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WETLAND DELINEATION STUDY

FOR THE EXPANSION OF RAILWAY LINES AT PYRAMID SOUTH, PRETORIA, SOUTH AFRICA.

3424302.022S

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Contract No.	Date	Status
3424302.022S	October 2017	Draft

October 2017

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EXECUTIVE SUMMARY

Introduction

Kimopax Pty Ltd has been appointed by Transnet Capital Projects as an independent environmental assessment practitioner to apply for the Environmental Authorization and Water Use License Application for the expansion of a railway lines at Pyramid South, Gauteng Province. The project is situated within the City of Tshwane municipality. As part of the Environmental Impact Assessment process, this Wetland Delineation study has been undertaken in order to identify all the wetlands on site, determine the potential impacts of the proposed development on the wetlands and develop mitigation measures where appropriate.

Approach and Methodology

The approach was based on desktop and ground truthing methodologies as follows:

- Various data sources were utilised to obtain background information, including 1:50000 Maps, National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2010) (NFEPA) maps.
- Wet-Health tool for the assessment of the present ecological status or health of the wetland.
- Assessment of ecological importance and sensitivity of the wetland.
- Impact assessment was undertaken using the principles of the IWWMP operational guidelines developed by the Department of Water and Sanitation.

Wetland Assessment Results

a) Site description

The site is well developed with extensive railway line infrastructure, but on the southern part of the railway line there are two (2) distinct wetlands as indicated by the following attributes:

- Presence of hydromorphic soils that display characteristics resulting from prolonged saturation; and
- The presence of water loving plants (hydrophytes).

The catchment and water resources adjacent to the site includes a national wetland located across the railway line to the north (Source: SANBI).

b) Classification of wetlands

Based on the recently published Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel et. al., 2011), there are wetlands within 500m of the proposed developments. Wetland 1 and Wetland 2 are both connected to the catchment hydrological system (Source SANBI), and there is evidence that the existing railway line infrastructure disturbed the channelled valley bottom wetlands on site. Time series google images from the year 2001 to 2016 (Appendix 1) shows the long-standing wetland connectivity across the railways line and also supported by the SANBI dataset.

Wetland Health Assessment

Wetland ecological status was assessed by considering impacts to wetland hydrology, geomorphology and vegetation. A summary of the findings is outlined in this report. Prominent land use features surrounding the delineated wetlands, and within the wetlands, include:

- Road network;
- Railway lines; and
- Agriculture areas (game and cattle).

Transnet Capital Projects	Hydrology Impact Score	Geomorphology Impact Score	Vegetation Impact Score	Overall Impact score	Health Category
Pyramid South Wetland	6,70	8,30	6,00	6,96	E

Wetland Ecological Importance and Sensitivity

According to the Gauteng C-Plan the proposed Pyramid South expansion projects is outside of the important critical biodiversity area. While on the wetlands there is a thriving combination of fauna and flora, there is low species diversity as the area is disturbed by agriculture activities and the existing railway infrastructure that has been existing for over 20 years. For these reasons, the wetland on site was assigned a LOW ecological importance and sensitivity.

Assessment of Impact

The proposed railway line expansion will have minimal to no impact on the 2 wetlands on site. Any additional water inputs will therefore be channelled offsite through these existing systems. However, due care still needs to be exercised around this area.

Conclusion

The current study approves the expansion of the railway line at Pyramid South and a range of mitigation measures are recommended to inform the environmental management plan and the water use licence.

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LIST OF TERMS AND ABBREVIATIONS

Delineation – the technique of establishing the boundary of an aquatic resource such as a wetland or riparian area.

Drain – In the context of wetlands, refers to a natural or artificial feature such as a ditch or trench created for the purpose of removing surface and sub-surface water from an area (commonly used in agriculture).

DWS- Department of Water and Sanitation

Ecological Importance – An expression of the importance of an environmental resource for the maintenance of biological diversity and ecological functioning on local and wider scales.

Ecological Sensitivity – A system's ability to resist disturbance and its capability to recover from disturbance once it has occurred.

EIS – Ecological Importance & Sensitivity.

GIS – Geographical Information Systems.

GPS – Global Positioning System.

Gulley (or erosion gulley) - A gully (commonly called a "donga") is an erosion landform or feature, created by running water eroding sharply into soil. Gullies generally resemble small ditches that can be several meters in depth and width. Gullying or gully erosion is the process by which gullies are formed.

HGM – Hydro-Geomorphic.

NFEPA – National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2010).

PES – Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting change from its reference condition.

SANBI – South African National Biodiversity Institute

1. INTRODUCTION

Kimopax Pty Ltd has been appointed by Transnet Capital Projects as an independent environmental assessment practitioner to apply for the Environmental Authorization and Water Use License Application for the expansion of a railway lines at Pyramid South, Gauteng Province. The project is situated within the City of Tshwane municipality.

Kimopax Pty Ltd is applying for environmental authorisation on behalf of the proponent for the expansion of railway lines in accordance with the National Environmental Management Act, 1998 (Act 107 of 1998) as amended and the Environmental Impact Assessment Regulations of 2017 as well as all relevant regulations promulgated in terms thereof for the proposed expansion of a railway yard at Pyramid South, Gauteng. See Figure 1 below:

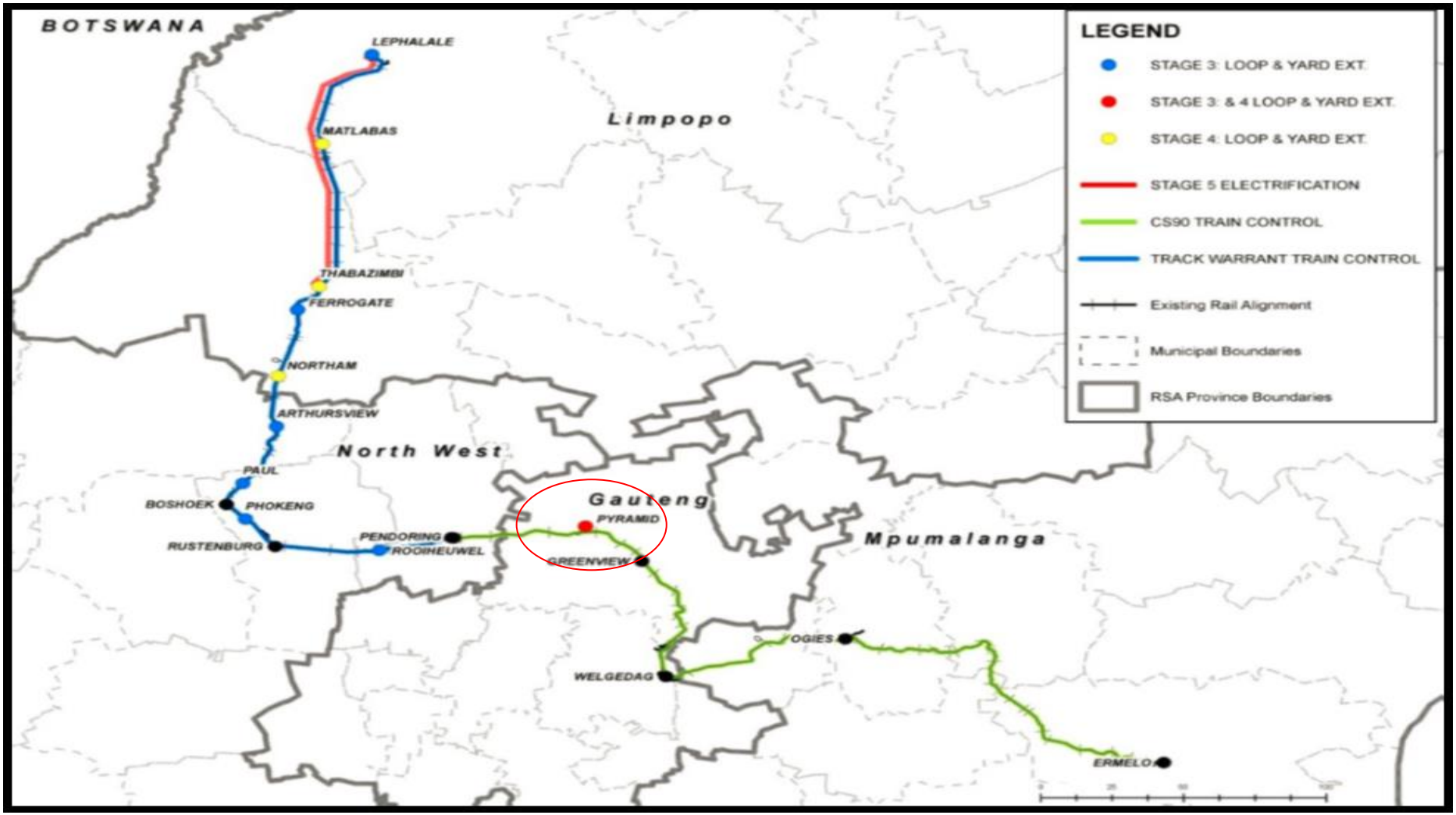

Figure 1: Spatial Location of Pyramid South railway yard

2. SITE LOCATION

Pyramid South is in the Onderstepoort, Bon Accord in Pretoria North, Gauteng Province and is situated along the old Warmbaths road (R101) in the Northern part of Rooiberg Asphalt Pyramid in Pretoria North. The proposed project is located on farm Doornpoort 295 JR within City of Tshwane Metropolitan Municipality (Figure 2).

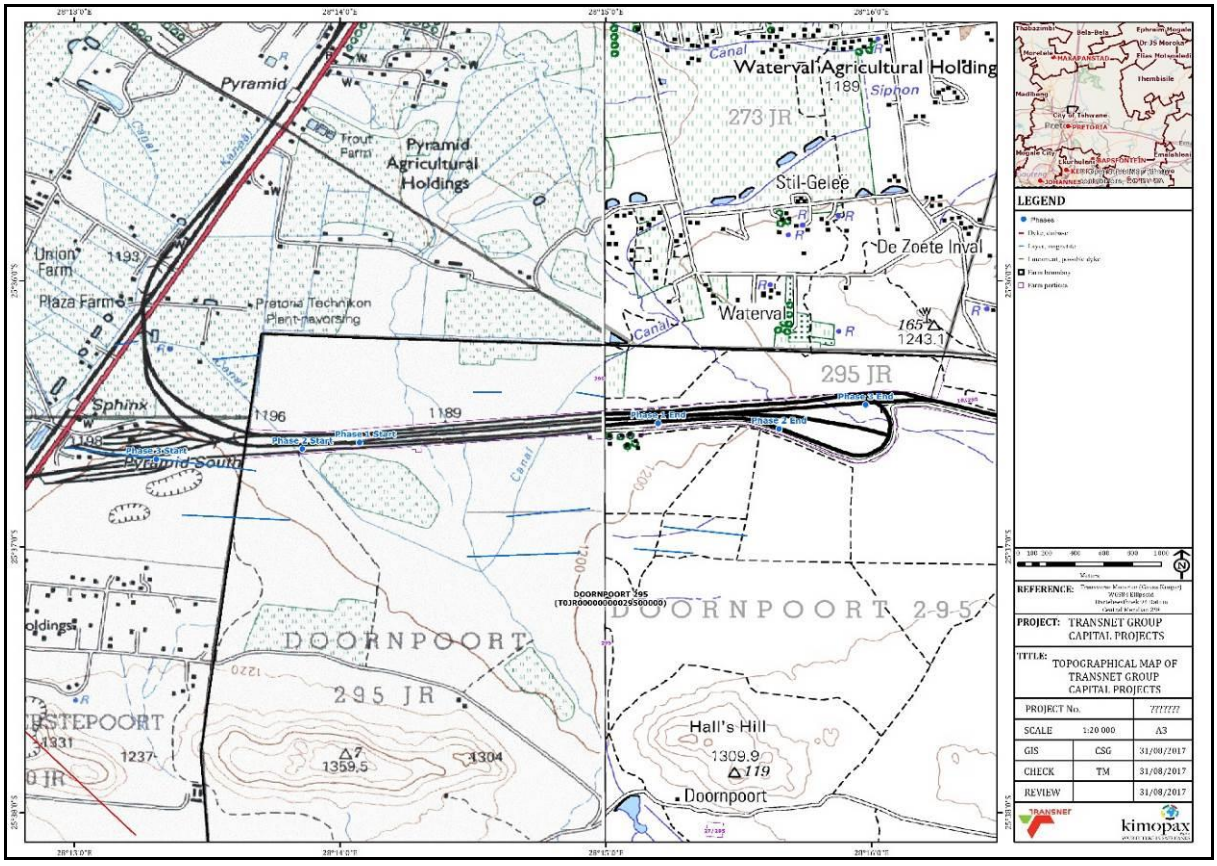

Figure 2: Locality Map of the proposed project

3. PROJECT DESCRIPTION

The project forms part of the Transnet Waterberg rail corridor expansion programme between Ermelo, located in Mpumalanga Province, and Lephalale, located in the Limpopo Province. The railway line is a key corridor to Transnet for the transportation of various commodities, including coal, chrome, ferrochrome, cement, lime, granite, iron ore, containers and general freight. The construction activities focus specifically on the upgrades required for the coal expansion of the line.

Unlocking the Waterberg area is a key priority in Government's National Development Plan and has been identified as part of Strategic Infrastructure Projects (SIP 1) by the Presidential Infrastructure Coordinating Commission (PICC). Specifically, for coal, expansion in rail capacity was identified as a strategic initiative and received much attention from Government as a key driver for the South African economy. The latest rail capacity demand from coal miners in the Waterberg is informed by mine expansion projects and proposed new mine developments. In line with these strategic priorities for the country, Transnet has developed a programme for expansion of railway infrastructure between Lephalale in the Limpopo province and Pyramid South in Gauteng. The expansions will ultimately feed the heavy haul Coal Line for increased coal exports through the Port of Richards Bay and also deliver coal to several power stations along the existing rail route. The scope of the project at Pyramid South yard includes the expansion of the existing railway lines in the yard. The yard is a switching yard which switches from 25 kV AC to 3 kV DC. The yard is located on the railway network between Rustenburg and Northam. The yard expansion will be undertaken within the Transnet servitude, therefore no additional land will be acquired (Figure 3). The expansion requires the construction of new culverts, extension of culverts and new surface drains (Table 2).

Table 1: Pyramid South yard coordinates

	Latitude	**Longitude**
Phase 1		
Start	25°36'36.50"S	28°14'4.39"E
End	25°36'32.15"S	28°15'11.77"E
Phase 2		
Start	25°36'37.94"S	28°13'51.47"E
End	25°36'33.40"S	28°15'39.06"E
Phase 3		
Start	25°36'40.27"S	28°13'18.53"E
End	25°36'28.00"S	28°15'58.65"E

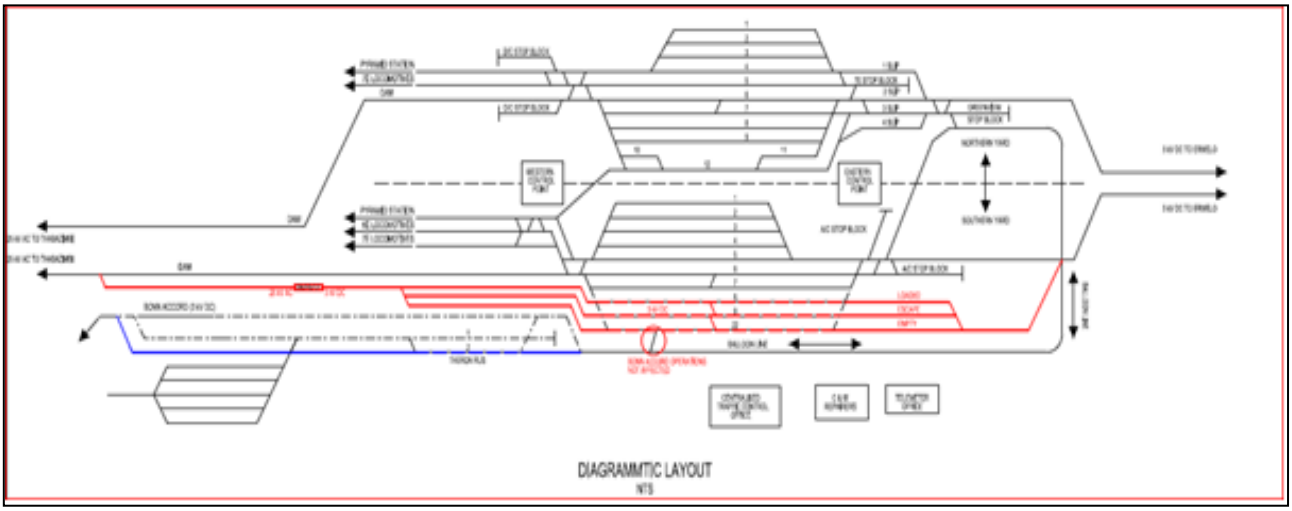

Figure 3: Diagrammatic layout Pyramid South yard (Blue line: Phase 1 (Bonn Accord Deviation), Red lines: Phase 2 (End-state))

Table 2: Waterberg Stage 3 culverts for Pyramid South

Loop	Coordinates	Culvert size	Length of Extension Or New Culvert	Details
Pyramid South Yard	25°36'37.51"S 28°14'0.22"E	Pipe: Ø900	11,5 m	Existing culvert to be extended
	25°36'36.79"S 28°14'13.61"E	Triple Box: 2,00 x 2,00	10m	Existing culvert to be extended
	25°36'35.79"S 28°14'26.48"E	Box: 3,10 X 2,00	10 m	Existing culvert to be extended
	25°36'28.86"S 28°15'49.95"E	Triple Box: 2,00 X 1,50	17 m	New culvert (Precast elements)

4. TERMS OF REFERENCE

The Wetland delineation covers the following:

- A map demarcating the relevant local drainage area of the respective wetland/s, i.e. the wetland, its respective catchment and other wetland areas within a 500m radius of the study area. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the zone of influence.
- Maps depicting demarcated wetland areas delineated to a scale of 1:10 000, following the methodology described by the (Department of Water Affairs and Forestry) DWAF (2005), together with a classification of delineated wetland areas, according to the methods contained in the Level 1 WET-Health methodology and the latest National Wetland Classification System (2010).

- The determination of the ecological state of any wetland areas, estimating their biodiversity, conservation and ecosystem function importance with regard ecosystem services. (Note that this determination will not include avifaunal, herpetological or invertebrate studies; however possible habitat for species of special concern would be commented on).
- Recommend buffer zones and No-go areas around any delineated wetland areas based on the relevant legislation or best practice.
- Assess the potential impacts, based on a supplied methodology
- Assessment of the risk to wetlands of a major or catastrophic oil spill during construction and Operation Phase.

5. APPROACH AND METHODOLOGY FOLLOWED

a. Consulted Data Sources

The following data sources were used to inform the assessment:

- National Freshwater Ecosystem Priority Areas (NFEPA) wetland coverage, which shows location of Freshwater Ecosystem Priority Areas (FEPA) wetland sites.
- 1:50,000 imagery as well as latest Google Map Imagery for desktop assessment of the site.
- Wet-Health tool for the assessment of the present ecological status or health of the wetland.
- Eco-Services tool for the assessment of ecological importance and sensitivity of the wetland.

b. Data Collection

The topography data was obtained from the Surveyor General's 1:50 000 toposheet data for the region. Contours were combined from the topographical map sheets to form a combined contours layer.

c. Wetland Delineation

The riparian zone and wetlands were delineated according to the Department of Water and Sanitation (previously DWAF) guideline, 2003: A practical guideline procedure for the identification and delineation of wetlands and riparian zones.

The guidelines indicate that wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water loving plants (hydrophytes); and
- A high water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50 centimetres of the soil.

During the site investigation the following indicators of potential wetlands were identified:

- Terrain unit indicator;
- Soil form indicator;
- Soil wetness indicator; and
- Vegetation indicator.

d. Classification of Wetlands

This stage includes breaking the wetland units into Hydro-geomorphic types (HGM); which are defined based on geomorphic setting (e.g. hillslope or valley bottom), water source (surface water dominated or sub-surface water dominated) and how water flows through the wetland unit (diffusely or channelled). Each wetland unit distinguished based on hydro-geomorphic type, were assessed individually. Figure 4 below indicates the wetland hydro-geomorphic setting of inland wetlands in South Africa as well as wetland classification applied on wetlands for assessment.

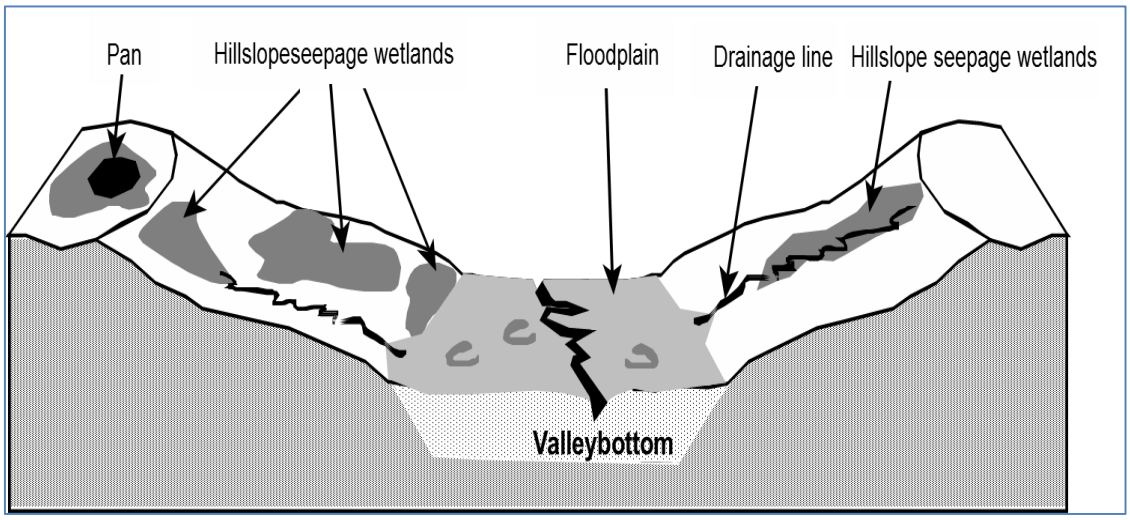

Figure 4: Wetland hydro-geomorphic setting

e. Existing Impacts and Catchment Context

Using available information, existing impacts to the wetlands and within the delineated micro-catchment were mapped and described.

f. Wetland Health Assessment

A level 2 Wet-Health method was used to determine the health of wetlands on site, thus describing their present ecological status (PES) (Macfarlane, et al. 2008). This method utilises geomorphology, hydrology and vegetation to determine the health of a wetland. The hydrology module assesses the

land use descriptors (irrigation, level of reduction or increase in flows, hydro-geomorphic setting of the wetland and extent of canalisation and gully formations). The vegetation module assesses the level of vegetation transformation, which is indicated by level of alien species invasion, terrestrial species encroachment and encroachment by indigenous invasive species. The geomorphology module captures deviations in the sedimentary inputs and outputs to and from wetlands that are consequence of human activities.

Values range from Class A (largely natural) to Class F (critically modified). Table 3 below describes the overall HGM health categories and their scores. This is calculated as 10 -Impact scores to get the overall impact score.

Table 3: Health categories used by WET-Health for describing the integrity of wetlands

HEALTH CATEGORY	DESCRIPTION	Min Score
A	Unmodified, natural.	**0 – 0.9**
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**1 – 1.9**
C	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**
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	**4 – 5.9**
E	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**
F	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**

An overall wetland health score was calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

This overall score assists in providing an indication of wetland health/condition which can in turn be used for recommending appropriate management measures.

g. Wetland Ecological Importance and Sensitivity (EIS)

An assessment of the importance and sensitivity of wetland systems using the Wetland EIS (Ecological Importance and Sensitivity) assessment tool was undertaken using the outcomes of the WET-Health assessment and other valuable information gathered in the field as well as available desktop information. The tool includes an assessment of three components:

- Biodiversity support
- Landscape scale importance
- Sensitivity of the wetland to floods and water quality changes

The maximum score for these components was taken as the importance rating for the wetland which is rated using Table 4, below.

Table 4: Ecological Importance and Sensitivity rating table

RATING	EXPLANATION
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime.
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime.
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime.
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime.
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime.

h. Impact Assessment

The information gained from the functional integrity and EIS assessments was used to inform an assessment of the likelihood and significance of potential impacts associated with the proposed mining activities. The following methodology (Table 5) has been adopted from the DWA's Operational Guideline, 2010 entitled "Operational Guideline: Integrated Water and Waste Management Plan.

Table 5: Ranking scales for impact assessment

DURATION (D)	MAGNITUDE (M)

5 – Permanent 4 - Long term (ceases with operational life) 3 - Medium term (5-15 years) 2 - Short term (0-5 years)	10 - Very high/do not know 8 - High 6 - Moderate 4 - Low
SCALE (S)	**PROBABILITY (P)**
5 – International 4 - National 3 - Regional	5 - Definite/do not know 4 - Highly probable 3 - Medium probability 2 - low probability 1- Improbable
SIGNIFICANCE POINTS (SP) = (D+M+S) X P	
HIGH (H) = >60 POINTS	
MODERATE (M) = 30-60 POINTS	
LOW (L) = <30 POINTS	
NO SIGNIFICANCE = 0	
POSITIVE IMPACT	

The maximum value of significance points is 100. Environmental effects could therefore be rated as either high (H), moderate (M), or low (L) significance, as seen above.

6. WETLAND ASSESSMENT RESULTS

a. Site Description

The site is well developed with extensive railway line infrastructure. On the southern part of the railway line, there are two (2) distinct wetlands as indicated by the following attributes:

- Presence of hydromorphic soils that display characteristics resulting from prolonged saturation; and
- The presence of water loving plants (hydrophytes) (Figure 5 and Figure 6).

Figure 5: Typha capensis (hydrophytes) and freshwater at Pyramid South Wetland 1

Figure 6: Hydromorphic soils at Pyramid South Wetland 1

Time series google images from the year 2001 to 2016 (Appendix 1) shows the long-standing wetland connectivity across the railways line and this is also supported by the SANBI dataset (Figure 8 and 9).

Figure 7: Two distinct wetlands observed on the southern side of the proposed railway expansion site (Wetland 1 and Wetland 2)

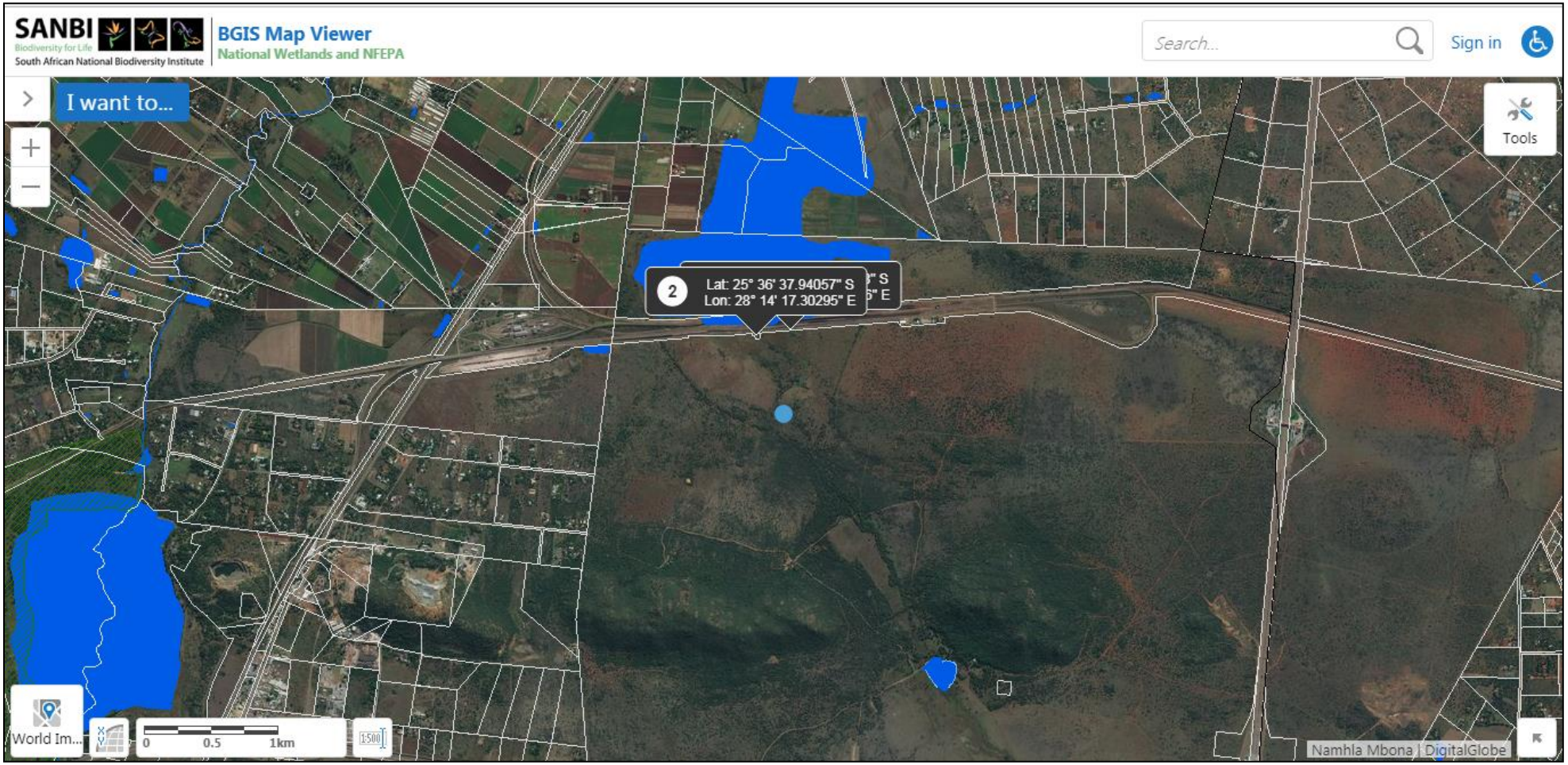

Figure 8: The catchment and water resources (blue) adjacent to the site includes a national wetland (shaded blue across the railway line to the north) (Source: SANBI).

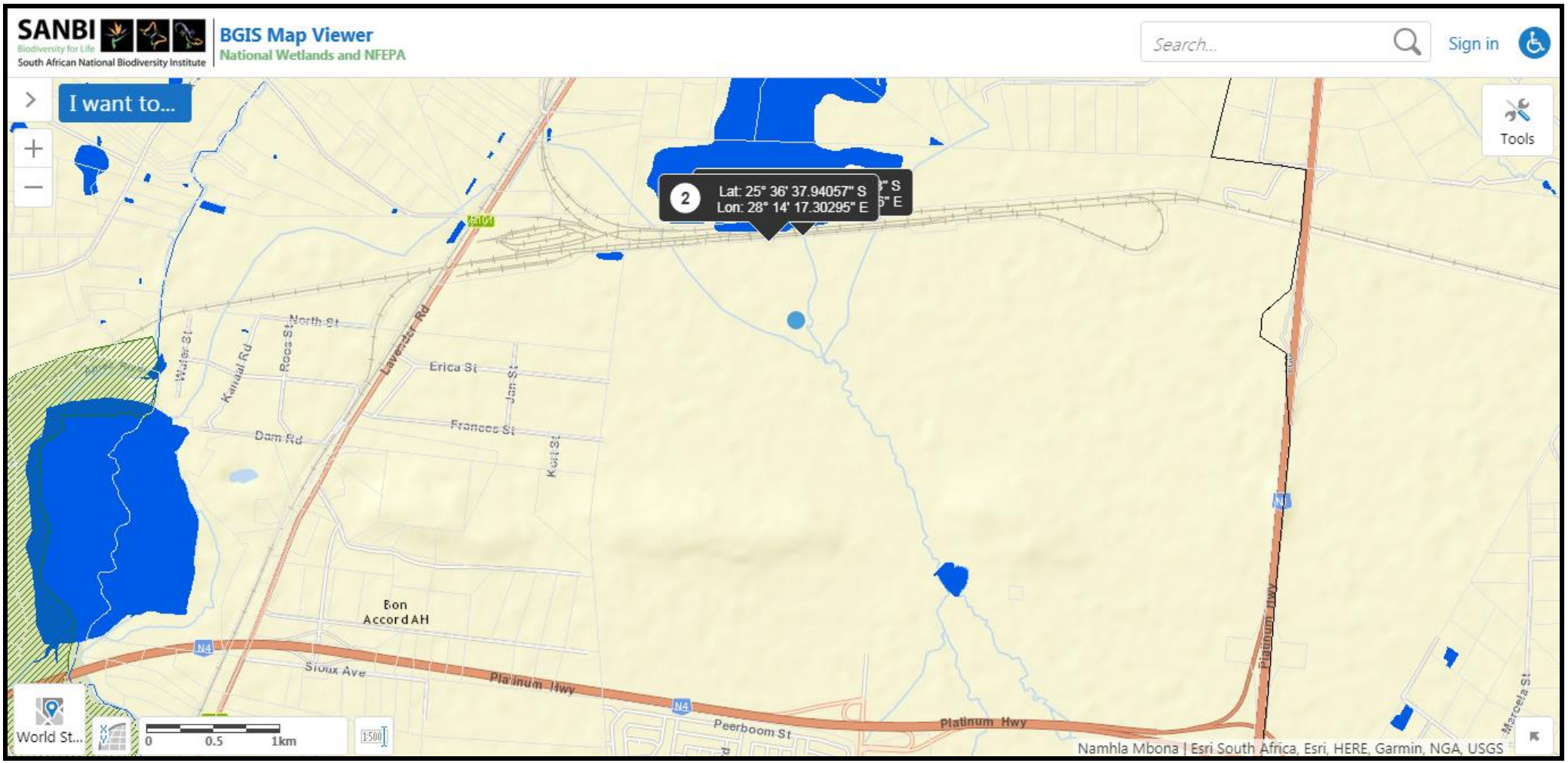

Figure 9: Wetland 1 and Wetland 2 connected to the catchment hydrological system (Source SANBI), (evidence of railway line disturbed channelled valley bottom wetlands)

b. National Wetland Inventory (NWI) AND NFEPA

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, 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. Freshwater Ecosystem Priority Areas (FEPA's) 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. High water yield areas and high groundwater recharge areas were also identified as part of the project.

Based on the recently published Atlas of Freshwater Ecosystem Priority Areas in South Africa (Nel et. al., 2011), there are wetlands within 500m of the proposed developments at Pyramid South. This is also consistent with the findings of this report.

c. Wetland Health Assessment

Wetland ecological status was assessed by considering impacts to wetland hydrology, geomorphology and vegetation. A summary of the findings is outlined in this report. Prominent land use features surrounding the delineated wetlands, and within the wetlands, include:

- Road network;
- Railway lines; and
- Agriculture areas (game and cattle).

d. Hydrology

The major hydrological impact associated with the channelled valley bottom wetland on site includes the water inputs from the, culverts.

Table 6: Assessment of hydrological changes of the wetlands on the site

HGM Unit	HGM Impact Score	Overall Impact Score	Health Category
Channelled valley bottom	3.3	6.7	E

Table 7: Summary of impact scores and health category associated with changes in hydrology

IMPACT CATEGORY	DESCRIPTION	SCORE	HYDROLOGICAL HEALTH CATEGORY
None	No discernible modification or the modification is such that it has no impact on hydrological integrity.	**0 – 0.9**	**A**
Small	Although identifiable, the impact of this modification on hydrological integrity is small.	**1 – 1.9**	**B**
Moderate	The impact of this modification on hydrological integrity is clearly identifiable, but limited.	**2 – 3.9**	**C**
Large	The modification has a clearly detrimental impact on hydrological integrity. Approximately 50% of hydrological integrity has been lost.	**4 – 5.9**	**D**
Serious	The modification has a clearly adverse effect on hydrological integrity. Well in excess of 50% of the hydrological integrity has been lost.	**6 – 7.9**	**E**
Critical	The modification is so great that the ecosystem processes of this component of hydrological health are drastically altered. 80% or more of the hydrological integrity has been lost.	**8 – 10**	**F**

e. Geomorphology

The wetland on site mimics a canalised system where geomorphological features are immaterial.

Table 8: Assessment of geomorphological changes of the wetlands on the site

HGM Unit	Overall Impact Score	Health Category
Channelled valley bottom	**8.3**	**E**

Table 9: Summary of the impact scores associated with geomorphological changes

Threat Category	Description	Score	GEOMORPHOLOGY HEALTH CATEGORY
None	No discernible threat or the threat is such that no impact on wetland geomorphic integrity could be expected.	**0 – 0.9**	**A**
Small	Although identifiable, the threat posed could only be expected to have a small impact on wetland integrity.	**1 – 1.9**	**B**
Moderate	The threat posed could be expected to have an identifiable, but limited impact on wetland integrity.	**2 – 3.9**	**C**
Large	The threat posed could be expected to reduce wetland integrity by approximately 50%.	**4 – 5.9**	**D**
Serious	The threat posed could be expected to reduce wetland integrity in excess of 50%.	**6 – 7.9**	**E**
Critical	The threat posed could be expected to destroy ecosystem processes.	**8 – 10**	**F**

f. Vegetation

The site was characterised by vegetation lacking in species richness. The plant species identified included *typha capensis* and some *sedges*.

Figure 10: Some vegetation species identified on the Pyramid South site

Tables 10 and 11 are the results of the vegetation assessment and the summary of wetland health scores.

Table 10: Assessment of vegetation changes of the wetlands on the site

HGM Unit	HGM Impact Score	Overall Impact Score	Health Category
Channelled valley bottom	4.0	6.0	E

Table 11: Summary of the Health scores associated with vegetation changes

DESCRIPTION	Score	HEALTH Category
Vegetation composition appears natural.	**0 – 0.9**	**A**
A very minor change to vegetation composition is evident at the site.	**1 – 1.9**	**B**
Compositional changes are evident but the site still contains mostly species expected in the reference state. Vegetation composition has been clearly altered but still contains a large proportion of natural species expected in the reference state.	**2 – 3.9**	**C**
Vegetation composition has been largely altered and introduced, alien and/or ruderal species are abundant but most characteristic wetland species are usually still present.	**4 – 5.9**	**D**
Vegetation composition has been substantially altered but some characteristic species remain, although the vegetation consists mainly of introduced, alien and/or ruderal species.	**6 – 7.9**	**E**
Vegetation composition has been totally or almost totally altered, and if any characteristic species still remain, their extent is very low.	**8 – 10**	**F**

g. Summary of the Impact Scores

When the results of the three modules detailed above are combined, the PES results for the wetlands were as follows (Table 12):

Table 12: Summary of the wetland PES assessment

HGM Unit	Hydrology Impact Score	Geomorphology Impact Score	Vegetation Impact Score	Overall Impact score	Health Category
Pyramid South wetlands	6,70	8,30	6,00	6,96	E

h. Wetland Ecological Importance and Sensitivity (EIS)

Ecological Importance and Sensitivity is a concept introduced in the reserve methodology to evaluate a wetland in terms of:

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

The ecological importance of the disturbed channelled valley bottom wetland was assessed based on terrestrial and aquatic biodiversity.

Table 13: Generic hydrological functions performed by wetlands

WETLAND HYDRO-GEOMORP HIC TYPE	Source of water maintaining the wetland		HYDROLOGICAL FUNCTIONS POTENTIALLY PERFORMED BY THE WETLAND								
			Flood attenuation		Stream flow augmentation		Erosion control	Potential for water quality enhancement			
	Surface	Sub-surface	Early wet season	Late wet season	Early wet season	Late wet season		Sediment trapping	Phosphate removal	Nitrates	Toxicants
1. Valley bottom - channelled	*	*	+	0	0	0	++	+	+	+	+

Water source: Contribution usually small

0

* Important contribution

Rating:

The wetlands ecological importance and sensitivity is summarised below.

Table 14: Summarised wetland ecological importance and sensitivity

HGM Unit	EIS
Channelled Valley Bottom	Low

7. MITIGATION MEASURES AND RECOMMENDATION

The proposed expansion of rail infrastructure will have minimal to no impact on the 2 wetlands on site. The site is already heavily disturbed due to many years of railway infrastructure on site. Any additional water inputs will therefore be channelled offsite through these existing systems. However, due care still needs to be exercised around this area. General recommendations are listed below.

a. Loss and disturbance of wetland habitat

Mitigation:

- Avoid additional wetland loss by limiting construction activities to as small an area as possible.
- Mark wetland areas with 'No-Go' signage.
- Limit all activities within the demarcated areas.
- Include environmental awareness aspects into the site induction program to ensure all construction staff are aware of the location and importance of wetland habitats.
- Establish emergency response measures and a clearly defined chain of communication to rapidly deal with any unforeseen impacts to wetlands, e.g. spills.
- No stockpiling of material may take place within the wetland areas and temporary construction camps and infrastructure should also be located outside the wetland footprint.
- Regular cleaning up of the wetland areas should be undertaken to remove litter.

b. Increased sediment transport into wetlands

Mitigation:

- Where practically possible, the major earthworks should be undertaken during the dry season (roughly from April to August) to limit erosion due to rainfall runoff.

c. Water quality deterioration within wetlands

Mitigation:

- Store and handle potentially polluting substances and waste in designated, bunded facilities.

- Waste should be regularly removed from the construction site by suitably equipped and qualified operators and disposed of in approved facilities.
- Locate temporary waste and hazardous substance storage facilities a minimum of 100m from any wetland edge.
- Keep sufficient quantities of spill clean-up materials on site.

8. CONCLUSION

The Pyramid South 2 channelled valley bottom wetland are within 500m of the proposed expansion of railway lines. The wetlands highly impacted with a present ecological status of an E category. This means that very little hydrological, geomorphological and vegetation importance can be expected from this wetland. No impacts to the wetland could be established by the current assessment; although precautionary measures that relate to increased hydrology should be taken. The current study approves the expansion of the railway line at the site.

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APPENDIX 1

Aerial images: Time series (2001- 2016)

Image 1: August 2016

Image 2: August 2015

Image 3: May 2013

Image 4: September 2013

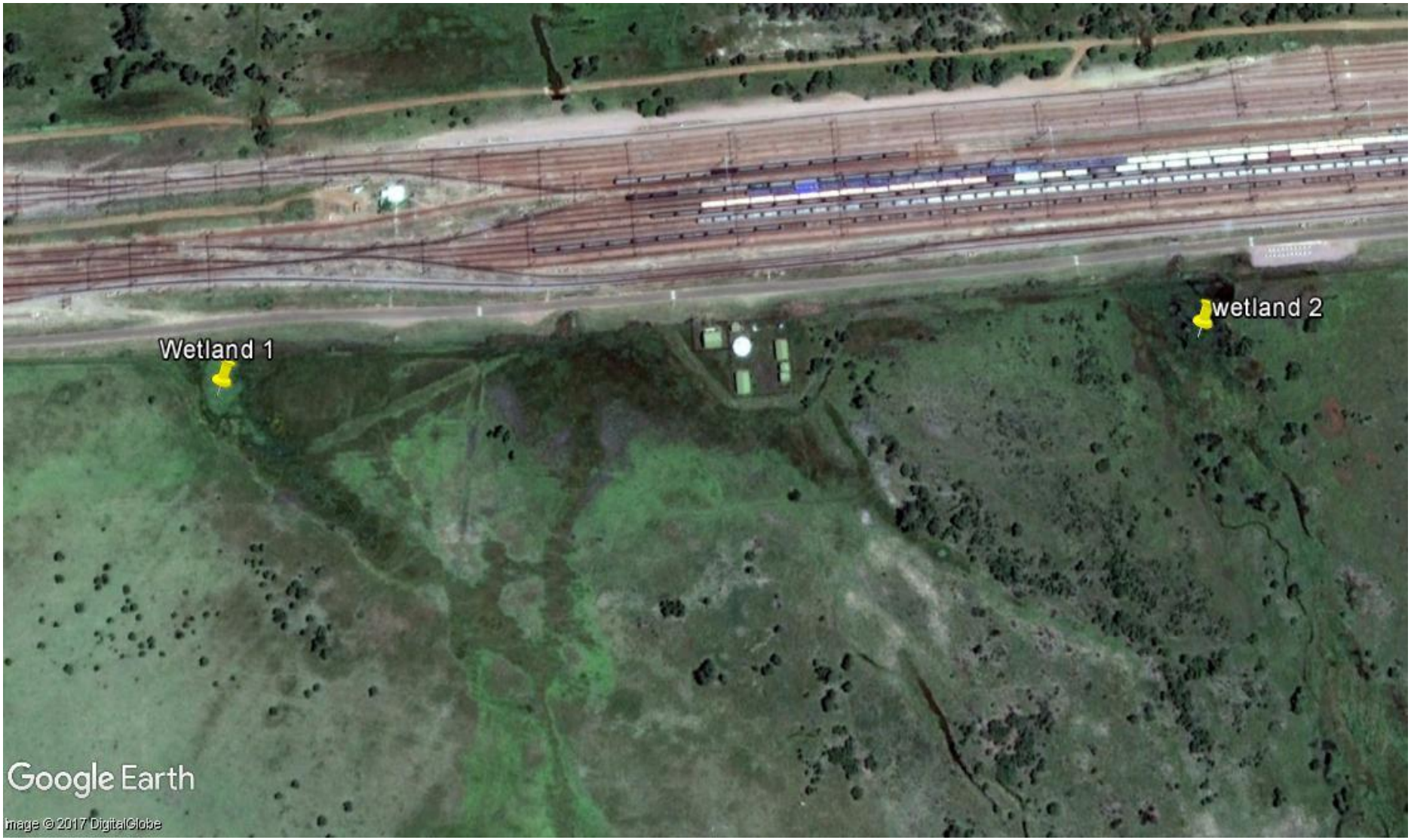

Image 5: March 2012

Image 6: March 2011

Image 7: February 2005

Image 8: February2004

Image 9: July 2001