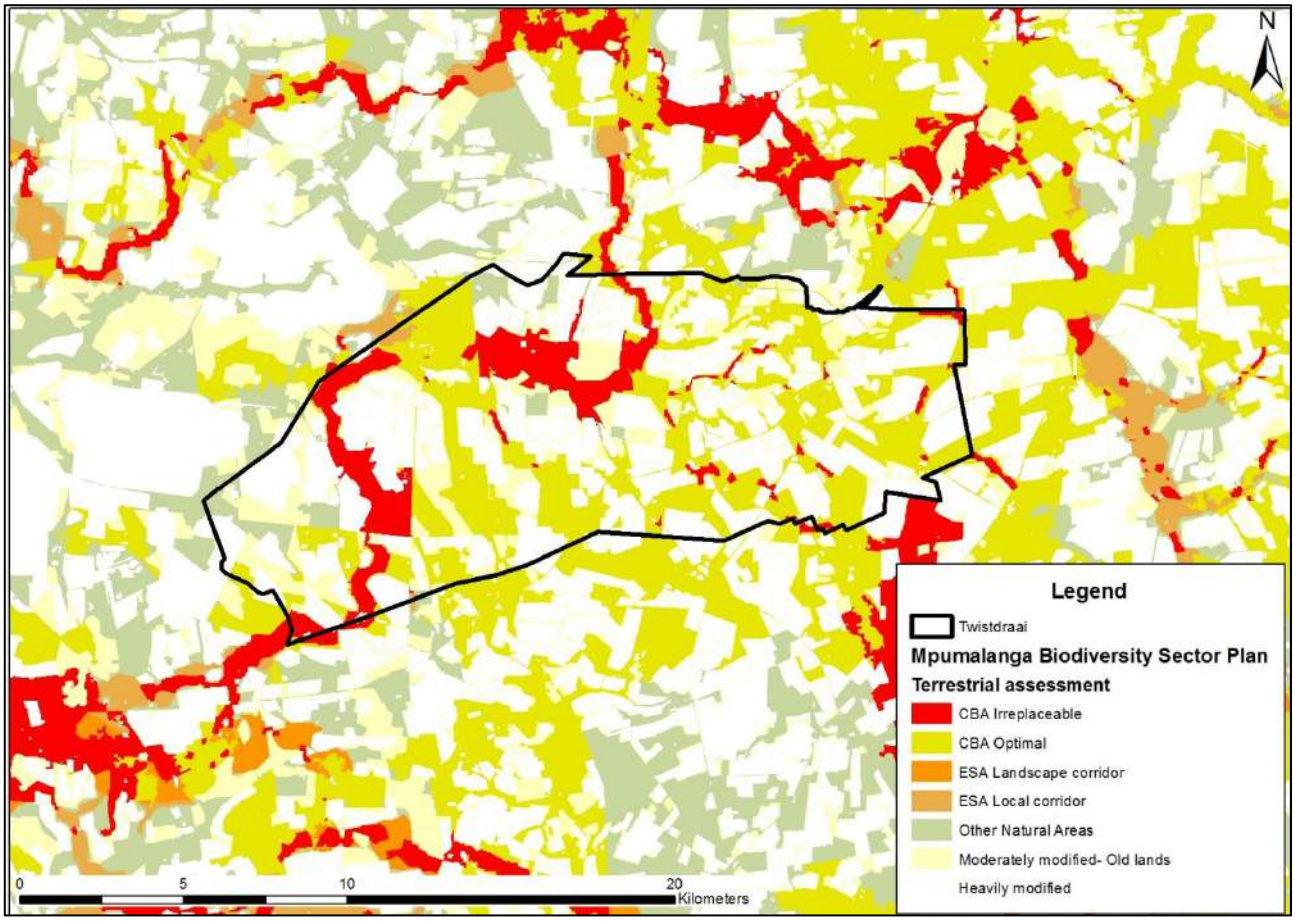

Figure 5. Extract from the provincial conservation plan for the study area.

5. APPROACH

5.1 Wetland Delineation and Classification

The National Water Act, Act 36 of 1998, defines wetlands as follows:

> *"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

The presence of wetlands in the landscape can be linked to the presence of both surface water and perched groundwater. Wetland types are differentiated based on their hydro-geomorphic (HGM) characteristics; i.e. on the position of the wetland in the landscape, as well as the way in which water moves into, through and out of the wetland systems. A schematic diagram of how these wetland systems are positioned in the landscape is given in the figure below.

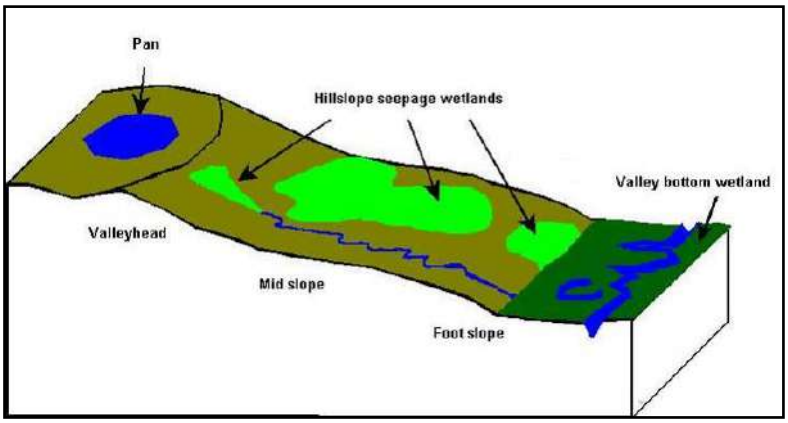

Figure 6. Diagram illustrating the position of the various wetland types within the landscape

A desktop delineation of suspected wetland areas was undertaken by identifying rivers and wetness signatures using the most recent available aerial imagery (1:10000 NGI imagery, ESRI World Imagery Basemap, and Google Earth imagery). Initial desktop mapping was carried out at a scale of between 1:5 000 and 1:10 000 and was based on visible wetness and greenness signatures, available 5m contours of the area and prevailing soil conditions.

Areas suspected to be wetlands were then further investigated in the field. The wetlands were visited in the field and delineated over the course of several months (January - March 2018). The site visits fell within the wet season on the Mpumalanga Highveld (November – April) and allowed the identification and use of vegetation indicators in determining the wetland extent.

Wetlands were identified and delineated according to the delineation procedure as set out by the "*A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas*" document, as described by DWAF (2005) and Kotze and Marneweck (1999). Using this procedure, wetlands were identified and delineated using the Terrain Unit Indicator, the Soil Form Indicator, the Soil Wetness Indicator and the Vegetation Indicator.

For the purposes of delineating the actual wetland boundaries use is made of indirect indicators of prolonged saturation, namely wetland plants (hydrophytes) and wetland soils (hydromorphic soils), with particular emphasis on hydromorphic soils. It is important to note that under normal conditions hydromorphic soils must display signs of wetness (mottling and gleying) within 50cm of the soil surface for an area to be classified as a wetland (*A practical field procedure for identification and delineation of wetlands and riparian areas*, DWAF).

Large portions of the study area are characterised by vertic clay soils, which do not display clear soil wetness indicators. Therefore, in these areas, identification of wetland plants (vegetation indicator) played a key role in identifying the wetland boundaries. A high resolution DEM was made available for the majority of the study area, and aided, particularly in the case of the floodplain wetlands, in determining the wetland extent, as well as in identifying areas of surface subsidence. Where surface subsidence was noted within areas of natural wetland habitat, the presence of subsidence was not mapped, but did influence the PES of the wetland. However, in cases where wetland habitat was determined to have developed as a direct result of subsidence, these areas were mapped as artificial wetlands.

Due to the extent of the area and the mapping scale used, the actual extent of the boundaries of the mapped wetland systems is likely to be underestimated or overestimated in places. This may range from metres to tens of metres but generally is regarded as being of sufficient accuracy for the purposes of this study. While an attempt was made to map and verify all wetlands within the study area, it is likely that some small or isolated wetlands may have been missed and not mapped.

Delineated wetlands were then typed according to the hydro-geomorphic classification systems originally proposed by Brinson (1993), and and most recently modified for use in South African conditions by Ollis *et al*. (2013).

Existing wetland information was available for the Sasol Secunda Industrial Complex and immediate surrounds from a wetland study undertaken by Wet-Earth Eco-Specs in 2017. Where this existing wetland information overlapped with the project study area, use was made of the wetland delineation, PES and IS as indicated in the Wet-Earth Eco-Specs report.

5.2 Desktop Biodiversity Assessments

A desktop study was conducted to determine the faunal species (mammals, avifauna, amphibians and reptiles) potentially occurring within the Quarter Degree Squares (QDS's) across which the study area extends based upon available information on faunal distribution ranges in southern Africa. The desktop faunal assessment was undertaken at the scale of the regional study area (which forms the focus of a separate report) and therefore encompasses all three of the Sasol Secunda Mines assessed – Twistdraai, Brandspruit and Middelbult.

A list of bird species likely to occur within the study area was obtained from the Southern African Bird Atlas Project 2 website (http://sabap2.adu.org.za/). Species likely to occur were then assessed in terms of habitat requirements to determine which species are likely to be dependent

on wetland habitat. Threatened species and their habitat requirements were informed by the Eskom Red Data Book of Birds 2015 (Taylor, Peacock and Wanless, 2015).

Information on the distribution ranges, habitat requirements and Red Data List status of mammal, reptile and amphibian species was gained from various reference texts and Red Data books and datasets. In addition, confirmation of species presence within the relevant QDS's was obtained from the Animal Demography Unit's online resource – The Virtual Museum, which provides identification of recent historical species sightings based on photographic evidence (http://vmus.adu.org.za) as well as observations of signs of species presence (tracks, scats, visual sightings) made during fieldwork undertaken as part of the wetland assessment/s.

5.3 Present Ecological State Assessment

The present ecological state (PES) of floodplain, valley bottom and seep wetland HGM units and drainage lines was assessed using WET-Health Level I (Macfarlane *et al*., 2007); an assessment technique based on readily described indicators that critically examine the three components of wetland ecological integrity, namely:

- Hydrology;
- Geomorphology; and
- Vegetation.

Despite its value as a wetland assessment tool, WET-Health is not an applicable tool for assessing the PES of pans or depressions. As such it could not be applied to these wetlands and the PES scores for the depression/pan wetlands were thus derived from a new assessment method developed by WCS, modified from the scoring system as described in the document "Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems" (DWAF, 1999).

The PES of artificial wetlands formed within the footprint of surface subsidence was not determined, as the PES methodology is designed to assess the current integrity of a natural wetland compared to its reference condition. Artificial wetlands have no reference condition and therefore cannot be assessed.

These assessments assisted in identifying the current impacts that are undermining the integrity of each wetland. The scale used to rate the various components of wetland PES is provided in **Table 2** below.

Table 2. Rating scale used for the PES assessment.

Description	Combined impact score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	F

5.4 Wetland Importance and Sensitivity Assessment

A wetland importance and sensitivity (IS) assessment was conducted for each wetland system assessed. This was done in order to provide an indication of the conservation value and sensitivity of the wetlands. For the purpose of this study, the Rountree *et al.* (2013) assessment criteria were used. The scale used to rate the various components of wetland IS is provided in **Table 3** below.

Although the PES of artificial wetlands created as a result of surface subsidence was not assessed, the IS of artificial, subsidence wetlands was assessed to provide an indication of the potential value of these systems within the landscape.

Table 3. Rating scale used for the IS assessment.

Wetland Importance and Sensitivity Categories	Range of IS 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

5.5 Target Ecological Category Assessment

The Target Ecological Category (TEC) was determined based on the approach described for determining the recommended ecological category (REC) for wetlands as outlined in the Manual for the Rapid Ecological Reserve Determination of Wetlands (Version 2.0) (Rountree *et al*., 2013)

and adapted as per the requirements of the Department of Water and Sanitation (Barbara Weston, pers. comm.).

The TEC is determined by the Present Ecological State of the water resource and the Importance and Sensitivity of the water resource. The following guidelines apply:

- PES is in an E or F category:
  - The TEC should be set at at least a D, since E and F ecological categories are considered unsustainable.
- The PES category is in a A, B, C or D category, AND the IS criteria are Low or Moderate OR the IS criteria are high or even very high, but it is not feasible or practicable for the PES to be improved:
  - The TEC is set at the current PES.
- The PES category is in a B, C or D category, AND the IS criteria are High AND it is feasible or practicable for the PES to be improved:
  - The TEC is set at least half an Ecological Category higher than the current PES.
- The PES category is in a B, C or D category, AND the IS criteria are Very High AND it is feasible or practicable for the PES to be improved:
  - The TEC is set at least one Ecological Category higher than the current PES.
- The PES category is in an A category, AND the IS criteria are High or Very High:
  - The TEC is set at the current PES.

5.6 Functional Assessment

A functional assessment of a representative grouping of wetlands on site was undertaken using the level 2 assessment as described in "Wet-EcoServices" (Kotze *et al*., 2007). WET-EcoServices is a tool developed to provide an initial, high-level, qualitative assessment of the goods and services that individual wetlands provide so as to aid informed planning and decision making (Kotze *et al*., 2009). In interpreting the results of the WET-EcoServices assessment, the following must be borne in mind:

- *The level of services delivered is based on current as well as future potential benefits* (i.e. a wetland might have high ability to perform a service such as trapping pollutants but is currently afforded little opportunity to perform the service due to a lack of pollutants within the wetland catchment, resulting in an intermediate score);
- *WET-EcoServices scores make no reference to the size of the wetland* (i.e. a 3ha wetland and a 300ha wetland might both score 3 for flood attenuation. Given the size of the wetlands in question, the overall importance of flood attenuation performed by the 300ha wetland is obviously greater than for the 3ha wetland);
- *Scores between different hydro-geomorphic wetland units (i.e. different wetland types) should not be compared directly.*

6. FINDINGS

6.1 Wetland Delineation and Typing

Within the study area 6 different hydro-geomorphic (HGM) wetland types were identified, namely:

- Channelled Valley Bottom wetland
- Unchannelled Valley Bottom wetland
- Floodplain wetland
- Seep wetland
- Sheetrock wetland
- Wetland Flats

In addition to the wetlands, three further watercourse types were mapped and included within the wetland delineation:

- Drainage Line
- Artificial wetland – wetland habitat formed within areas of subsidence.
- Artificial – manmade features, i.e.: pollution control dams (PCD's), excavations, trenches.

Together the wetlands and the watercourses within the study area cover approximately 2 199 hectares or 16 % of the study area (study area covers 13 763.1 ha).

The delineated wetlands and watercourses are illustrated in the map below (**Figure 7**), while **Table 4** provides information on the actual extent of the wetlands in terms of area and the contribution that the different types of wetlands make towards the total wetland area.

Table 4. Summary of the different wetland types and extents recorded within the study area.

Wetland Type	Area (ha)	% of wetland area	% of study area
Artificial Depression	16.63	0.76%	0.12%
Artificial Wetland	3.43	0.16%	0.02%
Channelled Valley Bottom	851.38	38.72%	6.19%
Digging/Excavation	53.04	2.41%	0.39%
Drainage Line	36.32	1.65%	0.26%
Flat	0.78	0.04%	0.01%
Floodplain	574.00	26.10%	4.17%
PCD Dam	17.08	0.78%	0.12%
Seep	166.97	7.59%	1.21%
Sheet Rock	69.67	3.17%	0.51%
Trench	0.09	0.00%	0.00%
Unchannelled Valley Bottom	409.62	18.63%	2.98%
Grand Total	**2199.03**	**100.00%**	**15.98%**

Altogether 99 dams were identified within the wetlands on site, covering more than 179 hectares.

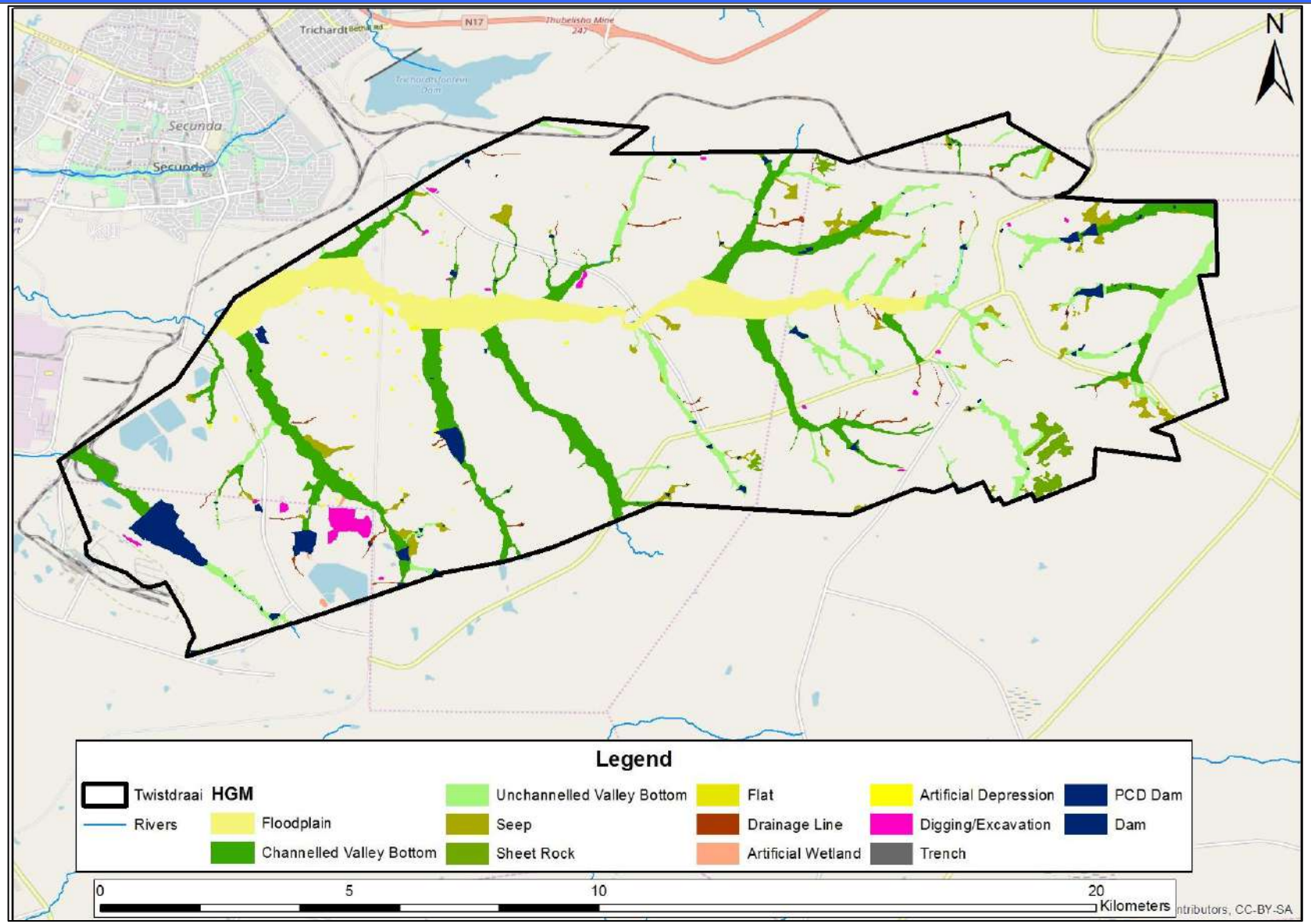

Figure 7. Map of the delineated wetlands and watercourses within the study area.

Figure 8. Photographic examples of some of the wetland habitat observed on site (left to right, top to bottom): river channel in a floodplain, backwater depression in a floodplain, livestock trampling and erosion in a channelled valley bottom, a well vegetated channelled valley bottom wetland, Channel valley bottom wetland with adjacent seep, Headcut erosion in an unchannelled valley bottom, *Crinum* flowering in an unchannelled valley bottom, unchannelled valley bottom wetland, unchannelled valley bottom wetland showing intermittent ponding.

Figure 8 cont. Photographic examples of some of the wetland habitat observed on site (left to right, top to bottom): hillslope seepage wetland, hillslope seepage wetland, hillslope seepage wetland, sheetrock wetland, drainage line, drainage line showing progression of headcut erosion, large artificial depression adjacent to floodplain habitat, artificial depression overlying subsidence, artificial depression overlying subsidence within a cultivated field.

Channelled valley bottom wetlands are the most extensive wetland type on site, covering 851.4 ha (38.7 % of the wetland area). These systems range from small, narrow headwater wetlands to large, broad systems grading into floodplain wetlands. Channelled valley bottom wetlands, as the name indicates, are always associated with a stream channel, are located along valley floors and do not display typical floodplain features. These wetlands can vary from temporary to permanent in nature and are maintained predominantly by surface water inputs.

Floodplain wetlands are associated with the Klipspruit, which forms a tributary of the Waterval River. They cover 574 ha (26 % of the wetland area) of the identified wetland habitat on site. Typically these are broad, flat wetland systems with clearly defined channels and obvious floodplain features such as oxbows, cut-off meanders, off-channel depressions and levees. In many cases the deeply incised channels of the floodplain wetlands on site limits the occurrence of bank overtopping flood events, making these systems very dependent on lateral flow inputs. Within the study area such lateral flow inputs are likely more important in maintaining saturation of the floodplain margins than channel overtopping events derived from upstream inputs. As a result of limited bank overtopping, many of these floodplain wetlands contain large areas of rather temporary wetness that in some cases might even be classed as terrestrial. However, for the purpose of this study, the floodplain wetland boundaries were delineated, using the DEM, along the edge of the topographic valley floor. In several instances, the presence of surface subsidence related to underground mining has led to the formation of artificial depression wetlands. Where this subsidence has occurred within the floodplain wetland, this has created wetland habitat similar to natural backwater depressions.

Unchannelled valley bottom wetlands are characterised by their position along valley floors, the absence of a defined channel and the prevalence of diffuse flows. Within the study area they typically occur near the headwaters of the various drainage systems and in reaches characterised by a gently sloping, low energy environment. Although these wetlands cover over 409 ha of the study area, it is considered likely that under natural conditions these wetlands would have been even more extensive, with changes in landuse (e.g. conversion to cultivation), linear infrastructure crossings and dams resulting in channel incision within many of the wetlands on site. Typically the unchannelled valley bottom wetlands of the study area can be considered seasonal systems.

Seep wetlands cover only 167 ha of the study area, or 7.6 % of the land surface. Seep wetlands are typically maintained by sub-surface interflow through the soil profile, with surface water only appearing during periods of complete saturation. Given the widespread vertic clay soils within the study area which are generally not conducive to interflow, Seep wetlands are limited in occurrence and extent, especially when compared to other regions of the Mpumalanga Highveld characterised by more sandy soils (e.g. the Witbank coalfields).

Wetland Flats cover less than a hectare within the study area and are limited to a handful of small, isolated patches of wetland habitat. Wetland flats are typically level or near-level wetland areas that are not fed by water from a river channel, and which are typically situated on a plain or bench within the landscape. The primary source of water is generally precipitation and horizontal water movements within the wetland are typically weak and multidirectional, if present at all.

Sheetrock wetlands have shallow soils (usually < 15 cm deep) and are associated with seepage along weathered sections of sandstone and flat bedrock. In general, sheetrock wetlands are systems that occur on shallow soils in exposed sheetrock areas where surface water regularly flows (trickles) or seepage water accumulates. The shallow gradient and bedrock surface form an impervious substrate which allows water to accumulate from seepage out of fissures and cracks in the rocks. As these systems are characterised by very shallow soils on rock with no source of permanent saturation they tend to be temporarily wet. They usually remain saturated for short periods following rainfall events only, though they may remain damp for extended periods (weeks to months depending on rainfall and local temperatures). The flora therefore comprises species tolerant of both the harsh conditions on the rock sheets when the systems are dry and the saturated and damp conditions present when the systems are wet. As such, these wetlands often support a different and unique plant species assemblage compared to both surrounding terrestrial and wetland areas.

Artificial Depression wetlands were observed to have established within areas of surface subsidence associated with past underground mining. Areas of subsidence were identified based on signatures evident on the DEM of the study area, and any wetland habitat occurring within the identified subsidence footprints was classified as artificial in origin. These depression wetlands are thought to be a product of flow accumulation, primarily from precipitation and surface runoff, in low points within the landscape created by subsidence. In many instances, these depressions are small and lie within cultivated lands, and represent temporary wetland habitat with very limited plant species diversity. However, several depressions have developed along the margins of valley bottom or floodplain habitat and appear to be temporarily to seasonally saturated and represent an extension of the adjacent natural wetland habitat.

Drainage Lines. A number of drainage lines were mapped within the study area (36 ha). These are not wetlands, but rather represent visible preferential flow paths that convey surface runoff into downslope wetlands. Typically the drainage lines display a discernable flow path but are characterised by a mix of terrestrial grass species. Within the study area they are usually associated with black clay soils of the Arcadia soil form.

6.2 Desktop Biodiversity Assessments

6.2.1 Avifauna

Data obtained from the Southern African Bird Atlas Project 2 (SABAP2 - http://sabap2.adu.org.za/) indicates that 319 bird species (full species list included as an Appendix to the Sasol Secunda Regional Wetland Report) have been recorded in the quarter degree squares intersected by the greater regional study area. Of these, approximately 110 species are dependent on, or extensively utilise, wetland and aquatic habitats.

Table 5 details the list of regionally and globally threatened bird species expected to occur in the area and which have been observed in the affected quarter degree squares over the course of SABAP2. 9 of the 18 threatened species are considered wetland species, with the Blue Crane also extensively utilising wetland habitats. Of special significance is the Critically Endangered Wattled

Crane which has been fairly regularly observed (5% reporting rate) in the north west of the study area (quarter degree squares 2628BD and 2628DB). All observations of Wattled Crane have occurred during the winter months (May to August) and likely relate to a single individual that is known to overwinter in the general vicinity of Devon, often in the company of a large flock of Blue Cranes.

The Vulnerable African Grass Owl, a species seldom observed due to its nocturnal habits and secretive nature, is likely to occur in suitable habitats through the wetlands of the study area. This species is particularly fond of dense stands of the grass *Imperata cylindrica* for roosting and nesting.

The two flamingo species, both listed as Near Threatened regionally, are also likely to be regulars within the study area when the larger pans contain water, and are also known to regularly utilise the large Leeuwpan Dam.

Figure 9. Photograph of Blue Cranes (Near threatened) seen to the south of Leandra. Photograph dates from 2016.

Table 5. List of threatened bird species observed within the quarter degree squares intersected by the regional study area. Data derived from Southern African Bird Atlas Project 2 (SABAP2). Species dependent on wetland habitat have been highlighted in yellow.

Common Name	Taxon Name	Reporting Rate	Occurrence [1]	Wetland Species[2]	Threatened Species		Wetland Habitat Requirements
					Regional (2015)	Global	
Courser, Double-banded	*Rhinoptilus africanus*	2%	Vagrant		NT	LC	
Crane, Blue	***Anthropoides paradiseus***	**13%**	**Uncommon**	**F**	**NT**	**VU**	**All grasslands. Roost in open water, i.e. pans or dams**
Crane, Grey Crowned	***Balearica regulorum***	**1%**	**Vagrant**	**O**	**EN**	**EN**	**All wetlands, predominantly large valley bottoms and floodplains**
Crane, Wattled	***Bugeranus carunculatus***	**5%**	**Rare**		**CR**	**VU**	**Occurs in the eastern grasslands of South Africa, breeds in permanently inundated sedge wetlands.**
Duck, Maccoa	***Oxyura maccoa***	**8%**	**Rare**	**O**	**NT**	**NT**	**Open water habitats, i.e. pans and dams**
Eagle, Martial	*Polemaetus bellicosus*	0%	Vagrant		EN	VU	
Falcon, Red-footed	*Falco vespertinus*	1%	Vagrant		NT	NT	
Flamingo, Greater	***Phoenicopterus ruber***	**23%**	**Common**	**O**	**NT**	**LC**	**Predominantly pans**
Flamingo, Lesser	***Phoenicopterus minor***	**4%**	**Rare**	**O**	**NT**	**NT**	**Predominantly pans**
Grass-owl, African	***Tyto capensis***	**1%**	**Vagrant**	**O**	**VU**	**LC**	**All wetlands, especially supporting stands of *Imperata cylindrica***
Harrier, Black	*Circus maurus*	6%	Rare		EN	VU	
Harrier, Pallid	*Circus macrourus*	2%	Vagrant		NT	NT	
Korhaan, Blue	*Eupodotis caerulescens*	26%	Common		LC	NT	
Lark, Melodious	*Mirafra cheniana*	1%	Vagrant		LC	NT	
Marsh-harrier, African	***Circus ranivorus***	**6%**	**Rare**	**O**	**EN**	**LC**	**Large valley bottom wetlands and floodplains. Permanent wetlands especially.**
Painted-snipe, Greater	***Rostratula benghalensis***	**1%**	**Vagrant**	**O**	**NT**	**LC**	**All wetlands. Saturated soils with emergent vegetation and muddy flats**
Stork, Yellow-billed	***Mycteria ibis***	**3%**	**Rare**	**O**	**EN**	**LC**	**Open water habitats, i.e. pans, dams and river channels**
Vulture, Cape	*Gyps coprotheres*	0%	Vagrant		EN	VU	

[1] "Vagrant" indicates species with less than 2 % reporting rate, "Rare" indicates reporting rate between 2% and 10%, "Uncommon" indicates reporting rate between 10% and 20%, "Common" indicates reporting rate between 20% and 50%, "Abundant" indicates reporting rate over 50 %
[2] O indicates obligate wetland species, F indicates facultative wetland species (i.e. species that utilise wetlands as well as terrestrial areas).

6.2.2 Mammals

Data obtained from Skinner & Chimimba (2005) and the Mammal Atlas of Africa (MammalMAP- http://mammalmap.adu.org.za/) indicates that 90 mammal species (full species list included as an Appendix to the Sasol Secunda Regional Wetland Report) have a distribution range that extends across, or have been recorded in, the quarter degree squares intersected by the greater regional study area.

Table 6 details the list of regionally threatened mammal species expected to occur in the area and/or which have been observed in the affected quarter degree squares. Eight of the 18 threatened species are considered to be wetland species, of which the two otter species and two shrew species are considered obligate wetland species, being confined to moist, wetland or aquatic habitat, though they may cross terrestrial habitat occasionally. The remaining "wetland" species are expected to utilize both wetland/aquatic habitat and terrestrial habitat, but preferentially utilise wetland/aquatic habitat due to feeding or breeding requirements or as a suitable refuge for rest. With the exception of the Dark-footed Forest Shrew, which is unlikely to be present on site due to a lack of suitable montane forest or montane grassland habitat, all of the 8 threatened wetland species have been observed within the region of the study area based on recent documented sightings (MammalMAP). Servals (Near Threatened) were flushed from vegetation cover within wetland habitat during the wetland surveys on two separate occasions. Once, from within dense vegetation along a channelled section of valley bottom wetland within the Twistdraai Mine and again from within disturbed, rank vegetation along a dam margin in a valley bottom wetland within the Brandspruit Mine. Servals are likely to utilise valley bottom and floodplain habitat most often.

Signs and/or direct observations of Cape Clawless Otter (Near Threatened) have been made by members of the wetland specialist team within the region of the study area in recent years. An individual was observed within the Waterval River in 2016, and signs, such as tracks and scats, were noted along the edges of open water/channels in several valley bottom and floodplain wetland systems within the study area (**Figure 10**).

Other mammal species observed during the site visits within Brandspruit Mine include Steenbok, Common Duiker, Black-backed Jackal, Water Mongoose, Yellow Mongoose, Slender Mongoose, Scrub Hare and Cape Porcupine.

Figure 10. Photographs of (from left to right, top to bottom): a Cape Clawless Otter (Near Threatened) observed within the Waterval River in 2016, Cape Clawless Otter spraint observed during 2018, Scrub Hare observed on site.

Table 6. List of threatened mammal species observed within the quarter degree squares intersected by the regional study area. Data derived from Skinner & Chimimba (2005) and the Mammal Atlas of Africa (MammalMAP). Species dependent on wetland habitat have been highlighted in yellow.

Order	Scientific Name	Common Name	2016 Regional Listing	Wetland Species	Distribution Range	Observed (ADU & Personal Observations)	Wetland Habitat Requirements
Afrosoricida	*Amblysomus septentrionalis*	Highveld Golden Mole	**Near Threatened**	**F**	**x**	**x**	**Vleis of the grassland biome**
Artiodactyla	*Ourebia ourebi ourebi*	Oribi	**Endangered**	**F**	**x**	**x**	**Open grasslands or floodplains, extensive grassed vleis. Grassland where *Themeda triandra* and *Rendlia altera* are dominant**
Artiodactyla	*Pelea capreolus*	Grey Rhebok	**Near Threatened**		**x**		
Artiodactyla	*Redunca fulvorufula fulvorufula*	Mountain Reedbuck	**Endangered**		**x**		
Carnivora	*Felis nigripes*	Black-footed Cat	**Vulnerable**		**x**	**x**	
Carnivora	*Leptailurus serval*	Serval	**Near Threatened**	**F**		**x**	**Tall grass, underbrush, reed beds or riparian vegetation in close proximity to water. Floodplain and valley bottom wetlands**
Carnivora	*Panthera pardus*	Leopard	**Vulnerable**		**x**		
Carnivora	*Parahyaena brunnea*	Brown Hyaena	**Near Threatened**		**x**	**x**	
Carnivora	*Aonyx capensis*	Cape Clawless Otter	**Near Threatened**	**O**	**x**	**x**	**Rivers, valley bottom wetlands, lakes, swamps, dams**
Carnivora	*Hydrictis maculicollis*	Spotted-necked Otter	**Vulnerable**	**O**	**x**	**x**	**Confined to larger rivers, lakes and swamps with extensive open waterbodies. Utilise habitat such as large impoundments, oxbow lakes on floodplains, rivers, lakes, swamps, and to a lesser extent, minor streams**
Carnivora	*Poecilogale albinucha*	African Striped Weasel	**Near Threatened**		**x**		
Chiroptera	*Miniopterus schreibersii*	Schreibers' Long-fingered Bat	**Near Threatened (2004)**		**x**		
Erinaceomorpha	*Atelerix frontalis*	South African Hedgehog	**Near Threatened**		**x**	**x**	

Rodentia	*Georychus capensis* (Mpumalanga subpopulation)	Cape Mole-rat (Mpumalanga subpopulation)	**Data Deficient**		**x**		
Rodentia	*Otomys auratus*	Vlei Rat (Grassland type)	**Near Threatened**	**F**	**x**	**x**	**Occurs throughout grassland habitat, but more abundant in habitat associated with damp soil in vleis, or along streams and rivers, or on the fringes of swamps.**
Rodentia	*Mystromys albicaudatus*	White-tailed Rat	**Vulnerable**		**x**		
Soricomorpha	*Crocidura mariquensis*	Swamp Musk Shrew	**Near Threatened**	**O**	**x**	**x**	**Occurs only in moist habitats, such as reed beds, swamps and the thick grass along river banks. Also occurs in moist habitat in and adjacent to dams.**
Soricomorpha	*Myosorex cafer*	Dark-Footed Forest Shrew	**Vulnerable**	**O**	**x**		**Confined to moist densely vegetated habitat. Adjacent to mountain streams and wet areas in montane grassland. No suitable habitat present on site.**

6.2.3 Herpetofauna (Amphibians and Reptiles)

Data obtained from the South African Frog Atlas Project (SAFAP) and the Southern African Reptile Conservation Assessment (SARCA) databases indicate that 15 amphibian and 24 reptile species (full species list included as an Appendix to the Sasol Secunda Regional Wetland Report) have been recorded in the quarter degree squares intersected by the regional study area. Of these, all of the amphibian species and 2 reptile species (Brown Water Snake and Water Monitor – both categorised as Least Concern) are dependent on, or extensively utilise, wetland and aquatic habitats.

No regionally threatened amphibian species occur in the study area. **Table 7** details the list of regionally threatened reptile species expected to occur in the area and which have been observed in the affected quarter degree squares. Only one threatened reptile species has been recorded within the region of the study area (in QDS 2629CD), the Vulnerable Giant Girdled Lizard, which is not considered a wetland species.

Table 7. List of threatened reptile species observed within the quarter degree squares intersected by the regional study area. Data derived from the Southern African Reptile Conservation Assessment (SARCA).

Family	Scientific Name	Common Name	Red List Category (SARCA 2014)	Wetland Species
Cordylidae	*Smaug giganteus*	Giant Girdled Lizard	Vulnerable	No

6.2.4 Flora

A full assessment of important flora occurring in the study area did not form part of the scope of this study. However, a number of noteworthy plant species were identified during the course of the site visits which are worth highlighting as they are listed as protected according to the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) and/or are listed according to the Red List of South African Plants (2017).

- *Crinum bulbispermum* – Protected (MNCA)
- *Eucomis autumnalis* - Protected (MNCA)
- *Haemanthus montanus* - Protected (MNCA)
- *Gladiolus crassifolius* - Protected (MNCA)

Species such as *C. bulbispernum* and *E. autumnalis* typically occur within wetland habitats, whereas the *H. montanus* and *G. crassifolius* are likely to occur either within wetland habitat or in adjacent grassland habitat.

Figure 11. *Haemanthus montanus* (left) and *Crinum bulbispermum* (right) observed on site.

6.3 Present Ecological State Assessment

The results of the Present Ecological State (PES) assessment are summarised in **Table 8** and illustrated in **Figure 12**.

The bulk of wetland habitat was determined to be in PES categories C (Moderately Modified) and D (Largely Modified), with almost 96 % of wetland habitat by area falling within these two categories. No wetland habitat was found to fall within PES category A (Pristine), and only 1.2 % of the wetland habitat within the study area was determined to fall within PES category B and thus considered to be in a Mostly Natural state. Approximately 3% of the wetland habitat onsite was found to fall within PES categories E and F (Seriously to Critically Modified). The majority of wetlands found to be in such poor condition lie downstream of very large water storage or pollution control dams, which can have a very significant impact on the hydrology supporting the downstream wetlands.

Table 8. Summarised results of the PES assessment. Table shows the percentage of each wetland type (in terms of extent) falling into each PES category, as well as the overall percentage per category (bottom row).

Wetland Type	PES B	PES C	PES D	PES E	PES F	TOTAL (ha)
Channelled Valley Bottom	0.00%	6.49%	31.51%	0.22%	2.15%	851.38
Drainage Line	0.03%	1.06%	0.23%	0.41%	0.00%	36.32
Flat	0.04%	0.00%	0.00%	0.00%	0.00%	0.78
Floodplain	0.00%	27.22%	0.00%	0.00%	0.00%	574.00
Seep	0.74%	4.40%	2.32%	0.46%	0.00%	166.97
Sheet Rock	0.35%	2.96%	0.00%	0.00%	0.00%	69.67
Unchannelled Valley Bottom	0.06%	8.37%	11.00%	0.00%	0.00%	409.62
TOTAL (ha)	**25.45**	**1064.64**	**950.26**	**23.10**	**45.30**	**2108.75**
% per PES category	**1.21%**	**50.49%**	**45.06%**	**1.10%**	**2.15%**	**100.00%**

Further observations from the results include:

- All floodplain wetlands were considered to be Moderately Modified (PES C).
- Channelled valley bottom wetlands were the most impacted, with more than 30 % of these wetlands considered Largely Modified (PES category D). This is likely a consequence of impacts such as channel incision, headcut erosion and the presence of numerous dams and road crossings impounding and concentrating flows.

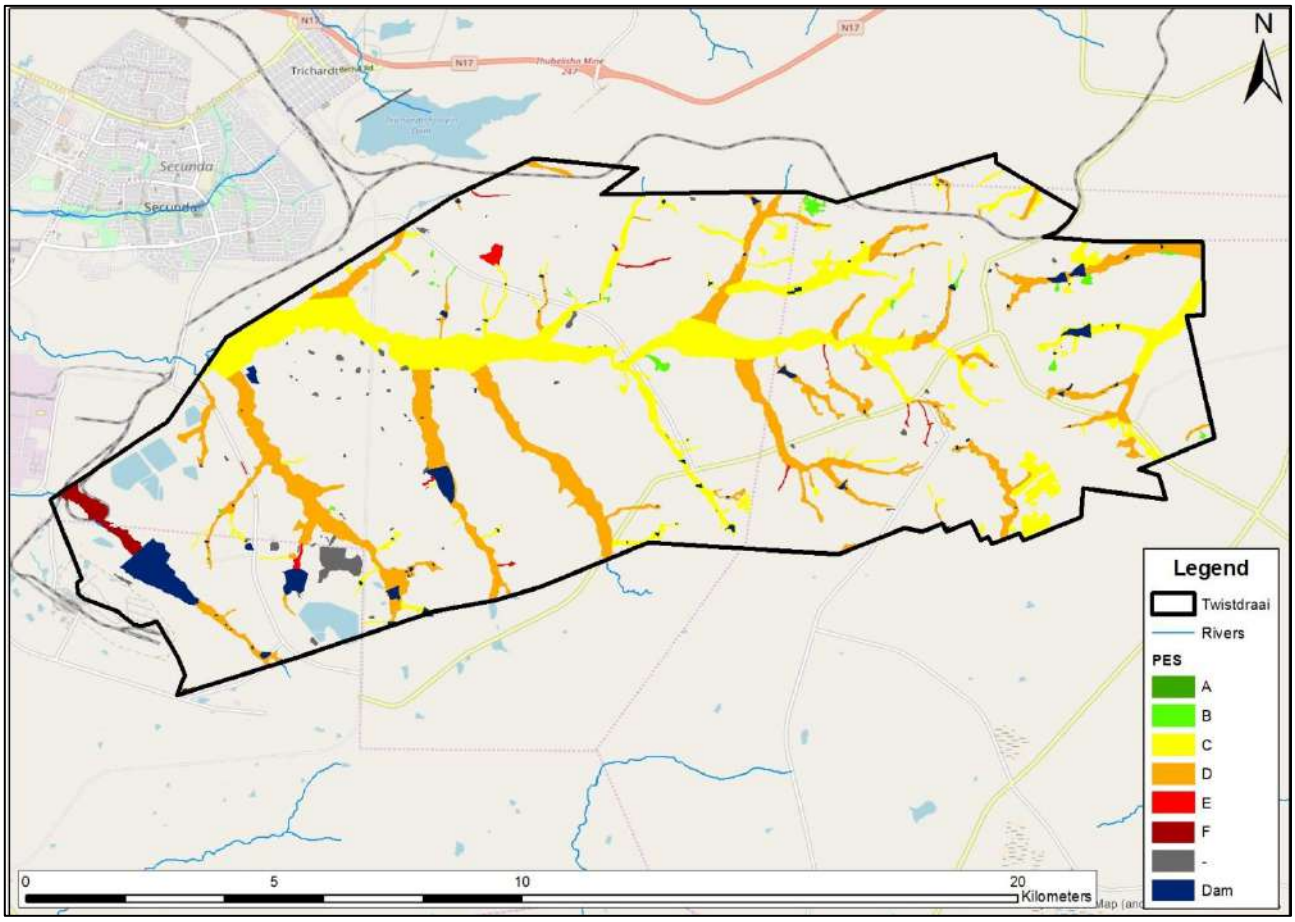

Figure 12. Map illustrating the results of the PES assessment.

6.4 Wetland Importance and Sensitivity Assessment

The results of the Wetland Importance and Sensitivity (IS) assessment are summarised in **Table 9** and illustrated in **Figure 13**.

Approximately 32 % of wetland habitat was considered to be of High Importance and Sensitivity, with this including all of the Floodplain wetlands on site. A key determinant resulting in the High Importance and Sensitivity rating of the Floodplain wetlands was the ecological importance and sensitivity, specifically the landscape level aspect. The threatened status of the vegetation type of the area, the diversity of habitats supported by the floodplain wetlands and the large size of these wetlands contributed towards this rating.

Just less than 58 % of the wetlands were considered to be of Moderate Importance and Sensitivity and this included most of the valley bottom wetlands. The importance of these systems at a landscape scale, as well as their sensitivity to changes in flow characteristics are important factors contributing to their overall importance and sensitivity. Most of the drainage lines, the sheetrock wetlands and the smaller seeps were found to be of Low/Marginal Importance and Sensitivity.

Table 9. Summarised results of the Wetland Importance and Sensitivity assessment. Table shows the percentage of each wetland type (in terms of extent) falling into each IS category, as well as the overall percentage per category (bottom row).

Wetland Type	High	Moderate	Low/Marginal	TOTAL (ha)
Artificial Depression	0.06%	0.17%	0.55%	16.63
Channelled Valley Bottom	5.26%	33.96%	0.83%	851.38
Drainage Line	0.00%	0.32%	1.39%	36.32
Flat	0.00%	0.04%	0.00%	0.78
Floodplain	27.01%	0.00%	0.00%	574.00
Seep	0.00%	4.16%	3.70%	166.97
Sheet Rock	0.00%	0.00%	3.28%	69.67
Unchannelled Valley Bottom	0.00%	19.14%	0.13%	409.62
TOTAL (ha)	**687.16**	**1228.13**	**210.09**	**2125.38**
% per IS category	**32.33%**	**57.78%**	**9.88%**	**100.00%**

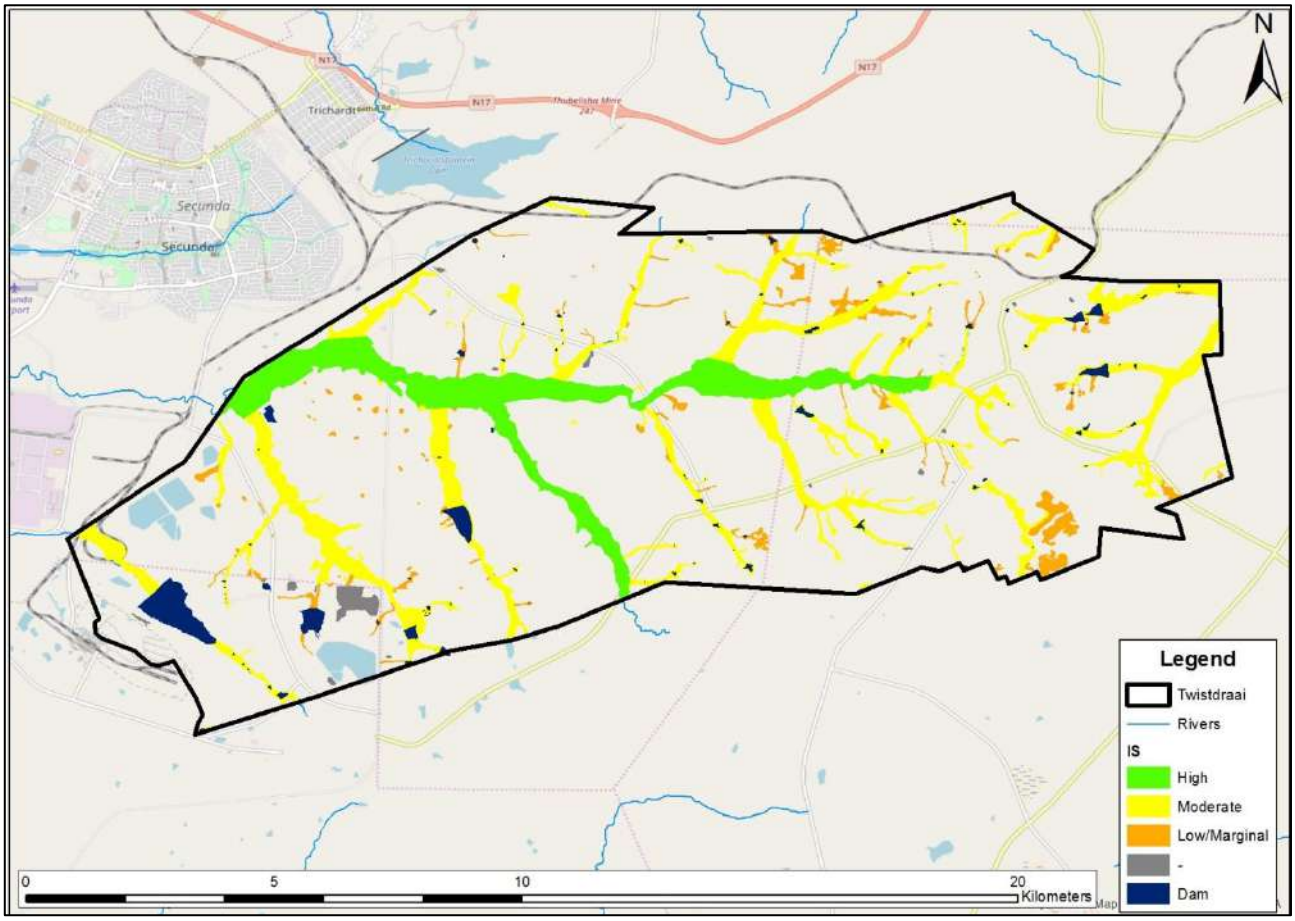

Figure 13. Map showing the results of the wetland IS assessment.

6.1 Target Ecological Category Assessment

The results of the Wetland Importance and Sensitivity (IS) assessment are summarised in **Table 10** and illustrated in **Figure 14**.

As a result of the assessment, the TEC for all wetlands found to be in an E or F PES category is set at a D. The majority of the wetlands on site were found to be of Low/Marginal to Moderate IS and therefore their TEC's remain within the same category as their PES's. A number of the wetlands with High IS had their PES scores increased by half a category as per the methodology applied; however, this was not sufficient to cause a change in TEC from the current PES category. As such, The TEC of all wetlands in PES categories of D or above remain the same as the PES categories determined

Table 10. Summarised results of the Target Ecological Category assessment. Table shows the percentage of each wetland type (in terms of extent) falling into each TEC category, as well as the overall percentage per category (bottom row).

Wetland Type	PES B	PES C	PES D	TOTAL (ha)
Channelled Valley Bottom	0.00%	6.49%	33.88%	851.38
Drainage Line	0.03%	1.06%	0.64%	36.32
Flat	0.04%	0.00%	0.00%	0.78
Floodplain	0.00%	27.22%	0.00%	574.00
Seep	0.74%	4.40%	2.78%	166.97
Sheet Rock	0.35%	2.96%	0.00%	69.67
Unchannelled Valley Bottom	0.06%	8.37%	11.00%	409.62
TOTAL (ha)	**25.45**	**1064.64**	**1018.65**	**2108.75**
% per PES category	**1.21%**	**50.49%**	**48.31%**	**100.00%**

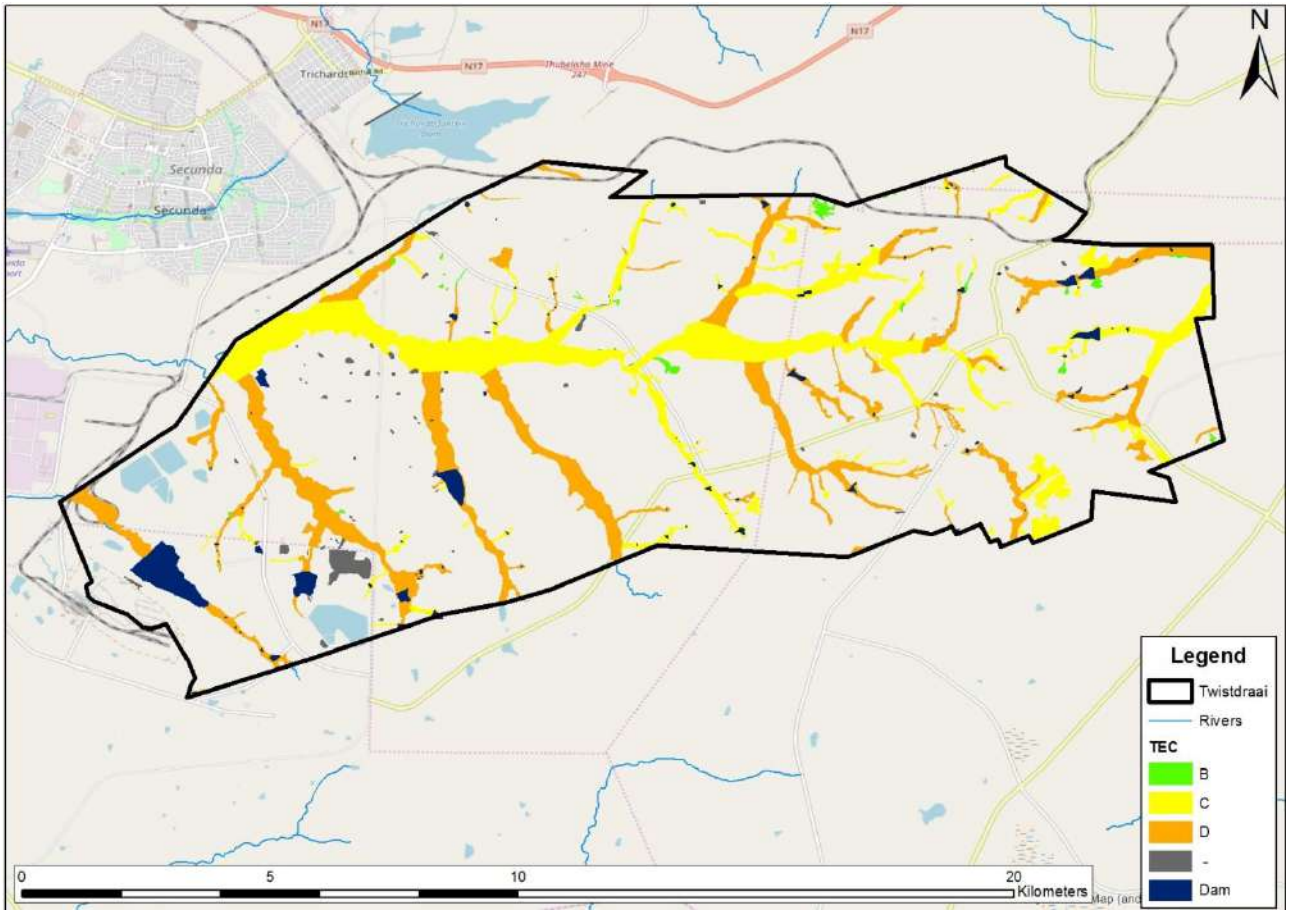

Figure 14. Map showing the results of the wetland TEC assessment.

6.2 Functional Assessment

A rapid functional assessment was undertaken for typical representative wetland systems of each of the different wetland types identified within the area. It can be assumed that wetlands of similar type within a similar landscape setting and supporting similar species can be expected to support similar functions. Undertaking the functional assessment for wetland type groupings within the study area was therefore considered appropriate for this study.

The results of the WET-EcoServices assessment are illustrated in **Figure 15**.

Most of the different wetland types are likely to play a role in water quality maintenance, though wetlands with diffuse flow and extended retention times such as Seep wetlands and Unchannelled Valley Bottom wetlands are best placed to perform these functions.

Floodplain wetlands scored surprisingly low in terms of flood attenuation. However, this can be explained by the relatively limited bank overtopping occurring in the floodplains on site. The floodplains are mostly incised with increased channel competency, limiting overtopping to only very big flood events.

The wetlands also mostly scored moderately high in terms of biodiversity support, with Depression wetlands and Floodplain wetlands considered most important in this regard due to their support of threatened species.

All of the wetlands scored relatively low in terms of direct human use benefits, though the importance of the wetlands as a grazing resource needs to be highlighted. Especially in areas of extensive cultivation the wetlands represent virtually the only remaining grazing lands for livestock and wildlife. Some of the larger dams within the wetlands on site are also important as a source of irrigation water, as well as the Waterval River which supports numerous centre pivot irrigation systems in the area.

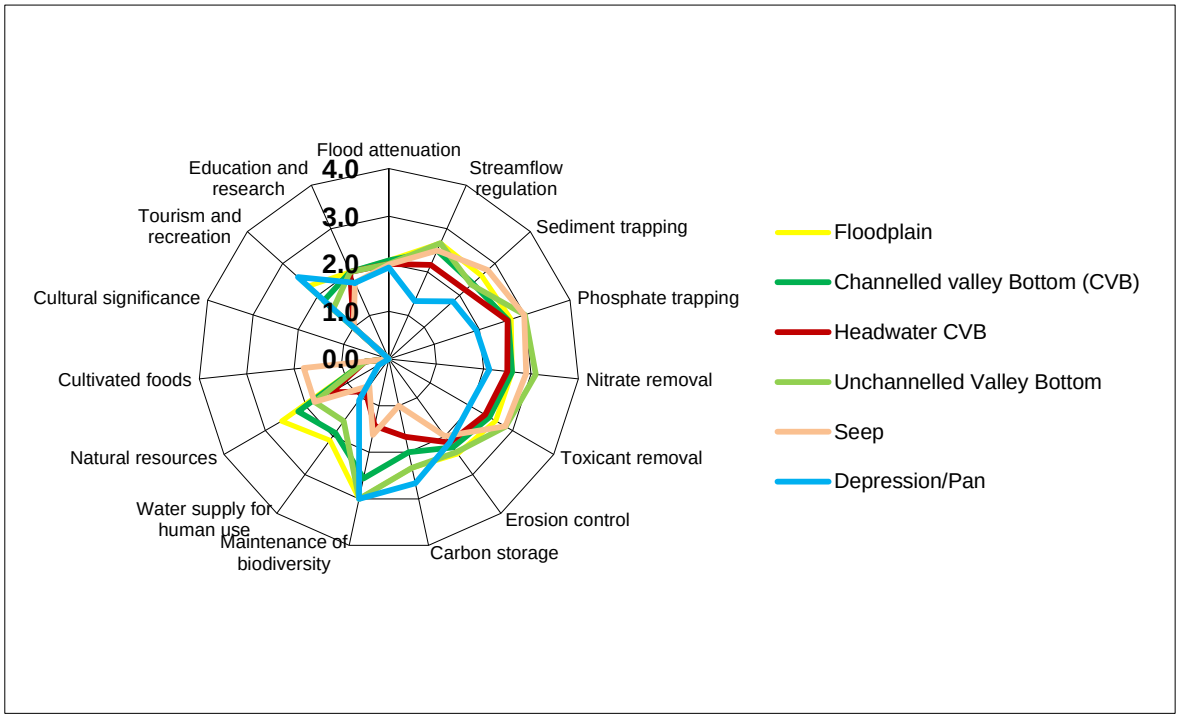

Figure 15. Results of the functional assessment of wetland types identified within the study area.

7. GIS DATASET

The key deliverable of the project was a GIS dataset of the identified wetlands compiled in shapefile format (Sasol_Twistdraai_Verified_Wetlands_06082018.shp), which forms the input to the risk assessment modelling being undertaken by Jones & Wagener. This shapefile, which includes the delineated wetland boundaries of all wetlands identified within the study area, includes the following attributes for every individual wetland:

- Wetland Type (hydro-geomorphic classification)
- Wetland area (in hectares)
- PES assessment results
- IS assessment results
- TEC assessment results

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INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and Wetland Consulting Services (Pty.) Ltd. and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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