9. IMPACT ASSESSMENT FOR DAMS AND ASSOCIATED WATER INFRASTRUCTURE

This Chapter presents the findings of the environmental impact assessment for the dams and associated activities (DEA Ref no. 14/12/16/3/3/2/677).

The activities assessed under this chapter are listed below:

- The Ntabelanga and Lalini Dams;
- Five flow gauging weirs;
- Primary and secondary bulk potable water infrastructure:
    - Primary infrastructure: main water treatment works, including four major treated water pumping stations and three minor treated water pumping stations, main bulk treated water rising mains, and eight Command Reservoirs that will supply the whole region;
    - Secondary distribution lines: conveying bulk treated water from Command Reservoirs to existing and new District Reservoirs;
- Bulk raw water conveyance infrastructure (abstraction, pipelines, one raw water pumping station, one reservoir and two booster pumping stations) for irrigated agriculture (raw water supply up to field edge);
- Impact of commercial agriculture in earmarked irrigation areas;
- WWTWs at the Ntabelanga and Lalini Dam sites;
- Accommodation for operational staff at the Ntabelanga and Lalini Dam sites;
- Ten construction materials quarries and borrow pits;
- River intake structures and associated works;
- Information centres at the two dam sites; and
- Miscellaneous construction camps, lay down areas, and storage sites.

9.1 CONSTRUCTION AND DECOMMISSIONING PHASES

9.1.1 Plants

The following key impacts on plants have been identified for the construction, first filling and decommissioning phases:

9.1.1.1 Impact on habitat for floral species

Ntabelanga Dam and associated infrastructure

Vegetation surrounding the Ntabelanga Dam wall consists of rocky ridge vegetation, mostly indigenous to the area. Little transformation has occurred within this area. During the first filling 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.

Lalini Dam and associated infrastructure

The Lalini Dam consists mainly of transformed vegetation due to overgrazing and trampling of veld by livestock and the surrounding rural communities clearing vegetation for small scale agricultural activities.

More sensitive habitat consisting of a rocky ridge and riparian zone complex, including the *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. The impact significance associated with the loss of species habitat is considered to be high prior to implementation of mitigation measures.

Another aspect that was considered was the type of vegetation and the growth of specific floral species such as cremnophytes. These are floral species, mostly succulents that are associated with cliffs but have distributions that extend to non-cliff habitats. Water-holding capacity is important as it directly relates to cliff vegetation. Mostly obligate succulent cremnophytes have a relatively shallow root system and 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.

Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure

The primary and secondary pipelines will be constructed close to main or existing roads, where the vegetation has been transformed. The irrigation pipelines are mostly situated south of the township of Tsolo, 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 where some extent that bush encroachment has occurred.

According to the National List of Threatened Terrestrial Ecosystems (2011) sections of the proposed road upgrades, southern section of the pipelines and small portions of the Lalini Dam fall into a vulnerable ecosystem in terms of the original and remaining extent of the associated vegetation types. Rocky outcrop areas also occur within these sections.

The impact of the pipelines will be low, should all possible mitigation measures be implemented.

Recommended mitigation:

- As far as possible avoid disturbance of Mountain Rocky Outcrops and avoid disturbance of protected floral species when construction activities of the associated dam infrastructure takes place. Should it be evident that protected species within the Mountain Rocky Outcrops will be disturbed, permits to cut or destroy trees must be obtained prior to construction taking place or alternatively, route re-alignment (for pipelines) should be considered.

- Rescue and relocation of indigenous vegetation (e.g. young seedlings, *Aloe* species, *Euphorbia* species, *and Cussonia* species) must be implemented in more sensitive areas such as the mountain/rocky ridge habitat before construction commences. Floral species must be relocated to similar habitat types, outside of infrastructure footprint areas. Community members could be involved in this specific phase of the project.
- 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 preferred alternative.
- An investigation must be undertaken by a qualified specialist to determine whether any waterfall dependant plants in the gorge and on the cliff could be significantly impacted and whether they require relocation; and findings of the investigation must be implemented. Where applicable, permit applications should be obtained from the relevant authority to rescue and relocate these species.

9.1.1.2 Impact on floral diversity

Ntabelanga Dam and associated infrastructure

The only areas of high floral diversity are within the mountain / rocky outcrop habitat unit. Vegetation clearance for the construction of the dam wall and first filling will decrease the floral diversity within the immediate area. The duration of this impact will be permanent. Due to the permanent duration within the full supply level, it is proposed that indigenous species be relocated and established in a holding nursery to use as part of rehabilitation around the dam information centres or accommodation areas for the operational staff.

The areas associated with infrastructure (camp sites, quarries and borrow pits, accommodation for operational staff, WWTW’s and information centre) are considered of low sensitivity. It must be ensured that only the areas designated for the specific activity are cleared, therefore minimising the overall footprint area of these infrastructures. Where possible, avoid placing any associated infrastructure within the Mountain Rocky Outcrop or Wetland Habitat Units.

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

Lalini Dam and associated infrastructure

The floral diversity within the Lalini dam, especially around the dam wall, is very high with numerous indigenous woody species. Although during the site assessments, no protected or important floral species were recorded, the habitat is suitable for protected woody vegetation to occur. 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 diversity.

The impact significance associated with the loss of species diversity is considered to be high prior to implementation of mitigation measures for all alternatives.

Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure

The impact of the pipelines will be low, should all possible mitigation measures be implemented (see also **section 10.1.1.1**).

Recommended mitigation:

- Planning of temporary roads should take place within areas of lower sensitivity or where historic vegetation transformation has occurred.
- A floral species rescue operation must be implemented, targeting indigenous floral species, where possible.
- Possible re-alignment of pipelines should be considered to ensure that areas of lower sensitivity will be affected by construction (see **Figure 41**).
- A holding nursery should be established for indigenous vegetation suitable for re-planting as part of rehabilitation of disturbed areas and around the dam information centres or accommodation areas for the operational staff. The holding nursery can become an on-going community project.

9.1.1.3 Impact on important and protected floral species

Ntabelanga Dam and associated infrastructure

The Mountain / Rocky Outcrop habitat located within the Ntabelanga Dam contain numerous indigenous woody vegetation. Although no protected tree species were noted during the site assessments, the probability of occurrence is high, therefore impacting on the important and protected floral communities. No important or protected species were located within transformed vegetation habitat due to overgrazed and trampled veld. The duration of this impact will be permanent for the areas affected by the construction of the dam wall and the first filling. The impact significance associated with the loss of species habitat is considered to be medium-high prior to implementation of mitigation measures.

The areas associated with camp sites, quarries and borrow pits, accommodation for operational staff, WWTW's and information centre are considered of low sensitivity. Should any of the protected species listed within this report be located within the specific area designated for these infrastructure, applicable permit approval documents must be required before any other activities takes place.

Lalini Dam

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 the Mountain / Rocky Outcrops habitat unit. There is a high probability that protected or RDL floral or tree 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.

Primary, secondary and irrigation pipelines

The pipelines traverse pockets of rocky outcrops or mountain areas. These areas were mapped on a desktop level to indicate where vegetation has changed. Mitigation measures should considered to minimise impacts within these areas.

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). 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.

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.

Recommended mitigation:

- Re-alignment of infrastructure to avoid protected trees wherever possible.
- Permits for the removal or destruction of 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.
- A floral species rescue operation should be implemented, targeting indigenous floral species within the mountain/rocky ridges.
- A holding nursery should be established for indigenous vegetation suitable for re-planting on rehabilitated surfaces and the accommodation area for operational staff and information centres.

9.1.1.4 Assessment of floral impacts during the construction, first filling and decommissioning phases

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high

		term)					(-)
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	1 (Low)	5 (Definite)	High	Medium-low (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
With Mitigation	2 (Local)	1 (Short term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low (-)

Residual Impact:

- Proliferation of alien and weed species in disturbed areas will lead to altered vegetation communities.
- Loss of floral habitat may lead to altered floral biodiversity.
- Increased settlement around the dams will results in further fragmentation and loss of untransformed habitat.

Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 (Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)

With Mitigation	2 (Local)	1 (Short term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low (-)
Residual Impact: • Decrease in floral species diversity may occur due to habitat transformation as a result of construction activities. • Ineffective rehabilitation within the primary and secondary pipelines may lead to permanent transformation of floral habitat. • Proliferation of alien and weed species in disturbed areas will lead to lowered vegetation biodiversity along the pipeline routes.							
Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (Site)	2 (Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	1 (Site)	2 Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	4 (High)	5 (Definite)	High	High (-)
With Mitigation	1 (Site)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	1 (Site)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)
With Mitigation	1 (Site)	2 Medium term)	2 (Low)	1 (Low)	3 (Medium)	High	Low (-)
Residual Impact: • A decrease in potential RDL/ protected floral species diversity may lead to a loss of species richness over time within the region.							

9.1.2 Fauna

The following key impacts on fauna have been identified for the construction, first filling and decommissioning phases:

9.1.2.1 Impact on faunal habitat

Lalini Dam[1]

Lalini Dam provides ideal faunal habitat to a wide variety of faunal species. The most sensitive faunal habitat is that of the rocky outcrop areas and the mountain bushveld habitat. The dam wall is located within this mountain bushveld habitat, and will have

[1] All associated infrastructure (gauging weirs, construction camps, reservoirs etc), unless specifically addressed within the impact tables, has been included within the impact of the dam itself.

a large impact on the faunal habitat here. The subsequent first filling, will submerge most of the rocky outcrop and mountain bushveld habitat, rendering it lost and unrecoverable. The first filling will also result in the inundation of all the wetlands in the Lalini Dam study area, resulting in a loss of faunal habitat for many endangered crane species. All three alternatives based on the various sizes of the dams will have large impacts on faunal habitat, as all will result in the inundation of large areas of habitat, with the smallest dam alternative having the least impact of the three.

Ntabelanga Dam[1]

At first filling the Ntabelanga Dam will result in total and irreversible loss in faunal habitat found below the indicated high level water line. This inundation will result in the flooding of the lowland grassland and wetland areas, key habitat for many crane species in the area. There are also substantial rocky outcrop areas located in the proposed location of the Ntabelanga Dam wall that will also be lost.

Primary, secondary and irrigation pipelines

The primary and secondary pipelines will be constructed close to main or secondary existing roads, and as such will not have a high impact on faunal habitat or species. The irrigation pipelines are mostly located around the town of Tsolo, in an already disturbed area, and as such will have a low impact on faunal habitat and species thereof.

Recommended mitigation:

- Restrict vehicles to designated roadways to limit the ecological footprint of the proposed development activities as well as to reduce the possibility of collisions;
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity;
- Rehabilitate and naturalise areas beyond the development footprint, which have been affected by the construction activities, using indigenous grass species.

9.1.2.2 Impact on faunal diversity

Lalini and Ntabelanga Dams

There are various vegetation types in the study area providing a diverse range of habitat to faunal species. Most importantly are the rocky outcrop, wetland and mountain bushveld areas. The wetlands found along the river provide foraging and breeding habitat for endangered and important crane species, which will be lost when the first filling of the dam occurs. The rocky outcrops and mountain bushveld areas provide habitat for the indigenous *Hadogenes sp* of scorpions, which along with the cranes are a protected species in South Africa. The dam will result in a significant loss of habitat for these scorpions and subsequent decrease in population numbers. Due to the increase of human activities in the study area, the risk of informal fires as well as collision of vehicles with faunal species will also increase, and need to be addressed accordingly. All associated infrastructure (gauging weirs, construction camps, reservoirs etc), unless specifically addressed within the impact tables has been included within the impact of the dams themselves.

Primary, secondary and irrigation pipelines

The primary and secondary pipelines will be constructed close to main or secondary existing roads, and as such will not have a high impact on faunal habitat or species. The irrigation pipelines are mostly located around the town of Tsolo, in already disturbed areas, and as such will have a low impact on faunal habitat and species thereof.

Recommended mitigation:

- No areas falling outside of the project footprint area may be cleared for construction purposes;
- Should any RDL or other common faunal species be found within the affected environment, these species must be relocated to similar habitat within the vicinity of the study area with the assistance of a suitably qualified specialist;
- Rescue and relocation of faunal species needs to be conducted by an appointed specialist where islands are formed as the water levels rise and areas that will be inundated when the full supply level of the dams is reached;
- Edge effects of all operational activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity; and
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

9.1.2.3 Impact on faunal species of conservational concern and RDL species

Lalini Dam and Ntabelanga Dam and associated infrastructure

The study area is host to a number of RDL faunal species, most notably the various crane species as well as protected scorpions. The first filling of the dams and the construction of the dam walls will inevitably push these species out of the area as a result of large expanses of habitat loss sustained. This will lead to a decrease in overall population numbers of these species within the area and region. With the resultant new high water level, RDL species will be forced to utilise habitat that is closer to roads and local communities, and so will come under increased pressure from poaching and accidental mortalities from vehicle collisions. All associated infrastructure (gauging weirs, construction camps, reservoirs etc), unless specifically addressed within the impact tables has been included within the impact of the dams themselves.

Primary, secondary and irrigation pipelines

The primary and secondary pipeline will be constructed close to main or secondary existing roads, and as such will not have a high impact on faunal habitat or species.

The irrigation pipelines are mostly located around the town of Tsolo, in already disturbed areas, and as such will have a low impact on faunal habitat and species thereof.

Recommended mitigation:

- Should any RDL faunal species or species of conservational concern be found within the development footprint area, these species should be relocated to similar habitat within the vicinity of the study area, which will not be affected by the development activities with the assistance of a suitably qualified specialist;
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity; and
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

9.1.2.4 Assessment of faunal impacts during the construction, first filling and decommissioning phases

Impact on faunal habitat	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	High (4)	Medium (3)	High (4)	High	Medium-low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
Primary pipelines							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	High (4)	High	Low (-)
Secondary pipelines							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	High (4)	High	Low (-)
Irrigation pipelines							
Without Mitigation	Local (2)	Medium	Medium	Medium (3)	Definite	High	Medium-high

		term (2)	(3)		(5)		(-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	High (4)	High	Low (-)
Cumulative Impact – Construction of the dam wall in sensitive faunal habitat will lead to a loss of sensitive habitat and associated sensitive faunal species. The first filling phase will inundate faunal habitat and displace a large number of terrestrial faunal species, leading to a significant decline in population sizes, most notably those located in the mountain bushveld and *Euphorbia* forest near the Lalini Dam wall.							

Impact on faunal diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	High (4)	Medium (3)	High (4)	High	Medium-low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
Primary pipelines							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	High (4)	High	Low (-)
Secondary pipelines							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	High (4)	High	Low (-)
Irrigation pipelines							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	High (4)	High	Low (-)
Cumulative Impact – Overall loss of species diversity and numbers within the study area due to limited resources. Loss of population potential in the study area leading to a negative growth of species numbers, resulting in a decrease in species variety and numbers.							

Species of conservational concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)

With Mitigation	Site (1)	Medium term (2)	High (4)	Medium (3)	High (4)	High	Medium-low (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	High (4)	Medium (3)	High (4)	High	Medium-low
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	High (4)	Medium (3)	High (4)	High	Medium-low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	High (5)	Definite (5)	High	High
With Mitigation	Site (1)	Medium term (2)	High (4)	Medium (3)	High (4)	High	Medium-low (-)
Primary pipelines							
Without Mitigation	Local (2)	Short term (1)	Medium (3)	Medium (3)	Definite (5)	High	Medium-low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	High (4)	High	Low (-)
Secondary pipelines							
Without Mitigation	Local (2)	Short term (1)	Medium (3)	Medium (3)	Definite (5)	High	Medium-low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	High (4)	High	Low (-)
Irrigation pipelines							
Without Mitigation	Local (2)	Short term (1)	Medium (3)	Medium (3)	Definite (5)	High	Medium-low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	High (4)	High	Low (-)
Cumulative Impact – Overall loss of RDL species diversity within the study area, with particular emphasis on the more niche species such as the cranes and *Hadogenes* scorpions which only occur in limited favourable habitat zones.							

9.1.3 Aquatic ecology

The following key impacts on aquatic ecology have been identified for the construction, first filling and decommissioning phases:

9.1.3.1 Loss of aquatic habitat

Dam construction will lead to habitat loss and/or alteration of the aquatic and riparian resources in the study area. Construction of the dam wall will be disruptive to current habitat conditions in the Tsitsa River within the dam wall footprint area. Construction activities also generally result in destruction of bank cover, generation of loose soil and other debris that may result in silting and sedimentation of downstream habitat. Apart from dam wall construction, construction of flow gauging weirs, bulk potable water infrastructure (pumping stations, reservoirs, treatment works and distribution lines) and bulk raw water conveyance infrastructure (pipelines, pumping station and reservoir) quarries and borrow pits, accommodation infrastructure and infrastructure will potentially have the same effect on the aquatic resources of the region albeit on a much smaller local scale. The macro-invertebrate community of the Tsitsa River relies on clear water and a stream substrate that is clear of fine silt and sediment. Close monitoring of erosion patterns downstream of the construction area is deemed essential and any areas which are showing erosion to be occurring should immediately be rehabilitated through resloping, stabilisation and revegetation techniques as part of the catchment management plan.

Inundation of upstream habitat as the dam fills will result in severe habitat changes, pertaining to the water column depth habitat as well as availability of riffle and rapid habitats upstream of the dam on a local scale. The impounding of the dam will thus lead to a localised significant loss of habitats comprising of flowing water over rock substrate which is significant for many aquatic macro-invertebrate taxa in the system. Less desirable species of fish such as *Micropterus salmoides* and *Cyprinus carpio* are expected to become dominant in the system to the detriment of the endemic ecology of the region. Impacts due to sedimentation can be significant and have the potential to affect the biodiversity and functioning of the system. The still water in the newly created impoundment will allow sediment to settle and will smother the rocky substrate in the stream leading to a loss of rocky habitat types.

Recommended mitigation

- The construction of the dams will lead to reduced stream flow and hence loss of fast shallow riffle habitat and glide habitat. This impact is considered to be of high significance in the construction phase and even with mitigation the impact remains relatively unchanged. It is however deemed important that during construction the maintenance of baseflows in the system is maintained at all times and that the duration of impacts on flows is limited to as short a period as possible.
- Limit the footprint area of all construction activities to what is absolutely essential in order to minimise the loss of clean water runoff areas and the concomitant recharge of streams in the area;
- Ensure that all stockpiles are well managed and have measures such as berms and hessian sheets implemented to prevent erosion and sedimentation;
- Ensure that good construction practice is followed in terms of the clearing of areas, including use of water control berms and clearing footprint areas that are as small as possible;
- On-going aquatic biomonitoring on a minimum of a quarterly basis must take place from 6 months prior to construction till one year after construction to determine trends in ecology and define any impacts requiring mitigation.

9.1.3.2 Impact on flow dependant species

The damming of drainage areas that occur upstream of the proposed dam walls will lead to a loss of flow and an altered instream flow regime in the Tsitsa River system further downstream. The aquatic macro-invertebrate community of the Tsitsa River system is reliant on good flow of water over the rocky stream substrate and the area downstream of the Lalini Dam, due to its remote nature, the gorge has an intact biodiversity. Impacts on instream flow can be significant and have the potential to affect the biodiversity and functioning of the system. Apart from the dam wall itself resulting in local to regional impact, gauging weirs will also have a smaller, local impact in terms of flow, habitat alteration and risk of erosion and sedimentation. With the varying hydro-electric energy generation options, there are varying levels of impact significance on the receiving aquatic environment with the degree of impact varying based on the extent of river in which a significant portion of the instream flow will be lost. All the proposed options are considered to have a borderline high to very high level of impact prior to mitigation while with mitigation, with specific mention of adhering to the Environmental Water Requirement releases the overall significance of the impacts can be reduced to high level impacts.

Recommended mitigation

- EWR releases as specified in the Reserve determination must be implemented;
- Impact on flow-dependent species is considered to be of high to very high in the construction phase and even with mitigation the impact remains relatively unchanged;
- During construction the maintenance of baseflows in the system must be maintained at all times and the duration of impacts on flows should be limited to as short a period as possible;

9.1.3.3 Loss of aquatic biodiversity

The Tsitsa River is regarded as being of very high importance for migration of eels although the significance of eel migration is considered limited. The system may also provide some migratory connectivity for smaller faunal species including avifauna. In addition to impacts on migration impacts on habitat and instream flow are likely to lead to impacts on biodiversity with the loss of taxa which are sensitive to habitat changes as well changes/reductions in flow.

In particular, the impact on the aquatic macro-invertebrate community which relies on rocky substrate in fast flowing clear water will be significantly impacted by the proposed development.

The movement of instream taxa, with special mention of eels, will be severely affected by the proposed dam, including local effects from gauging weirs. This is because eels mostly migrate by moving up cracks in the natural rock faces of the waterfall, however with the dam wall being very smooth and mostly dry they will not be able to navigate it. In addition, the dams will release water from various levels with outlet structures with water forming a spout out of the wall, which will be impossible for the eels.

Impacts on migratory movements are likely to occur during the construction and operational phase of the proposed development. In the long term this may negatively affect populations upstream of the dams and may result in loss of this species in certain sections.

In addition loss of habitat and alteration of flow rate discussed previously will also negatively affect the diversity of the macro-invertebrate community within the system on a local scale. Even with mitigation the impact on aquatic ecology is considered high.

Recommended mitigation

- An investigation of the necessity and design specifications for an eel-way should be undertaken and the findings implemented.
- During construction, baseflows in the system must be maintained at all times and the duration of impacts on flows should be limited to as short a period as possible;
- On-going aquatic biomonitoring on a minimum of a quarterly basis must take place from 6 months prior to construction until one year after construction is complete to determine trends in ecology and define any impacts requiring mitigation.

9.1.3.4 Impact on species with conservation concern

The proposed infrastructures, with special mention of the proposed dam and to a lesser extent gauging weirs, will lead to the formation of an migratory barrier for fish species and in particular eels, as mentioned in the previous section. The area is known to harbour endemic mayflies (Kleynhans 1999). With the location of the two dams situated between two waterfalls and hence geographically isolated, the area is likely to contain several macro-invertebrate species of conservation concern. Both prior to and after mitigation this impact is considered to be high to moderately high. Through minimising the time in which stream flow, water quality and habitat is affected during the construction phase of the project this impact can, however, be mitigated to a limited degree. The “construction phase” does not only refer to dam wall construction, but also all related activities and in particular the gauging weirs.

Recommended mitigation

Even with attempted mitigation impact will remain high, as first filling causing upstream inundation and alteration of flow rate downstream cannot be mitigated to any great extent.

- During construction the maintenance of baseflows in the system must be maintained at all times and the duration of impacts on flows should be limited to as short a period as possible.

9.1.3.5 Assessment of impacts on aquatic ecology during the construction, first filling and decommissioning phases

Loss of aquatic habitat	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Local (2)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
Cumulative Impact – Construction of the dam wall may result in destruction of bank cover and site-specific habitat types. First filling will result in inundation resulting in a variety of habitat types over a large area being permanently lost. The larger the dam the greater the area affected by inundation, shifting impact from site specific to local relevance with specific mention of the management of instream flows.							

Impact on flow dependant species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Regional	Permanent –	High (4)	High (5)	Definite	High	High

	(3)	with mitigation (4)			(5)		(-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High (-)
Cumulative Impact – Construction of the dam wall will restrict downstream flow to baseline as required by legislation. This will result in reduced downstream flow, particularly in terms of seasonal flow variation, that will affect flow-sensitive macro-invertebrate community composition and also possibly eel migration negatively. Upstream of the development inundation will also reduce flow and negatively affect flow-sensitive species.							
Loss of aquatic biodiversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	Medium (3)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	Definite (5)	High	High (-)
Lalini Dam size 3 (alterative) and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	Definite (5)	High	High (-)
Cumulative Impact – Construction of the dam wall will negatively affect biodiversity in the immediate site vicinity because of direct impacts resulting from habitat destruction and flow disruption. Inundation upstream will result in further habitat destruction and with associated downstream baseflow restriction, impact extent will be local.							
Impact on species of conservation concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	High(4)	High	Medium-High (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)

With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	High(4)	High	Medium-High (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	High(4)	High	Medium-High (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – no mitigation (5)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	High (5)	High(4)	High	Medium-High (-)
Cumulative Impact – Two taxa of concern are local mayflies species (Order Ephemeroptera) and to a lesser extend eels. Construction of the dam wall will have limited direct negative effects but changes resulting from initial filling will result in more substantial negative effects. This will pertain to destruction of habitat limiting habitat suitable to mayfly inhabitation as well as creating barriers to eel migration.							
N.B.: reference to the respective projects also considers impact from associated activities, including gauging weirs, bulk potable water infrastructure, bulk raw water conveyance infrastructure, irrigation and agriculture, WWTWs, accommodation infrastructure, quarries and pits, river intake structures and associated works, information centres and miscellaneous activities like constructions camps, lay down areas and storage sites.							

9.1.4 Wetlands

The following key impacts on wetlands have been identified for the construction, first filling and decommissioning phases:

Ntabelanga Dam and associated infrastructure

Construction of the dam wall not only necessitates the removal of riparian vegetation, but also requires the movement of construction vehicles in the vicinity of or through wetland features (existing roads, earmarked for upgrades, currently traverse several wetland features). The first filling of the dam will result in the permanent loss of wetland habitat; due to the nature of the development, this cannot be avoided. It is therefore imperative that measures are taken in order to minimise the impact on those portions of the affected wetland features which will not be inundated. Construction of associated infrastructure such as accommodation, WWTW and the information centre should be placed outside wetland areas (refer to **Figures 53** and **54)**.

Lalini Dam and associated infrastructure

It is anticipated that the impacts on wetland and riparian habitat as a result of the construction and first filling of the Lalini Dam will be similar in nature to the impacts of the construction of the Ntabelanga Dam, i.e. loss of vegetation, sedimentation of features and permanent loss of habitat due to inundation.

Primary and secondary potable water pipelines, and irrigation pipelines

Where pipelines cross wetland / riparian habitat, drainage lines and channelled valley bottom wetlands, support structures should not be constructed within the active channels and must be placed outside of wetland / riparian habitat. In order to achieve this wetland crossings should take place at 90 degree angles wherever possible.

The construction of the infrastructure associated with the pipelines, including but not limited to main water treatment works, pumping stations, command reservoirs, rising mains and booster pumps must not take place within the wetland resources or their respective buffer zones in order to prevent further losses of wetland resources within the study area.

Mitigation measures for these impacts are given below.

9.1.4.1 Loss of wetland / riparian habitat and ecological structure, loss of wetland / riparian ecoservices and impacts on wetland / riparian hydrology and sediment balance

Recommended mitigation:

- Minimise the construction footprints and implement strict controls of edge effects;
- An alien vegetation control programme must be implemented, as encroachment of alien vegetation is apparent and is expected to increase as a result of the disturbances resulting during the construction process. Rehabilitation of disturbed areas, utilising indigenous wetland vegetation species, will assist in reducing the impact of construction;
- A method statement for erosion management and sediment controls must be developed, including the possible use of gabions or reno mattresses, re-vegetation of profiled slopes, erosion berms, drift fences with hessian and silt traps, from the outset of construction activities;
- Implement measures such as sediment control, and prevention of pollution (solid wastes, oil spills, discharge of sewage) to minimise impacts on the water quality of nearby adjacent rivers;
- Support structures for pipelines must be placed outside of riparian features, channelled valley bottom wetlands and drainage lines. Should it be essential to place such support structures within these features, the designs of such structures must ensure that the creation of turbulent flow in the system is minimised, in order to prevent downstream erosion. No support pillars should be constructed within the active channels and infrastructure should cross wetlands at right angles.

9.1.4.2 Assessment of impacts on wetlands during the construction, first filling and decommissioning phases

Loss of wetland / riparian habitat and ecological structure	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	2 (local)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)

With Mitigation	2 (local)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (local)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	2 (local)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (local)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	2 (local)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (local)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	2 (local)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (local)	1 (short)	3 (Medium)	3 (medium)	3 (medium)	High	Low (-)
With Mitigation	2 (local)	1 (short)	1 (Negligible)	1 (Low)	2 (low)	High	Very Low (-)

Cumulative Impact:

- Permanent loss, or transformation of wetland / riparian habitat leading to a reduced ability to support wetland / riparian vegetation and faunal species naturally occurring within the system;
- Proliferation of alien vegetation as a result of disturbances to the soil profile during construction, leading to transformed wetland / riparian habitat.
- Erosion and sedimentation of wetland resources downstream of pipelines and dams.

Loss of wetland / riparian ecoservices	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 3 and associated infrastructure							

Without Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (local)	1 (short)	2 (Low)	3 (medium)	3 (medium)	High	Low (-)
With Mitigation	2 (local)	1 (short)	1 (Negligible)	1 (Low)	2 (low)	High	Very Low (-)

Cumulative Impact:

Permanent loss of wetland / riparian habitat leading to a reduction in the capability of wetland resources to provide ecological services and functions such as flood attenuation, sediment trapping, nutrient and toxicant assimilation etc.

Impacts on wetland / riparian hydrology and sediment balance	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Lalini Dam size 3 and associated infrastructure							
Without Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
With Mitigation	1 (site)	2 (medium)	5 (Very high)	5 (High)	(5) Definite	High	High (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (local)	1 (short)	2 (Low)	3 (medium)	3 (medium)	High	Low (-)
With Mitigation	2 (local)	1 (short)	1 (Negligible)	1 (Low)	2 (low)	High	Very Low (-)

Cumulative Impact:

- Increased sedimentation of rivers and wetland features as a result of increased erosion due to vegetation loss and due to increased runoff arising from increase impermeable surfaces;
- Altered flow patterns within wetland / riparian features, particularly within drainage lines, channelled valley bottom wetlands and rivers due to support structures placed within active channels;
- Earthworks within wetland / riparian habitats and in the vicinity of highly sensitive wetland / riparian areas leading to increased runoff and erosion and altered runoff patterns;
- Reduced ability to provide ecological services such as streamflow regulation, flood attenuation and sediment

	trapping as a result of altered habitat.

9.1.5 Water quality

The following key impacts on water quality have been identified for the construction first filling and decommissioning phases:

9.1.5.1 Impact on river water quality: Contamination of river water by construction materials and the discharge of waste from the construction site.

Lalini and Ntabelanga Dams and associated infrastructure

Some impacts on water quality may occur during the construction and decommissioning phases. These have to do with possible contamination of the river by construction materials, as well as the discharge of waste from the construction site. During construction some increases in sedimentation of the Tsitsa River system and ultimately the Mzimvubu River system is deemed likely. The significance of these impacts is however considered limited as the duration of the impact will be limited to relatively short periods of time. These occurrences are governed by the National Water Act, and as long as this is adhered to, the effect will be minimal. This applies at both sites, namely the proposed Ntabelanga dam and the proposed Lalini dam.

Recommended mitigation:

As long as the construction site and the construction activities are managed properly in accordance with accepted practice, incidences of contamination should only occur under extraordinary circumstances.

9.1.5.2 Impacts during first filling of the dam: The creation of anoxic conditions due to decomposition of organic material.

Lalini and Ntabelanga Dams and associated infrastructure

A potential problem that could occur is that any vegetation that is left in the dam basin will begin to decompose once the dam basin is filled with water. This will create anoxic conditions that may persist for a considerable period of time, and will pose a risk to downstream aquatic life, will render the dam basin itself unfit to support aquatic life, and will cause problems at the water treatment plant. The anoxic zone may consist as close as two meters from the surface.

Factors that should be considered when determining if de-bushing is required include:

- the depth of the water in storage;
- the size of the surface area;
- MAR;
- current and expected future water quality;
- land cover; and
- planned future use of the water surface.

The following general principles regarding dam basin clearing are recommended:

The Developer should generally not de-bush the dam basin except for a 300 m stretch upstream of the entire dam wall (in order to prevent blocking of the outlet works and safety boom). Exceptions (i.e. basins that should be selectively de-bushed up to a predetermined level below the FSL depending on the nature of the dam) should be identified on a case by case basis and could include:

- Cases where commercial fish harvesting is viable;
- Cases where current or future water quality indicate that potential negative impacts could be caused by rotting vegetation;
- Cases where the recreational use of the dam is envisaged and requires the removal of potential dangerous obstacles; and
- If cleared strips are required for silt surveys in the future.

This does not address the issues of community collection of plant material or plant rescue for biodiversity conservation purposes.

The proposed Ntabelanga Dam and Lalini Dam sites both have a very small woody component with the area dominated by grass. Bush removal is recommended, but the amount of biomass is too little to cause serious oxygen depletion even over the short term.

Recommended mitigation:
In the cases where clearing is recommended the following principles should apply:

- Vegetation clearing should generally be understood to include trees and bushes, and to exclude grass. Identified very large trees may be left.
- The roots of plants should not be removed, but plants should rather be cut down close to ground level with a chain-saw.
- Topsoil should not be disturbed.
- The material that is removed will first be made available to the communities in the area.
- Non-commercial material to be removed should be burned in a hot fire in order to minimise air quality impacts. This can be achieved by stacking the material in rows and burning.
- The areas of the basin that are cleared/ not cleared should be marked on a map for future use.

9.1.5.3 Assessment of impacts on water quality during the construction, first filling and decommissioning phases

Impact on river water quality: Contamination by construction materials	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance

Ntabelanga Dam and associated infrastructure							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium –Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium -Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium -Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium -Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Cumulative Impact – *Additional loss of in stream and riparian habitat may occur downstream of the two dams.*							

Creation of anoxic conditions during first filling of the dam	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Low	Medium	Very low (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)

Cumulative Impact – *Additional loss of in stream and riparian habitat may occur downstream of the two dams.*

9.1.6 Heritage resources

The following key impacts on heritage resources have been identified for the construction phase:

9.1.6.1 Impacts on places, buildings and structures

All places, buildings and structures within the full supply levels of the dams will be destroyed by inundation, while associated infrastructure could damage or destroy those outside the full supply levels

Recommended mitigation:

- Thorough identification of abandoned homesteads and recording of field ownership, preferably in the presence of headmen and community elders, is required.
- Structures such as number 3 in Table 10, the extant livestock byre, will require replacement so that the relevant family's socio-economic activities can continue.
- No further recording of abandoned homestead structures is required before destruction; as they have been recorded sufficiently during this Phase 1 HIA.
- A destruction permit is required from ECPHRA. If possible a single permit should be obtained for all structures.

9.1.6.2 Impacts on graves and burial grounds

All graves within the full supply levels of the dams will be destroyed by inundation, while associated infrastructure could damage or destroy those outside the full supply levels

Recommended mitigation:

- The locations of ancestral graves at abandoned homesteads must be ascertained. The exact location and date of the burial, name and age of the deceased, and name(s) and contact details of next-of-kin must be recorded, and the burial place should be described and photographed.
- All graves within the full supply levels of the dams should be relocated, with the permission of the next-of-kin and a permit from ECPHRA.
- No associated infrastructure may be located within 100 m of graves outside the full supply levels, and if unavoidable, these graves should be relocated.
- All graves outside the full supply level within 300 m of associated infrastructure should be demarcated by the Environmental Control Officer, in consultation with the next-of-kin, for the duration of construction with metal stanchions, fencing wire and red and white barrier tape.

9.1.6.3 Impacts on archaeological sites

All archaeological sites within the full supply levels of the dams will be destroyed by inundation, while associated infrastructure could damage or destroy those outside the full supply levels

Recommended mitigation:

- The archaeological site identified in the proposed Ntabelanga Dam basin should be mapped in detail, with judicious sampling, authorised by a permit from ECPHRA. Thereafter the site may be destroyed once a destruction permit has been issued by ECPHRA.
- The archaeological site identified in the proposed Lalini Dam basin should be mapped and excavated/sampled, authorised by a permit from ECPHRA. Thereafter the site may be destroyed once a destruction permit has been issued by ECPHRA.
- A detailed survey of potential Early Iron Age sites should be undertaken once crops have been harvested and vegetation clearance has occurred.
- Should any heritage artefacts or graves be exposed during excavation, work on the area where the artefacts or remains were discovered shall cease immediately.
- All discoveries shall be reported immediately to the archaeologist is available, so that an investigation and evaluation of the finds can be made. Necessary actions must be taken based on the advice from the heritage specialist.

9.1.6.4 Assessment of impacts on heritage resources during the construction phase

Impacts on places, buildings and structures	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Lalini Dam size 1 (preferred alternative)							
Without Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
With Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lalini Dam size 2							
Without Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
With Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lalini Dam size 3							
Without Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
With Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ntabelanga Dam							
Without Mitigation	Site	Long term	Negligible	Low	Improbable	Medium-High	Low (-)
With Mitigation	Site	Long term	Negligible	Low	Improbable	Medium-High	Low (-)
Cumulative Impact Not applicable							
Impacts on ancestral graves	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Lalini Dam size 1 (preferred alternative)							
Without Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
With Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Lalini Dam size 2							
Without Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
With Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Lalini Dam size 3							
Without Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
With Mitigation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ntabelanga Dam							
Without Mitigation	Local	Permanent – no mitigation	Very high	High	Definite	High	High (-)
With Mitigation	Site	Permanent – mitigated	Low	Medium	Low	Medium-High	Low (-)
Cumulative Impact Not applicable							
Impacts on archaeological sites	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Lalini Dam size 1 (preferred alternative)							
Without Mitigation	Site	Permanent – no mitigation	Very high	High	Medium-High	High	High (-)
With Mitigation	Site	Permanent – mitigated	Low	Medium	Low	Medium-High	Low (-)
Lalini Dam size 2							
Without Mitigation	Site	Permanent – no mitigation	Very high	High	Medium-High	High	High (-)
With Mitigation	Site	Permanent – mitigated	Low	Medium	Low	Medium-High	Low (-)
Lalini Dam size 3							
Without Mitigation	Site	Permanent – no mitigation	Very high	High	Medium-High	High	High (-)
With Mitigation	Site	Permanent – mitigated	Low	Medium	Low	Medium-High	Low (-)
Ntabelanga Dam							
Without Mitigation	Site	Permanent – no mitigation	Very high	High	Medium-High	High	High (-)
With Mitigation	Site	Permanent – mitigated	Low	Medium	Low	Medium-High	Low (-)
Cumulative Impact Not applicable							

9.1.7 Visual

The impact assessment addresses the visual impacts associated with the larger components of the project, namely the two dam sites, the alternative power lines from the Lalini Dam hydropower plant, the Tsolo Irrigation scheme and the main Tsolo and Maclear access roads. Components that will have a temporary or negligible visual impact such as construction camps, borrow areas and quarries, pipelines and reservoirs were not assessed.

Alteration to the sense of place is considered the most important visual impact.

Recommended mitigation:

- Rehabilitate all construction scarring outside dam basin.

9.1.7.1 Assessment of visual impacts during the construction phase

Aesthetics	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga and Lalini Dams (all alternatives)							
Without Mitigation	Regional	Long term	Very high	High	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	Very high	High	Definite	Medium	Medium-Low (-)
Cumulative Impact –the impact on the sense of place is regarded as high in that the dam will visually alter the entire valley. However, the significance is considered to be medium low in that a water body is usually regarded as having a high positive aesthetical appeal.							

9.1.8 Social

9.1.8.1 Health and social well-being impacts

The health and social well-being impacts related to the construction of the Ntabelanga and Lalini dams as well as the associated water infrastructure include:

- Annoyance, dust and noise resulting from construction activities.
- Fear of crime due to influx of construction workers.
- Increased actual crime possible due to opportunities and perceived opportunities generated by construction attracting construction workers, but also job seekers, other informal enterprises and prostitution.
- Increased risk of HIV and AIDS associated with the gathering of construction workers in a concentrated area and the availability of disposable income which may attract prostitution.
  - Increased social tensions, conflict or serious divisions within the community in event of the Traditional Authorities and Ward Councillors not retaining control over the distribution of jobs and illegal settlement in the area. These tensions are likely to be between local communities and work seekers as well as opportunists looking for opportunities to set up micro enterprises, such as food stalls in the area.
- Presence of construction workers.
- Reduced actual personal safety, increased hazard exposure resulting from construction activities and traffic.

One of the haul roads between the borrow pits and the Lalini Dam construction site will go through the town of Lalini (**Figure**). Due to increased traffic hazards, dust and noise, this would increase the level of health and safety risks. Consequently a proposed mitigation measure is to identify an alternative route.

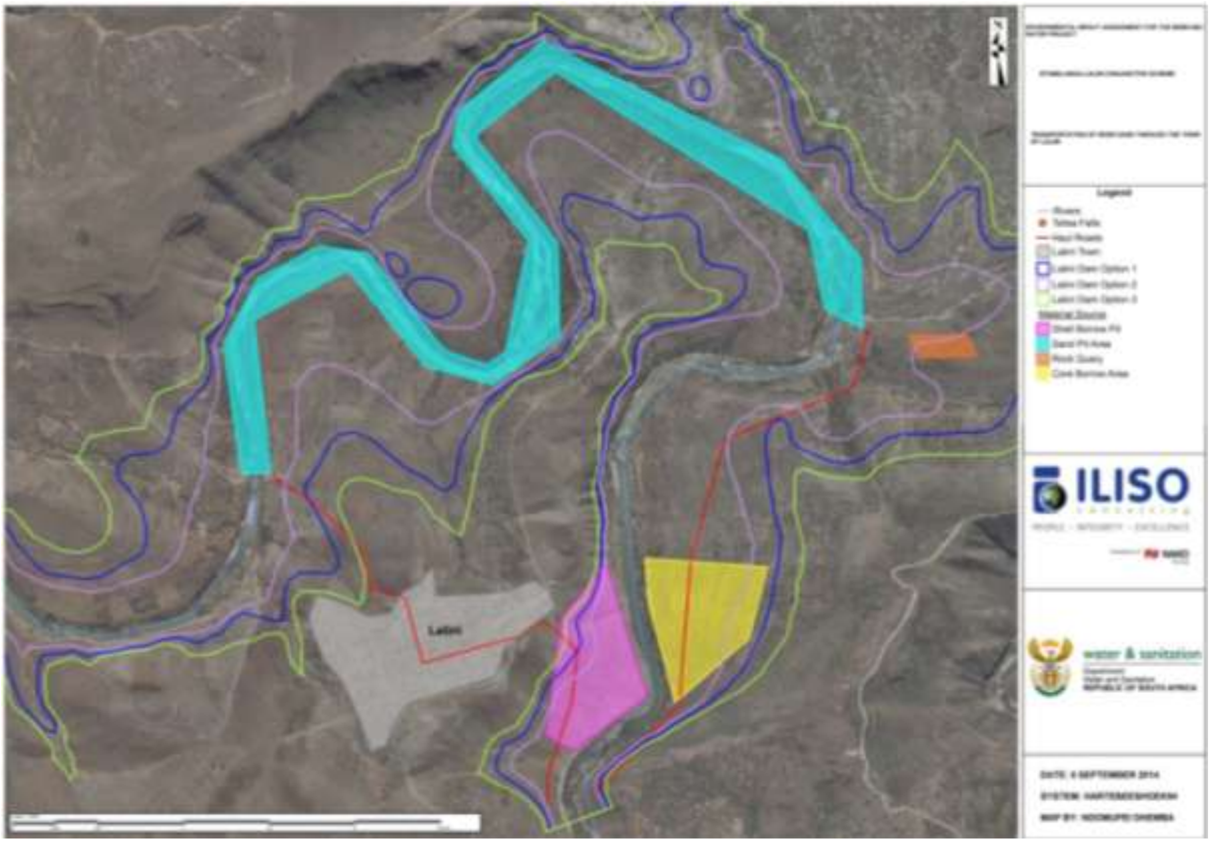

Figure 77: Haul road traversing the town of Lalini

The health and social well-being impacts are most prominent during the construction phase of the project as it is during this time that most of the disruptive activities occur. However, the impact of these activities can be managed to some degree, although small, with carefully considered and successfully applied mitigation measures.

Recommended mitigation:

- Apply dust suppression and noise reduction mitigation measures listed in the EMPR (**Appendix D**).
- Ensure that construction workers are clearly identifiable. All workers should carry identification cards and wear identifiable clothing.
- Fence off all construction sites and control access to these sites.
- Clearly mark any hazardous areas and regularly monitor these areas to ensure that people and animals avoid these areas.
- Liaise with the South African Police Services (SAPS) and Community Policing Forums to ensure that construction sites are monitored.
- Encourage local people to report any suspicious activity associated with the construction sites.
- Prevent loitering within the vicinity of the construction camp as well as construction sites.

- Ensure that an on-site HIV and AIDS policy is in place and that construction workers have easy access to condoms.
- Draw up a recruitment policy in conjunction with the Traditional Authorities and Ward Councillors of the area and ensure compliance with this policy.
- Communicate the limitation of opportunities created by the project through the Traditional Authorities and Ward Councillors.
- Ensure all construction equipment and vehicles are properly maintained at all times.
- Ensure that operators and drivers are properly trained and make them aware, through regular toolbox talks, of any risk they or their equipment may pose to the community. Place specific emphasis on the vulnerable sector of the population such as children and the elderly.
- Ensure that recreational fires lit by construction staff are in designated areas and that safety precautions, such as not lighting fires in strong winds and that fires are completely extinguished before being left unattended, are strictly followed.
- Make staff aware of the dangers of fire during regular tool box talks.

9.1.8.2 Quality of the living environment (liveability) impacts

The following quality of the living environment impacts related to the construction of the Ntabelanga and Lalini dams as well as the associated water infrastructure include:

- Disruption of daily living resulting from resettlement, loss of land, altered movement patterns and access to land, facilities and other community members.
- Increased population density and crowding
- Reduced adequacy of community social infrastructure
- Reduced adequacy of physical infrastructure
- Reduced quality of housing
- Reduction in perceived quality of life.

The peak workforce across the project is estimated at 3 114 people with about 1 238 being recruited locally and 1 877 coming into the area. This relatively sudden increase in population will result in pressures being placed on the district and local authorities to supply adequate facilities in the area. These authorities, having underperformed for some time now (Department of Cooperative Governance and Traditional Affairs, 2009) will find it extremely difficult to deliver the required service, which is likely to have a negative effect on the quality of the living environment.

Recommended mitigation:

- Ensure that any dwellings that are replaced are equal to, or better, than the original dwelling that it replaces.
- Ensure that, at all times, people have access to their properties as well as to social facilities such as schools, churches, transport and shops.

- Appoint a Professional Service Provider to establish and facilitate an independent forum for communication and liaison (thereafter referred to as “The Forum”), consisting of representatives of the Traditional Authority, municipalities, ward councillors and communities to address any concerns or grievances that community members may have regarding the project, and to facilitate relocation and other activities affecting the community.
- Consult The Forum in an effort to reduce the impact that the project may have on the movement patterns of people. This should be done, in an attempt to retain these patterns as far as is possible.
- Alert local businesses to the fact that with the arrival of construction workers the population of the area will increase and they are likely to be faced with a higher demand and will need to purchase sufficient stock.
- Establish channels of communication between local communities and contractors to ensure that construction workers behave in a manner acceptable to these local communities.
- Put procedures and regulations in place to control loitering and the construction of informal dwellings in the vicinity of the construction camp and sites.
- Monitor the effect that construction is having on infrastructure on a regular basis and immediately report any damage to infrastructure to the relevant authority to carry out maintenance or repairs.
- Where damage has been reported regularly follow up is required to ensure rapid repair.
- Investigate and consult local communities on the need to provide suitable hard access points around the dam basin for people and animals.

9.1.8.3 Economic and material well-being impacts (negative)

The negative economic and material well-being impacts associated with the construction of the Ntabelanga and Lalini dams, as well as the associated water infrastructure include:

- Relocation of households: A maximum of 202 dwellings could be relocated as a result of the project. This number will, however, vary depending on the number of dwellings that can be saved through adjustments to the realignment of the pipelines and access roads and the final size selected for the Lalini Dam.
- Deteriorating economic situation.
- Decreased autonomy, independence, security of livelihoods.

A substantial number of households are to be relocated as a result of the project and this will have a significant negative economic effect on both these household as well as the host communities. Apart from this the livelihoods of hunters, who use packs of hunting dogs as observed by the Fauna Specialist (DWS, 2014b) in the vicinity of the Lalini Dam Basin, may be threatened with the inundation of the dam basin. These negative economic and material well-being impacts are assessed below.

Recommended mitigation:

- Afford both displaced persons and host communities opportunities to participate in planning.
- Ensure that the Relocation Action Plan (RAP) takes the risk of impoverishment fully into account and includes support structures aimed at minimising such risks.
- Keep family units, and where possible, social networks intact.
- Residents should be sufficiently compensated and assisted throughout the relocation process and resettlement period.
- The Forum should consider the feasibility of establishing a trust fund to assist affected households in re-establishing themselves. Particular emphasis should be placed on marginal and vulnerable groups.
- Assist with the relocation of livestock and, where feasible, after construction swiftly rehabilitate the land to its original condition.
- Where land cannot be rehabilitated within a reasonable period of time ensure that stock feed or an acceptable alternative is provided in consultation with The Forum.

9.1.8.4 Economic and material well-being impacts (positive)

The positive economic and material well-being impacts associated with the construction of the Ntabelanga and Lalini dams, as well as the associated water infrastructure include:

- Increases in employment opportunities
- Increased opportunities for SMMEs.

Other economic changes leading to positive impacts during the construction phase addressed in the Economic Specialist's report (DWS, 2014h) are:

- Economic stimulation of the area
- Increased tax revenue
- Income and expenditure (tax revenue).

With an estimated 3 114 direct, 1 334 indirect and 1 640 induced jobs being created during the peak of the construction phase of the project this will have a significant **positive impact** and is assessed below as **positive**. Taking the findings of the Economic Specialist regarding the macro economy into account (DWS, 2014h) these impacts are assessed here at a national level.

Recommended optimisation measures:

- Local residents should be recruited to fill semi and unskilled jobs.
- Women should be given equal employment opportunities and encouraged to apply for positions.
- A skills development plan should be put in place at an early stage and workers should be provided the opportunity to develop their skills which they can use to secure jobs elsewhere post-construction.

- A procurement policy promoting the use of local business, where applicable, should be put in place to be applied throughout the construction phase.
- Careful consideration must be given to the suitability of the crop selection for the irrigation development.
- A well-constructed agricultural development training and support system focused on assisting the new farmers will need to be implemented.
- The assistance of the Department of Rural Development and Agrarian Reform, Tsolo Agricultural College, and Jongiliswe Agricultural College for Traditional Leaders must be enlisted to train, mentor and support developing farmers.
- This training must include business training, and training in project planning, monitoring and evaluation.

9.1.8.5 Cultural impacts

The heritage sites associated with the dams and associated water infrastructure identified by the Heritage Specialist (DWS, 2014e) include:

- Places, buildings and structures
- Graves and burial grounds
- Archaeological sites

These sites are identified and addressed in the Heritage Specialist's report and will be assessed here at a social level and in this respect the following processes will be considered:

- Diminished cultural integrity
- Loss of rights over and access to natural resources
- Changes in movement patterns
- Loss or negative influences on sites of archaeological, cultural, and/or historical significance.

The loss of burial sites will be of significant importance to communities relocated from within the Ntabelanga Dam Basin as there are three abandoned homesteads with possible grave sites and five existing homesteads with grave sites within the area. Where necessary the relocation of grave sites will need to be undertaken in consultation with the next-of-kin.

Recommended mitigation

- Sensitise construction workers from outside the area to the traditions and practices of local communities.
- Provide communication channels and mechanisms through which local communities and construction workers can address their expectations and concerns.
- Consult traditional healers, herbalists, traditional doctors and elderly people of the area to ensure that any lost access to natural resources is restored to former levels.

- Follow the mitigation measures suggested by the Heritage Specialist.

9.1.8.6 Family and community impacts

Both the displacement of people as well as the influx of construction workers will occur during the construction phase of the project and will have lasting effects well into the operational phase, and have an impact on families and the sense of community within the vicinity of the project. These impacts are likely to include:

- Disruption to family structures and social networks
- Changed attitudes towards local communities, level of satisfaction with the neighbourhood.

Although the intention is to recruit as many workers as is possible from amongst the local communities, it is still likely that somewhere around 50 percent of the workforce will have to be brought into the area. Considering this, at peak construction and taking into account the intention to recruit locally, some 1 877 outside construction workers coming into the area may disrupt the family structures and social networks of local communities. The arrival of what is a significant number of people may also result in changing attitudes towards local communities and dissatisfaction with the neighbourhood. These impacts are assessed here in respect of the construction of the Ntabelanga and Lalini dams, as well as the associated water infrastructure.

Recommended mitigation

- Include a section in the induction programme for construction workers that cover local traditions and practices.
- Regularly reinforce, amongst construction workers, the importance of respecting local traditions and practices through toolbox talks. In this regard encourage the participation of locally recruited construction workers to assist in reinforcing this point.
- Provide a communication channel through The Forum through which local communities can voice their experiences and expectations of construction workers.
- Avoid involuntary resettlement wherever possible.
- Where feasible encourage displaced people to resettle themselves and support them throughout the process.
- Undertake consultations with displaced people about acceptable alternatives and strategies and include them in the planning, implementing and monitoring processes.
- Choose the relocation site to ensure that the minimum disruption to displaced families as well as host communities occurs.
- Sensitise host communities to the pending arrival of the displaced communities.
- Establish a forum or resettlement committee through which resettlement and integration can be controlled by those affected.

- A formal accessible grievance procedure should be implemented and communicated to both the displaced and host communities.
- Address all grievances swiftly, in a fair and transparent manner.
- Provide swift and honest feedback in response to all queries.
- Ensure the infrastructure and social facilities within the host communities will not be compromised with the arrival of additional people into the area.

9.1.8.7 Institutional, legal, political and equity impacts

The institutional, legal, political and equity impacts associated with the construction of the Ntabelanga and Lalini dams, as well as the associated water infrastructure include:

- Increased demand on existing infrastructure, facilities and social services
- Attitude formation towards project
- Increased opportunity for corruption
- Decreased level of community participation in decision making, loss of empowerment.

The main issue with the construction of the dams and associated water infrastructure is that there is likely to be a rapid increase in demand placed on the infrastructure, facilities and social services in the area. The area already suffers from poorly maintained and inadequate social facilities due to years of neglect (Masualle, 2014, pp. 11-12) and any additional strain will make it rather difficult for the municipal and provincial authorities to meet increased demands.

Recommended mitigation:

- Ensure that the receiving environment is prepared and has adequate infrastructure, facilities and social services to support both the displaced and host communities, prior to moving the displaced communities.
- Ensure that the facilities and services available to both displaced and host communities are equitable.
- Ensure equitable access to common resources such as water, grazing land and forests.
- Set up a grievance committee comprising of host and displaced community representatives as well as representatives of the responsible authorities.
- Provide a channel through which both the host and resettled communities can route grievances or concerns regarding service delivery.
- Swiftly address any grievance raised concerning service delivery in a transparent and equitable manner.
- Regularly monitor the effect that the resettlement has had on existing infrastructure facilities and social services within the host community.
- Promptly deal with any raised expectations amongst communities regarding perceived benefits, through a process of communication and consultation.

- Ensure that the appropriate procurement policies are put in place and closely followed.
- Any contravention of the procurement policies must be swiftly, transparently and appropriately dealt with.
- Assist both displaced and host communities to become self-reliant thus raising their self-esteem and empowering them.
- During both construction and operation implement surveillance and monitoring programmes, and undertake regular dam safety inspections.
- Implement a disaster management plan that includes a well-developed public communication process and evacuation plan.
- Ensure that all communication and warning systems are regularly tested and maintained.

9.1.8.8 Gender relations impacts

The gender relationships associated with the construction of the Ntabelanga and Lalini dams, as well as the associated water infrastructure includes:

- The burden of resettlement
- Cultural resistance towards women
- Division of labour.

Undoubtedly, considering the gender distribution of the area and the high number of female headed households, women will carry the greatest burden of resettlement, a factor that needs to be considered. The patriarchal nature of the culture of the area is also likely to result in a degree of resistance against women entering the workforce.

The division of labour associated with the construction phase of the project relates to the integration of women into the workforce and the need to create a workforce accessible to both women and men. The challenge will be in accommodating the biological, sex, gender and health need requirements of women and for the different roles occupied by women and men within the family structure.

Recommended mitigation:

- Ensure that all consultation is gender inclusive.
- Promote equal job opportunities for women and men during the construction process.
- Ensure gender inclusivity and equity with respect to all compensation.
- Prioritise gender inclusivity and equity in access to resources, goods, services and decision making with the aim of empowering women.
- Prioritise and articulate gender inclusivity and equity in the project documents by including specific strategies and guidelines for implementation.
- The project documents should also include clear mechanisms through which the actual implementation of the activities and the impact on the ground can be monitored and evaluated.

- Develop a grievance procedure to specifically address gender matters.
- Factors such as culture should be considered when planning for gender activities since they play a great role in influencing gender relations.
- In implementing the project consider the gender equity objectives of the Food and Agricultural Organisation (FAO) these objectives to be obtained by 2025 include.

  "*1. Women participate equally with men as decision-makers in rural institutions and in shaping laws, policies and programs.*

  2. Women and men have equal access to and control over decent employment and income, land and other productive resources.

  3. Women and men have equal access to goods and services for agricultural development and to markets.

  4. Women's work burden is reduced by 20% through improved technologies, services and infrastructure.

  5. Percentage of agricultural aid committed to women/gender-equality related projects is increased to 30% of total agricultural aid" (Food and Agricultural Organization of the United Nations, 2012, pp. 4-5).
- An important aspect of programme design is to gain an understanding of the differing roles, responsibilities, capacities, and constraints of women and men in the region.
- Ensure that strategies are put in place to monitor and prevent child labour from emerging in the area.

9.1.8.9 Assessment of social impacts during the construction and decommissioning phases

Health and social well-being impacts	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Medium term	High	Medium	Definite	Medium	High
With Mitigation	Negative	Regional	Medium term	Medium	Medium	Definite	Medium	Medium-high
Cumulative Impact – The area is poor and there is a high degree of malnutrition and food insecurity (Dlamini, 2013, pp. 10-11) that could exacerbate the health risks particularly those related to HIV & AIDS. There is a high level of crime across the county with 1 264 crimes being recorded in Tsolo in 2013 (Crime Stats SA , 2013).								
Quality of the living environment (liveability) impacts	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Medium term	Very high	High	Definite	Medium	High
With Mitigation	Negative	Regional	Medium term	High	High	Definite	Medium	High
Cumulative Impact – The area is relatively quiet and with the arrival of a large workforce the population of the area will suddenly increase thus initiating a number of impacts associated with this demographic change process.								

Economic and material well-being impacts (negative)	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Long term	Very high	High	Definite	Medium	High
With Mitigation	Negative	Regional	Long term	High	Medium	Definite	Medium	High
Cumulative Impact – People in the area are poor which will result in a range of financial difficulties as people respond to relocations. Vulnerable communities are less able to care for themselves (The World Bank, 2004, p. 72) and are susceptible to a number of knock on impacts such as a decreased food security, threats to sustainable livelihoods and access to social services.								
Economic and material well-being impacts (positive)	**Nature**	**Extent**	**Duration**	**Intensity**	**Potential for gain of resources**	**Probability**	**Confidence**	**Significance**
Without Optimisation	Positive	National	Medium term	Very high	High	Definite	Medium	Very high
With Optimisation	Positive	National	Medium term	Very high	High	Definite	Medium	Very high
Cumulative Impact – The creasing of a large number of jobs within an area that has a high level of unemployment and few development opportunities will result in a number of impacts such as the development of skills and a more secure household income albeit over a 3 to 10 years period.								
Cultural impacts	**Nature**	**Extent**	**Duration**	**Intensity**	**Potential for irreplaceable loss of resources**	**Probability**	**Confidence**	**Significance**
Without Mitigation	Negative	Regional	Medium term	High	Medium	Definite	Medium	High
With Mitigation	Negative	Regional	Medium term	Medium	Medium	Definite	Medium	Medium-high
Cumulative Impact – The rate of globalisation in the area may be accelerated through the arrival of construction companies and workers which could have significant consequences for local culture.								
Family and community impacts	**Nature**	**Extent**	**Duration**	**Intensity**	**Potential for irreplaceable loss of resources**	**Probability**	**Confidence**	**Significance**
Without Mitigation	Negative	Regional	Permanent - mitigated	Very high	High	Definite	Medium	Very high
With Mitigation	Negative	Regional	Permanent - mitigated	High	High	Definite	Medium	High
Cumulative Impact – Changes in family structure and social networks as well as changes with regard to the satisfaction with the neighbourhood are likely to extend well beyond the construction phase of the project, particularly if a number of construction workers choose to remain in the area after the construction phase, which has been the experience with other South African dam projects (Rossouw, 2008, p. 10). This will result in result in a number of impacts that will last over a long period.								
Institutional, legal, political and equity impacts	**Nature**	**Extent**	**Duration**	**Intensity**	**Potential for irreplaceable loss of resources**	**Probability**	**Confidence**	**Significance**
Without Mitigation	Negative	Regional	Medium	High	Medium	Definite	Medium	High

			term					
With Mitigation	Negative	Regional	Medium term	Medium	Medium	Definite	Medium	Medium-high
Cumulative Impact – The speed with which the project unfolds will have an effect on a number of impacts as the social and institutional environment is unlikely to cope well with too rapid a development.								
Gender relations impacts	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Medium term	High	Medium	Definite	Medium	High
With Mitigation	Negative	Regional	Medium term	Medium	Medium	Definite	Medium	Medium-high
Cumulative Impact – There is likely to be a cultural resistance to women entering the workforce which may even take a passive form and manifest in unintended consequences such as resistance within the family as the nurturing and domestic roles of women are seen to be compromised.								

9.1.9 Economics

9.1.9.1 Impact on growth and poverty alleviation

The economic impact of the construction phase relates mainly to value added to GDP as well as employment and the benefit to the local rural community.

Recommended mitigation:
The construction phase will provide short term employment and mitigation measures can be set so that the local community benefits in the form of payments to households and an increase in expenditure in the region. Payments to households refer to the circular flow of income in an economy thus, an increase in payments to households result in an increase in expenditure on goods and services for a specific region, promoting economic growth of that region.

9.1.9.2 Assessment of economic impacts during the construction phase

Impact on GDP and low-income households	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Construction of Ntabelanga and Lalini dams – Impact on GDP							
Without Mitigation	Provincial	Short term	High	Medium	High	Medium	Medium-high (+)
With Mitigation	Regional	Short term	Very high	Low	Definite	High	Medium-high (+)
Construction of Ntabelanga and Lalini dams – Impact on low-income households							
Without Mitigation	Provincial	Short term	High	Medium	High	Medium	Medium-high (+)
With Mitigation	Regional	Short term	Very high	Low	Definite	High	Medium-high (+)

Construction of primary and secondary bulk potable water infrastructure – Impact on GDP							
Without Mitigation	Regional	Short term	Medium	Medium	Low	Medium	Medium-low (+)
With Mitigation	Local	Short term	Medium	Low	High	High	Medium-low (+)
Construction of primary and secondary bulk potable water infrastructure – Impact on low-income households							
Without Mitigation	Regional	Short term	Medium	Medium	Low	Medium	Medium-low (+)
With Mitigation	Local	Short term	Medium	Low	High	High	Medium-low (+)
Construction of bulk raw water conveyance infrastructure – Impact on GDP							
Without Mitigation	Regional	Short term	Medium	Medium	Low	Medium	Medium-low (+)
With Mitigation	Local	Short term	Medium	Low	High	High	Medium-low (+)
Construction of bulk raw water conveyance infrastructure – Impact on low-income households							
Without Mitigation	Regional	Short term	Medium	Medium	Low	Medium	Medium-low (+)
With Mitigation	Local	Short term	Medium	Low	High	High	Medium-low (+)

Cumulative Impact

Dams – during the peak of the construction of the Ntabelanga and Lalini Dams and associated infrastructure, 2500 direct employment opportunities will be created with another 1 247 indirect and 1 767 induced jobs in the national economy. Of the direct jobs an estimated 1 102 will be semi-skilled and 807 low-skilled of which probably most will be recruited from the local community if mitigation is set in place.

There is also a positive impact on the Gross Domestic Product to the value of R1 494 million. Low income households also receive a total of R158 million out of a total of R984 million of the total impact on households.

Pipelines – during the peak of the construction of the primary and secondary bulk potable water infrastructure, 630 direct employment opportunities will be created with another 434 indirect and 522 induced jobs in the national economy. Of the direct jobs an estimated 283 will be semi-skilled and 187 low - of which probably most will be recruited from the local community if mitigation is set in place.

There is also a positive impact on the Gross Domestic Product to the value of R435 million. Low income households also receive a total of R45 million out of a total of R290 million of the total impact on households.

Irrigation pipelines – during the peak of the construction of the bulk raw water conveyance infrastructure, 1 054 direct employment opportunities will be created with another 443 indirect and 937 induced jobs in the national economy. Of the direct jobs an estimated 471 will be semi-skilled and 326 low-skilled of which probably most will be recruited from the local community if mitigation is set in place.

There is also a positive impact on the Gross Domestic Product to the value of R269 million. Low income households also receive a total of R43 million out of a total of R139 million of the total impact on households.

9.2 OPERATION PHASE

9.2.1 Plants

The following key impacts on flora have been identified for the operation phase:

9.2.1.1 Impact on habitat for floral species

Ntabelanga and Lalini Dams

During the operation phase, impacts from the first filling would already have taken place, thus clearing vegetation within the full supply level. During the operation phase water from the dams will be used to generate electricity and base flow and peak flow. The dam levels will fluctuate, which will slightly impact on the floral habitat. During certain periods, vegetation will be exposed but the duration will not be enough to recover. It is expected that an increase in sedimentation will occur along the banks of the dam.

Primary, secondary and irrigation pipelines

No major impacts are expected during the operational phase, should rehabilitation of the affected areas be effectively implemented. It must be ensured that alien proliferation is controlled during the operation phase to ensure that indigenous floral habitat is not lost. During the maintenance of the pipelines, all vehicles should travel on designated roads to limit the ecological footprint and reduce further degradation or loss of floral habitat.

Recommended mitigation:

- Ensure that operational related activities are kept strictly within the development footprint.

9.2.1.2 Impact on floral diversity

Ntabelanga and Lalini Dams

The diversity of floral species within the dam basins will be lost during the operational phase within the Ntabelanga and the Lalini Dams. The dams will also act as a barrier disrupting seed dispersal by water (along the river) or animals (across river). No mitigation measures are available to reduce these impacts. Fire can also have an impact, were the natural fire regime across the river is disrupted, affecting species composition and structure of vegetation communities.

The significance associated with the loss of the floral diversity is considered medium-high.

Primary, secondary and irrigation pipelines

The impact significance associated with the loss of species diversity is considered to be low prior to the implementation of mitigation measures.

Recommended mitigation

- Removal of the alien and weed species encountered within the footprint area must take place in order to comply with existing legislation. An annual monitoring of levels of infestation of the dam basins by alien floral species must take place.
- Restrict maintenance vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- To prevent the erosion of top-soil, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any wetland areas susceptible to erosion.
- Maintain holding nursery of local indigenous floral species suitable for re-planting during the operational phase.
- Burns on both sides of dam should take place at similar frequency and at similar times.

9.2.1.3 Impact on important and protected floral species

Important floral species located within along the secondary pipeline route should have been removed with valid permits (obtained before construction commences). Habitat will be lost, therefore decreasing the probability of protected and important species to occur.

Alien floral species need to be controlled and monitored during the life of the operation. Invader Alien Plants can significantly alter the composition, structure and functionality of ecosystems. As a result, they degrade the productive potential of the land; intensify the damage caused by veld fires and flooding, increase soil erosion, and impact on the health of rivers and estuaries. Indigenous species may be reduced in numbers/coverage, or may be lost as a result of alien floral infestations.

Recommended mitigation

- Ensure that operational related activities are kept strictly within the development footprint.
- Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

9.2.1.4 Assessment of floral impacts during the operation phase

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high (-)

With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	1 (Low)	4 (High)	High	Low (-)
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low (-)

Residual Impact:

- Increased settlement around dams could result in further fragmentation and loss of untransformed habitat.
- The loss of floral habitat will lead to altered floral biodiversity.

Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	1 (Low)	4 (High)	High	Low (-)
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low (-)

Residual Impact:

- Permanent loss of floral diversity within the dam footprint area.
- Increased settlement around dams could result in harvesting of floral resources outside of the dam footprint area.

Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance

Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (Site)	2 (Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	1 (Site)	2 Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	1 (Site)	2 (Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high (-)
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	1 (Low)	4 (High)	High	Low (-)
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low (-)
Residual Impact: • A decrease in medicinal or protected floral species diversity may lead to a loss of species richness over time within the region.							

9.2.2 Animals

The following key impacts on fauna have been identified for the operation phase:

9.2.2.1 Impact on faunal habitat

Minimal further impact will occur within the study area during the operational phase, as affected habitat from construction phase will be inundated by this point and lost. The fluctuating water levels of the Lalini Dam that are linked the hydroelectric power generation will however further affect faunal habitat, as the riparian zone will not be able to re-establish itself along the new water's edge. There will be an increased risk of alien vegetation establishing along the water's edge, outcompeting the natural riparian vegetation. The alien riparian vegetation will not provide suitable habitat for the faunal species within the study area. Vegetation where the pipelines were laid should recover once again and provide habitat to the species that were there beforehand, provided the mitigation measures are followed. All associated infrastructure (gauging weirs, reservoirs etc), unless specifically addressed within the impact tables has been included within the impact of the dams themselves.

Recommended mitigation:

- Restrict vehicles to designated roadways to limit the ecological footprint of the proposed development activities as well as to reduce the possibility of collisions;
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity; and
- Rehabilitate and naturalise areas beyond the development footprint, which have been affected by the construction activities, using indigenous grass species.

9.2.2.2 Impact on faunal diversity

Species that are better able to adapt and utilise the dams will continue to occur within the study area. However, species that rely on specific habitat zones that were flooded will have to migrate to new more suitable habitat zones within the region, or will slowly decrease in numbers until they no longer occur within the study area. The increased threat of poaching will also contribute to the diminished species numbers within the study area. Vegetation where the pipelines were laid should recover once again and provide habitat to the species that were there beforehand, provided the mitigation measures are followed.

Recommended mitigation:

- Edge effects of all operational activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity;
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

9.2.2.3 Impact on species of conservational concern

Balearica regulorum (Crowned Crane), *Anthropoides paradisea* (Blue crane), *Grus carunculatus* (Wattled crane) and protected scorpions will have been forced to migrate to more suitable habitats as the dams reach full capacity. The cranes will be forced to find more suitable breeding habitat in the surrounding area, so any further impacts that happen within the study area are less likely to have a direct impact on the. The protected scorpions will be pushed further up the cliffs and rocky outcrops as the water levels rise. If they find suitable habitat higher up the mountain they will continue to persist through the operational lifetime of the dam, provided that there are sufficient resources available to them in these new habitat areas, however overall population abundances are deemed likely to decrease on a regional level. The operation of the pipelines will have a very low impact on species of conservational concern as the pipelines they are not located in any areas were these species were observed, or are expected to readily occur.

Recommended mitigation:

- Edge effects of all operational activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity;
- Should any RDL faunal species or species of conservational concern be found within the operational footprint area, these species should be relocated to similar habitat within the vicinity of the study area with the assistance of a suitably qualified specialist;
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities;
- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the power and pipeline. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Ensure that operational related activities are kept strictly within the development footprint.

9.2.2.4 Assessment of faunal impacts during the operation phase

Impact on faunal habitat	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Medium (3)	Low (1)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Permanent (5)	Low (2)	Low (1)	Definite (5)	High	Medium-high (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Medium (3)	Low(1)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Permanent (5)	Low (2)	Low(1)	Definite (5)	High	Medium-high (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Medium (3)	Low (1)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Permanent (5)	Low (2)	Low (1)	Definite (5)	High	Medium-high
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Medium (3)	Low (1)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Permanent (5)	Low (2)	Low (1)	Definite (5)	High	Medium-high (-)
Primary pipelines							
Without Mitigation	Site (1)	Short term (1)	Medium (3)	Low (1)	High (4)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
Secondary pipelines							
Without Mitigation	Site (1)	Short term (1)	Medium (3)	Low (1)	High (4)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)

Irrigation pipelines							
Without Mitigation	Site (1)	Short term (1)	Medium (3)	Low (1)	High (4)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
Cumulative Impact – Once the dams have been established the level of impacts on the faunal habitat will cease. However the fluctuating water level of the Lalini Dam will make it hard to re-establish a riparian habitat there.							

Impact on faunal diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Medium (3)	Low (1)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Permanent (5)	Low (2)	Low (1)	Definite (5)	High	Medium-high (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Medium (3)	Low (1)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Permanent (5)	Low (2)	Low (1)	Definite (5)	High	Medium-high (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Medium (3)	Low (1)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Permanent (5)	Low (2)	Low (1)	Definite (5)	High	Medium-high (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Medium (3)	Low (1)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Permanent (5)	Low (2)	Low (1)	Definite (5)	High	Medium-high (-)
Primary pipelines							
Without Mitigation	Site (1)	Short term (1)	Medium (3)	Low (1)	High (4)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
Secondary pipelines							
Without Mitigation	Site (1)	Short term (1)	Medium (3)	Low (1)	High (4)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
Irrigation pipelines							
Without Mitigation	Site (1)	Short term (1)	Medium (3)	Low (1)	High (4)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
Cumulative Impact – The remaining more hardy faunal species will adapt to the new decreased habitat zones and change in available resources. The niche and more sensitive species will either exist in small pockets or migrate to more favourable habitat if such is available in the surrounding area. However overall population abundances are deemed likely to decrease on a regional level.							

Impact on species of conservational concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Site (1)	Permanent	Negligible	Low (1)	Definite (5)	High	Medium-low

		(5)	(1)				(-)
With Mitigation	Site (1)	Permanent (5)	Negligible (1)	Low (1)	Definite (5)	High	Medium-low (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Negligible (1)	Low (1)	Definite (5)	High	Medium-low (-)
With Mitigation	Site (1)	Permanent (5)	Negligible (1)	Low (1)	Definite (5)	High	Medium-low (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Negligible (1)	Low (1)	Definite (5)	High	Medium-low (-)
With Mitigation	Site (1)	Permanent (5)	Negligible (1)	Low (1)	Definite (5)	High	Medium-low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Site (1)	Permanent (5)	Negligible (1)	Low (1)	Definite (5)	High	Medium-low (-)
With Mitigation	Site (1)	Permanent (5)	Negligible (1)	Low (1)	Definite (5)	High	Medium-low (-)
Primary pipelines							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Negligible (1)	Low (1)	Low (2)	High	Very-low (-)
Secondary pipelines							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Negligible (1)	Low (1)	Low (2)	High	Very-low (-)
Irrigation pipelines							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Negligible (1)	Low (1)	Low (2)	High	Very-low (-)
Cumulative Impact – Continued decrease in species of conservational concern. The few that remain will be found only in isolated pockets of the remaining habitats.							

9.2.3 Aquatic ecology

During operation, the impact will remain local for all dam size alternatives. Dam size differences will also have no effect on the duration or intensity impacts associated with the operation. The flow regime will have greater relevance in terms of impact and is assessed in **section 10.2.3**. Other impacts are assessed below.

9.2.3.1 Loss of aquatic biodiversity

The proposed dam walls will lead to the formation of a migratory barrier and the movement of instream taxa, with special mention of eels, will be severely and permanently affected. As for the construction phase, permanent alteration of natural flow rates and habitat will negative affect aquatic biodiversity with specific reference to macro-invertebrates and riparian vegetation.

9.2.3.2 Impact on species of conservation concern

The impact pertains to eel migration and presence of endemic mayflies. With the two dams situated between two waterfalls and hence geographically isolated, the area is likely to contain several macro-invertebrate species of conservation concern. The impact associated with the operational phase will be permanent and the only mitigation measures applicable pertain to flow regime.

Recommended mitigation:

- The EWR defined for the system must be maintained at all times.

9.2.3.3 Assessment of impacts on aquatic ecology during the operation phase

Loss of aquatic biodiversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Lalini Dam and associated infrastructure (all alternatives)							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Cumulative Impact and Comments – Both changes in habitat modification as well as flow regime will be permanent. Mitigation measures, either in terms of base flow or variation in flow when employing a peak generation, will result in constant impact that would preclude species sensitive to either habitat or flow suitability. Decrease in biodiversity is deemed unavoidable.							
Impact on species of conservation concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	Medium (3)	High	Medium-Low (-)
Lalini Dam and associated infrastructure (all alternatives)							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	Medium (3)	High	Medium-Low (-)
Please note that reference to the respective projects also considers impact from associated activities, including gauging weirs,							

WWTWs, accommodation infrastructure, river intake structures and associated works and information centres.

9.2.4 Wetlands

The following key impacts on wetlands have been identified for the operation phase:

Ntabelanga and Lalini Dams

Impacts on wetland / riparian habitat will be of a considerably lower intensity during the operational phase of the project in comparison to the construction phase. This is attributed to the anticipated loss of habitat which will occur during the first filling of the dams. Thus, although the duration of the impact is considered to be permanent without the possibility of rehabilitation of those features which will be inundated, the intensity of the impact is considered low.

Primary, secondary and irrigation pipelines

Major impacts on wetland / riparian features during the operational phases of the pipelines are not anticipated, provided that the impacts on these features are minimised during the construction phase, and that any wetland / riparian areas which were impacted during construction are monitored regularly for proliferation of alien vegetation and sedimentation in the areas of disturbance. During maintenance of pipelines, it is essential that maintenance vehicles remain on designated roads in order to limit the ecological footprint of maintenance activities and reduce further degradation of the wetland / riparian habitat.

Mitigation measures for these impacts are provided below.

9.2.4.1 Loss of wetland / riparian habitat and ecological structure, loss of wetland / riparian ecoservices and Impacts on wetland / riparian hydrology and sediment balance

Recommended mitigation:

- The Ecological Water Requirements (EWR) as set out in the Reserve Determination Volume 1: River (Report P WMA 12/T30/00/5212/7) for the Ntabelanga Dam, and the EWR determined for the Lalini Dam, must be adhered to;
- During operational use and maintenance of infrastructure, vehicles must remain on designated roads and not be permitted to drive through sensitive wetland / riparian habitat, and therefore ability of the wetlands to provide ecological services, is already compromised.
- Close monitoring of erosion patterns downstream of the dams is deemed essential and any areas which are showing erosion to be occurring should immediately be rehabilitated through re-sloping, stabilisation and re-vegetation techniques as part of the catchment management plan.

9.2.4.2 Assessment of wetland impacts during the operation phase

Loss of wetland / riparian habitat and ecological structure	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (local)	1 (short)	2 (Low)	3 (medium)	3 (Medium)	High	Low (-)
With Mitigation	2 (local)	1 (short)	1 (Negligible)	1 (Low)	2 (Low)	High	Very Low (-)

Cumulative Impact:

- Fluctuating water levels downstream of the dams as a result of periodic release of water from the dams, leading to altered wetland / riparian species composition and community structure, in turn resulting in altered habitats and decreased ability to support biodiversity;
- Increased water inputs to wetland features as a result of runoff arising from increased impermeable surfaces (paving, roofs, dam walls, etc);
- Increased sediment inputs to wetland / riparian habitat due to increased traffic volumes in the vicinity.

Loss of wetland / riparian ecoservices	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent	2 (Low)	3 (medium)	5 (Definite)	High	Medium

		– mitigation)					High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (local)	1 (short)	2 (Low)	3 (medium)	3 (Medium)	High	Low
With Mitigation	2 (local)	1 (short)	1 (Negligible)	1 (Low)	2 (Low)	High	Very Low (-)

Cumulative Impact:

- Wetland / riparian functionality and capacity to provide ecological services, already compromised as a result of the construction of the dams, may be further reduced as a result of continued disturbances during operations.

Impacts on wetland / riparian hydrology and sediment balance	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium High (-)
Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (local)	4 (Permanent – mitigation)	2 (Low)	3 (medium)	5 (Definite)	High	Medium High (-)
With Mitigation	2 (local)	4 (Permanent	2 (Low)	1 (Low)	5 (Definite)	High	Medium

		– mitigation)					High (-)
Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (local)	1 (short)	2 (Low)	3 (medium)	3 (Medium)	High	Low
With Mitigation	2 (local)	1 (short)	1 (Negligible)	1 (Low)	2 (Low)	High	Very Low (-)

Cumulative Impact:

- Increased sediment inputs arising from increased run-off into wetland / riparian features;
- Sedimentation of the wetland / riparian habitat may lead to altered habitat, resulting in decreased ability to support biodiversity;
- Loss of riparian zone cover and species due to desiccation or flooding as a result of fluctuations in downstream water volumes.

9.2.5 Water quality

The following key impacts on water quality downstream of the dams and associated infrastructure have been identified for the operation phase.

9.2.5.1 Water Quality (Downstream effects): Temperature and Oxygen

Lalini and Ntabelanga Dams and associated infrastructure

The storage of a large quantity of water in the proposed dams could lead to eutrophic conditions and an increase in salinity due to the concentrating effect of evaporation losses. These problems tend to be accentuated during periods of prolonged low inflow.

The release of cold and anaerobic bottom water during periods when the dams become stratified could impact on water quality.

Recommended mitigation:

The installation of multiple level outlets and proper operation will completely mitigate the effect of water quality changes downstream of the proposed dam.

9.2.5.2 Impact on water quality: Sediment balance

Lalini and Ntabelanga Dams and associated infrastructure

The sediment balance of the Mzimvubu River and associated estuary will be slightly altered during the life cycle of the project. During the operational phase of the two dams there will be reduced sediment input to areas below the dams. Although the reduced sediment load may lead to increased erosion and armouring of the river downstream of the dams this impact is not considered highly significant. The aquatic macro-invertebrate community of the Tsitsa River relies on fast flowing water and a substrate free of sediments on the rocky substrate. The reduced sediment load downstream of the dams therefore has the potential to improve the aquatic ecology in these sections of the system.

The Mzimvubu catchment is severely impacted by the erosion of soils due to the highly erodible nature of the soils in the catchment as well as the topography in the catchment and the associated agricultural practices in the catchment. The reduced sediment input that will occur from the Tsitsa River into the Mzimvubu River system is unlikely to lead to negative impacts on the Mzimvubu River and the associated estuary and some improvements in the overall sediment balance of the system is considered possible.

Recommended mitigation:

- There are not many options available to minimise impacts of altered sedimentation downstream of the impoundments however if any areas downstream of the two proposed dams are observed where excessive erosion is occurring, these areas should be rehabilitated immediately. Such measures should be included into the operation management programme of the dams.
- In order to minimise the impacts on sedimentation within the dam a sediment management program should be implemented as part of the catchment management plan for the dam catchments and should include awareness training on sustainable agricultural practices.

Flow Gauging Weirs

Sedimentation will occur upstream behind the weir structures. Although this is unavoidable, no mitigation is required as this will not impact on the water quality downstream of the weir and the extent of habitat alteration will be very limited.

Recommended mitigation:

No mitigation required.

9.2.5.3 Impact on water quality: Salinity

The impact on water quality by fertilizers contained in the runoff from irrigated areas was determined by calculating the potential salinity level in the dam. There will be a slight increase in the conductivity and phosphorous levels in the dam. Although this is relevant, it is not significant and the water quality still falls within the ideal range.

Recommended mitigation:

No mitigation is recommended as the water quality falls within the ideal range.

9.2.5.4 Assessment of water quality impacts during the operation phase

Water Quality (Downstream Effects): Temperature and Oxygen	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Regional	Long term	Medium	High	High	High	Medium-high (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	High	Very Low (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Regional	Long term	Medium	High	High	High	Medium-high (-)

With Mitigation	Site	Short term	Negligible	Low	Improbable	High	Very Low (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Regional	Long term	Medium	High	High	High	Medium-high (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	High	Very Low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Regional	Long term	Medium	High	High	High	Medium-high (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	High	Very Low (-)
Cumulative Impact – *Additional loss of in stream and riparian habitat may occur downstream of the two dams.*							

Water Quality (Downstream Effects) : Sediment balance	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Regional	Long term	Low	Medium	High	High	Medium Low (-)
With Mitigation	Regional	Long term	Negligible	Low	Medium	High	Low (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Regional	Long term	Low	Medium	High	High	Medium Low (-)
With Mitigation	Regional	Long term	Negligible	Low	Medium	High	Low (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Regional	Long term	Low	Medium	High	High	Medium Low (-)
With Mitigation	Regional	Long term	Negligible	Low	Medium	High	Low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Regional	Long term	Low	Medium	High	High	Medium Low (-)
With Mitigation	Regional	Long term	Negligible	Low	Medium	High	Low (-)
Cumulative Impact – *Additional loss of in stream and riparian habitat may occur downstream of the two dams.*							

Sedimentation upstream of weirs	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Low	Medium	Very low (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 2 (alternative) and associated infrastructure							

Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Cumulative Impact – *Additional loss of in stream and riparian habitat may occur downstream of the two dams.*							

Salinity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Low	Medium	Very low (-)
Lalini Dam size 1 (preferred) and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 2 (alternative) and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Lalini Dam size 3 (alternative) and associated infrastructure							
Without Mitigation	Local	Short term	Low	Low	Low	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Cumulative Impact – *Additional loss of in stream and riparian habitat may occur downstream of the two dams.*							

9.2.6 Heritage resources

This section is not applicable, since impacts on heritage resources will be confined entirely to the construction phase.

9.2.7 Visual

Alteration to the sense of place is considered the most important visual impact.

9.2.7.1 Assessment of visual impacts during the operation phase

Aesthetics	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga and Lalini Dams (all alternatives)							

Without Mitigation	Regional	Long term	Very high	High	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	Very high	High	Definite	Medium	Medium-Low (-)
Cumulative Impact –the impact on the sense of place is regarded as high in that the dam will visually alter the entire valley. However, the significance is considered to be medium low in that a water body is usually regarded as having a high positive aesthetical appeal.							

9.2.8 Social

9.2.8.1 Health and social well-being impacts

The health and social well-being risk related to the operation of the dams and associated water infrastructure include:

- Increased actual crime
- Increased social tensions, conflict or serious divisions within the community
- Presence of construction workers
- Reduced actual personal safety, increased hazard exposure.

If a number of construction workers remain in the area after construction and are unable to secure employment, then it is possible that crime could rise. An increase in tourism may also aggravate the situation as it provides an opportunity for opportunist crime. Any remaining construction workers competing with the local communities could also result in an increase in tensions and conflict within the community. With the inundation of the dams a large body of water will emerge creating a risk of drowning for communities living close to and visiting the dam. This risk will be most severe for children and people unable to swim.

Recommended mitigation:

- Consider the viability of having life guard facilities available, particularly if recreational facilities associated with the dam are developed. Encourage/facilitate swimming lessons within the communities surrounding the dam basins.
- Ensure that fires are only lit in designated areas and not during the windy season. All fires must also be extinguished before being left unattended. In this regard warning signs must be placed in appropriate areas.

9.2.8.2 Quality of the living environment (liveability) impacts

The following quality of the living environment impacts apply to the operational phase of the dams and associated water infrastructure:

- Increased population density and crowding
- Reduced adequacy of community social infrastructure
- Reduced adequacy of physical infrastructure
- Reduced quality of housing

- Quality of life.

If a significant number of construction workers choose to remain in the area and if the recreational potential of the dams materialises, there will probably be an increase in the population in the areas around the dams. This will place pressure on social and physical infrastructure in the area and if not adequately addressed may result in frustrations. Although these frustrations may have the potential to reduce the quality of life they can be mitigated. Conversely, the aesthetic value of dams also has the potential to increase property values and improve the quality of life.

In areas where access to water for people and animals is disrupted due to the fencing of the dams it may be necessary to construct suitable access points. In this regard further investigation may be required during implementation, in consultation with local communities, to determine the need for and details of suitable access points.

According to the Feasibility Study some 539 000 people initially, estimated to rise to 730 000 by 2025, will be supplied with domestic water through the scheme. In addition to this approximately 2 900 ha of land will also be irrigated as a result of the Ntabelanga Dam with a potential to create an estimated 1 976 full time jobs. All this will undoubtedly have a significantly positive effect on the quality of life of these people.

Recommended enhancement:

- Investigate and consult local communities on the need to provide suitable hard access points around the dam basin for people and animals.

9.2.8.3 Economic and material well-being impacts

The following economic and material well-being impacts apply to the operational phase of the dams and associated water infrastructure:

- Increases in employment opportunities
- Increased opportunities for SMMEs.

Other economic changes leading to positive impacts during the operational phase addressed in the Economic Specialist’s report (DWS, 2014h) include economic stimulation of the area; increased tax revenue and income and expenditure (tax revenue).

Recommended enhancement:

- Careful consideration must be given to the suitability of the crop selection for the irrigation development.
- A well-constructed agricultural development training and support system focused on assisting the new farmers will need to be implemented.

- The assistance of the Department of Rural Development and Agrarian Reform, Tsolo Agricultural College, and Jongiliswe Agricultural College for Traditional Leaders must be enlisted to train, mentor and support developing farmers.
- This training must include business training, and training in project planning, monitoring and evaluation.

9.2.8.4 Cultural impacts

The cultural impacts are likely to be less severe over the operational phase of the project than they are during construction. However, during the operational phase, an influx of tourists and day visitors will result in local communities experiencing greater contact with the outside world which will, over time, result in changed cultural norms.

Apart from this the supply of domestic water and the irrigation of land could have a cultural impact over time, particularly in respect of gender relations (see **section 10.2.7.7**).

No mitigation is required.

9.2.8.5 Family and community impacts

The following family and community impacts apply to the operational phase of the dams and associated water infrastructure:

- Disruption to family structures and social networks
- Changed attitudes towards local communities, level of satisfaction with the neighbourhood.

Local people, having been skilled during the construction process, may leave the area in search of alternative employment. During this stage the communities will gradually return to a more mundane post construction existence.

Domestic water supply

With the domestic water supply being rolled out to a substantial portion of the population it is likely that less time will be spent in collecting water with more time becoming available to allocate to family activities (see **section 10.2.7.7**).

Irrigation

With water becoming available for irrigation it is likely that food will become more accessible and a number of people will find employment on the farms resulting in improved food security for families in the area as a result of an improved purchasing power. If food security is improved this is likely to help in relieving stress within the family and communities.

The insecurity of food has been an endemic problem in South Africa with over fifty percent of the population experiencing food insecurity. Linked to this is the fact that food insecurity can result in mental health problems amongst mothers and children.

The effective implementation of the domestic water supply system and of the commercial irrigation components of the project will be the responsibility of parties other than the applicant.

9.2.8.6 Institutional, legal, political and equity impacts

The institutional, legal, political and equity impacts associated with the operation of the Ntabelanga and Lalini dams, as well as the associated water infrastructure include:

- Increased demand on existing infrastructure, facilities and social services
- Increased opportunity for corruption
- Institutional and financial arrangements
- Decreased level of community participation in decision making, loss of empowerment.

It is envisaged that the construction of the dams and related water infrastructure will, together with the other associated activities, stimulate development nodes in Maclear and Tsolo. This development will possibly last after the construction phase, particularly if the tourist potential of the dam is realised and there is a growth in recreational locations and water based activities, as has been the experience with similar projects (Muller, 2014, p. 9). If such a process does happen to unfold, then there is likely to be some demand placed on existing infrastructure, facilities and social services.

There is also a risk that favouritism, cronyism, and nepotism could creep in, particularly with the allocation of domestic water and agricultural plots, a situation that would need to be carefully monitored and addressed. It is critical that the right institutional and financial arrangements are put in place and that consultation is undertaken on a broad, inclusive and transparent basis throughout the operational phase of the project.

Recommended mitigation:

- Regularly monitor the effect that the resettlement has had on existing infrastructure facilities and social services within the host community.
- Assist both displaced and host communities to become self-reliant thus raising their self-esteem and empowering them.
- Ensure that the appropriate procurement policies are put in place and closely followed.
- Implement surveillance and monitoring programmes, and undertake regular dam safety inspections.
- Implement a disaster management plan that includes a well-developed public communication process and evacuation plan.

- Ensure that all communication and warning systems are regularly tested and maintained.

9.2.9 Gender relations impacts

The operational phase of the project will have a significant impact on the division of labour in the area as a result of the domestic water supply component of the project. Women currently spend a great deal of time collecting water and fuel for energy and with the delivery of domestic water to households many women will be freed of the task of collecting water. This will have a positive impact on the time some of these women can spend on other activities.

No mitigation required.

However, the irrigation aspect of the project is likely to have a negative impact from a gender perspective. In this regard factors such as access to and control over resources, institutional arrangements, changes in the production process and occupational structures, exclusion from the decision-making process, increased workload due to double or triple cropping, will all impact on women.

Recommended mitigation:

- Prioritise gender inclusivity and equity in access to resources, goods, services and decision making with the aim of empowering women.
- Prioritise and articulate gender inclusivity and equity in the project documents by including specific strategies and guidelines for implementation.
- The project documents should also include clear mechanisms through which the actual implementation of the activities and the impact on the ground can be monitored and evaluated.
- Develop a grievance procedure to specifically address gender matters.
- Factors such as culture should be considered when planning for gender activities since they play a great role in influencing gender relations.
- In implementing the project consider the gender equity objectives of the Food and Agricultural Organisation (FAO) these objectives to be obtained by 2025 include.

  "*1. Women participate equally with men as decision-makers in rural institutions and in shaping laws, policies and programs.*

  2. Women and men have equal access to and control over decent employment and income, land and other productive resources.

  3. Women and men have equal access to goods and services for agricultural development and to markets.

  4. Women's work burden is reduced by 20% through improved technologies, services and infrastructure.

5. Percentage of agricultural aid committed to women/gender-equality related projects is increased to 30% of total agricultural aid" (Food and Agricultural Organization of the United Nations, 2012, pp. 4-5).

- An important aspect of programme design is to gain an understanding of the differing roles, responsibilities, capacities, and constraints of women and men in the region.
- Ensure that strategies are put in place to monitor and prevent child labour from emerging in the area.

9.2.9.1 Assessment of social impacts during the operation phase

Health and social well-being impacts	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Long term	High	Medium	High	Medium	Medium high
With Mitigation	Negative	Regional	Long term	Medium	Medium	High	Medium	Medium-high
Cumulative Impact – If a significant number of construction workers remain in the area, which has been the experience with other projects (Rossouw, 2008, p. 4), competition between these remaining workers and local communities could intensify resulting in conflict.								
Quality of the living environment (liveability) impacts	Nature	Extent	Duration	Intensity	Potential for gain of resources	Probability	Confidence	Significance
Without Optimisation	Positive	Regional	Permanent - no mitigation	High	High	High	Medium	High
With Optimisation	Positive	Regional	Permanent - no mitigation	Very high	High	High	Medium	High
Cumulative Impact – Any influx of people into the area on a more permanent basis will have various developmental related impacts. Successful implementation of the project will drastically improve the quality of life of a large number of people and in this sense will have numerous knock on effects								
Economic and material well-being impacts	Nature	Extent	Duration	Intensity	Potential for gain of resources	Probability	Confidence	Significance
Without Optimisation	Positive	National	Permanent - mitigated	High	High	High	Medium	High
With Optimisation	Positive	National	Permanent - mitigated	Very high	High	Definite	Medium	Very high
Cumulative Impact – If successful the project is likely to have significant impacts on the quality of life of people in the area and the province.								
Cultural impacts	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Medium term	High	Medium	Definite	Medium	High
With Mitigation	Negative	Regional	Medium term	Medium	Medium	Definite	Medium	Medium-high
Cumulative Impact – Changes in respect of the division of labour could, over time, have an impact on culture. In this respect Mehta and Srinivasan (2000, p. 8) point out that "[i]*n some cases, the social impacts of dams might lead to more egalitarian gender relations…* " as was found in a resettlement scheme in Zimbabwe. The impact of culture on gender relations was also indicated in a								

study undertaken in Malawi (Msofi, 2014, p. 16). Apart from this the rate of globalisation may be accelerate due to easier access to the area and increased tourism which could have significant consequences for local culture. In this regard tourism in the vicinity of the dams may attract multinational companies, such as McDonalds, KFC and Nando's to the area as well as hospitality service provides. For the effects of globalisation and cultural tourism see Cultural Tourism: Global and Local Perspectives (Richard, 2011)								
Family and community impacts	Nature	Extent	Duration	Intensity	Potential for gain of resources	Probability	Confidence	Significance
Without Optimisation	Positive	Regional	Permanent – no mitigation	High	High	High	Medium	High
With Optimisation	Positive	Regional	Permanent – no mitigation	Very high	High	High	Medium	High
Cumulative Impact – In the event of the success of the project there is likely to be a number of positive impacts that will accrue particularly in respect of family relationships.								
Institutional, legal, political and equity impacts	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Medium term	High	Medium	Definite	Medium	High
With Mitigation	Negative	Regional	Medium term	Medium	Medium	Definite	Medium	Medium-high
Cumulative Impact – The capacity of the district and local municipalities is limited with two of the district municipalities, O.R. Tambo and Alfred Nzo, being amongst the 10 most vulnerable municipalities in the country and three of the local municipalities, Umzimvubu, Mhlontlo and Ntabankulu amongst the 20 poorest performing local municipalities (Department of Cooperative Governance and Traditional Affairs, 2009, pp. 28-29). This is likely to result in a number of institutional and performance related impacts.								
Gender relations impacts associated with domestic water supply	Nature	Extent	Duration	Intensity	Potential for gain of resources	Probability	Confidence	Significance
Without Optimisation	Positive	Regional	Permanent	High	High	Definite	Medium	High
With Optimisation	Positive	Regional	Permanent	Very high	High	Definite	Medium	Very-high
Cumulative Impact – The released of women from the time consuming tasks of collecting water could have a significant impact on a range of personal and family related matters.								
Gender relations impacts associated with irrigation	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Long term	High	Medium	High	Medium	High
With Mitigation	Negative	Regional	Long term	Medium	Medium	Medium	Medium	Medium-high
Cumulative Impact – The issue of gender relations would need to be considered on a cultural basis as this would have a significant and far reaching impact.								

9.2.10 Economics

9.2.10.1 Impact on community welfare

The economic impact of the operational phase relates to the change in overall welfare of the rural community as a result of clean potable water.

Recommended mitigation:

The operational phase will create the environment for improved welfare to the local community if mitigation is set in place to maintain the potable water infrastructure, control the pollution and curb illegal taps. If no such measures are implemented the community may be worse off as a result of water borne diseases or no water at all.

9.2.10.2 Impact on economic growth and poverty alleviation

The economic impact of the operational phase relates mainly to value added to GDP as well as employment and the benefit to the local rural community.

Recommended mitigation:
Support structures should be available right from the start to assist the management. This support must cover the whole spectrum of the undertaking, from planting to marketing and the overall management. The best possible management will have to be available right from the start, which means the selection of the unit managers as well as the accepted management structure will eventually determine the success of the irrigation scheme.

9.2.10.3 Assessment of economic impacts during the operation phase

Impact on community welfare	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Operation phase of primary and secondary bulk potable water – Impact on community welfare							
Without Mitigation	Site	Short term	Very high	High	Medium	Medium	Medium-low (+)
With Mitigation	Local	Long term	Very high	Low	Definite	High	High (+)

Cumulative Impact – The impact of water on community welfare can be described by the value of the water that is added to the community. This value is usually expressed in the form of tariffs charged for the water. This is not applicable to rural households since very few households would actually be able to afford the tariffs. Therefore the value of the water added to the community is calculated by the following method: The economic value of water is determined in two components. The first component deals with the social (public) portion of 25 litres of water per capita/per day. This portion is in accordance with the government's policy on minimum water requirements for urban and rural households.

The second component deals with the volume of water consumed above the 25 litres per capita per day. This water is regarded as a purely private good.

The value of water then computes to R472 million in 2020 to R599 million in 2050.

It then follows that the overall cumulative impact is of medium-low significance on community welfare if mitigation is not set in place, without proper mitigation potable water supply may cease to exist. With mitigation the overall cumulative impact on community welfare will be high. This is because an essential need in a very rural community will be fulfilled.

Impact on GDP and low-income households	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Operation of commercial agriculture – Impact on GDP							
Without Mitigation	Regional	Permanent – no mitigation	Medium	High	Definite	Medium	High (+)
With Mitigation	Provincial	Permanent - Mitigated	High	Medium	High	High	High (+)
Operation of commercial agriculture – Impact on low income households							
Without Mitigation	Regional	Permanent – no mitigation	Medium	High	Definite	Medium	High (+)
With Mitigation	Provincial	Permanent - Mitigated	High	Medium	High	High	High (+)

Cumulative Impact – during the operational phase of the commercial agriculture at full production, 1 301 direct employment opportunities will be created with another 675 indirect and induced jobs in the national economy.

The total fulltime employment opportunities is estimated at 1 976 of which 1 301 are direct on the farms. The figure of 1 301 needs to be unpacked because the model provides only fulltime opportunities, while in agriculture and specifically the proposed crop mix will involve a large number of temporary employees. A separate calculation was done based on the accepted employment norms per hectare and the 1 301 unpacked, represents the following number of people:

- Permanently on the farms – 7 per unit and 315 in total. This will be tractor drivers, irrigation workers and workshop staff.
- The temporary workers are estimated at 80 per unit with a total of 3 600. This is very often the only job that these workers have and over time a clearer picture will emerge regarding their social situation.

There is also a positive impact on the Gross Domestic Product to the value of R129.3 million. Low income households also receive a total of R38.6 million.

The potential for irreplaceable loss of resources is high, given the historical performance of such projects.

It then follows that the overall cumulative impact is of high significance on GDP and on low-income households if there is no mitigation in place, this is evident in the historical commercial agriculture projects in South Africa, where unattended land is all that remained of such projects. On the other hand, a successful implementation of a commercial agriculture scheme will have a high positive economic impact on GDP and low-income households if proper mitigation is set in place.

10. IMPACT ASSESSMENT FOR ELECTRICITY GENERATION AND DISTRIBUTION INFRASTRUCTURE

This Chapter presents the findings of the environmental impact assessment for the electricity generation and distribution related activities (DEA Ref no. 14/12/16/3/3/2/678).

The activities assessed under this chapter are listed below:

- Pipeline and tunnel (including tunnel alternatives) at the proposed Lalini Dam;
- Generation of hydro power and feeding of this power into the existing grid; and
- 13km power line from the Lalini Dam tunnel.

10.1 CONSTRUCTION AND DECOMMISSIONING PHASES

10.1.1 Plants

10.1.1.1 Impact on habitat for floral species and on floral diversity

All three power line alternatives traverse transformed (grassland) habitat units, where grasslands and mostly *Acacia karroo* and *Acacia caffra* occurs. The floral habitat within this habitat unit has been significantly disturbed and floral diversity has been decreased; as such placement of infrastructure within this habitat unit will most likely have a low impact significance.

All three sections of the power line alternatives, closer to the Tsitsa River traverse more sensitive habitat associated with mountain / afromontane forests and 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. Power line alternatives 1 and 3 will have a much higher impact, even if mitigated due to the power lines crossing larger sections of indigenous vegetation, including possible protected trees. The loss of indigenous and possible protected and important tree and other floral species will be very high should the preferred power line route be alternative 1 or 3. The preferred power line alternative would thus be alternative 2 due to a lower impact on the receiving environment.

Recommended Mitigation

- Planning the placement of the power line support towers should be kept within the low sensitivity areas as far as possible. It is recommended that alternative 2 of the power lines be considered as the preferred option.
- If possible, avoid placement of infrastructure within rocky outcrop or mountain/afromontane forest habitat units.
- Permits for the removal or destruction of protected tree species (should they occur within the construction footprint area) need to be obtained from the relevant authorities before any construction activities occur within the power line route.
- Placement areas of support towers should remain as small as possible.

- Restrict vehicles as far as possible to travel on designated roadways to limit the ecological footprint of the infrastructure.
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect floral habitat, need to be strictly managed.
- It must be ensured that construction related waste or spillage and effluent do not affect the immediate and surrounding habitat boundaries.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- Areas affected by the construction of infrastructure related to the power line should be rehabilitated.

10.1.1.2 Impact on important and protected floral species

Sections of the power line routes traverse mountain and afromontane forest 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. Permit applications for the removal of protected and important species will be required.

The impact associated with important and protected floral species will be high to very high for all three alternative power lines, especially within the mountain /afromontane forest areas prior to mitigation measures being implemented. The significance rating for alternative 2 could be decreased to a slightly lower level should mitigation measures be implemented.

Recommended mitigation

- The proposed power line footprint area should be kept as small as possible and confined to areas presently / historically transformed and which are of a lower ecological importance.
- Planning the placement of the support towers should be kept within the low sensitivity areas as far as possible. It is recommended that alternative 2 of the power lines be considered as the more preferred option
- Rescue and relocation of protected species along the power lines within the rocky /mountain areas should take place prior to construction.
- Edge effects from construction activities needs to be implemented to ensure no further degradation takes place outside of the power line footprint area.
- Where protected trees will be disturbed, ensure effective relocation of individuals (if possible) to suitable similar habitat.
- Permits for the removal or destruction of 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 the power line route.

10.1.1.3 Assessment of floral impacts during the construction and decommissioning phases

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-high (-)
Power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-low (-)
Power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	4 (High)	High	Medium-high (-)
Residual Impact: • Loss of floral habitat will lead to altered floral biodiversity within the project footprint areas.							
Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-high (-)
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-low (-)
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	4 (High)	High	Medium-high (-)
Residual Impact: • Permanent loss of floral diversity within areas where construction has taken place. • Alien and invasive species proliferation and bush encroachment into disturbed areas. • Ineffective rehabilitation may lead to permanent loss of floral biodiversity							
Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	3 (Long	5 (Very	5 (High)	5 (Definite)	High	High

		term)	high)				(-)
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-high (-)
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-low (-)
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	3 (Long term)	5 (Very high)	5 (High)	5 (Definite)	High	High (-)
With Mitigation	1 (Site)	2 (Medium term)	4 (High)	5 (High)	4 (High)	High	Medium-high (-)
Residual Impact: • A decrease in medicinal floral species diversity may lead to a loss of species richness over time within the region.							

10.1.2 Animals

The following key impacts on fauna have been identified for the construction and decommissioning phases:

10.1.2.1 Impact on faunal habitat, faunal diversity and species of conservational concern

The main impact on faunal habitat will occur during the construction phase. The hydropower tunnel, as it is located underground, poses a negligible threat to faunal habitat when compared to a surface pipe system. However, the entry and exit points of the tunnel will pose a threat to faunal habitat. Tunnel alternative 1 will impact heavily on sensitive faunal habitat, most notably the habitat located in the gorge below the Tsitsa falls. Tunnel alternatives 2 and 3 (i.e. medium and long tunnels) do not pose a large threat to faunal habitat, as they are not impacting on any sensitive habitat areas. Tunnel alternative 1and the associated power line will however have a large impact on faunal habitat as it traverses sensitive mountain habitat on both sides of the mountain, and down into the gorge, with a high faunal diversity, most notably the Rock Scorpion, a protected species.. As such any infrastructure within this area will have a negative impact of faunal biodiversity, as well as have a high risk of avifaunal collisions and mortalities from the proposed power line traversing the mountain down into the gorge immediately below the falls.

The remaining power line options (alternatives 2 and 3) do not pose serious threats to faunal habitat, as they traverse previously disturbed habitat.

The fluctuating water levels of Lalini Dam with regard to providing peak or base power generation will further impact faunal habitat, more specifically the ability of the faunal habitat to recover, especially species associated with riparian zone habitats.

Recommended mitigation:

- Tunnel no.. 1 and associated power line should not be implemented.

- The power line passing through the town of Lotana towards the Tsitsa River (alternative 2) should if possible be rerouted slightly to follow down the crest of the mountain slope and not drop off through the sensitive mountain vegetation areas in the steep southern slopes.
- No areas falling outside of the study area may be cleared for construction purposes;
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity;
- Should any RDL faunal species, species of conservational concern, or other common faunal species be found within the development footprint area, these species must be relocated to similar habitat within the vicinity of the study area with the assistance of a suitably qualified specialist;
- Restrict vehicles to designated roadways to limit the ecological footprint of the proposed development activities as well as to reduce the possibility of collisions; and
- Rehabilitate and naturalise areas beyond the development footprint, which have been affected by the construction activities, using indigenous grass species.

10.1.2.2 Assessment of faunal impacts during the construction and decommissioning phases

Impact on faunal habitat	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	Very high (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	High (4)	Medium (3)	High (4)	High	Medium-low (-)
Peak power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (2)	High (4)	High	Medium-low (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (2)	Medium (3)	High	Low (-)
Peak power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (2)	High (4)	High	Medium-low (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (2)	Medium (3)	High	Low (-)
Base-load power generation and with hydropower short tunnel and power line alternative 1							
Without Mitigation	Local (2)	Medium term (2)	Very high (5)	Very high (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	High (4)	Medium (3)	High (4)	High	Medium-low (-)
Base-load power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (2)	High (4)	High	Medium-low (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (2)	Medium (3)	High	Low (-)
Base-load power generation with hydropower long tunnel and power line alternative 3							

Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (2)	High (4)	High	Medium-low (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (2)	Medium (3)	High	Low (-)
Cumulative Impact – Loss of faunal habitat in sensitive areas resulting in a lower carrying capacities and decrease in faunal species within the study area. Loss of forging grounds for far ranging species, forcing them to forage over greater distances.							
Impact on faunal diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	Local (2)	Medium term (2)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
Peak power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Peak power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Base-load power generation and with hydropower short tunnel and power line alternative 1							
Without Mitigation	Local (2)	Medium term (2)	High (4)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
Base-load power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Base-load power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Cumulative Impact – Infrastructure placed in areas of high diversity will result in negative impacts on faunal species within the study area, resulting in an overall decrease in faunal diversity.							
Impact on species of conservational concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	Site (1)	Medium term (2)	High (5)	High (5)	High (4)	High	Medium-high
With Mitigation	Site (1)	Short term (1)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
Peak power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Peak power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Site (1)	Medium	Medium	Medium (3)	Medium (3)	High	Low

		term (2)	(3)				(-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Base-load power generation and with hydropower short tunnel and power line alternative 1							
Without Mitigation	Site (1)	Medium term (2)	High (5)	High (5)	High (4)	High	Medium-high (-)
With Mitigation	Site (1)	Short term (1)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
Base-load power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Base-load power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Cumulative Impact – A decrease in protected faunal species numbers within the study area contributes to a lower regional/ national population number. With regard to endangered species, the loss or decrease of even a small population places increased stress on species numbers on a regional scale.							

10.1.3 Aquatic ecology

The following key impacts on aquatic ecology have been identified for the construction and decommissioning phases:

10.1.3.1 Loss of aquatic habitat

Impacts due to canalisation and erosion will potentially be caused due to the disturbance of soils, during site clearing and construction, and the alteration of flow regimes in the Tsitsa River.

Recommended mitigation

- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of clean water runoff areas and the concomitant recharge of streams in the area;
- Ensure that all stockpiles are well managed and have measures such as berms and hessian sheets implemented to prevent erosion and sedimentation;
- Through ensuring that good construction practice is followed in terms of the clearing of areas, such as the use of water control berms and clearing footprint areas that are as small as possible, the severity of the impact can be reduced.
- During construction the maintenance of baseflows in the system must be maintained at all times and the duration of impacts on flows should be limited to as short a period as possible.

10.1.3.2 Impact on flow dependant species, loss of aquatic biodiversity, and impact on species with conservation concern

Impacts on flow will mostly pertain to general construction activities and baseline flow as effected through the Lalini Dam tunnel. Impacts on diversity will mostly pertain to habitat alteration and flow alteration as effected through the Lalini Dam tunnel. These effects have been discussed with reference to dam impact. Construction of the electricity generation and distribution phases will have lower impact compared to that associated with the dams due to the smaller scale of both activity and potential impact. It must however be noted that the further the tunnel daylights from the Lalini dam wall the larger the impact on the instream ecology will be.

Recommended mitigation

- Limit the footprint area of the construction activity to what is absolutely essential;
- During construction the maintenance of baseflows in the system must be maintained at all times and the duration of impacts on flows should be limited to as short a period as possible.

10.1.3.3 Assessment of impacts on aquatic ecology during the construction and decommissioning phases

Loss of aquatic habitat	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (3)	High (4)	High	Low (-)
Proposed Project with Lalini Dam hydroelectric generation site 1 (near falls) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Low (-)
Proposed Project with Lalini Dam hydroelectric generation site 2 (medium range) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Low (-)
Proposed Project with Lalini Dam hydroelectric generation site 3 (furthest from falls largest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Low (-)
Cumulative Impact and Comments– Construction of the development will have temporary impact that could be mitigated to some extent.							
Impact of flow dependant species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)

Proposed Project with Lalini Dam hydroelectric generation site 1 (nearest to falls lowest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
Proposed Project with Lalini Dam hydroelectric generation site 2 (midway option) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
Proposed Project with Lalini Dam hydroelectric generation site 3 (furthest from falls largest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
Cumulative Impact and Comments– Construction of the development will have temporary impact that could be mitigated to some extent.							
Loss of aquatic biodiversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
Proposed Project with Lalini Dam hydroelectric generation site 1 (nearest to falls lowest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
Proposed Project with Lalini Dam hydroelectric generation site 2 (midway option) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
Proposed Project with Lalini Dam hydroelectric generation site 3 (furthest from falls largest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
Cumulative Impact and Comments– Construction of the development will have temporary impact that could be mitigated to some extent.							
Impact on species with conservation concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)
Proposed Project with Lalini Dam hydroelectric generation site 1 (nearest to falls lowest generation potential) and							

associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)
Proposed Project with Lalini Dam hydroelectric generation site 2 (midway option) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)
Proposed Project with Lalini Dam hydroelectric generation site 3 (furthest from falls largest generation potential)							
High	Local (2)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)
Cumulative Impact and Comments– Construction of the development will have temporary impact that could be mitigated to some extent.							
Please note that reference to the respective hydroelectric generation projects also considers impact from associated power lines and the Lalini Dam tunnel.							

10.1.4 Wetlands

The following key impacts on wetlands have been identified for the construction phase:

The construction of power lines is considered to be a moderately low risk activity in terms of wetland and riparian habitat conservation. The primary concern associated with this activity is the placement of support towers. Care should be taken to ensure that these structures are not placed within wetland or riparian habitat, or within their respective buffer zones. As with the construction of the pipelines, should it be necessary to place pylons within wetland habitat, it is highly recommended that these structures be placed outside of the active channels (in the case of the drainage lines or channelled valley bottom wetland features), in order to minimise the impacts on the hydrology of these systems.

Mitigation measures for these impacts are given below.

10.1.4.1 Loss of wetland / riparian habitat and ecological structure

Recommended mitigation:

- Careful planning of the placement of the pylons taking into consideration the sensitivity map (**Figure 77**) must be undertaken prior to commencing construction. Support towers for power lines should not be placed within sensitive wetland / riparian habitat;
- Construction vehicles must not be permitted to drive through wetland / riparian habitat, and must remain on designated roads; and
- Edge effects of construction, such as proliferation of alien vegetation and increased sedimentation due to soil disturbances must be strictly controlled, particularly in the vicinity of wetland resources, in order to minimise the loss of wetland habitat.

10.1.4.2 Loss of wetland / riparian ecoservices

Recommended mitigation:

- Construction vehicles must not be permitted to drive through wetland / riparian habitat, and must remain on designated roads; and
- Edge effects of construction, such as proliferation of alien vegetation and increased sedimentation due to soil disturbances must be strictly controlled, particularly in the vicinity of wetland resources, in order to minimise the loss of wetland habitat.

10.1.4.3 Impacts on wetland / riparian hydrology and sediment balance

Recommended mitigation:

- Planning of the placement of the infrastructure, utilising the sensitivity map (**Figure 77**) is essential, in order to prevent the placement of pylons within sensitive wetland habitat, particularly within active channels of drainage lines, channelled valley bottom wetlands and active river channels; and
- Strict control of edge effects of the construction of the power line infrastructure must be implemented in order to minimise sedimentation and erosion as a result of vegetation clearing and disturbances to the soil profile.

10.1.4.4 Assessment of wetland impacts during the construction and decommissioning phases

Loss of wetland / riparian habitat and ecological structure	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower tunnel and power line alternative 1							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Peak power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Peak power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation and with hydropower tunnel and power line alternative 1							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)

Base-load power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)

Cumulative Impact:

- Loss of wetland / riparian habitat will lead to an overall reduction in biodiversity and functionality of the wetlands / riparian areas.

Loss of wetland / riparian ecoservices	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower tunnel and power line alternative 1							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Peak power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Peak power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation and with hydropower tunnel and power line alternative 1							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)

Cumulative Impact:

- Loss of ecological service provision arising from alteration or loss of habitat leading to increased erosion and sedimentation of the wetland / riparian features;
- Habitat alteration or loss arising during construction activities leading to a decreased capacity to support a variety of wetland faunal and floral species;
- Proliferation of alien vegetation due to soil disturbances during construction leading to altered habitat, thus a reduction in the ability of the wetland / riparian features to provide essential ecological services.

Impacts on wetland / riparian hydrology and sediment balance	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower tunnel and power line alternative 1							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low

							(-)
Peak power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Peak power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation and with hydropower tunnel and power line alternative 1							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Cumulative Impact: • Poor planning, leading to placement of pylons within wetland / riparian areas, leading to altered flow patterns within active channels; • Altered hydrology as a result of the above, leading to increased incision of channels, and increased sedimentation of the system as a result.							

10.1.5 Water quality

Some impacts on water quality may occur during the construction and decommissioning phases. These have to do with possible contamination of the river by construction materials. These occurrences are governed by the National Water Act, and as long as this is adhered to, the effect will be minimal. This applies to the proposed Lalini Dam site.

10.1.5.1 Assessment of water quality impacts during the construction and decommissioning phases

Contamination by construction materials	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower tunnel and power line alternative 1							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium –Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Peak power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	Regional	Medium	Medium	Medium	High	Medium	Medium -Low

		term					(-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Peak power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium -Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Base-load power generation and with hydropower tunnel and power line alternative 1							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium -Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Base-load power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium -Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Base-load power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium -Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Cumulative Impact – *Additional loss of in stream and riparian habitat may occur downstream of the two dams.*							

10.1.6 Heritage resources

No significant impacts on heritage have been identified.

A walkdown to identify potential heritage resources affected by the power line must be undertaken once the power line route has been finalised and exact locations of towers are known.

10.1.7 Visual

Alteration to the sense of place is considered the most important visual impact.

Recommended mitigation:

- Alternative 1 (closest to the Tsitsa Falls) should be avoided as it will have a high negative impact on the sense of place of the Tsitsa Falls and associated valley.
- It is recommended that Alternative 3 (furthest from the Falls) be selected but re-aligned to drop below the ridge line into the adjacent valley where it will have the valley sides to provide a backdrop and reduce the silhouette image against the skyline.

10.1.7.1 Assessment of visual impacts during the construction and decommissioning phases

Aesthetics	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Power line 1							
Without Mitigation	Regional	Long term	High	High	Definite	Medium	Very High (-)
With Mitigation	Regional	Long term	High	High	Definite	Medium	Very High (-)
Proposed Power line 2							
Without Mitigation	Regional	Long term	High	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	High	Medium	Definite	Medium	Medium-Low (-)
Proposed Power line 3							
Without Mitigation	Regional	Long term	High	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	High	Medium	Definite	Medium	Low (-)
Cumulative Impact –the cumulative impact is high as this introduces a transmission into an environment that there previously had not been one. he impact on the sense of place is by Alternative 3 is regarded as high in that the transmission line and associated infrastructure will visually alter the entire valley and is of very high significance due to the impact on the nearby Tsitsa Falls. The significance of Alternative 2 is considered to be medium in that there will still be an impact on the valley bottom but it does not impact on the Tsitsa Falls.							

10.1.8 Social

In undertaking the social impact assessment consideration was given to all project components (i.e. dams and associated infrastructure, electricity generation and distribution as well as the road infrastructure) in **Chapter 9** as, on a social level, these activities cannot be seen in isolation. The extent of the project is such that it is important to consider the demographic, economic, social and cultural change processes associated across the entire project on a cumulative basis rather than various components in isolation. The specific issues associated with the construction of the electricity generation and distribution components of the project are addressed here.

One dwelling has been identified as being within 5 m of the Lalini Hydro Pipeline construction servitude. This dwelling lies close to the intersection of where the pipeline meets the tunnel and is located north of the pipeline at a slightly lower elevation than that of the pipeline. This is likely to result in relatively high impacts during construction, and the risk of flooding in the event of a ruptured pipe during operation, both of which must be considered.

Recommended mitigation:

It seems that there may be some scope to move the pipeline and tunnel junction further west or south, where there are no dwellings, which is the socially preferred option.

10.1.9 Economics

10.1.9.1 Impact on economic growth and poverty alleviation

The economic impact of the construction phase relates mainly to value added to GDP as well as employment and the benefit to the local rural community.

The three different tunnels and power line alternatives were considered and the worst-case scenario was run in the model so that the other scenarios will only improve on this impact.

Recommended mitigation:
The construction phase will provide short term employment and mitigation measures can be set so that the local community benefit in the form of payments to households and an increase in expenditure in the region. Payments to households refer to the circular flow of income in an economy thus, an increase in payments to households result in an increase in expenditure on goods and services for a specific region, promoting economic growth of that region.

10.1.9.2 Assessment of economic impacts during the construction phase

Impact on GDP and low-income households	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Construction of tunnel at the proposed Lalini Dam – Impact on GDP							
Without Mitigation	Regional	Short term	Low	Low	Low	Medium	Very low (+)
With Mitigation	Local	Short term	Medium	Low	High	High	Low (+)
Construction of tunnel at the proposed Lalini Dam – Impact on low-income households							
Without Mitigation	Regional	Short term	Low	Low	Low	Medium	Very low (+)
With Mitigation	Local	Short term	Medium	Low	High	High	Low (+)
Construction of hydro-power scheme – Impact on GDP							
Without Mitigation	Provincial	Short term	High	Medium	High	Medium	Medium-high (+)
With Mitigation	Regional	Short term	Very high	Low	Definite	High	Medium-high (+)
Construction of hydro-power scheme – Impact on low-income households							
Without Mitigation	Provincial	Short term	High	Medium	High	Medium	Medium-high (+)
With Mitigation	Regional	Short term	Very high	Low	Definite	High	Medium-high (+)
Cumulative Impact – during the peak of the construction of the tunnel and power lines, 593 direct employment opportunities will be created in the national economy with another 288 indirect and 427 induced jobs. Of the direct jobs an estimated 265 will be semi-skilled and 203 low-skilled and which probably most will be recruited from the local community if mitigation is set in place. During the peak of the construction of the hydro-power scheme, 712 direct employment opportunities will be created in the national economy with another 283 indirect and 529 induced jobs. Of the direct jobs an estimated 311 will be semi-skilled and 252 low-skilled of which probably most will be recruited from the local community if mitigation is set in place. There is also a positive impact on the Gross Domestic Product to the value of R362 million. Low income households also receive a total of R39 million out of a total of R237 million of the total impact on households.							

10.2 OPERATION PHASE

10.2.1 Plants

10.2.1.1 Impact on habitat for floral species, floral diversity and important and protected floral species

During the operational phase, power line maintenance and servicing will take place. No major impacts are expected, should rehabilitation of the areas affected by construction have been effective.

All three power line alternatives traverse habitat that is associated with disturbance such as overgrazing and trampling of veld by livestock, bush encroachment and proliferation of alien and invader floral species. However, sections of the power line and hydropower tunnels traverse mountain / afromontane forest habitat. The floral diversity within this habitat unit is high and needs to be maintained during the operational phase, especially larger sections in alternatives 1 and 3, traversing sensitive habitat and possible protected tree species.

With the implementation of mitigation measures the impact of power line alternatives 1 and 3 can be decreased to low significance and alternative 2 to a very low significance. The impact of loss of species diversity within the transformed habitat unit is expected to be of low significance.

Recommended mitigation

- Alien and invasive species must be eradicated and controlled to prevent their spread beyond the power line servitude and ensure that indigenous floral habitat is not lost. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled.
- Ensure that operational and maintenance related activities are kept strictly within the development footprint of the power line.
- During the maintenance of the access road, all vehicles should travel on the designated road to limit the ecological footprint and reduce further degradation or loss of floral habitat.

10.2.1.2 Assessment of floral impacts during the operation phase

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low (-)
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)

With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	1 (Low)	2 (Low)	High	Very low (-)
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low (-)

Residual Impact :

- Proliferation of alien and weed species in disturbed areas will lead to altered vegetation communities within the power line.
- Loss of floral habitat may lead to altered floral biodiversity.
- Ineffective rehabilitation may lead to permanent transformation of floral habitat.

Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low (-)
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	1 (Low)	2 (Low)	High	Very low (-)
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low (-)

Residual Impact:

- Permanent loss of floral diversity within areas where construction has taken place.
- Alien and invasive species proliferation and bush encroachment into disturbed areas.
- Ineffective rehabilitation may lead to permanent loss of floral biodiversity.

Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low (-)
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	2 (Low)	High	Low (-)
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low (-)
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	2 (Low)	High	Low (-)

Residual Impact:

- A decrease in medicinal or protected and important floral species diversity may lead to a loss of species richness over time within the region.

10.2.2 Animals

The following key impacts on fauna have been identified for the operation phase:

10.2.2.1 Impact on faunal habitat

The operational phase will have a marked decrease in impacts on the faunal habitat, more so if mitigation measures were implemented correctly during the construction phase. The functioning of the hydropower tunnel will have a very minimal effect on faunal habitat, and will the associated power lines. However impact will occur from the access roads to check and maintain the infrastructure, and this needs to be taken into consideration during this phase.

Recommended mitigation:

- Restrict vehicles to designated roadways to limit the ecological footprint of the proposed development activities as well as to reduce the possibility of collisions;
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity; and
- Rehabilitate and naturalize areas beyond the development footprint, which have been affected by the construction activities, using indigenous grass species.

10.2.2.2 Impact on faunal diversity

If the mitigation measures are correctly implemented during the construction phase, there should be minimal long term impacts during the operational phase. It may however be necessary to place bird flappers/ diverters on the power lines to help mitigate avifaunal collisions with overhead transmission lines.

Recommended mitigation:

- All informal fires in the vicinity of operational areas should be prohibited;
- Edge effects of all operational activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity;
- Should any RDL or other common faunal species be found within the development footprint area, these species should be relocated to similar habitat within the vicinity of the study area with the assistance of a suitably qualified specialist; and
- Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

10.2.2.3 Impact on faunal species of conservational concern

Operational activities infringing into and impacting upon areas that are known to provide habitat to RDL and protected species must be limited to minimal levels.

Access and maintenance roads passing through sensitive faunal habitat areas needs to be kept to a minimum, as these areas are utilised by RDL and protected species. Avifaunal species, (cranes and raptors) are prone to collision induced mortalities due to overhead cable. This needs to be taken into consideration to mitigate these impacts during the operational phase of the project.

Recommended mitigation:

- In the rocky outcrops and mountain bushveld habitat, bird flappers/ diverters must be installed on overhead power lines to help minimise bird strikes and subsequent mortalities;
- Edge effects of all operational activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity;
- Should any RDL faunal species or species of conservational concern be found within the operational footprint area, these species must be relocated to similar habitat within the vicinity of the study area with the assistance of a suitably qualified specialist;
- The proposed operational footprint areas should remain as small as possible and where possible be confined to already disturbed areas; and
- Vehicles must be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

10.2.2.4 Assessment of faunal impacts during the operation phase

Impact on faunal habitat	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	Site (1)	Long term (3)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Long term (3)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Peak power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Site (1)	Long term (3)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Long term (3)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Peak power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Site (1)	Long term (3)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Long term (3)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Base-load power generation and with hydropower short tunnel and power line alternative 1							
Without Mitigation	Site (1)	Long term (3)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Long term (3)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Base-load power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Site (1)	Long term (3)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Long term	Low (2)	Low (1)	Low (2)	High	Very-low

		(3)					(-)
Base-load power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Site (1)	Long term (3)	Medium (3)	Medium (3)	Medium (3)	High	Medium-low (-)
With Mitigation	Site (1)	Long term (3)	Low (2)	Low (1)	Low (2)	High	Very-low (-)
Cumulative Impact –							
Impact on faunal diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Peak power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Peak power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Base-load power generation and with hydropower short tunnel and power line alternative 1							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Base-load power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Base-load power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Cumulative Impact –							
Impact on species of conservational concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Peak power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Peak power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Site (1)	Long term	Low (2)	Medium (3)	Low (2)	High	Low

		(3)					(-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Base-load power generation and with hydropower short tunnel and power line alternative 1							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Base-load power generation with hydropower medium tunnel and power line alternative 2							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Base-load power generation with hydropower long tunnel and power line alternative 3							
Without Mitigation	Site (1)	Long term (3)	Low (2)	Medium (3)	Low (2)	High	Low (-)
With Mitigation	Site (1)	Long term (3)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Cumulative Impact –							

10.2.3 Aquatic ecology

The following key impacts on aquatic ecology have been identified for the operation phase:

10.2.3.1 Loss of aquatic habitat

The section directly below the dam wall up to the dam discharge point will only experience controlled base flow conditions that would lead to loss of the waterfall habitat as well as loss of seasonal natural flow fluctuation events that will affect availability of especially riffle and rapid habitats. Peak flow will result in daily changes in habitat availability, whilst seasonal peak flow (winter only) will result in seasonal variations in habitat availability. Both scenarios will have a high to medium-high impact, with the latter option restricting impact to a single season.

Water released from the Lalini Dam, if not correctly designed can lead to severe erosion and canalisation of the system at the point where the discharge from the Lalini Dam enters the river. This impact can be significant on a site to local scale in terms of river modification and habitat loss, with the potential to affect the hydrological functioning and biodiversity of riverine and wetland systems on a local to regional scale. The closer to the dam wall the pipeline enters the river, the shorter the section subjected to reduced instream flow will be. These impacts have been discussed previously with reference to the operational phase of the dams (**Chapter 9**).

The section directly below the dam wall up to the dam discharge point will only experience controlled base flow conditions at most times that would lead to loss of the waterfall habitat as well as loss of seasonal natural flow fluctuation events that will affect availability of especially riffle and rapid habitats. It must be noted that although the impact significance for each of the alternative tunnel lengths was classified as being the same, the further from the dam wall water is re-introduced to the system the larger the impact on flow dependent species and on the Tsitsa River will be due altered instream flows.

Recommended mitigation

- The EWR defined for the Tsitsa system must be maintained at all times.
- The discharge point and discharge structure must be designed and positioned in a way that would minimise incision, erosion and changes to instream habitat structures.
- The infrastructure should be adequately maintained to retain the smallest footprint possible and prevent post construction impacts on the local instream habitat due to a lack of infrastructure maintenance.
- An investigation must be undertaken by a qualified specialist to determine whether any waterfall dependant plants in the gorge and on the cliff could be significantly impacted and whether they require relocation; and findings of the investigation must be implemented

10.2.3.2 Impact on flow dependant species

Abstraction for agricultural and other purposes from Ntabelanga Dam, will negatively affect the amount of water for release and hence flow in the river section between the Ntabelanga and Tsitsa Dams. Even with the base- and peak flow regimes in operation at Lalini Dam, the river section between the dam wall and entry point of the discharge pipe will experience low flows at most times which may affect some more sensitive taxa. As discussed in the section above there will be an impact on the aquatic community downstream of the dam due to the impacts altered streamflow regimes.

With an altered flow regime the river system, this section may be subjected to excessive vegetation growth or silting over the long term which will negatively affect flow-dependant species. Daily peak energy generation will lead to drastic daily fluctuations in flow rate that will also negatively affect flow-sensitive species and a change in the natural aquatic macro-invertebrate community structure is deemed highly likely. For this reason peak generation is not deemed appropriate.

Recommended mitigation:

- The infrastructure should be adequately maintained to retain the smallest footprint possible and minimise post construction impacts on local habitat.
- The EWR defined for the Tsitsa system must be maintained at all times.

10.2.3.3 Loss of aquatic biodiversity

Permanent alteration of natural flow rates and habitat will negative affect aquatic biodiversity with specific reference to macro-invertebrates and riparian vegetation.

Potential loss of biodiversity, with particular reference to mayflies from the order *Ephemeroptera*, will mostly pertain to habitat alteration and flow alteration as effected through the Lalini Dam tunnel. These effects have been discussed with reference to dam impact (**Chapter 9**). Construction of the electricity generation and distribution phases will have lower impact compared to that associated with the dams due to the smaller scale of both activity and potential impact. It must be noted that although the impact significance for each option of the Lalini dam was classified as being the same the further from the dam wall water is re-introduced to the system the larger the impact on the Tsitsa River due altered instream flows.

Recommended mitigation:

- The EWR defined for the Tsitsa system must be maintained at all times.
- The infrastructure should be adequately maintained to retain the smallest footprint possible and minimise post construction impacts on local habitat.

10.2.3.4 Impact on species with conservation concern

This impact pertains mainly to eel migration and presence of endemic mayflies. With the two dams situated between two waterfalls and hence geographically isolated, the area is likely to contain several macro-invertebrate species of conservation concern. The impact associated with the operational phase will be permanent and the only mitigation measures applicable relate to the flow regime.

Recommended mitigation:

- The EWR defined for the Tsitsa system must be maintained at all times.

10.2.3.5 Assessment of impacts on aquatic ecology during the operation phase

Loss of aquatic habitat due to changes in flow regime	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-high
Lalini Dam Base generation only							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-high
Lalini Dam Peak time generation							
Without Mitigation	Local (2)	Permanent –	High (4)	High (5)	Definite (5)	High	High

		with mitigation (4)					
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-high
Lalini Dam Base generation in summer and Peak in winter							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	High (4)	High (5)	Definite (5)	High	High
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-high
Cumulative Impact and Comments – Base generation will preclude natural seasonal variation in flow to some degree, which may include scouring of the system to maintain riffle and rapid habitats and alter breeding ques. Absence of such events will lead to long-term loss of certain habitat types and the associated aquatic biota. Peak flow will result in daily variations in habitat availability. Seasonal peak flow will restrict such variations to one season (winter) only. Mitigation measures with reference to individual peak flow regimes are not possible, with mitigation effect value of each option to be evaluated individually as part of the EWR assessment.							
Impact on flow dependant species due to changes in flow regime	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	High (4)	Medium (3)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Lalini Dam Base flow only and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	High (4)	Medium (3)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Lalini Dam Peak time generation and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	High (4)	Medium (3)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Lalini Dam Base flow in summer and Peak in winter and associated infrastructure							
Without Mitigation	Regional (3)	Permanent – with mitigation (4)	High (4)	Medium (3)	Definite (5)	High	High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Cumulative Impact and Comments – Baseline flow only will alter natural variation in flow. peak energy generation is not considered							

appropriate for this system. The Lalini Dam section below the dam wall up to where the discharge pipe enters will experience constant significantly altered flow regimes. This will result in permanent changes in flow in this river segment as well seasonal variation in flow. Upstream, flow will be permanently disrupted due to inundation. It is essential that the Ntabalanga and Lalini dams be managed conjunctively to ensure that EWR's are met and natural discharge patterns are accurately simulated.							
Loss of aquatic biodiversity due to changes in flow regime	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Lalini Dam Base generation only and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Lalini Dam Peak time generation and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Lalini Dam Base generation in summer and Peak generation in winter and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with no mitigation (5)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
Cumulative Impact and Comments – Both changes in habitat modification as well as flow regime will be permanent. Mitigation measures, either in terms of base flow or variation in flow when employing a peak generation, will result in constant impact that would preclude species sensitive to either habitat or flow suitability. Decrease in biodiversity is deemed unavoidable.							
Impact on species of conservation concern due to changes in flow regime	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	Medium (3)	High	Medium-Low (-)
Lalini Dam Base generation only and associated infrastructure							

Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	Medium (3)	High	Medium-Low (-)
Lalini Dam Peak time generation and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	Medium (3)	High	Medium-Low (-)
Lalini Dam Base generation in summer and Peak generation in winter and associated infrastructure							
Without Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	High (4)	High	Medium-High (-)
With Mitigation	Local (2)	Permanent – with mitigation (4)	Medium (3)	Medium (3)	Medium (3)	High	Medium-Low (-)
Loss of aquatic habitat due to electrical infrastructure	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 1 (nearest to falls lowest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 2 (midway option) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 3 (furthest from falls largest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Impact on flow dependant species due to electrical infrastructure	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance

Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 1 (nearest to falls lowest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 2 (midway option) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 3 (furthest from falls largest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	High (4)	High	Medium-Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Residual Impact and Comments– Construction of the development will have temporary impact that could be mitigated to some extent.							

Loss of aquatic biodiversity due to electrical infrastructure	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 1 (nearest to falls lowest generation potential) and associated infrastructure							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 2 (midway option) and associated infrastructure							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 3 (furthest from falls largest generation potential) and associated infrastructure							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
Residual Impact and Comments– Construction of the development will have temporary impact that could be mitigated to some extent.							

Impact on species with conservation concern due to electrical infrastructure	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Ntabelanga Dam and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 1 (nearest to falls lowest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 2 (midway option) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)
Lalini Dam hydroelectric generation site 3 (furthest from falls largest generation potential) and associated infrastructure							
Without Mitigation	Local (2)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)
Residual Impact and Comments– Construction of the development will have temporary impact that could be mitigated to some extent.							
Please note that reference to the respective hydroelectric generation projects also considers impact from associated power lines and the Lalini Dam tunnel.							

10.2.4 Wetlands

10.2.4.1 Loss of wetland / riparian habitat and ecological structure, loss of wetland / riparian habitat ecoservices and impacts on wetland / riparian hydrology and sediment balance

Release of water in the generation tunnels, and maintenance of the power line infrastructure will be the primary impacting factors on wetland / riparian habitat during the operational phase. Species composition and community structure of riparian vegetation may be influenced by the release of water in the generation tunnels if the EWR is not managed properly.

Recommended mitigation:

- The Ecological Water Requirements (EWR) as set out in the Reserve Determination Volume 1: River (Report P WMA 12/T30/00/5212/7) for the Ntabelanga Dam, and the EWR determined for the Lalini Dam, must be adhered to;
- Maintenance vehicles must remain on designated roads, and must not be permitted to traverse wetland / riparian habitat; and

- Maintenance personnel must ensure that any tools and/or waste products resulting from maintenance activities are removed from the site following completion of maintenance.

10.2.4.2 Assessment of wetland impacts during the operation phase

Loss of wetland / riparian habitat and ecological structure, loss of wetland / riparian habitat ecoservices, and impacts on wetland / riparian hydrology and sediment balance	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower tunnel and power line alternative 1							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Peak power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-Low
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Peak power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-Low
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation and with hydropower tunnel and power line alternative 1							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-Low
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-Low
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Base-load power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	1 (site)	1 (Short)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-Low
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Cumulative Impact: • Periodic disturbances to vegetation and soil profile in the immediate vicinity of each pylon during maintenance activities leading to altered wetland vegetation community structure and species composition, and increased sedimentation. • Periodic disturbances to the soil profile and natural wetland / riparian vegetation as a result of routine maintenance activities leading to reduced ability to provide essential wetland ecological services such as flood attenuation, sediment trapping and erosion control, etc.							

10.2.5 Water quality

The main impact during operation relates to water quality changes (temperature) in the river downstream of the proposed hydropower plant outlet.

10.2.5.1 Assessment of water quality impacts during the operation phase

Water quality changes (Temperature)	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower tunnel and power line alternative 1							
Without Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Peak power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Peak power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Base-load power generation and with hydropower tunnel and power line alternative 1							
Without Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Base-load power generation with hydropower tunnel and power line alternative 2							
Without Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Base-load power generation with hydropower tunnel and power line alternative 3							
Without Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Cumulative Impact – *The increase in water temperature from the outlet is negligible and does not require any mitigation.*							

10.2.6 Heritage resources

This section is not applicable, since impacts on heritage resources will be confined entirely to the construction phase.

10.2.7 Visual

Alteration to the sense of place is considered the most important visual impact.

10.2.7.1 Assessment of visual impacts during the operation phase

Aesthetics	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Power line 1							
Without Mitigation	Regional	Long term	High	High	Definite	Medium	Very High (-)
With Mitigation	Regional	Long term	High	High	Definite	Medium	Very High (-)
Proposed Power line 2							
Without Mitigation	Regional	Long term	High	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	High	Medium	Definite	Medium	Medium-Low (-)
Proposed Power line 3							
Without Mitigation	Regional	Long term	High	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	High	Medium	Definite	Medium	Low (-)
Cumulative Impact –the cumulative impact is high as this introduces a transmission into an environment that there previously had not been one. The impact on the sense of place is by Alternative 1 is regarded as high in that the transmission line and associated infrastructure will visually alter the entire valley and is of very high significance due to the impact on the nearby Tsitsa Falls. The significance of Alternative 2 is considered to be medium in that there will still be an impact on the valley bottom but it does not impact on the Tsitsa Falls.							

10.2.8 Social

In undertaking the social impact assessment consideration was given to all project components (i.e. dams and associated infrastructure, electricity generation and distribution as well as the road infrastructure) in **Chapter 10** as, on a social level, these activities cannot be seen in isolation. The extent of the project is such that it is important to consider the demographic, economic, social and cultural change processes associated across the entire project on a cumulative basis rather than various components in isolation. The specific issues associated with the operation of the electricity generation and distribution components of the project are addressed here.

The generation and transmission of electricity will result in electromagnetic fields within close proximity of the power lines. Although well documented, this issue remains somewhat controversial with little agreement amongst authorities regarding the actual risk that electromagnetic fields pose to the health of people and animals.

Although it is difficult to establish the real dangers of exposure to electromagnetic fields, what is clear is that people, at least perceive this as a risk to health, and that in turn this may also cause secondary health risks brought about due to elevated stress levels. It is in this sense that this impact is assessed here as associated with the electricity generation and distribution related activities.

10.2.8.1 Assessment of social impacts during the operation phase

Electromagnetic radiation	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Regional	Medium term	High	Medium	Definite	Medium	High
With Mitigation	Negative	Regional	Medium term	Medium	Medium	Definite	Medium	Medium-high
Cumulative Impact – It has been established that the rate of cancer in the area is six times that of the national rate (Sewram, 2011) and any additional risks could compound the situation.								

10.2.9 Economics

10.2.9.1 Impact on economic growth and poverty alleviation

The economic impact of the operational phase relates to the benefit added to GDP.

Recommended mitigation:

Mitigation measures that can be taken relate mainly to proper management structures.

10.2.9.2 Assessment of economic impacts during the operation phase

Benefit to GDP	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Generation of hydro-power – Benefit to GDP							
Without Mitigation	Regional	Permanent – No mitigation	High	High	Medium	Medium	Medium- high (+)
With Mitigation	Provincial	Permanent – Mitigated	Very high	Medium	High	High	High (+)

Cumulative Impact – the value of the hydro-power can then be addressed in the following way. The output multiplied with the Eskom price, where price is the tariff together with cost of the water provision.

Our approach is then:

- Output – 281.896 million kWh,-
- The tariff is R0.61 per kWh plus the levelled cost at 8% discount of R0.94 per kWh = R1.61/kWh;
- Total value of = R453.85 million per annum.

The potential for irreplaceable loss of resources is high without mitigation, there will be unrecoverable capital lost if the hydro-power scheme is not managed properly.

11. IMPACT ASSESSMENT FOR ROADS INFRASTRUCTURE

This Chapter presents the findings of the environmental impact assessment for the road infrastructure (DEA Ref no. 14/12/16/3/3/1/1169).

The activities included under this chapter are listed below:

- Upgrading and relocation of roads and bridges; and
- Construction of new access roads around the Lalini Dam site.

11.1 CONSTRUCTION AND DECOMMISSIONING PHASES

11.1.1 Plants

11.1.1.1 Impact on habitat for floral species and floral diversity

The roads to be upgraded are existing roads, some of which will serve as access roads to the dams. The road upgrades are mostly in the Ntabelanga Dam study area. Overgrazed veld and surrounding community villages 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 existing roads. The impact of further transformation of floral habitat will be very low, should all possible mitigation measures be implemented.

Other areas of the road upgrades are located within the higher altitude areas. Indigenous species such as *Aloe marlothii, Aloe ferox* and *Aloe aborescence* occur alongside the current road. These areas are more sensitive than the transformed vegetation areas. Therefore mitigation measures must be implemented to ensure that the impact is kept as small as possible.

The majority of the proposed new access roads in the Lalini Dam area 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 however 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.

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, especially in the rocky outcrops and Mountain / afromontane forest sections close to the dam wall. Several medicinal species are also located within this habitat unit. It will be very important to implement effective rehabilitation and prevent collection of indigenous vegetation used for medicinal purposes within these areas by construction workers to ensure that the diversity of floral species within the rocky and mountain areas are maintained.

The proposed access road to the hydropower plant 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. The impact on the immediate and surrounding area of the proposed road is very high. This route is thus not recommended due to the high impacts and loss of floral habitat and diversity. The hydropower plant site is however surrounded by this habitat area and no alternative access that avoids the impact is possible.

Alien proliferation alongside the roads is also a concern. Disturbances of the ground through excavations often lead to the dominance of alien pioneer species that rapidly monopolise the area. Invader alien plants can significantly alter the composition, structure and functionality of ecosystems. As a result, they degrade the productive potential of the land; intensify the damage caused by veld fires and flooding, increase soil erosion, and impact on the health of rivers and estuaries. Indigenous species may be reduced in numbers/coverage, or may be lost as a result of alien plant infestation.

Recommended mitigation

- Alien and invasive species should be eradicated and controlled to prevent their spread beyond the road upgrade footprint.
- Erosion needs to be strictly managed.
- Areas falling outside of the footprint area of the road upgrade and affected by construction should be rehabilitated with indigenous grass species. Eroded areas, especially in around the wetland crossings should also be addressed, as per the wetland assessment mitigation measures. All rehabilitated areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated.
- A walk-down of the areas impacted by the access road to the hydropower plant and haul roads must be undertaken before clearing. Search and rescue of indigenous vegetation must be undertaken by a suitably qualified specialist. Floral species needs to be relocated to similar habitat types, outside of infrastructure footprint areas.

11.1.1.2 Impact on important and protected floral species

Podocarpus falcatus and *P. latifolius* were located alongside the road upgrade 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 under the National Forests Act, 1998 (Act No. 84 of 1998). 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 road upgrade and new roads located within the Lalini Dam area, especially in the Mountain / afromontane forest sections close to the dam wall.

The proposed access road to the hydropower plant will be constructed within a highly sensitive habitat area, and will impact on habitat for protected tree species and other important and RDL floral species such as *Encephalartos* species. This route is thus not recommended due to the high impacts and loss of floral habitat and diversity.

Other medicinal species such as *Aloe* species were located along the road upgrade routes. These species and other species should be relocated, if possible, should they occur within the footprint area of the road upgrade. During construction, collection of these important species by construction workers should be prevented to ensure that the diversity of the species within the area is still maintained. Vehicles used during the construction should also be prevented to drive through areas outside of the footprint area. This will decrease floral habitat, therefore suitable habitat for important species to occur. The impact associated with the loss of the species is considered to be of medium-low significance prior to the implementation of mitigation measures.

Recommended mitigation

- Possible re-alignment of the roads where protected tree species were found, in order to avoid cutting and destroying the trees
- Protected tree species *Podocarpus fulcatus* and *P. latifolius* were located along the sections scheduled for road upgrades. The following must be ensured:
    - Where protected trees will be disturbed, ensure effective relocation of individuals (if possible) to suitable similar habitat.
    - Permit applications must be obtained from relevant authorities.
- Prohibit the collection of plant material for firewood or for medicinal purposes during the construction phase.
- A walk-down of the areas impacted by the access road to the hydropower plant and haul roads must be undertaken before clearing. Search and rescue of indigenous vegetation must be undertaken by a suitably qualified specialist. Floral species needs to be relocated to similar habitat types, outside of infrastructure footprint areas

11.1.1.3 Assessment of floral impacts during the construction phase

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	2 (Medium) term	2 (Low)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (Site)	1 (Short term)	1 (Negligible)	1 (Low)	2 (Low)	High	Very low (-)

Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium) term	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	2 (Medium) term	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
Road construction associated with the Lalini hydropower plant							
Without Mitigation	3 (Regional)	5 (Permanent – no mitigation)	5 (Very high)	5 (High)	5 (Definite)	High	Very high (-)
With Mitigation	2 (Local)	3 (Long) term	5 (Very high)	3 (Medium)	5 (Definite)	High	High (-)
Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	2 (Medium) term	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	2 (Low)	High	Very low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium) term	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	2 (Medium) term	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
Road construction associated with the Lalini hydropower plant							
Without Mitigation	3 (Regional)	5 (Permanent – no mitigation)	5 (Very high)	5 (High)	5 (Definite)	High	Very high (-)
With Mitigation	2 (Local)	3 (Long) term	5 (Very high)	3 (Medium)	5 (Definite)	High	High (-)
Residual Impact: • Loss of floral habitat may lead to altered floral diversity.							
Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium) term	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high (-)
With Mitigation	1 (Site)	2 (Medium) term	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
Road construction associated with the Lalini hydropower plant							
Without Mitigation	3 (Regional)	5 (Permanent – no mitigation)	5 (Very high)	5 (High)	5 (Definite)	High	Very high (-)
With Mitigation	2 (Local)	3 (Long) term	5 (Very high)	3 (Medium)	5 (Definite)	High	High (-)

Residual Impact:
• A decrease in potential medicinal / protected floral species diversity may lead to a loss of species richness over time within the region.

11.1.2 Animals

The following key impacts on fauna have been identified for the construction and decommissioning phases:

11.1.2.1 Impact on faunal habitat, faunal diversity and on faunal species of conservational concern (SCC)

Road infrastructure is not deemed to have any major impact on RDL and protected species within the Ntabelanga Dam study area. The existing roads are not located within sensitive faunal habitat and as such, the upgrading of these roads will have minimal impacts on faunal habitats and on the faunal diversity. Care must be taken to ensure excess water runoff and erosion are controlled, as the soils in the study area are susceptible to erosion. If left unchecked erosion gulleys may form, leading to a further loss of faunal habitat.

Other areas of the road upgrade are located within the higher altitude areas, where indigenous plant species are located, providing suitable habitat to a large diversity of faunal species. These areas are more sensitive than the transformed vegetation area, and as such mitigation measures must be implemented to ensure that the impact is kept as small as possible.

The majority of the proposed new access roads in the Lalini Dam area 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, however, will have a very high impact on the overall loss of faunal habitat, since these mountain areas provide suitable habitat for indigenous and protected faunal species, as well as a large variety of other faunal species. Therefore the construction of these access roads is not recommended and alternative routes should be considered based on the floral sensitivity maps.

The Lalini hydropower plant access road will be constructed within a highly sensitive habitat area, containing a high diversity of faunal species. These areas have the potential to provide habitat to the *Hadogenes* scorpions, a protected scorpion species. This increases the diversity and overall sensitivity of the area. The construction of this road will result in a large portion of faunal habitat and species 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 faunal habitat and faunal species.

Recommended mitigation:

- Any animals found in the development footprint area should be relocated to similar habitat within the vicinity of the study area with the assistance of a suitably qualified specialist;
- Roads must be sloped and berms constructed to deal with surface water run-off in an effective manner so as to mitigate any erosion issues alongside the roadways;
- Where high speed travelling is possible, speed bumps/ berms must be placed across the road to slow moving vehicles;
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, need to be strictly managed in all areas of increased ecological sensitivity;
- No areas falling outside of the project area may be cleared for construction purposes.
- Restrict vehicles to designated roadways to limit the ecological footprint of the proposed development activities as well as to reduce the possibility of collisions; and
- Rehabilitate and naturalise areas beyond the development footprint, which have been affected by the construction activities, using indigenous grass species.

11.1.2.2 Assessment of faunal impacts during the construction phase

Impact on faunal habitat	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades and road realignments associated with the Ntabelanga Dam							
Without Mitigation	Site (1)	Medium term (2)	Low (2)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Negligible (1)	Low (1)	Low (2)	High	Very low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	Definite (5)	High	Medium-high (-)
With Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-low (-)
Road construction associated with the power generated long tunnel (alternative 3)							
Without Mitigation	Regional (3)	Permanent (5)	Very high (5)	High (5)	Definite (5)	High	Very high (-)
With Mitigation	Local (2)	Long term (3)	Very high (5)	Medium (3)	Definite (5)	High	High (-)
Cumulative Impact –Extended habitat loss around the roads through non-management of the project footprint, erosional activities and an increase in alien plant species in the disturbed areas all resulting in a decrease in faunal habitat. Development of roads through sensitive habitat areas will result in a loss of vegetation and faunal habitat.							

Impact on faunal diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades and road realignments associated with the Ntabelanga Dam							
Without Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term	Low (2)	Low (1)	2 (Low)	High	Very low

		(1)					(-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Definite (5)	High	Medium-high (-)
Road construction associated with the power generated long tunnel							
Without Mitigation	3 (Regional)	Permanent (5)	Very high (5)	High (5)	Definite (5)	High	Very high (-)
With Mitigation	Local (2)	Long term (3)	Very high (5)	Medium (3)	Definite (5)	High	High (-)
Cumulative Impact – Erosion and edge effects leading to disturbance of faunal species within the vicinity of the roads being upgraded. Road placement by the Lalini Dam wall area and within the afromontane habitat will result in a high impact on faunal diversity, notably on protected species.							

Impact on species of conservational concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades and road realignments associated with the Ntabelanga Dam							
Without Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Medium (3)	High	Low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	High (5)	Definite (5)	High	High (-)
With Mitigation	Site (1)	Medium term (2)	Medium (3)	Medium (3)	Definite (5)	High	Medium-high (-)
Road construction associated with the power generated long tunnel (alternative 3)							
Without Mitigation	3 (Regional)	Permanent (5)	Very high (5)	High (5)	Definite (5)	High	Very high (-)
With Mitigation	Local (2)	Long term (3)	Very high (5)	Medium (3)	Definite (5)	High	High (-)
Cumulative Impact – Minimal impact will occur to SCC's within the Ntabelanga Dam. Roads through the sensitive faunal habitat areas by the Lalini Dam wall and the proposed hydropower tunnel 3 will have a high impact of SCC's through direct species loss as well as loss of SCC habitat.							

11.1.3 Aquatic ecology

Relocation and upgrading of bridges will have site specific impacts at riverine points of construction. Impacts due to canalisation and erosion will potentially be caused due to the disturbance of soils, during site clearing, and the alteration of flow regimes in the Tsitsa River and tributaries. If effectively mitigated, such impacts will be of short duration and low intensity. It must be noted that many of the crossings will be over small streams of limited ecological importance and sensitivity although due to the limited flow in the systems care must be taken during construction to not adversely affect these systems.

Probable latent impacts on a site specific to local scale thus include:

- Localised erosion (not significant);
- Localised changes to instream and riparian habitat (not significant);

- Localised sedimentation of the system may lead to altered instream habitat (potentially significant);
- Localised changes to instream and riparian habitat (not significant);
- Some localised changes to aquatic and riparian zone community assemblages (not significant).
- Some changes to the hydrology of the system may occur altering instream habitats on a localised scale (not significant).
- Localised changes to instream and riparian habitat and cover types (not significant);
- Some localised changes to aquatic and riparian zone community assemblages (not significant).

Recommended mitigation

- All crossing construction should be undertaken in the low flow season;
- The duration of construction works needs to be kept to the absolute minimum and all project planning must be very well orchestrated to reach this goal;
- The construction infrastructure and coffer dams and stream diversions must at no time lead to upstream ponding and inundation or lead to the constriction of flow and downstream erosion;
- Minimise disturbance of instream and bankside areas and minimise activities in these areas;
- As far as possible keep all instream areas and stream banks off limits to general activity during the construction phase;
- Any construction-related waste must not be placed in the vicinity of any riparian areas;
- Ensure that on-site camp fires are forbidden;
- Edge effects (impacts on areas beyond the construction footprint due to less than desirable care and management) during construction and operation need to be strictly controlled through ensuring good housekeeping and strict management of activities near the stream crossing;
- During construction, drift fences constructed from hessian sheets should be installed at erodible areas to minimise erosion. Silt traps should also be provided to remove sand/silt particles from runoff;
- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise environmental damage;
- Riparian areas that may have been disturbed during construction should be rehabilitated through re-profiling and re-vegetation upon completion of the construction phase;
- Desilt all riparian areas affected by construction activities;
- Re-profiling of the banks of disturbed drainage areas to a maximum gradient of 1:3 to ensure bank stability if necessary;

- Reinforce banks and drainage features where necessary with gabions, reno mattresses and geotextiles;
- During construction care must be taken to disrupt the riparian zone as little as possible to avoid erosion and sediment load into the system. This can be achieved by permitting only essential construction personnel within 32m of all riparian systems.
- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of clean water runoff areas and the concomitant recharge of streams in the area.

11.1.3.1 Assessment of impacts on aquatic ecology during the construction phase

General impact	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Roadways							
Without Mitigation	Local (1)	Short term (1)	Low (2)	Medium (3)	Medium (3)	High	Very low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Medium (3)	Low (2)	High	Very low (-)

11.1.4 Wetlands

The following key impacts on wetlands have been identified for the construction and decommissioning phases:

Existing roads currently traverse some wetland and riparian habitat, and these habitats have already undergone some transformation as a result. The construction of new roads poses a greater threat to the integrity of wetland or riparian habitats in the vicinity of the Lalini Dam where few roads presently exist.

Mitigation measures for these impacts are provided below.

11.1.4.1 Loss of wetland / riparian habitat and ecological structure and impacts on wetland / riparian hydrology and sediment balance

Recommended mitigation:

- Where it is necessary to traverse channelled valley bottom wetlands and riparian habitat, the crossing designs of bridges must ensure that the creation of turbulent flow in the system is minimised, in order to prevent downstream erosion. minimal support pillars should be constructed within the active channels. In order to achieve this all crossings of wetlands should take place at right angles wherever possible;
- If it is absolutely unavoidable that wetland / riparian habitat is affected during the construction of new roads, especially during bridge or culvert construction, disturbance to any wetland crossings must be minimised and suitably rehabilitated. The design of such culverts / bridges should allow for wetland soil

conditions to be maintained both upstream and downstream of the crossing to such a degree that wetland vegetation community structures upstream and downstream of the crossing are maintained. In this regard, special mention is made of:

- The design of such culverts and/or bridges should ensure that the permanent wetland zone should have inundated soil conditions throughout the year extending to the soil surface;
- The design of such culverts and/or bridges should ensure that the seasonal wetland zone should have water-logged soils within 300mm of the soil surface at all times;
- Temporary wetland zone areas should have waterlogged soil conditions occurring to within 300m of the land surface during the summer season;

- Stabilisation of river banks in the vicinity of any bridge crossings over the Tsitsa River or any of its tributaries by either employing one of the individual techniques below or a combination thereof, including:
  - Re-sloping of banks to a maximum of a 1:3 slope or to pre-construction slope;
  - Re-vegetation of re-profiled slopes;
  - Temporary stabilisation of slopes using geotextiles; and
  - Installation of gabions and reno mattresses.
- Construction vehicles must be restricted to designated access roads and should not be permitted to drive through sensitive wetland / riparian habitat;
- Strict controls of edge effects such as proliferation of alien vegetation and increased sedimentation due to disturbances to the soil profile must be implemented;
- Ensure that no incision and canalisation of the wetland system takes place as a result of the construction of the culverts;
- It must be ensured that flow connectivity along the wetland features is maintained;
- Reinforce banks and drainage features where necessary with gabions, reno mattresses and geotextiles; and
- Monitor all systems for incision and sedimentation.

11.1.4.2 Loss of wetland / riparian ecoservices

Recommended mitigation:

- Edge effects of activities including erosion and alien / weed control need to be strictly managed in the wetland areas;
- As much vegetation growth as possible should be promoted within the wetland areas in order to protect soils. In this regard, special mention is made of the need to use indigenous vegetation species where hydroseeding, wetland and rehabilitation planting (where applicable) are to be implemented.

11.1.4.3 Assessment of wetland impacts during the construction phase

Loss of wetland / riparian habitat and ecological structure and impacts on wetland / riparian hydrology and sediment balance	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	1 (site)	1 (short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Cumulative Impact: • Permanent loss of wetland habitat during construction phases							
Loss of wetland / riparian ecoservices	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	1 (site)	1 (short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Cumulative Impact: • Reduction in the ability of wetland / riparian features to provide ecological services due to altered habitat arising from construction-related activities.							

11.1.5 Water quality

Some impacts on water quality may occur during the construction and decommissioning phases. These have to do with possible contamination of the river by construction materials. These occurrences are governed by the National Water Act, and as long as this is adhered to, the effect will be minimal. This applies to the proposed upgrading, realignment and construction of access roads.

11.1.5.1 Assessment of water quality impact during the construction phase

Contamination by construction materials	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Regional	Medium term	Medium	Medium	High	Medium	Medium –Low (-)
With Mitigation	Site	Short term	Negligible	Low	Improbable	Medium	Very low (-)
Cumulative Impact – *Additional loss of in stream and riparian habitat may occur downstream of the two dams.*							

11.1.6 Heritage resources

Heritage resources associated with the road infrastructure were not identified. Fieldwork to identify these and recommend mitigation measures should be undertaken once final infrastructural locations and routes have been surveyed and pegged.

11.1.7 Visual

Alteration to the sense of place is considered the most important visual impact.

11.1.7.1 Assessment of visual impact during the construction phase

Aesthetics	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Access Road from Maclear							
Without Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
Proposed Access Road from Tsolo							
Without Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
Proposed Road re-alignments							
Without Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
Cumulative Impact –the cumulative impact is medium. It is not considered that the road upgrades will add to the existing impact of road infrastructure from a visual point of view. Falls.							

11.1.8 Social

In undertaking the social impact assessment consideration was given to all project components (i.e. dams and associated infrastructure, electricity generation and distribution as well as the road infrastructure) in **Chapter 10** as, on a social level, these activities cannot be seen in isolation. The extent of the project is such that it is important to consider the demographic, economic, social and cultural change processes associated across the entire project on a cumulative basis rather than various components in isolation. The specific issues associated with the construction of the road infrastructure component of the project are addressed here.

Twenty eight dwellings are at risk of being relocated as a result of the road infrastructure. It is quite possible that a significant number of these dwellings can be avoided as the final alignments of the roads have yet to be fixed and there is some room for adjustments.

The construction of roads will result in the generation of dust and noise as well as a heightened safety and security risk with the use of heavy machinery and vehicles, and the influx of construction workers.

Recommended mitigation:
Adjust road alignments so as to avoid as many structures as is feasible.

11.1.8.1 Assessment of social impact during the construction phase

Health and social well-being impacts	Nature	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	Negative	Local	Short term	Medium	Medium	High	Medium	Medium low
With Mitigation	Negative	Local	Short term	Low	Medium	High	Medium	Low
Cumulative Impact – The cumulative impacts are related to the other components of the project and are assessed as such in association with these components.								

11.1.9 Economics

11.1.9.1 Impact on economic growth and poverty alleviation

The economic impact of the construction phase relates mainly to value added to GDP as well as employment and the benefit to the local rural community.

Recommended mitigation:
The construction phase will provide short term employment and mitigation measures can be set so that the local community benefits in the form of payments to households and an increase in expenditure in the region. Payments to households refer to the circular flow of income in an economy thus, an increase in payments to households result in an increase in expenditure on goods and services for a specific region, promoting economic growth of that region.

11.1.9.2 Assessment of economic impact during the construction phase

Impact on GDP and low-income households	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Construction and upgrading of roads and bridges – Impact on GDP							
Without Mitigation	Local	Short term	Low	Medium	Low	Medium	Low (+)
With Mitigation	Local	Short term	Medium	Low	High	High	Low (+)
Construction and upgrading of roads and bridges – Impact on low-income households							
Without Mitigation	Local	Short term	Low	Medium	Low	Medium	Low (+)
With Mitigation	Local	Short term	Medium	Low	High	High	Low (+)
Cumulative Impact – during the peak of the construction and upgrading of the roads and bridges, 67 direct employment opportunities will be created with another 27 indirect and 50 induced jobs in the national economy. Of the direct jobs an estimated 29 will be semi-skilled and 24 low-skilled of which probably most will be recruited from the local community if mitigation is set in place. There is also a positive impact on the Gross Domestic Product to the value of R42 million. Low income households also receive a total of R4.52 million out of a total of R28 million of the total impact on households. It then follows that the overall cumulative impact is of low significance on GDP and low-income households.							

11.2 OPERATION PHASE

11.2.1 Flora

11.2.1.1 Impact on habitat for floral species and floral diversity

Floral diversity within all habitat units has been decreased as a result of historic and on-going disturbances. The species diversity is however higher within the rocky ridge and mountain areas than that associated with the transformed habitat unit.

During the operational phase no major impacts for the roads around the Ntabelanga and Lalini Dams are expected, should rehabilitation of the areas affected by construction have been effective. The diversity of floral species within higher sensitivity areas such as the tunnel access roads and new access roads close to the Lalini Dam wall will however still be affected during the operational phase due to edge effects from the road.

Recommended mitigation

- Ensure that operational related activities are kept strictly within the development footprint. Ensure that indigenous floral species are not removed and edge effects from the road are controlled.
- During the maintenance of the access road, all vehicles should travel on the designated road to limit the ecological footprint and reduce further degradation or loss of floral habitat and in turn the diversity of species in the area.
- Alien and invasive vegetation control should take place throughout the operational phase of the development.

11.2.1.2 Impact on important and protected floral species

Alien proliferation alongside the road is one of the main concerns. Disturbances of the ground through excavations often lead to the dominance of alien pioneer species that rapidly dominate the area. Invader Alien Plants can significantly alter the composition, structure and functionality of ecosystems. As a result, they degrade the productive potential of the land; intensify the damage caused by veld fires and flooding, increase soil erosion, and impact on the health of rivers and estuaries. Indigenous species may be reduced in numbers/coverage, or may be lost as a result of alien floral infestations.

Recommended mitigation

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the footprint areas.

11.2.1.3 Assessment of floral impacts during the operation phase

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance

Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	1 (Short)	2 (Low)	1 (Low)	2 (Low)	High	Very low (-)
With Mitigation	1 (Site)	1 (Short)	1 (Negligible)	1 (Low)	1 (Improbable)	High	Very low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low (-)
Access road associated with the hydropower plant							
Without Mitigation	2 (Local)	5 (Permanent – no mitigation)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-high (-)
With Mitigation	2 (Local)	3 (Long) term	2 (Low)	3 (Medium)	3 (Medium)	High	Medium-low (-)
Residual Impact: • Poor rehabilitation measures after construction activities could lead to further floral habitat loss and soil erosion							
Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	1 (Short)	2 (Low)	1 (Low)	2 (Low)	High	Very low (-)
With Mitigation	1 (Site)	1 (Short)	1 (Negligible)	1 (Low)	1 (Improbable)	High	Very low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low (-)
Access road associated with the hydropower plant							
Without Mitigation	2 (Local)	5 (Permanent – no mitigation)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-high (-)
With Mitigation	2 (Local)	3 (Long) term	2 (Low)	3 (Medium)	3 (Medium)	High	Medium-low (-)
Residual Impact: • Ineffective rehabilitation may lead to permanent transformation of floral habitat and species composition.							
Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	2 (Medium term)	2 (Low)	1 (Low)	2 (Low)	High	Very low (-)
With Mitigation	1 (Site)	2 (Medium term)	1 (Negligible)	1 (Low)	1 (Improbable)	High	Very low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low (-)
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low (-)

Access road associated with the hydropower plant							
Without Mitigation	2 (Local)	5 (Permanent – no mitigation)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-high (-)
With Mitigation	2 (Local)	3 (Long) term	2 (Low)	3 (Medium)	3 (Medium)	High	Medium-low (-)
Residual Impact: • A decrease in potential RDL/ protected floral species diversity may lead to a loss of species richness over time within the region.							

11.2.2 Fauna

The following key impacts on fauna have been identified for the operation phase:

11.2.2.1 Impact on faunal habitat

During the operational phase no major impacts for the roads around the Ntabelanga and Lalini Dams are expected, provided rehabilitation of the affected areas has been implemented correctly. It must be ensured that alien plant proliferation is controlled during the operation phase to ensure that further faunal habitat is not lost. During the maintenance of the access road, all vehicles should travel on the designated road to limit the ecological footprint and reduce further degradation or loss of faunal habitat. Impacts of the tunnel access road will still be high since edge effects from the road will still take place. Care must be taken to ensure excess water runoff and erosion is controlled, as the soils in the study area are very sandy and susceptible to erosion. If left unchecked erosion gulley's may form, leading to a loss of faunal habitat in the vicinity of the roads.

Recommended mitigation:

- Road must be sloped and berms constructed to deal with surface water runoff in an effective manner so as to mitigate any erosion issues alongside the roadways;
- Restrict vehicles to designated roadways to limit the ecological footprint of the proposed development activities as well as to reduce the possibility of collisions;
- Rehabilitate and naturalize areas beyond the development footprint, which have been affected by the construction activities, using indigenous grass species; and
- Alien and invasive vegetation control should take place throughout the operational phase of the development.

11.2.2.2 Impact on faunal diversity and species of conservational concern

Road infrastructure and associated operational activities are not deemed to have any major impact on faunal species, including on RDL and protected species.

As the majority of the roads are pre-existing, and new ones located in less sensitive areas, the road impact will be significantly lessened. However the tar road will allow for more vehicle traffic and higher travelling speeds, and may result in an increase of operational vehicle collisions with faunal species. Impacts of the tunnel access road will still be high since edge effects from the road will still take place. Faunal species within the areas surrounding the hydropower plant access road and new access roads close to the Lalini Dam wall will still be affected during the operational phase and will still have a negative impact on species of conservational concern within the study area due to edge effects from the road and potential ineffective implementation of mitigation measures.

Recommended mitigation:

- Edge effects of all operational activities, such as erosion and alien plant species proliferation, which may affect faunal habitat within surrounding areas, must to be strictly managed in all areas of increased ecological sensitivity;
- Vehicles must be restricted to travelling only on designated roadways to limit the ecological footprint of the proposed development activities; and
- Where high speed travelling is possible, speed bumps/ berms must be placed across the road to slow moving vehicles and also help control surface water runoff.
- The use of the access road to the hydropower plant by motor vehicles must be controlled by way of a manned boom gate or other suitable control method.

11.2.2.3 Assessment of faunal impacts during the operation phase

Impact on faunal habitat	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades and road realignments associated with the Ntabelanga Dam							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
With Mitigation	1 (Site)	Short term (1)	Negligible (1)	Low (1)	Improbable (1)	High	Very low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-low
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low
Access road associated with the hydropower plant							
Without Mitigation	Local (2)	Permanent (5)	Medium (3)	Medium (3)	High (4)	High	Medium-high (-)
With Mitigation	Local (2)	Long term (3)	Low (2)	Medium (3)	Medium (3)	High	Medium-low (-)
Cumulative Impact – Erosional activities result in loss of surface vegetation (faunal habitat). Reduction in habitat lowers carrying capacity and so affects faunal specie numbers in the study area.							

Impact on habitat for faunal species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades and road realignments associated with the Ntabelanga Dam							
Without Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Low (2)	High	Very low (-)
With Mitigation	Site (1)	Short term (1)	Negligible (1)	Low (1)	Improbable (1)	High	Very low) (-)

Road upgrades associated with the Lalini Dam							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low (-)
Access road associated with the hydropower plant							
Without Mitigation	Local (2)	Permanent (5)	Medium (3)	Medium (3)	High (4)	High	Medium-high (-)
With Mitigation	Local (2)	Long term (3)	Low (2)	Medium (3)	Medium (3)	High	Medium-low (-)
Cumulative Impact: Minimal faunal species loss is expected to occur within the transformed habitat areas, however the sensitive habitat areas that have a high faunal diversity there is still an increased risk of species loss due to habitat transformation or collision with operational vehicles.							
Impact on species of conservational concern	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades and road realignments associated with the Ntabelanga Dam							
Without Mitigation	Site (1)	Medium term (2)	Low (2)	Low (1)	Low (2)	High	Very low (-)
With Mitigation	Site (1)	Medium term (2)	Negligible (1)	Low (1)	Improbable (1)	High	Very low (-)
Road upgrades associated with the Lalini Dam							
Without Mitigation	Local (2)	Medium term (2)	Medium (3)	Medium (3)	High (4)	High	Medium-low
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (1)	Medium (3)	High	Low
Access road associated with the hydropower plant							
Without Mitigation	Local (2)	Permanent (5)	Medium (3)	Medium (3)	High (4)	High	Medium-high (-)
With Mitigation	Local (2)	Long term (3)	Low (2)	Medium (3)	Medium (3)	High	Medium-low (-)
Cumulative Impact: Minimal impact to SCC's are expected within the Ntabelanga Dam area and transformed habitat areas. The access roads by the Lalini Dam wall and the long hydropower tunnel will still negatively impact SCC's through edge effects and vehicle collisions, resulting in a decrease of species.							

11.2.3 Aquatic ecology

Extensive development project activities often cause a change to peak flows in the river system downstream of the project site, due to changes in surface coverage. Development of a project area will change the surface coverage in some areas from vegetated soil to buildings, hardened gravel roads, paved areas (parking), and compacted earth. These new surface types will allow considerably less infiltration into the ground (typically 0-20%) as compared to the natural surface (typically 60-70%), resulting in more surface runoff following storms and consequently higher peak flow rates. However, such an impact on river peak flow rates would be large insignificant on a local or regional scale. On a site specific scale run-off may result in erosion and sedimentation but such impact can be mitigated.

Recommended mitigation

- Roads and associated pipeline developments must be well maintained to avoid site specific impacts such as erosion or sedimentation resulting from run-off.
- Sheet runoff from access roads and the final road structure needs to be curtailed and slowed down by the strategic placement of energy dissipation structures;
- Adequate stormwater management must be incorporated into the design of the proposed structure in order to prevent erosion and the associated sedimentation of the system for the life of the structure; and
- As far as possible, all construction activities should occur in the low flow season, during the drier summer months;
- It must be ensured that migratory connectivity and stream continuity is maintained throughout the construction phase of the project;
- Removal of alien vegetation and good housekeeping within the road reserve must take place at all times;
- Any spills by maintenance teams or road users should be cleaned up immediately and all work overseen by a suitably qualified professional.

11.2.3.1 Assessment of impacts on aquatic ecology during the operation phase

General impact	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed road upgrades							
Without Mitigation	Local (1)	Short term (1)	Low (2)	Low (2)	Low (2)	High	Very low (-)
With Mitigation	Site (1)	Short term (1)	Low (2)	Low (2)	Low (2)	High	Very low (-)
Cumulative Impact and Comments– Construction of the development will have temporary impact that could be mitigated to some extent.							

11.2.4 Wetlands

11.2.4.1 Loss of wetland / riparian habitat and ecological structure, loss of wetland / riparian ecoservices and impact on wetland / riparian hydrology and sediment budget

As with the pipelines and power lines, the primary impact on wetland / riparian habitat during the operational phase of the roads is related to maintenance. Additionally, the anticipated increased volume of traffic on the roads due to the continued operations of the dams escalates the risk of toxicants such as motor vehicle oil reaching the wetlands and river systems in runoff from the roads. In the same manner, the likelihood of increased sediment and water inputs to the wetlands and river systems is increased.

Recommended mitigation:

- Regular maintenance of all roads, with specific mention of wetland / riparian crossings, must take place in order to minimise the risk of further degradation to wetland / riparian habitat;
- Regularly inspect wetland and riparian crossings for sedimentation and incision;

- Monitor wetland crossings for proliferation of alien vegetation;
- Spills from motor vehicles must be cleaned up and treated immediately; and
- All staff motor vehicles should be regularly inspected for leaks, and re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.

11.2.4.2 Assessment of wetland impacts during the operation phase

Loss of wetland / riparian habitat and ecological structure	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	1 (site)	1 (short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Cumulative Impact: • Runoff from road surfaces contaminating wetland / riparian areas; • Erosion and sedimentation of wetland / riparian habitat due to altered runoff patterns.							
Loss of wetland / riparian ecoservices	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	1 (site)	1 (short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Cumulative Impact: • Inability to support biodiversity as a result of changes to water quality, increased sedimentation and alteration of natural hydrological regimes; • Alteration of natural hydrological regime, impacting on flood attenuation and streamflow regulation capabilities							
	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Without Mitigation	1 (site)	1 (short)	3 (Medium)	3 (Medium)	3 (Medium)	High	Low (-)
With Mitigation	1 (site)	1 (Short)	2 (Low)	3 (Medium)	2 (Low)	High	Very Low (-)
Cumulative Impact: • Erosion and increased sedimentation leading to altered geomorphology and smothering of wetland biota							

11.2.5 Water quality

There will be no impacts on water quality of the Tsitsa River during the operation of the access roads.

11.2.6 Heritage resources

This section is not applicable, since impacts on heritage resources will be confined entirely to the construction phase.

11.2.7 Visual

Alteration to the sense of place is considered the most important visual impact.

11.2.7.1 Assessment of visual impacts during the operation phase

Aesthetics	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Access Road from Maclear							
Without Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
Proposed Access Road from Tsolo							
Without Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	Medium	Medium	Definite	Medium	Medium-Low (-)
Proposed Road re-alignments							
Without Mitigation	Regional	Long term	Medium	High	Definite	Medium	Medium-Low (-)
With Mitigation	Regional	Long term	Medium	High	Definite	Medium	Medium-Low (-)
Cumulative Impact –the cumulative impact is medium. It is not considered that the road upgrades will add to the existing impact of road infrastructure from a visual point of view. Falls.							

11.2.8 Social

In undertaking the social impact assessment consideration was given to all project components (i.e. dams and associated infrastructure, electricity generation and distribution as well as the road infrastructure) in **Chapter 10** as, on a social level, these activities cannot be seen in isolation. The extent of the project is such that it is important to consider the demographic, economic, social and cultural change processes associated across the entire project on a cumulative basis rather than various components in isolation. The specific issues associated with the operation of the road infrastructure component of the project are addressed here.

The specific impacts associated with the operational phase of the project relate to greater access to the more remote areas as a result of the roads. Greater access has both a positive and negative element attached. On the positive side communities living in the area will have easier access into and out of the area as will tourists wanting to visit the area. On a more negative basis, easier access could hasten the effects of globalisation and the changes to local norms and culture. Vulnerable groups may also face greater psychological and social impacts due to rapid change as a result of greater access and exposure to outsiders.

11.2.8.1 Assessment of social impacts during the operation phase

Positive impacts associated with access	Nature	Extent	Duration	Intensity	Potential for gain of resources	Probability	Confidence	Significance
Without Optimisation	Positive	Regional	Permanent mitigated	High	High	High	Medium	High
With Optimisation	Positive	Regional	Permanent mitigated	High	High	High	Medium	High
Cumulative Impact – Greater access to the area could lead to an increase in tourism and associated economic impacts. The quality of life could also be improved with improved transport facilities								
Negative impacts associated with access	**Nature**	**Extent**	**Duration**	**Intensity**	**Potential for irreplaceable loss of resources**	**Probability**	**Confidence**	**Significance**
Without Mitigation	Negative	Regional	Permanent mitigated	High	High	High	Medium	High
With Mitigation	Negative	Regional	Permanent mitigated	High	High	High	Medium	High
Cumulative Impact – Greater exposure to outsiders is likely to have the greatest impact on the youth and could result in rapid cultural change in the area.								

12. IMPACT ASSESSMENT FOR THE NO PROJECT ALTERNATIVE

By and large, the no project alternative will result in the status quo being maintained.

The following points can however be noted:

- Although no loss or decrease in sensitive species and habitats is expected, the current impacts such as overgrazed veld and alien proliferation along the riparian features will continue. Thus the ecological state of these areas will not improve if the no project alternative is implemented.
- No loss of faunal habitat and RDL and protected species is expected. This should be seen in contrast to the definite impact on population size of endangered, vulnerable and protected indigenous faunal species resulting from the construction of the Lalini Dam.
- In terms of aquatic ecology, the no project alternative will best ensure maintenance of ecological integrity within the system with the current rocky habitat in fast flowing clear water being maintained.
- It is expected that wetland habitats will still undergo alterations as a result of the continued impacts of anthropogenic activities such as vegetation clearing, sediment winning, crop cultivation within wetland habitats, etc. Additionally, due to the extensive erosion within the study area and the catchment, sediment inputs to wetland and riparian habitats are anticipated, thus potentially altering flow patterns within wetlands and riparian zones, as well as smothering vegetation and aquatic macro-invertebrates.
- No negative impacts will accrue to heritage resources. In particular, residents will not be subject to the high emotional cost associated with ancestral grave relocation. Conversely, the scientific knowledge inherent in resources such as archaeological sites will remain unrecovered until and unless funding for research is obtained from another source.
- There is an obligation on the State to advance the interests of the poor and, in accordance with the Bill of Rights, take adequate measures in ensuring that all citizens have access to basic housing, health care, food, water, social security, education and a healthy. In addition to this South Africa has a policy of recognising the human right to water at both the Constitutional and policy levels. A no project alternative would contradict these obligations as the Department of Water and Sanitation and the Eastern Cape Province would lose an opportunity to supplement the water resources in the area and consequently to deliver both domestic water and water for irrigation. Together with this lost opportunity would be the loss of a number of job opportunities, not only associated with the construction of the dams and infrastructure, but also associated with the productive potential of the irrigation scheme. With the area being one of the least developed and poorest in the country these losses will have severe social consequences. With the Mzimvubu River being the largest undeveloped water resource in the country any loss of benefits associated with the use of this river will be of national significance.

13. ENVIRONMENTAL IMPACT STATEMENT

While the project was assessed holistically, it is acknowledged that the impacts associated with the various infrastructure components have different degrees of significance. Impacts are summarised below for the dams and associated infrastructure, electricity generation and distribution infrastructure, and road infrastructure.

13.1 DAMS AND ASSOCIATED INFRASTRUCTURE

The construction of the dams, and to a lesser extent the associated infrastructure (including construction offices, potable and raw water distribution infrastructure, borrow pits and quarries etc.) will have significant negative impacts on the terrestrial and aquatic ecology, as well as on the wetlands. To a large extent these impacts will be permanent.

The riparian and wetland areas, as well as the mountain/rocky outcrop areas and Euphorbia Forest near the Lalini Dam wall that provide habitat for sensitive indigenous vegetation as well as fauna, including possible red data list and protected species, will be lost and the habitat within the river will be permanently altered. This impact is considered to be of high significance.

In addition, wetlands in the project area provide important ecological services in the way of sediment trapping, nutrient cycling and toxicant assimilation, flood attenuation and biodiversity maintenance. Considering the extensive, and often severe, erosion within the study area and greater catchment, sediment trapping is especially important. In view of this, the permanent loss of wetland habitat due to inundation is regarded as being of high significance. The anticipated cumulative loss of riparian and wetland habitat arising from the construction of the dams is estimated to be 1034.30 hectares. Overall however, the loss of riparian and wetland habitat is deemed to constitute a relatively insignificant fraction of the wetland resources within the Mzimvubu sub Water Management Area.

At Lalini Dam, large scale loss of habitat for animals will result in a loss of animal species numbers and diversity, as species leave the area, adapt to the new environment in lower numbers, or are lost in totality within the study area. In particular, the loss of wetlands, lower grassland areas, mountain bushveld and rocky outcrops will directly impact on the population of red data list and protected species.

At Ntabelanga Dam, the main concern relates to the loss of key breeding crane populations. Wetlands and grasslands within the Ntabelanga Dam basin are used by cranes (Crowned Cranes, Blue Cranes and Wattled Cranes) for breeding and foraging. Cranes are red data list species, threatened with extinction throughout South Africa; Crowned Cranes in particular are listed as endangered by IUCN with rapidly declining populations. Loss of wetlands and grasslands has been identified as one of the main contributing factors. This impact is considered to be of high significance.

Most of the above-mentioned impacts are permanent and thus extend into the operation phase.

The EAP recommends, as indicated by DEA, that any Environmental Authorisation is subject to the Water Use Licence (WUL) being obtained and complied with. The WUL takes the Reserve, which includes the Ecological Water Requirements (EWR), into account. The EWR are determined to protect the in-stream aquatic and riparian ecology of the river by setting the limits of deviation from the natural flow beyond which the impact would be unacceptable.

For this assessment, the specialists and EAP have assumed that the EWR, as defined in the Reserve determinations will be adhered to during the construction and operational phases. Adhering to the EWR will ensure that sufficient water goes over the Tsitsa Falls to prevent the endemic cremnophytes identified at the Falls from being negatively affected, and that the river downstream of the hydropower plant outlet works can also be maintained in an acceptable ecological state.

The most critical socio-economic impacts associated with the construction of the dams relate to relocation and resettlement, the influx of construction workers, and risks and nuisances associated with construction activities. These impacts can be highly disruptive to communities and need to be carefully managed and mitigated.

In terms of affected households and assets, 62 structures and 19.9 km^2 of cultivated land are located within the Ntabelanga Dam basin and will have to be relocated or compensated. At the Lalini Dam site, 12 structures and 7.6 km^2 of cultivated land are located within the dam basin (alternative 1).

Regarding the proposed potable and raw water pipeline routes, 124 structures are located within the pipeline servitudes (feasibility level pipeline routes). This is a large number but it is possible to realign the pipelines during the detailed design stage to avoid most of these structures and minimise, or altogether eliminate, the need for relocation and associated negative social impacts.

The proposed pipelines are largely located within transformed habitat and construction will have a low to very low impact on terrestrial and aquatic ecology and wetlands, provided the mitigation measures contained in the EMPR are adhered to. These include, inter alia, minor realignments to avoid protected trees, and realignments to avoid wetlands where possible.

The Tsitsa River contributes a small percentage of the flow in the Mzimvubu River that reaches the estuary. The Ntabelanga/Lalini system will always be operated in a manner that fulfills the EWR downstream of the hydropower plant outfall, both in terms of minimum and maximum flows. The project is also not expected to impact on the water quality. The sizes of the Ntabalanga and Lalini Dams are such that they will support the EWR and the

Best Attainable State for the estuary, as set out in the estuarine Reserve determination.The impact on the estuary is therefore predicted to be negligible.

The Macro-Economic Impact Analysis found that during the peak of the construction period, the Ntabelanga Dam will result in 2 299 direct employment opportunities created in the Province, with another 843 indirect and 1 036 induced jobs. Of the direct jobs an estimated 1 057 will be semi-skilled and 771 low-skilled and should be recruited from the local community. There is a positive impact on the GDP to the value of R282.7 million. Low income households will also receive a total of R82.42 million out of a total of R528.11 million.

Although only for a short period, the construction activity of the Ntabelanga Dam will contribute considerably to the economy of the region and the province.

The proposed construction of the Lalini Dam and accompanying hydropower plant will also contribute considerably to the economy. At the peak of construction of the dam 815 direct jobs will be created with another 491 indirect and 604 induced jobs in the provincial economy. Of the direct jobs an estimated 375 will be semi-skilled and 273 low-skilled, most of which should be recruited from the local community. There is a positive impact on the Gross Domestic Product to the value of R164.6 million. Low income households are expected to receive a total of R52.38 million out of a total of R335.64 million of the total impact on households.

During operation, both dams will indirectly provide important social and economic benefits at a local, provincial and national level, as the water they supply will enable:

- The provision of potable water to many households in the project area and beyond, which will have a direct positive impact on the quality of life of the recipients;
- The emergence of an agricultural sector which will be able to actively contribute to the economy of the area and of the province; and
- The provision of electricity to alleviate pressures on the national grid and cross-subsidise the cost of the other components of the project.

The irrigation component of the project will contribute an estimated R129.3 million per year to the GDP and a total household income at R146.6 million with R38.6 million for low-income households. The total fulltime employment opportunities is estimated at 1 976 of which 1 301 is direct on the farms.

The agricultural component of the project may, however, place an additional work burden on women who may have to undertake such tasks as weeding.

13.2 ELECTRICITY GENERATION AND DISTRIBUTION

During construction, the main impact of the electricity generation and distribution infrastructure relates to the construction of the tunnel/conduit and hydropower plant. For the construction of the power line linking the Lalini hydropower plant to the grid, three alternatives were considered and are discussed in more detail below.

During operation, the primary concern relates to the alteration of the natural flow rate and water levels in the Tsitsa River due to releases of water through the tunnel/conduit for hydropower generation. This constitutes a risk for the riparian habitat and the ability of the riparian zone to support biodiversity, with secondary impacts on flow sensitive species, species of conservation concern and aquatic biodiversity in general. The EWR should be adhered to at all times in order to manage this risk. After mitigation, the impact is rated as very low to medium low.

The impact on health of electromagnetic fields associated with power lines has not been determined. From a social point of view, the risk, or perceived risk, is considered to be the main impact of the power line during operation. The precautionary principle will be applied and human settlements and activities within the power line servitude will be restricted.

As far as the electricity generation and distribution component of the project is concerned, the main benefit will be the substantial income generated from the sale of renewable energy, and feeding this power into the national grid.

13.3 ROADS

In general, road upgrades, and to a lesser extent new access roads and road realignments will have a low to very low impact on terrestrial and aquatic ecology and wetlands, provided effective mitigation is implemented.

However, the construction of new roads in the vicinity of the Lalini Dam wall (i.e. haul roads), as well as the access road to the Lalini hydropower plant are located within highly sensitive areas with regard to fauna and flora, and will have a very high negative impact. Alternative access routes to the hydropower plant that could avoid the impact on this sensitive area need to be considered. It is also recommended that a walk-down to undertake search and rescue be done by a qualified specialist before construction of the haul road and access road commences.

During operation, roads will result in a risk of collisions with animals, which is likely not to be fully mitigated.

From a social perspective, 26 structures are within the footprint of proposed roads and road servitudes and may require relocation. The preferred mitigation is to realign the roads to avoid structures as much as possible in order to minimise or altogether eliminate the need for relocation and associated negative social impacts.

Road alignments, the new and upgraded roads will facilitate easier access to the areas served which may indirectly stimulate economic development. On the other hand, this could hasten effects of globalisation and changes to local norms and culture.

13.4 COMPARATIVE ASSESSMENT OF ALTERNATIVES

13.4.1 Preferred power generation mode

The EWR have been determined to protect the in-stream aquatic and riparian ecology of the river by setting the limits of deviation from the natural flow beyond which the impact would be unacceptable. Whichever option of hydropower generation results in the greatest financial income while still fully meeting the EWR is therefore recommended. This still needs to be confirmed.

13.4.2 Preferred tunnel/power line alternative

The aquatic assessment found that in order to reduce the area of impact in terms of silting, sedimentation, decrease in water quality and excessive vegetation growth, the shortest possible section between the dam wall and discharge point should be preferred (i.e. Alternative 1: short hydropower tunnel and associated power line). However, fatal flaws have been identified for Alternative 1 in terms of faunal, floral, and visual impacts. In particular, the power line crosses large sections of indigenous and possible protected trees, and the impact on the faunal habitat on the mountain and within the gorge was not considered viable.

After the environmental assessment had been conducted Alternatives 1 and 2 (associated with the short and medium length tunnels respectively) were eliminated by the technical team due to the presence of deep steep gorges which provide no access to where the tunnel daylights and the hydropower plant would be located. In addition Alternatives 1 and 2 would have significantly less head to generate power, leaving only Alternative 3.

Alternative 3 (associated with the longest pipeline/tunnel and power line) as it is currently proposed has a very high visual impact and also crosses more sensitive floral habitats. It was recommended that this power line be realigned in order to avoid sensitive areas in terms of ecology and visual aspects. The power line route recommended by the EAP is shown in **Figure 78.**

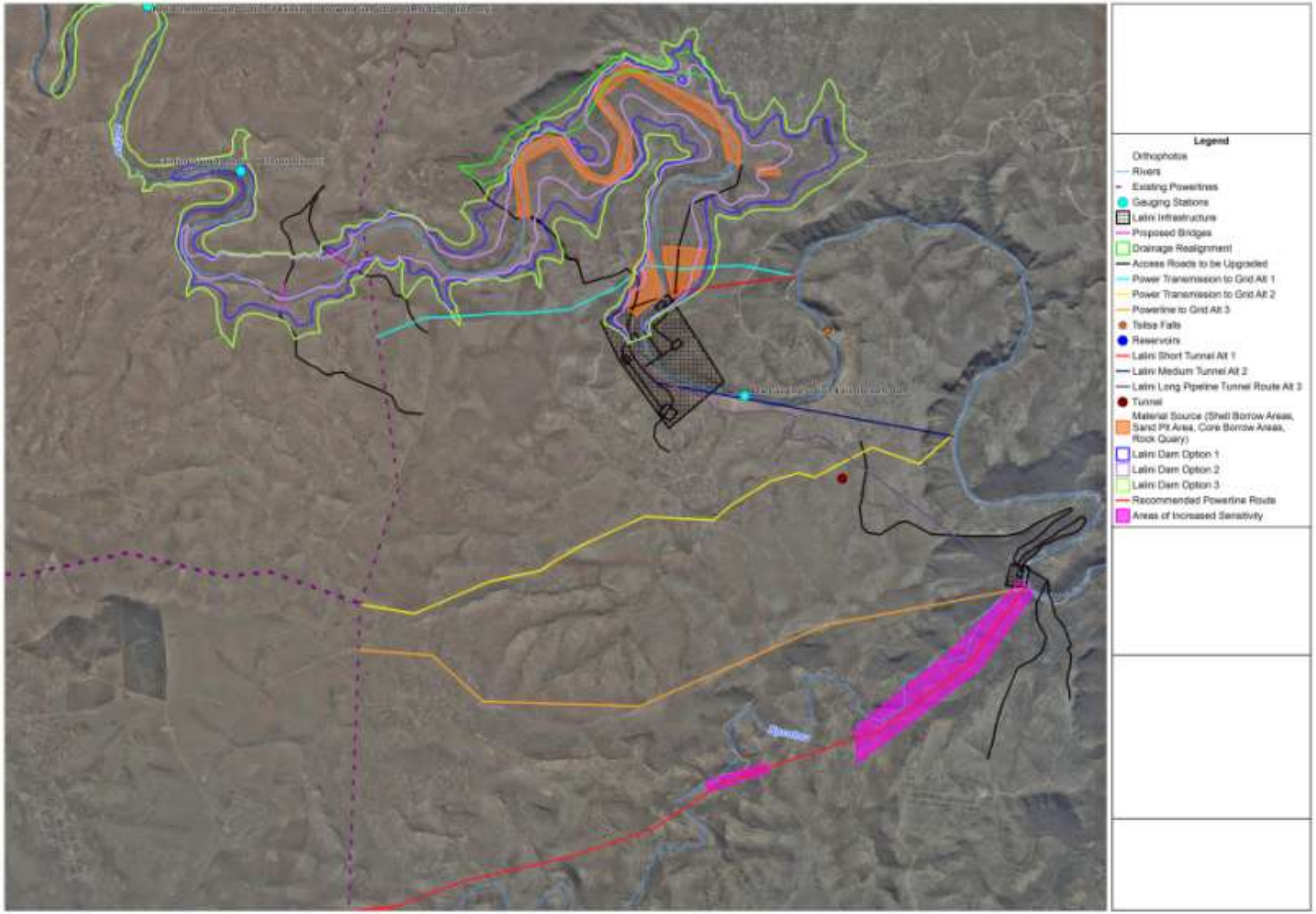

Figure 78: Recommended power line route alignment

13.4.3 Preferred dam size for Lalini Dam

With regard to the Lalini Dam, three dam sizes were considered.

The smallest dam size (Alternative 2) is preferred from a number of perspectives. Firstly, it involves the least loss of cultivated land and structures (i.e. 1 dwelling and 4.9km^2 of cultivated land, compared to 12 structures and 7.6km^2 of cultivated land for technically preferred Alternative 1) and is therefore the socially preferred option. Secondly, it will result in the lowest direct loss of wetland habitat, and is thus considered to be the most viable option in terms of wetland conservation. Thirdly, it will result in the inundation of the least amount of floral and especially sensitive floral vegetation and habitat and is therefore the preferred alternative in terms of floral impacts. Finally, while all 3 alternative dam sizes will lead to a definite impact on population size of endangered, vulnerable and protected indigenous faunal species. Alternative 2 is regarded as impacting the least on faunal RDL species.

Notwithstanding this, no major red flags or fatal flaws were found with technically preferred Alternative 1 (i.e. medium dam size). The technically preferred option is therefore acceptable with the careful application of mitigation measures aimed at reducing the social impact on displaced and host communities, as well as the impacts on ecology and wetlands.

As detailed designs have not yet been finalised for the Lalini Dam, the EAP's recommendation is that the final dam size be within the range of proposed Alternatives 1 and 2 (i.e. a Full Supply Level of between 752.42 mamsl and 763.61 mamsl).

13.5 KEY MITIGATION MEASURES, RELOCATION POLICY FRAMEWORK AND OFFSETS

Based on the findings of the EIA, an EMPR has been compiled. The draft EMPR outlines how negative environmental impacts will be managed and minimized, and how positive impacts will be maximised, before, during and after construction.

13.5.1 Key mitigation measures

While a comprehensive set of mitigation measures has been provided in the EMPR, the following mitigation measures have been identified as essential to minimise significant environmental impacts, and implementation of these measures is a condition to the project proceeding.

Key mitigation measures to be implemented during the pre-construction phase

- A walk-down of the areas impacted by the access road to the hydropower plant and haul roads must be undertaken before clearing. Search and rescue of protected vegetation must be undertaken by a suitably qualified specialist. Floral species needs to be relocated to similar habitat types, outside of infrastructure footprint areas.

- The haul road linking the borrow areas to the Lalini Dam construction site must be realigned to avoid going through the town of Lalini, if possible.
- Protected tree species Podocarpus fulcatus and P. latifolius were located along the sections scheduled for road upgrades. The following must be ensured:
  - Possible re-alignment of the roads where protected tree species were found, in order to avoid cutting and destroying the trees;
  - Where protected trees will be disturbed, ensure effective relocation of individuals (if possible) to suitable similar habitat; and
  - Permit applications must be obtained from relevant authorities.
- Rescue and relocation of medicinal important floral species, RDL and protected floral species is essential to minimise impacts from inundation.
- RDL faunal species or species of conservational concern found within the operational footprint area must be relocated to similar habitat within the vicinity of the study area with the assistance of a suitably qualified specialist.
- No hunting or trapping of faunal species is to occur.
- The construction footprint needs to remain as small as possible, especially in the sensitive habitats.
- Aquatic bio-monitoring must take place and if any trends are observed where impacts on the aquatic ecology is becoming unacceptable, measures to reduce the impacts must be immediately implemented.
- Baseline studies must be undertaken for noise, air quality, and water quality.
- An investigation must be undertaken by a qualified specialist to determine whether any waterfall dependant plants in the gorge and on the cliff could be significantly impacted and whether they require relocation. All findings of the investigation must be implemented.
- Areas of increased sensitivity, as shown in the sensitivity maps developed (Figures 4 and 5) should ideally be avoided in terms of the placement of infrastructure in order to minimise the footprints within wetland features. Where it is not possible, mitigation measures to limit the impacts (such as ensuring the design of crossings allows for the retention of wetland soil conditions as presented in the EMPR) must be implemented.
- Support structures for pipelines must be placed outside of riparian features, channelled valley bottom wetlands and drainage lines. Should it be essential to place such support structures within these features, the designs of such structures must ensure that the creation of turbulent flow in the system is minimised, in order to prevent downstream erosion. No support pillars should be constructed within the active channels. In order to achieve this all crossings of wetlands should take place at right angles wherever possible.
- Where new roads traverse wetland / riparian habitats, with special mention of drainage lines, channelled valley bottom wetlands and riparian habitat, disturbance to any wetland crossings must be minimised and suitably

rehabilitated. The crossing designs of bridges must ensure that the creation of turbulent flow in the system is minimised, in order to prevent downstream erosion. All crossings of wetlands should take place at right angles wherever possible.

- The design of culverts / bridges should allow for wetland soil conditions to be maintained both upstream and downstream of the crossing to such a degree that wetland vegetation community structures upstream and downstream of the crossing are maintained. In this regard, special mention is made of:
    - The design of such culverts and/or bridges should ensure that the permanent wetland zone should have inundated soil conditions throughout the year extending to the soil surface;
    - The design of such culverts and/or bridges should ensure that the seasonal wetland zone should have water-logged soils within 500mm of the soil surface during the summer rainfall period; and
- Temporary wetland zone areas should have waterlogged soil conditions occurring to within 300mm of the land surface during the summer rainfall period.
- Ensure that no incision and canalisation of the wetland system takes place as a result of the construction of the culverts.
- It must be ensured that flow connectivity along the wetland features is maintained;
- The Ecological Water Requirements (EWR) as set out in the Reserve Determination Volume 1: River (Report P WMA 12/T30/00/5212/7) for the Ntabelanga Dam, and the EWR determined for the Lalini Dam, must be adhered to.
- The installation of multiple level outlets, with outlets at approximately 8 m intervals from 6 m below the full supply level of the dams and proper operation is required to mitigate the effect of water quality changes downstream of the proposed dams.
- The archaeological site identified in the proposed Ntabelanga Dam basin should be mapped in detail, with judicious sampling, authorised by a permit from ECPHRA. Thereafter the site may be destroyed once a destruction permit has been issued by ECPHRA.
- The archaeological site identified in the proposed Lalini Dam basin should be mapped and excavated/sampled, authorised by a permit from ECPHRA. Thereafter the site may be destroyed once a destruction permit has been issued by ECPHRA.
- A detailed survey of potential Early Iron Age sites should be undertaken once crops have been harvested and vegetation clearance has occurred.
- New roads and pipelines should be realigned as much as possible to avoid structures.
- The proposed access road for construction vehicles through Lotana village must be realigned to avoid the village.

- Fieldwork to identify heritage resources affected by roads and electrical infrastructure must be undertaken, and mitigation measures recommended, once final infrastructural locations and routes have been finalised, surveyed and pegged.
- All graves outside the full supply levels within 300 m of associated infrastructure should be demarcated by the Engineer's environmental representative, in consultation with the next-of-kin, for the duration of construction. These graves should not be disturbed.
- The power line linking the Lalini hydropower plant to the grid must be realigned to avoid the ridge, as shown in **Figure 78**.
- All access roads impacted by inundation must be compensated by providing new roads and bridges.
- The RPF must be implemented in a consultative manner.
- A dedicated Project Management Unit should be set up to manage the project.
- Ensure continued liaison with authorities responsible for potable water distribution. The social impacts and institutional arrangements for the proposed commercial irrigated farming scheme (land tenure/ ownership, farming model, farmer identification and support, funding, etc.) needs to be resolved between affected communities and role players before the scheme is implemented.
- A Decisions Register must be established and maintained, and must be available to any member of the public who wishes to access it. The register should include all commitments made to stakeholders during the public participation process, which are recorded in the Issues and Responses Report.
- An employment and skills development policy, maximising employment opportunities and skills development for local communities and promoting gender inclusivity and equity must be developed.
- A procurement policy, promoting business opportunities for local communities and gender inclusivity and equity, must be developed.
- An investigation on the necessity and design specifications for an eel-way should be undertaken and findings implemented.

Key mitigation measures to be implemented during the construction phase

- An alien vegetation control programme must be implemented, as encroachment of alien vegetation is already apparent in the study area and is expected to increase as a result of the disturbances resulting during the construction process. Rehabilitation of disturbed areas, utilising indigenous wetland vegetation species, will assist in retaining essential wetland ecological services, particularly flood attenuation, sediment trapping and erosion control, and assimilation of nutrients and toxicants, thus reducing the impacts of construction related activities.
- Prohibit the collection of plant material, outside of the proposed dam basins, for firewood or for medicinal purposes during the construction phase by construction staff.

- Restrict vehicles as far as possible to travel on designated roadways to limit the ecological footprint.
- No hunting or trapping of faunal species is to occur.
- The construction footprint needs to remain as small as possible, especially in the sensitive habitats.
- Sections of power lines that require bird diverters must be identified and implemented.
- Aquatic bio-monitoring must take place, starting six months prior to construction activities, and if any trends are observed where impacts on the aquatic ecology is becoming unacceptable, measures to reduce the impacts must be immediately implemented.
- Identified areas where erosion could occur must be appropriately protected by installing the necessary temporary and/or permanent drainage works as soon as possible and by taking other appropriate measures to prevent water from being concentrated in rivers/streams and from scouring slopes, banks or other areas.
- Storm water control measures must provide for erosion and sedimentation control, and for reinforcement of banks and drainage features, where required. Possible measures include the use of gabions or reno mattresses and geotextiles, re-vegetation of profiled slopes, erosion berms, drift fences with hessian and silt traps.
- It must be ensured that flow connectivity along the wetland features is maintained.
- Monitor rivers and wetlands for incision and sedimentation.
- Implement a water quality and quantity monitoring programme.
- The EWR as set out in the Reserve Determination Volume 1: River (Report P WMA 12/T30/00/5212/7) for the Ntabelanga Dam, and the EWR determined for the Lalini Dam, must be adhered to at all times.
- Develop a Water Management Method Statement (WMMS), including measures for water conservation, for approval by the Engineer prior to the commencement of the works.
- Construction personnel accommodation on site must be as limited as possible. Construction workers should as much as possible be recruited from neighbouring communities and transport provided to the construction site(s).
- Local residents should be recruited to fill semi and unskilled jobs.
- Women should be given equal employment opportunities and encouraged to apply for positions.
- A skills development plan should be put in place at an early stage and workers should be provided the opportunity to develop their skills which they can use to secure jobs elsewhere post-construction.
- A procurement policy promoting the use of local business, where applicable, should be put in place to be applied throughout the construction phase.
- Ensure that the appropriate procurement policies are put in place and closely followed.

- Ensure that all consultation is gender inclusive.
- Ensure that the Decisions Register is maintained, and is available to any member of the public who wishes to access it.

Key mitigation measures to be implemented during the operation phase

- Implement a communication strategy for the implementation phase.
- No hunting or trapping of faunal species by operational staff is to occur.
- Aquatic bio-monitoring must take place and if any trends are observed where impacts on the aquatic ecology is becoming unacceptable, measures to reduce the impacts must be immediately implemented.
- An alien vegetation control programme must be maintained, as encroachment of alien vegetation is already apparent in the study area and special attention needs to be given to areas disturbed during the construction process. Rehabilitation of disturbed areas, utilising indigenous wetland vegetation species, will assist in retaining essential wetland ecological services, particularly flood attenuation, sediment trapping and erosion control, and assimilation of nutrients and toxicants.
- The EWR as set out in the Reserve Determination Volume 1: River (Report P WMA 12/T30/00/5212/7) for the Ntabelanga Dam, and the EWR determined for the Lalini Dam, must be adhered to at all times.
- During operation and maintenance of infrastructure, vehicles must remain on designated roads and not be permitted to drive through sensitive wetland / riparian habitat, particularly on the edges of the dams where loss of wetland habitat and therefore ability of the wetlands to provide ecological services, is already compromised.
- Maintenance personnel must ensure that any tools and/or waste products resulting from maintenance activities are removed from the site following completion of maintenance.
- Regular maintenance of all roads, with specific mention of wetland / riparian crossings, must take place in order to minimise the risk of further degradation to wetland / riparian habitat.
- Ensure that the Decisions Register is maintained, and is available to any member of the public who wishes to access it.
- Maintain the potable water infrastructure, control pollution and curb illegal taps. If no such measures are implemented the community may be worse off as a result of water borne diseases or no water at all.
- The use of the access road to the hydropower plant by vehicles must be controlled by way of a manned boom gate or other suitable control system.

13.5.2 Relocation Policy Framework

Recommendations in the RPF include:

- Thorough identification of abandoned homesteads and recording of field ownership is required.

- The locations of ancestral graves at abandoned homesteads affected by the project must be ascertained.
- Certain structures will require replacement so that the relevant family's socio-economic activities can continue.
- All graves within the full supply levels of the dam should be relocated, with the permission of the next-of-kin and a permit from ECPHRA.
- No associated infrastructure may be located within 100 m of graves outside the full supply levels, and if unavoidable, these graves should also be relocated.
- A destruction permit is required from ECPHRA; if possible a single permit should be obtained for all affected structures.
- Avoid involuntary resettlement wherever possible.
- Undertake consultations with displaced people about acceptable alternatives and strategies and include them in the planning, implementing and monitoring processes.
- Choose the relocation site to ensure that the minimum disruption to displaced families and host communities occurs.
- Sensitise host communities to the pending arrival of the displaced communities;
- Establish a forum or resettlement committee through which resettlement and integration can be controlled by those affected.
- A formal accessible grievance procedure should be implemented and communicated to both the displaced and host communities.
- Ensure that the receiving environment is prepared and has adequate infrastructure, facilities and social services to support both the displaced and host communities, prior to moving the displaced communities.

13.5.3 Offsets

The Mzimvubu Water Project will inundate wetland and riparian habitats that are breeding and foraging areas for protected and endangered cranes. The access road to the hydropower plant site also traverses a highly sensitive area. These impacts have been assessed by the ecologist to be of high significance. It is not possible to avoid, minimize or rehabilitate the impact completely. The only mitigation measure that could potentially reduce the residual negative impact significantly is an offset. One of the difficulties associated with a biodiversity offsets are that during this EIA, it has not been possible to establish whether suitable offset areas exist in the catchment, especially if a like for like principle is applied. The process to be followed would be to compile a detailed Baseline Report of the areas to be lost, to reach agreement of the offset ratios/principles, identify offset options, then implement and manage them indefinitely. Although the likelihood of successful and sustainable implementation of a biodiversity offset is questionable, the EAP is confident that some form of conservation initiative aimed at cranes could be implemented somewhere in the province. This option has also not been investigated any further during this EIA, but offers a wider selection of implementation options.

In order to estimate a budget for implementing a traditional biodiversity offset, the area of wetlands and riparian vegetation to be inundated was calculated (approximately 412 ha at the Ntabelanga Dam and 623 ha at the Lalini Dam site), multiplied by an offset ratio associated with the vegetation type (8:1 for Ntabelanga and 17:1 for Lalini) and multiplied by a factor of 3 to allow for the practical packaging of land parcels, in order to estimate an amount of land that would have to be acquired and set aside for protection. Any current use of this land will have to be compensated for. This is expected to be mostly grazing as dwellings are seldom located in wetlands or river beds and banks. If a budget of R2000-00 per ha is used to cover these costs, then approximately R90 million is required to make the land available. An additional R10 million will be required to implement the offset.

The EAP therefore recommends that the planning and initiation of some form of crane conservation project be stipulated as a condition of the authorisation of this project, and that a budget amount of R100 million be incorporated into the planning process.

Without taking the R100 million for an offset into account, the NPV of the project with population scenario 1 is R 1 827.11 million. Allocating an additional R100 million changes NPV to R 1 748.47 million. This is about a 4% change which doesn't change the economic viability of the project. The same applies to the Benefit-Cost Ratio and Internal Rate of Return.

13.6 RECOMMENDATIONS FOR THE IRRIGATION COMPONENT OF THE PROJECT

Although authorisation for the irrigation component of the Mzimvubu Water Project was not applied for as part of this EIA process, the success of the irrigation component is considered essential for the success of the overall project. This will depend on a number of conditions being met, which are presented in the Economic Impact Assessment.

In view of the above, these recommendations are intended to guide relevant parties in planning and designing the proposed irrigation scheme:

- Careful consideration must be given to the suitability of the crop selection for the irrigation development.
- A well-constructed agricultural development training and support system focused on assisting the new farmers will need to be implemented.
- Support structures should be available right from the start to assist with management. This support must cover the whole spectrum of the undertaking, from planting to marketing and the overall management. The best possible management will have to be available right from the start, which

means the selection of the unit managers as well as the accepted management structure will eventually determine the success of the irrigation scheme.

- The assistance of the Department of Rural Development and Agrarian Reform, Tsolo Agricultural College, and Jongiliswe Agricultural College for Traditional Leaders must be enlisted to train, mentor and support developing farmers.
- This training must include business training, and training in project planning, monitoring and evaluation.

Consideration should also be given to the promotion of gender inclusivity and equity.

14. CONCLUSION AND RECOMMENDATIONS

The main aim of the Mzimvubu Water Project is the socio-economic upliftment of the largely undeveloped and impoverished communities within the project area. This is to be achieved through:

- Supply schemes for domestic and industrial water;
- Supply schemes for irrigated agriculture;
- Hydropower generation; and
- The creation of temporary and permanent jobs.

The provision of potable water to a number of rural and small urban areas is a very important aspect of the total project and is also a constitutional requirement. It should be noted here that while the bulk water distribution infrastructure will enable this constitutional requirement to be fulfilled, the District Municipalities, and not the applicant, will be responsible for the tertiary infrastructure and ultimately distributing potable water to communities. Coordination with these municipalities is therefore required to ensure they can fulfil this mandate.

The analysis of the socio-economic situation in the proposed area indicates very high levels of unemployment and household poverty, which is seen as an indication that a very small number of households will be able to pay for water. The recommendation is that this is seen as part of a developmental project and that government accepts that this will entail a grant with subsidised funding for the basic water needs over a very long period.

Financial viability is not a requirement for a project of this nature, as the objective of the project is not to make a profit on the investment, but rather to contribute to the development of the project area. However the economic impact assessment found that the project can be economically viable, in that the direct and indirect socio-economic benefits will exceed the financial cost of the project.

The benefits of the project in terms of economic and social development are expected to be high, provided the necessary conditions for the success of the project are met and the recommended mitigation and enhancement measures are adhered to.

However, some significant negative impacts, mostly related to flora, fauna, aquatic ecology and wetlands, have been identified. Some of these impacts are permanent and cannot be mitigated to an acceptable level.

In instances where high residual impacts are expected, an offset is the last resort for mitigating these impacts. In addition to their purpose in terms of mitigation, offsets in this particular context may also constitute an opportunity to enhance the potential benefits of the project.

In view of the above, the positive impacts expected to result from the project, in terms of social and economic development are considered to outweigh the negative impacts.

It is therefore recommended that the proposed project proceed, on condition that the mitigation measures proposed are adhered to and that appropriate offsets are implemented.

As the success of the project in terms of socio-economic development rests largely on parties other than the applicant, and depends on factors outside the control of the applicant, it is critical that the necessary institutional arrangements and cooperation between all parties involved be in place, in order to ensure the primary objective of the project is achieved.

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