
Appendix F:

Impact Assessment



Environmental Management Group (Pty) Ltd

Specialists in Environmental Management Integrating Industry and Infrastructure with the Environment



Environmental
Management
Group (Pty) Ltd.

**IMPACT ASSESSMENT
FOR:**

Proposed Upgrade of the
DR3342 Between DR3463 Near
Gasese and N14 Near
Washington, Northern Cape
Province.

Prepared for:

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1. Introduction:

The social and environmental impacts assessment generated by the **Proposed Upgrade of the DR3342 Between DR3463 Near Gasese and N14 Near Washington, Northern Cape Province** is presented as the risk assessment methodology and associated results. This process aims to identify possible impacts associated with the proposed development and evaluate their significance to ensure appropriate mitigation is applied. The recommendations of suitable mitigation measures that should be implemented to reduce the consequences of likely impacts associated with the project have been formulated by industry best practice principles, professional experience, and relevant legislation.

2. Methodology:

Management and risk assessment plays a key role in the proponent's business. Managing the risks must be integrated into day-to-day business-related processes to ensure that both operational and strategic decisions are risk-based. The risk management system provides a framework to identify both threats and opportunities. The system then compensates and initiates resources that are allocated to treat the risks. It is required to review the risks as an ongoing process and then proceed to review the efficacy of the controls.

The risk assessment comprises quantifying the magnitude of potential impacts and the likelihood of these impacts to occur. The Consequence (**C**) and Likelihood (**L**) matrix combine the qualitative and or semi-quantitative ratings of consequence and the likelihood that a specific consequence will occur to calculate a risk score and risk rating (Equation 1). Essentially, the greater a probability of an adverse impact occurring, the greater the risk level associated with it will be.

C = Overall consequence

L = Likelihood of occurrence

Equation 1: Calculation of environmental significance.

$$\text{Environmental Significance} = C \times L$$

2.1. Determination of consequence:

Consequence analysis is a combination of quantitative and qualitative information, and the outcome can be positive or negative. Several factors can be used to determine consequence. For the purpose of determining the environmental significance in terms of consequence, the following factors were chosen:

- **Severity/Intensity;**
- **Duration;** and
- **Extent/Spatial Scale.**

Each factor is assigned a rating between 1 to 5, as described in the tables below.

- **Determination of intensity:**

Intensity relates to the nature of the event, aspect or impact to the environment and describes how intense a given aspect's impact on the biophysical and socio-economic environment will be.

Table 1: Rating criteria describing the intensity of a given aspect.

Type of criteria	Rating				
	1	2	3	4	5
Quantitative	0-20%	21-40%	41-60%	61-80%	81-100%
Qualitative	Insignificant / non-harmful	Small / Potentially harmful	Significant / Harmful	Great / Very harmful	Disastrous / Extremely harmful
Social/ Community response	Acceptable / I&AP satisfied	Slightly tolerable / Possible objections	Intolerable/ Sporadic complaints	Unacceptable / Widespread complaints	Totally unacceptable / Possible legal action
Irreversibility	Very low cost to mitigate/ High potential to mitigate impacts to level of insignificance / Easily reversible	Low cost to mitigate	Substantial cost to mitigate / Potential to mitigate impacts / Potential to reverse impact	High cost to mitigate	Prohibitive cost to mitigate / Little or no mechanism to mitigate impact / Irreversible
Biophysical (Air quality, water quantity and quality, waste production, fauna and flora)	Insignificant change / deterioration or disturbance	Medium change / deterioration or disturbance	Significant change / deterioration or disturbance	Very significant change / deterioration or disturbance	Disastrous change / deterioration or disturbance

- **Determination of duration:**

Duration refers to the amount of time the receiving environment will be exposed to a given aspect, risk or impact, given the absence of intervention/mitigation.

Table 2: Rating criteria for determination of duration

Rating	Description
1: Low	1 Month
2: Low-Medium	1 – 3 Months
3: Medium	More than 3 Months
4: Medium-High	5 – 10 Years
5: High	More than 10 Years

- **Determination of extent/spatial scale:**

Extent refers to the spatial influence of an impact, be it contained to the immediate surroundings (site), extending to the surrounding area, regional (will have an impact on the region), national (will have an impact on a national scale) or international (impact across international borders).

Table 3: Rating criteria for the determination of extent/spatial scale

Rating	Description
1: Low	Immediate, fully contained area (site)
2: Low-Medium	Surrounding area
3: Medium	Regional
4: Medium-High	National
5: High	International

- **Determination of overall consequence:**

The overall consequence is determined by calculating the sum of all impact factors described above and those summarised below, divided by the total number of impact factors (three) (Equation 2).

I = Intensity

D = Duration

E = Extent

n = number of factors

Equation 2: Calculation of overall consequence.

$$\text{Overall Consequence} = \frac{\Sigma(I+D+E)}{n}$$

- **Determination of likelihood:**

Likelihood refers to the probability of a given aspect/impact to occur given that no mitigation measures are implemented.

Table 4: Rating Criteria for the determination of likelihood.

Rating	Description
1: Low	< 30% chance of occurrence
2: Low-Medium	30% - 50% chance of occurrence
3: Medium	50% - 70% chance of occurrence
4: Medium-High	70 – 90% chance of occurrence
5: High	>90% of occurrence

2.2. Determination of overall environmental significance:

2.2.1. Quantitative analysis of the overall environmental significance:

The overall environmental significance is determined by multiplying the overall consequence (C) by the likelihood of occurrence (L) (Equation 1). The rationale of the overall environmental significance relates to identifying and quantifying the sum of environmental impacts arising from the proposed development and the recommendation of appropriate mitigation measures.

Table 5: Environmental significance evaluation score sheet.

Aspect	Specific	Low	Low-Medium	Medium	Medium-High	High
Environmental significance						
Overall Consequence x Overall Likelihood (Equation 1)		1-5	6-10	11-15	16-20	21-25

2.2.2. Qualitative description or magnitude of the environmental significance:

The qualitative description of environmental significance attempts to provide an indication of the nature and or magnitude associated with the proposed development. It also guides the prioritisation and decision-making process related to this event, aspect or impact.

Table 6: Rating criteria for impact significance.

Significance	Low	Low-Medium	Medium	Medium-High	High
Impact Magnitude	Impact is of very low order and therefore likely to have very little real effect. Acceptable.	Impact is of low order and therefore likely to have little real effect. Acceptable.	Impact is real, and potentially substantial in relation to other impacts. Can pose a risk to the company	Impact is real and substantial in relation to other impacts. Pose a risk to the company and environment. Unacceptable	Impact is of the highest order possible. Unacceptable. Fatal flaw.
Action Required	Maintain current management measures. Where possible improve.	Maintain current management measures. Implement monitoring and evaluate to determine potential increase in risk. Where possible improve	Implement monitoring. Investigate mitigation measures and improve management measures to reduce risk, where possible.	Improve management measures to reduce risk.	Implement significant mitigation measures or implement alternatives.

3. Impact assessment for the preferred alternative:

3.1. Ecological impacts:

Ecological impacts refer to those impacts that affect the natural biological, physical and chemical processes and interactions in the environment. These impacts result in alterations to ecosystem resilience (the ability to absorb future disturbances) and ecosystem services (such as air purification, water purification, food sources, recreational etc). Impacts may take the form of destruction of components (habitat loss), disruption of processes (chasing away of fauna) or even the introduction of foreign elements (alien and invasive species infestation). These impacts not only result in direct alteration of ecosystem functioning and provision of services but also cascade into indirect impacts (See section 4: Cumulative Impacts). It is thus imperative to prevent, wherever possible, and minimise, where not preventable, ecological impacts to preserve ecosystem functioning (including the ability to absorb disturbance events without subsequent ecosystem collapse).

Habitat loss								
Impact	Permanent alteration and destruction of natural habitats leading to impaired ecological functioning.							
Activities	- Physical clearance of vegetation - Habitat fragmentation leading to edge effects - Trampling - Accidental events such as fire - Loss of protected species							
Constructional Phase								
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance	
	Negative	2	2	2	2	4	8	Adjusted, to 5
Mitigation	- Removal of indigenous flora should be kept at a minimum. - No collection of plants other than for holding for use in rehabilitation is allowed. - Disturbance-related activities may only occur in the authorised area. - Vehicle movement should strictly be kept on designated dirt/gravel roads and/or bypasses. - Soil erosion mitigation measures need to be implemented. - Post-development open/barren areas should be revegetated and kept free of exotic plant species. - Vehicles may only move within the demarcated space of the development area. - Construction should be limited to the existing road reserve and should not encroach into the adjacent natural areas. - Construction within any of the watercourses should preferably be undertaken during the winter months (June to September) when flooding will be unlikely.							
After Mitigation		Severity	Duration	Extent	Consequences	Likelihood	Significance	
	Negative	1	2	1	1	4	4	
Operational Phase								
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance	
	Negative	2	1	2	2	3	6	
Mitigation	- Removal of indigenous flora should be kept at a minimum. - Disturbance-related activities may only occur in the authorised area. - Soil erosion mitigation measures need to be implemented. - Post-development open/barren areas should be revegetated and kept free of exotic plant species. - Construction within any of the watercourses should preferably be undertaken during the winter months (June to September) when flooding will be unlikely.							
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance	
	Negative	1	1	1	1	3	3	
Cumulative Impacts	Loss of local biodiversity. Incremental development leading to the eventual destabilisation of the ecosystem through the gradual loss of environmental units. Eventual ecological breakdown.							

Additional Notes:	The output of this impact assessment significance rating was adjusted to match that of the specialist report. The terrestrial ecological report did not mention mitigations during the operational phase of the development. While it is agreed and acknowledged that the development itself will not generate new risks to be mediated during its operational phase per se, mitigation measures should be implemented in the incidence of road maintenance.
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A terrestrial ecological assessment was conducted by a specialist (See appendix D of the BAR) in February 2025.

The overall expected disturbance is anticipated to be relatively small as the development entails the minimal expansion of an already transformed gravel road. Despite numerous past disturbances noted along the development footprint (anthropogenic movements, agricultural activities, infrastructure developments, illegal dumping, alien infestation etc) large areas were noted to have experienced little to no disturbance besides grazing (Appendix D of the BAR) and as such require minimisation mitigation wherever possible. Given that the proposed development is a linear activity and that it is proposed to occur on an already existing gravel road with a history of disturbances (thus minimising impacts compared to an alternative of situating the activity on an undisturbed area of land) the overall impact of the proposed development was anticipated to be **'low-medium'**. With the implementation of minimisation mitigation measures wherever possible, this could be further reduced to **'low'**.

The proposed activity entails the establishment of a permanent structure with a fixed footprint and does not produce any emissions thus it is not anticipated that the development should result in additional risks during the operational phase of development. However, in the incidence of maintenance several risks pertinent to the development phase again present themselves and require mitigation. While the anticipated risks associated with the maintenance is anticipated to be lower than the development itself (having a reduced spatial and time scale for instance), minimisation mitigation measures should still be employed to reduce the associated risk as far as possible (i.e. **'low'** pre-mitigation and **'low'** post-mitigation).

Loss of CBAs and ESAs								
Impact	The deterioration of sensitive habitats leading to the impaired ecological functioning.							
Activities	- Physical clearance of vegetation - Loss of protected species - Habitat fragmentation - Accidental events such as fire - Increased anthropogenic movement							
Constructional Phase								
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance	
	Negative	3	2	2	2	4	8	Adjusted to 5
Mitigation	- Limit the removal of vegetation in these CBA/ESA areas. - Low impact transplanting techniques must be utilised. - Vegetation and topsoil must be kept for use in rehabilitation. - Holding areas for plants must be demarcated and utilised. - Topsoil storage must be prevented from contamination and invasion by alien and invasive species. - General works should, where possible, take place from the edge of the existing road to the side opposite a watercourse. In cases where the watercourses intersect the road, care must be taken to limit the distance across affected by construction activities. - No heavy machinery or material storage should occur on the side closest to a water course or within 100m of a watercourse.							

	• A comprehensive fire management plan needs to be drafted prior to construction. • Removal of indigenous flora should be kept at a minimum. • Disturbance related activities may only occur in the authorised area. • No unnecessary clearance of vegetation or topsoil may take place outside of the development area. • No other activity than that authorised may be taken within the authorised area. • Where possible, indigenous vegetation removed from the development area must be transplanted in other neighbouring areas to try and improve or re-establish ecological functioning. • Post-development open areas should be revegetated and kept free of exotic plant species. • Vehicles may only move within the demarcated space of the development area. • Soil erosion mitigation measures need to be implemented. • Construction within any of the watercourses should preferably be undertaken during the winter months (June to September) when flooding will be unlikely.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	1	1	1	3	3
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	1	2	2	3	6
Mitigation	• Removal of indigenous flora should be kept at a minimum. • Limit the removal of vegetation in these CBA/ESA areas. • Disturbance-related activities may only occur in the authorised area. • Soil erosion mitigation measures need to be implemented. • Post-development open/barren areas should be revegetated and kept free of exotic plant species.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	1	1	1	1	1
Cumulative Impacts	The deterioration of ESAs leading to the subsequent deterioration of CBAs. The loss of ecosystem services offered by either CBAs or ESAs. Deteriorated resilience of the ESAs and CBAs. Subsequent alteration of surrounding ecosystems and habitats. Loss of biodiversity.						
Additional Notes:	The output of this impact assessment significance rating was adjusted to match that of the specialist report.						

Ecosystem support areas are areas which play a vital role in providing ecosystem functions and preventing the degradation of critical biodiversity areas (CBAs). They can be either aquatic (riverine environments supporting surrounding CBAs) or terrestrial (riparian habitats). CBAs can also be either terrestrial or aquatic and play a critical role in preserving ecological processes and meeting biodiversity targets.

According to the terrestrial ecological assessment, the proposed development area does not fulfil the requirements of constituting either a CBA (remaining in a largely natural ecological condition) or ESA (at least semi-natural ecological condition) from a terrestrial perspective largely on account of the already extensive modification of the current road surface. The CBAs and ESAs noted to be present in close proximity to the development footprint (or traversed by the development footprint) are largely, however, associated with the watercourses (predominantly ephemeral). To ensure conservation of these systems, no serious modification of these systems may take place by the proposed road modification.

Given that the scope of the proposed development is largely limited to the already existing gravel road as well as the inadequacy of the current culverts to provide sufficient flow capacity it is not anticipated that the proposed development will have a significant impact on the ESAs or the CBAs, above the current disturbances. Hence a '**low-medium**' risk score has been attributed. However, given the importance of ESAs and CBAs for ecosystem functioning and the continued provision of ecosystem services, impacts should be minimised as far as possible

and no activity may result in the modification of the watercourses and associated riparian habitats which make up the CBAs and ESAs. The risk score can accordingly be reduced to **'low'** risk if the mitigation measures are implemented.

As with the risks anticipated with habitat destruction the development entails the establishment of a permanent structure with a fixed footprint which does not produce any further emissions. Thus it is not anticipated that the development should have impacts during the operational phase in addition to the risks associated with the construction phase of development. However, in the incidence of maintenance several risks pertinent to the development phase again present themselves and require mitigation. While the anticipated risks associated with the maintenance is anticipated to be lower than the development itself (having a reduced spatial and time scale for instance), minimisation mitigation measures should still be employed to reduce the associated risk as far as possible (i.e. **'low'** pre-mitigation and **'low'** post-mitigation).

Loss of indigenous floral and faunal diversity							
Impact	Loss of indigenous vegetation and subsequent stable networks of energy transfer. Loss of localised fauna.						
Activities	- Physical clearance of vegetation - Loss of protected species - Trampling - Habitat fragmentation - Accidental events such as fire, oil spills etc - Unlawful harvesting of plants - Unlawful hunting/ poaching of animals - Road mortalities						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	2	2	2	2	4
Mitigation	- Development may only occur within the clearly demarked area. - Monitoring for the emergence of exotic species should be conducted. - An alien invasive species management plan must be drafted in the incidence of exotic species. - Vehicle movement should remain within the authorised boundaries. - A comprehensive rehabilitation plan must be adhered to. - No unnecessary destruction or removal of vegetation is allowed. - Wildlife elements such as nests and burrows should be carefully inspected, and animals responsibly removed by a relevant specialist. - Post-development open areas should be revegetated and kept free of exotic plant species. - Any other relevant recommendations listed in this report should be implemented. - An alien and invasive management plan (AIMP) should be developed to avoid the possibility of invasions and supply eradication techniques should they arise in the development area.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	2	1	1	1	1
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	2	2	2	2	4
Mitigation	- Ensure all construction residue has been removed at the end of the construction phase. - Ensure the sloping towards the road is smooth/to an acceptable angle. - An alien and invasive management plan (AIMP) should be developed to avoid the possibility of invasions and supply eradication techniques should they arise in the development area. - Quarterly alien and invasive species monitoring should take place according to the AIMP.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	2	1	1	1	1

Cumulative Impacts	Disturbance of established ecosystems. Deterioration of ecosystem functioning. Loss of biodiversity.
Additional Notes:	

As noted in the Terrestrial Ecology Assessment Report (Appendix 3), indigenous vegetation and fauna have greater conservation value on account of the established stable networks of energy transfer. Given their adaptations to their particular environments and ecosystems, they interconnect to produce a stable network which through feedback loops provides the ability to absorb disturbances while maintaining vital ecosystem functioning. The introduction of alien invasive vegetation and species which are not adapted to these ecosystems threaten to outcompete indigenous species, upsetting the stability of the ecosystems and in extreme cases reducing the biodiversity in the ecosystems such that they are more prone to deterioration and less capable of absorbing disturbances and providing ecosystem services.

On account of the alien and invasive vegetation in the development area being restricted and the migration of localised fauna from construction areas being temporary it was regarded that the proposed development poses a '**low**' risk to indigenous floral and faunal diversity even without mitigation measures. The score (while still '**low**') can still be further reduced, however, by the implementation of several mitigation factors.

While the development itself is not anticipated to generate new risks during the operational phase of development, some of the risks associated with the loss of indigenous flora and fauna may continue into the operational phase of development particularly if not mitigated during the construction phase of development (e.g. in the incidence that invasive vegetation is not removed they will continue to compete with indigenous vegetation). These risks while '**low-medium**' can be further reduced to '**low**' if the mitigation measures are implemented.

Loss of floral and faunal species of conservation concern							
Impact	Destruction of species of conservation concern. Loss of biodiversity						
Activities	• Clearance of vegetation • Loss of protected species • Habitat fragmentation • Poaching, unlawful hunting and gathering of plants and animals • Careless and reckless behaviour • Trampling • Accidental road mortalities • Accidental events such as fire etc.						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	3	2	2	3	6
Mitigation	Prior to development • A thorough walk-through of the study area by a qualified botanist should occur to locate any potential SCC/protected species. • All staff should be trained on SCC/protected species, observations of SCC/protected species and the reporting procedure. • In the case of SCC observations, a GPS co-ordinate and photo must be recorded by the onsite environmental officer and supplied to the associated qualified botanist. • On-site environmental and health and safety officers must report any observations of CC/protected species to a qualified botanist and apply the recommended buffer area for that SCC/protected species. • Protected plant species should be located and demarcated. • Removal or relocation of the SCC are prohibited without the appropriate permits. • DAERL should be consulted with regard to the feasibility of transplanting or removing provincially protected species.						

	- Removal or transplant permits from DAERL must be obtained for all provincially protected flora. - If DAERL indicates transplant or relocation of some of the provincially protected flora, a formal relocation management plan should be drafted and implemented. - Vehicle movement should strictly be contained on designated roads. No off-roading must be allowed. - No harvesting of plant material allowed. - The presence of alien and invasive species needs to be monitored and eradicated quarterly. Construction - The relocation plan should be strictly supervised by a qualified botanist. - All construction staff should be informed on SCCs and protected species or species of special conservation concern. - A relevant specialist should be notified when any of the mentioned SCC and protected flora are observed during construction. - All disturbance-related activities must be restricted to the authorised development boundary. - No illegal harvesting of plant material is allowed. - All damage-causing activities should strictly be restricted to the authorised development area.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	1	1	1	2	2
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	2	2	2	3	6
Mitigation	The presence of alien and invasive species needs to be monitored and eradicated quarterly.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	1	1	1	2	2
Cumulative Impacts	The loss of rare and vulnerable species. Loss of biodiversity. Secondary deterioration of biodiversity through the loss of species engaging in species specific interactions with species of conservation concern.						
Additional Notes:							

As noted in the Terrestrial Ecology Assessment report, species of conservation concern are so declared on account of various population declining factors such as urban expansion, the loss of species-specific symbiotic relationships, innately small population sizes and historical habitat loss. While the feasibility of transplanting protected flora must be determined in correspondence with DAERL following a pre-development identification process by a qualified botanist, the anticipated impact on the loss of floral species of conservation concern is anticipated to be **‘low-medium’**. This is partly on account of the limited extent of the proposed development (entailing largely the modification of an already existing transformed area) as well as the reversibility of the loss of species of conservation concern by active rehabilitation. Following the mitigations proposed, however, would further reduce the risk associated with the loss of species of conservation concern, thus rendering the risk to be **‘low’**.

While the development itself is not anticipated to generate new risks during the operational phase of development, some of the risks associated with the loss of species of conservation concern may continue into the operational phase of development particularly if not mitigated during the construction phase of development (e.g. in the incidence that invasive vegetation is not removed they will continue to compete with indigenous vegetation including species of conservation concern). These risks while **‘low-medium’** can be further reduced to **‘low’** if the mitigation measures are implemented.

3.2. Heritage:

The phase 1 Heritage Impact Assessment (HIA) takes into consideration archaeological/cultural as well as palaeontological artefacts and sensitivities in assessing the potential impact the development may have to the collective heritage of South Africa.

Archaeological and Heritage Resources							
Impact	Destruction of archaeological and heritage resources such as remains and graves.						
Activities	- Grubbing - Trenching						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	4	5	1	4	1	4
Mitigation	Implement traffic control to ensure that commuters remain in bypasses in the development area and do not create bypasses adjacent to the development area.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	N/A					
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	4	5	1	3	1	3
Mitigation	Institute a maintenance plan for the upkeep of the road to prevent commuters from creating by-passes thus destroying potential undiscovered artefacts adjacent to the proposed development area.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	N/A					
Cumulative Impacts	The gradual loss of artefacts, cryptic graves, (and structures) of value to both local and national heritage.						
Additional Notes:							

A Phase 1 Heritage Impact Assessment was conducted of the proposed development area in February 2025.

During the HIA it was found that while the area did occasionally yield Stone Age archaeological assemblages, rock engravings reflecting Late Stone Age/Iron Age frontier interaction, stone wall enclosures and stone-walled settlements, the proposed development area itself had no indications of:

- Stone Age archaeological material, capped or distributed as surface scatters on the landscape
- rock art (engravings)
- stone-walled structures
- graves
- historically significant buildings older than 60 years within the boundaries of the footprint corridor.

Therefore, while it was indicated in the HIA that the likely risk associated with the proposed development on archaeological resources would be '**negligible**', in a pre-mitigation scenario in which the bounds of the development area are not enforced, there exists the potential (albeit unlikely) possibility of the creation of bypasses or disturbance beyond the assessed development footprint. As this could result in the destruction of archaeological resources an associated risk of '**low**' is attributed to a pre-mitigation scenario. If the development footprint is adhered to, however, the risk becomes '**negligible**'.

Palaeontological Resources							
Impact	Destruction of undiscovered artefacts of palaeontological significance.						
Activities	- Grubbing - Trenching						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	4	5	1	3	1	3
Mitigation	- Implement traffic control to ensure that commuters remain in bypasses in the development area and do not create bypasses adjacent to the development area. - Implement the chance finds protocol included in the HIA. - Train all construction personnel (and new personnel) on the contents of the chance finds protocol during toolbox talks.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	1	1	1	1	1
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	4	5	1	3	1	3
Mitigation	Institute a maintenance plan for the upkeep of the road to prevent commuters from creating by-passes, thus potentially (albeit improbably) destroying any palaeontological artefacts alongside the road.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	N/A					
Cumulative Impacts	The destruction and loss of artefacts of palaeontological significance. Loss of artefacts which contribute to a sense of national identity.						
Additional Notes:							

Per the HIA, which includes an investigation into the palaeontological heritage resources in the development area, the development footprint lies within an outcrop area of Ghaap Group carbonate rocks, consisting of stromatolite-bearing dolomite, dolomitic limestone and chert members. The development footprint, however, consists of predominantly severely degraded surface limestone, calcretes and windblown sand from construction and maintenance activities associated with the current road. As such the HIA indicated a **'low'** risk associated with the proposed development. As with consideration of archaeological heritage, there exists, albeit unlikely, a pre-mitigation possibility in which the creation of bypasses or disturbance beyond the assessed development footprint results in the destruction of palaeontological resources. As such an associated risk of **'low'** is attributed. If the development footprint is adhered to, however, the risk becomes lower, while still ascribed a score corresponding to a **'low'** risk.

3.3. Water resources:

A specialist conducted a Wetland Assessment of the area of the proposed development to confirm, identify and delineate the watercourses that might be impacted by the proposed development in both the construction and operational phases. Biodiversity Sensitivity Ratings were determined with recourse to numerous factors such as:

- Habitat diversity and species richness
- Presence of rare and endangered species
- Ecological function
- Degree of rarity/conservation value
- Percentage ground cover
- Vegetation structure
- Infestation with exotic weeds and invader plants
- Degree of grazing/browsing impact
- Signs of erosion
- Terrestrial animals

An Index of Habitat Integrity (IHI) was conducted for the main river system (the Kuruman River) into which all of the other sampled watercourses drain into. The IHI was to serve as a representative of the other smaller watercourses. To improve the accuracy of the determination made by the IHI a WET-Health Assessment was conducted on the floodplain wetland system associated with the Manyeding River to determine the Present Ecological State (PES).

A Risk Assessment Matrix (RAM) was conducted which considered the current condition of the watercourses, the anticipated scale of impact of the proposed development in terms of the size, severity and duration as well as the importance on the particular watercourses.

In assessment of the watercourses proposed to be traversed by the development footprint, the watercourses were found to be in good condition but with significant disturbances present. Several watercourses proposed to be crossed by the proposed development (and riparian habitats) are noted to be categorised as Ecological Support Areas (ESAs) in the Northern Cape Bioregional Plan while in one stretch the proposed development crosses into a region categorised as a Critical Biodiversity Area (CBA) 2, comprising the 500m buffer of a pan categorised as a CBA 1.

The majority of the watercourses assessed in the Wetland assessment are strictly ephemeral watercourses, only displaying surface water during rainy seasons. Furthermore, the assessed watercourses display numerous significant disturbances such as the existing road and reserve, overgrazing and presence of settlements. In spite of this they are noted to be in good condition, with moderate habitat and species diversity and fair ecological function.

The Index of Habitat Integrity (IHI) conducted on the Kuruman River revealed an Instream IHI of Category C: Moderately modified and a Riparian IHI of Category C: Moderately modified. The WET-Health assessment conducted on the Manyeding River indicated a PES Category of C.

Ground and Surface Water Quality							
Impact	The deterioration of ground and surface water quality.						
Activities	- Construction activities leading to runoff of pollutants into watercourses. - Disturbance of bed and banks of watercourses promoting sedimentation.						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	3	3	2	3	4	12
Mitigation	- No littering may be allowed. All litter must be removed from the site - The timeframe for construction through the watercourses should be kept to a minimum. - Construction should be limited to the existing road reserve. - The construction site must be inspected for erosion (erosion preventative and corrective measures must be implemented where appropriate). - The soil surface should be re-instated to the virgin soil level and not depressed or elevated as this will promote erosion and cause flow barriers. - After rehabilitation any excess soil or material should be removed and disposed of at a registered disposal facility. - The watercourse bed and bank morphology should also be re-instated as far as possible, which will also speed up the stabilisation of the bed and banks. - Where concrete is utilised the detrimental impacts of uncured cement on watercourses must be taken into consideration. - Construction within any of the watercourses should preferably be undertaken during the winter months (June to September) when flooding will be unlikely. - Compliance monitoring should be implemented.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	3	2	2	3	6
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	2	1	2	2	4
Mitigation	- After construction of the road section, the area must be rehabilitated. This includes removal of all construction material. Excavated rock may not be left in heaps and must be removed and disposed of at a registered facility. - Compacted areas must be ripped. Construction roads not being utilised must afterwards be rehabilitated.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	1	1	1	2	2
Cumulative Impacts	The deterioration of water quality by introduction of pollutants associated with construction and sedimentation associated with alteration of bed and banks of watercourses will lead to the decline of aquatic organisms as well as organisms which depend on them (food sources, pollination etc.). Impaired aquatic community structures will reduce the watercourses capacity to buffer disturbances and provide ecosystem functions.						
Additional Notes:							

In assessment of the likely risks associated with construction including disturbance, and excavation of the watercourses the RAM indicated a **‘medium’** risk. The findings of the RAM also informed the pre-mitigation scenario in which the risk associated on ground and water quality was found to be **‘medium’**. There were, however, no fatal flaws identified, and with the implementation of the proposed mitigation measures it is anticipated that the risk associated with the proposed development can be reduced to **‘low-medium’**. The importance, and therefore sensitivity of the watercourses must, however, be stressed. As such the mitigation of conducting compliance assessments during construction is crucial.

While there is not anticipated to be any new risks generated by the proposed development during the operational phase of development, periodic maintenance may entail new disturbance. This was assessed in the RAM to have a **‘low’** associated risk, largely on account

of the reduced scale. This can be reduced further by the implementation of the mitigation measures also applicable to the construction phase.

Aquatic and Riparian Ecosystems							
Impact	The deterioration of biodiversity through the direct removal of species and the accidental introduction of alien and invasive species which outcompete indigenous fauna.						
Activities	• Grubbing • Clearing • Movement of construction workers and vehicles. • Construction activities leading to runoff of pollutants into watercourses. • Disturbance of bed and banks of watercourses promoting sedimentation.						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	3	3	2	3	4	12
Mitigation	• Adequate monitoring of weed establishment and its continued eradication must be maintained. • Problematic weeds must be eradicated where these establish on the proposed road section. • The timeframe for construction through the watercourses should be kept to a minimum. • Any disturbance and removal of vegetation within these watercourses should be kept to a minimum. • Construction should be limited to the existing road reserve. • Weed eradication should be initiated at the construction site prior to construction and be continued until rehabilitation of the road reserve has been completed. • When excavating through any of the watercourses, the upper 30 cm, or topsoil, should be removed together with the vegetation and stored as sods on the site. These should then be replaced when rehabilitating the construction area. • Subsoil should be used as backfilling and not as top dressing. Only removed sods and topsoil should be utilised to rehabilitate the soil surface. • Compliance monitoring should be implemented.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	3	2	2	3	6
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	4	1	2	2	4
Mitigation	• Weed eradication should be initiated at the construction site prior to construction and be continued until rehabilitation of the road reserve has been completed.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	1	1	1	1	1
Cumulative Impacts	Grubbing and clearing in the riparian and immediate terrestrial habitats will result in the loss of aquatic biodiversity. The disturbance of soils may result in the proliferation of alien and invasive vegetation. The loss of biodiversity through active clearing as well as the indirect loss of biodiversity by introducing greater competition for resources in the form of alien and invasive vegetation, will result in impaired ecosystem functioning. This will make the aquatic ecosystems less capable of absorbing disturbances and less capable of supporting ecosystem functions.						
Additional Notes:							

The risks associated with the active removal of vegetation from both the road reserves as well as the riparian habitats which includes the secondary impacts of promoting erosion, sedimentation and the establishment of exotic weeds was also assessed in the RAM. It was determined that the risk associated with the clearing of vegetation within the road reserve was lower (**‘low’**) than the removal of riparian vegetation (**‘medium’**). This was also integrated into the pre-mitigation scenario in which it was determined that the overall risks associated with vegetation clearance (integrating both riparian and terrestrial vegetation) was **‘medium’**.

There were, however, no fatal flaws identified and with the implementation of the proposed mitigation measures it is anticipated that the risk associated with the proposed development can be reduced to '**low-medium**'. As with consideration of risks to the ground water and surface water quality, the importance, and sensitivity of the watercourses must, be stressed and as such the mitigation of conducting compliance assessments during construction is crucial.

3.4. Aesthetics:

The aesthetic theme is focused on the alteration of the visual characteristics of the area and overall impact on landscape appreciation. Landscape appreciation is inherently subjective with few metrics allowing for an objective impact assessment. However, several aspects concerning visual impacts associated with road developments may be objectively assessed. These include development size, aesthetic deterioration due to construction, and line of sight distance.

Aesthetic degradation associated with construction activities.							
Impact	The construction of paved roads over the current footprint of the gravel roads.						
Activities	- Grubbing and clearing. - Trenching. - Stockpiling. - Movement of construction vehicles. - Road surface preparation.						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	3	2	2	4	8
Mitigation	- Limit construction activities to the development footprint. - Implement house-keeping practices in which attention is given to neat storage of materials. - Do not grub or clear beyond the operational area. - Implement rehabilitation methods where possible during construction activities. - Implement good house-keeping practises						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
		1	2	1	1	4	4
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	5	1	2	2	4
Mitigation	Institute a maintenance plan for the upkeep of the road to prevent commuters from creating by-passes, thus increasing the surface area the gravel road.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
		1	5	1	2	1	2
Cumulative Impacts	The aesthetic quality of the area would be reduced leading to a decrease in quality of living for the local residents and commuters.						
Additional Notes:							

The proposed development entails the construction of a road over the footprint of an already existing gravel road, as such the aesthetic implication is not necessarily a negative one. However, while it could be argued that the upgrading of the gravel roads to paved roads, including the associated curbing, could constitute an aesthetic improvement as this would reduce the overall service area, by limiting motorists from extending the driving surface of the road, there are some risks still associated the aesthetic quality of the proposed development.

If, during the construction phase attention is not paid to housekeeping practises, the limitation of the construction footprint is not abided to, and clearance and construction activities extend

beyond that of the what can be feasibly maintained then the aesthetic quality of the area could be significantly reduced such that a score corresponding to at least a '**low-medium**' is attributed to the pre-mitigation construction phase. If, however, good housekeeping practises are implemented, construction activities are limited to the construction footprint, and construction activities such as clearing, grubbing and trenching do not extend beyond what can be feasibly maintained, a risk score corresponding to '**low**' risk can be ascribed to the post mitigation construction phase.

On account of the proposed development entailing a road with a fixed surface area which is maximally disturbed during the construction phase and then at best maintained during the operational phase it is highly unlikely that there should be any further deterioration of the aesthetic quality of the area, provided that the road is maintained. If the road is not maintained, however, its eventual deterioration would also result in the deterioration of the aesthetic quality of the area. As such while argued to have a risk score associated with a category of '**low**' for the pre and post mitigation operational phase of the proposed development instituting a maintenance plan would still reduce the risk score attributed to the pre-mitigation operational phase.

3.5. Air quality, noise and vibrations:

Noise and air quality assessments are based upon the type of equipment being used during a specific activity and the degree of disturbance that will occur. This will have repercussions to the surrounding vegetation, wildlife, domestic animals and people.

Mitigation	Generation of exhaust fumes and particulate matter						
Impact	The degradation of air quality on account of gases from construction vehicles and aerosolized particulate matter. Road accidents associated with obstruction of view.						
Activities	- Dust generation associated with construction activities. - Exhaust fume generation associated with construction vehicle activity.						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	3	2	2	4	8
Mitigation	- Dust suppression methods such as watering down of bare surfaces. - Regular maintenance of construction vehicles to ensure minimal exhaust emissions. - Minimising the clearance of vegetation to the active construction area. - Implement a curfew of only operating between the hours of 7:00 and 17:00. - Active revegetation of cleared areas immediately after construction.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	2	1	1	2	2
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	5	1	2	4	8 Adjusted to 2
Mitigation	N/A						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	5	1	2	4	8 Adjusted to 2
Cumulative Impacts	The reduction in air quality could lead to respiratory ailments of people and fauna, as well as a decline in vegetation (in the incidence of excessive particulate matter).						
Additional Notes:							

The primary contributor to the degeneration of air quality in the area (and its immediate surroundings) of the development on account of the generation of exhaust fumes and particulate matter associated with the utilisation and movement of construction vehicles. While

the project's scope is relatively small and in an open environment which would entail the fast diffusion of fumes produced, if no mitigation measures are implemented this could still result in detrimental effects on vegetation growth, as well as on the health and living standards of the local community and construction workers. Additionally, obfuscation of oncoming traffic by dust clouds may increase the chances of road accidents. Thus, a risk score corresponding to at least a **'low-medium'** risk is attributed to the pre-mitigation construction phase of the proposed development. If, however, the mitigation measures are implemented, constant dust generation would be minimized and the anticipated risk score of the post mitigation construction phase would correspond to a **'low'** risk score.

The proposed development necessarily entails the utilisation of the development by future commuters. Furthermore, given the number of mines in relatively close proximity to the proposed road as well as its strategic location in connecting the R31 and N14, the possibility exists that the road will be utilised by an increasing number of trucks. While this contingency has been taken into consideration in the designs concerning safety and long-term structural integrity, this will inevitably result in an increase in exhaust emissions. While there are no potential active mitigation measures to reduce the amount of exhaust fumes generated by the motorists, the risk associated with the generation of exhaust fumes is not expected to be high and given an amended score of **'low'**. The initial score was reflected as being **'medium'** largely on account of its high likelihood given the inevitability of an increase in exhaust fumes in the local area. This was amended to be **'low'** on account of there not being a net greater amount of exhaust fumes being generated, rather, motorists that would be generating exhaust fumes while driving on alternative routes will make use of the upgraded road instead. Additionally, the communities are a sufficient distance from the road such that exhaust fumes should dissipate before becoming a significant concern for nearby communities.

Noise and Vibrations									
Impact	Noise generated associated with construction activities causing a disturbance to local residents resulting in reduced standards of living.								
Activities	- Noise associated with construction vehicles. - Noise associated with construction activities. - Noise associated with construction workers. - Noise associated with motorists.								
Constructional Phase									
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance		
	Negative	2	3	2	2	4	8		
Mitigation	- Implement a curfew of only operating between the hours of 7:00 and 17:00. - Ensure regular maintenance of construction vehicles and equipment to limit noise produced.								
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance		
	Negative	1		2	2	4	8	Adjusted to 1	
Operational Phase									
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance		
	Negative	2	5	1	3	5	15	Adjusted to 5	
Mitigation	Implement signage and speed bumps to control the acceleration and speed of commuters which will reduce noise associated with the utilisation of the road by commuters.								
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance		
	Negative	1	5	1	2	5	10	Adjusted to 1	
Cumulative Impacts	The degradation of standard of living associated experienced by local residents on account of excessive noise.								
Additional Notes:									

While it is not anticipated that a large degree of vibrations will be produced by the proposed development, noise may, in the absence of mitigation measures become a nuisance to the local community. This, is, therefore, given a risk score which corresponds to a **'low-medium'** risk a pre-mitigation scenario for the construction phase. In the incidence of mitigation measures that would reduce the noise generated as far as possible and limit construction activities to within the permitted time frames (Section F6 of SANS 10400, 2010) this risk score can be reduced.

A score correlated to a **'low-medium'** risk was initially reflected on account of the inevitability and permanence of noise generated associated with the proposed development. This was however adjusted to a score correlating to **'low'** risk on account of the relative distance between the proposed development and the neighbouring communities.

Noise will further be inevitably produced by the traffic of commuters who make use of the proposed development. This may increase on account of the strategic positioning of the road in connecting the R31 and the N14, particularly given the number of mining trucks which utilise the road. A score correlated to a **'medium'** risk was initially reflected on account of the inevitability and permanence of noise generated associated with the proposed development, however adjusted to a score correlating to **'low'** risk on account of the relative distance between the proposed development and the neighbouring communities.

3.6. Socio-economic:

Socio-economic impacts focus on the effects the development will have on the economic drivers in the surrounding area as well as emphasising the integration of economic development concerning the needs of the people. It also looks at the potential ramifications that the proposed development may have on the well-being and livelihoods of communities and individuals impacted directly and indirectly by the proposed development.

Job creation and the influx of job seekers							
Impact	Dissatisfaction of community members and opposition to the development on account of the impression of unfair recruitment and procurement practices.						
Activities	- Procurement Practices - Recruitment Practices						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	3	3	2	3	2	4
Mitigation	Ensure fair recruitment practices in which where locals workers and service providers are utilised wherever possible.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	3	2	2	1	2
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	3	2	2	2	4
Mitigation	Ensure fair recruitment practices in which where locals workers and service providers are utilised wherever possible in the maintenance of the roads.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	1	3	2	2	1	2
Cumulative Impacts	Deterioration in trust and communication between community members, local service providers, and the local municipality, which may lead to retardation of future community developments and programmes compromising prompt service delivery.						
Additional Notes:							

Socio-economic impacts can be multifaceted depending on how the employment and procurement process is conducted. The development, if employing as far as possible local employees and service providers, would be a definite positive impact to the local community. If driven in a way perceived as unfair by the local community, however, the perception of the development can be a negative impact resulting in resistance from community members, which would be regarded as negative socio-economic impact. Given that protest action over the perception of unfair recruitment practises may result in delayed development, this could hold at least a **'low-medium'** risk. This can be readily reduced to a **'low'** anticipated risk, however, by utilising local workers and service providers wherever possible.

While no permanent workers are anticipated to be utilized in the operational phase of the development, temporary workers may be utilised during the maintenance of the road, for which the same principles of fair procurement and recruitment practises hold. Together with the institution of a maintenance plan, the risk score associated with **'low'** risk can be further reduced.

Relocation of a Property							
Impact	Relocation of individuals						
Activities	- Requesting permission for the relocation of one property implicated in the re-alignment of an intersection. - In the incidence of permission being obtained, facilitating the relocation of the property owner.						
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	4	5	1	3	5	15
Mitigation	- Adequate public participation. - Fair appraisal of property worth and timeous compensation. - Provision of an alternative location. - Sufficient time provided to re-establish in another location.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	3	5	1	3	5	15
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	N/A						
Mitigation	NA						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	N/A						
Cumulative Impacts	(Only in the incidence mitigations not being implemented). The loss of a safe location for individuals to live. Secondary ramifications on health, job security and general well-being.						
Additional Notes:							

In the subsequent re-alignment of the intersections to ensure that safety standards are maintained, the development area will be traversing one property with a permanent structure. Ongoing consultation and discussion will be required with the occupants to obtain permission to relocate them to a different area. Fair compensation to at least the value of loss will need to be determined and agreed upon. Complete relocation of the occupants to an equally safe area will need to take place before any construction on the occupant's property may take place. This process imposes the most significant risk determinable in the development with a **'medium'** risk, given the uncertainty of agreement with the occupants and the inherent risk of affecting livelihoods. The occupants will have to be promptly informed and consulted. An alternative location will need to be arranged with the landowners (tribal leaders) for reestablishment of the property occupants. Sufficient compensation will need to be provided

to assist the occupants to rebuild their home, and cover any expenses incurred in work loss. Continuous consultation with the affected occupants will need to take place to time their relocation to the project development to ensure that no construction takes place on the occupants' property until they are completely relocated and established. In the incidence that the compensatory process is fair and the agreements made timeously, the process need not pose significant disruptions to the proposed development.

The inherent risk in the nature of the relocation process, is unfortunately such that even with adequate mitigations, some uncertainty remains. Accordingly, even with mitigation measures to ensure that the occupants' rights are adhered to, there will still be at least a **'medium'** risk.

No such risks are foreseen during the operational phase of the road in which the development area will have been established and permanent.

Loss of grazing land in the re-establishment of servitudes.							
Impact	Temporary loss of grazing potential. Reduction in area of some properties in close proximity to the road.						
Activities	- Removal and re-establishment of fencelines to re-establish the servitude. - Clearance of vegetation. - Compaction of soil.						
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	3	5	1	3	4	12
Mitigation	- Adequate public participation. - Fair appraisal of land worth and timeous compensation. - Removal of indigenous flora should be kept at a minimum. - Disturbance-related activities may only occur in the authorised area. - Soil erosion mitigation measures need to be implemented. - Post-development open/barren areas should be revegetated and kept free of exotic plant species.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	2	1	2	5	10
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	N/A						
Mitigation	NA						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	N/A						
Cumulative Impacts	Loss of grazing potential of the land. Localised loss of carrying capacity.						
Additional Notes:							

While this component is addressed in section 3.1. from an environmental perspective, it is here assessed from a socio-economic perspective. As a precautionary measure to ensure that risk is not underestimated, risk is assessed for the localised context in which it will be most acutely experienced.

The re-establishment of the servitudes and the creation of temporary bypasses will entail the clearance of vegetation. The area of vegetation which will need to be cleared will be 34m in width for the length of the road. If a scenario is assessed in which the area after vegetation removal does not undergo any rehabilitative measures and natural revegetation is slow, then there will be a **'medium'** risk attached. This will implicate that the grazing potential of the area is inhibited for potentially a number of months. This could also lead to erosion of topsoil further inhibiting subsequent natural revegetation.

In the incidence of mitigation measures, however, natural revegetation is anticipated to take place not long after rehabilitative measures are implemented (e.g. scarifying the soil to facilitate water infiltration and seed establishment). Thus, in a post mitigation scenario it is not likely that there should be risks to grazing potential (and its subsequent socio-economic impacts) greater than a '**low-medium**' risk. This is particularly informed by the fact that while the 34m servitude is larger than the current gravel road layout, the permanent surface area of the proposed road will in most places be narrower than the current gravel road. Accordingly with all the mitigation measures in place it is envisioned that there will not be a net loss of grazing land available subsequent to development.

3.7. Waste

Waste generated on site during the construction and operational phase can take many forms and can if inappropriately handled and disposed entail a myriad of repercussions to the natural environment as well as to surrounding communities. Consideration and accounting for the potential risk factors associated with waste production, storage and disposal thus eliminates many potential long-lasting detrimental impacts.

General Solid and Liquid Waste							
Impact	Litter generated by construction workers strewn in the area, which gets further dispersed, resulting in the degradation of the aesthetic quality of the area. Osmotically active chemicals in construction materials leaching into soil and watercourses leading to the deterioration of soil and river health. Contamination of soil related to spillages.						
Activities	• Litter production. • Solid construction waste material production. • Liquid waste produced.						
Constructional Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	4	3	2	3	4	12
Mitigation	• Receptacles should be made available for the construction workers to dispose of litter into the receptacles. • Waste should be disposed of at a licenced landfill on at least a monthly basis. • Secure waste receptacle bins with lids to prevent wind-blown litter. • Any hazardous waste must be stored separately out of direct sunlight and out of rain in the incidence of precipitation. • Any liquid waste generated must be stored in watertight containers. • Any construction material with leachable material must be covered and secured with impermeable tarp in the incidence of rain. • Any leftover construction material after the construction phase has terminated must be disposed of at a licenced landfill facility.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	Negative	2	2	2	2	2	4
Operational Phase							
Before Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	N/A						
Mitigation	No waste is anticipated to be produced during the operational phase.						
After Mitigation	Status	Severity	Duration	Extent	Consequences	Likelihood	Significance
	N/A						
Cumulative Impacts	The accumulation of solid waste, as well as the chemicals that leach into the soil and water courses from construction material will result in the aesthetic degradation of the area, death and deformation of vegetation and fauna who ingest the toxins either directly (water borne) or indirectly (bioaccumulation) leading to loss of biodiversity and degeneration of ecosystems.						
Additional Notes:							

It is not anticipated that a large amount of residual waste will be leftover from the proposed development. The inadequate disposal of waste (such as it is), the inappropriate storage of construction materials not necessarily intended as waste, as well as the inappropriate storage of harmful chemicals utilised in the development of roads can lead to detrimental impacts on wildlife, domestic animals, plants and humans alike. This is particularly true given the large number of watercourses in the area which would distribute any waste deposited into the watercourses to a much wider area than the development footprint itself. On account of this, a risk score of **‘medium’** was attributed to the proposed development in the incidence that no mitigation measures are implemented.

If the mitigation measures are implemented and the buffer zones particularly adhered to, the potential severity of the impact can be reduced. Minimisation of risk will also reduce the duration and spatial extent over which the detrimental impacts of waste are experienced. The associated risk can therefore be reduced to **‘low’**.

4. Cumulative impacts

Cumulative impact refers to a combination of environmental impacts of a new development when considering the past, present and future developments. These impacts, which have the potential to gradually degrade the environment, can be synergistic, additive, or incremental. The assessment of cumulative impacts is a legislative requirement in terms of NEMA (Act No. 107 of 1998) which mandates that environmental decision-making consider the broader, long-term consequences of a proposed development.

According to DEAT (2004), cumulative impacts can be assessed with consideration of the following underlying principles:

Type	Characteristic
Time crowding	Frequent and repetitive effects.
Time lags	Delayed effects.
Space crowding	High spatial density of effects.
Cross-boundary	Effects occur away from the source.
Fragmentation	Change in landscape pattern.
Compounding effects.	Effects arising from multiple sources or pathways.
Indirect effects	Secondary effects.
Triggers and thresholds	Fundamental changes in system functioning and structure.

(DEAT (2004) Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7, Department of Environmental Affairs and Tourism (DEAT), Pretoria.)

Due to the multifaceted nature of cumulative impacts in which the implications of a particular activity cannot be neatly isolated into a particular theme or sensitivity, anticipated risks can also be traced from the development through to tertiary impacts, then further categorised in terms of the aforementioned mechanisms.

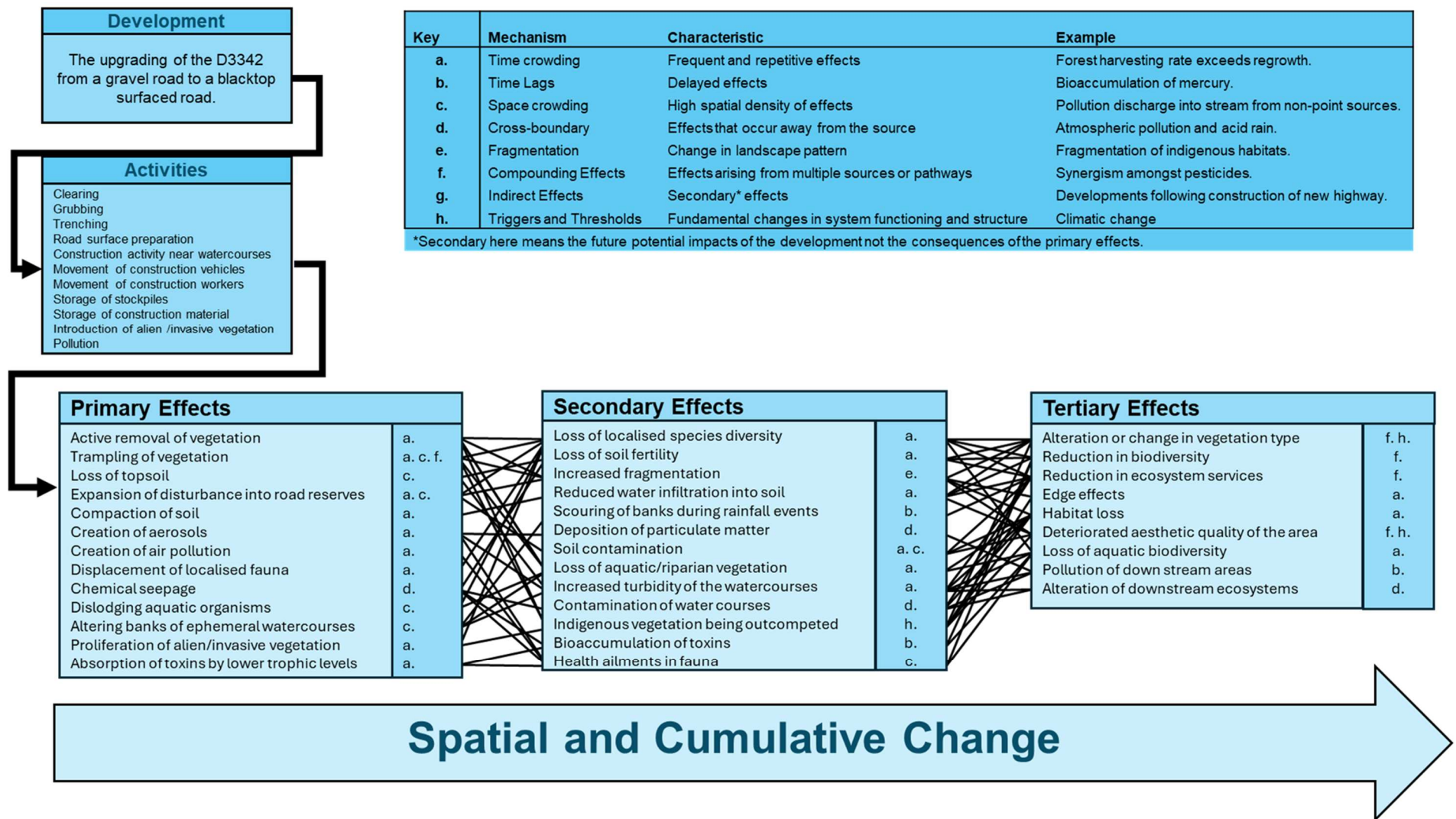


Figure 1: Impacts associated with the construction of the proposed development traced from activity to tertiary effects.

Implication:

While it is futile to attempt to give an exhaustive account of all potential causal pathways, given the intricacy, multitude of nodes and presence of feedback loops in nature. In considering the most pertinent disturbances it can be shown by the concentration of connections that there are considerable implications in ecosystems when the most foundational components are impacted.

In assessment of the disturbances associated with the proposed development, it is revealed that disturbances to vegetation and soil have the most prolific potential outcomes. This does not of course discount, necessarily the magnitude of other potential impacts, but it does suggest that mitigation measures focussed on: 1. reducing the impact to the foundational components of vegetation and soil and 2. rehabilitating these components given the inevitability of their disturbance will account for the greatest diversity of secondary and tertiary effects.

While, given the context of the development, mitigation measures need not be as concentrated with regards to fauna, the potential, albeit highly improbable presence birds species of conservation importance noted to be in decline, particularly on account of habitat transformation in particular (see Appendix J of the BAR: Site Sensitivity Report), mitigation measures to mitigate for the transformation of remaining natural habitat must be enforced concurrently with development wherever possible. Rehabilitative measures must be implemented where revegetation is slow.

Particularly sensitive socio-economic impacts:

The socio-economic significance to the occupiers of one permanent structure must be underscored. While this is not anticipated to have significant broader socio-economic or environmental implications, scrupulous public participation involving the property occupants and landowners is going to need to be conducted to ensure that they are kept updated in the public participation process, that they are fairly compensated and that they are provided with sufficient opportunity and means to relocate with minimal costs to themselves.

4.1. No-go alternative:

The no-go alternative assumes that the proposed project will not go ahead i.e. it is the option of not constructing the proposed development. This alternative would result in no environmental impacts on the site or surrounding local area. It provides the baseline against which other alternatives were compared. The following implications will occur if the “no-go” alternative is implemented:

-  Socio-economic benefits directly associated with the construction and maintenance of the proposed development:
 - job creation,
 - skills development,
 - local economic growth will be lost.
-  The greater accessibility to resources and services offered to the communities by the road development (increased ease of access by courier, health and police services) would be lost.

- There would be an expensive financial implication to the local municipality on account of the gravel road requiring more frequent maintenance.
- There would be a greater net amount of dust deposition in the surrounding areas as well as in the numerous watercourses traversed by the proposed development.
- The area of compacted soils and trampled vegetation would be increased given the tendency of commuters to expand the road surface area.
- Erosion associated with the lack of stormwater infrastructure and gravel roads would continue.
- The status-quo culverts currently incapable of adequately absorbing the ephemeral flow of the numerous watercourses traversed by the current road would not be upgraded to better accommodate the ephemeral watercourses. They would thus continue their pattern of acting as obstructions to flow regimes and resulting in scouring and sedimentation.

5. Conclusion

Total Combined Impacts		
<i>Factors</i>	<i>Impact Before Mitigation</i>	<i>Impact After Mitigation</i>
Fauna and Flora	6	2
Heritage	4	1
Water Resources	8	4
Aesthetics	6	3
Air Quality, Noise and Vibrations	6	2
Waste	6	2
Socio-economic	11	9
Overall Impact	46	22

The overall negative potential impacts in the incidence of no mitigation measures comprise of **one (1) 'Medium' risk score five (5) sensitivity themes with a 'Low-Medium' risk score, one (1) 'Medium' risk score**. By implementing the proposed mitigations, however, the risk score can be reduced to an overall **'Low' risk'**. While in some categories even the mitigated scenario still presents an inherent risk (Ground and Surface Water Quality, Socio-economic) given the sensitivity of some of the areas traversed by the proposed development (watercourses) as well as the necessary implication of the realignment approaching intersections to abide by safety standards. The overall risks associated with the proposed development can still be satisfactorily mitigated with no fatal flaws identified. Given the inadequacy of the current road (and associated stormwater infrastructure) the implementation of the proposed development (provided mitigations are also implemented) will significantly contribute to numerous socio-economic considerations. The implementation may also contribute towards restoring the natural flow of the ephemeral watercourses (insofar as they are currently impacted by blockages, subsequent sedimentation and scouring associated with the current culverts).