SPECIALIST STUDY: HERTZOGVILLE

WETLAND IDENTIFICATION, RISK AND IMPACT ASSESSMENT OF THE CONSTRUCTION OF THE PROPOSED BETA POWER PLANT IN FREE STATE PROVINCE

COMPILED FOR:
BETA SOLAR POWER PLANT (RF) (PTY) LTD

INDEX (PTY) LTD P.O. BOX 96023 WATERKLOOF VILLAGE PRETORIA, 0145 TEL: +27 (0)12 346-5307 E-MAIL: index@iafrica.com	**FIELDWORK** DR ANDRIES GOUWS **REPORT AND VERIFICATION** DR ANDRIES GOUWS PROF LESLIE BROWN

August 2021

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DECLARATION

The study was undertaken by Dr A Gouws and Prof. LR Brown (PhD UP). Dr Gouws conducted the field work and data analysis, while the report was compiled in consultation with Prof LR Brown. They have the following qualifications:

Prof Brown is registered as a Professional Natural Scientist: Reg. No. 400075/98 (Botanical Science and Ecological Science).

Dr Gouws is registered as a Professional Natural Scientist: Reg. No. 400140/06 (Soils and Agricultural Science). Professional Affiliation: Soil Science Society of South Africa.

SPECIALIST	QUALIFICATION
Prof. L.R. Brown	PhD Terrestrial plant ecology MSc. Water ecology BSc Hons (Botany) BSc (Ed) (Botany, Zoology, Education) Wetland and Riparian Delineation *(DWAF Accredited Course)* Soil Classification and Wetland Delineation Short Course – TERRASOIL Science Wetland Legislation Course - Wetrest
Dr A Gouws	PhD. Multidisciplinary studies BSc. Agric Hons (Soil Science and Agronomy) BSc. Agric (Soil science, Pedology, Botany, Geology) Stereoscopic interpretation of Natural Resources for planning (Agricultural College, Potchefstroom)

The observations, conclusions and recommendations made in this report are based on the best available data and on best scientific and professional knowledge of the directors of INDEX (Pty) Ltd. The report is based on GIS programming and utilises satellite tracking to map survey points. Survey points are normally accurate to within 3 metres; which must be considered in the use of the information.

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General declaration:

- INDEX acted as the independent specialist in this application;
- Performed the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- There were no circumstances that may compromise INDEX's objectivity in performing such work;
- INDEX have expertise in conducting the specialist report relevant to this application, including knowledge of NEMA and its regulations and any guidelines that have relevance to the proposed activity;
- Have no and will not engage in conflicting interests in the undertaking of the activity.

for INDEX(PTY) LTD

Survey and report: August 2021

SUMMARY

In the National Water Act, a wetland is described as 'land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land that is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.'

According to the owner of the property they experienced drought or less than average rainfall for at least a decade. This had the effect that many of the wetland plant species disappeared in favour of grasses like Themeda triandra and Panicum. Both these are not facultative wetland plants. It was, therefore, difficult to accurately plot wetland plants. The survey relayed more on soils and historic photos to find the boundaries of land that can be saturated seasonally.

The soil derived from weathering of dolerite or Ecca sand and mudstone, weathered into deep yellowish sandy loam soils on the plateau, and higher laying areas. Clay often accumulates in the valleys to form heavily structured sandy clay soils that has impeded drainage. This is where wetlands are encountered.

The area is located within the Western Free State Clay grassland. Few isolated individual Vachellia karroo trees were observed.

Two sites with wetlands were identified: The wetland flat in the central part of the site consists of terrestrial grass species. The soil in the pan is strongly structured with a very low infiltration rate. Although no obligate hydrophytes were found it is highly likely that terrestrial grasses proliferated over the past dry cycle. Rainwater drains as surface flow in a north westerly direction, and during prolonged rainstorms may overtop and flow towards the north western boundary.

The pan on the north western boundary has soils that are gleyed which is indicative of wetland conditions. No obligate hydrophytic species were identified and the site is dry at present, the area is inward draining and was classified as a depression.

A number of small flats were found but they show no signs of wetland conditions.

The total size of land identified as wetlands is 5,73 ha.

The environmental importance of the pan can be classified as low. They are dry for most of the year. The present ecological state of the wetland indicate that it is largely natural with few modifications, but with some loss of natural habitats. This is because the veld is intensively utilised by livestock.

It is recommended that building that produces sewerage and the conservancy tank be placed away from the wetland. If the sewerage is removed from the premises for disposal it will ensure that there is no impact on groundwater resources.

The purpose of the risk matrix is to determine the impact that an activity will have on a water resource after mitigation measures had been implemented. Construction will pose low risk on the pan or wetland flat. Notwithstanding, the low risk, the following mitigation measures are recommended:

- *Don't place any permanent buildings or support infrastructure on the valley bottom.*
- *Monitor any vehicles for leaks of petroleum products that could pollute runoff water.*
- *Suppress dust by spraying construction roads.*
- *Do not install PV panels within the wetland and buffers.*

Construction and maintenance at the wetland do not require any mitigation provided that no activities occur within the wetland and the ecological buffer.

Because the risk is very low, it is recommended that a WULA General Authorisation be granted.

DEFINITIONS

1. "diverting" means to, in any manner, cause the instream flow of water to be rerouted temporarily or permanently;
2. "delineation of a wetland and riparian habitat" means delineation of wetlands and riparian habitat according to the methodology as contained in the Department of Water Affairs and Forestry, 2005 publication: A Practical Field Procedure for Delineation of Wetlands and Riparian Areas;
3. "extent of a watercourse" means:

   (a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; and

   (b) Wetlands and pans: the delineated boundary (outer temporary zone) of any wetland or pan.

4. "flow- altering" means to, in any manner, alter the instream flow route, speed or quantity of water temporarily or permanently;
5. "impeding" means to, in any manner, hinder or obstruct the instream flow of water temporarily or permanently, but excludes the damming of flow so as to cause storage of water;
6. NWA indicated the National Water Act;
7. The maps are projected as follows:

Projected Coordinate System:	Transverse Mercator
Central meridian:	25
Scale factor:	1
Linear Unit:	Meter
Geographic Coordinate System:	GCS WGS 1984
Datum:	WS84
Prime Meridian:	Greenwich
Angular Unit:	Degree

1 TERMS OF REFERENCE

Index was commissioned to conduct a wetland investigation for 180 hectares on the farm Talana no. 1241. The property is located alongside the R708 that links Hertzogville with Bultfontein.

The locality is indicated on Figure 1.

Attribute	
Location	Lat/Lon: 28.17035642° S, 25.67676284° E
City/town	Hertzogville, Free State
Length of watercourse	None.
Wetland on the site	Two depressions. Total size is less than 6 ha

This report was prepared based on a site investigation in August 2021. The TOR requires a report focussing on the risk analysis and recommendation required for the WULA. The following should be provided:

1. Wetland delineation
2. Risk Assessment Matrix

PES, EIS and assessment of any significant wetlands found to be present within the 500 m regulated area in terms of Section 25 of the Water Act.

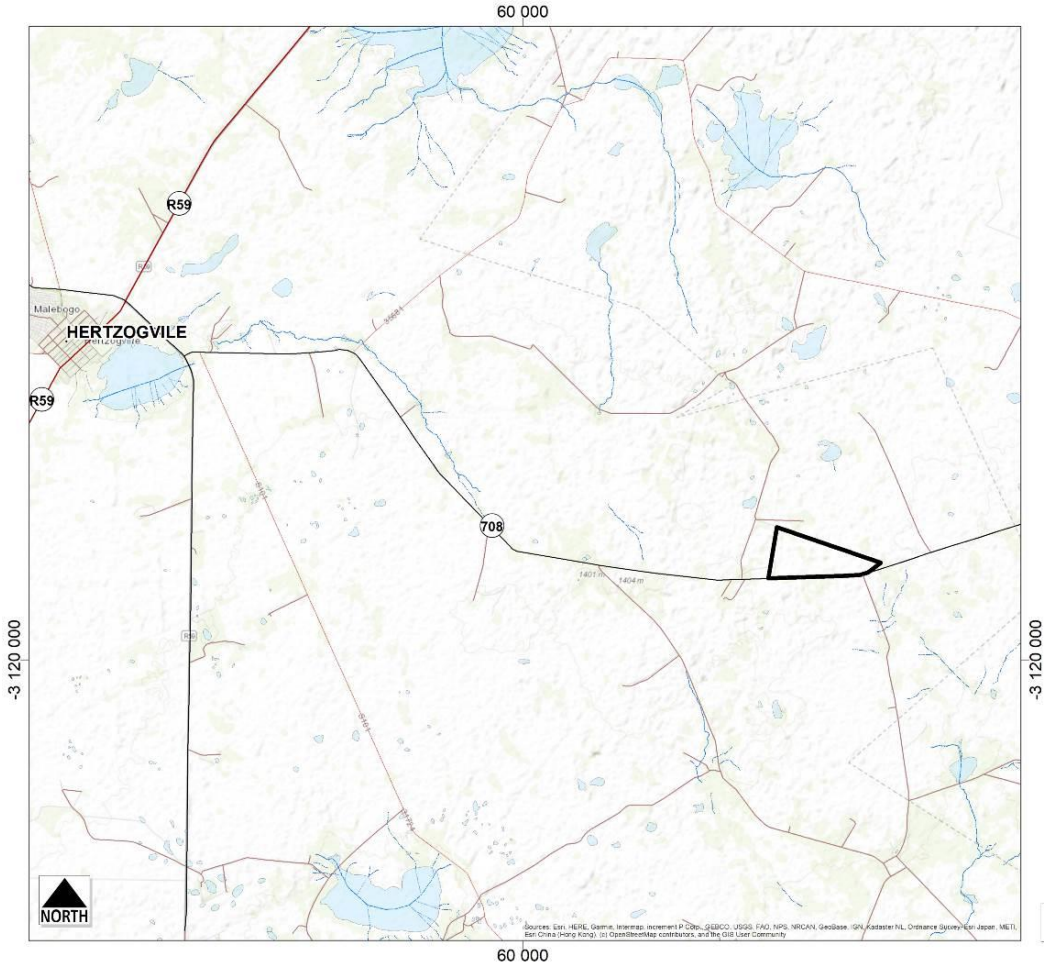


Figure 1. Locality of the site

The report addresses the requirements of the Department of Water and Sanitation (DWS) when applying for a Water use License (WULA) and includes the following:

- Broad description of the natural environment;
- Present ecological status (PES) of wetlands on the site;
- Discussion of aspects determining wetland formation;
- Wetland delineation;
- Impact assessment of the development,
- Risk Matrix, and
- Conclusions and findings.

This assessment focuses on the delineation of wetlands using four main indicators: terrain unit, vegetation, soil properties.

The dry cycle that the farm has experienced in the past decade or so has likely modified the plant composition of terrestrial and wetland areas to the degree that more reliance was placed on the topography and soil properties.

2 LEGISLATION

2.1 THE NATIONAL WATER ACT - WETLANDS

In the National Water Act, a wetland is described as '*land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land that is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*.'

Riparian zones are described as '*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 areas*.'

According to DWAF (2005), Wetlands must have one or more of the following attributes:

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

The following is quoted from the Department of Water Affairs: Wetland delineation guidelines (2005), and is a description of hydromorphic soils:

A hydromorphic soil displays unique characteristics resulting from its prolonged and repeated saturation. These anaerobic conditions make wetlands highly efficient in removing many pollutants from water, since the chemical mechanisms by which this is done need to take place in the absence of oxygen.

Prolonged anaerobic soil conditions result in a change in the chemical characteristics of the soil. Certain soil components, such as iron and manganese, which are insoluble under aerobic conditions, become soluble when the soil becomes anaerobic due to water saturation, and can thus be leached out of the soil profile.

Iron is one of the most abundant elements in soils, and is responsible for the red and brown colours of many soils. Once most of the iron has been dissolved from a soil as a result of prolonged anaerobic conditions, the soil matrix is left a greyish, greenish or bluish colour, and is said to be gleyed.

A fluctuating water table, common in wetlands that are seasonally or temporarily saturated, results in alternation between aerobic and anaerobic conditions in the soil. Lowering of the water table results in a switch from anaerobic

to aerobic soil conditions, causing dissolved iron to become insoluble and then be deposited show as mottles. Recurrence of this cycle of wetting and drying over many decades concentrates these bright, insoluble iron compounds.

REGULATED ZONE IN TERMS OF SECTION 21 OF THE WATER ACT

General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998): in accordance with GN 509 of 2016, a regulated area of a watercourse for Section 21(c), 21(g) and 21(i) of the NWA, 1998 is defined as:

- the outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
- in the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
- a 500 m radius from the delineated boundary (extent) of any wetland or pan.

This notice should be read together with the Risk Assessment provisions in the General Authorisation Notice in Relation to Section 21.

2.2 BUFFER

In terms of NEMA EIA Regulations and the National Water Act: The authorisation process must recognise the risk the activity posed to a wetland based on the relevant reports submitted to the regulator, including method statements; master layout plan that shows very clearly all water use activities in relation to:

- All wetlands,
- Riparian areas and the 1:100 year flood line,
- The 500 m radius from the boundary of a wetland, where applicable;
- Environmental management plan and environmental impact assessment;
- Wetland delineation and assessment (PES & EIS) report and rehabilitation plan.

DWS published guidelines to calculate the development buffer (Buffer Zone Guidelines for Wetlands, Rivers and Estuaries Part 2: Practical Guide, Douglas Macfarlane and Ian Bredin, 2017). These were used to determine development buffers.

3 WETLAND CLASSIFICATION

3.1 THE SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE (SANBI) [1]

SANBI was established on 1 September 2004 through the signing of the National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004. The Act expands the mandate of the former National Botanical Institute to include responsibilities relating to the full diversity of South Africa's fauna and flora.

The Classification System that was developed allows for the identification of Hydro-Geomorphic Units (HGM Units) within an inland aquatic ecosystem.

HGM Units are distinguished primarily on the basis of the following:

(i) Landform, which defines the shape and localised setting of the aquatic ecosystem.

[1] SANBI Biodiversity Series 22 - Classification system for wetlands and other aquatic ecosystems in South Africa. (Ollis, et al. 2013).

(ii) Hydrological characteristics, which describe the nature of water movement into, through and out of the aquatic ecosystem.
(iii) Hydrodynamics, which describe the direction and strength of flow through the aquatic ecosystem.

Seven primary HGM Types are recognised for Inland Systems:

(i) **River** - a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit;
(ii) **Floodplain wetland**—a wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by overtopping of the channel bank. Floodplain wetlands, as the name implies, generally occur on a plain and are typically characterised by a suite of geomorphological features associated with river-derived depositional processes, including point bars, scroll bars, oxbow lakes and levees. Floodplain wetlands must be considered as wetland ecosystems that are distinct from but associated with the adjacent river channel itself, which must be classified as a 'river'. Remember that some river channels, especially in the more arid parts of South Africa, are vegetated;
(iii) **Valley-bottom wetland** - a mostly flat wetland area located along a valley floor, often connected to an upstream or adjoining river channel. This can be either a channelled valley-bottom wetland with a river channel running through it; or an un-channelled valley-bottom wetland, which is characterised by their location on valley floors, an absence of distinct channel banks and the prevalence of diffuse flows.
(iv) **Depression** - a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates. Although they may at times have a river flowing into or out of them, depressions are especially characterised by their closed (or at least near-closed) contour shape, which makes them relatively easy to identify on topographic maps. Depressions may be flat-bottomed (in which case they are often referred to as pans. The characterisation of the inflow characteristics of a depression is important in understanding the functioning of these types of aquatic ecosystems, and in their management. Depressions can be classified as 'exorheic' (i.e. outward-draining) or 'endorheic' (i.e. inward-draining) in terms of their outflow drainage, with a third option to categorise a depression with an artificially regulated outflow drainage as 'dammed'.
(v) **Seeps** - a wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend onto a valley floor.
(vi) **Wetland flat**—a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat.

However, dams and lakes are included in the definition of a wetland by the Water Act, are included in the assessment and were accordingly delineated.

3.2 PROCESS USED FOR THE DELINEATION OF WETLANDS

The importance of retaining and maintaining functional wetlands are well established. The following criteria discussed in *A Practical Field Guide for the Identification and Delineation of Wetlands and Riparian Areas*, published by DWAF are used as baseline information. According to these guidelines the main indicators are the following:

Soil conditions are the primary criterion that signifies waterlogged conditions. These conditions manifest itself through plant communities that can tolerate hydromorphic soils. These plants are hydrophytes that are adapted to stresses imposed on plants through temporary or permanent waterlogged conditions.

For an area to be considered a wetland, redoximorphic features must be present within the upper 500 mm of the soil profile. Redoximorphic features are the result of the reduction, translocation and oxidation, i.e., precipitation of Fe (iron) and Mn (manganese) oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Only once soils within 500 mm of the surface display these redoximorphic features can the soils be considered to be hydric (wetland) soils. Redoximorphic features typically occur in three types:

- A reduced matrix - i.e., an in situ low chroma (soil colour);
- Redox depletions - the "grey" or low chroma bodies within the soil; and
- Redox concentrations - Accumulation of iron and manganese oxides, which are also called mottles.

Under most circumstances the presence or absence of redoximorphic features within the upper 500 mm of the soil profile alone is sufficient to differentiate between wetland and non-wetland.

The following criteria are used to identify wetlands:

Terrain morphology

Wetlands predominantly occur on valley bottoms and on seeps in other terrain forms.

Soil form

Soils that are gleyed or organic soils indicate permanently saturated zones. Forms that are heavily mottled and that have a grey matrix in the subsoil indicate seasonally and temporary waterlogged conditions. A list of qualifying soils is provided in the annexures.

Soil wetness

Soil colour is markedly influenced by the oxidation statues of manganese and iron. Yellow, red and reddish brown soils form under well-oxidised conditions and greyish colours when aeration is poorer. Prolonged periods of water saturation producing gleysation, where grey and blue mottles are formed and are a condition in which hydrophilic plants flourish. Qualifying colours, according to the Munsell colour chart are indicated in the annexures.

Vegetation

Vegetation is a reflection of the soil conditions and geology and is an important visual method of finding areas where a wetland may occur:

- A large proportion of hydrophytes: reeds, sedges, and floating or submerged aquatic plants indicate permanently saturated wetlands;
- Hydrophilic sedges and a variety of grass and hydrophilic woody plants are dominant on seasonally waterlogged soils;
- A variety of water tolerant grasses and woody species that may also occur on non-wetland areas can be indicative of temporarily waterlogged conditions.

Detail of the criteria is provided in the annexures.

3.3 METHODS FOR INVESTIGATION OF WETLAND SOILS

The procedure followed was as follows:

- Possible wetlands, and in particular, pans or depressions were identified from satellite images and from orthophotos supplied by the Surveyor General;
- Vegetation in this instance was not very helpful in indicating wetlands. According to the farmer that owns the property, they experienced drought or less that average rainfall for at least a decade. This had the effect that many of the wetland plant species disappeared in favour of grasses like *Themeda triandra* and *Panicum maximum*. Both these are not facultative wetland plants although they can occur in areas where moist conditions prevail. It was, therefore, difficult to accurately plot wetland plants. The survey therefore relied more on soils, historic photos and topography to find the boundaries of land that could be seasonally moist/wet;
- Identification of hydromorphic (wetland) soils, soil form and wetness indicators are then used to establish permanent, seasonal, and temporary wetland zones, the latter being the edge of the wetland;
- Soils are classified in accordance with the Binomial Classification System for Southern Africa (Soil Classification Working Group, 1991, revised 2016). Initial delineation of the soil forms will take into account

the following: vegetation type, terrain form, colour and texture of the soil. The boundaries are then refined through soil auger and or soil probe. All qualifying soil forms are then investigated in more detail;

- A soil auger is used to investigate the soil profile along transects. Should the soil show typical gleyed properties, it is classified as wetland;
- Matrix colours and mottle of the subsoil at a depth less than 500 mm are then measured against the criteria indicated above and the areas of *Temporary* and *Seasonal waterlogged* conditions mapped;
- Positions of observation points are taken with GPS and placed on a base map, and combined with texture and colour on aerial photographs.
- The final boundary of the wetland is then delineated.

4 SITE DESCRIPTION

4.1 OBSERVATIONS

Forty one observations were photographed during the site visit. These are provided as addenda.

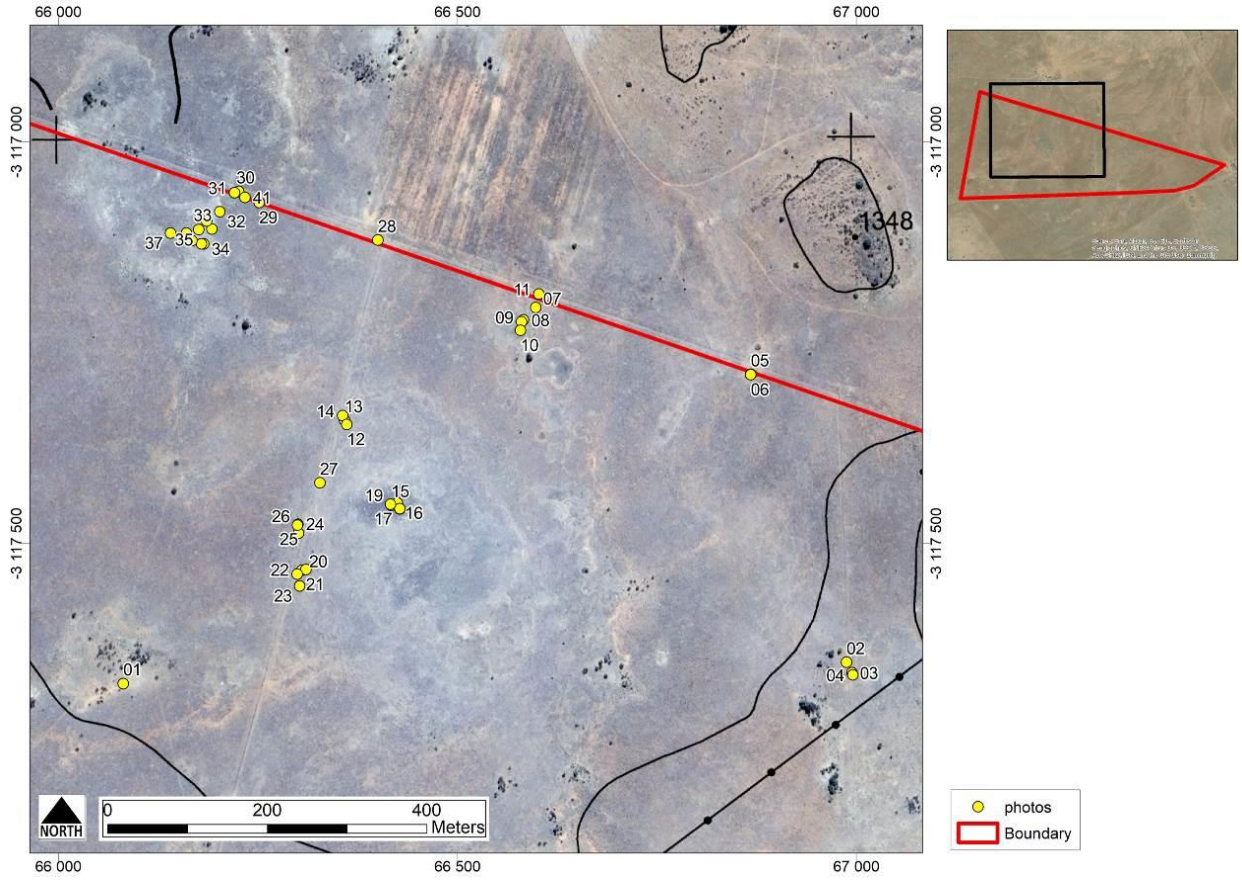


Figure 2. Observations recorded

Five areas were identified as potential wetland sites in the interpretation and the digital terrain model (DEM). Each of the target areas will be described in more detail in Section 5.

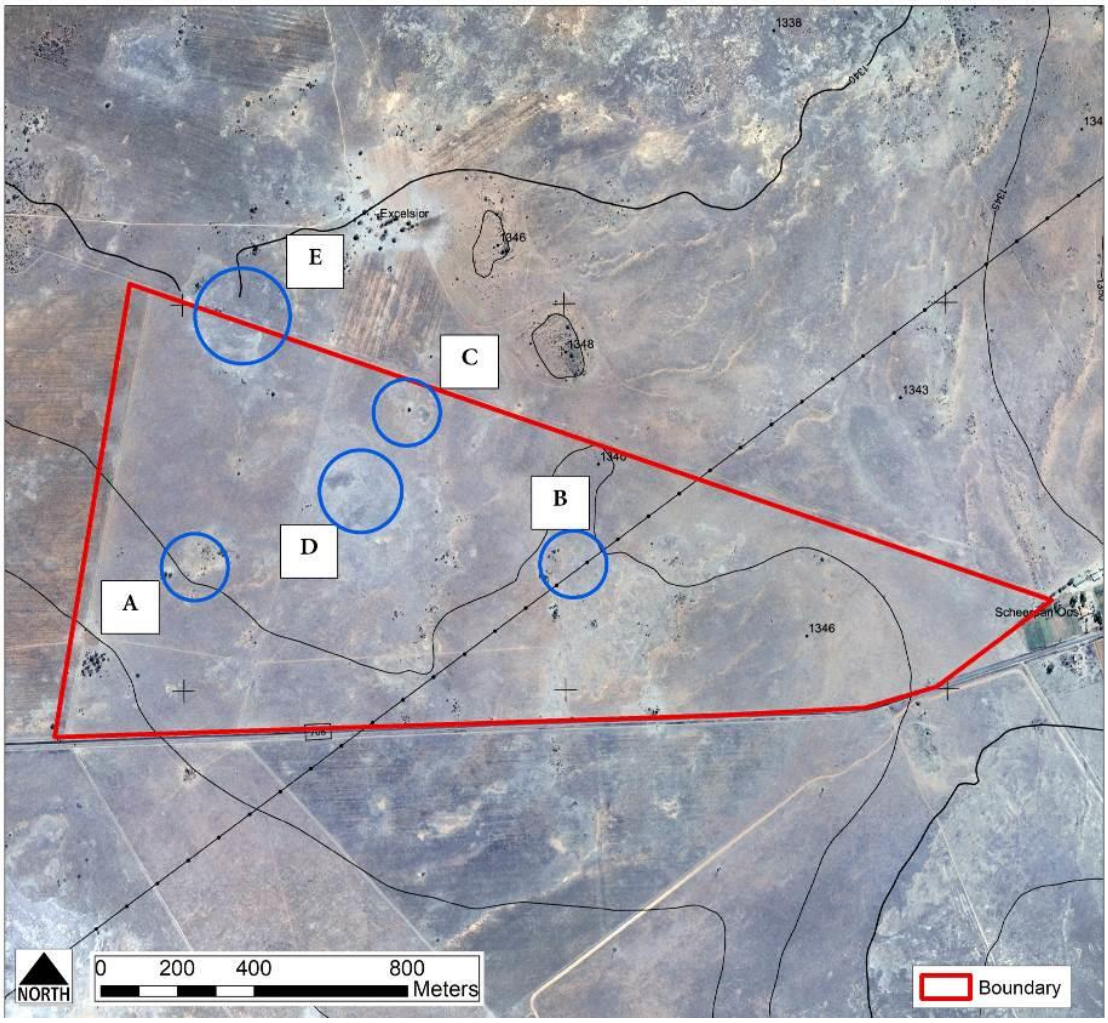


Figure 3. Areas investigated that was identified as possible sites of interest

4.2 LAND USE

The entire property is used as animal grazing.

4.3 SOIL

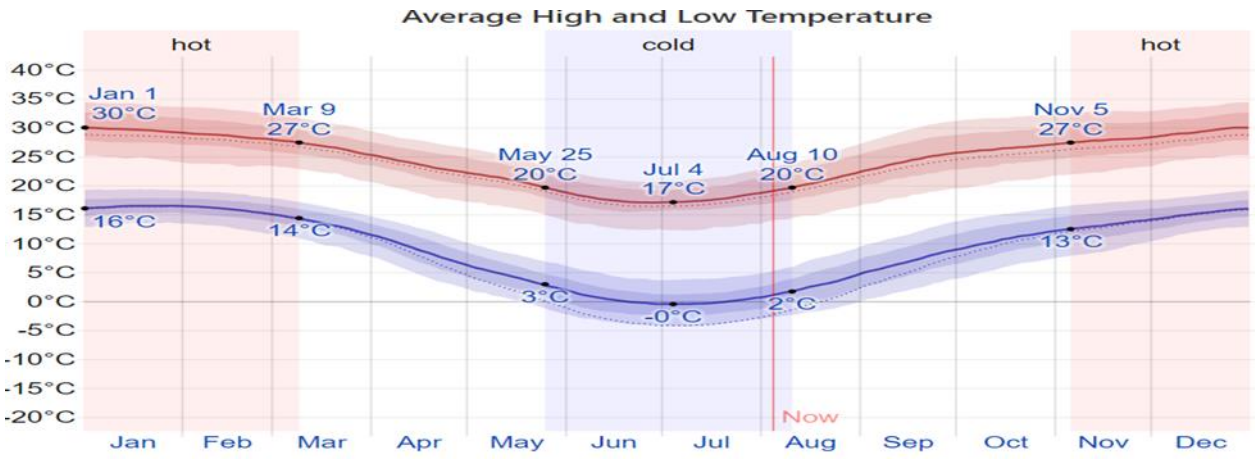
The soil derived from weathering of Karroo dolerite and Volksrust Ecca. The dolerite normally yields clayey soils that are moderately deep and with a reddish colour. The Ecca varies between sandstone and mudstone. On this property it weathered into deep yellowish sandy loam soils on the plateau and higher laying areas. Clay often accumulates in the valleys to form heavily structured sandy clay soils that has impeded drainage, which occurs in the landscape where wetland are encountered. The soil types recognised on the latter are Sepane, Rensburg, Bonheim and Valsrivier.

4.4 CLIMATE

The site is located in the Free State Province. It has a typical summer rainfall pattern. A summary of the climate data is as follows:

Temperature

The average monthly maximum of 30 ^{O}C is reached in January while the minimum of 0 ^{O}C is normally experienced in July.



Rainfall

The average amount of precipitation for the year at Bultfontein is 450 mm indicating relatively arid conditions. The month with the most precipitation on average is January. The driest month is July.

Wind

Average wind speeds are around 13 km/h, but can experience gusts of more than 18 km/h or higher.

4.5 VEGETATION

When rainfall is plotted against temperature at a ratio of 1:2 the resulting graph indicates the growing season. The growing season commences only in mid-February when precipitation exceeds 50% of transpiration. This lasts until mid-April. The dry season with a rain deficit lasts for more than 10 months of the year. The winter period and well as most of the summer is dry with vegetative growth that is under stress.

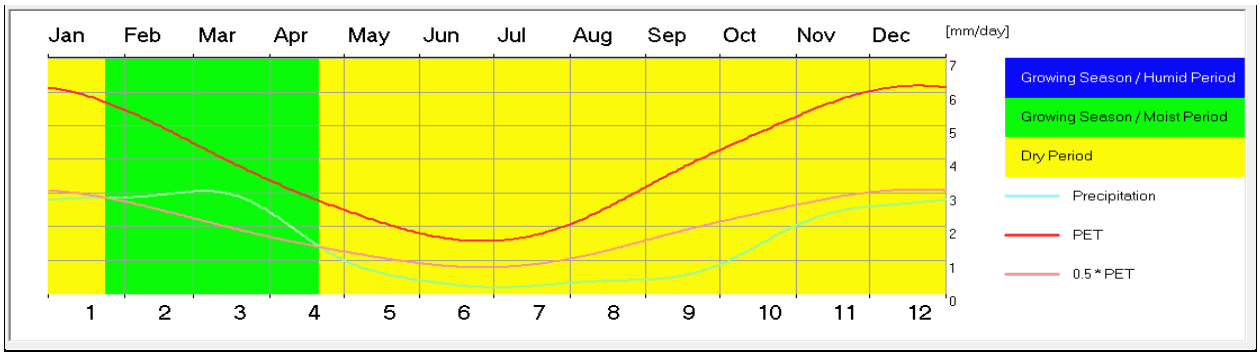


Figure 4. Climatogram

The area is located within the Western Free State Clay grassland (Mucina & Rutherford, 2006). Few isolated individual *Vachellia karroo* trees were observed. The grassveld that is dominated by *Themeda triandra*, *Cymbopogon plurinodis*, *Elionorus argenteus* and *Hyparrhenia* spp. These occur in the flat plains as well, notwithstanding the very strongly structured soils.

4.6 TOPOGRAPHY AND HYDROLOGY

A digital elevation model (DEM) of 25 metres was obtained from the Surveyor General. From this data an attempt was made to identify possible flow patterns of stormwater. The conclusion was that all the water drains as surface flow, no watercourses were found.

The site has a slope of less than 1,4%. Effectively, water remains on the site and is lost through evapotranspiration and infiltration into the subsoil. Most of the soils are deep with a moderate water retention capacity. They are regarded as being recharge soils. The soils on the flats have a very slow infiltration rate and are shallow responsive soils. Most of the water is lost from the surface through evaporation.

The topographic model indicates that there is a slow surface flow towards the depression in the central part of the property. Most of the surface water in the pan is lost through evaporation, but can overtop towards the north-western pan.

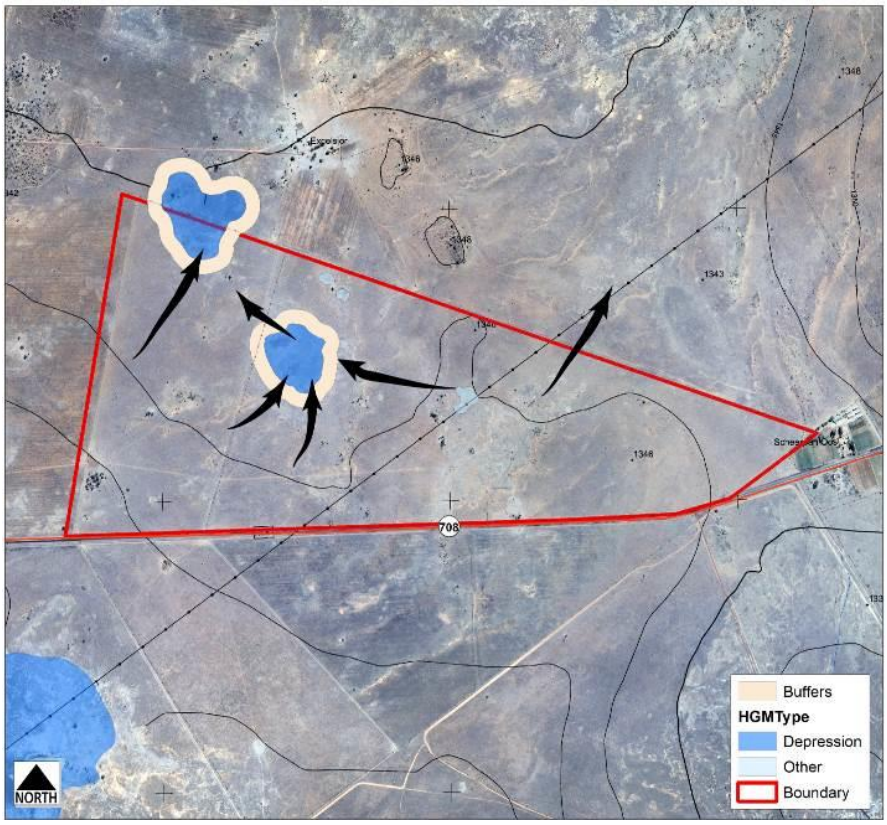


Figure 5. Surface runoff

5 WETLAND DELINEATION

5.1 WETLAND BOUNDARY

The objective of the delineation procedure is to identify the outer edge of the wetland (temporary wet zone). This outer edge marks the boundary between the wetland and adjacent terrestrial areas.

Various positions were identified from aerial photos that could possibly be wetlands. These were visited on the site or through photo interpretation to determine if they were wetland and then to delineate them and evaluate them further.

Five sites were identified that required further investigation (marked as A through to E on Figure 6).

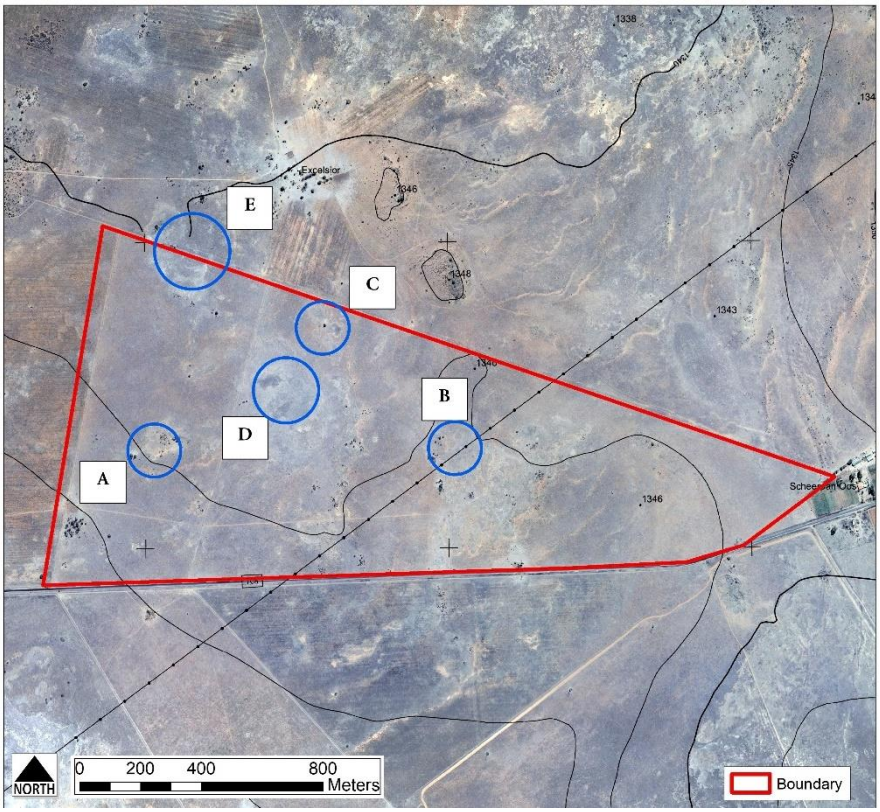


Figure 6. Positions investigated

Position A

This site consists of mainly terrestrial grass species, *Themeda Triandra*, *Aristida congesta* and *Eragrostis lehmanniana.* The soils are Hutton and Shortlands. These types are weakly structured with a moderate to high infiltration rate. There appears to be a slight accumulation of clay around the windmill, but the colour remains dark brown, which is not indicative of wetland conditions. This portion has neither hydrophytes plants nor gleyed soils it is not wetlands. The vegetation is typically terrestrial with some indicating degradation.	 ***Photo 1. Hutton soils on terrestrial vegetation***

Position B

This site consists of mainly terrestrial grass species, *Themeda Triandra*, *Aristida congesta* and *Eragrostis lehmanniana.* The soils are Sepane and Sterkspruit and are shallow on an impervious layer. The result is that the topsoil is not able to retain moisture to overcome seasonal dry periods. No hydrophytes were observed. There Is no clear depression or drainage line that would indicate waterlogged or wetland conditions which is confirmed by the presence of terrestrial vegetation. The soils, however, are clayey and may require geotechnical evaluation if construction on them is considered. This area is not classified as a wetland.	 ***Photo 2. Reddish structures soils***

Position C

The site consists of a flat even surface with mostly terrestrial grasses, like *Themeda Triandra*, *Aristida congesta* and *Eragrostis lehmanniana.* A small patch was found where clay accumulated and *Panicum* spp together with other terrestrial species are dominant. Along the fringes are red and yellow soils (Hutton, Shortlands) that gradually become dark brown towards the centre where Sepane and Sterkspruit soils were found. This area has neither wetland plants nor waterlogged soils or suitable topography. The site was not classified as a wetland.	 ***Photo 3. Terrestrial vegetation dominates***

Position D

This site consists of mainly terrestrial grass species, *Themeda Triandra* around the edges but with *Panicum* in the central part. The soil around the wetland flat is Avalon that gradually transition to Sepane. The soils are Bonheim, Sepane and Sterkspruit that are strongly structured with a very low infiltration rate. The deeper subsoil has very strongly developed structure but is moist with grey and olive mottles. The colour of the soil is very dark brown and black. Although no obligate hydrophytes were found it is highly likely that terrestrial grasses proliferated over the past dry cycle. According to the farmer below	 ***Photo 4. Sepane soils that is temporarily wet following period of prolonged rains***

average rainfall occurred for the past decade during which the flat or depression dried out. The topography indicates a slight depression, it was however, classified as a "flat" pan (*wetland flat)*. Rainwater drains as surface flow in a north westerly direction into the pan, and during prolonged rainstorms may overtop and flow towards Position E. Although the site is currently dry with many terrestrial grasses (many pioneer species), it is our opinion that that facultative wetland plant species will become more dominant once rainfall increases. The dominance of the grass *Panicum maximum* in the central depression area is an indication of highly nutritious conditions as experienced along river edges, floodplains, depressions and underneath *Acacia* spp. The area is a flat and is classified as wetland.	 ***Photo 5. Sepane soils with crusts of clay that is indicative of temporary ponding in period of prolonged rains***

Position E

This site consists of facultative terrestrial grass species, but *Themeda Triandra, Panicum,* and *Eragrostis* are dominant. The soils are gleyed in the subsoil which is indicative of wetland conditions. Bonheim, Sepane, Longlands and Sterkspruit soil types occur. They are strongly structured with a very low infiltration rate. No obligate hydrophytic species were identified and the soils are not water saturated at present. The gleyed soils indicate wetland conditions. This land is not outward draining and was, therefore, classified as a depression. This depression was classified as wetlands.	 ***Photo 6. Waterlogged soils that is temporarily wet following period of prolonged rains***

Conclusions

- Two wetland areas were identified within the study area. Positions D and E, are regarded as depression areas. They are located in the central and north eastern part of the site.
- Other areas identified as possible wetland areas from the aerial photographs, showed no signs of wetland conditions. These areas warrant geotechnical investigation to determine if the deeper subsoil consists of expansive clays that could require specialised construction methods.
- The total area identified as wetland is 5,73 ha.

The wetland and buffers are indicated below:

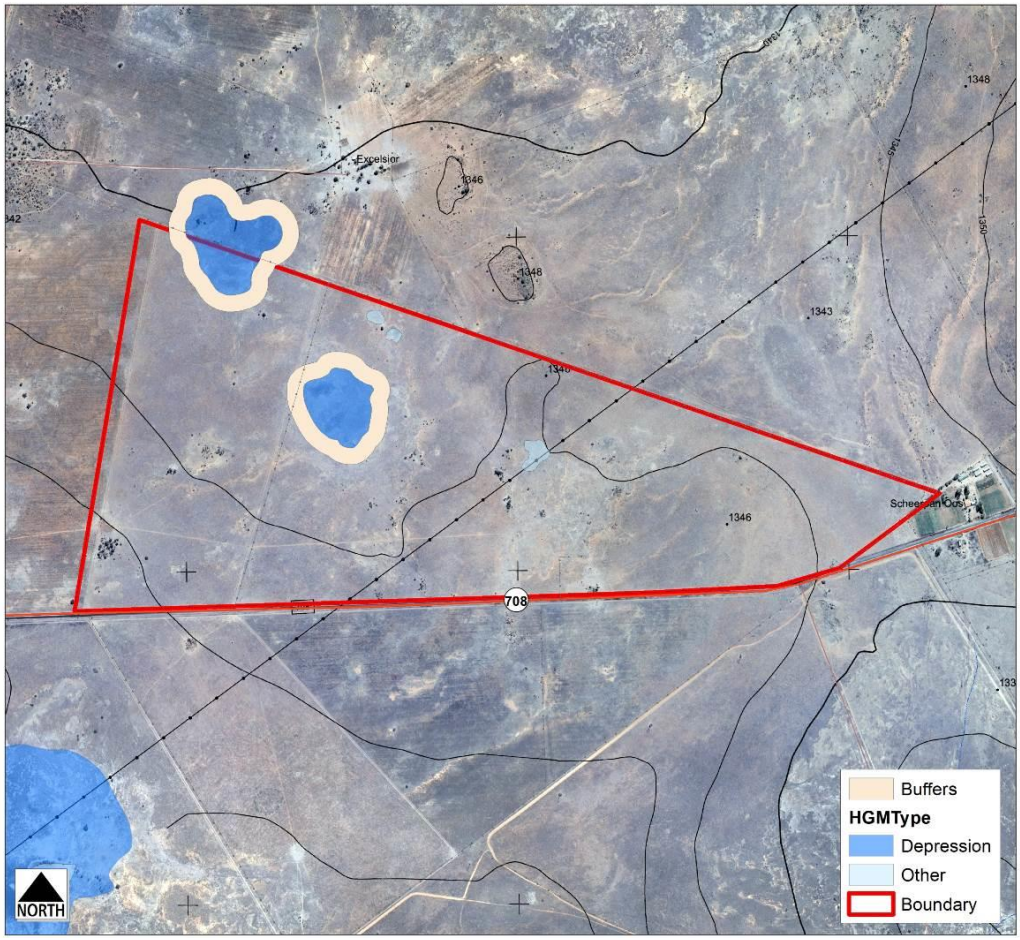


Figure 7. Wetlands and buffers

5.2 WATER SATURATION

Permanently saturated areas could not be detected on any of the sites investigated. The soil on both the flat and the depression are dry because of prolonged droughts. The soils were found to be very hard because of the strongly developed structure and the dry conditions. It further appears that terrestrial plant species have become dominant.

Due to the pedocutanic structure of the Sepane soils, the subsoil will more than likely remain dry while surface flow drains the rainwater. The deeper soil layers are dry with no signs of gleying.

6 REGULATED AREA IN TERMS OF NWA

General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998): in accordance with GN 509 of 2016, a regulated area of a watercourse for Section 21(c) 21(g) and 21(i) of the NWA, 1998 is defined as:

- The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
- In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
- A 500 m radius from the delineated boundary (extent) of any wetland or pan.

The wetlands were found within the site boundary and a further one south of the site. Accordingly the regulated area is 500 m from the outer edge of the pan was delineated.

7 BUFFER ZONE

Wetlands and riparian zones are defined in the Water Act as a water resource and any activities contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998).

According to the Buffer Zone Tool, a desktop buffer is proposed of 30 metres and for 15 metres when modified for site conditions.

The buffer distance required by NEMA is 50 metres from the edge of the wetland then it occurs outside of urban areas.

This was used for the final wetland buffer. Figure 7 indicates the wetland and buffer located within the regulated area in terms of Section 21 of the Water Act.

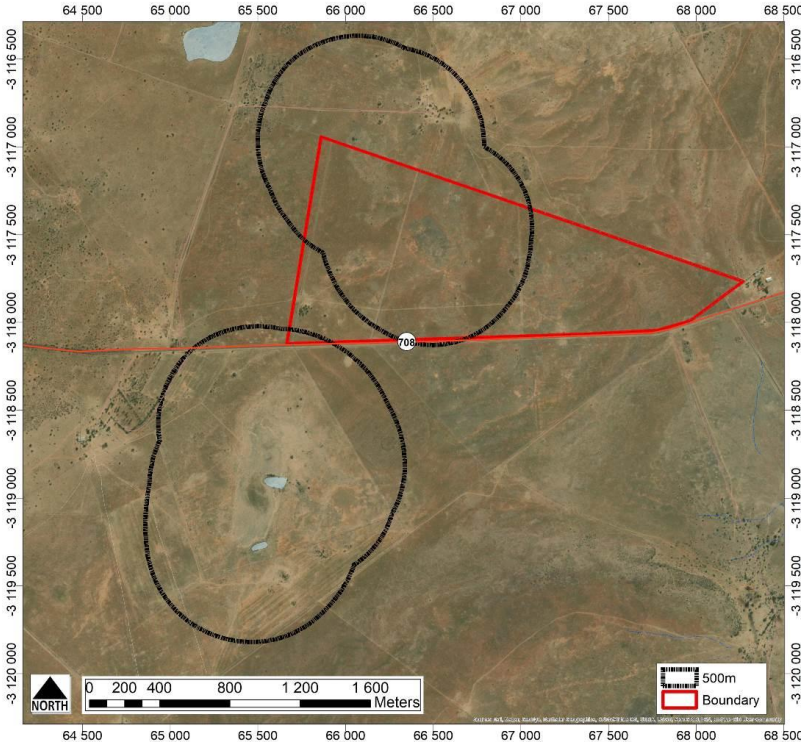


Figure 8. Regulated area in terms of the NWA.

A buffer area of 50 metres will not encroach onto the site and altering the width will have no impact of the development. Figure 8 indicates the regulated zone in terms of the Water Act.

8 ECOLOGICAL IMPORTANCE AND SENSITIVITY

8.1 THE ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

The ecological importance of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning at local and wider scales (DWAF 1999). It assesses ecological importance and sensitivity, hydro-functional importance, and direct human benefits (DWA, 2013). See the table below for EIS classification scores.

Table 1. Ecological Importance and Sensitivity classes. (DWA 2013, p43)

Ecological Importance and Sensitivity Categories	Range of EIS Score	EIS Class
Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	4	A
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quality and quantity of water in major rivers.	>3 and <4	B
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow	>2 and </=3	C

Ecological Importance and Sensitivity Categories	Range of EIS Score	EIS Class
and habitat modifications. They play a small role in moderating the quantity and quality of water of major river.		
Low/Marginal: Wetlands that is not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>1 and </=2	D
None: Wetlands that is rarely sensitive to changes in water quality/hydrological regime.	0	E

EIS of the depression

The environmental importance of the flat and the pan can be classified as low: Wetlands that are not ecologically important and sensitive at any scale. They play an insignificant role in moderating the quantity and quality of water of major rivers.

These depressions are dry for most of the year.

Table 2. Ecological Importance and Sensitivity classes of the study area

HGM Type	Channelled floodplain
Area	<6 ha
Rare & Endangered Species	0
Species/taxon Richness	0
Diversity of Habitat Types	1
Refuge value of habitat	2
Sensitivity to Changes in Hydrology	0
Sensitivity to Water Quality Changes	0
Energy Dissipation & Particulate Removal	0
Protected Status	0
Ecological Integrity	0
Median	0,2
Overall Ecological Importance and Sensitivity	Low

8.2 WETLAND ECOLOGICAL STATE (PES)

The classification used in assessing the PES is as follows:

Table 3. Impact scores and PES categories used by WET-Health for describing the integrity of wetlands

Description	PES Category
Unmodified, natural.	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	F

PES of the wetland at the site is CATEGORY B which means the wetland is largely natural with few modifications, but with some loss of natural habitats. The veld in the depressions, and especially at Position E on Figure 6 are intensively utilised by livestock and has been exposed to degradation as a result thereof.

Shallow brown-greyish soils are present in proximity of the wetlands. No sedges and other hydrophytes were observed. Neitherthe depressions have areas where water pool for extended periods which may retain water and attract water birds.

It is anticipated that the proposed development would not influence the hydrological regime of the depression provided that the buffers are honoured in the design.

9 PROPOSED INFRASTRUCTURE

The site will be placed under solar panels and their associated infrastructure.

Sewerage will be collected and stored in a conservancy tank, from where it will be removed from the site and disposed of as a recognised sewerage treatment plant. The tank will be placed far away from the wetland or any sensitive environments. The position will be outside of the m regulated area in terms of Section 21 of the Water Act.

10 STORMWATER MANAGEMENT

An operational phase stormwater management plan should be designed and implemented if not already addressed by the mitigations implemented as part of construction, with a view to preventing the passage of concentrated flows off hardened surfaces and onto natural areas.

An attempt was made to model possible flow patterns of stormwater from the DEM obtained from the Surveyor General. The conclusion was that all the water drains as surface flow, no watercourses were found. The pans are further inward draining with a slope of less than 1,4%.

Effectively, water remains on the site and is lost through evapotranspiration and infiltration into the subsoil. Most of the soils are deep with a moderate water retention capacity. They are regarded as being recharge soils. The soils on the flats have a very slow infiltration rate and are shallow responsive soils. Most of the water is lost through evaporation.

It is widely recognised that developments could impact negatively on drainage systems. By taking greater cognisance of natural hydrological patterns and processes it is possible to develop stormwater management systems in a manner that reduces these potentially negative impacts and mimic nature. The main risks associated with inappropriate stormwater management are increased erosion risk and risks associated with flooding. Therefore, this stormwater management plan and the erosion management plan are closely linked to one another and should be managed together.

This Stormwater Management Plan addresses the management of stormwater runoff from the development site and significant impacts relating to resultant impacts such as soil erosion and downstream sedimentation. The main factors influencing the planning of stormwater management measures and infrastructure are:

- Annual average rainfall;
- Rainfall intensities;
- Soil and vegetation cover;
- Topography and slope gradients; and
- Placing of infrastructure and infrastructure design.

The objective of the plan is to provide measures to address runoff from disturbed portions of the site, such that they:

- do not result in concentrated flows into natural watercourses i.e. provision should be made for temporary or permanent measures that allow for attenuation, control of velocities and capturing of sediment upstream of natural watercourses.
- do not result in any necessity for concrete or other lining of natural watercourses to protect them from concentrated flows off the development if not necessary.
- do not divert flows out of their natural flow pathways, thus depriving downstream watercourses of water.

This storm water management plan must be updated and refined once the construction/ civil engineering plans have been finalised following detailed design.

RELEVANT ASPECTS OF THE SITE

The proposed development is located on a terrain unit of level plains with some relief at an altitude of around 1,350 meters. Slope is less than 2% across the site.

The underlying geology is sandstone, shale and mudstone of the Ecca Group of the Karoo Supergroup, with dolerite intrusions.

There are no drainage courses on the site. In some areas perched surface water is likely to occur in places, after sufficient rain.

Engineering Specifications

A detailed engineering specifications Stormwater Management Plan describing and illustrating the proposed stormwater control measures must be prepared by the Civil Engineers during the detailed design phase and should be based on the underlying principles of this Stormwater Management Plan. This should include erosion control measures. Requirements for project design include:

- Erosion control measures to be implemented before and during the construction period, including the final stormwater control measures (post construction).
- All temporary and permanent water management structures or stabilisation methods must be indicated within the Stormwater Management Plan.
- The drainage system for the site should be designed to specifications that can adequately deal with a 1:50 year intensity rainfall event or more to ensure sufficient capacity for carrying storm waters around and away from infrastructure.
- Procedures for storm water flow through a project site need to take into consideration both normal operating practice and special circumstances. Special circumstances in this case typically include severe rainfall events.
- An onsite Engineer or Environmental Officer to be responsible for ensuring implementation of the erosion control measures on site during the construction period.
- The EPC Contractor holds ultimate responsibility for remedial action in the event that the approved stormwater plan is not correctly or appropriately implemented and damage to the environment is caused.

During the construction phase, the contractor must prepare a Stormwater Control Method Statement to ensure that all construction methods adopted on site do not cause, or precipitate soil erosion and shall take adequate steps to ensure that the requirements of the Stormwater Management Plan are met before, during and after construction. The designated responsible person on site, as must be indicated in the Stormwater Control Method Statement shall ensure that no construction work takes place before the relevant stormwater control measures are in place.

11 IMPACT ASSESSMENT

Potentially the most significant impacts will occur during the construction phase, which will include the following activities:

- Terrain levelling if necessary;
- Clearing the site of any debris;
- Rehabilitating disturbed area.
- Monitoring PES of the site.

The PV panels will be placed outside the edge of the pan's ecological buffer.

Sewerage will be collected and stored in a conservancy tank and removed from the site for disposal. No impact is foreseen and no mitigation is necessary.

Implementation of the projects will have no impact on the wetlands.

Summary of impacts

The impacts are as follows:

Table 4. Summary of impacts

COMPONENT	IMPACT
Effect/Nature	No impact
Extent	Site
Probability	Unlikely
Reversibility	NA
Irreplaceable loss of resources	NA
Duration	NA
Cumulative effect	Low cumulative Impact
Significance Rating	No impact
Mitigation	No impact – no mitigation required.

12 RISK MATRIX

Registered water uses are defined in Section 21 of the NWA as the following:

S21(a)	Taking water from a water resource;
S21(b)	Storing water;
S21(c)	Impeding or diverting the flow of water in a watercourse;
S21(d)	Engaging in a stream flow reduction activity (currently only commercial afforestation);
S21(e)	Engaging in a controlled activity – activities which impact detrimentally on a water resource (activities identified in s37(1) or declared as such under s38(1)) namely: 1. Irrigation of any land with waste or water containing waste which is generated through an industrial activity or a waterwork; 2. An activity aimed at the modification of atmospheric precipitation; 3. A power generation activity which alters the flow regime of a water resource; 4. Intentional recharge of an aquifer with any waste or water containing waste
S21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
S21(g)	Disposing of waste or water containing waste in a manner which may detrimentally impact on a water resource;
S21(h)	Disposing in any manner of water which contains waste from, or has been heated in, any industrial or power generation process;
S21(i)	Altering the bed, banks, course or characteristics of a watercourse;
S21(j)	Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation if an activity or for the safety of people; and
S21(k)	Using water for recreational purpose

The purpose of the risk matrix is to determine the impact that an activity will have on a water resource after mitigation measures had been implemented.

Two sections related to the Section 21 of the Act will be impacted on by the development, and that is:

i) Impeding or diverting the flow of water in a watercourse [Section 21(c)].
ii) Altering the bed, banks, course or characteristics of a watercourse [Section 21(i)].

Section 21 (g) deals with disposing of waste or water containing waste in a manner which may detrimentally impact on a water resource.

Disposal of sewerage falls into this category. The conservancy tank that is proposed is not a regulated activity in terms of NEMA or Section 21 or the Water Act.

It is recommended that the building that produces sewerage and the conservancy tank be placed outside of the regulated area of 500 m for a wetland. Then automatically there will be no impact on any wetland. Further, there will be no impact on groundwater resources if the sewerage is removed from the premises for disposal.
No authorisation is, therefore, required.

The following tables describe the risk of the development on the natural environment and also indicate the Water Uses as defined by the Act:

Table 5. Risk matrix

Activity	Aspect	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
CONSTRUCTION PHASE																
Install PV Panels	Clear land	1	1	1	1	1	1	1	1	1	1	1	1	4	12	Low
	Dig foundation	1	1	1	1	1	1	1	1	1	1	1	1	4	12	Low
	Construction	1	1	1	1	1	1	1	1	1	1	1	1	4	12	Low
	Rehabilitate disturbed areas	1	1	1	1	1	1	1	1	1	1	1	1	4	12	Low
Waste disposal	Conservancy tank	1	1	1	1	1	1	1	1	1	1	1	1	4	12	Low
	Solid waste	1	1	1	1	1	1	1	1	1	1	1	1	4	12	Low
OPERATIONAL PHASE																
Maintain footprint		1	1	1	1	1	1	3	5	1	1	1	1	4	20	Low
CUMULATIVE RISK															**20**	**Low**

1) Sewerage will be stored in a conservancy tank and disposed of at a registered works located at Hertzogville
2) All solid waste will also be disposed of at the Hertzogville.
3) Both these will have a low impact on the wetland, firstly because they are located outside of the regulated area and that processing will not be done on the site itself

Table 6. Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is; or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notable, require mitigation measures on a higher level, which costs more and require specialist input. Licence is required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence is required.

The risk for the construction of the PV panels is low.

IMPACTED WETLAND / ACTIVITY	IMPACT SCORE	IMPACT RATING
Construction in the regulated area	12	Low
Maintenance of infrastructure	20	Low

13 MITIGATION

There are two wetlands located on the site. Their catchment's are within the site. However, the surrounding vegetation is well established grassland and the only runoff is through surface flow during high rainfall events. Construction will pose low risk on the pan or wetland flat. Notwithstanding, the low risk, the following mitigation measures are recommended:

- Don't place any permanent buildings or support infrastructure within the regulated area of 500 m of the pans (D & E on Figure 8). This includes the conservancy tank.
- Monitor any vehicles for leaks of petroleum products that could pollute runoff water.
- Suppress dust by spraying construction roads.
- Do not install PV panels within the wetland and buffers.

Construction and maintenance at the wetland do not require any mitigation provided that no activities occur within the wetland and the ecological buffer.

- The wetland and buffers are not within the construction footprint and no impact is foreseen.
- No mitigation is required.
- It is recommended that the area below the panels be maintained to ensure that no bare patches develop that could increase siltation.

Erosion, surface runoff & stormwater

PV installations is characterised by large areas surfaces that is under impervious material. As a result, infiltration is considerably reduced with an increase in surface run-off. However, the soil below the panels are grassed that will retard water flow that occurs toward the pans. This run-off will be largely free of pollutants. Construction activities can lead to short/medium-term erosion unless adequate measures are implemented to control surface run-off.

Description & mitigation

The proposed development area is mostly flat and levelled with slight indentations.

It is unlikely that erosion problems would be caused during construction. Care must however be taken that construction activities does not result in soil being deposited into the wetland and associated buffer zone since that would result in long-term damage to the wetland. Clearing activities and earth scraping should preferably be restricted to the dry season to prevent erosion. It is recommended that sandbags are placed along the edge of the pan's buffer to prevent unnecessary erosion. No stockpiling of soil must be done close to the buffer zone.

A stormwater management plan must be developed and approved for the proposed development by the relevant authorities before construction commences. This plan must make provision for trapping pollutants before the water is released into the pan. In addition the water should be released at various points so as to prevent any erosion.

14 MONITORING & REPORTING

The following should be monitored:

- Recovery of disturbed areas after construction had been complete;
- Habitat assessment study annually for 3 years after construction had been complete;
- Habitat assessment study (audits and remedial actions) submitted for approval within 6 months after completion of the construction phase.
-

Recognised environmental controls

- The PES status as discussed in Section 8 should be the benchmark status against which monitoring should be measured.
- Monitoring should include species composition, plant density and if any, recording of alien plant species.

15 CONCLUSIONS AND RECOMMENDATIONS

The topographic model indicates that there is some surface flow towards the depression areas (D & E) in the central part of the property during high rainfall events. Most of the surface water in the pan is however, lost through evaporation, but can overtop towards a pan in the north-western boundary of the property.

The pan in the central part of the site consists of terrestrial grass species. The soil in the pan is strongly structured with a very low infiltration rate. Although no obligate hydrophytes were found it is highly likely that terrestrial grasses proliferated over the past dry cycle. Rainwater drains as surface flow in a north westerly direction, and during prolonged rainstorms may overtop and flow towards the north western boundary.

The pan on the north western boundary has soils that are gleyed in the subsoil which is indicative of wetland conditions. No obligate hydrophytic species were identified and the site is dry at present, the area is inward draining and was classified as a depression.

A number of small flat area was found but they show no signs of wetland conditions. These areas warrant a geotechnical investigation to determine if the deeper subsoil consists of clays that could require specialised construction methods.

The total area identified as wetlands comprises 5,73 ha.

The purpose of the risk matrix is to determine the impact that an activity will have on a water resource after mitigation measures had been implemented. Construction will pose low risk on the pan or wetland flat. Notwithstanding, the low risk, the following mitigation measures are recommended:

- Don't place any permanent buildings or support infrastructure in/on the pan areas.
- Monitor any vehicles for leaks of petroleum products that could pollute runoff water.
- Suppress dust by spraying construction roads.
- Do not install PV panels within the wetland and buffers.

Construction and maintenance at the wetland do not require any mitigation provided that no activities occur within the wetland and the ecological buffer.

Because the risk is very low, it is recommended that a WULA General Authorisation be granted.

16 WATER USE LICENSE APPLICATION

No construction will take place within the wetland and its buffer. Some of the PV panels will be laced within the regulated area of the depressions. However, no construction of permanent building or offices will trigger Section 21 and will require a full WULA.

Two wetlands were identified:

i) Depression at Position D Lat/Lon: 28.16592918° S, 25.67327925° E
ii) Depression at Position E Lat/Lon: 28.17035642° S, 25.67676284° E

The risk matrix indicates that the construction of the Solar Power Plant poses a low risk on the wetland.

It is recommended that a General Authorisation be granted.

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18 ADDENDA

18.1 WATER USES IN TERMS OF SECTION 21

- S21(a) Taking water from a water resource
- S21(b) Storing water
- S21(c) Impeding or diverting the flow of water in a watercourse
- S21(d) Engaging in a stream flow reduction activity
- S21(e) Engaging in a controlled activity
- S21(f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit
- S21(g) Disposing of waste in a manner which may detrimentally impact on a water resource

- S21(h) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process
- S21(i) Altering the bed, banks, course or characteristics of a watercourse
- S21(j) Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons
- S21(k) Using water for recreational purposes

18.2 RISK ASSESSMENT RATINGS FOR SECTION 21

SEVERITY	**Rating**
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
SPATIAL SCALE	
Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5
DURATION	
One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
FREQUENCY OF THE ACTIVITY	
Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5
FREQUENCY OF THE INCIDENT/IMPACT	
Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5
LEGAL ISSUES	
No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
DETECTION	
Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

18.3 CRITERIA FOR THE DELINEATION OF WETLANDS

Soil condition is the primary criterion that signifies waterlogged conditions. These conditions manifest itself through plants communities that can tolerate hydromorphic soils. These plants are hydrophytes that are adapted to tresses imposed on plants through temporary or permanent waterlogged conditions.

The importance of retaining and maintaining functional wetlands are well established - the process of establishing the boundaries less so. The following criteria discussed in *A Practical Field Guide for the Identification and Delineation of Wetlands and Riparian Areas*, published by DWAF are used as baseline information.

CRITERIA FOR THE IDENTIFICATION OF WETLANDS

According to DWAF, the main indicators are:

1) Terrain – Valley bottom and seep on slopes
2) Soil form indicator –
3) Soil wetness indicator
    a. Hue 2.5YR
        i. >5 value and <2 chroma, or
        ii. >6 value and <4 chroma
    b. Hue 10YR
        i. 4 value and <2 chroma, or
        ii. 5 value and <3 chroma, or
        iii. 6 value and <4 chroma
    c. Hue 7.5YR
        i. 5 value and <2 chroma, or
        ii. >6 value and <4 chroma
    d. Hue 5YR
        i. 5 value and <2 chroma, or
        ii. >6 value and <4 chroma
    e. Hue 5Y
        i. >5 value and <2 chroma, or
4) Vegetation indicator – Will contain hydrophyte plants

There are three wetland vegetation indicators, each associated with specific soil properties.

PERMANENTLY WATERLOGGED CONDITIONS ARE GREY COLOURED OR ORGANIC SOILS.

- Valley bottom terrain morphology;
- Champagne, Katspruit, Willowbrook and Rensburg soil form – all forms have gleyed subsoil;
- Wetness - prominent grey matrix, few to no high chromas within 500 mm.
- Vegetation
    - Large proportion of hydrophytes
    - Emergent plans: reeds, sedges, etc.;
    - Floating or submerged aquatic plants.

SEASONALLY WATERLOGGED SOILS HAVE A GREY MATRIX WITH MANY MOTTLES.

They usually occur just outside the area of normal base flow and are saturated for a significant portion of the rainy season.

- Valley bottom terrain morphology;
- Kroonstad, Longlands, Wasbank, Lamotte, Escourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Fernwood, Westleigh, Dresden, Avalon, Glencoe, Pinedene, Bainsvlei, Bloemdal, Witfontein, Sepane, Tukulu, Montagu.
- Wetness
    - Grey matrix (>10%)

- Many high chroma mottles

- Vegetation
  - Hydrophilic sedges that are restricted to wetland areas

TEMPORARY WATERLOGGED SOILS ARE NORMALLY GREY-BROWN ON COLOUR WITH FEW MOTTLES.

- Valley bottom terrain morphology;
- Inhoek, Tstitsikamma, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa or Dundee.
- Wetness
  - Minimal grey matrix (>10%)
  - Few high chroma mottles

- Vegetation
  - Predominantly grasses which occur on non-wetland areas and hydrotropic species.
  - Predominantly woody species which occur on non-wetland areas and hydrotropic species.

Outside this zone is the adjacent terrestrial area that is not classified as wetlands.

PROCESS USED FOR THE DELINEATION OF WETLANDS

1) Soils are classified in accordance with the Binomial classification system for southern Africa (Soil Classification Working Group, 1991). Initial delineation of the soil forms will take into account the following: vegetation type, terrain form, colour and texture of the soil. The boundaries are then refined through soil auger and or soil probe. All qualifying soil forms are then investigated in more detail;
2) River and streams are then delineated in different components, i.e., base flow and riparian areas. Uplands water saturated areas are mapped (normally belonging to soil forms with gleyed subsoil. These boundaries will indicate the *permanently saturated zone*;
3) Matrix colours and mottle of the subsoil at a depth less than 500 mm are then measured against the criteria indicated above and the areas of Temporary and Seasonal waterlogged conditions mapped;
4) Positions of observation points are taken with GPS and placed on a base map, and combined with texture and colour on aerial photographs; the final boundary of the wetland is then delineated.

Indicator plants where wetlands may occur

Gramineae (Grasses)

1) *Imperata cylindrica* Temporary wetness
2) *Setaria sphacelata* Temporary and seasonal
3) *Pennisetum thunbergii* Temporary and seasonal
4) *Hemarthria altissima* Temporary and seasonal
5) *Paspalum urvillei* Temporary
6) *Paspalum dilatatum* Temporary
7) *Paspalum distichum* Seasonal and permanent
8) *Andropogon appendiculatis* Temporary and seasonal
9) *Ischaemum fasciculatum* Seasonal and permanent
10) *Arundinella nepalensis* Temporary and seasonal
11) *Andropogon eucomus* Temporary and seasonal
12) *Festuca caprina* Temporary and seasonal
13) *Aristida junciformis* Temporary and seasonal
14) Eragrostis plana Temporary
15) *Eragrostis planiculmis* Temporary and seasonal
16) *Phragmites australis* Permanent
17) *Leersia hexandra* Temporary and seasonal
18) *Miscanthus capensis* Temporary and seasonal
19) *Miscanthus junceus* Temporary and seasonal

Cyperaceae (Sedges)

1) *Cyperus sexangularis* Temporary and seasonal
2) *Cyperus latifolius* Seasonal and permanent
3) *Cyperus fastigiatus*
4) *Cyperus marginatus*
5) *Fuirena pubescence*
6) *Kyllinga erecta*
7) *Scleria welwitschii*
8) *Eleocharis dregeana*
9) *Eleocharis limosa*
10) *Schoenoplectus brachycerus*
11) *Schoenoplectus corymbosus*

Juncaceae (Rushes)

1) *Typhaceae* (Bullrushes) Permanent
2) *Typha capensis*

Potamogetonaceae (Pondweeds)

1) *Potamogeton thunbergii* Permanent

Asphodelaceae (Red-hot pokers) Wetland and non-wetland

1) *Kniphofia species*
2) *Kniphofia linearifolia*

Amaryllidaceae (Vlei lilies) Wetland and non-wetland

1) *Crinum species*
2) *Crinum macowanii*

Polygonaceae (Knotweeds) Permanent and or seasonal

1) *Persicaria attenuata*

Additional species form other families:

1) *Xyris capensis*
2) *Satyrium hallackii*
3) *Ranunculus multifidus*
4) *Sium repandum*
5) *Gunnera repandum*
6) *Mentha aquatica*

18.4 DETERMINANTS OF ECOLOGICAL IMPORTANCE AND SENSITIVITY

Biotic determinants (instream and riparian) for assessment of ecological importance and sensitivity.

Guidelines And Description	Scoring Guidelines
Rare and endangered biota	
Biota can be rare or endangered on a local, Provincial and National scale. Useful sources for this information include the South African Red Data Books that are suitable for assessment on a National scale. However, species (or taxa in the case of invertebrates) can be rare or endangered on a Provincial or local scale but not on a National scale. Professional judgement needs to be utilised in such cases.	Very High - rating=4; One or more species/taxon judged as rare or endangered on a National scale High - rating=3; One or more species/taxon judged to be rare or endangered on a Provincial/regional scale. Moderate - rating=2; More than one species/taxon judged to be rare or endangered on a local scale. Marginal - rating=1; One species/taxon judged as rare or endangered at a local scale.

	None - rating=0; No rare or endangered species/ taxon at any scale
Species/taxon richness	
Species/taxon richness can be assessed on a comparative basis according to a local, Provincial or National scale.	Very High - rating=4; Rated on a National scale. High - rating=3; Rated on a Provincial/regional scale. Moderate - rating=2; Rated on a local scale. Marginal/low - rating=1; Not significant at any scale.
Diversity of aquatic habitat types or features	
Diversity of habitat types in a river delineation should be assessed according to local, Provincial and National scales (riffles, rapids, runs, pools and backwaters and the associated marginal areas and substrate types, lotic wetlands (source sponges, floodplain habitat types) and the riparian zone).	Very High - rating=4; Rated on a National scale. High - rating=3; Rated on a Provincial/regional scale. Moderate - rating=2; Rated on a local scale Marginal/low – rating=1; Not significant at any scale.
Refuge value of habitat types	
The functionality of the habitat types present should be assessed in terms of their ability to provide refuge to biota during periods of environmental stress on a local, Provincial and National scale.	Very High – rating=4; Rated on a National scale. High - rating=3; Rated on a Provincial/regional scale. Moderate - rating=2; Rated on a local scale Marginal/low - rating=1; Not significant at any scale.
Sensitivity of habitat to flow changes	
This assessment should essentially take into account the size of the stream as well as the habitat types available. The presumption is that only a limited decrease or increase in the flow (and the related depth and width) of certain rivers (often "smaller" streams) will result in particular physical habitat types (i.e. riffles), becoming unsuitable for biota as compared to "larger" streams. Assessment is based on available information and expert judgement.	Very High - rating=4; Streams of a particular size and with abundant habitat types highly sensitive to flow decreases or increases at all times High - rating=3; Streams of a particular size and with some habitat types being highly sensitive to flow decreases or decreases at all times. Moderate - rating=2; Streams of a particular size and with some habitat types being susceptible to flow decreases or increases during certain seasons. Marginal/low - rating=1; Streams of a particular size and with habitat types rarely sensitive to flow decreases or increases.
Sensitivity to flow related water quality changes	
This assessment should also consider the size and flow of the stream in terms of its sensitivity to water quality changes. A decrease in the natural flow volume may, for example, result in a diminished assimilative capacity (in the situation where effluent forms part of the total flow volume) or may cause natural water quality variables (i.e. water temperature and oxygen) to reach levels detrimental for biota (also applicable to increases in flow). The assumption regarding the sensitivity of "smaller" streams is also applicable here. In terms of organic pollution load, it has been pointed out that slow flowing deep rivers would be impacted over greater distances than fast flowing shallow rivers where re-areation rates would be high (Chutter 1999).	Very High - rating=4; Streams of a particular size (usually "small") and with abundant habitat types highly sensitive to water quality changes related to flow decreases or increases at all times. High - rating=3; Streams of a particular size (usually "small") and with some habitat types being highly sensitive to water quality related changes related to flow decreases or increases at all times. Moderate - rating=2; Streams of a particular size (often "larger") and with some habitat types being sensitive to water quality related flow decreases or increases during certain seasons. Marginal/low - rating=1; Streams of a particular size (often "larger") and with habitat types rarely sensitive to water quality change related to flow decreases or increases.
National parks, Wilderness areas, Nature reserves Natural Heritage sites Natural areas	
The presence of conservation (i.e. National Parks, Wilderness areas and Nature Reserves) and natural areas (i.e. unproclaimed, relatively unmodified /undisturbed areas) within a stream delineation will	Very high - score=4; The stream delineation is present within an area very important on a National and even international scale. High - score=3; The stream delineation is present on a National scale.

logically place an additional emphasis on the ecological importance and sensitivity of a stream.	Moderate - score=2; The stream delineation is present within an area important on a provincial /regional scale. Marginal/Low - score=1; The stream delineation is present within an area important on a local scale. Very low - score=0; The stream delineation is not important for the conservation on any scale.

Ecological importance and sensitivity categories. Interpretation of median scores for biotic and habitat determinants.

Ecological Importance And Sensitivity Category	**Range Of Median**
Very high Quaternaries/delineations that are considered unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3 and ≤4
High Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but may have a substantial capacity for use.	>2 and ≤3
Moderate Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use.	>1 and ≤2
Low/marginal Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	>0 and ≤1

18.5 PHOTOS


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