Riparian Delineation and Assessment

Various Portions of the Farm Rooikoppies 297-JQ, Rustenburg, North West Province

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INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

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

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1. BACKGROUND INFORMATION

WCS Scientific (Pty.) Ltd. was appointed by Seaton Thomson & Associates to undertake a wetland and riparian delineation and assessment of a number of portions of the Farm Rooikoppies 297-JQ to the east of Rustenburg in the North West Province, to determine the extent and current condition of any wetlands or riparian habitat on site.

The requirement to establish the existence and/or extent of wetlands on the property is based on the legal requirements contained in NEMA and the National Water Act. Given the stringent legislation regarding developments within or near wetland areas, it is important that these areas are identified and developments planned sensitively to minimize any potential impacts.

2. TERMS OF REFERENCE

The following tasks informed the terms of reference of the study:

- Review of available information with regards to wetlands and rivers of the area (e.g. existing reports, NFEPA database etc.);
- Field verification to confirm the presence and extent of any wetland or riparian habitats on site using the DWAF (2005) wetland delineation guidelines;
- Undertake a functional assessment of all identified wetlands using the WET-EcoServices methodology (Kotze *et al*., 2007)
- Undertake Present Ecological Status (PES) assessments of all wetlands using the WET-Health (Macfarlane *et al*., 2007) methodology, and of all riparian habitat using the VEGRAI tool;
- Undertake an Ecological Importance and Sensitivity (EIS) assessment of all wetlands using the Rountree *et al.* (2103) methodology;
- Identification and assessment of likely impacts to wetlands and riparian habitat;
- Provision of suitable and practically implementable mitigation and management measures;
- Production of shapefiles in geographic co-ordinate system WGS 84; and
- Compilation of a wetland/riparian delineation and impact assessment report detailing all of the above.

3. LIMITATIONS

- Wetland and riparian boundaries reflect the ecological boundary where the interaction between water and plants influences the soils, but more importantly the plant communities. The depth to the water table where this begins to influence plant communities is approximately 50 centimetres. This boundary, based on plant species composition, can vary depending on antecedent rainfall conditions, and can introduce a degree of variability in the wetland boundary between years and/or sampling period. Furthermore, due to the scale of the remote imagery used (1:10 000 orthophotos), as well as the accuracy of the handheld GPS unit used to delineate wetlands in the field, the delineated wetland boundaries cannot be guaranteed beyond an accuracy of about 15m on the ground.

- Due to time constraints related to the project, the site visit was undertaken during the dry season in August 2019. Therefore, confidence in the delineated wetland and/or riparian boundaries is limited as a consequence and it is possible that wetland or riparian boundaries may have been over or under estimated in cases and that some small or temporarily saturated areas may have been overlooked.

4. APPROACH

4.1 Wetland Delineation and Assessment

No natural wetlands were identified within the study area during the site visits.

4.2 Riparian Habitat Delineation

The National Water Act, Act 36 of 1998, defines 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.*"

Use was made of 1:50 000 topographic maps, 1:10 000 black and white orthophotos and geo-referenced Google Earth images to generate digital base maps of the study area onto which the

riparian zone boundaries were delineated using ArcGIS 9.2. A desktop delineation of suspected wetlands and riparian zones was undertaken by identifying rivers and wetness signatures from the digital base maps. All identified areas suspected of being wetlands or riparian zones were then further investigated in the field.

Riparian zones were delineated according to the delineation procedure as set out by the "A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas" document, as published by DWAF (2005). Riparian zones were identified and delineated based on the following indicators as described by DWAF (2005):

- The outer edge of the macro-channel bank (topography);
- Vegetation; and
- Presence of alluvial soils and deposited material.

4.3 Riparian Habitat Ecological Category Assessment

The Present Ecological State of the riparian habitat was assessed using a level 3 VEGRAI (Riparian Vegetation Response Assessment Index), a tool from the River Health Programme. The Level 3 VEGRAI is for application in the River Health Programme and for rapid Ecological Reserve purposes. VEGRAI focuses on the impacts which have affected the riparian vegetation and the level of vegetation change within the various riparian zones (as detailed in **Table 1** and illustrated in **Figure 1** below) when compared to a constructed reference state (Kleynhans, Mackenzie & Louw 2006). **Table 2** provides a description of the ecological categories that are assigned based on the outcomes of the VEGRAI assessment.

Table 1: Description of riparian vegetation zones

	Marginal	**Lower**	**Upper**
Alternative descriptions	Active features Wet bank	Seasonal features Wet bank	Ephemeral features Dry bank
Extends from	Water level at low flow	Marginal zone	Lower zone
Extends to	Features that are hydrologically activated for the greater part of the year	Usually a marked increase in lateral elevation.	Usually a marked decrease in lateral elevation
Characterized by	See above	Geomorphic features that are hydrological activated on a seasonal basis. May have different species than marginal zone	Geomorphic features that are hydrological activated on an ephemeral basis. Presence of riparian and terrestrial species Terrestrial species with increased stature

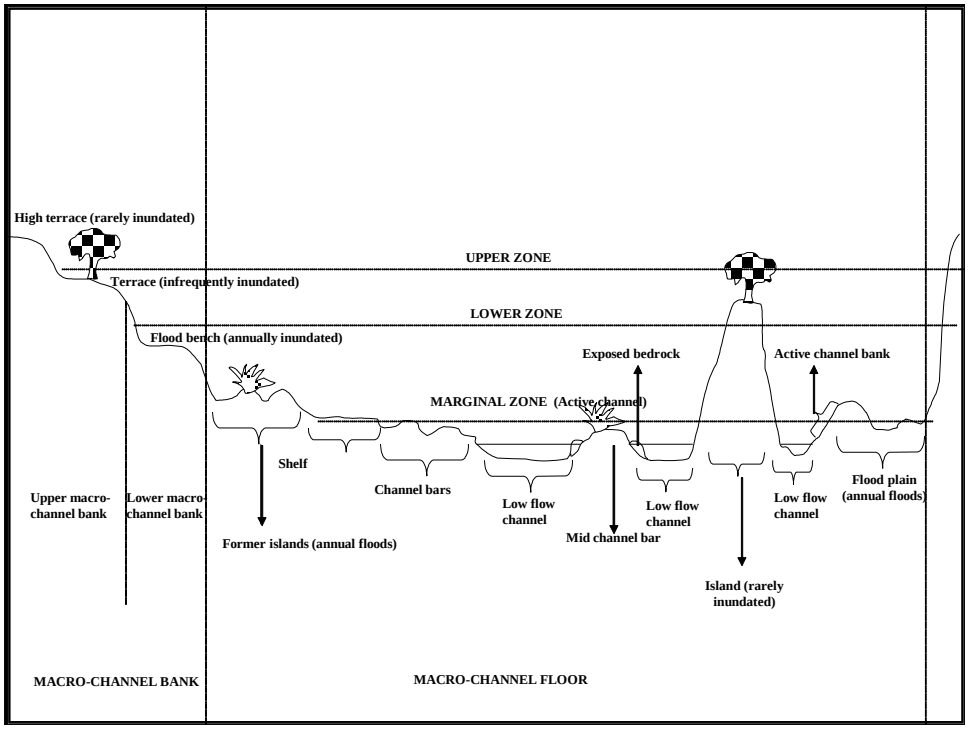

Figure 1: Schematic diagram illustrating an example of where the 3 zones would be placed relative to geomorphic diversity

Table 2: Generic ecological categories for EcoStatus components (modified from Kleynhans 1996 & Kleynhans 1999).

Class	Description	Score (% of total)
A	Unmodified	100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-99
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions have occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions are extensive.	20-39
F	Modifications have reached a critical level and the lotic system has 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.	0-19

4.4 Impact Assessment

To ensure uniformity, the assessment of potential impacts will be addressed in a standard manner so that a wide range of impacts is comparable. For this reason a clearly defined rating scale will be utilised to assess the impacts on watercourses associated with the existing developments. Each impact identified will be assessed in terms of probability (likelihood of occurring), extent (spatial scale), intensity (severity) and duration (temporal scale). To enable a scientific approach

to the determination of the impact significance (importance), a numerical value will be linked to each rating scale. The sum of the numerical values will define the significance. More details on the scoring system used in this impact rating procedure are provided in **Tables 3 and 4.**

Table 3: Generic rating scale used in the assessment of impacts.

Aspect	Category	Rating	Description
Probability	Definite	3	More than 90 percent sure of a particular fact or of the likelihood of that impact occurring
	Probable	2	70 to 90 percent sure of a particular fact or of the likelihood of that impact occurring
	Possible	1	40 to 70 percent sure of a particular fact or of the likelihood of that impact occurring
	Improbable	0	Less than 40 percent sure of a particular fact or of the likelihood of that impact occurring
Extent	Site	1	Immediate project site
	Local	2	Up to 5 km from the project site
	Regional	3	20 km radius from the project site
	Provincial	4	Provincial
	National	5	South African
	International	6	Neighbouring countries/overseas
Duration	Very short-term	1	Less than 1 year
	Short-term	2	1 to 5 years
	Medium-term	3	5 to 10 years
	Long-term	4	10 to 15 years
	Very long-term	5	Greater than 15 years
	Permanent	6	Permanent
Intensity	Very low	0	Where the impact affects the environment in such a way that natural, cultural and social functions are not affected
	Low	1	Where the impact affects the environment in such a way that natural, cultural and social functions are only marginally affected
	Medium	2	Where the affected environment is altered but natural, cultural and social function and processes continue albeit in a modified way
	High	3	Where natural, cultural or social functions or processes are altered to the extent that they will temporarily cease
	Very high	4	Where natural, cultural or social functions or processes are altered to the extent that they will permanently cease

Table 4: Overall impact significance rating scale.

	Score	Significance Rating
Overall Significance Rating	2 – 4	Low
	5 – 7	Low to Moderate
	8 – 10	Moderate
	11 - 13	Moderate to High
	14 – 16	High
	17 – 19	Very High

5. REGIONAL CHARACTERISTICS OF THE STUDY AREA

5.1 Location

The study area is located just south of the settlement of Marikana, which lies approximately 23 km east of Rustenburg in the North West Province. The dominant landuse on site is low density residential use in the west of the site and cultivation, natural veld and rehabilitated mine land across the majority of the site. A tarred road running north-south between Marikana and the N4 highway to the south dissects the western portion of the study area. Mining, agriculture and rural/urban settlements are the primary landuses in the surrounding landscape. The regional location and extent of the site is indicated in **Figures 2** and **3**. The Sterkstroom River, which flows northwards and contributes flow to the Crocodile River forms the western boundary of the study area. The study area is approximately 119 hectares.

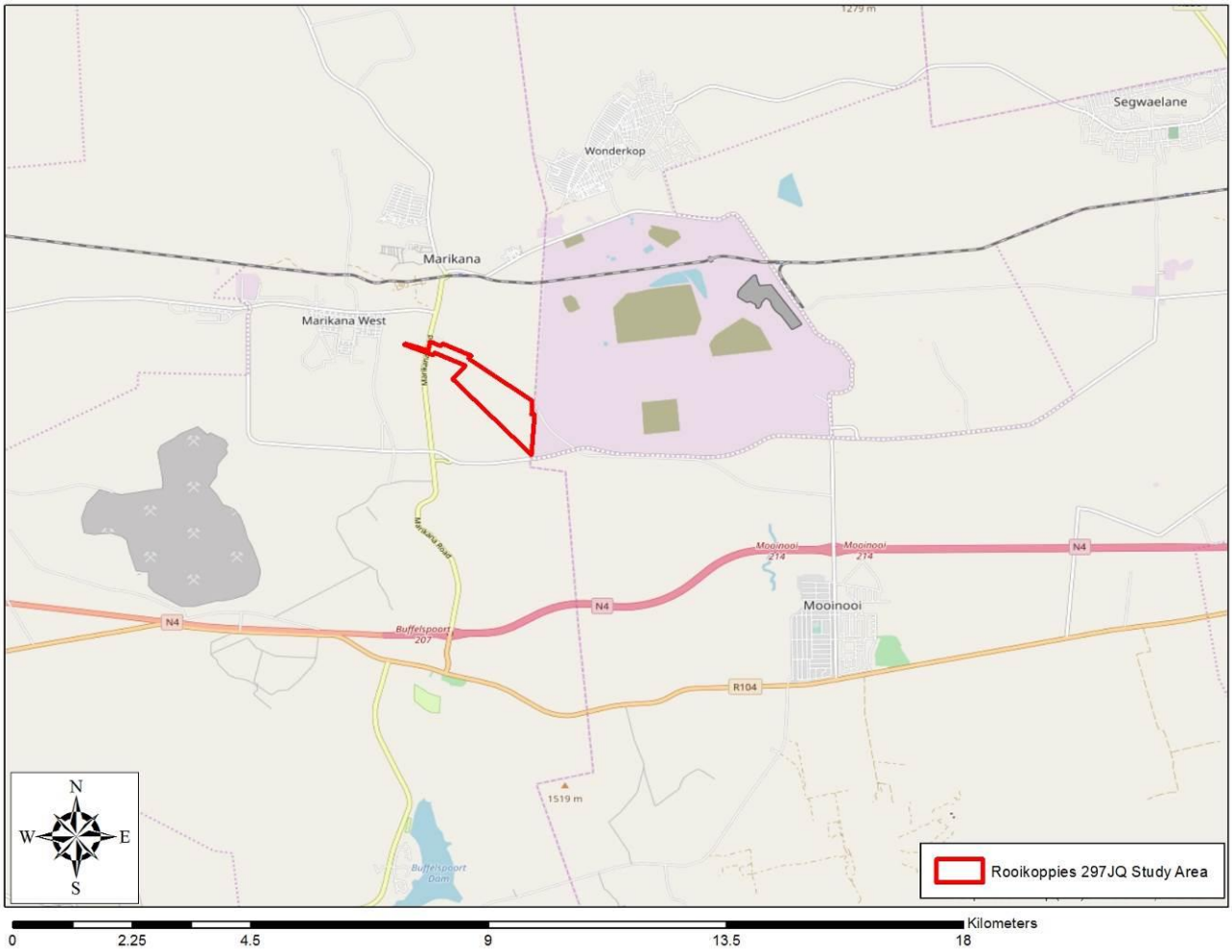

Figure 2: Location and approximate extent of the study area.

Figure 3: Study area boundaries overlaid onto recent aerial imagery of the area.

5.2 Catchment

The study site lies within quaternary catchment A21K (**Figure 4**). The Sterkstroom River forms the western boundary of the study area, drains northwards and forms part of the Crocodile River's catchment. The eastern majority of the study area is drained by a non-perennial stream that drains into the Maretlwana River, which also lies in the catchment of the Crocodile River. Details of the rainfall and runoff characteristics of catchment A21K are provided in **Table 5** below. The study site forms part of the Crocodile (West) and Marico Water Management Area, and lies within the Bushveld Basin DWA River Ecoregion (Kleynhans, Thirion and Moolman; 2005). The Bushveld Basin Ecoregion is described as consisting predominantly of plains with a low relief and the definitive vegetation type is Mixed Bushveld. Several perennial rivers traverse the region, e.g. the Marico, Elands (West), Crocodile (West), Pienaars and Olifants. It is indicated that virtually no perennial tributaries arise in the region (Kleynhans *et al.*, 2005).

Table 5: Quaternary catchment characteristics for the study area (Middleton, B.J., Midgley, D.C and Pitman, W.V., 1990).

Quaternary Catchment	Area (Hectares)	Mean Annual Precipitation (mm)	Mean Annual Evaporation (mm)	Mean Annual Runoff (mm)	MAR as a % of MAP
A21K	86460	717.65	1600-1800	100	13.93

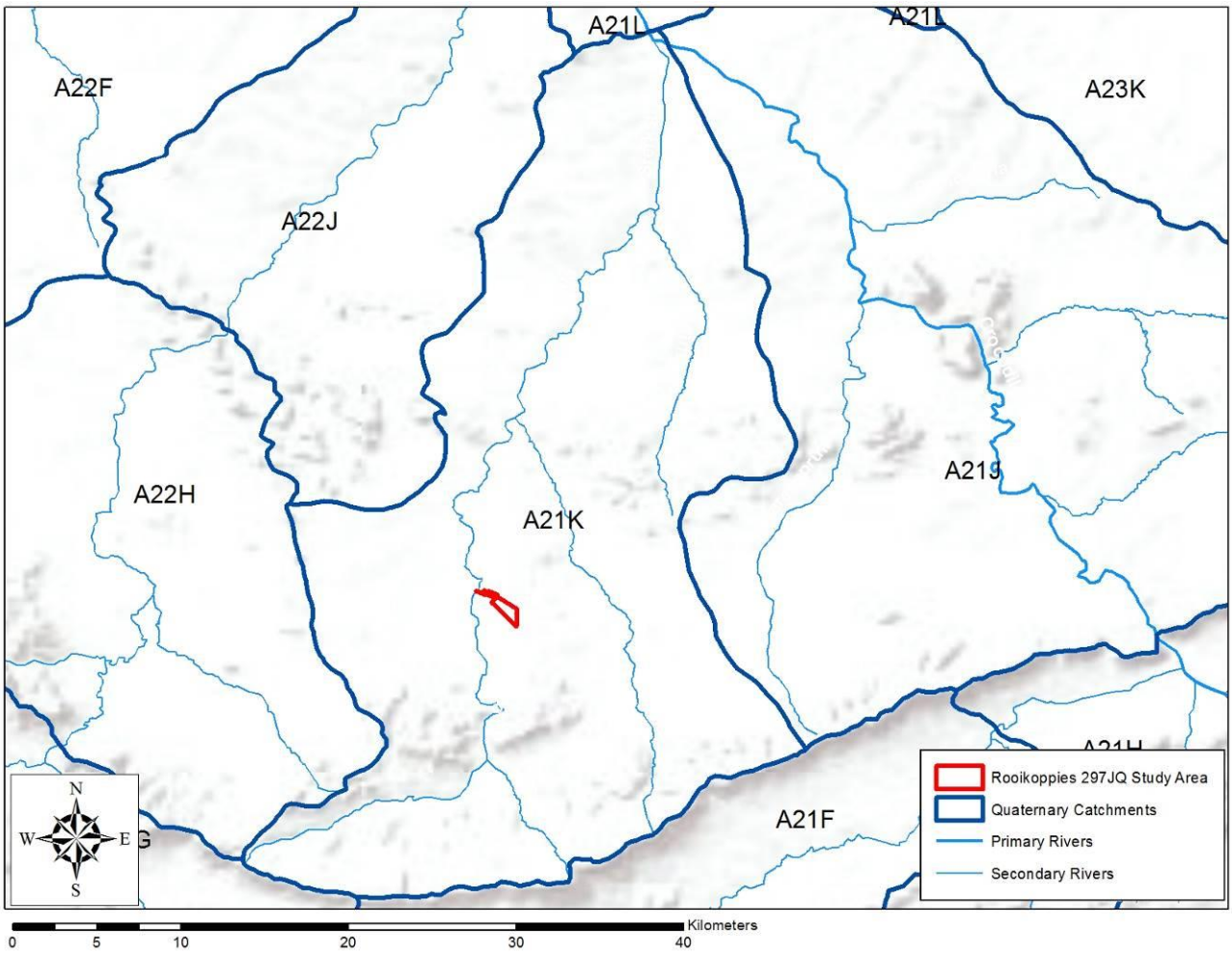

Figure 4: Quaternary catchments in relation to the study area.

5.3 Geology and Soils

The geology of the area belongs to the Rustenburg Layered Suite of the Bushveld Complex. According to the 1:250 000 geological map (2526 Rustenburg) the unit present across the northern portion of the site is Pyramid Gabbro-Norite. This unit comprises gabbro and norite layers that gently dip to the east. The southern portion of the site is characterised by the Schilpadnest

subsuite, also of the Rustenburg Layered Suite of the Bushveld Complex. The lithology includes pyroxenite, leuconorite, anorthosite and chromitite.

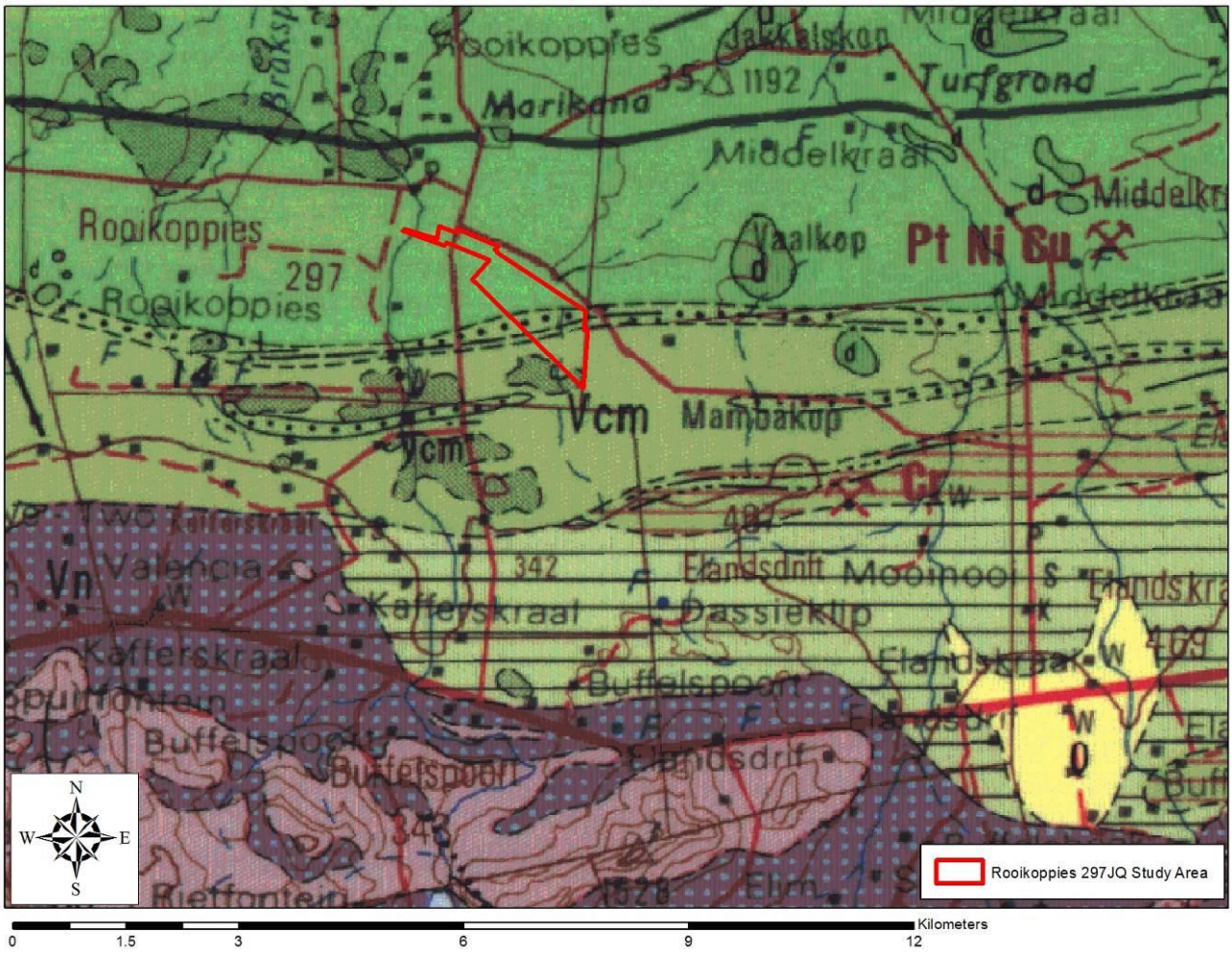

Figure 5: Geology of the study area and surrounds.

5.4 Vegetation

The vegetation across the study area is classified as Marikana Thornveld (SVcb 6), a subset of the Central Bushveld Bioregion within the Savanna Biome (Mucina & Rutherford, 2006) which occurs in the North West and Gauteng Provinces on plains from the Rustenburg area in the west, through Marikana and Brits to the Pretoria area in the east. According to Mucina & Rutherford (2006), Marikana Thornveld is considered Endangered as the conservation target for this vegetation type is 19%, yet less than 1% is statutorily conserved. Marikana Thornveld is highly impacted with at least 48% transformed, primarily due to cultivation and urban or built-up areas. However, according to the published National List of Ecosystems that are Threatened and in Need of Protection (GN1002 of GG34809, NEMBA 2004), Marikana Thornveld is listed as Vulnerable and

falls within Criterion A1 which represents ecosystems which have suffered an irreversible loss of natural habitat.

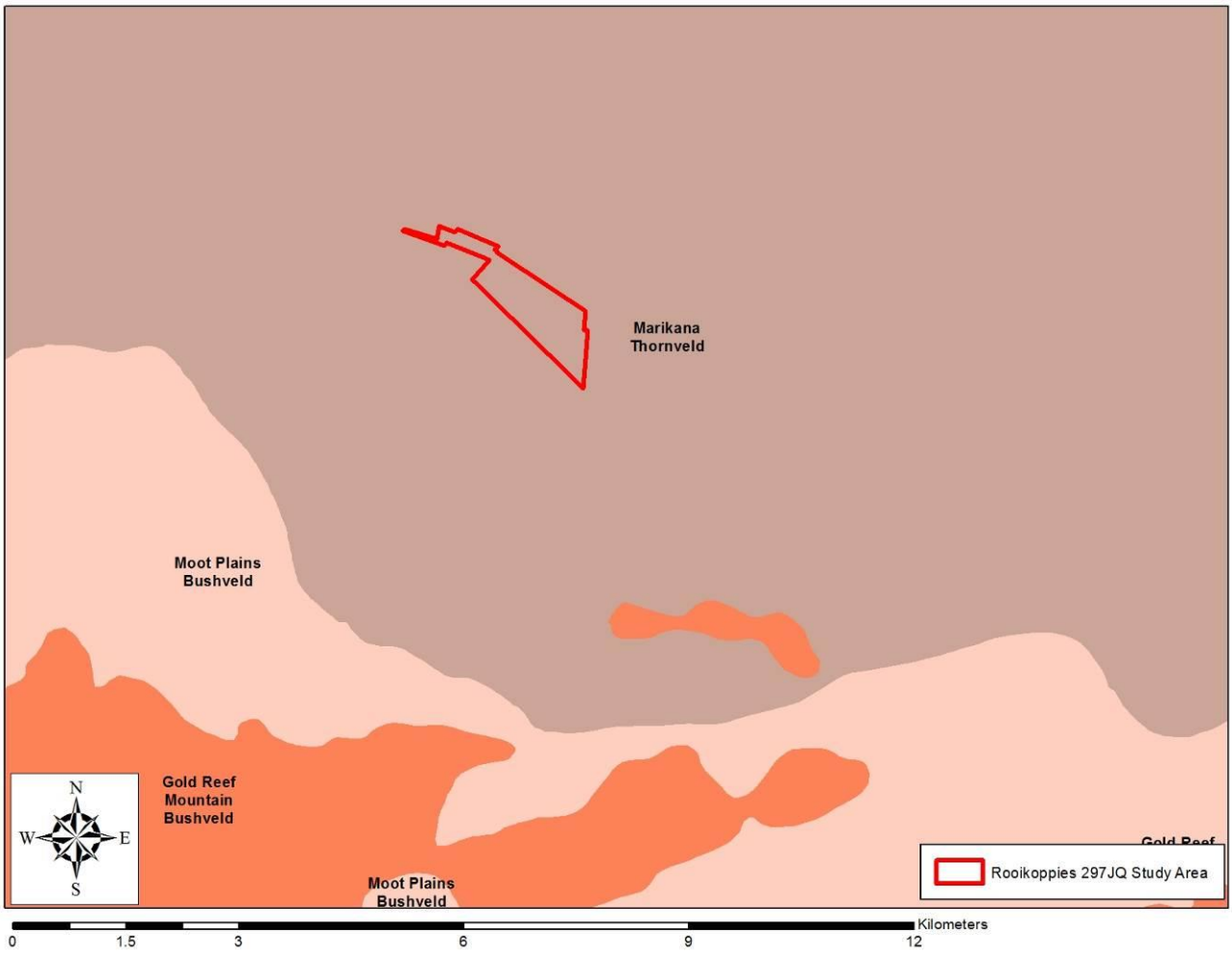

Figure 6: Vegetation units of the study area and surrounds.

5.5 National Freshwater Ecosystem Priority Areas (NFEPA)

The Atlas of Freshwater Ecosystem Priority Areas (FEPA) in South Africa (Nel *et al,* 2011) which represents the culmination of the National Freshwater Ecosystem Priority Areas project (NFEPA), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. FEPA's were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such

as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat.

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

According to the NFEPA database, no FEPA wetlands or rivers occur within the study area. However, the Sterkstroom River is categorised as a Phase 2 FEPA which were "*identified in moderately modified rivers (C ecological category), only in cases where it was not possible to meet biodiversity targets for river ecosystems in rivers that were still in good condition (A or B ecological category). The river condition of these Phase 2 FEPAs should not be degraded further, as they may in future be considered for rehabilitation once FEPAs in good condition (A or B ecological category) are considered fully rehabilitated and well managed*" (Driver *et al*., 2011).

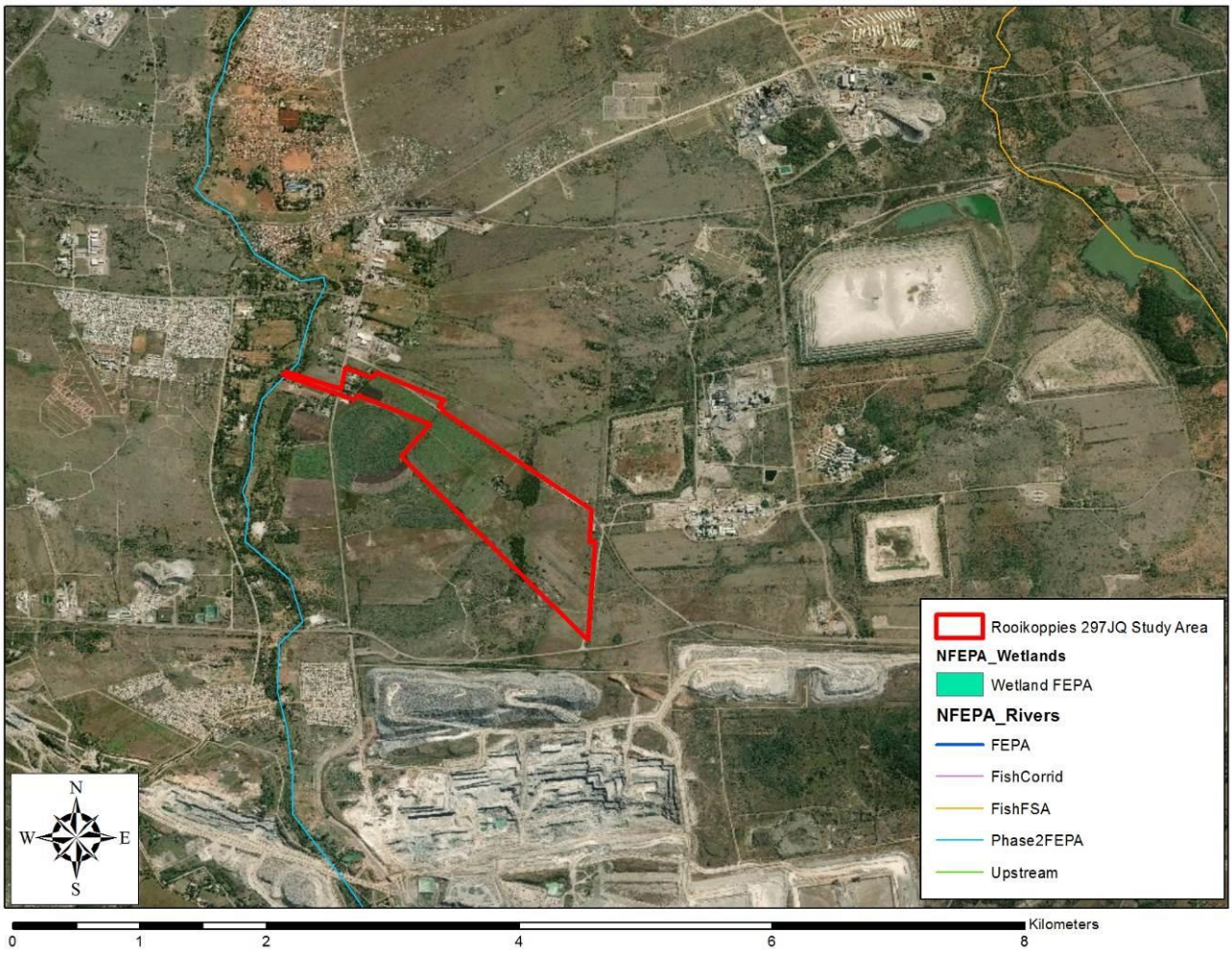

Figure 7: NFEPA wetlands and rivers in relation to the study area.

5.6 Conservation Importance

The North West Province's Biodiversity Sector Plan (BSP) database is split into terrestrial and aquatic layers which indicate Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) from both an aquatic and terrestrial perspective. CBAs are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. Failure to maintain these areas as such would result in the biodiversity targets for the province not being met. ESAs are terrestrial and aquatic areas that are not essential for meeting biodiversity representation targets (thresholds), but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration (READ, 2015)

Priority rivers and catchments, as identified as part of the NFEPA project, have, for the most part, been incorporated into the aquatic CBAs and ESAs (READ, 2015). **Figure 8** shows the categorisation of different areas according to the aquatic component of the BSP. The Sterkstroom River is indicated as a CBA1, and a 100 metre buffer of the channel is indicated as a CBA2. The entire catchment of the Maretlwana River in the east where it overlaps with the study area is considered as either an ESA1 or ESA2. **Figure 9** shows the categorisation of different areas according to the terrestrial component of the BSP, and in this case both the Sterkstroom River in the west and a watercourse in the east of the site are listed as CBA2, while most of the remainder of the site is either ESA1 or ESA2.

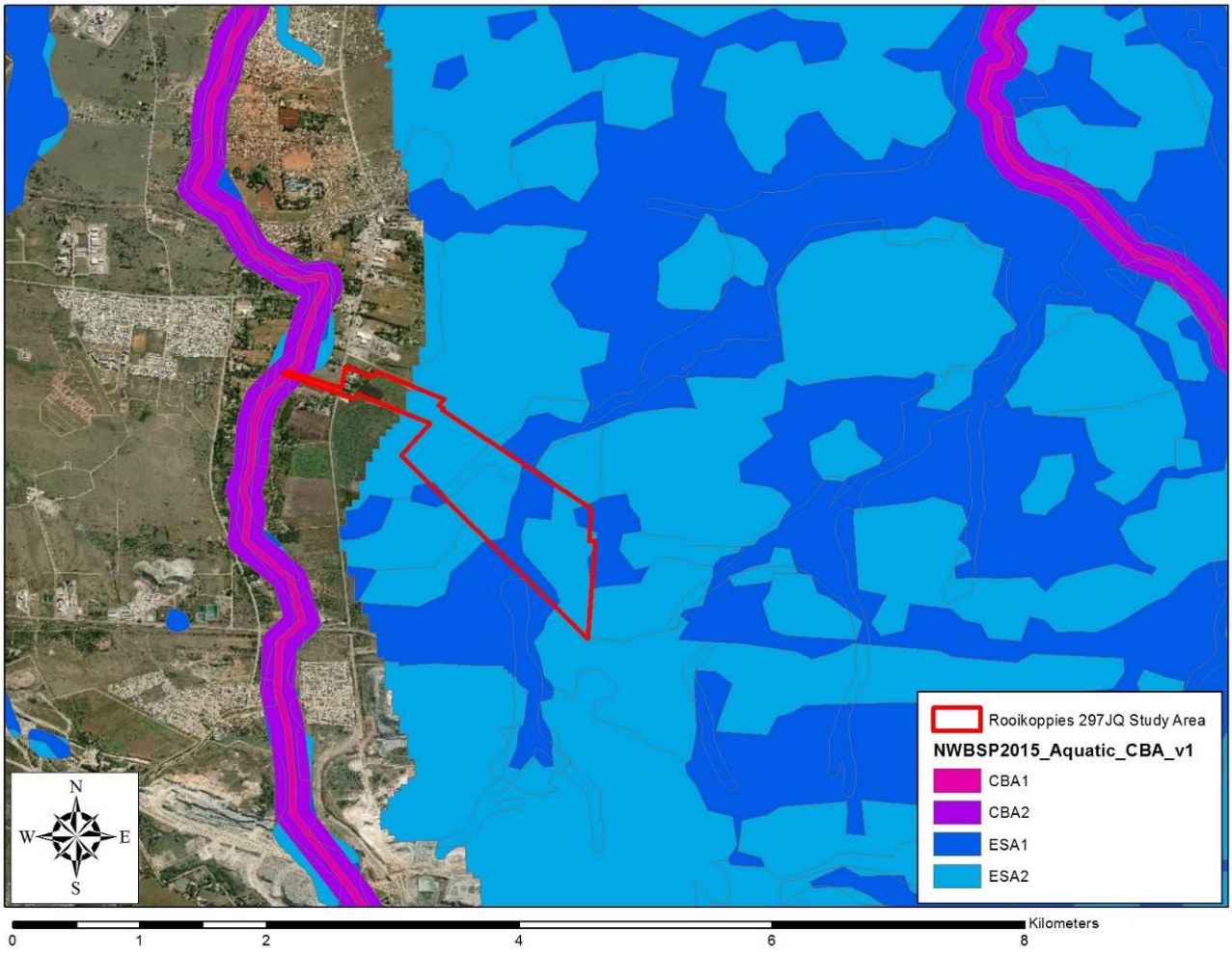

Figure 8: Conservation Importance of the study area according to the current North West Province Biodiversity Sector Plan's Aquatic Layer.

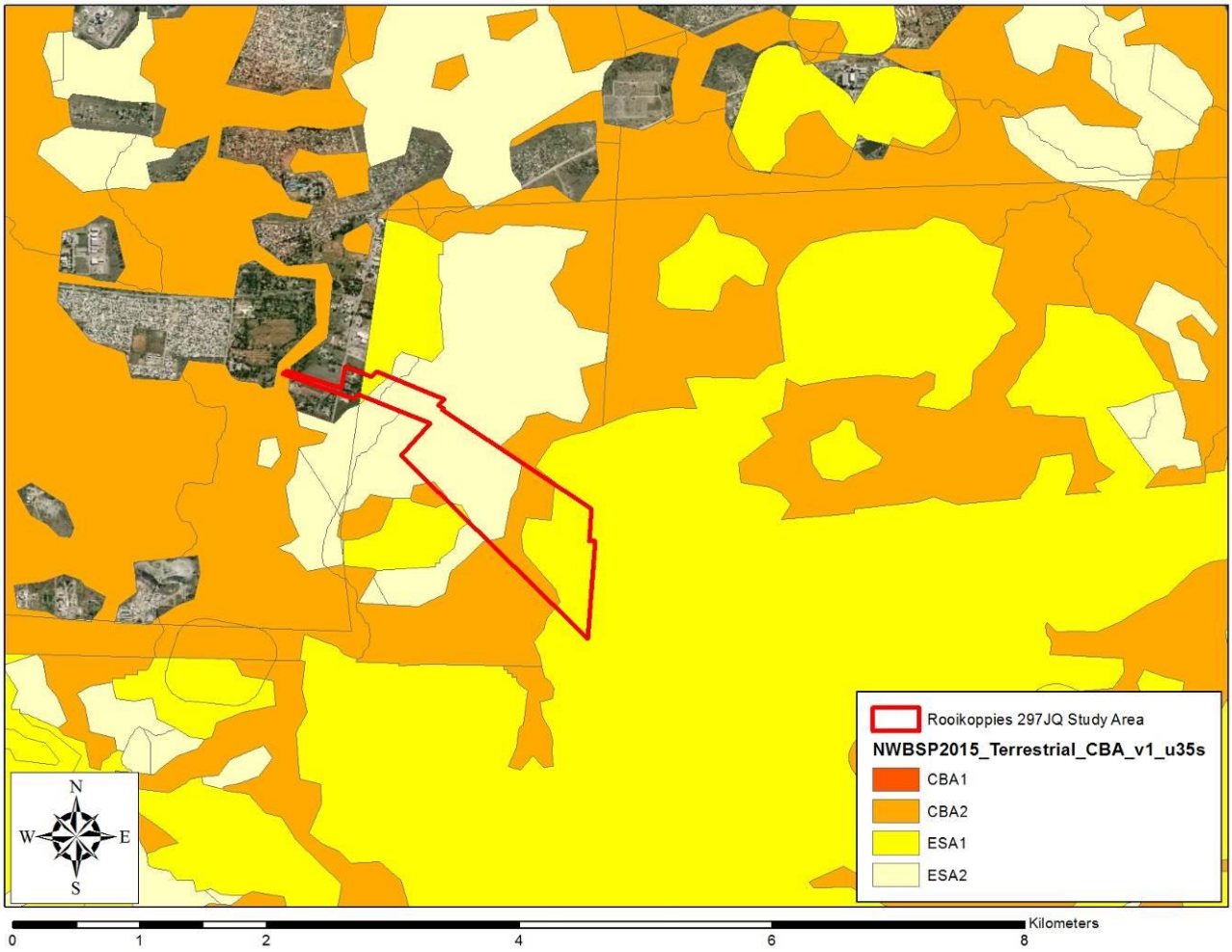

Figure 9: Conservation Importance of the study area according to the current North West Province Biodiversity Sector Plan's Terrestrial Layer.

6. FINDINGS

6.1 Riparian Baseline Assessment

6.1.1 Riparian Delineation

A site assessment was undertaken in August 2019 to determine the extent of wetlands and riparian habitat on site. No natural wetlands were identified within the study area. However, two distinct river channels cross the site and riparian habitat associated with these channels was delineated. In addition, a narrow drainage line was identified draining towards the northeast and several areas of artificial wetness were identified, associated with irrigation dams and an

unidentified water source. The extents and locations of the riparian habitat and other delineated features are illustrated in **Figure 10** and the areas covered by each feature are detailed in **Table 6**.

Table 6: Extent of the riparian habitat and other features delineated on site.

TYPE	AREA (HA)	PERCENTAGE OF STUDY AREA (%)
Riparian Habitat	6	5.05
Recreated Watercourse	0.5	0.42
Drainage Line	1.2	1.01
Artificial Wet Areas	1.5	1.26
TOTAL	**9.2**	**7.74**

As mentioned above, two defined watercourses or river channels cross the site, namely the Sterkstroom River along the western boundary of the site and a second, smaller stream in the eastern half of the site. Both flow in a generally northerly direction. Riparian habitat is associated with both of these watercourses. Riparian vegetation along both channels is a mix of woody and non-woody vegetation and is classified as riparian woodland according to the vegetation survey conducted for the study area (D. Hoare, Pers. Comm., September 2019). The marginal zones of both watercourses, however, are dominated by non-woody grass and sedge species. The riparian vegetation along the Sterkstroom is heavily degraded due to extensive use by the surrounding communities and alteration of the flow regime through damming upstream. The eastern riparian habitat is largely intact in the north and south of the site. However, past surface mining has taken place through the central portion of this watercourse and resulted in removal of the central section of riparian vegetation and the natural channel. The mined area has since been rehabilitated, and the affected section of watercourse recreated across the mine footprint. As a result, this section of channel is straight, compared to the up and downstream reaches which meander through the riparian vegetation, and the woodland typical of the surrounding natural riparian vegetation has been replaced with a low profile, graminoid dominated vegetation community, with little to no woody component. Identification of vegetation was hampered by the season in which the survey was undertaken (winter) as vegetation, particularly grasses and herbaceous species were mostly dead or not flowering. The riparian vegetation was dominated by woody tree and shrub species, and where not extensively cleared, species including *Rhus lancea*, *Acacia* sp., *Protasparagus* sp., and *Ziziphus mucronata* were observed. The grass species *Ischaemum afrum* was observed frequently, particularly along the margins of the riparian woodland and in open patches within this vegetation type. Within the marginal zone of the riparian habitat, namely within the wetter active channel, typical hydrophytes such as *Cyperus sexangularis*, *Typha capensis* and *Phragmites*

australis were present. Alien vegetation observed included species such as *Populus* sp., *Melia azedarach* and *Lantana camara.*

The soils east of the tar road are dark, vertic clays with limited permeability, which explains the lack of wetland habitat identified on site. The soils west of the tar road, along the Sterkstroom River are sandier in nature, but did not show any hydromorphic characteristics.

A narrow drainage line was noted to the west of the eastern riparian zone. The soils in this area of the site were dark, vertic clays and showed no signs of prolonged saturation. The vegetation within the drainage line did not differ noticeably from the adjacent terrestrial vegetation. Although this drainage line is not classified as a wetland or riparian zone, it does represent a preferential flow pathway for flows across the site.

Several artificial wet areas were noted, and mapped, within the study area. These wet areas are associated with irrigation dams for the most part. However, an area of seasonal to permanent saturation, supporting obligate hydrophytic vegetation such as *T. capensis* and *P. australis,* was observed along the northern edge of the site, a short distance east of the tar road. Given the nature of the soils (vertic, black clay) and position within the landscape (near the crest of the hill); it is unlikely that this is a natural wetland feature in the landscape. The wet vegetation is well established in this area and suggests that whatever water source supports this vegetation has been present for an extended period of time.

Photographs of the riparian habitats observed on site are provided in **Figure 11**.

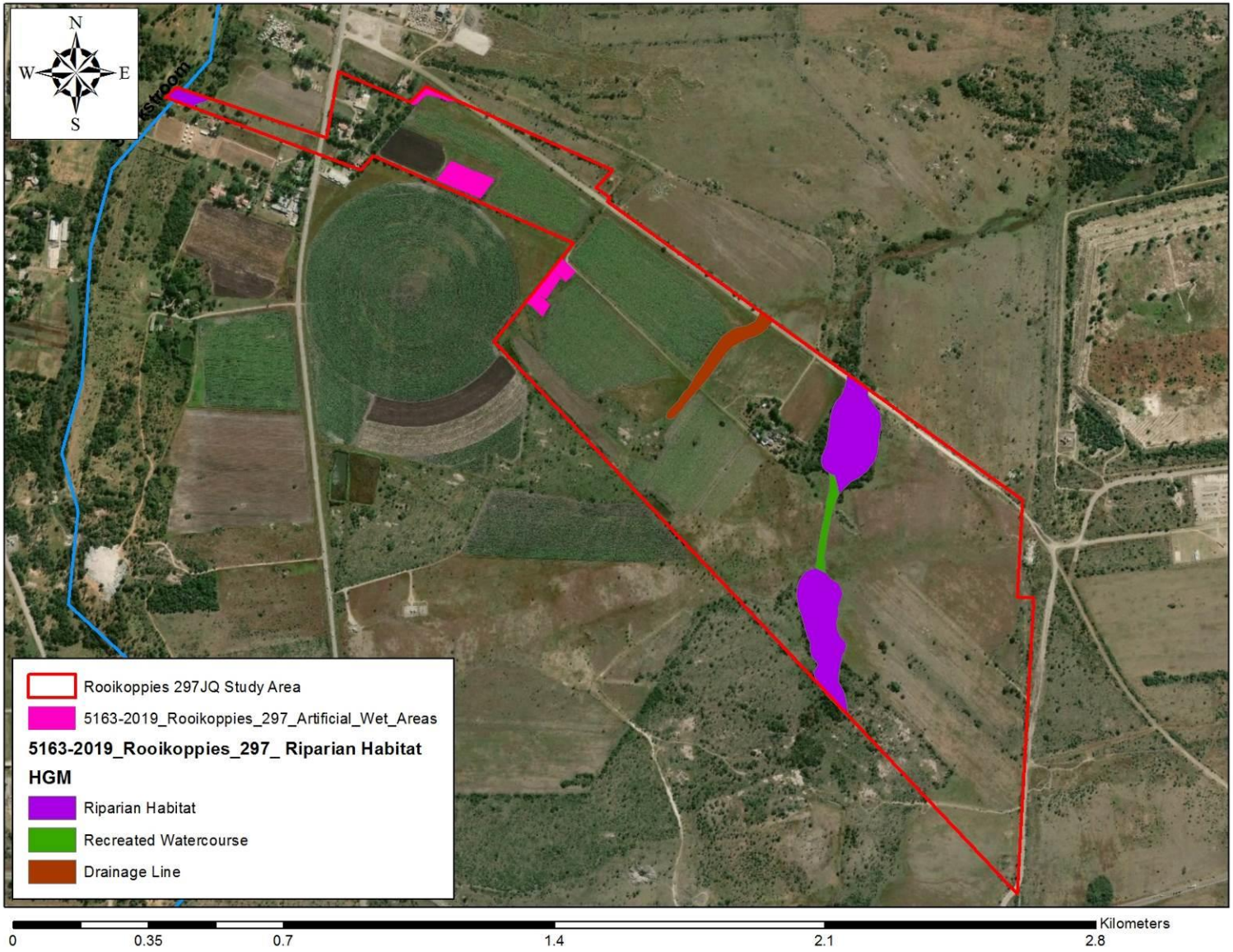

Figure 10: Location and extent of riparian habitat and other notable features within the study area.

Figure 11: Riparian habitat observed on site: (top row) Recreated watercourse; (middle row) Eastern riparian zone; (bottom row) Sterkstroom riparian zone.

6.1.2 Ecological Category of the Riparian Habitat

The riparian areas on site have been impacted upon as a result of the surrounding landuses. The Sterkstroom riparian zone has suffered from harvesting of vegetation, overgrazing by livestock, excavation of soils, dumping of litter and other materials, alien vegetation encroachment and reduced flows as a result of damming of the river both a short distance upstream and in the Buffelspoort Dam higher in the catchment. As a result of these impacts and their effect on the cover, abundance and species composition of the riparian vegetation, the current Ecological Category of this riparian zone is a "D" which indicates a largely modified system which has sustained a large loss of natural habitat, biota and basic ecosystem functions.

The eastern riparian zone lies further from the local communities and has therefore experienced less utilisation, though a degree of woody vegetation harvesting and livestock grazing was noted. A small degree of alien vegetation encroachment was also observed. Flows to this watercourse may have been affected by opencast mining in the catchment, resulting in reduced flows to the watercourse. The most significant impact affecting the eastern riparian zone is past mining which resulted in removal of the central section of the channel and riparian vegetation. Connectivity was reinstated post-mining in the form of a recreated watercourse, but the woody riparian vegetation was lost. As the reference state (pre-mining) of the recreated watercourse is riparian habitat, this system was assessed using VEGRAI Level 3, in the same way as were the other delineated riparian zones. **Figure 12** shows the state of the riparian habitat in the central section before mining and the current recreated watercourse after mining. The intact riparian vegetation and the recreated watercourse were assessed separately and found to be moderately modified (EC of "C") and seriously modified (EC of "E"), respectively. The results of the VEGRAI Level 3 assessments are detailed in **Table 7** and **Figure 13** below.

Figure 12: Comparison of the eastern riparian zone in 2004 (left) and 2019 (right), showing the change from intact riparian habitat to a recreated watercourse in the central section of the channel on site.

Table 7: Results of the of the VEGRAI level 3 assessment for the riparian habitat on site.

RIPARIAN ZONE	LEVEL 3 VEGRAI (%)	VEGRAI ECOLOGICAL CATEGORY	AVERAGE CONFIDENCE
Sterkstroom Riparian Zone	54.2	**D**	2.4
Eastern Riparian Zone	71.7	**C**	2.8
Recreated Watercourse	36.7	**E**	3

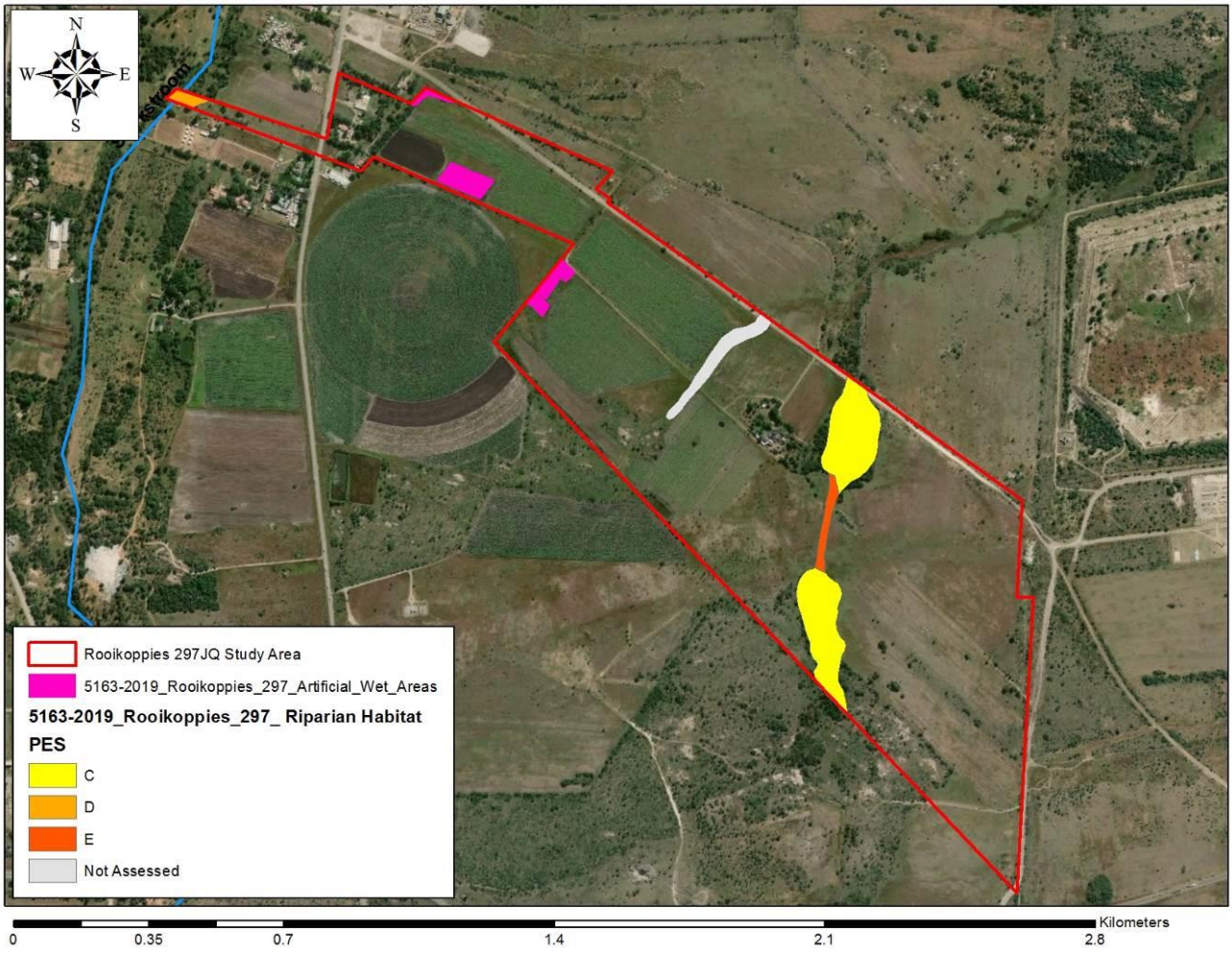

Figure 13: Present ecological state (PES) of the riparian habitat.

6.1.3 Functionality and Importance of the Riparian Habitat

No formal assessment tools are available to assess the functionality or importance and sensitivity of riparian habitat; however, certain statements can be made with regards to the functionality and importance of the riparian habitat on site. The riparian habitat can play an important role through the following functions:

- It provides habitat and migratory pathways for terrestrial and aquatic fauna within a transformed landscape,
- Buffers the aquatic environment from increasing surface runoff and noise pollution,

- The rooting system of the trees (and other vegetation) helps to stabilise the banks and limit erosion.

- The plants provide a refuge for aquatic species utilizing the river and stream, and also create a mosaic of habitats which encourage greater diversity among the species able to utilise the river ecosystem,

- Organic inputs to the river provide a food source for aquatic species, and

- The canopy cover provided by the trees shades the channel and contributes towards maintaining lower water temperatures.

In terms of importance, the riparian habitats delineated fall within areas considered to be Critical Biodiversity Areas according to the North West Province's Biodiversity Sector Plan (READ, 2015), which means that these areas are necessary in meeting the provinces biodiversity targets. The vegetation unit for the area – Marikana Thornveld – is considered Vulnerable according to the published National List of Ecosystems that are Threatened and in Need of Protection (GN1002 of GG34809, NEMBA 2004), and therefore intact areas of habitat should be maintained to limit further losses. The Sterkstroom is also classified as a Phase 2 FEPA (see Section 5.5 for further details).

Given the above points, the riparian habitat on site can be considered important from both a functional and conservation perspective and should be properly managed and prevented from deteriorating further.

6.1.4 Sensitivity Mapping

The North West Province does not currently have any wetland or riparian buffer guidelines in place. Within Gauteng, the GDARD Guidelines for Biodiversity Assessments recommend a 50 metre buffer for wetlands in a rural setting, a 30 metre buffer for wetlands in an urban setting and a 32 metre buffer for riparian habitat. However, in order to establish appropriate, site-specific buffers for the riparian habitat on site, the River Buffer Determination Tool, which forms part of the "Buffer zone guidelines for rivers, wetlands and estuaries" (Macfarlane *et al.*, 2017), was utilised to determine a suitable, site and development specific buffer zone for the rivers and riparian habitat. Based on the site and watercourse characteristics, as well as the proposed development type – high density housing – a buffer of 50-52 metres is recommended (with no assumption of mitigation included). A significant impact that contributes to the calculation of this buffer width range is the

potential for increased sediment inputs and turbidity to the receiving rivers due to erosion off bare soils and stockpiles during the construction phase. If appropriate mitigation measures are put in place to limit sediment runoff from the construction areas during the construction phase, the total required buffer width drops to 29-30 metres. As no stormwater management plan or construction stormwater runoff management plan is currently available on which to base an assumption of mitigation, it is recommended that a greater buffer width of 50 metres be applied to the riparian areas on site (see **Figure 14**). It should also be noted that the buffers determined using the River Buffer Determination Tool are specific to addressing diffuse lateral flow/pollutant inputs. The buffering of point source inputs is not catered for in the tool and therefore, additional measures would be necessary to protect the riparian habitat from associated impacts.

Should any development be planned within the delineated watercourses on site which will impact the water resource, such development is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998), and will require the submission of a Water Use Licence for all relevant activities.

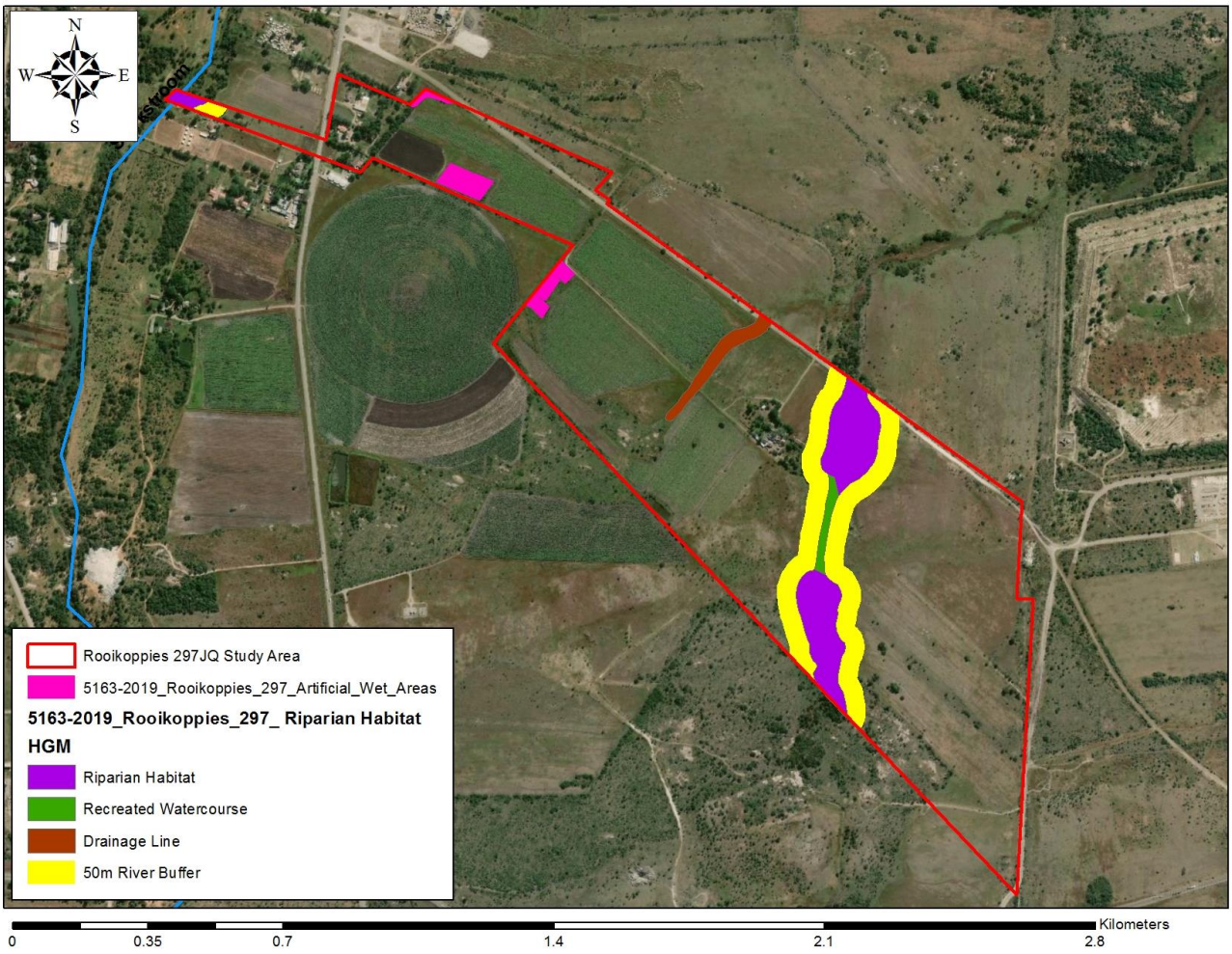

Figure 14: Sensitivity map of the study area showing the delineated riparian habitat and the recommended buffer zone.

6.2 Impact Assessment

6.2.1 Project Description

The proposed development within the study area is high density residential plots, including both RDP and Bonded Units. The estimated total number of housing units is 2553 within the study area, which equates to approximately 25 units per hectare, assuming all housing units remain outside of the riparian habitat and the 50 metre buffer. In addition to the residential units and access road network, support infrastructure such as small business and community facility hubs, parks and public open spaces and a sewage treatment facility will be included in the development layout for the study area. In summary the following is proposed for the site:

- High density housing;
- Access road network;
- Business and community facilities;
- Parks and public open spaces;
- A road crossing through the recreated watercourse; and
- A sewage treatment facility.

According to information provided by the client, all infrastructures will remain outside of the delineated riparian zones and the associated 50 metre buffer, with the exception of an access road crossing through the recreated watercourse (modified riparian habitat). Impacts to the riparian habitat on site that can be expected as a result of the above mentioned activities are detailed below:

- High density housing – Loss of soil storativity and increased stormwater runoff, increased risk of erosion, water quality deterioration and riparian habitat disturbance.
- Road crossing through the recreated watercourse/riparian zone - Loss of rehabilitated riparian habitat, impoundment and concentration of flows, Increased risk of erosion and water quality deterioration
- Sewage works – Water quality deterioration, increased flow volumes.

6.2.2 Impact Description and Mitigation Measures

6.2.2.1 Loss of Riparian Habitat

Direct loss of intact riparian habitat is not anticipated within the footprint of the residential units as long as all development and construction activity remains outside of the riparian habitat, and preferably the buffer zone as well. Within the footprint of the road crossing through the recreated watercourse, some re-established marginal riparian vegetation will be lost, though given the highly altered nature of the riparian vegetation within the recreated watercourse, the intensity of this impact is very low. The most important consideration will be to retain the flow characteristics in the channel up and downstream of the road crossing.

Mitigation Measures

As long as the development footprint remains outside of the riparian habitat, no mitigation is required. Ideally, existing channel crossings should be utilised rather that establishing new road crossings over the channel. However, if new road crossings are required, placing them through the recreated watercourse, which is already highly altered due to past mining and rehabilitation activities, rather than through intact riparian vegetation is preferable.

In addition, a stormwater management plan will need to be developed and implemented to handle all hydrological and flow changes anticipated on site with the objective of protecting the receiving environment from damage or negative impact caused by the development. The development layout design and stormwater management system should both be designed with cognisance of the presence of the riparian habitat and watercourses and the natural flow patterns across the site and supporting the riparian vegetation.

It must be noted that any development planned within the delineated watercourses, which will impact the water resource, may be subject to authorisation under Section 21 of the National Water Act (Act 36, 1998), and if such is the case, would require the submission of a Water Use Licence application for all relevant activities.

6.2.2.2 Loss of Soil Storativity/Increased Stormwater Runoff

One of the consequences of urbanisation is the interception of rainfall by impervious surfaces. Water that previously either infiltrated into the catchment soils or flowed as diffuse surface flows into the drainage network is generally captured in storm water drains and conveyed into the watercourses and low points where it is released as point source discharges. In an undeveloped scenario, the vegetation intercepts precipitation and surface flows and they are absorbed to a greater or lesser degree into the permeable soil profile, where these flows move in a slow, diffuse manner. By replacing the permeable soils with impermeable surfaces, soil storativity is lost, and those flows which would have been absorbed now move through, and off, the site as surface runoff. A number of knock-on impacts can then occur as a consequence of increased surface flow, such as erosion and water quality deterioration. Aside from increased volumes of surface runoff, this runoff also tends to have a higher velocity, particularly during peak flow events, which can cause erosion and property damage.

Mitigation Measures

Two strategies can be employed simultaneously to manage this impact. Firstly, the development can be designed in such a way that the extent of impermeable surfaces is reduced as far as possible through the use of Sustainable Urban Drainage Systems (SUDS), a strategy which is being successfully employed locally and internationally. This method involves the incorporation of features, such as vegetated swales, permeable paving, infiltration trenches and rainwater tanks for water storage and harvesting for onsite purposes, into the development design, in order to help maintain or replicate pre-development water cycles (Lloyd, Wong & Chesterfield 2002; UPRTS 2004). Secondly, any increased surface runoff that is generated should be properly managed onsite to ensure no net increase in the quantity or velocity of flows in downstream watercourses. This can be achieved through inclusion of flow attenuation facilities in the design layout. Attenuation should be provided to ensure that the post-development flow velocities in receiving systems is not increased beyond the pre-development flow velocities at any time for storm events up to 25 year return intervals, or as required by the authorities. All such attenuation facilities should also be designed so that outflows from these facilities enter the riparian zones and watercourses concerned in a diffuse manner. All stormwater outlets should be situated outside of the riparian boundaries to prevent erosion of the wetter soils. Where stormwater outlets occur on steeper slopes, attenuation facilities should be placed at the outlets to prevent erosion on steeper slopes. Stormwater outlets should be designed and constructed so that no concentration of flows takes place downslope of the development. At points where stormwater outlets or road culverts discharge into downslope watercourses, discharge points should be suitably protected against erosion. Consideration should also be given to ensuring that velocities do not increase to the extent that they accelerate downstream erosion.

The above-mentioned mitigation measures should be incorporated into a stormwater management plan for the site which must detail the anticipated increases in flow volumes and velocities across the site and how these will be managed to ensure no impact to the receiving environment.

6.2.2.3 Impoundment and Concentration of Flows

The placement of road infrastructure across the recreated watercourse could lead to the impoundment of flows upstream of the structure and concentration of flows through culverts or other confining features. This will alter the natural hydrology of the watercourse by altering flow patterns, and can lead to erosion downstream of concentration points.

Mitigation Measures

Where possible, use must be made of existing crossings, even if upgrades are required, in order to limit the extent of the impact.

If a road crossing over the watercourse cannot be avoided, it must be designed to allow free flow of water across/beneath it and prevent concentration of flows. This can be achieved by using multiple culverts spaced across the entire channel front at the crossing to limit concentration typical at single culverts. At outflow points from culverts, erosion protection structures should be incorporated to further encourage diffuse flows and to slow flow velocities.

6.2.2.4 Increased Risk of Erosion and Sedimentation within Riparian Habitat and Watercourses

Clearing of vegetation during construction and increases in the quantity, velocity and concentration of surface runoff across the study site may result in erosion of exposed soil surfaces, especially along preferential flow pathways, such as at stormwater outlet points. This is a particular concern given the nature of the soils within the study area. The potential for channel bank erosion is high at this site given the shrink and swell characteristics of the vertic clay soils, a property which is likely to accelerate the erosion process once started. In addition to causing damage on site and along downstream watercourses, eroded sediments can be transported downstream, where they settle in dams and other attenuation facilities, reducing capacity over time and causing deterioration in water quality by increasing the sediment loads in the water column.

Mitigation Measures

To minimise the risk of erosion, the extent of disturbed vegetation and soil should be kept to a minimum. It is recommended that prior to the commencement of construction activities the entire construction servitude, including lay down areas and stock pile areas etc., should be fenced off and clearly demarcated. All construction activity should be contained within this demarcated servitude.

Further recommendations include:

- A construction stormwater plan must be developed and implemented to limit surface runoff from the construction areas and the risk of soil erosion and sediment transport to downstream watercourses.

- The construction process should be phased so as to limit the area of cleared vegetation and the extent of exposed areas at any one time, and so that for any specific area, the time between initial disturbance and completion of construction is as short as possible.
- Construction activities should ideally take place within the dry season, specifically construction within or immediately adjacent to any of the riparian zones and watercourses.
- Following the completion of construction activities, any remaining disturbed areas should be ripped, scarified, landscaped to the original landscape profile, and re-vegetated with suitable indigenous grass species that will aid in soil stabilisation.
- Erosion resulting from the concentration of flows through culverts and stormwater drains can be minimised at outlet points by reducing flow velocities and promoting diffuse flows. This can be achieved by reducing the gradient between outlet points and the receiving watercourses, by providing multiple outlet points or culverts across the watercourse front rather than a single large outlet to minimise erosion and channel formation and through the inclusion of erosion control and energy dissipating structures between outlets/culverts and the receiving environment, such as reno mattresses, riprap aprons or baffled aprons. These erosion control measures should be applied to all planned culverts and stormwater outlets. The mitigation measures suggested to handle increased stormwater runoff (SuDs, attenuation facilities) will also reduce the risk of erosion by promoting the infiltration of flows, reduce flow velocities, and capture any eroded sediments onsite.

6.2.2.5 Increased Flow Volumes

It is anticipated that if the sewage treatment facility treats sewage generated within the development, the clean water will be released to the environment via the eastern riparian zone on site. This will lead to a potentially large increase in the volume of water within the watercourse downstream, which could lead to increased erosion, sedimentation, and when combined with natural high flow events, flooding and damage to property downstream.

Mitigation Measures

Water generated from the sewage treatment facility should be utilised within the development as far as possible. Irrigation of vegetated areas and maintenance of any water features should be done using treated sewage water (assuming the treated water meets water quality standards for these uses). Any water discharged into the river network should be discharged in such a way that

the increased volume of water does not cause erosion either at the discharge point or further downstream. To this end, discharged flows should be dissipated before entering the river and the volumes released should not fluctuate, but should remain constant and as minimal as possible. It is suggested that a series of vegetated attenuation ponds/artificial wetlands be considered between the sewage treatment facility and the receiving riparian zone to dissipate increased flow volumes and velocities, allow the evaporation of some of the increased flows from the ponds or utilisation by the vegetation, create additional habitat, and to create a small measure of buffering to handle any fluctuations in discharge volumes.

6.2.2.6 Water Quality Deterioration

Water quality deterioration can be expected in both the riparian habitat and watercourses on site and in downstream watercourses due to the input of potentially polluting substances during the construction process (e.g. oil, diesel, cement etc.) which could lead to the pollution of water resources through spillages, leakages, accidents or incorrect disposal of used containers and waste. During the operational phase of the proposed development, stormwater runoff from impermeable surfaces such as buildings, pavements and roads will lead to water quality deterioration within the receiving water resources. Stormwater runoff is expected to contain various contaminants, including hydrocarbons, metals and domestic/commercial pollutants, derived from regular use of the access road network by motor vehicles (e.g. oil leaks, etc.) and from activities within the residential areas.

The sewage treatment facility represents a risk of water contamination if any leaks or spills occur which allow raw sewage to flow directly into the stream channel. Such an impact to water quality would pose a risk to both downstream water users and may affect the biota utilising the aquatic ecosystem.

Mitigation Measures

Use of potentially polluting substances on site should be strictly controlled and only handled in designated areas under supervision of competent and trained personnel. To prevent spillages, no diesel or oil should be stored on site during the construction phase, other than what is required for work undertaken during the course of 1 day. Such diesel and oil should be stored in a way that will allow any spillages to be easily and quickly isolated (e.g. stored on plastic sheeting or on impermeable bunded areas), and spills should be cleaned-up with approved absorbent materials.

These should be kept in sufficient quantities on site to deal with small spills. Absorbent material and contaminated soil should be disposed of at a registered hazardous waste site.

The following guidelines should be applied to the handling of cement on site:

- Carefully control all on-site operations that involve the use of cement and concrete.
- Limit cement and concrete mixing to single sites where possible.
- Use plastic trays or liners when mixing cement and concrete: Do not mix cement and concrete directly on the ground.
- Dispose of all visible remains of excess cement and concrete after the completion of tasks.
- Dispose of in the approved manner (solid waste concrete may be treated as inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste)

Options for reducing the source of contaminants in stormwater from the residential houses during the operational life of the proposed development are limited and not all feasible to implement. It is therefore recommended that stormwater from the residential developments be discharged into vegetated swales or bioretention areas protected against erosion rather than directly into adjacent riparian zones or water resources. Water quality can be improved or maintained by encouraging infiltration of flows into the soils on site (as much as the vertic soils allow), as soils can act as a natural filter removing pollutants and excess nutrients from sub surface flows. Retention of flows in attenuation facilities, water tanks or water features will also allow time for suspended pollutants and other suspended solids to settle out of the water column. Mitigation measures suggested to minimise riparian habitat deterioration and soil erosion will also reduce the likelihood of water quality deterioration. Oil sumps should be placed on stormwater drains receiving flows from parking areas or any areas where hydrocarbons are likely to occur. The extent of bare soils remaining during the operational phase of the development should be limited by promoting revegetation of bare soils. This would limit the risk of erosion of sediment into downstream watercourses.

With regards to the proposed sewage treatment facility, emergency protocols need to be put in place to ensure that if leaks or spills are identified, immediate and effective action is taken to stop the leak or spill, contain polluted flows away from the riparian zone and channel if possible, and clean-up is effective and damage to the environment is limited. Regular monitoring of the sewage treatment facility is essential to identify any maintenance required to avoid leaks and to identify

leaks that require rapid and effective action to resolve. All discharge from the sewage treatment facility must meet minimum quality requirements for discharge into the environment.

6.2.2.7 Disturbance of Riparian Habitat

Disturbance of riparian habitat can occur during the construction phase if any persons, vehicles or machinery cause damage to the riparian vegetation or if erosion of catchment sediments causes sediment deposition into the riparian habitat.

Disturbance of riparian habitat is expected to occur during the operational phase if residents of the development utilise the riparian areas as a thoroughfare, for dumping of litter and other waste, harvesting of wood for building or for firewood, excavation of soils, or grazing of livestock. These are all uses that have been noted in wetlands, riparian habitat and other open spaces in close proximity to similar high density, low income residential developments. This impact is cumulative and can result in significant degradation of the riparian habitat and the water resource over time.

Mitigation Measures

Disturbance during the construction phase should be avoided by clearly demarcating or fencing off the edge of the 50m buffer of the riparian zone and excluding the riparian zone and buffer zone from any use. The only area within the riparian zones/recreated watercourse that should be accessed is the servitude for the road crossing construction.

During the operational phase, use of the riparian habitat should be prevented by securely fencing off the riparian habitat and buffer zone to prevent access. Signage should also be placed around the perimeter that indicates why the area is fenced off and what uses are prohibited within the fenced off riparian habitat and buffer zone. Regular monitoring of the fencing and riparian habitat should be undertaken to ensure that the sensitive habitat is not being utilised and that the fencing remains intact.

6.2.3 Impact Rating

The results of the impact assessment rating are detailed in **Table 8** below. All impacts range in significance from ***Moderate*** to ***Moderate to High***. However, if the mitigation measures detailed in

the section above are fully and effectively implemented, the significance of many of the anticipated impacts will be lowered either by reducing the probability of the impact occurring or by reducing the duration and/or intensity of the impact.

Table 8: Impact rating of the expected impacts associated with the proposed development.

ANTICIPATED IMPACTS TO RIPARIAN HABITAT						
Expected Impact	**Probability**	**Extent**	**Duration**	**Intensity**	**Significance of Impact**	**Rating**
Loss of Riparian Habitat	Definite	Site	Permanent	Medium	**MODERATE**	10
Loss of Soil Storativity and Increased Stormwater Runoff	Probable	Local	Permanent	Medium	**MODERATE TO HIGH**	12
Concentration and Impoundment of Flows	Probable	Site	Permanent	Low	**MODERATE**	10
Increased Flow Volumes	Probable	Local	Long-term	Medium	**MODERATE**	10
Increased Risk of Erosion	Probable	Local	Long-term	Medium	**MODERATE**	10
Water Quality Deterioration	Definite	Local	Long-term	Medium	**MODERATE TO HIGH**	11
Disturbance of Riparian Habitat	Possible	Regional	Permanent	High	**MODERATE TO HIGH**	12

7. SUMMARY OF FINDINGS

A site assessment was undertaken in August 2019 to determine the extent of wetlands and riparian habitat on site. No natural wetlands were identified within the study area. However, two distinct river channels cross the site and riparian habitat associated with these channels was delineated. In addition, a narrow drainage line was identified draining towards the northeast and several areas of artificial wetness were identified, associated with irrigation dams and an unidentified water source. As a result of the current landuse and extent of development and disturbance within and in the catchments of the riparian zones, the ecological category of the riparian habitat was determined to be moderately to seriously modified with a moderate to serious change in ecosystem processes and loss of natural habitat and biota.

The proposed development for the site is high density residential plots with an estimated total number of housing units of 2553 within the study area, which equates to approximately 25 units per hectare, assuming all housing units remain outside of the riparian habitat and the 50 metre buffer calculated for the riparian habitat. Anticipated impacts to the riparian habitat and watercourses associated with the development of high density residential units, as well as support infrastructure, on site include loss of highly disturbed riparian habitat, impoundment and concentration of flows, loss of soil storativity and increased stormwater runoff, increased flow volumes, increased risk of erosion, water quality deterioration and riparian habitat disturbance.

Should any development (including attenuation facilities) be planned within the delineated watercourses on site which will impact the water resource, such development is subject to authorisation under Section 21 of the National Water Act (Act 36, 1998), and will require the submission of a Water Use Licence application for all relevant activities.

8. REFERENCES

Department of Water Affairs and Forestry, 2005. *A practical field procedure for identification and delineation of wetland and riparian areas*. DWAF, Pretoria.

Driver, A., Nel, J. L., Snaddon, K., Murray, K., Roux, D. J., Hill, L., Swartz, E. R., Manuel, J., and N. Funke. 2011. *Implementation Manual for Freshwater Ecosystem Priority Areas.* Water Research Commission, WRC Report No. 1801/1/11.

GN1002 of GG34809, NEMBA. 2004. *National List of Ecosystems that are Threatened and in Need of Protection*. National Environmental Management: Biodiversity Act (Act No. 10 OF 2004). Republic of South Africa.

Kleynhans C.J., Mackenzie J., Louw M.D. 2007. *Module F: Riparian Vegetation Response Assessment Index in River EcoClassification: Manual for EcoStatus Determination (version 2).* Joint Water Research Commission and Department of Water Affairs and Forestry report.

Kleynhans, C.J., Thirion, C. and Moolman, J. 2005. *A Level I River Ecoregion classification System for South Africa, Lesotho and Swaziland.* Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B., 2007. *WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands.* WRC Report No TT 339/08, Water Research Commission, Pretoria.

Macfarlane D.M., Kotze D.C., Ellery W.N., Walters D., Koopman V., Goodman P. and Goge C. 2007. *WET-Health: A technique for rapidly assessing wetland health*. WRC Report No TT 340/08, Water Research Commission, Pretoria.

Middleton, B.J. and Bailey, A.K. 2008. *Water Resources of South Africa*, 2005 Study (WR2005). WRC Report No TT380/08, Water Research Commission, Pretoria.

Mucina, L. and Rutherford, M.C. 2006. *The Vegetation of South Africa, Lesotho and Swaziland.* Strelizia 19. SANBI, Pretoria.

Nel, J.L., Driver, A., Strydom, W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J., Nienaber, S., van Deventer, H. Swartz, E. and Smith-Adao, L.B. 2011. *Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources.* Water Research Commission, Gezina. WRC Report No. TT 500/11.

North West Department of Rural, Environment and Agricultural Development (READ). 2015. *North West Biodiversity Sector Plan*. North West Provincial Government, Mahikeng. December 2015.

Ollis, D. J., Ewart-Smith, J. L., Day, J. A, Job, N. M., Macfarlane, D. M., Snaddon, C. D., Sieben, E. J. J., Dini, J. A. and N. Mbona. 2015. *The development of a classification system for inland aquatic ecosystems in South Africa*. Water SA Vol. 41, No. 5, Page 727.

Ollis, D., Snaddon, K., Job. N. and Mbona. N. 2013. *Classification system for wetland and other aquatic ecosystems in South Africa.* User manual: inland systems. SANBI biodiversity series 22. SANBI Pretoria. Republic of South Africa. 1998. National Water Act (Act No 36 of 1998).

SANBI. 2018. *The Vegetation Map of South Africa, Lesotho and Swaziland.* Mucina, L., Rutherford, M.C. and Powrie, L.W. (Editors), Online, http://bgis.sanbi.org/SpatialDataset/Detail/18, Version 2018. South African National Biodiversity Institute, Pretoria, South Africa.

South Africa. 1998. National Water Act 38 of 1998. Pretoria: Government Printer.

Van Ginkel, C. E., Glen, R. P., Gordon-Gray, K. D., Cilliers, C. J., Muasya, M. and P. P. van Deventer. 2011. Easy identification of some South African wetland plants. WRC Report No TT 479/10.