NGWEDI SUBSTATION ENVIRONMENTAL MANAGEMENT PLAN (EMP) – WATERCOURSES (WETLANDS, RIPARIAN AREAS & DRAINAGE LINES)

Specialist Report

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Date: November 2012

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CC Reg. No: 2007/043725/23
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1. INTRODUCTION

1.1. Background

Baagi Environmental Consultancy approached Imperata Consulting to compile an Environmental Management Plan (EMP) for watercourse impacts associated with the proposed construction of the Ngwedi Substation. The EMP fieldwork component formed part of a "walk down" survey associated with the separate, but related, 400 kV Ngwedi transmission line project. The Ngwedi Substation forms the start point of the 400 kV line project. The Ngwedi Substation study area overlaps with the south-eastern most portion of the 400 kV line project, referred to as the Ngwedi Corridor in this report.

Watercourses identified during the study were largely based on the following definitions of a watercourse listed in the National Water Act, 1998 (NWA), Act No. 36 of 1998:

- A river or spring.
- A wetland, lake or dam into which, or from which, water flows.
- A natural channel in which water flows regularly or intermittently.

In addition, drainage line features that were not clearly defined as wetlands, riparian habitat or natural channels were also demarcated along with more distinct watercourses. This was done as part of a conservative approach where opportunities for field verification and detailed watercourse delineation were constrained. This report focuses on the possible impacts of the proposed Ngwedi Substationon on the physical state of the study area, specifcially on watercourses and other drainage lines that may be present.

1.2. Terms of Reference

The terms of references followed for this component of the larger Environmental Management Plan (EMP) include:

- A desktop and literature review of watercourses and other drainage lines expected in this study area (illustrated Ngwedi Corridor), specifically at the proposed Ngwedi Substation position.
- A "walk-down" survey that will investigated investigate the position of the Ngwedi Substation.
- A description of the general study area.
- Identification of potential project-related watercourses impacts and mitigation measures.
- Prepare a graphic presentation of "problem areas" in need of mitigation.
- Include specific actions that should be included in the EMP.

- Make recommendations on sections that require pro-active management procedures during the construction and operation of the substation, including movement/repositioning should the substation overlap with sensitive watercourse features.
- Identification of assumptions, exclusions and key uncertainties.

1.3. General assumptions

- This study assumes that the project proponents will always strive to *avoid, mitigate* or *offset* potentially negative project related impacts on the environment, with impact avoidance being considered the most successful approach, followed by mitigation and offset. It further assumes that the project proponents will seek to enhance potential positive impacts on the environment.
- Spatial datasets received and used as part of the field survey and desktop analyses are accurate. This is of particular reference to the localities of pylons associated with the two parallel power lines (alignment 1 and 2).
- The project proponents will commission an additional study to assess the impact(s) if there is a change in the size and/or extent of the study area (power lines) that is likely to have a potentially highly significant and/or unavoidable impact on surface watercourses (e.g. wetlands).

1.4. Overview of wetlands and riparian habitat as surface watercourses

1.4.1. What are wetlands?

In terms of the Ramsar Convention on Wetlands (Iran 1971), to which South Africa is a contracting party, "… wetlands include a wide variety of habitats such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as salt marshes, mangroves, and sea grass beds, but also coral reefs and other marine areas no deeper than six meters at low tide, as well as human-made wetlands such as waste-water treatment ponds and reservoirs" (Ramsar Convention Secretariat 2007).

In South Africa, wetlands are defined as "…land which 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 land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil" (National Water Act, Act No. 36 of 1998), (NWA). Wetlands are also included in the definition of a watercourse within the NWA, which implies that whatever legislation refers to watercourses will also be applicable to wetlands. The types of features included within the definition of a watercourse include:

- "…a river or spring…"
- "…a natural channel in which water flows regularly or intermittently…"
- "…a wetland, lake or dam into which, or from which, water flows…"
- "…any collection of water which the Minister may, by notice in the *Gazette*, declare to be a watercourse…"

In addition, the NWA stipulates that "…reference to a watercourse includes, where relevant, its bed and banks…". This has important implications for the management of watercourses and encroachment on their boundaries, as discussed further on in this document.

The NWA defines riparian areas as "…the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas…" Note that this does not imply that the plant species within a riparian zone must be aquatic, only that the species composition of plant assemblages must be different within the riparian area and adjacent uplands.

In terms of the latest wetland delineation document available from the Department of Water Affairs and Forestry (DWAF), now known as the Department of Water and Environmental Affairs (DWEA), "wetlands must have one of the following attributes" (DWAF 2005):

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

It follows that the level of confidence associated with a specific area being considered as a wetland is proportionate to the number of confirmed indicators that positively correlate with wetland habitat. Not all indicators are always present within a specific biophysical and land use setting, while not all indicators are always reliable and/or useful under all conditions. The use of additional wetness indicators from different disciplines that are internationally applied therefore adds value and confidence in the identification and delineation of wetland habitats, especially in challenging environments (Illgner et al., 2009).

1.4.2. Why are wetlands important?

Wetlands are reputed to inter alia (Castelle et al., 1992; Kotze et al., 2005):

- Attenuate floods.

- Recycle contaminants, nutrients and sediments.
- Can contribute to the recharge of groundwater resources.
- Provide an important habitat that support biodiversity.
- Provide food, building and other materials for a variety of direct human uses.

However, it is important to note that not all wetlands perform all of these functions to the same extend and that certain functions can be absent in certain wetland types. In addition, the potential of a wetland to perform specific functions (ecosystem services) also depends on the available opportunity and the integrity (state) of the wetland system (Kotze et al. 2005; Macfarlane et al. 2008).

1.4.3. Why protect headwater drainage lines and small wetlands?

Small drainage lines and other surface watercourses should be afforded the same protection as well defined wetlands and larger watercourses, as these systems also provide important functions.

Headwater drainage lines

Headwater drainage lines that only carry storm flow are ephemeral streams or A section channels that form part of first-order and even second-order streams of rivers, located at the source of drainage line networks. These drainage lines are never or very seldom in connection with the zone of saturation and they consequently never have base flow and are unlikely to support wetland conditions (DWAF 2005).

The Practical Field Procedure for Delineation of Wetlands and Riparian Areas document describes A section headwater channels as (DWAF 2005): "…headward channels that are situated well above the zone of saturation at its highest level and because the channel bed is never in contact with the zone of saturation, these channels do not carry baseflow. They do however carry storm runoff during fairly high rainfall events but the flow is of short duration because there is no baseflow component. It is important to note that these steep, eroding, headward watercourses do not have a riparian habitat because they are too steep to be associated with deposition of alluvial soils and are not flooded with sufficient frequency to support vegetation of a type that is distinct from the adjacent land areas." "The A sections are the least sensitive watercourses in terms of impacts on water yield from the catchment. They are situated in the unsaturated zone and in this respect their position in the landscape is little different from nonriparian hillslope positions."

It can be argued that indistinct drainage lines should still be regarded as important landscape features based on international literature:

- The role and functions of headwater streams within catchments and their linkages with downstream aquatic systems are not thoroughly understood (Gomi et al., 2002). Recent research, however, ascribes increasing importance to these systems regarding catchment and water resource management (Berner et al., 2008).
- Headwater drainage lines are crucial systems for nutrient dynamics as a link between hillslopes and downstream watercourses (Gomi et al., 2002).
- They are directly linked to downstream aquatic systems and have a direct bearing on the health and functioning of larger aquatic systems, especially regarding water quality of downstream aquatic systems (Gomi et al., 2002; Dodds & Oaks 2008).
- "Seasonal streams and wetlands are usually linked to the larger network through groundwater even when they have no visible overland connections." (Meyer et al., undated).
- The large spatial extent of headwater channels in the total catchment area make these systems important sources of sediment, water, nutrients and organic matter for downstream systems (Gomi et al., 2002).
- "…scientists know that headwater streams make up at least 80 percent of the nation's stream network" (Meyer et al. undated, with reference to the United States of America).
- "Headwater systems are important sources of sediments, water, nutrients, and organic matter for downstream reaches." (Gomi et al., 2002).

Small and isolated wetlands such as endorheic depressions (pans)

- "Ecologists describe the value of small isolated wetlands by their aggregate role in protecting wetland-dependent species through "source-sink dynamics". More variable than larger wetlands, each small wetland in an area may fluctuate in the number of individuals of a species it contains; at times a wetland may act as a "sink" when the population of a species dies out locally from that wetland, or it may be a "source" that produces surplus individuals, which can colonize a nearby sink wetland. Populations of a species that are spread over a number of locations are referred to as "metapopulations", and this source-sink dynamic is crucial to the regional survival of species. A metapopulation of a wetland-dependent species depends on the abundance and proximity of wetlands, rather than a critical size threshold. The disappearance of small wetlands from an area that relies on source-sink dynamics could result in the loss of ecological connectedness and potentially collapse the metapopulations of wetland-dependent species, causing many local extinctions." (Semlitsch, 2000).
- "To protect ecological connectedness and source-sink dynamics of species populations, wetland regulations should focus not just on size but also on local and regional wetland distribution. At the very least, wetland regulations should protect wetlands as small as 0.2 hectares – the lower limit of detection by most remote sensing – until additional data are available to directly compare diversity across a range of wetland sizes." (Semlitsch, 2000).

1.5. Experience of the author

1.5.1. L.E.R. Grobler

Retief Grobler has majors in Botany (UP) and Soil Science (UP), an honours degree in Botany from the University of Pretoria (cum laude), and a MSc (cum laude) from the Department of Plant Sciences (UP), with a focus on peatland wetland systems. He is a registered Pr. Sci. Nat. professional natural scientist in the fields of Botanical Science and Ecological Science (Reg. no. 400097/09). He has been working as a consultant based in Gauteng, with working experience in Mpumalanga, North-West, Northern Cape, Free State, and KwaZulu-Natal Provinces over the last six years. Areas of interest include wetlands, peatlands, headwater systems and drainage lines in arid environments.

2. METHOD

2.1. General

The following approach and method were used as part of the surface watercourse EMP study:

- A "walk-down" survey around the Ngwedi Substation. A desktop analysis of aerial photographs, 1: 50 000 topographical maps and Google Earth imagery.
- These spatial datasets were used to identify the occurrence of watercourses at the proposed Ngwedi Substation and the surrounding study area. The surrounding study area includes the south-eastern portion of the Ngwedi Corridor and a 500 metre buffer area around the proposed substation. The Ngwedi Corridor is associated with a separate 400 kV line that is defined by a 500 m buffer around the centerline of the proposed alignment (Figure 1).
- Watercourse impacts in the Ngwedi Corridor associated with the proposed 400 kV transmission line forms part of a separate study, which incorporates the Elands River (Figure 1).
- Potential wetland riparian habitat was identified and demarcated through the procedure described by DWA (previously DWAF) in their document entitled: "A Practical field procedure for the identification and delineation of wetlands and riparian areas" (DWAF 2005).
- Available watercourse indicators were investigated including hydromorphic features, presence of hydrophytes, and terrain unit features (e.g. valley bottom settings and "nick points") at different sample points. Additional indicators of temporary to permanent saturated surface or near surface conditions that are available in scientific literature were also recorded (Noble et al. 2005).

- Maps were created that illustrate watercourse features along with the proposed Ngwedi Substation in the south-eastern portion of the Ngwedi Corridor.
- Mitigation measures are provided to address several possible watercourse impacts associated with the construction and operational phases of the project.

2.2. Limitations

The following refers to limitations that affect information represented within this report:

- It is important to note that limited fieldwork was undertaken due to the "walk down" nature of the survey, which also included an investigation of pylon positions as part of the 400kV project.
- The investigation of watercourse features in the study area was further constrained by limited vegetation indicators as a result of winter growing conditions. A strong desktop component was therefore used to demarcate drainage line features located in close proximity and further away from the proposed Ngwedi Substation.
- Consequently the level of accuracy associated with watercourse boundaries is regarded as moderate. A conservative delineation approach was adopted to make provision for uncertainty in the extent of watercourse boundaries.
- A follow-up survey was undertaken in early November at the start of the growing season to investigate dominant plants species present in a watercourse. Clarification was required on the nature of the watercourse, as it appeared transitional between wetland and riparian habitat.
- No wetland or riparian classifications, detailed descriptions or ecosystem integrity assessments, such as Present Ecological State (PES) & Ecological Importance and Sensitivity (EIS) Assessments, form part of this study.
- No specialist ecological or watercourse-related report that may have been produced during the Ngwedi EIA or BA process was available at the time of report writing

3. STUDY AREA DESCRIPTION

3.1. Location

- The study area is located approximately 33km north-northwest of Rustenburg in the North-West Province.
- Existing power line pylons are present north and south of Ngwedi Substation.
- The study area is characterised by open thornveld on plains with more woody savanna elements on rocky outcrops. Typical land use in the study area includes livestock grazing, while road crossings, existing power lines, and historic kraal settlements (ruins) are the most common anthropogenic features.
- Modern dwellings (settlements) are dispersed around the corridor, while a mine is located approximately 700m southwest of Ngwedi Substation.
- Frischgewaagd settlement is located approximately 3.3 km northwest of Ngwedi Substation, while Chaneng Settlement is located approximately 2.9 km to the east (Figure 1).

3.2. Catchments

- The study area forms part of the Crocodile (West) and Marico Water Management Area (WMA).
- The study area falls within Quaternary Catchment A22F.
- Quaternary Catchment A22F has a class D *largely modified* Present Ecological State (PES). The Ecological Importance and Sensitivity (EIS) class of the catchment is considered as *moderate* (Middleton & Bailey 2008).

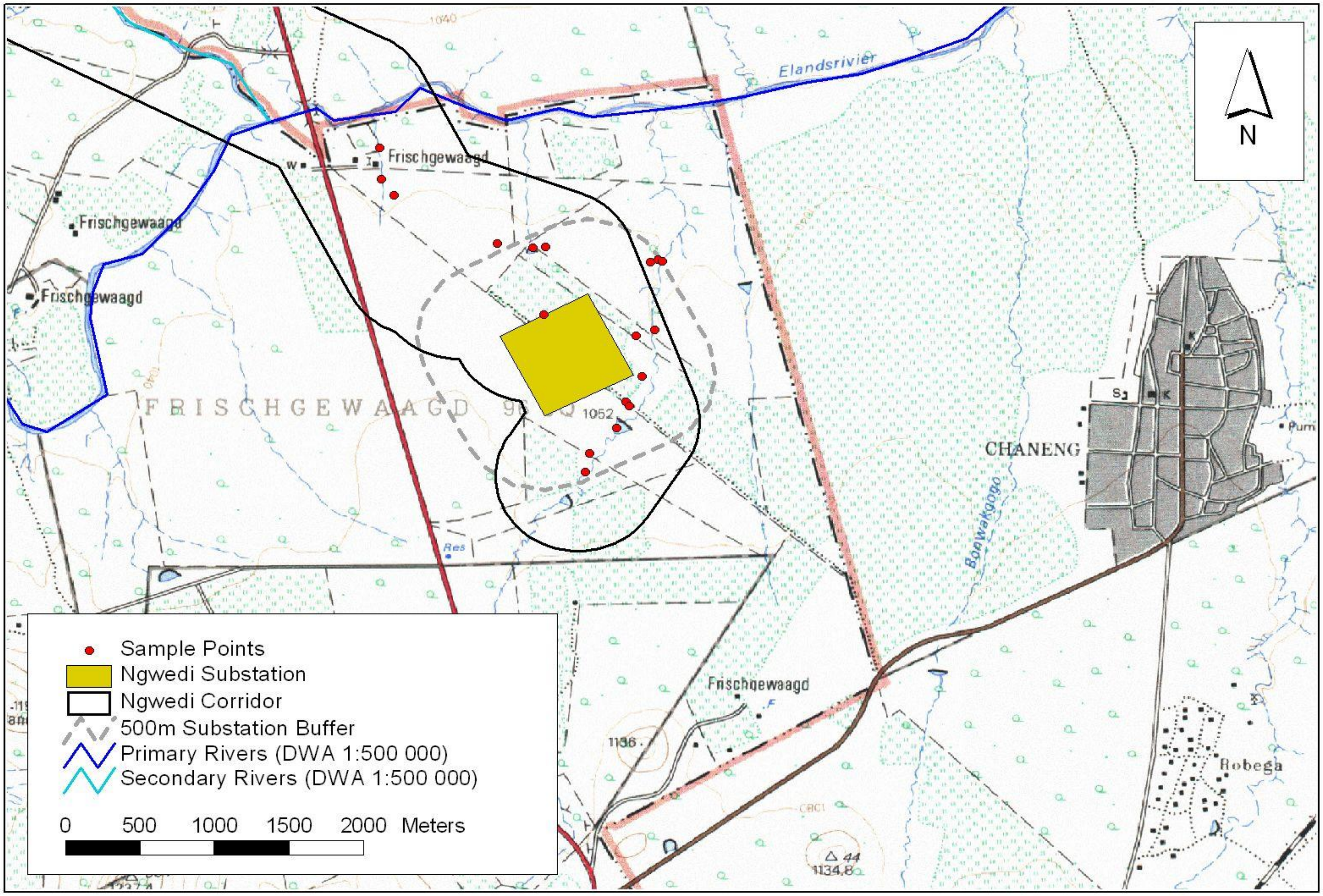

Figure 1: Location map of the proposed Ngwedi Substation, the south-eastern portion of the Ngwedi Corridor associated with the separate transmission line project, and a 500 metre buffer around the substation (topographic map 2527AC).

3.3. Local climate

- The study area is located the summer rainfall region with dry winters. The Mean Annual Precipitation (MAP) of ±600 mm is significantly lower than the Mean Annual Potential Evaporation (MAPE) of ±2484 mm (Middleton & Bailey 2008; Mucina & Rutherford 2006).
- The study area has a Mean Annual Temperature of approximately 18.6°C, while the number of Mean Frost Days per annum ranges between 23-26 (Mucina & Rutherford 2006).

3.4. Regional geology and soils

- Grass dominated plains are associated with high base-status clay soils with deep profiles that often display vertical properties (swelling and shrinking), while shallower and sandier soils are associated with quartzite ridges further to the west away from the study area (Mucina & Rutherford, 2006).
- The volcanic derived alkaline complex associated with the Pilanesburg Mountains is located north of the study area.

3.5. Vegetation

- The vegetation of the site is located within the Central Bushveld Bioregion and forms part of the recently described Zeerust Thronveld vegetation unit (Mucina & Rutherford, 2006).
- The vegetation unit has a least-threatened conservation status (Mucina & Rutherford, 2006).
- No linear wetlands connected to the drainage network were mapped by Mucina & Rutherford (2006) within the study area and its immediate surroundings.
- The reason for the exclusion of linear wetlands and pans is due to the azonal nature of wetland and riparian systems that constrains their incorporation into regional vegetation maps (Mucina & Rutherford, 2006).

4. FINDINGS & DISCUSSION

4.1. Identified watercourses and infrastructure impacts

- Identified watercourses that include wetlands, riparian habitat and small pan wetlands, as well as indistinct drainage lines were buffered by 50 m (Figure 2).
- These buffered watercourse areas are regarded as sensitive features that should be excluded from construction impacts (Figure 2).
- Figure 2 illustrates different watercourses demarcated within the Ngwedi Substation footprint and its surroundings in the Ngwedi Corridor study area.
- Figure 3 illustrates the combined sensitive watercourses, which includes all of the identified watercourses, as well as their associated buffer zones.
- Buffer zone sizes have been derived from published literature in a South African context for rural areas where the development pressure is lower compared to watercourses located inside highly urbanised areas (GDARD 2011).
- Delineated watercourses around the Ngwedi Substation and in a 500 m buffer thereof include the following:
    - An indistinct drainage line in the north that lacks clear wetland or riparian indicators, but die have channel features, often in the form of swales, which are considered to be consistent with the author's interpretation for a natural channel in which water regularly or intermittently, as defined in the National Water Act, Act No. 36 of 1998.
    - A better defined watercourse is present south and south-east of the proposed substation and is regarded to consist predominantly of riparian habitat. Its downstream portion supports well defined riparian habitat on rocky channel banks and bed. Typical riparian species include *Acacia mellifera, Grewia flava, Searsia lancea, Ziziphus mucronata,* and *Acacia caffra* (Figure 4). The upstream portion does not contain a high abundance of riparian species, but woody species such as *Searsia lancea* and *Asparagus laricinus* are present. This portion of the watercourse is, however, not regarded as a wetland due to the absence of obligated hydrophytes and inconclusive signs of soil wetness in the vertic clays. Channel features and vegetation with a different species composition is present in this portion of the watercourse; it lacks outcrops and is dominated by clay heavy soils (Figure 5). In addition, the grass species *Bothriochloa* cf. *radicans* is present in dense stands in the lowest-lying and wettest portions of the upstream watercourse section. *B.* cf. *radicans* is not an obligate hydrophyte but grows in disturbed places on clayey soils. This grass forms hybrids with *B. insculpta* (hence the cf. abbreviation), another facultative wetland species (not an obligated hydrophyte), which often grows on clayey

soils were water collects temporarily (Van Oudtshoorn 1992). Based on the existing vegetation response as determined in early November 2012 and inconclusive soil indicators, no wetland habitat is regarded to be present within the southern watercourse. The area can therefore be best described as a riparian watercourse.

- Buffered watercourses and overlapping project-related infrastructure include the following (Figure 2 & 3):
    - A riparian watercourse southeast of Ngwedi substation with two overlapping towers. The two towers are existing pylons: Existing Mar Ma 487 (inside the watercourse) & Existing Mar Ma 94 (on the outer edge of the buffer zone).
    - The southeastern corner of the Ngwedi substation partially overlaps (0.02 ha) with the 50m riparian watercourse buffer.
    - An earlier access road, not illustrated in Figure 2 & 3, crossed the two drainage lines and their associated 50 metre buffers, delineated north of the Ngwedi Substation

4.2. Key Recommendations

- All drainage lines, wetlands and other watercourses are regarded as sensitive areas. Buffer zones demarcated around different watercourses are also regarded as sensitive areas (Figure 3.).
- All infrastructure that overlap with watercourses and their buffers should be moved to avoid negative impacts and legislative transgressions.
- Alternatively unavoidable encroachment into watercourses, such as road crossings, should be minimised and mitigated to reduce impacts, while the necessary environmental authorization is obtained. No construction personnel or vehicles may enter such an area without the necessary authorisation/permission.
- The proposed access road should be moved south to avoid overlap with the buffered drainage lines. The access road should not overlap with any delineated watercourses and their buffers.
- The proposed Ngwedi substation should be moved a short distance to the west (approximately 50-100m) to avoid overlap with the watercourse buffer (Figure 2 & 3).

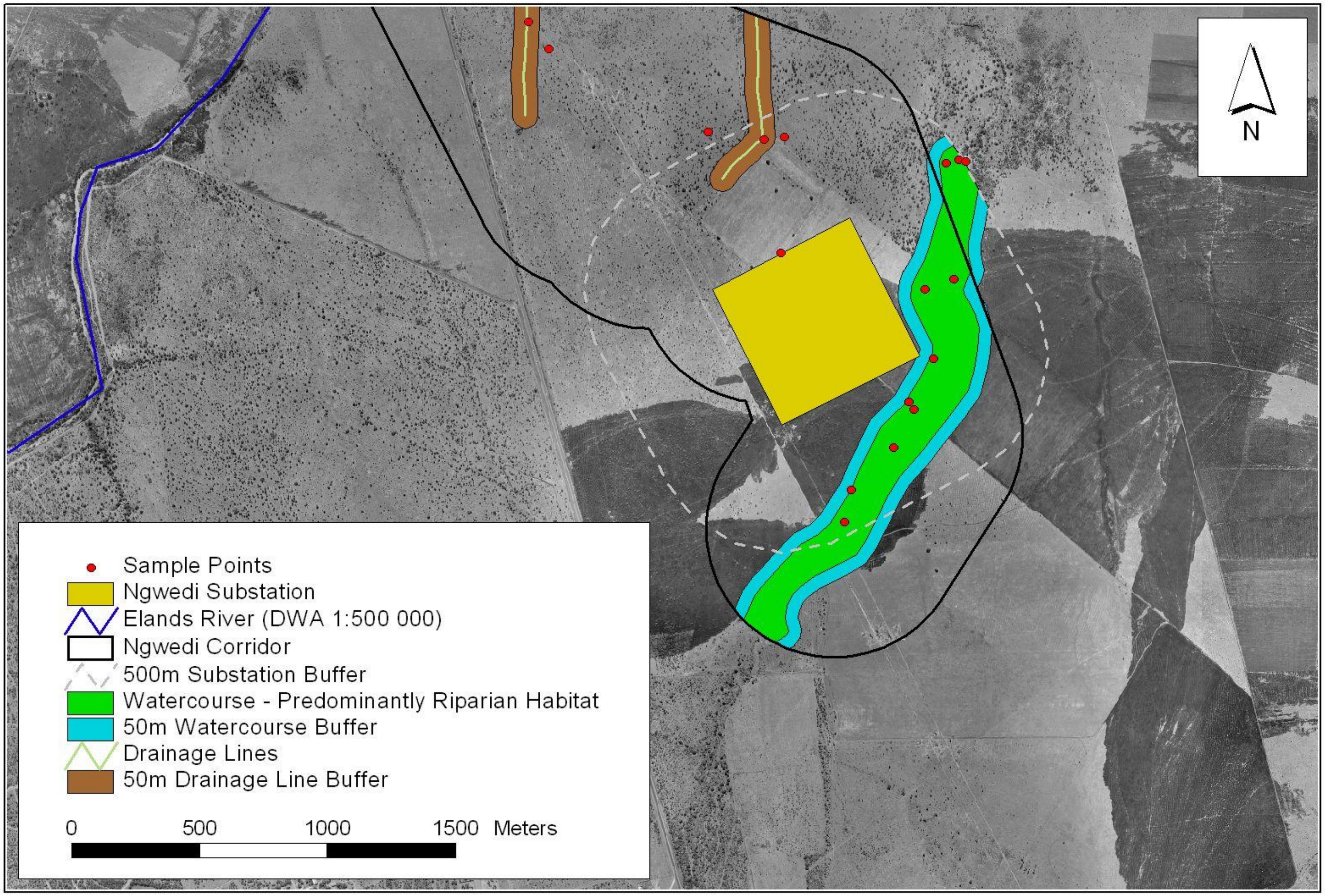

Figure 2: Demarcated watercourses and their associated buffers around the Ngwedi Substation, the south-eastern portion of the Ngwedi Corridor (associated with a separate transmission line project), and a 500 m buffer around the substation.

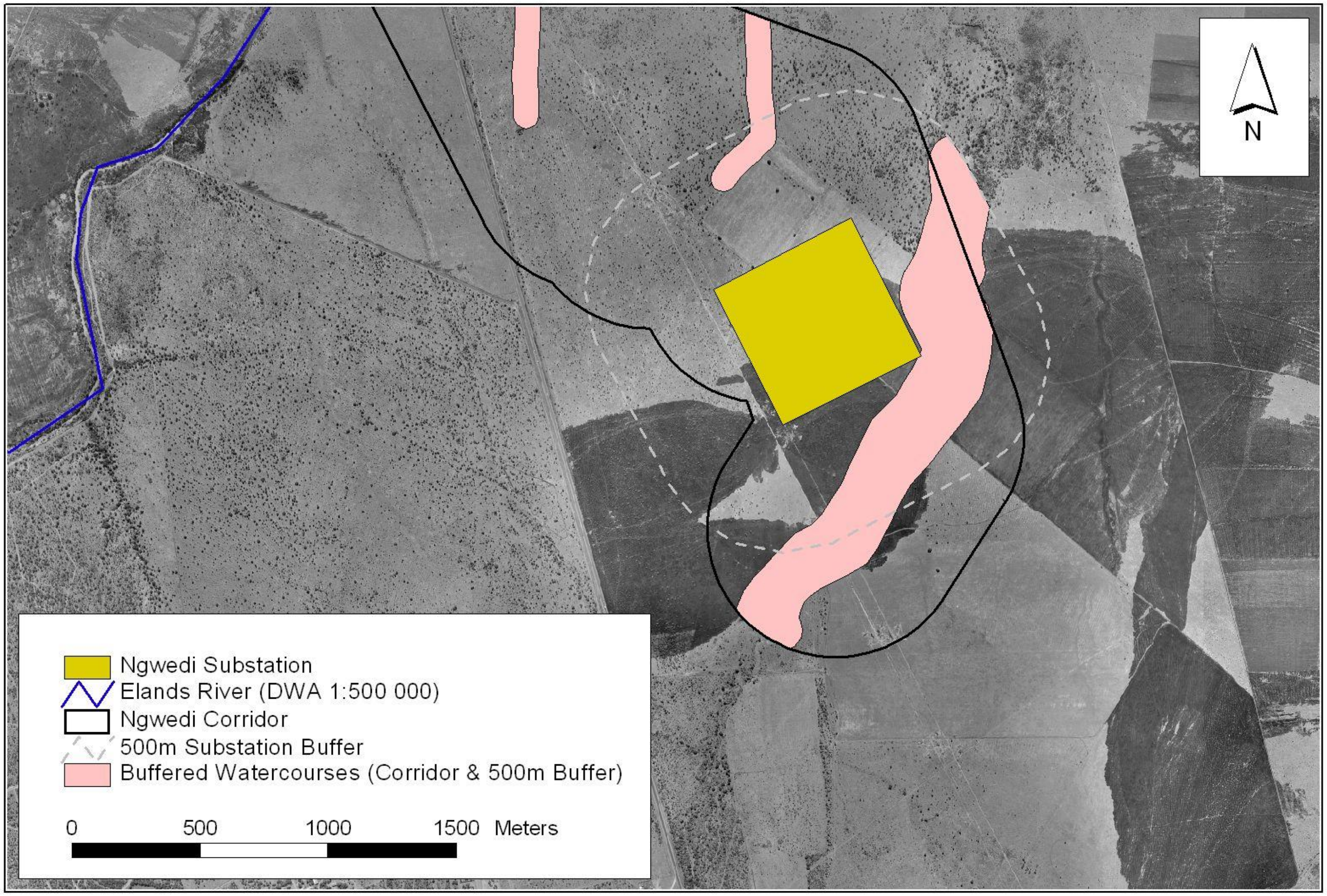

Figure 3: Buffered watercourses around the Ngwedi Substation and the south-eastern portion of the Ngwedi Corridor (associated with a separate transmission line project), and a 500 m buffer around the substation.

Figure 4: Illustrates a range of photos of well developed riparian habitat associated with a bedrock channel in the downstream half of the delineated watercourse located southeast of the Ngwedi Substation.

Figure 5: Illustrates indistinct riparian habitat in the upstream half of the delineated watercourse located south of the Ngwedi Substation. This includes the absence of well developed channel features and obligated hydrophytes (top, center and bottom), temporary surface ponding (center), and the presence of an existing pylon within the watercourse (bottom).

4.3. Water Use License considerations

- Access to the substation will linear infrastructure such as roads that may result in unavoidable watercourse crossings.
- These crossings may result in watercourse habitat and vegetation loss, surface flow obstructions, erosion, and desiccation impacts.
- Wetlands and other watercourses are protected water resources in the National Water Act (NWA), Act 36 of 1998. Development or transformation of the watercourses is regarded as a *water use*, which can only be allowed through an approved Water Use License, irrespective of the condition of the affected watercourse.
- The NWA defines water use in a watercourse specifically related to wetlands and riparian areas as follow:
  (c) impeding or diverting the flow of water in a watercourse.
  (i) altering the bed, banks, course or characteristics of a watercourse.
- New access roads cannot be created through watercourses without a Water Use License. It is therefore important that existing roads be used for access through watercourses to avoid the creation of new tracks or roads crossings.
- All unavoidable watercourse road crossings, even temporary crossings during the construction phase of the project, will require a Water Use License. A re-alignment of the proposed access road to avoid overlap with buffered watercourses will therefore not require a Water Use License application based on available information for the 500 m Ngwedi Substation buffer area (Figure 3).
- It follows that no other infrastructure can be constructed within a watercourse without a Water Use License.
- A recent DWA stipulation published in Government Gazette No 32805 also require that a Water Use License should be applied for when water use activities in terms of section 21 *(c)* and section 21 *(i)* are present within a 500 m radius from the boundary of any wetland (DWA, 2009).
- It is understood that the Department of Water Affairs (DWA) introduced this requirement to make provision for wetland impacts caused by catchment transformations. Hydrological modifications caused by excavations and the creation of new hardened surfaces through infrastructure development are specifically targeted.
- Individual pylons associated with the separate 400kV line project are not expected to be affected by the 500 m Water Use License (WUL) requirement due to minimal hydrological impacts when located outside of buffered watercourses.
- It is recommended that DWA is engaged to determine their specific requirements for this project. The department typically requires additional wetland-specific information, such as Present Ecological State (PES) assessments, Ecological Importance and

Sensitivity (EIS) assessments, risk assessments, and a rehabilitation plan as part of a WULA. These extend beyond the scope of this watercourse investigation.

- However, it must be noted that no wetland area was delineated within a 500 m radius area of the proposed Ngwedi Substation. A Water Use License Application in terms of Section21 (c) and (i) is therefore not expected to be required based on the 500m radius requirement.

4.4. Overview of possible project-related watercourse impacts

4.4.1. Flow Modification

Potential Causes: Concentration of surface flow patterns.
Potential Effects: Changes to the hydrological regime (e.g. duration, frequency, timing, volume and/or velocity of flows) and hence spatial extent of watercourses and/or hydrological cues for aquatic biota.

Potential project-related impacts:

- Alteration of surface flows (surface and subsurface) as a result of crossing structures that function as flow obstructions. These crossings may be envisaged where access and maintenance roads are absent, inadequate or not useable.
- Habitat fragmentation and modified flow patterns within watercourses as a result of surface infrastructure construction (e.g. permanent substation infrastructure, stockpiles, vehicle movement, and temporary infrastructure in watercourses).
- Compaction of soils in watercourses as a result of vehicle movement and construction activities. Compacted soils can result in lower rainfall infiltration and interflow to watercourses.
- Flow modifications associated with the excavation of new quarry pits in watercourses during the construction phase.

4.4.2. Water Quality

Potential Causes: Hydrocarbons (e.g. diesel and petrol) polluting watercourses.
Potential Effects: Oxygen depletion, bioaccumulation of toxic compounds in biota, disruption of the endocrine system in biota.

Potential project related impacts:

- Decrease in water quality as a result of refueling vehicles and machinery inside watercourses.

4.4.3. Sediment load modification

Potential Causes: - Loss of vegetation cover (e.g. through vegetation clearing) and erosion.
Potential Effects: Loss in watercourse habitat, change in vegetation cover, potential increase in turbidity and hence decrease in water quality.

Potential project related impacts:

- Loss of watercourse habitat as a result of erosion in response to vegetation clearing and soil excavation for pylon construction.
- Change in substrate conditions (habitat for biota) and erosion damage at new road crossings.

4.4.4. Canalisation

Potential Effects: Lowering of the water table adjacent to the channel and decrease in the frequency of overbank flooding. Channel initiation can also occur in watercourses that lack a well defined channel.

Potential project related impacts:

- Loss of watercourse habitat as a result of canalization at road crossings.

4.4.5. Topographic Alteration

Potential Causes: Pylon construction, roads, stockpiles, fences and other infrastructure.
Potential Effects: Modifies watercourse habitat, change flow patterns and surface ponding.

Potential project related impacts:

- Loss of watercourse habitat as a result of the construction activities within watercourses (e.g. new watercourse crossing structures and other infrastructure).
- Vehicle track entrenchment in watercourses as a result of vehicle movement through watercourses.
- Road related mortality of migrating/ foraging watercourse-associated fauna.
- Watercourse modification associated with the excavation of foundations in a watercourse during the construction phase.
- Watercourse modification associated with the creation of new construction camps on watercourses during the construction phase.

4.4.6. Indigenous vegetation removal

Potential Causes: Construction activities in wetlands and riparian habitat (e.g. erection of pylons and the construction of temporary and permanent watercourse crossings).
Potential Effects: Lower flow resistance, loss of habitat, and elevated erosion risk.

Potential project related impacts:

- Alteration of watercourse habitat as a result of vegetation removal during construction activities.
- Aggravation and/or initiation of watercourse erosion features (e.g. headcuts).

4.4.7. Invasive plant encroachment

Potential Causes: Downstream dispersal of exotic plant species, change to a drier hydrological regime.
Potential Effects: Shading, lowering of the water table, channel incision, loss of habitat.

Potential project related impacts:

- Alteration of species composition of watercourses due to the encroachment of invasive alien plant species.

4.5. Proposed project-related mitigation measures:

- Information presented here should be used in association with Section 4.6.3.
- Buffered watercourses, including small drainage lines should be demarcated on site along the construction servitude, as well as in the surrounding corridor, as identified in this report, prior and during the construction phase of the project.
- GIS shapefiles of buffered watercourses (sensitive areas) should be made available along with this report that can be used by Environmental Control Officers (ECOs) and Environmental Officers (EOs) for identification purposes with a handheld GPS device or reproduced maps for orientation.
- Signage and maps that demarcate and identify buffered wetlands and drainage lines as sensitive features should also be explained to the contractor during toolbox talks and other communications, so as to help ensure that access and construction-related impacts are avoided. Apart from access-related impacts, this will also help to avoid vehicle refueling, temporary toilets, and stockpiling impacts inside wetlands and drainage lines.
- Signage used on site to demarcate buffered watercourses should be regularly maintained by ECOs during the construction phase.

- New access roads through watercourses should be avoided. Unavoidable new access roads will require a Water Use License (Section 4.3.); while a construction method statement should be prepared by the contractor with input from an ecologist with watercourse-related experience.
- All refueling should occur outside of buffered watercourses and drainage lines. Buffered watercourses and drainage lines in the study area are illustrated in Figure 2 & 3.
- Any topographical watercourse-related impact, such as vehicle track entrenchment should be repaired once observed. This can be done by reinstating a topographic profile that is similar to the pre-constriction condition of the watercourse.
- Erosion features such as channel initiation or new headcut development should be stabilised through rehabilitation measures once they are recorded. Rehabilitation action can include “soft” and “hard” interventions that should ideally be selected and designed by a soil conservation engineer.
- An alien vegetation monitoring and control plan should be compiled and implemented during the operational phase of the project.

4.6. Impact evaluation and mitigation

4.6.1. Introduction

This section of the report evaluates the potential impact of the proposed development on the environment, specifically regarding watercourses present within the selected alternative. The impact of the development should ideally be assessed in terms of the following development phases:

- Construction Phase
- Operational Phase
- Decommissioning Phase

Limited emphasis will be provided on the decommissioning phase, with most of the attention focused on the construction followed by the operational phase of the project.

4.6.2. Approach

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need. The significance of the impacts will be determined through a synthesis of the criteria below:

Probability: Described the likelihood of the impact actually occurring.

Improbable - The possibility of the impact occurring is very low, due to the circumstances, design or experience.

Probable - There is a probability that the impact will occur to the extent that provision must be made therefore.

Highly Probable - It is most likely that the impact will occur at some stage of the development.

Definite - The impact will take place regardless of any prevention plans and there can only be relied on mitigatory measures or contingency plans to contain the effect.

Duration: The lifetime of the project

Short Term: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.

Medium Term: The impact will last up to the end of the phases, where after it will be negated.

Long Term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.

Permanent: The impact is non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Spatial Scale. The physical and spatial size of the impacy

Local: The impacted area extends only as far as the activity, e.g. footprint

Site: The impact could affect the whole, or a measurable portion of the above mentioned properties.

Regional: The impact could affect the area including the neighbouring residential areas.

Magnitude/ Severity: Does the impact destroy the environment, or alter its function

Low: The impact alters the affected environment in such a way that natural processes are not affected.

Medium: The affected environment is altered, but functions and processes continue in a modified way.

High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance: This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.

Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.

Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.

High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

Each of the abovementioned ratings are associated with specific weights illustrated in Table 1.

Table 1: The following weights are assigned to each attribute as part of the impact evaluation process.

Aspect	**Description**	**Weight**
Probability	Improbable	1
	Probable	2
	Highly probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	Sum (Duration, Scale, Magnitude) x Probability	
	Negligible	≤20
	Low	>20 ≤40
	Moderate	>40 ≤60
	High	>60

4.6.3. Impact assessment table

Project-related impacts on wetlands, riparian areas, and other drainage line, as well as recommended mitigation measures are discussed below for different project phases based on the above. The significance of each impact is rated without mitigation measures and with mitigation measures. Buffers around watercourses (Figure 2 & 3) form a general means of impact mitigation. Different ways through which watercourse buffers can help to mitigate project-related impacts is discussed in Appendix A along with constrains in their application. Appendix A should be used in association with mitigation measures listed in the table below.

<table>
<tr><th>Impact</th><th>Probability</th><th>Duration</th><th>Scale</th><th>Magnitude/Severity</th><th>Significance (without mitigation)</th><th>Significance (with mitigation)</th></tr>
<tr><td colspan="7">CONSTRUCTION PHASE</td></tr>
<tr><td>1. Compaction of watercourse soils</td><td>Definite</td><td>Short term</td><td>Local</td><td>Medium</td><td>Moderate</td><td>Negligible</td></tr>
<tr><td></td><td colspan="6">Recommendation(s):
Avoid driving on watercourses during construction of substation to prevent vehicle track incision and the potential for channel initiation. Where this is unavoidable crossing structures should be in place across affected wetlands and other watercourses along with a relevant Water Use License (WULA). These crossing structures can include the following:
• A wearing course (wear surface) should be added as a surface layer on top of geotextile fabrics, which forms base for surface capping.
• A wearing course (surface cap) of good quality clastic or gravel material also has the potential to reduce surface scour by creating a mix that will easily bind together and minimise detachment of particles.
• Geotextiles provide four important functions in temporary road and trail surface construction that includes separation, drainage, reinforcement, and stabilisation.
• Geotextiles work as separation fabrics when they are placed between gravel caps and underlying soils to prevent the materials from mixing.
• Additional benefits of such as crossing structure include:
o It defines a single route alignment for vehicle travel.
o Provides a ‘wear and carry’ surface over unsuitable and easily compactable wetland soils.
o This results in a stable, durable crossing surface for vehicle access, including heavy motor vehicle traffic.
o Halts the widening and the development of braided crossing sections, while formerly used track alignments are allowed to naturally stabilise and revegetate.</td></tr>
<tr><td>2. Changes to the hydrological regime caused by infrastructure construction in watercourses</td><td>Definite</td><td>Long term</td><td>Site</td><td>High</td><td>High</td><td>Low</td></tr>
</table>

Impact	Probability	Duration	Scale	Magnitude/Severity	Significance (without mitigation)	Significance (with mitigation)
	Recommendation(s): • Restrict the construction of infrastructure in watercourses as far as possible. • The Ngwedi Substation should be located outside of buffered watercourses. Construction and maintenance tracks and roads should also be located outside of buffered watercourses (see impact 1.). • All unavoidable overlap between substation infrastructure, associated access roads, and future pylons in demarcated watercourses will require a Water Use License (WUL). It is recommended that Ngwedi Substation be moved out of the watercourse buffer to the west.					
4. Decrease in water quality	Highly probable	Medium term	Site	High	**High**	**Negligible**
	• Recommendation(s): ○ No refueling of construction vehicles should occur within 50 m of demarcated watercourses. Hydrocarbons should not be stored within 50 m of buffered watercourses. ○ A stormwater management plan should be developed for the substation so as to reduce the risk of water quality deterioration associated with stormwater release.					
5. Loss of wetland, riparian, and drainage line vegetation and habitat as a result of pylon construction, new quarries and created construction camps.	Definite	Long term	Local	High	**High**	**Negligible**
	Recommendation(s): • No substation associated infrastructure , construction camps or quarries should be constructed within buffered watercourses, apart from unavoidable road crossings, which should be minimised.					

<table>
<tr><th>Impact</th><th>Probability</th><th>Duration</th><th>Scale</th><th>Magnitude/Severity</th><th>Significance (without mitigation)</th><th>Significance (with mitigation)</th></tr>
<tr><td></td><td colspan="6">• Road construction activities in watercourse crossings should be completed in the shortest possible time and preferably during the dry season.
• Watercourses affected by unavoidable construction activities should be re-sloped to a stable gradient (e.g. at least a slope of 1:3), revegetated with suitable indigenous plant species, such as Eragrostis tef, and covered with biojute to help facilitate revegetation soon after construction.</td></tr>
<tr><td colspan="7">OPERATIONAL PHASE</td></tr>
<tr><td>6. Increased sedimentation and erosion</td><td>Highly probable</td><td>Long term</td><td>Site</td><td>Moderate</td><td>Moderate</td><td>Negligible</td></tr>
<tr><td></td><td colspan="6">Recommendation(s):
• The inclusion of vegetated stormwater drains and attenuation facilities should be considered before stormwater is released into watercourses. It is recommended that a well designed stormwater management plan will be required to attenuate flood peak events and prevent excessive erosion. Such a stormwater management plan can entail the following:
o Stormwater outflows should not be allowed to enter directly into a watercourse.
o Discharged stormwater must be released in a controlled manner with a diffuse flow patter across as a buffered vegetation strip and be accompanied by energy dissipating interventions to prevent erosion.
o Other stormwater control measures can also be considered, such as swales, and retention ponds.
o Buildings and other hardened surface infrastructure (including stormwater attenuation measures) should be located outside of buffered watercourses as far as possible.
o Any channelised flows (as opposed to diffuse flows) that traverse the buffer could largely negate some of the benefits associated with wetland buffers.
• Road crossings should make provision for dispersed flow and energy dissipation; they should also transverse watercourses across the shortest possible distance. Also refer to the abovementioned recommendation regarding pylon (tower) construction in watercourses.</td></tr>
<tr><td>7. Encroachment of invasive alien vegetation into watercourses</td><td>Probable</td><td>Long term</td><td>Site</td><td>Moderate</td><td>Moderate</td><td>Low</td></tr>
</table>

Impact	**Probability**	**Duration**	**Scale**	**Magnitude/Severity**	**Significance (without mitigation)**	**Significance (with mitigation)**
	Recommendation(s): • Restrict the clearing of watercourse vegetation as far as possible. Areas that have been cleared should be revegetated with indigenous species or other suitable plant species, such as *Eragrostis tef*, after construction. • Compile and implement an alien plant control program during the operational phase of the project.					

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APPENDIX A: BUFFERS ZONES AS IMPACT MITIGATION MEASURES FOR SURFACE WATERCOURSES

Buffer functions

Buffers are reputed to provide a number of important benefits for watercourses. Some of these potential benefits are listed below (Castelle et al., 1992):

- Sediment retention.
- Retention of pollutants.
- Lower erosion risk.
- Moderation of flows from uplands into wetlands.
- Provision of faunal habitat.
- Screen a wetland from adjacent developed areas.
- Limitation of direct human impacts on a wetland (e.g. waste disposal and trampling).
- Wetland buffers are also helpful where uncertainty in the location of the outer boundary of the wetland exists. This is useful in challenging delineation environments.

Project-related watercourse impacts that be mitigated by buffers in part

- An increase in impervious surfaces cause by the construction of hardened surfaces will result in less water infiltration and more runoff. Consequently natural patterns of diffuse water runoff will become concentrated into point source discharges into watercourses. This is expected to result in an influx of pollutants into watercourses that will degrade the water quality of the system.
- Higher runoff velocities and concentrated flow patterns are expected to degrade wetland vegetation and initiate or aggravate existing erosion features.
- Hardened surface within watercourses will result in the permanent loss of watercourse habitat.
- Recommended mitigation measures:
    - Interventions and mechanisms can be included in the development to facilitate a higher percentage of infiltration and reduce stormwater flows without concentrating their outflows where possible.
    - It is recommended that a well designed stormwater management plan will be required to attenuate flood peak events and prevent excessive erosion. Stormwater outflows should not be allowed to enter directly into a watercourse.
    - Discharged stormwater must be released in a controlled manner with a diffuse flow patter across as a buffered vegetation strip and be accompanied by energy dissipating interventions to prevent erosion (Kotze *et al*., 2002). Other

stormwater control measures can also be considered, such as swales, and retention ponds.

- Buildings and other hardened surface infrastructure (including stormwater attenuation measures) should be located outside of buffered watercourses as far as possible. Any channelised flows (as opposed to diffuse flows) that traverse the buffer could largely negate some of the benefits associated with wetland buffers.
- Buffers are not an inclusive single mitigation solution, but require an integrated approach along with the design and spatial arrangement of upland infrastructure, land use practices and stormwater systems.
- Buffers should not be viewed as "walk away" mitigation solutions, as they remain susceptible to impacts and deterioration (e.g. concentrated and low water quality stormwater discharges, encroachment by alien plant species and future land transformations).
- Buffer zones should therefore be managed to maintain the presence of indigenous grasses, forbs and geophytes, with no preferential flow paths created by unintentional channels from stormwater outflow points.
- Vegetated buffers should be monitored for the establishment of alien plant species and controlled through acceptable methods. It is recommended that an alien plant species management plan be drawn up and implemented during the operation phase of the development.
- Erosion features should be stabilised in the buffer zone once observed.
- Stormwater management measures, as well as development and land use on upland areas surrounding buffer zones are therefore intrinsically linked to the functioning and effectiveness of a watercourse buffer.
- The appropriate design, structure selection, and discharge volumes, flow patterns and water quality of stormwater management systems are equally important to the long-term integrity and functioning of receiving wetland and riparian systems.
- The range of recommended watercourse buffers does not make provision for watercourse-dependant biodiversity or Red Data species.