KALAHARI-EAST WATER SUPPLY SCHEME EXTENSION: PHASE 1

Proposed extension of the Kalahari-East Water Supply Scheme and associated infrastructure to the Mier Municipality,
ZF Mgcawu District Municipality, Mier Local Municipality (Northern Cape Province).

BIODIVERSITY & BOTANICAL SCAN

Biodiversity & Botanical scan of the proposed route to determine the possible impact on biodiversity with emphasis on vegetation and plant species

1 July, 2014

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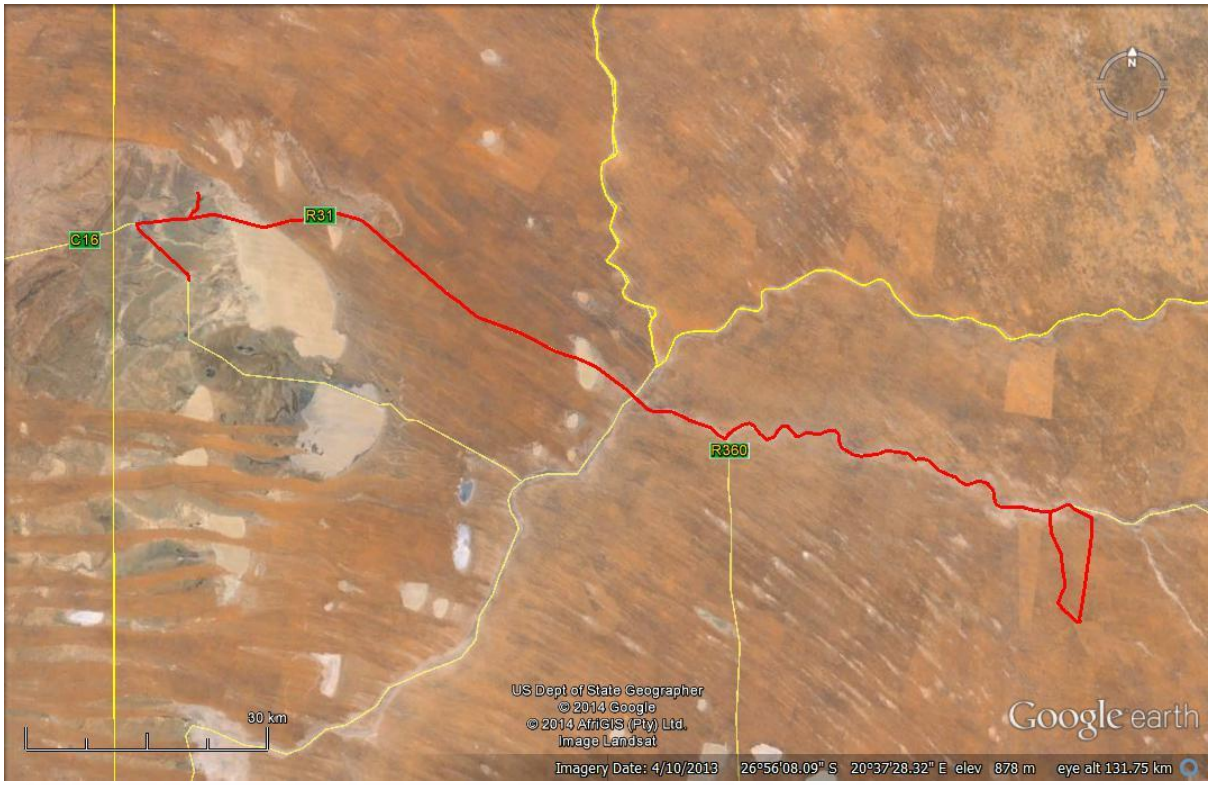

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REQUESTED BY: BVI ENGINEERS PTY. LTD.

INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant and has no interest in the activity other than fair remuneration for services rendered. Remuneration for services is not linked to approval by decision making authorities and PB Consult has no interest in secondary or downstream development as a result of the authorization of this proposed project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given here are based on the author's best scientific and professional knowledge and available information. PB Consult reserves the right to modify aspects of this report, including the recommendations if new information becomes available which may have a significant impact on the findings of this report.

RELEVANT QUALITFICATIONS & EXPERIENCE OF THE AUTHOR

Mr. Peet Botes holds a BSc. (Hons.) degree in Plant Ecology from the University of Stellenbosch (Nature Conservation III & IV as extra subjects). Since qualifying with his degree, he has been employed for more than 20 years in the environmental management field, first at the Overberg Test Range (a Division of Denel) managing the environmental department of OTB and being responsible for developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve). In 2005 he joined Enviroscientific, an independent environmental consultancy specializing in wastewater management, botanical assessments and developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits. He was also responsible for helping develop the botanical part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 botanical and environmental legal compliance audits. During 2010 he joined EnviroAfrica in order to move back to the biodiversity aspects of environmental management. Experience with EnviroAfrica includes NEMA applications, biodiversity- and botanical assessments, environmental compliance audits and environmental control work.

Mr. Botes is also a registered Professional Environmental and Ecological Scientists at SACNASP (South African Council for Natural Scientific Professions) as required in terms of Section 18(1)(a) of the Natural Scientific Professions Act, 2003, since 2005.

SUMMARY - MAIN CONCLUSIONS

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SUMMARY OF POSSIBLE SIGNIFICANT BIODIVERSITY FEATURES			
Potential impacts on biophysical environment			
Geology & soils	Geology & soils vary only slightly in the larger study area.	No special features have been encountered (e.g. true quartz patches or broken veld) and the impact on geology and soils is expected to be very localised and low. Mitigation will entail staying within the road reserve and minimising footprint.	
		Without mitigation: Low	**With mitigation: Insignificant**
Land use and cover	The proposed route will follow existing road reserves and with little impact on any farming activity.	The area is been utilised mainly for grazing. The impact is considered short term, temporary and localised with regards to land use. Mitigation will entail staying within the road reserve and minimising footprint.	
		Without mitigation: Low	**With mitigation: Insignificant**
Potential impacts on threatened or protected ecosystems			
Vegetation type(s)	Seven vegetation types were encountered (refer to Table 2):	All vegetation types are classified as "Least threatened" but not all are well protected. However, the proposed footprint follows existing road reserves. Associated infrastructure (e.g. additional roads) will not be required. In addition the impact will be short term and temporary of nature and is therefore not considered significant. Mitigation will entail staying within the road reserve and minimising footprint.	
		Without mitigation: Low	**With mitigation: Insignificant**
Corridors and conservation priority areas/networks.	Draft Environmental Management Framework (EMF) for the Siyanda District Municipality.	According to the EMF, Kalahari Karroid Shrubland has a high conservation priority, while Southern Kalahari Salt Pans vegetation has a medium/low sensitivity index due to both not being adequately protected. However, the proposed footprint follows existing road reserves. Associated infrastructure (e.g. additional roads) will not be required The impact on river and wetland corridors will similarly fall within already disturbed areas within the road reserve. In addition the impact will be short term and temporary of nature. Mitigation will entail staying within the road reserve and minimising the footprint especially when crossing water courses. It will be especially important to minimise the impact on riparian vegetation and to ensure erosion control through good rehabilitation. Correct alien eradication will also be important.	
		Without mitigation: Medium	**With mitigation: Low**
Protected plant species	No SA red list species was observed. Three (3) tree species protected in terms of the NFA was encountered. Eight (8) plant species protected in terms of the NCNCA was observed.	A great number of trees listed in terms of the NFA, most notably Camelthorn and Sheppard's trees were encountered along the proposed route. More than 400 trees can potentially be impacted by the proposed pipeline route (even though it is located within the disturbed road reserve). However, with good mitigation between 90 – 95% of these trees can be conserved. Previous experience showed that both Camelthorn and Sheppard's tree have deep root systems, which mean excavation can be done quite close to the tree without impacting on the root system. In addition at least eight species protected in terms of the NCNCA are likely to be impacted by the proposed development. Again good topsoil	

		conservation and rehabilitation can negate this impact to a large degree. Mitigation will entail excellent environmental control, slight route alterations to avoid as many mature indigenous tree species as possible; good topsoil conservation and rehabilitation practices; and application for permits in terms of the NFA and the NCNCA.	
		Without mitigation: High	**With mitigation: Medium - Low**
Fauna & Avi-fauna	The proposed route will follow existing road reserves and with low impact on habitat.	Because of the temporary and localised nature of the activity it is considered highly unlikely that it will have any significant impact on fauna or avi-fauna. Mitigation will entail staying within the road reserve and minimising footprint and the impact on mature indigenous tree species.	
		Without mitigation: Medium	**With mitigation: Insignificant**
Rivers & wetlands	The proposed route will follow the Kuruman River and will cross the Molopo River. It will also cross two Southern Kalahari Salt pans as well as numerous ephemeral and also seasonal streams which drain the Mier, Rietfontein and Philandersbron area into the Hakskeenpan.	The preparation and installation of the pipeline has the potential to impact on both the riparian and in stream zones of these water courses. The disturbance of habitat during and after the construction activities also provides an opportunity for further invasive alien plants to establish in the area and might leave erosion potential. Mitigation will entail excellent environmental control in order to minimise the impact on riparian zones, to ensure good rehabilitation and re-vegetation with suitable indigenous vegetation to reduce the risk of erosion in the stream channels. Follow up work should be carried out after rehabilitation to ensure that no invasive alien plants re-establish itself.	
		Without mitigation: Medium	**With mitigation: Low**
Invasive alien infestation	*Prosopis, Calotropis* and *Gomphocarpus* species was observed along the route.	All listed invasive alien species must be removed during the construction. However, incorrect alien control methods used for especially Prosopis species may aggravate the situation and result in spreading in place of control of these species. Mitigation will entail correct alien control methods coupled with follow up work after rehabilitation.	
		Without mitigation: Medium	**With mitigation: Positive**
Potential direct impacts			
Direct impacts	Refers to those impacts with a direct impact on biodiversity features.	The proposed pipeline will have a direct impact on natural vegetation, which is likely to include protected plant species in terms of the NFA and NCNCA, small seasonal ephemeral streams and vegetation with a potential high conservation value. The impact on soil, landuse, fauna and avi-fauna and veld fire is considered to be negligible. Apart from the potential impact on mature indigenous trees the impacts will be mostly short termed, temporary and localized. Mitigation will include all the mitigation aspects discussed above.	
		Without mitigation: High (Protected tree species)	**With mitigation: Medium/Low**
Potential indirect impacts			
Indirect impacts	Refers to impacts that are not a direct result of the main activity, but are impacts associated or resulting from the main activity.	It is very likely that the proposed project will have indirect impacts like the establishment of temporary lay-down areas, quarry sites for bedding and blanket material, temporary construction sites and concrete mixing areas. However, with good environmental control it will be possible to minimise the impact of such indirect impacts. Mitigation will entail excellent environmental control, placement of temporary lay-down areas or construction sites within areas that are not environmentally sensitive and will not impact on protected plant species. It will also entail good waste and wastewater control.	
		Without mitigation: Medium/high	**With mitigation: Low**
Potential cumulative impacts			
Cumulative impacts	Refers to the cumulative loss of ecological function and other biodiversity features on a regional basis.	The proposed project will have a temporary and localised impact, which should not result in significant additional permanent impacts (apart from the new). Overall it is not considered likely that the cumulative impact will result in any significant additional impact on regional biodiversity targets, but it is likely that the project will impact on protected plant species and watercourses. Mitigation will entail excellent environmental control and all of the	

		mitigation measures addressed above	
		Without mitigation: High	**With mitigation: Medium/Low**
The No-Go Option			
The No-Go Option	The "No-Go alternative" does not signify significant biodiversity gain or loss especially on a regional basis. However, it will ensure that none of the potential impacts above occur.	The Mier Municipal area is extremely dry with no permanent surface water sources. The large rural farms and towns depend on borehole water and windmills for their daily needs. Apart from those at Rietfontein the water quality of these boreholes are mostly poor with yields that are unsustainable during dry seasons. Only one third of the Mier households have access to water inside their dwellings and many farmers, on a daily basis, have to pump water for stock through pipelines or transport it per road and over long distances. In their integrated development plan for the Mier area, the Mier Municipality has identified the need for water and sanitation provision as their priority issue for the next 5 years (Mier IDP, 2013/14). According to engineering evaluation the proposed pipeline is the only viable option to ensure sustainable water supply to the Mier community in the long run. The need for sustainable water has been identified as high socio-economical need and priority of the Mier community. It is thus unlikely that a similar project will not have to be implemented. The specific route is most likely the one with the lowest potential environmental impact and the one which makes the best long term sense with the only negative the potential impact on the mature indigenous trees within the road reserve.	

RECOMMENDATION

Having evaluated the biodiversity aspects and associated impacts pertaining to the proposed development, the author is of the opinion that the proposed route matches the most logical choice from a biodiversity perspective, by minimising the impact on threatened habitats, vegetation and species, while conforming to the objectives of the Draft Siyanda Municipal EMF. With mitigation it is possible that the proposed development will have a minimal permanent impact on the environment.

The evaluation of the potential environmental impacts indicates the most significant potential impacts identified where:

- The potential impact on a great number of NFA protected tree species, especially *Acacia erioloba* and *Acacia haematoxylon* within the Kuruman River corridor, and *Boscia albitrunca* also within the Kuruman River corridor and near Mier.
- The potential impact on NCNCA protected plant species
- The potential impact on Kalahari Karroid Shrubland which has a high conservation priority.
- The potential impact on the Southern Kalahari Salt Pans vegetation, which has medium/low sensitivity.
- The potential impact on seasonal water courses and ephemeral streams.

With the available information to the author's disposal it is recommended that project be approved, provided that mitigation is adequately addresses

(with special focus on the minimisation the impacts on indigenous tree species).

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1. INTRODUCTION

The Mier Local Municipality forms part of the ZF Mgcawu District Municipality (formerly known as Siyanda District Municipality) and is at the north-west boundary of South Africa. It shares boundaries with Namibia to the west, the Kgalagadi Transfrontier Park to the north and Botswana to the north-east. The Municipality (which is bigger than the Free State Province) is primarily a rural area, with jurisdiction over nine small towns as well as the !Khomani San community, with Rietfontein as its main town. The area is extremely dry with no permanent surface water sources. The large rural farms and towns depend on borehole water and windmills for their daily needs. Apart from those at Rietfontein the water quality of these boreholes are mostly poor with yields that are unsustainable during dry seasons. Only one third of the Mier households have access to water inside their dwellings and many farmers, on a daily basis, have to pump water for stock through pipelines or transport it per road and over long distances. In their integrated development plan for the Mier area, the Mier Municipality has identified the need for water and sanitation provision as their priority issue for the next 5 years (Mier IDP, 2013/14).

BVi (Northern Cape) was appointed to investigate water supply options to address the water shortage and needs of the Mier Municipality. The results show that the only feasible long term water supply option will be to connect to the Kalahari-East Water Supply Scheme. This will not only protect the existing underground water resources, but will, for the first time, establish a means to sustainable farming activities in the region. Note that the Kalahari-East water supply scheme was designed to supply water to the Mier area.

The proposed pipeline extension will connect to the existing Kalahari-East Pipeline on the farm Cramond, crossing the farm towards the R31, from where it will be placed within the road reserve of the R31, past Askham, Andriesvale, Groot- and Klein Mier, to Rietfontein and then on to Philandersbron. The first portion of the pipeline (along the R31) it will follow the Kuruman River and cross the Molopo near Andriesvale. From there it will also cross Koopan and Hakskeenpan towards Rietfontein and then a number of smaller ephemeral seasonal streams, mainly between Rietfontein and Philandersbron.

BVi Engineers (Pty) Ltd. appointed EnviroAfrica to undertake the NEMA environmental application process. PB Consult was appointed by EnviroAfrica to conduct a biodiversity and botanical scan of the proposed route.

1.1 TERMS OF REFERENCE

EnviroAfrica (Pty) Ltd was appointed by BVi Engineers (Pty) Ltd as the independent Environmental Assessment Practitioner (EAP) to undertake the Basic Assessment (EIA) Process for the proposed development. PB Consult was appointed by EnviroAfrica to conduct a biodiversity and botanical scan of the proposed route.

PB Consult was appointed within the following terms of reference:

- Complete a biodiversity scan of the proposed site in order to evaluate the potential impact of the proposed pipeline route on specifically botanical features.
- Make recommendations on impact minimisation should it be required
-
- Consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

The study includes the following:

- A brief discussion of the local environment in order to provide background on the ecological factors influencing the ecological drivers associated with the specific area.
- A brief discussion of the vegetation types expected and encountered with emphasis on protected species encountered.
- A list of plant species encountered during the site visit.
- Determination of the occurrence, or possible occurrence of threatened or sensitive plant species, and sensitive plant communities, on the basis of the field survey and records obtained from the South African National Biodiversity Institute (SANBI) and available literature.
- Assessment of habitat sensitivity, incorporating faunal distribution based on the field survey and from available literature.
- An evaluation of the potential impact of the proposed project on habitat and species.
- A discussion of significant impacts focusing on possible mitigation and amendments to the development proposal.

2. APPLICABLE LEGISLATION

Constitution of the Republic of South Africa (1996): of special relevance in terms of environment is section 24

Conservation of Agricultural Resources Act 43 of 1983 (CARA): supports conservation of natural agricultural resources (soil, water, plant biodiversity) by maintaining the production potential of the land and combating/preventing erosion; for example, by controlling or eradicating declared weeds and invader plants.

Hazardous Substances Act 15 of 1973: to control substances that may cause injury, ill-health, or death through their toxic, corrosive, irritant, strongly sensitizing or flammable nature, or by the generation of pressure

National Environmental Management Act 107 of 1998 (as amended): replaces the Environmental Conservation Act (ECA) and establishes principles for decision-making on matters affecting the environment, and for matters connected therewith.

- **Environmental Impact Assessment Regulations** (R543 of 2010): procedures to be followed for application to conduct a listed activity.

National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA): replaces the Atmospheric Pollution Prevention Act (No. 45 of 1965).

National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA): supports conservation of plant and animal biodiversity, including the soil and water upon which it depends.

- **National list of ecosystems that are threatened and in need of protection** (GN 1002 of 9 December 2011).

National Environmental Management: Protected Areas Act 57 of 2003 (as amended Act 31 of 2004) (NEMPAA): To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes.

National Environmental Management: Waste Act 59 of 2008 (NEMWA): To reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.

- **List of Waste Management Activities that have, or are likely to have a detrimental effect on the environment** (GN 718 of 3 July 2009): Identifies activities in respect of which a waste management license is required.

National Forests Act 84 of 1998 (as amended): supports sustainable forest management and the restructuring of the forestry sector.

- **List of protected tree species** (GN 716 of 7 September 2012)

National Heritage Resources Act 25 of 1999: supports an integrated and interactive system for the management of national heritage resources, including supports soil, water and animal and plant biodiversity.

National Veld and Forest Fire Act 101 of 1998 (NVFFA): protects soil, water and plant life through the prevention and combating of veld, forest, and mountain fires

National Water Act 36 of 1998 (NWA): promotes the protection, use, development, conservation, management, and control of water resources in a sustainable and equitable manner.

Northern Cape Nature Conservation Act 9 of 2009 (NCNCA): which provides for the sustainable utilization of wild animals, aquatic biota and plants.

3. DEFINITIONS & ABBREVIATIONS

3.1 DEFINITIONS

Contaminated water: means water contaminated by the activities associated with construction, *e.g.* concrete water and runoff from plant/ personnel wash areas.

Environment: means the surroundings within which humans exist and that are made up of:

- the land, water and atmosphere of the earth;
- micro-organisms, plant and animal life;
- any part of the combination of the above two bullets and the interrelationships between them;
- the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being

Environmental Aspect: any element of any construction activity, product or services that can interact with the environment.

Environmental Control Officer: a suitably qualified environmental agent responsible for overseeing the environmental aspects of the Construction phase of the EMP.

Environmental Impact: any change to the environment, whether adverse or beneficial, wholly or partially resulting from any construction activity, product or services.

No-Go Area(s): an area of such (environmental/aesthetical) importance that no person or activity are allowed within a designated boundary surrounding this area.

Owner: the owner, or dedicated person, responsible for the management of the property on which the proposed activity will be performed.

Solid waste: means all solid waste, including construction debris, chemical waste, excess cement/concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

Precautionary principle: means the basic principle, that when in doubt or having insufficient or unreliable information on which to base a decision, to then limit activities in order to minimise any possible environmental impact.

Watercourse: in this report the author uses a very simplified classification system to define the difference between a river, a water course and an ephemeral stream as encountered in the study area.

- River: A river is a natural watercourse with a riverbed wider than 3m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.
- Water course: A small river or natural watercourse with a riverbed of less than 3 m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.

- Ephemeral stream: A very small and poorly defined watercourse, mostly on relatively flat areas, which only flows for a short period after heavy rains, usually feeding into a stream or river or dries up completely before reaching another body of water.

3.2 ABBREVIATIONS

BGIS	Biodiversity Geographical Information System
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Areas (Municipal)
DEA	Department of Environmental Affairs
EAP	Environmental assessment practitioner
EIA	Environmental impact assessment
EMF	(Municipal) Environmental Management Framework
EMP	Environmental management plan
IDP	Integrated development plan
NCNCA	Northern Cape Nature Conservation Act, Act 9 of 2009
NEMA	National Environmental Management Act, Act 107 of 1998
NEMAQA	National Environmental Management Air Quality Act 39 of 2004
NEMBA	National Environmental Management Biodiversity Act, Act 10 of 2004
NEMPAA	National Environmental Management Protected Areas Act 57 of 2003
NEMWA	National Environmental Management Waste Act 59 of 2008
NFA	National Forests Act 84 of 1998
NSBA	National Spatial Biodiversity Assessment
NVFFA	National Veld and Forest Fire Act 101 of 1998
NWA	National Water Act 36 of 1998
SABIF	South African Biodiversity Information Facility
SANBI	South African National Biodiversity Institute
SIBIS	SANBI's Integrated Biodiversity Information System
SKEP	Succulent Karoo Ecosystem Project
WWTW	Wastewater Treatment Works

4. PROJECT DESCRIPTION

The Kalahari-East Water Supply Scheme was finished in 1994 and supply water (76 l/s) to farms in the Kalahari (and the Middelputs area in Botswana) through approximately 1 200 km of pipelines. The main east to west pipeline (A-line) was designed to deliver a supply of up to 27 l/s to the Mier area at the end of the line. At present the Kalahari-East supply line stop on the Farm Visch Gat No. 201 approximately 17 km south of the R31 (Askham – Van Zylsrus road) and approximately 52 km east of Askham. The eventual target area for water supply to Mier will include water for 8 small towns, the !Khomani San community, 185 small farms, 3 border control posts, 38 commercial farms and Twee Rivieren at the Kgalagadi Transfrontier National Park (600 km of pipeline, servicing 1.48 million Ha.). Current planning sees this objective achieved through 6 phases of which this study only deals with phase 1.

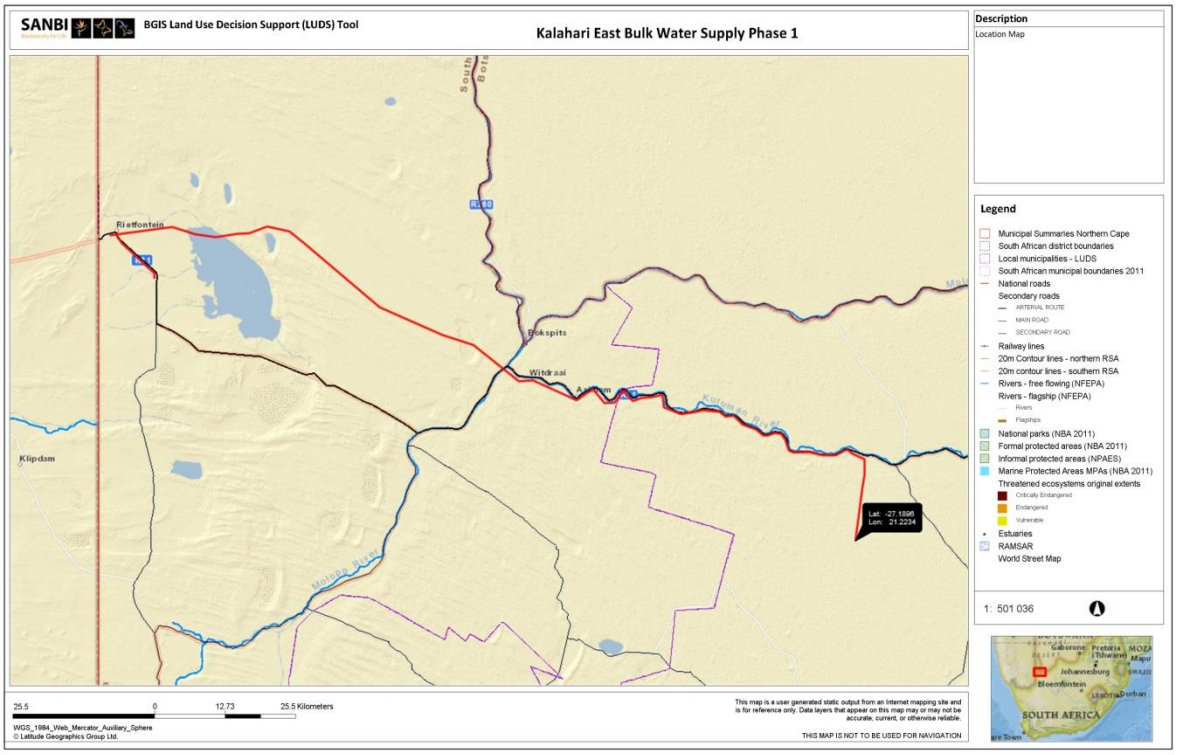

Figure 1: Overview of the proposed pipeline route

Phase 1 of the Kalahari-East extension into the Mier Municipality proposes the extension of the Kalahari-East main supply line from its current end point (Visch Gat Farm) westwards up to Rietfontein and then south towards Philandersbron (mainly following the road reserve of the R31). Along the road it will utilise existing reservoirs of the various towns, but at least one larger balancing Reservoir will be constructed just east of Groot Mier. The total route (approximately 165 km in length) can be described as follows:

- From the current end point the A-line will be extended about 100 m directly west onto the Farm Cramond No. 202.
- It will then follow the eastern boundary of the Farm Cramond (existing 2 spoor track) for approximately 17 km till it reaches the R31 (Askham – Van Zylsrus road).

- It will then follow the southern road reserve (where possible) of the R31 for approximately 52 km to Askham.
- From Askham it will follow the southern road reserve of the R360 (Upington – Kgalagadi road) to Andriesvale (approximately 14 km).
- From Andriesvale it will again follow the R31 (southern road reserve) over Koopan past Groot- and Klein Mier then over Hakskeenpan up to the Rietfontein Reservoir (a total distance of approximately 70 km).
- Apart from the pipeline itself a new floating reservoir (approximately 0.5 ha in size) will have to be constructed in order to ensure sustainable water supply. The location was chosen to co-inside with the highest elevation along the pipeline (which was encountered just east of Mier) which will enable gravity feed to the remaining the downstream towns and farms.
- From Rietfontein it will follow the western road reserve of the R31 to the Philandersbron Reservoir (approximately 11 km).

4.1 METHODS USED

Desktop studies were conducted, coupled by a 4 day physical site visit (from the 12th to the 15th of June 2014). During the desktop study significant biodiversity features associated with the larger surroundings were identified, and researched. The desktop study also took into account the biodiversity status as classified in the National Spatial Biodiversity Assessment (2004) as well as the 2011 National Spatial Assessment or National List of Threatened Ecosystems (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. It also aims to take, Municipal Environmental Management Frameworks (EMF's), Municipal Biodiversity Sector Plans and Municipal Critical Biodiversity Areas (CBA's) into account where applicable. In the case of the Mier Local Municipality, the Municipal Biodiversity Summaries Projects (2010) was the most relevant Biodiversity conservation plans (SANBI: BGIS). However, a draft Environmental Management Framework (EMF) for the Siyanda District Municipal was published in 2008, and even though this report was never formally approved, the findings were also used to guide decision making for this report.

The site survey was conducted by driving the route, stopping every 5 km (or when features of special interest were observed) to walk portions of the route, examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, including rivers, streams or wetlands, special plant species and or specific soil conditions which may indicate special botanical features (e.g. salt marsh areas, rocky outcrops or silcrete patches). The timing of the site visit was good in that the Kalahari recently experienced good rains (accounting for the apparent dominance of grass species in places). Perennial plants and a good number of seasonal plants were identifiable and although the possibility remains that a few species may have been missed, the author is confident that a fairly good understanding of the vegetation status in the area was obtained.

5. DESCRIPTION OF ENVIRONMENT

The aim of this description is to place the study area in context with regards to all significant biodiversity features which are expected and or were encountered within the study area. The study area has been taken as the proposed route and its immediate surroundings.

5.1 LOCATION & LAYOUT

The Mier Municipality is located within the ZF Mgcawu District Municipality (formerly known as Siyanda District Municipality) along the north-west boundary of South Africa (Figure 2). The proposed route spans both the !!Khara Hais and Mier Local Municipalities. Askham is located approximately 180 km north of Upington, where the R360 intersects with the R31. Rietfontein (the main town of the Mier Municipality) is a border post town, located in the central western section of the Mier Municipality on the old road linking Rietfontein with Groot-Mier, north of Noenieput and approximately 264 km north-north-west of Upington.

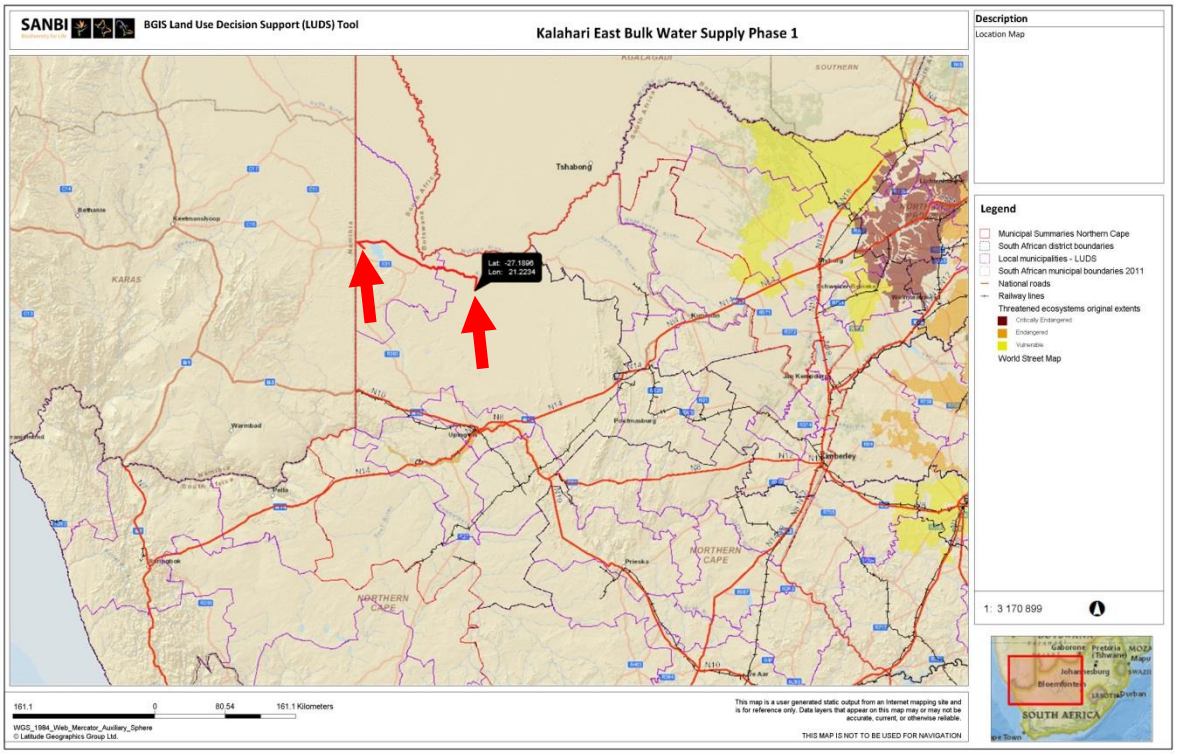

Figure 2: Location of the proposed route from Cramond to Philandersbron

The proposed pipeline extension will connect to the existing Kalahari-East Pipeline on the farm Cramond, crossing the farm towards the R31, from where it will be placed within the road reserve of the R31, past Askham, Andriesvale, Groot- and Klein Mier, to Rietfontein and then on to Philandersbron. Please refer to Chapter 4 (Project description) for a full description of the proposed pipeline route.

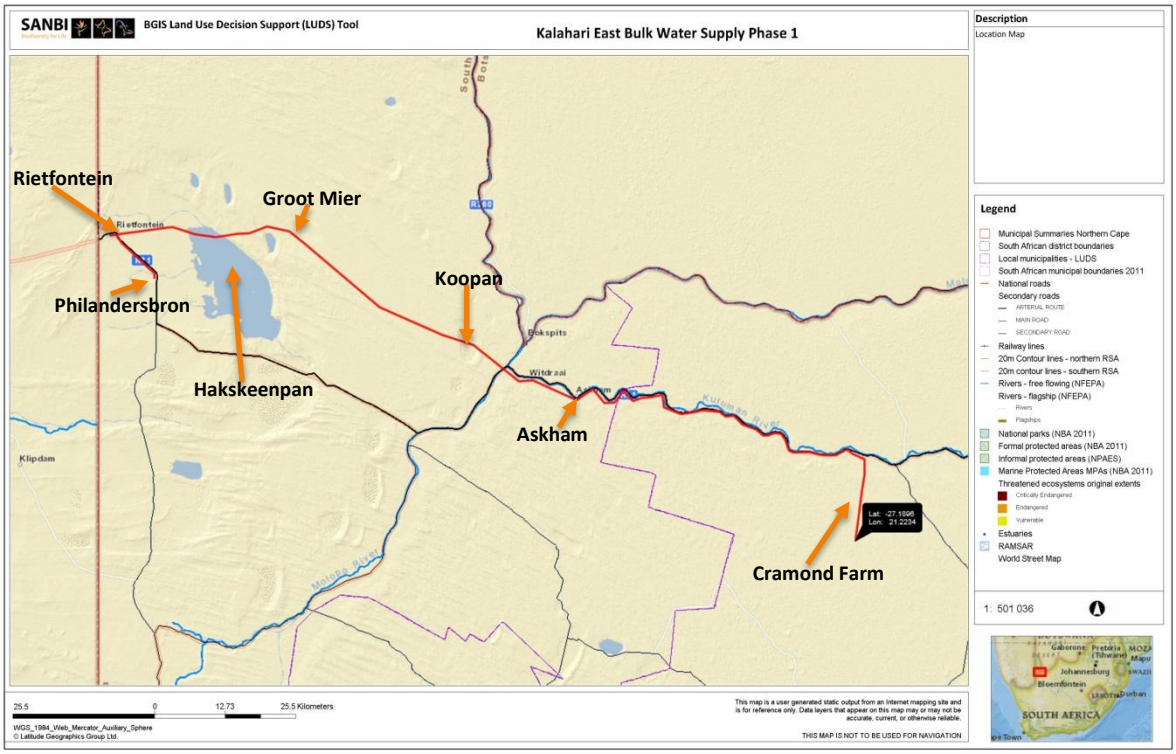

Figure 3: Map indicating the proposed route (in red) from Cramond Farm to Rietfontein and Philandersbron

Table 1: GPS coordinates for Kalahari-East Water Supply Scheme Extension: Phase 1 route

DESCRIPTION	LATITUDE AND LONGITUDE	ALTITUDE
Kalahari-East Extension Start point (Visch Gat Farm)	S27 11 23.2 E21 13 27.4	919 m
Cramond / R31 intersection	S27 03 27.9 E21 12 31.7	883 m
Askham	S26 58 49.9 E20 46 51.5	851 m
Andriesvale	S26 56 16.7 E20 39 34.9	849 m
Koopan	S26 54 10.4 E20 36 00.4	836 m
New Balancing Reservoir (East of Groot Mier)	S26 46 35.9 E20 21 31.8	896 m
Groot Mier	S26 44 29.4 E20 19 18.7	842 m
Klein Mier	S26 44 19.8 E20 16 28.5	848 m
Hakskeenpan	S26 44 45.4 E20 10 01.6	801 m
Rietfontein Reservoir	S26 44 56.1 E20 00 53.9	865 m
Philandersbron Reservoir	S26 48 59.6 E20 05 33.0	836 m

5.2 TOPOGRAPHY

The Kalahari basin stretches northwards from just north of the Orange River into Botswana and Namibia. It is a flat, sand covered, semi-desert area, on average between 900 m to 1200 m above sea-level. It is characterised by a number of large pans to the north of Upington, by dry river beds (such as the Kuruman, Nossob and Molopo Rivers) and by dunes which strike north-west to south-east. The region is underlain by Karoo rocks and rocks belonging to the tertiary Kalahari Group. Outcrops are rare (Siyanda Draft EMF).

The area in which the proposed route falls, forms part of the Kalahari dale, and is typically characterised by continuous linear dunes and inter dune straaten. The landscape is one of the simplest in the world and consists mainly out of sandy dunes inter-specked with calciferous plains and dry pans. The area is drained by three very sporadic flowing streams, i.e. Nossob River, Auob River and Molopo River. Last recordings of flows in the lower reaches of the Molopo and Kuruman Rivers were in 1933 and again in the 1974/5 and 1975/6 season. However, underground water may occur. The Kalahari dunes are mostly open shrubland dominated by grasses with trees, especially *Acacia* trees, sometimes prominent (especially along water courses). The calciferous plains are mostly covered with low Karroid shrubland. Elevation along the pipeline route varies between 800 – 1 000 m above sea level, with a slight slope from east to west (refer to Figure 4).

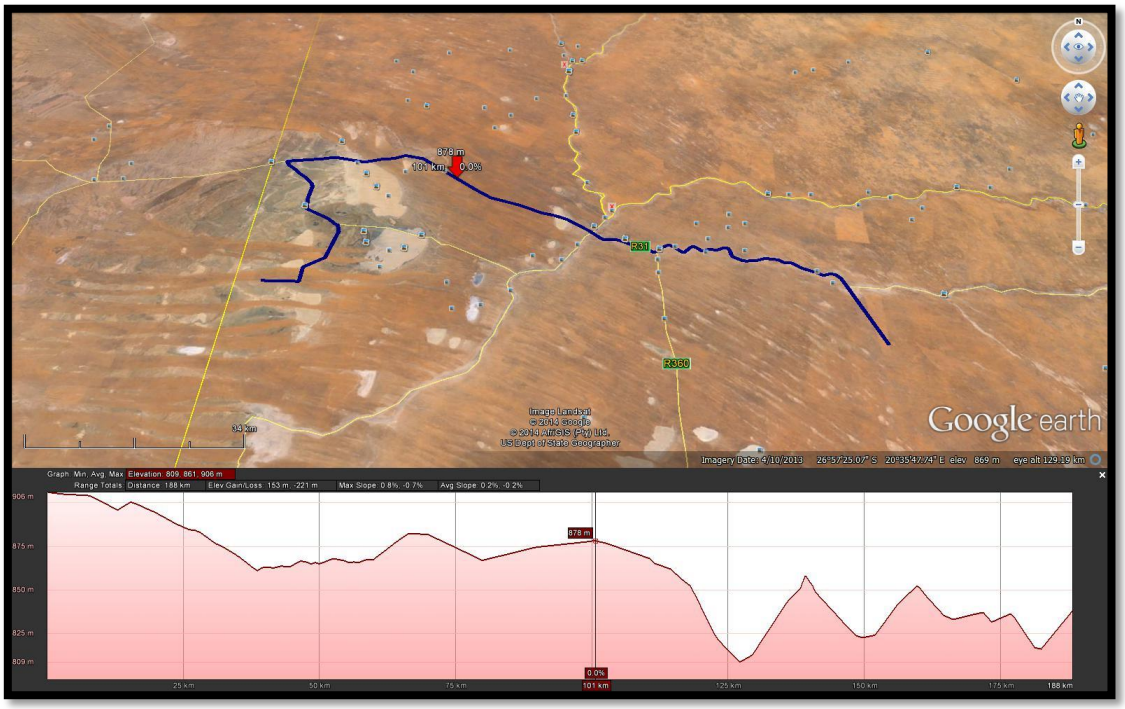

Figure 4: Google image showing the expected elevation of the proposed route

5.3 CLIMATE

According to the Mier IDP (2013/14), the Mier area falls within a rain shadow, with an average rainfall of 120 mm per year, typical of a semi-desert. It is located in the summer rainfall region of South Africa and approximately 70 percent of the average rainfall occurs during the period October to April each year. Summer is very hot with maximum temperatures of up to 40°C (average 25°C) and winters are cool to cold with average temperatures of 10°C, although it could drop to below 0°C coupled with typical frost. The predominantly wind direction is north-south with very variation in direction.

According to saexplorer (www.saexplorer.co.za), Askham normally receives about 84 mm of rain per year, with occurring mainly during summer. It receives the lowest rainfall (0 mm) in May and the highest (24 mm) in February. Average daily maximum temperatures range from 20°C in June to 33°C in January. The region is the coldest during July with temperatures as low as 2.9°C on average during the night. Mier normally receives

about 83 mm of rain per year, also occurring mainly during summer. It receives the lowest rainfall (0 mm) in May and the highest (26 mm) in March. Average daily maximum temperatures range from 20°C in July to 33°C in January. The region is the coldest during July with temperatures as low as 3°C on average during the night.

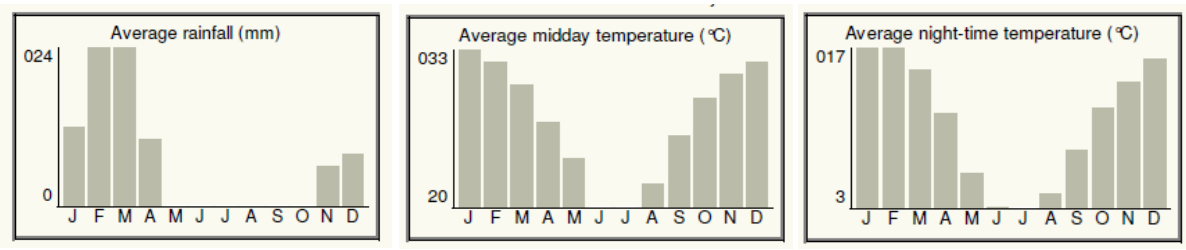

Figure 5: Average rainfall, temperature and night-time temperatures for Askham (www.saexplorer.co.za)

5.4 GEOLOGY & SOILS

According to Mucina *et al*(2006), Rutherford *et al*(2006) and the SANBI Biodiversity Geographical Information System, the geology and soils for this area differs slightly, but can be described as aeolian sand underlain by superficial silcretes and calcretes of the Kalahari Group (also refer to Figure 6). Mostly fixed parallel sand dunes with Af land type almost exclusively, while sandy soils of the Namib soil form may be expected on the flat plains. Outcrops of calcrete can be expected in the Auob Duneveld.

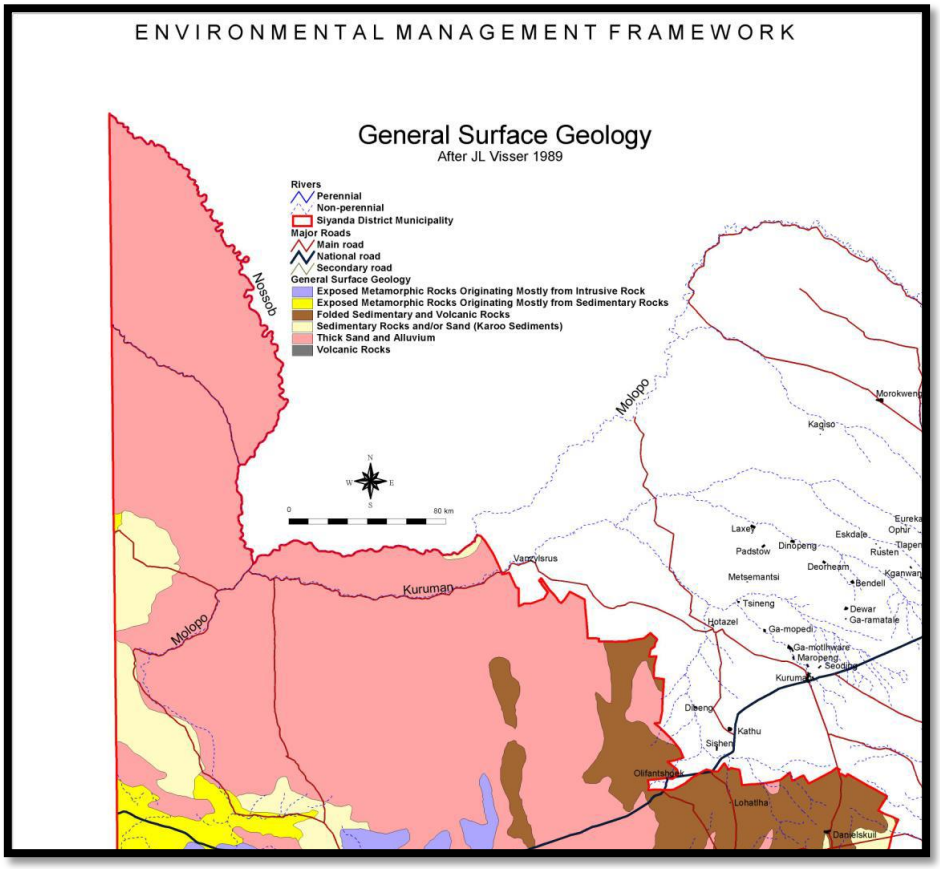

Figure 6: From Siyanda Draft EMF (2008): General surface geology

The geology and soils varied only slightly along the proposed route. No special features have been encountered (e.g. true quartz patches or broken veld) and the impact on geology and soils is expected to be very localised and low and within an area already disturbed (road and imported material).

5.5 LANDUSE AND COVER

According to the Mier IDP, area is predominantly used for stock and game farming, with sheep farming probably the most important farming activity. Other farming activities such as cattle, donkeys, mules, goats and game are currently secondary in the area. Sheep is marketed either locally at auctions in Loubos and Askham, or per road transported to auctions in Upington, or for slaughtering in Upington and Groblershoop. Game is mainly marketed seasonally as "biltong"-hunting for hunters from outside of the area. The current game farming forms an important source of income, for the Mier Council, through council owned game farms. Two of the farms owned by the !Khomani San Association also supports that could be marketed. It is important to note that there is a definite shift amongst commercial farmers on the Botswana border to change from stock farming to game farming, due to the change in weather conditions and the poor access to water for their stock.

Apart from the first 17 km across the farm Cramond, phase 1 of the proposed route will be placed almost exclusively within existing road reserves. The impact on farming properties will thus be minimal and temporary of nature (being placed under ground). It is highly unlikely that it will lead to any long term impacts on current land-use or land use conflicts apart from the very positive effect of eventually supplying water for human and stock consumption to a great number of these farms.

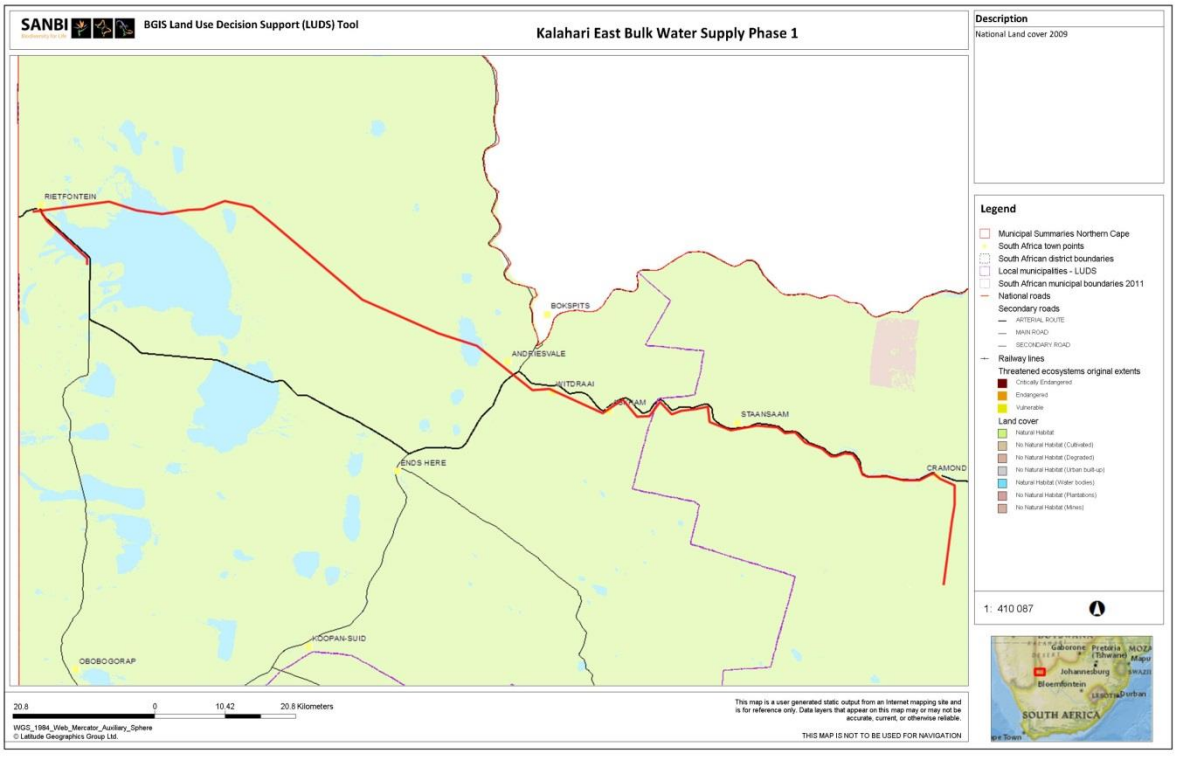

Figure 7: Land-use map for the proposed sites and surroundings

5.6 BROAD SCALE VEGETATION EXPECTED

The almost 170 km of proposed pipeline will span two Biomes, most of which falls within the Savanna Biome (Kalahari Duneveld Bioregion), but the last portion of the pipeline near Rietfontein will also cross vegetation belonging to the Nama-Karoo Biome. Apart from the vegetation associated with these major biomes, the pipeline will also cross or intersect Inland Azonal Vegetation (along the Kuruman River). Azonal Vegetation is described by Mucina *et al* 2006 as locations where special substrate (e.g. special soil types or bedrock) and/or hydrogeological conditions (e.g. waterlogging, flooding) exert an overriding influence on floristic composition, structure and dynamics over macroclimate (e.g. riparian vegetation along river courses).

The Savanna Biome is the most widespread Biome in Africa and also occupies most of the far-northern part of the Northern Cape, including the Kalahari Duneveld. According to Rutherford *et al*(2006), the Savanna in South Africa has a low species to area ratio, and become even lower in the southern Kalahari part of the biome (with a sharply decreasing diversity of trees from east to west). On the other hand, Savanna is well known for its diversity of mammals. Similarly Nama-Karoo flora is also not particularly species rich with very low local endemism, which might indicate a relatively youthful biome linked to the remarkable geological and environmental homogeneity of the Nama-Karoo (Mucina *et al*2006a). Rainfall seasonality and frequency are too unpredictable and winter temperatures too low to enable leaf succulents to dominate (like in the Succulent Karoo), while summers are too dry for dominance by perennial grasses alone, and the soils are generally too shallow and rainfall too low for trees.

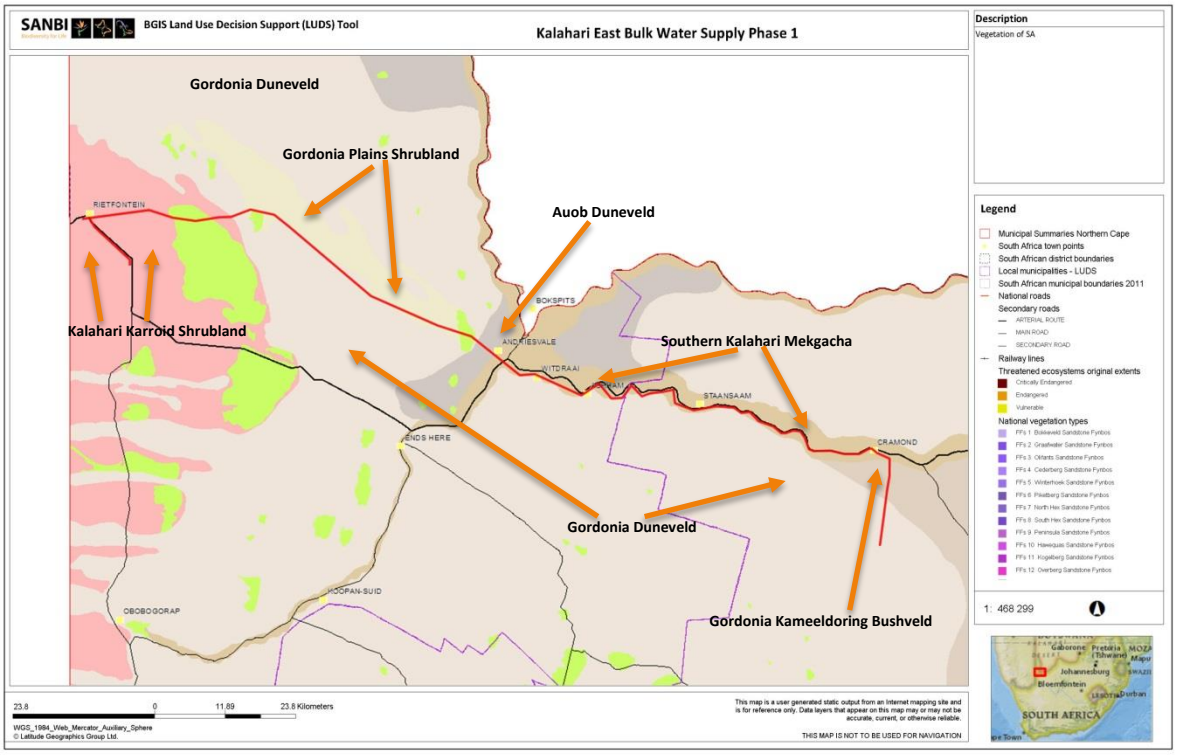

Figure 8: Vegetation map of South Africa, showing the vegetation types expected along the proposed route

According to the Vegetation Map of South Africa (Mucina & Rutherford, 2006) four vegetation types within the Savanna Biome might be encountered along the pipeline route namely: Gordonia Duneveld, Gordonia Kameeldoring Bushveld, Auob Duneveld and Gordonia Plains Shrubland. Kalahari Karroid Shrubland (part of the Nama-Karoo Biome) is expected in the vicinity and surroundings of Rietfontein, while Southern Kalahari Mekgacha (part of the Azonal Vegetation) is expected along the Kuruman- and Molopo Rivers and Southern Kalahari Salt Pans were also encountered. The status of each vegetation type according to the 2004 National Spatial Biodiversity Assessment and the 2011 National Spatial Assessment or National List of Threatened Ecosystems (GN 1002, December 2011) are given in Table 2.

Table 2: Vegetation status according to the 2004 National Spatial Biodiversity Assessment and 2011 National Biodiversity Assessment

VEGETATION TYPE	NATIONAL STATUS 2011	REMAINING (2004)	CONSERVATION TARGET	FORMALLY CONSERVED
Kalahari Karroid Shrubland (NKb 5)	Least Threatened	99.2%	21%	0.1%
Gordonia Plains Shrubland (SVk 16)	Least Threatened	99.6%	16%	8.6%
Gordonia Duneveld (SVkd 1)	Least Threatened	99.8%	16%	14.2%
Gordonia Kameeldoring Bushveld (SVkd 2)	Least Threatened	99.8%	16%	37.6%
Auob Duneveld (SVkd 3)	Least Threatened	99.8%	16%	57.2%
Southern Kalahari Mekgacha (AZi 3)	Least Threatened	98.3%	24%	17.5%
Southern Kalahari Salt Pans	Least Threatened	98.8%	24%	8.2%

5.6.1 Kalahari Karroid Shrubland

Mucina *et al* (2006a) describe Kalahari Karroid Shrubland as a low Karroid shrubland on flat, gravel plains, where Karoo elements meet with northern floristic elements, indicating a transition to the Kalahari region and sandy soils. Although trees are not common, *Acacia mellifera*, *Parkinsonia africana* and *Boscia foetida* may be encountered. Taller shrubs include *Rhigozum trichotomum* while lower shrubs like *Hermannia* species, *Limeum aethiopicum*, *Phaeoptilum spinosum*, *Aizoon schellenbergii*, *Aptosimum* species, *Barleria rigida*, *Indigorera heterotricha*, *Monechma genistifolium*, *Tephrosia dregeana* are more common. Herbs like *Dicoma capensis*, *Chamaesyce inaequilatera*, *Amaranthus praetermissus*, *Barleria lichtensteiniana*, *Cucumis africanus*, *Geigeria ornativa*, *Hermannia abrotanoides*, *Monsonia umbellate*, *Sesamum capense* are likely to be encountered as well as succulent herbs like *Giseka* species and *Trianthema parvifolia*. Grasses is likely to include species of *Aristida*, *Enneapogon*, *Eragrostis*, *Schmidtia kalahariensis*, *Stipagrostis* and *Tragus racemosus*.

5.6.2 Gordonia Plains Shrubland

Rutherford *et al* (2006) describe Gordonia Plains Shrubland as open grassland plains with occasional shrubs which include *Rhigozum trichotomum* and *Grewia flava*, sometimes including *Acacia haematoxylon* and scattered individuals of *Acacia erioloba*. Other species that are likely to be encountered includes the small tree *Acacia mellifera* and the tall shrub *Grewia flava*. Low shrubs include *Jatropha erythropoda*, *Plinthus sericeus* and *Requienia sphaerosperma* as well as the herbaceous climber *Merremia tridentata*. Grasses are

likely to include *Aristida meridionalis, Centropodia glauca, Eragrostis Iehmanniana, Schmidtia kalahariensis, Brachiaria glomerata, Bulbostylis hispidula, Eragrostis pallens* and *Stipagrostis uniplumis*. Herbs like *Acanthosicyos naudinianus, Cucumis africanus, Dicoma capensis, Harpagophytum procumbens, Heliotropium ciliatum, Hermannia tomentosa, Ipomoea hackeliana, Limeum argute-carinatum, Oxygonum dregeanum, Senna italica* and *Sericorema remotiflora* are also common

5.6.3 Gordonia Duneveld

Rutherford *et al* (2006) describe Gordonia Duneveld open shrubland with ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests and *Acacia haematoxylon* on the dune slopes, also with *A. mellifera* on lower slopes and *Rhigozum trichotomum* in the interdune straaten, occurring on parallel dunes 3-8 m above the plains. The small tree *Acacia mellifera* subsp. *detinens* is likely to occur, while tall shrubs like *Grewia flava* and *Rhigozum trichotomum* are common. Low shrubs like *Aptosimum albomarginatum*, *Monechma incanum* and *Requienia sphaerosperma* are frequent together with succulent shrubs which may include *Lycium bosciifolium*, *L. pumilum* and *Talinum caffrum.* Grasses are dominant and is likely to include *Schmidtia kalahariensis*, *Brachiaria glomerata*, *Bulbostylis hispidula*, *Centropodia glauca* (Kalahari-Gha Grass), *Eragrostis Iehmanniana*, *Stipagrostis ciliata*, *S. obtusa* and *S. uniplumis*. The following herbs may also be encountered namely *Hermbstaedtia fleckii*, *Acanthosicyos naudinianus*, *Hermannia tomentosa*, *Limeum arenicolum*, *L argute-carinatum*, *Oxygonum dregeanum* subsp. *canescens* var. *canescens*, *Sericorema remotiflora*, *Sesamum triphyllum* and *Tribulus zeyheri*.

5.6.4 Gordonia Kameeldoring Bushveld

Rutherford *et al* (2006) describe Gordonia Kameeldoring Bushveld as vegetation occurring on the dune slopes and dune straaten with a well-developed tree layer, dominated by *Acacia erioloba* and *Boscia albitrunca* and shrub layer with *Acacia haematoxylon*, *A. mellifera* and *Rhigozum trichotomum* prominent, while the grass layer is described as very scanty. Other species associated with this vegetation type include the tall shrubs *Ehretia rigida* subsp. *rigida*, *Grewia flava*, *Lycium villosum* and *Searsia tenuinervis*, the low shrubs *Aptosimum albomarginatum*, *Jatropha erythropoda*, *Plinthus sericeus* and *Requienia sphaerosperma*. Grasses my include *Aristida meridionalis*, *Centropodia glauca*, *Eragrostis Iehmanniana*, *Schmidtia kalahariensis*, *Stipagrostis ciliata*, *Brachiaria glomerata*, *Stipagrostis obtusa, S. uniplumis* while the herbs *Acanthosicyos naudinianus*, *Hermannia tomentosa, Limeum arenicolum, Senna italica* subsp. *arachoides* and *Tribulus zeyheri*.

5.6.5 Auob Duneveld

Rutherford *et al* (2006) describe Auob Duneveld as open shrubland with a low shrub layer dominated by *Acacia haematoxylon*, *A. mellifera* and *Rhigozum trichotomum*, while trees of *A. erioloba* and *Boscia albitrunca* are widely scattered and the grass layer is scanty. Other important species may include the tall shrub *Grewia flava*, the low shrub: *Requienia sphaerosperma* and the following grass species: *Schmidtia kalahariensis*, *Stipagrostis ciliata*, *S. uniplumis*, *Brachiaria glomerata*, *Bulbostylis hispidula*, *Centropodia glauca* and *Eragrostis*

trichophora. Herbs may include *Acanthosicyos naudinianus*, *Acrotome angustifolia*, *Hermannia tomentosa*, *Limeum arenicolum* and *Sesamum triphyllum*.

5.6.6 Southern Kalahari Mekgacha

Mucina *et al* (2006) describe Southern Kalahari Mekgacha as sparse, patchy grass-lands, sedqelands and low herblands dominated by CA grasses (*Panicum, Eragrostis, Enneapogon, Tragus, Chloris and Cenchrus*) on the bottom of (mostly) dry riverbeds. Low shrublands are found in places with patches of taller shrubland (with *Schotia afra*) on the banks of the rivers. Relatively tall *Acacia erioloba* trees can form a dominant belt along some of the rivers, for example the middle and lower reaches of the Kuruman River In some other rivers the taller trees are scattered. The term 'mekgacha' (singular 'mokgacha') is of Setswana origin and means 'dry (river) valley'. Tall Shrubs may include *Calobota linearifolia*, *Sisyndite spartea* and *Deverra denudata* subsp. *aphylla,* while the herbs are likely to include *Amaranthus* species, *Boerhavia repens*, *Chamaesyce inaequi-atera*, *Cucumis africanus*, *Geigeria* species, *Heliotropium lineare*, *Indigofera* species, *Kohautia cynanchica*, *Lotononis platycarpa*, *Osteospermum muricatum*, *Platycarpha carlinoides*, *Radyera urens*, *Stachys spathulata*, *Tribulus terrestris*. The succulent herbs *Zygophyllum simplex* may be encountered, while grasses include species of *Cenchrus ciliaris*, *Chloris virgata*, *Enneapogon desvauxii*, *Eragrostis* species, *Odyssea paucinervis*, *Panicum coloratum*, *Panicum impeditum* and *Sporobolus nervosus*.

5.6.7 Southern Kalahari Salt Pans

Mucina *et al* (2006b) describe Southern Kalahari Salt Pans as low grasslands on pan bottoms (these often devoid of vegetation) often dominated by *Sporobolus* species, with a mixture of dwarf shrubs. The low shrubland dominated by *Lycium* and/or *Rhigozum* usually forms the outer belt in the salt-pan zonation systems. Other important plant species associated with these pans are *Zygophyllum tenue* and *Salsola scopiformis* as well as the herbs *Hirpicium gazanioides*, *Tribulus terrestris*; the succulent herb *Trianthema triquetra* subsp. *parvifolia* and the grasses *Enneapogon desvauxii*, *Eragrostis truncata*, *Sporobolus coromandelianus, S. rangei* and *Panicum impeditum*.

5.7 FINE-SCALE MAPPING (CBA'S)

The Municipal Biodiversity Summaries Projects (2010) are the most relevant Biodiversity conservation plans for the Mier Municipality (SANBI: BGIS). No fine-scale mapping is as yet available for this area and as a result no critical biodiversity areas or biodiversity support areas has been promulgated for this area. However, a draft Environmental Management Framework (EMF) for the Siyanda District Municipal was published in 2008, and even though this report was never formally approved, the findings were used to guide decision making for this report.

The proposed priorities for conservation in the Siyanda District is depicted on Maps 12a (Refer Figure 9) and 12b of the EMF and are based on local occurrence, the national conservation target, the national ecosystem status and the national protection level of the vegetation types. A proposal is made for the prioritisation of

vegetation types in the Siyanda District Municipality (now ZF Mgcawu District Municipality). The landcover of the Siyanda district reflects the results of the 2000 national landcover determination and is depicted on Map 13 of the EMF from which it is evident that most of the Mier area is still in its natural state.

A sensitivity index is shown on Map 14 of the Draft EMF (Figure 10 of this report). The main factors that were used to compile the index include the erosion potential of soils, the conservation priority of veld types, topographical areas with a high variance in shape and form, all watercourses, drainage lines and pans (including a 32m buffer on either side) and transformed areas. Map 14 of the EMP give a scale of -1 (transformed) to 8, where 8 represent the highest environmental sensitivity.

Environmental control zones are depicted on Map 15 of the EMF. The purpose of environmental control zones is to indicate areas that require a specific type or regime of control due to unique environmental elements that occur in these areas. It may or may not be linked to the application of EIA legislation and should be dealt with at a more strategic level where it should serve as a guide for decision-making and planning.

5.7.1 Summary of findings according to the EMF

According to the Siyanda Environmental Management Framework the proposed site falls within the following categories according to the various maps.

Table 3: Siyanda Municipal Draft EMF (2008): Conservation priority classification of the route according to Vegetation type

VEGETATION TYPE	Conservation Priority	Sensitivity index	Control zones
Kalahari Karroid Shrubland (NKb 5)	3 - High	2 – Low/medium	Zone 3 Potential high conservation
Gordonia Plains Shrubland (SVk 16)	2 - Medium	1 - Low	Zone 7 Low control Zone
Gordonia Duneveld (SVkd 1)	1 - Low	1 - Low	Zone 2 Potential wind erosion area
Gordonia Kameeldoring Bushveld (SVkd 2)	1 – Low (Well protected)	1 - Low	Zone 2 Potential wind erosion area
Auob Duneveld (SVkd 3)	1 – Low (Well protected)	1 - Low	Zone 2 Potential wind erosion area
Southern Kalahari Mekgacha (AZi 3)	1 - Low	1 - Low	Zone 2 Potential wind erosion area
Southern Kalahari Salt Pans	2 - Medium	3 – Medium/low	Zone 7 Low control Zone

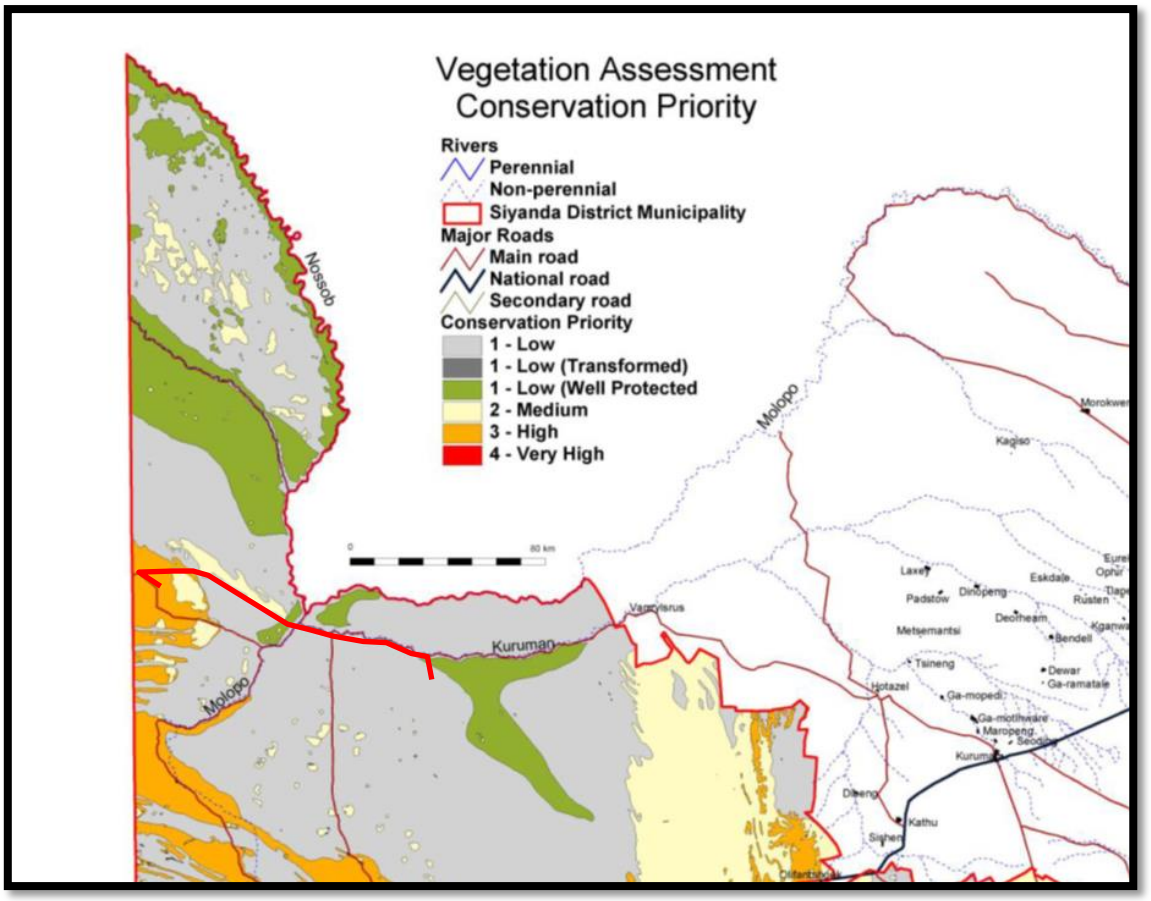

Figure 9: Siyanda Municipal Draft EMF (2008) – Map 12a: Conservation priority areas

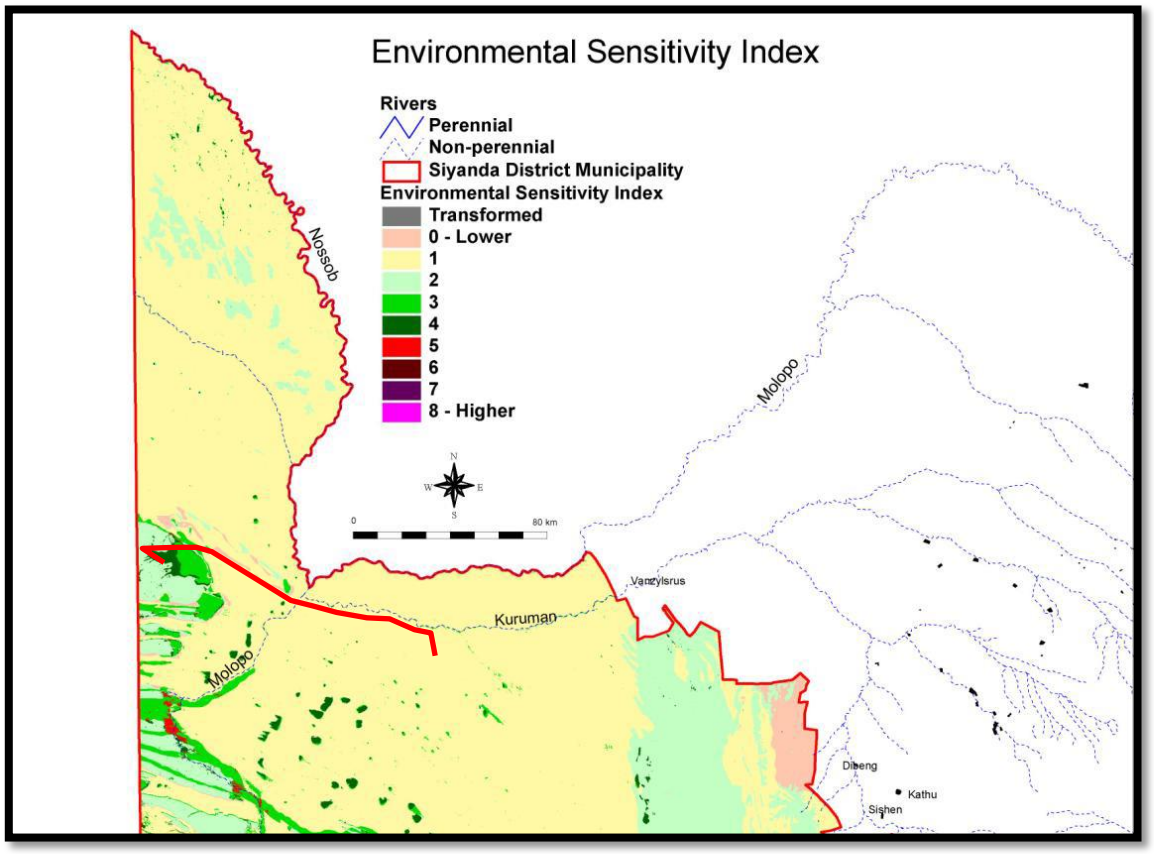

Figure 10: Siyanda Municipal Draft EMF (2008) – Map 14: Environmental Sensitivity Index

5.8 VEGETATION ENCOUNTERED

The description of the vegetation underneath follows the proposed pipeline route from the east to the west (Cramond farm) to Rietfontein and ultimately Philandersbron.

5.8.1 Vegetation encountered on the Farm Cramond

The farm Cramond was characterised by continuous linear dunes and inter dune straaten, which give way to the dry Kuruman riverbed next to the R31. Originally it was proposed that the route will follow the eastern fence of the farm Cramond, right next to an existing twee-spoor track (Route option 1 in Figure 11). This route will have difficulties in that it will run over the crests of numerous high dunes (4x4 vehicle access only) which will also be prone to wind erosion should adequate rehabilitation and protective measures not be implemented. No new roads will have to be established, but the existing roads will have to be enlarged / formalised in order to accommodate construction vehicle access. It is also likely that some *Acacia haematoxylon* and possibly some *Boscia* individuals may be impacted by the proposed route (even though slight route alterations will enable the protection of the major portion of these protected trees).

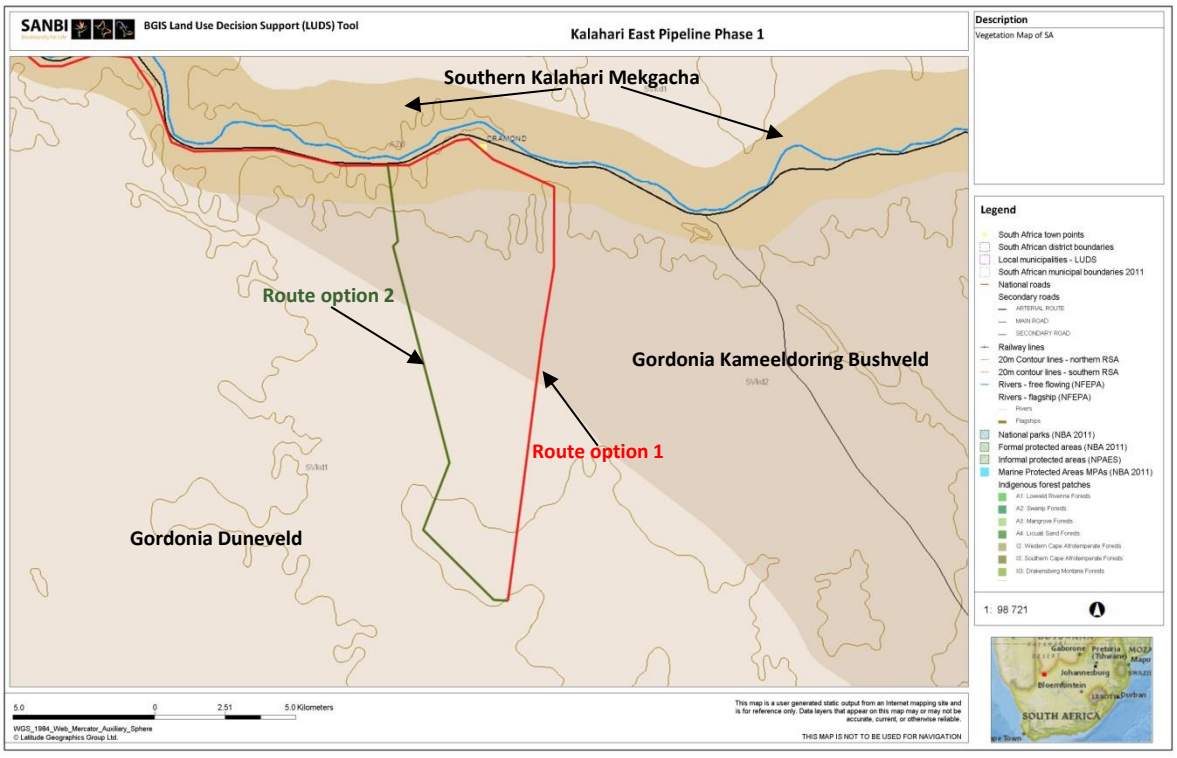

Figure 11: Vegetation map of SA, showing the first two portion of the proposed pipeline route as described underneath

Because of the anticipated difficulty with vehicle access as well as the significant wind erosion potential a second route option (Route option 2 in Figure 11) was proposed by the engineers in consultation with the land owners. Route 2 will follow the main access road on the farm, which is established in an area where the dunes are lower (much easier access) and will also follow the interdune straaten where-ever possible (which will have a positive impact on wind erosion protection). Erosion protection along this route should be easier to

implement and access will be much easier (minimising the need for heavy specialised 4 x 4 construction vehicles and should result in a much lower impact).

5.8.1.1 Route option 1: Following the Cramond farm boundary

The southern portion of the farm showed typical Gordonia Duneveld and was covered by an open shrubland dominated by grassland with *Stipagrostis amabilis* almost always present on the dune crests. Both *Acacia haematoxylon* and *A. mellifera* was commonly encountered on the dune slopes, while *Boscia albitrunca* and *Grewia flava* were also encountered along the dune slopes, but less common. *Acacia hebeclada* was observed occasionally while *Rhigozum trichotomum* were common, often dominating sections of the inter dune straaten (refer to Figure 11 and Picture 1). *Acacia erioloba* was also encountered but was much less prominent than towards the northern portion of the farm.

Photo 1: Gordonia Duneveld on the southern portion of Cramond, showing the proposed pipeline route (green) from south to north

Other species observe includes various grass species (e.g. *Schmidtia-*, *Brachiaria-*, *Centropodia glauca,* Kalahari-Gha Grass), *Eragrostis-* and *Stipagrostis* species*).* Apart from *Hermannia* cf. *tomentosa*, *Lycium bosciifolium* and *Tribulus zeyheri*, very few other shrub species were observed.

To the north, the farm the vegetation changes to Gordonia Kameeldoring Bushveld. The species encountered were very similar to that encountered in the Gordonia Duneveld, but the species composition differed slightly with *Acacia erioloba* becoming more prominent while *Acacia haematoxylon* (also prominent) becomes less dominant than in the Gordonia Duneveld (refer to Figure 11 and Photo 2). The grassy component also changed slightly with less Gha- and Bushman grass and more sour grass species. Species encountered includes: *Acacia mellifera, Rhigozum trichotomum, Grewia flava, Lycium bosciifolium, Acacia hebeclada,*

Hermannia cf. *tomentosa* as well as *Boscia albitrunca*. Other species not previously encountered included, *Aptosimum albomarginatum*, *A. spinescens, Cadaba aphylla* and *Monechma incanum*.

Photo 2: Gordonia Kameeldoring Bushveld encountered towards the northern portion of the farm

5.8.1.2 Route option 2: Following the main access within Cramond farm

Vegetation composition is very similar to that discussed above. Again it will be quite likely that some protected species might be impacted by the proposed route. However, as above the impact on protected species can be minimised with slight route alterations, and the possible impact on these species is considered lower (with mitigation) than the potential of wind erosion. However, in this case the first section of the pipeline will be placed within the dune straaten (lower potential wind erosion factor) (Photo 3).

Photo 3: Gordonia Duneveld in the inter straaten section of the proposed route 2

The remainder of the line will run crossways to the dune system, but will be placed in an area where the dunes are much lower and access much easier (Photo 4 + Photo 5 + Photo 6). Thus the potential for wind erosion will be much less than for route option 1. In addition, since this is the main access route any potential issues will be much easier observed.

Photo 4: Lower dunes in the southern Gordonia Duneveld vegetation type on the farm Cramond

Photo 5: Denser stands of Camel Thorn trees within the Gordonia Kameeldoring Bushveld in the northern portion of the farm Cramond

Photo 6: Southern Kalahari Mekgacha in the northern portion of the farm Cramond

Both route option 1 and 2 may potentially impact on protected tree species (*Acacia erioloba*, *A. haematoxylon*, *Boscia albitrunca* and *B. foetida*). However, with good environmental control and site specific route alterations the impact can be much reduced. With good mitigation it is likely than only single individuals of the above are impacted. Wind erosion, on the other hand, can potentially have a much bigger impact on the veld as a whole as a result of the footprint that will be opened in this sensitive dune landscape in order to lay the pipe. In order to minimise the potential wind erosion impact, the following mitigation actions are recommended:

- Firstly it is very likely that route option 2 will have a lower wind erosion potential (since the dunes are lower and will be easier to rehabilitate) and should thus be the preferred route.
- The excavation footprint should be minimised in order to minimise the impact on ground cover vegetation (which binds the sand and are the main protection feature of the dune systems). The protection of the grassy and herbaceous ground cover layer is thus of great importance. In order to achieve this, it is suggested that (as opposed to the general recommendation of topsoil being removed for the whole of the construction footprint) that topsoil removal are not done and that disturbance is minimised to the actual trench line (which must be closed and rehabilitated immediately after placement of the pipeline – a "one go action").
- The exposed trench line over the dunes must be further protected by the placement of shrub on the exposed sands. Both *Acacia mellifera* and *Rhigozum trichotomum* branches have been used with great success on similar projects in the Kalahari.

5.8.2 Vegetation encountered along the R31 from Cramond to Andriesvale

The pipeline encounters the R31 on the north-eastern boundary of Cramond from where it follows R31 road reserve all the way to Rietfontein and eventually to Philandersbron. From Cramond up to Andriesvale (almost 70 km) the R31 follows the dry river bed of the Kuruman River within the Mekgacha vegetation type. It was though prudent to describe the vegetation encountered along this section (Southern Kalahari Mekgacha) separately, as Camelthorn trees (*Acacia erioloba*) are particularly common and even dominant in this portion of the route. *Acacia haematoxylon* and *Boscia albitrunca* were also relatively commonly encountered within this section. The vegetation along the road reserve conforms to typical Southern Kalahari Mekgacha, dominated by *Acacia erioloba* and dry grasses (resulting from recent good rains) with low shrubs also common. However, it was also noted that the vegetation had been subjected to disturbance as a result of continual impact (works along the route) and the imported road material used for hardening the roads surface (mostly calcrete mixtures). Even some of the species encountered along the roads were only encountered in association with the calcrete and are species more commonly encountered with calcrete outcrops.

Of special concern along this portion of the proposed pipeline route, however, is the presence of a great number of *Acacia erioloba* as well the occasional *Acacia haematoxylon* and *Boscia* individuals along this almost 70 km portion of the route.

From Cramond the pipeline route will follow the road reserve of the R31. However, the R31 does not follow the middle of the road reserve in all instances, the southern reserve being mostly wider of at least as wide as the northern road reserve, but at bends in the road, the southern road reserve was sometimes relegated to a very narrow strip, while the northern boundary then becomes much wider.

Photo 7: Proposed route near Cramond, note the broadness of the southern road reserve and absence of large trees in this portion

The proposed pipeline route will follow the southern road reserve wherever possible, which will place the pipeline away from the Kuruman River corridor and which for the most part was also the broader road reserve (Photo 7). However, it was also proposed that in areas where the southern road reserve are too narrow or too congested (protected species) the pipeline route may jump the R31 to follow the northern boundary for short stretches. Two such crossing will be necessitated as a result of very narrow southern boundaries (Photo 8).

Photo 8: Note the narrow southern (left of road in picture) boundary at portions of the route (mostly at bends in the road)

Within the first 10 – 15 km section from Cramond to Askham the vegetation is more open (Photo 7) with large trees less common. Further along the route towards Askham, Camelthorn becomes much more common, also within the road reserve (Photo 8 + Photo 9), sometimes forming clusters of young trees or individual large trees. Shepard's trees were also frequently encountered, while False Camelthorn seems to be more frequent towards the east of the pipeline route.

Photo 9: Proposed route between Cramond and Askham, note the large Camelthorn trees along this portion of the route

The locations of the Camelthorn, False Camelthorn and Boscia species was marked with a GPS, but since they are so numerous it will be of little value to describe and plot each individual. Having evaluated the route the author is of the opinion that most of the indigenous trees (90-95%) that might be impacted by the proposed route can be protected by small route adjustments within the road reserve (Photo 10).

Photo 10: Proposed route near Askham (southern road reserve)

In some instances there are no alternative except re-directing the route either to private property (adjacent to the road reserve) or by jumping the road (Photo 8). The engineers confirmed that they would like to limit the number of road crossing as it may lead to higher installation costs (longer length) but especially maintenance costs (as a result of number of bends – which are also normally a weak point). However, where limiting factors necessitate such crossings it will be entertained.

From Askham towards Andriesvale (14 km), Camelthorn trees are still numerous in portions, but should be more easily averted (Photo 11). A few individuals of the alien *Prosopis* tree were also encountered along this section.

Photo 11: A section of the route from Askham to Andriesvale with few trees within the road reserve

Other plant species encountered along this portion of the route includes the trees and larger shrubs; *Acacia hebeclada*, *Acacia mellifera*, *Boscia foetida*, *Crotalaria spartioides*, *Deverra denudata, Galenia africana, Calobota linearifolia, Lycium bosciifolium L. hirsutum, Parkinsonia africana, Pechuel-Loeschea leubnitziae, Rhigozum trichotomum* and *Ziziphus mucronata.* Smaller shrubs and herbs includes: *Aptosimum spinescens, Hermannia tomentosa, Hirpicium gazanioides, Monechma genistifolium, Psilocaulon* spp*., Rogeria longifolia, Ursinia* spp. and *Verbesina encelioides,* while the following prostrate and bulbaceous plants were encountered: *Boerhavia repens, Cucumis africanus, Cullen tomentosum, Geigeria ornativa* and *Mesembryanthemum guerichianum.* Grasses includes the species from the following genus's: *Brachiaria glomerata, Cenchrus*, *Centropodia glauca*, *Chloris*, *Enneapogon*, *Eragrostis* species, *Odyssea*, *Panicum*, *Panicum* and *Sporobolus* species.

5.8.3 Vegetation encountered from Andriesvale to Hakskeenpan

From Andriesvale westwards the route will again follow the southern road reserve next to the R31 as it heads past Koopan towards Groot- and Klein Mier and then towards Hakskeenpan. The vegetation changes from

Southern Kalahari Mekgacha to Auob Duneveld, then the dry Southern Kalahari Salt Pans (Koopan), from Koopan the vegetation are mostly Gordonia Plains Shrubland up to Groot- en Klein Mier. The vegetation then reverts back to Gordonia Duneveld, before entering Kalahari Karroid Shrubland just before Hakskeenpan and Southern Kalahari Salt Pans encountered at Hakskeenpan.

The occurrence of larger trees en especially protected trees decreases dramatically, although *Acacia erioloba, A. haematoxylon, Boscia albitrunca* and *B. foetida* are still found along the proposed route. However, in most cases it will be relatively easy to negate impact to any of the indigenous trees encountered along the route by slight alterations during construction. Between Andriesvale and Koopan (Photo 12) very few protected trees were encountered, all of which should be easy to avoid through small route alterations (if necessary).

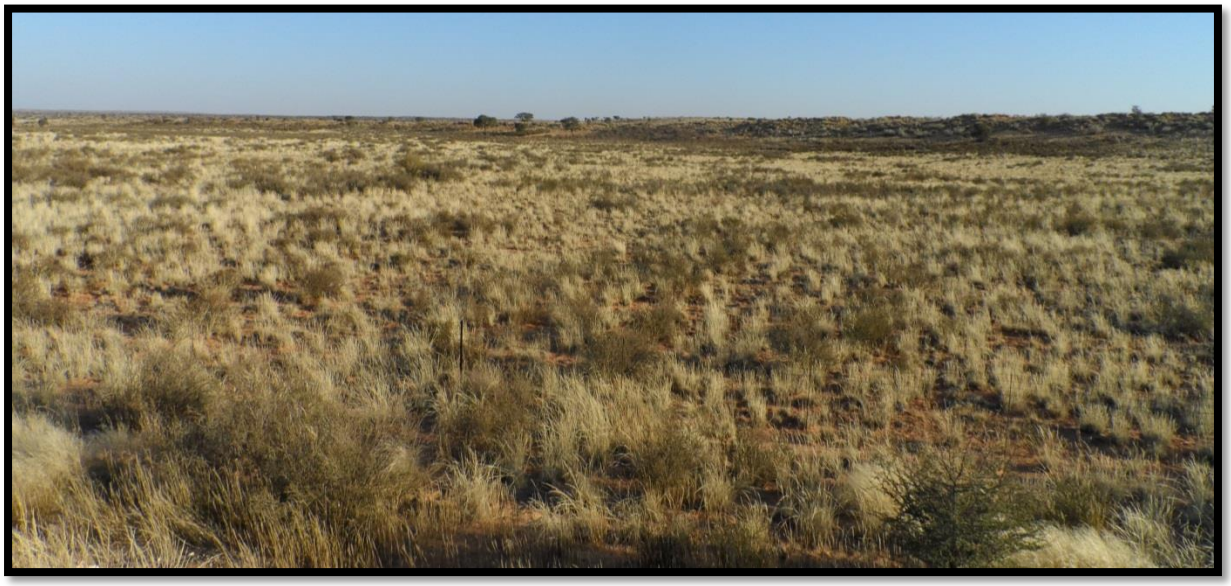

Photo 12: Auob Duneveld between Andriesvale and Koopan

Plant species encountered within the Auob Duneveld (Photo 12) included scattered individuals of *Acacia haematoxylon* and *A. mellifera.* After the recent good rains the vegetation was dominated by grass species with *Rhigozum trichotomum* prominent, while scattered individuals of *Acacia erioloba* and *Boscia albitrunca* was also present (but rarely close to the proposed footprint). The road reserve remains impacted as a result of the imported material used for road building (calcrete). Other species includes *Hermannia tomentosa* and *Hirpicium gazanioides*.

Koopan was characterised by the almost lack of plant species (Photo 13). Grasses are found along the road verges with a few Aizoaceae and Mesembryanthemum species also associated therewith. *Salsola* species as well as the herbs *Hirpicium gazanioides* were encountered.

Photo 13: A view of Koopan

From Koopan to just east of Mier the vegetation reverts to open grassland plains with the occasional tree and shrubs. Scattered individuals of *Acacia haematoxylon*, *A. erioloba* and *Boscia* were encountered (Photo 14).

Photo 14: Typical vegetation encountered between Koopan up to just east of Mier

As one closes on Mier, *Boscia albitrunca, B. foetida, Acacia erioloba* and *A. haematoxylon* again becomes more prominent, especially in the vicinity of the rocky outcrops (near Mier) and watercourses (Photo 15). The alien *Prosopis* tree was also occasionally found near watercourses.

Photo 15: Vegetation encountered in the vicinity of Mier

Just before Hakskeenpan the road cuts through larger dunes, which will hamper the construction footprint (Photo 16). In this section a few *Acacia haematoxylon* and *Acacia erioloba* was encountered which might prove to be difficult to avoid. Other plant species encountered in the section from Koopan to Hakskeenpan includes the following shrubs and trees: *Aptosimum spinescens*, *Calobota linearifolia*, *C. spinescens*, *Codon royenii*, *Crotalaria spartioides, Galenia africana, Geigeria ornativa, Hermannia tomentosa, Hirpicium gazanioides, Calobota linearifolia, Lycium bosciifolium, Mesembryanthemum guerichianum, Monechma genistifolium, Parkinsonia africana, Pechuel-Loeschea leubnitziae, Requienia sphaerosperma, Rhigozum trichotomum, Stoeberia spp., Tapinanthus oleifolius, Tetragonia sarcophylla* and *Ziziphus mucronata.*

Photo 16: Larger dunes just east of Hakskeenpan

At Hakskeenpan the vegetation was again almost only associated with the disturbed road verge (Photo 17), which included Aizoaceae and *Mesembryanthemum* as well as *Tetragonia*, *Salsola* and some grass species.

Photo 17: Vegetation encountered at Hakskeenpan

No protected tree species were encountered within any of the dry salt pan areas.

5.8.4 Vegetation encountered at proposed reservoir site

Apart from the pipeline itself a new floating reservoir (approximately 1.5 ha in size) will have to be constructed in order to ensure sustainable water supply. However, it is very important to note that in order to construct the dam walls a cut and fill process are planned which will enlarge the actual footprint to approximately **3.5 ha**.

Photo 18: Typical vegetation encountered at reservoir location (Note *Acacia mellifera* dominance with *Boscia* species in background)

The location was chosen to co-inside with the highest elevation along the pipeline (which was encountered just east of Mier) which will enable gravity feed to the remaining the downstream towns and farms. The

vegetation on the proposed reservoir (Photo 18) site conformed to Gordonia duneveld dominated by *Acacia mellifera, Rhigozum trichotomum, Parkinsonia africana* and *Lycium* cf. *bosciifolium* with a number of grass species also prominent. The main feature of note was the presence of large number of *Boscia foetida* (protected in terms of the NCNCA). A few individuals of *Boscia albitrunca* and *Acacia erioloba* was also encountered (protected in terms of the National Forest Act). What was also very interesting is the size of the *Boscia foetida* individuals encountered (with quite a number of them reaching well over 2 meters in height).

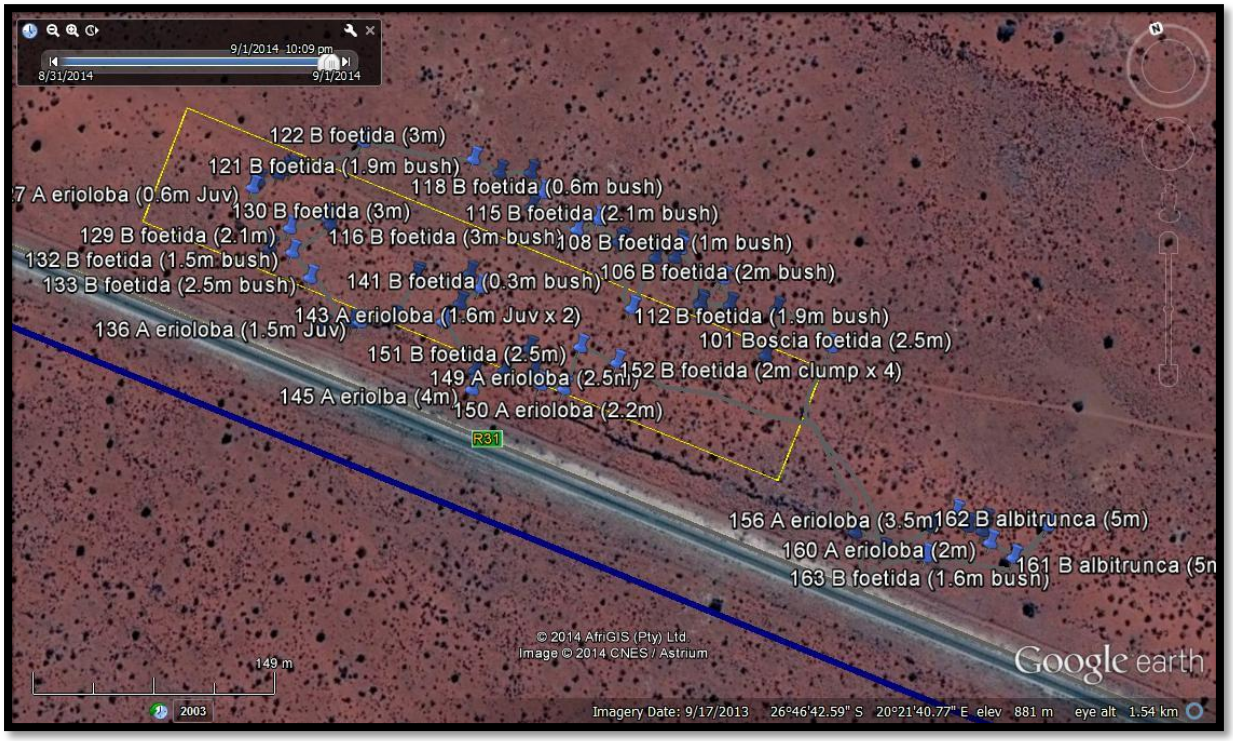

Figure 12: A Google image showing the actual reservoir footprint (yellow) and the protected species encountered

Just over 60 protected tree species were encountered in the immediate vicinity of the proposed reservoir site (Refer to Figure 12). The surrounding areas where also investigated in order to see if a slight layout change may result in better protection of tree species. Of the 62 trees encountered, 24 will be or are likely to be impacted by the current proposed site location. The following is a summary of the findings (Refer to Table 4):

- Although a number of *Boscia albitrunca* trees were encountered, only 1 of them will be impacted by the proposed layout (while the remainder where encountered to the east of the current site location).
- Most of the *Acacia erioloba* trees encountered will not be impacted (located to the south of the dune which will be retained in order to visually screen the reservoir from the R31). In addition, only one of the *Acacia erioloba* trees is in close proximity of the actual reservoir location. However, a number of these trees might be impacted in the adjoining area that will be utilised for the cut and fill action. However, it is the opinion of the author that almost all *Acacia erioloba* trees can be protected through good environmental control during construction.
- Potentially approximately 30 *Boscia foetida* individuals (some of them magnificent specimen) may be impacted by the proposed construction. At present 14 *Boscia foetida* individuals will be impacted by the actual reservoir location (the remainder falling within the associated cut and fill area). In addition

a great number of the larger trees could also be saved through good environmental control and protection during the construction period (by working around as many of the trees as possible).

Table 4: Protected tree species encountered at the proposed reservoir site

WP NO.	SPECIES NAME	HEIGHT	POSITION	ALTITUDE
1.	***Boscia foetida***	3 m, Mature	S26 46 43.4 E20 21 44.2	874 m
2.	***Boscia albitrunca***	1.9 m, Mature	S26 46 41.6 E20 21 41.6	875 m
3.	***Boscia foetida***	2 m, Mature	S26 46 36.5 E20 21 35.1	877 m
4.	***Acacia erioloba***	0.6 m, Juvenile	S26 46 36.5 E20 21 34.9	876 m
5.	***Boscia foetida***	1.6 m, Mature	S26 46 36.5 E20 21 34.7	877 m
6.	***Boscia foetida***	1 m, Mature	S26 46 36.5 E20 21 34.3	879 m
7.	***Acacia erioloba***	0.6 m, Juvenile	S26 46 36.6 E20 21 34.1	879 m
8.	***Acacia erioloba***	3 m, Mature	S26 46 38.0 E20 21 34.1	879 m
9.	***Boscia foetida***	2.1 m, Mature	S26 46 37.7 E20 21 34.6	879 m
10.	***Boscia foetida***	3 m, Mature	S26 46 37.7 E20 21 35.5	878 m
11.	***Boscia foetida***	2 m, Mature	S26 46 37.9 E20 21 35.6	879 m
12.	***Boscia foetida***	1.5 m, Mature	S26 46 38.2 E20 21 34.5	880 m
13.	***Boscia foetida***	2.5 m, Mature	S26 46 38.8 E20 21 34.7	881 m
14.	***Boscia foetida***	2.5 m, Clump of 6 individuals	S26 46 40.2 E20 21 36.3	882 m
15.	***Acacia erioloba***	1.6 m, Juvenile	S26 46 39.5 E20 21 37.1	880 m
16.	***Boscia foetida***	1.5 m, Mature	S26 46 39.5 E20 21 37.1	879 m
17.	***Boscia foetida***	0.3 m, Mature	S26 46 40.1 E20 21 38.4	879 m
18.	***Boscia foetida***	2.2 m, Bush	S26 46 40.3 E20 21 37.9	879 m
19.	***Acacia erioloba***	1.6 m, 2 Juvenile trees	S26 46 40.6 E20 21 37.4	881 m
20.	***Boscia foetida***	1.8 m, Bush	S26 46 41.7 E20 21 39.1	881 m
21.	***Acacia erioloba***	4 m, Mature tree	S26 46 42.1 E20 21 39.0	880 m
22.	***Acacia erioloba***	2.2 m, Juvenile tree	S26 46 42.7 E20 21 39.5	881 m
23.	***Boscia foetida***	2.5 m Bush	S26 46 42.0 E20 21 40.2	881 m
24.	***Boscia foetida***	2 m, Clump of 4 bushes	S26 46 42.5 E20 21 40.9	880 m

5.8.5 Vegetation encountered from Hakskeenpan to Philandersbron

The route follows the R31 over Hakskeenpan still staying in the southern road reserve on to Rietfontein. From Rietfontein it will follow the western road reserve up to the Philandersbron Reservoir. The vegetation encountered from Hakskeenpan to Philandersbron differs slightly in that it becomes Kalahari Karroid Shrubland. The route will remain within the disturbed road reserve (lower impact, Photo 19) but will cross a number of water courses in the vicinity of Rietfontein and Philandersbron.

Photo 19: The southern road reserve of the R31 between Hakskeenpan and Rietfontein

The vegetation between Hakskeenpan and Philandersbron can be described as a low karroid shrubland on flat, gravel plains a transition from Karroo vegetation to the Kalahari region's sandy soils. Although trees were not common, *Acacia mellifera*, *Parkinsonia africana* and *Boscia foetida* were occasionally encountered. Taller shrubs like *Rhigozum trichotomum* are more common.

Between Hakskeenpan and Rietfontein the vegetation showed an open shrubland (with grasses dominant due to recent good rains). Very few protected tree species were encountered and the route should have little additional impact on the already relatively disturbed vegetation within the road reserve (Photo 19). Interestingly a single individual of the alien invasive plant *Calotropis procera* (Picture left) was encountered. This was the first observation of this alien plant in the Northern Cape Province which up to now was only known in the Limpopo area (Blouberg – Mapungupwe – Messina and Letaba Dam areas). The presence of this plant was reported to the ARC-Plant Protection Research Institute and will be removed by the alien invader response team.

Just south of Rietfontein the R31 cross a salty marsh area (Photo 20) as well as two larger seasonal streams (Photo 22), which eventually towards Hakskeenpan. As expected the marshy area as well as the riparian vegetation showed a markedly different species composition from that of the surrounding karroid vegetation.

Photo 20: Vegetation encountered just south of Rietfontein, note the slight salt marsh features

Photo 21: *Cryptolepis decidua*

The following species were encountered in association within the marshy area just south of Rietfontein: *Tetragonia schenckii, Cryptolepis decidua, Galenia sarcophylla, Mesembryanthemum guerichianum, Psilocaulon* spp., *Stoeberia* spp., together with one of the Cyperaceae (Sedges).

The two larger streams just south of Rietfontein showed a very definite riparian component dominated by *Acacia karroo*. *Prosopis* individuals were also observed within the riparian zone. Other species in close association with the riparian vegetation included *Acacia hebeclada, Tamarix usneoides* and *Lycium* species.

Photo 22: One of two larger seasonal water courses just south of Rietfontein

Photo 23: Typical vegetation encountered within the road reserve between Rietfontein and Philandersbron

Other species encountered along the route within the karroid shrubland (Photo 23) included the following species: *Acacia mellifera, Aptosimum spinescens, Augea capensis, Boscia foetida, Calicorema capitata, Catophractes alexandri, Codon royenii, Dicoma capensis, Geigeria ornativa, Gomphocarpus fruticosus, Hermannia tomentosa, Kleinia longiflora, Lessertia physodes, Monechma genistifolium, Parkinsonia africana, Phaeoptilum spinosum, Psilocaulon junceum, Requienia sphaerosperma, Rhigozum trichotomum, Salsola* spp.*, Tapinanthus oleifolius, Ziziphus mucronata, Zygophyllum decumbens, Zygophyllum simplex* and *Zygophyllum tenue.* Grass species were also prominent after the recent good rains and included *Aristida congesta*, *Enneapogon*, *Eragrostis*, *Schmidtia kalahariensis*, *Setaria* cf. *verticillata*, *Stipagrostis* and *Tragus racemosus.*

Photo 24: View of the route through Philandersbron, note the weed *Gomphocarpus fruticosus*

Going into Philandersbron (Photo 24) the route again cross a seasonal stream, but the vegetation also showed quite clearly the impact of urban settlement. The weed *Gomphocarpus fruticosus* was encountered in association with the seasonal stream.

5.8.6 Vegetation encountered at the Loubos connecting line

All the towns along the route will be connected from the main line as part of the phase 1. Most of these connecting lines are very short and falls within an existing disturbed footprint. However, the pipeline which will connect Loubos is significantly longer (approximately 4 km) and also crosses the seasonal Swartbas stream as it comes from the Katnael Dam (Refer to Figure 13). As such the biodiversity features of this route was discussed in more detail.

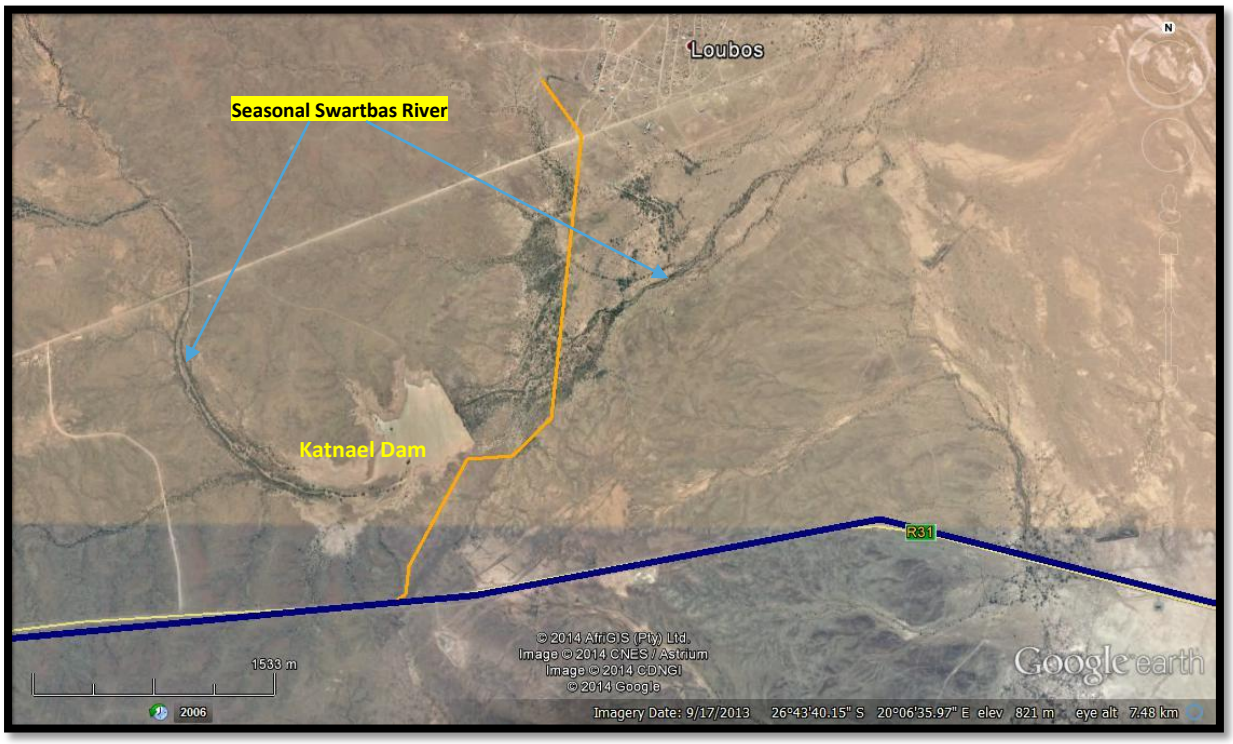

Figure 13: The proposed route for the Loubos connection pipeline (yellow)

The proposed route runs just west of the boundary of Portion 104 of the Farm Mier No. 585 on Municipal property. It follows the boundary between the farms, next to an existing road, till almost due south of Loubos from where it turns north, crosses the seasonal Swartbas River/Stream and then follows just east of a seasonal drainage area, crossing the minor gravel road leading to Loubos, towards the existing Loubos Reservoir. Note that the route is based on the route followed by the Eskom power lines supplying Loubos. From the R31 up to where it crosses the Swartbas River the vegetation is typically Kalahari Karroid Shrubland with species similar

than that described in the previous section (Photo 25). The only botanical feature of interest was the presence of a few individuals of the NCNCA protected *Aloe hereroensis* (Picture above), encountered along the ridges of the slight koppie over which the pipeline is routed, next to the R31. But, it is highly unlikely that construction will impact on these *Aloe* individuals.

Photo 25: The existing road and the Karroid Shrubland encountered from the R31 up to the Swartbas seasonal stream

Crossing the Swartbas River the pipeline will again follow just west of the existing power line (Refer to Photo 26). In this section the main botanical/biodiversity feature of significance is the Swartbas River and the fact that the riparian zone as well seasonal drainage area to the north of the Katnael dam is densely infested by the alien invader, *Prosopis*. When crossing the Swartbas River the same care will have to be taken as with all river crossings along the route. However, because it is seasonal the river crossing can be done with minimum long term impact so long as it is done with good environmental control.

Photo 26: Route location just west of Eskom power line as it nears Loubos

However, the **management of the alien invader species, especially *Prosopis* will be of much more concern** as mechanical removal without prior chemical treatment is likely to stimulate very dense regrowth which will be detrimental to the environment. It is imperative that good control mechanisms are in place.

5.9 FLORA ENCOUNTERED

Please note that this study never intended to be full botanical assessment. However, a scan of significant species was done during the site visit, and even though the author does not claim that all species encountered were identified, all efforts were made to do just that. Table 5 gives a list of the species encountered on the two sites. Appendix 1 gives a list of plant species expected in along the route (SANBI, BGIS data).

Table 5: List of species encountered on the sites (excluding grass species)

SPECIES NAME		OCCURRENCE	FAMILY	SANBI / NCNCA / NFA Status
1.	*Acacia erioloba*	Common from Andriesvale eastwards	FABACEAE	Protected in terms of the NFA
2.	*Acacia haematoxylon*	Common from Mier eastwards	FABACEAE	Protected in terms of the NFA
3.	*Acacia karroo*	Along water courses	FABACEAE	LC
4.	*Acacia mellifera*	Common throughout	FABACEAE	LC
5.	*Aptosimum spinescens*	Common up to Cramond farm	SCROPHULAREACEAE	LC
6.	*Argemone ochroleuca*	Occasional near watercourses	PAPAVERACEAE	**Category 1 Invader**
7.	*Aristida congesta*	Common grass	POACEAE	LC
8.	*Augea capensis*	Abundant – found in patches in more sandy soil	ZYGOPHYLLACEAE	LC
9.	*Blepharis mitrata*	Occasionally in karroid veld	ACANTHACEAE	LC
10.	*Boscia albitrunca*	Regularly encountered	CAPPARACEAE	Protected in terms of the NFA
11.	*Boscia foetida*	Occasionally in karroid vegetation and Mekgacha	CAPPARACEAE	Protected in terms of the NCNCA
12.	*Calicorema capitata*	Occasionally in road reserve	AMARANTHACEAE	LC
13.	*Cullen tomentosum*	Occasionally in road reserve		
14.	*Calobota linearifolia*	Occasionally	FABACEAE	LC
15.	*Calobota spinescens*	One occurrence outside of proposed footprint	FABACEAE	Not evaluated
16.	***Calotropis procera***	Only one individual observed. NB First observation of this Species in Northern Cape	APOCYNACEAE	**Alien weed, previously only encountered in Limpopo**
17.	*Catophractes alexandri*	Occasionally Rietfontein area	BIGNONIACEAE	LC
18.	*Codon royenii*	Occasionally	BORAGINACEAE	LC
19.	*Crotalaria spartioides*	Occasionally along roadsides	FABACEAE	LC
20.	*Cryptolepis decidua*	Occasionally in salt marches	APOCYNACEAE	LC
21.	*Cucumis africanus*	Occasionally near Askham	CUCURBITACEAE	LC
22.	*Deverra denudata*	Occasionally near Askham	APIACEAE	LC
23.	*Dicoma capensis*	Occasionally in road verges	ASTERACEAE	LC
24.	*Fingerhuthia africana*	Common	POACEAE	LC
25.	*Galenia africana*	Common	AIZOACEAE	LC, Protected in terms of the NCNCA
26.	*Galenia sarcophylla*	Common	AIZOACEAE	LC, Protected in terms of the NCNCA
27.	*Geigeria ornativa*	Relatively common	ASTERACEAE	LC
28.	***Gomphocarpus fruticosus***	Occasionally	APOCYANACEAE	**Weed**
29.	*Hermannia tomentosa*	Occasionally	STERCULIACEAE	LC

SPECIES NAME		OCCURRENCE	FAMILY	SANBI / NCNCA / NFA Status
30.	*Hirpicium gazanioides*	Occasionally on road verges	MALVACEAE	LC
31.	*Kleinia longiflora*	Rarely encountered in karroid	ASTERACEAE	LC
32.	*Lessertia physodes*	Occasionally	FABACEAE	LC
33.	*Lycium bosciifolium*	Common throughout	SOLANACEAE	LC
34.	*Lycium cinereum*	Common to karroid	SOLANACEAE	LC
35.	*Lycium hirsutum*	Occasionally in Mekgacha	SOLANACEAE	LC
36.	*Mesembryanthemum guerichianum*	Occasionally disturbed areas	AIZOACEAE	LC, but all species protected in terms of the NCNCA
37.	*Monechma genistifolium*	Commonly found	AANTHACEAE	LC
38.	*Parkinsonia africana*	Occasionally near streams	FABACEAE	LC
39.	*Pechuel-Loeschea leubnitziae*	Occasionally	ASTERACEAE	LC
40.	*Phaeoptilum spinosum*	Occasionally	NYCTAGINACEAE	LC
41.	*Phragmites australis*	Occasionally next to streams	POACEAE	LC
42.	***Prosopis grandulosa***	Occasionally near water courses	FABACEAE	**Category 2 invader**
43.	*Psilocaulon* spp.	Occasionally	AIZOACEAE	LC, but all species protected in terms of the NCNCA
44.	*Psilocaulon junceum*	Occasionally	AIZOACEAE	LC, but all species protected in terms of the NCNCA
45.	*Requienia sphaerosperma*	Occasionally	FABACEAE	LC
46.	*Rhigozum trichotomum*	Common	BIGNONIACEAE	LC
47.	*Rogeria longiflora*	Occasionally	PEDALIACEAE	LC
48.	*Salsola* cf. *aphylla*	Commonly encountered	CHENOPODIACEAE	LC
49.	*Salsola kali*	Occasional in disturbed areas	CHENOPODIACEAE	Weed
50.	*Stipagrostis amabilis*	On dune crests	POACEAE	LC
51.	*Stipagrostis ciliata*	Common if not grazed	POACEAE	LC
52.	*Stipagrostis namaquensis*	Near streams	POACEAE	LC
53.	*Stipagrostis obtusa*	Common when not grazed	POACEAE	LC
54.	*Tamarix usneoides*	Occasionally next to streams	TAMARICACEAE	LC
55.	*Tapinanthus oleifolius*	A parasite on larger trees	LORANTHACEAE	LC
56.	*Tetragonia* cf. *sarcophylla*	Occasionally near watercourses.	AIZOACEAE	LC, but all species protected in terms of the NCNCA
57.	*Tetragonia schenckii*	Occasionally in salty areas	AIZOACEAE	Not evaluated, but all species protected in terms of the NCNCA
58.	*Ursinia* spp.	Occasionally near watercourse	ASTERACEAE	LC
59.	*Verbesina encelioides*	Occasionally	ASTERACEAE	Not evaluated
60.	*Ziziphus mucronata*	Only one observation	RHAMNACEAE	LC
61.	*Zygophyllum decumbens*	Occasionally	ZYGOPHYLLACEAE	LC
62.	*Zygophyllum simplex*	Occasionally	ZYGOPHYLLACEAE	LC
63.	*Zygophyllum tenue*	Occasionally	ZYGOPHYLLACEAE	LC

5.10 SIGNIFICANT AND/OR PROTECTED PLANT SPECIES

South Africa has become the first country to fully assess the status of its entire flora.

5.10.1 Red list of South African Plants

The Red List of South African Plants online provides up to date information on the national conservation status of South Africa's indigenous plants (www.redlist.sanbi.org). The table below provides guidelines for specialists on appropriate recommendations for species of conservation concern found on a proposed development site. The recommendations differ depending on both the Red List status of the species, as well as the Red List criteria met.

Table 6: Guidelines for specialists on appropriate recommendations for species of conservation concern (www.redlist.sanbi.org)

STATUS	CRITERION	GUIDELINES FOR RECOMMENDATION
Critically Endangered	PE	No further loss of natural habitat should be permitted as the species is on the brink of extinction, and all other known subpopulations have been lost. The subpopulation in question is likely to be newly discovered and the only remaining subpopulation of this species.
Critically Endangered	A,B,C,D	No further loss of natural habitat should be permitted as the species is on the verge of extinction.
Endangered	B,C,D	No further loss of habitat should be permitted as the species is likely to go extinct in the near future if current pressures continue. All remaining subpopulations have to be conserved if this species is to survive in the long term.
Endangered	Listed under A only	If the species has a restricted range (EOO < 2 000 km^2), recommend no further loss of habitat. If range size is larger, the species is possibly long- lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the National Environmental Management: Protected Areas Act (Act 57 of 2003), and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
Vulnerable	D	This species either constitutes less than 1 000 individuals or is known from a very restricted range. No further loss of habitat should be permitted as the species' status will immediately become either Critically Endangered or Endangered, should habitat be lost.
Vulnerable	B,C	The species is approaching extinction but there are still a number of subpopulations in existence. Recommend no further loss of habitat as this will increase the extinction risk of the species.
Vulnerable	Listed under A only	If the species has a restricted range, EOO < 2 000 km^2, recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the Protected Areas Act, and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
Data Deficient	D	This species is very poorly known, with insufficient information on its habitat, population status or distribution to assess it. However, it is highly likely to be threatened. If a Data Deficient species will be affected by a proposed activity, the subpopulation should be well surveyed and the data sent to the Threatened Species Programme. The species will be reassessed and the new status of the species, with a recommendation, will be provided within a short timeframe.
Data Deficient	T	There is uncertainty regarding the taxonomic status of this species, but it is likely to be threatened. Contact the taxonomist working on this group to resolve its taxonomic status; the species will then be reassessed by the Threatened Species Programme.
Near Threatened	D	Currently known from fewer than 10 locations, therefore preferably recommend no loss of habitat. Should loss of this species' habitat be considered, then an offset that includes conserving another viable subpopulation (in terms of the Protected Areas Act) should be implemented, provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
Near Threatened	B,C	The species is approaching thresholds for listing as threatened but there are still a number of subpopulations in existence and therefore there is need to minimise loss of habitat. Conservation of subpopulations is essential if they occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
Near Threatened	Listed under A only	If the species has a restricted range, EOO < 2 000 km^2, then recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered. Conservation of subpopulations is essential if they occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant biodiversity conservation plan or (iii) on a site associated with additional ecological sensitivities.
Critically Rare		This is a highly range-restricted species, known from a single site, and therefore no loss of habitat should be permitted as it may lead to extinction of the species. The Threatened Species Programme is not aware of any current threats to this species and should be notified without delay.
Rare		The species is likely to have a restricted range, or be highly habitat specific, or have small numbers of individuals, all of which makes it vulnerable to extinction should it lose habitat. Recommend no loss of habitat. The Threatened Species Programme is not aware of any current threats to this species and should be notified without delay.
Declining		The species is declining but the population has not yet reached a threshold of concern; limited loss of habitat may be permitted. Should the species is known to be used for traditional medicine and if individuals will not be conserved in situ, plants should be rescued and used as mother stock for medicinal plant cultivation programmes.

No species of conservation concern was recorded in terms of the latest Red List of species for South Africa (Refer to Table 5).

5.10.2 Protected species in terms of the NFA

The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species (GN 71 6 of 7 September 2012).

Three (3) species protected in terms of the NFA were encountered namely:

- ***Acacia erioloba***
- ***Acacia haematoxylon***
- ***Boscia albitrunca***

5.10.2.1 Camelthorn

The slow-growing Camelthorn grows well in poor soils and in harsh environmental conditions. However, they will take up to 10 years before starting to flower, and only by age 20, will produce regular large pod crops (Seymour & Milton, 2003). It is this of great important that especially mature seed producing individuals are protected. Most benefits brought by *A. erioloba* are not immediately apparent, and it is only when they are large, years after establishment, that they begin to appreciably affect soil quality, produce large patches of shade, and produce pods, gum, and fuel wood. Large trees also diminish nutrient leaching, increase nutrient levels beneath their canopies (owing to nutrient cycling and concentration of livestock dung), mitigate soil degradation, prevent soil erosion on steep slopes, sequester carbon and replenish organic matter. Pod production is linearly related to tree size, so as trees become older, they become more valuable as a source of seed and forage, as livestock relish eating the pods (Seymour and Milton, 2003). In addition, it is often the only available dense shade tree in the hot arid environment of the south-western regions of its distribution.

The Camelthorn tree exhibits distinctive high quality red heartwood and is a used as a firewood as well as fodder (especially the pods). It holds economic significance in the southern Kalahari region. Camelthorn wood is regarded as the best source of firewood in the region where fuel wood is scarce. As a result this tree has been utilised extensively in the past and are now protected species tree species in South Africa in terms of National Forests Act (GN 716 of 7 September 2012).

5.10.2.2 Sheppard's tree

According to Alias & Milton (2003) *Boscia albitrunca* is a keystone species in arid southern Africa, where it primarily provides browse to livestock and game, shade and food and shelter to other animals including invertebrates and birds. The laws of numerous African traditions strictly prohibit destruction of this tree. The wood is not favoured as a fuel wood and has no commercial value, although it is sometimes used in rural areas for making household items such as tables, chairs, spoons and dishes.

This species is under threat, however, owing to intense use of its branches to supplement livestock feed, particularly in times of drought. Its nutritious foliage suggests that this species obtains nutrients from ground water and perhaps also from the concentration of nutrients beneath its canopy because of animal activities. It therefore contributes to nutrient cycling in mainly oligotrophic sands, as well as performing other ecological services such as reducing nutrient leaching, mitigating soil degradation, preventing soil erosion, sequestering carbon and replenishing organic matter.

This species is observed to establish beneath other large trees within its environment, primarily *A. erioloba*, which serve as resting and perch sites for animals and birds, making the species dependent on large tree species in arid savannah. Therefore, threats to species that provide these micro-sites also constitute a threat to *B. albitrunca*. Within the arid Kalahari, indiscriminate removal of Camelthorn (*Acacia erioloba*) trees could reduce the availability of suitable germination sites (Alias & Milton, 2003).

5.10.3 Species protected in terms of the NCNCA

The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, and also provides for the sustainable utilization of wild animals, aquatic biota and plants. Schedule 1 and 2 of the act give extensive lists of specially protected and protected fauna and flora species in accordance with this act.

Eight (8) species listed in terms of the NCNCA were encountered along the route. However, all of these species are considered to be of Least Concern in terms of IUCN status (the International Union for the Conservation of Nature). In most cases these species was locally abundant, however, a flora permit will have to be applied for in terms of the NCNCA since there remains a possibility that some of these species will be impacted.

5.11 FAUNA AND AVI-FAUNA

Although natural fauna and avi-fauna may still be present, it is expected that it would be limited to avi-fauna, insects and maybe some reptile's species. Because of the proximity of the route to the R31 and the temporary nature of the project it is not expected that game or avi-fauna will be significantly adversely affected, apart from the possible impact which will be left by the removal of larger indigenous trees. It is a known fact that many animal and bird species associate with large *Acacia erioloba* as well as *Boscia albitrunca* trees and the removal of mature trees of these species will have an impact on such wildlife (even though very localised).

Mammals: The site falls within the distribution range of approximately 50 mammal species indicating moderate diversity. Human activity in the area is medium-high and it is highly unlikely that a fair representation of these mammals will be found along the route. The impact will be temporary and it is considered highly unlikely that it will pose a significant impact on mammal species and as a result the impact is deemed negligible.

Reptiles: The site falls within the distribution range of approximately 30 reptile species, indicating low diversity. As a result of the open planes on site the reptile composition is likely to be dominated by species which inhabit open areas, such as snakes, lizards and geckos. Human activity in the area is medium-high and it is highly unlikely that large numbers of these species will be present on site. As such, the impact on reptiles should be negligible.

Amphibians: The site falls within the distribution range of approximately 10 amphibian species. However, no suitable breeding places were observed on the proposed site and it is highly unlikely that the proposed development will have any significant impact on amphibian species. In addition, most amphibians require perennial water and will thus not be affected at all.

Avi-fauna: The site falls within the distribution range of approximately 200 bird species known from the broad area. But because of the medium-high human activity it is not expected that a fair representation of these species will be encountered on site or its immediate vicinity. Apart from the possible impact on mature trees (mentioned above) the proposed activity is not expected to have a significant impact on avi-fauna. However, it remains important that all larger indigenous trees must be protected wherever possible in order to minimise the possible impact (although localised) on bird species.

5.12 RIVERS AND WETLANDS

Rivers maintain unique biotic resources and provide critical water supplies to people. South Africa's limited supplies of fresh water and irreplaceable biodiversity are very vulnerable to human mismanagement. Multiple environmental stressors, such as agricultural runoff, pollution and invasive species, threaten rivers that serve the world's population. River corridors are important channels for plant and animal species movement,

because they link different valleys and mountain ranges. They are also important as a source of water for human use. Vegetation on riverbanks needs to be maintained in order for rivers themselves to remain healthy, thus the focus is not just on rivers themselves but on riverine corridors.

The proposed pipeline route will follow the dry riverbed of the Kuruman River from Cramond farm to Andriesvale where it connects with the Molopo River. Near Andriesvale the route will also cross the dry riverbed of the Molopo River. It will also cross two Southern Kalahari Salt pans namely the Koopan and Hakskeenpan as well as numerous ephemeral and also seasonal streams which drains the Mier, Rietfontein and Philandersbron area into the Hakskeenpan. However, the route will follow the existing R31 within the road reserve, an area already subjected to disturbance. The temporary nature of the construction phase should not add significantly to the impact on any of these streams in the long run, provided that the construction is done responsibly and with good environmental control. The route should have little impact on the Kuruman River as it will mostly run to the south of the already disturbed R31 corridor (away from the Kuruman River). The Molopo crossing will also follow the existing road reserve as will all other ephemeral and stream crossings. In the vicinity of Mier the route will cross a number of small streams or ephemeral drainage lines, all of which drains the Mier area towards Hakskeenpan. Some of these streams are delineated by well-established riparian vegetation. However, this riparian vegetation is in most cases already disturbed within the road reserve. The same is true for the streams and ephemeral drainage lines found in the vicinity of Rietfontein and Philandersbron.

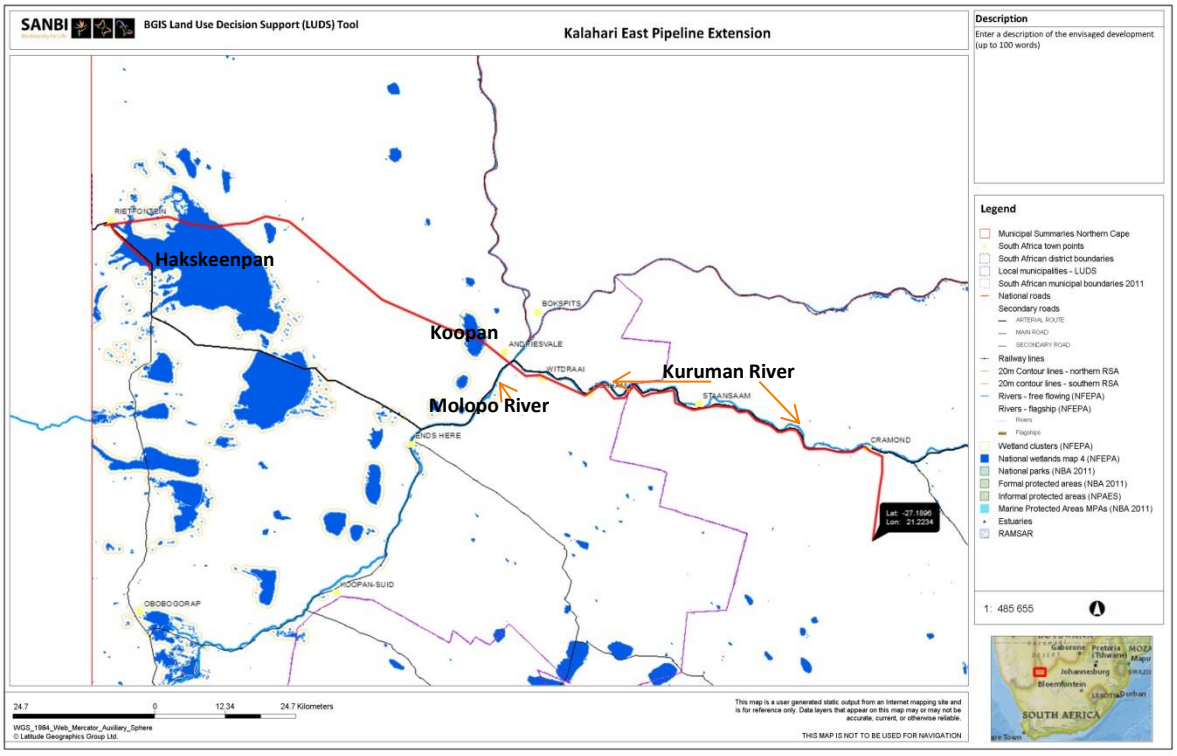

Figure 14: BGIS wetland map for the proposed route, showing the Kuruman and Molopo Rivers as well as Koopan and Hakskeenpan

5.12.1 Loss of riparian habitat and bed/bank modification:

The preparation and installation of the pipeline has the potential to impact on both the riparian and in stream zones of these water courses, during and directly after the installation. The disturbance of habitat during and after the construction activities also provides an opportunity for further invasive alien plants to establish in the area and might leave erosion potential. During the construction phase the impact on any riparian zone should be kept to a minimum. After the construction phase, the riparian area should be rehabilitated and the area re-vegetated with suitable indigenous vegetation to reduce the risk of erosion in the stream channels. Follow up work should be carried out after rehabilitation to ensure that no invasive alien plants establish themselves within the riparian zone at the proposed pipeline crossings as well as downstream of the crossings.

Because of the temporary and short term nature of the proposed impact the overall impact on water courses and wetlands are expected to be low. However, all construction work in the vicinity of these features should be done while they are dry and with good environmental control. Wherever possible the pipeline should cross water courses diagonally to prevent the excavation of trenches along (parallel) to the rivers in the riparian zone.

5.13 INVASIVE ALIEN INFESTATION

Probably because of the harshness of the environment coupled with the dry climate the general route show very little alien invader species. However, individuals of the alien tree *Prosopis grandulosa* (a category 2 invader) were encountered mostly in association with water courses.

A single individual of the alien invasive plant *Calotropis procera* was encountered near Rietfontein. This was the first observation of this alien plant in the Northern Cape Province which up to now was only known in the Limpopo area (Blouberg – Mapungupwe – Messina and Letaba Dam areas). The presence of this plant was reported to the ARC-Plant Protection Research Institute and will be removed by the alien invader response team.

Near Philandersbron a number of individuals of the weed *Gomphocarpus fruticosus* were encountered in association with the seasonal stream.

According to regulation 15 and 16 of CARA all listed alien invader plants and weeds must be removed/controlled.

In this case all *Prosopis, Calotropis* and *Gomphocarpus* individuals and other listed alien invader species encountered must be removed from the footprint (road reserve) and its immediate vicinity.

6. VELD FIRE RISK

The revised veldfire risk classification (Forsyth, 2010) in terms of the National Veld and Forest Fire Act 101 of 1998 was promulgated in March 2010. The purpose of the revised fire risk classification is to serve as a national framework for implementing the National Veld and Forest Fire Act, and to provide a basis for setting priorities for veldfire management interventions such as the promotion of and support to Fire Protection Associations. In the fire-ecology types and municipalities with High to Extreme fire risk, comprehensive risk management strategies are needed.

The proposed Kalahari-East Water Supply Scheme Extension is located in an area supporting low shrubland for the majority of the route which has been classified with a **medium to low fire risk classification** (Refer to Figure 15).

Although, the fire risk is not high it is still important that during construction and operation the site must adhere to all the requirements of the local Fire Protection Association (FPA) if applicable, or must adhere to responsible fire prevention and control measures.

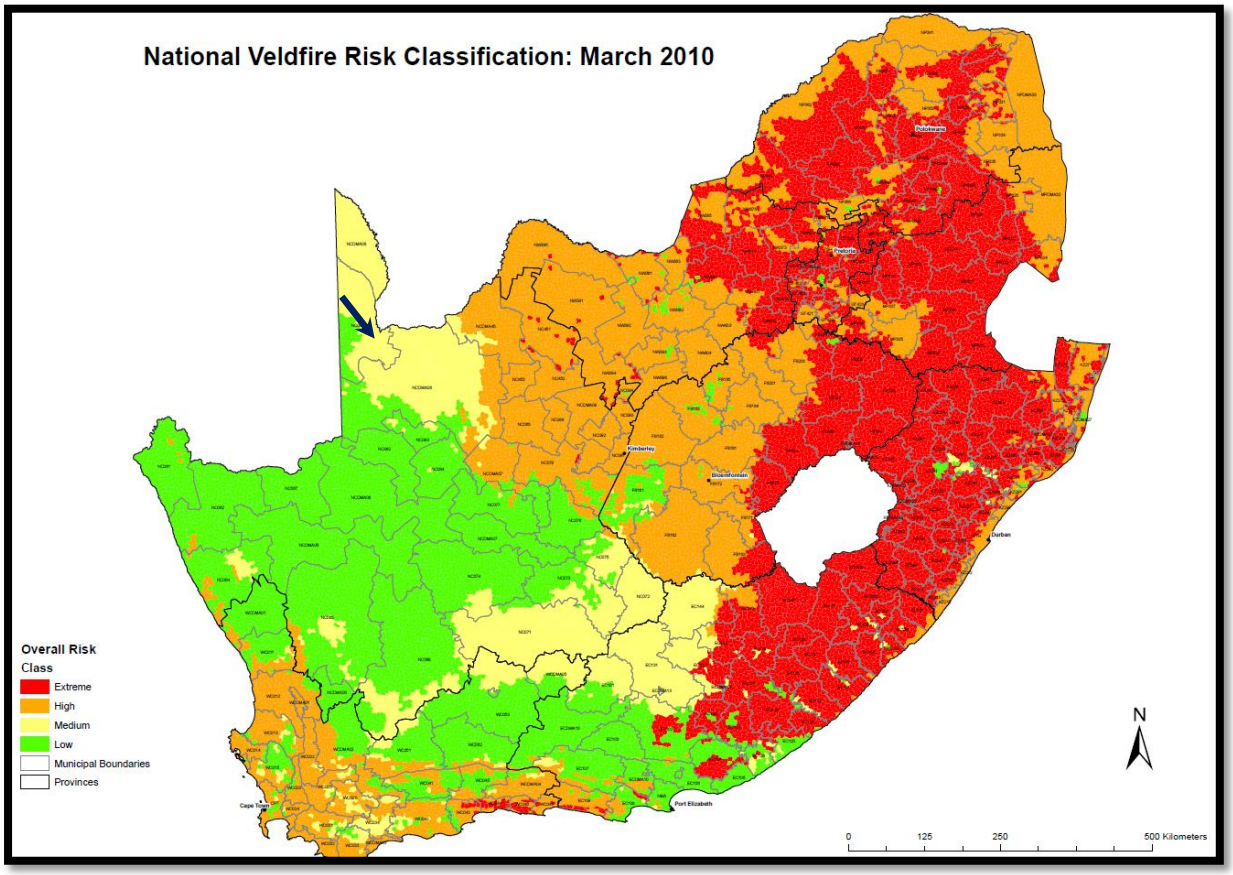

Figure 15: South African National Veldfire Risk Classification (March 2010)

7. BIODIVERSITY ASSESSMENT

Biological diversity, or biodiversity, refers to the variety of life on Earth. As defined by the United Nations Convention on Biological Diversity, it includes diversity of ecosystems, species and genes, and the ecological processes that support them. Natural diversity in ecosystems provides essential economic benefits and services to human society—such as food, clothing, shelter, fuel and medicines—as well as ecological, recreational, cultural and aesthetic values, and thus plays an important role in sustainable development. Biodiversity is under threat in many areas of the world. Concern about global biodiversity loss has emerged as a prominent and widespread public issue.

The objective of this study was to evaluate the biological diversity associated with the study area in order to identify significant environmental features which should be avoided during development activities and or to evaluate short and long term impact and possible mitigation actions in context of the proposed development.

As such the report aim to evaluate the biological diversity of the area using the Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al*., 2005), with emphasis on:

- Significant ecosystems
    - Threatened or protected ecosystems
    - Special habitats
    - Corridors and or conservancy networks
- Significant species
    - Threatened or endangered species
    - Protected species

7.1 DISCUSSION OF POTENTIAL IMPACTS

The Kalahari-East Water Supply Scheme Extension (Phase 1) and reservoir entails the construction of a new pipeline extension of approximately 165 km as well as a new floating reservoir (approximately 0.5 ha in size) from the farm Cramond in the east following the R31 road reserve from Cramond to Philandersbron *via*, Askham, Andriesvale, Mier and Rietfontein.

The placement of the proposed pipeline is fortunate in that the road reserve is already impacted to a degree and no new disturbance footprint will result. It will also not be necessary to construct any additional service roads since the proposed route follows existing roads all the way.

However, the route will follow the dry Kuruman River, will cross the Molopo River as well as a number of smaller seasonal streams and ephemeral drainage lines (which drains the Mier and Rietfontein area into the Hakskeenpan). It is also almost certain to impact on a number of well-established indigenous trees, including a

number of protected tree species (e.g. *Acacia erioloba, A. haematoxylon* and *Boscia albitrunca*). It will also impact on various species protected in terms of the Northern Cape Nature Conservation Act (Act 9 of 2009), most notably *Boscia foetida*.

Direct impacts will be associated with the relative short construction period (months) and are considered temporary, since the pipeline will be located underground. However, even though the impact will be localised and temporary in nature it will have (even though temporary) direct impacts on remaining natural vegetation and small ephemeral streams. Some alien vegetation (mostly *Prosopis* trees) was encountered and if not handled correctly can lead to further infestation.

The vegetation types encountered are all considered Least Threatened (thus not under any immediate threat in terms of extinction) but not all are well protected and will require further conservation efforts. It is important to understand that these vegetation types are not particularly rich in plant species and does not contain any centre of endemism. Unlike some biomes of South Africa, local endemism is also very low. **Meaning that the vegetation type is fairly similar over extended areas and it would be unlikely that small localised impacts will have any significant impact on any specific species or the vegetation type as a whole.** The vegetation is also not fragmented in any way with extended areas of excellent connectivity remaining throughout.

Even though 8 species protected in terms of the NCNCA was encountered, and the likelihood is high that individuals of these species may be impacted during the construction phase, it **is considered unlikely that the construction activities will have any significant impact on these populations**. Especially since none of the identified species are listed in the South African Red data list (all classified as of Least Concern).

The possible impact on the water courses and ephemeral streams are also considered to be short term and very localised and should not constitute a significant impact.

7.2 EVALUATION OF POTENTIAL ENVIRONMENTAL SIGNIFICANCE

The table underneath gives a summary of biodiversity features encountered during the site visit and a short discussion of their possible significance in terms of regional biodiversity targets.

BIODIVERSITY ASPECT	SHORT DESCRIPTION	SIGNIFICANCE RATING	
Potential impacts on biophysical environment			
Geology & soils	Geology & soils vary only slightly in the larger study area.	No special features have been encountered (e.g. true quartz patches or broken veld) and the impact on geology and soils is expected to be very localised and low. Mitigation will entail staying within the road reserve and minimising footprint.	
		Without mitigation: Low	**With mitigation: Insignificant**
Land use and cover	The proposed route will follow existing road reserves and with little impact on any farming activity.	The area is been utilised mainly for grazing. The impact is considered short term, temporary and localised with regards to land use. Mitigation will entail staying within the road reserve and minimising footprint.	
		Without mitigation: Low	**With mitigation: Insignificant**
Potential impacts on threatened or protected ecosystems			
Vegetation type(s)	Seven vegetation types were encountered (Refer to Table 2):	All vegetation types are classified as "Least threatened" but not all are well protected. However, the proposed footprint follows existing road reserves. Associated infrastructure (e.g. additional roads) will not be required. In addition the impact will be short term and temporary of nature and is therefore not considered significant. Mitigation will entail staying within the road reserve and minimising footprint.	
		Without mitigation: Low	**With mitigation: Insignificant**
Corridors and conservation priority areas/networks.	Draft Environmental Management Framework (EMF) for the Siyanda District Municipality.	According to the EMF, Kalahari Karroid Shrubland has a high conservation priority, while Southern Kalahari Salt Pans vegetation has a medium/low sensitivity index due to both not being adequately protected. However, the proposed footprint follows existing road reserves. Associated infrastructure (e.g. additional roads) will not be required The impact on river and wetland corridors will similarly fall within already disturbed areas within the road reserve. In addition the impact will be short term and temporary of nature. Mitigation will entail staying within the road reserve and minimising the footprint especially when crossing water courses. It will be especially important to minimise the impact on riparian vegetation and to ensure erosion control through good rehabilitation. Correct alien eradication will also be important.	
		Without mitigation: Medium	**With mitigation: Low**
Protected plant species	No SA red list species was observed. Three (3) tree species protected in terms of the NFA was encountered. Eight (8) plant species protected in terms of the NCNCA was observed.	A great number of trees listed in terms of the NFA, most notably Camelthorn and Sheppard's trees were encountered along the proposed route. More than 400 trees can potentially be impacted by the proposed pipeline route (even though it is located within the disturbed road reserve). However, with good mitigation between 90 – 95% of these trees can be conserved. Previous experience showed that both Camelthorn and Sheppard's tree have deep root systems, which mean excavation can be done quite close to the tree without impacting on the root system. In addition at least eight species protected in terms of the NCNCA are likely to be impacted by the proposed development. Again good topsoil conservation and rehabilitation can negate this impact to a large degree. Mitigation will entail excellent environmental control, slight route alterations to avoid as many mature indigenous tree species as possible; good topsoil conservation and rehabilitation practices; and application for permits in terms of the NFA and the NCNCA.	
		Without mitigation: High	**With mitigation: Medium - Low**

BIODIVERSITY ASPECT	SHORT DESCRIPTION	SIGNIFICANCE RATING	
Fauna & Avi-fauna	The proposed route will follow existing road reserves and with low impact on habitat.	Because of the temporary and localised nature of the activity it is considered highly unlikely that it will have any significant impact on fauna or avi-fauna. Mitigation will entail staying within the road reserve and minimising footprint and the impact on mature indigenous tree species.	
		Without mitigation: Medium	**With mitigation: Insignificant**
Rivers & wetlands	The proposed route will follow the Kuruman River and will cross the Molopo River. It will also cross two Southern Kalahari Salt pans as well as numerous ephemeral and also seasonal streams which drain the Mier, Rietfontein and Philandersbron area into the Hakskeenpan.	The preparation and installation of the pipeline has the potential to impact on both the riparian and in stream zones of these water courses. The disturbance of habitat during and after the construction activities also provides an opportunity for further invasive alien plants to establish in the area and might leave erosion potential. Mitigation will entail excellent environmental control in order to minimise the impact on riparian zones, to ensure good rehabilitation and re-vegetation with suitable indigenous vegetation to reduce the risk of erosion in the stream channels. Follow up work should be carried out after rehabilitation to ensure that no invasive alien plants re-establish itself.	
		Without mitigation: Medium	**With mitigation: Low**
Invasive alien infestation	*Prosopis, Calotropis* and *Gomphocarpus* species was observed along the route.	All listed invasive alien species must be removed during the construction. However, incorrect alien control methods used for especially Prosopis species may aggravate the situation and result in spreading in place of control of these species. Mitigation will entail correct alien control methods coupled with follow up work after rehabilitation.	
		Without mitigation: Medium	**With mitigation: Positive**
Potential direct impacts			
Direct impacts	Refers to those impacts with a direct impact on biodiversity features.	The proposed pipeline will have a direct impact on natural vegetation, which is likely to include protected plant species in terms of the NFA and NCNCA, small seasonal ephemeral streams and vegetation with a potential high conservation value. The impact on soil, landuse, fauna and avi-fauna and veld fire is considered to be negligible. Apart from the potential impact on mature indigenous trees the impacts will be mostly short termed, temporary and localized. Mitigation will include all the mitigation aspects discussed above.	
		Without mitigation: High (Protected tree species)	**With mitigation: Medium/Low**
Potential indirect impacts			
Indirect impacts	Refers to impacts that are not a direct result of the main activity, but are impacts associated or resulting from the main activity.	It is very likely that the proposed project will have indirect impacts like the establishment of temporary lay-down areas, quarry sites for bedding and blanket material, temporary construction sites and concrete mixing areas. However, with good environmental control it will be possible to minimise the impact of such indirect impacts. Mitigation will entail excellent environmental control, placement of temporary lay-down areas or construction sites within areas that are not environmentally sensitive and will not impact on protected plant species. It will also entail good waste and wastewater control.	
		Without mitigation: Medium/high	**With mitigation: Low**
Potential cumulative impacts			
Cumulative impacts	Refers to the cumulative loss of ecological function and other biodiversity features on a regional basis.	The proposed project will have a temporary and localised impact, which should not result in significant additional permanent impacts (apart from the new). Overall it is not considered likely that the cumulative impact will result in any significant additional impact on regional biodiversity targets, but it is likely that the project will impact on protected plant species and watercourses. Mitigation will entail excellent environmental control and all of the mitigation measures addressed above	
		Without mitigation: High	**With mitigation: Medium/Low**

BIODIVERSITY ASPECT	SHORT DESCRIPTION	SIGNIFICANCE RATING
The No-Go Option		
The No-Go Option	The "No-Go alternative" does not signify significant biodiversity gain or loss especially on a regional basis. However, it will ensure that none of the potential impacts above occur.	The Mier Municipal area is extremely dry with no permanent surface water sources. The large rural farms and towns depend on borehole water and windmills for their daily needs. Apart from those at Rietfontein the water quality of these boreholes are mostly poor with yields that are unsustainable during dry seasons. Only one third of the Mier households have access to water inside their dwellings and many farmers, on a daily basis, have to pump water for stock through pipelines or transport it per road and over long distances. In their integrated development plan for the Mier area, the Mier Municipality has identified the need for water and sanitation provision as their priority issue for the next 5 years (Mier IDP, 2013/14). According to engineering evaluation the proposed pipeline is the only viable option to ensure sustainable water supply to the Mier community in the long run. The need for sustainable water has been identified as high socio-economical need and priority of the Mier community. It is thus unlikely that a similar project will not have to be implemented. The specific route is most likely the one with the lowest potential environmental impact and the one which makes the best long term sense with the only negative the potential impact on the mature indigenous trees within the road reserve.

8. SUMMARY

Having evaluated the biodiversity aspects and associated impacts pertaining to the proposed development, the author is of the opinion that the proposed route most probably matches the most logical choice from a biodiversity perspective, by minimising the impact on threatened habitats, vegetation and species, while conforming to the objectives of the Draft Siyanda Municipal EMF. With mitigation it is possible that the proposed development will have minimal permanent impact on the environment.

The evaluation of the potential environmental impacts indicates the most significant potential impacts identified where:

- The potential impact on a great number of NFA protected tree species, especially *Acacia erioloba* and *Acacia haematoxylon* within the Kuruman River corridor, and *Boscia albitrunca* also within the Kuruman River corridor and near Mier.
- The potential impact on NCNCA protected plant species
- The potential impact on Kalahari Karroid Shrubland which has a high conservation priority.
- The potential impact on the Southern Kalahari Salt Pans vegetation, which has medium/low sensitivity.
- The potential impact on seasonal water courses and ephemeral streams.

With mitigation is, however, considered highly unlikely that the proposed project will contribute significantly to any of the following:

- Significant loss of vegetation type and associated habitat.
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to development and operational activities.
- Loss of local biodiversity and threatened plant species.
- Loss of ecosystem connectivity

Lastly it is felt that with good environmental planning and control during development (the appointment of a suitably qualified ECO and the implementation of an approved EMP) could significantly reduce environmental impact.

With the available information to the author's disposal it is recommended that project be approved, provided that mitigation is adequately addresses (with special focus on the minimisation the impacts on indigenous tree species).

9. MITIGATION RECOMMENDATIONS

9.1 GENERAL

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase in terms of the EMP and the Biodiversity study recommendations as well as any other conditions pertaining to other specialist studies and requirements of the DENC or DAFF.
- The ECO should give onsite advice with regards to final route layout with the main aim of minimising the impact on protected plant species.

9.2 OTHER LEGISLATION

- An **application must be made for a permit in terms of the NFA** with regards to the potential impact on protected tree species.
- An **application for a flora permit must be submitted for the temporary disturbance of listed species identified in terms of Schedule 1 and 2 of the NCNCA**.
- Should **borrow pits be required for the excavation of bedding or blanket material a sand mining permit must be obtained from the Department of Mineral Resources**.
- With regards to the applicability of a **Water Use Authorization** in terms of the NWA (National Water Act). In terms of the replacement General Authorization promulgated in terms of the NWA, on 18 December 2009 (GG No. 32805) with regards to the impeding or diverting the flow of water in a watercourse (Section 21(c)) and altering the bed, course or characteristics of a watercourse (Section 21(i)).NWA (National Water Act), a General Authorization or a License are required for the crossing of rivers / seasonal streams. Since numerous small and medium seasonal streams will have to be crossed as part of this project a water use authorization will be applicable. However, because of the following, it is very likely that the proposed activities will fall within the ambit of being **Generally Authorized (GA)**. However, please be advised that although application for a GA in terms of the NWA is not required as long as compliance can be proved, **it is recommended that the DWA confirms, in writing, the applicability or not of the General Authorization**. In terms of Government Notice 32805 the following:
  - Section 4: None of the rivers /streams falls within an excluded area.
  - Section 6: None of the crossings take place within 500 m radius of any wetland.
  - Section 6: The pipeline will transport fresh water (no sewerage or hazardous material).
  - Section 6: No impeding or diverting the flow or altering the bed, banks, course or characteristics of a watercourse (temporary excavation and immediate rehabilitation).
  - Section 7(2): No detrimental impact on another lawful water use.
  - Section 7(3): No structures or hardened surfaces will be installed.

- Section 7(4): With good environmental control (ECO), the activity will not have detrimental impact on riparian vegetation.
- Section 7(5): Activity will not change quantity, velocity pattern etc. of flow in the watercourse.
- Section 7(6): Will not result in detrimental change in water quality.
- Section 7(7): Will not result in detrimental change in biota.

9.3 SITE SPECIFIC RECOMMENDATION: CRAMOND FARM (KALAHARI DUNE AREAS)

- On the farm Cramond, route option 2 is the preferred option since it will have lower wind erosion potential (the dunes being lower and easier to rehabilitate).
- The protection of the grassy and herbaceous ground cover layer is of great importance, since it is this vegetation cover which is mainly responsible for binding the sand of the dunes (and thus the main protection feature of the dune systems). It is thus of great importance to minimise the actual disturbance footprint.
- In order to achieve this, it is suggested that topsoil removal is not done within the Kalahari dune areas on the farm Cramond and that disturbance is minimised to the actual trench line. In other words, only the trench line itself should be opened (which must be closed and rehabilitated immediately after placement of the pipeline – a "one go action") as opposed to the general recommendation of topsoil being removed for the whole of the construction footprint. Vehicles should minimise the impact on the surrounding vegetation, but should be allowed to "drive" over the existing vegetation cover (during excavation).
- The exposed trench line over the dunes must be further protected by the placement of shrub on the exposed sands. Both *Acacia mellifera* and *Rhigozum trichotomum* branches have been used with great success on similar projects in the Kalahari (Photo 27).

Photo 27: Acacia mellifera and Rhigozum branches used for dune stabilisation after construction near Middelputs (NC)

9.4 SITE SPECIFIC: ROAD RESERVE

- The construction footprint must stay within the already degraded road reserve with the overall aim of minimising additional disturbance.

- The final pipeline route must be adjusted on site *via* ECO approval, with the aim of minimising permanent impact on mature indigenous tree species (especially protected tree species), through slight route alterations.
- Additional lay-down areas or construction sites must be located within already disturbed areas or areas of low ecological value and must be pre-approved by the ECO.
- Indiscriminate clearing of areas must be avoided.

Photo 28: Calcrete used to stabilize steeper slopes of dunes within the existing road reserve

- Topsoil, the top 10-20 cm layer of soil, which should contain 80-90% of the seed bearing material and bulbs, must be protected throughout the project (removal and separately storage).
- The topsoil and vegetation must be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of plant species.
- Calcrete gravel should be used to stabilise steep exposed dunes which were disturbed during the construction phase (as is the general practice used along the roads of the Kalahari area) (Photo 28).

9.5 STREAMS & WETLANDS

- When working within or near water courses the impact on riparian vegetation must be minimised through excellent environmental control with the aim of minimising the impact on riparian zones; ensuring good rehabilitation and re-vegetation with suitable indigenous vegetation to reduce the risk of erosion in the stream channels.
- River crossing should only be done when they are not in flow (dry season) and wherever possible, the crossings should be diagonally to the river banks (the shortest route possible).
- Where possible all river crossing should aim at utilising already disturbed areas (e.g. road verges) thus minimising any additional footprint within the river corridor.

9.6 ALIEN VEGETATION MANAGEMENT

- All alien vegetation must be removed from within the construction footprint (the road reserve) and immediate surroundings (especially river corridors).
- It is imperative that the correct alien eradication methods are employed (especially with regards to Prosopis control) as incorrect methods **WILL** aggravate the infestation.
- Follow up work must be carried out after rehabilitation to ensure that no invasive alien plant re-establishes itself.

9.7 WASTE MANAGEMENT

- An integrated waste management approach must be implemented during construction.
- Construction related general and hazardous waste may only be disposed of at Municipal approved waste disposal sites.
- Spoil from excavation work should be used to fill or rehabilitate old quarry sites or new ones established for sand mining (if applicable).

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APPENDIX 1: BGIS SPECIES EXPECTED ALONG THE ROUTE (FLORA & FAUNA)

SCIENTIFIC NAME	FAMILY	CATEGORY
Agama aculeata	Agamidae	Animals
Agama anchietae	Agamidae	Animals
Bitis caudalis	Viperidae	Animals
Bitis schneideri	Viperidae	Animals
Cacosternum boettgeri	Ranidae	Animals
Cacosternum carinatus	Ranidae	Animals
Chondrodactylus angulifer	Gekkonidae	Animals
Colopus wahlbergii	Gekkonidae	Animals
Cordylus polyzonus	Cordylidae	Animals
Dasypeltis scabra	Colubridae	Animals
Dispholidus typus	Colubridae	Animals
Hyperolius sp.	Ranidae	Animals
Lamprophis aurora	Colubridae	Animals
Lamprophis capensis	Colubridae	Animals
Leptotyphlops distanti	Leptotyphlopidae	Animals
Lycophidion capense	Colubridae	Animals
Lygodactylus bradfieldi	Gekkonidae	Animals
Mabuya occidentalis	Scincidae	Animals
Mabuya sp.	Scincidae	Animals
Mabuya variegata	Scincidae	Animals
Meroles ctenodactylus	Lacertidae	Animals
Meroles knoxii	Lacertidae	Animals
Nucras tessellata	Lacertidae	Animals
Opius (Xynobius)	Braconidae	Animals
Pachydactylus capensis	Gekkonidae	Animals
Pachydactylus carinatus	Gekkonidae	Animals
Pedioplanis inornatus	Lacertidae	Animals
Pedioplanis lineoocellata	Lacertidae	Animals
Pedioplanis namaquensis	Lacertidae	Animals
Psammophis leightoni	Colubridae	Animals
Psammophylax rhombeatus	Colubridae	Animals
Ptenopus garrulus	Gekkonidae	Animals
Tomopterna cryptotis	Ranidae	Animals
Trachylepis sp.	Scincidae	Animals
Trachylepis sulcata	Scincidae	Animals
Typhlops bibronii	Typhlopidae	Animals

SCIENTIFIC NAME	FAMILY	CATEGORY
Typhlosaurus gariepensis	Scincidae	Animals
Typhlosaurus lineatus	Scincidae	Animals
SCIENTIFIC NAME	**FAMILY**	**CATEGORY**
Acacia haematoxylon	FABACEAE	Plants
Acacia mellifera subsp. detinens	FABACEAE	Plants
Anthephora schinzii	POACEAE	Plants
Aptosimum albomarginatum	SCROPHULARIACEAE	Plants
Aptosimum junceum	SCROPHULARIACEAE	Plants
Aptosimum lineare	SCROPHULARIACEAE	Plants
Asparagus cooperi	ASPARAGACEAE	Plants
Atriplex nummularia subsp. nummularia	CHENOPODIACEAE	Plants
Augea capensis	ZYGOPHYLLACEAE	Plants
Blepharis mitrata	ACANTHACEAE	Plants
Boscia albitrunca	CAPPARACEAE	Plants
Boscia foetida subsp. foetida	CAPPARACEAE	Plants
Calobota linearifolia	FABACEAE	Plants
Calobota spinescens	FABACEAE	Plants
Cenchrus ciliaris	POACEAE	Plants
Chloris virgata	POACEAE	Plants
Chrysocoma obtusata	ASTERACEAE	Plants
Convolvulus sagittatus	CONVOLVULACEAE	Plants
Corallocarpus schinzii	CUCURBITACEAE	Plants
Cucumis heptadactylus	CUCURBITACEAE	Plants
Cullen tomentosum	FABACEAE	Plants
Deverra denudata subsp. aphylla	APIACEAE	Plants
Dicerocaryum eriocarpum	PEDALIACEAE	Plants
Enneapogon scaber	POACEAE	Plants
Eragrostis annulata	POACEAE	Plants
Eragrostis brizantha	POACEAE	Plants
Eragrostis porosa	POACEAE	Plants
Galenia sarcophylla	AIZOACEAE	Plants
Geigeria filifolia	ASTERACEAE	Plants
Geigeria ornativa subsp. ornativa	ASTERACEAE	Plants
Geigeria pectidea	ASTERACEAE	Plants
Gisekia pharnacioides var. pharnacioides	GISEKIACEAE	Plants

SCIENTIFIC NAME	FAMILY	CATEGORY
Helichrysum argyrosphaerum	ASTERACEAE	Plants
Helichrysum herniarioides	ASTERACEAE	Plants
Heliotropium nelsonii	BORAGINACEAE	Plants
Hermannia bicolor	MALVACEAE	Plants
Hermannia minutiflora	MALVACEAE	Plants
Hermbstaedtia odorata var. odorata	AMARANTHACEAE	Plants
Hibiscus dongolensis	MALVACEAE	Plants
Hibiscus marlothianus	MALVACEAE	Plants
Hoodia gordonii	APOCYNACEAE	Plants
Hypertelis salsoloides var. salsoloides	MOLLUGINACEAE	Plants
Ifloga molluginoides	ASTERACEAE	Plants
Indigofera alternans var. alternans	FABACEAE	Plants
Jamesbrittenia canescens var. canescens	SCROPHULARIACEAE	Plants
Juncus oxycarpus	JUNCACEAE	Plants
Kohautia cynanchica	RUBIACEAE	Plants
Lapeirousia silenoides	IRIDACEAE	Plants
Lebeckia linearifolia	FABACEAE	Plants
Lessertia macrostachya var. macrostachya	FABACEAE	Plants
Leysera tenella	ASTERACEAE	Plants
Limeum aethiopicum var. lanceolatum	MOLLUGINACEAE	Plants
Lotononis marlothii	FABACEAE	Plants
Marsilea aegyptiaca	MARSILEACEAE	Plants
Melhania rehmannii	MALVACEAE	Plants
Mesembryanthemum crystallinum	MESEMBRYANTHEMACEAE	Plants
Mesembryanthemum guerichianum	AIZOACEAE	Plants
Mesembryanthemum sp.	AIZOACEAE	Plants
Monechma divaricatum	ACANTHACEAE	Plants
Nerine laticoma	AMARYLLIDACEAE	Plants
Osteospermum muricatum subsp. muricatum	ASTERACEAE	Plants
Oxygonum alatum	POLYGONACEAE	Plants
Parkinsonia africana	FABACEAE	Plants
Pavonia senegalensis	MALVACEAE	Plants
Pechuel-Loeschea leubnitziae	ASTERACEAE	Plants
Pegolettia senegalensis	ASTERACEAE	Plants
Peliostomum leucorrhizum	SCROPHULARIACEAE	Plants
Pentzia lanata	ASTERACEAE	Plants

SCIENTIFIC NAME	FAMILY	CATEGORY
Platycarphella carlinoides	ASTERACEAE	Plants
Prosopis chilensis	FABACEAE	Plants
Prosopis glandulosa var. glandulosa	FABACEAE	Plants
Prosopis glandulosa var. torreyana	FABACEAE	Plants
Prosopis velutina	FABACEAE	Plants
Psilocaulon coriarium	MESEMBRYANTHEMACEAE	Plants
Pteronia acuminata	ASTERACEAE	Plants
Pteronia mucronata	ASTERACEAE	Plants
Requienia sphaerosperma	FABACEAE	Plants
Salsola aellenii	CHENOPODIACEAE	Plants
Salsola rabieana	CHENOPODIACEAE	Plants
Sarcocaulon salmoniflorum	GERANIACEAE	Plants
Schmidtia kalahariensis	POACEAE	Plants
Senecio arenarius	ASTERACEAE	Plants
Senecio consanguineus	ASTERACEAE	Plants
Solanum burchellii	SOLANACEAE	Plants
Sporobolus rangei	POACEAE	Plants
Stipagrostis amabilis	POACEAE	Plants
Stipagrostis anomala	POACEAE	Plants
Stipagrostis ciliata var. capensis	POACEAE	Plants
Stipagrostis hochstetteriana var. secalina	POACEAE	Plants
Stipagrostis obtusa	POACEAE	Plants
Stipagrostis uniplumis var. uniplumis	POACEAE	Plants
Striga gesnerioides	OROBANCHACEAE	Plants
Tapinanthus oleifolius	LORANTHACEAE	Plants
Tribulus terrestris	ZYGOPHYLLACEAE	Plants
Tribulus zeyheri subsp. zeyheri	ZYGOPHYLLACEAE	Plants
Tridentea marientalensis subsp. marientalensis	APOCYNACEAE	Plants
Trochomeria debilis	CUCURBITACEAE	Plants
Zygophyllum dregeanum	ZYGOPHYLLACEAE	Plants
Zygophyllum simplex	ZYGOPHYLLACEAE	Plants