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REPORT NO. : P WMA 12/T30/00/5314/10

Environmental Impact Assessment

for the proposed

MZIMVUBU WATER PROJECT

DEA Ref. No.: 14/12/16/3/3/2/677 (Dam construction)
14/12/16/3/3/2/678 (Electricity generation)
14/12/16/3/3/1/1169 (Roads)

FLORAL IMPACT ASSESSMENT

NOVEMBER 2014

Prepared for:

ILISO Consulting
P.O. Box 68735
Highveld
0169

Prepared by:

Scientific Aquatic Services
P.O. Box 751779
Gardenview
2047

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT

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Authors:	*N. Cloete (Cand.Pri.Sci.Nat)* *S van Staden (Pri.Sci.Nat)*
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Approved for Scientific Aquatic Services *by:*

S van Staden
Managing member

DEPARTMENT OF WATER AND SANITATION – DIRECTORATE: OPTIONS ANALYSIS

Approved for DWS:

M Mugumo
Chief Engineer: Options Analysis (South)

L S Mabuda
Chief Director: Integrated Water Resource Planning

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT

LIST OF REPORTS

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ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT

DEA REF No. 14/12/16/3/3/2/677 (Dam construction application)
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Prepared for: Directorate – Options Analysis

Prepared by: Scientific Aquatic Services, P.O. Box 75177, Gardenview, 2047
Tel: (011) 6167893, Fax: (086) 724 3132
Contact: Stephen van Staden
Email: stephen@sasenvironmental.co.za

DECLARATION OF INDEPENDENCE

I, Stephen van Staden as authorised representative of Scientific Aquatic Services hereby confirm my independence as a specialist and declare that neither I nor Scientific Aquatic Services have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Scientific Aquatic Services was appointed as ecological impact assessment specialists in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Floral Impact Assessment for the Mzimvubu Water Project Environmental Impact Assessment. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – as is described in my attached report.

Signed: 

Date: 07/11/2014

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT FLORAL IMPACT ASSESSMENT

EXECUTIVE SUMMARY

BACKGROUND

The Department of Water and Sanitation (DWS) commissioned the Mzimvubu Water Project, an integrated multi-purpose (domestic water supply, agriculture, power generation, transport, tourism, conservation and industry) project, with the intention of providing socio-economic development opportunities for the region.

The proposed Ntabelanga Dam site is located approximately 25 km east of the town of Maclear and north of the R396 Road. The proposed Lalini Dam site is situated approximately 17 km north east of the small town Tsolo. Both are situated on the Tsitsa River.

The ecology in the vicinity of the three focal points of the study, namely the Ntabelanga Dam, Lalini Dam and the associated infrastructure (road upgrades / roads to be re-surfaced or new roads, primary and secondary pipelines, and sections of the power lines and tunnels) has undergone vegetation transformation due to historic agricultural activities, overgrazed and trampled veld from livestock from the local communities, alien proliferation along the riparian features and bush encroachment due to poor management measures. Other areas where less vegetation transformation has occurred and more natural and indigenous vegetation is still present includes sections of the power lines, Lalini Dam wall and associated new roads and portions within the Ntabelanga Dam and associated road upgrades.

ASSESSMENT OF IMPACT ON HABITAT UNITS

The following conclusion was made based on the assessment of the various habitat units:

- The ecological function and status of the **Mountain / Rocky Outcrops habitat unit** is considered to be of moderate to high sensitivity due to the few disturbances from agricultural activities, overgrazing and alien floral encroachment. In terms of conservation value, the moderate to high ecological functionality, good habitat integrity, the low incidence of bush or alien floral encroachment, combine to increase the ecological sensitivity of this habitat unit. No protected or RDL floral or tree species were located during the time of the site assessment, but there is a high probability that such species could be present within this habitat unit;
- The **Riparian / Wetland habitat unit** is considered to be of high ecological sensitivity due to the contribution of the various wetland and riparian systems to wetland ecoservices provision and the habitat provided for floral species. Although large sections along the riparian system are dominated by alien invader floral species, pockets of indigenous tree species exist along the Tsitsa River. Wetlands (and riparian areas) contribute to the maintenance of biodiversity through the provision of habitat and maintenance of natural processes. The integrity of a wetland or riparian feature contributes strongly to the capacity

of such a feature to provide this benefit, in addition to specific attributes such as the presence of threatened faunal or floral species;

- A decrease in floral diversity has occurred within the remainder of the study area as a result of the edge effects from ploughing and crop cultivation, overgrazing, trampling by livestock and vegetation clearance causing severe soil erosion. The **Grassland / *Acacia* Thornveld habitat unit** is considered to have a low ecological sensitivity and low conservation value due to the change in floral species composition and vegetation structure as a result of the above mentioned impacts. This habitat unit is furthermore well represented within the region, and loss thereof as a result of the dam construction and drowning of the valley, will not significantly affect the floral conservation in the region; and
- The **Transformed (Grassland) habitat unit** include areas where vegetation has been completely transformed by historic and on-going small scale agricultural activities and overgrazing of livestock causing erosion and a decrease in vegetation diversity in these areas, with reduced numbers of sensitive species present. Where vegetation has recovered from historic transformation, very little floral diversity occurs. This habitat unit is not under threat within the region, and loss thereof as a result of the proposed dam construction and associated flooding of the vegetation type will not significantly affect the floral conservation in the region.

The information gathered during the assessment of the study area was used to determine the Vegetation Index Score (VIS).

Habitat unit	Score	Class	Motivation
Mountain/Rocky Outcrops habitat unit	18	**Class B – largely natural with few modifications**	This habitat unit has remained relatively undisturbed and is known to support high levels of biodiversity and is therefore considered of relatively high ecological importance. Although high levels of biodiversity and ecological importance occur within this habitat unit, transformation has occurred in transition areas between the woody mountain habitat and the open veld habitat unit. Protected tree species, *Podocarpus falcatus* and *P. latifolius* were located within this management unit
Riparian/wetland habitat unit	14	**Class C/D – moderately/largely modified**	This habitat unit is characterised by high levels of erosion associated with donga formation. Numerous drainage lines, valley bottom wetlands and seeps are located within the study area.
Grassland / *Acacia* Thornveld habitat unit	10	**Class D/E – largely modified/Extensive loss of natural habitat**	This habitat unit has undergone transformation due to overutilisation of veld by cattle grazing and bush encroachment by *Acacia karroo*.
Transformed (Grassland) habitat unit	5	**Class E – extensive loss of natural habitat**	This habitat unit is associated primarily with community villages' historic cultivated fields and veld overgrazed and trampled by livestock. The ecological functionality and habitat integrity of the Transformed Habitat Unit is regarded as being extremely limited.

IMPACT OF ROAD INFRASTRUCTURE

The roads to be upgraded consist of either new access roads or re-alignment of roads that will be inundated, thus providing access to the dams during both the construction and operation of the dam and its facilities. In addition to this, some existing roads will be upgraded by resurfacing (gravel) and improving river crossings etc. The road upgrades are mostly in the vicinity of the Ntabelanga and Lalini Dam. In terms of vegetation diversity, the edge effects of the existing roads have transformed the vegetation to the extent that only grass species such as *Eragrostis curvula, E. chloromelas, Hyparrhenia hirta, Sporobulus africanus* and *Cynodon dactylon*, which are associated with more disturbed areas, occur alongside the current roads. Key mitigation measures for the Ntabelanga Dam infrastructure would include the possible re-alignment of the roads where protected tree species were found, in order to avoid cutting and destroying the trees.

Other areas of the road upgrade are located within the higher altitude areas. Indigenous species such as *Aloe marlothii, Aloe ferox* and *Aloe aborescence* occurred alongside the current road. These and other indigenous species could be relocated should they occur within the road upgrade (new access roads) footprint area.

New access roads are proposed within the Lalini Dam area. The habitat area (Mountain / Rocky Outcrops) where the proposed access roads will be situated is considered sensitive due to the higher floral species diversity and possible suitable habitat for protected species. It is suggested that a walk down be done for the Lalini HEP and access roads prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

IMPACT OF PIPELINE INFRASTRUCTURE

The proposed pipeline routes will be located along several riparian and wetland features, containing mostly alien invader floral species such as *Acacia mearnsii, A. dealbata, Eucalyptus grandis, E. camaldulensis, Melia azedarach* and *Solanum mauritianum*. The gramanoid assemblage is of increased diversity within the wetland and riparian areas when compared to the surrounding terrestrial areas which have been more affected by historical agricultural activities. Due to the severe vegetation transformation within most of the areas along the primary and secondary pipeline route, the low ecological function and state and the low diversity in floral species, the areas set out for the construction of the primary and secondary pipeline routes are not considered sensitive. Since the impact of the construction will be of a shorter duration and rehabilitation will be undertaken, the severity of the impact on the floral ecology of the area can be significantly reduced.

The irrigation pipelines are mostly situated south of the village of Tsolo. The majority of the sections for the proposed pipelines will be along existing dirt roads. Other vegetation habitat units that the pipelines traverse, which have been transformed due to historic and on-going small scale agricultural activities, include wetland habitat and rocky areas. The northern section of the irrigation pipeline traverses a woody vegetation habitat area that most likely has been dominated by *Acacia* species Thus; it is possible that some extent that bush encroachment has occurred. Some small scale plantation areas also occur within the woody habitat. It is possible that protected tree

species, favouring afromontane habitat, could occur along the irrigation pipeline route or in the surrounding area.

The irrigation fields were briefly assessed and selected areas were investigated as examples of the condition of these areas. The proposed agricultural fields are located within old farming lands. Field assessments indicated that these fields have been uniformly heavily disturbed due to prior farming activities, and as such provide very limited habitat to floral species within the area and region and the decommissioning of these areas as irrigated croplands is considered an insignificant impact to the regional floral ecology.

IMPACT OF POWER LINES

The majority of the power lines will traverse transformed (grassland) habitat units, where grasslands and mostly *Acacia karroo* and *Acacia caffra* occurs. The transformed habitat unit has been significantly disturbed as a result of historic and on-going agricultural activities and overgrazing of veld. The floral habitat within this habitat unit is therefore largely transformed and placement of infrastructure within this habitat unit will most likely have low impact significance.

Sections of the power line closer to the Tsitsa River will traverse more sensitive habitat associated with mountain and rocky outcrop habitat. These areas are more sensitive in terms of less vegetation disturbance, increased floral diversity and suitable habitat for important and protected species such as *Podocarpus* and *Encephalartos* species. It is suggested that a walk down be done for the section of the power line closer to the Tsitsa River and Mountain / Rocky Outcrops prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

ALIEN FLORAL SPECIES

A number of alien floral species occur within the study area, especially along the riparian features. The majority of the categorised alien floral species fall within Category 2 and 3, which are invaders with useful qualities, but not further proliferation of these species should be permitted. Weed species such as *Bidens pilosa*, *Cynodon dactylon* and *Tagetes minuta* are present that are associated with disturbance and agricultural activities. The transformed (Grassland) habitat unit contained mostly weed species associated with disturbance, overgrazing and trampling of veld by livestock.

Very little invader floral species occurred within the Mountain / Rocky Outcrop habitat unit. The Mountain / Rocky Outcrop habitat unit are the most at risk for alien tree species to encroach into the area. These areas need to be monitored as part of the Catchment Rehabilitation and Management Programme during the operational phase of the dam to ensure that alien invader tree species do not encroach into this habitat unit.

MEDICAL AND PROTECTED SPECIES

Several medicinal species were located within all of the habitat units such *Zantedeschia* and *Aloe* species. None of the medicinal species identified were important or protected species.

Podocarpus falcatus and *P. latifolius* were identified in low abundance alongside the road upgrade (roads to be resurfaced) areas within the Ntabelanga Dam, on the northern section of the dam.

More *Podocarpus* species were located on the secondary pipeline route south of the town Tsolo. These species are protected according to the notice of the list of protected tree species under the National Forests Act, 1998 (Act No. 84 of 1998) Possible mitigation measure would be to re-align the roads to avoid the trees from being removed or permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area.

Although most of the vegetation where the road upgrades or new roads will be constructed within the Lalini Dam has been transformed, it is possible that *Podocarpus* species, *Encephalartos* species and other protected and RDL floral species could occur along the proposed new Lalini Dam roads and the power line 1, in the vicinity of the Tsitsa Falls.

Another aspect that should be considered is the type of vegetation and the growth of specific floral species such as cremnophytes. The cremnophytes are floral species, mostly succulents that are associated with cliffs but have distributions that extent to non-cliff habitats. Some species include *Crassula cultrate, C. perforate, C. rupestris, Haemanthus albiflos* and *Portulacaria afra.* Water-holding capacity is important as it directly relates to cliff vegetation. Mostly obligate succulent cremnophytes have a relatively shallow root system and are found on cliffs that dry out rapidly (van Jaarsveld, 2011). Thus, the aspect of a lower overall flow rate at the Tsitsa waterfall, thus decreasing the amount of mist spray and water availability to the surrounding vegetation on the cliffs or within the gorge, needs to be taken into account. It is proposed that a detailed baseline study be conducted to determine the sensitivity of this area before any construction activities commence. Should any medicinal important or RDL species be located within this area during the site assessment, it is recommended that these species identified be rescues and relocated to similar habitat e.g. the upstream waterfall area. Where applicable, permit applications should be obtained from the relevant authority to rescue and relocate these species.

IMPACT STATEMENT

The following table summarises the impacts perceived before and after mitigation measures have been implemented. Impacts will be very high in areas that are associated with more sensitive habitat, such as the mountain and rocky areas due to more suitable habitat available for indigenous floral vegetation and protected and important tree species.

Impact	Construction and first filling		Operational phase	
Mitigation status	**Unmitigated**	**Mitigated**	**Unmitigated**	**Mitigated**
Roads and Infrastructure impact on habitat	High	High	Medium-high	Low
Roads and Infrastructure impact on floral diversity	High	High	Medium-high	Medium-low
Roads and Infrastructure impact on floral SCC	High	High	Medium-high	Medium-low
Electricity Generation and distribution impact on habitat	High	Medium-high	Medium-low	Low
Electricity Generation and distribution impact on species diversity	High	Medium-high	Medium-low	Low
Electricity Generation and distribution impact on SCC	High	Medium-high	Medium-low	Low
Dam impact on habitat	High	Medium-high	Medium-high	Medium-high
Dam impact on species diversity	High	Medium-high	Medium-high	Medium-high
Dam impact on SCC	High	Medium-high	High	Medium-high

NTABELANGA DAM

The proposed Ntabelanga Dam entails construction of the dam wall and associated infrastructures, such as the camp sites, quarries and burrow pits and accommodation for operational staff. The first filling will form part of the last stages once construction has occurred. Construction of the dam wall would entail the clearance of vegetation, movement of construction vehicles and storage of construction material, leading to the decrease in floral habitat.

Vegetation surrounding the Ntabelanga Dam wall consists of rocky ridge vegetation, mostly indigenous to the area. Little transformation has occurred within this area. The first filling will take approximately 0-3 years, meaning that vegetation located within the footprint area of the full supply level will be submerged under water. Habitat for indigenous floral vegetation along the riparian / wetland areas and the mountain / rocky outcrop areas will be lost.

The impact significance associated with the loss of species habitat is considered to be medium-high prior to implementation of mitigation measures.

Key mitigation measures for the Ntabelanga Dam and associated infrastructure would include the possible re-alignment of the roads where protected tree species were found, in order to avoid cutting and destroying the trees.

LALINI DAM

The Lalini Dam footprint consists mainly of transformed vegetation due to the surrounding rural communities clearing vegetation for small scale agricultural activities. Thus large sections of the Lalini Dam basin have undergone vegetation transformation, also caused by overgrazing and trampling of veld by livestock.

More sensitive habitat (*Euphorbia* forest) located closer to the dam wall will be affected by the construction of the dam wall and the first filling phase. Vegetation habitat for numerous and sensitive indigenous vegetation will be lost. No protected or RDL floral or tree species were located during the time of the site assessment, but there is a high probability that such species could be present within this habitat unit. The impacts of the loss of protected species will be medium-high to high due to the suitable habitat available for protected woody species to occur.

The impact significance associated with the loss of species habitat is considered to be high prior to implementation of mitigation measures. It is suggested that a walk down be done for the section of the power line closer to the Tsitsa River and Mountain / Rocky Outcrops prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

For the Lalini Dam construction, three alternatives were given. The alternatives covering the least amount of floral and especially sensitive floral vegetation and habitat should be considered. Therefore Alternative 2 would be the more preferred alternative.

Another aspect that should be considered is the type of vegetation and the growth of specific floral species such as cremnophytes. The cremnophytes are floral species, mostly succulents that are associated with cliffs but have distributions that extent to non-cliff habitats. Some species include *Crassula cultrate, C. perforate, C. rupestris, Haemanthus albiflos* and *Portulacaria afra.* Water-

holding capacity is important as it directly relates to cliff vegetation. Mostly obligate succulent cremnophytes have a relatively shallow root system and are found on cliffs that dry out rapidly (van Jaarsveld, 2011). Thus, the aspect of a lower overall flow rate at the Tsitsa waterfall, thus decreasing the amount of mist spray and water availability to the surrounding vegetation on the cliffs or within the gorge, needs to be taken into account. It is proposed that a detailed baseline study be conducted to determine the sensitivity of this area before any construction activities commence. Should any medicinal important or RDL species be located within this area during the site assessment, it is recommended that these species identified be rescues and relocated to similar habitat e.g. the upstream waterfall area. Where applicable, permit applications should be obtained from the relevant authority to rescue and relocate these species.

PRIMARY AND SECONDARY PIPELINES AND IRRIGATION PIPELINES

The primary and secondary pipeline will be constructed close to main or existing roads. Protected tree species located along the secondary pipeline route will be lost should re-alignment of these road not be considered. In terms of vegetation habitat, the edge effects of the existing roads, overgrazed veld and surrounding community villages have transformed the vegetation to the extent that only grass species, which are associated with more disturbed areas, occur alongside the current access roads. In areas that are associated with disturbance and vegetation clearance, the impact on further transformation of floral habitat of the pipelines will be low, should all possible mitigation measure be implemented.

The irrigation pipelines are mostly situated south of the township of Tsolo. The majority of the sections for the proposed pipelines will be along existing dirt roads. Other vegetation habitat units that the pipelines traverse which have been transformed due to historic and on-going small scale agricultural activities include wetland habitat and rocky areas. The northern section of the irrigation pipeline traverses a woody vegetation habitat area that seems to be more diverse in floral tree species than the rest of the pipeline route. It is possible that protected tree species, favouring afromontane habitat, could occur along the pipeline route or in the surrounding area.

ROAD UPGRADES

The roads to be upgraded are existing roads that will serve as access roads to the dams. In terms of vegetation diversity, the edge effects of the existing roads, overgrazing and trampling of veld by livestock and the surrounding community villages, have transformed the majority of the road upgrade areas. Alien proliferation alongside the road will also be one of the main concerns. Protected tree species located along the road upgrade area within the Ntabelanga Dam, will be lost.

New access roads will be constructed in the Lalini Dam area. The majority of the proposed access roads traverse transformed vegetation types. These areas will not be highly impacted upon since vegetation transformation has already occurred. Access roads close to the Lalini Dam wall will have a very high impact on the overall loss of floral habitat, since these mountain areas provide suitable habitat for numerous indigenous and possible protected floral species.

It is also proposed that a road will be constructed to access the long hydropower tunnel and corresponding alternative power line. This road will be constructed within a highly sensitive habitat area, containing a high diversity of floral species. Most of the floral species are indigenous to the

area and also provide suitable habitat for protected tree species and other important and RDL floral species such as *Encephalartos* species. This increases the diversity and overall sensitivity of the area. Should the construction of this road continue a large portion of floral habitat and diversity will be lost. Thus the impact on the immediate and surrounding area will be very high. This route is thus not recommended due to the high impacts and loss of floral habitat and diversity.

Key mitigation measures would include planning of routes within low sensitivity areas, re-alignment of routes, where possible, edge effects from the construction activity must be kept to a minimum and permit applications for protected tree species *Podocarpus fulcatus* and *P. latifolius* located along the sections scheduled for road upgrades.

POWER GENERATION WITH HYDROPOWER TUNNELS AND POWER LINE ALTERNATIVES

The majority of the power lines will traverse transformed (grassland) habitat units, where grasslands and mostly *Acacia karroo* and *Acacia caffra* occur. The transformed habitat unit has been significantly disturbed as a result of historic and on-going agricultural activities and overgrazing of veld. The floral habitat within this habitat unit is therefore largely transformed and placement of infrastructure within this habitat unit will most likely have low impact significance.

Sections of the power line closer to the Tsitsa River will traverse more sensitive habitat associated with mountain / afromontane forests and rocky outcrop habitat. These areas are more sensitive in terms of less vegetation disturbance, great floral diversity and suitable habitat for important and protected species such as *Podocarpus* and *Encephalartos* species. Vegetation clearance within this sensitive habitat will take place, resulting in the removal of protected and important species.

All three sections of the power line alternatives, closer to the Tsitsa River will traverse more sensitive habitat associated with Mountain Rocky Outcrop habitat. Due to the sensitive habitat and diversity of species occurring within these sections, placement of support towers will need to be considered, as indigenous and possible important / protected floral vegetation will be affected. According to the impact assessment results, the power line alternative 1 and 3 will have a much higher impact, even if mitigated due to the power lines crossing larger sections of indigenous and possible protected trees and other floral species. The more preferred power line alternative would be alternative 2 due to a lower impact on the receiving environment.

Key mitigation measures include rescue and relocation of protected tree species in high sensitive areas as per the sensitivity map. Permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area.

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE MZIMVUBU WATER PROJECT – FLORAL IMPACT ASSESSMENT

DEA REF No. 14/12/16/3/3/2/677 (Dam construction application)
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ACRONYMS AND ABBREVIATIONS

BLMC	Biodiversity Land Management Classes
CBA	Critical Biodiversity Areas
DEAT	Department of Environmental Affairs and Tourism
DMs	District Municipalities
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
ECBCP	Eastern Cape Biodiversity Conservation Plan
EIA	Environment Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Programme
EVC	Extent of Vegetation Cover
GSSA	Grassland Society of South Africa
IAIAsa	South African Affiliate of the International Association for Impact Assessment
IEM	Integrated Environmental Management
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NPAES	National Protected Area Expansion Strategy
PES	Present Ecological State
POC	Probability of Occurrence
PRECIS	Pretoria Computer Information Systems
PRS	Perceived Reference State
PS	Present State
PVC	Percentage Cover of Indigenous Species
QDS	Quarter Degree Square
RDL	Red Data Listed
RHP	River Health Programme
RIS	Recruitment of Indigenous Species
SAAB	South African Association of Botanists
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SASSO	South African Soil Surveyors Association
SI	Structural Intactness
TOPS	Threatened or Protected Species
VIS	Vegetation Index Score
WWTW	Waste Water Treatment Works

LIST OF UNITS

MW	Mega Watt
m	Metres
m^3	Cubic metres
km	Kilometres
km^2	Square Kilometres
ha	Hectare
°C	Degrees Celsius
%	Percentage

1 INTRODUCTION

1.1 BACKGROUND

The Department of Water and Sanitation (DWS) commissioned the Mzimvubu Water Project, an integrated multi-purpose (domestic water supply, agriculture, power generation, transport, tourism, conservation and industry) project, with the intention of providing a socio-economic development opportunity for the region.

Environmental authorisation is required for the infrastructure components of the project. The purpose of the Environmental Impact Assessment (EIA) is to assess the components of the project that are listed activities by the National Environmental Management Act (NEMA) for which DWS has the mandate and intention to implement. The EIA process will provide the information that the environmental authorities require to decide whether the project should be authorised or not, and if so then under what conditions.

As part of this EIA process Scientific Aquatic Services (SAS) have been contracted to undertake a Floral Impact Assessment for the proposed development of:

- the Ntabelanga Dam and associated infrastructure;
- the Lalini Dam and associated infrastructure;
- road upgrades (roads to be resurfaced);
- replacement on inundated roads;
- new roads;
- road re-alignments;
- primary and secondary pipelines and reservoirs; and
- power generation and transmission.

Reference will be made to the specific developments accordingly (hereinafter collectively referred to as the “study area”).

The study area is surrounded by land used for agricultural, forestry and rural settlements. The ecological assessment was confined to the study area and did not include an ecological assessment of surrounding properties. The surrounding area was however considered as part of the desktop assessment of the area as well as during general movement through the area by road and on foot.

1.2 PURPOSE OF THIS REPORT

This report, after consideration of the ecological integrity of the study area, must guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, by means of the presentation of results and recommendations, as to the ecological viability of the proposed development activities.

1.3 DETAILS AND EXPERTISE OF THE SPECIALIST

Nelanie Cloete is a botanist with a Master’s degree in Botany and Environmental Management. Since 2008 to the current date she acted as a specialist consultant on floral and wetland

assessments and other environmental processes and applications such as permit applications for Red Data Listed (RDL) floral and protected tree species. Currently Nelanie is also involved as a junior project manager for numerous projects within the company, managing specialist within and outside of the company, arranging and managing site assessments, project administration, guidance and interpretation of field data and liaising with clients.

Nelanie is registered at the South African Association of Botanists (SAAB) and is also registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP). Nelanie is also a professional member of the Grassland Society of South Africa (GSSA) and member of South African Affiliate of the International Association for Impact Assessment (IAIAsa) group (**Appendix A**).

Stephen van Staden completed a postgraduate degree in environmental management in 2002, where he did his mini dissertation in the field of aquatic resource management. In late 2003, Stephen started consulting as an independent environmental scientist, specialising in water resource management under the banner of Scientific Aquatic Services. In addition to aquatic ecological assessments, clients started enquiring about terrestrial ecological assessments and biodiversity assessments. Stephen, in conjunction with other qualified ecologists, began facilitating these studies as well as highly specialised studies on specific endangered species, including grass owls and arachnids and invertebrates and various vegetation species. Scientific Aquatic Services soon became recognised as a company capable of producing high quality terrestrial ecological assessments. Stephen soon began diversifying into other fields, including the development of EIA process, Environmental Management Programme (EMPR) activities and mine closure studies. Stephen is registered by the South African River Health Programme (SA RHP) as an accredited aquatic bio-monitoring specialist and is also registered as a Professional Natural Scientist with the SACNASP in the field of ecology. Stephen is also a member of the Gauteng Wetland Forum and South African Soil Surveyors Association (SASSO) (**Appendix A**).

1.4 STRUCTURE OF THIS REPORT

This specialist study is undertaken in compliance with Regulation 32 of GN 543. **Table 1** indicates how the requirements of Regulation 32 of GN 543 have been fulfilled in this report.

Table 1: Report content requirements in terms of Regulation 32 of GN 543

Regulatory Requirements in terms of Regulation 32 of GN 543	Section of Report
(a) The person who prepared the report; and the expertise of that person to carry out the specialist study or specialised process.	Chapter 1
(b) a declaration that the person is independent	Page iv
(c) an indication of the scope of, and the purpose for which, the report was prepared	Chapters 1 and 3
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process	Chapter 3
(e) a description of any assumptions made and any uncertainties or gaps in knowledge	Chapter 4
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Chapters 6 to 10

Regulatory Requirements in terms of Regulation 32 of GN 543	Section of Report
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	Chapter 6-10, 14
(h) a description of any consultation process that was undertaken during the course of carrying out the study	Chapter 12
(i) a summary and copies of any comments that were received during any consultation process	Chapter 12
(j) any other information requested by the competent authority.	Chapter 13

2 PROJECT BACKGROUND SUMMARY

2.1 LOCALITY

The project footprint spreads over three District Municipalities (DMs) namely the Joe Gqabi DM in the north west, the OR Tambo DM in the south west and the Alfred Nzo DM in the east and north east.

The proposed Ntabelanga Dam site is located approximately 25 km east of the town of Maclear and north of the R396 Road. The proposed Lalini Dam site is situated approximately 17 km north east of the small town Tsolo. Both are situated on the Tsitsa River.

2.2 MAIN PROJECT COMPONENTS

The project forms a large integrated project with several components. The proposed water resource infrastructure includes:

- A dam at the Ntabelanga site with a storage capacity of 490 million m^3;
- A dam at the Lalini site with a storage capacity of approximately 150 million m^3;
- A pipeline and tunnel and a power house at the Lalini Dam site for generating hydropower;
- Five new flow measuring weirs will be required in order to measure the flow that is entering and released from the dams. These flow gauging points will be important for monitoring the implementation of the Reserve and for operation of the dams.
- Wastewater treatment works at the dam sites;
- Accommodation for operations staff at the dam sites; and
- An information centre at each of the dam sites.

The Ntabelanga Dam will supply potable water to 539 000 people, which is estimated to rise to 730 000 people by the year 2050. The domestic water supply infrastructure will include:

- A river intake structure and associated works;
- A regional water treatment works at Ntabelanga Dam;
- Potable bulk water distribution infrastructure for domestic and industrial water requirements (primary and secondary distribution lines);
- Bulk treated water storage reservoirs strategically located; and
- Pumping stations.

The Ntabelanga Dam will also provide water to irrigate approximately 2 900 ha of arable land. This project includes bulk water conveyance infrastructure for raw water supply to edge of field.

About 2 450 ha of the high potential land suitable for irrigated agriculture are in the Tsolo area and the rest near the proposed Ntabelanga Dam and along the river, close to the villages of Machibini, Nxotwe, Culunca, Ntshongweni, Caba, Kwatsha and Luxeni.

There will be a small hydropower plant at the Ntabelanga Dam to generate between 0.75 MW and 5 MW (average 2.1 MW). This will comprise a raw water pipeline from the dam to a building containing the hydropower turbines and associated equipment, and a discharge pipeline back to the river just below the dam wall. The impact is expected to be similar to that of a pumping station.

The hydropower plant at the proposed Lalini Dam and tunnel (used conjunctively with the Ntabelanga Dam) will generate an average output of 35 MW when operated as a base load power station and up to 180 MW when operated as a peaking power station. The power plant will require a pipeline (approximately 4 km) and tunnel (approximately 4 km) linking the dam to the power plant downstream of the dam and below the gorge.

The power line to link the Lalini power station to the existing Eskom grid will be approximately 18.5 km and the power line linking the Ntabelanga Dam to the Eskom grid will be approximately 13 km.

The area to be inundated by the dams will submerge some roads. Approximately 80 km of local roads will therefore be re-aligned. Additional local roads will also be upgraded to support social and economic development in the area. The road design will be very similar to the existing roads as well as be constructed using similar materials.

The project is expected to cost R 12.45 billion and an annual income of R 5.9 billion is expected to be generated by or as a result of the project during construction and R 1.6 billion per annum during operation. It will create 3 880 new skilled employment opportunities and 2 930 un-skilled employment opportunities during construction.

2.3 ALTERNATIVES

The following project level alternatives will be assessed:

- Three hydro power tunnel positions and associated power lines;
- Peak versus Base load power generation;
- Three different dam sizes for the Lalini Dam; and
- The no project option.

For the construction camps, pipeline routes and new roads, the specialist will identify any sensitive areas and deviations to avoid these will be proposed in consultation with the technical team.

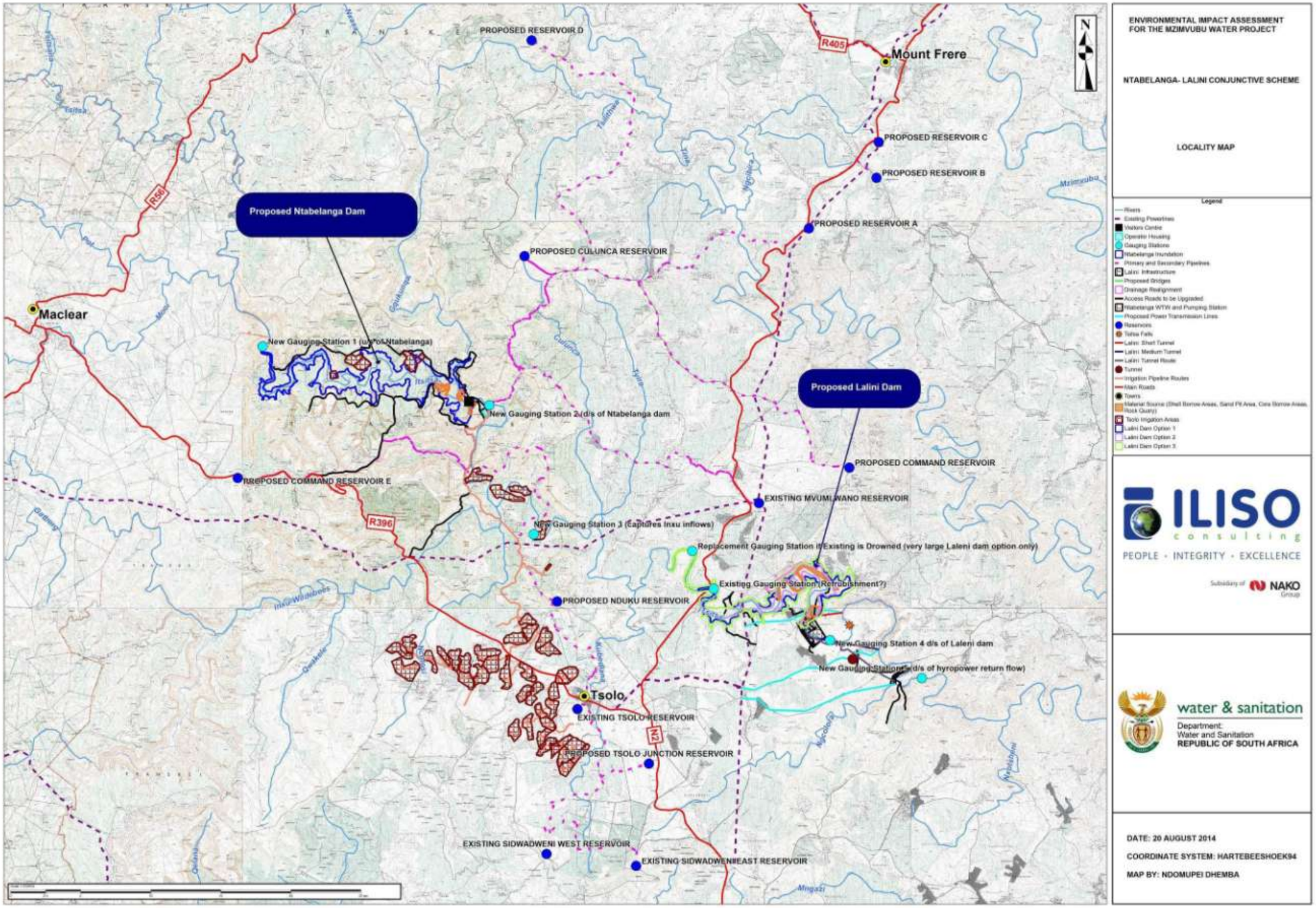

Figure 1: Locality map of the study area.

3 TERMS OF REFERENCE

3.1 SCOPE OF THE STUDY

- To conduct a Species of Conservation Concern and Protected Species Assessment, including potential for species to occur on the study area;
- To provide floral inventories of species as encountered within the study area;
- To define the Ecological Importance and Sensitivity (EIS) of the botanical resources on the vicinity of each proposed project component;
- To determine and describe habitats, communities and Ecological State of the two proposed dams and related infrastructure;
- To describe the spatial significance of the study area with regards to surrounding natural areas;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/or any other special features;
- To determine the environmental impacts of the proposed development activities on the floral ecology within the study area as per the impact assessment method prescribed by ILISO Consulting; and
- To present management and mitigation measures which should be included in the EMPR of the development to assist in minimising the impact on the receiving environment.

3.2 METHODOLOGY

3.2.1 Floral Species Composition and Transects

Vegetation surveys were undertaken by first identifying different habitat units and then analysing the floral species composition. Dominant floral species were recorded and a species list was compiled. These species lists were then also compared with the vegetation expected to be found in the six vegetation types (*Bisho Thornveld, Drakensberg Foothill Moist Grasslands, Eastern Valley Bushveld, Eastern Griqualand Grassland, Mthata Moist Grassland* and *Southern Mistbelt Forest*), which provided an accurate indication of the ecological integrity and conservational value of each habitat unit (Mucina and Rutherford, 2006).

3.2.2 Vegetation Index Score (VIS)

The VIS was designed to determine the ecological state of each habitat unit defined within an assessment area. This enables an accurate and consistent description of the Present Ecological State (PES) concerning the study area in question. The information gathered during the assessment also significantly contributes to sensitivity mapping, leading to a more truthful representation of ecological value and sensitive habitats.

Each defined habitat unit is assessed using separate data sheets (**Appendix B**) and all the information gathered then contributes to the final VIS score. The VIS is derived using the following formulas:

VIS = [(EVC) + (SI x PVC) + (RIS)]

Where:

1. **EVC** is extent of vegetation cover;
2. **SI** is structural intactness;
3. **PVC** is percentage cover of indigenous species and
4. **RIS** is recruitment of indigenous species.

Each of these contributing factors is individually calculated as discussed below. All scores and tables indicated are used in the final score calculation for each contributing factor.

1. EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score						
EVC 1 score	0	1	2	3	4	5
EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score						
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous								
Clumped								
Scattered								
Sparse								

*Present State (P/S) = currently applicable for each habitat unit

**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. ***PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]***

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %						
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %						
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	0	Very low	Low	Moderate	High	Very high
RIS						
RIS Score	0	1	2	3	4	5

The final VIS scores for each habitat unit are then categorised as follows:

VIS	Assessment Class	Description
22 to 25	A	Unmodified, natural
18 to 22	B	Largely natural with few modifications
14 to 18	C	Moderately modified
10 to 14	D	Largely modified
5 to 10	E	The loss of natural habitat extensive
<5	F	Modified completely

3.2.3 Red Data Species Assessment

Prior to the field visit a record of RDL floral species and their habitat requirements was acquired from the South African National Biodiversity Institute (SANBI) for the Quarter Degree Squares (QDS's) 3128BC, 3128BB, 3128BA, 3128BD and important and protected species as listed in the National Environmental Management Biodiversity Act (NEMBA) Threatened or Protected Species (TOPS) document. Throughout the floral assessment, special attention was paid to the identification of any RDL floral species, as listed by the QDS (SANBI) and the NEMBA TOPS list. Identification of suitable habitat that could potentially sustain these species was also assessed.

The Probability of Occurrence (POC) for each floral species of concern was determined using the following calculation wherein the habitat requirements and disturbance was considered. The accuracy of the calculation was based on the available knowledge about the species in question, with many of the species lacking in depth habitat research. Therefore, it is important that the literature available is also considered during the calculation. Each factor contributes an equal value to the calculation.

Literature availability						
	No literature available					Literature available
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat availability						
	No habitat available					Habitat available
Site score						
EVC 1 score	0	1	2	3	4	5
Habitat disturbance						
	0	Very low	Low	Moderate	High	Very high
Site score						
EVC 1 score	5	4	3	2	1	0

[Literature availability + Habitat availability + Habitat disturbance]/15 x 100 = POC %

3.3 IMPACT CRITERIA AND RATING SCALE

The floral impacts are rated in accordance with the Environmental Impact Assessment Regulations, 2010 and the criteria drawn from the Integrated Environmental Management (IEM) Guidelines Series, Guideline 5: Assessment of Alternatives and Impacts, published by the (DEAT, 2006) as well as the Guideline Document on Impact Significance (DEAT, 2002) as listed below:

The key issues identified during the Scoping Phase inform the terms of reference of this specialist study. Each issue consists of components that on their own or in combination with each other give rise to potential impacts, either positive or negative, from the project onto the environment or from the environment onto the project. The significance of the potential impacts is considered before and after identified mitigation is implemented, for direct, indirect, and residual impacts, in the short and long term.

A description of the nature of the impact, any specific legal requirements and the stage (construction/decommissioning or operation) is given. Impacts are considered to be the same during construction and decommissioning.

The following criteria have been used to evaluate significance:

- **Nature:** This is an appraisal of the type of effect the activity is likely to have on the affected environment. The description includes what is being affected and how. The nature of the impact will be classified as positive or negative, and direct or indirect.
- **Extent and location:** This indicates the spatial area that may be affected (**Table 2**).

Table 2: Geographical extent of impact

Rating	Extent	Description
1	Site	Impacted area is only at the site – the actual extent of the activity.
2	Local	Impacted area is limited to the site and its immediate surrounding area
3	Regional	Impacted area extends to the surrounding area, the immediate and the neighbouring properties.
4	Provincial	Impact considered of provincial importance
5	National	Impact considered of national importance – will affect entire country.

- **Duration:** This measure the lifetime of the impact (**Table 3**).

Table 3: Duration of Impact

Rating	Duration	Description
1	Short term	0 – 3 years, or length of construction period
2	Medium term	3 – 10 years
3	Long term	> 10 years, or entire operational life of project.
4	Permanent – mitigated	Mitigation measures of natural process will reduce impact – impact will remain after operational life of project.
5	Permanent – no mitigation	No mitigation measures of natural process will reduce impact after implementation – impact will remain after operational life of project.

- **Intensity/severity:** This is the degree to which the project affects or changes the environment; it includes a measure of the reversibility of impacts (

-
- Table 4).

Table 4: Intensity of Impact

Rating	Intensity	Description
1	Negligible	Change is slight, often not noticeable, natural functioning of environment not affected.
2	Low	Natural functioning of environment is minimally affected. Natural, cultural and Floral functions and processes can be reversed to their original state.
3	Medium	Environment remarkably altered, still functions, if in modified way. Negative impacts cannot be fully reversed.
4	High	Cultural and social functions and processes disturbed – potentially ceasing to function temporarily.
5	Very high	Natural, cultural and social functions and processes permanently cease, and valued, important, sensitive or vulnerable systems or communities are substantially affected. Negative impacts cannot be reversed.

- **Potential for irreplaceable loss of resources:** This is the degree to which the project will cause loss of resources that are irreplaceable (**Table 5**).

Table 5: Potential for irreplaceable loss of resources

Rating	Potential for irreplaceable loss of resources	Description
1	Low	No irreplaceable resources will be impacted.
3	Medium	Resources can be replaced, with effort.
5	High	There is no potential for replacing a particular vulnerable resource that will be impacted.

- **Probability:** This is the likelihood or the chances that the impact will occur (**Table 6**).

Table 6: Probability of Impact

Rating	Probability	Description
1	Improbable	Under normal conditions, no impacts expected.
2	Low	The probability of the impact to occur is low due to its design or historic experience.
3	Medium	There is a distinct probability of the impact occurring.
4	High	It is most likely that the impact will occur
5	Definite	The impact will occur regardless of any prevention measures.

- **Confidence:** This is the level of knowledge or information available, the environmental impact practitioner or a specialist had in his/her judgement (**Table 7**).

Table 7: Confidence in level of knowledge or information

Confidence	Description
Low	Judgement based on intuition, not knowledge / information.
Medium	Common sense and general knowledge informs decision.
High	Scientific / proven information informs decision.

- **Consequence:** This is calculated as extent + duration + intensity + potential impact on irreplaceable resources.
- **Significance:** The significance will be rated by combining the consequence of the impact and the probability of occurrence (i.e. consequence x probability = significance). The maximum value which can be obtained is 100 significance points (**Table 8**).

Table 8: Significance of issues (based on parameters)

Rating	Significance	Description
1-14	Very low	No action required.
15-29	Low	Impacts are within the acceptable range.
30-44	Medium-low	Impacts are within the acceptable range but should be mitigated to lower significance levels wherever possible.
45-59	Medium-high	Impacts are important and require attention; mitigation is required to reduce the negative impacts to acceptable levels.
60-80	High	Impacts are of great importance, mitigation is crucial.
81-100	Very high	Impacts are unacceptable.

- **Residual Impacts:** This refers to the combined, incremental effects of the impact. The possible residual impacts will also be considered.
- **Mitigation:** Mitigation for significant issues will be incorporated into the EMP.

3.4 LEGISLATION AND GUIDELINES CONSIDERED

3.4.1 National Environmental Management Act (NEMA) (Act No. 107 of 1998)

The Environmental Impact Assessment Regulations 2010 and the listing notices thereto: Section 24 of the NEMA allows the Minister of Environmental Affairs to identify and list or delist certain activities or particular areas, which require an environment authorisation prior to commencement of activities. Any person who wants to conduct such an activity is subject to completing an assessment of potential effects (positive and negative) of that activity on the environment and is subject to prosecution if he/she does not complete this assessment. EIA regulations 543 – 546 provide the processes to be undertaken to obtain environmental authorisation and lists the activities that the Minister has deemed necessary to require such a process.

3.4.2 National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004)

The objectives of this Act are (within the framework of NEMA) to provide for:

- the management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity;
- the use of indigenous biological resources in a sustainable manner;
- the fair and equitable sharing among stakeholders of benefits arising from bio prospecting involving indigenous biological resources;
- to give effect to ratified international agreements relating to biodiversity which are binding to the Republic;

- to provide for co-operative governance in biodiversity management and conservation; and
- to provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.

This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of surrounding areas are not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of benefits arising from indigenous biological resources.

3.4.3 The Protected Areas Act (Act No. 57 of 2003)

To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

This Act, as with the Forestry Act, alludes to the fact that the conservation status of all vegetation types needs to be considered when any development is taking place to ensure that the adequate conservation of all vegetation types is ensured.

3.4.4 National Forest Act (Act No. 84 of 1998)

Principles to guide decisions affecting forestry resources applicable to land development management are contained in the following principle:

Principle 3

3) The principles are that—

(a) natural forests must not be destroyed save in exceptional circumstances where, in the opinion of the Minister, a proposed new land use is preferable in terms of its economic, social or environmental benefits;

(b) a minimum area of each woodland type should be conserved and forests must be developed and managed to -

(i) conserve biological diversity, ecosystems and habitats;

(ii) sustain the potential yield of their economic, social and environmental benefits.

This section of the Act alludes to the fact that the conservation status of all vegetation types needs to be considered when any development is taking place to ensure that the adequate conservation of all vegetation types is ensured.

Principle 6

(6) Criteria and indicators may include but are not limited to, those for determining—

(a) the level of maintenance and development of—

(i) forest resources:

(ii) biological diversity in forests:

(iii) the health and vitality of forests:

(iv) the productive functions of forests:
(v) the protective and environmental functions of forests; and
(vi) the social functions of forests.

4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are applicable to this report:

- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral communities have been sufficiently assessed and considered for a project of this scale.
- Due to the vast extent of the study area, sampling by its nature, means that not all individual floral species were assessed and identified. Some species and taxa on the study area may therefore been missed during the assessment.
- Two site assessments were conducted, one during April 2014 and the other during June 2014. Due to the vast extent and limited duration spend during the site assessment, some infrastructure such as the irrigation pipelines and areas, access roads to Lalini Dam and the hydro tunnel routes were assessed on a desktop basis. Thus possible protected trees and other floral species having the possibility to occur within the more natural areas would have been missed.

5 DESCRIPTION OF THE AFFECTED ENVIRONMENT

5.1 ECOLOGICAL DESKTOP DESCRIPTION

The following sections (Sections 5.1.1 – 5.1.6) present data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the study area's actual site characteristics. This information is however considered to be useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and special attention will be afforded to areas indicated to be of higher conservation importance.

5.1.1 National List of Threatened Terrestrial Ecosystems for South Africa (2011)

The National List of Threatened Terrestrial Ecosystems for South Africa provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value (SANBI, BGIS).

According to the National List of Threatened Terrestrial Ecosystems (2011) sections of the proposed road upgrades, southern section of the pipelines, all three alternatives of the power lines, the medium and long hydro-tunnel and a very small portions of the Lalini Dam fall into a vulnerable ecosystem in terms of the original and remaining extent of the associated indigenous vegetation types (**Figure 2**). The vulnerable ecosystem indicates that a loss of structure, function and composition has occurred and that any further degradation should be prevented or minimised where possible. The Ntabelanga Dam road upgrades (new access roads and re-alignment of roads) and the irrigation areas and pipeline infrastructure also fall into a vulnerable ecosystem in terms of the original and remaining extent of the vegetation types. The Ntabelanga Dam and the primary and secondary pipelines fall into a least threatened ecosystem in terms of the original and remaining extent of the associated vegetation type (**Figure 3-4**).

5.1.2 National Protected Area Expansion Strategy (NPAES, 2010)

The goal of NPAES is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. It deals with land-based and marine protected areas across all of South Africa's territory (SANBI BGIS).

According to the NPAES database, the proposed dam infrastructure in the study area, besides the power transmission line 1, Lalini Dam long hydro tunnel and the Lalini roads towards the Tsitsa River, do not form part of areas earmarked as part of the NPAES (**Figure 5**). Therefore, it will be important that mitigation measures are adhered too in areas that are considered to be NPAES areas.

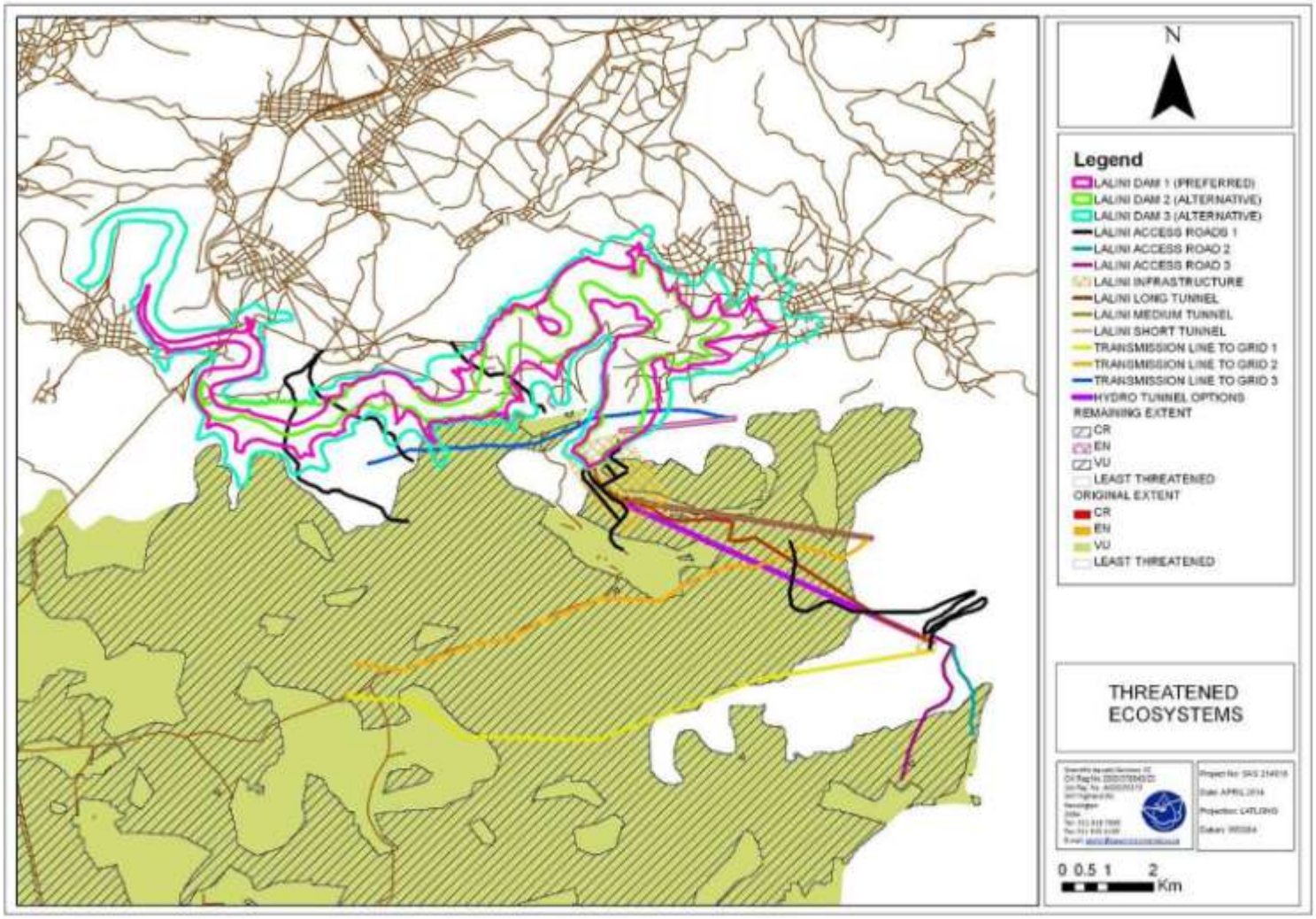

Figure 2: Threatened Ecosystems in terms of the original and remaining extent of the associated vegetation type distributed near the Lalini Dam and associated infrastructure (National List of Threatened Terrestrial Ecosystems, 2011).

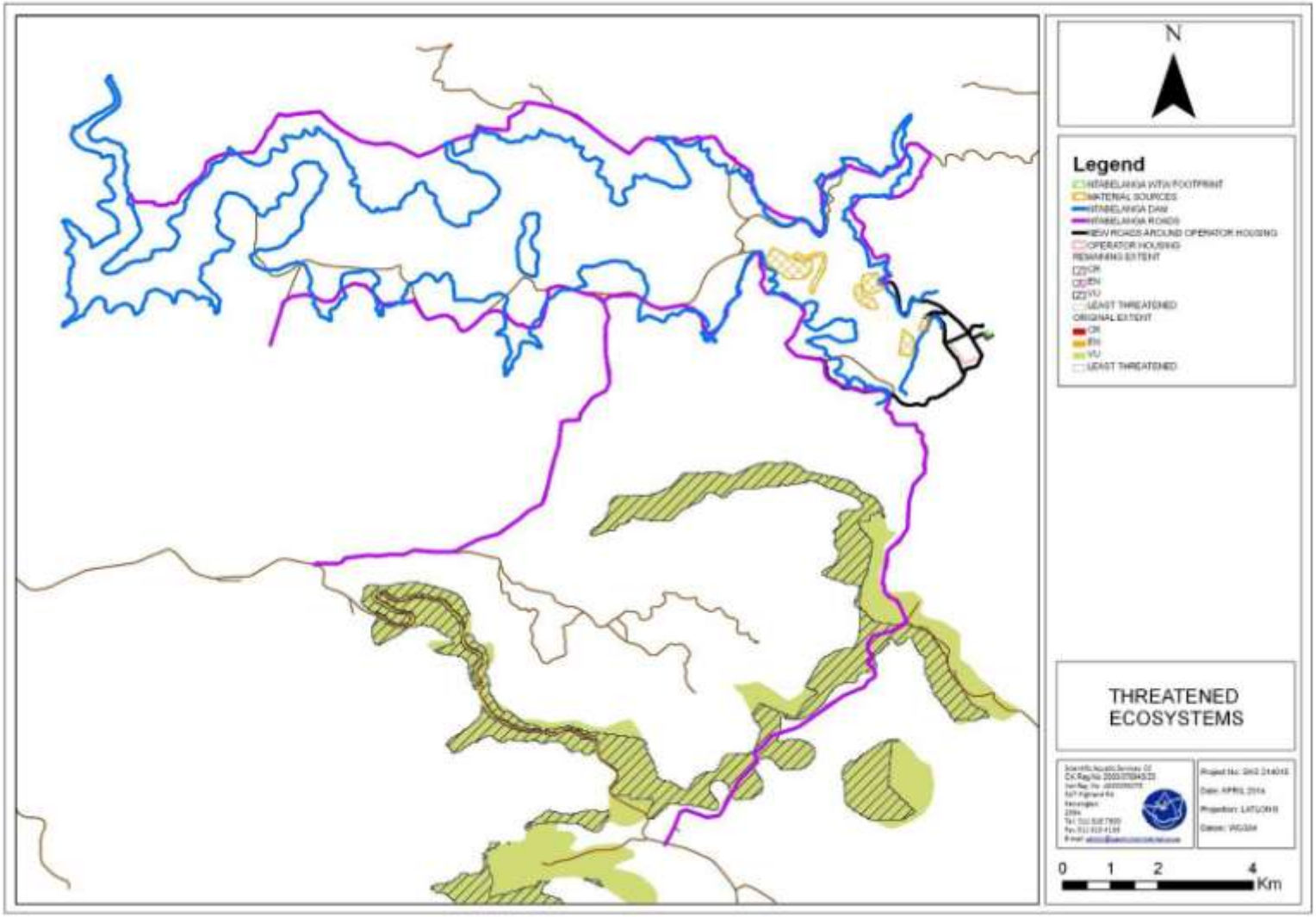

Figure 3: Threatened Ecosystems in terms of the original and remaining extent of the associated vegetation type distributed near the Ntabelanga Dam road upgrades (National List of Threatened Terrestrial Ecosystems, 2011).

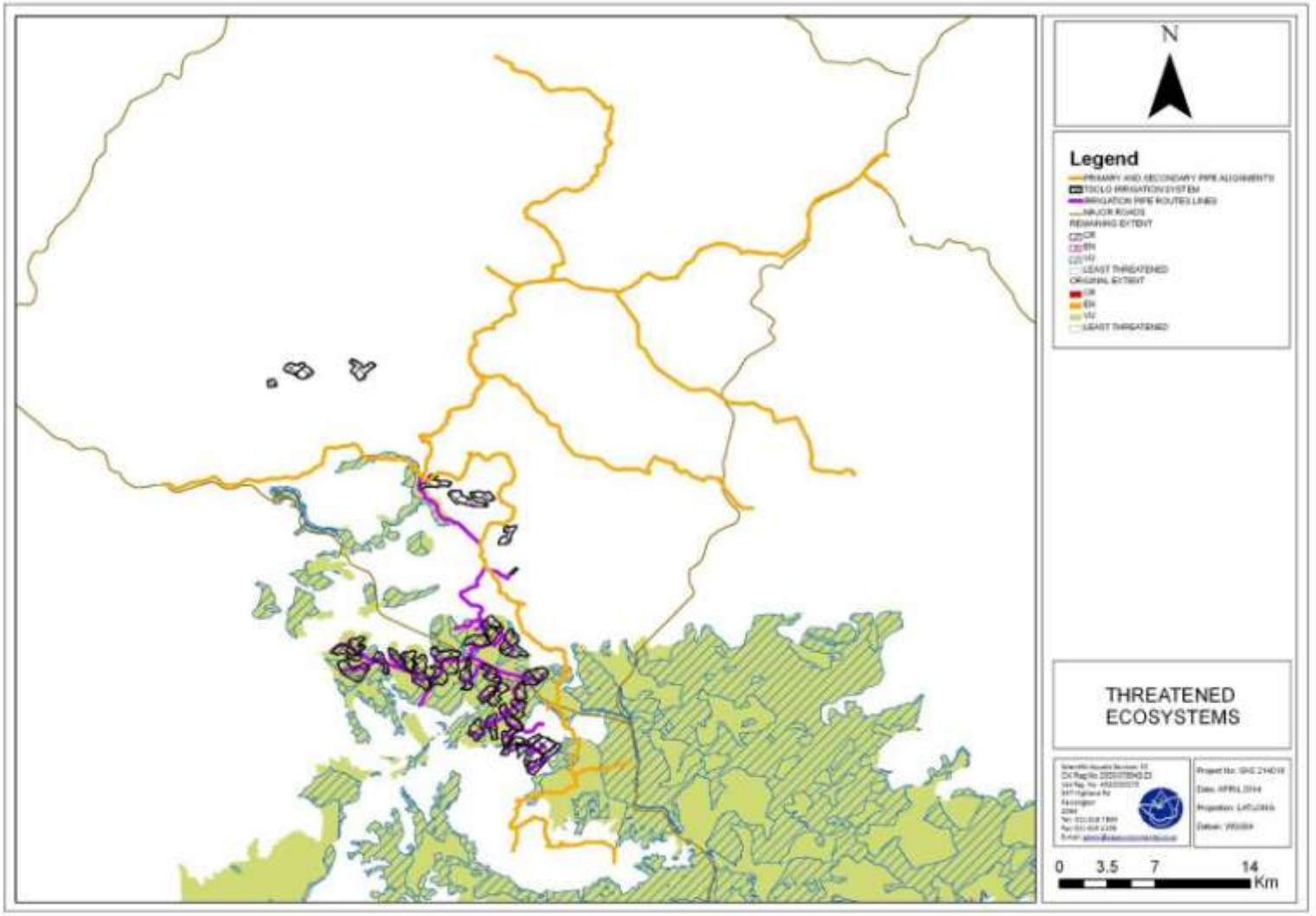

Figure 4: Threatened Ecosystems in terms of the original and remaining extent of the associated vegetation type associated with the irrigation areas and irrigation pipelines (National List of Threatened Terrestrial Ecosystems, 2011).

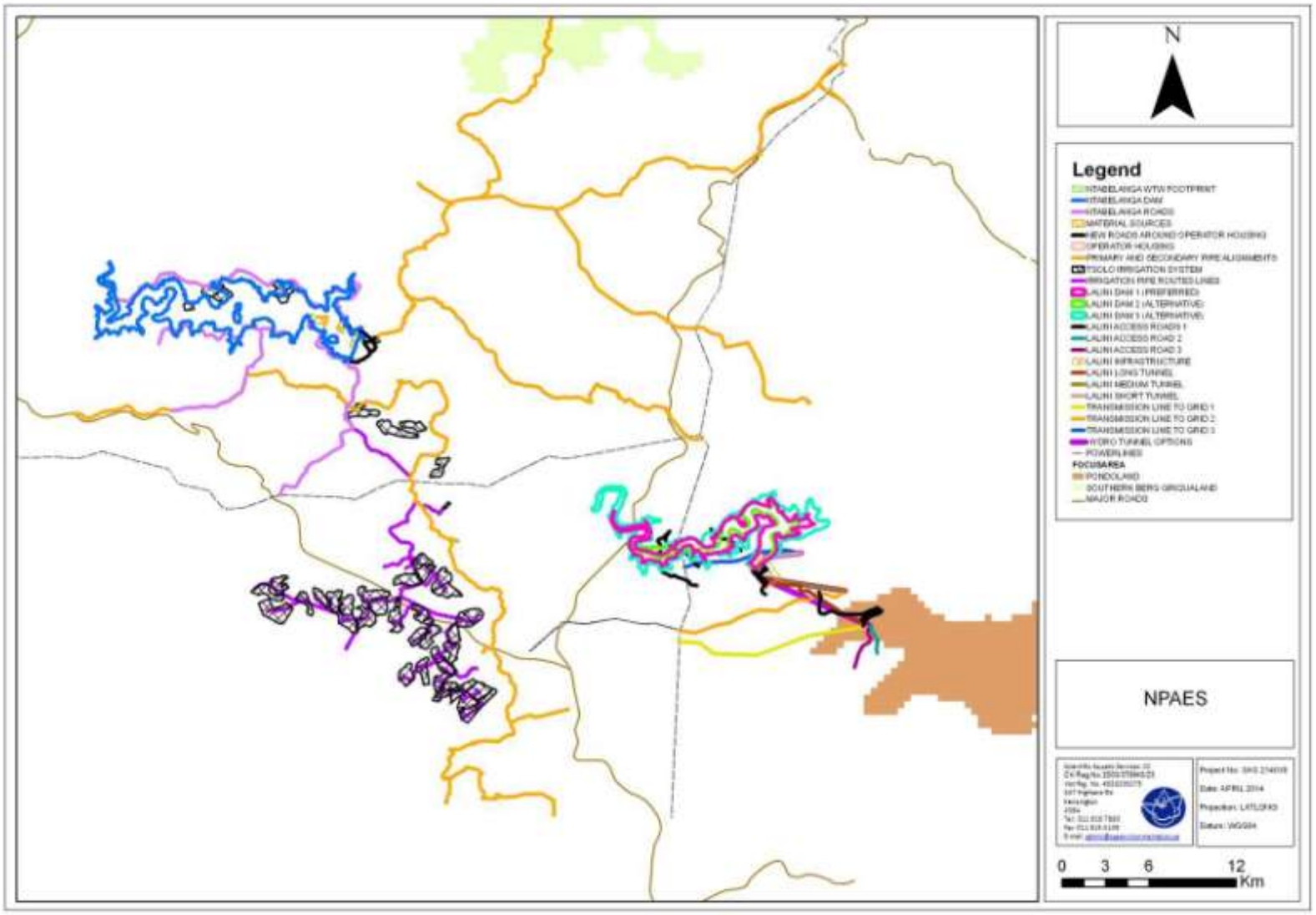

Figure 5: NPAES focus areas identified within the study area (National Protected Area Expansion Strategy, 2010).

5.1.3 National Biodiversity Assessment (NBA, 2011)

The recently completed NBA provides an assessment of South Africa's biodiversity and ecosystems, including headline indicators and national maps for the terrestrial, freshwater, estuarine and marine environments. The NBA was led by the SANBI in partnership with a range of organisations. It follows on from the National Spatial Biodiversity Assessment (NSBA, 2004), broadening the scope of the assessment to include key thematic issues as well as a spatial assessment. The NBA includes a summary of spatial biodiversity priority areas that have been identified through systematic biodiversity plans at national, provincial and local levels (SANBI BGIS).

The assessment of ecosystem level is then evaluated as the proportion of each vegetation type protected relative to the biodiversity target. According to the NBA, the locations for the proposed Lalini and Ntabelanga Dams are not located within a formally or informally protected area and are classified as *hardly protected.*

5.1.4 Importance According to the Eastern Cape Biodiversity Conservation Plan (ECBCP, 2007)

The Eastern Cape Biodiversity Conservation Plan (ECBCP) is a broad scale-biodiversity plan based on identifying Critical Biodiversity Areas (CBAs) and associated land use guidelines (bgis.sanbi.org). It recommends limits to the total amount of land transformation that should be allowed if biodiversity is to be conserved. The approach rests on the concept of Biodiversity Land Management Classes (BLMCs). Each BLMC sets out the desired ecological state that an area should be kept in to ensure biodiversity persistence. Only land use types that are compatible with maintaining this desired state should be allowed.

The ECBCP of the study area has indicated that:

- Besides the southern section of the pipelines, the study area does not fall into an Aquatic CBA.
- The southern pipelines and lower irrigation areas are categorised as an Aquatic CBA 1 area (A1 - *important river sub-catchments and all wetlands* and ABLMC1 - *Natural State*) (**Figure 6**).
- Small portions of the Lalini Dam and infrastructure and the majority of the Ntabelanga Dam and road upgrades are situated in a Terrestrial CBA 2 (BLMC 2 - *Near Natural landscape)* (**Figures 7-8**). These CBA areas provide ecological corridors as identified by other / previous studies or identified by the ECBCP.
- The primary and secondary pipelines and irrigation areas borders into Terrestrial CBA 1 (BLMC 1- *Natural Landscape*) and traverse CBA 2 (BLMC 2-*Near natural landscape*) areas (**Figure 9**).

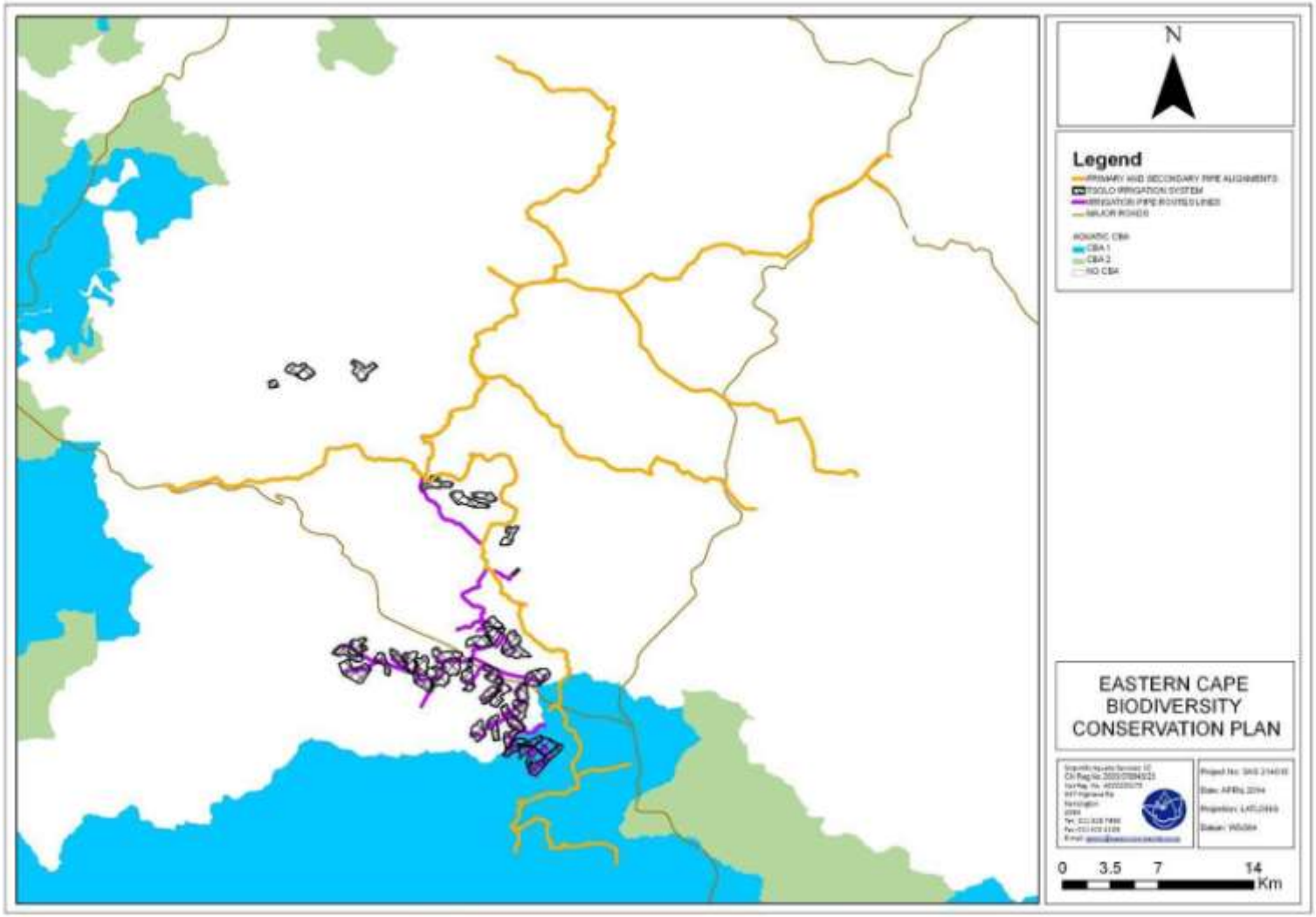

Figure 6: Aquatic Critical Biodiversity Areas associated with the southern section of the pipelines.

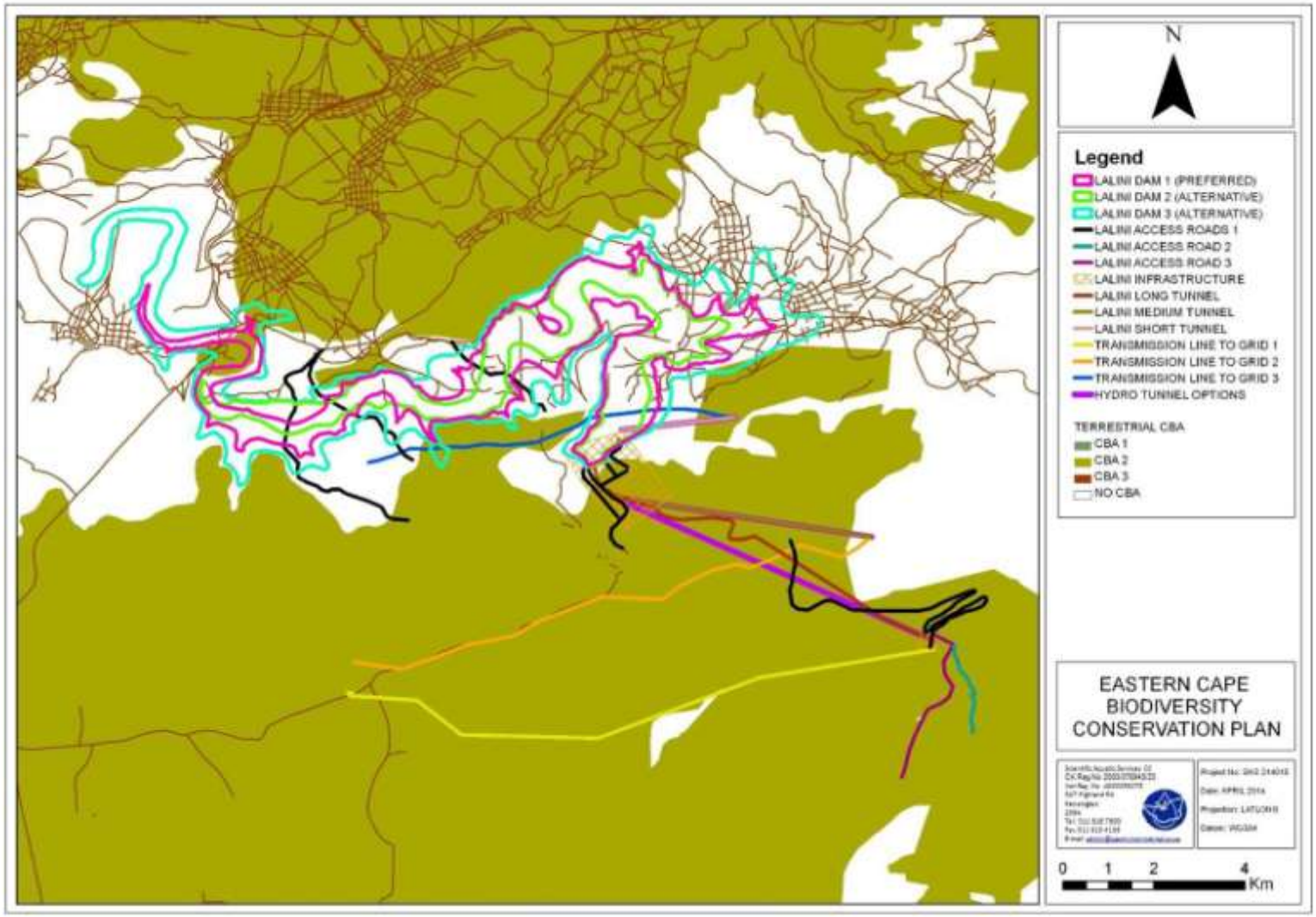

Figure 7: Terrestrial Critical Biodiversity Areas associated with Lalini Dam.

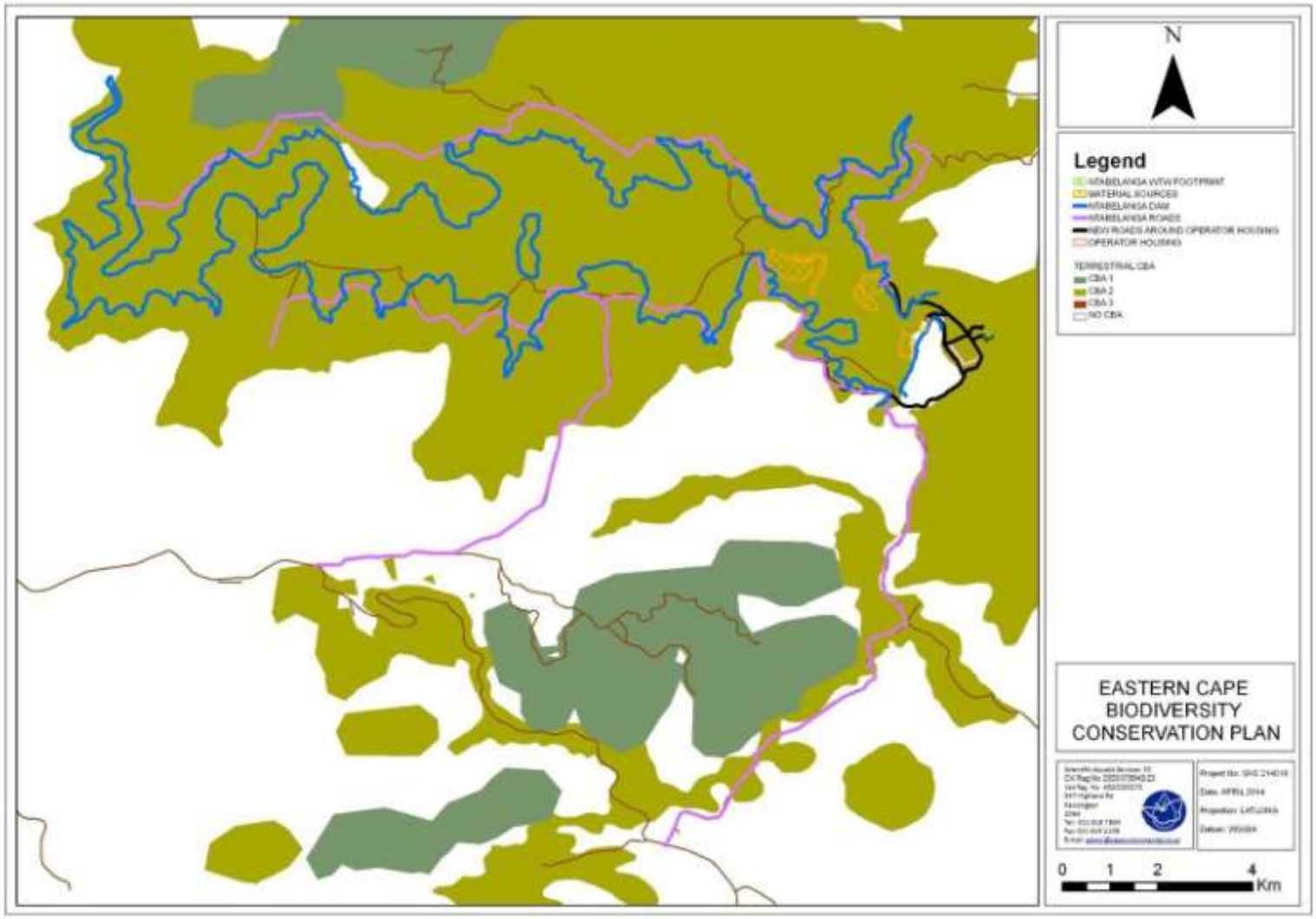

Figure 8: Terrestrial Critical Biodiversity Areas associated with Ntabelanga Dam and the road upgrades.

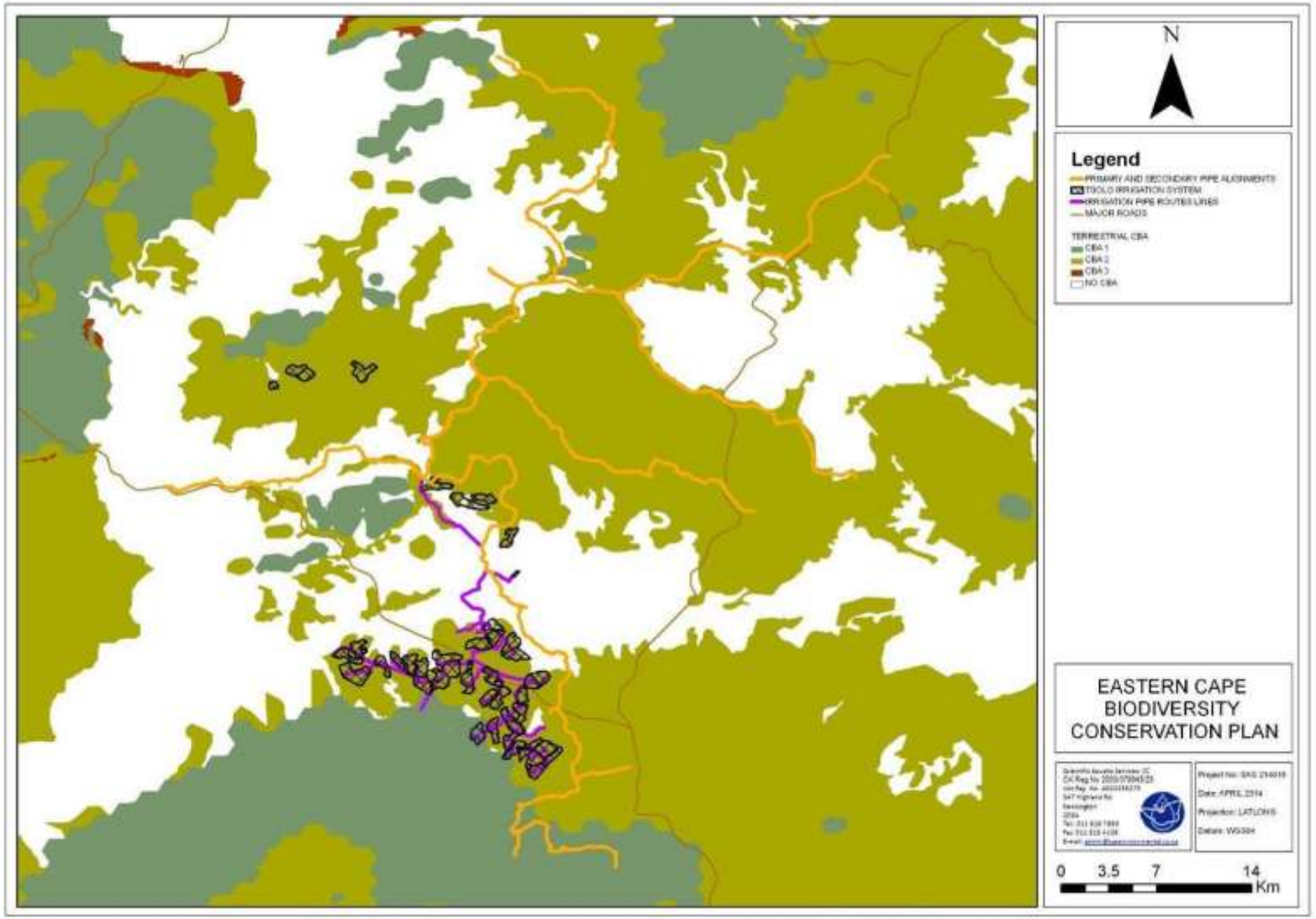

Figure 9: Terrestrial Critical Biodiversity Areas associated with the pipelines and irrigation areas.

5.1.5 Biomes and Bioregions

Biomes are broad ecological units that represent major life zones extending over large natural areas (Rutherford, 1997). The study area falls within both the Savanna and Grassland biome (Rutherford and Westfall, 1994). Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale. The study area falls within the Sub-escarpment Grassland and Sub-escarpment Savanna Bioregion (Mucina and Rutherford, 2006) (**Figures 10-12**).

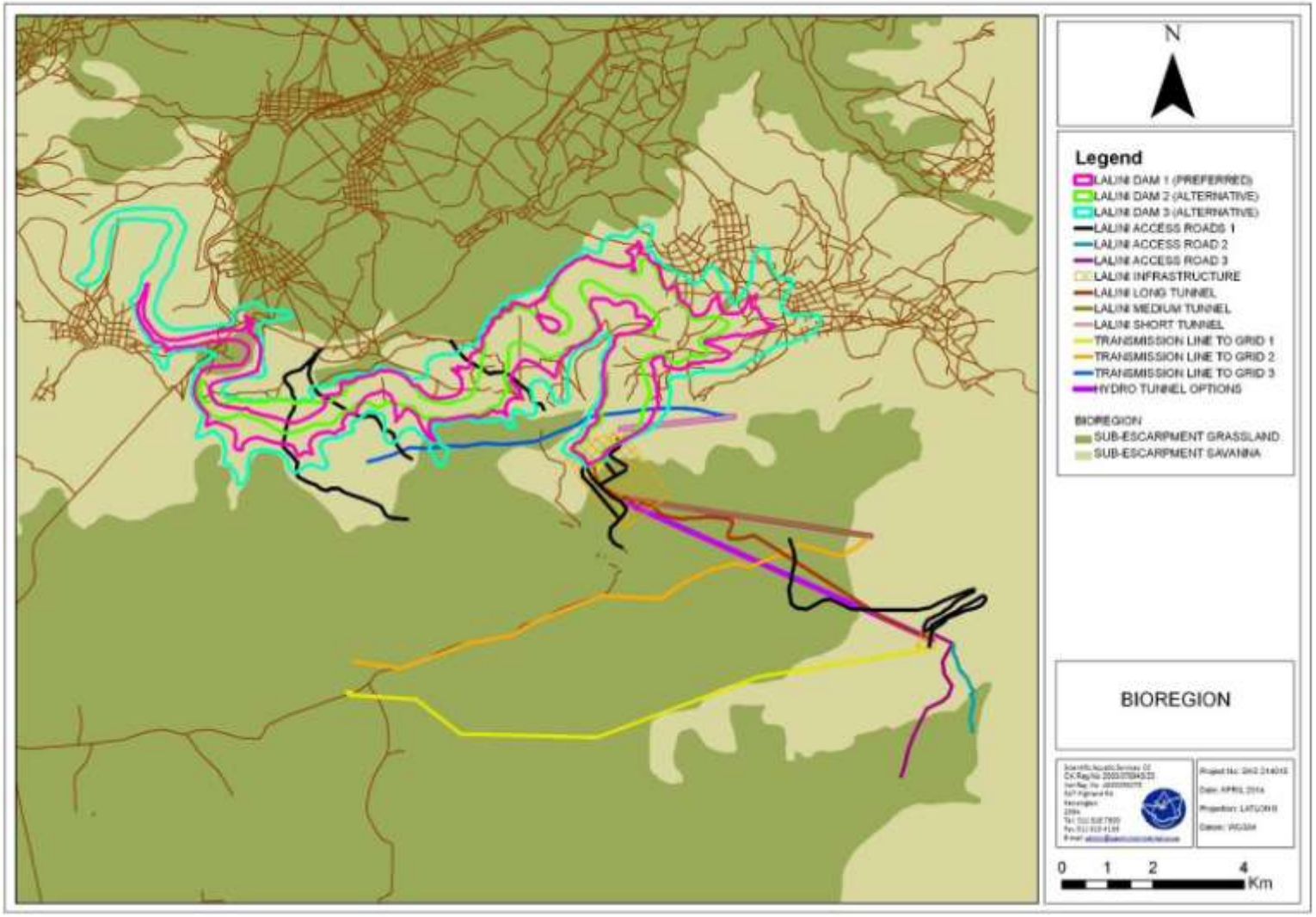

Figure 10: The bioregion associated with Lalini Dam (Mucina and Rutherford, 2006).

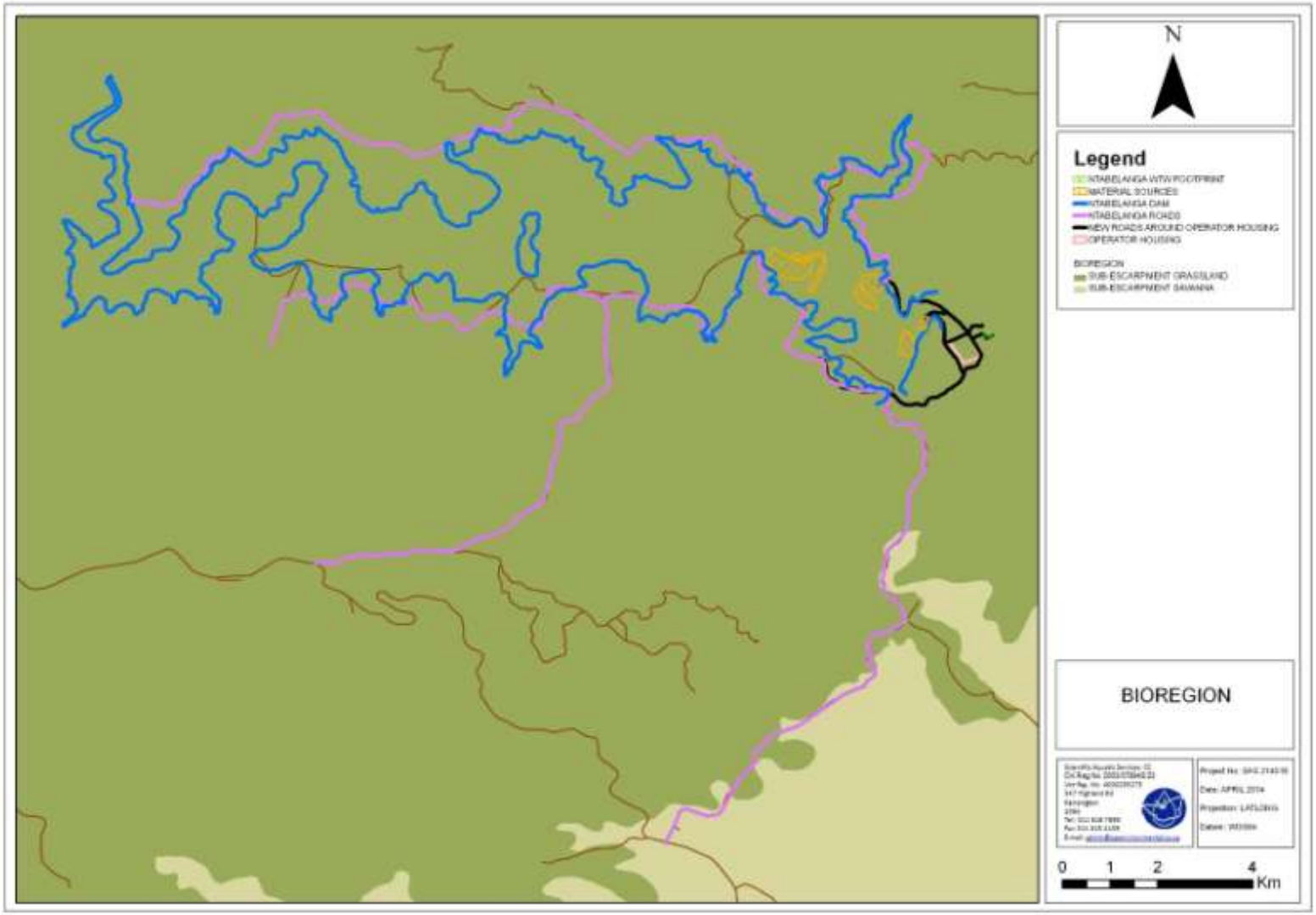

Figure 11: The bioregion associated with Ntabelanga Dam and the road upgrades (Mucina and Rutherford, 2006).

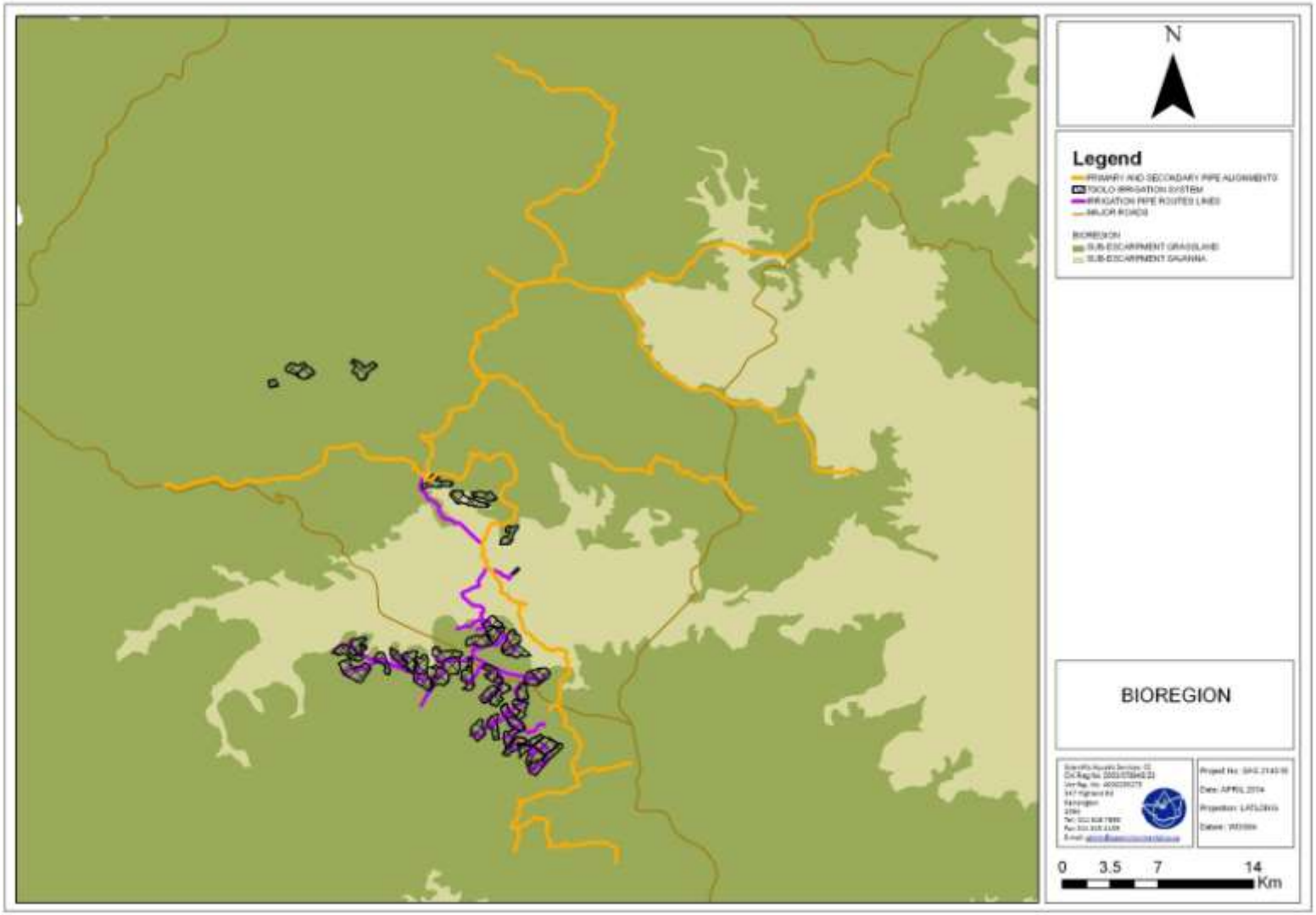

Figure 12: The bioregion associated with the pipelines (Mucina and Rutherford, 2006).

5.1.6 Vegetation Type

While biomes and bioregions are valuable as they describe broad ecological patterns, they provide limited information on the actual species that are expected to be found in an area. Knowing which vegetation type an area belongs to provides an indication of the floral composition that would be found if the assessment site was in a pristine condition, which can then be compared to the observed floral list and so give an accurate and timely description of the ecological integrity of the assessment site. When the boundary of the study site is superimposed on the vegetation types of the surrounding area (**Figure 13-15**), it is evident that the study area falls within a several vegetation types (Mucina and Rutherford, 2006). These include the *Bisho Thornveld, Drakensberg Foothill Moist Grasslands, Eastern Valley Bushveld, Eastern Griqualand Grassland, Mthata Moist Grassland* and *Southern Mistbelt Forest.* The characteristic of these vegetation types are discussed in the sections below.

Table 9: Primary vegetation types applicable to proposed dams and infrastructure.

Proposed development	Primary Vegetation types
Lalini Dam and associated infrastructure	*Bisho Thornveld* *Eastern Valley Bushveld* *Eastern Griqualand Grassland* *Mthata Moist Grassland*
Ntabelanga Dam, associated infrastructure and the road upgrades	*Eastern Griqualand Grassland* *Drakensberg Foothill Moist Grasslands* *Mthata Moist Grassland* *Eastern Valley Bushveld*
Pipelines and irrigation areas	*Eastern Griqualand Grassland* *Drakensberg Foothill Moist Grasslands* *Mthata Moist Grassland* *Eastern Valley Bushveld*

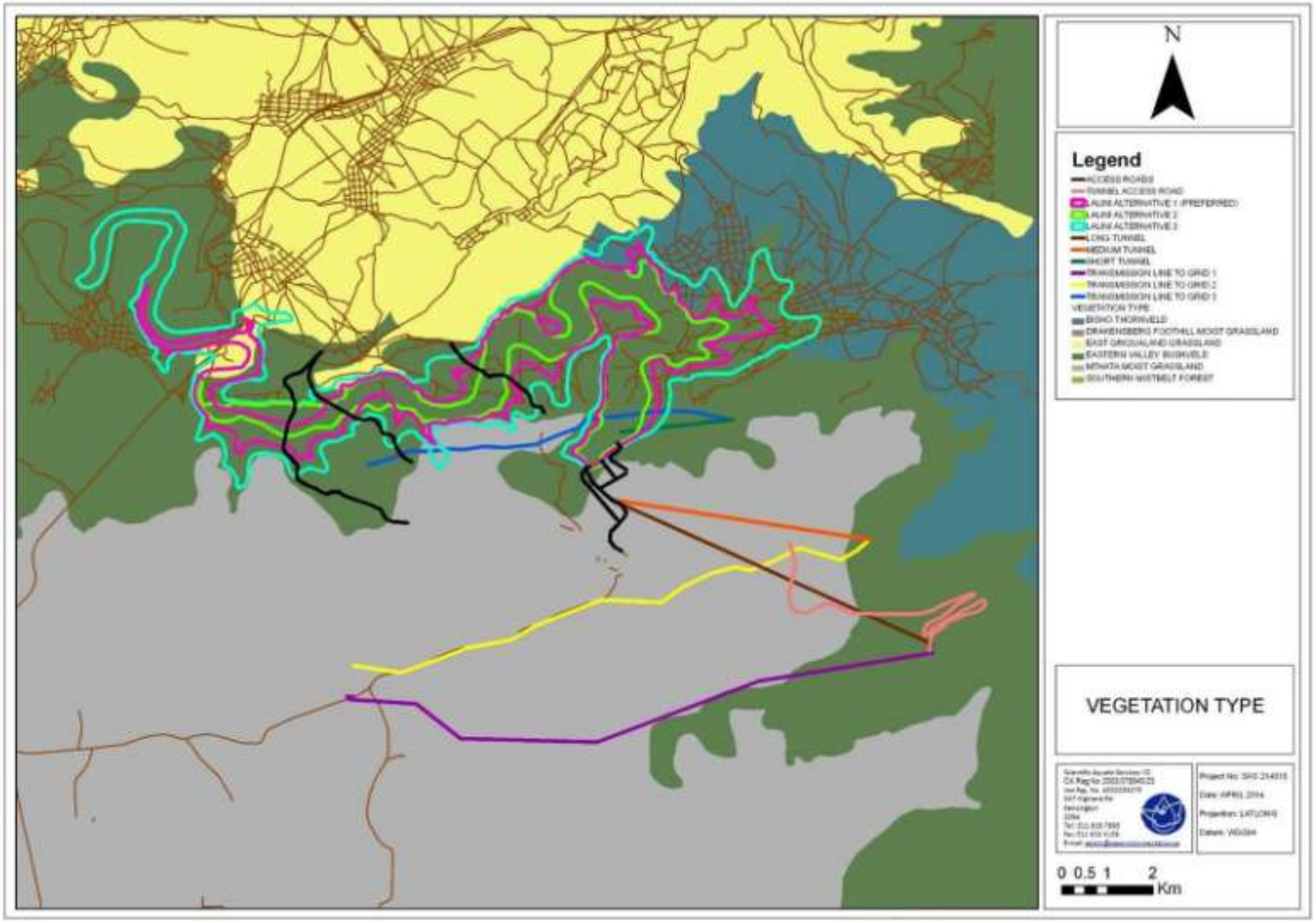

Figure 13: The vegetation type associated with Lalini Dam (Mucina and Rutherford, 2006).

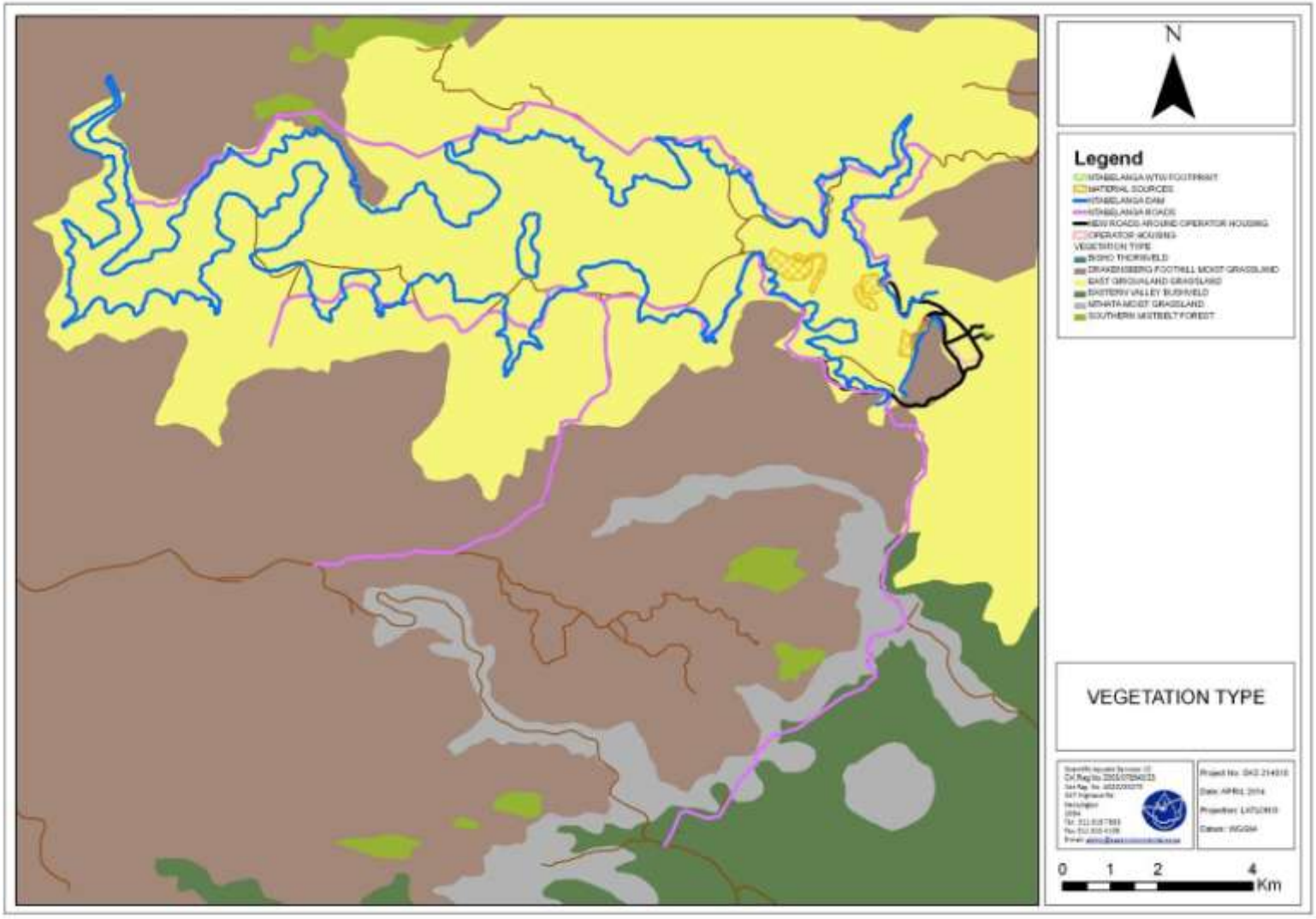

Figure 14: The vegetation type associated with Ntabelanga Dam and the road upgrades (Mucina and Rutherford, 2006).

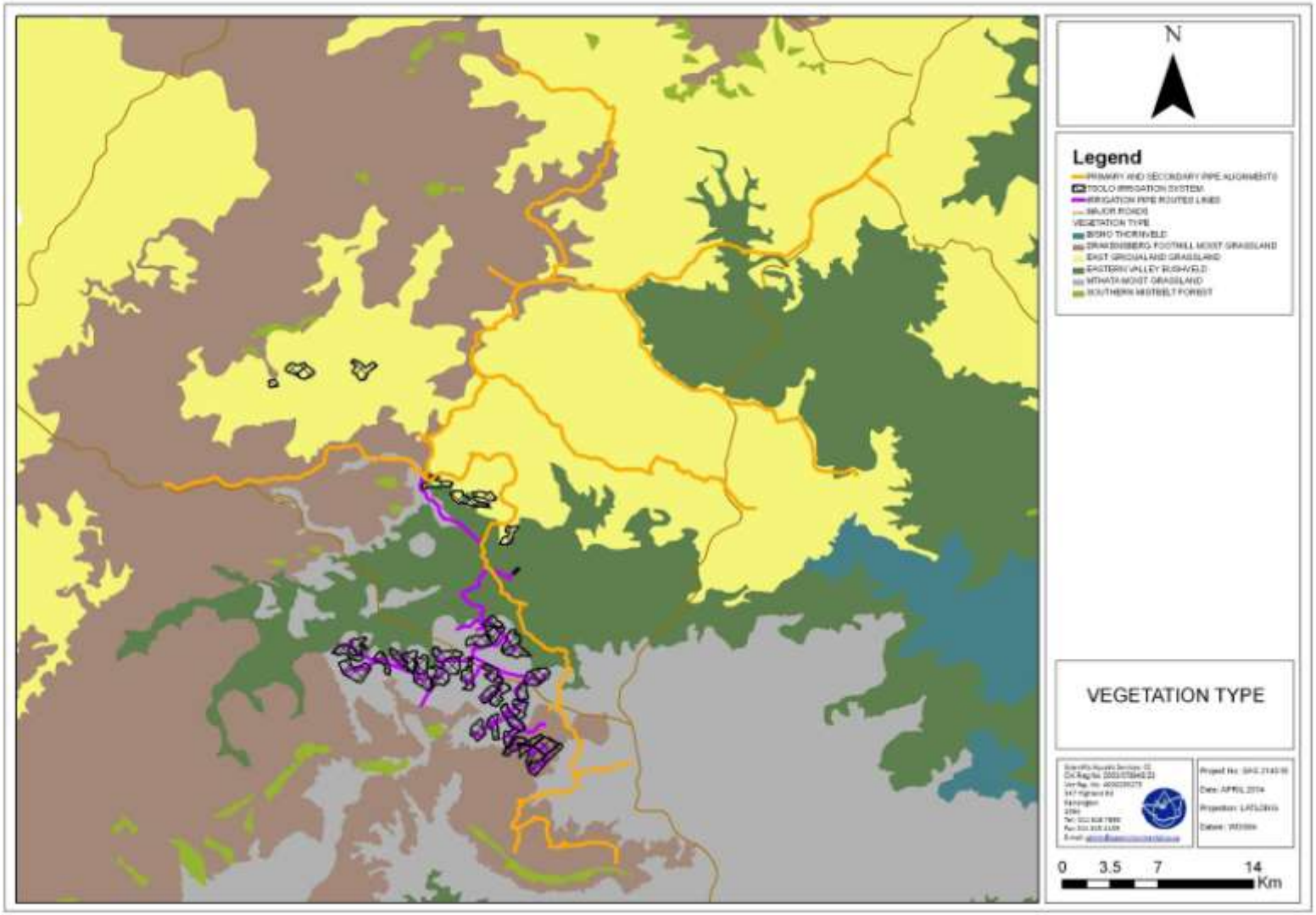

Figure 15: The vegetation type associated with the pipelines (Mucina and Rutherford, 2006).

5.1.6.1 Bisho Thornveld

Distribution

The *Bisho Thornveld* vegetation is distributed in the Eastern Cape Province from near Mthata in a band parallel to but inland of the coast to north of East London. It also extends to the southern side of the Amathole Mountains as far as Fort Beaufort. It is found at altitude spanning 200-700 m.

Conservation

The *Bisho Thornveld vegetation is formally classified* as a *Least Threatened* vegetation type (provincial conservation target is 25%). Up to 20% has been transformed for cultivation, urban development or plantations. Erosions range from low to moderate.

5.1.6.2 The Drakensberg Foothill Moist Grassland

Distribution

The Drakensberg Foothill Moist Grassland vegetation is distributed in KwaZulu-Natal and the Eastern Cape Province within a broad arc of Drakensberg piedmonts covering the surrounds of Bergville in the north, Nottingham Road, Impendle, Bulwer in the east and Kokstad, Mount Currie, Underberg and the surrounds of Mt Fletcher, Ugie, Maclear and Elliot in the south west. It is found at altitudes spanning 880-1 860 m.

Conservation

The Drakensberg Foothill Moist Grassland vegetation is formally classified as a Least Threatened vegetation type (provincial conservation target is 23%). Almost 20% has already been transformed for cultivation, plantations and urban sprawl. Alien woody species of *Rubus*, *Acacia dealbata* and *Solanum mauritianum* are potential invasive species in certain areas. Erosion ranges between very low (49%), low (28%) and moderate (17%). Biogeographically important taxa include *Schizochilus bulbinella* and *Schoenoxiphium burttii*.

5.1.6.3 Eastern Valley Bushveld

Distribution

The Eastern Valley Bushveld vegetation is distributed in KwaZulu-Natal and the Eastern Cape Province within deeply incised valleys of rivers including the lower reaches of the Thukela, Mvoti, Mgeni, Mlazi, Mkhomazi, Mzimkulu, Mzimkulwana, Mtamvuna, Mtentu, Msikaba, Mzimvubu (and its several tributaries), Mthata, Mbhashe, Shixini, Qhorha and the Great Kei. It very seldom extends to the coast. It is found at altitudes spanning 100-1 000 m.

Conservation

The Eastern Valley Bushveld vegetation is formally classified as Least Threatened (provincial conservation target is 25%). Up to 15% has been transformed mainly by cultivation. Alien plant

invasion are a serious threat with *Chromolaena odorata*, *Lantana camara* and *Caesalpinia decapetala* being the most problematic species.

5.1.6.4 Eastern Griqualand Grassland

Distribution

The Eastern Griqualand Grassland vegetation is distributed in KwaZulu-Natal and the Eastern Cape Province with a major portion of this unit covering most of East Griqualand (with Kokstad and Matatiele as centres). It is found at altitudes spanning 920-1 740 m.

Conservation

The East Griqualand Grassland is formally classified as a Vulnerable vegetation type (provincial conservation target is 23%). Over one quarter of the area has already undergone transformation due to cultivation of maize, plantations and urban sprawl. *Acacia dealbata* and *Acacia mearnsii* are invading this grassland in some places. Erosion ranges between low (31%), very low (30%) and moderate (30%) (Mucina and Rutherford, 2006). Biogeographically important taxon includes *Encephalartos friderici-guilielmi.*

5.1.6.5 Mthata Moist Grassland

Distribution

The Mthata Moist Grassland vegetation is distributed in the Eastern Cape Province on plains between Mthata and Butterworth parallel to the coastline and excluding the river valleys that intrude landwards into this unit. It is found at altitudes spanning 600-1 080 m.

Conservation

The Mthata Moist Grassland is formally classified as an Endangered vegetation type (provincial conservation target is 23%). More than 40% of the vegetation has been transformed for cultivation and plantations or by dense human settlements. Previous cultivated or fallow lands possibly constitute an estimated addition 25%. *Acacia mearnsii*, *Solanum mauritianum* and *Richardia humistrata* are the most important aliens. Erosion is a serious problem with high to very high erosion levels in 34% of the unit, moderate erosion in 35% and the remainder having low and very low erosion.

5.1.6.6 Southern Mistbelt Forest

Distribution

The Southern Mistbelt Forest vegetation is distributed in KwaZulu-Natal and the Eastern Cape Province. Forest patches vary in size and occur in fire-shadow habitats on south- and southeast-facing slopes located along the Great Escarpment, Somerset East, the Amathole Mountains, scarps of Transkei to the KwaZulu-Natal Midland and as far east as Ulundi. It is found at altitudes spanning 850-1 600 m (most patches occur between 1 000 and 1 400 m).

Conservation

The Southern Mistbelt Forest is formally classified as a Least Threatened vegetation type (provincial conservation target is 30%). Almost 5% has already been transformed for plantations. Invasive aliens include *Solanum mauritianum, Rubus* species and several *Acacia* and *Eucalyptus* species. Uncontrolled harvesting of timber, poles and firewood, overexploitation of non-timber forest products and grasslands are considered as current major threats.

5.2 HABITAT UNITS

Four habitat units have been identified within the study area, namely the Mountain / Rocky Outcrops habitat unit, Grassland / *Acacia* Thornveld habitat unit, Riparian / Wetland habitat unit and the Transformed (Grassland) habitat unit.

The sections below described the habitat units found within the three areas namely, the Ntabelanga Dam (**Figure 16**), Lalini Dam (**Figure 23**) and the road upgrades, pipelines and irrigation infrastructure and areas (**Figure 34-38).**

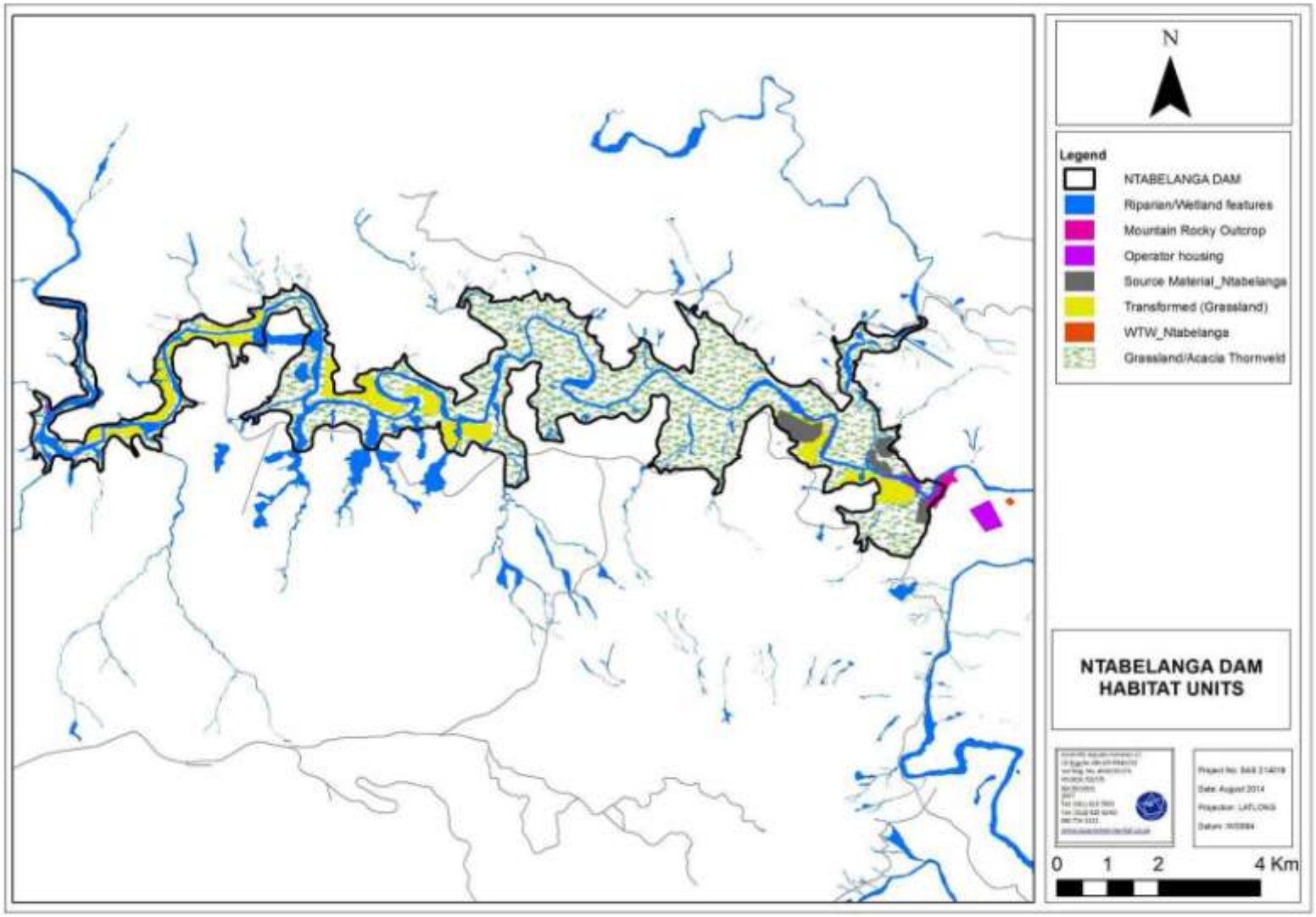

Figure 16: Habitat units identified within the Ntabelanga Dam study area.

5.3 NTABELANGA DAM

5.3.1 Mountain / Rocky Outcrop habitat unit

The Mountain / Rocky Outcrop habitat unit is limited to small sections within the Ntabelanga Dam study area. This habitat unit comprises areas of natural vegetation, which have remained largely undisturbed by historic agricultural activities, overgrazing and vegetation clearance from rural communities. These areas consist of well-developed grass and tree layers that provides habitat for a number of floral species considered indicators of the Eastern Griqualand Grassland vegetation type such as *Acacia karroo, Ziziphus mucronata* and *Leucosidea sericea*. Dominant woody species, in addition to the species mentioned previously, include *Searsia pyroides, Celtis africana, Cassonia spicata, Acacia caffra, Gymnosporia buxifolia, G. harveyana* and *Dovyalis caffra.* Graminoid layer is dominated by *Eragrostis curvula, Harpochloa falx, Melinis nerviglumis and Hyparrhenia hirta.* Forb species include *Aloe aborescence, Aloe ferox, Berkheya* species and *Kalanchoe thyrsiflora*.

Although the construction of the dam will most likely affect the immediate floral biodiversity and possibly the surrounding area by decreasing the floral species, it is important to note that most of the Mountain / Rocky Outcrop habitat occurs above the full supply level of the dam.

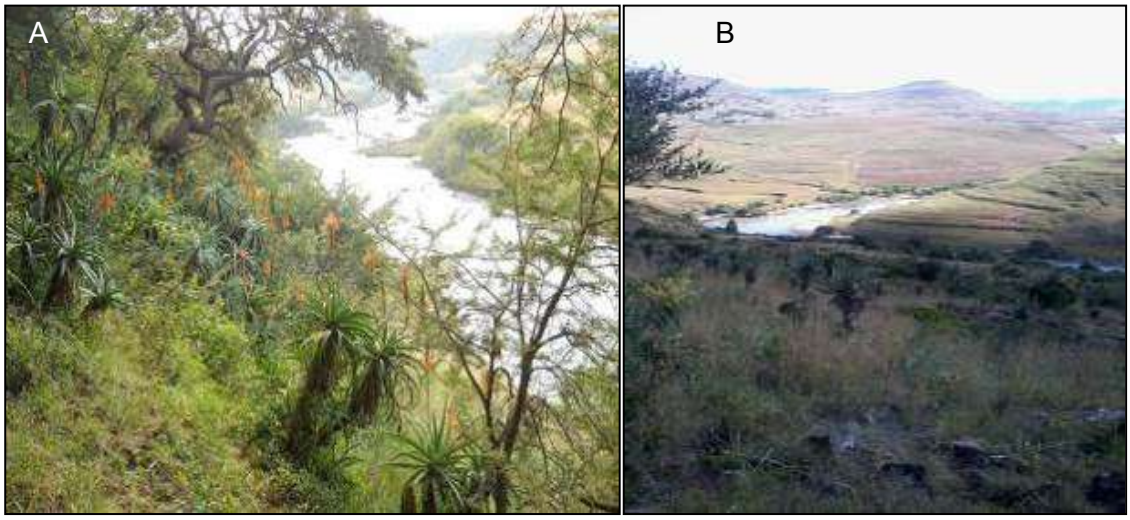

Figure 17: Mountain / rocky outcrop vegetation located within the A) western section of the Ntabelanga Dam footprint area and B) within the eastern section at the dam wall.

Table 10 presents the dominant floral species encountered within the Mountain / Rocky Outcrops habitat unit during the assessment.

Table 10: Dominant species encountered in the Mountain / Rocky Outcrops habitat unit. Alien species are indicated with an asterisk (*).

Tree species	Grass species	Forb species
Acacia caffra	*Aristida congesta*	*Aloe aborescence*
Acacia karroo	*Cymbopogon validus*	*Aloe transvaalensis*
**Acacia mearnsii*	*Eragrostis curvula*	*Berkheya sp.*
Buddleja saligna	*Eragrostis plana*	*Helichrysum herbaceum*
Cussonia paniculata	*Eragrostis rracemosa*	*Crassula ericoides*
Cassonia spicata	*Harpochloa falx*	*Crassula nudicaulis*
Celtis africana	*Hyparrhenia hirta*	*Helichrysum nudifolium*

Tree species	Grass species	Forb species
Dovyalis caffra	*Hyparrhenia tamba*	*Hermannia depressa*
Gymnosporia buxifolia	*Melinis nerviglumis*	*Kalanchoe thyrsiflora*
Gymnosporia harveyana	*Setaria nigrirostis*	*Senecio retrorsus*
Gymnosporia nemerosa	*Sporobulus africanus*	*Vernonia natalensis*
Searsia dendata		
Searsia pentheri		
Searsia pyroides		
Trema orientalis		
Ziziphus mucronata		

The ecological function and habitat of the Mountain / Rocky Outcrops habitat unit is considered to be moderate to high due to the few disturbances from agricultural activities, overgrazing and alien floral encroachment. In terms of conservation value, the moderate to high ecological functionality, good habitat integrity, the low incidence of bush or alien floral encroachment, combine to increase the ecological sensitivity of this habitat unit.

5.3.2 Grassland / *Acacia* Thornveld habitat unit

The Grassland / *Acacia* Thornveld habitat unit includes areas where poor veld management practices has led to extensive bush encroachment in some areas and changed the vegetation structure, as well as areas where historical cultivation activities have taken place. This habitat unit covers small sections within the Ntabelanga study area and in its present state consists of secondary bushveld, with lower expected floral species diversity. Other grassland areas occurred within mountain and rocky areas. These grasslands had some disturbance from grazing of livestock, but more natural species such as *Eragrostis* species, *Aristida* species and *Cymbopogon* species occurred here.

Dominant floral species within the Grassland / *Acacia* Thornveld habitat unit include the woody species *Acacia karroo*, A*. mearnsii, A. dealbata*, and *A. baileyana*. Most of these *Acacia*'s species are associated with disturbance and declared alien and/or invader floral species. A number of herbaceous species are present in this habitat unit and includes *Aloe marlothii, Helichrysum oreophilim, Hermannia transvaalensis* and *Taraxacum officinale.*

Figure 18: *Acacia karroo* dominating within the grassland / *Acacia* Thornveld habitat unit.

The section selected for the placement of infrastructure is located behind the Ntabelanga Dam wall within a grassland area. This area has undergone transformation due to historic agricultural activities. Currently the veld is dominated by *Hyparrhenia hirta*. This area is therefore low in floral diversity. It should also be noted that a floodplain wetland system is located further downwards downstream of the proposed dam wall construction site.

Figure 19: Veld dominated by Hyparrhenia hirta where the construction site will be located. A floodplain wetland feature located further downwards of the proposed site.

Table 11 outlines the dominant vegetation species encountered within this habitat unit.

Table 11: Dominant species encountered in the Grassland / *Acacia* Thornveld habitat unit. Alien species are indicated with an asterisk (*).

Tree species	Grass species	Forb species
Acacia karroo	*Andropogon contortus*	*Aloe marlothii*
Acacia caffra	*Aristida congesta var. congesta*	*Aloe ferox*
**Acacia mearnsii*	*Aristida congesta var. barbicollis*	*Berkheya bipinnatifida*
**Acacia dealbata*	*Bulbostylis hispidula*	*Helichrysum oreophilum*
**Acacia baileyana*	*Chloris virgata*	*Helichrysum nudifolium*
Carissa bispinosa	*Cymbopogon validus*	*Helichrysum krebsianum*
**Eucalyptus grandis*	**Cynodon dactylon*	*Hermannia transvaalensis*
**Eucalyptus camaldulensis*	*Dactyloctenium giganteum*	**Taraxacum officinale*
Flacourtia indica	*Eragrostis chloromelas*	
	Eragrostis curvula	
	Eragrostis gummiflua	
	Harpochloa falx	
	Heteropogon contortus	
	Hyparrhenia hirta	
	Melinis repens	
	Panicum maximum	
	Sporobulus africanus	
	Schoenoplectus corymbosus	

A decrease in floral diversity has occurred as a result of the edge effects from ploughing and crop cultivation, overgrazing, trampling by livestock and vegetation clearance causing severe soil erosion. The Grassland / *Acacia* Thornveld habitat unit is considered to have a medium to low ecological sensitivity and conservation value due to the change in floral species composition and vegetation structure as a result of the above mentioned impacts. This habitat

unit is furthermore well represented within the region, and loss thereof as a result of the dam construction will not significantly affect the floral conservation in the region.

5.3.3 Riparian / Wetland habitat unit

Various drainage lines, small tributaries and valley bottom wetlands traverse the study area, including the larger Tsitsa River, which drain in an eastern direction towards the dam wall.

The vegetation present within the Riparian / Wetland habitat unit contains many species observed within the Grassland / *Acacia* Thornveld habitat unit, but also includes a number of obligate wetlands species such as *Bulbostylis hispidula, Schoenoplectus corymbosus, Typha capensis and Cyperus* species. Vegetation within the Riparian / Wetland habitat unit varies from being woody along the larger rivers with associated riparian systems with more open grasslands due to vegetation clearance and erosion along the drainage lines and smaller tributaries.

Figure 20: Riparian and wetland vegetation along the Tsitsa River and smaller tributaries.

Large areas along the riparian features contain alien tree species such as *Acacia mearnsii, A. dealbata, A. baileyana*, *Eucalyptus grandis* and *E. camaldulensis*. These declared alien invader species compete with and replace indigenous grasslands and riverine species.

Figure 21: Alien invader species such as *Acacia dealbata* dominating the vegetation in the riparian zones of the main riparian systems.

Table 12 outlines the dominant vegetation species encountered within this habitat unit.

Table 12: Dominant species encountered in the Riparian / Wetland habitat unit. Alien species are indicated with an asterisk (*).

Permanent zone	Seasonal / temporary zone	Terrestrial zone
Phragmites australis	**Cynodon dactylon*	*Acacia karroo*
Schoenoplectus corymbosus	*Andropogon contortus*	**Acacia baileyana*
Typha capensis	*Persicaria serrulata*	**Acacia dealbata*
Miscanthus junceus	*Persicaria attenuata*	**Acacia mearnsii*
Leersia hexandra	*Phragmites australis*	*Acacia polycantha*
Miscanthus capensis	*Schoenoplectus corymbosus*	*Asparagus laricinus*
Bulbostylis hispidula	*Typha capensis*	*Combretum erythrophyllum*
	Schoenoplectus brachycerus	**Eucalyptus grandis*
	Brachyaria sp.	**Eucalyptus camaldulensis*
	Cyperus mariscus	*Gynmosporia senegalensis*
	Helichrysum sp.	*Searsia pyroides*
	Imperata cylindrica	*Senecio decurrens*
	Miscanthus junceus	**Taraxacum officinale*
	Sporobuls africana	*Aristida congesta subsp. barbicolus*
	Sporobulus festivus	*Berkheya bergiana*
	Setaria sphacelata var. sericea	*Chloris virgata*
	Eragrostis plana	*Cynodon dactylon*
	Eragrostis chloromelas	*Dactyloctenium giganteum*
	Eragrostis curvula	*Paspalum dilitatum*
	Eragrostis gummiflua	*Helichrysum cerastioides*
	Cymbopogon validus	*Helichrysum nudifolium*
	Arundinella nepalensis	*Helichrysum krebsianum*
		Hyparrhenia hirta
		**Taraxicum officinale*

The Riparian / Wetland habitat unit is considered to be of high ecological sensitivity due to the contribution of the various wetland and riparian systems to wetland ecoservices provision and the habitat provided for floral species. Although large sections along the riparian system are dominated by alien invader floral species, pockets of indigenous tree species exist along the Tsitsa River.

Wetlands (and riparian areas) contribute to the maintenance of biodiversity through the provision of habitat and maintenance of natural processes. The integrity of a wetland or riparian feature contributes strongly to the capacity of such a feature to provide this benefit, in addition to specific attributes such as the presence of threatened faunal or floral species (Kotze *et al.,* 2009).

5.3.4 Transformed (Grassland) habitat unit

The Transformed (Grassland) habitat unit includes areas where vegetation has been completely transformed by historic and on-going small scale agricultural activities and overgrazing of livestock causing erosion and a decrease in vegetation in these areas. Where vegetation has recovered from historic transformation, very little floral diversity occurs. Species dominating this habitat unit is usually associated with disturbance or grows in areas that have been previously cultivated such as *Hyparrhenia hirta, Heteropogon contortus* and *Eragrostis curvula*. *Acacia mearnsii* and *Acacia dealbata* were also common tree species located close to this habitat unit.

5.4 LALINI DAM

5.4.1 Mountain / Rocky Outcrop habitat unit

The Mountain / Rocky Outcrop habitat unit is limited to small sections within the Lalini Dam study area. The eastern section of the dam where the largest section of this habitat unit is located comprises of a *Euphorbia* forest and other indigenous tree species.

The *Euphorbia* forest comprises areas of natural vegetation, which have remained largely undisturbed by historic agricultural activities, overgrazing and vegetation clearance from rural communities due to the relative inaccessibility of these areas. These areas consist of well-developed grass and woody layers that provides habitat for a number of floral species considered indicators of the Eastern Griqualand Grassland vegetation type such as *Acacia karroo* and *Ziziphus mucronata*. Dominant woody species, in addition to the species mentioned previously, include *Euphorbia ingens. Euphorbia tirucalli, Gynmosporia senegalensis, Combretum erythrophyllum, Portulacaria afra* and *Ziziphus mucronata* and Graminoid layer is dominated by *Eragrostis curvula, Cympopogon validus, Melinis nerviglumis and Hyparrhenia tamba.* Forb species include *Aloe aborescence, Berkheya* species, *Kalanchoe rotundifolia, Crassula* species, *Bulbine abyssinica, Ledebouria ovatifolia* and *Senecio decurrens*.

Other Mountain / Rocky Outcrop areas were located mostly along the Tsitsa River, also comprising of indigenous tree and forb species. Species located in the western section of the Lalini Dam were the same as the *Euphoribia* forest section, although not as diverse as the eastern section close to the proposed dam wall. More bush encroached areas and alien invader species were located along the eastern section.

Although the construction of the dam will most likely to affect the immediate floral biodiversity and possibly the surrounding area by decreasing the floral species, it is important to note that the most significant impact will be on this vegetation type will be as a result of the flooding of the valley and a significant amount of this vegetation will be drowned once the dam reaches the full supply level.

Construction material for the Lalini Dam will be collected from the footprint area within the Lalini Dam. Section located within the Mountain / Rocky Outcrop where material will be collected needs to take the sensitive habitat into account, since possible protected tree species or other floral of conservational concern could occur within this area.

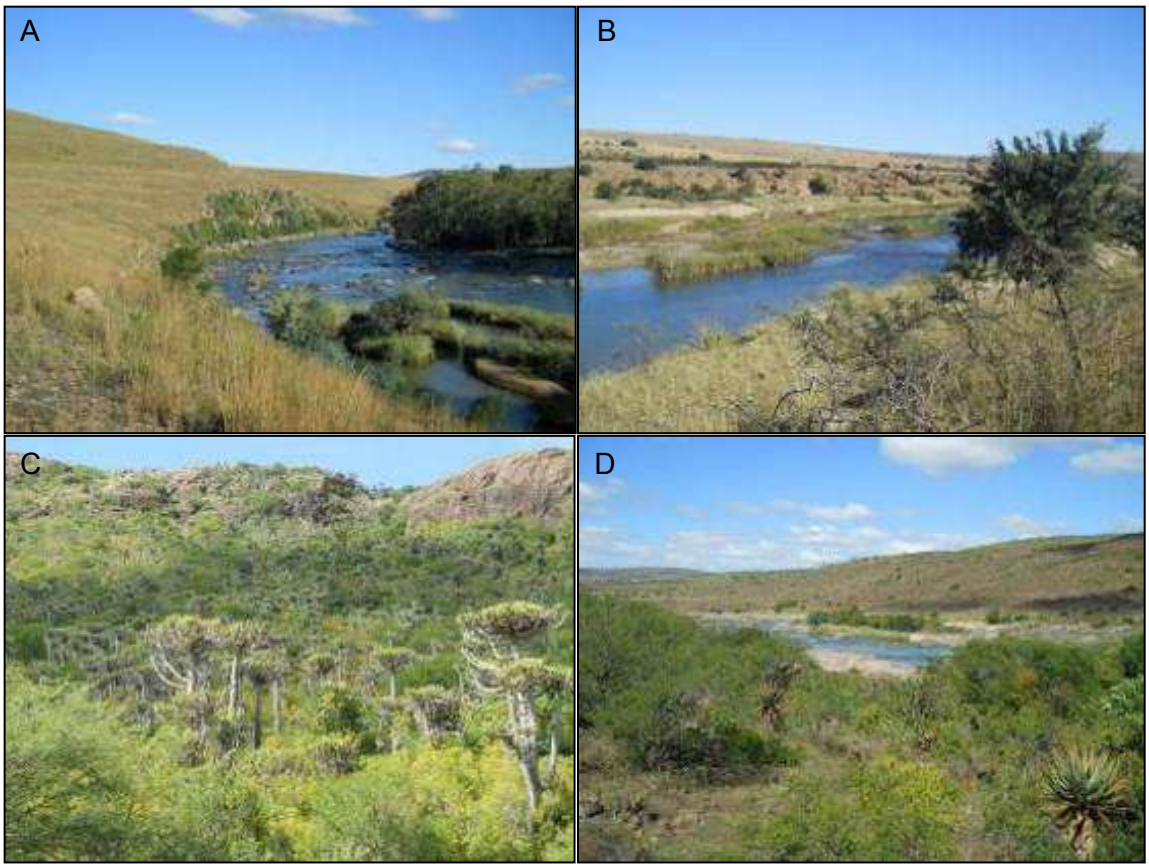

Figure 22: Mountain / rocky outcrop vegetation located within the A-B) western section of the Lalini dam footprint area and C-D) within the eastern section at the dam wall.

The ecological function and habitat of the Mountain / Rocky Outcrops habitat unit is considered to be moderate to high due to the few disturbances from agricultural activities, overgrazing and alien floral encroachment. In terms of conservation value, the moderate to high ecological functionality, good habitat integrity, the low incidence of bush or alien floral encroachment, combine to increase the ecological sensitivity of this habitat unit.

No protected or RDL floral or tree species were located during the time of the site assessment but there is a high probability that such species could be present within this habitat unit.

Table 13 presents the dominant floral species encountered within the Mountain / Rocky Outcrops habitat unit during the assessment.

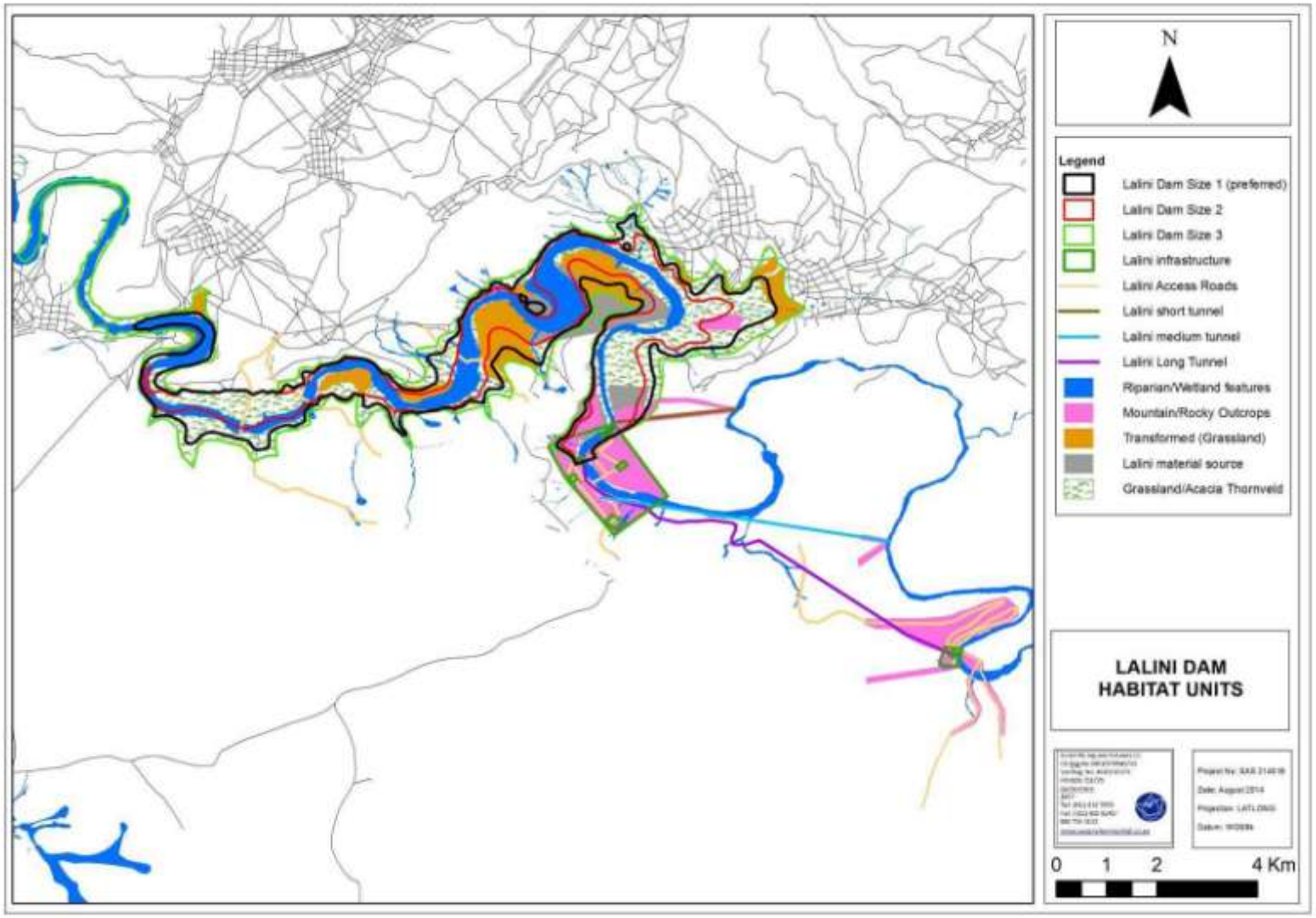

Figure 23: Habitat unit identified within the Lalini Dam study area.

Table 13: Dominant species encountered in the Mountain / Rocky Outcrops habitat unit. Alien species are indicated with an asterisk (*), Cremnophyte species are indicated in bold.

Tree species	Grass species	Forb species
Acacia burkei	*Andropogon eucomus*	*Aloe arborescense*
Acacia caffra	*Aristida congesta var congesta*	*Aloe marlothii*
Acacia karroo	*Bothriochloa insculpta*	*Aloe ferox*
Acacia polycantha	*Cymbopogon validus*	*Asparagus laricinus*
Athrixia phylicoides	*Eragrostis gummiflua*	*Ammi visnaga*
Canthium inerme	*Eragrostis curvula*	*Bauhinia tomentosa*
Combretum erythrophyllum	*Eragrostis cilianensis*	*Bulbine abyssinica*
Cussonia paniculata	*Hyparrhenia hirta*	*Chironia krebsii*
Dovyalis caffra	*Hyparrhenia tamba*	*Conium chaerophylloides*
Ehretia rigida	*Melinis nerviglumis*	***Crassula ericoides***
Euclea crispa	*Melinis repens*	***Crassula nudicaulis***
Euphorbia ingens	*Sporobulus africanus*	***Crassula obovata***
Euphorbia tirucalli		***Crassula lanceolata***
Ficus indica		***Crassula pellucida***
Gynmosporia senegalensis		*Delosperma caespitosum*
Gynmosporia polycantha		*Erica frigida*
Portulacaria afra		*Gazania krebsiana*
Olea capensis		*Haplocarpha scaposa*
Opuntia ficus-indica		*Hermannia transvaalensis*
Rhus gueinzii		*Indigofera species*
Ziziphus mucronata		*Ipomoea aquatica*
		Kalanchoe rotundifolia
		Kalanchoe luciae
		Lampranthus stipulaceus
		Ledebouria ovatifolia
		Nemesia fruticans
		Nerine angustifola
		Nerine appendiculata
		Pelargonium luridum
		Pellaea calomelanos
		**Plantago lanceolata*
		Plectranthus spicatus
		Polygala hottentotta
		Rhodohypoxis rubella
		Senecio decurrens
		Walenbergia cuspidata

5.4.2 Grassland / *Acacia* Thornveld habitat unit

The Grassland / *Acacia* Thornveld habitat unit includes areas where poor veld management practices has led to extensive bush encroachment in some areas and changed the vegetation structure, as well as areas where historical cultivation activities have taken place. This habitat unit covers small sections along the Tsitsa River within the Lalini study consisting of open grassland areas with a variable density of indigenous bush vegetation. Over grazing by livestock from the surrounding communities is one of the main contributors, where indigenous shrubs and trees increase in density to such as extent that other vegetation such as grass species is excluded.

Dominant floral species within the Grassland / *Acacia* Thornveld habitat unit include the woody species *Acacia karroo*. A number of herbaceous species are present in this habitat unit and includes *Aloe marlothii, Berkheya bipinnatifida, Hermannia transvaalensis, Kalanchoe*

rotundifolia, Tagetes minuta and Bidens pilosa. Graminoid layer is dominated by *Eragrostis curvula, Eragrostis gummiflua, Bothriochloa insculpta, Melinis nerviglumis, Sporobulus africanus and Hyparrhenia tamba.* All species mentioned here except for *Melinis nerviglumis* occur in areas associated with disturbance or trampled, overgrazed veld, indicating that a greater portion of the graminoid species located within this habitat unit grows in more disturbed areas.

Figure 24: Open grassland areas along the Tsitsa River on the western section of the Lalini dam study area.

Figure 25: *Acacia karroo* dominating within the grassland / *Acacia* Thornveld habitat unit.

Table 14 outlines the dominant plant species encountered within this habitat unit.

Table 14: Dominant species encountered in the Grassland / *Acacia* Thornveld habitat unit. Alien species are indicated with an asterisk (*).

Tree species	Grass species	Forb species
Acacia karroo	*Andropogon eucomus*	*Asparagus laricinus*
Acacia burkei	*Aristida congesta* var. *congesta*	*Aloe marlothii*
Acacia caffra	*Bothriochloa insculpta*	*Aloe ferox*
**Acacia mearnsii*	*Cynodon dactylon*	*Bauhinia tomentosa*
Acacia tortilis	*Cymbopogon validus*	*Berkheya bipinnatifida*
Combretum erythrophyllum	*Cymbopogon excavatus*	**Bidens pilosa*
**Eucalyptus grandis*	*Dactyloctenium giganteum*	*Conium chaerophylloides*
**Eucalyptus camaldulensis*	*Dactyloctenium australe*	*Helichrysum oreophilum*

Tree species	Grass species	Forb species
Ziziphus mucronata	*Eragrostis curvula* *Eragrostis gummiflua* *Eragrostis inamoena* *Hyparrhenia hirta* *Melinis nerviglumis* *Melinis repens* *Panicum maximum* *Paspalum distichum* **Pennisetum clandestinum* *Sporobulus africanus* *Sporobulus fimbriatus*	*Hermannia transvaalensis* *Ipomoea purpurea* *Kalanchoe rotundifolia* *Kalanchoe luciae* **Tagetes minuta*

A decrease in floral diversity has occurred as a result of overgrazing, trampling by livestock and vegetation clearance causing severe soil erosion. The Grassland / *Acacia* Thornveld habitat unit is considered to have a medium to low ecological sensitivity and conservation value due to the change in floral species composition and vegetation structure as a result of the above mentioned impacts. This habitat unit is furthermore well represented within the region, and loss thereof as a result of the dam construction will not be significantly affect floral conservation in the region.

5.4.3 Riparian / Wetland habitat unit

Various drainage lines, small tributaries traverse the study area, including the larger Tsitsa River. The vegetation present within the Riparian / Wetland habitat unit contains woody species, exotic and indigenous as observed within the Grassland / *Acacia* Thornveld habitat unit. Large areas along the riparian features contain alien tree species such as *Acacia mearnsii, Eucalyptus grandis* and *E. camaldulensis*. These declared alien invader species compete with and replace indigenous grasslands and riverine species. The remainder of the vegetation found within the drainage lines includes a number of obligate wetlands species such as *Bulbostylis hispidula, Schoenoplectus corymbosus, and various Cyperus* species.

Figure 26: Riparian and wetland vegetation along the Tsitsa River.

Table 15 outlines the dominant plant species encountered within this habitat unit.

Table 15: Dominant species encountered in the Riparian / Wetland habitat unit. Alien species are indicated with an asterisk (*).

Permanent zone	Seasonal / temporary zone	Terrestrial zone
Phragmites australis	**Cynodon dactylon*	*Acacia karroo*
Schoenoplectus corymbosus	*Persicaria serrulata*	**Acacia mearnsii*
Typha capensis	*Persicaria attenuata*	*Acacia polycantha*
Miscanthus junceus	*Phragmites australis*	*Asparagus laricinus*
Leersia hexandra	*Schoenoplectus corymbosus*	*Combretum erythrophyllum*
Miscanthus capensis	*Typha capensis*	**Eucalyptus grandis*
	Schoenoplectus brachycerus	**Eucalyptus camaldulensis*
	Brachyaria sp.	*Gynmosporia senegalensis*
	Cyperus mariscus	*Searsia pyroides*
	Helichrysum sp.	*Senecio decurrens*
	Imperata cylindrica	**Taraxacum officinale*
	Miscanthus junceus	*Aristida congesta subsp. barbicolus*
	Sporobuls africana	*Berkheya bergiana*
	Sporobulus festivus	*Chloris virgata*
	Setaria sphacelata var. sericea	*Cynodon dactylon*
	Eragrostis plana	*Dactyloctenium giganteum*
	Eragrostis chloromelas	*Paspalum dilitatum*
	Cymbopogon validus	*Hyparrhenia hirta*
	Arundinella nepalensis	
	Zantedeschia species	

The Riparian / Wetland habitat unit is considered to be of high ecological sensitivity due to the contribution of the various wetland and riparian systems to faunal migratory connectivity, wetland ecoservices provision and the habitat provided for floral species. Although large sections along the riparian system are dominated by alien invader floral species, pockets of indigenous tree species exist along the Tsitsa River.

5.4.4 Transformed (Grassland) habitat unit

The Transformed (Grassland) habitat unit includes areas where vegetation has been completely transformed by historic and on-going small scale agricultural activities and overgrazing of livestock causing erosion and a decrease in vegetation in these areas. Where vegetation has recovered from historic transformation, very little floral diversity occurs. Numerous communities / villages also occur outside of the Lalini Dam footprint area, also contributing towards the decrease in ecological integrity of the area. Species dominating this habitat unit is usually associated with disturbance or grows in areas that have been previously cultivated such as *Hyparrhenia hirta, Heteropogon contortus* and *Eragrostis curvula*. *Acacia mearnsii* and *Acacia dealbata* were also common tree species located close to this habitat unit.

5.5 ROAD UPGRADES AND PIPELINES

5.5.1 Road upgrades at Ntabelanga and Lalini Dams

Some new sections of road will be constructed either to provide access to the construction sites or to replace existing roads that will be inundated. In addition to this, some existing roads will be

upgraded by resurfacing and improving river crossings. The road upgrades are mostly in the Ntabelanga Dam study area. In terms of vegetation diversity, the edge effects of the existing roads has transformed the vegetation to the extent that only grass species such as *Eragrostis curvula, E. chloromelas, Hyparrhenia hirta, Sporobulus africanus* and *Cynodon dactylon*, which are associated with more disturbed areas, occur alongside the current access roads. Other areas of the road upgrade are located within the higher altitude areas. Indigenous species such as *Aloe marlothii, Aloe ferox* and *Aloe aborescence* occurred alongside the current road. These and other indigenous species could be relocated should they occur within the road upgrade footprint area.

Figure 27: Transformed grassland areas alongside the road upgrade area. Indigenous species such as *Aloe ferox* and *Aloe aborescence* located alongside the road to be upgraded entering the Ntabelanga site.

Numerous drainage lines, seeps, riparian systems and valley bottom wetland features traverse the road to be upgraded. The wetland features need to be considered when construction of the road upgrades commences to ensure that e.g. sedimentation of wetland features does not take place, wetlands that have undergone severe erosion close to the road, be reinforced to prevent further degradation and stream flow is established.

Figure 28: Riparian and wetland crossing along the road to be upgraded in the Ntabelanga Dam study area.

Podocarpus falcatus and *P. latifolius* were identified in low abundance alongside the road upgrade (roads to be resurfaced) areas within the Ntabelanga Dam, on the northern section of

the dam. More *Podocarpus* species were located on the secondary pipeline route south of the town Tsolo. These species are considered protected according to the notice of the list of protected tree species under the National Forests Act, 1998 (Act No. 84 of 1998). Possible mitigation measure would be to re-align the roads to avoid the trees from being removed or permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area.

Table 16: Coordinates of protected tree species located within the study area.

Podocarpus falcatus and P. latifolius along the road upgrade route within Ntabelanga Dam	**Coordinates**
GPS1	31° 4'43.25"S 28°33'30.09"E
GPS2	31° 4'42.57"S 28°33'30.27"E
GPS3	31° 4'43.96"S 28°33'20.62"E
GPS4	31° 4'45.51"S 28°33'4.57"E
Podocarpus falcatus and P. latifolius along the secondary pipeline route south of the town of Tsolo.	
GPS5	31°24'18.62"S 28°46'28.97"E
GPS6	31°24'21.15"S 28°45'1.87"E

Although most of the vegetation where the road upgrades or new roads will be constructed within the Lalini Dam has been transformed, it is possible that *Podocarpus* species, *Encephalartos* species and other protected and RDL floral species could occur along the proposed new Lalini Dam roads and the power line 1, in the vicinity of the Tsitsa Falls.

Figure 29: *Podocarpus falcatus* located on the northern section of the dam, along the road upgrade section.

5.5.2 Primary and secondary pipelines

Primary and secondary pipelines conveying water to selected areas are located within the Tsolo and Qumbu local areas. Most of the areas where the construction of these pipelines is proposed are located adjacent to main roads. This, due to the edge effects from the road, vegetation has been transformed. Very little indigenous vegetation occurred along the route. Species mostly associated with disturbance such as *Eragrostis curvula, Hyparrhenia hirta* and *Cynodon dactylon* were present. In some areas outside Qumbu current construction activities to upgrade the roads have already taken place.

Figure 30: Current construction activities to upgrade roads outside the Qumbu area.

Areas where the proposed primary and secondary pipeline will be located is crossing several riparian and wetland features, containing mostly alien invader floral species such as *Acacia mearnsii, A. dealbata, Eucalyptus grandis, E. camaldulensis, Melia azedarach* and *Solanum mauritianum.* Several wetland and riparian system traverse the primary and secondary pipeline routes supporting a different graminoid assemblage of increased diversity.

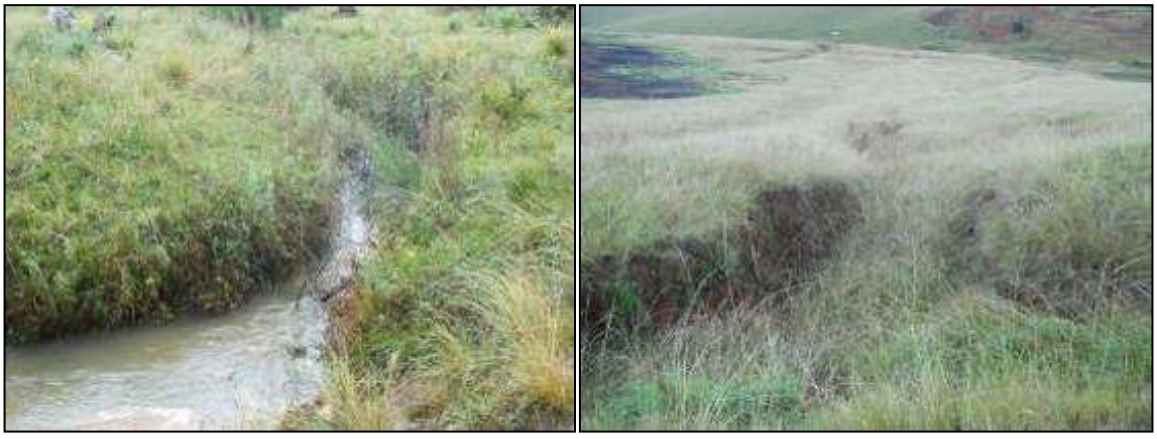

Figure 31: Riparian crossings and drainage lines crossing the proposed pipeline infrastructure.

Sections within the proposed primary and secondary pipeline route consist of totally transformed areas through local and rural communities, where vegetation has been completely cleared. Only species such as *Cynodon dactylon, Hyparrhenia hirta, Cosmostomium natlanse, Aeollanthus parvifolius* and numerous *Aloe* species were located within these areas.

Figure 32 indicates the locations of the wetland features traversing the pipeline. The remainder of the pipeline contains transformed grasslands, which were not indicated on the maps due to the scale of the pipeline locations.

Figure 32: Transformed grassland vegetation along the proposed pipeline.

Pockets of rocky outcrops or where the pipeline traverses mountain areas were located. These areas were mapped on a desktop level to indicate where vegetation has changed. Although not all areas of the rocky outcrops contained indigenous floral vegetation, these areas are still considered different to the remainder of the habitat units. Mitigation measures when construction of the pipeline takes places should considered these rocky areas and mountain passes and minimise the impacts within these areas.

Figure 33: Rocky outcrops located adjacent to the secondary pipeline routes.

Podocarpus species were located on the secondary pipeline route south of the town Tsolo. These species is considered protected according to the notice of the list of protected tree species under the National Forests Act, 1998 (Act No. 84 of 1998). Possible mitigation measure would be to re-align the roads to avoid the trees from being removed or permits for the removal of these protected tree species (should it occur within the construction footprint area of the associated infrastructure) need to be obtained at the relevant authorities before any construction activities occur within this area.

Table 17: Coordinates of protected tree species located within the study area.

Podocarpus falcatus and P. latifolius along the secondary pipeline route south of the town of Tsolo.	
GPS5	31°24'18.62"S 28°46'28.97"E
GPS6	31°24'21.15"S 28°45'1.87"E

Due to the severe vegetation transformation within most of the areas along the primary and secondary pipeline route, the low ecological function and state and the low diversity in floral species, the areas set out for the construction of the primary and secondary pipeline route is not considered sensitive. Since the impact of the construction will be of shorter duration and rehabilitation will be done, the severity of the impact will be lower.

5.5.3 Irrigation areas and pipelines

The irrigation pipelines are mostly situated south of the village of Tsolo. The majority of the sections for the proposed pipelines will be along existing dirt roads. Other vegetation habitat units that the pipelines traverse have been transformed due to historic and on-going small scale agricultural activities, wetland habitat and rocky areas. The northern section of the irrigation pipeline traverses a woody vegetation habitat area that most likely has been dominated by *Acacia* species so some extent that bush encroachment has occurred. Some small scale plantation areas also occur within the woody habitat. It is possible that protected tree species, favouring afromontane habitat, could occur along the irrigation pipeline route or in the surrounding area.

The irrigation fields were briefly assessed and selected areas were investigated as examples of the condition of these areas. The proposed agricultural fields are located within old farming lands, historically used since the have the highest agricultural potential and yield the highest harvests. Field assessments indicated that these fields have been uniformly heavily disturbed due to prior farming activities, and as such provide very limited habitat to floral species within the area and region and the decommissioning of these areas as irrigated croplands is considered an insignificant impact to the regional floral ecology.

5.6 PEAK POWER GENERATION WITH HYDROPOWER TUNNELS AND POWER LINE ALTERNATIVES

Both base load and peak load hydropower generation are being considered at the Lalini Dam. Three alternative power line routes, linking the hydropower plant downstream of Lalini Dam to the grid, are being considered. The three power line routes correspond to three possible tunnel lengths from Lalini Dam to the hydropower plant.

The majority of the power lines will traverse transformed (grassland) habitat units, where grasslands and mostly *Acacia karroo* and *Acacia caffra* occurs. The transformed habitat unit has been significantly disturbed as a result of historic and on-going agricultural activities and overgrazing of veld. The floral habitat within this habitat unit is therefore largely transformed and placement of infrastructure within this habitat unit will most likely have low impact significance.

Sections of the power line closer to the Tsitsa River will traverse more sensitive habitat associated with mountain and rocky outcrop habitat. These areas are more sensitive in terms of less vegetation disturbance, increased floral diversity and suitable habitat for important and protected species such as *Podocarpus* and *Encephalartos* species. Vegetation clearance within this sensitive habitat will take place, most likely resulting in the removal of protected and important species.

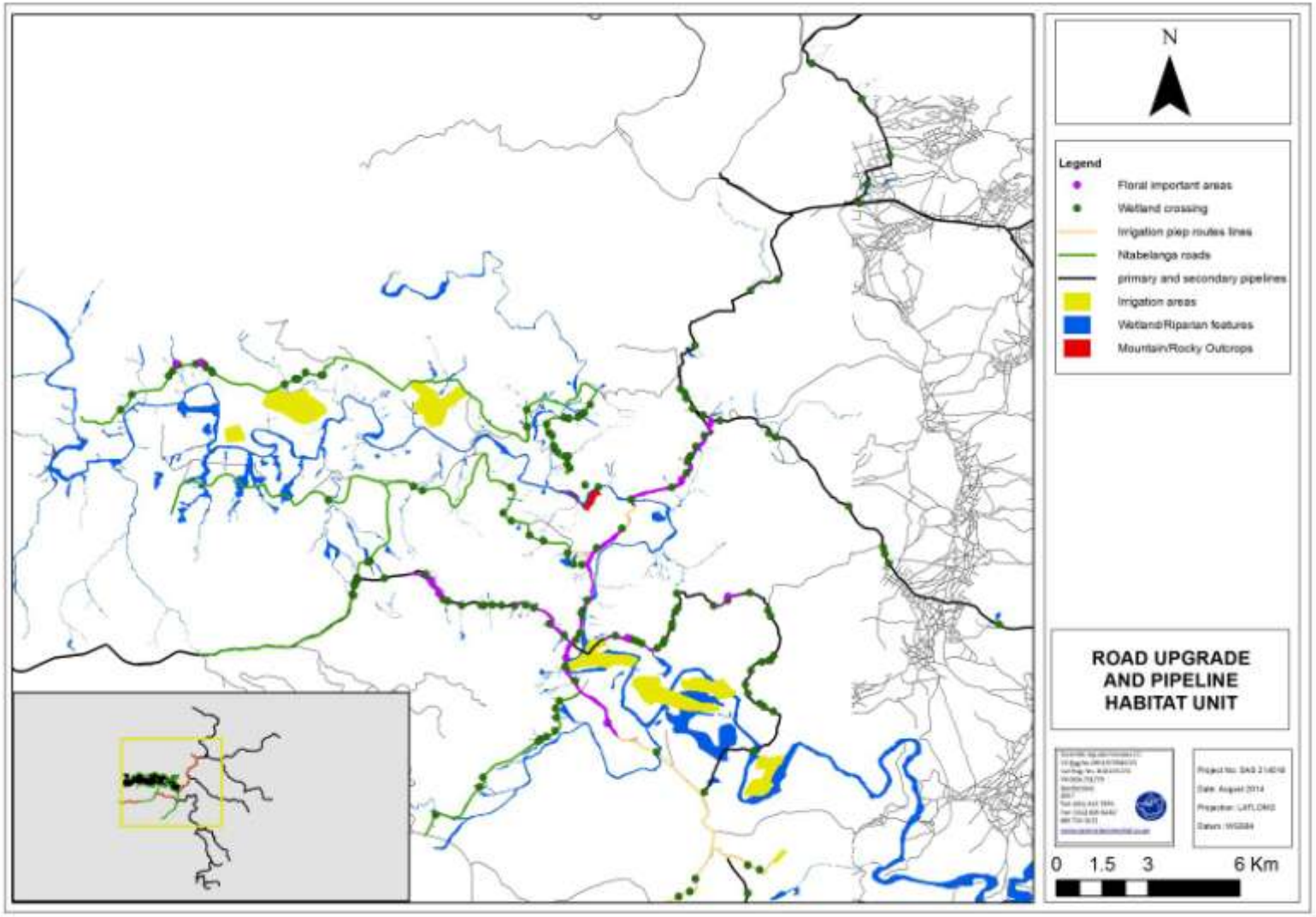

Figure 34: Wetland and riparian crossing and rocky areas along the proposed road upgrade and primary and secondary pipelines.

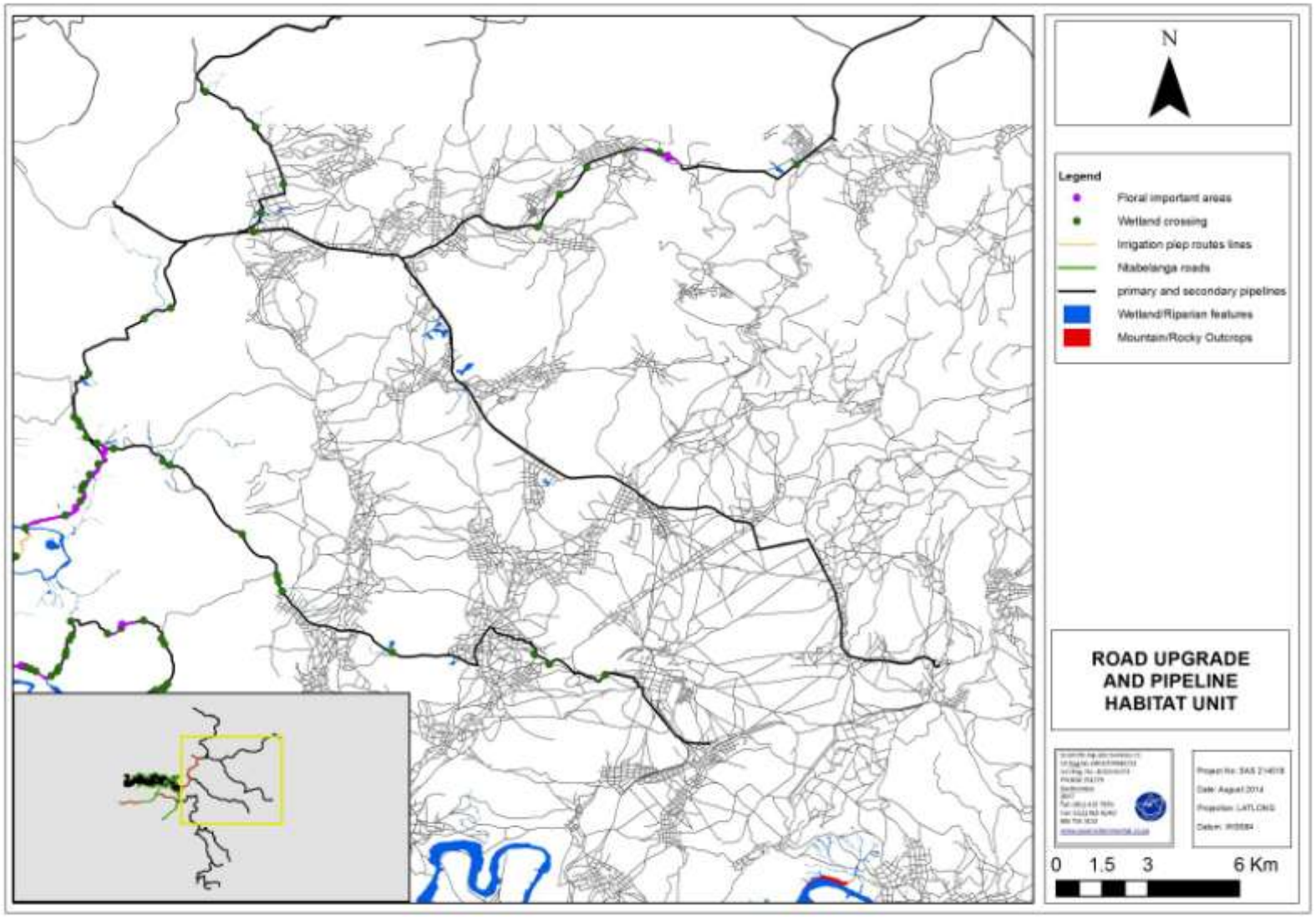

Figure 35: Wetland and riparian crossing and rocky areas along the proposed pipelines.

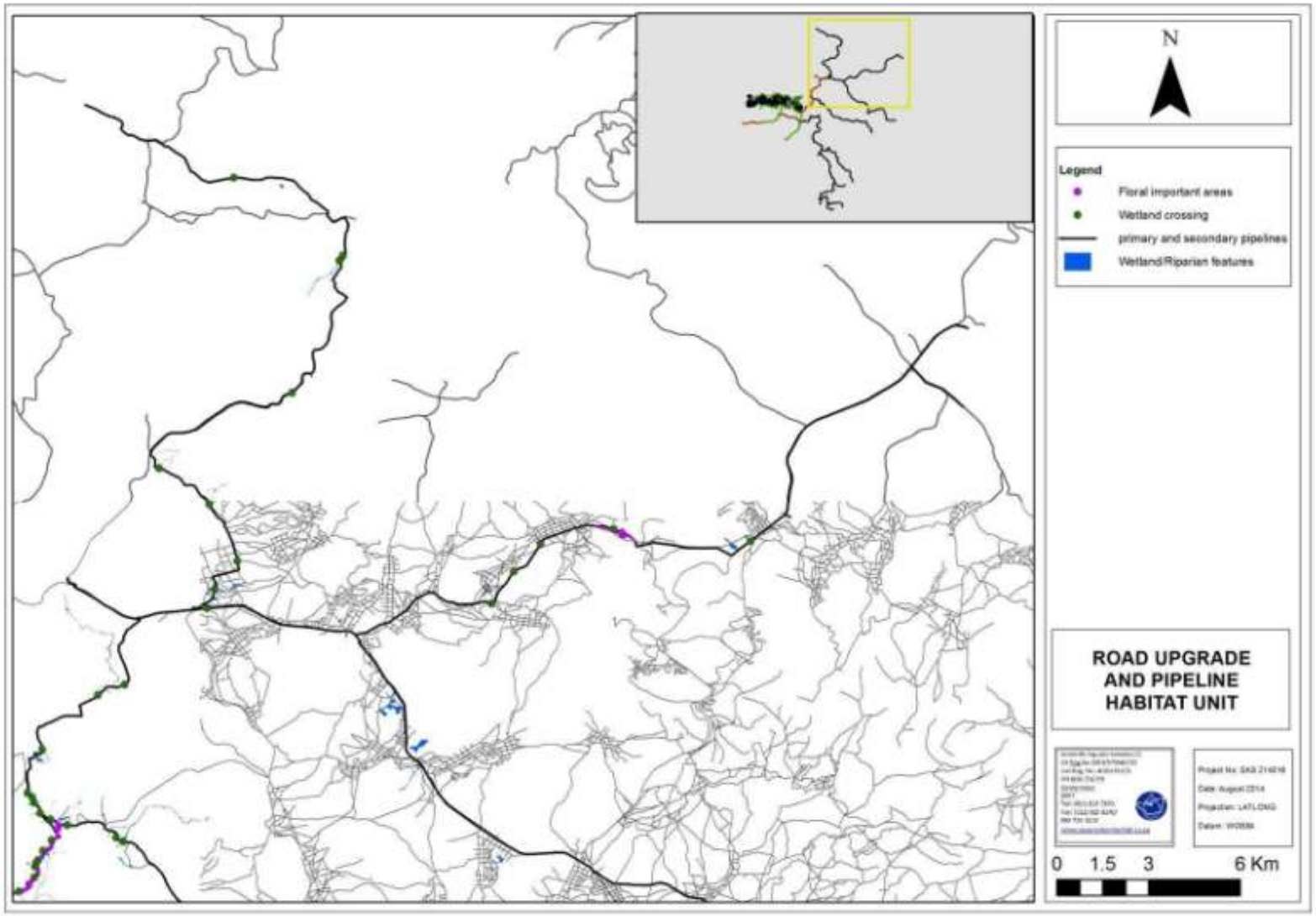

Figure 36: Wetland and riparian crossing and rocky areas along the proposed pipelines.

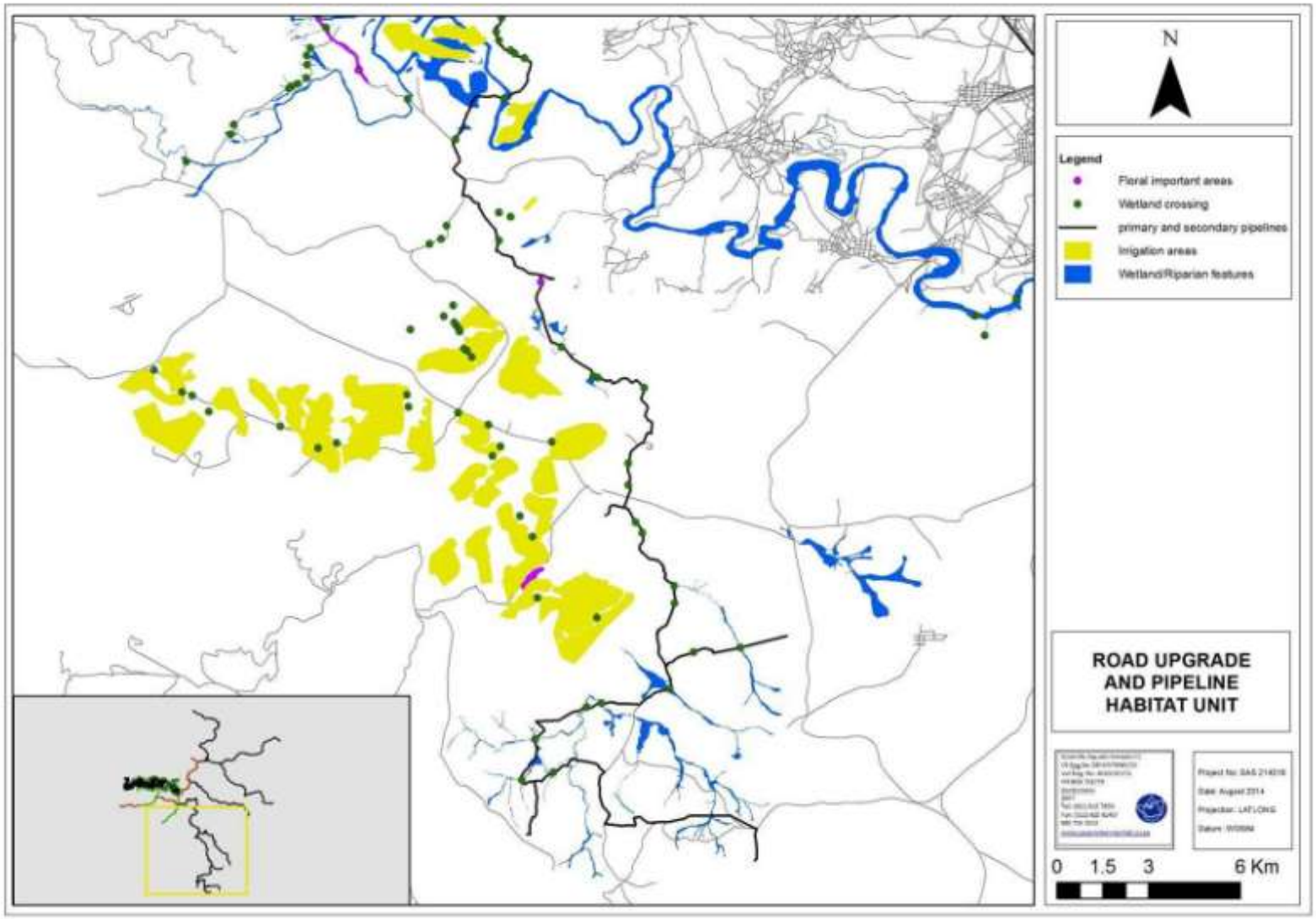

Figure 37: Wetland and riparian crossings and rocky areas along the proposed pipelines.

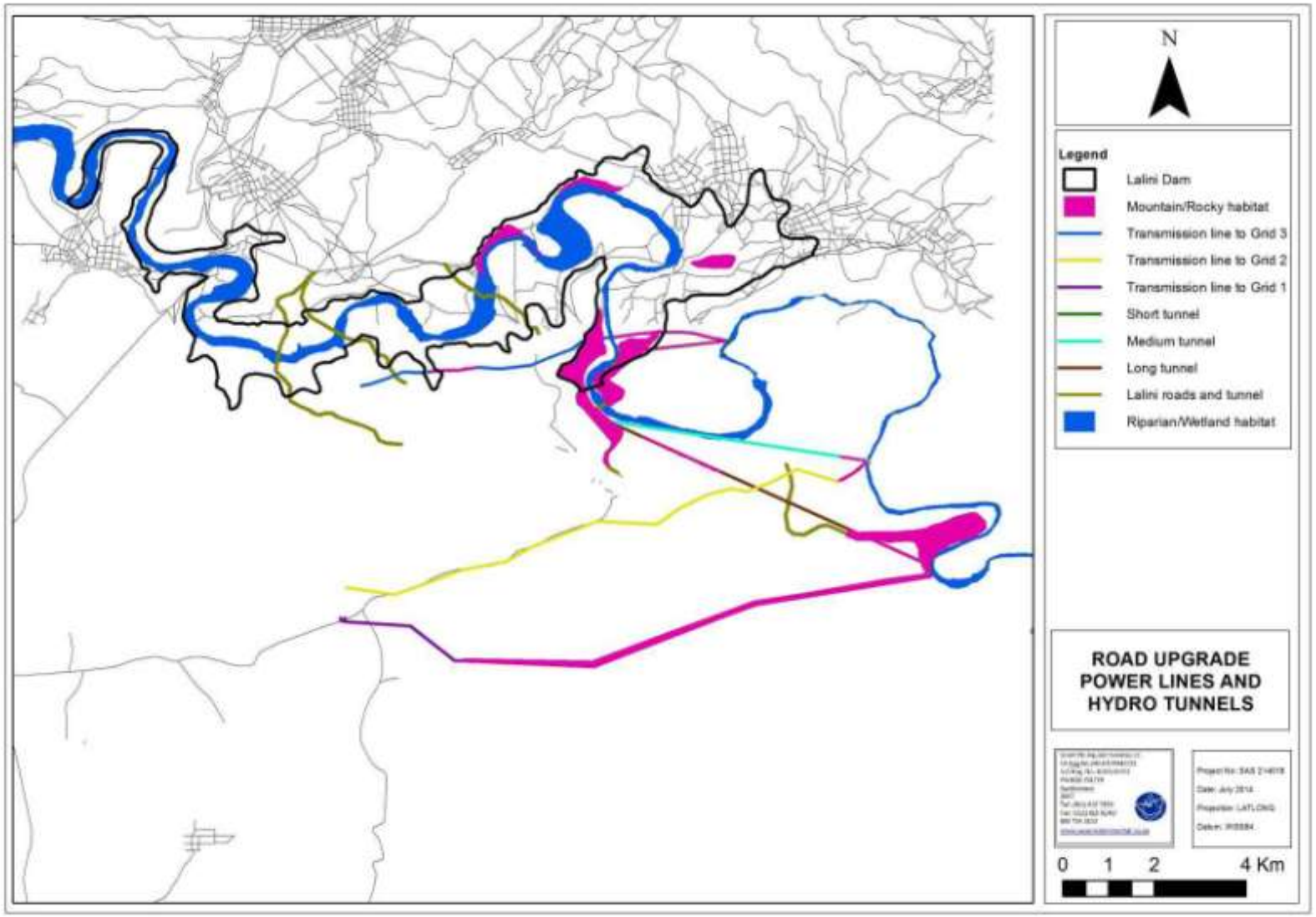

Figure 38: Mountain / Rocky Outcrop habitat located along the power lines and hydro tunnels.

5.7 ALIEN AND INVASIVE PLANT SPECIES

Alien invaders are plants that are of exotic origin and are invading previously pristine areas or ecological niches (Bromilow, 2001). Not all weeds are exotic in origin but, as these exotic plant species have very limited natural "check" mechanisms within the natural environment, they are often the most opportunistic and aggressively growing species within the ecosystem. Therefore, they are often the most dominant and noticeable within an area. Disturbance of soil through trampling, excavations or landscaping often lead to the dominance of exotic pioneer species that rapidly dominate the area. Under natural conditions, these pioneer species are overtaken by sub-climax and climax species through natural veld succession. This process, however, takes many years to occur, with the natural vegetation never reaching the balanced, pristine species composition prior to the disturbance. There are many species of indigenous pioneer plants, but very few indigenous species can out-compete their more aggressively growing exotic counterparts.

Alien vegetation invasion causes degradation of the ecological integrity of an area, causing (Bromilow, 2001):

- A decline in species diversity;
- Local extinction of indigenous species;
- Ecological imbalance;
- Decreased productivity of grazing pastures and
- Increased agricultural input costs.

During the floral study of the study area, all alien and weed species were identified and are listed in **Table 18**.

Table 18: Dominant alien vegetation species identified during the general site assessment.

Species	English name	Origin	Category*CARA
Trees/ shrubs			
Acacia mearnsii	Black wattle	Australia	2
Acacia dealbata	Silver wattle	Australia	1
Acacia baileyana	Bailey's wattle	Australia	3
Eucalyptus camaldulensis	Saligna	India	3
Eucalyptus grandis	Saligna gum	Australia	2
Melia azedarach	Syringa	India	3
Nicotiana glauca	Wild tobacco	Argentina	1
Opuntia ficus indica	Prickly pear	Mexico	1
Ricinus communis var. communis	Castor-oil plant	Africa	2
Salix babylonica	Weeping willow	Northern China	2
Forbs/ Grasses			
Bidens pilosa	Common blackjack	South America	N/A
Cosmostomium natlanse	Wild Pentas		N/A
Cynodon dactylon	Couch grass	Tropical Africa / Asia	X2
Pennisetum clandestinum	Kikuyu	East Africa	N/A
Plantago lanceolata	Buckhorn plantain	Europe	N/A

Species	English name	Origin	Category*CARA
Tagetes minuta	Tall khakiweed	South America	N/A
Taraxacum officinale	Common dandelion	Europe	N/A

Category 1 – Declared weeds. Prohibited plants, which must be controlled or eradicated.
Category 2 – Declared invader plants with a value. "Invaders" with certain useful qualities (i.e. commercial). Only allowed in controlled, demarcated areas.
Category 3 – Mostly ornamental plants. Alien plants presently growing in, or having escaped from, areas such as gardens, but are proven invaders. No further planting or trade in propagative material is allowed (Bromilow, 2001).

From **Table 18** above it is clear that a number of alien floral species occur within the study area, especially along the riparian features. The majority of the categorised alien floral species fall within Category 2 and 3, which are invaders with useful qualities.

Weed species such as *Bidens pilosa*, *Cynodon dactylon, Ricinus communis* var. *communis, Nicotiana glauca* and *Tagetes minuta* are present that are associated with disturbance and agricultural activities. The transformed (Grassland) habitat unit contained mostly weed species associated with disturbance, overgrazing and trampling of veld by livestock. Very little invader floral species occurred within the Mountain / Rocky Outcrop habitat unit. The Mountain / Rocky Outcrop habitat unit are the most at risk for alien tree species to encroach into the area. These areas need to be monitored during the operational phase of the dam construction to ensure that alien invader tree species does not encroach into this habitat unit.

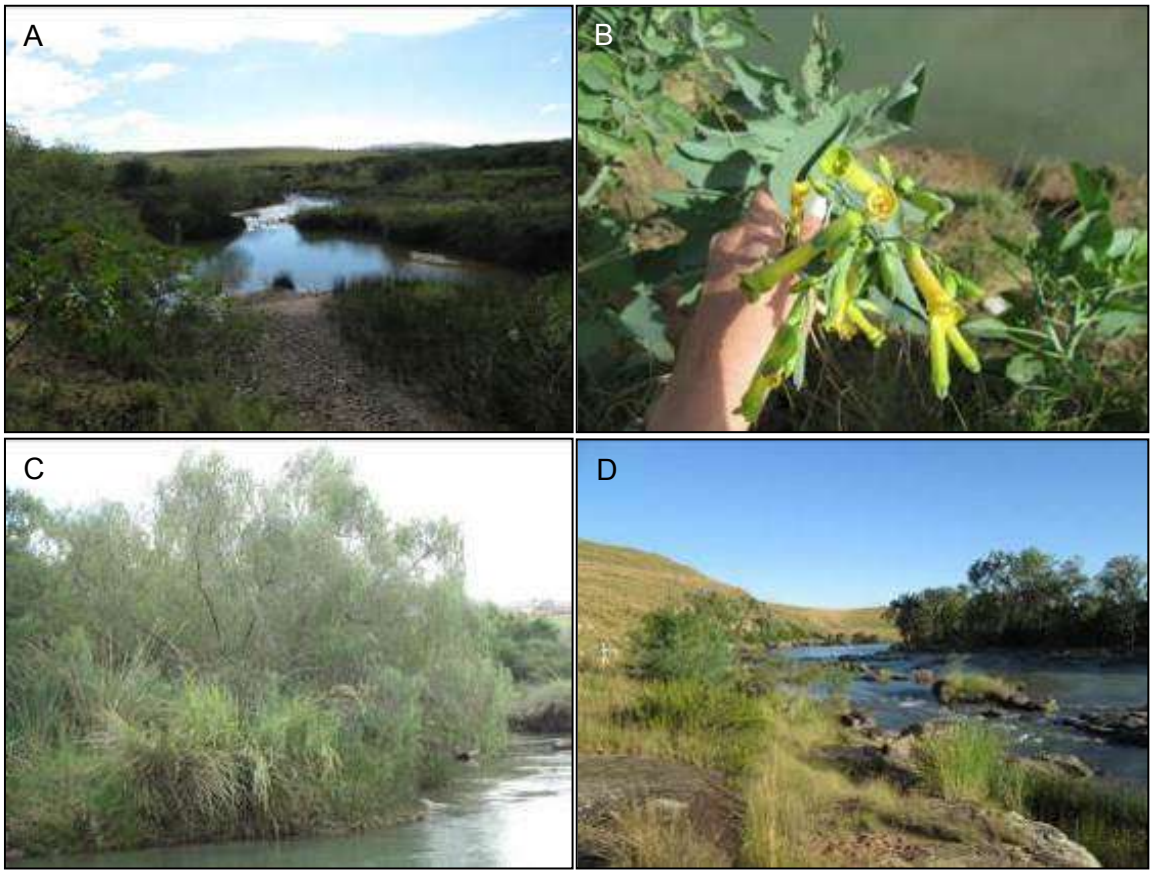

Figure 39: A) *Ricinus communis* var. *communis* and B) *Nicotiana glauca*, some of the many alien invader floral species located alongside the riparian zone, C) *Salix babylonica* and D) *Eucalyptus* species located along the Riparian / Wetland habitat unit.