

APPENDIX I7

WILDLIFE IMPACT ASSESSMENT



NABRO Ecological Analysts CC

Natural Asset and Botanical Resource Ordinations

Environmental Consultants & Wildlife Specialists

**PROPOSED MOKOLO CROCODILE RIVER
(WEST) WATER AUGMENTATION PROJECT
(PHASE 2A) (MCWAP-2A)
LIMPOPO PROVINCE
REPUBLIC OF SOUTH AFRICA**

WILDLIFE IMPACT ASSESSMENT

FINAL REPORT V03

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**WILDLIFE IMPACT ASSESSMENT REPORT ON THE PROPOSED MOKOLO CROCODILE RIVER (WEST)
WATER AUGMENTATION PROJECT (PHASE 2A) (MCWAP-2A)**

1 SPECIALIST DETAILS

The Natural Scientific Professions Act of 2003 aims to *'provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith'*. Quoting the Natural Scientific Professions Act of 2003: *'Only a registered person may practice in a consulting capacity'*.

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1.1. Declaration

All specialist investigators, project investigators and members of companies employed for the purpose of conducting this particular investigation declare that:

1. We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions;
2. At the time of completing this report, we did not have any interest, hidden or otherwise, in the proposed enterprise as outlined in this document, except for financial compensation for work done in a professional capacity;
3. We will not be affected in any manner by the outcome of the risk assessment process of which this report forms part of, other than being part of the general public;
4. We do not have any influence over decisions made by the governing authorities;
5. We do not necessarily object to or endorse the proposed enterprise, but aim to present facts and recommendations based on scientific data and relevant professional experience;
6. Should we consider ourselves to be in conflict with any of the above declarations we will formally submit a Notice of Withdrawal to all relevant parties.

Ben Orbán



2 INTRODUCTION

NABRO Ecological Analysts was commissioned to undertake a Wildlife Impact Study for the proposed Mokolo Crocodile River Water Augmentation Project (Phase 2A) (MCWAP-2A): Water Transfer Infrastructure (WTI) and Borrow Pits (BP). The project has a mandate to investigate the feasibility of constructing a water pipeline from Thabazimbi to Lephalele (Ellisras) in ensuring water supply requirements for the Medupi Power Station and associated industries in the region.

The WTI component consists of a proposed pipeline route, which has three alternatives (Alternative A1, A2, and C) close to Thabazimbi, a Central Route adjacent to the existing railway line (**Figure 1**) to Lephalele and four alternatives (Alternative D1, D2, D3 and D4) situated in the Steenbokpan and Lephalele area. The WTI design includes a weir and low-lift pump station, balancing dam with desilting works, high-lift pump station, breaking pressure reservoir and an operational reservoir.

Additionally, 23 borrow pits will be required for the sourcing of construction material (**Figure 2**).

The objectives of the Wildlife Impact Study were to (a) assess the wildlife industry and preferred land-use options applied along the proposed routes, (b) Identify the potential impacts on wildlife and wildlife enterprises, (c) provide an assessment of impacts with potential mitigations measures that can be implemented, and (d) provide an independent report stating conclusions.



Figure 1: The proposed route for the MCWAP-2A pipeline along the railway line

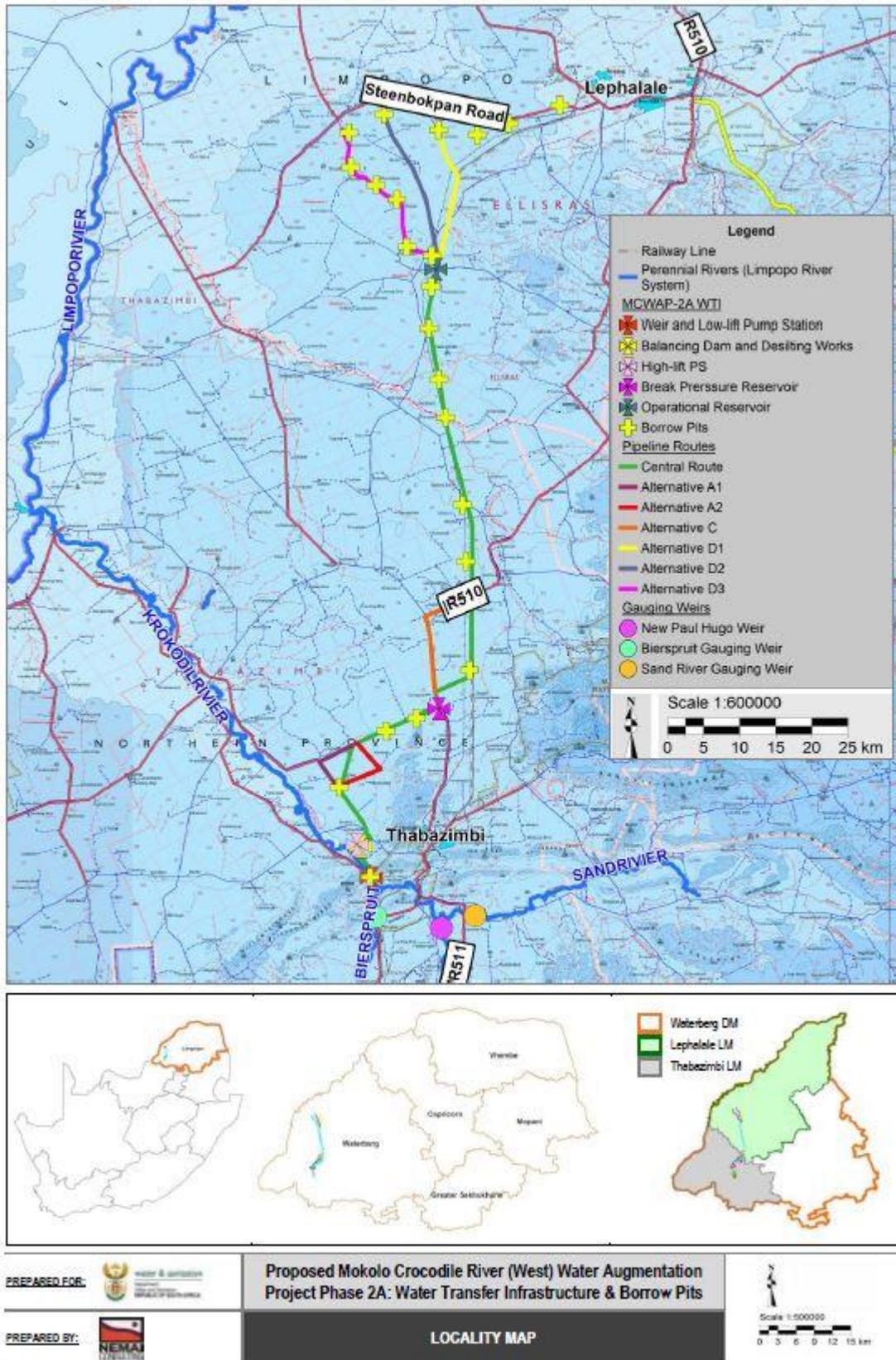


Figure 2: Location for the proposed MCWAP -2A project

2.1 Wildlife Habitat, Natural Resources Availability and Land-use

All successful wildlife is dependent on natural resources with clear niche separation between the requirements of different species. The four basic corner stones for a suitable habitat are based on the feeding, breeding, nesting and resting requirements for each species. Furthermore, competition for natural resources is reduced by facilitated feeding behaviour, where the feeding behaviour of one species changes the habitat such that it becomes more suitable for a follow-up species. This phenomenon is typically observed where buffalo will feed on tall grass, reducing grass length to a height where it is the preferred resource for wildebeest. Wildebeest in turn will reduce the grass length further, by grazing and trampling the grass, to a height which is preferred by blesbok and impala. Many wildlife species are dependent on this cascade; however, this is often obscured where non-endemic species (wildlife not from the area) are imported from other regions and released. This cascade effect then has to be simulated through active management intervention. This situation is further exacerbated where single species are selected and bred in a camp. In this case the cascade effect is removed with selected feeding behaviour ultimately changing the habitat such that it becomes unsuitable to that species. More intense management intervention such as supplementary feeding is thus required in breeding camps to maintain the desired goals of optimum production.

The approaches in wildlife breeding are based on extensive breeding systems (wildlife ranches with no internal fences) where habitat and stocking rates are manipulated to simulate the cascade effect, or intensive breeding systems (wildlife farms with separately fenced enclosures) where wildlife species are relegated to separate camps. The land-use options have separate spin-offs, where wildlife ranches are generally dependant on eco-tourism and hunting (**Figure 3**) on generating revenue, while wildlife farms are dependent on live sales of wildlife. However, often both approaches are implemented on the same property to ensure optimum financial gain.



Figure 3: Kuche Safaris in the study area

Eco-tourism, generally has high initial investment cost in establishing suitable facilities to comply with international tourism requirements, but once established ensure a steady stream of dependable income throughout the year. Hunting generally requires less investment capital in developing facilities and is, most often, only conducted in the winter months (May to October) with a peak in June, July and August.

The wildlife ranches/farms are currently stocked with black rhinoceros *Diceros bicornis*, white rhinoceros *Ceratotherium simum*, buffalo *Syncerus caffer*, giraffe *Giraffa camelopardalis*, roan antelope *Hippotragus equines*, the sable antelope *Hippotragus niger niger*, greater kudu *Tragelaphus strepsiceros*, waterbuck *Kobus ellipsiprymnus*; common impala *Aepyceros melampus melampus*; gemsbok *Oryx gazelle*, blue wildebeest *Connochaetes taurinus*, red hartebeest *Alcelaphus buselaphus*; plain's zebra *Equus quagga*, eland *Taurotragus oryx*, nyala *Tragelaphus angasii*; bushbuck *Tragelaphus scriptus* and warthog *Phacochoerus africanus*; while mountain reedbuck *Redunca fulvorufula* and klipspringer *Oreotragus oreotragus* occur in the mountainous areas of some properties. Steenbok *Raphicerus campestris* and common duiker *Sylvicapra grimmia* are some of the smaller wild ungulates that occur.

Carnivorous animals are the leopard *Panthera pardus*, brown hyaena *Parahyaena brunnea*, aardwolf *Proteles cristatus*, black-backed jackal *Canis mesomelas*, bat-eared fox *Otocyon megalotis*; Cape fox *Vulpes chama*, honey badger *Mellivora capensis*, African wildcat *Felis lybica*, caracal *Felis caracal*, serval *Leptailurus serval*, African civet *Civettictis civetta*, small-spotted genet *Genetta genetta*; yellow mongoose *Cynictis penicillate*, banded mongoose *Mungos mungos* and dwarf mongoose *Helogale parvula*. The bushpig *Potamochoerus larvatus*, aardvark *Orycteropus afer*, porcupine *Histrix africae australis*, springhare *Pedetes capensis* and lesser bushbaby *Galago moholi* are some of the nocturnal species found.

Other small mammals include a variety of mice and shrews as well as the tree squirrel *Paraxerus cepapi* and the rock hyrax *Procavia capensis*, which inhabit some of the rockier areas.

The mammal species of highest importance and most concern for study area is the black rhinoceros *Diceros bicornis* and short-eared trident bat *Cleotis percivali*. These mammals have a critically endangered extinction risk status and in need of strict conservation measures to ensure its survival. Black rhinoceros is present and suitable habitat exists for the short-eared trident bat with a high probability of occurrence. The African wild dog *Lycaon pictus* and tsessebe *Damaliscus lunatus lunatus* has an endangered extinction risk status.

3 STUDY AREA

Limpopo province is synonymous with wildlife conservation where the preferred land-use options includes wildlife ranching and wildlife farming, however, large tracts of land are still being used for cattle ranching. Furthermore, a combination of these land-use practices is often implemented by property owners to optimise natural resource use in ensuring economic viability. Properties with wildlife farming enterprises are especially reticent in sharing information with respect to rare and endangered wildlife species, such as black and white rhinoceros, since these animals are increasingly targeted by poaching syndicates. Direct reference to these animals or their location is thus avoided in this document.

The properties highlighted in blue (**Figure 4 and 5**) indicates ranches and farms where the proposed MCWAP-2A project will significantly influence current land-use practices and mitigation measures will be required to reduce the perceived impact on wildlife.

The preferred land-use options applied on Louma Boerdery (Hampton 320) are eco-tourism and hunting; Thabatholo (Startford 309, Bridgewater 307, Tarentaalkraal 120 and Amsterdam 123) is predominantly wildlife farming; Buffelsvley 127 and Karoobult 126 (**Figure 4**) are wildlife farming and hunting enterprises.

Although many wildlife ranches and hunting enterprises are present along the proposed MCWAP-2A project located next to the railway line, Cheetah Safaris (Rietfontein 15, Inkermann 10 and Groenland 397), predominantly a wildlife ranch with a few wildlife breeding facilities (**Figure 5**), is particularly sensitive to disruption due to their emphasis on international hunting activities. Mabulskop 406 is predominantly a wildlife ranch, however, a number of wildlife breeding camps are located along the railway line and some wildlife may need to be relocated. Rooipan 357 is a recently developed wildlife ranch with emphasis on eco-tourism. Land-use on Rooipan 357 will be affected by the proposed MCWAP-2A project and financial losses can occur. Kuche Safaris (Schuldpadfontein 328) and its associated infrastructure is located next to the road, with another residence directly opposite the entrance. Due to the relatively small size (400 ha) and the location of infrastructure on Kuche Safaris economic viability of the enterprise will be seriously compromised by the proposed PCWAP-2A project.

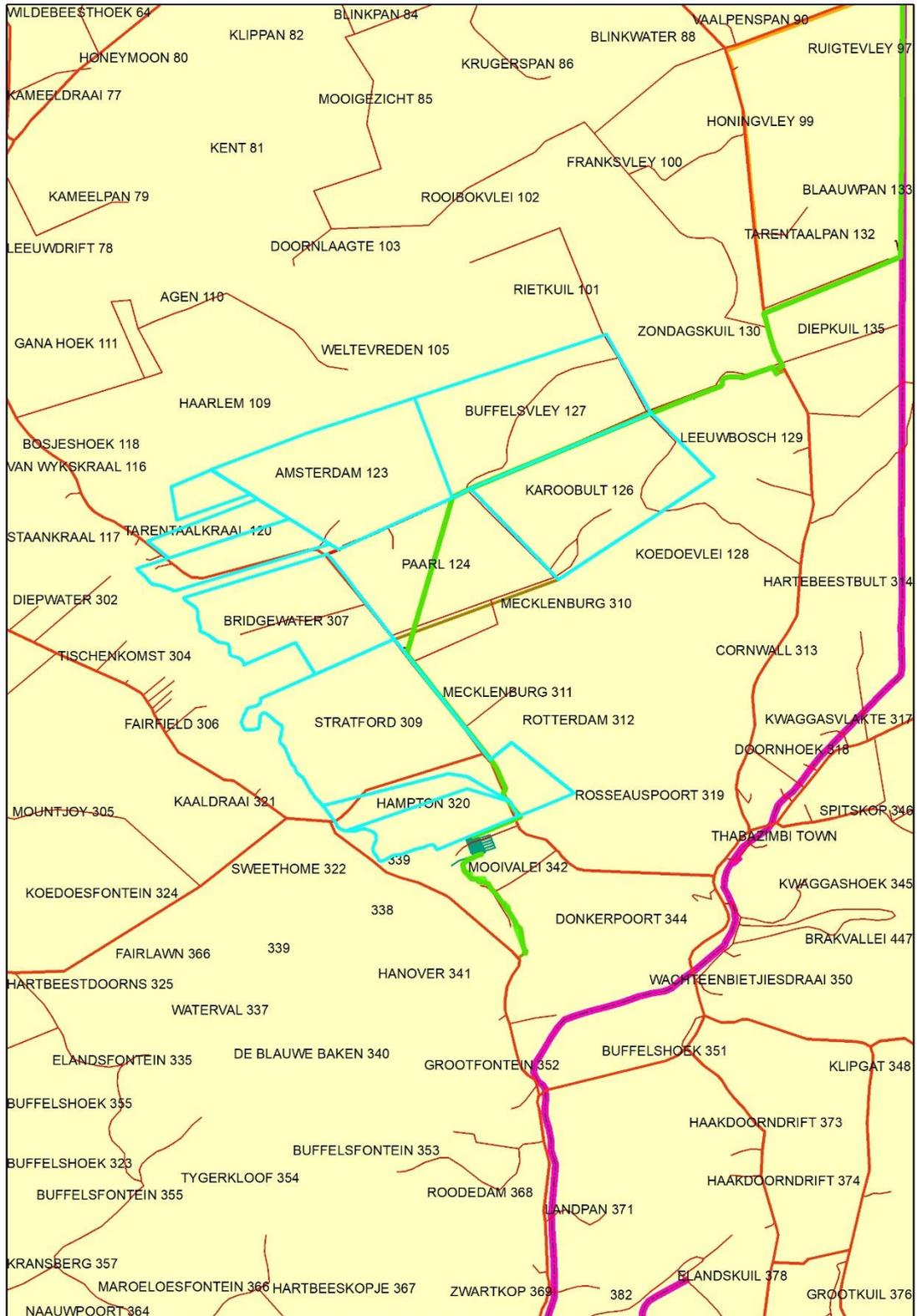


Figure 4: Highlighted ranches and farms (blue boundaries) where breeding camps may have to be moved and/or rare and endangered wildlife relocated to more secure areas

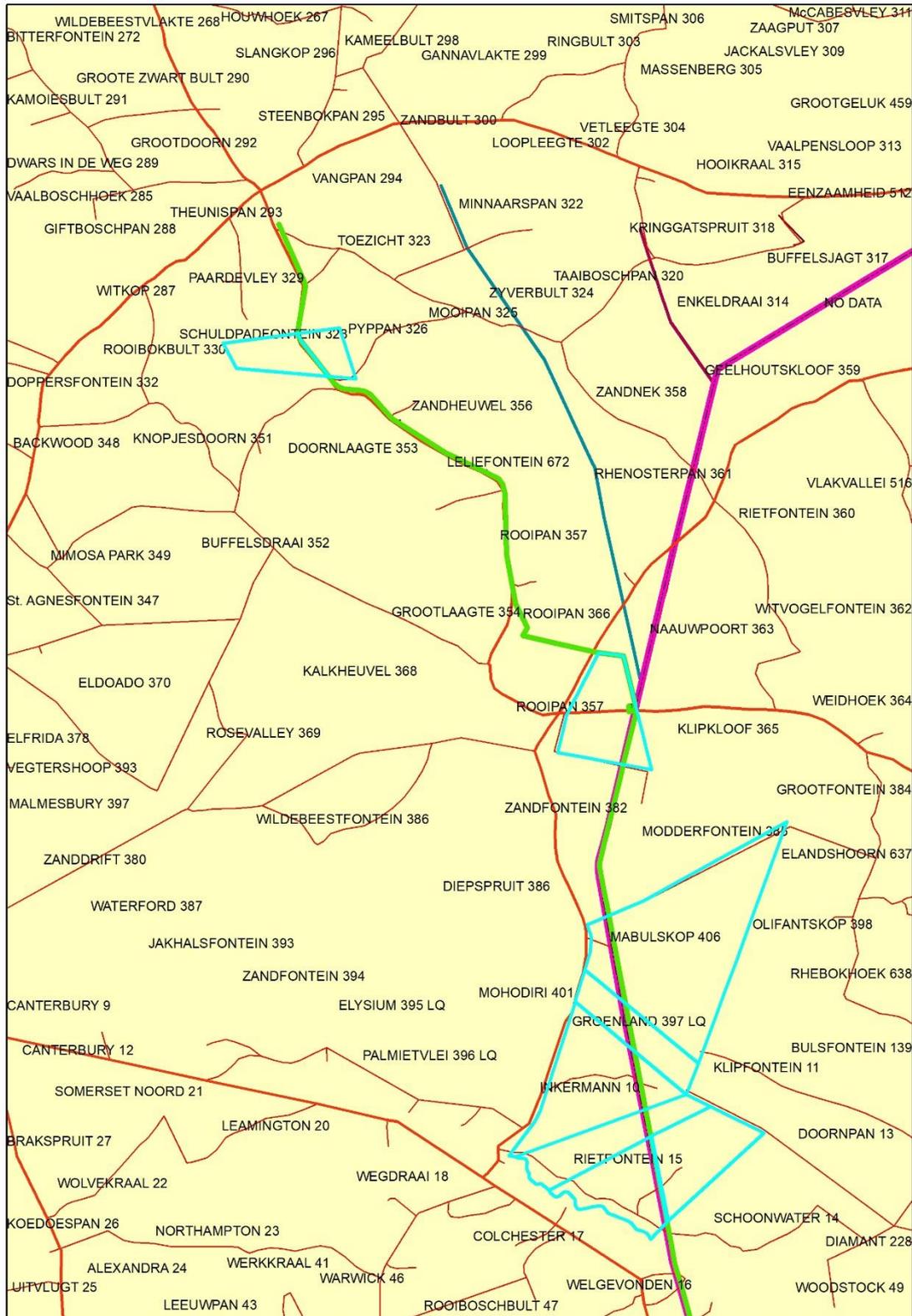


Figure 5: Highlighted ranches, farms and infrastructure (blue boundaries) where breeding camps may have to be moved and/or rare and endangered wildlife relocated to more secure areas. Economic viability of some wildlife enterprises may also be compromised

4 EXPECTED IMPACTS FROM THE MCWAP-2A

4.1.1 Habitat Loss

The linear configuration of the proposed MCWAP-2A will invariably result in current habitat loss, a reduction in the availability of natural resources, less wildlife that can be sustained and ultimately a reduction in revenue generated from the preferred land-use option applied. The pipeline corridor will result in complete habitat modification where all woody species are removed, making the habitat unsuitable for species dependant on this resource. However, after construction and rehabilitation of the construction zone the newly modified habitat will become more suitable to a number of plains game, potentially increasing species diversity. Resource availability may need to be recalculated; optimum stocking rates adjusted and applied management principles re-evaluated within the constraints of the land-use options available. Further infrastructural development may also be required to ensure that the remaining wildlife has access to sufficient basic resources such as open water.

4.1.2 Habitat Fragmentation

Habitat fragmentation is generally a concern where an ecosystems ability to sustain wildlife is negatively affected due to a reduction in feeding, breeding, nesting and resting requirements of wildlife species. However, the inadvertent creation of ecotones can also be beneficial since many smaller wildlife species are attracted, thus potentially increasing species diversity. The proposed MCWAP-2A design endeavoured to reduce habitat fragmentation by following existing infrastructure such as roads, railway lines and property boundary fence lines. However, where the boundary fence between two properties has been removed to create a larger conservation area, the construction corridor will bisect the properties for duration of the construction and rehabilitation phases.

4.1.3 Wildlife Dispersal and Migration

Natural migration of most wildlife species has been effectively curbed by the erection of property fence lines and internal camp systems and is seldom observed in South Africa; however, natural migrations of wildlife can still be seen in neighbouring African countries. Where the proposed MCWAP-2A affects properties, wildlife movement and access to resources will be temporarily arrested but can continue unabated after rehabilitation, with due consideration of habitat modification. The modified habitat in the construction zone will need to be re-evaluated to quantify the natural resources available before optimum stocking rates can be applied. Failure to do so can lead to sub-optimal resource use or habitat degradation and failure of rehabilitation measures applied in the construction zone.

4.1.4 Wildlife Diversity

Construction of the MCWAP-2A pipeline will result in the loss of habitat and thus indirectly a reduction in wildlife diversity, where animals will move to alternative areas where their requirements for feeding, breeding, nesting and resting are met. Concomitantly, other wildlife species will invariably move into the degraded/modified environment created during the construction of the MCWAP-2A pipeline. After cessation of construction and implementation of the proposed rehabilitation measures the modified habitat can contribute to species diversity due to the effective creation of a grassland habitat more suited to plains game.

4.1.5 Land-use

During the construction phase of the MCWAP-2A the currently preferred land-use practices applied by property owners will be negatively influenced by excessive noise levels and dust released from excavations. Wildlife will exhibit avoidance behaviour where possible; however, any breeding camp system in close proximity to these activities will negate any efforts in moving away from the disturbance. Excessive noise levels will also negatively affect wildlife enterprises dependant on eco-tourism and hunting where visitor experience will be tainted by undesirable environmental stimulation. This may have further indirect consequences since much of the marketing occurs from personal referral and returns to the same enterprise/hunting operator.

4.1.6 Noise Impact on Animals

Most work on the effects of noise on animals has focused on behavioural responses of animals and the effects on animal physiology, development, neural function and genetic effects. Although there are many natural sources of noise the effects of anthropogenic noise are becoming increasingly more prevalent with studies on how acoustic stimuli contribute to stress and impact on physiology and development (Kight & Swaddle 2011).

The impacts of noise on reproduction and development can be observed already in embryonic stage where excessive environmental noise (<85 dB) has been correlated to premature birth and growth abnormalities due to disruption of calcium regulation. Noise stress appears most often to be particularly damaging to females.

Animals susceptible to increased noise levels generally increase vigilance, hide or retreat thus spending less time foraging. If it is considered that anthropogenic noise is often accompanied by environmental constraints that can decrease food availability, this could cause decrease weight and condition loss over an extended period of time.

During stress reactions, the heart contracts more rapidly with vasoconstriction occurring throughout much of the body so that blood can deliver oxygen needed for flight or fight responses. However, frequent or long-term expression of these may have adverse effects on the health of the animal.

Chronic noise exposure, often accompanied by excess light, has been associated with depression and aggression¹. It is thus expected that exposure to chronic noise levels could alter behavioural interactions and population dynamics. The immune system can also be affected with reduced immunoglobulin levels, decreased number of T-cells and a decrease in phagocytic activity. Environmental noise is known to impact expression of several genes, especially in the brain, where the release of free radicals from cochlear reactive oxygen species (ROS) cause damage to the Dynamic Neuromuscular Stabilization system (DNS), proteins and lipids. However, it is important to note that many animals may habituate to stressors over time and that some types and levels of noise may enhance or play an important part in development.

4.1.7 Dust Impact on Animals

The effects of dust are difficult to determine since dust composition can vary tremendously and the composition will determine if it is potentially harmful. Furthermore, most studies have been conducted in controlled environments on domestic livestock². However, the effect of dust and airborne microorganisms on the health of man and animals cannot be separated allowing for deductions to be made. It is accepted that the diameter of particles determines how deeply they can

¹ U.S. Environmental Agency. 1971. Effects of noise on wildlife and other animals.

² Van der Hoven, R. Air pollution and domestic animals. www.intechopen.com

penetrate the respiratory tract. The impacts can be described as mechanical, chemical, infectious allergic and toxic (Hartung & Saleh 2006). Dust in the air can add significant burden to the respiratory tract of animals and must be considered in context of known respiratory disease patterns. However, inhalation of dust generally causes an overloading of clearance mechanisms in the respiratory passages which facilitates the beginning of infections. High dust concentrations have a general performance-reducing effect.

4.1.8 Environmental Pollution

It is expected that the influx of contractors and associated labour will be accompanied by urban behaviour where disposal and packaging products will be discarded without consequence to the environment. Furthermore, it is anticipated that other human waste and debris can be harmful to wildlife. Ingestion of especially plastic products will be extremely harmful to some species that is not as selective in their feeding behaviour. On-site waste and sanitary management measures stipulated in the EMPr will need to be implemented.

4.1.9 Veld Fires

Undesirable fires will be a matter of concern since these can have a devastating effect on any wildlife ranch or farm where not only will resources be destroyed, requiring supplementary feeding, but animals can also die. Run-away fires will not only have a regional affect but may have far reaching consequences on a broader scale.

4.1.10 Security

Poaching of wildlife, especially rare and endangered wildlife species will be a matter of concern. Security measures will be required on-site and security efforts implemented by wildlife ranchers and farmers may need to be intensified during the MCWAP-2A construction phase. Operation and management inspections will only be conducted by prior arrangement with the property owners after completion of construction and rehabilitation of the servitude area. All personnel must wear clearly identifiable identification and be in possession of legal documentation stating objectives for entering a property. It is furthermore recommended that all vehicles display decals for easy identification.

5 IMPACT CRITERIA

5.1 Characterising Impacts

In describing impacts in this assessment, various characteristics of an impact are described. These include aspects of the impacts type as well as spatial and temporal features. Additional or more refined definitions for a specific resource or receptors are provided in the impact discussion.

In this assessment there is a distinction between those impacts that will occur or are predicted to occur under normal conditions. These are distinguished from those associated with impacts that would be associated with non-routine activities such as accidents (vehicle collisions, fires) and upset process conditions. For these impacts, a probability factor is also applied as low (event is unlikely to occur), medium (event may occur infrequently) and high (event may occur frequently).

5.2 Impact Characteristics

5.2.1 Nature of Impact

An impact is a change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity. The nature is either negative or positive:

- **Negative** – an impact that is considered to represent an adverse change from the baseline or to introduce a new undesirable factor; and
- **Positive** – an impact that is considered to represent an improvement to the baseline or to introduce a new desirable factor.

5.2.2 Type of Impact

- **Direct (or primary)** – impacts that result from the direct interaction between a planned project activity and the receiving environment (e.g. between soil excavations and the air quality);
- **Secondary** – impacts that result from the primary interaction between the MCWAP-2A and its environment as a result of subsequent interactions within the environment; and
- **Indirect** – impacts that result from other activities that are encouraged to happen as a consequence of the MCWAP-2A.

5.2.3 Temporal Scale of Impact

- **Temporary** - impacts are predicted to be of short duration, reversible and intermittent/occasional in nature. The receptor will return to a previous state when the impact ceases or after a period of recovery;
- **Short-term** - impacts that are predicted to last only for a limited period i.e. during construction but will cease on completion of the activity, or as a result of mitigation measures and natural recovery (e.g. non-local construction workforce - local community interactions);
- **Long-term** - impacts that will continue for the life of the project but cease when the project stops operating. These will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended time period;
- **Permanent** - impacts that occur during the development of the MCWAP-2A and cause a permanent change in the affected receptor or resource that endures substantially beyond the MCWAP-2A lifetime; and
- **Continuous** – impacts that occur continuously or frequently during the life of the phase of the MCWAP-2A.

5.2.4 Spatial Scale of Impact

- **Local** - impacts that affect locally important environmental resources or are restricted to a single (local) administrative area or a single community. For this ESIA, *local* impacts are restricted to the MCWAP-2A and adjacent areas;

- **Regional** - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries;
- **National** - impacts that affect nationally important environmental resources; affect an area that is nationally important or protected; or have macro-economic consequences;
- **International** - impacts that affect internationally important resources such as areas protected by International Conventions; and
- **Trans-boundary** - impacts that are experienced in one country as a result of activities in another.

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is likelihood. The likelihood of an unplanned event occurring is designated using a qualitative scale (**Table 1**).

Table 1: Definitions for Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions;
Possible	The event is likely to occur at some time during normal operating conditions; and
Likely	The event will occur during normal operating conditions i.e. it is essentially inevitable.

5.2.5 Determining Impact Magnitude

The impact assessment describes what will happen by predicting the impacts and quantifying the impact magnitude to the extent practical. Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent – spatial and temporal;
- Duration;
- Scale; and
- Frequency.

The scale of magnitude (from small to large) is in practice a continuum, and evaluation along the spectrum requires the exercise of careful professional judgement and experience. Each impact is evaluated on a case by case basis, and the rationale for each determination is described. Additionally, for unplanned events only, magnitude incorporates the 'likelihood' factor discussed above.

The magnitude designations themselves are universally consistent, but the descriptions for these designations vary on a resource/ receptor-by-resource/ receptor basis. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;
- Medium; and
- Large.

In the case of a positive impact, no magnitude designation (aside from 'positive') is assigned. It is considered sufficient for the purpose of the Impact Assessment to indicate that the MCWAP-2A is expected to result in a positive impact, without characterising the exact degree of positive change likely to occur.

In the case of impacts resulting from unplanned events, the same resource receptor-specific approach to concluding a magnitude designation is utilised. The 'likelihood' factor is also considered, together with the other impact characteristics, when assigning a magnitude designation.

For biophysical impacts, the definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided.

5.2.6 Magnitude Criteria for Wildlife Impacts

- **High Magnitude Impacts** affects an entire population or species at sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations*. A high magnitude impact may also adversely affect the integrity of a site, habitat or ecosystem;
- **Moderate Magnitude Impacts** affects a portion of a population and may bring about a change in abundance and/or distribution over one or more generations* but does not threaten the integrity of that population or any population dependent on it. A moderate magnitude impact may also affect the ecological functioning of a site, habitat or ecosystem but without adversely affecting its overall integrity. The area affected is also important; and
- **Low Magnitude Impacts** affects a specific group of localised individuals within a population over a short time period (one generation* or less) but does not affect other trophic levels or the population itself.

* These are generations of the animal species under consideration not human generations. It should be noted that the restoration potential of an affected habitat also needs to be considered in applying the above criteria.

5.2.7 Sensitivity of Resources and Receptors

In addition to characterising the magnitude of impact, the other principal impact evaluation step is the definition of the sensitivity/ vulnerability/ importance of the impacted resource receptor. There are a range of factors to be taken into account when defining the sensitivity/ vulnerability/ importance of the resource receptor, which may be physical, biological, cultural or human. Other factors may also be considered when characterising sensitivity/ vulnerability/ importance, such as legal protection, government policy, stakeholder views and economic value.

As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource receptor basis. The sensitivity/ vulnerability/importance designations used herein for all wildlife receptors are:

- Low;
- Medium; and
- High.

5.2.8 Biophysical Receptors

For wildlife impacts, sensitivity is assigned as low, medium or high based on the conservation importance of habitats and species. For habitats, these are based on naturalness, extent, rarity, fragility, diversity and importance as a resource. The value or sensitivity of individual species was assessed based on specific criteria (**Table 2**)³.

(3) The above criteria should be applied with a degree of caution. Seasonal variations and species lifecycle stage should be taken into account when considering species sensitivity. For example, a population might be deemed as more sensitive during the breeding/spawning and nursery periods.

Table 2: Biophysical and Species Value / Sensitivity Criteria

Value / Sensitivity	Low	Medium	High
Criteria	Not protected or listed as common/ abundant; or not critical to other ecosystem functions (e.g. key prey species to other species).	Not protected or listed but may be a species common globally but rare in South Africa, one important to ecosystem functions or one under threat or population decline.	Specifically protected under South African legislation and/or international conventions e.g. CITIES ⁴ . Listed as rare, threatened or endangered e.g. IUCN.

5.2.9 Wildlife Receptors

For Wildlife impacts, the degree of sensitivity of a resource receptor is defined as the level of resilience (or capacity to cope) with sudden environmental changes. The sensitivity of a resource is based on its quality and value/importance by its local, regional, national or international designation, its importance to the rancher or wildlife industry, or its economic value (Table 3).

Table 3: Wildlife and Health Sensitivity Criteria

Value / Sensitivity	Low	Medium	High
Criteria	Wildlife affected is able to adapt with relative ease and maintain pre-impact status.	Wildlife affected is able to adapt with some difficulty and maintain pre-impact status but only with a degree of support.	Wildlife affected will not be able to adapt to changes and continue to maintain pre-impact status.

The wildlife industry may be more sensitive for a variety of reasons and for the purpose of this scheme the following factors have been considered:

- Land rights and ownership;
- Income/employment/unemployment;
- Livelihood (current and extent of livelihood alternatives);
- Reliance on wildlife ranching;
- Services, e.g. eco-tourism, hunting, breeding and amenities;
- Access to, and use of, natural resources including water;
- Exclusion or marginalisation (e.g. degree of access to resources, services and formalised rights); and
- Education and skills development.

(4) Convention on International Trade in Endangered Species of Wild Fauna and Flora

5.2.10 Assessment of Significance

For the purposes of this EIA, the following definition of significance has been adopted:

“An impact is significant if, in isolation or in combination with other impacts, it should, in the judgment of the EIA team, be taken into account in the decision-making process, including the identification of mitigation measures (by the MCWAP-2A) and consenting conditions (from Regulators and Stakeholders).”

There is no statutory definition of ‘significance’ and its determination is therefore, necessarily partially subjective. Criteria for assessing the significance of impacts stem from the following key elements:

- The magnitude (including nature, scale and duration) of the change to the natural environment (e.g. an increase in noise, an increase in dust and security considerations), expressed, wherever practicable, in quantitative terms. The magnitude of all impacts is viewed from the perspective of those affected by taking into account the likely perceived importance as understood through stakeholder engagement; and
- The nature and sensitivity of the impact receptor (physical, biological or wildlife). Where the receptor is physical, the assessment considers the quality, sensitivity to change and importance of the receptor. For a wildlife receptor, the sensitivity of the species or population is considered along with their ability to adapt to and manage the effects of the impact.

Once the magnitude of impact and sensitivity/ vulnerability/ importance of the resource receptor have been characterised, the significance can be assigned for each impact. Impact significance is designated using a matrix (**Table 4**).

Table 4: Significance Matrix

Significance	Sensitivity/Vulnerability/Importance of Wildlife Receptor		
	Low	Medium	High
Negligible	Negligible	Negligible	Negligible
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

The matrix applies universally to all wildlife receptors, and all impacts to these wildlife receptors, as the wildlife receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix. While this matrix applies for well-defined levels of sensitivity and magnitude, in reality these exist over continuum and occur over a range. In the same way, the significance of the impacts is occasionally reported as a combination of and/or graduation of these significance ratings (e.g. *minor-moderate*).

The context of impact ratings (**Table 5**) provides a contextual description for factor significance.

Table 5: Context of Impact Significances

Impact Significance	Context
Negligible	An impact of negligible significance is one where the wildlife receptor will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.
Minor	An impact of minor significance is one where wildlife receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the wildlife receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.
Moderate	An impact of moderate significance has an impact magnitude that is within applicable standards but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a limit. The emphasis for moderate impacts is therefore, on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.
Major	An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive wildlife receptors. An aim of WIA is to get to a position where the MCWAP-2A does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones in coming to a decision on the MCWAP-2A.

It is important to note that impact prediction and evaluation take into account any embedded controls i.e. physical or procedural controls that are already planned as part of the MCWAP-2A design, regardless of the results of the WIA Process.

5.2.11 Significance for Biophysical Impacts

The significance ratings of biophysical impacts are based on scientific information from the ecological baseline studies, professional judgement and experience on potential impacts, modelled results and legislative limits or limits. The biophysical impact significance is therefore not influenced directly by stakeholder concerns.

The results of the biophysical impact assessment are used as a basis for input to the assessment of the impacts/ effects on the wildlife receptors (e.g. the impacts of contaminated groundwater on wildlife populations). The results of the socio-economic impact assessment, which takes stakeholder concerns into account, in turn influences the level of rigour of the proposed mitigation measures applied to reduce the biophysical impact. In addition, stakeholder concerns have been taken into

account in the development of the structure of the impact assessment chapter to ensure that the issues raised are clearly addressed.

5.2.12 Significance for Socio-economic Impacts

For social impact assessment, the perceptions of stakeholders, expressed as opinions around certain issues, can be as important as actual impacts. Consequently, the concept of perception is explicitly brought into the evaluation of significance after an impact is evaluated. When an impact is of significant stakeholder concern, this may be cause to raise the significance rating. This prompts the formulation of more rigorous and appropriate mitigation measures which focus on the source of the impact and also address stakeholder perceptions. The risk of not addressing stakeholder perceptions is that reputational damage could arise, resulting in the loss of a 'social licence to operate'.

5.2.13 Mitigation Measures

One of the key objectives of an WIA is to identify and define socially, environmentally and technically acceptable and cost-effective mitigation measures. These should avoid unnecessary damage to the environment; safeguard valued or finite resources, natural areas, habitats and ecosystems; and protect humans and their associated social environments.

Mitigation measures are developed to avoid, reduce, remedy or compensate for any negative impacts identified, and to create or enhance positive impacts such as environmental and social benefits. In this context, the term "mitigation measures" includes operational controls as well as management actions. These measures are often established through industry standards and may include:

- Changes to the design of the project during the design process (e.g. Evaluating access options);
- Engineering controls and other physical measures applied (e.g. water treatment facilities);
- Operational plans and procedures (e.g. waste management plans); and
- The provision of like-for-like replacement, restoration or compensation.

For impacts that are assessed to be of *Major* significance, a change in design is usually required to avoid or reduce these. For impacts assessed to be of *Moderate* significance, specific mitigation measures such as engineering controls are usually required to reduce these impacts to ALARP levels. This approach takes into account the technical and financial feasibility of mitigation measures. Impacts assessed to be of *Minor* significance are usually managed through good industry practice, operational plans and procedures.

In developing mitigation measures, the first focus is on measures that will prevent or minimise impacts through the design and management of the MCWAP-2A rather than on reinstatement and compensation measures. For the purposes of this WIA the following Mitigation Hierarchy for planned activities (**Table 6**) and unplanned events (**Table 7**) are outlined below.

Table 6: Mitigation Hierarchy for Planned Events

Mitigation	Context
Avoid at Source; Reduce at Source	Avoiding or reducing at source through the design of the Project (e.g. avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
Abate on Site	Add something to the design to abate the impact (e.g. pollution control equipment).
Abate at Receptor	If an impact cannot be abated on-site then control measures can be implemented off-site (e.g. traffic measures).
Repair or Remedy	Some impacts involve unavoidable damage to a resource (e.g. material storage areas) and these impacts require repair, restoration and reinstatement measures.
Compensate in Kind; Compensate through other Means	Where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g. financial compensation for degrading agricultural land and impacting wildlife). It is emphasised that compensation to individuals with residual impacts to livelihood or quality of life will generally be non-financial and will have a focus on restoring livelihoods.

Table 7: Mitigation Hierarchy for Unplanned Events

Mitigation	Context
Avoid at Source; Reduce at Source	Avoiding or reducing at source through the design of the Project (e.g. avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
Control	This includes contingency plans and response, e.g. Emergency Response Plans and Standard Operating Procedures.

The Mitigation Hierarchy shows that the priority in mitigation is to first apply mitigation measures to the source of the impact i.e. to avoid or reduce the magnitude of the impact from the associated Project activity and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets i.e. to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude.

5.2.14 Determining Residual Impacts

Impact prediction takes into account any mitigation, control and operational management measures that are part of the project design and project plan. A residual impact is the impact that is predicted to remain once mitigation measures have been designed into the intended activity. The residual impacts are described in terms of their significance in accordance with the categories identified above.

6 WILDLIFE SPECIFIC IMPACTS

6.1 Habitat Loss

Source of Impact

The proposed water pipeline will require major excavation and blasting to fulfil the requirements of a buried, 4.5 m deep trench from Thabazimbi to Lephalale (Ellisras). These will include creating a 40 m wide servitude, where all vegetation will be cleared. A 25 m wide servitude will be retained after construction for operation and maintenance, where all woody vegetation will be permanently removed and rehabilitated by establishing a grassland vegetation cover to be maintained by regular chemical treatment of undesirable, newly germinated woody seedlings and coppicing shrubs and trees. Construction activities are expected to lead to substantial natural habitat loss but negated by implementation of mitigation measures.

Potential Consequence

Habitat loss is expected to be minor as the route is following arterial roads, the railway line and property boundary fences, albeit through natural habitat. Although existing habitat loss is inevitable due to the construction activities and rehabilitation limitations imposed, the rehabilitation measures to be implemented can be beneficial in establishing a highly productive, albeit modified habitat zone exceeding existing vegetation productivity.

Wildlife farmers (intensive wildlife breeding enterprises using limited sized enclosures) will need to re-evaluate the breeding camp design and layout where the proposed construction area corridor is adjacent or too close to camp structures. This may require the translocation of wildlife to more suitable enclosures away from the proposed pipeline corridor to limit the impacts or a reduction in camp size. However, a reduction in camp size will invariably limit natural resource availability, requiring a reduction in wildlife numbers or increased supplementary feeding during periods of reduced resource availability (winter season). Availability of sufficient natural resources is paramount since supplementary feeding of wildlife by wildlife farmers can be cost inhibitive.

Significance of Impact

Environmental impacts are considered to be minor and of short duration (**Table 8**), especially where measures such as environmental rehabilitation is implemented as mitigation. Although the impact on existing wildlife resources along the servitude will be permanent, the establishment of a grassland habitat after construction can increase productivity substantially.

Table 8: Significance of Habitat Loss

Impact	Loss of vegetation and habitats from pipeline construction.			
Nature	Negative	Positive	Neutral	
	Although the larger section of the proposed route is alongside transformed or degraded environments, vegetation clearance measures need be implemented before construction.			
Type	Direct	Indirect	Induced	
	Complete natural habitat loss and modification.			
Duration	Temporary	Short-term	Long-term	Permanent

	Impact on natural vegetation is envisioned as permanent; However, reclamation measures in establishing a grassland vegetation cover after termination of construction will establish a highly modified but functional habitat type.				
Extent	Local	Regional	International		
	Pipeline impact is considered of regional scale due to the linear route formation extending from Thabazimbi to Steenbokpan. However, unanticipated human induced impacts can be expected all the way to Lephalale (Ellisras), forming an arterial connection with access to many wildlife ranches and farms.				
Scale	The scale of the impact is directly associated with the pipeline construction.				
Frequency	Construction and maintenance of the pipeline are considered single short-term events.				
Likelihood	Likely				
Magnitude	Positive	Negligible	Small	Medium	Large
	Impact on existing floral assemblages is relatively small and although complete habitat modification will occur ecosystem functionality can be maintained or improved by the establishment of an herbaceous vegetation cover with potential for higher productivity after construction.				
Resource/Receptor Sensitivity/Value Importance	Low	Medium	High		
	The receptor sensitivity is low due to the presence of alternative habitat with the limited impact on natural resource-use by other wildlife along the pipeline. However, rivers, water courses and wetlands are considered of medium sensitivity.				
Significance	Negligible	Minor	Moderate	Major	
	Although minor habitat impact is expected in wildlife areas, the impacts associated with borrow pits will be significantly higher.				

Controls, Mitigation Measures and Monitoring

Avoidance Measures

- Unauthorized access to adjacent fenced-off properties must be avoided;
- Unauthorized use of natural resources from adjacent properties must be avoided and strictly enforced;
- All wildlife must be protected, with snaring or hunting strictly prohibited with stated consequences and penalties enforced;
- Unauthorized access to the construction site and adjacent properties must be avoided;
- Construction must be restricted to the construction zone and spill-over to adjacent properties avoided;
- Existing vegetation must be left in place where possible;
- Avoiding unnecessary disturbance of stable vegetated surfaces;
- Avoiding unnecessary clearance of vegetation;
- Avoid all pollution and spill-over into adjacent natural environment.

Minimisation measures

- All properties must be fenced off from the proposed pipeline corridor (40 m) before construction using suitable/acceptable fencing designs to be determined in consultation with affected parties;
- All breeding camps must have a protective buffer zone adjacent to the abovementioned fence line;
- The footprint of pipeline construction activities must be minimised through proper planning. Each activity must be well planned to determine the minimum footprint required, which must be demarcated on the ground in advance. This area must include vehicle parking areas, worker's toilet facilities, material and equipment lay down areas etc;
- Disturbance of river or stream banks must be kept to the minimum necessary and where required must be carefully planned to minimise any potential disruption to existing water flow and disturbance of riparian vegetation;
- Reduce potential impacts, such as soil compaction, by selecting those areas with high alien plant infestations/ encroaching species as first options in location selection;
- Each of these footprints must be buffered and where possible fenced off to reduce the potential of accidental spill-over into surrounding areas;
- Implement an alien plant control programme in eradicating existing alien plant infestations and limiting potential spread to other natural areas; and
- Impact can be reduced by establishing a high productive herbaceous canopy cover using grass species suited to the soils and climate.

Rehabilitation Measures

- Implement a construction closure plan in which rehabilitation measures are defined and budgeted;
- Maximum use of woodland resources must be achieved from areas that are cleared for construction activities. Trees that need to be felled must be utilised by local communities as firewood to reduce the demand for such resources from natural areas;
- Resources from construction areas can also be used in support of local education and development initiatives;
- All remaining combustible biomass from bush clearing operations must be removed from the area, unless it is to be used in rehabilitation measures;
- Tree branches can be used in rehabilitation measures implemented to facilitate establishment of a herbaceous canopy cover;
- Top soil removal from the excavation areas must be stockpiled for re-use in rehabilitation measures to be implemented;
- All remaining construction material must be removed from the construction site and the areas rehabilitated;
- Scarified soil surfaces exposed for long periods, must be stabilised by replanting;
- Select grass species suitable for rehabilitation measures based on *in situ* soil potential and reigning climatic conditions;
- Burrow pits must be rehabilitated using indigenous vegetation;
- All plant species for use by the project must be reviewed and approved by qualified specialists prior to use on site. Non-native species must not be authorised unless a formal

risk assessment has been completed and approved by the Project, the Government and other relevant stakeholders.

Significance of Residual Impacts

Residual wildlife impact is minor and can be further mitigated by implementing effective rehabilitation measures after completion of pipeline works. This can be beneficial where suitable indigenous plant species are used in rehabilitation, creating improved habitat and better productivity.

6.2 Habitat Fragmentation

Source of Impact

The proposed MCWAP-2A design endeavoured to reduce habitat fragmentation by following existing infrastructure such as roads, railway lines and property boundary fence lines. However, where the boundary fences between two properties have been removed to create a larger conservation area, the construction corridor will bisect the properties for duration of the construction and rehabilitation phases. Bi-section of properties will also occur, albeit for the duration of construction only, where the proposed pipeline follows the existing power lines.

Potential Consequence

The bi-section of a property will invariably limit natural resource availability, requiring that resource potential be recalculated; optimum stocking rates adjusted and applied management principles re-evaluated within the constraints of the land-use options available. Availability of sufficient natural resources is paramount since supplementary feeding of wildlife by wildlife farmers can be cost inhibitive. Further infrastructural development may also be required to ensure that the remaining wildlife has access to sufficient basic resources such as open water.

Significance of Impact

The potential for encountering consolidated properties where bi-section will be required for construction of the MCWAP-2A is low but can be mitigated as a minor impact (**Table 9**).

Table 9: Significance of Habitat Fragmentation

Impact	Bi-section of properties and restricted access to natural resources.			
Nature	Negative	Positive	Neutral	
	Although the larger section of the proposed route is alongside existing infrastructure such as roads, railway lines and boundary fence lines, consolidated properties to form larger conservation areas may be encountered. Temporary bi-section of properties may need to be implemented.			
Type	Direct	Indirect	Induced	
	Habitat loss and fragmentation. Disruption of animal movement and migration.			
Duration	Temporary	Short-term	Long-term	Permanent

	The impact on natural vegetation is envisioned as permanent. However, reclamation measures in establishing a grassland vegetation cover after termination of construction will establish a highly modified but functional habitat type. The impact on wildlife movement and migration will be of short-term duration i.e. duration of the construction and rehabilitation phases.				
Extent	Local	Regional		International	
	Impact is expected as local since only a few properties will be affected. Although the general pipeline impact is considered of regional scale due to the linear route formation extending from Thabazimbi to Steenbokpan, the properties impacted are considered isolated events.				
Scale	The scale of the impact is directly associated with the pipeline construction.				
Frequency	Construction and maintenance of the pipeline are considered single short-term events.				
Likelihood	Likely				
Magnitude	Positive	Negligible	Small	Medium	Large
	Fragmentation is relatively small and although ecosystem disruption will occur, functionality can be maintained by implementing mitigation measures.				
Resource/Receptor Sensitivity/Value Importance	Low		Medium	High	
	The receptor sensitivity is medium due to the presence of alternative habitat with the limited impact on wildlife movement and access to natural resources.				
Significance	Negligible	Minor	Moderate	Major	
	Significance is considered minor as only isolated instances of habitat fragmentation will possibly be encountered.				

Controls, Mitigation Measures and Monitoring

Avoidance measures

- Avoid pipeline construction through consolidated properties; and
- Implement a Biodiversity Protection Policy.

Minimisation measures

- Erect new fences on both sides of the pipeline construction corridor and secure wildlife on wildlife ranches and farms;
- Maintain access to natural resources by implementing a two phase construction approach, keeping fencing sections open for wildlife movement and migration; and
- Safe translocation of high value wildlife species encountered to areas of protection.

Rehabilitation measures

- Implement a pipeline construction plan in which rehabilitation measures are defined and budgeted; and

- Creating an alternative habitat with high productive potential during rehabilitation procedures by planting pipeline corridor with suitable indigenous grass species that will improve biodiversity.

6.3 Loss of Wildlife Biodiversity

Source of Impact

Loss of habitat and biodiversity is primarily associated with the construction of the pipeline and necessary borrow pits where general construction will require work sites for storage of building materials and top soil removed for use in the rehabilitation process. Potential negative impacts are loss of vegetation diversity due to clearing operations, soil disturbance, compaction and obstruction of water flow that can adversely affect eco-system functioning and wildlife diversity.

Potential Consequence

Direct loss of wildlife biodiversity due to construction works and maintenance is relatively minor since wildlife will move away from these disruptions but return after cessation of construction and rehabilitation activities. However, disruption of wildlife population dynamics is likely with possible short-term effects on fecundity resulting in poor natality. Inherently sensitive wildlife will be more susceptible to these disruptions. Wildlife diversity can potentially increase after rehabilitation since an alternative resource will become available that may be more suited to the feeding, breeding, nesting and resting requirements of some wildlife species. The linear design of the proposed project can also contribute to natural dispersal of smaller wildlife species, thus potentially increasing natural species diversity. Since access to open water is a prerequisite in sustaining wildlife any obstruction of natural water catchment and flow patterns must be avoided. Precautionary measures must be implemented to ensure that contamination of water resources does not occur.

Significance of Impact

Significance of impact is minor to moderate (**Table 10**) with regards to loss of biodiversity. All trees tree species with associated habitat and resources will need to be removed prior to construction, resulting in a reduction of available habitat and indirectly a decrease in biodiversity. However, where suitable indigenous plant species are used in rehabilitation procedures, biodiversity and availability of resources can be substantially improved and will contribute directly to habitat creation and increased faunal and floral diversity. It is expected that wildlife biodiversity will improve as more diverse and alternative habitat becomes available after implementation of rehabilitation measures.

Table 10: Significance of wildlife biodiversity loss

Impact	Loss of wildlife biodiversity from pipeline and borrow pit construction activities and maintenance.		
Nature	Negative	Positive	Neutral
	Habitat loss, transformation of vegetation and displacement of endemic wildlife will be inevitable. Disruption of wildlife populations dynamics is likely with possible short-term effects on fecundity resulting in poor natality. Inherently sensitive wildlife will be more susceptible to these disruptions.		
Type	Direct	Indirect	Induced

	Loss of suitable habitat and wildlife diversity from borrow pit areas. Complete habitat modification and displacement of wildlife along the proposed pipeline corridor. Potential influx of undesirable, opportunistic wildlife species adapted to these degraded environments. Direct and indirect loss of wildlife diversity due to construction activities along the pipeline corridor. Wildlife loss due to unauthorized access and increased poaching activities.			
Duration	Temporary	Short-term	Long-term	Permanent
	Impact is envisioned as temporary in nature since natural species diversity may increase after cessation of construction and implementation of rehabilitation measures as alternative habitat more suited to other wildlife becomes available.			
Extent	Local	Regional	International	
	The pipeline impact is considered of regional scale due to the linear route formation from Thabazimbi to Steenbokpan. However, unanticipated human induced impacts can be expected all the way to Lephalale (Ellisras), forming an arterial connection with access to many wildlife ranches and farms.			
Scale	Impact is restricted to the pipeline corridor.			
Frequency	The impact is considered disruptive initially with maintenance as a continuous low impact activity after construction. Furthermore, wildlife biodiversity loss is temporary with potential for improved biodiversity after rehabilitation measures are implemented.			
Likelihood	Likely			
Magnitude	Positive	Negligible	Small	Medium
	Impact on biodiversity is medium and extends mainly to the pipeline corridor where habitat will be destroyed and modified. Reduction of wildlife biodiversity is negligible and will be mitigated by implementing effective rehabilitation measures after the initial construction phase. Although the loss of rare and expensive wildlife is considered small, the financial implications of such a loss can be substantial to any wildlife enterprise.			
Resource/Receptor Sensitivity/Value/Importance	Low	Medium		High
	The receptor sensitivity is low where pipeline construction and maintenance activities are implemented, with higher sensitivity at borrow pits and where blasting activities are required.			
Significance	Negligible	Minor	Moderate	Major
	Impact is considered minor to where pipeline construction activities are restricted to the proposed corridor. Furthermore, impacts can effectively be mitigated with the implementation of suitable rehabilitation measures.			

Controls, Mitigation Measures and Monitoring

Avoidance measures

- Pre-construction walk-down and faunal surveys must be undertaken prior to construction site and borrow pit selection to identify medium to high value wildlife species and necessary action taken to avoid areas where they occur;
- Preserve high value wildlife species *in situ* where possible and protect unique wildlife habitats;
- Implement a Biodiversity Protection Policy.

Minimisation measures

- Erect new fence to delineate the pipeline construction corridor and secure wildlife on wildlife ranches and farms;
- Ensure a buffer zone of 100 m between the construction corridor and wildlife breeding camps;
- Safe translocation of high value wildlife species encountered to areas of protection;
- Creating an alternative habitat with high productive potential during rehabilitation procedures by planting pipeline corridor with suitable indigenous grass species that will improve biodiversity;

Rehabilitation measures

- Implement a pipeline construction plan in which rehabilitation measures are defined and budgeted;
- All topsoil from the pipeline trench and borrow pits must be stockpiled for restoration and rehabilitation works after construction;
- All plant species for use by the project must be reviewed and approved by qualified specialists prior to use on site. Non-native species will not be authorised unless a formal risk assessment has been completed and approved by the Project, the Government and other relevant stakeholders;
- Re-vegetation trials must be undertaken to determine the most appropriate species for the habitat; and
- Determine specific planting plans and schedules for each habitat type based on inherent environmental constraints where rehabilitation will be required.
- The environmental management programme must include environmental monitoring and maintenance procedures for effectivity of rehabilitation measures implemented.

Significance of Residual Impacts

The residual impacts for the biodiversity loss will see permanent shifts to a transformed habitat type over the life of the pipeline and beyond. However, the creation of alternative habitat after the implementation of rehabilitation measures can result in improved biodiversity where feeding, breeding, nesting and resting requirements are established for wildlife species more suited to the transformed habitat. The residual impact on biodiversity is thus considered as minor.

6.4 Wildlife dispersal and migration

Source of Impact

Prior to construction, all wildlife in the proposed construction corridor will need to be removed before the vegetation can be cleared or fences to contain the wildlife can be erected. Although it is expected that wildlife will voluntarily move away from these disruptive activities, some wildlife species may inadvertently be fenced out during fencing construction. These animals may require active relocation before pipeline construction activities can commence.

Potential Consequence

MCWAP-2A construction will require the removal of all larger wildlife species from the proposed construction corridor and animal movement will effectively be curtailed during the construction period and associated rehabilitation activities. Wildlife, inadvertently fenced into the proposed corridor may require active capture and relocation procedures.

Internal camp fences may also need to be moved to ensure that sufficient resources remain available to wildlife populations in breeding camps. It is important that wildlife have sufficient space for movement away from external disturbances, especially during the pipeline construction phase where high noise levels from mechanical ground moving machinery and rock blasting may result in attempted break-outs and possible deaths.

The construction of the pipeline and associated servitude for maintenance will invariably result in the disruption of current farming practices by requiring the implementation of movement restrictions on rare and endangered animal species in the servitude area. However, ranchers and associated management practices will not be impacted by these restrictions and wildlife will have free access to the natural resources available after construction and rehabilitation.

Significance of Impact

Significance of impact on wildlife movement and migration during site preparation is moderate (**Table 11**), due to the high noise levels associated with bush clearing operations. This disruption is expected to continue due to the use of other construction machinery, earth moving equipment and rock blasting activities during the pipeline construction phase. However, where effective control measures such as a sufficiently wide buffer zone between the activity zone and breeding camps are implemented, the risks to wildlife will be significantly reduced if not completely eliminated. The direct impacts can thus be mitigated to moderate acceptable levels of disruption.

Table 11: Significance of wildlife dispersal and migration

Impact	Restricted access to natural resources and disruption of wildlife breeding enterprises.		
Nature	Negative	Positive	Neutral
	All wildlife must be removed from the proposed pipeline corridor before vegetation clearing and construction can begin. Wildlife breeding camps may require adjustments to fences to ensure a recommended 100 m buffer zone from the pipeline corridor. Disruption of wildlife breeding enterprises and translocation of wildlife.		
Type	Direct	Indirect	Induced

	Wildlife movement on ranches and access to natural resources will be temporarily curtailed in the proposed pipeline construction zone. Rare and endangered wildlife on wildlife farms will be permanently excluded from the pipeline corridor. High noise levels associated with construction machinery, earth moving equipment and rock blasting will affect land-use viability of small properties and wildlife breeding enterprises.			
Duration	Temporary	Short-term	Long-term	Permanent
	Change of land-use can be short- or long-term, dependant on modification and re-design of infrastructure being required where wildlife breeding remains the preferred land-use option. Risk to wildlife in breeding camps adjacent to the pipeline corridor, although temporary, is high during the construction phase but dissipates completely after cessation of the initial activity.			
Extent	Local	Regional	International	
	Pipeline impact is considered of regional scale due to the linear route formation from Thabazimbi to Steenbokpan, disrupting applied land-use practices.			
Scale	Scale of impact is low in wildlife ranching but moderately high in wildlife farming where breeding camps may require redesign or translocation of rare and endangered wildlife to more suitable camps.			
Frequency	The impact is considered a single event with permanent implications to wildlife farming enterprises.			
Likelihood	Likely			
Magnitude	Positive	Negligible	Small	Medium
	Implementation of mitigation measures can reduce the impact on wildlife but the magnitude on intensive wildlife farming practices may require infrastructural changes, translocation of wildlife and active management intervention to ensure viability.			
Resource/Receptor Sensitivity/Value/Importance	Low	Medium	High	
	Although potential impact on wildlife enterprises is moderate, risks can be substantially reduced if precautionary mitigation measures are implemented.			
Significance	Negligible	Minor	Moderate	Major
	Impact on wildlife is considered moderate, requiring mitigation measures to reduce the potential impacts on, especially, wildlife farming enterprises.			

Controls, Mitigation Measures and Monitoring

Avoidance measures

- Devise and implement a monitoring policy to determine noise impacts on wildlife;
- Implement measures to prevent the use of unauthorised security firearms on the construction site;
- Prohibit the transport of live plants or other animals into natural areas;
- No domestic pets (dogs) are to be allowed on site;

- No open fires to be allowed on site; and
- Inspect all construction equipment, vehicles and machinery for wildlife and wildlife products.

Minimisation measures

- Vegetation removal and fence erection must be conducted in consultation with affected parties;
- All wildlife must have sufficient space to move away from construction disturbances;
- Breeding camps fences should not be located within 100 m from the construction corridor;
- Rare and expensive wildlife breeding stock should be relocated to alternative camps where noise and disturbance from construction is a matter of concern;
- Planned blasting activities must be communicated to all interested and affected parties;
- Implement precautionary measures to ensure that rock fall and debris from blasting do not damage existing infrastructure; and
- Design and Implement standard operating procedures for unexpected cases of emergency and support to ranchers/farmers i.e. unplanned veld fires, fence breaks and wildlife escapes.

Rehabilitation measures

- Fence failure and escape of wildlife into the construction corridor during the construction phase must be reported to the relevant rancher/farmer immediately;
- Fence failures during the construction phase must be fixed immediately;
- Unauthorised human activity and suspicious behaviour must be reported immediately to the rancher/farmer or security company;
- After levelling of construction areas and replacement of top soil, suitable indigenous vegetation can be established; and
- All plant species for use by the project must be reviewed and approved for functional habitat design by a qualified specialist prior to use on site. Non-native species will not be authorised unless a formal risk assessment has been completed and approved by the specialist, the Government and other relevant stakeholders.

Significance of Residual Impacts

Design a contingency plan with standard operating procedures for cases of emergency during the pipeline construction phase. After the construction phase residual impacts will be negligible but implementation of a medium-term (3 year) programme to monitor the effectivity of mitigation measures, especially with regards to rehabilitation is advised.

6.5 Land-use

Source of Impact

The construction of borrow pits, pipeline and associated servitudes required for maintenance will invariably affect the current preferred land-use and will significantly impact on wildlife enterprises geared to both national and internal tourism and hunting. Noise levels during the initial construction phase will not only affect the land-use and distribution of wildlife on the properties but also effectively eliminate the use of certain areas for hunting and eco-tourism activities. Although hunting can be conducted throughout the year on many ranches, international trophy hunting is most often conducted in the winter months from March to October. However, the most popular hunting months are June, July and August. Furthermore, eco-tourism facilities located in close proximity to the construction zone will invariably affect the wildlife experience so dearly valued by urban visitors.

Potential Consequence

Wildlife enterprises dependant on eco-tourism can be negatively affected by excessive noise levels during the construction phase of the pipeline. Where housing/lodge infrastructure is too close to the development, the rancher may need to cancel bookings for at least a season with dire financial consequences and potential loss of returning clients. Hunting safaris will also be affected where sufficient hunting areas are not available away from the noise population. Cancellation of hunting bookings from especially international clients can have far reaching consequences for returning clients where bookings are made well in advance.

Significance of Impact

Loss of revenue will be inevitable and recovery of client confidence can only be achieved with further medium- to long-term investment. The proposed pipeline location can also result in the demolition of infrastructures and ultimately the ruination of viable wildlife enterprises contributing to rural job creation and security. Significance of impact is considered of moderate to mayor (Table 12).

Table 12: Significance of Land-use

Impact	Land-use change and loss of revenue				
Nature	Negative	Positive		Neutral	
	Disruption of wildlife activity due to excessive noise levels associated with construction, disturbance of wildlife, reduced game viewing opportunities and poor wilderness experiences to national and international trophy hunting enterprises.				
Type	Direct	Indirect		Induced	
	Disruption of wildlife behaviour, avoidance and poor viewing/hunting opportunities. Facility location may be affected, requiring permanent relocation.				
Duration	Temporary	Short-term	Long-term	Permanent	
	The impact is considered of short-term duration.				
Extent	Local	Regional	International		
	Pipeline impact is considered of regional scale due to the linear route formation from Thabazimbi to Steenbokpan, disrupting preferred land-use practices. However, the extent may also be international where eco-tourism and hunting enterprises will be adversely affected during the construction phase.				
Scale	Scale of impact will be significant and will require a dynamic approach in dealing with induced impacts.				
Frequency	The impact is considered a single, short-term event with full recovery after the construction phase.				
Likelihood	Likely				
Magnitude	Positive	Negligible	Small	Medium	Large

	The impact on wildlife enterprises, especially eco-tourism and trophy hunting are moderate, and although recovery of clientele is possible this pipeline construction will result in undesirable financial setbacks and reduced job security. The magnitude on land-use and infrastructural changes will require a large investment		
Resource/Receptor Sensitivity/Value/Importance	Low	Medium	High
	Although the current sensitivity is only moderate, the potential consequence to wildlife enterprises can be substantially more.		
Significance	Negligible	Minor	Moderate
	The impact on wildlife ranches are considered moderate, with more devastating effects on eco-tourism and hunting enterprises.		

Existing Controls, Mitigation Measures and Monitoring

Avoidance measures

- Disruption of activities by functional wildlife enterprises must be avoided if possible;
- Avoid disruption of hunting activities by safari operators during the months of May to September (hunting season);
- Avoid disruption of eco-tourism activities by wildlife ranchers;

Minimisation measures

- Plan pipeline construction phases to select sections with cattle and wildlife farming enterprises during the winter months (May to September), with wildlife eco-tourism and hunting enterprises targeted for construction during the summer months (October to April) if possible within the constraints of the construction schedule; and
- Where this is not possible affected farmers/ranchers must be informed in writing of the proposed construction schedule to ensure pre-emptive action in mitigating impacts by cancellation of bookings or re-scheduling of planned land-use activities.

Rehabilitation measures

- Rehabilitation measures are not applicable or effective; and
- Affected parties must be compensated for loss of income.

Significance of Residual Impacts

Avoidance of adverse effects on eco-tourism and hunting enterprises will greatly reduce the impacts associated with the pipeline construction, in which case residual impacts will be negligible. However, where effective mitigation cannot be implemented, compensation for loss of income during the construction period may be required.

7 WILDLIFE MITIGATION MEASURES

7.1 Specific Mitigation Measures

The planned construction activities will take place on a relatively long but narrow footprint. However, the nature of construction is such that it has the potential to generate severe environmental impacts and comprehensive mitigation and environmental management is necessary.

The proposed pipeline construction area consists predominantly of natural vegetation, where preferred land-use options include both livestock and wildlife enterprises. Wildlife ranches are predominant dependant on national and international eco-tourism and hunting for maintaining economic viability, while wildlife farms have emphasis on breeding of rare and expensive wildlife species for live sales. However, combinations of wildlife ranching, cattle ranching and more intensive wildlife farming are often observed. The greatest potential for severe negative impacts arises from loss of habitat, disruption of preferred land-use options applied and loss of income. However, potential impacts on wildlife, especially in breeding camps are a matter of concern that will require remediation and compensation.

7.1.1 Habitat destruction

Habitat loss will be unavoidable and property owners will need to be compensated for loss of natural resources. Boundary fences of suitable construction that complies with Provincial legislation or in consultation with each property owner must be present along both sides of the proposed MCWAP-2A construction corridor (40 m) before any construction can begin. Existing property fences can be used to delineate one side of the corridor since the linear design follows infrastructure such as roads and railway lines. However, a second, temporary, fence will be required to delineate the construction corridor and safeguard wildlife from entering the construction zone during operations. Due consideration must be given to corridor clearing operations since vegetation clearing and earthworks may damage existing property boundary fences. Existing access to properties must be maintained since property owners may not have alternative access points to their properties. Where property access is disrupted by the pipeline construction, alternative temporary access points may need to be created.

Wildlife farmers (intensive wildlife breeding enterprises using limited sized enclosures) will need to re-evaluate breeding camp design and layout where the proposed construction area corridor is adjacent or too close to camp structures. This may require the translocation of wildlife to more suitable enclosures away from the proposed pipeline corridor to limit the impacts or a reduction and camp size. Affected properties may require reassessment of natural resource availability and the potential to sustain wildlife. New stocking rates must be determined and implemented where sufficient resources will not be available for the duration of the pipeline construction phase. Alternatively, supplementary feeding can be implemented by management's discretion. However, this option is not considered viable or cost efficient.

Although habitat loss is inevitable due to the construction activities and rehabilitation limitations imposed, the rehabilitation measures to be implemented can be beneficial in establishing a highly productive, albeit modified grassland habitat zone exceeding existing vegetation productivity.

7.1.2 Habitat fragmentation

The proposed MCWAP-2A design endeavoured to reduce habitat fragmentation by following existing infrastructure such as roads, railway lines and property boundary fence lines. However, where the boundary fence between two properties has been removed to create a larger conservation area, the construction corridor will bisect the properties for duration of the construction and rehabilitation phases. Double fence lines to delineate the construction corridor will be required. and it is recommended that open access points or migratory routes be maintained where possible.

Bisected properties may require reassessment of natural resource availability and the potential to sustain wildlife. New stocking rates for each section must be determined and implemented where sufficient resources will not be available for the duration of the pipeline construction phase. Alternatively, supplementary feeding can be implemented by management's discretion. However,

this option is not considered viable or cost efficient. It is recommended that open access points or migratory routes be maintained during the construction phase, where possible.

7.1.3 Wildlife diversity

Fencing of the proposed MCWAP-2A corridor and subsequent habitat destruction will invariably lead to a reduction in natural resource availability and wildlife diversity, at least for the duration of the construction and rehabilitation phases to be implemented. Wildlife may require supplementary feeding where natural resources are limiting. However, supplementary feeding can be cost inhibitive and wildlife stocking rates may have to be reduced, effecting wildlife diversity. Availability of open water must be ensured and obstruction of natural water catchment and flow patterns must be avoided.

Although the removal of all larger wildlife is considered inevitable, smaller opportunistic wildlife species will inhabit the corridor after cessation of construction activities, especially where rehabilitation and re-vegetation measures are implemented. Mitigation of vegetation destruction by establishing a grassland type habitat using suitable grass species after construction may increase resource availability and diversity. Although the natural vegetation structure will never be attained, the modified habitat can be highly productive and potentially increase wildlife species diversity.

7.1.4 Dispersal and migration

Larger wildlife will be excluded from the proposed MCWAP-2A pipeline construction corridor for the duration of excavation and rehabilitation. However, after successful establishment of an herbaceous layer in mitigation, the fence line can again be removed, giving larger wildlife access to the newly established resources. Due to the highly modified grassland structure and diversity in vegetation, potentially new feeding, breeding, nesting and resting attributes will become available to other naturally occurring wildlife species. Furthermore, the modified habitat will attract more plains game since the habitat is more suited to their requirements. It is thus expected that natural wildlife diversity will increase after cessation of construction and successful rehabilitation of the pipeline corridor.

7.1.5 Land-use

Wildlife enterprises dependant on eco-tourism can be negatively affected by the proposed MCWAP-2A pipeline construction. Where housing/lodge infrastructure is too close to the development, the rancher may need to cancel bookings for at least a season with dire financial consequences and potential loss of returning clients. Hunting safaris will also be affected where sufficient hunting areas are not available away from construction activities. Cancellation of hunting bookings from especially international clients can have far reaching financial consequences, thus affecting the economic viability of such an enterprise. Reducing the impacts on sensitive hunting and eco-tourism enterprises by implementing phase development is logistically very complex, especially since construction will be expedited by using multiple contractors and 24 hour site activities.

It is recommended that affected parties be informed in writing of construction progress and that they be warned well in advance (require 12 months' notice) of impending disruption. Pre-emptive action can then be taken by the affected parties by re-scheduling activities or cancelling bookings. It is expected that these measures will not be sufficient in mitigating all the negative implications and income loss from land-use activities will invariably occur. Compensation for financial losses may be the only solution.

7.1.6 Noise and Dust

It is expected that the noise generated by excavations at the borrow pits and blasting operations during construction of the proposed MCWAP-2A pipeline will exceed the general threshold of acceptability. Although wildlife will exhibit avoidance behaviour, exposure to sustained noise levels may have undesirable consequences in wildlife populations, especially by wildlife in breeding camps located in close proximity to the excavation works. In many cases these wildlife breeding camps are located adjacent or in close proximity of the construction areas. Furthermore, these breeding camps are often too small to allow wildlife movement away from the disturbance. It is recommended that all breeding camp fences be moved at least 100 m away from the pipeline corridor in an attempt to negate the potential negative implications (The 100 m buffer recommended is based on noise level measurements from mining activities and dissipation of noise over distance where noise levels are bearable and should not have long-term adverse effects on wildlife). The effectivity of this measure is influenced by vegetation cover, acting as a buffer, to dissipate noise between the construction site and wildlife. Extensive wildlife systems (wildlife ranching) will invariably be less affected since wildlife will move away from disturbance and perceived danger. However, intensive wildlife systems (wildlife farming) will require an additional buffer zone by moving the breeding camp outer fences away from the disturbance. This action may require modification of the camp design, change in location and the capture and relocation of wildlife. These issues and requirements need to be discussed with each individual owner following authorisation.

Although dust particles may affect wildlife health directly it is more likely that vegetation will take the brunt of the fall-out. This can in effect reduce photosynthesis and result in a reduction of natural resources available. Supplementary feeding may be required in areas with excessive fall-out where dispersal of wildlife to other unaffected areas are not possible.

7.1.7 Environmental Pollution

It is anticipated that human generated waste, especially, plastic products from the construction site will spill over into adjacent properties. These products can be extremely harmful if ingested by some species that is not as selective in their feeding behaviour. Precautionary measures *cf.* General Mitigation Measures, can be implemented on site.

7.1.8 Veld Fires

Accidental or run-away fires can be devastating in its consequences and precautionary measures are recommended on site. Undesirable biomass loss by a rancher/farmer due to negligent fires will result in supplementary feeding wildlife at high cost until recovery of the vegetation in the follow-up rainfall season. Precautionary measures should include a firebreak along the length of the MCWAP-2A pipeline construction site. It is recommended that this firebreak be located adjacent to the newly constructed fence line i.e. a firebreak inside and outside the temporary fence.

7.1.9 Security

Poaching of wildlife, especially rare and endangered wildlife species will be a matter of concern. Security measures will be required on-site and security efforts implemented by wildlife ranchers and farmers will need to be intensified, not only for the duration of construction on the affected properties but long-term measures will need to be implemented. Furthermore, information on the presence and movement of rare and endangered wildlife on neighbouring properties can be communicated to poaching syndicates. This is especially relevant since the newly created servitude will allow for ease of access by persons with criminal intent after completion of the MCWAP-2A development.

7.2 General Mitigation Measures

7.2.1 Habitat destruction and fragmentation

- a. Minimize area cleared for construction activities. This includes the area used by personnel and labour during construction.
- b. Infrastructural impacts during construction must be restricted to a radius of 40 m, preferably delineated and with a barrier erected.
- c. Red Data plant and animal species must be retained/protected where possible.
- d. Construction material to be located in a secure site. Care must be taken that construction materials cannot inadvertently land in the river system.

7.2.2 Habitat loss and fragmentation

- a. Retain indigenous vegetation where possible.
- b. All excess construction material must be removed
- c. Disturbed terrain must be levelled.
- d. Rehabilitated the site to allow natural vegetation regrowth.
- e. Elevate pipeline over high sensitivity areas where applicable.

7.2.3 Introduction of invasive plants

Care must be taken to limit the further introduction of alien invasive plant species by applying stringent measures in eliminating contamination from construction vehicles entering the area.

- a. Alien invasive species must not be promoted through ornamental planting on any of the project sites.
- b. Unless the level of infestation precludes selective mechanical removal, whenever encountered, alien invasive species must be removed and destroyed. This may be implemented by a small dedicated task team with knowledge of the target species and most suitable time of action for each species. Local labour may be hired to supplement the effort.

7.2.4 Soil damage during construction operations

- a. Where possible, soil should be ripped after compaction and before replanting areas disturbed by heavy construction machinery.
- b. Soil damaged during the construction process must be replaced and rehabilitated using naturally-occurring vegetation whenever feasible.
- c. An ecologist must be consulted if alternative solutions appear more desirable (for example the use of alien species with non-invasive characteristics).

7.2.5 Water pollution - stockpile run-off

- a. Considerable care must be taken that no pollutants reach surface or ground water sources, since the consequences of such pollution will be severe for downstream systems. Specifically, stockpile run-off must be contained such that no water entering the rivers or drainage-lines.
- b. Water quality is a key component of the monitoring programme that must occur during the construction and operational phases.

7.2.6 Run-off from topsoil exposure

- a. The top soil exposure must be planned in such a way as to minimise the time period of exposure of topsoil.

- b. Limit erosion potential through anti erosive measures.
- c. Rehabilitate as soon as possible to retain vegetation cover.

7.2.7 Water pollution

- a. Potential pollutants and chemicals to be stored in secure area.
- b. User control must be implemented and standard operating procedures drafted, in case of a spill.

7.2.8 Water flow obstruction

- a. The structures designed must not impede natural water flow.
- b. Structural designs must promote natural run off and flow of water to avoid the creation of standing water habitats.

7.2.9 Fuel spillages

- a. The diesel depot and generators must be bunded to prevent spilled diesel from spreading beyond the confines of either, and in particular from coming into contact with surface or ground water.
- b. Chemicals and equipment for the treatment of diesel spillages must be available on site at all times.

7.2.10 Pollution and littering

- a. Mitigate the use of earthmoving equipment, generators and any other equipment that results in noise, dust or pollution.
- b. Minimise the number of vehicles using access roads by limiting access to project vehicles only.
- c. Minimize lighting and noise generated. Animals at night are attracted to lights, and these should be kept to a minimum. If possible, yellow rather than white lights should be used.
- d. Construction personnel must be restricted to an allocated area of impact that can be rehabilitated.
- e. Ablution and toilet facilities must be provided as per World Health Organisation Standards and according to best practice industry standards.
- f. Littering must be controlled by education of the staff and the widespread availability of receptacles for common litter items (water bottles, cans, plastic bags, wrappings...) on all temporary project sites during the construction phase.
- g. Widespread availability of receptacles for common litter items (water bottles, cans, plastic bags, wrappings...) on all project sites must be implemented.
- h. A litter and rubbish management programme (collection of rubbish in all project sites and adequate disposal) must be implemented
- i. Dedicated personnel must be hired to control littering and facilities use on all sites, as well as to collect and properly dispose of the material collected in receptacles and temporary facilities.

7.2.11 Electromagnetic fields

- a. The use of electromagnetic devices must be minimised.
- b. All devices emitting electromagnetic radiation (EMR) must be appropriately shielded to contain any EMR.

7.2.12 Poaching

- a. All personnel on site must be informed on the conservation significance of wildlife areas and that poaching will not be tolerated;
- b. All personnel to formally acknowledge information and accept the legal consequences if caught; and
- c. Regular (weekly or monthly depending on the level of awareness of the staff) education and awareness meetings must be held to inform staff of any new development. Officials from the nature conservation services must be invited to some meetings.

7.2.13 Ecosystem functionality

- a. Retain ecosystem functionality by judicious management of resources.
- b. Avoid or reduce potential impacts in high sensitivity areas identified.

Various water courses and wetlands that occur throughout the area are considered highly sensitive habitats, and avoidance measures or buffer zones must be observed where possible.

Rehabilitation of the pipeline construction area should occur as soon as operations are relocated to a new section after the pipeline has been covered. Full rehabilitation measures must be implemented after cessation of the construction activity. Given the complexity of soil processes and interactions with surface ecology, it is recommended that a soil scientist be consulted in the development of a suitable rehabilitation protocol.

A comprehensive ecological monitoring programme must be seen as a fundamental component of the environmental management plan for the proposed construction activities. This monitoring program must include the further collection of baseline ecological data, at annual intervals during the operational phase, in order to identify any unforeseen negative impacts on adjacent properties.

8 DISCUSSION

Based on consultation with interested and effected parties and observations in the field, the main concerns regarding the proposed MCWAP-2A development is the effects on wildlife such as the loss of habitat, re-planning of a management strategy, moving camp breeding systems, translocation of game, reduced stocking rates and the requirement for supplementary feeding. Wildlife ranches dependant on eco-tourism and hunting in generating income will also be adversely affected by the construction due to high noise levels from earth moving excavations, blasting and other construction activities. Infrastructural losses and economic viability of some wildlife enterprises will also be severely compromised. Furthermore, wildlife and property security will need to be improved in an attempt to curb poaching activities and losses of rare and expensive wildlife species.

In implementing some of the mitigation measures above it is evident that compensation to and close collaboration with property owners will be required to achieve the desired mitigation required for successful implementation the proposed MCWAP-2A project.

Evaluation of the proposed MCWAP-2A WTI indicated that the noise generated by construction of the Balancing Dam, Desilting Works and High-lift Pump Station close to Thabazimbi will adversely affect the land-use options applied on Hampton 320 KQ, where eco-tourism and hunting are the main revenue generators. It is recommended that affected parties be informed in writing of construction progress and that they be warned well in advance (require 12 months' notice) of impending disruption. Pre-emptive action can then be taken by the affected parties by re-scheduling activities or cancelling bookings.

Least impact is expected following the Central Route from the Balancing Dam all the way to the railway line since Alternative A1 and A2 are more disruptive to wildlife farms and ranches located adjacent to these routes. Least impact is expected following the existing powerlines across Paarl 124 KQ. The Central Route from Paarl 124 KQ follows a servitude road that can be exploited in reducing the impact on affected properties. However, both Buffelsvley 127 KQ and Karoobult 126 KQ are wildlife farms that will require that internal fence-lines on the properties be moved to achieve the desired buffer zone from construction activities. Limited hunting is conducted on these two properties. Reduced impact is also observed on Zondagskuil 130 KQ and Diepkuil 135 KQ, both wildlife ranches with limited hunting operations. Alternative C is also considered as a viable option in reaching the railway line corridor with little additional impact on wildlife.

Following the Central Route along the railway line is considered least impact on wildlife and wildlife enterprises. Although some wildlife farming (breeding camps) are located adjacent to the railway line and will invariably be impacted by the proposed pipeline construction, recommended mitigation measures will reduce the perceived impacts.

Rietfontein 820 KQ, Inkerman 10 KQ, and Groenland 397 KQ will be affected since revenue is mainly generated from international hunting. Where it is not possible to implement phase development and avoidance measures during the peak hunting seasons, compensation for loss of income due to cancellation of bookings may be the only alternative. Mabulskop 406 LQ is a wildlife farm with infrastructure located adjacent to the railway line. The existing breeding camps may have to be moved or the animals relocated to facilities further away from the proposed MCWAP-2A construction site. Although the railway line will act as a barrier in noise reduction, the distance will not be sufficient in attaining the desired objective of a 100 m buffer zone. Camps systems may require re-design and translocation of wildlife to areas where impacts will be reduced. The farm Rooipan 357 LQ is a newly developed eco-tourism and hunting concern that will be adversely affected by the proposed MCWAP-2A development. The proposed Alternative D3 also impacts on the farm, potentially exacerbating the situation and effecting economic viability of the enterprise. Further consideration of the Alternative D3 pipeline route is not recommended since any development along this road is rife with complications. Not only will infrastructural development be affected (main road to Steenbokpan), but a number of structures will have to be demolished. Furthermore, not only a wetland is present on Leliefontein 672 LQ but Eskom pylons are erected on both sides of the road, less than 50 m from the boundary fence on Zandheuvel 356 LQ, requiring deviation from the proposed route. The presence of the Kuche Safaris hunting operation, with associated structures on Schuldpadfontein 326 LQ will require that the running concern be bought out, since economic viability will be severely compromised. All infrastructural development on Kuche Safaris is adjacent to the road and current delineation of the proposed pipeline will require that most structures be demolished. The property is too small (approximately 400 ha) for further development. Moving the pipeline corridor to the other side of the road is also not considered a suitable alternative since another homestead (**Figure 6**) is also located directly next to the road. The Alternative D1 and D2 routes are considered more viable with fewer challenges for the proposed MCWAP-2A project.



Figure 6: Homestead opposite Kuche Safaris

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