ESKOM HOLDINGS SOC LIMITED

PROPOSED ISUNDU 765/400 KV SUB-STATION AND TURN-IN TRANSMISSION LINES

CONSTRUCTION METHODOLOGY – SPECIFICALLY RELATING TO WETLANDS

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ABBREVIATIONS AND ACRONYMS

ACER	ACER (Africa) Environmental Consultants
AES	Agricultural Economics Study
Amafa	Amafa AkwaZulu-Natali
CRR	Comments and Responses Report
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department Environmental Affairs (national)
DEDTEA	Department of Economic Development, Tourism and Environmental Affairs
DOT	KZN Department of Transport
DSR	Draft Scoping Report
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EKZNW	Ezemvelo KwaZulu-Natal Wildlife
EMPr	Environmental Management Programme
Eskom	Eskom Holdings (SOC) Limited
FSR	Final Scoping Report
I&APs	Interested and Affected Parties
KZN	KwaZulu-Natal
MOU	Memorandum of Understanding
NEMA	National Environmental Management Act
NWA	National Water Act
PDA	Planning and Development Application
RE	Resident Engineer

1. INTRODUCTION

1.1 Background

The proposed Isundu Sub-station site is located near Ashburton, KwaZulu-Natal (Figure 1). The proposed project site falls within the Mkhambathini Local Municipality (LM) which is one of seven local municipalities which make up the uMgungundlovu District Municipality (DM). The proposed powerlines' corridor fall within the Mkhambathini LM, Msunduzi LM and the uMshwathi LM. The proposed project is aimed at strengthening the electricity network in KwaZulu-Natal (KZN).

Figure 1: Proposed Isundu Sub-station site

The proposed Isundu Sub-station project comprises the following main components:

- 1 x Isundu 765/400 kV Sub-station on a 100ha site.
- 1 x 765 kV transmission line (the authorised VSHA transmission line).
- 2 x 400 kV double-circuit transmission lines from the sub-station to tie into the existing Hector-Ariadne 400 kV double-circuit transmission lines approximately 4 km away.
- 2 x 400 kV lines from the proposed Mbewu Sub-station near Empangeni.

In addition, the site and layout design allows sufficient space to accommodate additional transmission lines if required at some point into the future. The space allowed will potentially accommodate the following additional transmission lines:

- 1 x 765 kV or High Voltage Direct Current (HVDC) transmission line.
- 2 x 400 kV transmission lines.

The project also entails the construction and maintenance of access roads in areas where there currently are no access roads, a microwave radio communication mast and oil and fuel storage facilities, including an oil bund to contain any transformer oil spills.
The construction of the sub-station will take approximately three years. However, during this period there will be a period of more intense activity lasting approximately 18 months. There

will be approximately 80 people working on the construction at any given time (ACER, 2015). As the construction of a sub-station and transmission lines require specialised skills, skilled personnel and construction teams will have to be brought in.

1.2 Project Description

1.2.1 General sub-station infrastructure

A sub-station is an important element of an electricity generation, transmission and distribution system. Its function is mainly to transform voltages from high to low or the reverse, using transformers and other heavy-duty electrical switchgear. Sub-stations are generally designed to accomplish the following functions:

- Stepping up or stepping down voltage.
- Regulating voltages to compensate for system voltage changes.
- Switching transmission and distribution circuits into and out of the grid system.
- Measuring the electric power qualities flowing in the circuits.
- Connecting communication signals to the circuits.
- Control of electrical surges, including from lightning.
- Connecting electric generation plants to the system.
- Facilitating interconnections between the electric systems of more than one utility.
- Control reactive kilovolt-amperes supplied to, and the flow of reactive kilovolt-amperes in the circuits.

Table 1 Sub-station components and their functions

EQUIPMENT	FUNCTION
Transformers	To step-down or step-up voltage and transfer power from one current to another. The windings of such large transformers are immersed in transformer oil, which is a highly refined mineral oil that is stable at high temperatures and has excellent electrical insulating properties. Its functions are to insulate, suppress corona and arcing, and to serve as a coolant for transformers
Circuit breakers	Automatic switching during normal or abnormal conditions
Feeder bay	Steelwork housing for circuits
Reactors	Equipment for the efficient operation of long transmission power lines as they compensate the voltage on power lines to avoid uncontrolled voltage rise, especially on lightly loaded lines
Isolators	Equipment for de-energising a circuit for maintenance and repair
Busbars	Incoming and outgoing circuits of the same voltage tie into a common node called a busbar, which consists of a number of tubular conductors made of aluminium
Oil holding dams	For containment of accidental oil spills from transformers
Wave trapper	Equipment for trapping communication signals sent via the transmission lines rather than the telephone network
Loop-in lines	Incoming power lines (connected to busbars)
Loop-out lines	Outgoing power lines (connected to busbars)
Telecommunication mast	Equipment used for remote communication with the sub-station
Buildings	Administrative office, control room, ablution blocks, equipment and storage areas
Lighting	For safety and security as well as for night-time emergency operations and maintenance

Plate 1 Sub-station busbars

Plate 2 Transformers

Plate 3 Transformer showing oil storage and fans for cooling

Plate 4 Sub-station and communication tower

Plate 5 Oil holding dam

1.2.2 Proposed Isundu Sub-station infrastructure

1.2.2.1 Electrical infrastructure

The proposed Isundu Sub-station is being planned to accommodate the following known transmission lines:

- 1 x 765 kV transmission line (the authorised VSHA transmission line).
- 2 x 400 kV double-circuit transmission lines from the sub-station to tie into the existing Hector-Ariadne 400 kV double-circuit transmission lines approximately 4 km away.

The EAP is also aware of the following transmission lines which are subject to a separate environmental authorisation process:

- 2 x 400 kV lines from the proposed Mbewu Sub-station near Empangeni.

In addition, the site and layout design allows sufficient space to accommodate additional transmission lines if required at some point into the future. The space allowed will potentially accommodate at an unknown time in the future the following additional transmission lines:

- 1 x 765 kV or High Voltage Direct Current (HVDC) transmission line.
- 3 x 400 kV transmission lines.

The proposed sub-station will include the standard electrical components required such as transformers, reactors, busbars, isolators etc. as listed in Table 3.

Environmental authorisation has been applied for a 100 ha site. If fully developed into the future, the sub-station infrastructure footprint will be approximately 50-60 ha, whilst for the initial phase of development the sub-station is likely to have a footprint in the region of 25 ha.

1.2.3 Other infrastructural components

Other infrastructure included in this application includes:

- A tarred access road to the sub-station with a total width, shoulder to shoulder, of approximately 9 m. The length is estimated to be approximately 750 m.
- Access to the towers will be via tracks across the veld from within the corridor, wherever possible.
- A microwave radio communication mast with a height of approximately 75 m.
- Floodlight masts approximately 36 m high.
- Oil and fuel storage facilities and an oil bund to contain any transformer oil spills with a capacity of ≥ 30 m^3 but ≤ 80 m^3.

1.2.4 Proposed transmission lines

This environmental application also includes the construction of two double-circuit 400 kV transmission lines from the proposed Isundu Sub-station to the existing Hector-Ariadne 400 kV double-circuit transmission line.

The reason for proposing a double-circuit transmission line is that it will allow Eskom in the future to increase capacity at the sub-station without needing to secure an additional servitude to the immediate south of the sub-station, an area which is rapidly developing.

Thus, the long-term planning advantage of constructing these towers now outweighs the financial disadvantage of constructing these more expensive towers over this short distance of approximately 4 km.

The required servitude for these 400 kV double circuit lines is 55 m for a single line and 110 m where the lines run in parallel (except if they go through forestry, which they do not in this area, where the servitude then increases to 131 m for a double-circuit transmission line).

The standard process for the construction of transmission lines is described in Section 5.5.

Plate 6 shows the existing Hector-Ariadne 400 kV double circuit transmission line towers which are 35.98 m high.

Plate 6 Double-circuit 400 kV transmission line

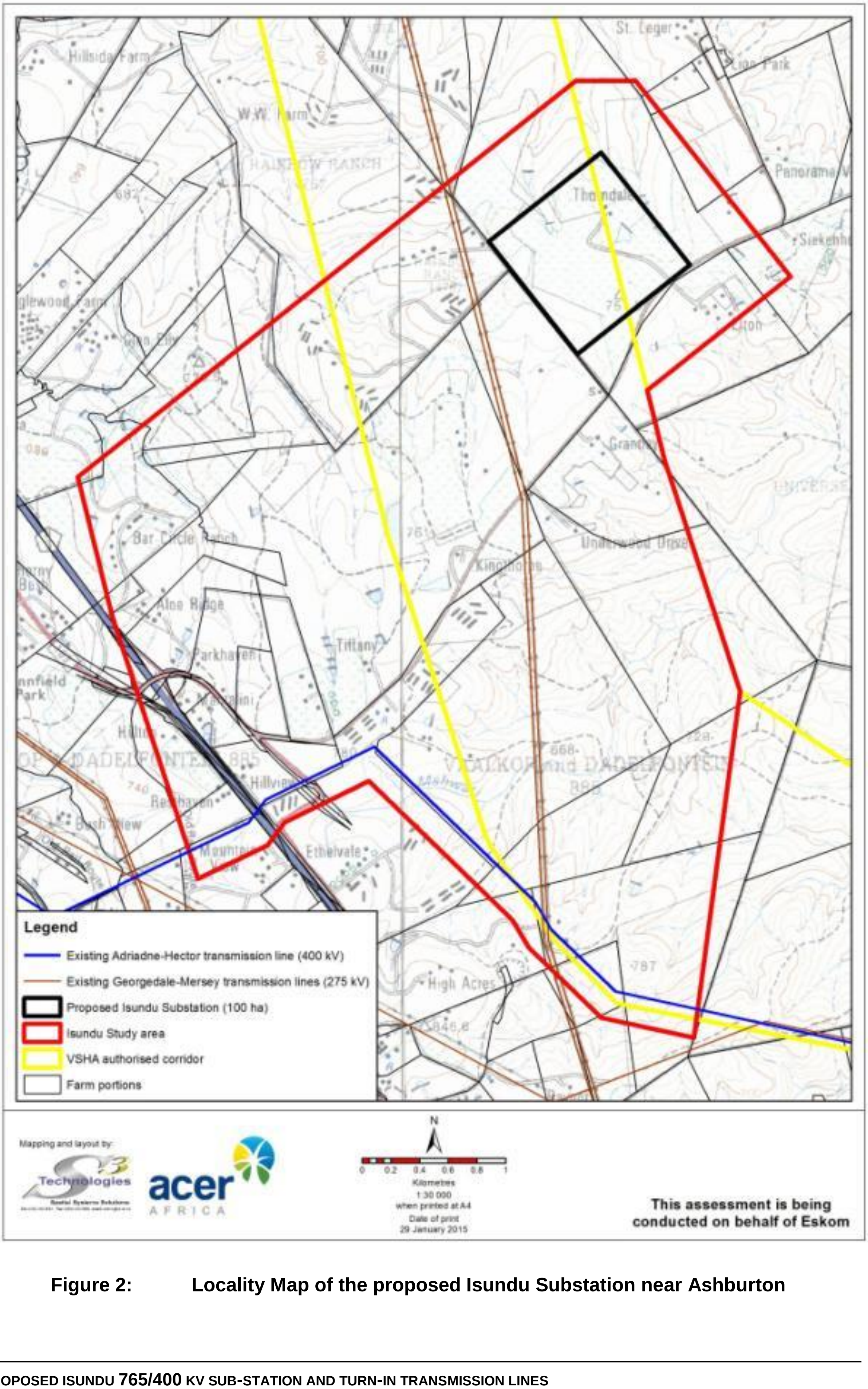

Figure 2: Locality Map of the proposed Isundu Substation near Ashburton

2. WETLAND ASSESSMENT

2.1 Overview of wetlands

According to the National Water Act, 1998 (Act 36 of 1998) vegetation is the primary indicator, which must be present under normal circumstances. For this reason vegetation was used as an indicator for the wetland delineation.

Wetland and riparian area boundaries were determined in the field in accordance with: Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas (DWAF, 2008). There are several, small aquatic ecosystems scattered across the site, which together only make up 1% of the site. The following wetland hydrogeomorphic types were identified on the sub-station site and within the 500 m buffer zone (after Kotze, *et. al*., 2007):

- Four pans/depression wetlands.
- Three isolated hillslope seepage wetlands.

There are 12 small farm dams located within the study area that range in size from 0.03 ha to 0.60 ha, averaging around 0.16 ha (Figure 3). Most of the dams occur within and/or are connected to the riparian systems draining the study area. The largest dam (i.e. D02; Figure 2) is located roughly in the centre of the property, and appears to hold water throughout the year. The other dams were found to be either completely dry or holding only a small amount of surface water at the time of the site visit.

The main farm dam (i.e. D02) has well-defined marginal wetland habitat (owing to the maintained water levels), and comprises a mix of aquatic herbs, sedges and grasses, dominated by *Cyperus dives* and *Typha capensis*. This dam has potential to support aquatic fauna, in particular several species of amphibian including conservation important species such as *Afrixalus spinifrons* (*c.f.* Fauna report; GroundTruth, 2015). Fish such as *Clarius gariepinus*, *Micropterus salmoides* (exotic), *Tilapia sparrmanii* and *Pseudocrenilabrus philander* are likely to occur within this dam. The other dams will also support various aquatic fauna and flora, but in lower abundances. All the dams are an important source of drinking water for larger mammals, especially during the dry periods when surface water becomes confined to several of the dams.

It is important to note that the wetlands found on site form part of a larger group of riparian wetlands which are situated all around the site. During the site visit, the following wetlands that were identified are shown in Figure 3.

Less than 50% of the site falls within the wetland area, however the site is surrounded by wetland areas. According to the National Water Act, 1998 (Act 36 of 1998), a water use licence would be required from the Department of Water Affairs to carry out any activity involving modifications to a watercourse as well as the bed or banks of the watercourse. Hence, no infrastructure should be located within a watercourse, or 30 m from its edge, unless it is authorised by the DWS.

2.2 Wetlands found on site

Table 2 Summary description of watercourses found in the study area

WETLANDS						
No on Map	Description	PES	EIS	Natural or Man-made	Where system flows	Location
P1	Wetland: seasonally wet pan affected directly by sub-station site. Natural Habitat: hydrophilic sedges, grasses and forbs	PES: A (Natural/ unmodified)	2.3	Natural	N/A	29°39′59.14″S 30°30′49.09″E
P2	Wetland: seasonally wet pan affected directly by sub-station site. Natural Habitat: hydrophilic sedges, grasses and forbs	PES: A (Natural/ unmodified)	2.3	Natural	N/A	29°39′49.44″S 30°30′47.23″E
P3	Wetland: seasonally wet pan affected directly by sub-station site. Natural Habitat: hydrophilic sedges, grasses and forbs	PES: A (Natural/ unmodified)	2.3	Natural	N/A	29°39′56.61″S 30°30′39.39″E
P4	Wetland: temporarily wet pan not directly affected by sub-station site. Natural habitat:	PES: A (Natural/ unmodified)	1.4	Wetland conditions are a result of altered ground levels due to road construction	N/A	29°40′05.07″S 30°30′36.71″E
HS1	Wetland: Hill-slope seepage not feeding a watercourse. Natural Habitat: mix of hydrophilic and terrestrial sedges, grasses and forbs. It is directly affected by sub-station	PES: A (Natural/ unmodified)	1.4	Natural	No direct surface water connection to a stream channel, however outflow is via diffuse flow to riparian area down slope	29°39′51.59″S 30°30′29.96″E
HS2	Wetland: Hill-slope seepage not feeding a watercourse. Natural Habitat: mix of hydrophilic and terrestrial grasses, sedges and forbs. It is not directly affected by sub-station	PES: A (Natural/ unmodified)	1.6	Natural	No direct surface water connection to a stream channel, however outflow is via diffuse flow to riparian area down slope	29°39′45.23″S 30°31′26.61″E
HS3	Wetland: Hill-slope seepage not feeding a watercourse. Natural Habitat: mix of hydrophilic and terrestrial grasses, sedges and forbs. It is not directly affected by sub-station	PES: A (Natural/ unmodified)	1.5	Natural	No direct surface water connection to a stream channel, however outflow is via diffuse flow to riparian area down slope	29°40'18.3"S 30°30'51.2"E

RIPARIAN HABITATS						
Site	**River Type**	**PES**	**IHI**	**Natural or Man-made**	**Where the system flows**	**Location**
RZ01	A Channel Moderate degree of alien plant infestation, notably by species such as *Lantana camara* and *Solanum mauritianum*. Other factors affecting these sections include flow modification due to small dams located upstream, and bank erosion (largely due to banks becoming exposed, de-stabilised and eroded as a result of alien vegetation).	PES: B (Largely natural)	83	Natural	Drains the site from the north	North eastern portion of the site.
RZ01	B Channel There is a small degree of alien plant infestation. Other impacts (albeit limited), are largely caused by bank erosion and flow modification by small dams.	PES: A/B (Natural / Largely natural)	90	Natural	Drains the site from the north	North eastern portion of the site.
RZ02	A Channel There is a small degree of alien plant infestation. Other impacts (albeit limited), are largely caused by bank erosion and flow modification by small dams.	PES: A/B (Natural / Largely natural)	93	Natural	Drains the site from the north	North western portion of the site.
RZ02	B Channel Impacts to the riparian zone are minor and include a light infestation of alien plants and limited flow modification by a small farm dam.	PES: A (Natural)	96	Natural	Drains the site from the north	North western portion of the site.
RZ03	A Channel A small to moderate infestation of alien plants (e.g. *Lantana camara*, *Schinus terebinthifolius* and *Solanum mauritianum*). More serious impacts include bank erosion, channel incision and flow modification, caused largely by the road and culverts, with concomitant impacts from stormwater runoff. Other impacts include vegetation removal and modification of channel, and a small amount of solid waste dumping.	PES: B/C (Largely natural / Moderately modified)	82	Natural	Drains from the west	West of the site
RZ04	A Channel Exotic vegetation and concomitant bank erosion are the dominant drivers of the moderate decline in riparian habitat condition. Bank erosion is exacerbated by increased stormwater runoff from the road, resulting in the bed becoming modified through sedimentation. There is localised dumping of solid waste on the left bank, below the road crossing. Other impacts include vegetation removal and modification of channel.	PES: C (Moderately modified)	66	Natural	Drains the site from the west	Western portion of the site

RZ05	A Channel Livestock result in moderate impacts resulting in localised vegetation removal, bank erosion and bank collapse. There is also a small to moderate infestation of alien plants (e.g. *Lantana camara* and *Solanum mauritianum*), with channel and flow modification affecting sections of riparian habitats downstream of the road crossing.	PES: A/B (Natural / Largely natural)	90	Natural	Drains the site from the west	South of the site.
RZ05	B Channel Impacts to the riparian zone are fairly limited with vegetation removal and bank erosion the principle drivers in the riparian system, and largely influenced by livestock impacts (e.g. grazing, trampling, etc.). Other impacts include a small infestation of alien plants and modification by footpaths.	PES: A/B (Natural / Largely natural)	92	Natural	Drains the site from the west	South of the site.
DAMS						
There are 12 small farm dams located within the study area that range in size from 0.03 ha to 0.60 ha, averaging around 0.16 ha (Figure 3). Most of the dams occur within and/or are connected to the riparian systems draining the study area. The largest dam (i.e. D02; Figure 3) is located roughly in the centre of the property, and appears to hold water throughout the year. The other dams were found to be either completely dry or holding only a small amount of surface water at the time of the site visit.						

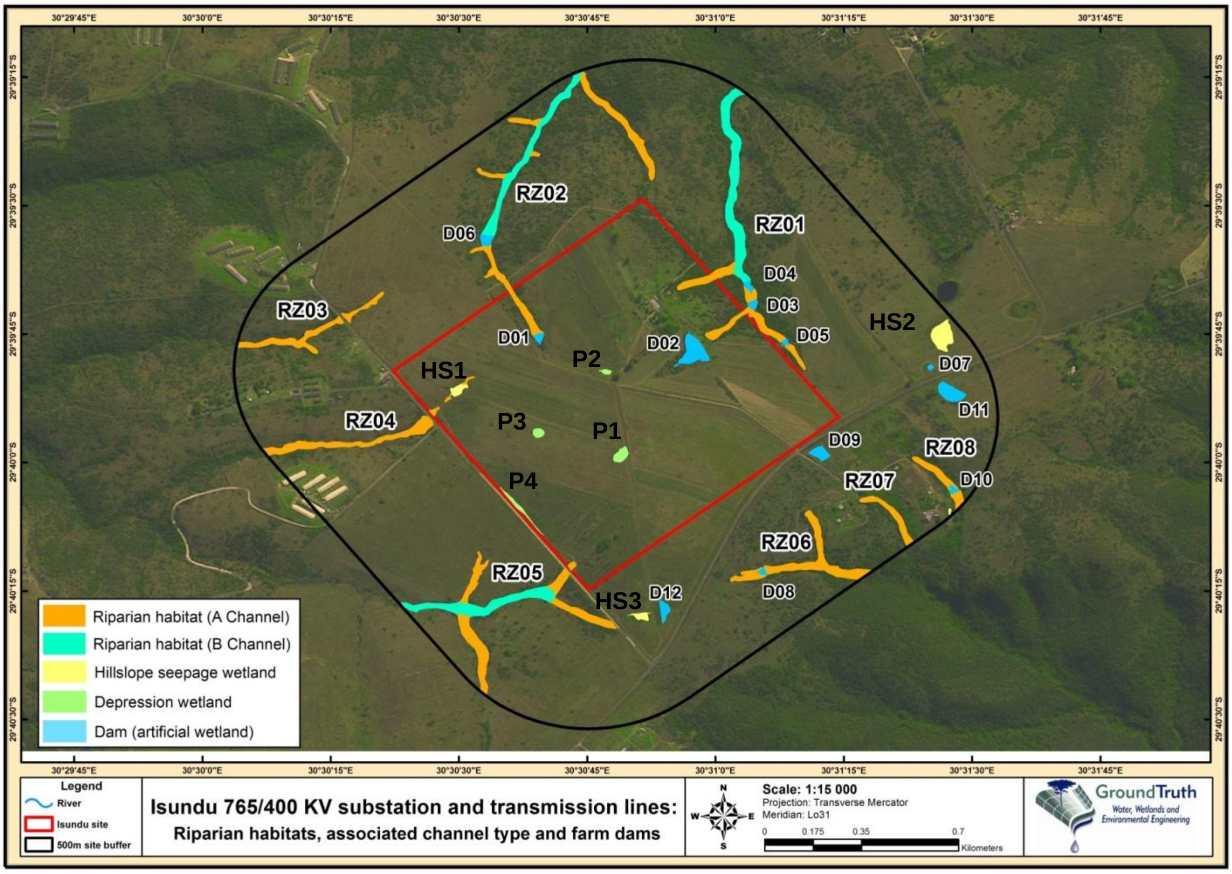

Figure 3 Water Courses in the Study Area

3. CONSTRUCTION METHODOLOGY FOR WORKING WITHIN WETLANDS

The construction methodology for working within wetlands, a requirement of the Section 21 (c) and (i) Water Use Licence Application, is a legally authorised document that must be implemented to fulfil the requirements of the authorisation. The construction methodology for working within wetlands supports and should be read in conjunction with the site specific Environmental Management Programme (EMPr) for the proposed Isundu Sub-station project.

This construction method statement is an evolving guideline that needs to be updated or adapted as progress is made, and successes and failures of procedures are identified. For successful rehabilitation, it is imperative that this plan is at all times used in conjunction with the approved EMPr.

- No construction activities are to be undertaken within wetlands and/or watercourses unless approved by the project manager, the ECO, DWS and the DEDTEA.
- Timing of the construction of the sub-station project should only occur during the dry season to minimise erosion, increased sedimentation and turbidity

3.1 Site demarcation

- The ECO and Contractor must ensure that all wetlands to be affected by the project have been identified, delineated, photographed and clearly demarcated by the ECO prior to any construction work on the sub-station commences.

3.2 Site Access

- No crossing of wetlands and/or watercourses is permitted by any heavy vehicle or heavy machinery, unless approved by the project manager, the ECO, DWS and the DEDTEA.

3.3 Site clearance

- All indigenous vegetation is to be removed as indicated by the ECO. This vegetation must be removed where possible with the rootball/root system intact. This vegetation is to be kept moist by means of placing it in the shade, covered with moistened hessian cloth until it is ready to be replanted. This action must be done under the guidance of the ECO or the specialist
- Plant material must be removed using the necessary machinery matching the scale of operation, i.e. a back hoe or tracked excavator will be the best machine to dig out, lift and place to the side, outside the construction area, and this applies to the plants that are affected by the construction of the sub-station.

3.4 Construction through Wetlands and Ephemeral Drainage Lines

- The Contractor must avoid the unnecessary compaction and impacts on sensitive wetland and riparian soils.
- The majority of the flow of the wetland/watercourse must be allowed to pass down the river (i.e. no damming must be allowed to take place). In-stream diversions must allow for continuous water flow. The construction of new channels is not permitted.
- No toxic or harmful substances may be used without prior approval from the DWS and the DEDTEA.

- Construction should not permanently alter the surface or subsurface flow of water through the wetlands and/or watercourses.
- No construction materials are to be stockpiled or spoil material deposited within any wetland and/or watercourses.

3.5 Erosion Control

- Care should be taken that the slopes do not cause erosion to the wetland.
- Surface or storm water must not be concentrated or allowed to flow down cut or fill slopes without erosion protection measures being in place.
- Temporary water diversion measures are to be designed and protected so that no undue scouring of river banks occurs.
- Ensure that channels do not discharge straight down contours. They should have the least possible angle when aligned to the contour.
- Rocks for use in gabion baskets/reno mattresses must not be obtained from a watercourse; these must be provided by the service provider.

3.6 Reinstatement of Wetlands and Watercourses

- Stockpiled wetland soil and vegetation that has been stockpiled alongside the servitude edges must be placed in the reverse order as to which it was removed (subsoil first followed by topsoil and finally the wetland plants) within disturbed wetland areas. Reinstated wetland soil must not be compacted, as this will prevent water saturation and proper vegetation reestablishment. Should compaction occur, then area must be ripped to reduce the density of the soil.
- Once the fill for the sub-station site has been placed and reshaped, the remaining wetlands should be left in a slightly rough state, the depressions will collect seed and water. These depressions can be created using the tines of a back hoe or excavator bucket run gently in the soils along the contour to a depth of about 100mm so that the water does not run off the disturbed area.
- All waste products (spoil, construction materials, fill, hazardous substances and general litter) must be removed from the wetland area and disposed of in proper local waste facilities.
- Watercourse banks are to be returned to their original profile.
- No ridge/depressions/unnatural depressions are to remain which could act as channels for preferential water flow.
- The contractor is to preserve all riparian and wetland vegetation for use in rehabilitation.
- Vegetation is to be replaced, where possible, in the immediate areas from where it was removed.
- An integrated invasive weed control programme is to be used to ensure that alien plants are eradicated within the trenching servitude. These invasive plants within the trenching servitude must be removed using only mechanical means. No herbicides are to be used in the wetland areas.

Post rehabilitation monitoring must be carried out by the onsite ECO to ensure that the wetland rehabilitation has been successful. Vegetation growth, hydrological functioning, evidence of erosion and deposition are some of the key areas to be checked regularly. In this way, any problems can be rectified in a timely fashion and so managed in an adaptive manner.