APPENDIX E: WELVERDIEND DETAILED ENVIRONMENTAL IMPACT ASSESSMENT

1. INTRODUCTION

This section contains the assessment of potentially significant positive and negative environmental impacts associated with the proposed project. Specific emphasis was placed on any relevant significant environmental, social and economic impacts identified from the specialist studies, issues raised in the public participation process and professional judgement of the EAP.

1.1 Ecology

The mining area is located in a botanical diverse area with at least five vegetation types (all belonging to the Succulent Karoo Biome) found on the property. Currently three of the five have been affected by mining activities, including Vanrhynsdorp Gannabosveld, Knersvlakte Dolomite Vygieveld and Namaqualand Riviere. Outside the mining areas, lime dust appears to be a problem, settling on the vegetation adjacent to the stockpile areas and roads. The remainder of the property seems to be in a good condition with conservation worthy vegetation. Past overgrazing and erosion in a few places are also evident. None of the vegetation types are currently listed as threatened. However, Vanrhynsdorp Gannabosveld is the most transformed vegetation type in the area, while Dolomite Vygieveld has a very limited distribution range. Currently, none of these vegetation types has any formal protection.

As an indirect impact, soil disturbance caused by mining activities provide ideal conditions for the establishment of alien invasive vegetation. However, it is unlikely that woody aliens, such as Prosopis glandulosa, will become a serious problem. Prosopis glandulosa and Nerium oleander are largely confined to the Wiedou and Troe Troe Rivers. Weedy pioneer species, such as Atriplex species and Stipa capensis, will probably be the first to establish and prevail. These will be difficult to control, but the impact is not considered significant, given the degraded condition of the mining areas.

With regards to the proposed access road to the Maskam mine, there are no great concerns from a biodiversity perspective, apart from the river crossing and the alignment of the alternative route option too close to the river. No Knersvlakte Dolomite Vygieveld or Quartz Vygieveld will be directly affected. Also, no Species of Conservation Concern were recorded along the route. It is recommended that the river crossing be made where an existing farm road crosses the river. In the preferred option, the route is set back ±200 m from the Wiedou River. In the alternative option, the route follows an existing farm road directly next to the riverine area from the limestone mine to the river crossing. Impact on the riverine area in terms of dust, noise and traffic is expected to be greater (medium-high significance) for the latter option. Mammals dwelling inside or visiting the riverine areas (such as grysbok) do so away from the mining areas. Mining currently affects a 1.6 km long section of the Troe Troe in the western part of the study area. The alternative route option will impact on an additional 3.5 km passage along the Wiedou east of the limestone mine. Faunal movement between the river and the veld to the south of the river will be affected. One can expect that large fauna will move away from this area with the commencement of truck movement and associated dust problems. The preferred route option will only impact on the Wiedou directly at the river crossing. The surrounding vegetation (irrespective of its condition) should be actively protected during the construction of the access road, especially along the western half where construction will take place in relatively undisturbed vegetation. Table 1 below summarises the impact.

Table 1: Impact of the access road options on biodiversity

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance-Preferred option**	**Significance-Alternative option**
Construction and Operational Phase							
Without Mitigation	Local 1	High 3	Long-term 3	Medium 6	Definite 4	MEDIUM	HIGH
With mitigation	Local 1	High 3	Long-term 3	Low 5	Probable 3	LOW	MEDIUM

1.2 Heritage

Archaeology

The footprint of the proposed upgrades does not lie on pristine ground but occurs in area already affected by modern developments that include farming quarrying and access roads. As revealed from desktop study, the archaeology of the area is concentrated along the valleys outside the proposed development footprint where 10 lithic clusters were reported. Those lithic artefacts that occur in the area, appear in isolated clusters and are of low significance. Four historical structures and features (cemetery, farm house, stonewalled fencing and a stonewalled fort) were also reported but much further away from development path. The potential for chance finds, still remains, and the developer and his contractors are requested to be diligent and observant during development. The procedure for reporting chance finds has clearly been laid out and if this report is adopted, development may continue.

Table 2: Significance of impacting on heritage resources

	Extent	Intensity	Duration	Consequence	Probability	Significance
Construction and Operational Phase						
Without mitigation	Local 1	Low 1	Short term 1	Very low 3	Possible 2	LOW
With mitigation	Local 1	Low 1	Short term 1	Very low 3	Possible 2	LOW

Palaeontology

According to the palaeontological study conducted by Dr JF Durand of Integrated Specialist Services (Pty) Ltd, no publications exist that mention fossils from the study site, several geological studies and palaeontological assessments have been done elsewhere on the same geological formations that occur at the study site. The ECO should take responsibility for supervising the development and should follow the Chance Find Procedure as stipulated on the EMPr section, if in the unlikely event a significant fossil discovery is made. If fossils are exposed during construction, geological exploration or mining, the ECO must follow the Chance Palaeontological Find Procedure as stipulated below and to contact a palaeontologist for further advice.

Figure 1: Palaeontological sensitivity map of the study area and surroundings (SAHRA, 2019)

Table 3: Interpretation of the palaeontology map

Colour	Palaeontological Significance	Action
GREEN	MODERATE	Desktop study is required.
BLUE	LOW	No palaeontological studies are required however, a protocol for finds is required.
WHITE	UNKNOWN	These areas will require a minimum of a desktop study. As more information becomes known, SAHRA will continue to populate the map.

Table 4: Significance of impacting on paleontology resources

	Extent	Intensity	Duration	Consequence	Probability	Significance
Construction and Operational Phase						
Without mitigation	Local 1	Low 1	Short term 1	Very low 3	Possible 2	LOW
With mitigation	Local 1	Low 1	Short term 1	Very low 3	Possible 2	LOW

1.3 Fresh Water Impacts

The new haul road will be a gravel road, built with the applicant's own road material (G5 material). The road will be 15 m wide. Where the road crosses narrow, confined or eroded watercourses (e.g. CL_2 to CL_4 and CL_6 to CL_8), the channel will be filled with run of mine material (boulders etc.) to elevate the road surface above the stream bed and overlaid with G5 material. No culverts are planned and water flow will pass through voids in the run of mine material. For broader unconfined watercourses (e.g. CL_1, CL_5 and CL_9 to CL_11) the road will follow the profile of the channel, directly through the stream bed and will not be filled with run of mine material to elevate the road above the stream bed. Road crossings in broad unconfined valleys are expected to be negligible. The lack of any serious erosion or other disturbances at existing road crossings (e.g. CL_5 and CL_9 to CL_11) provides evidence of this statement.

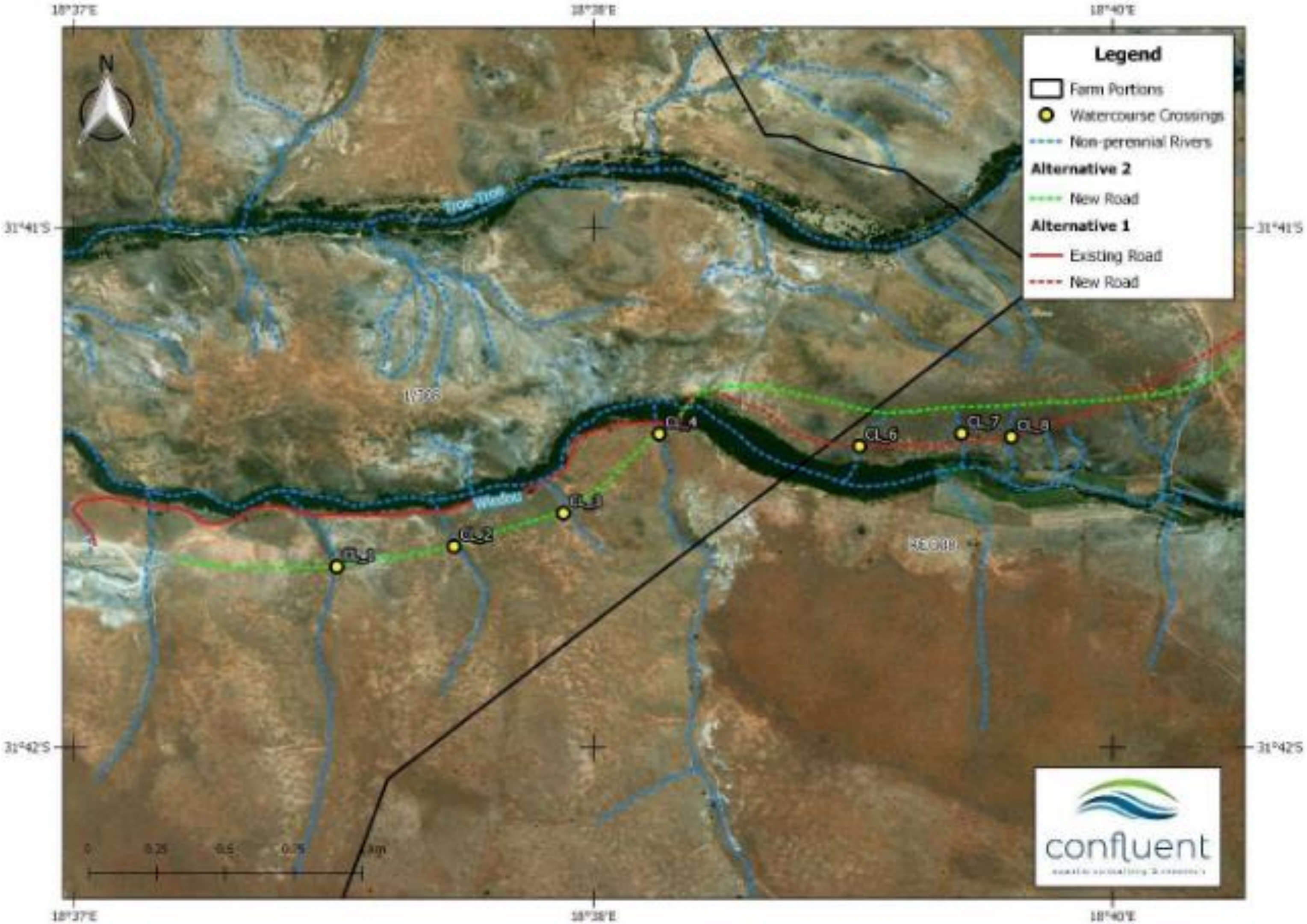

Figure 2: Watercourse crossing (CL _ 1 to CL _8) associated with proposed road and alternative 1

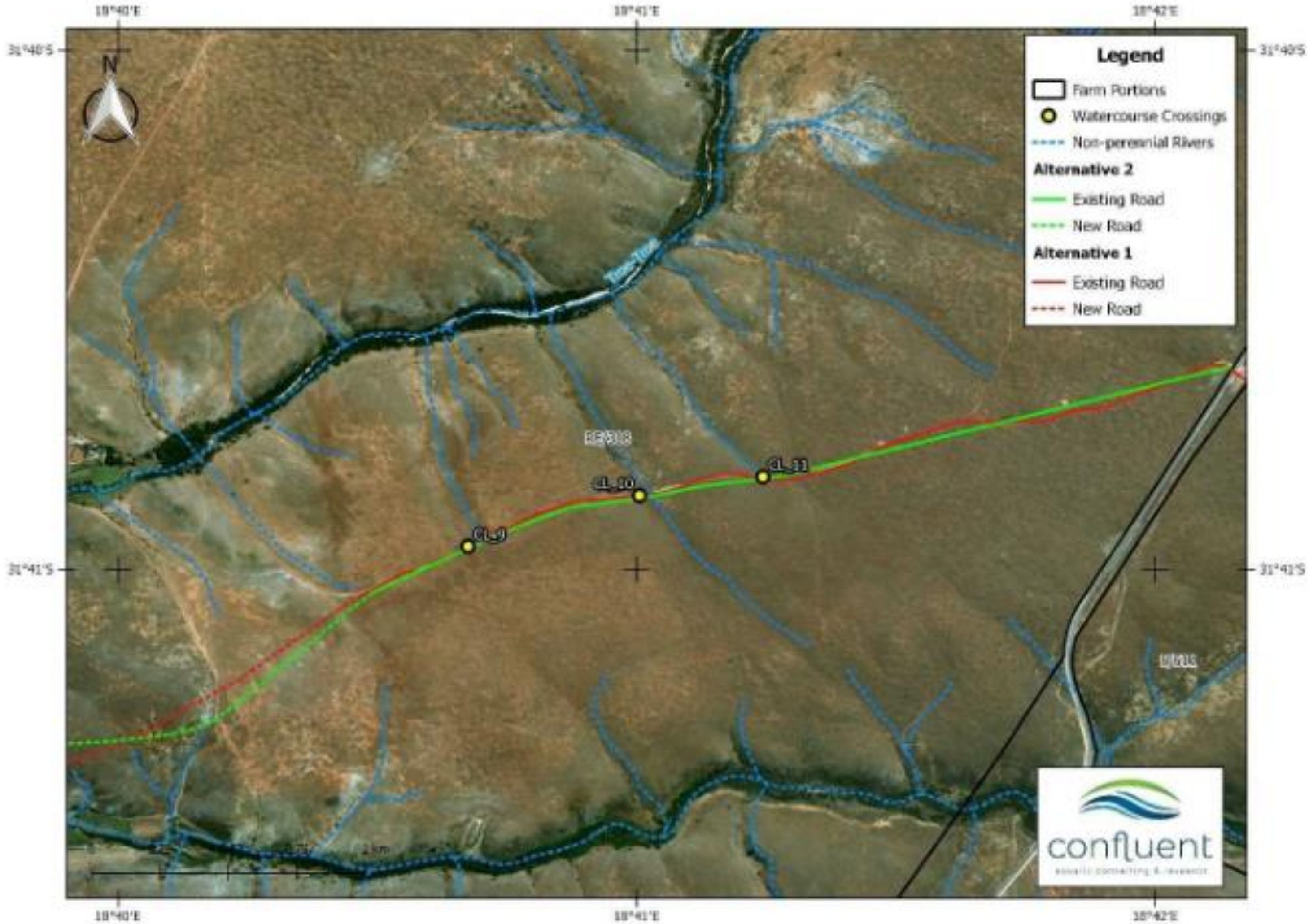

Figure 3: Watercourse crossing (CL _ 9 to CL _11) associated with proposed road and alternative 1

a) Layout and Design Phase

Operational phase impacts are primarily related to management of stormwater runoff and prevention of erosion of the bed and banks of watercourses. These impacts can be successfully mitigated through adequate adjustments to the design and layout of the road which can then be implemented during the construction phase of the project. In most instances the design has already included many of the proposed mitigation measures.

<u>Impact of Layout & Design on Hydrology</u>

The site is inherently arid with very low mean annual precipitation (< 200 mm). Flow in the Wiedou River and its tributaries is therefore expected to be highly intermittent, and the impact of road crossings on hydrology is therefore expected to be negligible and no impacts on base flows are expected. Stream crossings may result in localised areas of inundation upstream of crossings if barriers are created by the road. Mitigation options must therefore ensure the free flow of water on the rare occasion that the streams do flow. Using run of mine material to fill incised channels should still allow flow of water through the voids in the fill. Impacts associated with Alternative 1 are slightly lower due to the fact that this option crosses fewer drainage lines.

Table 5: Impact of Layout & Design on Hydrology

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	Low 1	Permanent 4	Medium 6	Probable 3	MEDIUM
With mitigation	Local 1	Low 1	Permanent 4	Medium 6	Improbable 1	LOW
Alternative 1						
Without mitigation	Local 1	Low 1	Permanent 4	Medium 6	Improbable 1	LOW
With mitigation	Local 1	Low 1	Permanent 4	Medium 6	Improbable 1	LOW

<u>Impact of Layout and Design on Geomorphology</u>

While the MAP is low, given the aridity of the environment and sparse vegetative cover, the area is susceptible to erosion and the construction and widening of roads at stream crossings leads to an increased risk of erosion during occasional rainfall events. Infilling of incised channels and erosion gullies with run of mine material will allow for diffuse flow through from upstream to downstream, reduce the energy of flow and could potentially alleviate erosion problems (particularly in eroded gullies) and prevent erosion in other channels. Over time the upstream side of the crossing may however fill with sediment which could lead to flows overtopping the road surface and entering the downstream channel from a point of higher elevation, creating a plunge effect which could lead to erosion downstream of the crossing. The creation of a broad flat road surface may also create preferential flow paths which could also lead to the formation of new erosion gullies. The location of a 2.3 km section of the road within the bed of the Wiedou River under the proposed road, represents a particularly high erosion risk. Impacts associated with Alternative 1 are lower due to the fact that this option crosses fewer drainage lines and avoids the alluvial fans of the southern drainage line as well as the section in the bed and banks of the Wiedou River.

Table 6: Impact of Layout and Design on Geomorphology

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**
Proposed Road						
Without mitigation	Local 1	High 3	Long term 3	High 7	Probable 3	HIGH
With mitigation	Local 1	Medium 2	Long Term 3	Low 5	Possible 1	VERY LOW
Alternative 1						
Without mitigation	Local 1	Medium 2	Long term 3	Low 5	Probable 3	LOW
With mitigation	Local 1	Low 1	Long Term 3	Very Low 4	Possible 1	INSIGNIFICANT

Impact of Layout & Design on Aquatic Habitat

Construction and widening of the road will result in the loss of aquatic habitat at the stream crossings which cannot be mitigated. Alternative 1 will however significantly minimise the loss of aquatic habitat due to fact that the route involves fewer stream crossings and avoids a large stretch of the bed of Wiedou River and the alluvial fans associated with the tributaries draining from the south.

Table 7: Impact of Layout & Design on Aquatic Habitat

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**
Proposed Road						
Without mitigation	Local 1	High 3	Permanent 4	High 7	Definite 4	HIGH
With mitigation	No mitigation possible					

Alternative 1						
Without mitigation	Local 1	Low 1	Permanent 4	Medium 6	Definite 4	MEDIU
With mitigation	No mitigation possible					

Impact of Layout & Design on Fragmentation

Infilling of the incised confined channels will result in longitudinal fragmentation of these watercourses. To persist in any given landscape, most species move to recolonize habitats and maintain mixtures of genetic materials. Species also connect habitats through time if they possess needed morphological, physiological, or behavioural traits to persist in a habitat through periods of unfavourable environmental conditions. As these watercourses are highly intermittent it is unlikely that localised disruptions in connectivity will have a significant impact on the life history of aquatic organisms that are adapted to these systems. Organisms that inhabit these systems are typically rstrategists and rapidly complete parts of their life cycle when water is available. Terrestrial species (e.g. amphibians and insects) may also use temporary pools to rapidly complete phases of their life cycle. The dependence on connected aquatic systems is therefore expected to be low. Impacts are slightly lower under Alternative 2 as fewer watercourses are crossed.

Table 8: Impact of Layout & Design on Fragmentation

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	Low 1	Permanent 4	Low 5	Improbable 1	VERY LOW
With mitigation	No mitigation possible					
Alternative 1						
Without mitigation	Local 1	Low 1	Permanent 4	Medium 6	Improbable 1	VERY LOW
With mitigation	No mitigation possible					

Impact of Layout & Design on Aquatic Biodiversity

Given the highly intermittent flow regime of all watercourses, the aquatic biodiversity of the site is very low. The sites are likely to become important following heavy rainfall events when remaining temporary pools are likely to become important breeding sites for invertebrates and some vertebrates (e.g. amphibians).

Table 9: Impact of Layout & Design on Aquatic Biodiversity

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Possible 2	INSIGNIFICANT
With mitigation	No mitigation possible					
Alternative 1						
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT
With mitigation	No mitigation possible					

b) Construction Phase Impacts

Construction Phase Impacts on Hydrology

Given the aridity of the region, the impacts of the road construction on hydrology are expected to be negligible for both alternatives

Table 10: Construction Phase Impacts on Hydrology

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT
Alternative 1						
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT

Construction Phase Impacts of Geomorphology

Excavation of the road route will expose bare soil to the environment and could lead to high rates of erosion and sedimentation under heavy rainfall events. Given the extreme aridity of the environment it is however unlikely that this impact will materialise. The proposed road would require extensive work being conducted within and directly adjacent to the Wiedou River and therefore represents a high intensity impact should a rainfall event occur. Alternative 1 results in less impact as fewer drainage lines will be crossed and the route will remain outside of the bed, banks and riparian area of the Wiedou River.

Table 11: Construction Phase Impacts of Geomorphology

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	High 3	Short term 1	Very Low 4	Possible 2	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT
Alternative 1						
Without mitigation	Local 1	Medium 3	Short term 1	Very Low 4	Improbable 1	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT

Construction Phase Impacts on Water Quality

Construction vehicles used in the construction of the road will operate within watercourses at all crossings. Hydrocarbon spillages (from leaks or refuelling) can potentially contaminate the watercourses and may be mobilised further downstream during rainfall events. Impacts associated with Alternative 1 are higher as construction within a larger extent of the Wiedou River has the potential to mobilise pollutants at a more local scale.

Table 12: Construction Phase Impacts on Water Quality

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Possible 2	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT
Alternative 1						
Without mitigation	Local 1	Medium 3	Short term 1	Very Low 4	Improbable 1	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT

Construction Phase Impacts on Aquatic Habitat & Biota

Impacts of the alternative routes on loss of aquatic habitat and biota have been assessed under the Design and Layout Phase. Additional impacts associated with the construction phase involve the loss of additional habitat and biota as a result of disturbances (e.g. from construction vehicles and machinery) that occur outside of the 15 m wide road alignment. This includes the establishment of alien invasive plant species that may establish in disturbed soils and drainage lines.

Table 13: Construction Phase Impacts on Aquatic Habitat & Biota

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Possible 2	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT
Alternative 1						
Without mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable 1	INSIGNIFICANT

c) Operational Phase Impacts

Operational Phase Impact on Hydrology

Over time, accumulation of sediment and debris at road crossings may cause obstructions which could impede flow or cause alternative preferential paths that may lead to erosion.

Table 14: Operational Phase Impact on Hydrology

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	Low 1	Permanent 4	Medium 6	Possible 2	LOW
With mitigation	Local 1	Low 1	Permanent 4	Medium 5	Improbable 1	LOW
Alternative 1						
Without mitigation	Local 1	Low 1	Permanent 4	Medium 6	Improbable 1	LOW
With mitigation	Local 1	Low 1	Permanent 4	Medium 6	Improbable 1	LOW

Operational Phase Impact on Geomorphology

Over time, accumulation of sediment and debris at road crossings may cause obstructions which could cause alternative preferential paths that may lead to erosion of watercourses. For the proposed road, the location of a large section of the road within the bed and banks of the Wiedou River represents a large erosion risk should a large flood event occur.

Table 15: Operational Phase Impact on Geomorphology

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	High 3	Permanent 4	Very High 8	Definite 4	VERY HIGH
With mitigation	Local 1	High 3	Permanent 4	Very High 8	Definite 4	VERY HIGH
Alternative 1						
Without mitigation	Local 1	Medium 2	Permanent 4	High 7	Possible 2	LOW
With mitigation	Local 1	Low 1	Permanent 4	Medium 6	Improbable 1	LOW

Operational Impacts on Aquatic Habitat

Extensive earth works may manifest in invasions of alien plant species in watercourses after completion of the construction phase

Table 16: Operational Impacts on Aquatic Habitat

	Extent	Intensity	Duration	Consequence	Probability	Significance
Proposed Road						
Without mitigation	Local 1	Medium 2	Permanent 4	High 7	Possible 2	MEDIUM
With mitigation	Local 1	Low 1	Permanent 4	Medium 6	Possible 2	LOW
Alternative 1						
Without mitigation	Local 1	Low 1	Permanent 4	Medium 6	Possible 2	LOW
With mitigation	Local 1	Low 1	Permanent 4	Medium 6	Improbable 1	LOW

According to the Fresh Water Assessment study the proposed haul road linking Maskam/Welverdiend Mine to the processing plant will result in the crossing of several watercourses (the Wiedou River and tributaries of the Wiedou and Troe Troe rivers). The PES of these systems is generally high, ranging from C to A/B, indicating a relatively low level of anthropogenic impacts on these systems. Given the aridity of the environment and the highly intermittent nature of flow in these systems the EIS ranges from Low (for tributaries) to Moderate (for the Wiedou River).

Based on the impact assessment, Alternative 1 is regarded as the preferred option as this option crosses fewer tributaries, avoids the alluvial fans associated with tributaries draining from the south into the Wiedou River and also avoids a large section of the bed and banks of the Wiedou River. This alternative is consistent with the management objectives of aquatic CBAs which are to be maintained in a natural or near-natural state, with no further loss of natural habitat (the habitat loss associated with widening the existing road crossing is considered to be negligible). Only low-impact, biodiversity-sensitive land uses are appropriate.

The proposed road, which would involve widening an existing section of 2.3 km jeep track road in the bed of the Wiedou River, is not consistent with the management objectives for aquatic CBAs and is therefore not recommended.

1.4 Impact on ambient noise

The operational machinery will be a source of continuous noise throughout the operational phase. The crushing and screening activities during operational phase are identified as the highest noise producing source. Dump mining fleet vehicles working on loading and transporting of clinker-bearing material also result in increased noise. Clearing of bins when trucks enter the loading facility also result in ambient noise increasing. Various vehicles travelling on the access road leading to the offices and main operational complex will also contribute to ambient noise levels increasing. Conveyors also contribute to noise, although there's minimal noise sensitive receptors in the vicinity of this infrastructure.

Table 17: Significance of noise impact during operational phase

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	Medium 2	Short term 1	Very Low 4	Definite 4	LOW
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Probable 3	VERY LOW

Decommissioning and Closure Phases

The following activities during the decommissioning phase are identified as possible noise sources and may impact on the ambient noise level at the relevant noise sensitive receivers:

- Demolition and Removal of all infrastructure (incl. transportation off site),
- Reshaping of the area that was mined,
- Rehabilitation - spreading of soil, re-vegetation & profiling/contouring with heavy machinery,
- Aftercare and maintenance of rehabilitated areas.

The machinery involved with the above-mentioned activities will be a source of continuous noise throughout the decommissioning and closure phase. The results will be similar to that of the construction phase with regards to the expected noise levels, therefore it is probable that the noise from the proposed mining activities will be similar or lower to that of the current ambient noise levels at the indicated noise sensitive receivers.

Table 18: Decommissioning phase impacts

	Extent		Intensity	Duration	Consequence	Probability	Significance
	Operational Phase						
Without Mitigation	Local 1		Medium 2	Short-term 1	Very Low 4	Probable 3	VERY LOW
With mitigation	Local 1		Low 1	Short-term 1	Very Low 4	Probable 3	VERY LOW

1.5 Socio-economic impacts

New projects are known to bring changes to their surrounding human populations. It is therefore important that such changes be studied in detail to determine the impact the project will bring. The social and labour plan project will initiate Local Economic Development Programmes for the nearby community since in an effort to boost the socio-economic status of the area.

It is anticipated that 30 people will be employed as a result of the expansion of the operations and this will be a combination of permanent skilled operators and local workers will be employed at the site. The two proposed kilns will require +/- 12 each. The workforce will increase as production increases as the demand of the products grow.

Table 19: Significance of creation of employment and income

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	Medium 2	Medium term 1	Low 5	Probable 3	MEDIUM (Positive)
With mitigation	Local 1	Low 1	Medium term 1	Low 5	Definite 4	HIGH (Positive)

Table 20: Health impacts associated with the operations

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	High 3	Medium term 2	Medium 6	Probable 3	MEDIUM
With mitigation	Local 1	Low 1	Medium term 1	Low 5	Definite 4	LOW

The nuisance is expected to last a short while in which the ash dump will be completely removed at the end of operation and therefore restore the sense of place and aesthetic value.

Table 21: Potential safety impacts associated with crush machinery and movement of vehicles

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	High 3	Medium term 2	Medium 6	Probable 3	MEDIUM
With mitigation	Local 1	Medium 1	Medium term 3	Low 5	Probable 3	LOW

Table 22: Visual impact associated with the proposed operations

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	High 3	Medium term 2	Medium 6	Definite 3	MEDIUM
With mitigation	Local 1	High 1	Permanent 4	Very high 9	Probable 3	VERY HIGH (Positive)

Table 23: Potential safety impacts associated with crush machinery and movement of vehicles

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	High 3	Medium term 2	Medium 6	Probable 3	MEDIUM
With mitigation	Local 1	Medium 1	Medium term 3	Low 5	Probable 3	LOW

Socio-economic Cumulative impacts

Positive Cumulative Impacts

- Creation of permanent employment and skills and development opportunities for members from the local community and creation of additional business and economic opportunities in the area.
- Promotion of social and economic development and improvement in the overall well-being of the community
- At the completion of the project, the aesthetic value of the site will be restored as the site will not be having at ash dump any more.

Negative Cumulative Impacts

- Long term exposure of the workers to dust and uncontrolled emissions from the kils could give rise to potential illness in a long run.

1.6 Air Quality

The results of the dispersion modelling study show that the estimated maximum ground-level concentrations of all controlled pollutants emitted from the calciner only are well below the relevant ambient air quality standards. Should Cape Lime expand its operations by installing two additional calciners, the combined impact of the three calciners is expected to result in ground-level concentrations that will still be below the official air quality standards. However, as is shown in this report, the major sources of particulate emissions are the primary crusher and road traffic, and emission from these sources will have a major impact on air quality in the area.

Of the pollutants discussed in this study, ambient air quality standards for Hg are not available, there are standards for; PM10, CO, NO2 (a sub-set of NOx) are included and the limits are:

PM_{10}

Annual average:	40 µg/m3 , no exceedences
Maximum daily concentration:	75 µg/m3 , 4 exceedences

SO_2

Annual running average	50 µg/m3 , no exceedences
1-hour maximum	350 mg/m3 , 88 exceedences
NOx (as NO2)	
Annual average limit	40 µg/m3 , no exceedences
1-hour maximum	200 µg/m3 , 88 exceedences

TPM: No official ambient air quality standards exist in South Africa.

The number of exceedences mentioned is approximately 1% of the time, i.e. daily exceedences of 4 times per year are marginally more than 1% of the time (3.65). Similarly, 88 exceedences of hourly limits form approximately 1% of the total number of hours per year (1% of 8 760 is 87.6). As a result LAQS modelled 99-percentile concentrations to reflect the maximum level below which concentrations may occur for 1% of the time.

PM_{10} PARTICULATE MATTER

All sources:

The highest annual average ground-level concentration of PM10 is estimated to be 1 080 µg/m^3, i.e. significantly higher than the current ambient air quality level. This estimated maximum annual average concentration will occur immediately north of the primary crusher. The maximum 99-percentile daily ground-level concentration was shown to be 2 350 µg/m^3, also significantly higher than the current ambient air quality level. This estimated maximum annual average concentration will also occur immediately north of the primary crusher.

Calciner only:

Should emissions from the calciner be at the maximum allowed, the highest annual average ground-level concentration of PM_{10} is estimated to be 0.6 µg/m^3, i.e. well below the current ambient air quality level. This estimated maximum annual average concentration will occur approximately 600 m north-east of the calciner stack. The maximum annual average concentration, based on typical emissions, is estimated to be 0.4 µg/m^3. The maximum 99-percentile daily concentration was shown to be 4.9 µg/m^3, i.e. also well below the current ambient air quality level. This estimated maximum annual average concentration will occur approximately 1 860 m north-east of the calciner stack. The maximum annual average concentration, based on typical emissions, is estimated to be 3.5 µg/m^3.

SULPHUR DIOXIDE

Should emissions from the calciner be at the maximum allowed, the highest annual average concentration of SO_2 is estimated to be 4.5 µg/m^3, i.e. well below the current ambient air quality level. This estimated maximum annual average concentration will occur approximately 600 m north-east of the calciner stack. The maximum annual average concentration, based on typical emissions, is estimated to be 0.6 µg/m^3.

The maximum 99-percentile daily concentration was shown to be 61.0 µg/m^3, i.e. also well below the current ambient air quality level. This estimated maximum annual average concentration will occur approximately 1 860 m north-east of the calciner stack. The maximum annual average concentration, based on typical emissions, is estimated to be 4.8 µg/m^3 .

NITROGEN DIOXIDE

Should emissions from the calciner be at the maximum allowed, the highest annual average concentration of NO_2 is estimated to be 6.3 µg/m^3, i.e. well below the current ambient air quality level. This estimated maximum annual average concentration will occur approximately 600 m north-east of the calciner stack. The maximum annual average concentration, based on typical emissions, is estimated to be 1.7 µg/m^3.

Table 24: Operational Impact

	Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**
Operational Phase						
Without mitigation	Local 1	Medium 2	Short term 2	Low 4	Possible 2	LOW
With mitigation	Local 1	Low 1	Short term 2	Low 4	Improbable 1	VERY LOW

The maximum 99-percentile daily concentration was shown to be 70.8 $\mu g/m^3$, i.e. also well below the current ambient air quality level. This estimated maximum annual average concentration will occur approximately 1 860 m north-east of the calciner stack. The maximum annual average concentration, based on typical emissions, is estimated to be 13.0 $\mu g/m^3$.

As far as the calciners are concerned, i.e. the only activities regulated under Section 21 of the Air Quality Act, the estimated ground-level concentrations of the three pollutants are expected to be below that ambient air quality standards published in GN1210, should two additional calciners be commissioned.

Cumulative Impacts

Air quality

The mining activities will result in dust nuisance caused by excavations, stripping and stockpiling of top soil, loading and transportation of sand by trucks to clients.

1.7 Geohydrology

The industrial nature of the site and presence of several contaminant sources means that groundwater and surface water contamination may occur.

The risk can be mitigated by implementing monitoring of water quality along the down gradient boundary of the property and at points where groundwater discharge enters rivers

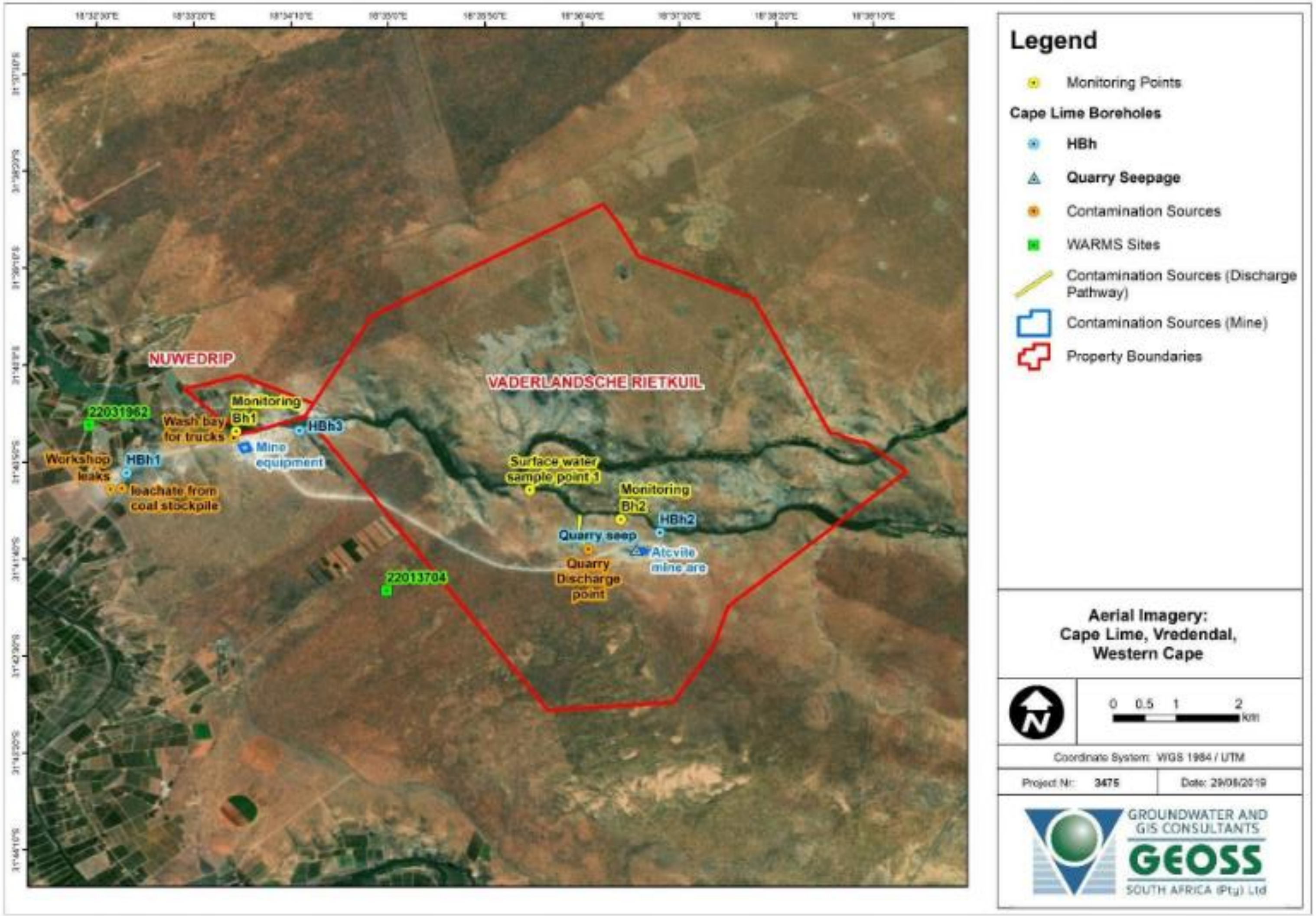

Figure 4: Potential Contamination sources and monitoring points

Removing and discharge groundwater into a surface water body

Increase risk of introducing contaminants into surface water body, should vehicle and equipment break downs and leaks occur in mine pit

Table 25: Removing and discharge groundwater into a surface water body

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	High 3	Long-term 3	Very High 8	Possible 2	HIGH
With mitigation	Local 1	Low 1	Short-term 2	Very Low 4	Improbable 1	INSIGNIFICANT

Cleaning of mine vehicle near river

Increase risk of introducing contaminants into surface water body.

Table 26: Cleaning of mine vehicle near river

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	High 3	Long-term 3	Very High 8	Possible 2	HIGH
With mitigation	Local 1	Low 1	Short-term 2	Very Low 4	Improbable 1	INSIGNIFICANT

Contamination of groundwater by leaching of coal stock piles

Leachate water from stockpiles may infiltrate into the ground water system

Table 27: Contamination of groundwater by leaching of coal stock piles

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	High 3	Long-term 3	Very High 8	Possible 2	HIGH
With mitigation	Local 1	Low 1	Short-term 1	Very Low 3	Improbable 1	INSIGNIFICANT

Contamination of groundwater by workshop leaks

Contaminants from onsite fuel and potential chemical storage

Table 28: Contamination of groundwater by workshop leaks

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	Low 1	Short-term 1	Very Low 3	Possible 2	INSIGNIFICANT
With mitigation	Local 1	Low 1	Short-term 1	Very Low 3	Improbable 1	INSIGNIFICANT

Agricultural Impact Assessment

It is inevitable that the proposed material extraction process will permanently impact on the site, not only during the life of the mine, but also after the closure of the mine as extracted material is removed from the site for processing. Due to extremely shallow nature of the topsoil there is surplus material available for topdressing mined areas. This is an inherent component of any opencast mining operation, particularly in areas without readily available topsoil. The social offset in this instance is not only the creation of employment at the site but also downstream employment in transport, kilns, administration and marketing. The economic offset is a contribution to Gross Domestic Product (GDP) from land that previously contributed nothing. Ecological damage to the Surface Working Area (SWA) of the site in the form of offices, accommodation, roads and material storage can be repaired once the life of mine has expired. Apart from nuisance dust, the material extraction process and activities in the SWA will have no impact, either positive or negative on the remainder of the Maskam property or the adjoining land parcels.

Impact on extraction site

Impact on the material extraction site will be long term, irreversible and severe. The impact on the surface working area will also be long term, but reversible and moderate. For the purpose of the table below, values derived from the material extraction site are used. The entire operation takes place within the context of presently vacant, unutilized arid rangeland that employs nobody. The long term economic and social benefits are positive in that food security will be provide for a number of families in the form of permanent employment.

Table 29: Impact on extraction site

	Extent	Intensity	Duration	Consequence	Probability	Significance
Operational Phase						
Without mitigation	Local 1	Medium 2	Long-term 3	Very High 9	Definite 4	High

With mitigation	Local 1	Medium 2	Long-term 3	Very High 9	Definite 4	High

Residual Impacts

The material extraction area can never be fully rehabilitated as the extracted material is removed from the site for processing elsewhere and therefore cannot be used as backfill. Areas where vegetation has been removed or damaged should be lightly ripped with a vlegploeg or similar implement in order to release buried seed and organic material. Locally collected seeds may be added. Re-colonisation will occur rapidly after the first rain. Other residual impacts are civil engineering and safety concerns etc. that will be addressed by others

Cumulative Impacts

The Nature of the Cumulative Impact Impact on the material extraction site is within the context of arid rangeland and even more arid mountains that extend from horizon to horizon. Apart from the existing N7 National Highway which passes by approximately 1.5 km away, there is no other development within 10 km of the site.

Preferred Route

According to the biodiversity study, the access road options to the Welverdiend mine, consideration should be given to the preferred route option, which is set back furthest away from the Wiedou River. It will result in the least impact on the river and its fauna due to dust, traffic and noise related issues. With mitigation, the impact on the local biodiversity and biodiversity network will be of low-medium significance. The impact will be long term to permanent, depending on rehabilitation success after the completion of mining activities.

Based on the Fresh Water impact assessment, Alternative 2 is regarded as the preferred option as this option crosses fewer tributaries, avoids the alluvial fans associated with tributaries draining from the south into the Wiedou River and also avoids a large section of the bed and banks of the Wiedou River. This alternative is consistent with the management objectives of aquatic CBAs which are to be maintained in a natural or near-natural state, with no further loss of natural habitat (the habitat loss associated with widening the existing road crossing is considered to be negligible). Only low-impact, biodiversity-sensitive land uses are appropriate.

Alternative 1, which would involve widening an existing section of 2.3 km jeep track road in the bed of the Wiedou River, is not consistent with the management objectives for aquatic CBAs and is therefore not recommended.

Crossings over the small drainage channels are also consistent with the management objective of ESAs which is to maintain them in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised. In this respect, road crossings in broad unconfined valleys are expected to be negligible. The lack of any serious erosion or other disturbances at existing road crossings (e.g. CL_5 and CL_9 to CL_11) provides evidence of this statement.