WETLAND ASSESSMENT

VENTERSBURG CONSOLIDATED PROJECT, VENTERSBURG, FREE STATE PROVINCE

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Report prepared by:

ENVIRONMENT RESEARCH CONSULTING

ERC forms part of **Benah Con cc**

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INTRODUCTION

This study was undertaken for Shango Solutions by Environment Research Consulting (ERC) in support of a Basic Assessment for a prospecting right application for Ventersburg Consolidated. The study area is situated about 8 km north of Ventersburg and 25 km south of Kroonstad and is bisected by the N1 highway.

This report presents the findings of the wetland assessment of which the fieldwork was conducted on site on 18 – 20 January 2018.

METHODOLOGY

A visual reconnaissance of the area was undertaken before surveying commenced. Maps and Google Earth images were studied in order to determine the position of possible wetlands and/or riparian zones in the study area. All possible wetlands were subsequently surveyed in order to determine the delineation thereof. The method described by the Department of Water Affairs and Forestry (DWAF, 2005) was followed in the delineation of the wetlands in the study area. Where access to a wetland or sections a wetland was restricted or impossible, the onsite delineation of adjacent areas was extrapolated on a desktop level using the data collected in the field.

RECEIVING ENVIRONMENT

General

The study area is situated about 14 km north to north-east of Ventersburg and about 25 km south of Kroonstad and is bisected by the N1 highway.

The climate of the area includes mild to hot summers and extremely cold winters and receives summer rainfall.

Three vegetation types according to Mucina and Rutherford (2006) occur in or in close proximity to the studied area. The Vaal-Vet Sandy Grassland (Gh10) covers the largest part with smaller areas of Central Free State Grassland (Gh6) and Highveld Salt Pans (AZi10).

Surface hydrology

The study area falls in the Vaal Water Management Area, which includes major rivers such as the Vaal, Wilge, Liebenbergsvlei, Mooi, Renoster, Vals, Sand, Vet, Harts and Molopo Rivers it includes 12 tertiary catchment areas is specifically situated in quaternary catchment C42J.

Two streams, the Rietspruit and Kromspruit, which have a non-perennial nature within the boundaries of the study area, drain north-west and south-westwards. A third, unnamed non-perennial stream drains into the Rietspruit north of the Kromspruit in the study area. East of the study area the

Enslinspruit drains northwards. Further south of the study area the Slootspruit drains north-westwards into the Rietspruit.

The wetlands in the study area consist of a variety of types namely: un-channeled and channeled valley bottom wetlands that are associated with the various streams mentioned in the previous paragraph. In some areas of the streams there are associated floodplain wetlands as well. There are also a number of natural pans or depressions where water accumulates during the wet season, and lastly, there are also a number of man-made dams in the area, most of which are associated with the natural streams and drainage lines and others that are not.

Wetland vegetation

Vegetation assemblages in the study area, which are associated with natural drainage lines and streams, small natural pans/depressions and man-made dams, do in fact consist of water and moisture-loving plants. These areas are generally poor in terms of ecological veld condition due to decades of over utilisation by livestock. A number of frequently occurring plant species that area specifically associated with wetlands, are mentioned.

Wetland soils

Five soil forms were generally encountered in the establishment of wetland boundaries in the study area. These are Katspruit, Kroonstad, Bloemdal, Sepane and Rensburg. Along the course of the Rietspruit and the un-named drainage line just to its south, Katspruit, Kroonstad and Sepane soil forms were the most prevalent. Soil forms that were mostly recorded along the course of the Kromspruit are Katspruit, Sepane and Rensburg. Soil forms associated with pans and depressions mostly include Katspruit, Kroonstad, Bloemdal and Rensburg.

WETLAND DELINEATION

Accessible parts of all wetlands in the study area were investigated and delineated. Where such areas were not accessible during the time of this study, portions of the stream courses and other wetlands were delineated by means of extrapolating the results obtained from the field data to neighbouring areas. Buffer zones of 32 m from the edge of the wetlands, as prescribed in Government Notice 327 in Government Gazette 40772 of 7 April 2017, was delineated and mapped. An image is also presented where six proposed drill sites are currently positioned in relation to the delineated positions of wetlands in their vicinity. Dominant soil types and plant species occurring in the different wetland types that were recorded in the study area are presented

PRESENT ECOLOGICAL STATUS (PES)

The different types of wetlands in the study area were assessed separately on a broad general scale.

The wetlands in the study area all fall between a PESC of B and E – most being largely natural with some habitat modification, but some are seriously modified. The broad scores (highest and lowest values) that the different wetlands in the study area achieved in the PES scoring are indicated in Table A.

Table A: Broad PES values and categories of the wetlands in the study area

Wetland segment	Mean PES Value	PESC
Wetlands of streams	3.5 – 2.9	B or C
Pans / depressions	3.1 – 2.0	B, C or D
Man-made dams	2.8 – 1.7	C, D or E

ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

The wetlands in the study area have EIS categories and EMC values as indicated in Table B.

Table B: EIS and EMC values of wetlands in the study area

Wetland	EIS category	EMC
Wetlands of streams	Moderate (Median Value 1.6)	C
Pans / depressions	Moderate (Median Value 0.8)	D
Man-made dams	Moderate (Median Value 1.3)	C

WETLAND ECOSYSTEM SERVICES (ES)

The wetlands in the study area have ES values as indicated in Table C.

Table C: ES values of wetlands in the study area

Wetland	ES value
Wetlands of streams	3
Pans / depressions	1
Man-made dams	2

HABITAT SENSITIVITY AND CONSERVATION STATUS OF LOCAL ECOSYSTEMS

A sensitivity rating of High is attributed to the wetlands in the study area. This is mainly due to their important function as water drainage and storage habitat for surrounding ecosystems and the faunal and floral assemblages that depend on it, as well as its relevant connectivity with terrestrial habitats along its mostly linear distribution. The fact that any significant damage to the linear drainage lines, which mostly contain the wetlands of the study area, will have a significant impact on similar habitats downstream, further enhances the sensitive nature of these habitats.

According to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA, 2004): National List of Ecosystems That Are Threatened and In Need of Protection, The Vaal-Vet Sandy Grassland (Gh10), which most of the wetlands in the study area lies embedded in, is an

Endangered Ecosystem, which has to be protected. Historically, Gh10 covered the largest portion of the study area, but was virtually totally destroyed due to crop cultivation and other agricultural activities.

No specific guidelines are given for the Free State Province in terms of habitat sensitivity mapping. The 2015 Free State Biodiversity Plan (http://bgis.sanbi.org), however, provides a map of Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESA's), which has conservation guidelines of different land-use areas in the province in mind. According to this map it appears as if mostly wetland areas in the study area are classified as CBA 1 areas. According to SANBI, however, the CBA map for aquatic systems in the Free State province is still incomplete.

WETLAND REHABILITATION AND MANAGEMENT

Successful wetland rehabilitation depends upon conceptual planning, research and design flexibility. Wetlands are ever-changing systems that have adapted to local conditions over many decades. It is not only important that a rehabilitated wetland looks like a wetland, it must also function as one. One of the most important factors to the rehabilitation of wetlands is the re-establishment of an environment that is as close to the natural hydraulic regime (depth, duration and intensity of flooding) as possible. This is achieved through reducing the velocity of water through the system and promoting the spreading of flow across the wetland.

The six drill sites that are proposed will not directly negatively impact the wetland habitats from their current positions. The following rehabilitation recommendations are made with regards to the area in general.

- The PESC and EIS of the wetland(s) in the study area indicate that they are in moderately to highly modified condition with some loss of natural habitats and that they are considered to be ecologically important and sensitive on a provincial or local scale and that the biodiversity of these floodplains 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.
- The fact that the wetland(s) in the study area are in a moderately to highly modified condition gives the indication that some degree of rehabilitation is necessary going forward. This rehabilitation will include the stabilizing of eroded stream banks through promoting the growth of indigenous vegetation. This may or may not require active rehabilitation.
- The eradication and control of alien weeds and invaders in the wetland system in the study area and also up and down stream will serve to enhance the PES and Ecological integrity of this particular area. It will, however, not be successful if the weeds and invaders are not eradicated and controlled in the adjacent terrestrial habitats. This too will have to become a high priority in the management of the natural habitat as a whole.

IMPACT ASSESSMENT

Impact rating and mitigation

The assessment was conducted only for the six proposed drill sites with the focus on wetland habitats. From the assessments it is clear that no major impacts are expected from the currently proposed prospecting activities.

Two possible impacts and their mitigation measures were assessed:

- Degradation and/or destruction of wetland habitats.
- loss of indigenous fauna and flora diversity associated with wetlands.

Assessment of the no-go alternative

Currently there is no proposal from a wetland point of view of a no-go alternative. It is not expected that the currently proposed activities and the proposed positions of the activities will have any major impact on the wetlands in the study area. If, however, the nature of the activities and the positioning of any proposed activities will encroach on the wetlands and the buffer zones proposed in this study, this option will have to be re-evaluated

If for whatever reason the no-go alternative is enforced, it will see the present ecological status of the wetlands in the study area stay the same taking natural fluctuations in to consideration.

Monitoring requirements

No monitoring requirements are currently proposed, unless prospecting sites and activities change in such a way to encroach on wetland positions and the proposed buffer zones.

FINAL COMMENTS

Based on the data presented in this report as well as observations made during the survey and comments above, the following is recommended in conclusion:

- Take note of and as far as possible comply with the mitigation measures and recommendations given in this report.
- During the planning, operational and rehabilitation phases all recommendations made and concerns raised in this document should be taken into consideration.
- From a wetland point of view, there are no major objections against the proposed prospecting activities, as long as mitigation measures and recommendations are seriously considered and implemented, and as

long as due diligence is practiced in terms of environmental legislation and other relevant policies and guidelines.

2 DECLARATION OF INDEPENDENCE AND SUMMARY OF EXPERTISE OF SPECIALIST INVESTIGATOR

2.1 Declaration of independence

The specialist investigator responsible for conducting this particular specialist vegetation study declares that:

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP).
- at the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity.
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favorable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being a member of the general public.
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data.
- I do not have any influence over decisions made by the governing authorities.
- should I, at any point, consider myself to be in conflict with any of the above declarations, I shall formally submit a Notice of Withdrawal to all relevant parties and formally register as an Interested and Affected Party.
- I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant.
- I have expertise and experience in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- this document and all information contained herein is and will remain the intellectual property Environment Research Consulting and the specialist investigator responsible for conducting the study. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigator.
- I will comply with the Act, regulations and all other applicable legislation.
- All the particulars furnished by me in this document are true and correct.

- I realize that a false declaration is an offence in terms of Regulation 71 of NEMA and is punishable in terms of section 24F of the Act.

A.R. Götze (M.Sc.; *Pr.Sci.Nat.*)

2.2 Summary of expertise

Specialist investigator:	Albert R. Götze
Highest tertiary qualification:	M.Sc. *cum laude* (Phytosociology and Restoration Ecology, NWU, Potchefstroom).
Professional affiliation:	SACNASP (since 2008, Membership no: 400011/08).

I have been a professional ecologist, botanist and soil scientist since 2002. I gained valuable experience in the fields of vegetation classification, various restoration disciplines, faunal trapping and surveying, soil surveying and wetland delineations during my post graduate studies and later as fieldwork mentor for post graduate ecology students of the Northwest University (2008 - 2014), and on occasion for game ranch management students of the Tshwane University of Technology. I have experience in various types of scientific floral and faunal studies and wetland assessments in the grassland and savannah in Gauteng, North West, Limpopo, Mpumalanga, Free State, Eastern and Northern Cape. I have also on occasion performed similar studies in the KwaZulu-Natal savannah and Indian Ocean Coastal Belt, the Eastern Cape thicket, the Western Cape fynbos, Namaqualand, the Karoo and Swaziland. I have 15 years' experience in specialist biodiversity, soil and wetland studies and have performed numerous (at least 120) such studies since 2002. I also have wide experience in monitoring of rehabilitated mine dumps, opencast and other similar areas for several large mining groups in South Africa. I have authored two and co-authored four scientific papers for various local scientific publications since 2004.

3 INTRODUCTION

This study was undertaken for Shango Solutions by Environment Research Consulting (ERC) in support of a Basic Assessment for a prospecting right application by Western Allen Ridge Gold Mines (Pty) Ltd for the Ventersburg Consolidated Project over a number of farms comprising a total surface area of 7943.07 ha. The study area is situated about 14 km north and north-east of Ventersburg and 25 km south of Kroonstad and is bisected by the N1 highway.

This report presents the findings of the wetland assessment and delineation of which the fieldwork was conducted on site (Figures 1 and 2) on 18 – 20 January 2018.

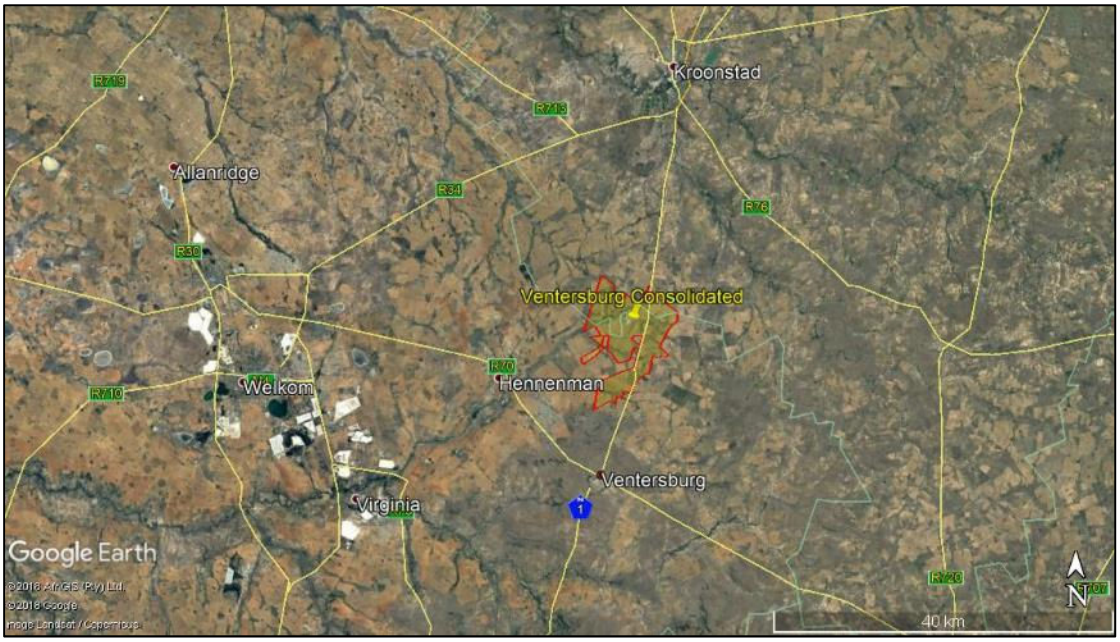

Figure 1: Google earth image indicating the regional setting of the study area.

Figure 2: Google earth image indicating the local setting of the study area.

3.1 Scope of work

- Description of the baseline receiving environment specific to the field of expertise (general surrounding as well as site specific environment).
    - Delineation of all wetlands occurring in the study area.
    - General description of the wetland(s) in the study area.
    - Evaluate the Present Ecological Status (PES) of wetlands (wetland integrity).
    - Assess wetland ecosystem services (ES).
    - Determine the ecological importance and sensitivity (EIS) of the wetland(s) in the study area.
- identification and description of any sensitive receptors in terms of wetlands that occur in the study area, and the manner in which these sensitive receptors may be affected by prospecting.
- Mapping of sensitive receptors in the study area, based on available maps, database information and site inspection.
- Screening to identify any critical issues pertaining to wetlands (potential fatal flaws) that may result in project delays or rejection of the application.
- identification and description of any impacts that may result from the proposed prospecting activities during all phases of the project, including cumulative, residual and latent impacts.
- Provide detailed mitigation/management measures for the management of the identified impacts for inclusion in the Environmental Management Program.
- Identification of any legislated constraints (e.g., 'No-Go' areas or buffer zones) and preparation of a map illustrating No-Go areas and buffers where relevant.

3.2 Assumptions and Limitations

- It is assumed that wetland plant species flowering only during specific times of the year could be confused with a very similar species of the same genus.
- Some wetland plant species that emerge and bloom during another time of the year or under very specific circumstances may have been missed entirely.
- In order to obtain a comprehensive understanding of the dynamics of the wetland habitats of the study area, surveys should ideally have been replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible and this survey was conducted in one season during a once-off site visit of two and a half days.

- Data collection in this study relied heavily on data from representative, homogenous wetland sections, as well as general observations, analysis of satellite imagery from the past until the present, generic data and a desktop analysis.
- During the fieldwork phase of this assessment, access to all farms was not possible due to lack of contact details at the time. The final wetland delineation therefore relied somewhat on extrapolation form areas that were actually visited and delineated in detail.
- No formal water quality or aquatic faunal assessments (e.g. SASS 5) were conducted as part of this study. All comments on these subjects were made from estimations of the current, visible situation in the field.
- The specialist responsible for this study reserves the right to amend this report, recommendations and/or conclusions at any stage should any additional or otherwise significant information come to light.

3.3 Methodology

A visual reconnaissance of the area was undertaken before surveying commenced. Maps and Google Earth™ images were studied in order to determine the position of possible wetlands and/or riparian zones in the study area. All possible wetlands and water courses were subsequently surveyed in order to determine the delineation thereof.

The method described by (DWAF, 2005) and followed in the delineation of the water courses and wetlands in the study area is as follows:

- First the position of the wetland is visually determined (Terrain Unit Indicator).
- Starting at the wettest parts, a transect is then followed width ways across the wetland and using a soil auger the soil profile is examined up to a depth of 50cm for the presence of soil form indicators and / or soil wetness indicators. Vegetation indicators are also recorded.
- Proceeding outwards towards the estimated edge of the wetland, sampling continues at regular intervals to check for wetness and vegetation indicators.
- The outer edge of the wetland is subsequently defined as the point where soil wetness indicators are no longer visible within the top 50cm of the soil profile.
- The outer edge is recorded with a handheld GPS and eventually the GPS waypoints are plotted and joined on a map to visually indicate the extent of the outer edge (temporary zone) of the wetland.
- Several further transects are then also followed at regular intervals and at other strategic points in the wetland paying particular attention to features that may disrupt the wetland boundary, such as seeps entering the wetland, large floodplains, etc.

Where access to a wetland or sections a wetland was restricted or impossible, the onsite delineation of adjacent areas was extrapolated on a desktop level using the data collected in the field.

3.4 Legislative and policy framework

General Regulatory Requirements

Specialists' reports must comply with Appendix 6 of Government Notice No. 326 of 07 April 2017 as published under sections 24(5), and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and whereby the following are to be included:

- The details of:
    - The specialist who prepared the report.
    - The expertise of that specialist to compile a specialist report including curriculum vitae.
- A declaration that the specialist is independent in a form as may be specified by the competent authority.
- An indication of the scope of, and the purpose for which, the report was prepared.
- The date and season of the site investigation and the relevance of the season to the outcome of the assessment.
- A description of the methodology adopted in preparing the report or carrying out the specialised process; the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.
- An identification of any areas to be avoided, including buffers.
- A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.
- A description of any assumptions made and any uncertainties or gaps in knowledge.
- A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment.
- Any mitigation measures for inclusion in the EMPR.
- Any conditions for inclusion in the environmental authorisation.
- Any monitoring requirements for inclusion in the EMPR or environmental authorisation.
- A reasoned opinion-
    - As to whether the proposed activity or portions thereof should be authorised.

    - If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPR, and where applicable, the closure plan.
- A description of any consultation process that was undertaken during the course of preparing the specialist report.
- A summary and copies of any comments received during any consultation process and where applicable all responses thereto.
- Any other information requested by the competent authority.

The National Water Act

The National Water Act (Act No. 36 of 1998) (NWA, 1998) was drafted in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. According to NWA (1998) a water resource is defined as one of, or a combination of, the following

- A watercourse.
- Surface water.
- An estuary.
- An aquifer.

For the purpose of this study the description of a watercourse has reference and is defined by NWA (1998) as (*inter alia*):

- A river or spring.
- A natural channel in which water flows regularly or intermittently.
- A wetland, lake or dam into which, or from which, water flows.

It is important to note that any reference to a watercourse includes its bed and banks.

The NWA (1998) defines a wetland 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”.

Moreover, wetlands are regarded as an area of land on which the period of saturation of water is sufficient to allow for the development of hydric/hydromorphic soils, which in normal circumstances would support hydrophilic vegetation (i.e. vegetation adapted to grow in differing levels of saturated and anaerobic soil conditions).

Wetland indicators, zones and types

According to the Department Water Affairs and Forestry – DWAF (2005), the four main indicators of the presence of a wetland are:

- The presence of water (hydrology).
- The presence of wetland (hydromorphic) soils.
- The presence of water loving plants (hydrophytes and hygrophytes).
- The terrain unit, which indicates the position in the landscape where wetlands are most likely to occur.

Although all four indicators are important in the identification and delineation of a wetland the soil form indicator is the most important and the most accurate due to the fact that the morphological indicators in the soil are far more permanent and will hold signs of frequent saturation long after a wetland has been drained or otherwise transformed. The other three indicators are used more in a confirmatory role (DWAF, 2005). Because of this and because it is difficult to define the minimum frequency and duration of saturation that creates a wetland, the finding of the outer edge of the wetland is dependent on four, more specific indicators:

- The Terrain Unit Indicator (as mentioned above).
- The Soil Form Indicator, which identifies soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator, which identifies the morphological signatures that develop in the soil profile as a result of prolonged and frequent saturation.
- The Vegetation Indicator, which identifies hydrophilic[1] vegetation that is associated with permanent or frequently saturated soils.

Three zones are distinguished within a wetland i.e. the permanent zone (all year-round wetness), the seasonal zone (wet for at least three months of a year), and the temporary zone (wet for less than three months of a year). The object of a wetland delineation procedure, therefore, is to identify the outer edge of the temporary zone. This outer edge marks the boundary between the wetland and the adjacent terrestrial areas (DWAF, 2005).

Wetlands may either be palustrine (marsh-like) or lacustrine (lake-like) in nature. Palustrine and lacustrine wetlands can be divided up into different hydro-geomorphic forms, based on their position within the landscape, hydrological connectivity and water input. Kotze *et al*. (2009) have described a number of different wetland hydro-geomorphic forms:

- Hillslope Seepage feeding a stream.
- Hillslope Seepage not feeding a stream.
- Channelled Valley Bottom.
- Un-channelled Valley Bottom.
- Pan / Depression.
- Floodplain.

[1] Having an affinity to water

4 RECEIVING ENVIRONMENT

4.1 General Description

The study area is situated about 14 km north to north-east of Ventersburg and about 25 km south of Kroonstad and is bisected by the N1 highway (Figures 1 and 2).

The climate of the area includes mild to hot summers and extremely cold winters and receives summer rainfall.

Three vegetation types according to Mucina and Rutherford (2006) occur in or in close proximity to the studied area. The Vaal-Vet Sandy Grassland (Gh10) covers the largest part with smaller areas of Central Free State Grassland (Gh6) and Highveld Salt Pans (AZi10) (Figure 3).

The descriptions of Gh6, Gh10 are not given as these vegetation types are relevant for the terrestrial environment surrounding the wetlands in the study area. The description of AZi10, however is given below (**Error! Reference source not found.**), and directly summarised from Mucina and Rutherford (2006).

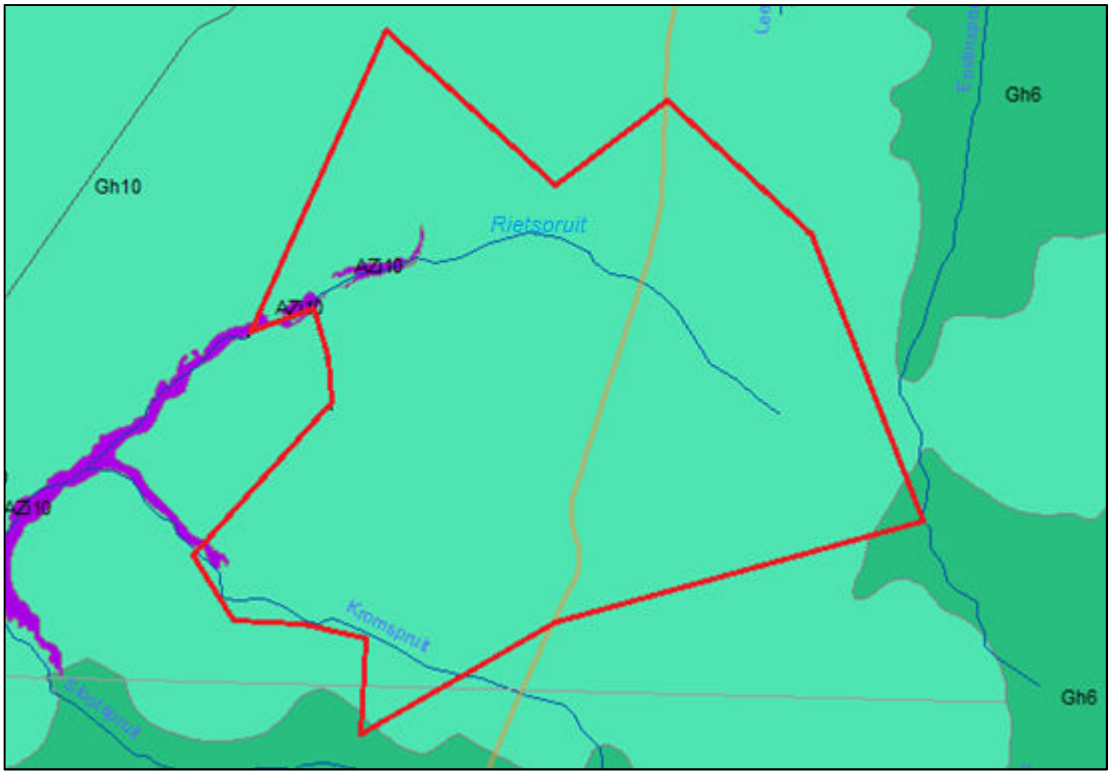

Figure 3: Distribution of vegetation types in and around the study area according to Mucina and Rutherford (2006).

4.1.1 Highveld Salt Pans (AZi10)

AZi10 occurs over a wide distribution area that stretches from the Eastern Cape, Northern Cape, North-West, Gauteng and Free State Provinces and is characterized by depressions in the plateau landscape. The central parts of

the pans are seasonally inundated, sometimes with floating macrophyte vegetation, or the vegetation layer develops on drained bottoms of the pans with a zoned concentric pastern and open grassland to sparse grassy dwarf shrubland on the edges of the pans, which mostly develops when the pan is under continuous heavy grazing pressure. Geologically the depressions of AZi10 are usually formed by shales of the Ecca Group giving rise to vertic clayey soils.

From a vegetation point of view plant species that are significant in the pan habitat are the dominant graminoids[2] *Chloris virgata, Cynodon dactylon, C. transvaalensis, Cyperus laevigatus, C. marginatus, Eragrostis bicolor, E. chloromelas, E. plana, Hemarthria altissima, Juncus rigidus, Leptochloa fusca, Panicum coloratum, P. schinzii* and *Setaria incrassata.* Karoo shrubs and herbs include *Atriplex vestita, Alternanthera sessilis, Aponogeton rehmannii, Amaranthus praetermissus, Felicia filifolia, F. muricata, Lycium cinereum, Nenax microphylla, Phyla nodiflora, Pentzia globosa, P. incana, Platycarpha parvifolia, Salsola glabrescens, Suaeda fruticosa, Senecio reptans, Titanopsis hugoschlechteri* and *Zygophyllum simplex*. A biogeographcally important species that occur in these pans is the Highveld Endemic *Rorippa fluviatilis* var. *caledonica*, and also one species that is endemic to AZi10, the herb *Gnaphalium simii*.

Pans of AZi10 are inundated and / or saturated only during the wet summer months, which occurs in the summer months in the north-eastern region and bimodal elsewhere in the distribution area of these pans. Winters are cold with frequent frost.

Only a very small portion of this vegetation type is statutorily conserved in the Vaalbos National Park and Bloemhof Dam, Soetdoring, Willem Pretorius, Baberspan and S.A. Lombard Nature Reserves. About 4% of AZi10 has been transformed as a result of agriculture, building of roads, mining and urbanization. All these threats are ever increasing and putting pressure on more areas of this vegetation type.

4.2 Surface hydrology

The study area falls in the Vaal Water Management Area (Figure 4), which includes major rivers such as the Vaal, Wilge, Liebenbergsvlei, Mooi, Renoster, Vals, Sand, Vet, Harts and Molopo Rivers it includes 12 tertiary catchment areas is specifically situated in quaternary catchment C42J (Figure 5).

This section, amongst other information, refers to the terrain unit indicator of wetlands according to DWAF (2005):

- The Terrain Unit Indicator, which indicates the position in a landscape where wetlands are most likely to occur.

Two streams, the Rietspruit and Kromspruit, which have a non-perennial nature within the boundaries of the study area, drain north-west and south-westwards. A third, unnamed non-perennial stream drains into the Rietspruit north of the Kromspruit in the study area. East of the study area the

[2] Grass and grass like plants

Enslinspruit drains northwards. Further south of the study area the Slootspruit drains north-westwards into the Rietspruit (Figure 6).

The wetlands in the study area consist of a variety of types namely: un-channeled and channeled valley bottom wetlands that are associated with the various streams mentioned in the previous paragraph. In some areas of the streams there are associated floodplain wetlands as well. There are also a number of natural pans or depressions where water accumulates during the wet season, and lastly, there are also a number of man-made dams in the area, most of which are associated with the natural streams and drainage lines and others that are not.

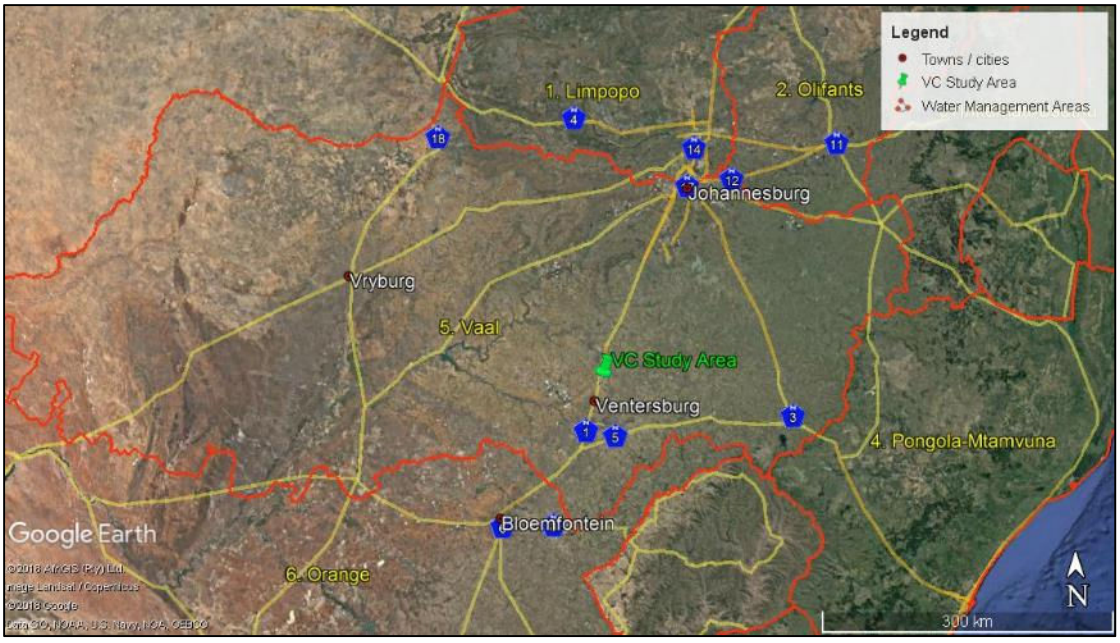

Figure 4: Water Management Areas of Central and Northern South Africa.

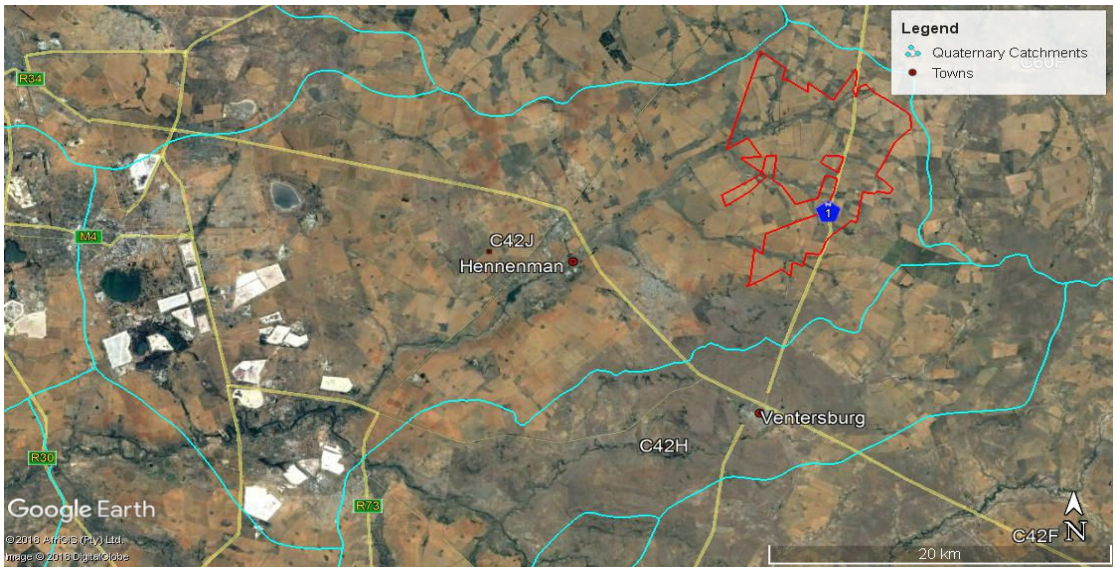

Figure 5: Quaternary Catchment Areas of the study area (red polygon) and surroundings.

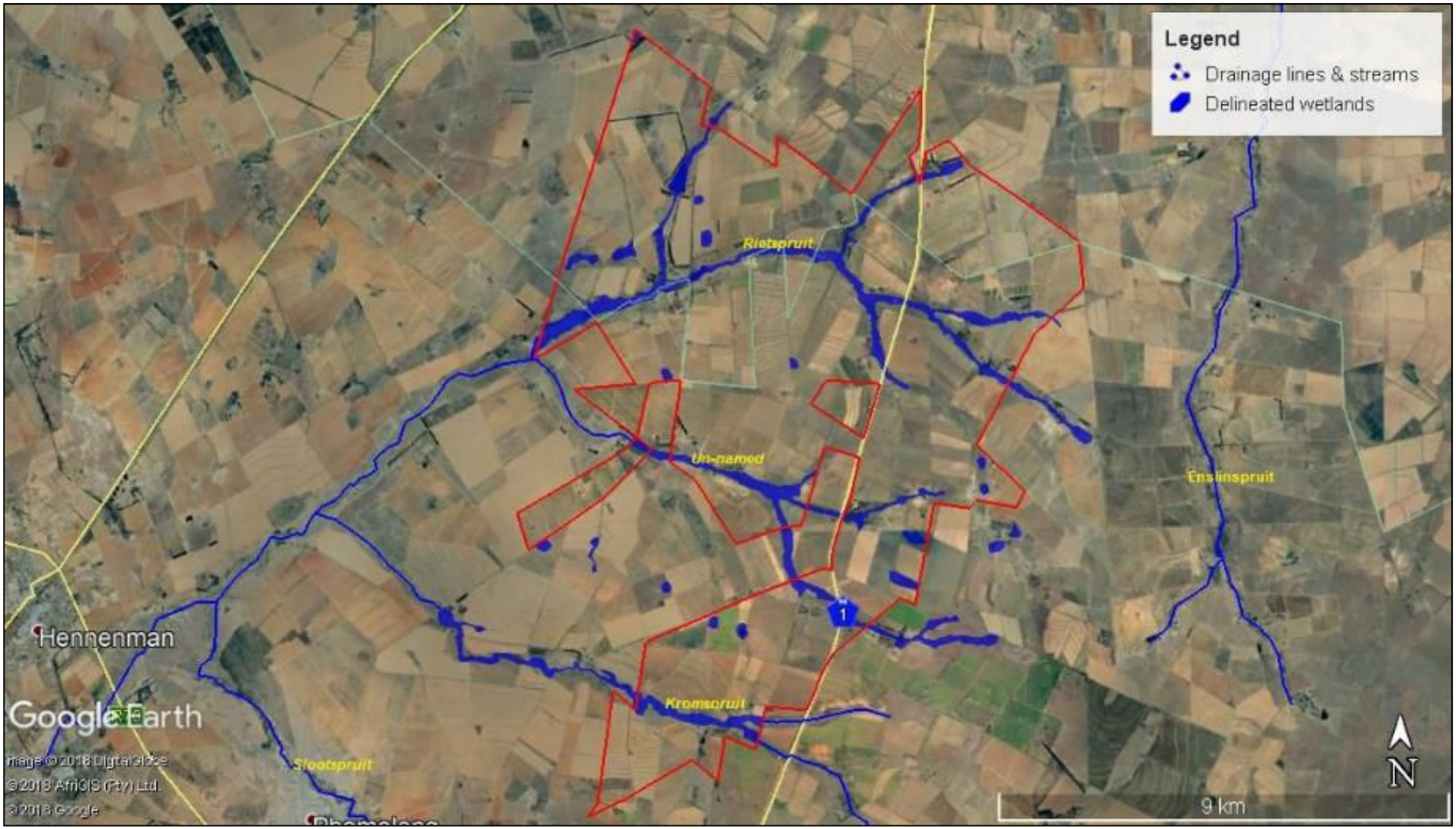

Figure 6: Image depicting the wetlands and other drainage lines recorded in the study area (red polygon) and beyond.

4.3 Wetland vegetation

DWAF (2005) describes one of the important indicators of the presence of a wetland as the vegetation indicator, i.e.:

- The Vegetation Indicator, which identifies hydrophilic vegetation (macrophytes[3], hydrophytes[4] and hygrophytes[5]) that is associated with permanent or frequently saturated soils.

Vegetation assemblages in the study area, which are associated with natural drainage lines and streams (Figures 7 and 8), small natural pans/depressions (Figure 9) and man-made dams (Figures 10 and 11), do in fact consist of water and moisture-loving plants. These areas are generally poor in terms of veld condition due to decades of over utilisation by livestock.

Dominant graminoids include the reed *Phragmites australis*, the indigenous grasses *Andropogon appendiculatus, Agrostis lachnantha, Cynodon transvaalensis, Echinochloa holubii, Eragrostis micrantha, E. plana, Hemarthria altissima, Leersia hexandra, Paspalum distichum,* and the exotics *Bromus catharticus, Paspalum dilatatum* and *P. urvillei,* and also the sedges *Cyperus denudatus, C. fulgens, C. longus, Eleocharis dregeana, Juncus rigidus, Kyllinga erecta* and *Pycreus macranthus.* Forbs and other herbs that mostly occur are the indigenous *Falckia oblonga, Helichrysum acutatum, Mimulus gracilis, Persicaria decipiens, Potamogeton thunbergii, Salvia runcinata, Vahlia capensis, and the exotics Alternanthera sessilis, Aster squamatus, Cirsium vulgare, Oenothera rosea, Persicaria lapathifolia, Typha capensis* and *Verbena officinalis.* Trees and woody shrubs do occur, but in low numbers and is dominated by exotics such as *Acer negundo, Eucalyptus camaldulensis, Populus deltoids, P. x canescens* and *Salix babylonica.*

During this assessment, a total of 126 plant species (16 woody plants – *9 exotics*, 44 graminoid species – *4 exotics*, and 66 herbaceous forbs and shrubs – *25 exotics*) were identified in the wetland habitats of the studied area.

[3] Plants that grow in or near water and is either emergent, submergent, or floating
[4] Plants that grow wholly or partly submerged in water
[5] Plants that grow in wet or waterlogged soil

Figure 7: A section of the Kromspruit with typical wetland vegetation in and along a channelled wetland with a floodplain.

Figure 8: A section of a small northern tributary of the Rietspruit with typical wetland vegetation in an un-channelled wetland.

Figure 9: A small, isolated, natural pan/depression filled with water from recent rains.

Figure 10: A large man-made dam situated at the confluence of three tributaries along the course of the un-named non-perennial drainage line north of the Kromspruit.

Figure 11: A dammed section of the Rietspruit above an area where a district road crosses the natural drainage line.

4.4 Wetland soils

Two of the important wetland indicators, according to DWAF (2005), that prove the presence of a wetland are directly associated to soils, namely:

- The Soil Form Indicator, which identifies (hydromorphic[6]) soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator, which identifies the morphological signatures that develop in the soil profile as a result of prolonged and frequent saturation.

4.4.1 Soil forms

Five soil forms were generally encountered in the establishment of wetland boundaries in the study area. These are:

Katspruit – Orthic A-horizon / G-horizon (Figure 12).

Kroonstad – Orthic A-horizon / E-horizon / G-horizon (Figure 13).

Bloemdal – Orthic A-horizon / red apedal B-horizon / unspecified

[6] Soils having morphological characteristics that are developed when there is excess water in the soil profile all or part of the time.

material with signs of wetness.

Sepane – Orthic A-horizon / pedocutanic B-horizon / unconsolidated material with signs of wetness (Figure 14).

Rensburg – Vertic A-horizon / G-horizon (Figure 15).

Along the course of the Rietspruit and the un-named drainage line just to its south, Katspruit, Kroonstad and Sepane soil forms were the most prevalent. Soil forms that were mostly recorded along the course of the Kromspruit are Katspruit, Sepane and Rensburg. Soil forms associated with pans and depressions mostly include Katspruit, Kroonstad, Bloemdal and Rensburg.

Figure 12: Katspruit soil form photographed in the permanent zone of a wetland just upstream of the man-made dam in the un-named drainage line in Figure 8.

Figure 13: Kroonstad soil form in a seasonal zone of the Rietspruit.

Figure 14: Sepane soil form in the temporal zone in the un-named drainage line.

Figure 15: A Rensburg soil form in an eroded temporary zone along the Kromspruit.

4.4.2 Soil wetness indicators

Soil Wetness Indicators identifies are the morphological signatures that develop in the soil profile as a result of prolonged and frequent saturation with water. These indicators may appear in the upper parts of the profile, mostly in the permanent zone of a wetland or in the lower horizons in seasonal and temporal zones.

The morphological characteristics that define hydromorphic soils mostly include a grey and low chroma soil colour as well as sesquioxide[7] mottles, which may be red, yellow, brown, olive-brown or black in colour (Figures 16 and 17). These form as a result of permanent or at least long periods of water saturation in that particular zone where they appear. It has been recorded that even if a wetland has been drained for more than 20 years, these mottles will remain in the soil profile as a reminder of the once hydromorphic character of that particular area.

[7] Free iron, aluminium and manganese oxides in the soil

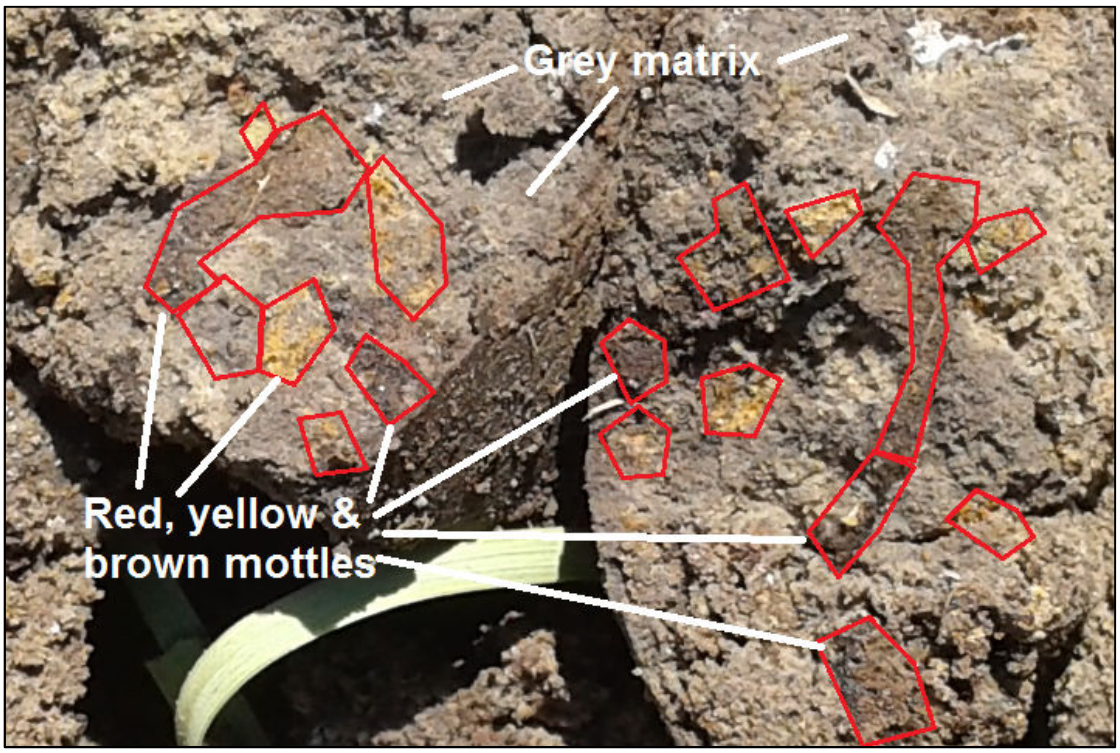

Figure 16: Low chroma grey matrix and sesquioxide mottles in the subsoil of a Sepane soil form.

Figure 17: Low chroma grey matrix and sesquioxide mottles in the G-horizon of a Kroonstad soil form.

5 WETLAND DELINEATION

Accessible parts of all wetlands in the study area were investigated and delineated. Where such areas were not accessible during the time of this study, portions of the stream courses and other wetlands were delineated by means of extrapolating the results obtained from the field data to neighbouring areas. Buffer zones of 32 m from the edge of the wetlands, as prescribed in Government Notice 327 in Government Gazette 40772 of 07 April 2017, was delineated and mapped (Figures 18 and 19). An image is also presented where six proposed drill sites are currently positioned (Figure 20) in relation to the delineated positions of wetlands in their vicinity. Dominant soil types and plant species occurring in the different wetland types that were recorded in the study area are presented in Tables 1 to 3. (NOTE: * = exotic species in Table 1 to 3)

Table 1: Soils and plant species associated with different wetness zones of channelled and un-channelled wetlands associated with streams/drainage lines.

	Permanent zone	**Seasonal zone**	**Temporary zone**
Dominant soil forms (SCWG, 1991):	Katspruit Kroonstad Rensburg	Katspruit Kroonstad Sepane Rensburg	Kroonstad Sepane Rensburg
Dominant and other commonly occurring plant species:	*Agrostis lachnantha* *Carex glomerabilis* *Cycnium tubulosum* *Cyperus fulgens* *C. laevigatus* *C. longus* *Eleocharis dregeana* *Eragrostis heteromera* *Leersia hexandra* *Marsilea capensis* *Mimulus gracilis* *Paspalum distichum* **Paspalum urvillei* *Persicaria decipiens* **Persicaria lapathifolia* **Rumex crispus* *Typha capensis*	*Andropogon appendiculatus* **Bromus catharticus* **Cirsium vulgare* *Cyperus denudatus* *C. fulgens* *Cynodon transvaalensis* *Eragrostis heteromera* *E. micrantha* *E. plana* *Falckia oblonga* *Hemarthria altissima* *Kyllinga erecta* *Mimulus gracilis* **Oenothera rosea* *Panicum schinzii* **Paspalum dilatatum* *Plantago lanceolata* *Platycarpha parvifolia* *Pycreus macranthus* **Rumex crispus* *Setaria incrassata* *Vahlia capensis*	*Andropogon appendiculatus* **Bromus catharticus* **Cirsium vulgare* *Conyza podocephala* *Cynodon dactylon* *C. transvaalensis* *Eragrostis chloromelas* *E. plana* *Falckia oblonga* *Heteropogon contortus* *Helichrysum acutatum* *Hemarthria altissima* **Oenothera rosea* **Paspalum dilatatum* *Plantago lanceolata* *Platycarpha parvifolia* *Pycreus macranthus* *Salvia runcinata* *Setaria incrassata* *Themeda triandra* *Vahlia capensis*

Table 2: Soils and plant species associated with different wetness zones of natural pans and depression.

	Permanent zone	Seasonal zone	Temporary zone
Dominant soil forms (SCWG, 1991):	Katspruit Kroonstad Rensburg	Katspruit Kroonstad Rensburg Bloemdal	Kroonstad Rensburg Bloemdal
Dominant and other commonly occurring plant species:	*Agrostis lachnantha* *Cycnium tubulosum* *Cyperus fulgens* *C. laevigatus* *Eleocharis dregeana* *Eragrostis heteromera* *Juncus effusus* *Leptochloa fusca* **Paspalum notatum* *Paspalum distichum* **Paspalum urvillei* *Persicaria decipiens* **Persicaria lapathifolia*	*Cyperus esculentus* *Eragrostis heteromera* *E. plana* *Falckia oblonga* *Hemarthria altissima* *Juncus effusus* **Oenothera rosea* *Panicum schinzii* **Paspalum dilatatum* *Plantago lanceolata* *Pycreus macranthus* **Rumex crispus* *Setaria incrassata* *S. pumila* *Vahlia capensis* *Verbena officinalis*	*Conyza podocephala* *Cyperus esculentus* *Cynodon dactylon* *Eragrostis chloromelas* *E. plana* *Falckia oblonga* *Helichrysum acutatum* *Heteropogon contortus* *Hemarthria altissima* **Oenothera rosea* **Paspalum dilatatum* *Plantago lanceolata* *Pycreus macranthus* *Salvia runcinata* *Setaria incrassata* *Themeda triandra* *Vahlia capensis* *Verbena officinalis*

Table 3: Soils and plant species associated with different wetness zones of man-made dams associated with streams/drainage lines.

	Permanent zone	Seasonal zone	Temporary zone
Dominant soil forms (SCWG, 1991):	Katspruit Kroonstad Rensburg	Katspruit Kroonstad Sepane Rensburg	Kroonstad Sepane Rensburg
Dominant and other commonly occurring plant species:	*Agrostis lachnantha* **Aster squamatus* *Carex glomerabilis* *Cycnium tubulosum* *Cyperus fulgens* *C. laevigatus* *C. longus* *Eleocharis dregeana* *Eragrostis heteromera* *Juncus effusus* *Lagarosiphon major* *Leersia hexandra* *Lemna gibba* *Leptochloa fusca* *Marsilea capensis* *Paspalum distichum* **Paspalum urvillei* *Persicaria decipiens* **Persicaria lapathifolia* *Phragmites australis* *Potamogeton thunbergii* *Typha capensis*	*Andropogon appendiculatus* **Aster squamatus* *Cyperus fulgens* *C. laevigatus* *C. longus* *Cynodon transvaalensis* *Eragrostis heteromera* *E. micrantha* *E. plana* *Falckia oblonga* *Helichrysum acutatum* *Hemarthria altissima* *Juncus effusus* **Oenothera rosea* *Panicum schinzii* **Paspalum dilatatum* *Plantago lanceolata* *Platycarpha parvifolia* *Pycreus macranthus* **Rumex crispus* *Vahlia capensis* *Verbena officinalis*	*Andropogon appendiculatus* **Alternanthera sessilis* *Conyza podocephala* *Cynodon dactylon* *C. transvaalensis* *Eragrostis chloromelas* *E. gummiflua* *E. plana* *Falckia oblonga* *Helichrysum acutatum* *Heteropogon contortus* *Hemarthria altissima* **Oenothera rosea* **Paspalum dilatatum* *Plantago lanceolata* *Platycarpha parvifolia* *Pycreus macranthus* *Salvia runcinata* *Themeda triandra* *Vahlia capensis* *Verbena officinalis*

Figure 18: Delineated wetlands with 32 m buffer zones (northern half of study area).

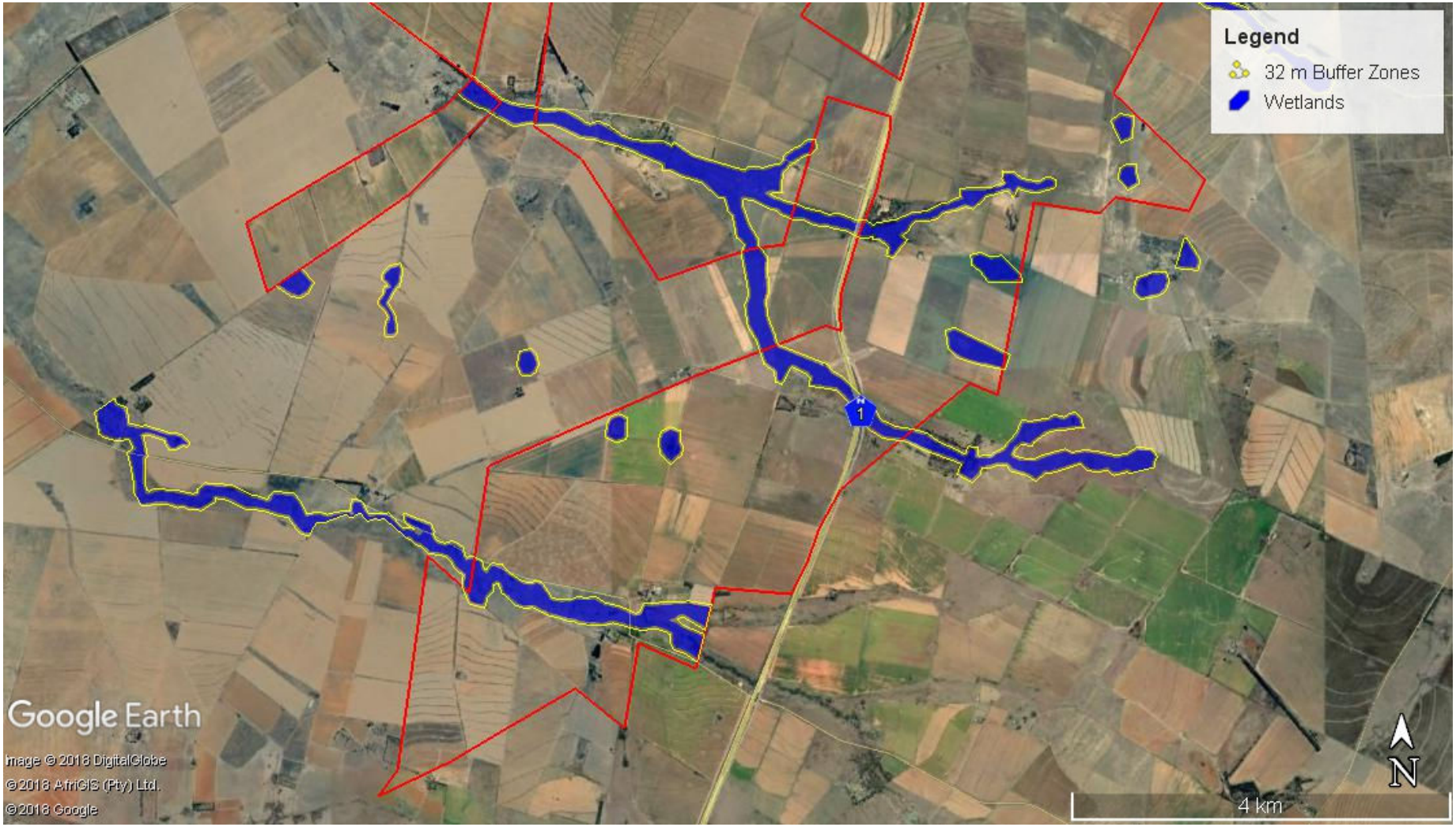

Figure 19: Delineated wetlands with 32 m buffer zones (southern half of study area).

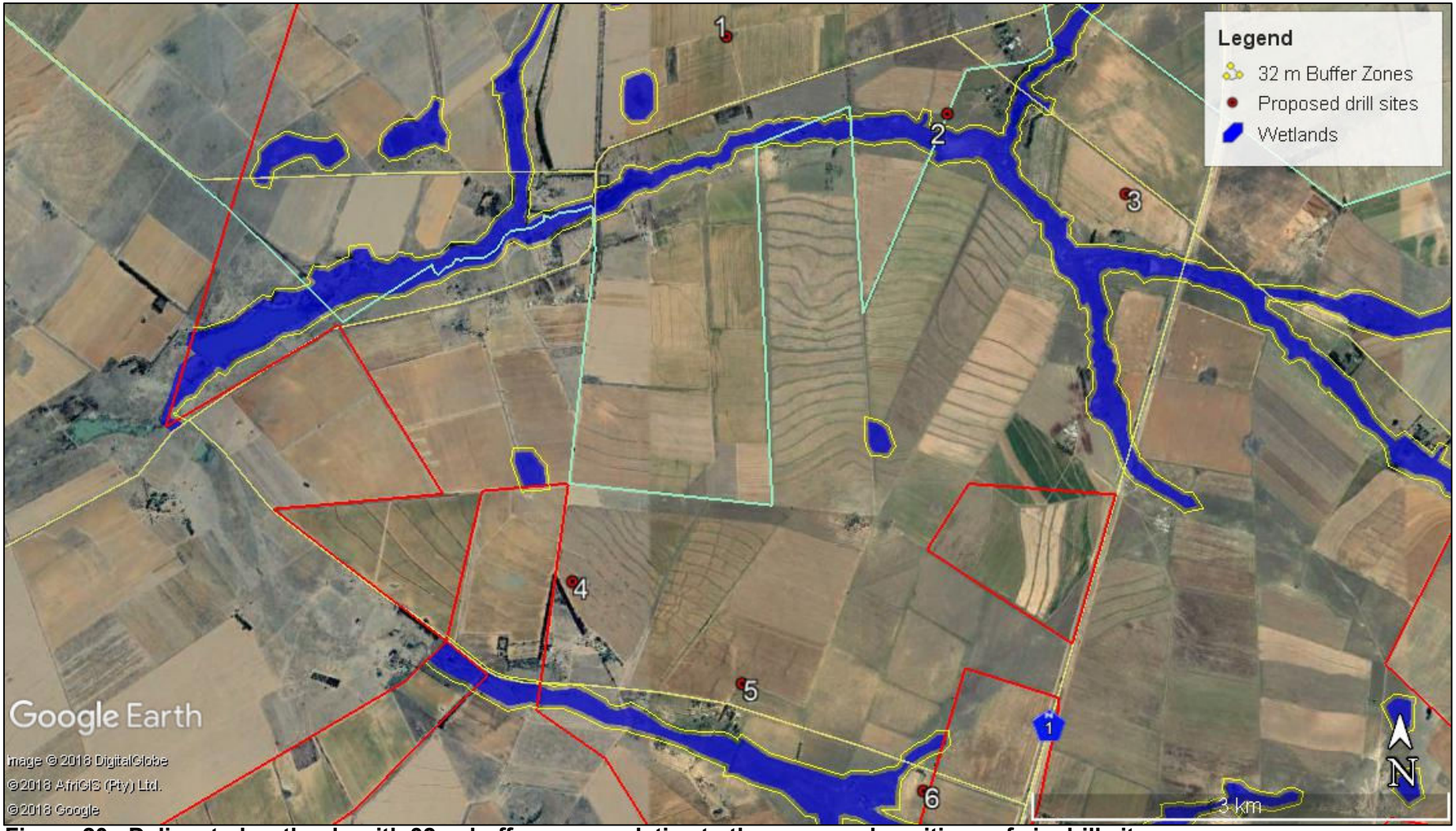

Figure 20: Delineated wetlands with 32 m buffer zones relative to the proposed positions of six drill sites.

6 PRESENT ECOLOGICAL STATUS (PES)

6.1 PES methodology

The Present Ecological Status (PES) Method (DWAF 1999) was used to attempt to establish the integrity of the wetlands in the study area and was based on the modified Habitat Integrity approach developed by Kleynhans (1999, in DWAF 1999). The delineated wetland units were assessed as a whole due to the inability to access all areas. A broad assessment of the PES of all wetlands in the study area is therefore presented. Table 4 shows the criteria for assessing the habitat integrity of palustrine wetlands along with Table 5 describing the allocation of scores to attributes and the rating of confidence levels associated with each score. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland.

Table 4: Habitat integrity assessment criteria for palustrine wetlands (DWAF, 1999).

CRITERIA AND ATTRIBUTES	RELEVANCE	SCORE	CONFIDENCE
Hydrologic			
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.		
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.		
Water Quality			
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland		
Sediment load modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.		
Hydraulic/Geomorphic			
Canalization	Results in desiccation or changes to inundation patterns of wetland and thus		

CRITERIA AND ATTRIBUTES	RELEVANCE	SCORE	CONFIDENCE
	changes in habitats. River diversions or drainage.		
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activity which reduces or changes wetland habitat directly or through changes in inundation patterns.		
Biota			
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.		
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.		
Invasive plant encroachment	Affect habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).		
Alien fauna	Presence of alien fauna affecting faunal community structure.		
Over utilisation of biota	Overgrazing, Over-fishing, etc.		

Table 5: Scoring guidelines and relative confidence scores for the habitat integrity assessment for palustrine wetlands (DWAF, 1999).

Scoring guidelines per attribute	Score
Natural, unmodified	5
Largely natural	4
Moderately modified	3
Largely modified	2
Seriously modified	1
Critically modified	0
Relative confidence of score	**Score**
Very high confidence	4
High confidence	3
Moderate confidence	2
Marginal/low confidence	1

Table 6 provides guidelines for the determination of the Present Ecological Status Category (PESC), based on the mean score determined for Table 4. This approach is based on the assumption that extensive degradation of any of the wetland attributes may determine the PESC (DWAF, 1999).

Table 6: Category's assigned to the scores achieved in the wetland habitat assessment (Kleynhans, 1999; DWAF, 1999).

Category	Mean	Score Category Description
WITHIN GENERALLY ACCEPTABLE RANGE		
A	>4	Unmodified or approximated natural condition.
B	>3 and ≤4	Largely natural with few modifications, but with some loss of natural habitats.
C	>2 and ≤3	Moderately modified, but with some loss of natural habitats.
D	2	Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
OUTSIDE GENERALLY ACCEPTABLE RANGE		
E	>0 and <2	Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
F	0	Critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

6.2 PES of wetlands in the study area

The different types of wetlands in the study area were assessed separately on a broad general scale.

The wetlands in the study area all fall between a PESC of B and E – most being largely natural with some habitat modification, but some are seriously modified. The broad scores (highest and lowest values) that the different wetlands in the study area achieved in the PES scoring are indicated in Table 7.

Table 7: Broad PES values and categories of the wetlands in the study area.

Wetland segment	Mean PES Value	PESC
Wetlands of streams	3.5 – 2.9	B or C
Pans / depressions	3.1 – 2.0	B, C or D
Man-made dams	2.8 – 1.7	C, D or E

7 ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

7.1 EIS methodology

The following method is outlined in Appendix W5 of DWAF (1999). A series of determinants for EIS (Table 8) are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The method is used as a guideline for the professional judgement of individuals familiar with an area and its wetlands. The relative confidence of each rating is estimated based on a scale of four categories as indicated in Table 9.

Table 8: Score sheet for determining EIS.

Determinant	Score	Confidence
PRIMARY DETERMINANTS		
Rare and Endangered Species.		
Populations of Unique Species.		
Species/taxon Richness.		
Diversity of Habitat Types or Features.		
Migration route/breeding and feeding site for wetland species.		
Sensitivity to Changes in the Natural Hydrological Regime.		
Sensitivity to Water Quality Changes.		
Flood Storage, Energy Dissipation and Particulate or Element Removal.		
MODIFYING DETERMINANTS		
Protected Status.		
Ecological Integrity.		
TOTAL:		
MEDIAN:		
OVERALL ESI:		

Table 9: Scoring guidelines and relative confidence scores for the habitat integrity assessment for palustrine wetlands (DWAF, 1999).

Scoring guidelines per attribute	Score
Very High	4
High	3
Moderate	2
Marginal / Low	1
None	0
Relative confidence of score	**Score**
Very high confidence	4
High confidence	3
Moderate confidence	2
Marginal/low confidence	1

The median score for the biotic and habitat determinants (Table 8) is interpreted and translated into an Ecological Management Class (EMC) as indicated in Table 10. If the EIS Class indicates a higher EMC value than the Present Ecological Status Category (PESC) (see section 6) then a well-motivated decision may be taken to peg the Reserve on the higher EMC. The EMC can be set equivalent to, but not below the PES Class.

Table 10: Ecological importance and sensitivity categories. Interpretation of median scores for biotic and habitat determinants into an EMC.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class (EMC)
Very high Wetlands/Floodplains that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these floodplains 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	A
High Wetlands/Floodplains that are considered to be ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and ≤3	B
Moderate Wetlands/Floodplains that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains 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	C
Low/marginal Wetlands/Floodplains that is not ecologically important and sensitive at any scale. The biodiversity of these floodplains 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	D

7.2 EIS of wetlands in the study area

The wetlands in the study area have EIS categories and EMC values as indicated in Table 11.

Table 11: EIS and EMC values of wetlands in the study area.

Wetland	EIS category	EMC
Wetlands of streams	Moderate (Median Value 1.6)	C
Pans / depressions	Moderate (Median Value 0.8)	D
Man-made dams	Moderate (Median Value 1.3)	C

8 WETLAND ECOSYSTEM SERVICES (ES)

8.1 ES methodology

The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze et al (2009). A Level 2 assessment was undertaken which examines and rates the following services:

- Flood attenuation.
- Stream flow regulation.
- Sediment trapping.
- Phosphate trapping.
- Nitrate removal.
- Toxicant removal.
- Erosion control.
- Carbon storage.
- Maintenance of biodiversity.
- Water supply for human use.
- Natural resources.
- Cultivated foods.
- Cultural significance.
- Tourism and recreation.
- Education and research.

These characteristics were scored according to the following general levels of services provided in Table 12:

Table 12: Levels of ecosystem service ratings.

Services Rating Score	Services Rating Category
0	Low
1	Moderately Low
2	Intermediate
3	Moderately High
4	High

8.2 ES of wetlands in the study area

The wetlands in the study area have ES values as indicated in Table 13.

Table 13: ES values of wetlands in the study area.

Wetland	ES value
Wetlands of streams	3
Pans / depressions	1
Man-made dams	2

9 HABITAT SENSITIVITY

The objective of a sensitivity mapping exercise is to determine the location and extent of all sensitive areas that must be protected from transforming land uses as far as possible. A development proposal should only to be considered compatible with the biodiversity sensitivities of the site if all sensitive areas are avoided and are incorporated into an open space system (GDARD, 2014). A number of criteria are generally used to determine habitat sensitivity of which the following are some of the main ones:

- Ecological function. This relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or overall preservation of biodiversity. The potential of the habitat to deliver ecosystem services within itself and to other neighboring habitats are also taken in to consideration.
- Conservation importance. This relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.
- Other factors.
    - Current diversity of exotic species.

- Degree to which the natural habitat has been degraded due to various factors.
- Degree of habitat transformation.
- Degree of habitat fragmentation.
- Degree of bush encroachment.

Three ratings were considered to describe the sensitivity of the study area:

High – sensitive ecosystem with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems or with high species diversity and usually provide suitable habitat for a number of species of conservation significance. These areas should be protected.

Moderate/Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for species of conservation significance.

Low – Degraded and highly disturbed / transformed systems with little ecological function and are generally very poor in species diversity.

A sensitivity rating of High is attributed to the wetlands in the study area. This is mainly due to their important function as water drainage and storage habitat for surrounding ecosystems and the faunal and floral assemblages that depend on it, as well as its relevant connectivity with terrestrial habitats along its mostly linear distribution. The fact that any significant damage to the linear drainage lines, which mostly contain the wetlands of the study area, will have a significant impact on similar habitats downstream, further enhances the sensitive nature of these habitats.

Figure 21 presents the sensitivity of wetland habitats in the study area, inclusive of the prescribed 32 m buffer zones, relevant to the positions of six proposed drill sites and Figure 22 illustrates the distribution of wetland sensitivity over the whole study area.

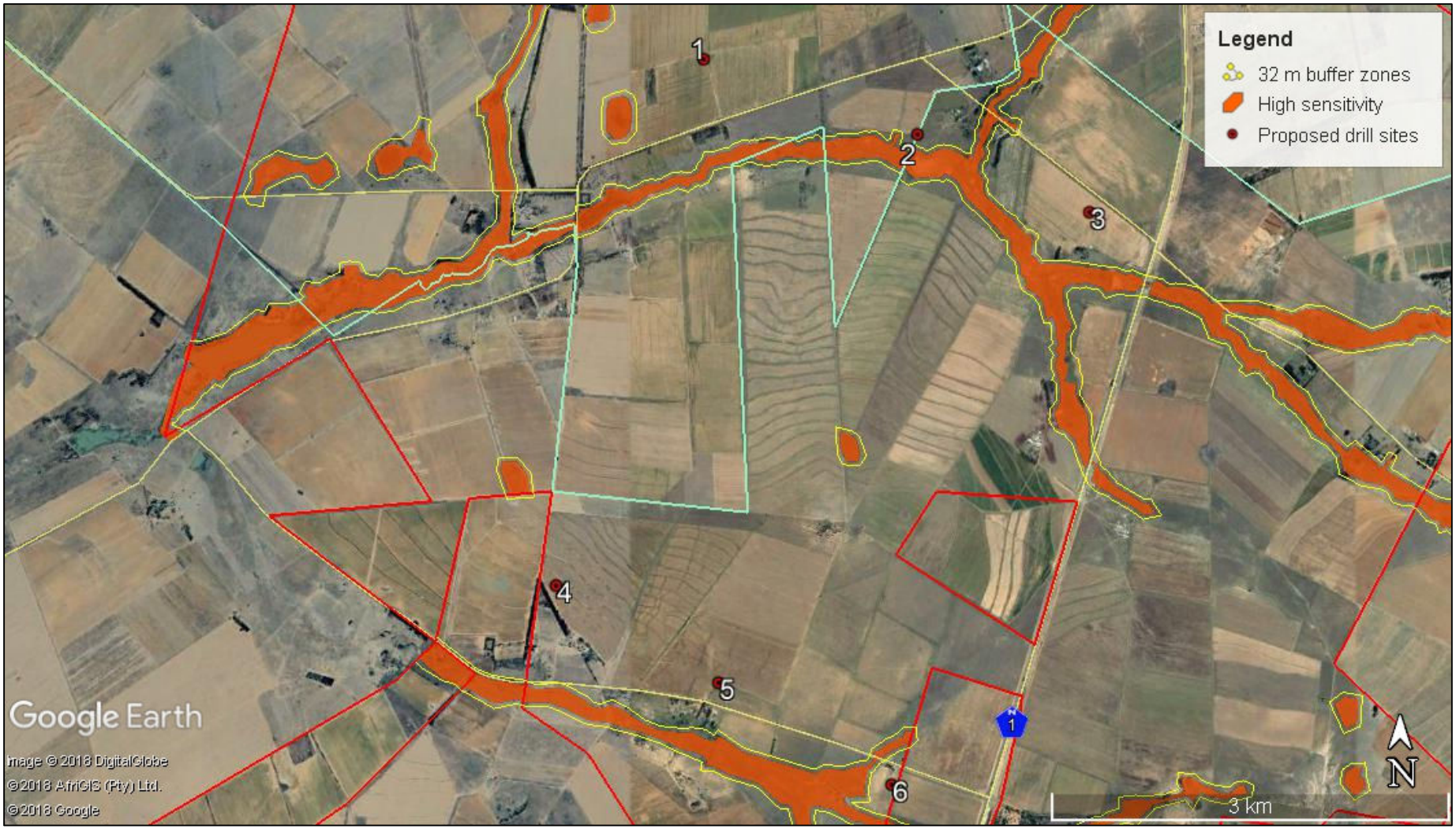

Figure 21: Wetland sensitivity and 32 m buffer zones in relation to six proposed drill sites in the study area.

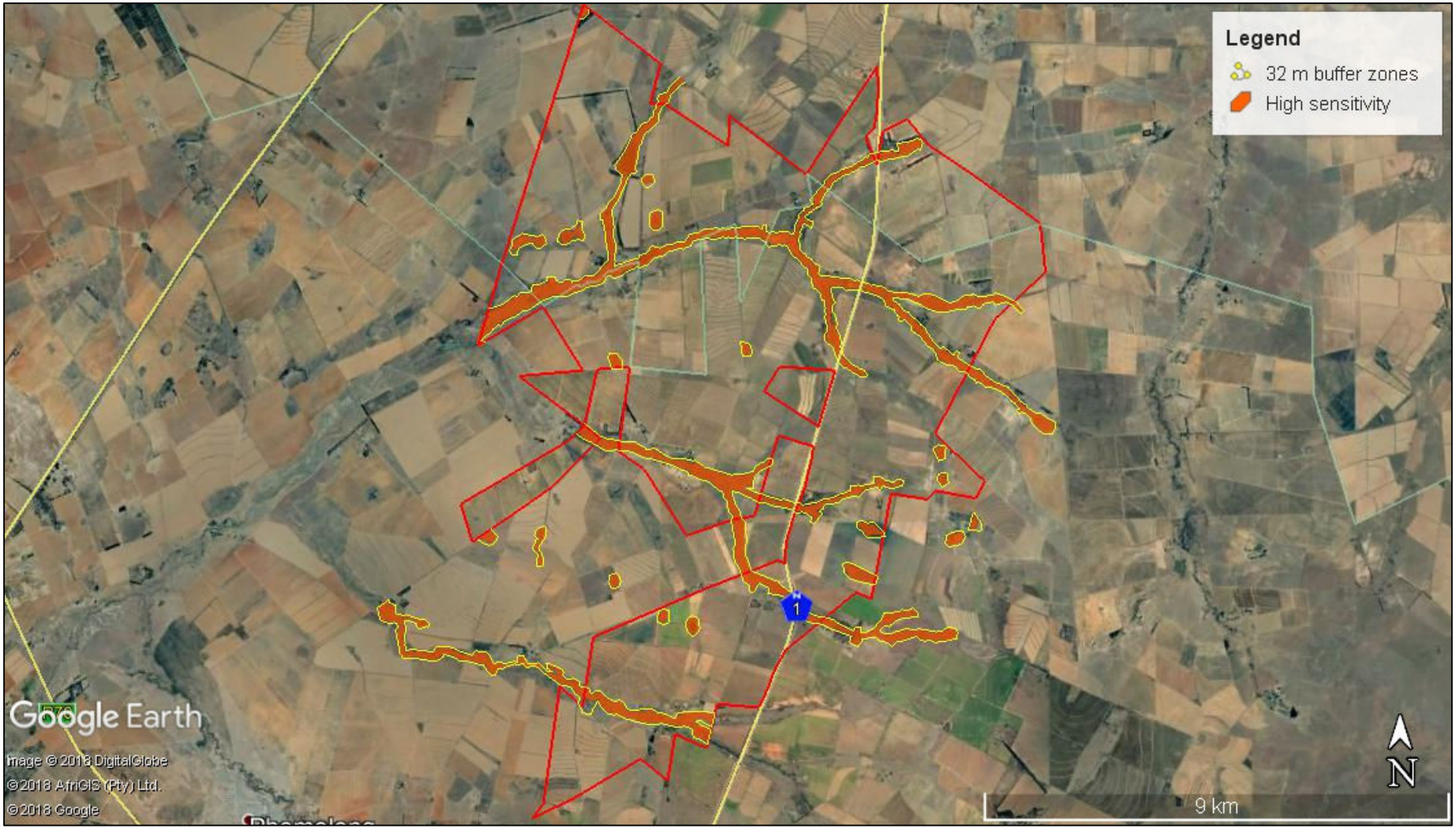

Figure 22: Wetland sensitivity and 32 m buffer zones over the whole study area.

10 CONSERVATION STATUS OF LOCAL ECOSYSTEMS

According to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA, 2004): National List of Ecosystems That Are Threatened and In Need of Protection, The Vaal-Vet Sandy Grassland (Gh10) (Figure 3), which most of the wetlands in the study area lies embedded in, is an Endangered Ecosystem, which has to be protected. Historically Gh10 covered the largest portion of the study area, but was virtually totally destroyed due to crop cultivation and other agricultural activities.

No specific guidelines are given for the Free State Province in terms of habitat sensitivity mapping. The 2015 Free State Biodiversity Plan (http://bgis.sanbi.org), however, provides a map of Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESA's), which has conservation guidelines of different land-use areas in the province in mind. To my knowledge, different management criteria and recommendations for CBA's and ESA's are still under development and are expected to be published somewhere in 2018 (http://bgis.sanbi.org). It may, however be expected that these criteria and guidelines will be similar to that of other provinces where agriculture is one of the more important land uses. For this reason and in order to present some data in this regard, and excerpt of the criterion used by the Limpopo Conservation Plan – version 2 (LCPv2, Desmet *et al,* 2013) is presented below:

> "CBA's within the bioregion are the portfolio of sites that are required to meet the region's biodiversity targets, and need to be maintained in the appropriate condition for their category.
>
> "Based on the LCPv2, 40% of the province is designated as CBA. These CBA's have been split into CBA 1 and CBA 2 on the basis of selection frequency and the underlying characteristics of the biodiversity features which are being protected.
>
> "An additional 23% of the province is designated as ESA. This category has also been split on the basis of land-cover into ESA 1 (16%) and ESA 2 (7%), with ESA 1 being in a largely natural state while ESA 2 areas are no longer intact but potentially retain significant importance from a process perspective (e.g. maintaining landscape connectivity). Other Natural Areas make up 20% of the province and just over 11% is designated as formal Protected Areas.
>
> "Land-use guidelines are given to provide guidance on what types of land-use activities are compatible with the biodiversity management objectives of each CBA map category. These guidelines do not grant or take away existing land-use rights or the statutory requirement for permits and environmental authorizations. It is however recommended that any planned activity within the identified sensitive conservation areas, even those not requiring specified permits or authorisations, comply with the Duty of Care obligations of Section 28 of the National Environmental Management Act No 107 of 1998."

Figure 23 presents the distribution of CBA's and ESA's in the study area according to the 2015 Free State Biodiversity Plan. From this image it appears as if mostly wetland areas are classified as CBA 1 areas. According to SANBI, however, the CBA map for aquatic systems in the Free State province is still incomplete (http://bgis.sanbi.org).

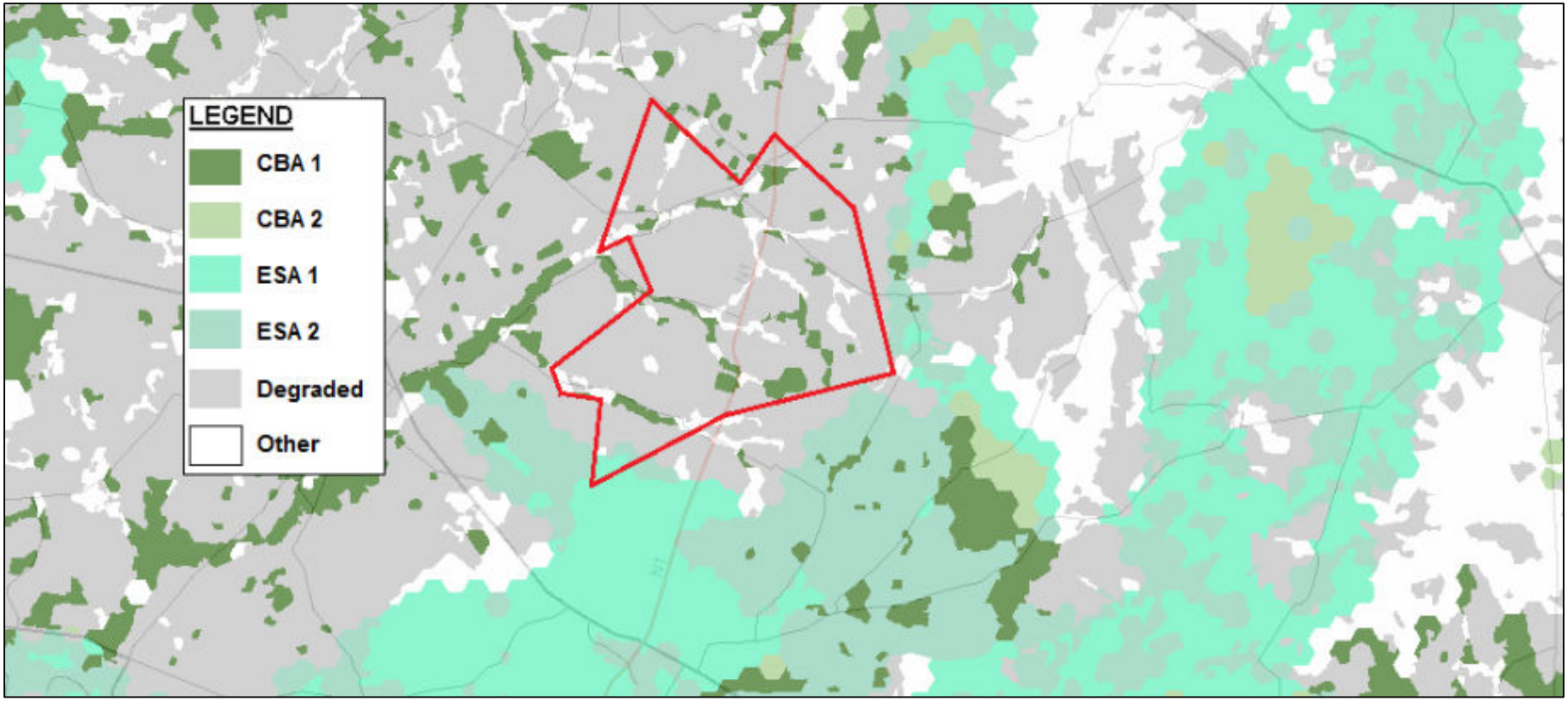

Figure 23: CBA and ESA image for the study area (red polygon) according to the 2015 Free State Biodiversity Plan.

11 WETLAND REHABILITATION AND MANAGEMENT

11.1 Rehabilitation Principles

Successful rehabilitation depends upon conceptual planning, research and design flexibility. Wetlands are ever-changing systems that have adapted to local conditions over many decades. It is not only important that a rehabilitated wetland looks like a wetland, it must also function as one (Mullins, 2012).

There are many things to consider, including:

- The ability of the local catchment has to allow rainwater to infiltrate the ground water system and subsequently, to slowly release this water subterraneous into the wetland.
- The wetland should have capacity to receive both catchment and incident water without being eroded, hold excess water and release it slowly into the downstream system. Erosion from surface runoff reduced to the barest minimum.
- The wetland needs to be able to receive and accommodate soil and solute eroded from the surrounding catchment, and prevent the scouring and gullying, reducing siltation in the stream.
- The presence and/or quality of a seed bank, or a natural source in the area that allows for re-colonization of vegetation.
- The wetland must have capacity to accumulate organic matter.
- The critical balance between inputs and outputs; water, nutrients and soil have to be maintained.

The following benefits may arise from wetland rehabilitation:

a. Direct benefits

- Biodiversity support.
- Water quality enhancement.
- Flood attenuation.
- Erosion control.
- Stream flow regulation.
- Groundwater recharge/discharge.

a. Indirect benefits

- Grazing for livestock.
- Fiber plants for crafts and construction.
- Medicinal plants.
- Tourism.

- Areas for cultivation.
- Wood.

One of the most important factors to the rehabilitation of wetlands is the re-establishment of an environment that is as close to the natural hydraulic regime (depth, duration and intensity of flooding) as possible. This is achieved through reducing the velocity of water through the system and promoting the spreading of flow across the wetland. Water velocity through a wetland is controlled by three factors:

- The hydraulic radius (R) – shallow, wide flow moves slower than canalized, deep flow.
- The slope of the wetland (S) – steeper the wetland gradient, the faster the flow.
- The roughness of the channel (n) – greater resistance offered in the channel, the slower the flow.

With these principles and goals in mind, a vision for the rehabilitation program may be developed to improve the functionality of the wetlands in the study area and raise the overall value of the systems at both a local and broader landscape level.

11.2 Rehabilitation Management

A number of management strategies must be implemented in the rehabilitation of wetland areas. Some of these measures are listed below:

- Promotion of back flooding of eroded areas to the re-establish a more natural wetness regime by one or more of the following:
    - Earth plugs or rock weirs for low energy / low flow situations.
    - Gabion, concrete or mass-gravity weirs for high energy/flow situations or larger interventions.
- Re-Vegetation with indigenous vegetation to:
    - Increase the habitat and biodiversity value of the wetland.
    - Increase the roughness of the system, helping slow water moving through the wetland, trapping sediment and improving water quality.
- Alien invasive plants control program. Removal and subsequent management of alien species is very important in maintaining the biodiversity value and integrity of wetlands.
- Human disturbance minimization measures must be put in place. The wetlands in the study area currently face a variety of pressures from direct anthropogenic disturbances. These include uncontrolled access by vehicles, vagrants and squatters, illegal dumping and medicinal plant harvesting.

- Storm water Management from nearby built-up areas and other unnatural hard surfaces.
- Pollution control.
- Periodic monitoring in any rehabilitation project is extremely important in order to know whether the rehabilitation effort is improving the value of the system. Regular monitoring also allows one to identify the need for corrective action for problems that may arise during the course of the rehabilitation program (e.g. an erosion control structure begins to wash away). Monitoring therefore helps improve the focus and procedures of a project as it proceeds. Monitoring of individual wetland sites also helps us to be more successful in the future when undertaking new projects by improving our general understanding of wetland rehabilitation (Mullins, 2012). Monitoring must be done during all phases of the rehabilitation effort i.e.:
    - Implementation and Remediation phase (weekly).
    - Recovery phase (monthly).
    - Operational phase (annual / bi-annual).

11.3 Rehabilitation Recommendations

The six drill sites that are proposed will not directly impact the wetland habitats from their current positions. The following rehabilitation recommendations are made with regards to the area in general.

- The PESC and EIS of the wetland(s) in the study area indicate that they are in moderately to highly modified condition with some loss of natural habitats and that they are considered to be ecologically important and sensitive on a provincial or local scale and that the biodiversity of these floodplains 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.
- The fact that the wetland(s) in the study area are in a moderately to highly modified condition gives the indication that some degree of rehabilitation is necessary going forward. This rehabilitation will include the stabilizing of eroded stream banks through promoting the growth of indigenous vegetation. This may or may not require active rehabilitation.
- The eradication and control of alien weeds and invaders in the wetland system in the study area and also up and down stream will serve to enhance the PES and Ecological integrity of this particular area. It will, however, not be successful if the weeds and invaders are not eradicated and controlled in the adjacent terrestrial habitats. This too will have to become a high priority in the management of the natural habitat as a whole.

12 IMPACT ASSESSMENT

12.1 Impact rating and mitigation

The following impact assessment is supplied. The assessment was conducted only for the six proposed drill sites with the focus on wetland habitats. From the assessments it is clear that no major impacts are expected from the currently proposed prospecting activities. Tables 14 to 20 summarize the expected impacts.

Table 14: Impact 1: Degradation and / or destruction of wetland habitats.

Impact Name	**1. Degradation and/or destruction of wetland habitats.**				
Alternative	**Proposal**				
Phase	**All phases**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	1	1
Extent of Impact	1	1	Reversibility of Impact	2	1
Duration of Impact	2	1	Probability	3	2
Environmental Risk (Pre-mitigation)					-4.50
Mitigation Measures					

In terms of section 19 of the NWA (1998), owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution or degradation of a water resource must take all reasonable measures to prevent any such disturbance from occurring, continuing or recurring. These measures may include measures to (inter alia):

- Cease, modify, or control any act or process causing the pollution/degradation.
- Comply with any prescribed waste standard or management practice.
- Contain or prevent the movement of pollutants or the source of degradation.
- Remedy the effects of the pollution/degradation.
- Remedy the effects of any disturbance to the bed and banks of a watercourse/wetland.

According to the NWA (1998) part of the definition of pollution of water resources states that any physical alterations to a water resource, for example the excavation of a wetland / stream or changes to the morphology of such a water resource may be considered to be pollution. Activities which cause an alteration to the biological properties of a wetland i.e. the fauna and flora contained within and supported by that water resource are therefore also considered to be a form of pollution.

Any construction activities in or within a delineated buffer zone of a water resource may only take place after the necessary water use license has been obtained.

Where wetlands may be encroached upon by proposed activities, the edge of the wetland must be clearly demarcated in the field with pegs or poles that will last for the duration of the construction phase, color-coded as follows:

- RED – Indicating the edge of the wetland (Note: This includes the permanent, seasonal and temporal zones of wetlands, or parts thereof; and no vehicles or building materials are allowed in this zone). These should be put along the entire length of the site.
- ORANGE – Indicating the edge of the buffer zone

Prospecting machinery and associated vehicles may not be allowed to enter wetlands. Strictly no re-fueling of vehicles or machinery should be allowed to take place in any area close to a wetland.

During and after construction areas of exposed soil can easily erode and subsequently end up in the wetlands. A well-designed storm water system must be put in place to avoid erosion into wetlands. Natural runoff from the natural terrestrial habitat surrounding the wetlands should however not be restricted unnecessarily.

The use of potential pollutants (paint, chemicals, etc.) during construction and operational phases must be strictly controlled and a high quality of management and supervision concerning such materials must be enforced, especially close to wetland buffer zone areas. Sanitary facilities must be made available to prospecting workers to prevent urine and human waste entering the wetlands. If at any point prospecting activities encroach on wetlands, it is strongly advised that a wetland/aquatic specialist is appointed during all phases to monitor impacts and related mitigation measures regarding wetland habitats.

Environmental Risk (Post-mitigation)	-2.00
Degree of confidence in impact prediction:	High
Impact Prioritisation	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	1
The impact is unlikely to result in irreplaceable loss of resources.	
Prioritisation Factor	1.17
Final Significance	-2.33

Table 15: Impact 2: Loss of indigenous fauna and flora diversity associated with wetlands.

Impact Name	**2. Loss of indigenous fauna and flora diversity associated with wetlands.**				
Alternative	**Proposal**				
Phase	**All phases**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	1	Reversibility of Impact	4	2
Duration of Impact	2	2	Probability	2	1
Environmental Risk (Pre-mitigation)					-5.00
Mitigation Measures					
Destruction of natural wetland vegetation must be avoided at all cost. Special attention should be paid to alien and invasive control within the whole study area. Alien and invasive vegetation control should take place throughout all development phases to prevent loss of habitat of indigenous fauna and flora. Movement of vehicles and construction workers in wetlands and buffer zones should be strictly prohibited. No harvesting of plants or animals should be allowed. Any specimens of protected plant species known to occur in the wetlands and the delineated buffer zone and may potentially be impacted by the prospecting activities, are to be fenced off for the duration of the activity. Conservation of these specie and their natural habitat must be a high priority. If at any point prospecting activities encroach on wetlands, it is strongly advised that a wetland/aquatic specialist is appointed during all phases to monitor impacts and related mitigation measures regarding wetland habitats. Red Data listed and protected species as well as sensitive habitats related to wetlands					

should be strictly monitored. Any conservation recommendations and measures that aim to mitigate the impacts of this development must also be monitored by such a specialist during the construction, operational and decommissioning phases.	
Environmental Risk (Post-mitigation)	-1.50
Degree of confidence in impact prediction:	High
Impact Prioritisation	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.	
Prioritisation Factor	1.33
Final Significance	-2.00

12.2 Assessment of the no-go alternative

Currently there is no proposal from a wetland point of view of a no-go alternative. It is not expected that the currently proposed activities and the proposed positions of the activities will have any major impact on the wetlands in the study area. If, however, the nature of the activities and the positioning of any proposed activities will encroach on the wetlands and the buffer zones proposed in this study, this option will have to be re-evaluated.

If for whatever reason the no-go alternative is enforced, it will see the present ecological status of the wetlands in the study area stay the same taking natural fluctuations in to consideration.

12.3 Monitoring requirements

No monitoring requirements are currently proposed, unless prospecting sites and activities change in such a way to encroach on wetland positions and the proposed buffer zones.

In the event that the nature of the activities and the positioning of any proposed prospecting activities will encroach on the wetlands and the buffer zones in the study area, the following is strongly advised from a wetland point of view:

- Monitoring of the edge of the wetland, which must be clearly demarcated in the field with pegs or poles that will last for the duration of the construction phase.
    - RED markers Indicating the edge of the wetland.
    - ORANGE markers Indicating the edge of the buffer zone.
- Populations of Red listed and other protected species in wetlands and buffer zones must be recorded and monitored during all project phases.

- It is strongly advised that a wetland/aquatic specialist is appointed during the construction, operational and decommissioning phases to monitor impacts and related mitigation measures regarding wetlands and the faunal and floral assemblages occurring in this habitat.
- If the no-go alternative is enforced no monitoring is advised at this stage.

13 FINAL COMMENTS AND RECOMMENDATIONS

Wetland areas are important in an ecological and hydrological sense. Ecologically they are usually areas with specialised plant species diversity that support many forms of terrestrial and aquatic life. From a hydrological point of view wetlands act as water reservoirs that purify water, trap sediments and slowly release water into the surrounding ecosystem during the dry season and also act as buffers against floods and soil (stream bank) erosion. The protection and rehabilitation of wetlands and thereby promote their ecological and hydrological functioning is a matter of high priority from a national water resource conservation point of view. Linear water courses and drainage lines sensitive to and easily fragmented and a high conservation value is attributed to the plant communities and faunal assemblages of these areas as they contribute significantly to the biodiversity of a region.

Important to note that according to the NWA (1998) part of the definition of pollution of water resources entails that any physical alterations to a water resource, for example the excavation of a wetland or changes to the morphology of a water body may be considered to be pollution. Activities which cause an alteration to the biological properties of a watercourse, i.e. the fauna and flora contained within and supported by that watercourse are therefore also considered to be a form of pollution.

In terms of section 19 of the NWA (1998), owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution or degradation of a water resource must take all reasonable measures to prevent any such disturbance from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- Cease, modify, or control any act or process causing the pollution/degradation.
- Comply with any prescribed waste standard or management practice.
- Contain or prevent the movement of pollutants or the source of degradation.
- Remedy the effects of the pollution/degradation.
- Remedy the effects of any disturbance to the bed and banks of a watercourse/wetland.

Based on the data presented in this report as well as observations made during the survey and comments above, the following is recommended in conclusion:

- Take note of and as far as possible comply with the mitigation measures and recommendations given in this report.
- During the planning, operational and rehabilitation phases all recommendations made and concerns raised in this document should be taken into consideration.
- From a wetland point of view, there are no major objections against the proposed prospecting activities, as long as mitigation measures and recommendations are seriously considered and implemented, and as long as due diligence is practiced in terms of environmental legislation and other relevant policies and guidelines.

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