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An aquatic assessment of the proposed Seaview Greenbushes bulk water expansion project area, Nelson Mandela Bay Metropolitan Area, Eastern Cape

August 2016

An aquatic assessment of the proposed Seaview Greenbushes bulk water expansion project area, Nelson Mandela Bay Metropolitan Area, Eastern Cape

by

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Commissioned by

SRK Consulting

Project 485194

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DECLARATION OF INDEPENDENCE

I, George Johannes Bredenkamp, Id 4602105019086, declare that I:

- Hold a DSc in biological sciences, am registered with SACNASP as a professional ecological scientist which sanctions me to function independently as a specialist consultant
- Declare that, as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003, this project was my work from its inception, reflects exclusively my observations and unbiased scientific interpretations, and was executed to the best of my ability
- abide by the Code of Ethics of the SACNASP
- Am the owner of Eco-Agent CC, CK 95/37116/23
- Act as an independent specialist consultant in the field of ecology, vegetation science, botany and wetlands
- Am committed to biodiversity conservation but concomitantly recognize the need for economic development
- Am assigned as specialist consultant by SRK Consulting for the proposed project “An aquatic assessment of the proposed Seaview Greenbushes bulk water expansion project area, Nelson Mandela Bay Metropolitan Area, Eastern Cape” described in this report
- Do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work performed
- Have or will not have any vested interest in the proposed activity proceeding
- Have no and will not engage in conflicting interests in the undertaking of the activity
- Undertake to disclose to the client and the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2014
- Will provide the client and competent authority with access to all information at my disposal, regarding this project, whether favourable or not.
- Reserve the right to only transfer my intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, I recognise that written consent from the client(s) will be required for me to release any part of this report to third parties.

GJ Bredenkamp

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SUMMARY

The Nelson Mandela Bay Municipality (NMBM) proposed to expand current bulk water supply infrastructure for the future provision of potable water to the Seaview and Greenbushes supply areas.

Of the 22 wetlands or potential wetlands and aquatic systems identified within a 500 m buffer of proposed construction activities using existing databases and own observations, six are natural, six are artificial and ten sites contained no wetland. The presence of twelve wetlands / aquatic systems therefore implies that a Water Use Licence will be needed in terms of the stipulation published in Government Gazette No 32805 on 18 December 2009.

All 22 sites were visited during the field survey conducted during 4-15 August 2016. An assessment was made at each site where a wetland or other aquatic systems were present. The assessment included a general description and delineation of the

wetland or other aquatic system, a wetland classification, and an assessment of the Present Ecological status (PES) and Environmental Importance and Sensitivity (EIS).

Local government policies require that protective wetland buffer zones be calculated from the outer edge of the temporary zone of a wetland and river buffer zones be calculated from the outer edge of the riparian zone. There are guidelines and local policies for the determination of buffer zones from a wetland or watercourse Macfarlane *et al.* (2010), however generally 32 m is regarded as a standard for buffer zone (Ezemvelo IEM, 2011; Biodiversity Act, 2004 (Act 10 of 2004), and particularly the recently policy published in Regulation 983, Government Gazette 38282, December 2014).

The impact assessment showed that the impact of the development on all the wetland and aquatic systems will be insignificant. From an ecological perspective, all wetlands and aquatic systems identified within the study area are regarded as not threatened by the proposed pipeline development and any conservation value they may have will not be jeopardised by the development. Future water flow, after construction of the pipeline, may again cause unwanted wet conditions over the pipeline, and a drainage system may be needed locally to prevent damming of water over the pipeline, depending on the opinion of the design engineers.

It was furthermore derived from the assessments of all the wetlands and aquatic systems, that the proposed pipeline development will not affect any of the wetlands or aquatic systems present within the study area, negatively.

It is suggested that the proposed pipeline development can be supported.

1. ASSIGNMENT

The Nelson Mandela Bay Municipality (NMBM) proposed to expand current bulk water supply infrastructure for the future provision of potable water to the Seaview and Greenbushes supply areas. The proposed project activities could have an impact on nearby wetlands and surface water courses. For this reason, an Impact

Assessment is proposed to identify and determine the significance of any such impacts.

PROPOSED TERMS OF REFERENCE

- Confirm the scope of work, clarify the nature of the project and obtain background information;
- Conduct a desktop research study regarding the wetlands within 500 m of the proposed construction activities as well as other watercourses that could potentially be affected;
- Site visit to ground truth the information obtained in the desktop study. This will include delineation of wetlands within 500 m of the proposed structures as well as affected watercourses;
- Classify all identified wetlands;
- Compile the relevant maps indicating wetlands, watercourses and buffers (if required);
- Determine the Present Ecological State (PES) and the Ecological Importance and Sensitivity (EIS) and comment on the conservation status and ecosystem function and/ or importance of wetlands and watercourses; and
- Compile a report that will include a description and condition of identified wetlands and watercourses. The report will also include the identification of potential impacts of the proposed activity on the aquatic environment and suggest mitigation measures to prevent such impacts. Actions to enhance the functioning of identified aquatic features will also be considered and recommended, if any.

ACTIVITY DESCRIPTION

The proposed development aims to expand current bulk water supply infrastructure in order to address the future provision of potable water to the Seaview and Greenbushes supply areas. The Nelson Mandela Bay Municipality proposes to develop Phase 1 which entails the provision of bulk water infrastructure to 8,020 erven within the relevant supply areas. The proposed bulk infrastructure for this phase is based on proposed developments currently at planning stage.

Seaview Bulk Water Supply (Phase 1)

This supply area is currently supplied from the Seaview pump station 1.2 ML sump/ reservoir and via a number of small local schemes drawing directly from the two adjacent Churchill pipelines. The existing Seaview pump station complex will be expanded to accommodate the proposed bulk infrastructure. The infrastructure planned for the Seaview supply area is as follows:

- The construction of a 2.5 ML clear water bulk storage reservoir at the existing Seaview pump station complex;
- The construction of a 2.5 ML clear water bulk storage reservoir at the proposed Upper Seaview Bulk Storage Reservoir site;

- The construction of a 3 m wide gravel access road at the 2.5 ML reservoir at the Upper Seaview Bulk Storage Reservoir site;
- The upgrading/ modification of the pump station at the existing Seaview pump station complex to supply the proposed 2.5 ML reservoir at the Upper Seaview reservoir site;
- The construction of a pumping main, 315 mmØ pipeline from the Seaview pump station complex to the 2.5
- ML Upper Seaview Bulk Storage Reservoir, approximately 1,630 m in length within a proposed 3 m wide servitude;
- The construction of a 350 mmØ bulk gravity supply pipeline from the 2.5 ML bulk storage reservoir at the Upper Seaview site, approximately 1,300 m in length, which connects to a Tee above the Seaview pump station complex and thereafter splits towards the supply areas;
- The construction of a 250 mmØ gravity main pipeline (approximately 3,220 m in length) connecting Zone 2 to the Tee above the Seaview pump station, along a 3 m wide pipeline servitude;
- The construction of a 315 mmØ (1,500 m in length) gravity main pipeline connecting Zone 5 to the Tee above the Seaview pump station, along a 3 m wide pipeline servitude;
- The construction of a 315 mmØ (400 m in length) bulk gravity supply pipeline from the 2.5 ML bulk storage reservoir at the Seaview pump station complex connecting into the existing and future pipe-work below the reservoir;
- Gravity connections from the service reservoirs to existing and proposed reticulation (inter-connections between proposed and new pipelines within the Seaview pump station complex); and
- Installation of metering at the Seaview pump station complex.

Greenbushes Bulk Water Supply (Phase 1)

As a result of increasing developments inland and up to Cape Road is it necessary to augment the reticulation of water to this area. Therefore, it is proposed to install a 750 mmØ (outside diameter) steel pipeline, approximately 3,500 m in length, connecting the Greenbushes reservoir to the existing pipe-work at the Chelsea reservoir site.

The aquatic specialist input must therefore identify and determine the potential impacts of the project on any wetland within 500 m of the alignment of the proposed pipelines and associated developments. EcoAgent CC Ecology and Biodiversity Consultants were appointed by SRK Consulting to undertake an independent investigation to the possible presence of wetlands and other aquatic systems within the relevant area, in accordance with the above Term of Reference. In accordance

with The Natural Scientific Professions Act (Act 27 of 2003) only a person registered with the South African Council for Natural Scientific Professions may practice in a consulting capacity. Prof GJ Bredenkamp undertook an independent assessment of the possible presence of wetlands on the site. Surveys were conducted during on 4-15 August 2016.

This investigation is in accordance with the EIA Regulations No. R982-985, Department of Environmental Affairs and Tourism, 4 December 2014 emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as well as the National Water Act 1998 (Act 36 of 1998) (and as amended 2014) and other relevant legislation.

SCOPE

The scope of work is interpreted as follows:

- Conclusively identify the presence or absence of wetlands and other aquatic systems, as prescribed by the DWAF (2005), within 500 m of the proposed development (DWA 2009);
- Delineate the identified wetlands and aquatic systems;
- Classify the wetland or riparian areas according to the system proposed in the national wetlands inventory if relevant;
- Indicate the Present Ecological State (PES), the Ecological Importance and Sensitivity (EIS) and relative functional importance of the wetland or riparian areas;
- Indicate possible impacts of the proposed development on the wetland; and
- Recommend mitigation measures in order to limit the impact of the proposed development on the wetland or riparian areas.

Assumptions and Limitations

Access to the two artificial Aquatic Systems (Dams) at Tembani Lodge, within 500 m of the proposed development was not possible, however they could at least be adequately observed from nearby property boundary fences. As these two aquatic systems are located about 500 m from the proposed alignment of the pipeline, further investigation of these two systems was not regarded necessary. The presence of 22 wetlands / aquatic systems within the 500 m buffer from the proposed pipeline alignment implies that a Water Use Licence will be needed.

2. RATIONALE

It is widely recognised that it is of utmost importance to conserve natural resources in order to maintain ecological processes and life support systems for plants, animals and humans. To ensure that sustainable development takes place, it is therefore important that the environment is considered before relevant authorities approve any development. This led to legislation protecting the natural environment. The Environmental Conservation Act (Act 73 of 1989), the National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998), the National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004) and the National Water Act 1998 (Act 36 of 1998) ensure the protection of ecological processes, natural systems and natural beauty as well as the preservation of water resources and biotic diversity in the natural environment. It also ensures the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes or products or human activities. A draft list of Threatened Ecosystems was published (Government Gazette 2009) as part of the National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). Details of these Threatened Ecosystems have been described by SANBI & DEAT (2009) and a list of Threatened or Protected Species (TOPS) regulations is also available (NEMBA Notice 388 of 2013). International and national Red Data lists have also been produced for various threatened plant and animal taxa.

All components of the ecosystems (physical environment, including water resources, vegetation, animals) of a site are interrelated and interdependent. A holistic approach is therefore imperative to effectively include the development, utilisation and where necessary conservation of the given natural resources in an integrated development plan, which will address all the needs of the modern human population (Bredenkamp & Brown 2001).

In order to evaluate the wetland habitats, it is necessary to make a thorough inventory of these ecosystems on the site, and within 500 m of the footprint of the proposed development. This inventory should then serve as a scientific and ecological basis for the planning exercises.

Definitions and Legal Framework

In a South African legal context, the term watercourse is often used rather than the terms wetland or river. The National Water Act (NWA) (1998) includes wetlands and rivers into the definition of the term watercourse.

Watercourse means:

- 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, and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Riparian habitat is the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005). The National Water Act, 1998 (Act No. 36 of 1998), defines a riparian habitat as follows: "Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse, which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.".

In contrast, the National Water Act, 1998 (Act 36 of 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."(see also Ollis *et al*. 2013, NEMA Government Notices 983, 984, 985, December 2014).

There are guidelines and local policies for the determination of buffer zones from a wetland or watercourse (Macfarlane *et al.* 2010), however generally 32 m is still regarded as a standard for buffer zone (Ezemvelo IEM, 2011; Biodiversity Act, 2004 (Act 10 of 2004), and particularly the recently policy published in Regulation 983, Government Gazette 38282, December 2014).

Authoritative legislation that lists impacts and activities on biodiversity and wetlands and riparian areas that requires authorisation includes (Armstrong, 2009):

- National Environmental Management Act, 1998 (Act No. 107 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- The older Environment Conservation Act, 1989 (Act 73 of 1989);
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983);
- National Water Act, 1998 (Act 36 of 1998);
- National Forests Act, 1998 (Act 84 of 1998);
- National Environmental Management: Protected Areas Act 2003 (Act 57 Of 2003) (as Amendment Act 31 of 2004 and Amendment Act 15 of 2009)
- Government Notice Regulation 982, 983, 984 and 985 of 4 December 2014 (NEMA).

In summary:

- Vegetation, Flora and ecosystems are protected by National Environmental Management Act, 1998 (Act No. 107 of 1998) and the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- Wetlands and other watercourses are protected water resources in the National Water Act (NWA), Act 36 of 1998.
- Development or transformation of a watercourse is regarded as a water use, which can only be allowed through an approved Water Use License, irrespective of the condition of the affected watercourse.
- The NWA defines water use in a watercourse specifically related to wetlands and riparian areas as broad impacts that include the following:
    - impeding or diverting the flow of water in a watercourse (Section 21 c); and
    - altering the bed, banks, course or characteristics of a watercourse (Section 21 i);
- A recent DWS stipulation published in Government Gazette No 32805 on 18 December 2009 also require that a Water Use License should be applied for when any wetlands are present within a 500 m radius of water use activities as defined by section 21 (c) and section 21 (i) of the NWA.
- Wetlands are also protected in other environmental legislation, such as the National Environmental Management Act (NEMA), Act 107 of 1998. The act lists several activities that require authorisation before they can be implemented.

- NEMA lists various activities that require authorisation, when the activity is located within 32 m or less from the edge of a wetland or other watercourse.

3. STUDY AREA

3.1 Location and the receiving environment

The study area is located about 5 km west of the Bay West Mall, about 11 km west of the Cape Road / N2 interchange in Port Elizabeth (Figures 1 & 2).

The proposed **Greenbushes** project area is located along Seaview Rd from the N2 southwards to the Kragga Kamma Rd at Colleen Glen Agricultural Holdings. The pipeline will connect the Greenbushes reservoir to the existing pipe-work at the Chelsea reservoir site. (Figures 1 & 2).

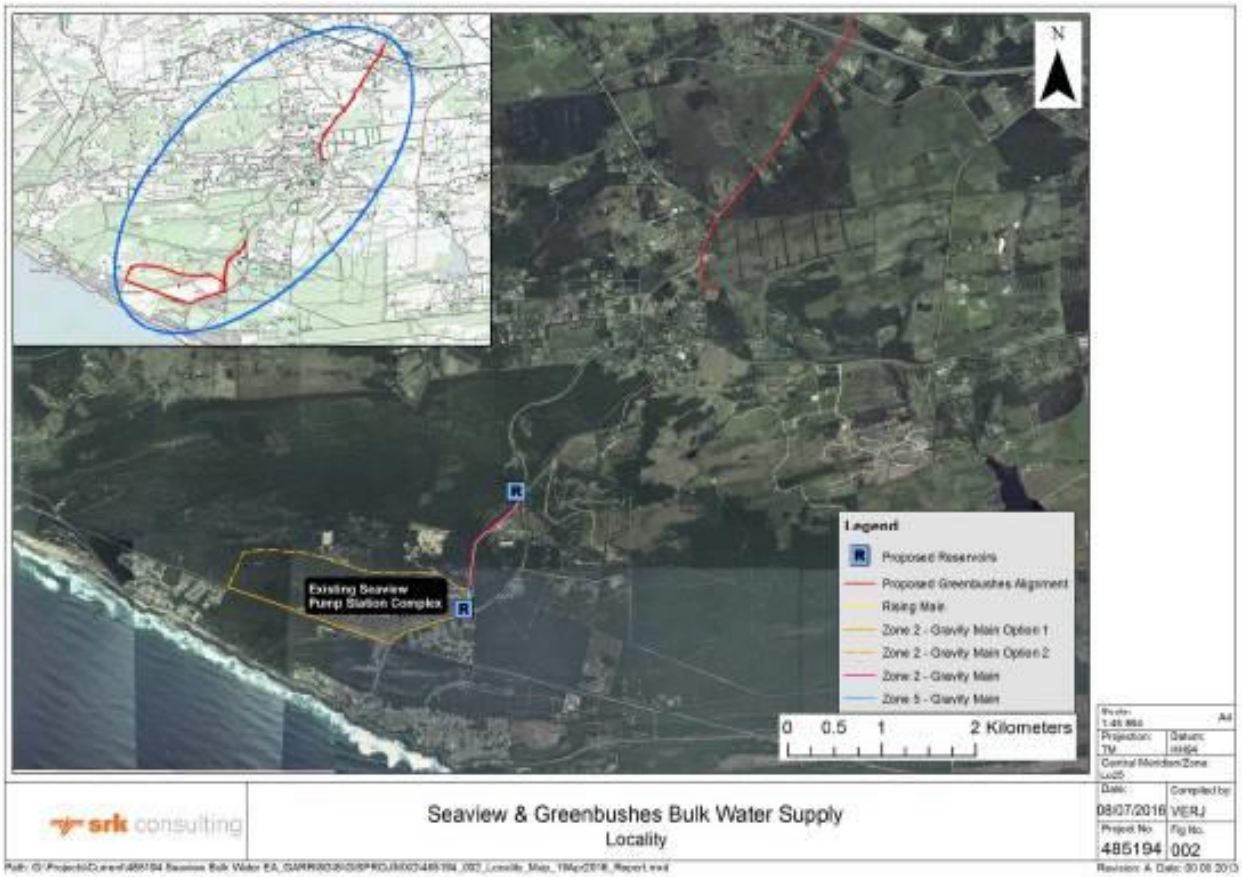


Figure 1: The location of the study site (SRK Consulting).

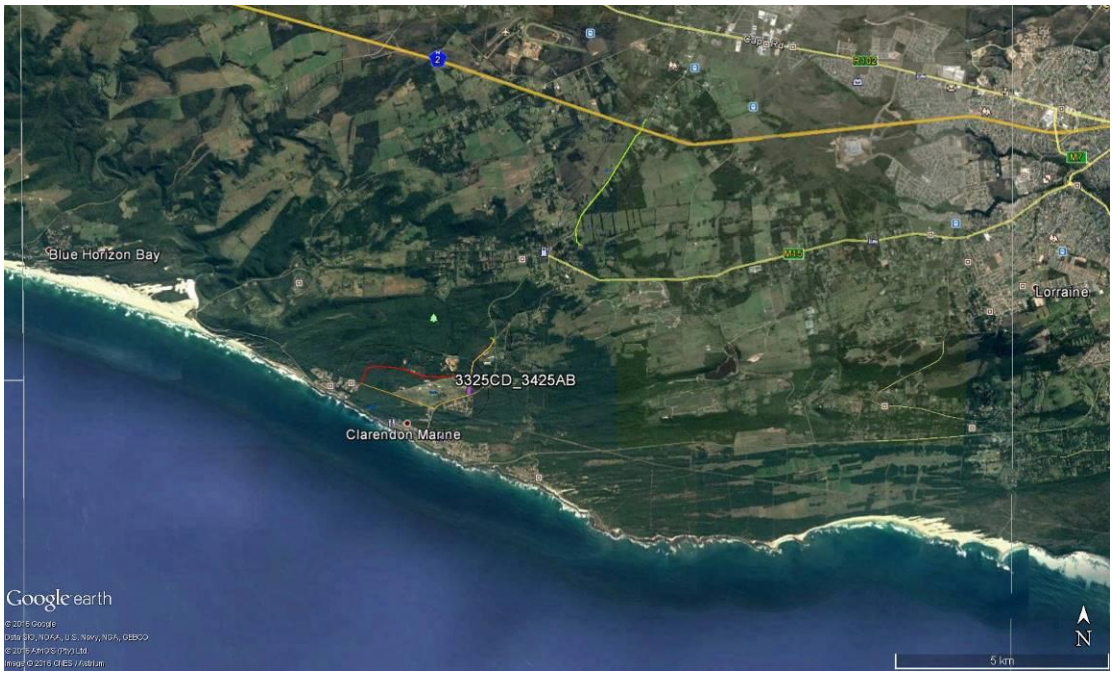


Figure 2: The location of the study site as a Google Earth image

The proposed **Seaview** project area includes a new reservoir in the Island Nature Reserve, close to Seaview Rd, at approximately 33°59S'28.5" S; 25 ° o22'08.7" E. Two pipelines from this reservoir will run south-eastwards in an existing servitude from the existing Seaview reservoir and pump station. This pump station will be upgraded. From this pump station two alternative routes running westwards were proposed, the preferred (southern) route (option 1) is preferred by the project team as it runs within the existing servitude along Seaview Rd and then along an existing pipeline servitude to Beach view. The alternative route (option 2) runs along the gravel road towards Stan's quarry, and then further through the bush towards Beach view.

The following applies for wetlands within the Seaview and Greenbushes pipeline alignments:

- Most of the pipeline route for the Greenbushes alignment is within the road reserve of Seaview Rd (Figures 1 & 2);
- Ten small wetlands are located within the 500 m buffer of the proposed Greenbushes pipeline, as indicated on the National NFEPA and local NMBM GIS layers for wetlands;

- The proposed new reservoir for the Seaview project is located within the Island Nature Reserve;
- Two alternative pipeline routes were proposed for the Seaview project, the preferred along Seaview Rd, the alternative along the gravel road to the quarry and further along an old servitude and through the bush;
- Twelve possible small wetlands are located within the 500 m buffer of the proposed Seaview pipeline, as indicated on the National NFEPA and local NMBM GIS layers for wetlands.

3.2 Physical Environment

Vegetation Types

The proposed Greenbushes pipeline falls within the Algoa Sandstone Fynbos (Vegetation Unit FFs29) Mucina & Rutherford (2006) (Figure 3), however the line is almost entirely located in the road reserve of Seaview Road. Within the 500 m buffer zone where wetlands were identified, the original fynbos is either disturbed, or transformed by clearing into secondary grassland or totally invaded by alien Australian *Acacia* species, or by plantations of *Eucalyptus* species.

The proposed Seaview pipeline alignment is located in Algoa Dune Strandveld (Vegetation Unit AZs1) Mucina & Rutherford (2006), though according to Lloyd *et al.* (2002), Lombard *et al.* (2003) and Vlok & Euston-Brown (2002), between 40% and even >50% of this vegetation unit area has been transformed (Figures 4 & 5) and these areas are now covered by dense alien vegetation dominated by *Acacia cyclops,* which is a Category 2 Invader (Conservation of Agricultural Resources Act, 1983, Henderson 2001). Patches of Southern Coastal Forest (Foz6 Vegetation Unit) occur scattered in the area, especially in the northern part of the Seaview pipeline alignment (Figure 3).

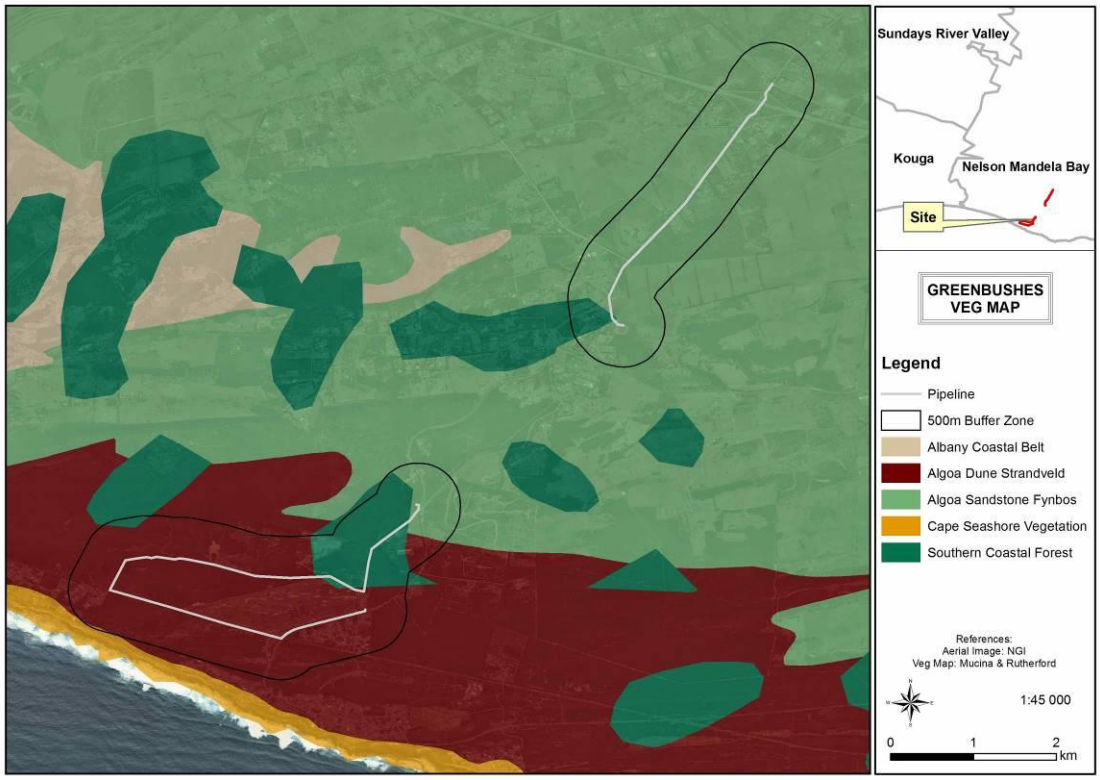


Figure 3: The Vegetation Units according to Mucina & Rutherford (2006).

Regional Climate

The area receives non-seasonal (summer and winter) rainfall of about 600-700 mm per year. Mean monthly maximum and minimum temperatures range from 25^{o}C in February to 7-8^{o}C in July.

Geology and soil

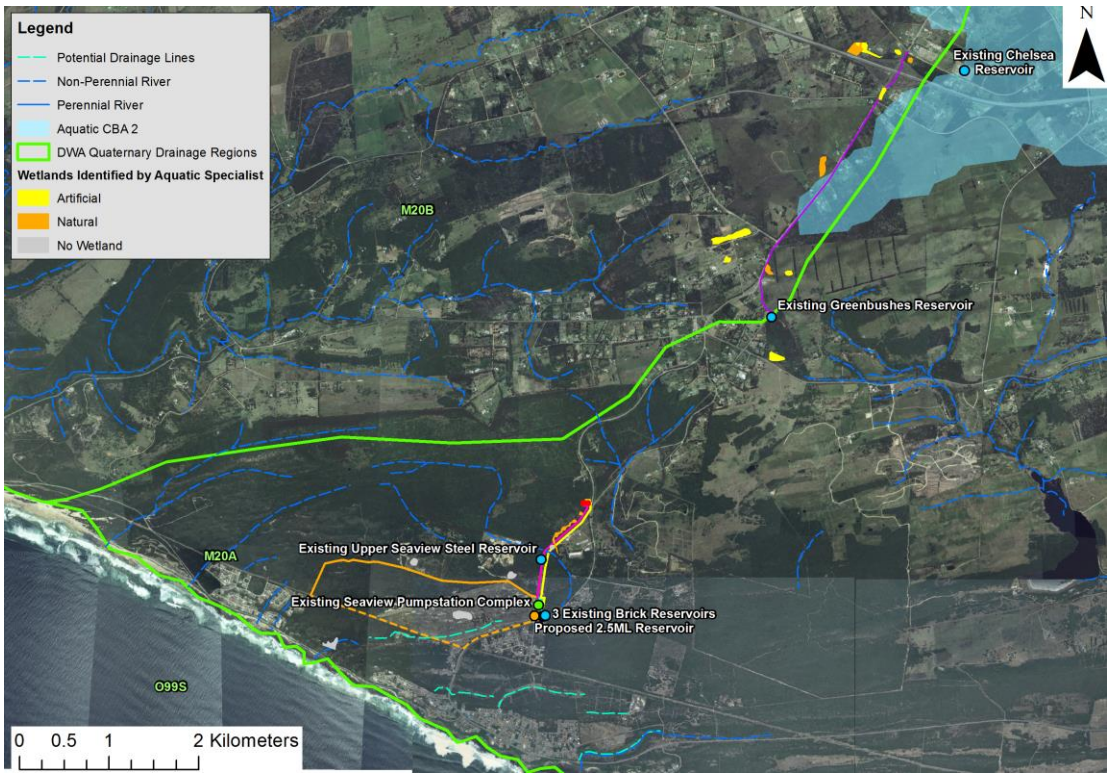
In the Greenbushes area the shallow acidic lithosol soils are derived from Ordovician sandstones of the Table Mountain Group of the Cape Supergroup. The soils are mostly quite shallow and sandy. In general aeolian dune sands of the Schelm Hoek Formation of the Algoa Group cover the area closer to the sea. The Seaview area is partly covered with calcrete bedrock.

Topography and drainage

The Greenbushes area is a flat to slightly undulating plain at about 200 m.a.s.l. supporting the grassy fynbos of the area. The lowland areas may support wetlands, mostly in the form of pans, but often also as man-made, excavated “dams”. Three

dams were built in very small drainage lines. These are regarded as aquatic systems.

The Seaview site is located in a moderately undulating coastal plain with sand dunes, at an altitude of about 100-150 m.a.s.l. Some wetlands occur in the Coastal Forest area, but on the coastal plain most of the wetter areas are man-made, disturbed sites. One of the sites is a highly transformed potential drainage line, regarded as a potential Aquatic System.



This map was prepared by SRK Consulting

A portion of the Greenbushes alignment falls within an Aquatic CBA 2 within quaternary catchment M20A (Baakens estuary). There is also a drainage line that crosses both the Seaview 350 mm diameter Gravity Main and 315 mm diameter Rising Main north of the existing Upper Seaview Steel Reservoir. A potential drainage line was also observed crossing a point on the preferred Option 1 250 mm ø class 12 uPVC gravity main pipeline.

Land-use

In the Greenbushes area land-use is mostly agriculture, often on small holdings. In the Seaview area land use varies from agriculture to conservation and from residential to mining (quarry).

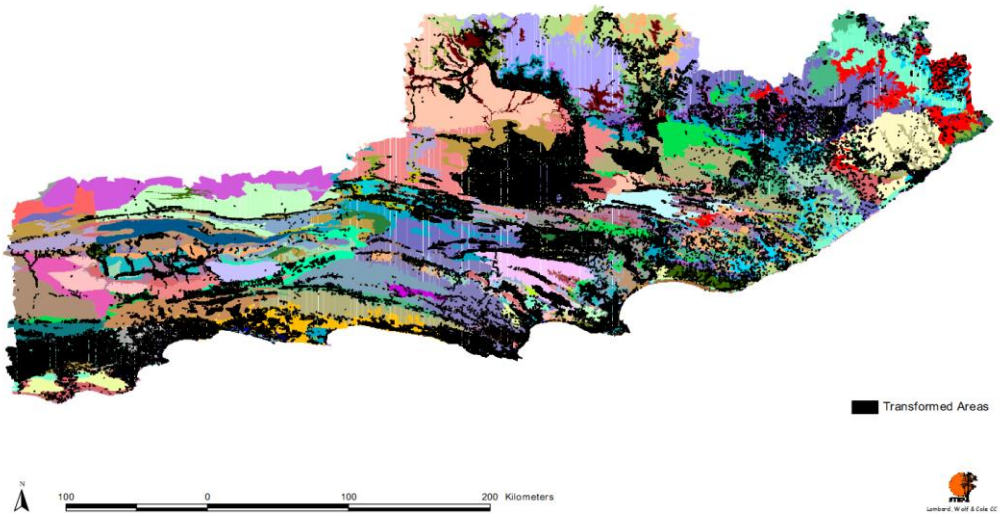


Figure 33. Transformed areas from the STEP land cover map within STEP vegetation.

Figure 4: Map from the STEP reports (Lombard *et* al. 2003; Figure 33), showing transformed areas in the area of Port Elizabeth and surrounding areas

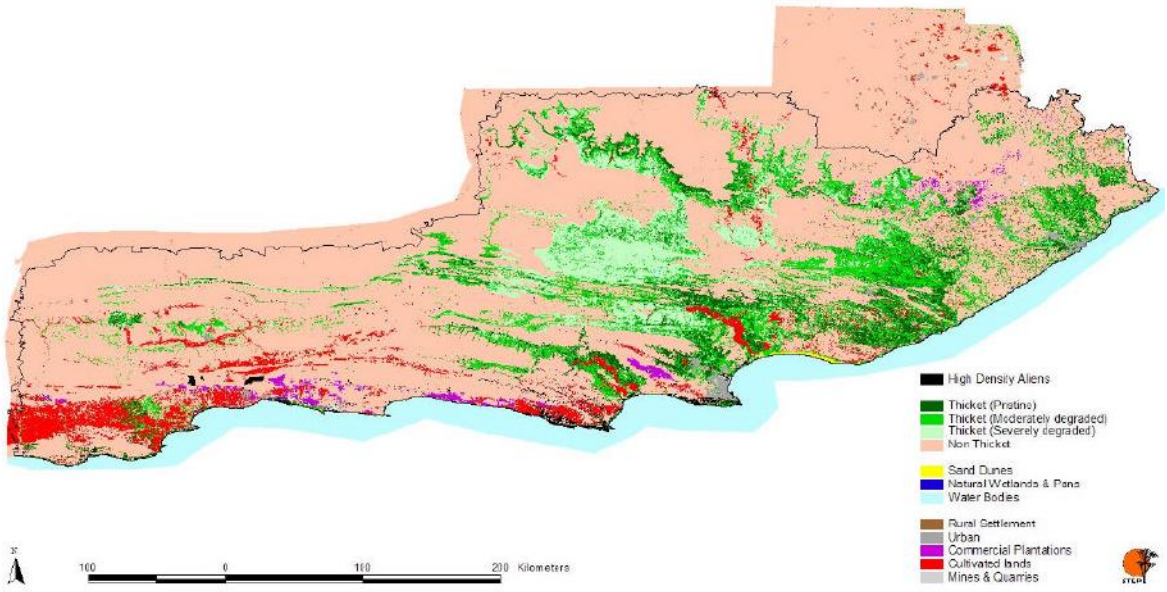


Figure 6.1. Extent of transformation and habitat degradation in the planning domain.

Figure 5: Map from Cowling *et al.* (2003, Figure 6.1) showing urban areas, non-thicket (in this case Fynbos or secondary grassland or agriculture) and the high density alien plant areas in the vicinity of Seaview.

No aquatic Critical Biodiversity Areas occur within the study area.

4. METHODS

Initial preparations:

For background information, the relevant maps, aerial photographs and other information on the natural environment of the concerned area were obtained. Of special interest were the maps derived from the National NFEPA and local NMBM GIS layers for wetlands, within the 500 m buffer of the proposed pipelines. An aerial image with additional potential wetlands was provided by SRK Consulting. Furthermore, a few wetlands / aquatic systems that are not indicated on the three maps were identified during the field visit. A total of 22 wetlands / aquatic systems or potential wetlands / aquatic systems were identified from these three maps and the field visit.

The following approach was adopted:

- Mark the co-ordinates of all the identified wetlands, within 500 m of the proposed pipeline route, on Google Earth images of the area – these are needed in terms of the DWA stipulation published in Government Gazette No 32805 on 18 December 2009 that requires that a Water Use License should be applied for when any wetlands are present within a 500 m radius of water use activities as defined by section 21 (c) and section 21 (i) of the NWA;
- Visit, as far as possible, all the marked wetlands, and do a wetland assessment, including a description, type of wetland (classification), broad delineation, indicating the outer edge of the wetland; and
- Identify all wetlands that are within 500 m of the proposed pipeline route. In terms of the Biodiversity Act, 2004 (Act 10 of 2004), and Government Gazette No 32805 on 18 December 2009 (Department of Water Affairs 2009).

Site visit

Mss Karissa Nel and Tamarin Burton of SRK Consulting introduced Prof GJ Bredenkamp to the site on 4 August 2016. The field survey was done between 4 and 15 August 2016 by Prof GJ Bredenkamp, accompanied by Dr CL Bredenkamp (botanist).

Wetland assessment

The **delineation** method documented by the Department of Water affairs and Forestry in their document "A practical field procedure for identification and delineation of wetlands and riparian areas" (DWAF, 2005), was followed. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas, such as soil and vegetation as well as the terrain unit indicator. Vegetation and soil was used to determine the outer edge of the wetland and aquatic systems. Soils were investigated for wetland properties using a soil auger, to a depth of about 60 cm.

A hand held Garmin Montana GPS was used to capture GPS co-ordinates in the field. Google maps and 1:50 000 cadastral maps were used as reference material for the mapping of the wetland boundaries. These were converted to digital image backdrops and delineation lines (wetland boundaries) were imposed accordingly after the field survey.

The **wetland classification** follows the guidelines described by (Ollis *et al.* 2013).

Present Ecological State (PES) is used to determine the current ecological condition of the resource (Macfarlane *et al.* 2007). This is assessed relative to the deviation from the Reference State which is the natural or pre-impacted condition of the system. The reference state refers to the natural dynamics of the wetland system prior to development. The method described by Macfarlane *et al.* (2007) were used to score PES categories and these PES categories for every component are integrated into an overall PES for the wetland being investigated. This integrated PES is also referred to as the EcoStatus of the wetland (Grobler 2013).

5. RESULTS: WETLAND ASSESSMENT

5.1 General Characteristics

In terms of the definitions given in the National Water Act, 1998 (Act No. 36 of 1998), no rivers and very limited spruits (four drainage lines / aquatic systems) were identified within 500 m from the alignment of the proposed pipelines (Figures 1 & 2). However, natural pans and other wetlands do occur while some man-made dams (excavated or with a dam wall) do also occur on the site. In spite of good rains that fell in the months preceding this survey, most of the wetlands had no or very limited surface water. Some standing surface water does however occur in some of the wetlands identified. This is indicated in the following descriptions. Most of the wetlands identified did not show obvious zonation and as the wetlands and aquatic systems are all relatively small and often far from the proposed alignment (see results below) zonation was not regarded necessary.

5.2 Wetland mapping

Overview maps are provided for the Greenbushes wetland and the Seaview wetlands (Figures 6 & 7).

The 22 potential wetlands and aquatic systems were identified from existing databases, information from SRK Consulting and personal observations and are labelled as follows:

Greenbushes wetlands

1 = Wetland complex (artificial, natural and trench)

2 = Artificial wetland (north of N2)

3 = Natural wetland (pan north of N2)

4 = Artificial wetland (on Seaview Rd reserve)

5 = Natural wetland (pan on cattle farm)

6 = Artificial Aquatic System (series of dams at Tembani Lodge)

7 = Artificial Aquatic System (dam at Tembani Lodge)

8 = Artificial Wetland (kraal)

9 = Natural wetland (on Seaview Rd reserve)

10 = Artificial Aquatic System (Dam in forest area)

Seaview wetlands

11 = Natural wetland (pan in Island Nature Reserve)

12 = Natural wetland (in Island Nature Reserve)

13 = Not wetland (built structure)

14 = Not wetland (built structure)

15 = Wetland destroyed (Kikuyu parking area)

16 = Not wetland (quarry)

17 = Not wetland (quarry)

18 = Not wetland (bush)

19 = Not wetland (cleared bush area)

20 = Not wetland (dense bush)

21 = Not wetland (cleared and disturbed secondary grassland area)

22 = Transformed potential Aquatic System

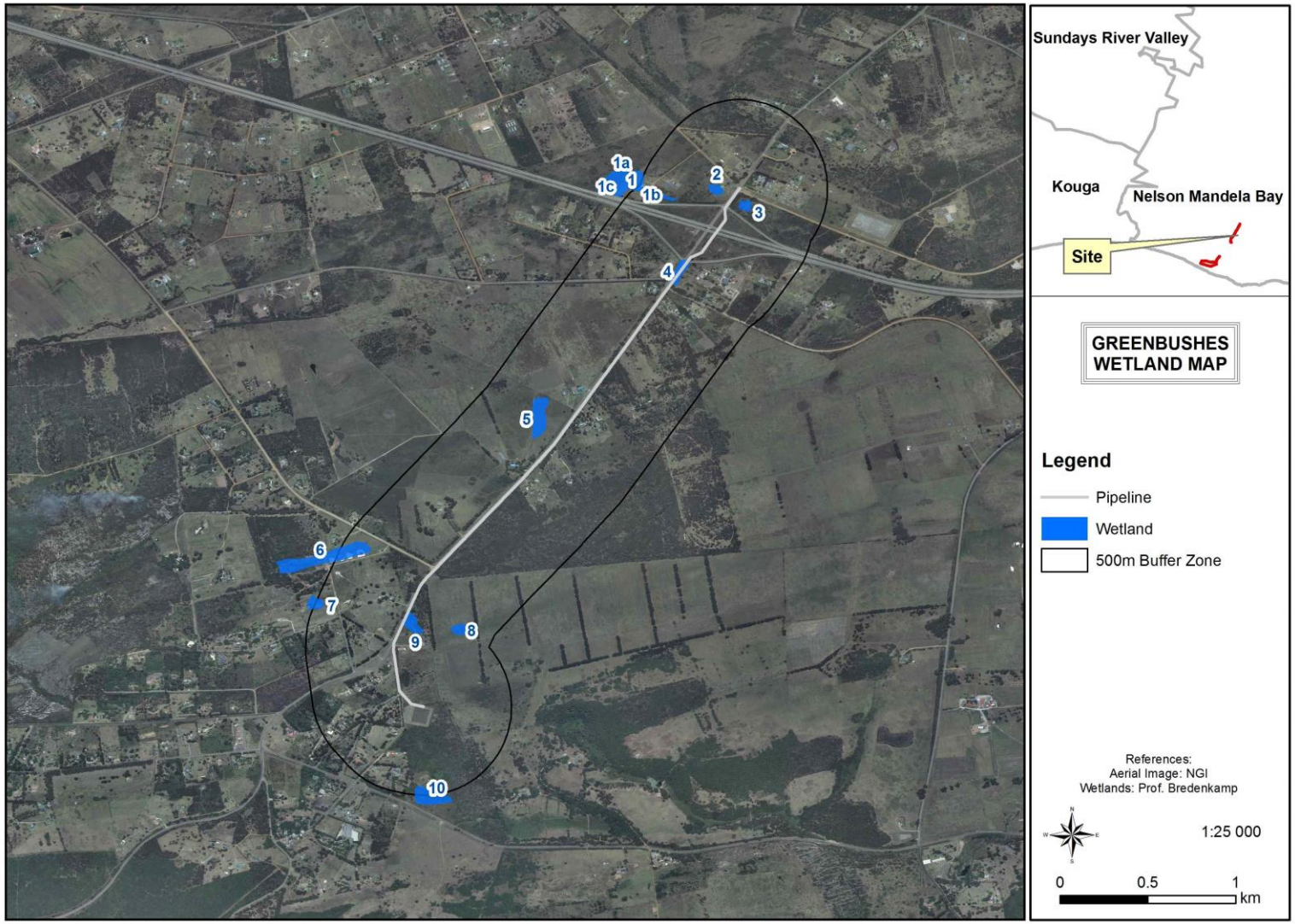


Figure 6: The distribution of wetlands in the area of the proposed Greenbushes pipeline

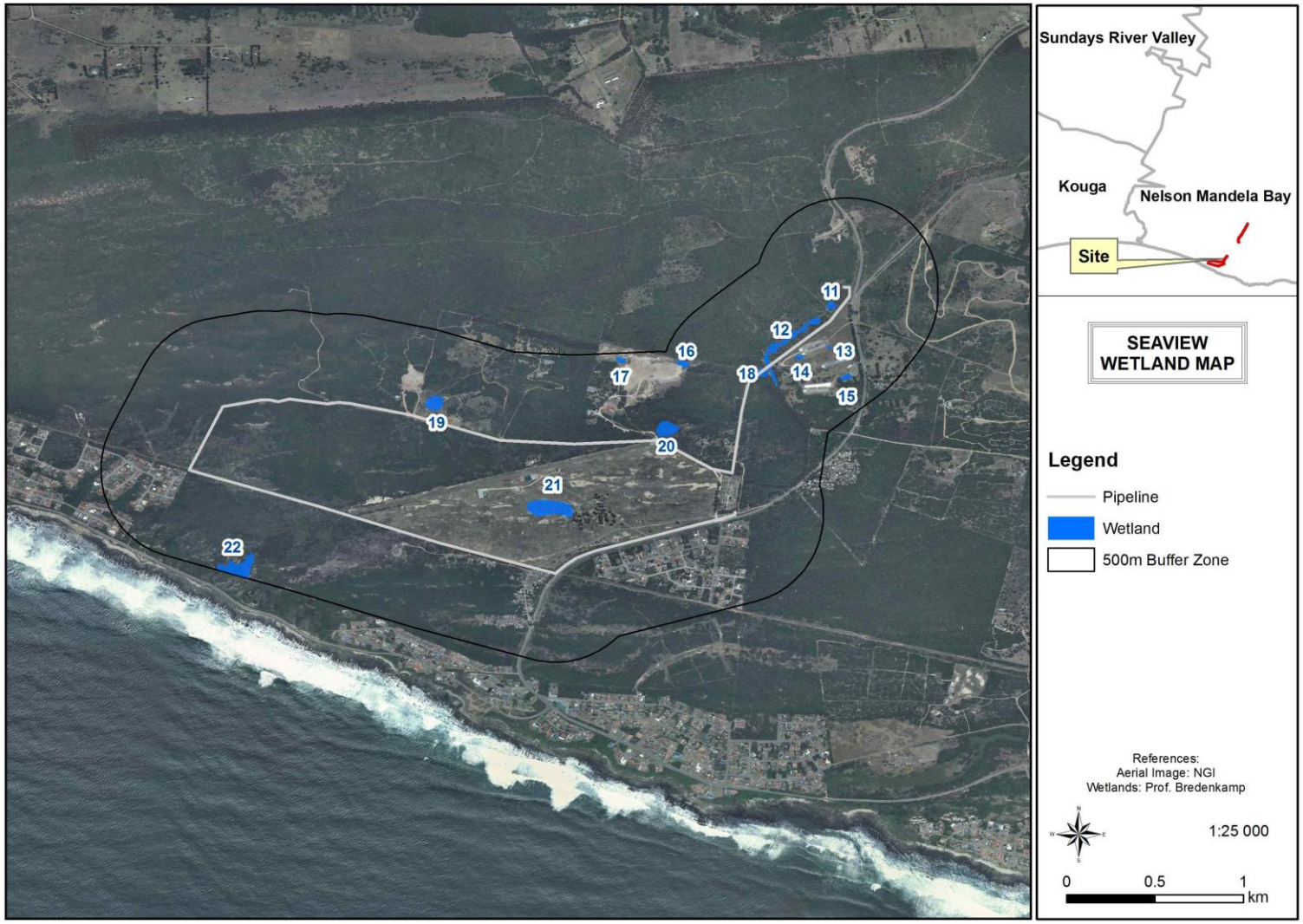


Figure 7: The distribution of wetlands in the area of the proposed Seaview pipeline

5.3 Description and Classification of the identified wetlands

5.3.1 Greenbushes Wetlands North of the N2 Highway

Three wetlands occur in the area north of the N2 Highway. All these wetlands occur on Small Agricultural Holdings, bounded in the south by the N2 Highway.

Vegetation and soil

The vegetation of this area had been severely impacted on by the agricultural activities over many years. At some localities (not at the wetlands) relicts of the original fynbos vegetation were evident. Local residents indicated that almost the entire area was covered with dense bushes of the alien invader *Acacia cyclops,* though in areas in the direct vicinity of the wetlands, the bush was cleared for grazing and also as a safety measure. Currently the vegetation is dominated by *Pennisetum clandestinum* (Kikuju grass), *Stenotaphrum secundatum* and *Cynodon dactylon*, with several weed species also present. The soils are very sandy, though shallow and the water table is often less than 50 cm deep.

Wetland 1

This is a complex of wetlands located in the north-western part of the study site (Figure 6). It is indicated on both the NFEPA and NMBM GIS layers for wetlands. In the NFEPA map it is indicated as an artificial wetland. However ground-truthing of the area indicates that this is a complex of three wetlands situated at 33^{o}56'43.3"S; 25^{o}24'09.9"E (Figure 8). Most of these wetlands are located outside the 500 m buffer line, only a small part occurs within the 500 m buffer zone. The complex includes:

1) The two man-made excavated dams (Figure 9), both occurring outside the 500 m buffer, and therefore not discussed further.

2) A man-made trench (artificial wetland) within the 500 m buffer. Wetland plant species occur in the trench, notably *Zantedeschia aethiopica* (Figure 8). This trench often transports water westwards into two manmade dams (artificial wetlands).

3) South of the two dams wetland conditions prevail, considered to represent a natural wetland, though the wet conditions are enhanced by overflow of the trench and dams during high rainfall periods. Water flows in a southerly direction towards the N2 Highway where the flow is basically blocked. The dominant plant species are *Pennisetum clandestinum* (Kikuju grass) and *Stenotaphrum secundatum* and the

vegetation is grazed by sheep and donkeys (Figure 10). Many little ant mounds covered with grass occur throughout this wetland (Figure 9).

Figure 8: The trench within Wetland 1, with *Zantedeschia aethiopica*

Figure 9: One of the dams at Wetland 1, with wetland in the foreground. Note the ant mounds covered with grass.

Figure 10: Natural, though disturbed, wetland at Wetland 1, grazed by sheep and donkeys.

Wetland 2

This artificial wetland is also located in the north-western part of the study site at 33°56'45.2"S; 25°24'25.1"E, just west of Seaview Rd and close to the foundation ruins of an old demolished house (Figures 6 and 11). It is indicated on both the NFEPA and NMBM GIS layers for wetlands. In the NFEPA map it is indicated as an artificial wetland. There is almost no indication that was a (man-made, artificial) wetland. The soil is sandy and the vegetation secondary and weedy but some fynbos plant species have started to re-appear. It is suggested that the wetland does not exist anymore.

Figure 11: The old foundation ruins at Wetland 2. The wetland occurred between the ruins and the bush in the background.

Wetland 3

This wetland is located east of Seaview Rd, at 33^{o}56’48.8”S; 25^{o}24’28.6”E.

This is considered to be a natural wetland, but it is highly disturbed. It is wedged into the triangle formed by Seaview Rd, and the gravel road that leads to the Greenbushes reservoir near the N2 Highway off-ramp. Further, there are ruins of a demolished building and extensive soil dumps directly west and plantation directly east of the wetland (Figure 6). There are also stumps indicating that trees (plantation) previously occurred in the area of the wetland. However, the wetland is in a natural bottomland position in the landscape and the central part of the wetland has black sandy loam soil and surface water (Figure 12). The areas surrounding the central part have sandy soil with mottles and are very wet (but no surface water) and all slope down towards the central part. The vegetation is dominated by *Stenotaphrum secundatum* and some weedy species are present. The area is grazed by livestock. There is no obvious outlet, implying that the area could be interpreted as being a pan.

Figure 12: Wetland 3, representing a natural but disturbed pan.

5.3.2 Central Greenbushes Wetlands between the N2 Highway and Tembani Road

Two totally different wetlands occur within this area, namely (1) wetland conditions caused by the slightly raised Seaview Rd and (2) a natural pan.

Vegetation and soil

The vegetation of this area had been severely impacted on by the agricultural activities over many years. At many localities signs of old agricultural fields can be seen (also on Google Earth images). Plantations also occur in the area. Currently very little of the original fynbos is left, most of the vegetation is secondary grassland. The soils are sandy, though shallow and the water table is less than 50-100 cm deep.

Wetland 4

The wet conditions of Wetland 4 occur on the eastern road servitude of Seaview Rd, between the N2 off-ramps to the south and Wyndomayne Rd, at 33^{o}57’01.5”S; 25^{o}24’15.4”E.

The wet conditions are caused by a damming effect of water flowing down the west-facing slope towards the slightly raised Seaview Rd. Consequently wetland vegetation, including hygrophilous grasses, sedges and *Juncus* species became established (Figure 13). Surface water and frogs occur in this habitat.

Although regarded as artificial and definitely unwanted, these wet conditions do perform limited ecological function by creating habitat conditions suitable for wetland plants and certain fauna species.

The proposed pipeline will transect and destroy this wet area on the road reserve. Future water flow, after construction of the pipeline may again cause unwanted wet conditions over the pipeline, and a drainage system may be needed, depending on the opinion of the design engineers.

Figure 13: The wetland conditions along Seaview Road.

Wetland 5

This wetland is indicated on both the NFEPA and NMBM GIS layers for wetlands. In the NFEPA map it is indicated as a natural wetland. It is located on farmland west of Seaview Rd, at 33°57’22.6”S; 25°23’52.2”E (Figure 6).

Ground-truthing indicates that the wetland is a natural pan with surface water. The farm is well-known for its livestock farming practise, and the cattle utilise the pan for drinking water. The vegetation of the entire surrounding area is therefore grazed. Note that the pan is crossed by a fence (Figure 14). It also seems that the area south of the pan, up to Seaview Rd, represents temporary (intermittent) wetland conditions (Figure 14).

The soil in the pan is saturated sandy-clay and the vegetation within the pan is mainly sedges and hygrophilous grass. The temporary zone of the wetland is moist grassland intensively grazed, and it seems that this area is an old agricultural field, therefore this zone of the wetland had been intensively modified. This area has sandy clay soil with signs of reduction (mottles).

Figure 14: The pan (Wetland 5) on farmland. Note the lower-lying inflow area stretching from the pan towards the left of the photograph.

5.3.3 Southern Greenbushes Wetlands between Tembani Road and Kragga-Kamma Rd (M15).

Vegetation and soil

The vegetation of this area had been severely impacted on by the agricultural activities over many years. At some localities relicts of the original fynbos vegetation

were evident. In the general area, close to the wetlands or aquatic systems, the soils are sandy, though shallow and the water table is often less than 100 cm deep.

Wetland 6 (Aquatic system)

This aquatic system is indicated on both the NFEPA and NMBM GIS layers for wetlands. In the NFEPA map it is indicated as an artificial wetland. The northern part of Spruce Rd, South of Tembani Rd has been closed, and the properties on both sides of Spruce Rd were consolidated and strongly fenced in a larger conservation/development area (Tembani Lodge). This aquatic system is located within this area at 33^{o}57'51.4"S; 25^{o}23'16.4"E. It consists of a series of six man-made dams (Figures 15 & 16), close to each other in a shallow drainage line flowing eastwards, away from the proposed pipeline. All these dams are artificial aquatic systems. The dams provide drinking water for game, and for fishing and bird watching.

Three of these dams are located within the 500 m buffer zone, the closest one being more than 300m from Seaview Rd. Limited housing development occurs in the area of the dams.

It should be noted that according to the national vegetation map (Mucina & Rutherford 2006) this area is still located in Algoa Sandstone Fynbos, patches of Southern Coastal Forest occur in the area. The grassland in the area is secondary, it developed were the fynbos vegetation had been destroyed.

The dominant moist grassland vegetation in the small and dry catchment area above the dams shows wetland properties. This area is highly disturbed with some residential dwellings (Figure 15).The dam edges have a limited fringe of sedges. The areas surrounding the dams are all secondary grassland.

Figure 15: The catchment area of the dams as seen from Tembani Rd.

Figure 16: The series of dams in the background as seen from the gate at Spruce Rd.

Wetland 7 (Aquatic System)

This aquatic system is indicated on both the NFEPA and NMBM GIS layers for wetlands. In the NFEPA map it is indicated as an artificial wetland. This is a small manmade dam within the same conservation area as Wetland 6. It is located on the

500 m buffer line, close to Spruce Rd at 33°58'00.8"S; 25°23'09.9"E. This dam was made in higher-lying secondary grassland, 500 m from the proposed pipeline (Figures 6 & 17).

Figure 17: The man-made dam (Wetland 7) in secondary grassland

Wetland 8

This wetland is indicated on the NMBM GIS layer for wetlands and it is considered on this database to be natural. It is located at 33°58'05.1"S; 25°23'36.2"E. However, the site visit revealed that this is rather an old kraal and not a wetland. This wetland will not be discussed further.

Wetland 9

This wetland is not shown by any of the GIS layers. It is located east of Seaview Rd on farmland, at 33°58'04.5"S; 25°23'27.2"E, and stretches down the slight slope to the road reserve. Water flows from the adjacent grassland and is basically blocked by the Seaview Rd (Figures 6 & 18). The road reserve is wet with surface water. The wetland is regarded to be natural, but enhanced by the damming effect of the road. The soil is wet with definite mottles.

The vegetation of the lower part of this wetland is dominated by sedges and hygrophilous grasses, but higher up on the farmland is moist grassland (Figure 19).

Figure 18: The wetland vegetation of Wetland 9 along Seaview Rd

Figure 19: The moist grassland on the farmland of Wetland 9.

The proposed pipeline will transect and destroy this wet area on the road reserve. Future water flow, after construction of the pipeline may again cause unwanted wet conditions over the pipeline, and a drainage system may be needed, depending on the opinion of the design engineers.

Wetland 10 (Aquatic System)

This aquatic system is indicated in the NFEPA and NMBM databases and is located 500 m south of the reservoir at the southern endpoint of the proposed pipeline. The wetland occurs at 33°58'34.3"S; 25°23'28.4"E, in the Colleen Glen Agricultural Holdings on Kragga Kamma Rd (Figure 6). A small patch of Southern Coastal Forest

occurs in the area. A small artificial dam is present close to a residential house. The dam has water and is covered with *Typha capensis* and other sedges (Figure 20). The dam may overflow (over the dam wall and entrance road to the house) into adjacent forest.

Figure 20: The dam of Wetland 10, with *Typha capensis* and the adjacent forest.

Although this wetland displays wetland function in creating suitable habitat for wetland vegetation and associated fauna, these will not be impacted on by the proposed pipeline.

5.3.4 Seaview Wetlands

In accordance with the national vegetation map (Mucina & Rutherford 2006), Wetlands 11-20 (ten potential wetlands) are situated within Southern Coastal Forest, while Wetlands 21 and 22 are situated in Algoa Dune Strandveld. All these wetlands are on farmland, though the forest was cleared at Wetland 13, 14 and 15 (chicken farm) and Wetlands 16 and 17 (sand quarry). The Dune Strandveld was cleared at Wetland 21 while no wetland occurs at the site of Wetland 22. From the proposed new reservoir at 33^{o}59'27.9"S; 25^{o}22'08.1"E, two proposed pipelines will run southwards through the farmland on an existing servitude to the existing Seaview reservoir at 34^{o}00'07.5"S; 25^{o}21'47.5"E.

Vegetation and soil

Except where cleared, the forest vegetation is intact and primary, forming very dense bush and thicket. Patches of plantation, notably of *Eucalyptus* occur scattered in the area. The vegetation of the Dune Strandveld was cleared at Wetland 21 while the dense indigenous Standveld bush vegetation at site 22 occurs in a deeply incised

valley in the dunes facing the sea. In some areas dense bushes of the alien invader *Acacia cyclops* occur.

Wetland 11: Natural pan in forest

This wetland is not indicated on any of the GIS layers, though it is indicated on an aerial image provided by SRK Consulting. It is located at 33°59'31.7"S; 25°22'06.5"E. This wetland is a small natural pan of 15-18 m in diameter, hidden by indigenous forest (Figure 21), though on its eastern side is an *Eucalyptus* plantation (Figure 22). The pan is about 40 m from the pipeline servitude and about 90 m to Seaview Road. The pan floor is 10 m wide with wet clay-loam soil and covered with hygrophilous grass and sedges. At the time of the survey there was no surface water. The banks are quite steep, about 4 m wide and covered with sparse shrubs.

Figure 21: The natural pan (Wetland 11) in the forest.

Figure 22: The pan fringed by indigenous forest and *Eucalyptus.*

Wetland 12: Natural wetland

This northeast-southwest stretching low-lying wetland is currently dry but is located in a low valley without a channel (Figure 7) and is regarded as a potential wetland. This wetland does not occur on the existing databases but was indicated on the aerial photograph provided by SRK Consulting. The wetland is 200 m long and the width varies from 13 to 35 m. The central part of the wetland is at about 33°59'37.1"S; 25°21'59.9"E. The vegetation is short, moist grassland with several sedge species present (Figure 23). The soil is clay-loam, with signs of mottles. On the north-western side the wetland is bordered by indigenous forest and on the south-eastern side by a *Eucalyptus* plantation.

This wetland runs parallel to the proposed pipelines and is about 40 m from the pipeline servitude. Between the pipeline servitude and the wetland is a 40 m wide *Eucalyptus* plantation.

Figure 23: The natural Wetland 12 between natural forest and *Eucalyptus* plantation

Wetlands 13 and 14

These two potential wetlands at 33°59'39.5"S; 25°22'05.9"E and 33°59'41.5"S; 25°22'00.4"E respectively, and indicated on the NMBM GIS wetland layer, were found to be constructed water reservoirs for use on the Daleside chicken farm (Figure 7) and are not classified as wetlands. They are not discussed further.

Wetland 15

This was a small wetland close to the gate of the Daleside chicken farm at 33°59'44.0"S; 25°22'10.9"E (Figure 7). The wetland was transformed into a Kikuyu grass-covered parking area for visitors to the chicken farm. A small part of the Kikuyu-lawn is currently quite wet with some surface water (Figure 24).

Figure 24: The Kikuyu lawn (Wetland 15) at the parking lot of the Daleside chicken farm.

Wetlands 16 and 17

These two potential wetlands located at 33°59'43.5"S; 25°21'39.6"E and 33°59'42.4"S; 25°21'28.1"E respectively, and indicated on the NMBM GIS wetland layer, were found to be within the Stan's Quarry area (Figure 7). This area was

already mined for sand and had been rehabilitated. No wetlands occur currently in this area. They are not discussed further.

Wetland 18

A potential wetland was indicated on the aerial photograph provided by SRK Consulting. During the field visit no wetland could be found at this locality at approximately 33°59'46.2"S; 25°21'51.4"E. This location will therefore not be discussed further.

Wetland 19

This potential wetland located at 33°59'43.5"S; 25°20'53.0"E, and indicated on the NMBM GIS wetland layer (Figure 7) was found to be a cleared area in the bush, now planted with Kikuyu grass, and no wetland occurs here (Figure 25). This location will therefore not be discussed further.

Figure 25: Area of potential Wetland 19 is Kikuyu grass on a cleared area in the bush.

Wetland 20

This potential wetland located at 33°59'55.2"S; 25°21'35.0"E, and indicated on the aerial photograph provided by SRK Consulting (Figure 7) was found to be dense

bush and no wetland occurs here (Figure 26). This location will therefore not be discussed further.

Figure 26: Dense bush in the area of potential Wetland 20.

Wetland 21

The bush in this area was cleared (date unknown) and secondary grassland / planted pasture established (Figure 27). Large areas are covered by this planted pasture grass, (which is often mowed) while large areas are covered by the grass *Imperata cylindrica,* which is mostly associated with the drier outside edge of wetlands. In this case the *Imperata cylindrica* is however not restricted to lower-lying areas, but often occur over the dune crests. It should be noted that a linear a low-lying area that could be a drainage line, is present in the southern part of the site parallel to Seaview Road This is discussed under Wetland 22.

Two adjacent wetlands were indicated by the NMBM GIS layer for wetlands. These potential wetlands are located at approximately 34°00’09.4”S; 25°21’15.0”E, in the cleared area within the Algoa Dune Strandveld (Figure 7). This is a gently and irregularly undulating area, consisting of sandy dunes (Figure 27). However, no wetlands could be identified during the field survey. This location will therefore not be discussed further.

An airstrip and hangers for aircraft are present on this site.

Figure 27: The undulating cleared area of potential Wetland 21. Note the darker patches of *Imperata cylindrica.*

Wetland 22 (Aquatic System)

This potential aquatic system (drainage line) is located within a linear low-lying area in the southern part of the cleared area, also mentioned under Wetland 21. This drainage line is indicated on a map provided by SRK Consulting, but is not indicated by any NFEPA or NMBM databases.

The original bush that occurred in this area was cleared (date unknown) and secondary grassland / planted pasture established (Figure 27). Large areas are covered by this planted pasture grass, which is often mowed. The grass *Imperata cylindrica,* which is mostly associated with the somewhat drier outside edge of wetlands, also occurs in this area, however. in this case the *Imperata cylindrica* is not restricted to the lower-lying area, but often occur over the dune crests.

During the site visit no indication of wet conditions could be found in the area of this potential drainage line, there was no surface water and the soil was very sandy without signs of wetness, in spite of good rains during the preceding weeks.

It is concluded that, if any drainage line previously existed here, it was destroyed during the bush clearing and establishment of the planted pasture.

It must be noted that a potential wetland occurs on the southernmost 500 m buffer line, close to the M9 Road along the sea at 34°00’20.7”S; 25°20’18.2”E Figure 7). This is a deep kloof in the sand dunes and no wetland could be identified at this locality. However, it is postulated that this deep kloof could have been the endpoint of

the potential drainage line discussed above, but was dessicated when the drainage line was destroyed. To investigate this is beyond the scope of this report.

5.3 Wetland Soils

At least one soil sample was taken with a soil auger at all wetlands except Wetlands 6 and 7, where access was not possible. In general the soils were wet to moist, sandy to loamy and often with signs of wetness (Figure 13). The soil sample was made to confirm wetland conditions, rather than to indicate zonation.

Figure 13: An example of a soil sample taken with a soil auger

5.4 Classification of the wetlands

A classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (Ewart-Smith *et al.* 2006). This classification system was further developed and refined and a new classification system, the “Classification System for Wetlands and other Aquatic Ecosystem in South Africa” was published (Ollis *et al.* 2013).

The current wetland study follows this new classification system, by attempting to classify the wetlands and aquatic systems in the study area in terms of a functional unit in line with a Level 6 category recognised in the classification system proposed (Ollis *et al*, 2013).

Level 1:

Inland system

Level 2: Regional Setting

DWA Ecoregion

According to the DWA Level 1 Ecoregions the area falls under the South Eastern Coastal Belt (Ecoregion 20) (Kleynhans *et al*. 2005).

Bioregions

The site falls within the Sandstone Fynbos and Eastern Strandveld Bioregion of Mucina & Rutherford (2006).

Level 3: Landscape setting

The area is classified as a Plain, - an extensive area of low relief. These areas are characterised by relatively level, gently undulating or uniformly sloping land (with dunes) with a very gentle gradient that is not located within a valley. The gradient is typically < 0.01 or 1:100. (Ollis *et al*. 2013).

Level 4a: Hydrogeomorphic Unit (HGM unit)

Most of the wetlands recorded on the study site represented the **depression** HGM wetland unit. Only limited (3) represented **valley bottom wetlands**, one with a channel, but totally transformed by dams (Wetlands 6 and 10) and the other without a channel (Wetland 12).

Level 4b: Outflow drainage characteristics

The outflow drainage may be endorheic as water exits the depression by evaporation and/or infiltration only (inward draining) (Ollis *et al*. 2013).

Only in the exceptional cases of valley bottom wetland there is an outflow, namely in the case of Wetlands 6, 10 and Wetland 12.

Level 5: Hydrological Regime - Categories for non-river inland systems

This level refers to the perenniality of rivers and to the period and depth of inundation or period of saturation of the soil for non-river systems. All wetlands in this study are non-river systems except Wetlands 6, 10 12. and the other without a channel (Wetland 12).

Level 5a: Inundation periodicity: Although the period of inundation is unknown, it is thought that the period of inundation is seasonal, i.e. water can be seen on top of the ground surface for extended periods during the wet season, but may dry up annually, either to complete dryness or to saturation (low confidence)(Ollis *et al*. 2013). This has little relevance to the study area as all the wetlands and aquatic systems except those on the road reserve (Wetlands 4 and 9) are too far to be affected by the proposed pipeline

Level 5b: Period of saturation: Although the period of saturation is unknown, it is thought that the soil is at least seasonally or intermittently saturated, i.e. all the spaces between the soil particles are filled with water for extended periods during the wet season, but dry for the rest of the year (Ollis *et al*. 2013). This has little relevance to the study area as all the wetlands and aquatic systems except those on the road reserve (Wetlands 4 and 9) are too far to be affected by the proposed pipeline

Level 5c: Inundation depth class: The maximum depth of this system is about 30-40 cm (<2m = littoral system)(Ollis *et al.* 2013). The water in the dams of Wetlands 6, 7 and 10 are deeper.

Level 6: Descriptors:

The wetland systems of the study area are either artificial or natural:

Natural wetlands are limited and include the following:

Wetland 1 –partly natural, mostly artificial

Wetland 3 – Highly disturbed

Wetland 5 – natural pan

Wetland 9 – natural but dammed by Seaview Road

Wetland 11 – natural pan in the Island Nature Reserve

Wetland 12 – natural linear wetland in the Island Nature Reserve. This wetland has a limited outflow

Wetland 15 is a natural wetland transformed into a parking lot.

All the remaining wetlands and aquatic systems are regarded to be artificial, either excavated or constructed.

Most of the wetlands, natural or artificial, have scattered, emergent, indigenous vegetation including grasses, sedges, forbs and sometimes *Typha*, but weedy species are also often present. Alien shrubs (*Acacia cyclops*) may sometimes be present close to the wetlands.

5.5 Wetland Condition (WET-Health)/ Present Ecological Status (PES)

Wetland Condition is defined as a measure of the deviation of wetland structure and function from its natural reference condition (Macfarlane *et al.*, 2007).

It is important to emphasise that the wetlands in question are either natural or artificial.

In the current assessment the hydrological, geo-morphological and vegetation integrity was assessed for the wetland units associated with the study site, to provide a Present Ecological Status (PES) score (Macfarlane *et al.*, 2007). In terms of wetland functionality and status, health categories used by WET-Health are indicated in Table1.

Table 1: Health categories used by WET-Health for describing the integrity of wetlands (Kleynhans *et al.* 1999, Macfarlane *et al.*, 2007)

DESCRIPTION	PES SCORE	MANAGEMENT
Unmodified, natural.	A	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place, but the ecosystem functions are essentially unchanged.	B	Some human-related disturbance, but mostly of low impact
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact and the basic ecosystem functions are still predominantly unchanged..	C	Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	D	

		degradation
The change in ecosystem processes and loss of natural habitat and biota is serious. The loss of natural habitat, biota and basic ecosystem functions is extensive	E	Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	F	

Results are given in Table 3 below.

5.6 Ecological Importance and Sensitivity (EIS)

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity;
- Ecological functions; and
- Basic human needs.

Table 2: Environmental Importance and Sensitivity rating scale used for calculation of EIS scores (DWAF, 1999)

Ecological Importance and Sensitivity Categories	Rating	Recommended Ecological Management Class
Very High Wetlands that are considered ecologically important and sensitive on a national level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers	>3 and <=4	A
High Wetlands that are considered to be ecologically important and	>2 and <=3	B

Ecological Importance and Sensitivity Categories	Rating	Recommended Ecological Management Class
sensitive on a provincial level. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers		
Moderate Wetlands that are considered to be ecologically important and sensitive on a local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	>1 and <=2	C
Low/Marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <=1	D

Results:

Table 3: The Present Ecological Status (PES) and Environmental Importance and Sensitivity (EIS) of the wetlands and aquatic systems in the study area.

Wetland Number	**Short description**	**PES** Refer to Table 1	**EIS**	**REC** Refer to Table 2
1	Complex wetland, mainly artificial, very disturbed, part natural	D	Moderate to Low	C/D
2	Artificial – totally modified	F	Low	D
3	Natural, highly disturbed	E	Moderate	C
4	Artificial, unwanted on road reserve	E	Low	D
5	Natural pan, area highly grazed	C	Moderate	C
6	Artificial aquatic system - series of dams in conservation area	C/D	Moderate	C
7	Artificial aquatic system – small isolated dam in conservation area	D/E	Low	D
8	No wetland	-		-

Wetland Number	Short description	PES Refer to Table 1	EIS	REC Refer to Table 2
9	Natural but dammed on road reserve	D/E	Moderate to Low	C/D
10	Artificial aquatic system in forest area	D	Moderate	C
11	Natural pan in forest in nature reserve	B	Moderate	C
12	Natural linear wetland in shallow valley in nature reserve	C	Moderate	C
13	No wetland	-		-
14	No wetland	-		-
15	Highly modified wetland on parking lot	F	Low	D
16	No wetland, quarry	-		-
17	No wetland, quarry	-		-
18	No wetland, natural bush	-		-
19	No wetland, cleared area in natural bush	-		-
20	No wetland, natural bush	-		-
21	No wetland, totally disturbed, planted grassland	-		-
22	Transformed aquatic system – potential drainage line No wetland, kloof in dunes	-D	Low	D-

5.7 Buffer Zones

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A development could potentially have several impacts on the surrounding environment and on a wetland or riparian area. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. A hard impervious surface such as parking areas, roads and roofs adjacent to the wetland area will change normal water flow to the wetland, and will increase storm water flow during a rainfall event. An increased

volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments.

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream activities and adjoining land-uses; and (iii) providing habitat for various aspects of biodiversity.

A brief description of each of the functions and associated services is outlined in Table 4:

Table 4: Generic functions of buffer zones relevant to the study site (adapted from Macfarlane *et al.*, 2010)

Primary Role	Buffer Functions
Maintaining basic aquatic processes, services and values.	• Groundwater recharge: Seasonal flooding into wetland areas allows infiltration to the water table and replenishment of groundwater. This groundwater will often discharge during the dry season providing the base flow for streams, rivers, and wetlands. • Flood attenuation: Wetland vegetation increases the roughness of stream margins, slowing down flood-flows. This may therefore reduce flood damage in downstream areas. Vegetated buffers have therefore been promoted as providing cost-effective alternatives to highly engineered structures to reduce erosion and control flooding, particularly in urban settings.
Reducing impacts from upstream activities and adjoining land-uses	• Storm water attenuation: Flooding into the buffer zone increases the area and reduces the velocity of storm flow. Roots, braches and leaves of plants provide direct resistance to water flowing through the buffer, decreasing its velocity and thereby reducing its erosion potential. More water is exchanged in this area with soil moisture and groundwater, rather than simply transferring out of the area via overland flow. • Sediment removal: Surface roughness provided by vegetation, or litter, reduces the velocity of overland flow, enhancing settling of particles. Buffer zones can therefore act as effective sediment traps, removing sediment from runoff water from adjoining lands thus reducing the sediment load of surface waters. • Removal of toxics: Buffer zones can remove toxic pollutants, such hydrocarbons that would otherwise affect the quality of water resources and thus their suitability for aquatic biota and for human use. • Nutrient removal: Wetland vegetation and vegetation in terrestrial buffer zones may significantly reduce the amount of nutrients (N & P), entering a water body reducing the potential for excessive outbreaks of microalgae that can have an adverse effect on both freshwater and estuarine environments. • Removal of pathogens: By slowing water contaminated with faecal material, buffer zones encourage deposition of pathogens, which soon die when exposed to the elements.

Despite limitations, buffer zones are well suited to perform functions such as sediment trapping, erosion control and nutrient retention which can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are generally proposed as a standard mitigation measure to reduce impacts of land-uses / activities that are planned adjacent to water resources.

Local government policies require that protective wetland buffer zones be calculated from the outer edge of the temporary zone of a wetland and river buffer zones be calculated from the outer edge of the riparian zone.

There are guidelines and local policies for the determination of buffer zones from a wetland or watercourse Macfarlane *et al.* (2010), however generally 32 m is regarded as a standard for buffer zone (Ezemvelo IEM, 2011; Biodiversity Act, 2004 (Act 10 of 2004), and particularly the recently policy published in Regulation 983, Government Gazette 38282, December 2014).

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The only wetlands that are in the way of the development are Wetlands 4 and 9, which are located on the road reserve. All the other wetlands and aquatic systems are so far from the proposed pipeline alignment that they do not require any buffer for this particular development. Wetlands 4 and 9 on the road reserve will be partly destroyed, but they are not important (see impact assessment below).

6. IMPACT ASSESSMENT

6.1 Methods

The significance of all potential impacts that would result from the proposed project is determined using SRK's Prescribed Impact Assessment Methodology (attached to Appendix 1).

6.2 Results

Table 5: Minimum distance (m) of identified wetlands from the proposed pipeline development

Wetland Number	Short description	Distance (m)
1	Complex of wetlands, natural and artificial, very disturbed	Trench 362 Artificial 450

		Natural 442
2*	Artificial – totally modified	28
3	Natural, highly disturbed	42
4*	Artificial, unwanted on road reserve	0
5	Natural pan, area highly grazed	Pan 144 Temporary zone 82
6	Artificial series of dams in conservation area	313
7	Artificial – small isolated dam in conservation area	402
8	No wetland	-
9*	Natural but dammed on road reserve	0
10	Artificial in forest area	468
11	Natural pan in forest in nature reserve	40
12	Natural linear wetland in shallow valley in nature reserve	40
13	No wetland	-
14	No wetland	-
15	Highly modified wetland on parking lot	75
16	No wetland, quarry	-
17	No wetland, quarry	-
18	No wetland, natural bush	-
19	No wetland, cleared area in natural bush	-
20	No wetland, natural bush	-
21	No wetland, totally disturbed, planted grassland	-
22	No wetland, kloof in dunes	-

Background

An assessment of the 22 wet areas identified within the study site (Table 4) shows that no wetlands occur at positions 8, 13, 14, and 16-22. These are excluded from the following impact assessments.

Possible impacts that the construction and/or operation of the proposed pipeline may have on the identified wetlands include:

- Destruction of wetland habitat during construction;

- Sedimentation into wetlands during construction and operation; and
- Pollution into wetlands and potential to affect water quality during construction and operation.

Greenbushes Wetlands

Impact: Destruction of wetland habitat during construction

This impact is applicable to the construction phase only.

Wetland 1

Wetland No 1	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This is the complex of three wetlands, most of it occurring outside the 500 m buffer line. It is clear that the construction of the proposed water pipeline will not have any impact on this wetland.

Wetland 2

Wetland No 2	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

It is suggested that the artificial wetland that once occurred here has been destroyed and does not exist any more. Fynbos plant species have established in this area. Although this locality is only 28 m from the proposed pipeline, a possible impact is irrelevant, as there is no wetland remaining on the site.

Wetland 3

Wetland No 3	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This natural pan wetland is situated isolated from the proposed alignment of the pipeline by roads and by extensive soil dumps. Construction cannot impact on this wetland.

Wetland 4

Wetland No 4	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	High 3	Short-term 1	**Low** 5	Definite	**Low**	neutral	High
With mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High

The proposed pipeline will transect and destroy this artificial wetland that occurs on the road reserve.

The wet conditions are caused by a damming effect of water flowing down the west-facing slope towards the slightly raised Seaview Rd. Consequently wetland vegetation, including hygrophilous grasses, sedges and *Juncus* species became established. Surface water and frogs occur in this habitat.

From an ecological perspective, this wetland is regarded as not important and it does not have any conservation value.

Future water flow, after construction of the pipeline may again cause unwanted wet conditions over the pipeline, and a drainage system may be needed, depending on the opinion of the design engineers. Preferably the drainage system should allow the water to flow through a pipe, under the road, so that the water can flow further down the slope, as was probably the case before the road was constructed. This will prevent damming and the artificial wetland conditions will disappear.

Wetland 5

Wetland No 5	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This natural pan is located 144 m from the proposed alignment of the pipeline, therefore construction of the pipeline cannot destroy or impact on the wetland habitat.

The temporary zone of the pan (82 m from the proposed alignment) has been transformed (previously ploughed) and is currently intensively grazed by livestock. Construction of the pipeline will also not destroy any part of this zone.

Wetland 6

Wetland No 6	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This artificial wetland consists of a series of dams, the one closest to the proposed pipeline alignment being more than 300 m. The construction of the pipeline will not destroy any part of this wetland.

Wetland 7

Wetland No 7	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This artificial wetland is a small dam 500 m from the proposed pipeline alignment. The construction of the pipeline will not destroy any part of this wetland.

Wetland 9

Wetland No 9	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	High 3	Short-term 1	**Low** 5	Definite	**Low**	neutral	High
With mitigation	Local 1	Low 1	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This is a natural wetland that is located close to Seaview road. Water flows from the adjacent grassland and is then basically blocked by Seaview Rd. The wetland conditions are enhanced by the damming effect of the slightly raised road.The road reserve is wet with surface water.

The proposed pipeline will transect and destroy the wetland area on the road reserve.

Future water flow, after construction of the pipeline may again cause unwanted wet conditions over the pipeline, and a drainage system may be needed, depending on the opinion of the design engineers. Preferably the drainage system should allow the water to flow through a pipe, under the road, so that the water can flow further down the slope, as was probably the case before the road was constructed. This will prevent damming and the enhanced wetland conditions on the road reserve will disappear.

From an ecological perspective, the wetland area on the road reserve is regarded as not important and it does not have any conservation value.

Wetland 10

Wetland No 10	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This artificial wetland is a small dam 500 m from the proposed pipeline alignment. The construction of the pipeline will not destroy any part of this wetland.

Impact: Sedimentation into wetlands during construction and operation

Wetland 1

Wetland No 1	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This is the complex of three wetlands, most of it occurring outside the 500 m buffer line. It is clear that the sedimentation from the proposed water pipeline will not have any impact on this wetland during the construction or operational phases. It will not influence water supply or drainage of this wetland.

Wetland 2

Wetland No 2	***Spatial extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

It is suggested that the artificial wetland that once occurred here has been destroyed and does not exist any more. Fynbos plant species have established in this area. Although this locality is only 28 m from the proposed pipeline, a possible impact from sedimentation is irrelevant, as there is no wetland remaining on the site.

Wetland 3

Wetland No 3	***Spatial extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This natural pan wetland is situated isolated from the proposed alignment of the pipeline by roads and by extensive soil dumps. Sedimentation during construction and operational phases cannot impact on this wetland.

Wetland 4

Wetland No 4	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

The wet conditions are caused by a damming effect of water flowing down the west-facing slope towards the slightly raised Seaview Rd. Consequently the pipeline alignment is through the bottom end of the wetland and sedimentation is not possible during neither the construction nor the operational phases.

From an ecological perspective, this wetland is regarded as not important and it does not have any conservation value.

Future water flow, after construction of the pipeline may again cause unwanted wet conditions over the pipeline, and a drainage system may be needed, depending on the opinion of the design engineers. Preferably the drainage system should allow the water to flow through a pipe, under the road, so that the water can flow further down the slope, as was probably the case before the road was constructed. This may cause some sedimentation lower down the slope, but this is outside the current artificial wetland. The artificial wetland conditions may disappear should a drainage system be implemented.

Wetland 5

Wetland No 5	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This natural pan is located 144 m, downslope from the proposed alignment of the pipeline but west of (across) Seaview Rd. The temporary zone of the pan (82 m from the proposed alignment) has been transformed (previously ploughed) and is currently intensively grazed by livestock.

Although some limited sedimentation may occur during the construction phase and operational phase, this is considered to be Insignificant.

Wetland 6

Wetland No 6	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This artificial wetland consists of a series of dams, the one closest to the proposed pipeline alignment being more than 300 m. Impacts due to sedimentation are highly improbable during the construction phase or the operational phase.

Wetland 7

Wetland No 7	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This artificial wetland is a small dam 500 m from the proposed pipeline alignment. Neither the construction nor the operation of the pipeline will have any impact on this wetland.

Wetland 9

Wetland No 9	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This is a natural wetland that is located close to Seaview road. The wet conditions are caused by a damming effect of water flowing down the west-facing slope towards the slightly raised Seaview Rd. Consequently the pipeline alignment is through the bottom end of the wetland and sedimentation is not possible during neither the construction nor the operational phases.

Future water flow, after construction of the pipeline may again cause unwanted wet conditions over the pipeline, and a drainage system may be needed, depending on the opinion of the design engineers. Preferably the drainage system should allow the water to flow through a pipe, under the road, so that the water can flow further down

the slope, as was probably the case before the road was constructed. This may cause some sedimentation lower down the slope, but this is outside the current wetland. The wetland conditions on the road reserve may disappear should a drainage system be implemented.

From an ecological perspective, the wetland area on the road reserve is regarded as not important and it does not have any conservation value.

Wetland 10

Wetland No 10	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This artificial wetland is a small dam 500 m from the proposed pipeline alignment. Impacts due to sedimentation are highly improbable during neither the construction phase nor the operational phase.

Impact: Pollution into wetlands and potential to affect water quality during construction and operation

Wetland 1

Wetland No 1	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This is the complex of three wetlands, most of it occurring outside the 500 m buffer line. It is clear that possible pollution from the proposed water pipeline will not have any impact on this wetland during the construction or operational phases. It will not influence water supply or drainage of this wetland.

Wetland 2

Wetland No 2	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

It is suggested that the artificial wetland that once occurred here has been destroyed and does not exist any more. Fynbos plant species have established in this area. Although this locality is only 28 m from the proposed pipeline, a possible impact from sedimentation is irrelevant, as there is no wetland remaining on the site.

Wetland 3

Wetland No 3	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This natural pan wetland is situated isolated from the proposed alignment of the pipeline by roads and by extensive soil dumps. Possible pollution from the proposed water pipeline will not have any impact on this wetland during the construction or operational phases. It will not influence water supply or drainage of this wetland.

Wetland 4

Wetland No 4	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

The wet conditions are caused by a damming effect of water flowing down the west-facing slope towards the slightly raised Seaview Rd. Consequently the pipeline alignment is through the bottom end of the wetland. Although some pollution is possible during the construction phase (e.g. from spills of the equipment used, or from pollution caused by staff working on the project), it is regarded as of very low consequence and therefore insignificant. The construction phase is however of short duration. No pollution is foreseen during the operational phase.

From an ecological perspective, this wetland is regarded as not important and it does not have any conservation value.

Wetland 5

Wetland No 5	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This natural pan is located 144 m, downslope from the proposed alignment of the pipeline but west of (across) Seaview Rd. The temporary zone of the pan (82 m from

the proposed alignment) has been transformed (previously ploughed) and is currently intensively grazed by livestock.

Although some limited pollution may occur during the construction phase, this is considered to be Insignificant. No pollution is foreseen during the operational phase.

Wetland 6

Wetland No 6	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This artificial wetland consists of a series of dams, the one closest to the proposed pipeline alignment being more than 300 m. Impacts due to pollution are highly improbable during the construction phase or the operational phase.

Wetland 7

Wetland No 7	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This artificial wetland is a small dam 500 m from the proposed pipeline alignment. Neither the construction nor the operation of the pipeline will have any impact on this wetland.

Wetland 9

Wetland No 9	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This is a natural wetland that is located close to Seaview road. The wet conditions are caused by a damming effect of water flowing down the west-facing slope towards the slightly raised Seaview Rd. Consequently the pipeline alignment is through the bottom end of the wetland Although some pollution is possible during the construction phase (e.g. from spills of the equipment used, or from pollution caused by staff working on the project), it is regarded as of very low consequence and therefore insignificant. The construction phase is however of short duration. No pollution is foreseen during the operational phase.

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From an ecological perspective, this wetland is regarded as not important and it does not have any conservation value.

Wetland 10

Wetland No 10	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This artificial wetland is a small dam 500 m from the proposed pipeline alignment. Impacts due to pollution are highly improbable during neither the construction phase nor the operational phase.

Seaview wetlands

Impact: Destruction of wetland habitat during construction

This impact is applicable to the construction phase only.

Wetland 11

Wetland No 11	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This is a natural pan hidden by indigenous forest and an *Eucalyptus* plantation within the Island Nature Reserve and should be conserved. The construction of the proposed pipelines should, however, not have an impact on the habitat this pan, as it is located 40 m from the proposed pipeline alignment, across Seaview Rd.

Although it is realised that this is not the responsibility of the applicant for the development, it is suggested that the *Eucalyptus* trees that occur close to the pan edge be removed (by the owner?) to allow natural forest to regenerate here.

Wetland 12

Wetland No 12	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This northeast-southwest stretching low-lying wetland is current dry but is located in a low valley without a channel and is regarded as a potential wetland. This wetland runs parallel to the proposed alignment of the pipelines and is about 40 m from the pipeline servitude. Between the pipeline servitude and the wetland is a 40 m wide *Eucalyptus* plantation.

This is a natural valley bottom wetland within the Island Nature Reserve and should be conserved. The construction of the proposed pipelines should, however, not have an impact on this wetland.

Wetland 15

Wetland No 15	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High

This was a small wetland close to the gate of the Daleside chicken farm. The wetland was transformed into a Kikuyu grass-covered parking area for visitors to the chicken farm. A small part of the Kikuyu-lawn is currently quite wet, after good rains, and some water is present on the surface. This wetland is now of no ecological importance. Construction cannot impact on this wetland, as it is located 75 m from the proposed alignment of the pipelines.

Impact: Sedimentation into wetlands during construction and operation

Wetland 11

Wetland No 11	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This natural pan wetland is located 40 m from the proposed pipeline alignment. The wetland is hidden in forest. The Seaview Rd and a 40 m wide *Eucalyptus* plantation isolate the pan from the pipeline alignment It is clear that the sedimentation from the proposed water pipeline will not have any impact on this wetland during the construction or operational phases.

Wetland 12

Wetland No 12	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This natural wetland is located 40 m from the proposed pipeline alignment. The wetland occurs between a 40 m wide *Eucalyptus* plantation and natural forest. It is clear that the sedimentation from the proposed water pipeline will not have any impact on this wetland during the construction or operational phases.

Wetland 15

Wetland No 15	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This was a small wetland close to the gate of the Daleside chicken farm. The wetland was transformed into a Kikuyu grass-covered parking area for visitors to the chicken farm. A small part of the Kikuyu-lawn is currently quite wet, after good rains, and some water is present on the surface. This wetland is now of no ecological importance. Sedimentation due to the construction of the pipeline is improbable and should not impact on this wetland, as it is located 75 m from the proposed alignment of the pipelines.

Impact: Pollution into wetlands and potential to affect water quality during construction and operation

Wetland 11

Wetland No 11	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This natural pan wetland is located 40 m from the proposed pipeline alignment. The wetland is hidden in forest. The Seaview Rd and a 40 m wide *Eucalyptus* plantation isolate the pan from the pipeline alignment. Possible pollution caused by construction or during the operational phases will not have any impact on this wetland.

Wetland 12

Wetland No 12	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low 3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This natural wetland is located 40 m from the proposed pipeline alignment. The wetland occurs between a 40 m wide *Eucalyptus* plantation and natural forest. Possible pollution from the proposed water pipeline will not have any impact on this wetland during the construction or operational phases.

Wetland 15

Wetland No 15	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant 2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low 4**	improbable	**Insignificant**	neutral	High

This was a small wetland close to the gate of the Daleside chicken farm. The wetland was transformed into a Kikuyu grass-covered parking area for visitors to the chicken farm. A small part of the Kikuyu-lawn is currently quite wet, after good rains, and some water is present on the surface. This wetland is now of no ecological importance. Pollution due to the construction of the pipeline is improbable and should not impact on this wetland, as it is located 75 m from the proposed alignment of the pipelines.

6.3 Mitigation recommendations

The following mitigations are suggested:

- Preventing wet conditions to develop on the road reserve in the case of Wetlands 4 and 9;
- Care should be taken to ensure that the construction does not create new depressions where water can accumulate;
- Proper drainage and management of storm water is necessary to avoid undesirable accumulation of rainwater and erosion;
- Avoid erosion at all times to avoid sedimentation or pollution of nearby wetlands or drainage lines. Erosion control measures should form part of the planning as well as the construction and implementation phases of the development. A rehabilitation plan should be put into place that will address any erosion of the general area;
- Control waste dumping and avoid pollution at all times; and

- Re-vegetating of cleared areas with suitable indigenous species as soon as possible after the disturbance, together with an alien species monitoring and eradication program during the liability period should prevent encroachment of alien species.

7. GENERAL DISCUSSION AND CONCLUSION: WETLAND STUDY

Of the 22 potential wetlands and aquatic systems identified within the 500 m buffer, six are natural, six are artificial and ten sites contained no wetland. The presence of twelve wetlands / aquatic systems therefore implies that a Water Use Licence will be needed in terms of the DWS stipulation published in Government Gazette No 32805 on 18 December 2009.

All 22 sites were visited during the field survey. A general wetland / aquatic assessment was made at each site where a wetland was present. The assessment included a general description of the wetland, a wetland classification, and an assessment of the Present Ecological status (PES) and Environmental Importance and Sensitivity (EIS).

Local government policies require that protective wetland buffer zones be calculated from the outer edge of the temporary zone of a wetland and river buffer zones be calculated from the outer edge of the riparian zone. There are guidelines and local policies for the determination of buffer zones from a wetland or watercourse Macfarlane *et al.* (2010), however generally 32 m is regarded as a standard for buffer zone (Ezemvelo IEM, 2011; Biodiversity Act, 2004 (Act 10 of 2004), and particularly the recently policy published in Regulation 983, Government Gazette 38282, December 2014).

The impact assessments showed that the impact of the development on all wetlands identified within 500 m of the proposed pipeline alignment will be insignificant. Future water flow, after construction of the pipeline, may again cause unwanted wet conditions over the pipeline, and a drainage system may be needed to prevent damming of water over the pipeline, depending on the opinion of the design engineers.

It was furthermore derived from the assessments of all the wetlands, that the proposed pipeline development will not affect any of the wetlands present within the study area, negatively.

The proposed **Seaview** project area includes a new reservoir in the Island Nature Reserve, close to Seaview Rd, at approximately 33^{o}59S'28.5" S; 25 ^{o} o22'08.7" E. Two pipelines from this reservoir will run south-eastwards in an existing servitude from the existing Seaview reservoir and pump station. This pump station will be upgraded. From this pump station two alternative routes running westwards were proposed, the preferred (southern) route (option 1) is preferred by the project team as it runs within the existing servitude along Seaview Rd and then along an existing pipeline servitude to Beach view. The alternative route (option 2) runs along the gravel road towards Stan's quarry, and then further through the bush towards Beach view.

From an ecological perspective Option 1 is preferred, as it runs within the existing servitude along Seaview Rd and then along an existing pipeline servitude to Beach view. Option 2 runs through natural bush and this is ecologically less preferable.

It is suggested that the proposed pipeline development can be supported.

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Qualifications:

1963 Matriculation Certificate, Kemptonpark High School

1967 B.Sc. University of Pretoria, Botany and Zoology as majors,

1968 B.Sc. Hons. (cum laude) University of Pretoria, Botany.

1969 T.H.E.D. (cum laude) Pretoria Teachers Training College.

1975 M.Sc. University of Pretoria, Plant Ecology .

1982 D.Sc. (Ph.D.) University of Pretoria, Plant Ecology.

Theses: (M.Sc. and D.Sc.) on plant community ecology and wildlife management in nature reserves in South African grassland and savanna.

Professional titles:

- MSAIE South African Institute of Ecologists and Environmental Scientists
  - 1989-1990 Council member
- MGSSA Grassland Society of Southern Africa
  - 1986 Elected as Sub-editor for the Journal
  - 1986-1989 Serve on the Editorial Board of the Journal

- - 1990 Organising Committee: International Conference: Meeting Rangeland challenges in Southern Africa
- 1993 Elected as professional member

• PrSciNat. South African Council for Natural Scientific Professions **Registration Number 400086/83**

- 1993-1997 **Chairman** of the Professional Advisory Committee: Botanical Sciences
- 1993-1997: **Council** Member
- 1992-1994: Publicity Committee
- 1994-1997: Professional Registration Committee

Professional career:

- Teacher in Biology 1970-1973 in Transvaal Schools
- Lecturer and senior lecturer in Botany 1974-1983 at University of the North
- Associate professor in Plant Ecology 1984-1988 at Potchefstroom University for CHE
- Professor in Plant Ecology 1988-2008 at University of Pretoria.
- 2009 – current Professor Extra-ordinary in the Dept of Plant Science, University of Pretoria
- • Founder and owner of the Professional Ecological Consultancy firms Ecotrust Environmental Services CC and Eco-Agent CC, 1988-present.

Academic career:

• Students:

- Completed post graduate students: M.Sc. 53; Ph.D. 14.
- Presently enrolled post-graduate students: M.Sc. 4; Ph.D. 2.

• Author of:

- 175 scientific papers in refereed journals
- >150 papers at national and international congresses
- >250 scientific (unpublished) reports on environment and natural resources
- 17 popular scientific papers.
- 39 contributions in books

• Editorial Committee of

- South African Journal of Botany,
- Journal Grassland Society of Southern Africa,
- Bulletin of the South African Institute of Ecologists.
- Journal of Applied Vegetation Science.(Sweden)
- Phytocoenologia (Germany)
-

• FRD evaluation category: C2 (=leader in South Africa in the field of Vegetation Science/Plant Ecology)

Membership:

• International Association of Vegetation Science.
• British Ecological Society
• International Society for Ecology (Intecol)
• Association for the Taxonomic study of the Flora of Tropical Africa (AETFAT).
• South African Association of Botanists (SAAB)

1988-1993 Elected to the **Council** of SAAB.
1989-1990 Elected as **Chairman** of the Northern Transvaal Branch
1990 Elected to the Executive Council as **Vice-President**
1990- Sub-editor Editorial Board of the Journal
1991-1992 Elected as **President** (2-year period)
1993 **Vice-President** and Outgoing President

• Wildlife Management Society of Southern Africa
• Suid-Afrikaanse Akademie vir Wetenskap en Kuns
(=South African Academy for Science and Art).
• Wildlife Society of Southern Africa

1975 - 1988: Member
1975 - 1983: Committee member, Pietersburg Centre
1981 - 1982: **Chairman**, Pietersburg Centre

• Dendrological Society of Southern Africa

1984 - present: Member
1984 - 1988: Committee member, Western Transvaal Branch
1986 - 1988: **Chairman**, Western Transvaal Branch
1987 - 1989: Member, Central Committee (National level)
1990 - 2000: Examination Committee

• Succulent Society of South Africa

1987 - 2000

• Botanical Society of South Africa

2000 – present: Member

2001- 2008: Chairman, Pretoria Branch

2002 – 2006: Chairman, Northern Region Conservation Committee

2002- 2007: Member of Council

Special committees:

• Member of 10 special committees re ecology, botany, rangeland science in South Africa.

• Member of the International Code for Syntaxonomical Nomenclature 1993-present.

Merit awards and research grants:

1968 Post graduate merit bursary, CSIR, Pretoria.

1977-1979 Research Grant, Committee re Research Development, Dept. of Co-operation and Development, Pretoria.

1984-1989 Research Grant, Foundation for Research Development, CSIR, Pretoria.

1986-1987 Research Grant, Dept. of Agriculture and Water Supply, Potchefstroom.

1990-1997 Research Grant, Dept. of Environmental Affairs & Tourism, Pretoria.

1991-present Research Grant, National Research Foundation , Pretoria.

1991-1993 Research Grant, Water Research Commission.

1999-2003 Research Grant, Water Research Commission.

2006 South African Association of Botanists Silver Medal for outstanding contributions to South African Botany

Abroad:

1986 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom

Visits to Israel, Italy, Germany, United Kingdom, Portugal.

1987 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom.

Visits to Germany, Switzerland, Austria, The Netherlands, United Kingdom.

1990 Travel Grant, FRD.

Visit to Japan, Taiwan, Hong-Kong.

1991 Travel Grant, FRD.

Visits to Italy, Germany. Switzerland, Austria, France, The Netherlands, United Kingdom.

1993 Travel Grant, University of Pretoria.

Visits to the USA, Costa Rica, Czech Republic, Austria.

1994 Travel Grant FRD.

Visits to Switzerland, The Netherlands, Germany, Czech Republic.

1995 Travel Grant FRD, University of Pretoria

Visits to the USA

1996 Travel Grant, University of Pretoria

Visit to the UK.

1997 Travel Grant University of Pretoria, Visit Czech Republic, Bulgaria

1998 Travel Grant, University of Pretoria, Visit Czech Republic, Italy, Sweden

1999 Travel Grant, University of Pretoria, Visit Hungary, Spain, USA

2000 Travel Grant, University of Pretoria, Visit Poland, Italy, Greece.

2001 Travel Grant, NRF, Visit Brazil

2006 German Grant Invited lecture in Rinteln, Germany

Consultant

Founder and owner of Ecotrust Environmental Services CC and Eco-Agent CC

Since 1988 **>250** reports as consultant on environmental matters, including:

- Game Farm and Nature Reserve planning,
- Environmental Impact Assessments,
- Environmental Management Programme Reports,
- Vegetation Surveys,
- Wildlife Management,
- Veld Condition and Grazing Capacity Assessments,
- Red data analysis (plants and animals).

APPENDIX 1: SRK's Impact Rating Methodology

The significance of all potential impacts that would result from the proposed project is determined in order to assist decision-makers. The significance rating of impacts is considered by decision-makers, as shown below.

- **Insignificant:** the potential impact is negligible and will not have an influence on the decision regarding the proposed activity.
- **Very Low:** the potential impact is very small and should not have any meaningful influence on the decision regarding the proposed activity.
- **Low:** the potential impact may not have any meaningful influence on the decision regarding the proposed activity.
- **Medium:** the potential impact should influence the decision regarding the proposed activity.
- **High:** the potential impact will affect a decision regarding the proposed activity.
- **Very High:** The proposed activity should only be approved under special circumstances.

The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur. The significance of each identified impact must be rated according to the methodology set out below.

Step 1 – Determine the consequence rating for the impact by adding the score for each of the three criteria (A-C) listed below:

Rating	Definition of Rating	Score
A. *Extent* *– the area over which the impact will be experienced*		
None		0
Local	Confined to project or study area or part thereof (e.g. site)	1
Regional	The region, which may be defined in various ways, e.g. cadastral, catchment, topographic	2
(Inter) national	Nationally or beyond	3
B. ***Intensity*** *– the magnitude of the impact* ***in relation to the sensitivity of the receiving environment***		
None		0
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. ***Duration*** *– the time frame for which the impact will be experienced*		
None		0

Rating	Definition of Rating	Score
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a Consequence Rating, as follows:

***Combined Score* (A+B+C)**	0 – 2	3 – 4	5	6	7	8 – 9
Consequence Rating	Not significant	Very low	Low	Medium	High	Very high

Example 1:

Spatial extent	*Intensity*	*Duration*	***Consequence***
Regional 2	Medium 2	Long-term 3	**High** 7

Step 2 – Assess the probability of the impact occurring according to the following definitions:

Probability*– the likelihood of the impact occurring*	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

Example 2:

Spatial extent	*Intensity*	*Duration*	***Consequence***	***Probability***
Regional 2	Medium 2	Long-term 3	**High** 7	 Probable

Step 3 – Determine the overall significance of the impact as a combination of the consequence and probability ratings, as set out below:

Significance Rating	**Possible Impact Combinations**		
	Consequence		Probability
Insignificant	Very Low	&	Improbable
	Very Low	&	Possible
Very Low	Very Low	&	Probable

Significance Rating	Possible Impact Combinations		
	Consequence		Probability
	Very Low	&	Definite
	Low	&	Improbable
	Low	&	Possible
Low	Low	&	Probable
	Low	&	Definite
	Medium	&	Improbable
	Medium	&	Possible
Medium	Medium	&	Probable
	Medium	&	Definite
	High	&	Improbable
	High	&	Possible
High	High	&	Probable
	High	&	Definite
	Very High	&	Improbable
	Very High	&	Possible
Very High	Very High	&	Probable
	Very High	&	Definite

Example 3:

Spatial extent	*Intensity*	*Duration*	***Consequence***	***Probability***	***Significance***
Regional 2	Medium 2	Long-term 3	**High** 7	Probable	**HIGH**

Step 4 – Note the status of the impact (i.e. will the effect of the impact be negative or positive?)

Example 4:

Spatial extent	*Intensity*	*Duration*	***Consequence***	***Probability***	***Significance***	***Status***
Regional 2	Medium 2	Long-term 3	**High** 7	Probable	**HIGH**	**– ve**

Step 5 – State your level of confidence in the assessment of the impact (high, medium or low).

Depending on the data available, you may feel more confident in the assessment of some impacts than others. For example, if you are basing your assessment on

extrapolated data, you may reduce the confidence level to low, noting that further ground-truthing is required to improve this.

Example 5:

Spatial extent	*Intensity*	*Duration*	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Regional 2	Medium 2	Long-term 3	**High** 7	Probable	**HIGH**	**– ve**	High

Step 6 – Identify and describe practical mitigation measures that can be implemented effectively to reduce the significance of the impact. The impact should be re-assessed following mitigation, by following Steps 1 to 5 again to demonstrate how the spatial extent, intensity, duration and/or probability change after implementation of the proposed mitigation measures.

Example 6: A completed impact assessment table

	Spatial extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Without mitigation	Regional 2	Medium 2	Long-term 3	**High** 7	Probable	**HIGH**	**– ve**	High
With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Improbable	**VERY LOW**	**– ve**	High

In the report, mitigation measures must be described as either:

- Essential: must be implemented and are non-negotiable; and
- Optional: must be shown to have been considered and sound reasons provided by the developer if not implemented.

Step 7 – Summarise all impact significance ratings as follows in your executive summary:

Impact	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Impact 1: XXXX	Medium	Improbable	**LOW**	–ve	High
With Mitigation	Low	Improbable	**VERY LOW**		High
Impact 2: XXXX	Very Low	Definite	**VERY LOW**	–ve	Medium
With Mitigation:	*Not applicable*				

The specialist is required to recommend a monitoring and review programme that can track the achievement of the mitigation objectives (if appropriate).

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