FRESHWATER IMPACT ASSESSMENT FOR THE PROPOSED INSTALLATION OF BATTERY ENERGY STORAGE SYSTEM (BESS) AT THE WITZENBERG SUBSTATION

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EXECUTIVE SUMMARY

Eskom proposes to place a new Battery Energy Storage System (BESS) within the existing boundaries of the Witzenberg substation. The activity triggers a basic assessment in terms of the National Environmental Management Act Listing Notice 1, Activity 14. As the substation is located adjacent to two watercourses, there are associated potential impacts upon freshwater ecosystems. This report describes and assesses the watercourses adjacent to the substation.

The western stream flows past the north western corner of the substation site before turning south west and flowing away from the site. The stream arises on eastern facing slopes of the Hansiesberg and is largely unimpacted until it reaches the Witzenberg Valley Road, immediately upstream of the substation. The stream flows through the road via two pipe culverts. Downstream of the road the stream is also fed by storm water runoff from the road surface. The substrate of the stream is course quartzitic sands. The vegetation is dominated by rushes such as Juncus lomatophyllus and Juncus effusus as well as Pennisetum macrourum grass. Although the stream is seasonal, the hydrophilic rushes growing along the stream are evidence of regular soil wetness. The western stream is wetter than the eastern stream due to the lack of upstream impoundments.

The Eastern stream also arises north of the site on the eastern facing slopes of the Hansiesberg Mountains. Before it flows under the Witzenberg Valley Road, the stream is impounded in a large dam. There is no evidence of low flow release from instream dam. The instream dam has altered the streams flow regime as well as the soil wetness of the area surrounding the stream channel. There appears to be very little to no base low flow within the stream channel downstream of the dam. This has resulted in very dry conditions along the stream during summer and the loss of the hydrophilic plant communities observed along the western stream. The loss of this vegetation on the banks and in the channel of the stream has meant that fine particles in the stream channel are not well bound by plant roots. When flow does occur in the stream channel it is typically high energy and volume as the upstream dam overtops. This high flow volume has carried away much of the finer substrate and a low level of erosion and channel incision has taken place. The vegetation community along the eastern stream is dominated by restios such as Restio paniculatus and Elegia capensis. Terrestrial species such as Protea repens was also abundant along the stream channel.

The western stream is considered to be largely natural, with the only impact upon it being the Witzenberg Valley Road, through which it passes via pipe culverts. This stream is considered to be of moderate ecological importance and sensitivity. The eastern stream is modified by an instream dam above the study site which has affected the flow, sediment transport, channel form and riparian vegetation. Although these impacts have taken place it still retains fairly intact riparian habitat. It is considered to be moderately modified but also of moderate ecological importance and sensitivity.

Although the proposed BESS does contain potential hazardous and toxic materials, all the batteries will be containerized and make provision for secondary containment to accommodate any spill as a result of

normal operation and maintenance. Therefore there is not expected to be a potential water quality impact associated with the installation of the BESS

As the proposed activity is restricted to the already developed footprint of the substation, the only potential impact is water quality impairment as a result of storm water run-off or contaminated spills from the site. These can be mitigated by conducting the construction phase during the summer months when surface water run-off from the site is less likely. Furthermore, good housekeeping and good management of potential contaminants is very important.

This assessment of the proposed activity assumes that no activity will take place beyond the already developed footprint of the Witzenberg substation. If any activity, including the operation of machinery, clearing of vegetation, dumping of material or storage of material is proposed to take place outside of the already developed footprint the authors of this report reserve the right to significantly review their assessment of impacts.

An assessment to determine the risk of the proposed activity upon the water resources in the vicinity was not conducted. The risk assessment is a tool to determine the level of authorisation which a Section 21 (c) and Section 21 (i) water use will require. However, the authors of this report are of the opinion that the proposed activity does not trigger a water use provided the activity is restricted to the already developed footprint of the substation. However, the regional Department of Water and Sanitation office should be approached for their comment and assessment of the activity.

The current maintenance of the existing perimeter road around the substation appears to include the clearing of vegetation encroaching into the road area. The cut material is currently not being removed from the site but dumped into the natural vegetation. This dead and dry material smothers the natural vegetation but also poses a significant fire risk (more susceptible to burn and will increase the heat of fires). It is strongly advised that cleared materiel associated with the road be removed from the site to an appropriate dumping site.

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1. BACKGROUND

Eskom proposes to place new infrastructure within the existing boundaries of the Witzenberg substation. *The activity triggers a basic assessment in terms of the National Environmental Management Act Listing Notice 1, Activity 14. As the substation is located adjacent to two watercourses, there are associated potential impacts upon freshwater ecosystems. This report describes and assesses the watercourses adjacent to the substation.*

Table 1. Water resources information associated with the proposed activities

Descriptor	Name / details	Notes
Water Management Area (WMA)	Breede-Gouritz WMA	
Catchment Area	Breede River catchment - Waboomrivier	The Waboomrivier flows into the Modder River which is a tributary within the upper catchment of the Breede River
Quaternary Catchment	H10C	
Present Ecological State	Unnamed tributaries of the Modder/Dwars rivers Unnamed tributary (west) – Largely natural Unnamed tributary (east) – moderately modified	DWS (2012) Rapid assessments
Ecological Importance and Ecological Sensitivity	Unnamed tributaries: EI: Moderate; ES: Moderate	
Type of water resource	Rivers and streams	
Latitude	33°13'43.34"S	Location of the Witzenberg substation
Longitude	19°19'5.14"E	

2. TERMS OF REFERENCE

The scope of works for the Freshwater Impact Assessment is as follows:

1. Undertake a site visit to the study area and compile a specialist report that addresses the following:

    - Take cognizance of, and comply with, the substantive content requirements outlined within **Appendix 6 of GN R982**, which outlines the **legal minimum content requirements** for specialist studies in terms of the 2014 NEMA EIA Regulations;

    - Indicate and confirm the presence of surface water resources present on and or adjacent to the site (including but not limited to perennial rivers, non-perennial rivers, permanent wetland(s), seasonal wetland(s) and artificial wetland(s)), and where relevant provide a description of each. Watercourses must be illustrated on an aerial photograph or suitable map;

    - An overview of the ecological status of the watercourses that would potentially be affected by the proposed activities;

    - Comments on any rare or endangered aquatic species or habitats encountered or likely to be present in the affected areas should also be identified;

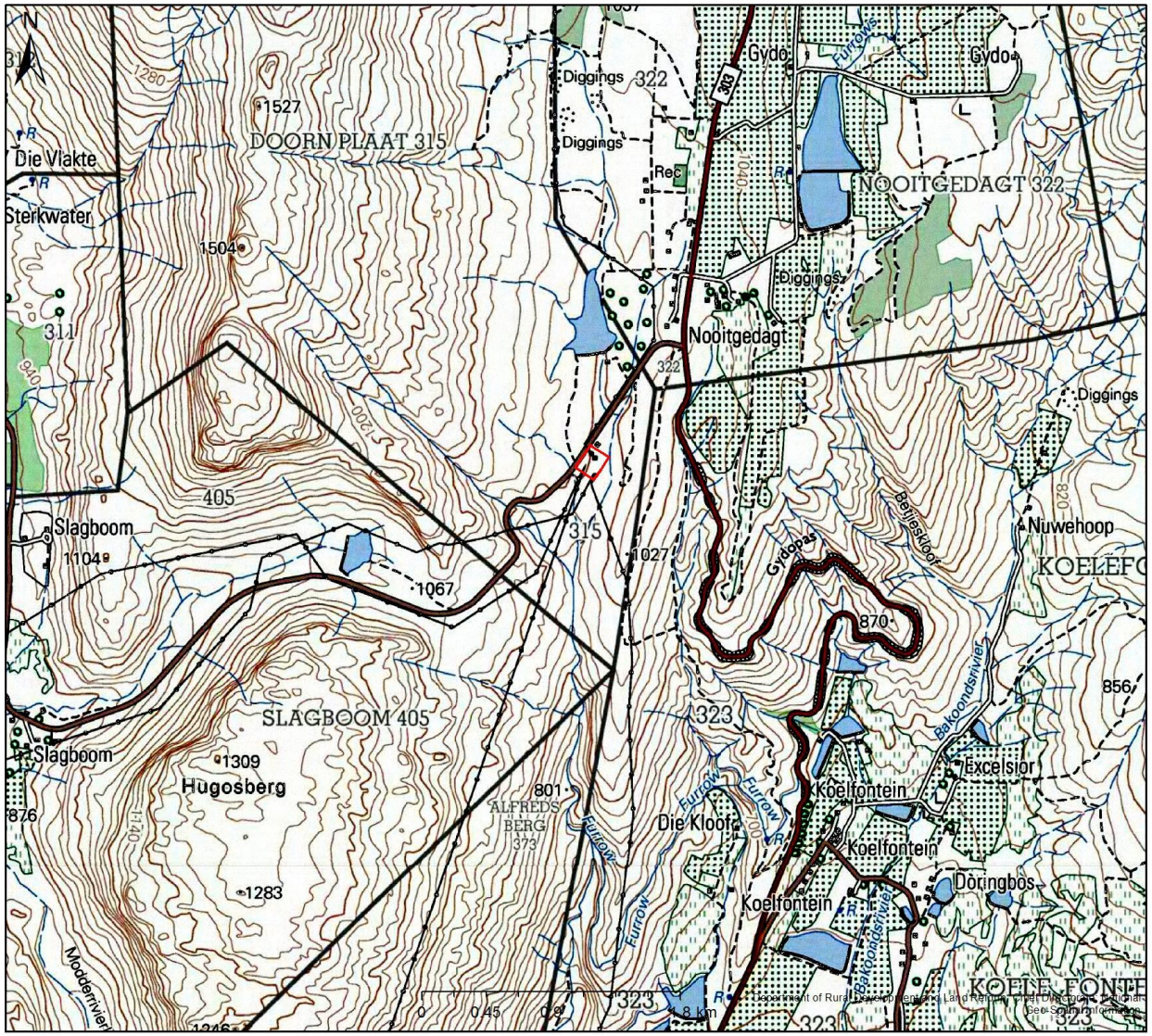

Figure 1. Topocadastral map of the study area (red rectangle represents the substation)

- The conservation status and value of the area as identified by the relevant biodiversity plans, bioregional planning documents, Environmental Management Frameworks, etc.; The components and activities of the project which have the potential to affect freshwater resources within the local and regional study area during the construction and operational phases;

- A description of the direct, indirect and cumulative freshwater impacts (both before and after mitigation) and an assessment of the significance of the impacts (on a nominal scale of Neutral/ Negligible, Very Low, Low, Medium, High) by evaluating: **(a) nature of the impacts** (positive/ negative), **(b) extent of the impacts** (zero/ site specific/ local/ regional/ national), **(c) magnitude** of the impacts (zero/ very low/ low/ medium/ high), **(d) duration of the impacts** (none/ short/ medium/ long term) and **(e) probability of occurrence of the impacts** (none/ unlikely/ possible/ definite). In addition, **(f) the level of confidence in findings** relating to potential impacts, **(g) reversibility of potential impacts** (i.e. the degree to which the impact can be reversed); and **(h) the degree to which the impact may cause irreplaceable loss of resources**.

- An indication of the **degree to which the impacts can be mitigated**, a description of the measures to mitigate any impacts, and an indication of whether or not the measures (if implemented) would change the significance of the impact, for the construction and operational phases of the project;

- In terms of the aquatic environment, identify all relevant legislation, permits, standards or licensing requirements that would apply to the proposed project;

- The presence of or proximity of the proposed sites to protected area(s) identified in terms of NEMPAA and proximity to a Biosphere Reserve (where relevant);

- Undertake a risk assessment of the proposed activities to inform the water use licence requirement; and

- The assessment must take into account and address public comments received during the Public Participation Process (PPP) relating to your area of expertise.

3. APPROACH TO THE STUDY AND STUDY LIMITATIONS AND ASSUMPTIONS

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 for the site. The site was visited on 14 January 2019 in mid-summer. Despite this the conditions at the time of the freshwater ecosystem features were still suitable to adequately undertake the required freshwater impact assessments.

During the field visit, the characterisation and integrity assessments of the freshwater features were undertaken. Mapping of the freshwater features was undertaken using a Garmin Colorado 300 GPS and mapped in PlanetGIS 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 as well as the instream flow requirement determination.

The following limitations apply to the techniques and methodology 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;
- The river health assessment was carried out using South African Department of Water and Sanitation developed methodologies. River Health assessments were carried out to provide information on the ecological condition and ecological importance and sensitivity of the river systems 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 riparian and wetland areas.
- The wetlands were subsequently classified according to their hydro-geomorphic determinants based on a classification system devised by Kotze *et al* (2004) and SANBI (2009).
- A Present Ecological State (PES) assessment was conducted for each hydro-geomorphic wetland unit 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.
- 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 habitat. 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 assessment was conducted according to the guidelines as developed by DWAF (1999).

The level of aquatic assessment and environmental water requirement determination undertaken was considered to be adequate for this study.

4. USE OF THIS 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. OVERVIEW OF THE PROPOSAL AND STUDY AREA

5.1. OVERVIEW OF THE STUDY AREA

The site lies on the southern edge of the Koue Bokkeveld plateau. The drainage through the site arises to the north and west and flows past the site down to the Ceres valley. The Hansiesberg mountain range lies west and north of the site. The mountain slopes are very rugged, with a dominance of rocky areas and cliffs.

Figure 2. View of the mountain slopes to the north west of the site

5.2. ACTIVITY DESCRIPTION

The proposed activity is to lay down a new Battery Energy Storage System (BESS) within the developed Witzenberg Substation site. There is no infrastructure planned beyond the current existing footprint of the substation. The batteries will containerized and make provision for secondary containment to accommodate any spill as a result of normal operation and maintenance.

5.3. LEGAL REQUIREMENTS

The following Acts, regulations and ordinances are specifically applicable to the proposed activities in terms of the freshwater aspects of the proposed activity:

THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT NO. 107 OF 1998)

Chapter Seven of the National Environmental Management Act (NEMA) states that:

"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment".

The Act also clearly states that the landowner, or the person using or controlling the land, is responsible for taking measures to control and rectify any degradation. These may include measures to:

"(a) investigate, assess and evaluate the impact on the environment;

(b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment:

(c) cease, modify or control any act, activity or process causing the pollution or degradation:

(d) contain or prevent the movement of pollutants or degradation: or

(e) eliminate any source of pollution or degradation: or

(f) remedy the effects of the pollution or degradation."

NEMA ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, GN R982 OF 2014

NEMA provides for the identification of activities which will impact the environment, in terms of Section 24. These activities were promulgated in terms of Government Notice No. R. 983, 984 and 985, dated 4 December 2014, as amended, and require environmental authorisation. The impacts of the listed activities must be investigated, assessed and reported to the competent authority before authorisation to commence with such listed activities can be granted.

Doug Jeffery Environmental Consultants have been appointed to undertake the Environmental Authorisation process for the proposed project in accordance with these regulations. This freshwater assessment is required to inform that process.

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 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

The proposed works within and adjacent to the rivers, streams and wetland areas are deemed to be changing the characteristics of the associated freshwater ecosystems as well as impeding flow in the watercourses and therefore require authorization. The authorisation of water use activities for Sections 21 (c) - change to the bed, banks and characteristics of a water course and 21 (i) - impeding and diverting the flow, will need to be applied for. 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). 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 was not carried out for the proposed activities. Although the site is located within close proximity of the watercourses, the activity is restricted to the developed footprint of the substation. Therefore, there will be no changes to the characteristics, flow, bed or banks of the watercourses. Should

any activity or an effect of the activity extend beyond the boundary of the existing substation footprint then this opinion would need to be revised.

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. AQUATIC SYSTEMS IN THE STUDY AREA

6.1. DESCRIPTION OF AREA

PHYSICAL CHARACTERISTICS

The site is on the edge of the Koue Bokkeveld plateau. It has a very gentle southerly aspect. The surrounding slopes are very rugged. Streams flow past the site, on its eastern and western boundaries. Before flowing past the site both sites flow through culverts in the Witzenberg Valley Road. Upstream of the road the eastern tributary is impounded. Both streams arise on rugged slopes to the north west of the site. The slopes are steep and east facing, but as the streams flow off the steep mountain slopes they turn south to flow past the site and down, off the Koue Bokkeveld Plateau.

CLIMATE

The Koue Bokkeveld has a Mediterranean climate and normally receives about 450 - 600 mm of rain per year, mostly during winter. The lowest rainfall (9 mm) is in January and the highest (94 mm) in June. The average midday temperatures for range from 8.9°C in July to 21°C in February (Figure 3). The annual rainfall is also substantially higher on the westerns slopes of the valley than on the eastern slopes. The annual evaporation for the quaternary catchments investigated are 1 850 mm. The average midday temperatures for the area range from 19°C in July to 29°C in January/February. The region is the coldest during July when the mercury drops to 7°C on average during the night.

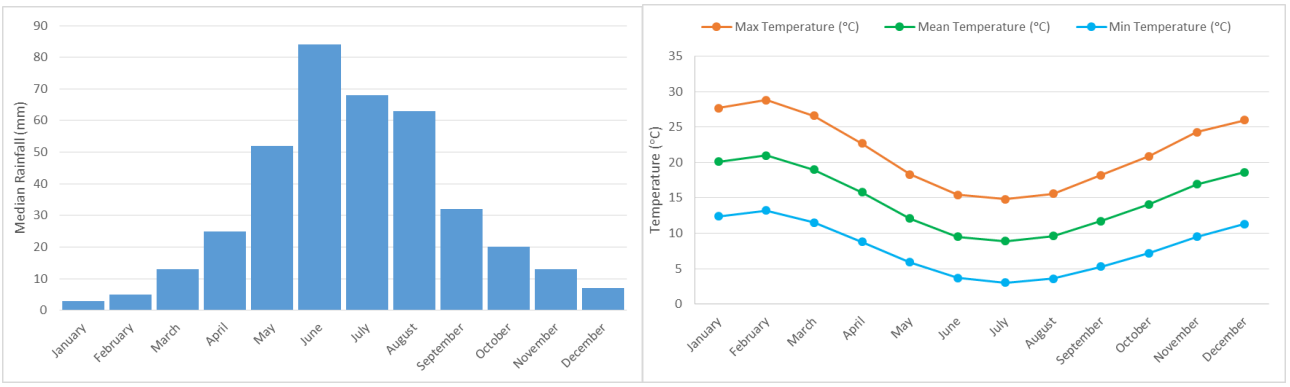

Figure 3. Average monthly rainfall (left) and temperature (right) for the area (CapeFarmMapper 2017)

GEOLOGY AND SOIL

The geology is feldspathic sandstone and siltstone of the Rietvlei Formation, Table Mountain Group. The soils are dominated by Glenrosa and Mispah forms, having limited pedological development. The soils are rocky.

FLORA

Mucina and Rutherford (2006) mapped the natural vegetation types in South Africa on a national scale. Where indigenous vegetation has been significantly removed, the mapping of vegetation was guided by variables such as soil type. Due to the large scale at which this mapping was conducted, the finer scale boundaries of mapped units are often not always very accurate. The mapping has been updated by the South African National Biodiversity Institute (SANBI) in 2009 and 2012 (Figure 5) shows the 2009 update of the mapping of Mucina and Rutherford (2006). There are no changes between the 2009 and 2012 versions of the vegetation map, for the study area.

The vegetation mapped on the site is Winterhoek Sandstone Fynbos. This vegetation type occurs across the Winterhoek mountains as well as surrounding ranges such as the Skurweberg and Hansiesberg. It occurs across the lower to upper slopes at altitudes ranging from 350 – 1800 meters above mean sea level (mamsl). The soils it occurs on are sandy, acidic and of sandstone origin. The vegetation is typically a closed restio land with sparse low shrubs. However, in driers and the shrub density increases and restio dominance decreases.

The site the vegetation is fairly intact with a low density of alien trees, however, aliens *Pinus pinaster* and *Acacia mearnsii* were observed along the stream channel. The existing footprint of the substation where new infrastructure is proposed is already developed and is devoid of vegetation.

AQUATIC FEATURES

The freshwater features in close proximity to the site consist of two unnamed watercourses which flow past the eastern and western boundaries of the sub-station. The national Freshwater Ecosystems Priority Areas mapping initiative has mapped wetlands on a national scale. However, the only wetland area mapped by this initiative in the vicinity of the substation is the farm dam located within the eastern watercourse upstream of the site. The eastern and western watercourses are assessed and described in Section 6 of this report.

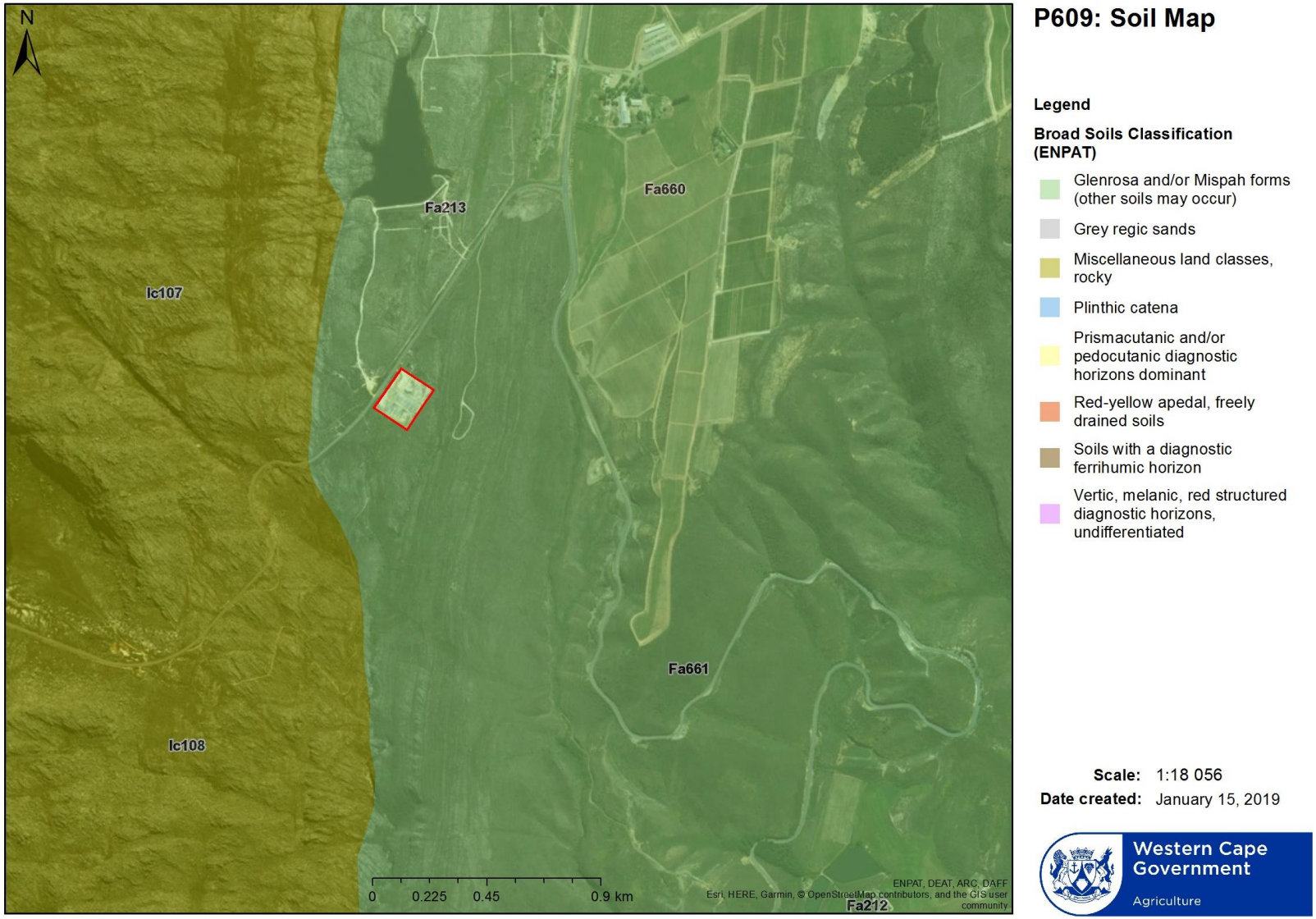

Figure 4. Soils map for the study area (red square) (ENPAT data available from CapeFarmMapper (https://gis.elsenburg.com/apps/cfm/) on 15 January 2019)

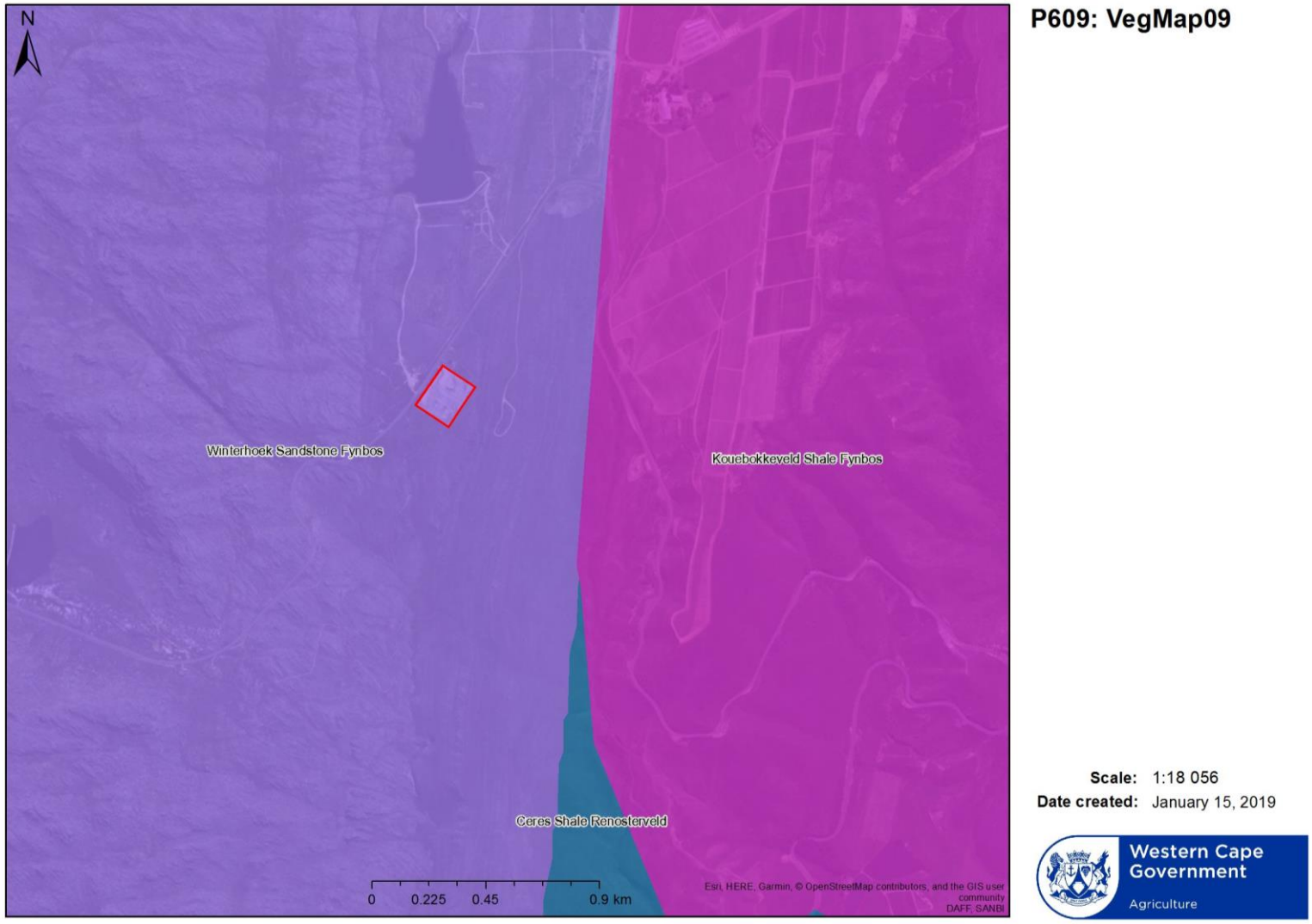

Figure 5. Vegetation map for study area (red square) (South African National Biodiversity Institute. 2009 Vegetation Map App [Vector] 2009, available from CapeFarmMapper (https://gis.elsenburg.com/apps/cfm/); downloaded on 15 January 2019

Figure 6. Google Earth image with the mapped watercourses adjacent to the substation

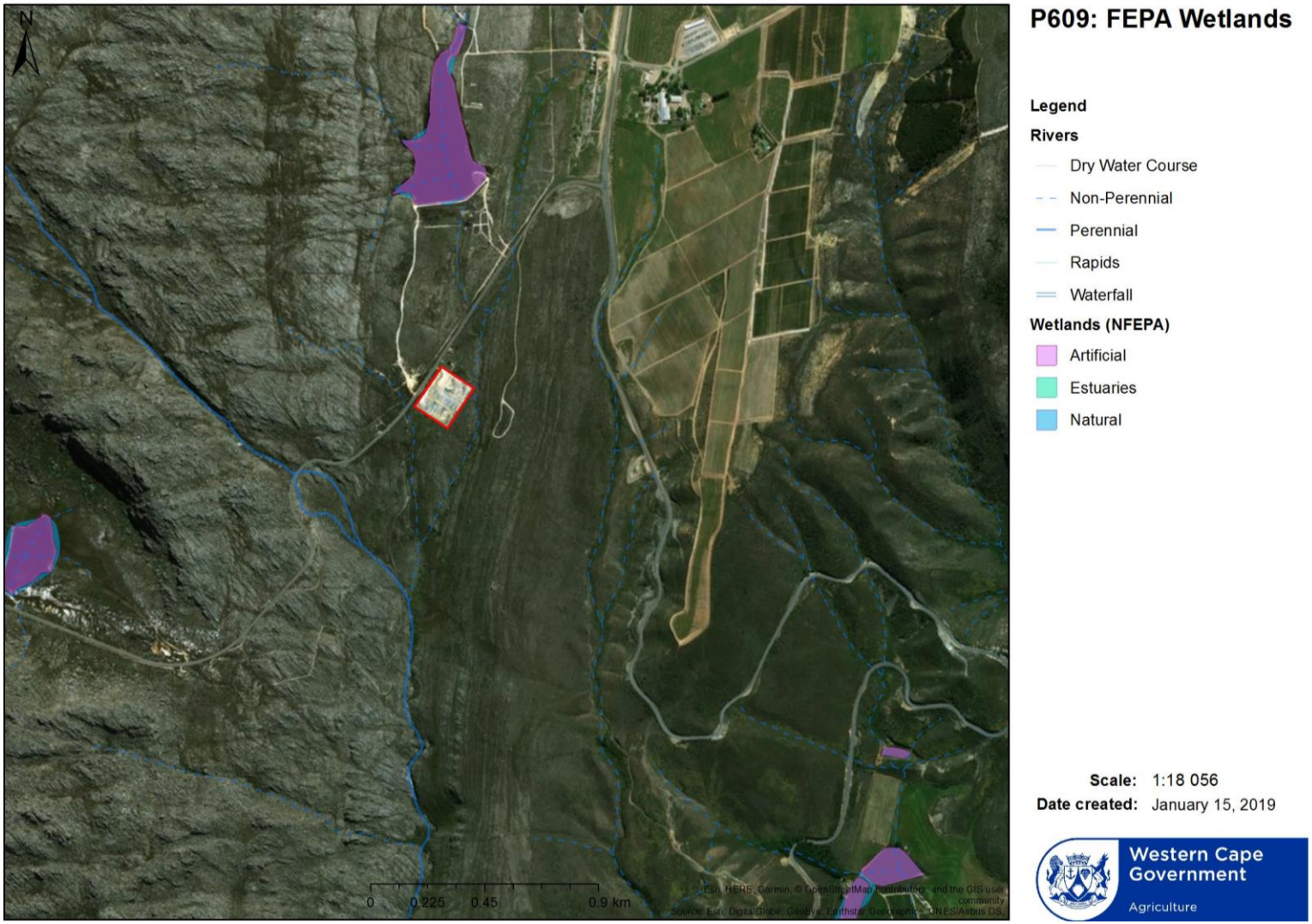

Figure 7. FEPA wetlands and rivers in the vicinity of the study area (red square) (Council for Scientific and Industrial Research, NFEPA rivers 2011 available from CapeFarmMapper (https://gis.elsenburg.com/apps/cfm/); downloaded on 15 January 2019)

LAND USE

While much of the wider area is used for agricultural purposes – primarily the cultivation of pome fruit – the substation itself is surrounded by natural vegetation that is fairly undisturbed.

BIODIVERSITY AND CONSERVATION VALUE

Two sets of conservation mapping results are of relevance to the national and provincial identification of the ecological importance that has been attributed to the freshwater features in the study area:- the Western Cape Biodiversity Spatial Plan (WCBSP) mapping of 2017 (Figure 9) and the national Freshwater Ecosystem Priority Areas (FEPA) mapping (Figure 10).

The WCBSP map aims to guide sustainable development by providing a synthesis of biodiversity information to decision makers to ensure appropriate land use and planning for the best possible long-term benefits and to promote integrated management of natural resources. The main categories are Critical Biodiversity Areas (CBA), Ecological Support Areas (ESA), and Protected Areas. CBAs represent the biodiversity priority areas which should be maintained in a natural to near natural state while ESAs are areas that should be restored.

The site is located within a protected area – namely the Winterhoek Mountain Catchment Area. Therefore, disturbance and loss of indigenous vegetation or natural habitats should be prevented. By containing all activities within the already developed substation footprint (including laydown areas, roads and storage of sand, rubble or other material) negative impact upon the natural habitats within the protected area will be avoided.

FEPAs are intended to provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. The maps 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. The river and wetland FEPAs are required to be maintained in a largely natural ecological state while fish support areas should not be allowed to degrade from their existing ecological condition.

The study site is located with a wider catchment / water management area that has been mapped as an upstream management area. This is because it is the upper catchment and headwaters of the Breede River. These areas are intended to be managed to avoid negative impacts upon the important downstream aquatic ecosystems. As with the protected areas, the impacts on the aquatic ecosystems can be avoided by containing all activities within the developed substation area.

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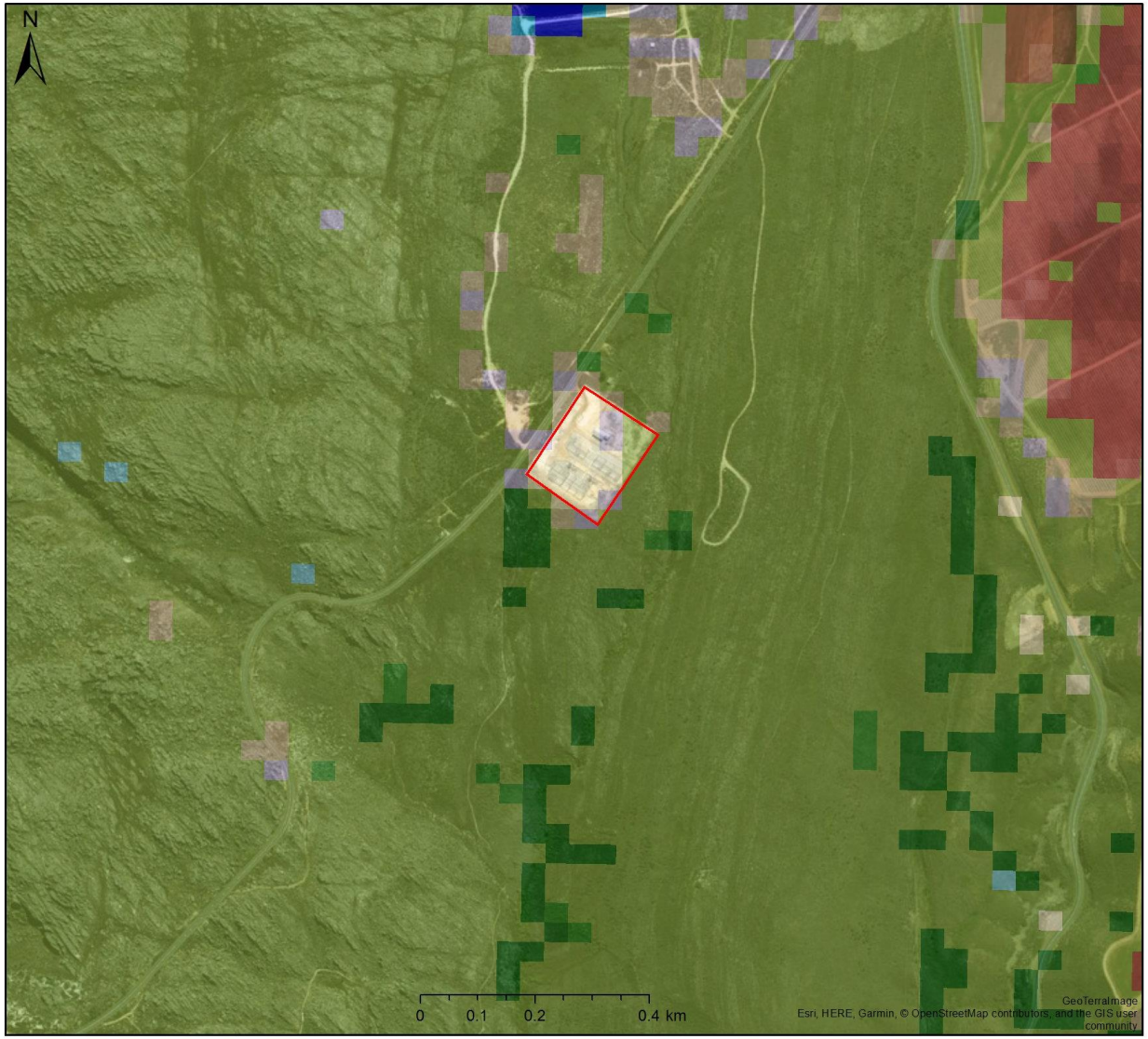

P609: Land Cover Map

Legend

WC Land Cover (2013-2014)
- Bare none vegetated
- Cultivated comm fields (high)
- Cultivated comm fields (low)
- Cultivated comm fields (med)
- Cultivated comm pivots (high)
- Cultivated comm pivots (low)
- Cultivated comm pivots (med)
- Cultivated orchards (high)
- Cultivated orchards (low)
- Cultivated orchards (med)
- Cultivated subsistence (high)
- Cultivated subsistence (low)
- Cultivated subsistence (med)
- Cultivated vines (high)
- Cultivated vines (low)
- Cultivated vines (med)
- Grassland
- Indigenous Forest
- Low shrubland
- Mine buildings
- Mines 1 bare
- Mines 2 semi-bare
- Mines water permanent
- Mines water seasonal
- Plantation / Woodlots clearfelled
- Plantation / Woodlots young
- Plantations / Woodlots mature
- Urban residential (low veg / grass)
- Urban residential (open trees / bush)
- Urban school and sports ground
- Urban smallholding (bare)
- Urban smallholding (dense trees / bush)
- Urban smallholding (low veg / grass)
- Urban smallholding (open trees / bush)
- Urban sports and golf (bare)
- Urban sports and golf (dense tree / bush)
- Urban sports and golf (low veg / grass)
- Urban sports and golf (open tree / bush)
- Urban township (bare)
- Urban township (dense trees / bush)
- Urban township (low veg / grass)
- Urban township (open trees / bush)
- Urban village (bare)
- Urban village (dense trees / bush)
- Urban village (low veg / grass)
- Urban village (open trees / bush)
- Water permanent
- Water seasonal
- Wetlands
- Woodlan/Open bush

Scale: 1:9 028
Date created: January 21, 2019

Western Cape Government
Agriculture

Figure 8. Land cover map for the area (SANBI Biodiversity GIS, 2019)

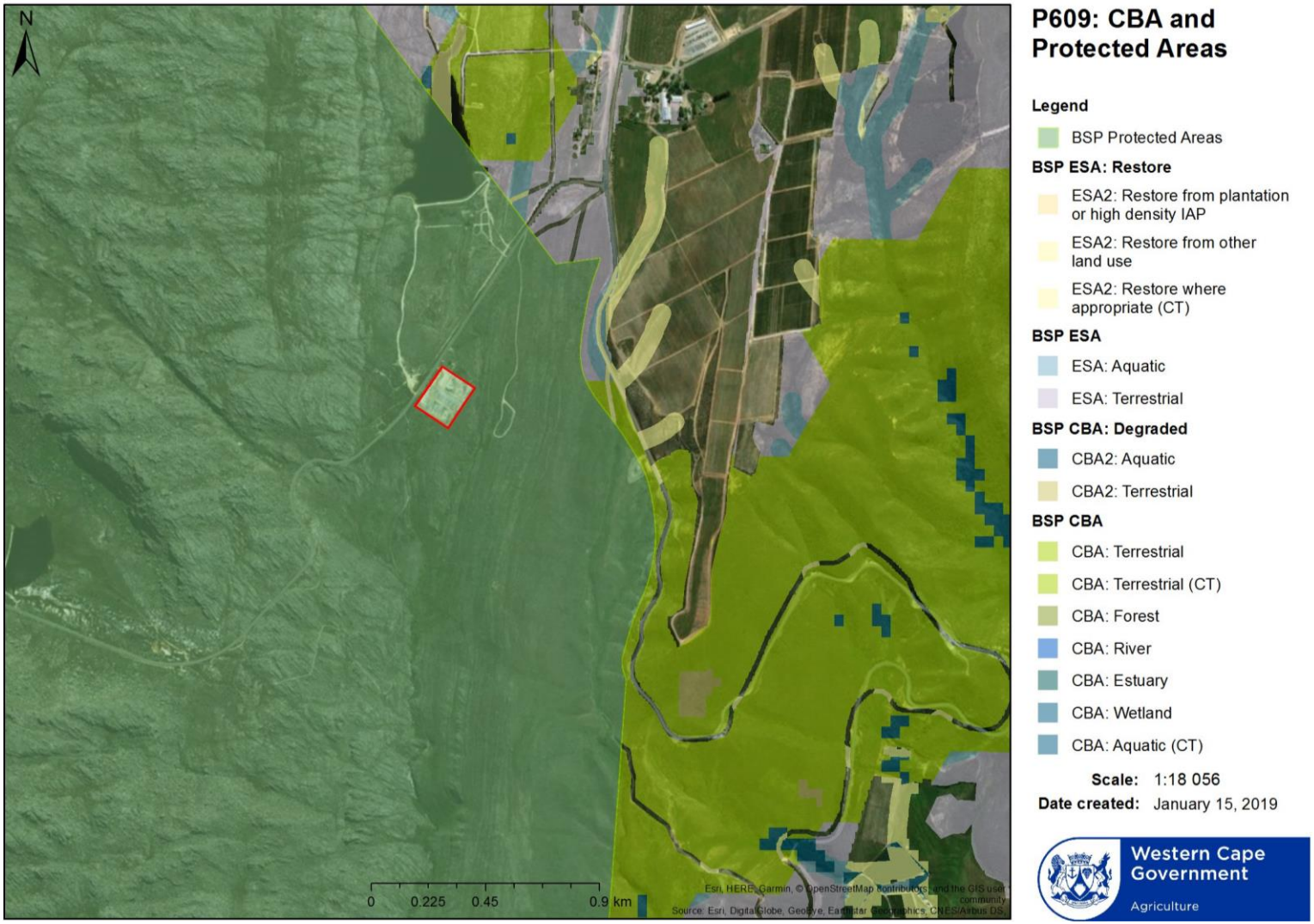

Figure 9: Critical Biodiversity Areas for the area surrounding the Witzenberg Substation (red square) (CapeNature. 2017 WCBSP Ecosystem Threat Status available from CapeFarmMapper (https://gis.elsenburg.com/apps/cfm/); accessed on 15 January 2019)

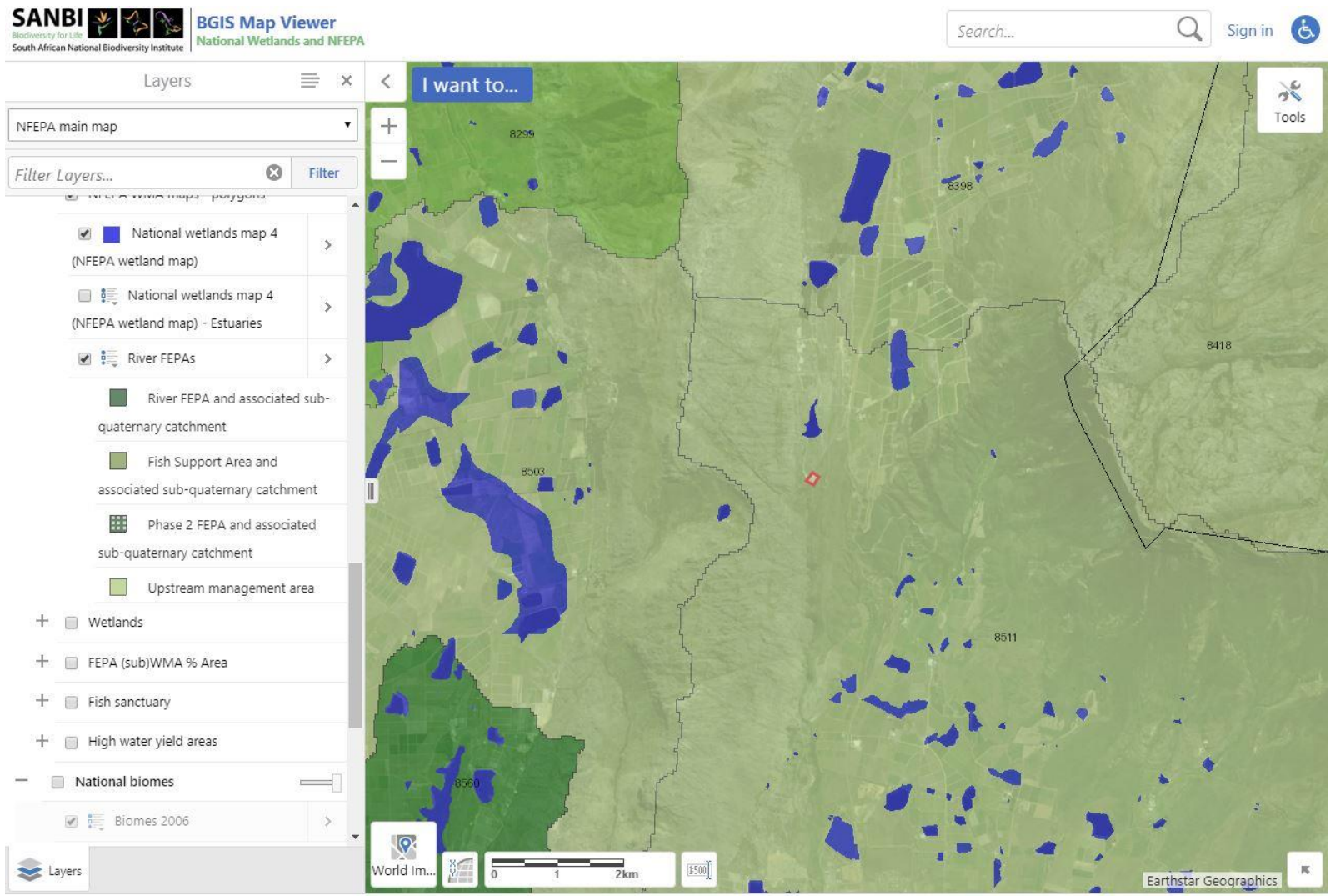

Figure 10: River Freshwater Ecosystem Priority Areas within the wider vicinity the study area (red square) (Council for Scientific and Industrial Research. NFEPA rivers 2011 available from SANBI BiodiversityGIS (http://bgis.sanbi.org); downloaded on 21 January 2019))

6.2. RIVER ASSESSMENT

Rivers assessed within are the eastern and western streams which flow past the substation. Index for Habitat Integrity (IHI) and Site Characterisation assessments were used to provide information on the ecological condition of these rivers. An assessment of the Ecological Importance and Sensitivity of the rivers was also undertaken.

DESCRIPTION OF RIVERS

WESTERN STREAM

The western stream flows past the north western corner of the substation site before turning south west and flowing away from the site. The stream arises on eastern facing slopes of the Hansiesberg and is largely unimpacted until it reaches the Witzenberg Valley Road, immediately upstream of the substation. The stream flows through the road via two pipe culverts. Downstream of the road the stream is also fed by storm water runoff from the road surface. The substrate of the stream is course quartzitic sands. The vegetation is dominated by rushes such as *Juncus lomatophyllus* and *Juncus effusus* as well as *Pennisetum macrourum* grass. Although the stream is seasonal, the hydrophilic rushes growing along the stream are evidence of regular soil wetness. The western stream is wetter than the eastern stream due to the lack of upstream impoundments.

Figure 11. The sandy bottomed and rush dominated channel of the western stream adjacent to the Witzenberg substation

EASTERN STREAM

The Eastern stream also arises north of the site on the eastern facing slopes of the Hansiesberg Mountains. Before it flows under the Witzenberg Valley Road, the stream is impounded in a large dam. There is no evidence of low flow release from instream dam. The instream dam has altered the streams flow regime as well as the soil wetness of the area surrounding the stream channel. There appears to be very little to no base low flow within the stream channel downstream of the dam during the low flow season. This has resulted in very dry conditions along the stream during summer

and the loss of the hydrophilic plant communities observed along the western stream. The loss of this vegetation on the banks and in the channel of the stream has meant that fine particles in the stream channel are not well bound by plant roots. When flow does occur in the stream channel it is typically high energy and volume as the upstream dam overtops late in the rain season. This high flow volume has carried away much of the finer substrate and a low level of erosion and channel incision has taken place. The vegetation community along the eastern stream is dominated by restios such as *Restio paniculatus* and *Elegia capensis*. Terrestrial species such as *Protea repens* was also abundant along the stream channel.

Figure 12. The boulders and bedrock channel and Restio dominated banks of the eastern stream

PAST MODIFICATION OF THE RIVERINE FEATURES

The earliest available Google Earth imagery, taken in 2005, shows that the substation and the upstream dam in the eastern stream had both already been constructed. Historical aerial imagery captured in 1949 shows the site prior the dam and substation construction. The channel form and location are in a similar position to its current day location.

Figure 13. A aerial image of the site in 2005 (top) and 1949 (bottom) (red circle shows the location of the sub-station)

RIVER CLASSIFICATION

In order to assess the condition and ecological importance and sensitivity of the watercourses within the study area, it is necessary to understand how the rivers or streams might have appeared under

unimpacted conditions. This is achieved through classifying rivers according to their ecological characteristics, in order that it 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 are 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 the Department of Water Affairs and Forestry in 1999, which divides the country's rivers into ecoregions, was used. The rivers assessed lies within the Western Folded Mountains Ecoregion, with the characteristics as described in Table 2.

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 streams assessed.

Table 2. Characteristics of the Western Folded Mountains Ecoregion 23 (Dominant Types in Bold)

Main Attributes	Characteristics (dominant types in bold)
Terrain Morphology	Plains; Low Relief (limited); Plains Moderate Relief (limited); Lowlands; Hills and Mountains; Moderate and High Relief; Closed Hills; Mountains; Moderate and High Relief; Table-Lands: Moderate and High Relief
Vegetation types	**Mountain Fynbos;** Central Mountain Renosterveld; West Coast Renosterveld (very limited); Little Succulent Karoo; Upland Succulent Karoo (very limited); Strandveld Succulent Karoo (very limited)
Altitude	300-1700 (m a.m.s.l)
Mean Annual Precipitation	200 to 1500 (mm)
Coefficient of Variation	<20 to 39 (% of annual precipitation)
Rainfall concentration index	50 to >65
Rainfall seasonality	Winter
Mean annual temp.	10 to 20 (°C)
Median annual runoff for quaternary catchment	<5 (limited); 5 to >250 (mm)

CHARACTERISATION OF RIVERS

From the Site Characterisation assessment, the geomorphological and physical characteristics of the rivers can be classified as shown in Table 3.

Table 3. Geomorphological and Physical features at the Witzenberg Substation

River	Western Stream	Eastern Stream
Geomorphological Zone	Mountain stream	
Lateral mobility	Largely unconfined	
Channel form	Single channel	
Channel pattern	Primarily a single thread with a moderate sinuosity	
Channel type	Sand.	Cobbles and boulders with some gravel
Channel modification	Low –receives storm water off the tarred road and flows through the road via pipe culverts	Moderate to high – upstream impoundment has had significant impact on flow and channel character
Hydrological type	Seasonal	
Ecoregion	Western Folded Mountains	
DWA catchment	H10C	
Vegetation type	Winterhoek Sandstone Fynbos	
Rainfall region	Winter	

INDEX OF HABITAT INTEGRITY FOR THE RIVERS

The evaluation of Index of Habitat Integrity (IHI) 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).

The IHI assessment is based on an evaluation of the impacts of two components of the rivers, the riparian zone and the instream habitat. The 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 3. Index of Habitat Integrity Assessment results and criteria assessed

Instream Criteria	Weight	Western Stream	Eastern Stream
Water abstraction	14	0	11
Flow modification	13	7	15
Bed modification	13	7	9
Channel modification	13	4	10
Water quality	14	7	4
Inundation	10	0	0
Exotic macrophytes	9	0	0
Exotic fauna	8	0	0
Solid waste disposal	6	3	2
	Category	**B**	**C**
Riparian Zone Criteria	Weight	Western Stream	Eastern Stream
Water abstraction	13	3	3
Inundation	11	3	3
Flow modification	12	2	9
Water quality	13	3	7
Indigenous veg removal	13	0	7
Exotic vegetation encroachment	12	0	0
Bank erosion	14	7	12
Channel modification	12	4	0
	Category	**B**	**C**

The Western stream is considered to be largely natural. Apart from the flow and water quality impacts associated with the road, the stream is largely natural. The Eastern Stream is considered to be moderately modified due to the impacts of the upstream dam on the flow, channel and riparian vegetation.

RIVERINE 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 4). The median of the resultant score is calculated to derive the EIS category (Table 6).

Table 4. 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 (i.e. SA Red Data Books)

Table 5. Results of the EIS assessment for the rivers

Biotic Determinants	Western and Eastern Stream
Rare and endangered biota	1
Unique biota	1
Intolerant biota	2
Species/taxon richness	2
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	2
Refuge value of habitat type	3
Sensitivity of habitat to flow changes	2
Sensitivity of flow related water quality changes	2
Migration route/corridor for instream and riparian biota	2
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	4
EIS CATEGORY	Moderate

Table 6. Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General description	Range of median
Very high	Quaternaries/delineations considered unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations considered unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations considered unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are 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 (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

The Eastern and Western Streams are considered to be of moderate ecological importance and sensitivity. Despite their small catchments and some modifications they retain mostly natural habitat and are located within the higher mountain catchment areas of important downstream ecosystems.

8. CONSIDERATION OF PROPOSED ACTIVITIES IN TERMS OF FRESHWATER CONSTRAINTS

The enlargement of the facility within the existing confines of the existing fenced area will most likely lead to the compaction and paving of larger areas resulting in increased runoff from the site and the need to deal with high rainfall event and the resulting storm water runoff. The discharge of the storm water to the nearby streams will impact upon the streams.

Although the proposed BESS does contain potential hazardous and toxic materials, all the batteries will be containerized and make provision for secondary containment to accommodate any spill as a result of normal operation and maintenance. Therefore there is not expected to be a potential water quality impact associated with the installation of the BESS.

The regular maintenance of the perimeter road on the outside of the fenced area is currently already impacting on the riparian zone and wider river corridors of both streams. The maintenance activities includes the grading of the existing gravel perimeter road and alien vegetation control in an around the facility with results in the dumping of soil and cut alien vegetation material around the perimeter of the facility and into the riparian zones of the river (Figures 14-17). These activities increase the risk of fire and will result in large areas being sterilised which will then become a susceptible for the establishment of new alien vegetation nuclei.

Figure 14: Cut vegetation dumped into the riparian zone of the eastern stream

Figure 15. Cut vegetation dumped into the riparian zone of the eastern stream

Figure 16. Cut vegetation dumped into the riparian zone of the eastern stream

Figure 17. Alien vegetation control methods used which is not complying with good practise

Figure 18. A Google Earth Image showing the Witzenberg substation and the streams adjacent to it highlighted in the red ovals

9. ASSESSMENT OF IMPACTS

The following impacts can potentially deteriorate the ecological condition of the streams surrounding the facility:

- Increased concentrated storm water runoff from the facility; and
- Riparian zone habitat impacts associated with the maintenance of vegetation in and around the facility.

9.1. IMPACT ASSOCIATED WITH THE PROPOSED NEW INFRASTRUCTURE WITHIN THE WITZENBERG SUBSTATION

9.1.1 INCREASED CONCENTRATED STORM WATER RUNOFF FROM THE FACILITY AND WATER QUALITY IMPAIRMENT

The impacts of the proposed activity are largely limited by containing the activities within the already developed substation area. There is a possible impact of water quality impairment upon the streams associated with run-off and spillages from activities on the substation site.

Significance of impacts without mitigation: Medium to Low negative impact

Proposed mitigation:

The construction phase of the new infrastructure should be conducted within the summer months when run-off from the site is unlikely. Any oils or other potential contaminants brought onto the site for the construction should be adequately contained and sealed within the substation site to prevent any spillages into the streams.

The runoff from the newly compacted and paved areas in the facility and the perimeter road around the facility should be managed to capture the storm water into smaller retention/holding ponds facilities and letting the flow slowly released into the streams. Alternatively, or in combination permeable pavers could also be used inside the facility to increase intrusion into the soil and reduced increased runoff during high rainfall events. The concentration of the waste water into to a single storm water outlet to either of the streams should be prevented. Ideally at least 4 outlet points draining to both streams should be considered.

Significance of impacts after mitigation: Low negative significance

Potential impact on freshwater features	Potential increased concentrated storm water runoff and water quality impairment from activities within close proximity to unnamed streams			
Nature	Water quality impairment increased sediment loads and riparian zone erosion		Status	-ve
Impact source(s)	New infrastructure on the Witzenberg Substation site			
Impacted aquatic ecosystem	Unnamed streams within the upper catchment of the Wabooms River			
Irreplaceability of resources	Medium			
Magnitude	Extent	Local (2)		
	Magnitude/Intensity	High to Medium (2.5)		
	Duration	Long term (3)		
	Reversibility	Low		
	Probability	Probable (3)		
Significance	Without mitigation	Medium to Low		M/L -ve
	With mitigation	Low		L -ve
Cumulative impact	Without mitigation	Low negative		
	With mitigation	Low negative		
Confidence	Sure			

9.1.2 RIPARIAN ZONE HABITAT IMPACTS ASSOCIATED WITH THE MAINTENANCE OF VEGETATION AND ROAD IN AND AROUND THE FACILITY

The impact of the existing and future maintenance of vegetation and road infrastructure around the facility includes the following activities:

- Pushing of soil and the widening of roads into the riparian zones;
- Dumping of cleared vegetation into the riparian zones; and
- The cutting and disposal of alien vegetation and trees utilising inappropriate methods.

Significance of impacts without mitigation: Medium to Low negative impact

Proposed mitigation:

Neither the construction nor the maintenance phase should allow any of the following activities to occur:

- Infilling and dumping of any material into the buffer areas along the streams;
- Expansion of the perimeter road in any direction; and
- Dumping of cut vegetation into the natural terrestrial vegetation of the riparian zones.

Significance of impacts after mitigation: Low negative significance

Potential impact on freshwater features	Reduction of the riparian zones and invading of invasive alien vegetation			
Nature	Habitat loss and infilling of riparian zones		Status	-ve
Impact source(s)	Maintenance activities of roads and vegetation at the Witzenberg Substation site			
Impacted aquatic ecosystem	Unnamed streams within the upper catchment of the Wabooms River			
Irreplaceability of resources	Medium			
Magnitude	Extent	Local (2)		
	Magnitude/Intensity	Medium (2)		
	Duration	Long term (4)		
	Reversibility	Low		
	Probability	Probable (3)		
Significance	Without mitigation	Medium to Low		M/L -ve
	With mitigation	Low		L -ve
Cumulative impact	Without mitigation	Low negative		
	With mitigation	Low negative		
Confidence	High			

9.4. CUMULATIVE IMPACTS

The cumulative impact of the development is very low, negligible as it is taking place within the already developed footprint of the substation.

From a freshwater perspective the constraints to development in the area are posed by the two streams. It is recommended that the two streams and its buffers be considered "no-go" areas for any development, placement, and temporary storage of any material or discharge. Requiring that all activities are adequately contained within the existing fenced area.

In order to minimise and prevent impacts on the streams, buffers are proposed around each stream and these buffers should be consider as no go areas for any activity related to the facility and/or maintenance activities related to the facility (Figure 19)

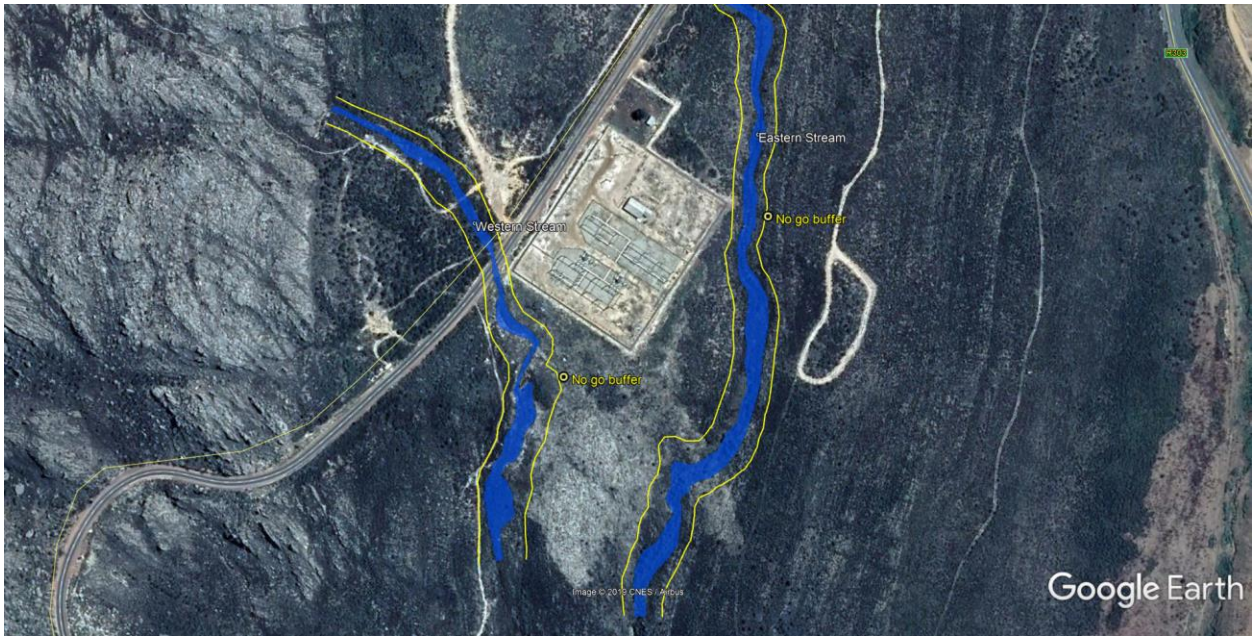

Figure 19. A Google Earth Image showing the Witzenberg substation and the surrounding streams providing the no go buffers around each stream (yellow lines)

10. RISK ASSESSMENT

A risk assessment was not carried out for the proposed activities. Although the site is located within close proximity of the watercourses, the activity is restricted to the developed footprint of the substation. Therefore, there will be no changes to the characteristics, flow, bed or banks of the watercourses. Should any activity or an effect of the activity extend beyond the boundary of the existing substation footprint then this opinion would need to be revised.

11. CONCLUSIONS AND RECOMMENDATIONS

Eskom proposes to place new infrastructure within the existing boundaries of the Witzenberg substation. The substation is located adjacent to two watercourses, on its eastern and western boundaries. The western stream is considered to be largely natural, with the only impact upon it being the Witzenberg Valley Road, through which it passes via pipe culverts. This stream is considered to be of moderate ecological importance and sensitivity. The eastern stream is modified by an instream dam above the study site which has affected the flow, sediment transport, channel form and riparian vegetation. Although these impacts have taken place it still retains fairly intact riparian habitat. It is considered to be moderately modified but also of moderate ecological importance and sensitivity.

As the proposed activity is restricted to the already developed footprint of the substation, the only potential impact is water quality impairment as a result of storm water run-off or contaminated spills from the site. These can be mitigated by conducting the construction phase during the summer months when surface water run-off from the site is less likely. Furthermore, good housekeeping and good management of potential contaminants is very important.

This assessment of the proposed activity assumes that no activity will take place beyond the already developed footprint of the Witzenberg substation. If any activity, including the operation of machinery, clearing of vegetation, dumping of material or storage of material is proposed to take place outside of the already developed footprint the authors of this report reserve the right to significantly review their assessment of impacts.

An assessment to determine the risk of the proposed activity upon the water resources in the vicinity was not conducted. The risk assessment is a tool to determine the level of authorisation which a Section 21 (c) and Section 21 (i) water use will require. However, the authors of this report are of the opinion that the proposed activity does not trigger a water use provided the activity is restricted to the already developed footprint of the substation. However, the regional Department of Water and Sanitation office should be approached for their comment and assessment of the activity.

The current maintenance of the existing perimeter road around the substation appears to include the clearing of vegetation encroaching into the road area. The cut material is currently not being removed from

the site but dumped into the natural vegetation. This dead and dry material smothers the natural vegetation but also poses a significant fire risk (more susceptible to burn and will increase the heat of fires). It is strongly advised that cleared materiel associated with the road be chipped and removed from the site to an appropriate dumping site.

The continued control of alien vegetation, utilising appropriate methods is essential to prevent the invasion of the area with invasive plants. This includes by are not limited to pine and black wattle trees.

Table 7. Summary Impact Table

Development Component	Extent of impact	Duration of impact	Consequence of impact or risk:	Probability of occurrence	Degree to which impact may cause irreplaceable loss	Degree to which impact can be reversed:	Degree to which the impact can be managed:	Degree to which the impact can be mitigated:
Extension of facility inside the fenced area	Local	Long term	Potential increased concentrated storm water runoff and water quality impairment from activities within close proximity to unnamed streams	Probable	Medium	Low	High - The runoff from the newly compacted and paved areas in the facility and the perimeter road around the facility should be managed to capture the storm water into smaller retention/holding ponds facilities and letting the flow slowly released into the streams.	High - impact of the storm water flow and water quality can be mitigated; water quality impacts during construction can be mitigated
Riparian zone habitat impacts associated with the maintenance of vegetation and service road in and around the facility	Site specific	Long term	Loss of riparian and instream habitat and bed/bank modification	Probable	Medium	Low	Neither the construction nor the maintenance phase should allow any of the following activities to occur: Infilling and dumping of any material into the buffer areas along the streams; Expansion of the perimeter road in any direction; and Dumping of cut vegetation into the natural terrestrial vegetation of the riparian zones	High - impacts of the road and maintenance activities near the watercourses are completely mitigatable

Table 8. Cumulative Impacts

Extent of impact	Duration of impact	Consequence of impact or risk:	Probability of occurrence	Degree to which the impact may cause irreplaceable loss of resources:	Degree to which the impact can be reversed:	Degree to which the impact can be managed:	Degree to which the impact can be mitigated:
Local	Long term	Aquatic habitat and water quality	Probable	Medium	Medium	Medium – ongoing control of alien vegetation in watercourses; need to monitor and manage water use in the catchment. Buffers of no go areas should not be utilised at all	High – Control of alien vegetation in an appropriate manner can be undertaken and should be ongoing;

12. REFERENCES

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APPENDIX 1: DECLARATION OF INDEPENDENCE

DECLARATION OF INDEPENDENCE BY THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I, Dana Grobler, 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: 25 February 2019

APPENDIX 2: ATTACHED CURRICULUM VITAE:

Contact details: PO Box 455, Somerset Mall, 7137

Names: Stuart Barrow, Dana Grobler and Antonia Belcher

Profession: Aquatic Scientists

Fields of Expertise: Specialist in freshwater assessments, monitoring and reporting

Relevant work experience:

Due to our involvement in the development and implementation of the River Health Programme in the Western Cape, as well as numerous freshwater impact assessments through the province and greater Southern Africa, we have taken part in many 'state-of-river' assessments as well as routine monitoring and specialized assessments of rivers and wetlands in the area.

Publications:

More than 350 reports and publications, papers and posters relating mostly to water resource quality and river and wetland health assessments in South Africa and their management.

Recent projects that we have been involved in are:

- Classification of Water Resources in the Olifants-Doorn Water Management Areas, Department of Water Affairs;
- **Maintenance and Management Plan (MMP)** for the **Berg River** zone 3 irrigation area, including a 36 km stretch of the Middle reaches of the Berg River;
- **Maintenance and Management Plan (MMP)** for the Upper **Berg River** catchment, including a 54 km stretch of the Upper Berg River;
- Planning and compilation of the **Eerste River** riparian zone rehabilitation and in Stellenbosch;
- Compilation of an ecosystem management plan for the **De Zalze Estate and the Blaauwklippen River;**
- Wemmersvlei wetland area restoration (Franshoek). Compilation and implementation of wetland restoration within ESKOM servitude;
- Free State River Health monitoring programme – undertook river health monitoring on a quarterly basis at approximately 70 sites across the province for a period of one year.
- Western Cape River Health Programme - Toni Belcher was the River Health programme champion in the Western Cape in the period 2000 to 2007. During this period Toni has managed a team of scientists to undertake river health monitoring throughout the province. She was also instrumental in the compilation and author of 7 State-of-River reports for the Western Cape Rivers, including undertaking the graphic design and layout of these reports.
- 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;
- 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 3: PRESENT ECOLOGICAL STATUS AND ECOLOGICAL IMPORTANCE AND ECOLOGICAL SENSITIVITY OF THE MODDER RIVER

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
H10C-08503	Modder	15.40	1	Y		LARGELY MODIFIED	D
MEAN EI CLASS	**MEAN ES CLASS**	**DEFAULT ECOLOGICAL CATEGORY (EC)**	**RECOMMENDED ECOLOGICAL CATEGORY**				
MODERATE	VERY HIGH	A	#NUM!				

PRESENT ECOLOGICAL STATE		ECOLOGICAL IMPORTANCE				ECOLOGICAL SENSITIVITY	
INSTREAM HABITAT CONTINUITY MOD	MODERATE	FISH SPP/SQ	3.00	INVERT TAXA/SQ	16.00	FISH PHYS-CHEM SENS DESCRIPTION	VERY HIGH
RIP/WETLAND ZONE CONTINUITY MOD	LARGE	FISH: AVERAGE CONFIDENCE	1.00	INVERT AVERAGE CONFIDENCE	5.00	FISH NO-FLOW SENSITIVITY DESCRIPTION	VERY HIGH
POTENTIAL INSTREAM HABITAT MOD ACT	LARGE	FISH REPRESENTIVITY PER SECONDARY: CLASS	VERY HIGH	INVERT REPRESENTIVITY PER SECONDARY, CLASS	LOW	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.	LARGE	FISH RARITY PER SECONDARY: CLASS	MODERATE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) RATING	HIGH	RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH) INTOLERANCE WATER LEVEL/FLOW CHANGES	VERY HIGH
POTENTIAL PHYSICO-CHEMICAL MOD ACTIVITIES	MODERATE	ECOLOGICAL IMPORTANCE: RIPARIAN-WETLAND-INSTREAM VERTEBRATES (EX FISH)	HIGH	HABITAT DIVERSITY CLASS	MODERATE	STREAM SIZE SENSITIVITY TO MODIFIED FLOW/WATER LEVEL CHANGES	HIGH
		RIPARIAN-WETLAND NATURAL VEG RATING BASED ON % NATURAL VEG IN 500m (100%=5)	MODERATE	HABITAT SIZE (LENGTH) CLASS	LOW	RIPARIAN-WETLAND VEG INTOLERANCE TO WATER LEVEL CHANGES	VERY HIGH
		RIPARIAN-WETLAND NATURAL VEG IMPORTANCE BASED ON EXPERT RATING	HIGH	INSTREAM MIGRATION LINK CLASS	HIGH		
				RIPARIAN-WETLAND ZONE MIGRATION LINK	MODERATE		
				RIPARIAN-WETLAND ZONE HABITAT INTEGRITY CLASS	MODERATE		
				INSTREAM HABITAT INTEGRITY CLASS	MODERATE		