FRESHWATER ASSESSMENT REPORT FOR THE UPGRADE OF SECTION 16 OF THE R63 ROAD, BETWEEN THE N6 AND N2 HIGHWAYS NEAR KOMGA IN THE EASTERN CAPE

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EXECUTIVE SUMMARY

The South African National Roads Agency SOC Limited (SANRAL) proposes to upgrade the National Route R63 Section 16 between the N6 Bridge and the N2 intersection east of Komga in the Eastern Cape. The section of road is 43.64km in length. The proposed upgrade includes aligning, widening and resurfacing of the road to improve road safety. In order to obtain material for the upgrades – SANRAL is also proposing sites for four borrow pits and four quarries.

The road passes along the watershed between the catchments of the Gqunube and Kwelera Rivers to the south and the Great-Kei River to the north. Most of the watercourses that are near or crossed by the R63 road to be upgraded thus form part of the upper reaches of the Great Kei, Kwelera and portions of the Gqunube Rivers that drain the higher lying and flat Amathole Montane Grasslands. These watercourses tend to meander through the flatter grassy terrain, with less defined riparian zones and wider seep areas. Many small dams have been constructed in these seep areas. The foothill reach of the Gqunube River flows within a deeper river valley in the Bhisho Thornveld. Some valley bottom wetlands are also associated with the watercourses.

The rivers in the area are largely deemed to be in a moderately to largely modified ecological condition while the wetlands are in general in a moderately modified ecological condition. The rivers areas are of moderate to high ecological importance and sensitivity and wetlands are of high ecological importance. This is with the exception of the artificially created depression wetlands that are deemed to be largely to seriously modified and of moderate importance.

The KwaMsenge River catchment is mapped as a River Freshwater Ecosystem Priority Areas (FEPA) as well as a Fish sanctuary while the Qumra River catchment is an Upstream River FEPA. Sub-quaternary catchments associated with the Great-Kei and Gqunube Rivers have been mapped as aquatic Critical Biodiversity Areas (Critically important river sub-catchments and all wetlands) with the KwaMasenge catchment mapped as a an important sub-catchments).

The proposed activities are likely to have a very limited impact on the aquatic habitats at the road crossings and immediately downstream for the watercourses. If the activities are kept to a minimum within the new road corridor and rehabilitated the potential impacts would be of a low significance. In particular the impacts of the activities on the downstream aquatic habitat in terms of increased sedimentation and alteration of the active channels of the rivers should be avoided or mitigated. In particular the sizing, level of the culvert structures in relation to the channel beds and the alignment of the river channels at the road crossings are important factors in trying to reduce the potential for sedimentation and erosion taking place at the road crossings. The new culvert structures should not be placed higher than the base level of the river channel to ensure that low flows are not impeded.

Storm water runoff from the road into the river channels at the crossings, particularly where they are located within a relatively steep valley, should also be mitigated to ensure that it does not result in erosion of the river channels. Any waste material associated with activities should be removed from the river channels once the construction activities are complete and the disturbed areas rehabilitated, revegetating where necessary to prevent invasive growth of alien vegetation and erosion of the river banks from taking place. The disturbed areas will need to be monitored and managed for a period of at least 3 years post construction to ensure that alien plants do not invade

these areas. The culvert structures should also be inspected and maintained regularly to proactively address blockages and erosion within the river channels.

The proposed borrow areas / quarries are mostly located adjacent to watercourses or contain watercourses or mapped wetland areas that are associated with past excavations within the sites. Various setback areas from these watercourses have been recommended for the borrow areas / quarries to ensure that these aquatic features are not impacted by the proposed activities. Should the proposed borrow areas / quarries and the associated removal of material remain outside of these setback areas, the potential aquatic ecosystem impacts would be of a low to very low significance. The associated risk that the proposed activities will detrimentally impact on the aquatic features is also considered to be low for the construction and operational phase, provided that the recommended mitigation measures are implemented. It is thus likely that these activities can be authorised in terms of the General Authorisations.

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1. BACKGROUND

The South African National Roads Agency SOC Limited (SANRAL) proposes to upgrade the National Route R63 Section 16 between the N6 Bridge and the N2 intersection east of Komga in the Eastern Cape. The section of road is 43.64km in length. The proposed upgrade includes aligning, widening and resurfacing of the road to improve road safety. In order to obtain material for the upgrades – SANRAL is also proposing sites for four borrow pits and four quarries.

The road passes along the watershed between the catchments of the Gqunube and Kwelera Rivers to the south and the Great-Kei River to the north. A number of wetlands and watercourses will potentially be impacted by the proposed activity. Lengthening of the watercourse crossing structures as well as construction of a new bridge will be required. This freshwater impact assessment report is intended to inform the decision making with regards to the environmental and water use authorisations by providing information on the aquatic ecosystems in the area, assessing the potential impacts and providing mitigation measures for those potential impacts.

Table 1. Key water resource information

Descriptor	Name / Details	Notes
Water Management Area	Mzimvubu to Keiskamma	
Quaternary Catchments	R30B – Kwelera River (KwaMehlwenyoka and KwaTshikitshiki) R30C – Gqunube and Thanga Rivers S60B & S60E – Kubusi of the Great-Kei River S70A – Qumra Tributary of the Great-Kei River S70F – KwaMsenga and Tyityaba Tributaries of the Great-Kei	Gqunube and Kwelera Rivers; and Great-Kei River Catchment Areas
Present Ecological State	Kwelera; KwaMsenga and Tyityaba – Largely natural Gqunube; Thanga – Moderately modified Kubusi – Moderately to largely modified Qumra – Largely modified	See Appendix C (DWAF, 2012)
Ecological Importance / Ecological Sensitivity	Kubusi, Kwelera, Gqunube, Thanga, Qumra,– Moderate/Moderate Tyityaba – Moderate/High Kubusi, KwaMsenga – High/High	
Water resource potentially impacted	Various drainage lines and tributaries of the Gqunube, Kwelera and Great–Kei Rivers and associated wetland areas	
Latitude	32°41'37.08"S	Start of road upgrades
Longitude	27°34'27.20"E	
Latitude	32°34'43.20"S	End of road upgrades at kilometre 43.64
Longitude	27°57'19.30"E	
Latitude	32°39'22.72"S	Centre point of Quarry 4
Longitude	27°38'51.00"E	
Latitude	32°35'42.27"S	Centre point of Quarry 11
Longitude	27°45'50.90"E	
Latitude	32°35'12.50"S	Centre point of Quarry 12
Longitude	27°45'44.90"E	
Latitude	32°33'32.96"S	Centre point of borrow pit 25
Longitude	27°46'4.12"E	
Latitude	32°35'3.50"S	Centre point of borrow pit 22
Longitude	27°46'13.10"E	
Latitude	32°35'14.92"S	Centre point of borrow pit 26
Longitude	27°50'19.11"E	
Latitude	32°34'37.12"S	Centre point of borrow pit 23
Longitude	27°55'59.18"E	
Latitude	32°33'50.89"S	Centre point of Quarry 9
Longitude	27°57'40.42"E	

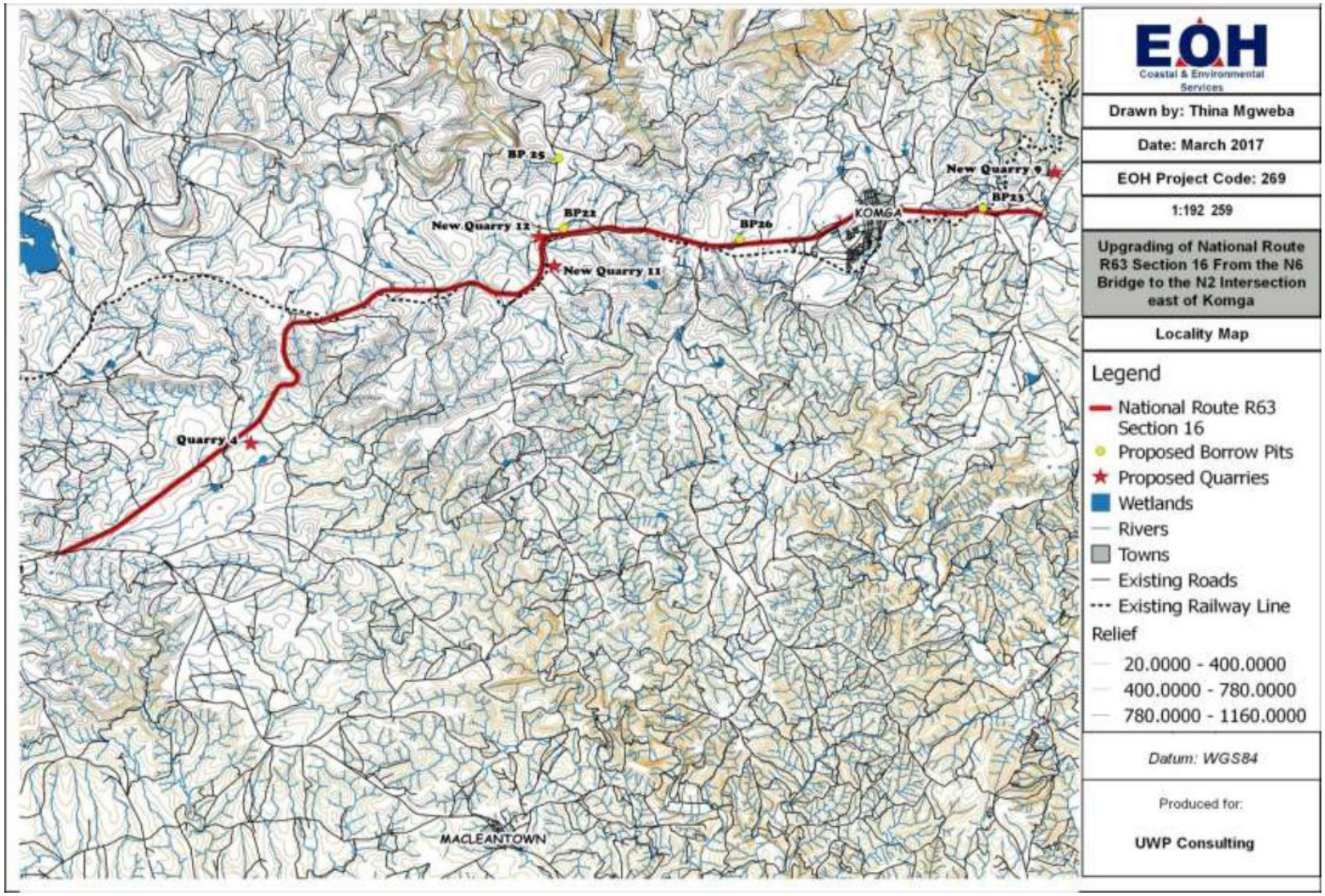


Figure 1. Locality map of Section 16 of the R63 between the N6 and the N2, where the upgrades and borrow pits / quarries are proposed

2. TERMS OF REFERENCE

The Scope of work for this freshwater assessment comprised of the following:

1. Freshwater assessment and risk assessment
2. Literature survey and initialisation
3. Site assessment
4. Freshwater and wetland impact assessment
5. Risk matrix assessment
6. Review and liaison

3. METHODS, ASSUMPTIONS AND LIMITATIONS OF THE STUDY

Input into this report was informed by a combination of desktop assessments of existing freshwater ecosystem information for the study area and catchment, as well as by a more detailed assessment of the freshwater features at the site. The site was visited for a day on 26 June 2017 in mid-winter. Within the study area rain occurs throughout the year therefore there was sufficient flow in the aquatic ecosystems to undertake the required assessments.

During the field visit, the characterisation and integrity assessments of the freshwater features were undertaken. Mapping of the freshwater features was undertaken using PlanetGIS and Google Earth Professional. The SANBI Biodiversity GIS website was also consulted to identify any constraints in terms of fine-scale biodiversity conservation mapping as well as possible freshwater features mapped in the Freshwater Ecosystem Priority Areas maps. This information/data was used to inform the resource protection related recommendations.

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The following techniques and methodology were utilized to undertake this study:

- Analysis of the freshwater ecosystems was undertaken at a rapid level and did not involve detailed habitat and biota assessments;
- Only those aquatic ecosystems within 500m of the activity that would potentially be impacted by the proposed activities were assessed;
- The river health assessments were carried out using nationally developed methodologies. These assessments were carried out to provide information on the present ecological status (PES) and ecological importance and sensitivity (EIS) of the river systems that could be impacted;
- The guideline document, “A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas” document, as published by DWAF (2005) was followed for the delineation of the wetland areas. According to the delineation procedure, the wetlands were delineated by considering the following wetland indicators: terrain unit indicator; Soil form indicator; Soil wetness indicator; and vegetation indicator;

- The wetlands were subsequently classified according to their hydro-geomorphic (HGM) determinants based on a classification system devised by Kotze *et al* (2004) and SANBI (2009). Notes were made on the levels of degradation in the wetlands based on field experience and a general understanding of the types of systems present;

- A Present Ecological State (PES) assessment was conducted for each wetland identified and delineated within the study area. For the purpose of this study, the tool WET-Health as defined in the WET Health Series developed for the Water Research Commission was used to assess the present ecological state of each wetland based on the modules: hydrology, geomorphology, water quality and vegetation;

- The functional wetland assessment technique, WET-EcoServices, developed by Kotze *et al* (2009) was used to provide an indication of the ecological benefits and services provided by delineated wetland habitats. This technique consists of assessing a combination of desktop and infield criteria in order to identify the importance and level of functioning of the wetland units within the landscape;

- The ecological importance and sensitivity assessments were conducted according to the guidelines as developed by DWAF (1999);

- Lists of plants, both alien and indigenous are for the purpose of describing the general and dominant habitat conditions and not comprehensive. A comprehensive botanical survey was not conducted of the aquatic habitats as part of this freshwater assessment, only the more dominant vegetation species are listed;

- Invasive alien categories refer to the National Environmental Management Biodiversity Act (NEMBA) where:

    - Category 1a: Species which must be combatted or eradicated

    - Category 1b: Species which must be controlled

    - Category 2: Species which require a permit to carry out a restricted activity within an area specified in the notice or an area specified in the permit. Outside of the specified area is considered a Category 1b.

    - Category 3: A species which is subject to exemptions or prohibitions but if occurring in riparian areas is considered a Category 1b.

The level of aquatic assessment undertaken was considered to be adequate for this study.

4. USE OF THE REPORT

This report reflects the professional judgment of its authors. The full and unedited content of this should be presented to the client. Any summary of these findings should only be produced in consultation with the authors.

5. LEGISLATIVE AND CONSERVATION PLANNING REQUIREMENTS

The proposed activity needs to take cognizance of the legislative requirements, policies, strategies, guidelines and principals of the relevant regulatory documents of the Amathole District and Great Kei Local Municipality, as well as the National Water Act (NWA) and the National Environmental Management Act (NEMA).

5.1. NEMA AND ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS

NEMA is the overarching piece of legislation for environmental management in South Africa and includes provisions that must be considered in order to give effect to the general objectives of integrated environmental management. These provisions are contained in Section 24 (4)(a)(b) of the Act, and will be considered during the EIA process. Activities listed in terms of Chapter 5 of NEMA in Government Notice No. R. 983, 984 and 985, dated 4 December 2014, as amended, trigger a mandatory Basic Assessment, or even a full scoping EIA process, prior to development.

5.2. NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

The purpose of the National Water Act, 1998 (NWA) is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorisation and register as users. The NWA also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

The Act aims to regulate the use of water and activities (as defined in Part 4, Section 21 of the NWA), which may impact on water resources through the categorisation of 'listed water uses' encompassing water abstraction and flow attenuation within catchments as well as the potential contamination of water resources, where the Department of Water and Sanitation (DWS) is the administering body in this regard. Defined water use activities require the approval of DWS in the form of a General Authorisation or Water Use Licence authorisation. There are restrictions on the extent and scale of listed activities for which General Authorisations apply.

Section 22(3) of the National Water Act allows for a responsible authority (DWS) to dispense with the requirement for a Water Use Licence if it is satisfied that the purpose of the Act will be met by the grant of a licence, permit or authorisation under any other law.

GENERAL AUTHORISATION IN TERMS OF SECTION. 39 OF THE NWA

According to the preamble to Part 6 of the NWA, "*This Part established a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing general*

authorisations in the Gazette…" "The use of water under a general authorisation does not require a licence until the general authorisation is revoked, in which case licensing will be necessary…"

The General Authorisations for Section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA have recently been revised (Government Notice R509 of 2016). The proposed works within or adjacent to the wetland areas and river channels are likely to change the characteristics of the associated freshwater ecosystems and may therefore require authorization. Determining if a water use licence is required for these water uses is now associated with the risk of degrading the ecological status of a watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA). A risk assessment for the proposed project will be included in the freshwater impact assessment report for the project. A risk assessment has been undertaken in this report.

REGULATIONS REQUIRING THAT A WATER USER BE REGISTERED, GN R.1352 (1999)

Regulations requiring the registration of water users were promulgated by the Minister of DWA in terms of provision made in section 26(1)(c), read together with section 69 of the National Water Act, 1998. Section 26(1)(c) of the Act allows for registration of all water uses including existing lawful water use in terms of section 34(2). Section 29(1)(b)(vi) also states that in the case of a general authorisation, the responsible authority may attach a condition requiring the registration of such water use. The Regulations (Art. 3) oblige any water user as defined under Section 21 of the Act to register such use with the responsible authority and effectively to apply for a Registration Certificate as contemplated under Art.7(1) of the Regulations.

6. PHYSICAL CHARACTERISTICS OF THE STUDY SITE

6.1. VISUAL CHARACTERISTICS

The study area is located within the Great-Kei Local Municipality in the Amathole District Municipal area. Section 16 of the R63 is located largely on the watershed at altitudes of between 550m at the Gqunube River to 766m in the central portion of the route (Figure 2).

The Gqunube and Kwelera Rivers occur to the south of the Section 16 of the R63 and the Great-Kei River to the north and west of the road. The higher-lying areas on the watershed comprise largely of montane grasslands while the lower lying areas within the valleys comprise of *Acacia* thornveld. The area is largely undeveloped, comprising primarily of livestock farming and cultivated areas. Komga and Qumra, towards to the eastern extent of the road, is the only urban development within the study area.

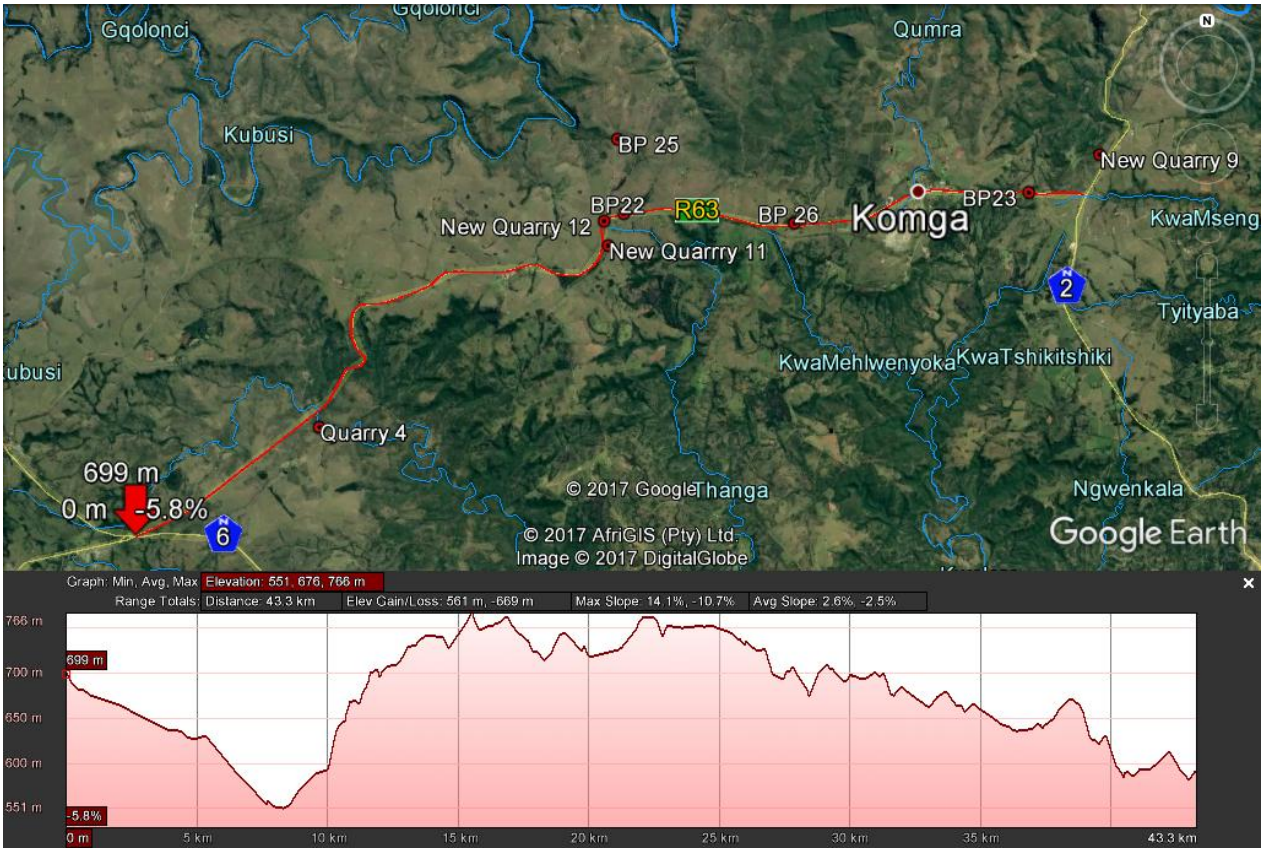


Figure 2. Google Earth image of the area showing the elevation profile of the R63 road to be upgraded

6.2 CLIMATE

The study area experiences a mean rainfall of 701mm per annum. The area receives most of its rainfall between November till March, with March receiving a mean rainfall of 91mm. Winter months receive much less rain, the mean rainfall for July is only 8mm. Temperatures in the area are fairly moderate. However, winters (June – August) are typically cooler than summers (December – February) (Figure 3).

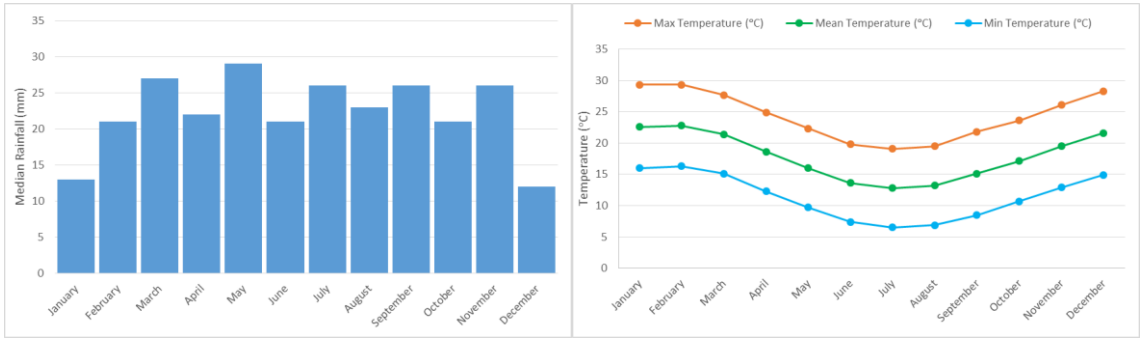


Figure 3. Average monthly rainfall (left) and temperatures (right) for the study area, collected between 1950 and 2000 (Schulze, 2009)

6.3 GEOLOGY AND SOIL

There are four main soil groupings through which Section 16 of the R63 Road passes. The light brown areas in Figure 4, labelled 1 refer to soils with an accumulation of clay, which are strongly structured and do not have red coloration. This soil type is the most conducive for wetland formation. In the tan areas, labelled 2 in Figure 4, the soils are shallow and occur on hard or weathering rock and are minimally developed. Lime is often occurs within these soils. The dark brown areas, labelled 3 in Figure 4, are soils which are have a structured topsoil layer and are melanic, having a dark colour and high base status. Lastly, the green areas, labelled 4 in Figure 4 are also minimally developed soils on hard or weathering rock, but unlike grouping 2, these soils seldom contain lime. These broad soil categories have been mapped nationally and this large scale means that it is likely that there will be fine scale variation within these groupings.

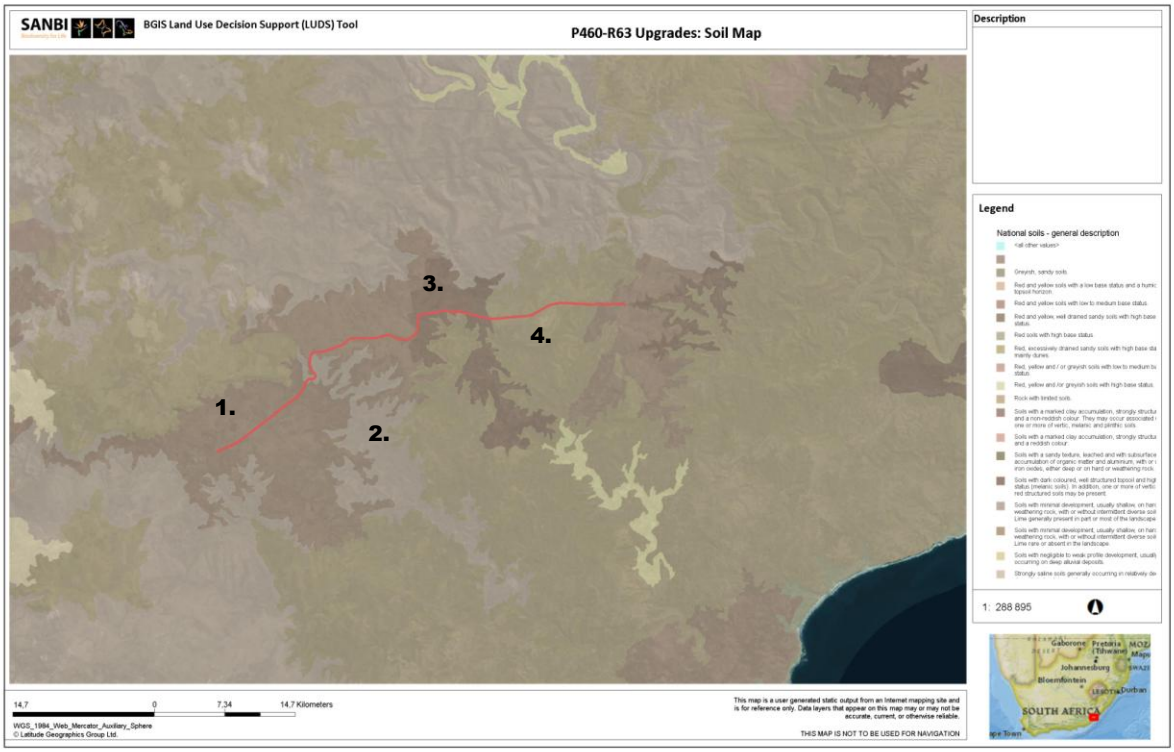


Figure 4. A Broad Soil Classification Map for the area (red represents the section of the R63 to be upgraded) (SANBI BiodiversityGIS, 2017)

6.4. FLORA

Section 16 of the R63 road passes through two vegetation types; Bhisho Thornveld in the lower lying areas and Amathole Montane Grassland in the higher lying areas. The Bhisho Thornveld occur on the hilly plains of the Eastern Cape from Mthatha to East London. It is typically an open savanna dominated by small *Acacia natalitia* trees and an understorey dominated by *Themeda triandra* grass. Approximately 20% of its original extent has been transformed by cultivation, urban development or plantations. It is considered to be a least threatened vegetation type.

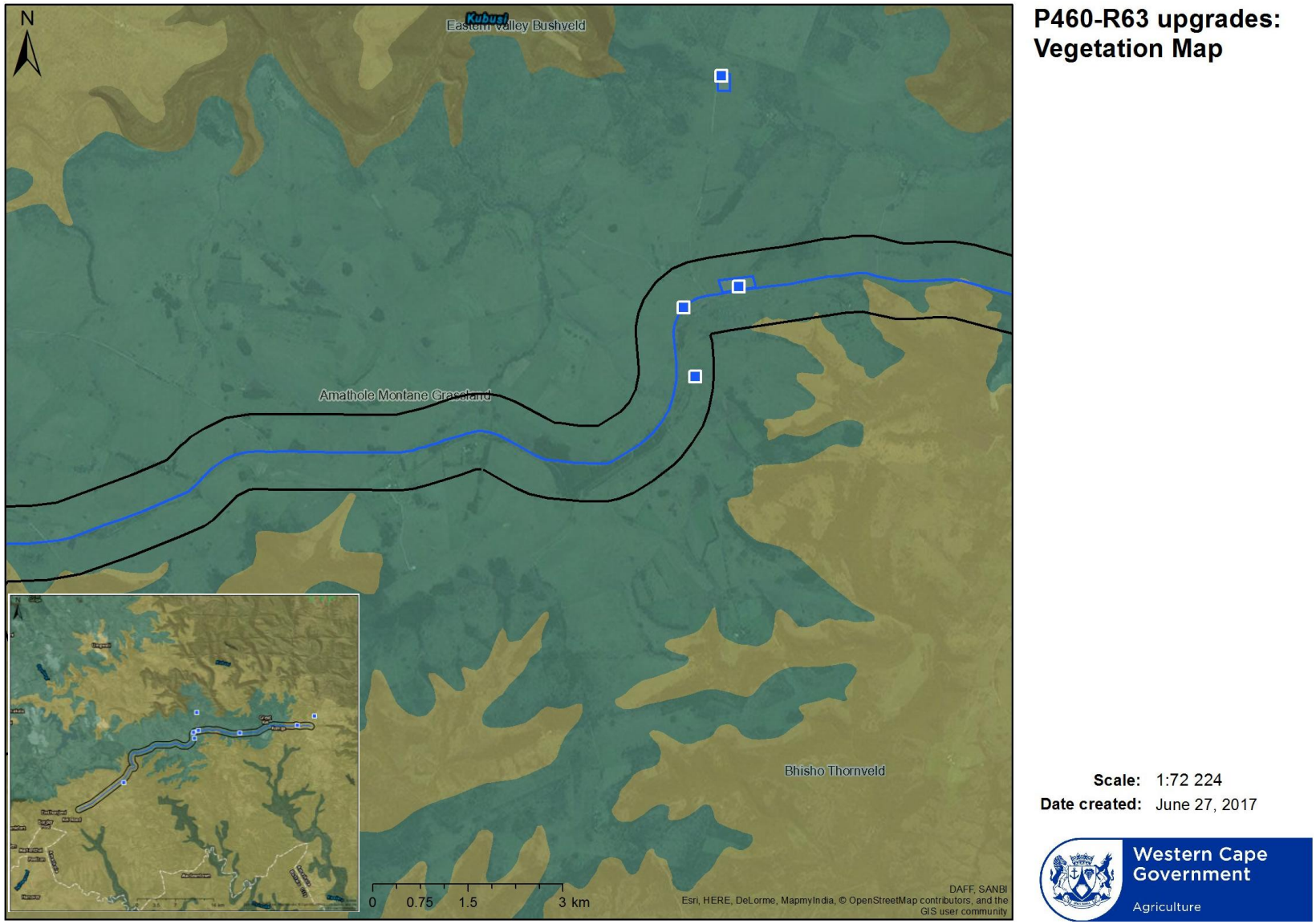


Figure 5. Vegetation map, updated from Mucina and Rutherford (2006), for the vicinity of the study site where the blue line represents the road, the black lines a 500m wide strip on either side of the road and the blue points are proposed quarries or borrow pits (Cape Farm Mapper, 2017)

Amathole Montane Grassland occurs on higher lying areas in the region at altitudes of 650m to 1500m (low mountains and high hills) It is typically a short grassland with a high species richness in non – graminoid herbaceous flowering plants (forbs). Amathole Montane Grassland is also considered a least threatened vegetation type. However it is heavily overgrazed in many places, resulting in uniform grassland with low species richness.

6.5. AQUATIC FEATURES

Section 16 of the R63 road lies within the R30C, (upper reaches of the Gqunube and Thanga Rivers) and then along the boundaries of quaternary catchments: R30B (KwaMehlwenyoka and KwaTshikitshiki Tributaries of the Kwelera River), S60B and S60E (Kubusi tributary of the Groot – Kei River), S70A (Qumra tributary of the Great–Kei River) and S70F (KwaMsenge and Tyityaba Tributaries of the Great–Kei River) (Figure 6). The section of road crosses a number of the streams or drainage features associated with the above-mentioned catchments. The Gqunube River is the most significant river in the study area. There are also numerous wetlands areas which have been mapped within 500m of this section of road by the National Freshwater Ecosystem Priority Areas (FEPA) initiative (Figure 7). Most of these (63 in total) have been mapped as artificial wetlands (such as farm dams and ponds) whilst 6 have been mapped as natural wetlands, with two of these having 'artificial' wetlands built within them (dams built within a natural wetland).

In terms of freshwater features near the proposed quarries and borrow pits, proposed Quarry 4 is an existing quarry which contains not mapped FEPA wetlands however it is located within 50m of the Gqunube River. Impacts of mining this quarry would thus need to be carefully contained to avoid impacts upon the river. Borrow Pit 26 contains a small dam which has been mapped as an artificial FEPA wetland. Three of the other borrow pits/quarries have existing pits that become inundated in the wet season but are not mapped as wetland areas in the conservation areas mapping.

The FEPA wetland mapping was conducted on a course scale and therefore has not been ground-truthed or assessed on a fine level. Many of the small dams, mapped as artificial wetlands, have been constructed in seep areas and channels which would have contained wetlands under natural conditions. Furthermore, there are some natural wetlands potentially impacted by the road upgrades and associated activities which have not been captured in the FEPA wetland mapping exercise. Identified wetland areas potentially impacted by the proposed activities are further discussed in Section 7 of this report based on the ground-truthing of the FEPA river and wetland mapping.

6.6 LAND USE

The road travels through natural and agricultural areas containing both thicket (green areas in Figure 8) and grassland (beige areas in Figure 8) vegetation cover. The town of the Komga (yellow areas in Figure 8) is the only urban development on the road section. There are also cultivated areas (red areas in Figure 8) near Komga. There are no protected areas within the study area however the Bhisho Kei Focus Area for the National Protected Area Expansion Strategy (NPAES 2010) occurs to the south of the R63 in the Gqunube River catchment (Figure 9). The proposed project activities fall outside of this area.

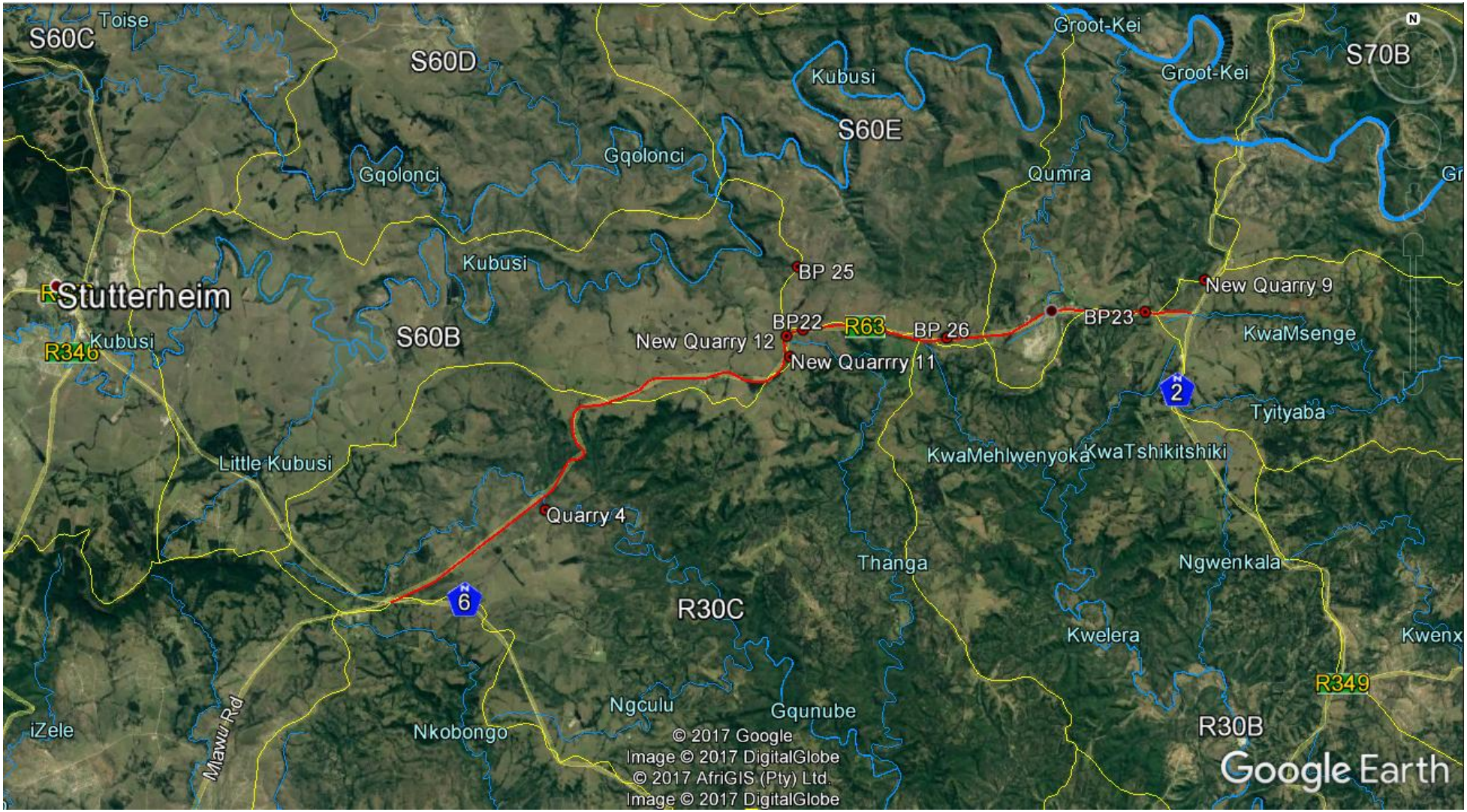
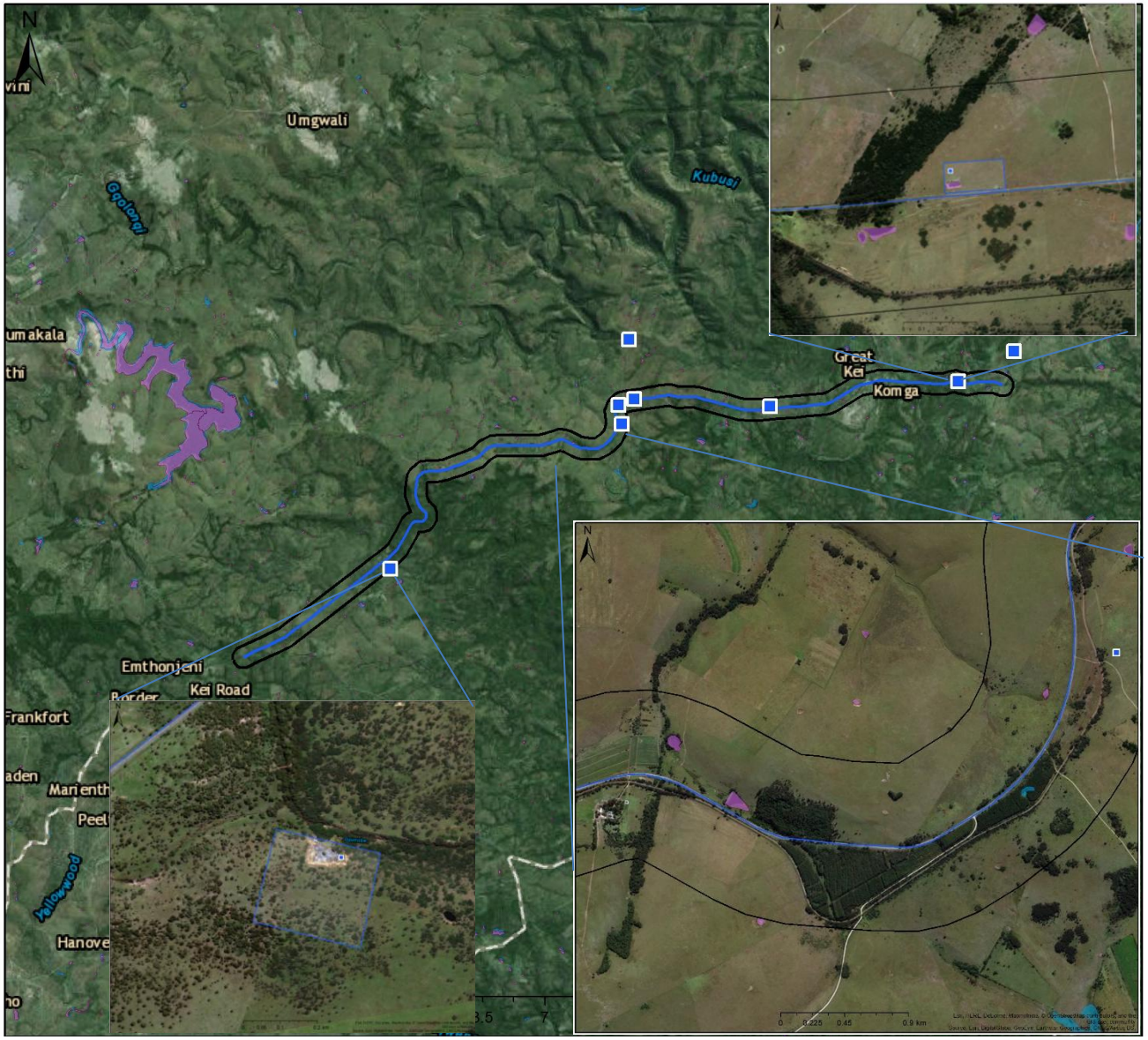


Figure 6. Google Earth image with the Section 16 of R63 (red line) and the proposed quarry and borrow pit sites indicated together with the main rivers and their quaternary catchment for the area



P460-R63 upgrades: Wetlands map

Legend

Wetlands (NFEPA)

- Artificial
- Estuaries
- Natural

Scale: 1:18 056

Date created: June 27, 2017

Western Cape Government
Agriculture

Figure 7. FEPA wetlands and rivers in the vicinity of the proposed activities (thick blue line represents road, the black lines represent a 500m wide strip on either site of the road and blue squares and polygons represent proposed borrow pit or quarry sites) (CapeFarmMapper, 2017

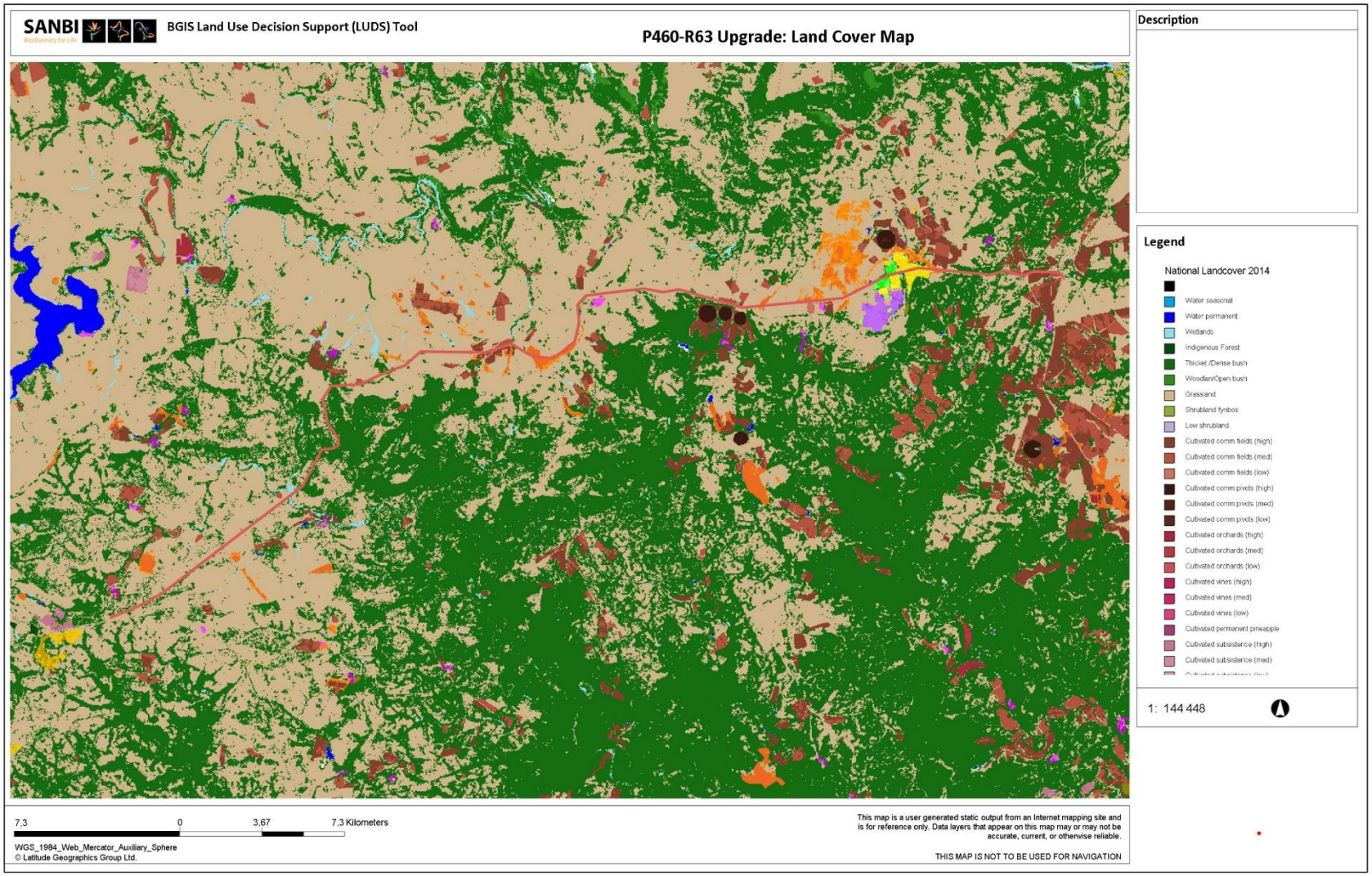


Figure 8. National Landcover map for the study area (red line) (CapeFarmMapper, 2017)

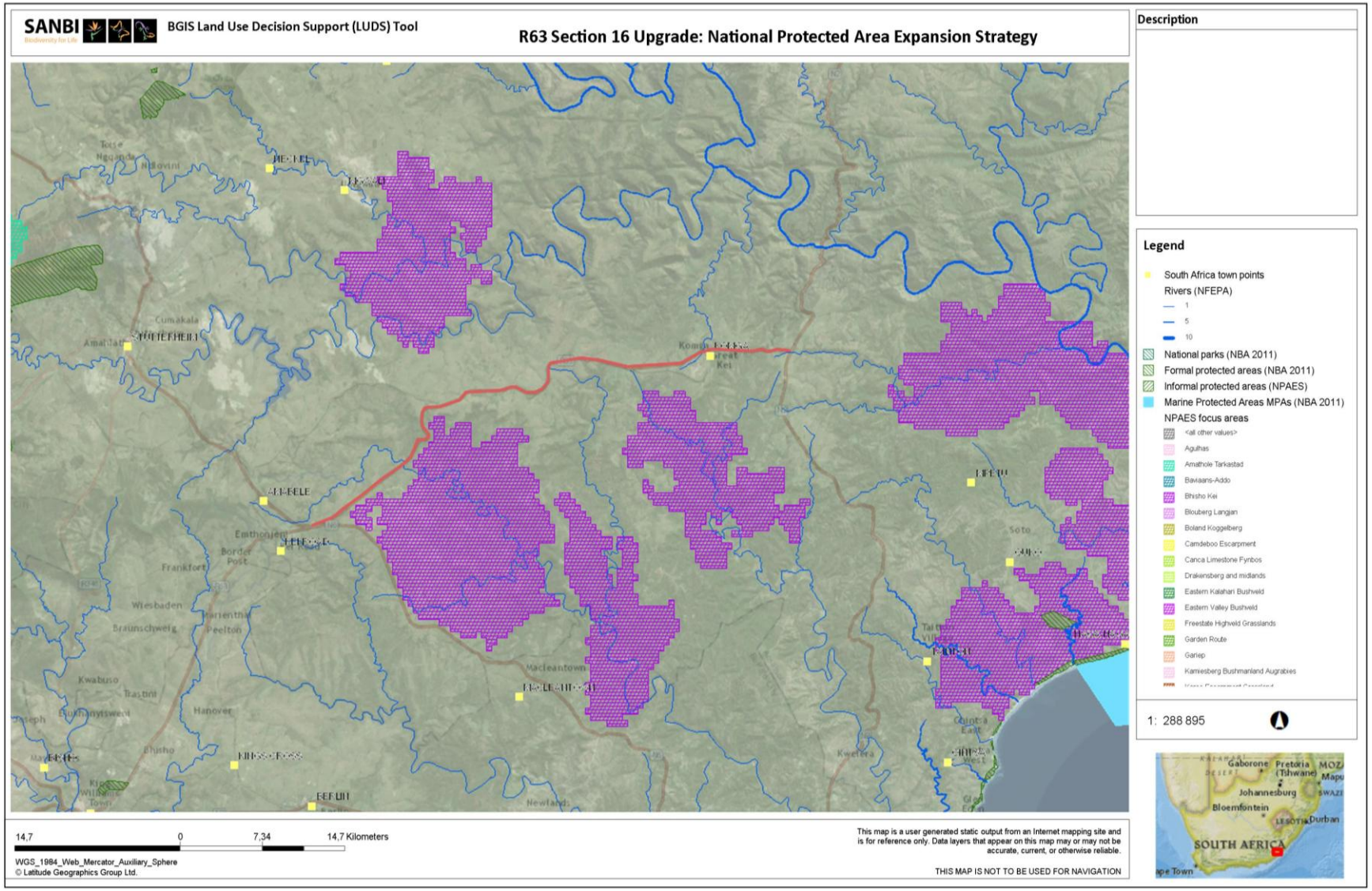


Figure 9. National Protected Area Expansion Strategy areas for the study area (SANBI Biodiversity GIS, 2017)

6.7 BIODIVERSITY CONSERVATION VALUE

There are two freshwater biodiversity conservation mapping initiatives of relevance to the study area, the national FEPAs and the Eastern Cape Biodiversity Conservation Plan (ECBCP).

FEPAs are intended to provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. FEPAs were determined through a process of systematic biodiversity planning and were identified using a range of criteria for serving ecosystems and associated biodiversity of rivers, wetlands and estuaries. FEPA river catchments in the area comprise of:

- The Nahoon River catchment immediately to the west of the N6 highway and outside of the study area that is mapped as a FEPA river and Fish sanctuary (darker green area in Figure 10).
- The KwaMsenge River catchment which is located east of the N2 and is mapped as a River FEPA as well as a Fish sanctuary.
- The Qumra River catchment which is an Upstream River FEPA (pale green in Figure 10). Upstream river FEPAs are identified as rivers which occur upstream of river FEPAs and Fish Support Areas.

FEPA catchments should be managed to prevent degradation and are important for ecosystem functioning such as the migration of threatened fish species. FEPA wetlands have also been mapped in the study area as discussed in Section 6.5.

The ECBCP was conducted in 2007 in order to guide land-use planning and decision making. Critical Biodiversity Areas (CBA) can be defined as features in the landscape which are considered to be critical for conserving biodiversity and maintaining ecosystem function. Aquatic CBAs were identified on a sub-quaternary catchment level. Sub- quaternary catchments which feed sensitive estuaries, maintain linkages between catchments and contain important rivers were identified as CBAs. Sub-quaternary catchments associated with the Great-Kei and Gqunube Rivers have been mapped as aquatic CBAs (Figure 11). Most of the aquatic CBAs are category CBA1 (Critically important river sub-catchments and all wetlands) with the KwaMasenge catchment mapped as a CBA2 (Important sub-catchments). For aquatic CBAs, the extent of land transformation that should be allowed is less than 10-15% of the total area of that sub-quaternary catchment. It is also recommended that a 50 m buffer be set for all wetlands within these catchments and a buffer of 32m be set for smaller upland streams and 50m for the larger mountain streams and upper foothills.

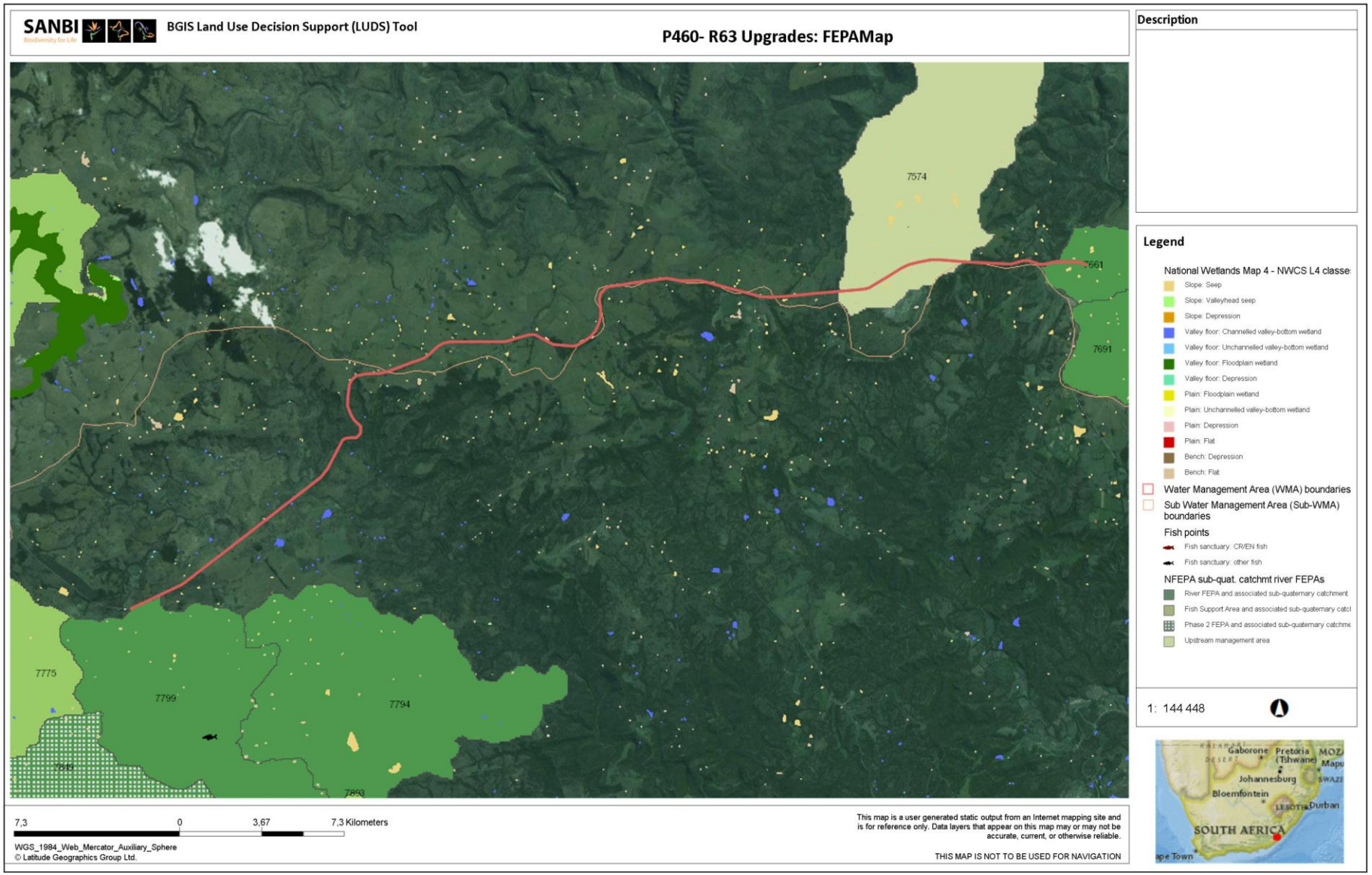


Figure 10. FEPA sub-catchments in the vicinity of the study area (red line) (SANBI BiodiversityGIS, 2017)

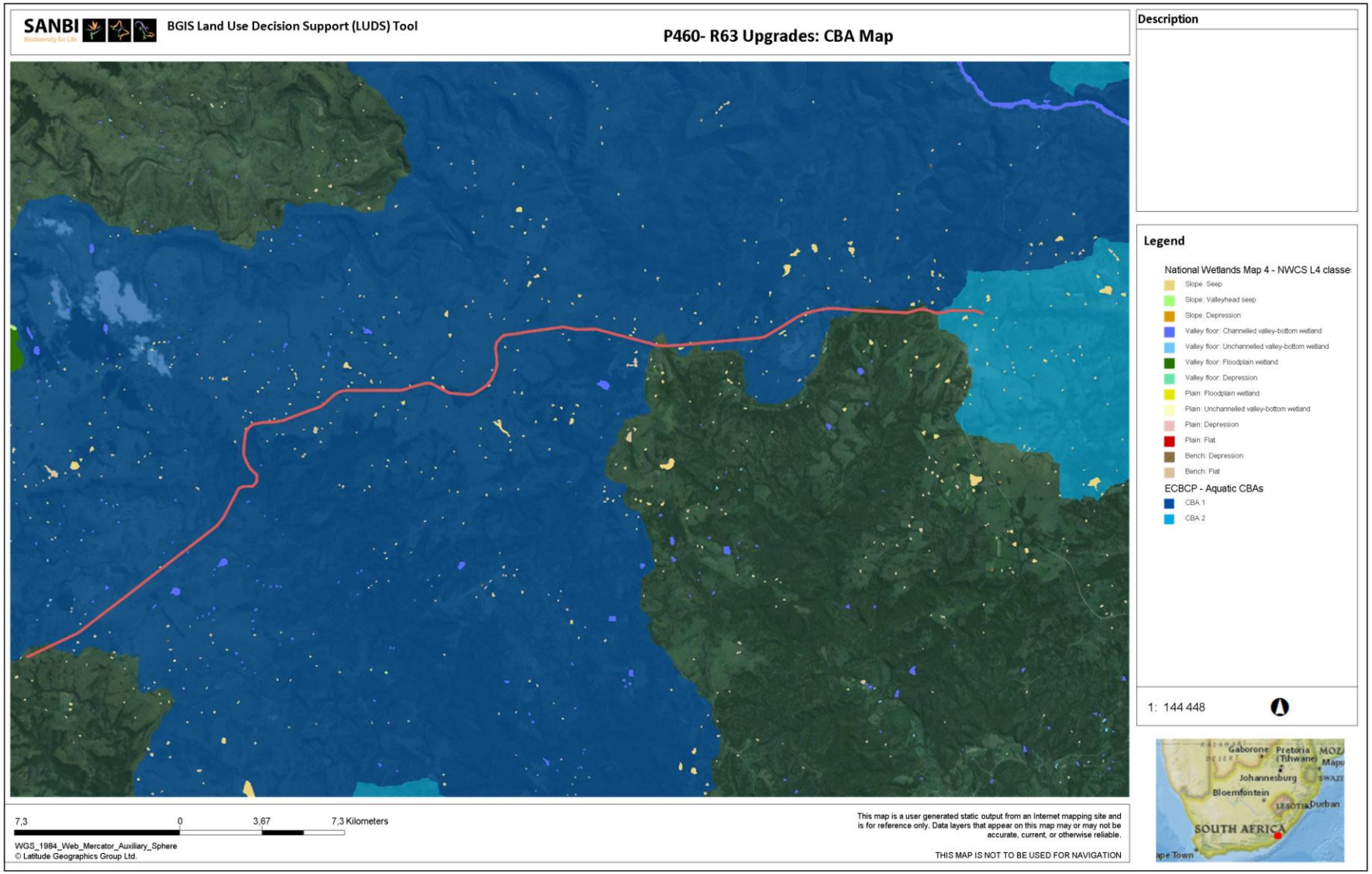


Figure 11. The ECBCP mapping for the study area (red line represents road to be upgraded) (SANBI BiodiversityGIS, 2017)

7. ASSESSMENT OF FRESHWATER FEATURES AND THEIR SIGNIFICANCE

7.1. DESCRIPTION OF FRESHWATER FEATURES

Most of the watercourses that are near or crossed by the proposed R63 road upgrade form part of the upper reaches of the Great Kei, Kwelera and portions of the Gqunube Rivers and drain the higher lying and flat Amathole Montane Grasslands. These watercourses tend to meander through the flatter grassy terrain, with less defined riparian zones and wider seep areas. Many small dams have been constructed in these seep areas. Typical vegetation associated with the streams comprises largely of the pale barked sweet thorn trees *Vachellia natalitia (*previously *Acacia natalitia)* with other shrubs such as the karees *Sersea gueinzii* and *S. lucida*, *Diospyros* sp., tree fuchsia *Halleria lucida* and camphor bush *Tarchonanhus comphoratus*. The trees are surrounded by a grassy understorey, usually dominated by red oat grass *Themeda triandra* together with other grasses such as *Sporobolus africanus* and *Eragrostis curvula* (Figure 12, top).

Figure 12. View of the typical riverine habitats in the study area with the KwaMenge River near the N2 shown in the top image and a grassland wetland at Komga shown in the bottom image

The instream habitat and seep areas of these streams comprise of common reed *Phragmites australis,* grasses and sedges such as *Pseudoschoenus inanis* and *Cyperus textilis*. Artificial wetlands associated with the small constructed dams tend to be dominated by bulrush *Typha capensis* but also contain sedges and other aquatic plants such as arum lilies *Zantedeschia aethiopica* and pennywort *Centella asiatic*. Invasive alien plants occur in the more disturbed areas of the watercourses and comprise of bugweed *Solanum mauritianum*, black wattles *Acacia mearnsii*, *Eucalyptus* trees, swamp cypress *Taxodium distichum*, weeping willows *Salix babylonica* amongst others, as well as aquatic weeds such as knotweed *Persicaria* sp..

The foothill reach of the Gqunube River flows within a deeper river valley in the Bhisho Thornveld. Here the river and its tributaries flow within a sandy boulder streambed with dense riparian vegetation that is dominated by larger trees such as the river bushwillow *Combretum erythrophyllum* and Cape chestnut *Calodendrum capense* (Figure 13).

Figure 13. View of the Gqunube River at Quarry 4

7.2. ECOLOGICAL ASSESSMENT OF THE RIVERS

The present ecological status of the Gqunube and Qumra Rivers and the minor tributaries crossed by the road were determined using Habitat Integrity (HI) Assessments and Site Characterisation information. The ecological importance and sensitivity of these watercourses were also assessed.

7.2.1. RIVER CLASSIFICATION

In order to assess the condition and ecological importance and sensitivity of the watercourses, it is necessary to understand how they might have appeared under unimpacted conditions. This is achieved through classifying the rivers according to their ecological characteristics, in order that they can be compared to ecologically similar rivers.

River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. Any comparative assessment of river condition should only be done between rivers that share similar physical and biological characteristics under natural conditions. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river types. The primary classification of rivers is a division into Ecoregions. Rivers within an ecoregion are further divided into sub-regions.

Ecoregions: groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification presented in DWAF (1999), which divides the country's rivers into ecoregions, was used. The study area falls within the South Eastern Uplands Ecoregion (Table 2).

Table 2. Characteristics of the South Eastern Uplands Ecoregion

Main Attributes	Characteristics
Terrain Morphology:	Lowlands; Hills and Mountains; Moderate and High Relief Closed Hills; Mountains; Moderate and High Relief
Vegetation types	Moist Upland Grassland; Eastern Thorn Bushveld; Short Mistbelt Grassland; North Eastern Mountain Grassland; Patches Afromontane Forest
Altitude	500-1700 (m a.m.s.l)
MAP	500 to 1000 (mm)
Rainfall seasonality	Early to very late summer
Mean annual temp.	10 to 22 (°C)
Median annual simulated runoff	40 to >250(mm) for quaternary catchment

Sub-regions: sub-regions (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota. Table 3 provides the geomorphological features of the rivers within the study area.

7.2.2. SITE CHARACTERISATION

From the Site Characterisation assessment, the geomorphological and physical characteristics of the channels can be classified as follows:

Table 3. Geomorphological and Physical features of the drainage channels on site

River	Gqunube	Qumra	Minor Tributaries
Geomorphological Zone	Upper Foothill Zone		Mountain stream/transitional/upper foothill
Lateral mobility	Semi-Confined		Largely unconfined
Channel form	Simple single channel		
Channel pattern	Single channel, moderate to low sinuosity		
Channel type	Boulders and alluvium	Alluvium	
Channel modification	Limited flow and habitat modification		
Hydrological type	Seasonal		
Ecoregion	South Eastern Uplands		
DWA catchment	R30C	S70A	R30B&C, S60B&E, S70A&F
Vegetation type	Bhisho Thornveld and Amathole Montane Grassland		
Rainfall region	All year		

7.2.3. HABITAT INTEGRITY

The evaluation of Habitat Integrity provides a measure of the degree to which a river has been modified from its natural state. The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale from 0 (no impact) to 25 (critical impact).

Habitat Integrity Assessments are based on assessments of the impacts on two components of a river, the riparian zone and the instream habitat. Total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category (Table 5). The results of the Habitat Integrity Assessment for the watercourses within the study area are shown in Table 4.

Table 4. Habitat Integrity assessment for the main rivers and their tributaries within the study area

Instream Criteria	Gqunube	Qumra	Minor Tributaries
Water Abstraction	7	8	5
Flow Modification	11	6	9
Bed Modification	8	11	7
Channel Modification	5	9	8
Water Quality	4	10	4
Inundation	6	8	8
Exotic Macrophytes	4	8	3
Exotic Fauna	3	5	0
Rubbish Dumping	3	6	2
Instream Habitat Integrity Score	76	65	78
Instream Integrity Class	**C**	**C**	**B/C**
Riparian Category	Gqunube	Qumra	Minor Tributaries
Vegetation Removal	12	12	12
Exotic Vegetation	8	14	9
Bank Erosion	8	7	12
Channel Modification	6	9	9
Water Abstraction	6	7	5
Inundation	5	8	8
Flow Modification	12	7	9
Water Quality	5	11	5
Riparian Zone Habitat Integrity Score	55	43	51
Riparian Integrity Category	**D**	**D**	**D**

Table 5. Habitat Integrity categories (From DWAF, 1999)

Category	Description	Score (%)
A	Unmodified, natural.	90-100
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.	80-90
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. Large loss of natural habitat, biota and ecosystem function has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is 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 worst instances, basic ecosystem functions have been destroyed and changes are irreversible.	0

The instream habitat of the rivers within the study area are in still in a largely natural to moderately modified ecological condition largely as a result of limited agricultural activities in their catchments

and the associated abstraction and storage of water. The riparian habitat is more degraded as a result of direct habitat modification as a result of adjacent farming activities that have resulted in removal of indigenous riparian vegetation and the subsequent growth of invasive alien plants in these disturbed areas. The Qumra River is slightly more degraded as a result of the surrounding urban activities at Komga. The integrity of the tributaries varies with some being less impacted than others.

7.2.4. ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

The EIS assessment considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table 6). The median of the resultant score is calculated to derive the EIS category (Table 7). The results of the EIS assessment are shown in Table 8.

Table 6. Scale used to assess biotic and habitat determinants indicating either importance or sensitivity

Scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale

Table 7. Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General description	Range
Very high	Quaternaries/delineations unique on a national / international level based on unique biodiversity. These rivers are usually very sensitive to flow modification and have very limited capacity for use.	>3-4
High	Quaternaries/delineations unique on a national scale based on their biodiversity. These rivers may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations unique on a provincial or local scale due to biodiversity. These rivers are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations not unique on any scale. These rivers are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 8. Results of the EIS assessment

Biotic Determinants	Gqunube	Qumra	Minor Tributaries
Rare and endangered biota	2	1.5	1.5
Unique biota	1.5	1.5	1.5
Intolerant biota	1.5	1.5	1.5
Species/taxon richness	2	1.5	1
Aquatic Habitat Determinants			
Diversity of aquatic habitat types or features	2	1.5	1
Refuge value of habitat type	2.5	1	1.5
Sensitivity of habitat to flow changes	1.5	2.5	2.5
Sensitivity of flow related water quality changes	1.5	2	2.5
Migration route/corridor for instream & riparian biota	2.5	2	1
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	1.5	1.5	1.5
Mean	1.8	1.6	1.5
EIS CATEGORY	Moderate/High	Moderate	Moderate

Indigenous fish species that are recorded to occur in the river systems in the area are longfin eel *Anguilla mossambica*, chubbyhead barb *Barbus anoplus* and scaly *Barbus natalensis*. Predacious invasive alien fishes such as sharptooth catfish *Clarias gariepinus* and spotted bass *Micropterus punctulatus.* The indigenous fishes occurring in the rivers are considered Least Concern.

Possible amphibians also associated with the rivers and their associated wetlands are spiny reed frogs *Afrixalus knysnae-spinifrons* (vulnerable), kloof frog *Natalobatrachus bonebergi* (endangered), Natal ghost frog *Heleophryne natalensis* (least concern), striped grass frog *Ptychadena porosissima* (least concern) and dainty frogs *Cacosternum boettgeri* (least concern).

7.3. WETLAND ASSESSMENT

Wetlands as defined by the National Water Act (Act 36 of 1998) "*are a portion of land that is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." Wetland delineation relates to the determination and marking of the boundary of a wetland to the outer edge of the temporary zone of wetness.

The wetland assessment consisted of the following wetland assessment components: Wetland delineation; Wetland classification; Wetland integrity; and Wetland importance.

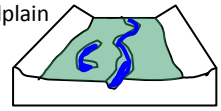
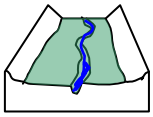
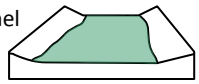
7.3.1 WETLAND DELINEATION

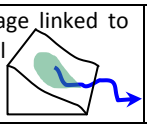
The wetland delineation process uses four wetland indicators to provide an estimate of the extent of a wetland. They are: landscape position (must be flat or depressed), vegetation (must be hydrophilic), soil form (must compliment an existing wetland type) and soil wetness (water table must be within 50 cm of profile). The wetlands on the study area consist of depressions that are associated with excavations and impoundments, grassland seeps and channelled valley bottom wetlands associated with the rivers and streams. The delineated wetland areas are as shown in Appendix D. These wetland areas are assessed further in this section.

7.3.2. WETLAND CLASSIFICATION

The classification of the wetland areas in the study area was based on the WET-EcoServices technique (Kotze *et al*, 2005). The WET-EcoServices technique identifies seven main types of wetland based on hydro-geomorphic characteristics (Table 9).

Table 9. Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa

Hydro-geomorphic types	Description	Wetland water source[1]	
		Surface	Sub-surface
Floodplain 	Valley bottom areas with a well-defined stream channel, gently sloped and characterized by floodplain features and the alluvial transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel and from adjacent slopes.	***	*
Valley bottom with a channel 	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel and from adjacent slopes.	***	*/ ***
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and from adjacent slopes.	***	*/ ***

Hillslope seepage linked to stream channel 	Slopes on hillsides, characterized by the colluvial movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important

Water source: * Contribution usually small
*** Contribution usually large
*/ *** Contribution may be small or important depending on the local circumstances
Wetland

According to hydro-geomorphic characteristics, the wetland features within the study area can be classified as follows:

Table 10. Classification of wetland areas within study area

Name	Artificial depressions	Grassland seeps	Valley bottom wetlands
System	Inland		
Ecoregion	South Eastern Uplands		
Landscape setting	Plains and hill slopes		Valley Bottom
Hydrogeomorphic Type	Depression	Hillslope seep	Channeled valley bottom
Longitudinal zonation	N/A	N/A	Lower Foothills
Drainage	Subsurface and surface drainage associated with seeps and watercourses as well as channeled runoff from road, with/without outflow	Diffuse sub-surface and/or surface inflow, with/without outflow	Channels flow through the wetlands
Seasonality	Largely permanent wetlands	Permanent to Seasonal areas	
Anthropogenic influence	Artificial depressions that are associated with excavations and impoundments	Largely natural with some agricultural disturbance, specifically for water supply purposes.	The wetlands have been moderately to largely modified by flow and habitat modification
Vegetation	Amathole Montane Grassland		Bhisho Thornveld
Substrate	Weathered sandstone		Alluvial with gravel/cobbles
Salinity	Fresh		

7.3.3. WETLAND INTEGRITY

The Present Ecological Status (PES) Method (DWAF 2005) was used to establish the integrity of the wetlands and was based on the modified Habitat Integrity approach developed by Kleynhans (DWAF, 1999; Dickens *et al*, 2003). Table 11 and Table 12 show the criteria and results from the assessment of the habitat integrity of the wetland. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland.

Table 11. Habitat integrity assessment criteria for palustrine wetlands (Dickens *et al*, 2003)

Criteria	Relevance
Hydrologic	
Flow Modification	From abstraction, impoundments or increased runoff from settlements or agriculture. Flow change that affect wetland habitat inundation resulting in floralistic changes or incorrect cues to biota.
Perm. Inundation	Consequence of impoundment. Result in natural wetland habitat loss and alter wetland biota cues.
Water Quality	
Water Quality Modification	From point or diffuse sources from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rate of erosion, accretion or infilling of wetlands.
Hydraulic/Geomorphic	
Canalisation	Desiccation or change wetland inundation pattern and habitats. River diversions or drainage.
Topographic Alteration	Infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities that reduce or change wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Veg Removal	Destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilisation	Overgrazing, over fishing, etc.

Table 12. Wetland habitat integrity assessment (score of 0=critically modified to 5=unmodified)

Criteria & Attributes	Artificial depressions	Grassland seeps	Valley Bottom wetlands
Hydrologic			
Flow Modification	1.0	3.4	3.2
Permanent Inundation	0.8	3.5	3.2
Water Quality			
Water Quality Modific	2.8	2.9	2.6
Sediment Load Modific	2.7	2.7	2.3
Hydraulic/Geomorphic			
Canalisation	1.3	3.7	3.2
Topographic Alteration	0.8	3.5	3.2
Biota			
Terrestrial Encroach	1.7	3.1	2.8
Indig. Veg Removal	1.0	3.2	2.8
Invasive Plant Encroach	2.0	3.2	2.6
Alien Fauna	1.8	3.1	2.9
Over utilisation of Biota	1.6	2.8	2.4
Total Mean	1.5	3.2	2.7
Category	**D/E–Large/Serious modif**	**B/C–Large natural/Mod modif**	**C–Moderately modified**

Table 13. Relation between scores given and ecological categories

Guidelines Per Attribute*	Mean* of Scores for all Attributes: Rating of Present Ecological Status Category (PESC)
Natural, unmodified - score=5.	CATEGORY A >4; Unmodified, or approximates natural condition.
Largely natural - score=4.	CATEGORY B >3 and ≤4; Largely natural with few modifications, but with some loss of natural habitats.
Moderately modified- score=3.	CATEGORY C >2 and ≤3; moderately modified, but with some loss of natural habitats.
Largely modified - score=2.	CATEGORY D ≤2; largely modified. Large loss of natural habitat & basic ecosystem function occurred.
	OUTSIDE GENERALLY ACCEPTABLE RANGE
Seriously modified - rating=1.	CATEGORY E >0 and <2; seriously modified. Extensive loss of natural habitat & basic ecosystem function.
Critically modified - rating=0.	CLASS F 0; critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

The WET-Health method was then used to determine that overall Present Ecological Status (PES) for the wetlands. PES scores were determined for geomorphology, hydrology, water quality and vegetation to generate the overall score and ecological category (Table 14).

Table 14. WET-Health assessment of wetland areas in the study area

Components	Method for assessment	Artificial depressions		Grassland seeps		Valley Bottom Wetlands	
		PES% Score	Ecological Category	PES% Score	Ecological Category	PES% Score	Ecological Category
Hydrology PES	WET-Health Hydro Module	60 %	**C/D**	85 %	**B**	65 %	**C**
Geomorphology PES	WET-Health Geomorph Module	73 %	**C**	86 %	**B**	76 %	**C**
Water quality PES	Landuse-WQ Model	93 %	**A**	98 %	**A**	83 %	**B**
Vegetation PES	WET-Health Veg Module	31 %	**E**	62 %	**C**	60 %	**C/D**
Overall Wetland PES	WET-Health weightings	55 %	**D**	82 %	**B**	69 %	**C**

The wetland areas have all been impacted by agricultural activities in and adjacent to the wetlands. The grassland seeps on the watershed are still largely natural while the channelled valley bottom wetlands have been more impacted, particularly in terms of their hydrology (upstream dams) and vegetation (invasive alien plant growth). The depression wetlands are artificially created and are associated with constructed dams.

7.3.4. WETLAND IMPORTANCE

The importance of the wetlands has been assessed according to the following components: the Ecological Importance and Sensitivity; and the ecosystem goods and services provided by the wetlands that consist of the Hydrological Functional Importance and the Direct Human Benefits of the wetlands.

The EIS Assessment for the wetland areas utilise a similar methodology to that for rivers as described in Section 7.2.4 of this report. The results from the wetland EIS assessment are provided in Table 15 below. The assessment of the ecosystem services supplied by the wetland areas (divided into Hydrological Functional Importance and Direct Human Benefits) was conducted according to the guidelines as described by Kotze *et* al (2005).

Table 15. Goods and services assessment results for the wetland in the study site (high=4; low=0)

WETLAND IMPORTANCE	Artificial depressions	Grassland seeps	Channeled Valley Bottom Wetlands
ECOLOGICAL IMPORTANCE AND SENSITIVITY:			
Biodiversity support	1.33	1.93	2.50
Presence of Red Data species	1.50	2.50	3.00
Populations of unique species	1.00	1.50	2.00
Migration/breeding/feeding sites	1.50	1.80	2.50
Landscape scale	1.00	1.80	1.50
Protection status of the wetland	1.00	1.00	1.00
Protection status of the vegetation type	1.00	1.00	1.00
Regional context of the ecological integrity	1.00	3.00	2.00
Size and rarity of the wetland type/s present	1.00	2.50	1.50
Diversity of habitat types	1.00	1.50	2.00
Sensitivity of the wetland	0.67	2.83	1.93

Sensitivity to changes in floods		0.50	3.00	1.80
Sensitivity to changes in low flows/dry season		0.50	3.00	2.00
Sensitivity to changes in water quality		1.00	2.50	2.00
Ecological Importance & Sensitivity Score		1.33	2.83	2.50
HYDROLOGICAL-FUNCTIONAL IMPORTANCE				
Flood attenuation		1.5	2	3
Streamflow regulation		1	2.5	2.8
Water Quality Enhancement	Sediment trapping	1.5	2.5	2.5
	Phosphate assimilation	1	1.5	1
	Nitrate assimilation	1	1.8	1.5
	Toxicant assimilation	1	1	1
	Erosion control	1	1.5	2.5
Carbon storage		1	2	1
Hydrological Functional Score:		1.13	1.85	1.91
IMPORTANCE OF DIRECT HUMAN BENEFITS				
Subsistence benefits	Water for human use	*3*	*2*	*2.5*
	Harvestable resources	*1*	*1.8*	*1.5*
	Cultivated foods	*1*	*1.5*	*1.5*
Cultural benefits	Cultural heritage	*1*	*1*	*1*
	Tourism and recreation	*1*	*1.5*	*1*
	Education and research	*0.5*	*1*	*1*
Direct Human Benefit Score:		1.25	*1.47*	1.42
TOTAL OVERALL SCORE:		1.33	2.83	2.5
		Moderate	High	High

The natural wetland areas are considered to be of a high importance, while the artificial wetland areas also provide important habitat or biota and are considered of moderate ecological importance and sensitivity (Figure 14).

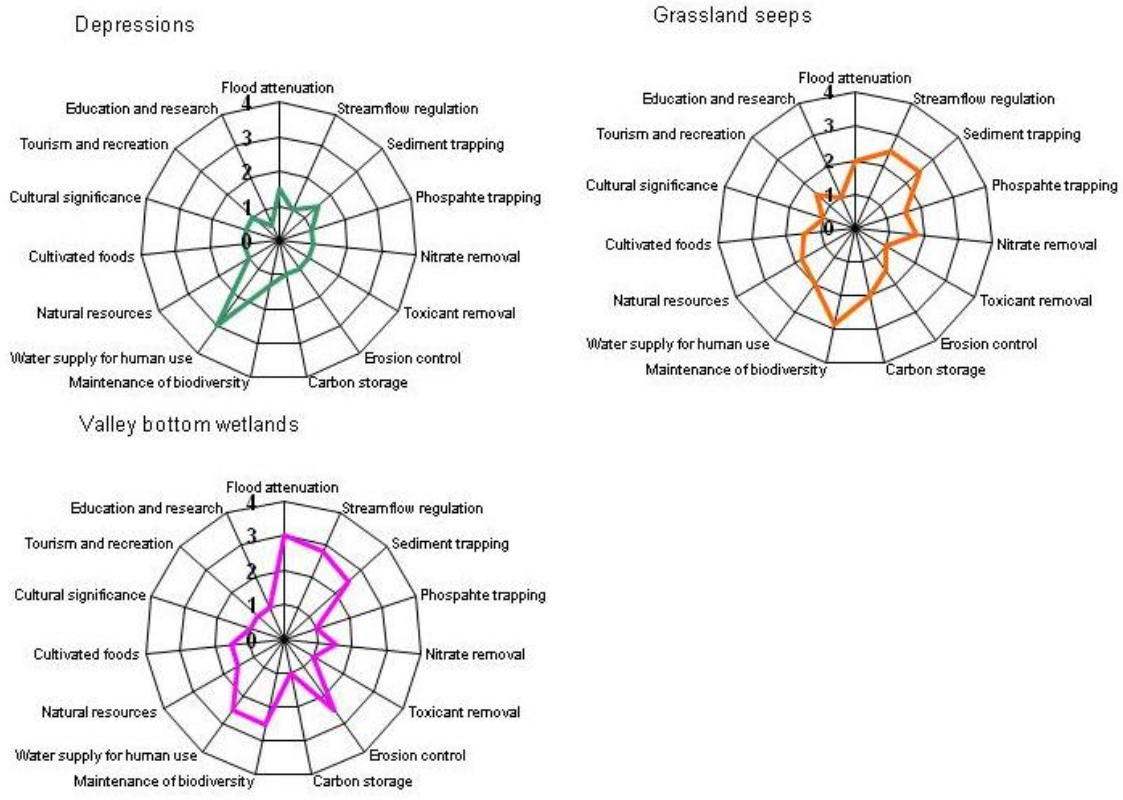


Figure 14. Ecosystem services provided by the wetland area

8. FRESHWATER CONSTRAINTS AND IMPACT ASSESSMENT

8.1. DESCRIPTION AND ASSESSMENT OF IMPACTS OF PROPOSED ACTIVITIES

This section provides an assessment of the potential aquatic ecosystem impacts that are likely to be associated with the proposed R63, Section 16 road improvement activities. The freshwater constraints assessment and recommended mitigation measures are discussed in more detail in Table 16.

The R63 road and associated structures are already in existence adjacent to or within the freshwater features described in the previous section. The road, together with some other physical modifications to the freshwater features in the upstream catchment, has resulted in the current ecological condition of the rivers and their associated wetland areas. Therefore it can be expected that the likely impacts of the activities associated with the proposed upgrade of the road within the watercourse crossings are of a limited extent and of a short term nature, occurring mostly during the construction phase.

Longer term impacts that are likely to occur as a result of the proposed activities relate to how the maintenance work is undertaken for the road as well as the potential encroachment of invasive alien vegetation into the freshwater features where they have been disturbed by the construction activities.

Various quarry and borrow pits have been identified to provide the materials required for the upgrade. While some of the quarries and borrow pits already exist, most would entail a new activity. As such each of the borrow pits is assessed separately in terms of whether any freshwater constraints within or adjacent to the identified areas and specific mitigation recommendations provided.

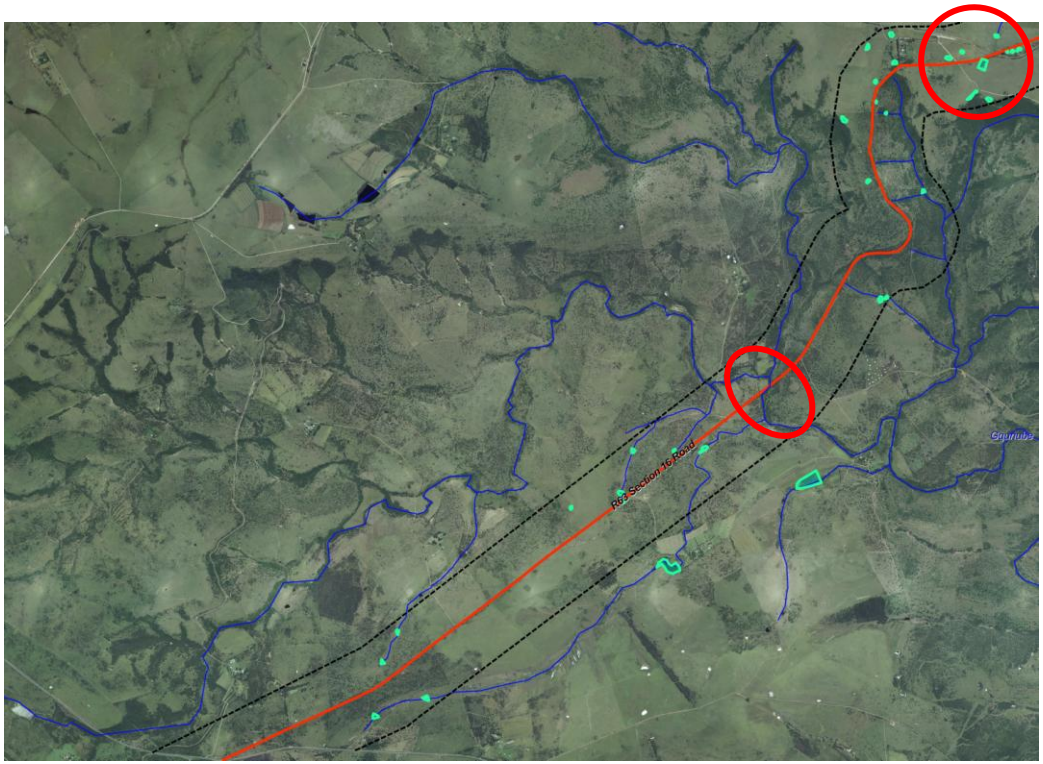
General mitigation measures are:

- Work within the river channels or wetland areas should be limited as far as possible and the disturbed areas rehabilitated immediately afterwards.
- Construction within the river channels should as far as possible take place during the drier months of the year.
- Rubble and debris from existing structures and construction activities should be removed after construction is complete so as not to impede flow in the rivers.
- Once construction is complete, the disturbed areas should be rehabilitated to resemble that of the surrounding bed and banks and where necessary vegetated with suitable local indigenous plants as occur at the site.
- The channel upstream of the crossings should be kept free of debris and sediment build-up, particularly at the culvert where it might impede flows.
- Any invasive alien plants occurring within the road reserve should be monitored and removed on an ongoing basis according to methods as provided by the Working for Water Programme.

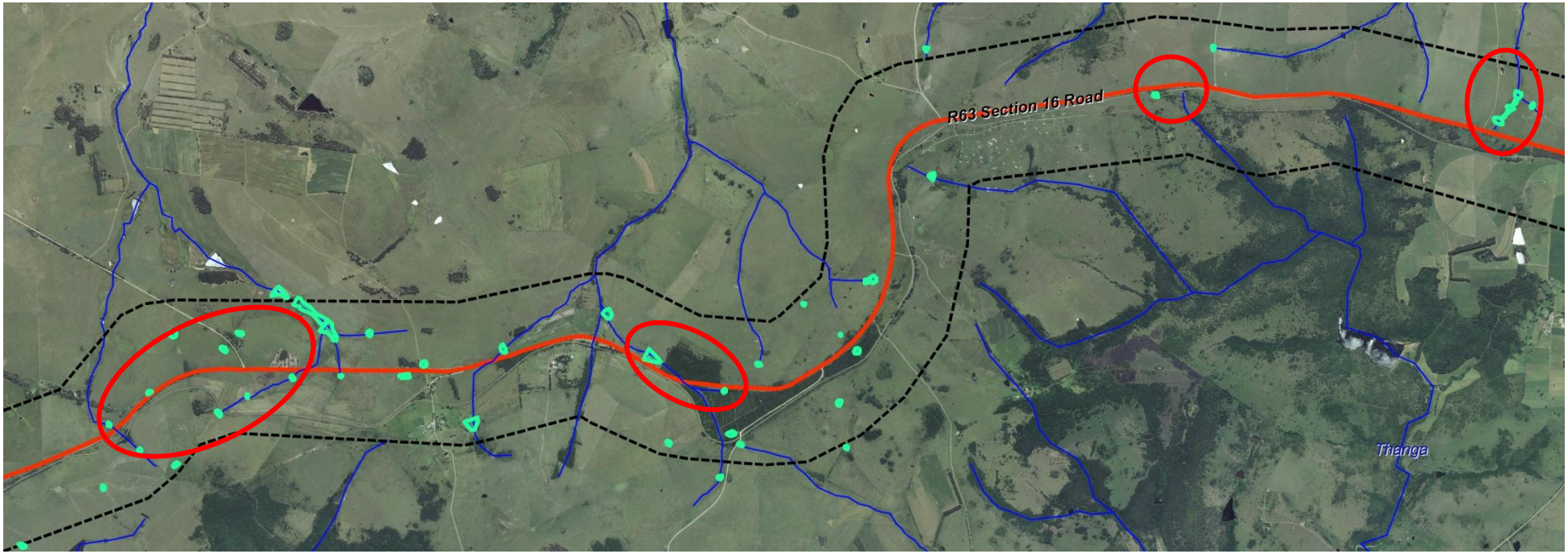
The DEADP Maintenance Management Plan guidelines (2013) provide the following set of guiding principles for maintenance work in water courses that are of relevance to this project:

- Minimise the spatial extent of disturbance and maximise physical diversity.
- Minimise the frequency of, or requirement for, maintenance activities.
- Minimise upstream/downstream impacts on the reach in which the sites are located.
- Do not impede the movement of aquatic and riparian biota.
- Minimise alterations to flow- and sediment-capacity.
- Rehabilitate and re-vegetate after construction.
- Clear alien plant species.
- Minimise impact on the structural integrity of the water course and maintain a minimum base flow at all times.
- Maintenance activities are best done during the dry season.
- All reasonable measures should be undertaken to ensure that river maintenance activities minimise erosion.
- Whenever possible existing access routes should be used. All potential pollutants should be kept away from rivers.
- Spoil material should be removed to approved dumping sites.
- After construction, any areas within the maintenance footprint that have been degraded from their condition prior to construction and as a result of the construction activities must be restored to their former condition.
- Channelization or canalization is actively discouraged as it tends to result in bigger problems than those it was intended to solve.
- Valuable biophysical or aesthetic areas, including meanders, and in-channel and floodplain habitat, should be retained.
- Cleared woody material must be removed from the riparian area to prevent it being washed into the river channel during the wet season.

Table 16. Freshwater Constraints associated with the proposed project where the blue lines indicate the rivers, green the wetland areas and black lines the 500m buffer

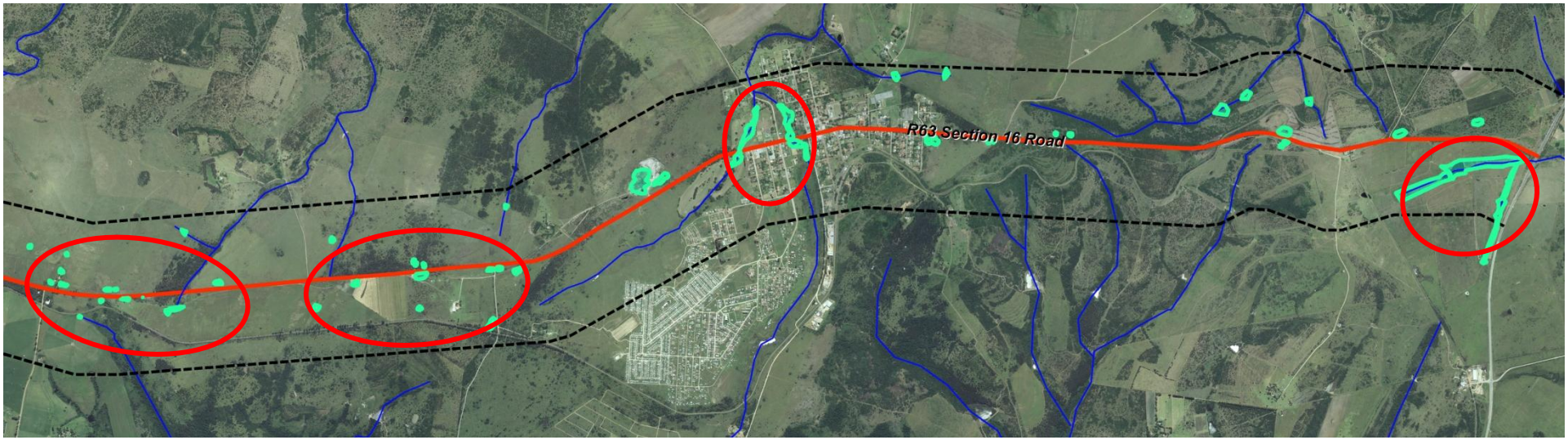
R63, Section 16 Upgrade - Western extent within the Gqunube Catchment and its tributaries: Orthophotograph 	**Comment:** Aquatic features within this portion of study area (shown left) comprise of the Gqunube River and its tributaries and associated wetlands. The wetland areas in this section comprise of small depression wetlands that are associated with impoundments that have been constructed in the area. As mentioned in the previous section, the Gqunube River and its tributaries in the area are deemed to be in a moderately to largely modified ecological condition while the depression wetlands are in a largely to seriously modified ecological condition. The rivers and wetlands are of moderate to high ecological importance and sensitivity. Areas of higher ecological importance and sensitivity are the Gqunube River channel and seep wetland are in the grasslands on the eastern corner of the image (indicated by the red ovals in the image). The aquatic habitats tend to be more impacted downstream (south) of the R63 road as a result of the existing roadworks and thus the impact of the proposed road upgrades would have less of an impact if any loss of aquatic habitat were to occur in the area immediately downstream of the road.

R63, Section 16 Upgrade – Central portion on the watershed between the Catchment and its tributaries: Orthophotograph



Comment: Aquatic features within this portion of study area comprise of southerly flowing tributaries of the Thanga River (a tributary of the Gqunube River) and tributaries of the Kwelera River and the north-easterly flowing tributaries of the Kubusi and Qumra Rivers. The road is located on the watershed and thus on crosses the upper reaches of some of these watercourses. There are also small depression wetlands that are associated with impoundments that have been constructed within this area. These impoundments have largely been constructed in grassland seeps that occur on the watershed. Some valley bottom wetlands are associated with the Qumra Tributaries. The rivers in the area are deemed to be in a moderately to largely modified ecological condition while the wetlands are in general in a moderately modified ecological condition. The rivers are of moderate ecological importance and sensitivity while the wetlands are of a moderate to high importance. Areas of higher ecological importance and sensitivity are the grasslands seeps and the valley bottom wetland indicated by the red ovals in the image. The aquatic habitats tend to be more impacted downstream (primarily north) of the R63 road. If the activities are kept to a minimum within the road corridor and particularly within the red oval area and rehabilitated the potential impacts would be of a low significance.

R63, Section 16 Upgrade - Eastern extent within the Catchment and its tributaries: Orthophotograph

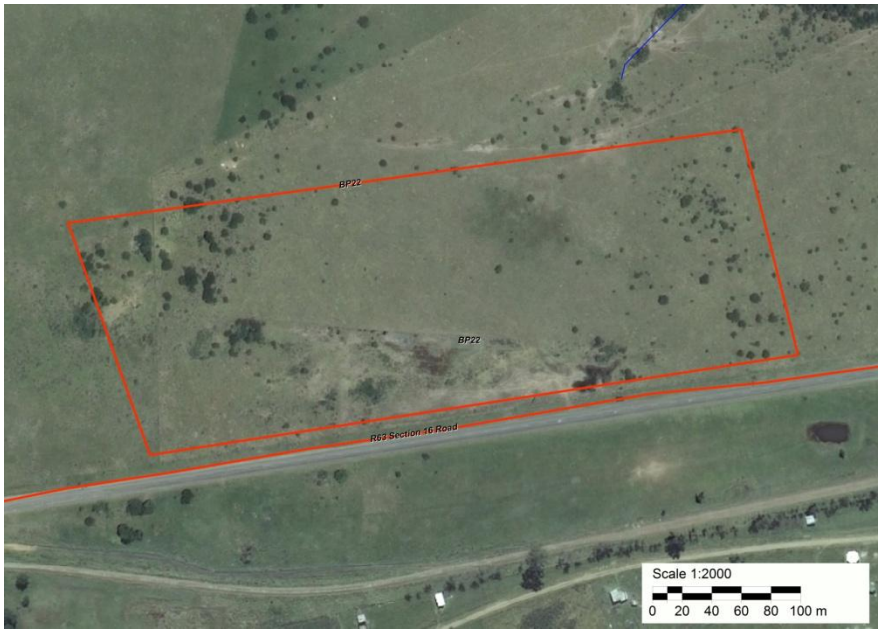


Comment: Aquatic features within this portion of study area, as shown above, comprise of southerly flowing tributaries of the Kwelera River; the north flowing tributaries of the Qumra River; and the north and east flowing tributaries of the Great-Kei River. The road is located on the watershed and thus on crosses the upper reaches of some of these watercourses. There are also small depression wetlands that are associated with impoundments that have been constructed within this area. These impoundments have largely been constructed in grassland seeps that occur on the watershed. Some valley bottom wetlands are associated with the Qumra Tributaries and the Great-Kei Tributaries. The rivers in the area are deemed to be in a moderately to largely modified ecological condition while the wetlands are in general in a moderately modified ecological condition. The rivers are of moderate ecological importance and sensitivity while the wetlands are of a moderate to high importance. Areas of higher ecological importance and sensitivity are the grasslands seeps and the valley bottom wetland indicated by the red ovals in the image. The aquatic habitats tend to be more impacted downstream (north) of the R63 road. If the activities are kept to a minimum within the road corridor and particularly within the red oval area and rehabilitated the potential impacts would be of a low significance.

The impacts of the activities on the downstream aquatic habitat in terms of increased sedimentation and alteration of the active channels of the rivers should be avoided or mitigated. In particular the sizing, level of the culvert structures in relation to the channel beds and the alignment of the river channels at the road crossings are important factors in trying to reduce the potential for sedimentation and erosion taking place at the road crossings. Reducing the capacity of the culvert/bridge structures is likely to intensify the flow at the structures and increase erosion of the stream channels downstream of the road. While increasing the flow capacity of the structures is preferred, it is also likely to result in deposition of sediment at the structure if not correctly sized which will require ongoing maintenance to prevent it from becoming blocked. The new culvert structures should not be placed higher than the base level of the river channel to ensure that low flows are not impeded. Placing the culverts lower than the base level of the river channels could result in increased erosion or down-cutting of the river channel at the road crossings.

Storm water runoff from the road into the river channels at the crossings, particularly where they are located within a relatively steep valley, should also be mitigated to ensure that it does not result in erosion of the river channels. Any waste material associated with activities should be removed from the river channels once the construction activities are complete and the disturbed areas rehabilitated, revegetating where necessary to prevent invasive growth of alien vegetation and erosion of the river banks from taking place. The disturbed areas will need to be monitored and managed for a period of at least 3 years post construction to ensure that alien plants do not invade these areas. The culvert structures should also be inspected and maintained regularly to proactively address blockages and erosion within the river channels.

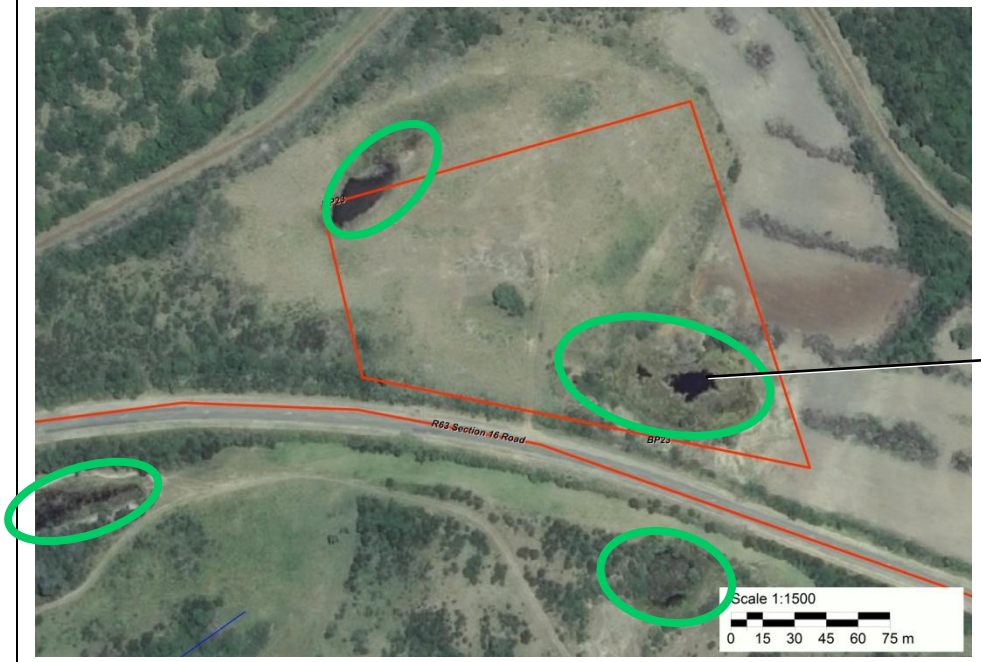
Borrow Area BP 22: Orthophotograph



Photograph of BP22:

Comment: Borrow Area BP22 is located adjacent to the R63 road on the watershed a minor tributary of the Kubusi River approximately 45m to the north and a tributary of the Thanga River approximately 250m to the south. There is an existing borrow area within site. The area comprises of grassland with some invasive black wattle trees and some indigenous sweet thorn trees and *Searsia* shrubs. There are no wetland area associated with the borrow area. Provided the proposed borrow area and the associated removal of material remain within the indicated area and do not extend any further to the north, the potential aquatic ecosystem impacts would be of a very low significance.

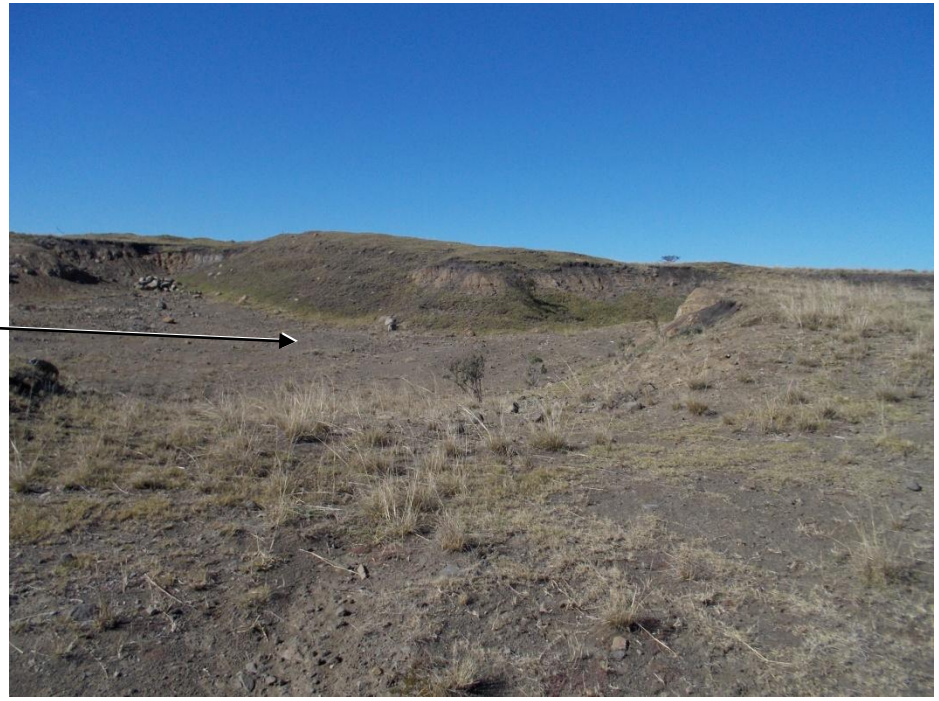
Borrow Area BP23 : Orthophotograph



Comment: Borrow Area BP23 is also located adjacent to the R63 road on the watershed between a minor tributary of the Great-Kei River; approximately 90m to the north-east and a tributary of the Kwelera River to approximately 150m to the south-west. There is an existing borrow area within site. The area comprises of grassland with some invasive black wattle trees and some indigenous sweet thorn trees and *Searsia* shrubs. There is a wetland area associated with the borrow area but it contains no significant aquatic habitat. Additional depression wetlands are located to the west and south of the site. The site is however bounded between the R63 road and the railway line, it could thus be expected that provided the proposed borrow area and the associated removal of material remain within the indicated area, the potential aquatic ecosystem impacts would be of a low to very low significance.

N2 Upgrade - Borrow Area BP 25: Orthophotograph

View of proposed Borrow Area BP25



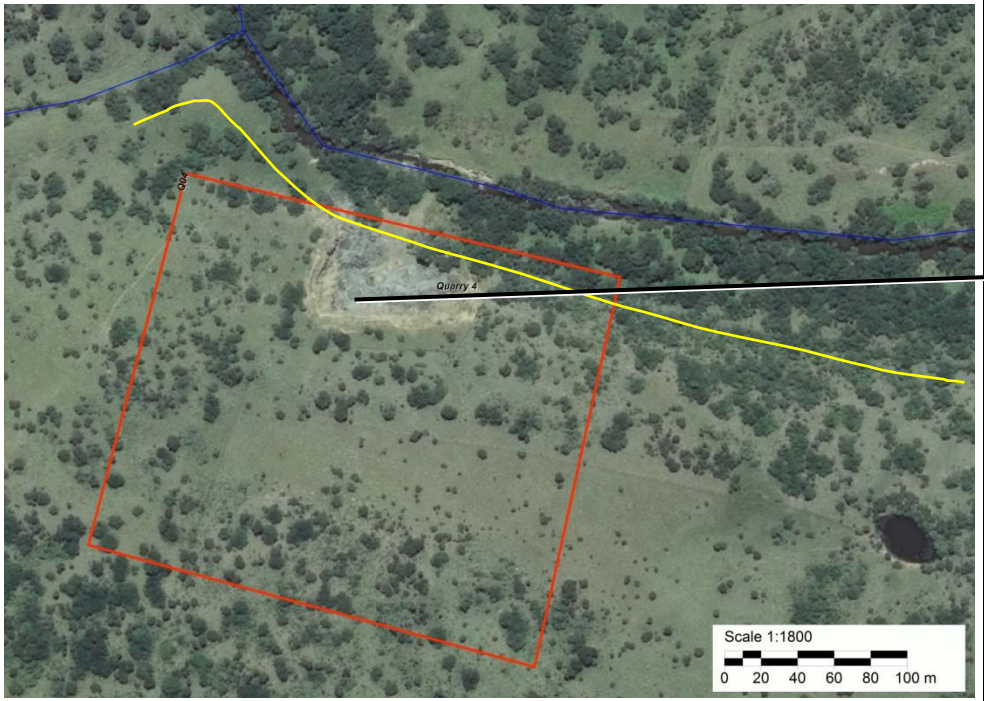
Comment: Borrow Area BP25 is located at the head of a tributary of the Kubusi River. There is an existing borrow area within site. The area comprises of grassland. There are no wetland areas associated with the borrow area however the tributary downstream of the borrow area is still largely natural with good indigenous riparian vegetation present. Provided the proposed borrow area and the associated removal of material remain within the indicated area, the potential aquatic ecosystem impacts would be of a low significance. Care should be taken not to increase the sediment load or the erosion of the stream, downstream of the gravel road at the borrow area.

N2 Upgrade - Borrow Area B26: Orthophotograph

View of the proposed Borrow area BP26

Comment: Borrow Area BP26 is also located adjacent to the R63 road on the watershed approximately 95m south-east of a minor tributary of the Kubusi River. There are two existing excavation areas within site that currently provide watering points for cattle within the surrounding grassland. The depression wetland areas associated with the excavations contain no significant aquatic habitat. Additional depression wetlands are located to the south-west of the site and are associated with a grassland seep area and the minor tributary. Due to the fact that the proposed borrow area is located nearby a seep area, the potential aquatic ecosystem impacts would be of a moderate to low significance.

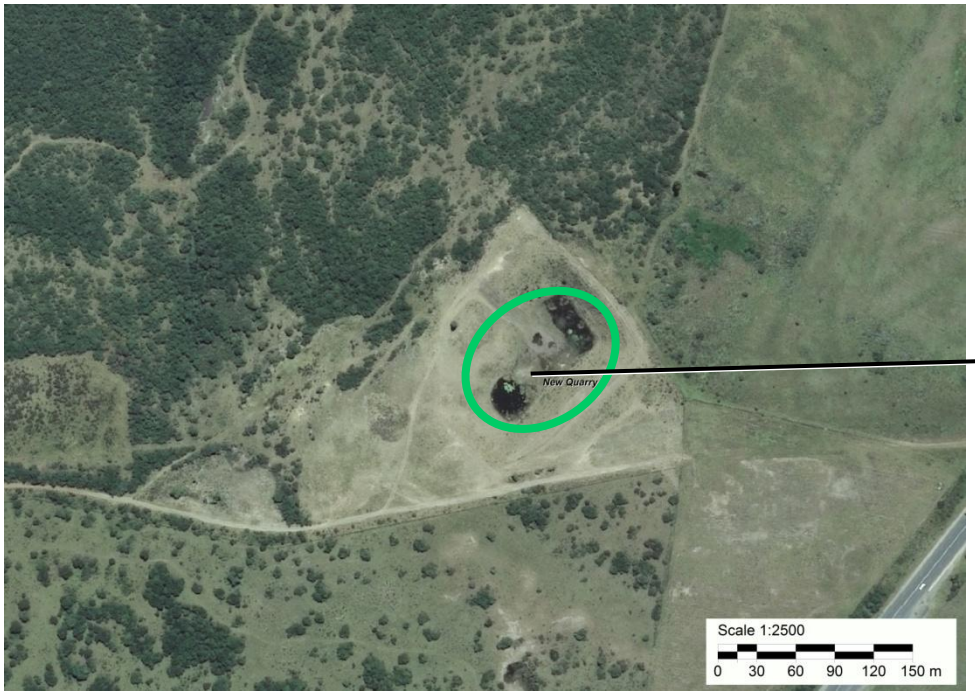
Quarry 4: Orthophotograph



Photograph of Quarry 4

Comment: Quarry 4 is located adjacent to the Gqunube River (approximately 35m to the north). A small dam is located approximately 200m to the east of the site. There is an existing quarry within site. The riparian zone of the adjacent river comprises of a number of large river bush willow trees *Combretum erythrophyllum*. The proposed quarry area and the associated activities should remain outside of the recommended buffer of the river indicated by the yellow line above. Access to the quarry should also avoid disturbing the riparian zone but should approach the site from the south or cross the river at the existing crossing points. If the quarry and associated activities remain outside of the recommended buffer area, the potential aquatic ecosystem impacts would be of a low significance.

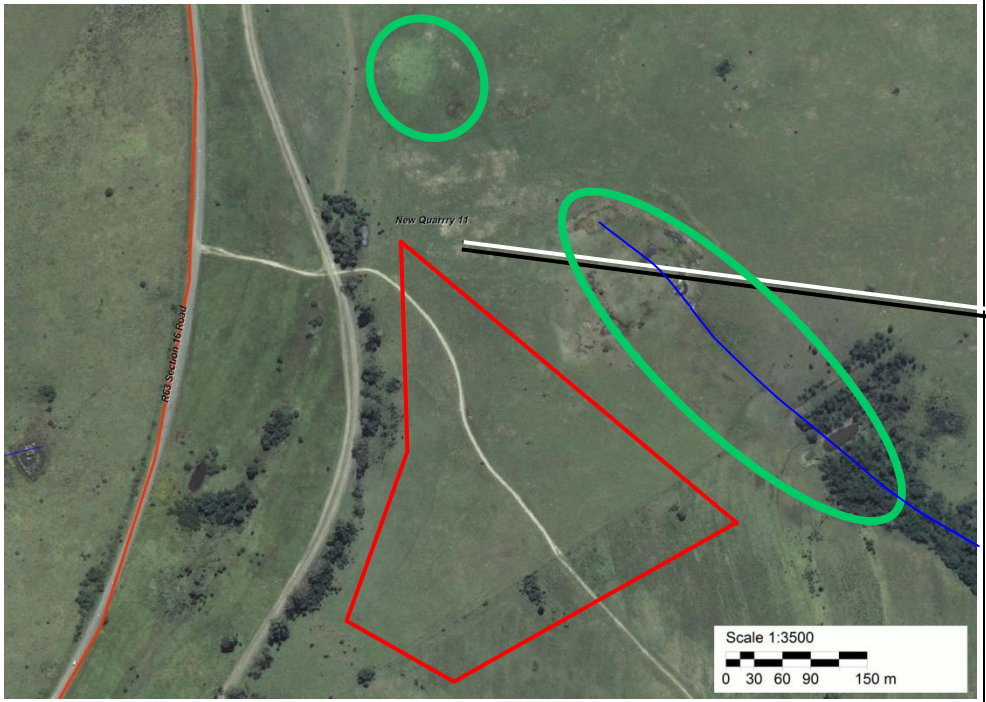
Quarry 9: Orthophotograph



Photograph of Quarry 9

Comment: Quarry 9 is also located on the watershed near a minor tributary of the Great-Kei River that is approximately 250m to the west of the site. There is an existing quarry area within site. The area comprises of grassland with some invasive black wattle trees and some indigenous sweet thorn trees and *Searsia* shrubs. There is a small wetland area associated with the quarry but it contains no significant aquatic habitat. Provided the proposed quarry and the associated removal of material remain within the indicated area, the potential aquatic ecosystem impacts would be of a very low significance.

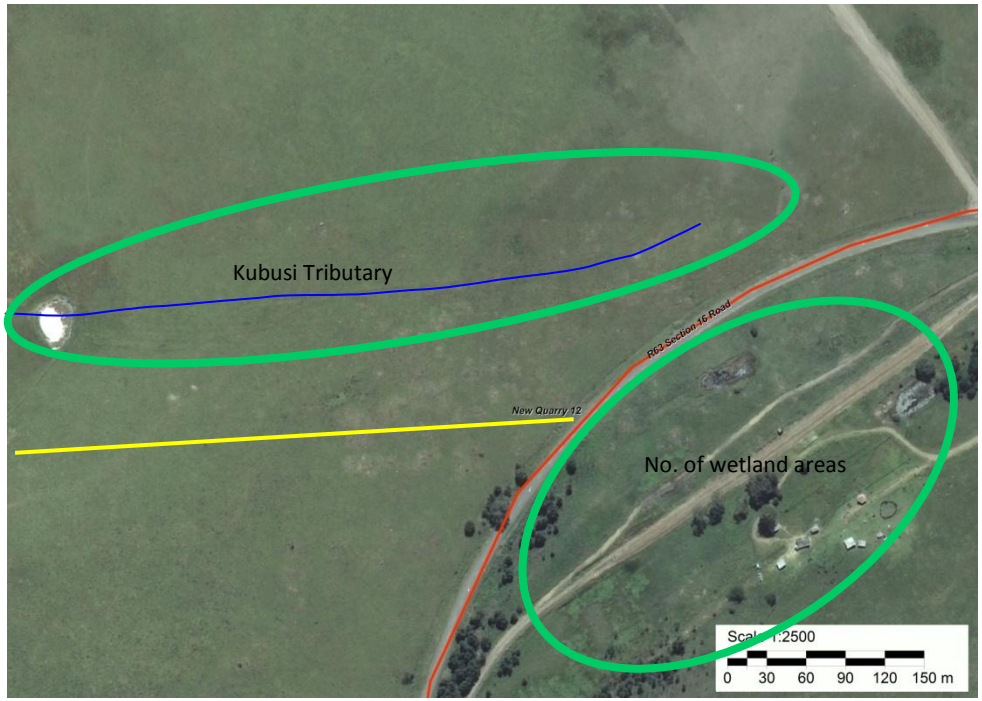
Quarry 11: Orthophotograph



Photograph of Quarry 11

Comment: Quarry Area 11 is located to the east of the railway line on the watershed between a minor tributary of the Thanga River and an associated seep area to the south-east and a tributary of the Kubusi River to approximately 300m to the north-west. There is no existing borrow area or quarry within site. The area comprises of grassland with some invasive black wattle trees and dolomitic outcrops. It is recommended that the quarry area preferably be largely located to the south of the existing gravel road as indicated in the above image. Provided the proposed quarry and the associated activities remain further than 120m from the watercourse (within indicated by the red polygon), the potential aquatic ecosystem impacts would be of a low significance.

Quarry 12: Orthophotograph



Comment: Quarry Area 12 is located to the west of the R63 road on the watershed between a minor tributary of the Thanga River approximately 200m to the south-east and a tributary of the Kubusi River to approximately 150m to the north-west. There is no existing borrow area or quarry within site. The area comprises of largely of grassland seep area with excavated depressions occurring in the area. Provided the proposed quarry and the associated activities remain further than 100m from the watercourse (south of the setback line indicated by the yellow line) and west of the R63 road, the potential aquatic ecosystem impacts would be of a low significance.

8.2. OVERALL ASSESSMENT OF IMPACTS OF PROPOSED ACTIVITIES

This section provides a combined assessment of the potential impacts to freshwater ecosystems that are likely to be associated with the proposed road upgrade activities. The specific assessment and recommended mitigation measures per borrow site are outlined in Section 8.1.

AQUATIC HABITAT MODIFICATION OR LOSS

Nature of Impact: A small risk of the possible impact to the ***aquatic habitats*** of the Gqunube and Qumra Rivers and their tributaries that are crossed by the road, together with wetland areas and the headwaters of minor tributaries of the Kwelera, Kubusi and Great-Kei Rivers that are located along the watershed within the study area (see Table 16) can be expected during the construction phase. The disturbance of aquatic habitat will also provide an opportunity for invasive alien plants to proliferate in areas which is currently relatively free of invasive alien plants.

Significance of impacts without mitigation:

Construction Phase: A localized impact of medium intensity in the short term that is expected to have a low negative significance in terms of its impact on the aquatic habitat in the study area. This is due to the fact that the aquatic habitat within the study area has already been disturbed as a result of the existing road and its structures and the surrounding agricultural and urban activities.

Operation Phase: Over the longer term a negative impact of a very low significance could be expected due to the need to undertake maintenance activities on the road with the associated disturbance of aquatic habitats over the long term and the potential for invasive alien plants to establish within these disturbed areas.

Proposed mitigation:

Construction Phase:

- Work within the river channels or wetland areas should be limited as far as possible and the disturbed areas rehabilitated immediately afterwards.
- Construction within the river channels should as far as possible take place during the drier months of the year.
- Once construction is complete, the area should be rehabilitated to resemble that of the surrounding bed and banks and where necessary vegetated with suitable local indigenous plants as occur at the sites (sweet thorn trees *Vachellia natalitia,* shrubs such as the karees *Sersea gueinzii* and *S. lucida*, *Diospyros* sp., tree fuchsia *Halleria lucida* and camphor bush *Tarchonanhus comphoratus* and grasses such red oat grass *Themeda triandra, Sporobolus africanus* and *Eragrostis curvula* within the riparian zones and common reeds *Phragmites australis,* mat sedge *Cyperus textilis* and other sedges and rushes such as *Pseudoschoenus inanis* within the instream habitat).
- Any invasive alien plants or waste material within the river channels at the river crossings should be removed from the channels.

Operation Phase:

- Any regrowth of invasive alien plants within the road reserve should be monitored and removed on an ongoing basis according to methods as provided by the Working for Water Programme.
- Any signs of erosion within the river channels at the road crossings, particularly as a result of storm water runoff to the watercourse should be identified and addressed as soon as possible. Regular monitoring of the culvert structures should also be undertaken to ensure that they do not become block with sediment and debris but remain open.

Significance of impacts after mitigation:

Construction Phase: The significance of the impact on the aquatic ecosystems with mitigation is expected to be a low (negative) in the short term.

Operation Phase: The significance of the impact on the aquatic ecosystems with mitigation is expected to be very low (negative) in the long term.

WATER QUALITY IMPACTS

Nature of impact: Impairment of the ***surface water quality*** could potentially occur during the construction phase.

Significance of impacts without mitigation:

Construction Phase: A slight risk of a localized water quality impact of low intensity that is expected to have a low overall significance in terms of its impact on the identified aquatic ecosystems in the area.

Proposed mitigation:

Construction Phase: Contaminated runoff from the construction site(s) should be prevented from entering the rivers, tributaries and wetland areas within the immediate area. The laydown area and main construction site(s) for the road upgrade should be located away from the rivers and wetland areas. If the construction site(s) need to be located near the rivers/streams, all materials on the construction site(s) should be properly stored and contained. Disposal of waste from the site(s) should also be properly managed. Construction workers should be given ablution facilities at the construction works that are located away from the river systems (at least 30m) and regularly serviced. These measures should be addressed, implemented and monitored in terms of the Environmental Management Plan for the construction phase.

Increased sedimentation or turbidity at each of the construction works within the river channels should be mitigated as far as possible by making use of sandbags, settling ponds or screens to minimise the load of sediment being washed downstream of the works.

Significance of impacts after mitigation:

Construction Phase: Provided that the mitigation measures are effectively implemented the water quality impacts of the proposed road upgrade should be of very low to negligible significance.

POTENTIAL FOR EROSION

Nature of Impact – There is a potential for ***increased erosion*** to take place at the river crossings and downstream of the borrow areas as a result of a change in the runoff characteristics, a loss of vegetation cover and physical disturbance of stream banks.

Significance of impacts without mitigation:

Operation Phase: Low localized impact.

Proposed mitigation:

The riparian vegetation cover associated with the watercourses should be disturbed as little as possible during the construction phase. Any disturbed areas should be rehabilitated as soon as possible after construction is completed and planted with suitable indigenous plants (sweet thorn trees *Vachellia natalitia,* shrubs such as the karees *Sersea gueinzii* and *S. lucida*, *Diospyros* sp., tree fuchsia *Halleria lucida* and camphor bush *Tarchonanhus comphoratus* and grasses such red oat grass *Themeda triandra, Sporobolus africanus* and *Eragrostis curvula* within the riparian zones and common reeds *Phragmites australis,* mat sedge *Cyperus textilis* and other sedges and rushes such as *Pseudoschoenus inanis* within the instream habitat) where necessary.

Storm water runoff from the road into the river channels may also need to be mitigated to prevent erosion at the crossings.

Significance of impacts after mitigation:

Operation Phase: Negligible localized impact during construction phase.

FLOW MODIFICATION

Nature of Impact: A ***temporary and longer term impedance of the flow*** or a change to the flow characteristics in the rivers at the river crossing sites may occur as a result of construction activities. Longer term maintenance of the river channels at the structures may be required to ensure that no debris blocks the channel at the road crossings.

Significance of impacts without mitigation:

Construction Phase: The construction activities would be expected to have a very limited impact on the flow in the rivers in terms of the extent and duration.

Operation Phase: The upgraded river crossing structures are likely to result in altered flow/hydraulic characteristics.

Proposed mitigation:

Construction Phase: Activities within the river channels during the construction phase should be limited as far as possible in terms of their spatial and temporal extent. Construction work within the river channel should preferably take place before the onset of the rainfall period to ensure minimal impact on flow. If flow occurs, flow in the river should be diverted around the construction works. In particular the low flow should not be impeded during construction.

Rubble and debris from existing structures and construction activities should be removed after construction is complete so as not to impede flow in the rivers.

Operation Phase: In the longer term, the upgraded structures and the box culverts/pipes should not impede the flow and in particular the low flow in the rivers. In particular, the new culvert structures should not be placed higher than the base level of the river channels to ensure that low flows are not impeded. In addition, the culvert structures must be placed within the natural drainage line of the rivers. The structures should also not impede the migration of biota. The channel upstream of the river crossings should be kept free of debris, intrusive growth of invasive alien plants and sediment build-up, particularly at the culverts where it might impede flows.

Significance of impacts after mitigation:

Construction Phase: A localised impact of low intensity that is expected to have a very low (negative) significance in terms of its impact on the identified aquatic ecosystems in the area during construction phase.

Operation Phase: An impact of very low (negative) significance is expected post-construction.

CUMULATIVE IMPACTS

The rivers, their tributaries and the wetland areas within the proposed road upgrade area that would be impacted by the proposed activities have already been modified as a result of previous road construction activities as well as the surrounding agricultural and urban activities. These activities have all contributed to a modification of both the instream and riparian aquatic habitats.

Considering that the proposed activities are to the existing road, one can expect that the cumulative impact of this activity on the river systems will be of a low to very low significance. The cumulative impacts will largely take place during the construction phase. While these impacts to the freshwater ecosystems in the study area are each of a low significance, it is essential that they be adequately mitigated to minimise the potential cumulative impacts.

Key cumulative impacts relate to increased disturbance of the river channels at a number of sites within the larger river systems that provide opportunity for the growth of alien invasive plants within riparian zones that currently have low densities of alien vegetation. It is thus essential that each site, once completed be rehabilitated. Ongoing monitoring and management of invasive alien plants within the disturbed areas along the road on an annual to twice yearly basis for a period of at least three years is recommended to ensure that the river corridor does not become invaded with alien invasive plants.

8.3. SUMMARY OF ASSESSMENT OF POTENTIAL IMPACTS OF THE PROPOSED ACTIVITIES

CONSTRUCTION PHASE:

Potential impact on freshwater features	Proposed upgrade of road and associated borrow pit and quarry areas
Nature of impact:	Limited disturbance of freshwater related habitats at the road crossing sites and near borrow / quarry areas
Extent and duration of impact:	Localised short term term impacts
Intensity of Impact	Medium
Probability of occurrence:	Probable as a result of construction activities at road crossings over the identified rivers and associated wetland areas
Degree to which impact can be reversed:	Partially reversible
Irreplaceability of resources:	Medium to low
Cumulative impact prior to mitigation:	Low negative due to the existing modification by the road within the river channels
Significance of impact pre-mitigation	Low negative
Degree of mitigation possible:	Low to Very low
Proposed mitigation:	Work within the river channels should be limited as far as possible and the river bed and banks rehabilitated immediately afterwards. Construction within the river channels should preferably take place during the drier months of the year. Disturbed areas should be rehabilitated once construction is complete.
Cumulative impact post mitigation:	Very Low negative
Significance after mitigation	Very Low negative /negligible

Potential impact on freshwater features	Proposed upgrade of road and associated borrow pit / quarry areas
Nature of impact:	Downstream ***water quality impacts*** as a result of runoff from construction activities
Extent and duration of impact:	Localised short term impacts
Intensity of Impact	Low
Probability of occurrence:	Probable
Degree to which impact can be reversed:	Reversible
Irreplaceability of resources:	Low
Cumulative impact prior to mitigation:	Low negative
Significance of impact pre-mitigation	Very Low negative
Degree of mitigation possible:	Low
Proposed mitigation:	Contaminated runoff from the construction site(s) should be prevented from entering the rivers/streams. All materials on the construction sites should be properly stored and contained. Disposal of waste from the sites should also be properly managed. Construction workers should be given ablution facilities at the construction sites that are located away from the river (at least 30m) and regularly serviced. These measures should be addressed, implemented and monitored in terms of the EMP for the construction phase. Sediment loads to river from construction activities should be prevented or minimized.
Cumulative impact post mitigation:	Very Low negative
Significance after mitigation	Very Low negative

Potential impact on freshwater features	Proposed upgrade of road and associated borrow pit / quarry areas
Nature of impact:	A temporary ***impedance of flow*** during construction activities
Extent and duration of impact:	Localised short term impacts
Intensity of Impact	Low
Probability of occurrence:	Probable
Degree to which impact can be reversed:	Reversible
Irreplaceability of resources:	Medium
Cumulative impact prior to mitigation:	Low
Significance of impact pre-mitigation	Very low negative
Degree of mitigation possible:	Very low
Proposed mitigation:	Activities within the river channels during the construction phase should be limited as far as possible in terms of their spatial and temporal extent. Construction work within the river channels should preferably take place before the onset of the rainfall period to ensure minimal impact on flow. In the longer term, the upgraded structures and the box culverts/pipes should not impede the flow and in particular the low flow in the rivers. In particular, the new culvert structures should not be placed higher than the base level of the river channels to ensure that low flows are not impeded. In addition, the culvert structures must be placed within the natural drainage line of the rivers. The structures should not impede the migration of fish species. All rubble and waste material associated with the river crossing upgrades that are within the channels should be removed after construction is complete.
Cumulative impact post mitigation:	Very Low negative to negligible impact
Significance after mitigation	Very Low negative

OPERATION PHASE

Potential impact on freshwater features	Proposed upgrade of road and associated borrow pit / quarry areas
Nature of impact:	Limited ***disturbance of freshwater related habitats*** at the road crossings where construction activities have taken place, with the potential for flow modification and erosion
Extent and duration of impact:	Localised longer term impacts
Intensity of Impact	Low
Probability of occurrence:	Probable as a result of operation activities within the river channels and riparian zones
Degree to which impact can be reversed:	Reversible
Irreplaceability of resources:	Low
Cumulative impact prior to mitigation:	Low negative
Significance of impact pre-mitigation	Low negative
Degree of mitigation possible:	Very low
Proposed mitigation:	Disturbed areas should be revegetated post-construction phase to reduce the risk of erosion – these areas should be monitored and kept free of invasive alien plant growth. The channel upstream of the river crossings should be kept free of debris and sediment build-up, particularly at the culvert structures where it might impede flows.
Cumulative impact post mitigation:	Very Low negative
Significance after mitigation	Very low negative

9. RISK ASSESSMENT

A risk assessment (summary provided in Table 17 and full assessment attached in Appendix E) has been undertaken to inform the water use authorisation process. Considering the scope of works proposed and the condition of the features within the study area, the associated risk of detrimentally impacting on the aquatic features is considered to be low for the construction and operational phase, provided that the recommended mitigation measures are implemented.

Table 17. A summary of the risk assessment for the proposed R63 Section 16 Upgrade

Phases	Activity	Aspect	Impact	Significance	Risk Rating *
Construction	Construction of Upgraded Road	Site preparation: Clearing of riparian vegetation and works on culvert structures in rivers	Disturbance of aquatic habitat and water quality impairment	49.5	L
		Sourcing of materials (Borrow areas and quarries based on setbacks)		53.625	L
Operation	Maintenance of culverts	Clearing of sediment and reeds, repair works to culvert structures	Disturbance of aquatic habitat	54	L

* A low risk equates to a significance of less than 56

10. CONCLUSIONS AND RECOMMENDATIONS

Most of the watercourses that are near or crossed by the R63 road to be upgraded form part of the upper reaches of the Great Kei, Kwelera and portions of the Gqunube Rivers and drain the higher lying and flat Amathole Montane Grasslands. These watercourses tend to meander through the flatter grassy terrain, with less defined riparian zones and wider seep areas. Many small dams have been constructed in these seep areas. The foothill reach of the Gqunube River flows within a deeper river valley in the Bhisho Thornveld. Some valley bottom wetlands are also associated with the watercourses.

The rivers in the area are largely deemed to be in a moderately to largely modified ecological condition while the wetlands are in general in a moderately modified ecological condition. The rivers areas are of moderate to high ecological importance and sensitivity and wetlands are of high ecological importance. This is with the exception of the artificially created depression wetlands that are deemed to be largely to seriously modified and of moderate importance.

The KwaMsenge River catchment is mapped as a River Freshwater Ecosystem Priority Areas (FEPA) as well as a Fish sanctuary while the Qumra River catchment is an Upstream River FEPA. Sub-quaternary catchments associated with the Great-Kei and Gqunube Rivers have been mapped as aquatic Critical Biodiversity Areas (Critically important river sub-catchments and all wetlands) with the KwaMasenge catchment mapped as a an important sub-catchments).

The proposed activities are likely to have a very limited impact on the aquatic habitats at the road crossings and immediately downstream for the watercourses. If the activities are kept to a minimum within the new road corridor and rehabilitated the potential impacts would be of a low significance. In particular the impacts of the activities on the downstream aquatic habitat in terms of increased sedimentation and alteration of the active channels of the rivers should be avoided or mitigated. In

particular the sizing, level of the culvert structures in relation to the channel beds and the alignment of the river channels at the road crossings are important factors in trying to reduce the potential for sedimentation and erosion taking place at the road crossings. The new culvert structures should not be placed higher than the base level of the river channel to ensure that low flows are not impeded.

Storm water runoff from the road into the river channels at the crossings, particularly where they are located within a relatively steep valley, should also be mitigated to ensure that it does not result in erosion of the river channels. Any waste material associated with activities should be removed from the river channels once the construction activities are complete and the disturbed areas rehabilitated, revegetating where necessary to prevent invasive growth of alien vegetation and erosion of the river banks from taking place. The disturbed areas will need to be monitored and managed for a period of at least 3 years post construction to ensure that alien plants do not invade these areas. The culvert structures should also be inspected and maintained regularly to proactively address blockages and erosion within the river channels.

The proposed borrow areas / quarries are mostly located adjacent to watercourses or contain watercourses or mapped wetland areas that are associated with past excavations within the sites. Various setback areas from these watercourses have been recommended for the borrow areas / quarries to ensure that these aquatic features are not impacted by the proposed activities. Should the proposed borrow areas / quarries and the associated removal of material remain outside of these setback areas, the potential aquatic ecosystem impacts would be of a low to very low significance. The associated risk that the proposed activities will detrimentally impact on the aquatic features is also considered to be low for the construction and operational phase, provided that the recommended mitigation measures are implemented. It is thus likely that these activities can be authorised in terms of the General Authorisations.

11. REFERENCES

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APPENDIX A: DECLARATION OF INDEPENDENCE

I, Antonia Belcher, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

Signature of the specialist: 

Date: 5 July 2017

APPENDIX B: BACKGROUND AND QUALIFICATIONS OF SPECIALIST CONSULTANT

Contact details: PO Box 455, Somerset Mall, 7137

Name: Antonia Belcher

Profession: Aquatic Scientist (Pr. Nat. Sc. 400040/10)

Fields of Expertise: Specialist in river and wetland monitoring and reporting

Relevant work experience:

Due to my involvement in the development and implementation of the River Health Programme as well as the Resource Directed Measures directorate of the Department of Water Affairs in the Western Cape, I have been a key part of the team that has undertaken six catchment or area wide 'state-of-river' assessments as well as routine monitoring and specialized assessments of rivers and wetlands in all the major catchments for the Western Cape. In the past eight years, I have undertaken numerous freshwater assessments as input into both the environmental authorization and water use authorization process throughout the Western Cape as well as greater Southern Africa.

Papers and Publications:

More than 200 publications, papers and posters relating mostly to water resource quality and river health assessments in South African rivers and their management.

Recent projects that she has been involved in are:

- Classification of Water Resources in the Olifants-Doorn Water Management Areas, Department of Water Affairs;
- Development and piloting of a National Strategy to Improve Gender Representation in Water Management Institutions, where the focus is on improving the capacity to participate in water related decision making, Department of Water Affairs and Forestry;
- Compilation of a background document as well as a framework management plan towards the development of an integrated water resources management plan for the Sandveld;
- Specialist on the City of Cape Town project: Determination of additional resources to manage pollution in storm water and river systems;
- River Health Programme monitoring for the Free State Region, Department of Water Affairs; and
- Framework for Education and Training in Water (FETWATER), Resource Directed Measures Network partner which has undertaken training initiatives on environmental water requirements in the SADC region.

APPENDIX C: PRESENT ECOLOGICAL STATUS AND ECOLOGICAL IMPORTANCE AND SENSITIVITY FOR THE RIVERS

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
R30B-07687	KwaMehlwenyoka	15.21	1	Y		NATURAL/CLOSE TO NATURAL	A
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
MODERATE	MODERATE	C	0.00				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	NONE	FISH SPP/SQ	2.00	INVERT TAXA/SQ	39.00	FISH PHYS-CHEM SENS DESCRIPTION	MODERATE
RIP/WETLAND ZONE CONTINUITY	MODERATE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	2.59	FISH NO-FLOW SENSITIVITY DESCRIPTION	MODERATE
POTENTIAL INSTREAM HABITAT MOD ACT.	SMALL	FISH REPRESENTIVITY PER SECONDARY:	VERY LOW	INVERT REPRESENTIVITY PER SECONDARY, CLASS	HIGH	INVERT PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIPARIAN-WETLAND ZONE MOD	MODERATE	FISH REPRESENTIVITY PER SECONDARY: CLASS	VERY LOW	INVERT RARITY PER SECONDARY: CLASS	VERY HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	NONE	FISH RARITY PER SECONDARY: CLASS	VERY LOW	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	NONE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	LOW	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS	VERY HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	HIGH		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	HIGH		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
R30B-07681	KwaTshikitshiki	13.97	1	Y		LARGELY NATURAL	B
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
MODERATE	MODERATE	C	0.00				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	SMALL	FISH SPP/SQ	2.00	INVERT TAXA/SQ	43.00	FISH PHYS-CHEM SENS DESCRIPTION	MODERATE
RIP/WETLAND ZONE CONTINUITY	MODERATE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	2.40	FISH NO-FLOW SENSITIVITY DESCRIPTION	MODERATE
POTENTIAL INSTREAM HABITAT MOD ACT.	SMALL	FISH REPRESENTIVITY PER SECONDARY:	VERY LOW	INVERT REPRESENTIVITY PER SECONDARY, CLASS	HIGH	INVERT PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIPARIAN-WETLAND ZONE MOD	MODERATE	FISH REPRESENTIVITY PER SECONDARY: CLASS	VERY LOW	INVERT RARITY PER SECONDARY: CLASS	VERY HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	SMALL	FISH RARITY PER SECONDARY: CLASS	VERY LOW	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	SMALL	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	MODERATE	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	LOW	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS	VERY HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	HIGH		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	HIGH		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
R30C-07695	Gqunube	42.55	1	Y		MODERATELY MODIFIED	C
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
MODERATE	MODERATE	C	0.00				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	MODERATE	FISH SPP/SQ	3.00	INVERT TAXA/SQ	34.00	FISH PHYS-CHEM SENS DESCRIPTION	MODERATE
RIP/WETLAND ZONE CONTINUITY	MODERATE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	1.00	FISH NO-FLOW SENSITIVITY DESCRIPTION	MODERATE
POTENTIAL INSTREAM HABITAT MOD ACT.	SMALL	FISH REPRESENTIVITY PER SECONDARY:	LOW	INVERT REPRESENTIVITY PER SECONDARY, CLASS	MODERATE	INVERT PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIPARIAN-WETLAND ZONE MOD	MODERATE	FISH REPRESENTIVITY PER SECONDARY: CLASS	LOW	INVERT RARITY PER SECONDARY: CLASS	HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	MODERATE	FISH RARITY PER SECONDARY: CLASS	LOW	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	NONE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	VERY HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	VERY HIGH	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS	HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	HIGH		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	HIGH		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
R30C-07683	Thanga	35.79	1	Y		MODERATELY MODIFIED	C
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
MODERATE	MODERATE	C	0.00				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	MODERATE	FISH SPP/SQ	3.00	INVERT TAXA/SQ	30.00	FISH PHYS-CHEM SENS DESCRIPTION	MODERATE
RIP/WETLAND ZONE CONTINUITY	MODERATE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	1.40	FISH NO-FLOW SENSITIVITY DESCRIPTION	MODERATE
POTENTIAL INSTREAM HABITAT MOD ACT.	SMALL	FISH REPRESENTIVITY PER SECONDARY:	LOW	INVERT REPRESENTIVITY PER SECONDARY, CLASS	MODERATE	INVERT PHYS-CHEM SENS DESCRIPTION	HIGH
RIPARIAN-WETLAND ZONE MOD	MODERATE	FISH REPRESENTIVITY PER SECONDARY: CLASS	LOW	INVERT RARITY PER SECONDARY: CLASS	MODERATE	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	MODERATE	FISH RARITY PER SECONDARY: CLASS	LOW	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	NONE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	VERY HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	HIGH	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS	HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	HIGH		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	HIGH		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
S60B-07635	Kubusi	47.15	2	Y		LARGELY MODIFIED	D
MEAN EI CLASS	MEAN ES CLASS	DEFAULT ECOLOGICAL CATEGORY (EC)	RECOMMENDED ECOLOGICAL CATEGORY (REC)				
MODERATE	MODERATE	C	#NUM!				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	LARGE	FISH SPP/SQ	3.00	INVERT TAXA/SQ	28.00	FISH PHYS-CHEM SENS DESCRIPTION	MODERATE
RIP/WETLAND ZONE CONTINUITY MOD	LARGE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	2.93	FISH NO-FLOW SENSITIVITY DESCRIPTION	MODERATE
POTENTIAL INSTREAM HABITAT MOD ACT.	MODERATE	FISH REPRESENTIVITY PER SECONDARY: CLASS	LOW	INVERT REPRESENTIVITY PER SECONDARY, CLASS	HIGH	INVERT PHYS-CHEM SENS DESCRIPTION	HIGH
RIPARIAN-WETLAND ZONE MOD	LARGE	FISH REPRESENTIVITY PER SECONDARY: CLASS	LOW	INVERT RARITY PER SECONDARY: CLASS	VERY HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	LARGE	FISH RARITY PER SECONDARY: CLASS	VERY LOW	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	MODERATE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	VERY HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	VERY HIGH	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG	LOW	INSTREAM MIGRATION LINK CLASS	MODERATE		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	MODERATE		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	MODERATE		
				INSTREAM HABITAT INTEGRITY CLASS	HIGH		

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
S60E-07531	Kubusi	45.05	3	Y		MODERATELY MODIFIED	C
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (EC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
HIGH	HIGH	B	#NUM!				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	NONE	FISH SPP/SQ	8.00	INVERT TAXA/SQ	17.00	FISH PHYS-CHEM SENS DESCRIPTION	HIGH
RIP/WETLAND ZONE CONTINUITY MOD	LARGE	FISH: AVERAGE CONFIDENCE	3.50	INVERT AVERAGE CONFIDENCE	1.12	FISH NO-FLOW SENSITIVITY DESCRIPTION	HIGH
POTENTIAL INSTREAM HABITAT MOD ACT.	MODERATE	FISH REPRESENTIVITY PER SECONDARY: CLASS	VERY HIGH	INVERT REPRESENTIVITY PER SECONDARY, CLASS	MODERATE	INVERT PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIPARIAN-WETLAND ZONE MOD	LARGE	FISH REPRESENTIVITY PER SECONDARY: CLASS	VERY HIGH	INVERT RARITY PER SECONDARY: CLASS	VERY HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	MODERATE	FISH RARITY PER SECONDARY: CLASS	VERY HIGH	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	SMALL	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	VERY HIGH	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG	LOW	INSTREAM MIGRATION LINK CLASS	VERY HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	MODERATE		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	MODERATE		
				INSTREAM HABITAT INTEGRITY CLASS	HIGH		

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
S70A-07574	Qumra	27.15	1	Y		LARGELY MODIFIED	D
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
MODERATE	MODERATE	C	0.00				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	LARGE	FISH SPP/SQ	5.00	INVERT TAXA/SQ	23.00	FISH PHYS-CHEM SENS DESCRIPTION	HIGH
RIP/WETLAND ZONE CONTINUITY MOD	LARGE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	1.78	FISH NO-FLOW SENSITIVITY DESCRIPTION	HIGH
POTENTIAL INSTREAM HABITAT MOD ACT.	SMALL	FISH REPRESENTIVITY PER SECONDARY: CLASS	MODERATE	INVERT REPRESENTIVITY PER SECONDARY, CLASS	MODERATE	INVERT PHYS-CHEM SENS DESCRIPTION	HIGH
RIPARIAN-WETLAND ZONE MOD	LARGE	FISH REPRESENTIVITY PER SECONDARY: CLASS	MODERATE	INVERT RARITY PER SECONDARY: CLASS	HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	MODERATE	FISH RARITY PER SECONDARY: CLASS	HIGH	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	MODERATE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	VERY HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	HIGH	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS	MODERATE		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	MODERATE		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	MODERATE		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

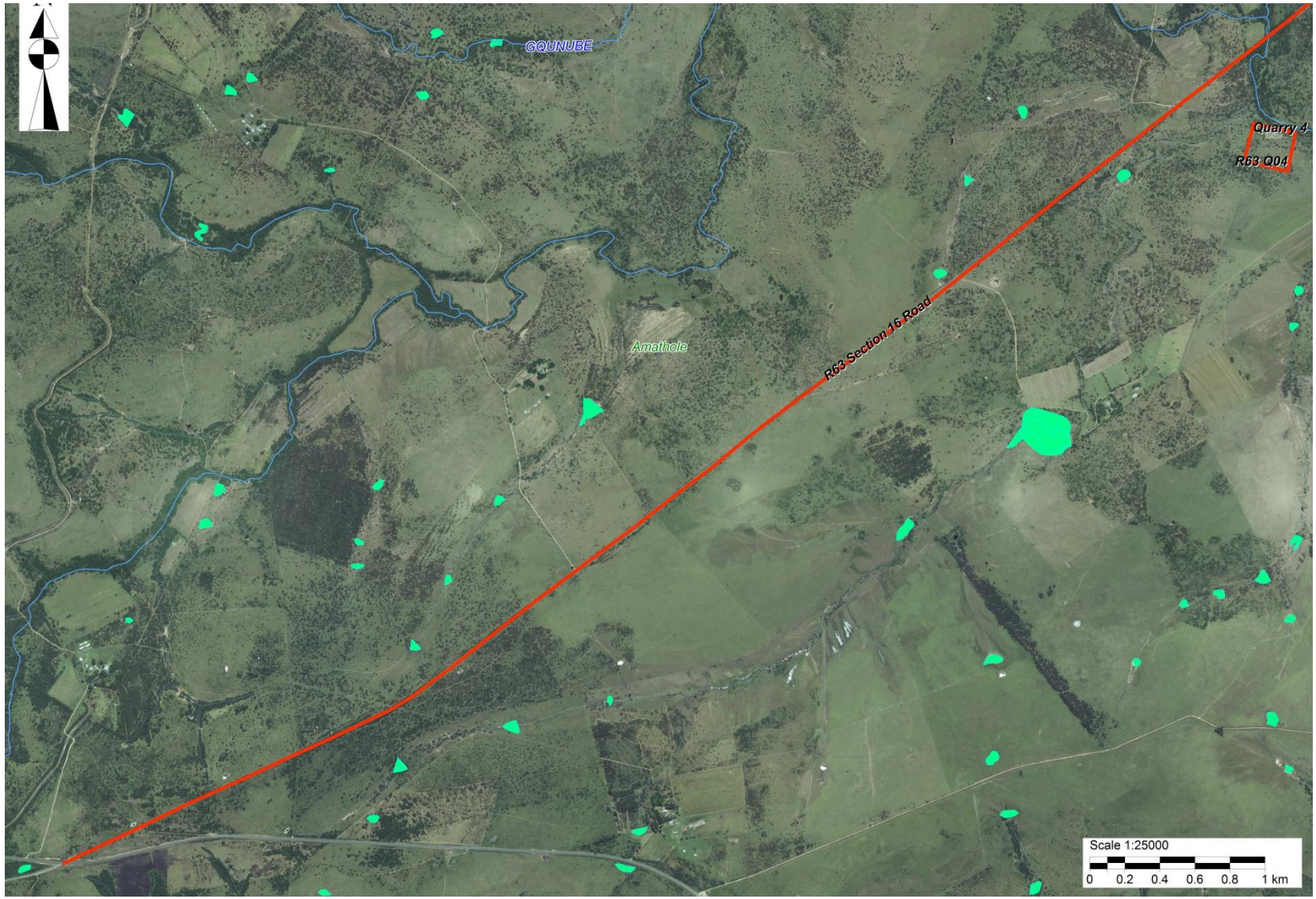
SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
S70F-07661	KwaMsenge	15.26	1	Y		LARGELY NATURAL	B
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
HIGH	HIGH	B	0.00				

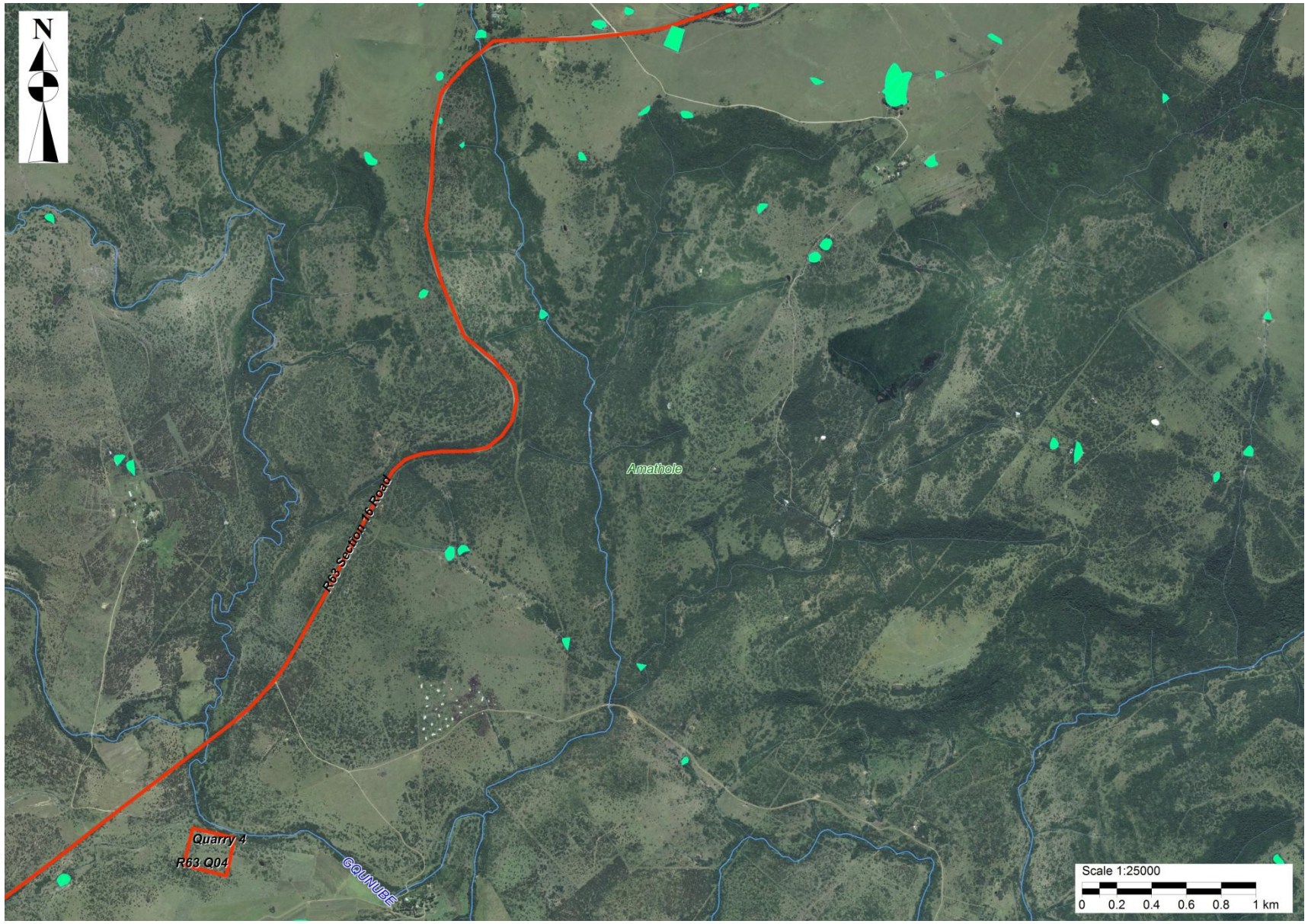
PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	SMALL	FISH SPP/SQ	5.00	INVERT TAXA/SQ	40.00	FISH PHYS-CHEM SENS DESCRIPTION	HIGH
RIP/WETLAND ZONE CONTINUITY MOD	LARGE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	1.65	FISH NO-FLOW SENSITIVITY DESCRIPTION	HIGH
POTENTIAL INSTREAM HABITAT MOD ACT.	SMALL	FISH REPRESENTIVITY PER SECONDARY: CLASS	MODERATE	INVERT REPRESENTIVITY PER SECONDARY, CLASS	VERY HIGH	INVERT PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIPARIAN-WETLAND ZONE MOD	LARGE	FISH REPRESENTIVITY PER SECONDARY: CLASS	MODERATE	INVERT RARITY PER SECONDARY: CLASS	VERY HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	SMALL	FISH RARITY PER SECONDARY: CLASS	HIGH	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	NONE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	LOW	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	LOW
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS	VERY HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	MODERATE		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	MODERATE		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

SELECT SQ REACH	SQR NAME	LENGTH km	STREAM ORDER	PES ASSESSED BY XPERTS? (IF TRUE="Y")	REASONS NOT ASSESSED	PES CATEGORY DESCRIPTION	PES CATEGORY BASED ON MEDIAN OF METRICS
S70F-07691	Tyityaba	11.99	1	Y		LARGELY NATURAL	B
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (DEC)**	**RECOMMENDED ECOLOGICAL CATEGORY (REC)**				
MODERATE	HIGH	B	0.00				

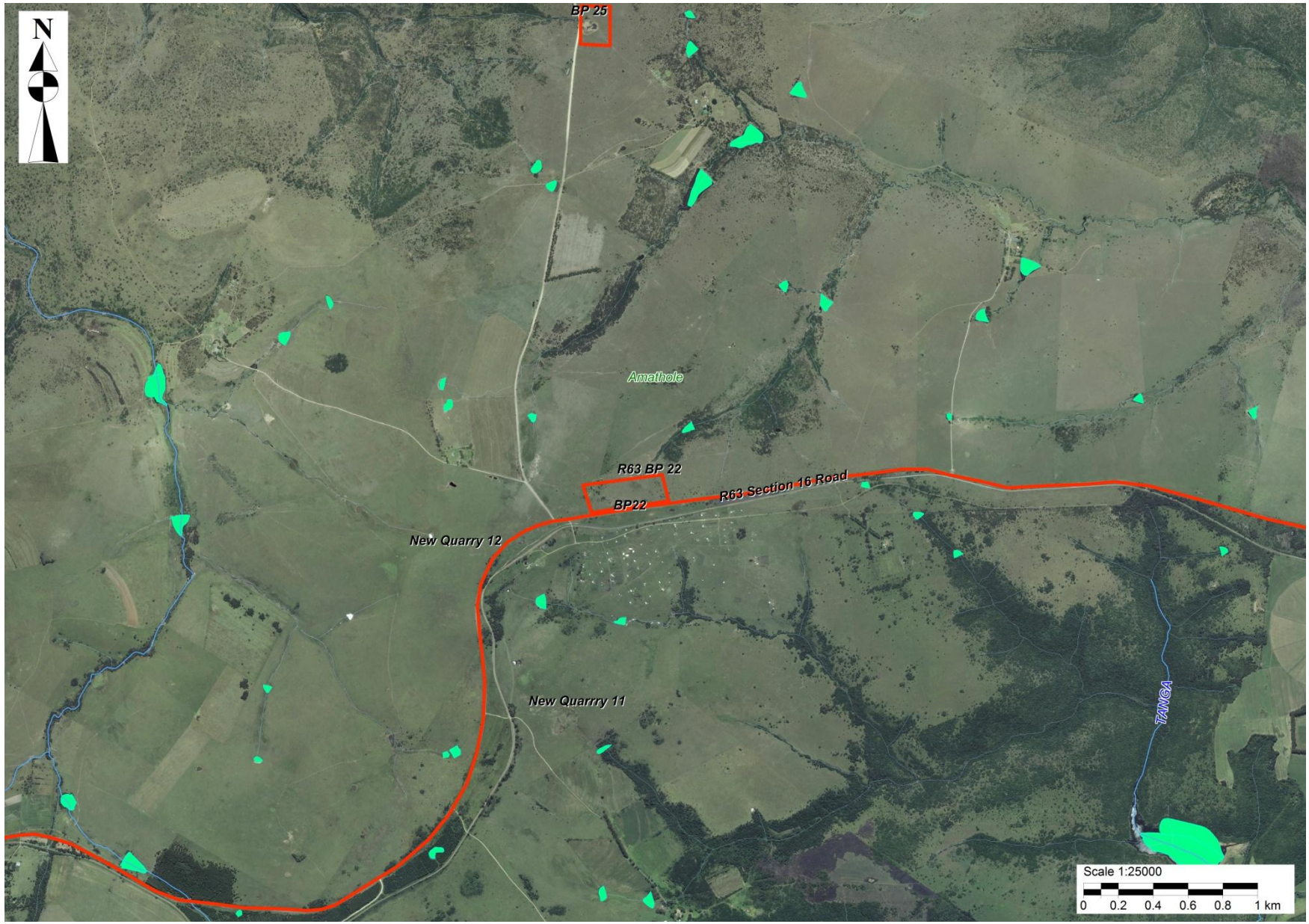
PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	NONE	FISH SPP/SQ	4.00	INVERT TAXA/SQ	39.00	FISH PHYS-CHEM SENS DESCRIPTION	MODERATE
RIP/WETLAND ZONE CONTINUITY MOD	LARGE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	1.56	FISH NO-FLOW SENSITIVITY DESCRIPTION	MODERATE
POTENTIAL INSTREAM HABITAT MOD ACT.	SMALL	FISH REPRESENTIVITY PER SECONDARY: CLASS	LOW	INVERT REPRESENTIVITY PER SECONDARY, CLASS	VERY HIGH	INVERT PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIPARIAN-WETLAND ZONE MOD	LARGE	FISH REPRESENTIVITY PER SECONDARY: CLASS	LOW	INVERT RARITY PER SECONDARY: CLASS	VERY HIGH	INVERTS VELOCITY SENSITIVITY	VERY HIGH
POTENTIAL FLOW MOD ACT.	SMALL	FISH RARITY PER SECONDARY: CLASS	VERY LOW	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES DESCRIPTION	LOW
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	NONE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	LOW	HABITAT DIVERSITY CLASS	VERY HIGH	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES DESCRIPTION	VERY HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	VERY HIGH	HABITAT SIZE (LENGTH) CLASS	LOW	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES DESCRIPTION	**LOW**
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	LOW	INSTREAM MIGRATION LINK CLASS	VERY HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	MODERATE		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	MODERATE		
				INSTREAM HABITAT INTEGRITY CLASS	VERY HIGH		

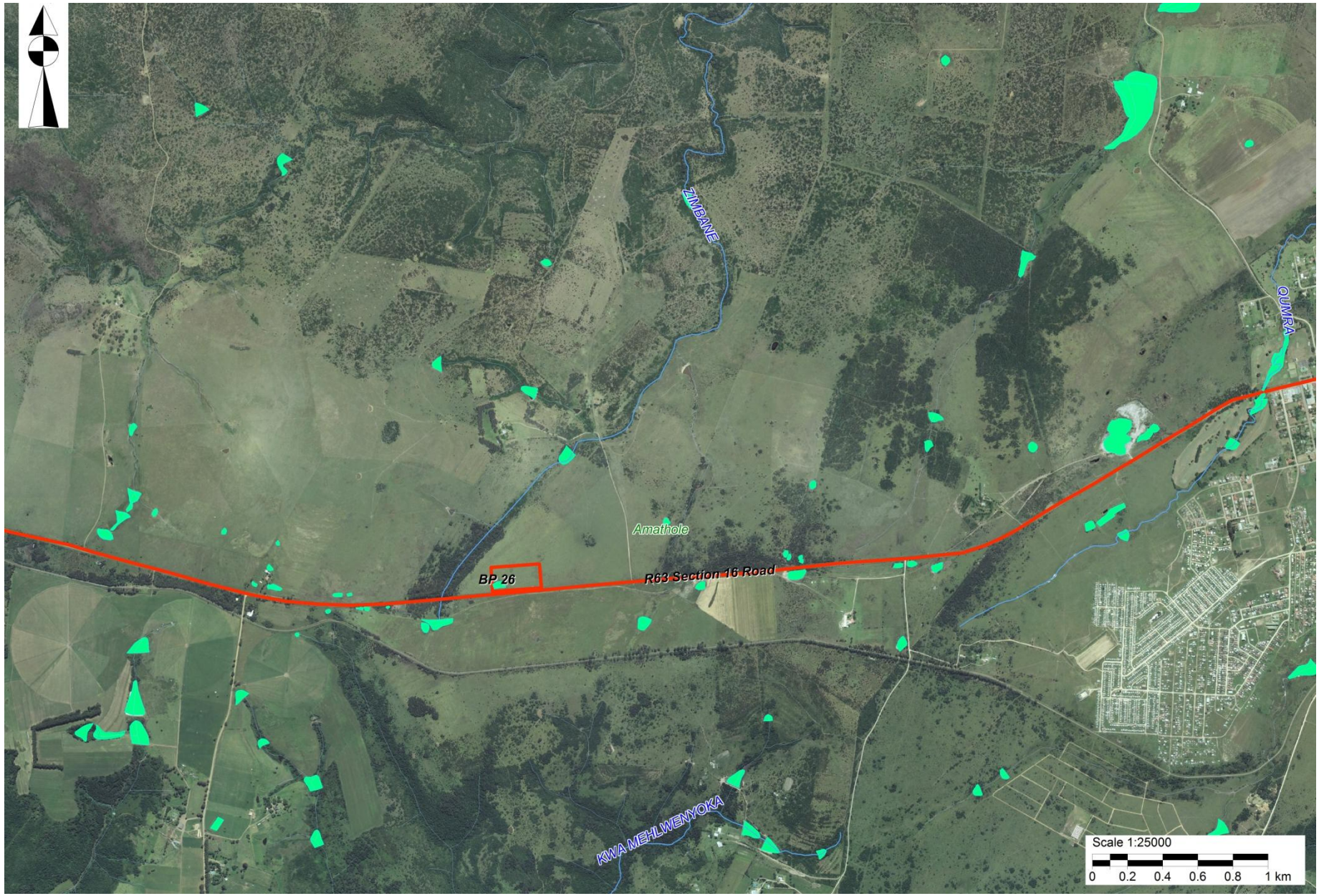
APPENDIX D: AQUATIC ECOSYSTEM MAPPING FOR THE PROJECT AREA (WEST TO EAST)

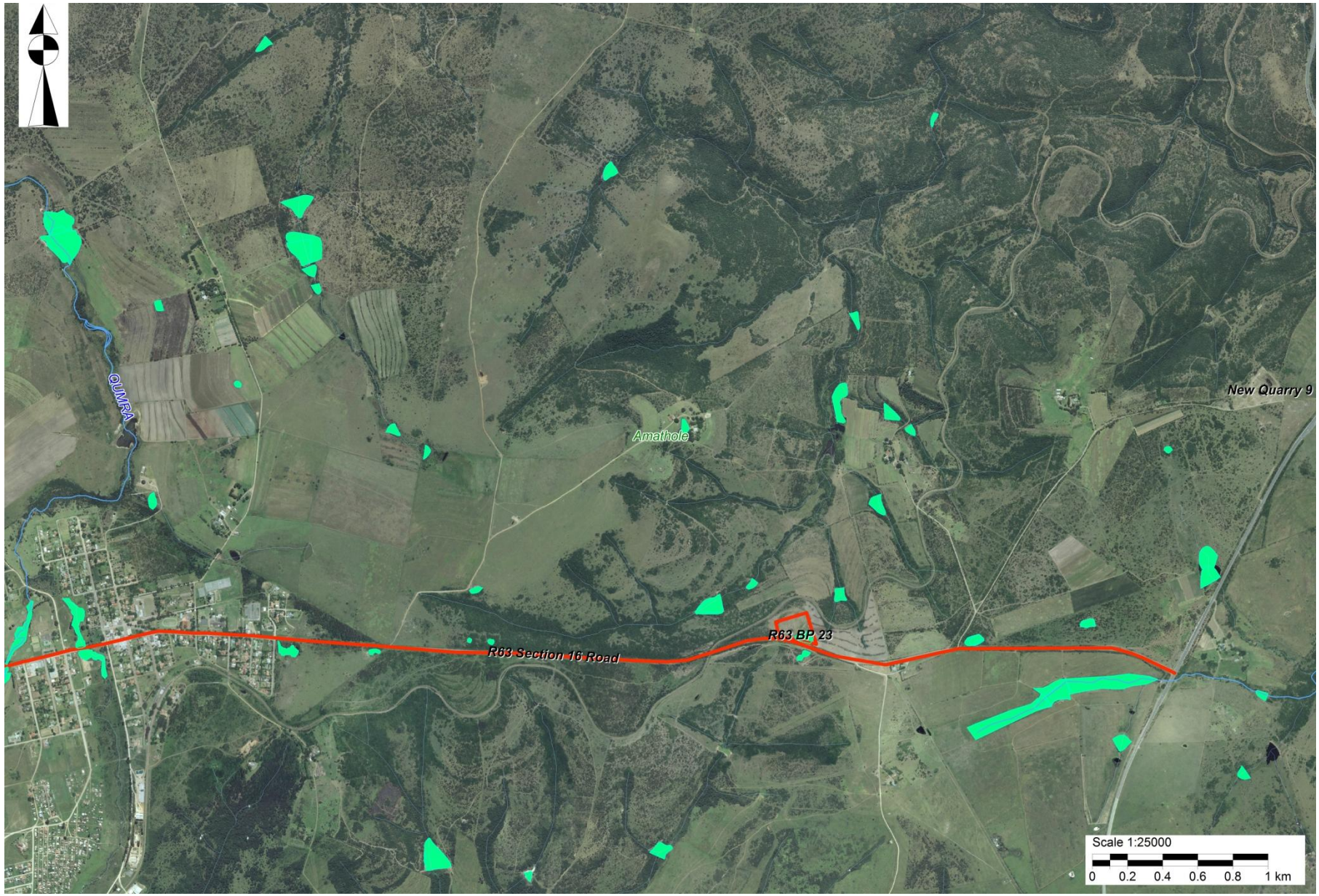



N
R63 Section 16 Road
Amathole
Quarry 4
R63 Q04
GQUNUBE
Scale 1:25000
0 0.2 0.4 0.6 0.8 1 km


N
KUBUSI
Amathole
R63 Section 16 Road
Scale 1:25000
0 0.2 0.4 0.6 0.8 1 km


N
BP 25
Amathole
R63 BP 22
BP22
R63 Section 16 Road
New Quarry 12
New Quarrry 11
TANGA
Scale 1:25000
0 0.2 0.4 0.6 0.8 1 km


ZIMBANE
QUMRA
Amathole
BP 26
R63 Section 16 Road
KWA MEHLWENYOKA
Scale 1:25000
0 0.2 0.4 0.6 0.8 1 km


QUMRA
Amathole
New Quarry 9
R63 Section 16 Road
R63 BP 23
Scale 1:25000
0 0.2 0.4 0.6 0.8 1 km

APPENDIX E: SIGNIFICANCE RATINGS OF POTENTIAL ENVIRONMENTAL IMPACTS

For each impact, the **EXTENT** (spatial scale), **MAGNITUDE** (severity of impact) and **DURATION** (time scale) are assessed and used to ascertain the **SIGNIFICANCE** of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The tables below indicate the scale used to assess these variables, and defines each of the rating categories.

Extent: "Extent" defines the physical extent or spatial scale of the impact.

Rating	Description
LOCAL	Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies to specify extent.
REGIONAL	Western Cape. Specialist studies to specify extent.
NATIONAL	South Africa
INTERNATIONAL	

Duration: "Duration" gives an indication of how long the impact would occur.

Rating	Description
SHORT TERM	0 - 5 years
MEDIUM TERM	5 - 15 years
LONG TERM	Where the impact will cease after the operational life of the activity, either because of natural processes or by human intervention.
PERMANENT	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient.

Intensity: "Intensity" establishes whether the impact would be destructive or benign.

Rating	Description
ZERO TO VERY LOW	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
LOW	Where the impact affects the environment in such a way that natural, cultural and social functions and processes continue, albeit in a slightly modified way.
MEDIUM	Where the affected environment is altered, but natural, cultural and social functions and processes continue, albeit in a modified way.
HIGH	Where natural, cultural and social functions or processes are altered to the extent that it will temporarily or permanently cease.

Loss of resources: "Loss of resource" refers to the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable.

Rating	Description
LOW	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
MEDIUM	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
HIGH	Where the activity results in an irreplaceable loss of a resource.

Status of impact: The status of an impact is used to describe whether the impact would have a negative, positive or zero effect on the affected environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

Probability: "Probability" describes the likelihood of the impact occurring.

Rating	Description
IMPROBABLE	Where the possibility of the impact to materialise is very low either because of design or historic experience.
PROBABLE	Where there is a distinct possibility that the impact will occur.
HIGHLY PROBABLE	Where it is most likely that the impact will occur.
DEFINITE	Where the impact will occur regardless of any prevention measures.

Degree of confidence: This indicates the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

Rating	Description
HIGH	Greater than 70% sure of impact prediction.
MEDIUM	Between 35% and 70% sure of impact prediction.
LOW	Less than 35% sure of impact prediction.

Significance: "Significance" attempts to evaluate the importance of a particular impact, and in doing so incorporates the above three scales (i.e. extent, duration and intensity).

Rating	Description
VERY HIGH	Impacts could be EITHER: of *high intensity* at a *regional level* and endure in the *long term*; OR of *high intensity* at a *national level* in the *medium term*; OR of *medium intensity* at a *national level* in the *long term.*
HIGH	Impacts could be EITHER: of *high intensity* at a *regional level* and endure in the *medium term*; OR of *high intensity* at a *national level* in the *short term*; OR of *medium intensity* at a *national level* in the *medium term;* OR of *low intensity* at a *national level* in the *long term*; OR of *high intensity* at a *local level* in the *long term*; OR of *medium intensity* at a *regional level* in the *long term.*
MEDIUM	Impacts could be EITHER: of *high intensity* at a *local level* and endure in the *medium term*; OR of *medium intensity* at a *regional level* in the *medium term*; OR of *high intensity* at a *regional level* in the *short term*; OR of *medium intensity* at a *national level* in the *short term*; OR of *medium intensity* at a *local level* in the *long term*; OR of *low intensity* at a *national level* in the *medium term;* OR of *low intensity* at a *regional level* in the *long term.*
LOW	Impacts could be EITHER of *low intensity* at a *regional level* and endure in the *medium term*; OR of *low intensity* at a *national level* in the *short term*; OR of *high intensity* at a *local level* and endure in the *short term*; OR of *medium intensity* at a *regional level* in the *short term*; OR of *low intensity* at a *local level* in the *long term*; OR of *medium intensity* at a *local level* and endure in the *medium term.*
VERY LOW	Impacts could be EITHER of *low intensity* at a *local level* and endure in the *medium term*; OR of *low intensity* at a *regional level* and endure in the *short term*; OR of *low to medium intensity* at a *local level* and endure in the *short term.*
INSIGNIFICANT	Impacts with: Zero to very low intensity with any combination of extent and duration.
UNKNOWN	In certain cases it may not be possible to determine the significance of an impact.

Degree to which impact can be mitigated: Degree to which an impact can be reduced / enhanced.

Rating	Description
NONE	No change in impact after mitigation.
VERY LOW	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
LOW	Where the significance rating drops by one level, after mitigation.
MEDIUM	Where the significance rating drops by two to three levels, after mitigation.
HIGH	Where the significance rating drops by more than three levels, after mitigation.

Reversibility of an impact: Degree to which an impact can be reversed.

Rating	Description
IRREVERSIBLE	Where the impact is permanent.
PARTIALLY REVERSIBLE	Where the impact can be partially reversed.
FULLY REVERSIBLE	Where the impact can be completely reversed.

APPENDIX F: RISK ASSESSMENT

Nr.	Phases	Activity	Aspect	Impact	Severity: Flow Regime	Severity: Physico & Chemical (Water Quality)	Severity: Habitat (Geomorph+ Vegetation)	Severity: Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures	Confidence	Type Watercourse; PES and EIS
1	Construction	Construction of Upgraded Road	Site preparation: Clearing of riparian vegetation and works on culvert structures in rivers	Disturbance of aquatic habitat and water quality impairment	2	2	2.5	2	2.125	1	1	**4.125**	1	4	5	2	**12**	**49.5**	L	See Freshwater Assessment Report	High	Rivers/tributaries: PES=C/D; EIS=M/H Natural Wetlands: PES=C; EIS=H Artificial Wetlands: PES=D/E; EIS=M
			Sourcing of materials from borrow pits and quarries		1	2	2.5	2	1.875	1	2	**4.875**	1	3	5	2	**11**	**53.625**	L		High	
	Operation	Maintenance of culverts	Clearing of sediment and reeds, repair works to culvert structures	Disturbance of aquatic habitat	1	1	1	1	1	1	4	**6**	1	1	5	2	**9**	**54**	L		High	